Management of Recreation Tourism in Grand Canyon National Park

Final Paper

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**Introduction**

In 1919, the Grand Canyon became part of the newly-minted National Park System (NPS), and thus fell under the purview of NPS management (Shalla 2017). National park managers are tasked with the mission to "preserve unimpaired the natural and cultural resources of the National Park System, for the enjoyment, education, and inspiration of this and future generations" (NPS 2020). This mission presents an implicit requirement for managers to support both natural resource conservation and visitor recreation. The management of recreation is thus a core activity of Grand Canyon National Park (hereafter, GCNP) managers. This activity relies on first having a definition and framework of recreation management (Part 1), as well as tools to monitor (Part 2) and manage (Part 3) the social impacts of recreation. Finally, it requires attention to the myriad trade-offs between recreational use and natural resource impact (Part 4). All of these elements come together in the adaptive management of allocating permits for noncommercial rafting trips in GCNP (Part 5). Ultimately, successful balance of resource conservation and recreation in GCNP serves not only this generation, but also future ones, suggesting a need to look forward and continually refine the complexities of recreation management.

**Part 1: Definitions and Frameworks for Recreation Management**

The National Park Service and other public agencies have been concerned about how to manage recreation in a way that balances natural resource preservation and human enjoyment for some time. An early framework used to describe and work towards this management challenge was the idea of recreational carrying capacity. This term was developed during the 1950s and 1960s, an era when multiple natural resource management arenas were using scientific methods to maximize sustained yield of the resource (e.g. maximum sustainable timber harvest; carrying capacity of livestock on rangelands). Transferred to recreation, recreational carrying capacity is defined as "the level of recreational use an area can withstand while providing a sustained quality of recreation" (Wagar 1964, pg 3). "Recreational use" is a well-defined concept for NPS; it refers to leisure activities that take place in park lands, and includes a wide range of activities. The "quality of recreation" refers to "physical and psychic well-being" of recreators (Wagar 1964, pg 3). This measure varies depending on the values of managers and recreators. As carrying capacity, there is a direct link between the natural resources of the area and the level of recreational use that can be sustained. At a certain point, if recreational use extends beyond the carrying capacity, the recreational quality will not be sustained based on the decline in social and ecological conditions. Thus, there are social, ecological, and management dimensions to recreational carrying capacity (Wagar 1964).

Since the development of the concept of recreational carrying capacity, managers have implemented this idea in management frameworks. The Visitor Experience and Resource Protection (VERP) Framework was developed by US Forest Service and NPS managers to link the various dimensions of recreation in wild areas. In this framework, managers assemble interdisciplinary teams to assess recreation management objectives, assemble indicators, describe potential alternative scenarios for use and impact, and ultimately take management action. This framework explicitly includes social and ecological impacts of visitation, and seeks to balance the trade-off between visitor use and impact (Valliere and Manning 2001). Ultimately, frameworks like VERP help translate the concept of recreational carrying capacity into an actionable management tool.

**Part 2: Social Data Collection on Recreation in GCNP**

The collection and analysis of high-quality social data is essential to successful recreation management (Manning 2001). Social data include visible factors like the number, distribution, and movement patterns of human visitors, and also invisible factors like visitor values and experiences (Cole 2003).

In GCNP, park rangers follow a detailed methodology to estimate the number of visitors the park receives. Inductive traffic counters are installed at the park's three main entrances (South Entrance, North Entrance, and Desert View) to count the number of vehicles that cross.The fourth entrance (Tuweep) is monitored by a remote sensor traffic counter. These traffic counters allow rangers to ascertain the number of vehicles entering the park at any given time. Using a person per vehicle conversion factor, which varies depending on the time of year, rangers estimate the number of human visitors associated with that vehicle count. The visitor count is augmented with reports from bus operators and Grand Canyon Rail. Finally, the number of visitors entering the park by river is recorded in boating permits (GCNP 2018). Overall, visitor count techniques reveal that annual visitation to GCNP has increased significantly in the past decade, with approximately six million visitors recorded for the past several years (see Appendix 1, figure 1).

