

# A system-wide assessment of night resources and night recreation in the U.S. national parks: A case for expanded definitions

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## THE NIGHTTIME ENVIRONMENT HAS HISTORICALLY IN-

cluded darkness in outdoor settings, brightened only to the degree that celestial objects and human-sourced light allowed. Human-caused lighting has increased in intensity and use over the last several decades, producing what is known as light pollution, or nuisance lighting. It is estimated that nearly 99% of the world's skies are now deemed light-polluted, and the severity and extent of light pollution are expected to increase substantially (Cinzano 2001; fig. 1). A key trait of nuisance lighting is that it shines where it is not wanted (Brons et al. 2008), creating light trespass, or is deemed problematic in some other way. The U.S. National Park Service (NPS) has documented light pollution up to 200 miles (322 km) from its source in the form of sky glow: the orange or milky-gray glow characteristic of many metropolitan areas at night. Remote locations that have few or no nuisance light sources of their own can be affected by distant light sources via sky glow.

The National Park Service has a small team of scientists dedicated to addressing what it calls “natural lightscapes.” The Night Skies Team (NST) uses science and technology to better understand the impact of anthropogenic light on the view of the celestial sky and to develop management recommendations for protection of these nighttime resources. Since its inception in 1999, the NST has expanded its scope to address the cultural, historical, ecological, and experiential (i.e., recreational) value of the night in the national parks. National Park Service management policies paralleled this change and in 2001 incorporated discussion of ecological and cultural values of natural lightscapes (natural resources and values found in the absence of human-caused light). Yet the bulk of nighttime stewardship remains focused on the celestial view and stargazing. This narrow bias may be a result of the decades of outreach by professional and amateur astronomers or the appearance of other park-related efforts and organizations. For example, the Starlight Initiative, the International Union for Conservation of Nature's (IUCN) World Commission on Protected Areas, and the International Dark-sky Association remain focused on the view of the sky, whether on scientific, aesthetic, or cultural grounds.

A consequence of this institutional narrow focus is that a park manager may dismiss or minimize the value of the nighttime environment if the desire for stargazing is low, and overlook the wide range of

## Abstract

Degradation of the night environment by light pollution poses a threat to the viability of nighttime outdoor recreation activities, experiences, and related resources in parks and protected areas (PPAs). The terms “night resources” and “night recreation” are often narrowly defined by PPAs, considering only the night sky or stargazing. These definitions may omit a wide range of other night-dependent resources or recreation activities, possibly resulting in a decreased ability of PPAs to protect and promote them. This article examines the range of night recreation activities offered by U.S. national and state parks through Web site analysis and uses this to propose more complete definitions of “night resources” and “night recreation.” The article then assesses the prevalence and characteristics of night recreation activities in U.S. National Park System units ( $n = 315$ ) through a mail survey. Results reveal that a diversity of night recreation activities are represented across National Park System units and that visitors participate in night recreation activities to a substantial degree. These findings support the call for more complete recognition of night resources to best protect them while providing for visitor enjoyment. Further implications and future research directions are discussed.

## Key words

light pollution, night recreation, night resources, night sky, outdoor recreation

other recreational activities that are linked to a naturally dark nighttime environment. Additionally, the fraction of the public that enjoys stargazing per se is likely smaller than the fraction that enjoys other nighttime recreational activities. Nighttime recreation may include other activities such as nocturnal species observation, historical or cultural learning, night fishing, camping, and night hiking (fig. 2). Night resources include nocturnal flora and fauna (fig. 3), the relative quiet of the night, and a natural dark environment. No accepted definitions of night recreation or night resources exist. This is problematic because an incompletely or incorrectly defined activity or resource cannot be properly managed, protected, or fully appreciated.

Empirical examinations of night resources—other than the night sky—and night recreation are just beginning to occur from a social science perspective. A need exists to better understand the diversity of activities, experience opportunities, and use levels of

night recreation in PPAs. This article presents (1) a census of night recreation activities offered in U.S. national and state parks; (2) proposed, expanded, and formalized definitions of *night recreation* and *night resources*; and (3) an assessment of opportunities, access to, and visitor participation in night recreation activities in the U.S. National Park System.

