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# Encounter norms, social carrying capacity indicators, and standards of quality at a marine protected area

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ABSTRACT

This article examines visitors' normative acceptance of encounters with boats at a marine protected area and the extent that the number of boats, size of boats, and size of boat on which individuals were traveling influences these encounter norms. Data were obtained from a survey of 439 people visiting Molokini Shoal Marine Life Conservation District in Hawai'i, and photographs depicting four levels of boat use and three proportions of boat size measured encounter norms. Number of boats most strongly influenced encounter norms, boat size was less influential, and the size of boats on which respondents were traveling had little influence. Visitors wanted fewer boats at this site and a majority would not accept encountering more than 15 or 16 boats at one time. When the impact of boat size was considered, they would not accept encountering more than 12 large boats to 17 small boats. Implications for future research and managing standards of quality and social carrying capacity indicators at this marine protected area are discussed.



## 1. Introduction

Recreation and tourism activities such as scuba diving and snorkeling are growing in popularity at many marine and coastal destinations, including marine protected areas. Over 80% of tourists visiting Hawai'i USA, for example, participate in some form of marine recreation during their visit (Friedlander et al., 2005). Many studies have examined biophysical impacts of these marine activities, which can include damage caused by people handling coral or standing on reefs (e.g., Barker and Roberts, 2004; Dinsdale and Harriott, 2004; Hawkins et al., 1999; Rodgers and Cox, 2003; Rouphael and Inglis, 2002; Meyer and Holland, 2008). Social impacts such as crowding and conflict in marine areas, however, have received less attention and the investigation of encounter norms and other indicators of social carrying capacity represents an emerging area of research in marine areas as the popularity of these areas continues to increase (Davis et al., 1995; Inglis et al., 1999; Lynch et al., 2004; Needham and Szuster, 2011; Szuster et al., 2011).

Encounter norms are typically defined as standards that individuals use for evaluating their acceptance of increasing numbers of encounters with other people or objects (Manning, 2007; Shelby et al., 1996). A substantial number of studies have investigated encounter norms in terrestrial parks and protected areas (see Manning, 1999, 2007; Needham and Rollins, 2009; Shelby et al., 1996 for reviews), but fewer examples exist in marine protected areas or other offshore environments. Studies of snorkelers at the Great Barrier Reef in Australia (Inglis et al., 1999), boaters at the Apostle Islands in Wisconsin (Kuentzel and Heberlein, 2003), and tour boat passengers at Glacier Bay in Alaska (Manning et al., 1996a) are a few of only a handful of studies evaluating encounter norms in marine environments. These studies assessed encounter norms using approaches consistent with similar research in terrestrial settings, but did little to examine multiple dimensions that could influence normative evaluations. Individuals, for example, may reach different normative conclusions about encounters when viewing a marine area from a small boat as opposed to a larger boat. They could also possess different normative tolerances based on the mix of small and large boats at a site. Given the potential importance of additional marine activity dimensions such as the number and size of vessels, and the possible influence of these additional dimensions on encounter norms, this article investigates these factors at a Hawaiian marine protected area. This article considers the extent that the number and size of boats influences encounter norms, and provides guidance for managers and researchers studying social carrying capacity indicators and standards of quality at marine protected areas.

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### 1.1. Conceptual foundation

The concepts of encounters, crowding, and norms have received considerable attention in the literature. *Reported encounters* are the number of other people or objects that an individual remembers seeing in a setting (Vaske and Donnelly, 2002). *Perceived crowding* is a subjective and negative evaluation that a specific number of encounters are excessive (Manning et al., 2000; Shelby and Heberlein, 1986; Vaske and Shelby, 2008). Understanding encounters and crowding may not, however, reveal use levels that are acceptable or unacceptable, or provide insight into how use levels should be managed. *Norms* provide a theoretical and applied foundation on which these issues can be considered, and represent standards applied by individuals to evaluate activities, environments, management strategies, or conditions as good or bad, better or worse (Donnelly et al., 2000; Vaske et al., 1986). Norms clarify what people believe conditions should or ought to be or not be, and encounter norms typically identify the number of other people or objects that respondents will accept or not accept in specific environments such as campgrounds, trails, parks, or wilderness areas. This information is useful in developing management strategies because it provides evaluative standards for conditions associated with use levels and other aspects of quality experiences (Donnelly et al., 2000; Shelby et al., 1996).

A substantial number of normative studies are based on the early work of Jackson (1965) focusing on a return potential model for evaluating acceptance of impacts associated with user experiences or resource conditions. *Indicators* (e.g., encounters) can be used within this model to measure social, resource, or managerial variables and define *standards of quality* (e.g., no more than 75 other people should be seen at any one time) or points where indicator conditions reach unacceptable levels (Manning, 1999, 2007). Indicators and standards of quality are central to carrying capacity based frameworks such as Limits of Acceptable Change (LAC), Visitor Impact Management (VIM), Visitor Experience and Resource Protection (VERP), and the Tourism Optimization Management Model (TOMM) that have been developed to plan and manage parks, protected areas, and other related settings (see Manning, 2004 for a review).

A simplified example may help to illustrate. The provision of opportunities for visitor solitude is a management goal in many parks and protected areas (Manning, 1999; Needham and Rollins, 2009). This goal, however, may be too general to guide management since it does not specify what constitutes solitude and how it should be measured and monitored. Indicators and standards of quality may help to resolve these issues. Surveys or interviews with visitors may show that the number of encounters with other people is an important aspect of solitude, suggesting that it may be one indicator of solitude. Research on encounter norms may reveal that once most users encounter 50 or more people in an area, they feel crowded and do not achieve an acceptable level of solitude. This suggests that encounters with 50 or more people may represent an appropriate standard of quality for managing and monitoring the area (Ormiston et al., 1998).

A social norm typically represents an average of personal norms reported by individuals in a population and this information is frequently displayed using a graph called a social norm curve (Manning et al., 1999) or an impact acceptability curve (Vaske et al., 1986). Fig. 1 depicts indicator impacts (e.g., encounters) increasing from left to right on the horizontal axis, and evaluative responses from positive to negative on the vertical axis. Most studies have adopted acceptability as the evaluative response for measuring encounter norms (see Manning et al., 1999 for other evaluations). These norm curves can be analyzed for several structural characteristics such as the minimum acceptable condition and norm intensity or salience.

