

# Research Reports

## Engaging park stewards through biodiversity discovery: Social outcomes of participation in bioblitzes

By Kirsten M. Leong and Gerard T. Kyle

**R**ESOURCE MANAGEMENT PROJECTS THAT incorporate public participation in scientific research (i.e., citizen science) are often designed, evaluated, and scrutinized with respect to the rigor of scientific data collection and analysis. Yet the social benefits of these endeavors are becoming increasingly recognized (Bonney et al. 2014; Kyle and Eccles 2009; NPS 2010) and can contribute directly to the National Park Service (NPS) mission. The Service has been engaging in bioblitzes at various scales since the term was coined in 1996 at an event at Kenilworth Park and Aquatic Gardens in Washington, D.C. The first long-running program to regularly incorporate bioblitzes was the All-Taxa Biodiversity Inventory initiated at Great Smoky Mountains National Park in 1997 (NPS 2010). Most bioblitzes at parks engage on the order of tens to hundreds of participants. In 2006 the National Park Service and National Geographic Society (NGS) entered into a partnership to cosponsor a large-scale “BioBlitz” each year for 10 years in a national park located near a large urban area, with the final event occurring in 2016, the year of the NPS centennial celebration. These bioblitzes attract thousands of participants and typically are compressed, 24-hour events<sup>1</sup> in which teams of volunteer scientists, families, students, teachers, and other community members work together to find and identify as many species of plants, animals, microbes, fungi, and other organisms as possible. They also include an educational “biodiversity fair” component with exhibitors, activities, and entertainment, as well as opportunities to engage with scientists processing specimens, entering data, or giving talks about their research. The NPS-NGS partnership has brought attention to the range of possibilities to engage the public in park inventories, particularly of lesser-known taxonomic groups, and also addresses the NPS Call to Action item “Next Generation Stewards” (NPS 2013), which emphasizes citizen involvement in biodiversity discovery in national parks, including urban units.

Large-scale NPS-NGS BioBlitzes also enable the evaluation of broad social-psychological outcomes because of the large number of participants and the range of activities available. Like other research activities in national parks that involve the public, NPS-NGS BioBlitzes serve multiple purposes. They document the

<sup>1</sup> NPS-NGS BioBlitzes typically start at noon on a Friday and run through noon on the following Saturday, to accommodate both school groups and the general public. This timing may be different from that of smaller-scale bioblitzes.

### Abstract

Large-scale bioblitzes, such as those conducted jointly by the National Park Service and National Geographic Society, provide an opportunity for visitors to engage directly in inventories of lesser-known species in parks. Working side by side with scientists, members of the public contribute to the development of knowledge about park resources, learn about the scientific method, and experience the park in a new way. This study examined the social outcomes of this type of citizen science effort to improve the design and promotion of future biodiversity discovery events. Results indicate that these bioblitzes are meeting primary social objectives and attract participants with a strong stewardship ethic and desire to contribute to the betterment of society and the environment. Bioblitzes also provide an opportunity for participants to deepen their connections with national parks. Future events should emphasize science contributions of bioblitz activities to help meet participants’ needs related to learning, conservation, and contributing to a greater good. This, in conjunction with the activity itself, can help improve the relevancy of parks, a goal of the National Park Service.

### Key words

bioblitz, citizen science, National Geographic Society, social-psychological science, visitor experiences

diversity of life in parks and engage curious citizens, educators, and other park supporters in science and stewardship. While the gain in scientific information is invaluable to park management, it is important to understand social-psychological outcomes to determine the degree to which bioblitzes achieve the goal of developing participants’ appreciation of science and stewardship.

To better understand bioblitz participants’ experiences, motivations, feelings about the natural environment, and demographic characteristics, we conducted a series of studies at the NPS-NGS BioBlitzes held at Biscayne National Park (hereafter “Biscayne,” near Miami, Florida) in 2010, Saguaro National Park (“Saguaro,” near Tucson, Arizona) in 2011, and Rocky Mountain National Park (“Rocky Mountain,” near Denver, Colorado) in 2012. Results can be used to improve the design and promotion of future biodiversity discovery events based on audience characteristics, motivations, and satisfaction. In addition, results demonstrate the degree to which these events attract and engage the public in science and

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**Figure 1.** A student from Texas A&M University surveys visitors at the NPS-NGS BioBlitz at Rocky Mountain National Park in 2012.

stewardship of parks. Full details of each study will be made available in the Natural Resource Stewardship and Science Natural Resource Report Series in 2015 (<http://www.nature.nps.gov/publications/nrpm/nrr.cfm>). In this article we highlight study results with particular management application.

