



Research article

The efficacy of combined educational and site management actions in reducing off-trail hiking in an urban-proximate protected area

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ABSTRACT

Park and protected area managers are tasked with protecting natural environments, a particularly daunting challenge in heavily visited urban-proximate areas where flora and fauna are already stressed by external threats. In this study, an adaptive management approach was taken to reduce extensive off-trail hiking along a popular trail through an ecologically diverse and significant area in the Chesapeake and Ohio National Historical Park near Washington DC. Substantial amounts of off-trail hiking there had created an extensive 16.1 km network of informal (visitor-created) trails on a 39 ha island in the Potomac Gorge. A research design with additive treatments integrating educational and site management actions was applied and evaluated using self-reported behavior from an on-site visitor survey and unobtrusive observations of off-trail hiking behavior at two locations along the trail. Study treatments included: 1) trailhead educational signs developed using attribution theory and injunctive-proscriptive wording, 2) symbolic “no hiking” prompter signs attached to logs placed across all informal trails, 3) placement of concealing leaf litter and small branches along initial sections of informal trails, 4) restoration work on selected trails with low fencing, and 5) contact with a trail steward to personally communicate the trailhead sign information. The final, most comprehensive treatment reduced visitor-reported intentional off-trail hiking from 70.3% to 43.0%. Direct observations documented reduction in off-trail hiking from 25.9% to 2.0%. The educational message and site management actions both contributed to the decline in off-trail travel and the two evaluation methods enhanced our ability to describe the efficacy of the different treatments in reducing off-trail travel.

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1. Introduction

Recreation visitation is a traditional, legitimate, and economically important type of ecosystem service of many protected natural areas (Costanza et al., 1997), which are typically established for their significant ecological value. A common strategy to achieve a balance between recreation and conservation goals is through provision of a recreational infrastructure of trails and recreation sites that concentrate traffic on hardened durable substrates (Eagles et al., 2002; Marion, 2016; Marion and Leung, 2004). Many of these facilities are sustainably located and designed to shield and protect sensitive natural resources from visitor pressure (Marion,

2016; Marion and Farrell, 2002). However, the effectiveness of this spatial containment strategy is compromised when visitors travel away from the formal infrastructure in sufficient numbers to create informal trails and sites (Cole et al., 2008).

Indeed, off-trail hiking and the associated creation and proliferation of informal trails present a prime example of this problem, which occurs within most protected areas (Leung et al., 2011; Wimpey and Marion, 2011a). Sometimes referred to as social trails, these undesirable trail segments are often products of heavy visitation coupled with diverse recreation interests and motivations that draw visitors off of formal trails. Their proliferation in number, expansion in length, and resource impacts are perennial management concerns (Marion et al., 2016). Research reporting that a majority of hikers travel off-trail underscores the importance of this issue (Bradford and McIntyre, 2007; Park et al., 2008; Swearingen and Johnson, 1994, 1995).

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Because informal trails are not professionally designed, constructed or maintained they can contribute substantially greater impacts to protected area resources than formal trails (Wimpey and Marion, 2011a). Many informal trail impacts are related to their poor design, including alignments parallel to steep slopes or along shorelines, multiple trails accessing the same destination, routes through fragile vegetation, soils, or sensitive wildlife habitats, and disturbance to rare flora, fauna, or archaeological sites (Cole, 2008; Dumont et al., 2005; Knight, 2000). These design attributes also make informal trails far more susceptible to tread impacts, including expansion in width, soil erosion, and muddiness (Leung and Marion, 1996; Wimpey and Marion, 2011a).

Many past studies of off-trail hiking and informal trails have been conducted in frontcountry zones of large protected natural areas such as Acadia National Park (Park et al., 2008), Mt. Rainier National Park (Rochefort and Gibbons, 1992), Rocky Mountain National Park (D'Antonio et al., 2013), and Yosemite National Park (Leung et al., 2011), with exceptions such as Boston Harbor Islands (Manning et al., 2005). While informal trails can form anytime visitors travel off-trail to common attraction features like vistas or campsites, they develop most frequently in high-use areas with environmental settings that permit off-trail traffic and have large numbers of off-trail attraction features (Marion et al., 2016; Walden-Schreiner and Leung, 2013). Inexplicably, small urban protected areas, which frequently receive high levels and densities of use, have received far less research attention (Alberti et al., 2003; Kaplan, 1983; Mora-Bourgeois, 2006). The apparent differences in the intensity and patterns of use, visitor characteristics, and resource conditions necessitate focused research on this end of the spectrum of protected areas to support effective management decisions regarding sustainable visitor use (Collins and Brown, 2007; Kyle and Graefe, 2007).