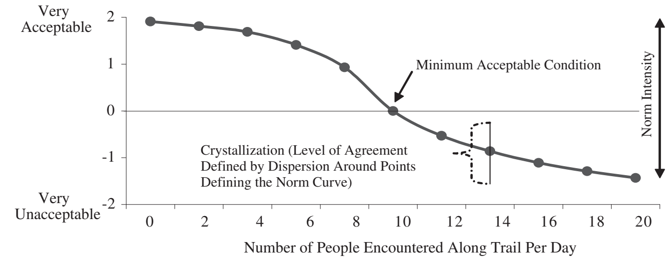


**Fig. 1.** Hypothetical social norm curve. Modified from Manning et al., 1999.

The *minimum acceptable condition* is often the point where the norm curve crosses the neutral line and impacts to an indicator such as encounters become viewed as unacceptable by the majority of respondents (Fig. 1). In several studies, this point has represented the standard of quality for the measured indicator (see Manning, 1999; Needham and Rollins, 2009 for reviews). *Norm intensity or salience* represents the importance of the indicator to respondents and is typically measured as the relative distance from the neutral line at each point on the curve independent of the direction of the evaluation. Norm intensity or salience can be measured as the sum of these distances across all points on the curve with greater intensity depicted by an increasing cumulative distance from the neutral line (Shelby and Heberlein, 1986; Vaske et al., 1986). A relatively flat curve close to the neutral line suggests that the indicator is not highly important to respondents and few people will be concerned if a standard is violated. A curve that declines sharply and remains negative suggests that the indicator is important and implies that more people may be concerned if a standard of quality is violated (Freimund et al., 2002).

Normative research in parks, protected areas, and related settings has most frequently measured indicators associated with use levels and encounters with other people (see Donnelly et al., 2000; Manning, 1999, 2007; Shelby et al., 1996; Vaske et al., 1986 for reviews). Most of this research has measured and compared encounter norms of users engaging in different activities or at different locations (e.g., Hall and Roggenbuck, 2002; Needham et al., 2004, 2005; Shelby et al., 1996; Vaske and Donnelly, 2002). Studies have also typically measured a single dimension of encounter norms by investigating the number of other people encountered at one time and subsequently assessing how this influences normative evaluations. In a marine environment, for example, Inglis et al. (1999) examined snorkeler norms and found that seeing 14 snorkelers from above the water and six users while in the water represented threshold points or standards at which social conditions became unacceptable and management attention would likely be needed.

Although some studies have measured visitor norms for other indicators such as noise (Freimund et al., 2002), vegetation loss at campsites (Needham and Rollins, 2005; Shelby et al., 1988), and litter (Heywood and Murdock, 2002), comparatively less is known about normative evaluations of use levels related to encounters with objects other than people, and this is especially important in marine settings where it may be difficult to see people in the water and encounter norms may be best measured using alternatives such as the number and size of boats (Lück, 2008; Orams, 1999). Some studies of boaters and tour boat passengers, for example, have found it more accurate to measure encounter norms associated with the number of boats instead of the number of people in marine areas (Kuentzel and Heberlein, 2003; Manning et al., 1996a).

There has also been limited research on different dimensions of encounters influencing these norms. Manning et al. (2002) examined encounter norms of users looking up or down a trail and found no differences, but Inglis et al. (1999) found that snorkelers' norms differed between above water and in water perspective dimensions. Szuster et al. (2011) examined scuba divers' encounter norms and found that both the number of divers and proximity of these divers were dimensions that influenced norms. In the context of encounters with boats in marine areas, most research has only examined the influence of the number of boats on encounter norms, not the size of these boats (e.g., Kuentzel and Heberlein, 2003; Manning et al., 1996a). Users, however, may reach different normative conclusions about encounters when viewing a marine area from a small boat as opposed to a larger boat, and they could possess different normative tolerances based on the mix of small and large boats present. Boat size is becoming an important dimension for managing carrying capacity issues in marine protected areas and other offshore environments, especially in places where boat numbers are capped by government permits but there is little restriction on boat sizes and operators are simply building bigger boats to accommodate more passengers (Lück, 2008; Markrich, 2004; Orams, 1999). Therefore, more research on the dimensionality of encounter norms in marine areas is warranted.

### 1.2. Research questions

This article investigates encounter norms associated with boats in a marine protected area and examines the influence of both the number of boats and size of boats as dimensions of these encounter norms. This article utilizes data from Molokini Shoal Marine Life Conservation District (MLCD) in Hawai'i to address three research questions. First, is the number or size of boats the most important dimension of encounter norms associated with boats at this marine protected area? Second, does the size of boat on which individuals are traveling also influence these encounter norms? Third, what are visitors' normative evaluations of encounters with boats at this marine protected area and how can this inform management of capacities at this site?

## 2. Methods

### 2.1. Study site and context

Molokini Shoal MLCD is a small offshore islet located off the south coast of the island of Maui, Hawai'i that is accessed most commonly by commercial tour boats, and its close proximity to Maui enables most boats to reach it in less than 1 h. Molokini's crescent shape provides a semi-enclosed area of relatively calm water boasting 77 acres of coral reef, more than 20 species of tropical fish, and larger marine life such as sharks and rays (Friedlander et al., 2005). The offshore location and lack of rainfall contribute to excellent underwater visibility and enhance the popularity of this site. Studies have estimated visitation at Molokini to be between 225,000 and 400,000 snorkelers and scuba divers annually, which makes it the second most visited marine protected area in Hawai'i with only Hanauma Bay on O'ahu receiving more visits (1.8 million annually; Friedlander et al., 2005; van Beukering and Cesar, 2004). These use levels are higher than other marine protected areas in this state. Honolua Bay on Maui, for example, is closer in proximity to Molokini and receives 160,000 visitors annually (Friedlander et al., 2005). Total economic benefits associated with recreation activities at Molokini averages US $20 million annually (i.e., direct use, indirect use, nonuse values) with more than US $4.5 million of this from direct recreation benefits (van Beukering and Cesar, 2004). By comparison, Hanauma Bay on O'ahu generates approximately US $35 million in total recreational benefits and over US $7 million in direct expenditures annually, whereas Honolua Bay on Maui generates less than US $3 million per year in total economic benefits (Cesar and van Beukering, 2004).