## Methods

### *Data collection*

On-site survey data were collected from participants at each bioblitz over a 26-hour period from 10 a.m. on Friday through noon on Saturday. This sampling period covered the duration of the event. Researchers were stationed at designated event parking lots, shuttle drop-off points, and event exhibition areas. Every second visitor was approached to participate in a brief (approximately three-minute) on-site survey (fig. 1). For groups of more than one, adults (>18 years of age) with the most recent birthday were asked to participate. We collected basic information about participants and an e-mail or postal address so that they could participate in a more in-depth survey following their bioblitz experience. Based on their stated preference, respondents then received either an e-mail or paper mail-back questionnaire one to two weeks after the bioblitz. Reminders, follow-ups, and thank-you notes were periodically sent to nonrespondents following protocols for the administration of mixed-mode surveys (Dillman et al. 2008). The survey questions were divided into five sections that related to (1) respondents' participation in past bioblitzes and park programs, (2) their experiences at the specific bioblitz, (3) their experiences with the park, (4) their feelings about the natural environment, and (5) sociodemographic information.

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### *Data analysis*

Completed and usable survey data were coded and entered into a database for analysis using SPSS (Statistical Package for the Social Sciences) version 20. For various response categories, we estimated frequency distributions and valid percentages (i.e., percentages excluding missing values from skipped questions). Also, we calculated descriptive statistics to illustrate mean values (i.e., averages) and standard deviations, and created figures for selected variables to guide interpretation of the study findings.

## Results

We received 133 completed follow-up surveys from participants at Rocky Mountain, 159 from Saguaro, and 100 from Biscayne, with response rates of 37.7%, 69.7%, and 66.2%, respectively. We used the initial contact information to compare characteristics of respondents with those of nonrespondents and did not see any significant differences that would indicate a nonrespondent bias. At all three parks, visitors reported similar levels of participation in past bioblitzes and other NPS programs in addition to the current bioblitz. Respondents did not report extensive previous experiences with bioblitzes in general; however, approximately six respondents at each park had participated in a previous bioblitz at locations ranging from other national parks and natural areas near their homes to Mexico. While visiting the respective parks, approximately one-third of respondents took part in NPS presentations or programs outside of the NPS-NGS-sponsored event.

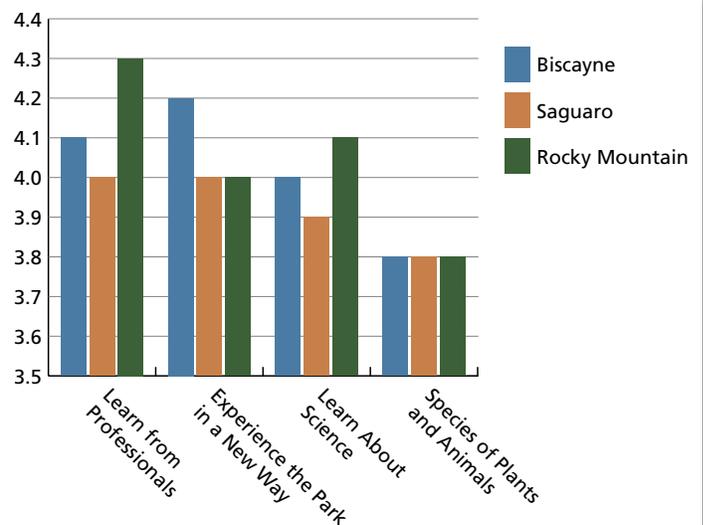
The majority of respondents at Biscayne, Saguaro, and Rocky Mountain participated in the event with friends, family, or col-

**Table 1. Reported motivation among participants in the three bioblitzes**

Motivation	Rocky Mountain		Saguaro		Biscayne	
	Mean	SD	Mean	SD	Mean	SD
Involve myself in something meaningful	4.2	1.0	4.0	1.5	3.7	1.2
Seek out and enjoy the wonders of nature	4.2	1.1	3.9	1.5	3.9	1.1
Feel like I am supporting the park	4.1	1.0	4.1	1.4	4.0	1.0
Feel I can play a role in the conservation of nature	4.0	1.6	4.1	1.1	3.9	1.1
Make life better for the coming generation	4.0	1.1	3.9	1.1	3.9	1.1
Learn about different species of flora and fauna	4.0	1.0	3.8	1.5	3.9	1.2
Have an opportunity to try new things	4.0	1.0	3.8	1.0	3.6	1.1
Be optimistic about nature's future	3.9	1.2	3.5	1.3	3.6	1.1
Be of benefit to society or the community	3.8	1.6	3.8	1.1	3.9	1.1
Learn how nature works	3.8	1.2	3.7	1.2	3.6	1.4
Learn about the practice of science	3.8	1.1	3.5	1.6	3.3	1.3
Feel I am doing something useful	3.7	1.7	3.9	1.2	3.8	1.2
Meet friendly and interesting people	3.7	1.3	3.6	1.1	3.5	1.1
Refine my understanding of science	3.7	1.6	3.2	1.3	3.3	1.2
Apply my scientific skills	3.5	1.9	2.4	2.1	3.1	1.4
Help me with my personal growth	3.4	1.5	2.7	1.3	2.7	1.4
Stay healthy	3.4	1.5	2.7	1.4	2.6	1.3
Be in a quiet peaceful spot	3.2	2.0	2.1	1.5	2.7	1.3
Work with different age groups	3.0	1.7	3.0	1.4	3.0	1.5
Be alone with my thoughts	2.7	2.2	1.7	1.4	1.9	1.1
Build my self-confidence and personal growth	2.6	1.7	2.1	1.2	2.0	1.2