## Methods

### *Census of night recreation and expanded definitions*

Because of the narrow, incomplete, and informal definitions of night recreation and night resources, a census of night activities offered in national ( $n = 392$ ) and state park ( $n = 3,500$ ) units with Web sites was conducted as a preliminary step. We visited and searched each park unit Web site by exploring the site systematically (i.e., home page, visitor activities information, activity calendars) and using specific search terms (i.e., night, dark, star, moon, and nocturnal). We assumed that Web site content and calendar listings of activities and educational programs were current and accurate. The census included both national and state parks to enhance the breadth of investigation of potential forms of night recreation and night resources. For each Web site visited, we recorded night-dependent or night-related recreation activities. This list then served as the basis for more complete definitions and examinations of night recreation and night resources.

### *Night opportunities and activities in the national parks*

Based on the census, we created a paper-based questionnaire to assess the opportunities for, access to, and visitor participation in night recreation activities in the National Park System. Also, the questionnaire allowed the activities identified through the Web site census to be examined for validity and completeness. We sent questionnaires to superintendents (or equivalent) of the national park units. The researchers included only those parks solely managed by the National Park Service. This yielded a final study population of 390 national park units.

We distributed questionnaires using a modified Dillman (2007) approach. This approach involved an initial mailing with the questionnaire and a cover letter, followed by a postcard reminder to nonrespondents, a second mailing of the questionnaire and a modified cover letter to nonrespondents, and a final contact by telephone. The cover letter and questionnaire contained a definition of night recreation and night resources (presented later in this article) and a request that the survey be forwarded to the park employee who the superintendent felt would best be able to answer the questions. Parks were asked to complete the survey even if they did not consider themselves a “night park” to ensure a complete assessment of night activities in the national parks.

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**Figure 1.** City lights in the United States, based on data from 2012.



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**Figure 2.** Camping is just one of 15 common types of night recreation that occurs in parks.



BENJAMIN DERGE, WIKIPEDIA COMMONS

**Figure 3.** Bioluminescent fungi are both natural and cultural night resources. Foxfire, created by such fungus, is a part of Appalachian folklore.

In the questionnaire, respondents were asked to indicate whether their park is ever open during dark hours. This question was intended to assess the number of parks that potentially could offer night activities or that may use night resources for visitor enjoyment. Additionally, the number of parks whose information facilities, such as visitor centers, are ever open during dark hours was captured. We then asked respondents whether the listed night resource activities occurred in their park and whether visitors could engage in the activity on their own or as part of a park program. Respondents were also able to indicate whether an activity is prohibited in their park. Finally, respondents were asked to note the number of both campers/lodgers and other nighttime visitors in their park.

## Results

### *Census of night recreation and defining night resources*

The census of night activities yielded 15 night-dependent or night-related recreation activities or categories of activities (table 1). This broad range of night activities is evidence that night resources and night activities go beyond the night sky and stargazing and supports the need for more comprehensive definitions of the terms “night resources” and “night recreation.” We note that no definition of these terms or concepts is given or implied in the 2006 NPS *Management Policies*, and the term “lightscape” used in this document is a limited and vague concept described as “natural resources and values that exist in the absence of human-caused light” (NPS 2006, p. 57). Based on the variety of night resource activities found in our census of Web sites, we propose that the terms “night resources” and “night recreation” be more comprehensively defined as follows:

Night resources: “anything that either enhances the visitor experience after sunset (including safety measures, recreational opportunities, and interpretive programs), or that is most active or prominent at night, including animals, plants, and features of the night sky.”

Night recreation: “any recreational activity occurring after sunset, including camping.”

### *Night opportunities and activities in the national parks*

A total of 313 National Park System units returned completed questionnaires (table 2), yielding a response rate of 80.3%. Of those, 80.2% (251 units) indicated that their park is open at least sometimes after sunset. Just over 54% of respondents indicated that information facilities in their park, such as visitor centers, are ever open to visitors at night.

Respondents were asked to indicate which of the 15 previously identified night activities visitors could participate in, under what conditions, and whether visitors engage in these activities (table 3,

page 58). Results show that each night resource activity listed occurs and is pursued by visitors in at least one park. Also, each activity was prohibited in at least one park. Night interpretive programming is the most widely offered ( $n = 210$ ) and pursued ( $n = 181$ ) night activity. (This difference in the number of parks in which programs are offered versus participated in may be partially due to measurement error—many respondents indicated that an activity is participated in at their park, but did not indicate whether or not visitors could do this activity on their own, as part of a park-facilitated program, or both.) Second to this, night hiking or walking was permitted as a self-facilitated activity in 190 parks, with 179 parks indicating that visitors engage in this activity. We note that a few unlisted activities were indicated by participants: night diving/snorkeling ( $n = 2$ ), beach fires ( $n = 1$ ), evening programming ( $n = 1$ ), drinking with friends ( $n = 1$ ), evening science lectures ( $n = 1$ ), Native American spiritual pursuits ( $n = 1$ ), night docking ( $n = 1$ ), and using or looking at lighthouses ( $n = 1$ ).