While the visitor count methodology allows rangers to understand how many visitors enter GCNP, it does not offer fine-scale understanding of the distribution and movement patterns of visitors once inside the park. Here, rangers turn to a variety of methodologies to track human activity, including permits, direct and automated observations, and surveys.

Permits are granted to GCNP visitors to allow certain restricted activities. While the primary purpose of permits is to allow rangers to limit the number or intensity of recreation activities, they also provide a record of use in the park. Permit data in GCNP reveals that visitors are using the park for activities including backpacking, rafting, camping, ceremonies, and public meetings (NPS 2019). Backcountry permits are increasing, though these still are far outweighed by overall visitor counts (see Appendix 1, figure 2). Noncommercial rafting permits are capped, so are not increasing; however records on permit applications reveals a similar trend of increasing demand for this recreation activity (see Appendix 1, figure 3).

To complement the use data from permits, rangers also monitor visitors through systematic observation and surveys. Systematic observation involves monitoring visitor activity through counts conducted by staff or volunteers, or through the use of automated counters (Cole 2013). While automated counts allow continuous time coverage, human counts can distinguish between particular use types like trail running versus hiking (Pettengill 2017). Surveys query visitors on their past use of the park resources, including questions about their mode of travel to the park, how long they will stay, and which trails or activities they experienced (Cothran and Combrick 2005, Pettengill 2017). Surveys can be conducted through in-person intercepts, over telephone, by mail or email, or online (DOI 2009).

In addition to providing finer-spatial scale of monitoring, surveys are also key to understanding invisible aspects of recreation. Through surveys, rangers can ask visitors about their perceptions on experiencing a certain part of the park or their opinion on ideal conditions (Cole 2013). For example, rangers surveyed hikers on their experience of extended corridor trails. By asking about experience and values, they learned that, on the whole, hikers are happy to see other people on the trail, but that their limit of acceptable encounters caps around 15 other hikers. After that point, hikers see the trail as more and more crowded, and their experience becomes less positive (Pettengill 2017). Surveys also allow

rangers to ascertain visitor support for different management measures (Cole 2013). In this case, they found that management interventions like increased education or limiting group size were acceptable to hikers, but options like requiring permits for day use were unacceptable (Pettengill 2017).

Non-traditional methods are emerging that use digital materials to survey visitor count, activity, and experience. Social media is thought to be partially responsible for a recent increase in park visitation, and it can also supply helpful data on levels and patterns of this visitation (Pettengill 2017). Crowd-sourced photographs on public social media are being used to estimate visitor count in particular park areas. These crowd-sourced photos can also be used to determine the visitor's origin and estimate how far they travelled to visit the park (Sessions et al 2016). Increasingly, NPS is exploring the use of social media to understand visitor perception of parks in addition to their presence (Miller and Freimund 2017). As yet, findings from non-traditional methods have not been reported for GCNP.

**Part 3: Tools for Recreational Management in GCNP**

After collecting data that reveal the status of social and ecological impacts of recreation, various management tools can be employed to adjust levels of social use. Management tools include rules and laws, permits, and information provision.

Rules and laws dictate acceptable and unacceptable behavior for all visitors. The law enforcement branch of park operations is responsible for ensuring the federal laws that apply across the park, like those that prohibit violence or drug smuggling. Law enforcement rangers are also responsible for supporting park-specific rules, like those that prohibit disrupting wildlife or cultural resources (Dept of Int 2020).

Informal rules, or norms, are also an important element of human behavior that extend to recreation (Ostrom, 1990). These informal rules can include behavior like refraining from listening to loud music while hiking or making way for someone on a trail. Norms describe behaviors that are not captured in official, written rules; instead, they are enforced by social pressure as recreators avoid possible negative social consequences of not following the rule (Whittaker et al 1988).