leagues, and learned about the bioblitz through various outlets, including others' recommendations and newspaper and magazine articles. For respondents at all three bioblitzes, contributing to society and opportunities to learn from others compelled participants to engage in the event. Items that scored particularly high as reasons for their participation related to getting involved in something meaningful, seeking out and enjoying the wonders of nature, supporting the park, playing a role in the conservation of nature, making life better for the coming generation, learning about different species of flora and fauna, and being a benefit to society or the community (table 1).

Impacts from participation in the bioblitz were widespread. On average, respondents at all parks agreed that the bioblitz was meeting objectives related to providing opportunities for visitors to learn from professionals, experience the park in a new way, and learn about science (fig. 2). In addition, they agreed that participation in the event increased their knowledge of the local ecosystem and its life-forms. At Rocky Mountain and Saguaro, a series of related questions was presented to respondents about potential implications of the bioblitz program for the National Park System as a whole. On average, respondents agreed that this kind of event



**Figure 2. Comparison among mean values of responses with four statements reflecting the human impact of participation in bioblitz programs across three national parks, measured on a Likert scale where 1 = strongly disagree, 2 = disagree, 3 = neither disagree nor agree, 4 = agree, and 5 = strongly agree.**

**Table 2. Bioblitz participants' values associated with nature- and human-oriented stewardship at three national parks**

Dimension and Survey Value	Factor 1*	Factor 2*	National Park	Mean	SD
<b>Nature-oriented stewardship</b>					
Preserving the environment in its natural state	0.763		Biscayne	4.5	0.7
			Saguaro	4.5	0.6
			Rocky Mountain	4.0	0.9
An ethical responsibility to care for the environment	0.819		Biscayne	4.4	0.7
			Saguaro	4.5	0.6
			Rocky Mountain	4.5	0.7
All animals' and plants' right to exist	0.699		Biscayne	4.3	0.8
			Saguaro	4.3	0.8
			Rocky Mountain	4.1	1.0
Protecting the environment for future generations	0.779		Biscayne	4.6	0.6
			Saguaro	3.9	1.0
			Rocky Mountain	4.5	0.6
Trying to reduce my negative impact on the environment	0.560		Biscayne	4.2	0.8
			Saguaro	4.4	0.7
			Rocky Mountain	4.4	0.7
<b>Human-oriented stewardship</b>					
Managing our natural resources wisely to provide for human needs		0.770	Biscayne	3.8	1.1
			Saguaro	3.9	0.9
			Rocky Mountain	4.0	1.0
Protecting all species because we may find a use for them later (e.g., curing disease)		0.570	Biscayne	3.7	1.0
			Saguaro	3.9	1.0
			Rocky Mountain	3.7	1.2
<p>Note: Bioblitz participants were asked the question "When I hear the term 'natural resource stewardship' in relation to [park name] I think of [value in list]." Their responses were measured on a Likert scale where 1 = strongly disagree, 2 = disagree, 3 = neither disagree nor agree, 4 = agree, and 5 = strongly agree.</p> <p>*Principal Axis Factoring with Varimax rotation and Kaiser normalization was used to determine underlying factors that each item represented. Two underlying factors were identified, which we labeled "nature-oriented" and "human-oriented" stewardship. Primary factor loadings for each item are shown.</p>					

would aid in management of the park's natural resources, add to science-based knowledge, increase understanding of biodiversity, and inform the public about park resources.

Respondents at all sites reported they had a strong stewardship ethic, reflected in their agreement with statements related to protecting the environment for future generations, having an ethical responsibility to care for the environment, and taking individual responsibility for actions that could affect the park. Respondents at Rocky Mountain considered themselves to be natural resource stewards to a greater degree than did those at the other two parks. Bioblitz participants at Biscayne showed the lowest levels of self-reported affinity for stewardship. Across all three parks, survey respondents perceived natural resource stewardship to be more nature-based than people-oriented, and displayed an intrinsic appreciation for nature regardless of its functional utility ( $z_{\text{Biscayne}} = 5.57, p < 0.001$ ;  $z_{\text{Saguaro}} = 5.75, p < 0.001$ ;  $z_{\text{Rocky Mountain}} = 5.23, p < 0.001$ ; table 2). Participants reported moderate willingness to engage in park protection behavior, such as volunteering time and paying more for products and services that improve park environments.