Over 40 tour boats have government issued permits to operate at Molokini with current vessel sizes ranging from smaller boats (<30 ft, <15 passengers) typically carrying scuba divers to much larger boats (>50 ft, up to 150 passengers) generally catering to snorkelers. There are currently 26 boat moorings available that restrict anchoring options and are primarily intended to prevent boats from damaging coral and other benthic habitat. Given that the number of boats visiting this site is restricted by these permits and moorings, tour boat operators have been retrofitting boats and building new boats that are larger in size to accommodate more paying passengers (Friedlander et al., 2005; Markrich, 2004).

### 2.2. Data collection

Three focus group meetings were conducted with commercial operators, community and environmental interest groups (e.g., boating clubs, conservation organizations), and agency representatives who manage Molokini. Participants were asked to describe existing conditions and prioritize indicators for the site, and the level of boat and human use at the site was among the most frequently mentioned concerns. Questionnaires measuring these issues were then administered onsite to passengers visiting Molokini on tour boats during both high use (spring break March 2009) and lower use (late April 2009) periods. Questionnaires were administered on six vessels operating out of the three harbors from which boats depart for Molokini. Most boats operate from Ma'alaea harbor where questionnaires were administered on two large boats carrying snorkelers and two smaller boats primarily serving scuba divers. Questionnaires were also administered on one smaller tour boat predominantly carrying scuba divers operating out of Lahaina harbor, and one smaller tour boat carrying scuba divers from the Kihei boat ramp. Questionnaires measuring encounters and norms were completed by individuals on these boats immediately after visiting Molokini while returning to the harbor (i.e., post-trip). A total of 439 of these questionnaires were completed (95% response rate) with approximately 85% completed on large snorkel boats and 15% on smaller dive boats. These percentages are similar to the distribution of snorkeler and scuba diver visitation at Molokini (Friedlander et al., 2005).

### 2.3. Analysis variables

Most studies measure encounter norms with a single dimension, which is typically the number of human encounters deemed acceptable or unacceptable at one time at a site (see Manning, 1999, 2007 for reviews). Site characteristics at Molokini, however, make this approach potentially unrealistic and imprecise because the ability to clearly distinguish and count people is constrained while snorkeling or scuba diving underwater and line of sight can be impeded by waves and other boats. Use levels at an offshore marine protected area such as Molokini are also directly linked to the number and size of boats at the site. For these reasons, the number and size of boats were selected as the two dimensions used for measuring encounter norms instead of individual humans. Image Capture Technology (ICT) was applied to measure norms and involves using software to manipulate photographs and create unique scenarios, and this approach has become popular for depicting indicator impacts associated with use levels in parks, protected areas, and related environments (e.g., Freimund et al., 2002; Inglis et al., 1999; Manning and Freimund, 2004; Manning et al., 1996b; Needham et al., 2004). This method allows users to rate their normative acceptance of photographs depicting indicator impacts varying from low to high and these ratings can then be plotted on norm curves to reveal minimum acceptable conditions (i.e., potential standards of quality) and norm intensity or salience (i.e., importance).

These types of visual techniques are becoming more common for measuring encounter norms, especially when indicator impacts are manipulated (see Manning and Freimund, 2004; Shelby et al., 1996 for reviews). These techniques provide respondents with a realistic and simple assessment tool that allows them to consider various encounter related scenarios and see what conditions would look like (Hall and Roggenbuck, 2002). This is especially important in high use areas where it may be difficult or unrealistic for respondents to evaluate acceptable or unacceptable conditions from written survey descriptions of indicators (Needham et al., 2004, 2005). There are, however, certain disadvantages of this approach, which can include excessive respondent burden and the imposition of static site conditions (Manning and Freimund, 2004).

The number and size of boats in the images used in this study were measured with 12 color photographs representing scenarios of encounters with boats at Molokini (Fig. 2). Number of boats was depicted using four different levels: 6, 12, 26, and 42 boats. These numbers of boats were chosen because there are currently 26 moorings at Molokini, 42 coincides with the number of tour boat permits currently allocated by the State of Hawai'i to operate at Molokini, and 12 and 6 were approximately half of 26 and 12, respectively. Size of boats was depicted using three levels based on the proportion of small and large boats: 100% small boats, 100% large boats, and 50% small and 50% large boats. This represents a full factorial design (i.e., 4 levels for number of boats $\times$ 3 proportions of boat size $=$ 12 encounter scenarios). The encounter scenario in each photograph is described in Table 1 with respondents evaluating each scenario on the same 9-point recoded scale of $-4$ "very unacceptable" to $+4$ "very acceptable" that has been used in most studies of encounter norms (see Manning, 1999, 2007; Manning and Freimund, 2004; Shelby et al., 1996; Vaske et al., 1986 for reviews).

Adobe Photoshop software was used to create photographs containing 26 boats on an image of the study site. This represents the full number of existing mooring sites at Molokini. The location of current moorings was derived from Global Positioning System (GPS) coordinates provided by the State of Hawai'i, and boat photographs were digitally placed on a background image depicting Molokini from an aerial perspective at a 25° angle above sea level. This was necessary because line of sight is impeded closer to sea level and many boats would not be visible if a lower angle or different perspective was adopted. Although this approach may not represent the exact perspective from onboard boats in the water, it asks visitors to take the more global or site perspective that managers typically take when using this type of carrying capacity information or remote sensing and geographic information system data to establish management standards for a site (Kuentzel and Heberlein, 2003). This aerial perspective is also similar to approaches used in some other studies (e.g., Inglis et al., 1999; Manning et al., 2002, 2005; Martin et al., 1989), which have shown that alterations in background perspective often do not have a substantial impact on normative evaluations. Boats were added in spaces between the existing 26 mooring locations to create photographs containing 42 boats, and images containing six and 12 boats were created by randomly removing boats from the initial 26-boat image.

**Table 1**
Full factorial design for photographs depicting encounter norm scenarios.[a]

| Photograph/scenario | Number of boats | Size of boats |
|---|---|---|
| 1 | 12 Boats | 50% Small, 50% large |
| 2 | 12 Boats | 100% Small |
| 3 | 6 Boats | 100% Small |
| 4 | 42 Boats | 100% Large |
| 5 | 26 Boats | 100% Large |
| 6 | 26 Boats | 50% Small, 50% large |
| 7 | 12 Boats | 100% Large |
| 8 | 6 Boats | 50% Small, 50% large |
| 9 | 6 Boats | 100% Large |
| 10 | 42 Boats | 50% Small, 50% large |
| 11 | 26 Boats | 100% Small |
| 12 | 42 Boats | 100% Small |

[a] The "number of boats" factor had four levels: 6, 12, 26, 42 boats. The "size of boat" factor had three levels: 100% small, 100% large, 50% small and 50% large. Respondents rated their norms for each image on 9-point recoded scales of $-4$ "very unacceptable" to $+4$ "very acceptable".