Fees and permits constitute a broad category of management tools. Essentially, fees and permits regulate the amount and types of activities that can occur in the park. Entrance fees, or requiring payment to access the park, turns this from an open-access resource to a limited-access resource (Walls 2016). Entrance fees vary with visitor activity. In GCNP the fee for entrance on foot or bicycle is reduced compared to entrance by car (NPS 2019). Setting different entrance fees is one coarse tool for influencing visitation (Walls 2016). Permits operate on a finer scale than entrance fees, as they regulate particular within-park activities. Permitted activities in GCNP include backcountry hiking, camping, rafting, large group activities, and ceremonies and public meetings (NPS 2019). Certain permits are granted to concessioners, who then disperse them to visitors; this is the case for mule trips, some rafting trips, and air tours (NPS 2019). Oftentimes, the number of available permits for an activity is capped. Rangers can manage visitation by modulating the number of permits available, timing of permits, cost of permits, and who can receive a permit (Roberts et al 2002).

The provision of services can also serve as a tool to manage recreation. By placing water, food, pathways, and amenities in particular areas of the park, managers can draw visitors to particular areas, concentrating or dispersing their use of space. Furthermore, managers can use these spatial strategies to overlap or segregate particular activities (Leung and Marion 1999).

Education is also a tool for managing human use of parks. Education can influence where visitors go and what they do in the park. In national parks, education can take many forms, from active education

through ranger programs to passive education through interpretive signs (Dept of the Int 2020). One popular example of educational program in visitor management is the Leave-No-Trace program. This program seeks to reduce visitor impact on the natural resources of a park through education around low-impact behavior. By exposing visitors to Leave-No-Trace educational programming, managers can reduce the negative impacts of visitation on resources (Cole et al 2008). Passive education, like trail signs, can also influence behavior and thus help manage recreation (Kidd et al 2015).

**Part 4: Balancing Natural Resources and Visitor Experience in GCNP**

Even with an abundance of data on park visitation and an ample variety of management tools, park managers still face a core challenge in balancing visitor experience and resource protection in the park. Management frameworks like social carrying capacity and VERP reinforce the idea that there are trade-offs between visitor use and resource impact (Wagar 1964, Valliere and Manning 2002). Using information specific to the resource and recreation activities at hand, managers can specify the use-impact relationship to help guide management decisions that uphold the NPS mission.

By tracking the condition of natural resources, managers work towards "preserv[ing] unimpaired the natural and cultural resources" of the park (NPS 2020). Typically, this involves identifying where the most impaired resources are and how to protect them from visitation damage. Broadly, rangers monitor the quality of land, water, air, vegetation, and wildlife resources in areas of possible visitor impact. Monitoring these resources allows managers to set levels of recreational carrying capacity (Manning 2001). For example, early studies of visitor impact on natural areas in the 1980s focused on the extent of damage to soil and vegetation in backcountry campgrounds across multiple ecosystem types. Resource monitoring revealed that, while the core tentsite area experienced high levels of soil compaction and vegetation trampling in all ecosystem types, these impacts quickly diminished at further distances from the tentsite. This monitoring effort allowed rangers to conclude that more visitors could be accommodated in the area without overly-adverse effects to the backcountry so long as it was concentrated rather than dispersed (Cole 1983). When this monitoring work was repeated in 2004, rangers found that the impacts on high-use areas were, still, severe but limited in area. However, the camping regulations had allowed more dispersed camping than anticipated, so that the number of tentsites had more than doubled in the intervening years. This effectively expanded the extent of soil and vegetation degradation. To preserve remaining resources, rangers recommended maintaining more than enough designated sites for campers, and better enforcement of dispersed camping (Cole et al 2008).