Respondents were asked to indicate their best estimate of visitors (both lodgers/campers and other nighttime visitors) who use their park at night on an annual basis (table 4, page 59). A majority of respondents did not supply a number, choosing either “Not Applicable” or “Don’t Know,” or did not respond to the item at all. Of those who did supply a numeric response, 56 (17.9%) estimated that fewer than 500 people camp or lodge in their park in an average year. Likewise, 43 (13.7%) indicated that fewer than 500 nighttime visitors (noncampers/lodgers) use their parks in a given year. Other response ranges were indicated with less frequency, but some parks indicated that hundreds of thousands or millions of visitors either stay in their parks overnight or visit during nighttime hours annually.

## Discussion

The majority of national park units responding to the survey reported that they are open during night hours at some point. This figure includes parks that only occasionally grant visitors access during night hours, such as for historical reenactments or holiday programs. However, just over half of responding national park units indicated that information facilities, such as visitor centers, are open during night hours. In these places, nighttime visitors may not have access to information about park resources and may not have the opportunity to interact with park personnel to learn about activities or resources not featured in printed information sources. Therefore, it is likely that nighttime visitors are not given information that would allow them to experience night resources, including simply being made aware of those resources. With the exception of scheduled campfire or evening programs, nighttime visitor use is often allowed but not supported by open facilities, available staff, or readily available information. Parks seldom cre-

**Table 1. Night-dependent or light-sensitive night recreation activities recorded in a census of state and national park Web sites**

| Activity  | A Participating Park                                | Activity Example   |
|---|---|--|
| Campfires   | Patapsco Valley State Park, Md.                     | Campfire programs with park-sponsored entertainment (i.e., cooking campfire food for audience, storytelling)     |
| Camping   | Whitewater State Park, Minn.                        | Overnight “I Can Camp” program that teaches participants how to set up tents, build campfires, and cook outdoors |
| Interpretive programs at night                              | New Bedford Whaling National Historical Park, Mass. | “AHA! Night” (Art, History, Architecture), held throughout the park district in collaboration with the community |
| Night bike riding   | Riverside State Park, Wash.                         | Nighttime mountain bike riding allowed within park boundaries (self-facilitated)                                 |
| Night boating, canoeing, kayaking, or rafting               | Lake Catherine State Park, Ark.                     | Full-moon kayak tours  |
| Night concerts or plays                                     | Cape Disappointment State Park, Wash.               | “Waikiki Beach concert series” throughout summer months  |
| Night fishing   | Bill Burton Fishing Pier State Park, Md.            | Fishing from piers specially lit for night fishing   |
| Night hiking or walking                                     | Rocky Mountain National Park, Colo.                 | “Walk into Twilight” (2 hours, ranger-led), observing sights and sounds of night in the park                     |
| Night hunting   | Big South Fork National Recreation Area, Tenn.      | Self-facilitated hunting of specified game   |
| Night photography   | Glacier National Park, Mont.                        | “Astrophotography of Glacier’s Night Sky” (ranger-led)   |
| Night snow skiing or snowshoeing                            | Voyageurs National Park, Minn.                      | “Night Light Snowshoe Hike” (ranger-led)   |
| Special night events or festivals                           | Antietam National Battlefield, Md.                  | “Civil War Soldier Campfire Program”   |
| Stargazing, star parties, or viewing the Northern Lights    | Blackwater Falls State Park, W.Va.                  | “Astronomy weekend” featuring speakers, workshops, and stargazing parties  |
| Viewing natural, cultural, or historical resources at night | Hawai‘i Volcanoes National Park, Hawaii             | Identifies “Night Glow” viewing areas for visitors based on current lava flow locations                          |
| Wildlife viewing at night (excluding spotlighting)          | Congaree National Park, S.C.                        | “Owl Prowls” (ranger-led)  |

ate areas intended for stargazing, actively encourage nighttime use of trails, or accommodate nighttime cultural events.

Most respondents did not know the number of nighttime visitors to their park unit. This may reflect a difficulty in counting visitors, but may also suggest that nighttime use of parks and demand on night resources are not well monitored. When provided, estimates of use suggest that night recreation in park units is often low, but some parks reported nighttime visitor use levels that are quite substantial. This variation is likely due to factors such as the night resources that a park contains, the uniqueness of these resources, how they are promoted or used, and the type and number of visitors to a park. Some parks seem more night-focused than others. For example, Golden Gate National Recreation Area has thousands of visitors who come to participate in night concerts and other performances. Other park units may not offer or recognize particular night recreation activities because they have no indication that it would appeal to visitors and have not identified any other reason to offer certain experiences.