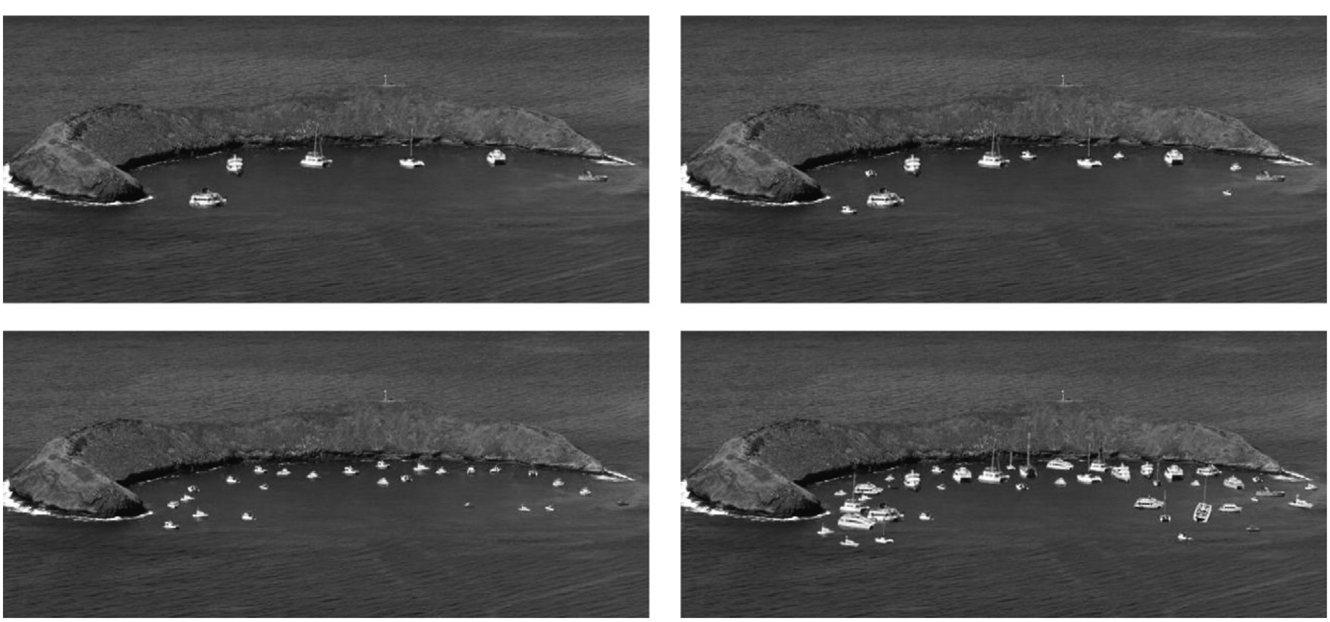

**Fig. 2.** Sample photographs used for measuring encounter norms.

Boat size was manipulated by obtaining actual photographs of both large and small boats taken at Molokini from a perspective similar to the background image. Distinguishing between large and small boats at a true scale was found to be difficult from this aerial perspective, so a decision was made to increase the size of large boats by 50% in the final images. Although this decision creates the possibility of slightly inflating the importance of the boat size dimension and influencing normative evaluations of large boats, it was necessary to ensure that respondents were able to clearly distinguish between small and large boats in the photographs. Slightly altering characteristics of people or objects in photographs, however, is common practice for cueing respondents to indicator impacts and improving accuracy of normative evaluations (Basman et al., 1996; Manning and Freimund, 2004). Research has also shown that minor alterations in scale can significantly improve the usability of ICT approaches and not have a substantial impact on evaluations (Inglis et al., 1999; Manning et al., 2002). The approach used in this study is virtually identical to numerous similar studies that have been rigorously tested and found to represent a reliable and valid approach for measuring normative evaluations of indicator conditions (e.g., Freimund et al., 2002; Hall and Roggenbuck, 2002; Manning and Freimund, 2004; Manning et al., 1996b, 1999, 2002; Needham et al., 2004, 2005).

## 3. Results

The first research question involved determining whether the number of boats or size of boats was the most important dimension of encounter norms. A 4 × 3 × 2 three-way analysis of variance examined: (a) individual main effects of the number of boats in the photographs, size of boats in these images, and size of boat on which respondents were surveyed; and (b) interaction effects among these three dimensions on encounter norms. Both the number and size of boats in the photographs significantly influenced encounter norms, $F = 50.52–1425.37$, $p < 0.001$. The interaction between these two dimensions was also significant, $F = 8.50$, $p < 0.001$ (Table 2).

For the second research question, the size of boats on which respondents were traveling did not significantly influence encounter norms, $F = 0.35$, $p = 0.554$ (Table 2). Interactions between the size of boat that respondents traveled on and both the number of boats and size of boats in the photographs were also not statistically significant, $F = 0.26–1.82$, $p = 0.163–0.956$. Given that the size of boat on which respondents were traveling was not important and did not influence normative evaluations, this factor was removed from further analysis and a final 4 × 3 two-way analysis of variance examined individual main effects and interaction effects of the number and size of boats on encounter norms. Both the number and size of boats in the photographs still influenced encounter norms, $F = 57.65–1991.53$, $p < 0.001$ (Table 3). The interaction between these two dimensions also remained significant, $F = 10.59$, $p < 0.001$.

**Table 3**
Two-way analysis of variance for influence of number of boats and size of boats on encounter norms.[a]

| | df | SS | MS | F-value | p-value | Partial eta squared ($\eta^2$) |
|---|---|---|---|---|---|---|
| Number of boats[b] | 3 | 22,457.63 | 7485.88 | 1991.53 | <0.001 | 0.57 |
| Size of boats[c] | 2 | 433.36 | 216.68 | 57.65 | <0.001 | 0.03 |
| Number × size interaction | 6 | 238.79 | 39.80 | 10.59 | <0.001 | 0.01 |

[a] Model adjusted $R^2 = 0.573$.
[b] Number of boats: 6, 12, 26, 42 boats.
[c] Size of boats: 100% small, 50% small/50% large, 100% large.