Resource condition is monitored not only to achieve the "preserve unimpaired" dictate of the NPS mission, but also because the condition of particular resources is shown to directly impact visitor experience, and thus is part of visitor "enjoyment, education, and inspiration" (NPS 2020). The condition of natural resources influences visitor enjoyment in a number of ways; in monitoring these impacts, social and natural resource monitoring intersect. This is evident in, for example, the park's work to monitor health conditions in water, wildlife, and humans. Visitor health is one very evident element of visitor experience. GCNP monitors for water-borne disease on the Colorado River and vector-borne disease throughout the park to ensure that risk to visitors can be mitigated (GCNP 2019b; Arizona Emergency Information Network 2019). Less tangible impacts than health include the aesthetic value a visitor places on certain resource conditions. For example, canyoneers (canyon rock climbers) prefer to experience seemingly pristine conditions, such as canyon walls that are not marked by the anchors of previous visitors (Jenkins 2017). By managing anchor placement on canyon walls in popular canyoneering spots,

rangers can ensure a more positive experience for future visitors (Jenkins 2017). As another example, visitor experience can be influenced by the soundscapes they experience. In GCNP, reducing air tourism had a positive impact on certain visitor experiences by reducing sound pollution for those visitors (Gramann 1999).

**Part 5: Case Study on Rafting Management**

One iconic recreation activity in GCNP is rafting the Colorado River through the canyon. Every year, tens of thousands of park visitors utilize the river for commercial and non-commercial boating trips that last anywhere from one to 25 days. For overnight trips, visitors make camp on riverside campsites, and progress downstream until they eventually exit GCNP lands and enter the Havasupai Indian Reservations (GCNP 2019a, GCNP 2017b).

Rafting the Grand Canyon started to become popular in the 1960s, after the creation of Glen Canyon Dam produced flow levels that were suitable for year-round rafting. Visitation levels increased rapidly in the late 1960s and early 1970s. At this time, managers faced uncertainty about the impact of high visitation on both the natural resources of the river and the experience of visitors. They froze use levels in 1972 as they assessed these impacts. In the 1970s and 1980s, managers allowed river use to expand again, and visitation rose steadily (Cole 1989).

Given the high demand for rafting the Colorado at GCNP, a permit system provides a way to regulate human impacts on the river. In addition to limiting the number of visitors, managers utilize a variety of other strategies to preserve the natural resources of the area, including Leave-No-Trace education, regulations against collecting firewood or discarding waste at campsites (GCNP n.d., GCNP 2019b). Managers also regulate visitor experience through a number of means. To promote health and safety, they mandate health reporting and require the presence of a professional guide on non-commercial trips (GCNP 2019b). To enhance a sense of wilderness and solitude, they regulate the number of groups that can launch on any given day to limit overcrowding, disallow motorized boating vehicles at certain times of year, and enforce quiet hours (Roberts et al 2002, GCNP 2019b).

While these efforts seem to be effective in promoting visitor experience once on the river, visitor experience and the NPS mission also includes implicit questions about the ability to access the resource (GCNP 2017b, NPS 2020). In the early era of rafting management, GCNP utilized a wait list to assign non-commercial rafting permits. Already by 1989, wait times for getting a permit exceeded seven years (Cole 1989). By the early 2000s, wait times were estimated to last 25 years (GCNP 2018a).

GCNP managers instituted a public process by which to develop a new method for noncommercial rafting trip permits. The use of public involvement in management development is aligned with VERP frameworks for recreation management (Valliere and Manning 2002). In 2006, GCNP instituted a new permit allocation system that relies on a weighted lottery to assign non-commercial river permits (GCNP 2019c). In this system, visitors hoping for a non-commercial permit enter an application in a lottery system. Their entries in the lottery are weighted higher if they have not previously been on a trip. Each spring, applications are randomly selected from the pool to assign river permits for the year. A secondary drawing is held to reallocate cancelled permits (GCNP 2018a). Managers also added rules to make a fair transition for previous waitlist applicants. First, they increased the weighting for waitlist applicants in the lottery pool, increasing their odds of winning a permit. Next, they calculated the projected year a waitlist applicant would have received a permit under the old system. If that year passes without the applicant having received a permit, managers ensure their ability to access a permit via triple

weighting in the lottery or selection from a shoulder season launch date. Waitlist applicants also have the option to withdraw entirely, and be reimbursed for their application fees (GCNP 2018a).