In this study, we investigated the efficacy of educational and site management actions designed to deter off-trail hiking along a popular National Park Service (NPS) trail located within the densely populated Washington D.C. metropolitan area. Previous efforts to deter off-trail hiking were unsuccessful, and an extensive network of informal trails was threatening numerous rare plants. We collaborated with managers to simulate an adaptive management process by developing an experimental design featuring additive treatments where additional site management and visitor education actions were integrated and sequentially applied to achieve the highest-possible reduction in off-trail hiking behaviors.

2. Literature review

The creation and use of informal trails by visitors are considered forms of non-compliant or depreciative behaviors (Gramann and Vander Stoep, 1987; Swearingen and Johnson, 1995). Depreciative behavior is impactful behavior by visitors ranging from unintentional actions to intentional acts of vandalism. The motivation or reason for a depreciative behavior influences the efficacy of interventions applied to reduce the undesired behavior (Gramann and Vander Stoep, 1987). The motivations and context of the visit can also influence the likelihood of depreciative behaviors. For example, there may be differences associated with urban-proximate parks, where urban visitors are engaged in activities such as dog walking, trail running, or short walks near their home that are uncommon in more distant traditional parks. In an effort to reduce impacts to natural resources, flora, and fauna caused by informal trail use, various educational and site management techniques have been evaluated for their efficacy in deterring off-trail travel. Early studies revealed that messages threatening a sanction are more effective in reducing off-trail hiking than ethical, humorous, symbolic, and hybrid messages (Johnson and

Swearingen, 1992; Swearingen and Johnson, 1994). Despite their effectiveness, managers are often hesitant to use “threatening” sanction messages due to their potential to degrade visitor experiences, so research began to focus on the efficacy of alternative educational or interpretive messages in deterring off-trail travel (Lucas, 1983; Winter, 2006).

Educational messages developed to reduce off-trail hiking can include an “awareness of consequence” component, informing visitors about the impact of off-trail hiking on the environment and instructing them about preferred low impact behaviors. An “ascription of responsibility” component is also common in educational messages, instilling a sense of personal responsibility to protect the area’s resources (Schwartz, 1975; Van Liere and Dunlap, 1978). Bradford and McIntyre (2007) reported that an attribution-based educational message (“Your feet have trampled the vegetation on this island. Please stay on the main wood-chipped trail”) was more effective in keeping visitors on formal trails than a non-attribution plea message. Winter (2006) found that a message with injunctive-proscriptive wording telling visitors what they should not do (“Please don’t go off the established paths and trails, in order to protect the Sequoias and natural vegetation in this park”) was more effective than prescriptive (encouraging positive behaviors) or descriptive (telling visitors what other visitors do) messages in deterring off-trail hiking.

The location of signs in relation to when decisions are made to hike off-trail has also been shown to be significant. Bradford and McIntyre (2007) found that 88% of visitors left the main trail when no sign was present; this percentage was not significantly reduced when a sign was placed at an information booth (87%), but a sign placed at the intersection of the informal and formal trails reduced the off-trail hiking rate to 65%.

Site management techniques, such as physical barriers and other site alterations, offer additional options for deterring off-trail hiking but a great majority of studies have focused on signage so there is little empirical evidence of site management efficacy. One common management practice is “brushing” – applying organic materials such as logs, branches, or organic litter, to physically deter hikers, to “hide” trails, or make them look less appealing. However, visitors who routinely use a trail or can still see it may remove obstructing brush, possibly thinking they are helping to maintain the trail. This was reported by Johnson et al. (1987), who also found that visitors dismantled brushings or circumvented them, prompting the creation of new trails that expanded the impacted area.

Various methods of fencing offer another site management option for effectively deterring informal trail use. Swearingen and Johnson (1994) study revealed a yellow rope barrier to be the most effective site management technique. This finding is supported by a recent study at Acadia National Park, which demonstrated that low fencing and signs located near informal trails were highly effective (Park et al., 2008), and by a Mt. Rainier National Park study that showed the presence of a uniformed employee and rope barriers to be the most effective treatment (Rochefort and Gibbons, 1992).

Several studies have found the presence of a uniformed employee to be effective in deterring depreciative behavior (Widner and Roggenbuck, 2000; Ward and Roggenbuck, 2003; Swearingen and Johnson, 1995). For example, Swearingen and Johnson (1995) reported the use of uniformed personnel to communicate low impact behaviors to be highly effective, attributing that success to employment of the “peripheral route to persuasion” which relies on an authoritative source. They also note that while use of uniformed staff may be viewed as unnecessarily intrusive, that “visitors accepted the uniformed employee presence when there was a perceived need for such a management action

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