The partial eta squared statistic offers one measure of norm intensity or salience, or the importance of these indicator dimensions to users. This effect size measures the proportion of variance in encounter norms explained by each dimension, with higher partial eta squared scores indicating that a dimension more strongly influenced encounter norms (Vaske, 2008). The number of boats in the photographs had by far the strongest influence on norms, with a partial eta squared of 0.57 indicating that 57% of the variance in normative evaluations could be attributed to this dimension (Table 3). The size of boats depicted in the photographs was much less important, explaining only 3% of the variance in norms (partial $\eta^2 = 0.03$). The interaction between the number and size of boats, although statistically significant, explained only 1% of the variance in norms (partial $\eta^2 = 0.01$). Taken together, these results suggest that: (a) both the number and size of boats in the photographs were significant dimensions of encounter norms at Molokini, although the number of boats was far more important than size; and (b) the size of boats on which respondents were traveling did not influence these normative evaluations.

The third research question involved determining visitors' normative evaluations for encounters with boats at Molokini. Respondents, on average, considered greater numbers of boats and larger boats to be less acceptable than fewer and smaller boats (Table 4). The image containing 42 large boats was considered to be the most unacceptable, whereas the image of six small boats was deemed most acceptable. Six boats of any size and 12 boats that are all small or split evenly between small and large were considered to be acceptable. All other scenarios were viewed as unacceptable, on average, by Molokini visitors. These results can be depicted using social norm curves displaying group normative evaluations. The minimum acceptable condition or threshold point where the norm curve crossed the neutral point for Molokini was 15.27 boats (Fig. 3). This suggests that mooring any number of boats over 15 or 16 at Molokini would generally be considered to be unacceptable by the majority of individuals visiting this site.

A second and more traditional method of measuring norm intensity or salience is to sum the relative distances from each point on the curve to the neutral line, independent of the direction of the

**Table 2**
Three-way analysis of variance for influence of number of boats, size of boats, and respondent boat size on encounter norms.[a]

| | df | SS | MS | F-value | p-value | Partial eta squared ($\eta^2$) |
|---|---|---|---|---|---|---|
| Number of boats[b] | 3 | 16,174.41 | 5391.47 | 1425.37 | <0.001 | 0.49 |
| Size of boats[c] | 2 | 382.17 | 191.08 | 50.52 | <0.001 | 0.02 |
| Respondent boat size[d] | 1 | 1.32 | 1.32 | 0.35 | 0.554 | 0.00 |
| Number × size interaction | 6 | 192.89 | 32.15 | 8.50 | <0.001 | 0.01 |
| Number × respondent boat size interaction | 3 | 3.67 | 1.22 | 0.32 | 0.809 | 0.00 |
| Size × respondent boat size interaction | 2 | 13.75 | 6.87 | 1.82 | 0.163 | 0.00 |
| Number × size × respondent boat size interaction | 6 | 5.85 | 0.98 | 0.26 | 0.956 | 0.00 |

[a] Model adjusted $R^2 = 0.571$.
[b] Number of boats: 6, 12, 26, 42 boats.
[c] Size of boats: 100% small, 50% small/50% large, 100% large.
[d] Size of boat on which users were surveyed (e.g., small: <30 passengers; large: ≥100 passengers).

**Table 4**
Mean encounter norms for number and size of boats.[a]

| Number of boats | Proportion of large and small boats | | | Estimated total |
|---|---|---|---|---|
| | 100% Small | 50% Small, 50% large | 100% Large | |
| 6 Boats | 2.62 | 2.44 | 2.39 | 2.48 |
| 12 Boats | 1.32 | 1.13 | −0.21 | 0.74 |
| 26 Boats | −2.24 | −2.27 | −2.78 | −2.43 |
| 42 Boats | −2.56 | −2.79 | −3.11 | −2.82 |
| Estimated total | −0.21 | −0.37 | −0.93 | |

[a] Cell entries are means on 9-point recoded scales of −4 "very unacceptable" to +4 "very acceptable".

evaluation (e.g., acceptable, unacceptable). Greater cumulative distances from the neutral line indicate higher intensity or salience. Intensity for the number of boats was 8.47 (maximum = 16) and the curve declined sharply and remained negative. This finding, coupled with the partial eta squared of 57%, confirms the importance of the number of boats to people visiting Molokini, and suggests that many visitors may be negatively impacted if the minimum acceptable condition of 15–16 boats is violated. In contrast, norm intensity for the boat size dimension was 1.51 (maximum = 12) with a partial eta squared of only 3%, which confirms that boat size was not a highly important dimension of encounter norms at Molokini.

Different norm curves also exist for each category of boat size evaluated in this study (Fig. 4). The minimum acceptable condition was 17.19 boats when only small boats were depicted in the photographs, 16.64 boats when they were evenly split between small and large boats, and 11.51 boats when only large boats were in the images. Tamhane's T2 post-hoc tests for unequal variances showed that visitors accepted significantly fewer boats ($p < 0.05$) when all boats in the images were large compared to images containing an even mix of small and large boats or entirely small boats. Norm intensity was similar and not statistically different ($p > 0.05$) across all three boat size scenarios (small = 8.74, mixed = 8.63, large = 8.49).

## 4. Discussion

This article examined the influence of two dimensions, number of boats and size of boats, on the encounter norms of people visiting Molokini Shoal MLCD in Hawai'i. The number of boats at this site was by far the most important dimension and this strongly influenced encounter norms. Although statistically significant, boat size alone was not salient and did not strongly influence normative evaluations. The size of boats on which respondents were traveling to the site also had a negligible direct effect on encounter norms. Normative evaluations suggested that visitors will strongly accept encountering fewer boats at this site and a majority of visitors would not accept encountering more than approximately 15 or 16