Night recreation activities may require facilitation by park personnel and may therefore add to the demand for park personnel in time and cost. Parks may find assistance from outside volunteers or organizations that are aligned with a given activity. For

**Table 2. Frequency of survey responses and nonresponses by National Park System designation**

| Unit Designation  | Responses | Non-responses |
|---|-----------|---------------|
| International Historic Site   | 1         | –             |
| Memorial  | 5         | –             |
| National Battlefield—Site, Park, or Memorial  | 14        | 2             |
| National Historic—Site, Park, Preserve, or Reserve  | 94        | 31            |
| National Lakeshore  | 4         | –             |
| National Memorial   | 10        | 5             |
| National Military Park  | 5         | 4             |
| National Monument   | 67        | 13            |
| National Park or National Park and Preserve   | 53        | 9             |
| National Preserve   | 3         | 2             |
| National Recreation Area  | 12        | 6             |
| National Reserve  | 1         | –             |
| National River—and Recreation Area, Scenic River, Scenic Riverway, or Wild and Scenic River | 12        | 2             |
| National Scenic Trail   | 1         | 1             |
| National Seashore   | 10        | –             |

**Table 3. Frequency of night recreation activity availability and reported visitor participation in the National Park System**

| Activity  | Specifically Prohibited | Permitted to Do This Activity on Their Own | Permitted to Do Activity as Part of Program | Visitors Engage in This Activity in My Park |
|---|-------------------------|--|---|---|
| Campfires   | 162 (51.4%)             | 90 (28.6%)                                 | 51 (16.2%)                                  | 123 (39.0%)                                 |
| Camping   | 165 (52.4%)             | 97 (30.8%)                                 | 37 (11.7%)                                  | 132 (42.2%)                                 |
| Interpretive programs at night                              | 25 (7.9%)               | 64 (20.3%)                                 | 210 (66.7%)                                 | 181 (57.5%)                                 |
| Night bike riding   | 127 (40.3%)             | 149 (47.3%)                                | 8 (2.5%)                                    | 88 (27.9%)                                  |
| Night boating, canoeing, kayaking, or rafting               | 151 (47.9%)             | 104 (33.0%)                                | 12 (3.8%)                                   | 76 (24.1%)                                  |
| Night concerts or plays                                     | 64 (20.3%)              | 41 (13.0%)                                 | 156 (49.5%)                                 | 91 (28.9%)                                  |
| Night fishing   | 153 (48.6%)             | 105 (33.3%)                                | 3 (1.0%)                                    | 98 (31.1%)                                  |
| Night hiking or walking                                     | 65 (20.6%)              | 190 (60.3%)                                | 77 (24.4%)                                  | 179 (56.8%)                                 |
| Night hunting   | 280 (88.9%)             | 17 (5.4%)                                  | 2 (0.6%)                                    | 32 (10.9%)                                  |
| Night photography   | 56 (17.8%)              | 193 (61.3%)                                | 51 (16.2%)                                  | 153 (48.6%)                                 |
| Night snow skiing or snowshoeing                            | 108 (34.3%)             | 112 (35.6%)                                | 16 (5.1%)                                   | 74 (23.5%)                                  |
| Special night events or festivals                           | 25 (7.9%)               | 53 (16.8%)                                 | 209 (66.3%)                                 | 143 (45.4%)                                 |
| Stargazing, starparties, or viewing the Northern Lights     | 37 (11.7%)              | 162 (51.4%)                                | 109 (34.6%)                                 | 168 (53.3%)                                 |
| Viewing natural, cultural, or historical resources at night | 36 (11.4%)              | 179 (56.8%)                                | 125 (39.7%)                                 | 166 (52.7%)                                 |
| Wildlife viewing at night (excluding spotlighting)          | 69 (21.9%)              | 177 (56.2%)                                | 61 (19.4%)                                  | 137 (43.5%)                                 |
| Other   | 1 (0.3%)                | 5 (1.6%)                                   | 1 (0.3%)                                    | 4 (1.3%)                                    |

Note: Frequencies represent the number and percentage of park units responding affirmatively.

example, a park that does not have personnel to facilitate a night hike may find volunteers in a nature-based organization who are able to lead such an activity. Likewise, astronomy groups may be a rich source of assistance for night sky programs.