Survey respondents formed connections with all three parks. Bioblitz participants at Rocky Mountain reported the highest levels of place attachment as well as more extensive visitation histories at the park. That is, over time Rocky Mountain respondents have developed connections with the park based on emotional ties (e.g., feelings of belonging and happiness), individual identity (e.g., believing the park is part of oneself), and opportunities to socialize (e.g., spending time with family and friends). Across all three parks, affect and emotion as well as social and individual factors underpinned human-place bonds. Sociodemographic characteristics were consistent across the three national parks. More males than females completed the survey, and most were in their mid-40s, well educated, and employed outside the home. Between half and three-quarters of respondents at the three parks reported earning more than \$50,000 annually. The majority were white and of non-Hispanic origin.

## Discussion

Results from these surveys suggest that NPS-NGS BioBlitzes are meeting the main social-psychological objectives related

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to providing park visitors with an opportunity to learn from professionals, experience the park in a new way, and learn about science and park ecosystems. Respondents believed their efforts helped manage the park's natural resources, added to science-based knowledge, increased understanding of biodiversity within the park, and informed the public about park resources. They reported a strong stewardship ethic and were willing to engage in park protection behavior.

Respondents' motivations for participation included seeking opportunities to contribute to society in a meaningful way and to learn about and contribute to the conservation of nature, indicating that the promotion of these events appropriately attracted individuals desiring a citizen-science experience. Like many research endeavors involving the public, bioblitzes can be designed to focus more strongly on either the science or education components of the event. Given the strong desire of participants to make a difference, bioblitz organizers will need to be careful not to allow future bioblitzes to swing so far to the education side that the scientific and conservation contributions of the event are minimized. In addition to teaching the scientific method and getting kids and adults outside, activities billed as inventories should include discussion of how public participation is helping to further our understanding of park resources and advance conservation of these resources.

Levels of place attachment were most pronounced in the Rocky Mountain sample and relatively low among participants at Biscayne. Affective/emotional bonds are key components of the connections formed between people and places, which can be maintained through experiential opportunities. Bioblitzes may help to foster attachment to park settings by allowing participants to interact with a park and its flora and fauna in new and exciting ways that conventional visitors seldom experience. Having natural and cultural histories interpreted by scientific guides also gives participants a unique understanding of the resource that they might not otherwise be exposed to during a typical visit. By nurturing attachment to parks, bioblitzes contribute to increasing the relevancy of national parks for participants.

On the whole, bioblitzes in the national parks are a relatively recent phenomenon. While some parks have engaged in them since the mid-1990s, Service-wide attention to these types of events has not been prevalent until the last decade. The NPS-NGS partnership initiated in 2006 has raised awareness of these events as a means to engage the public in science and stewardship, and since then, bioblitzes and biodiversity discovery activities have gained momentum across the National Park System and beyond. Published in 2012, the NPS Call to Action articulated numerous goals to guide the work of the National Park Service in the time leading up to the bureau's 100th anniversary in 2016. One of those goals is to conduct 100 bioblitzes in national parks by 2016, a goal that has already been exceeded, with park participation growing rapidly over the past few years. Nevertheless, these events are still relatively rare in comparison with the overall number of park visitors and interpretive and research programs that take place in a given year. Thus it is unsurprising that most respondents in this study had limited experience with other bioblitzes. Yet we also note that a number of respondents at each park had previously participated in bioblitzes, either at other national parks or elsewhere at local natural areas. Anecdotal accounts also indicate the potential for developing bioblitz "groupies" as prevalence of these opportunities increases.

## Conclusion

Given the growing popularity of bioblitzes, it will be important to ensure that these events continue to meet expectations of participants. Future bioblitzes can use lessons from this study to capitalize on the strong community and environmental ethic of visitors attracted to these events and to emphasize to a greater degree the role that participants play in contributing to park science and stewardship. Offering species inventories and other experiential research opportunities should remain an important and visible component of these kinds of events. In addition, providing central access to information about planned events could help bioblitz aficionados learn about upcoming opportunities and continue to spread interest via their own social networks. Finally, an effort should be made to reach out to underserved audiences to broaden the diversity of participants.

Although only adults were surveyed in this study, many attended the bioblitz in family groups and likely imparted their stewardship ethic to their children, many of whom also attended the bioblitz in school groups. Because an additional goal of NPS bioblitzes relates to creating the next generation of park stewards, our future research will examine the social outcomes of participation for teachers and students, the other major audience participating in NPS-NGS BioBlitzes.

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