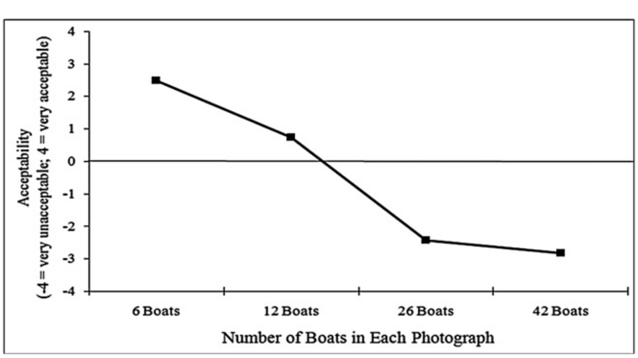


**Fig. 3.** Norm curve for total number of boats.

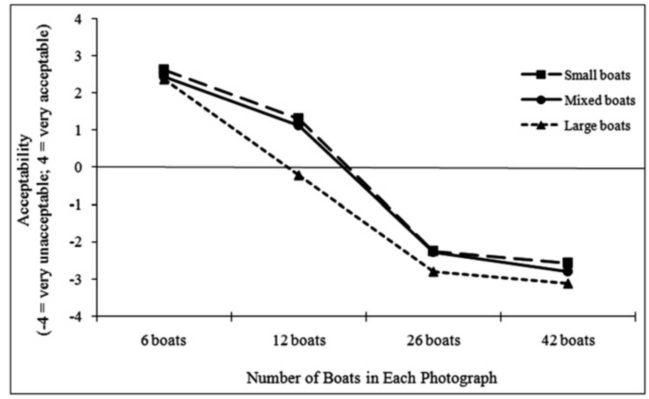


**Fig. 4.** Norm curve for number of each size of boat.

boats at any one time. When the impact of boat size was considered, minimum acceptable conditions ranged from approximately 12 large boats to 17 small boats. These findings have implications for management and future research.

### 4.1. Implications for management

From a management perspective, the normative approach has been applied widely in parks, protected areas, and related settings to understand indicator conditions and help formulate standards of quality that can guide management actions (see Manning, 1999, 2007; Needham and Rollins, 2009; Shelby et al., 1996 for reviews). Results of this study suggest that the number of boats present at one time at Molokini should not exceed approximately 15 or 16 at one time. Minimum acceptable conditions would fall to just 12 boats if only large vessels are present at the site at one time, or rise to 17 boats if only small vessels are present. These metrics can be used to inform management decisions related to controlling the number of moorings installed at the site. There are presently 26 moorings at Molokini and discussions have taken place to consider adding moorings. Adding moorings to the 26 currently in place could, however, exacerbate existing norm violations and degrade user experiences that occur when approximately 15 or 16 boats are at the site. Management actions based on maintaining minimum acceptable conditions identified in this study could even support the removal of several moorings to ensure that standards of quality are not violated irrespective of efforts to monitor and control access to the site.

Maintaining normative standards for encounters that are equal to or better than minimum acceptable conditions could, however, be problematic because of the need for strategies that limit or alter the timing and pattern of use. Such limitations are unlikely to be supported by commercial snorkel and dive tour operators whose economic livelihoods depend on their ability to transport substantial numbers of people to Molokini. Use restrictions may also be opposed by visitors who could potentially lose access to the site. Restricting use could be complicated and expensive to enforce, as any limitations on the number of vessels allowed at Molokini must be reflected in the agency permit process. Over 40 permits have been issued to allow commercial operator access to Molokini and if additional restrictions are implemented, this could result in lengthy and costly legal challenges that could delay implementation of any management actions.

A number of alternatives do exist, however, that could potentially achieve a reduction in user encounters with multiple boats without reducing the total number of permitted commercial operators at the site. Specifically, managers could consider spatial zoning strategies that involve removing a number of moorings or rearranging the placement of moorings to allow fewer boats to be visible at one time. Encouraging dive boats to moor outside of the islet (i.e., on its back side) is an example of this approach and would represent a specific management response to any existing violations of user encounter norms. Ocean conditions (e.g., swell, current) in these areas outside of the islet are generally unsuitable for snorkelers who require calmer waters for this activity, but dive boats can access these less visible areas on many days. This approach could not only address management issues related to encounter norms, but could also enhance the overall site experience for scuba divers since areas outside the more active inner portion of the islet possess both exceptional above water scenery and dramatic undersea species and topography.

Temporal zoning represents another possible approach that could limit the number of boats that users encounter at Molokini. This type of zoning is advantageous because it represents a form of "traffic management" that can redistribute access over a specific period of time and potentially allows managers to achieve the seemingly contradictory goal of simultaneously reducing boat encounters while maintaining overall visitation numbers. Temporal zoning could reduce the number of boats moored at Molokini at any one time without reducing the number of commercial permits or the total number of boats allowed at the site. This zoning strategy could involve restricting early morning access to smaller dive boats, which is the most favorable period for this activity (Szuster et al., 2011). Larger snorkel boats could then be admitted later in the morning. This narrow window of access is necessary because wind and ocean conditions often degrade later in the day and commercial tour operators typically abandon the site by the early afternoon (Friedlander et al., 2005). Any of these spatial or temporal zoning plans must not only be monitored and enforced, but also communicated to boaters using multiple channels to ensure information dissemination and effectiveness of messages (e.g., signs, internet).

Development and implementation of any of these management strategies based on normative evaluations cannot be done in isolation, and must be supported by carrying capacity based planning and management frameworks such as LAC, VIM, or VERP, and even broader planning processes such as Integrated Coastal Zone Management (ICZM). Integrating normative research into these planning approaches provides the best opportunity for applied research to benefit users and coastal communities, and support equitable sharing of marine resources (Clark, 1996). These approaches also represent opportunities for management actions to be informed by various community interests and provide for broad participation and the resolution of conflict (Clark, 1996; Edwards et al., 1997). Development of a systematic planning approach at Molokini that includes normative research represents an opportunity to improve management of existing use related conditions. A diverse group of interests exist at this site, including users, recreational boaters, commercial tour operators, native Hawaiians, environmental conservation groups, and government agencies. These groups can possess conflicting views on appropriate management responses, which have been magnified by a lack of human use data and the absence of systematic planning processes at the site. A growing degree of contention has developed over management of Molokini, but the application of normative research to assess use related issues within an inclusive planning process could help mitigate these concerns by bringing together competing interests and protecting the unique natural resources and attractions at this site.

### 4.2. Implications for research

From a research perspective, encounters and other use related concepts such as crowding are important indicators in outdoor settings. Most existing research examining encounter norms has focused on a single dimension of these norms, namely the number of people or objects that is deemed to be acceptable or unacceptable to encounter at any one time (see Manning, 1999, 2007; Needham and Rollins, 2009; Shelby et al., 1996 for reviews). Results from this study at Molokini support this approach because the number of boats was by far the most important dimension of encounter norms at this marine protected area. A second dimension of encounters (i.e., boat size) was also statistically significant, but did not strongly influence normative evaluations. This finding is consistent with recent research that has revealed additional dimensions of encounters and related norms (e.g., Inglis et al., 1999; Manning et al., 2002; Szuster et al., 2011). Future research should continue considering alternative dimensions of encounter norms when measuring this concept and using resulting data to inform planning and management.