Respondents were able to indicate whether any of the 15 listed night activities were prohibited in their park unit. Night hunting, camping, and campfires were most often prohibited, reflecting the philosophy and policy of many national parks, a lack of campground facilities, and wildfire threats, respectively. Other night recreation activities may be prohibited because of the inherent dangers of a given park or activity. For example, hiking and walking in parks during daytime hours are permitted in most parks, yet 20% of respondents reported that night hiking and night walks are explicitly prohibited in their park. This may be partially because of increased perceptions of risk (e.g., tripping, hostile wildlife, disorientation) associated with hiking at night. Several parks indicated that night access is limited in an effort to protect their night resources, such as sea turtles that nest at night.

Respondents were also able to indicate whether a given night recreation activity could occur as part of a park program or whether a visitor could engage in the night activity without supervision. Results suggest that a majority of night activities most often occur individually (i.e., “on your own”), rather than with a ranger or as part of a formal program. However, a substantial percentage of

activities did occur with a ranger or as part of a park program. This makes sense because many night activities (e.g., nocturnal species observation, astronomy, night concerts/events) require technical expertise, specialized equipment, or knowledge that makes participating in these activities as an individual less feasible. In such cases the park interpretive ranger or performer might be considered a park unit’s night resource.

We also note that findings from this study are an incomplete picture of night recreation and night resources because they represent only managers’ observations and management policies. Visitors must be polled about their perceptions of night recreation and night resources. It is likely that NPS managers do not have a completely accurate perception of which night recreation activities or related night resources are of value to visitors. Research demonstrates that park managers and visitors often have distinct and divergent attitudes, values, and beliefs (Manning 2011).

In many cases night may not be perceived as a distinct condition but rather as a gradual transition from or to daytime lighting. This may include *crepuscular* periods immediately before, during, or after sunrise or sunset. Likewise, some resources or recreation activities may not be distinctly night-focused, but are influenced heavily by natural light conditions. For example, the bat flight at Carlsbad Caverns National Park (New Mexico) and the sunrise at Haleakalā National Park (Hawaii) are both substantially night-

**Table 4. Number of night visitors (annually) reported by units of the National Park System**

| Quantity            | Campers and Lodgers |            | Noncampers/Lodgers |            |
|---------------------|---------------------|------------|--------------------|------------|
|                     | Frequency           | Percentage | Frequency          | Percentage |
| Less than 500       | 56                  | 17.9%      | 43                 | 13.7%      |
| 500 to 999          | 4                   | 1.3%       | 9                  | 2.9%       |
| 1,000 to 4,999      | 9                   | 2.9%       | 11                 | 3.5%       |
| 5,000 to 9,999      | 11                  | 3.5%       | 4                  | 1.3%       |
| 10,000 to 19,999    | 9                   | 2.9%       | 5                  | 1.6%       |
| 20,000 to 49,999    | 8                   | 2.6%       | 3                  | 1.0%       |
| 50,000 to 99,999    | 9                   | 2.9%       | 1                  | 0.3%       |
| 100,000 to 199,999  | 5                   | 1.6%       | 1                  | 0.3%       |
| 200,000 to 499,999  | 9                   | 2.9%       | 9                  | 2.9%       |
| 500,000 to 999,999  | 1                   | 0.3%       | 1                  | 0.3%       |
| More than 1,000,000 | 2                   | 0.6%       | 1                  | 0.3%       |
| Not Applicable      | 118                 | 37.7%      | 156                | 49.8%      |
| Don't Know          | 46                  | 14.7%      | 43                 | 13.7%      |
| No Response         | 25                  | 8.0%       | 21                 | 6.7%       |

and light-related, but may not occur wholly while the sun is below the horizon. Also, nature photographers often seek out and take advantage of special lighting conditions associated with the “golden hour” that occurs immediately before sunset or after sunrise (fig. 4). Resources and recreation activities such as these may be considered crepuscular resources or recreation activities. Likewise, caving and visiting pre-electricity-era historical structures could be considered light-dependent resources or recreation activities.

Perhaps the most substantial outcomes of the research presented here are the proposed definitions of both night recreation and night resources. Survey results show that these definitions are more inclusive and accurate than those informal and implied definitions that now limit consideration of night in parks to the night sky or night sky viewing. These proposed broadened definitions may enhance recognition of night resources, their use and enjoyment by visitors, and their management.

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**Figure 4.** Light-dependent resources and recreation are prevalent in many national park units. Photographers’ “golden hour” before sunset is just one example, such as in this view of Plum Orchard Mansion’s lawn at Cumberland Island National Seashore.