Research on social indicators such as encounter norms has focused primarily on the number of people visible at one time (see Manning, 1999, 2007; Needham and Rollins, 2009; Shelby et al., 1996 for reviews). This study is notable in that it is one of only a few to focus on encounters with boats (e.g., Kuentzel and Heberlein, 2003; Manning et al., 1996a) and this approach was adopted because it can be difficult to accurately distinguish and count people in a marine environment who are partially or fully underwater or obscured by waves or other boats. The featurelessness of the marine environment can also present an unfamiliar backdrop against which people can seem more or less numerous. In marine areas accessible only by boat, it may be more appropriate to measure encounters and norms associated with boats because use levels are directly linked to both the number and size of boats (i.e., capacity, occupancy). Studies have examined terrestrial encounters with nonhuman objects such as litter and trails (e.g., Heywood and Murdock, 2002; Needham and Rollins, 2005; Shelby et al., 1988), and findings from this and other studies suggest that objects such as boats should be considered where appropriate to assess encounter norms in marine environments (Kuentzel and Heberlein, 2003; Manning et al., 1996a).

Respondents in this study who reported their encounter norms for boats were passengers on small or large vessels visiting Molokini. The size of boats on which respondents were traveling did not appear to influence encounter norms in this study, and this finding is consistent with other studies that focused on assessing the influence of different perspectives on encounter norms. Manning et al. (2002), for example, found no substantive differences in normative responses to photographs representing two different perspectives of a trail (i.e., looking up the trail, down the trail). Although no significant differences in encounter norms associated with respondent perspectives were found at Molokini, it seems plausible that encounters with large boats from the perspective of a small boat could influence norms in that passengers on small vessels could be less tolerant of encounters with many large boats. Additional studies are needed to confirm this finding and assess the influence of perspective on encounter norms in other areas.

Photographs in this study depicted two dimensions of encounter norms concerning boats (i.e., number and size of boats). These were the most obvious dimensions associated with human use levels at Molokini, but may not represent the complete set of possibilities. Adding dimensions, however, can be problematic because it exponentially increases the complexity of the questionnaire and may intensify respondent burden to an unacceptable level, especially if onsite data collection approaches are utilized (Vaske, 2008). Future research should consider other dimensions that may influence encounter norms, such as boat type (e.g., sailboat, zodiac; Manning et al., 1996a) or previous experience in marine activities (Needham et al., 2005).

This study assessed user acceptance of indicator conditions depicted in photographs, which is consistent with most normative research (see Manning, 1999, 2007; Shelby et al., 1996 for reviews). Evaluations such as preferences and maximum tolerances of indicator conditions can differ from acceptance, and research should continue exploring differences among evaluative response categories. Respondents' minimum acceptable encounters with boats were represented in this study as conditions where norm curves crossed the neutral line. This is also consistent with most studies (see Manning, 2007; Shelby et al., 1996 for reviews), but it is debatable whether standards should be based on alternative points along the curves. Should standards be based, for example, on conditions most acceptable to all users (i.e., highest point on the curve such as six boats in this study) or should they be based on conditions acceptable to less than the majority of respondents? Basing standards on the most acceptable conditions is often impractical and in this study would result in only six boats being allowed to visit Molokini at one time. Conversely, if standards are based on a higher level of impact that is acceptable to only a minority of users, conditions may deteriorate to a point where most visitors are dissatisfied and may not return. Determining standards of quality that both maintain quality experiences and resources while permitting access in high use settings will remain a contentious issue for both managers and researchers, and this issue represents fertile ground for additional research.

Finally, data for this study were collected from individuals visiting Molokini during different use periods and on both small and large boats operating from multiple harbors. Given this sample composition, results may be representative of users at this site, but may not generalize to other groups with a vested interest in this site such as private recreational boaters, native Hawaiians, or environmental organizations. These groups may not share similar norms and incorporation of multiple groups can provide a more complete understanding of norms and how these can inform the management of coastal and marine environments. Findings are also limited to this one marine protected area and may not generalize to all high use coastal and marine environments where human use activities are common. Applicability of findings to other interest groups and geographical areas remains a topic for further empirical investigation.

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## References

Barker, N., Roberts, C., 2004. Scuba diver behavior and the management of diving impacts on coral reefs. Biological Conservation 120, 481–489.
Basman, C., Manfredo, M., Barro, S., Vaske, J., Watson, A., 1996. Norm accessibility: an exploratory study of backcountry and frontcountry recreational norms. Leisure Sciences 18, 177–191.
Cesar, H., van Beukering, P., 2004. Economic valuation of the coral reefs of Hawaii. Pacific Science 58, 231–242.
Clark, J., 1996. Coastal Zone Management Handbook. CRC Press, Florida, USA.
Davis, D., Harriott, V., MacNamara, C., Roberts, L., Austin, S., 1995. Conflicts in a marine protected area: scuba divers, economics, ecology, and management in Julian Rocks Aquatic Reserve. Australian Parks and Recreation 3, 29–35.
Dinsdale, E., Harriott, V., 2004. Assessing anchor damage on coral reefs: a case study in selection of environmental indicators. Environmental Management 33, 126–139.
Donnelly, M., Vaske, J., Whittaker, D., Shelby, B., 2000. Toward an understanding of norm prevalence: a comparative analysis of 20 years of research. Environmental Management 25, 403–414.
Edwards, S., Jones, P., Nowell, D., 1997. Participation in coastal zone management initiatives: a review and analysis of examples from the UK. Ocean and Coastal Management 36, 143–165.
Freimund, W., Vaske, J., Donnelly, M., Miller, T., 2002. Using video surveys to access dispersed backcountry visitors' norms. Leisure Sciences 24, 349–362.
Friedlander, A., Aeby, G., Brown, E., Clark, A., Coles, S., Dollar, S., 2005. The State of Coral Reef Ecosystems of the Main Hawaiian Islands. NOAA/NCCOS Center for Coastal Monitoring and Assessment Biogeography Team, Maryland, USA.
Hall, T., Roggenbuck, J., 2002. Response format effects in questions about norms: implications for the reliability and validity of the normative approach. Leisure Sciences 24, 325–338.
Hawkins, J., Roberts, C., Vant Hof, T., De Meyer, K., Tratalos, J., Aldam, C., 1999. Effects of scuba diving on Caribbean coral and fish communities. Conservation Biology 12, 888–897.
Heywood, J., Murdock, W., 2002. Social norms in outdoor recreation: searching for the behavior-condition link. Leisure Sciences 24, 283–296.
Inglis, G., Johnson, V., Ponte, F., 1999. Crowding norms in marine settings: a case study of snorkeling on the Great Barrier Reef. Environmental Management 24, 369–381.
Jackson, J., 1965. Structural Characteristics of Norms. Holt, Rinehart, Winston, New York, USA.
Kuentzel, W., Heberlein, T., 2003. More visitors, less crowding: change and stability of norms over time at the Apostle Islands. Journal of Leisure Research 35, 349–371.
Lück, M., 2008. The Encyclopedia of Tourism and Recreation in Marine Environments. CABI, Wallingford, UK.
Lynch, T., Wilkinson, E., Melling, L., Hamilton, R., Macready, A., Feary, S., 2004. Conflict and impacts of divers and anglers in a marine park. Environmental Management 33, 196–211.
Markrich, M., 2004. The Hawai'i Boat Industry 2003: A Survey and Economic Description. DBa/Marich Research, Hawaii, USA.
Manning, R., 1999. Studies in Outdoor Recreation: Search and Research for Satisfaction. Oregon State University Press, Oregon, USA.
Manning, R., 2004. Recreation planning frameworks. In: Manfredo, M., Vaske, J., Bruyere, B., Field, D., Brown, P. (Eds.), Society and Natural Resources: A Summary of Knowledge. Modern Litho, Missouri, USA, pp. 83–96.
Manning, R., 2007. Parks and Carrying Capacity: Commons Without Tragedy. Island Press, Washington, USA.
Manning, R., Freimund, W., 2004. Use of visual research methods to measure standards of quality for parks and outdoor recreation. Journal of Leisure Research 36, 557–579.
Manning, R., Johnson, D., Vande Kamp, M., 1996a. Norm congruence among tour boat passengers to Glacier Bay National Park. Leisure Sciences 18, 125–141.
Manning, R., Lawson, S.R., Newman, P., Laven, D., Valliere, W., 2002. Methodological issues in measuring crowding-related norms in outdoor recreation. Leisure Sciences 24, 339–348.
Manning, R., Lime, D., Freimund, W., Pitt, D., 1996b. Crowding norms at frontcountry sites: a visual approach to setting standards of quality. Leisure Sciences 18, 39–59.
Manning, R., Morrissey, J., Lawson, S., 2005. What's behind the numbers? Qualitative insights into normative research in outdoor recreation. Leisure Sciences 27, 205–224.
Manning, R., Valliere, W., Minteer, B., Wang, B., Jacobi, C., 2000. Crowding in parks and recreation: a theoretical, empirical, and managerial analysis. Journal of Park and Recreation Administration 15, 57–72.
Manning, R., Valliere, W., Wang, B., Jacobi, C., 1999. Crowding norms: alternative measurement approaches. Leisure Sciences 21, 97–115.
Martin, S., McCool, S., Lucas, R., 1989. Wilderness campsite impacts: do managers and visitors see them the same? Environmental Management 13, 623–629.
Meyer, C., Holland, K., 2008. Spatial dynamics and substrate impacts of recreational snorkelers and scuba divers in Hawaiian marine protected areas. Journal of Coastal Conservation 12, 209–216.
Needham, M., Rollins, R., 2005. Interest group standards for recreation and tourism impacts at ski areas in the summer. Tourism Management 26, 1–13.
Needham, M., Rollins, R., 2009. Social science, conservation, and protected areas theory. In: Dearden, P., Rollins, R. (Eds.), Parks and Protected Areas in Canada: Planning and Management. Oxford University Press, Ontario, Canada, pp. 135–168.
Needham, M., Rollins, R., Vaske, J., 2005. Skill level and normative evaluations among summer recreationists at alpine ski areas. Leisure/Loisir: Journal of the Canadian Association for Leisure Studies 29, 71–94.
Needham, M., Rollins, R., Wood, C., 2004. Site-specific encounters, norms and crowding of summer visitors at alpine ski areas. International Journal of Tourism Research 6, 421–437.
Needham, M., Szuster, B., 2011. Situational influences on normative evaluations of coastal tourism and recreation management strategies in Hawaii. Tourism Management 32, 732–740.

Orams, M., 1999. Marine Tourism: Development, Impacts, and Management. Routledge, London, UK.
Ormiston, D., Gilbert, A., Manning, R., 1998. Indicators and standards of quality for ski resort management. Journal of Travel Research 36, 35–41.
Rodgers, K., Cox, E., 2003. The effects of trampling on Hawaiian corals along a gradient of human use. Biological Conservation 112, 383–389.
Rouphael, A., Inglis, G., 2002. Increased spatial and temporal variability in coral damage caused by recreational scuba diving. Ecological Applications 12, 427–440.
Shelby, B., Heberlein, T., 1986. Carrying Capacity in Recreation Settings. Oregon State University Press, Oregon, USA.
Shelby, B., Vaske, J., Donnelly, M., 1996. Norms, standards and natural resources. Leisure Sciences 18, 103–123.
Shelby, B., Vaske, J., Harris, R., 1988. User standards for ecological impacts at wilderness campsites. Journal of Leisure Research 20, 245–256.
Szuster, B., Needham, M., McClure, B., 2011. Scuba diver perceptions and evaluations of crowding underwater. Tourism in Marine Environments 7.
van Beukering, P., Cesar, H., 2004. Economic Analysis of Marine Managed Areas in the Main Hawaiian Islands. Cesar Environmental Economics Consulting, Arnhem, The Netherlands.
Vaske, J., 2008. Survey Research and Analysis: Applications in Parks, Recreation and Human Dimensions. Venture Publishing, Pennsylvania, USA.
Vaske, J., Donnelly, M., 2002. Generalizing the encounter-norm-crowding relationship. Leisure Sciences 24, 255–269.
Vaske, J., Shelby, L., 2008. Crowding as a descriptive indicator and an evaluative standard: results from 30 years of research. Leisure Sciences 30, 111–126.
Vaske, J., Shelby, B., Graefe, A., Heberlein, T., 1986. Backcountry encounter norms: theory, method and empirical evidence. Journal of Leisure Research 18, 137–153.