The new permit allocation system seeks to overcome the challenge to visitor enjoyment that had become prevalent in the old waitlist system. First and foremost, the new system provides a better chance of access to the river for new applicants. Under the old system, visitors were assured a decades-long wait for river access; under the new system, new permit applicants plausibly could access the river during their first permit application, depending on their odds in the lottery. GCNP rangers see the new system as promoting the NPS mission to allow enjoyment of the park for "this and future generations" (NPS 2020). As one park ranger puts it, "I believe one of the problems with the old, waitlist system was that it was displacing use by future generations with unsuccessful, displaced users from previous generations" (Sullivan *pers. comm.*; see Appendix 2). Today, about 85% of the waitlist applicants that were on the waitlist in 2006 have successfully acquired a permit or chosen to leave the application process, and about 30% of all applicants successfully acquire a permit the year of their application (Sullivan 2019).

In addition to providing access for this generation, the modified process by which visitors receive permits may improve natural resource conditions, as well. According to one park ranger,

> "In comparison to our old, waitlist system, it is clear to me that the overall public frustration level is also way down. I believe when people are frustrated, they tend to take it out on those around them as well as on the environment around them." (Sullivan *pers. comm.*; see Appendix 2)

While social studies have not yet been conducted to verify this sentiment, it suggests that the way in which visitors are granted access to GCNP influences their enjoyment and their impact on natural resources. Permit allocation, then, is a central part of visitor experience and natural resource protection. As demand for rafting continues to increase, continued attention to (and, if needed, adaptation of) permit allocation systems will play a role in managing recreation to uphold the NPS mission.

**Conclusion**

National parks like GCNP face a challenging balance in ensuring protection for natural resources and the enjoyment of visitors, now and in the future. This challenge is likely to become more pronounced as interest and visitation in national parks continue to rise (Appendix 1, Dept of the Int 2020). However, managers are equipped with traditional and novel methods for monitoring the social and ecological impacts of visitation, as well as a suite of management tools to regulate use. The change in allocation of non-commercial river permits illustrates a case in which a visitor experience problem was identified, a solution was developed, and the implementation of the solution is being closely monitored to ensure success. This sort of adaptive management will be necessary in the future of recreation management at national parks like GCNP, to uphold the park mission for this and future generations.

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**Appendix 1: Visitation Trend Figures for GCNP**

Figures 1 and 2 produced using visitation counts accessed from STATS (Park Visitor Use Statistics) Data Portal, https://irma.nps.gov/STATS on 11 February 2020. Figure 3 produced using permit application reports from (Sullivan 2019).

Figure 1:



Figure 2:

Annual Backcountry Campers in Grand Canyon National Park

Figure 3: Annual Individual Applicants for Noncommercial Rafting Trip Permits
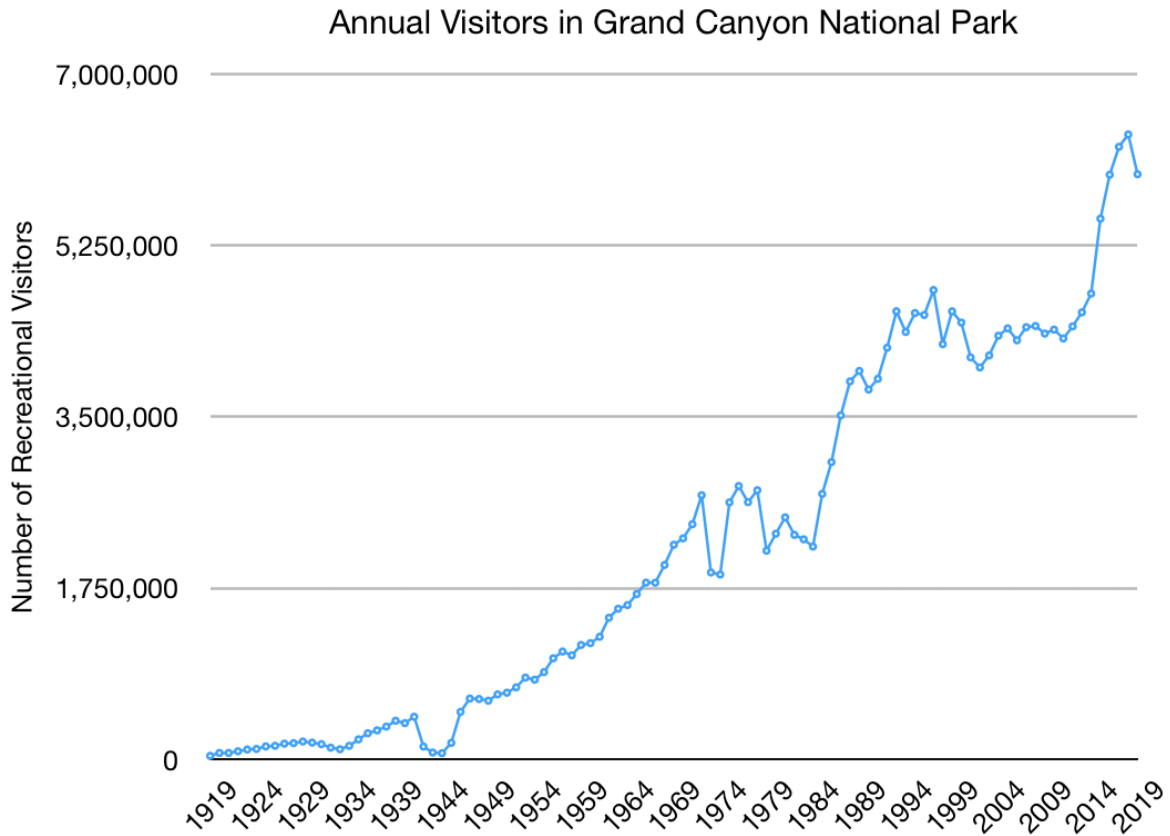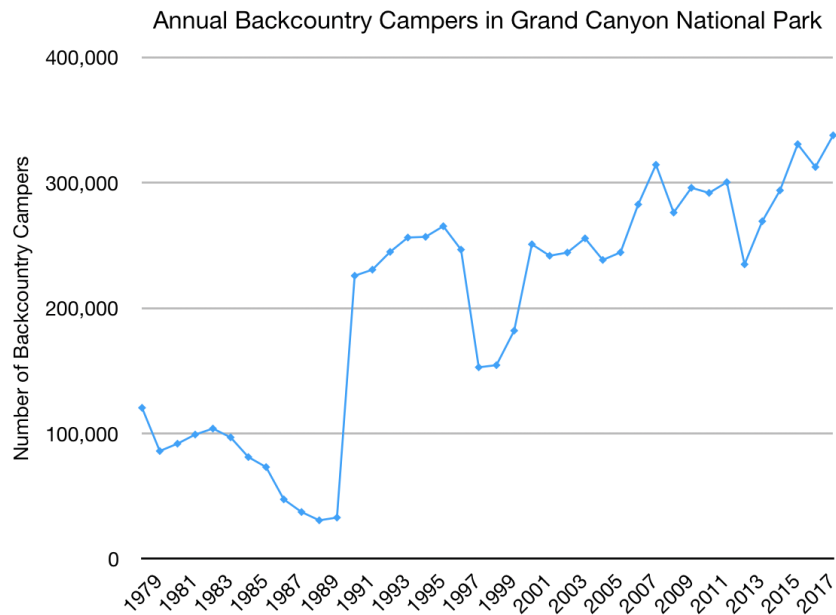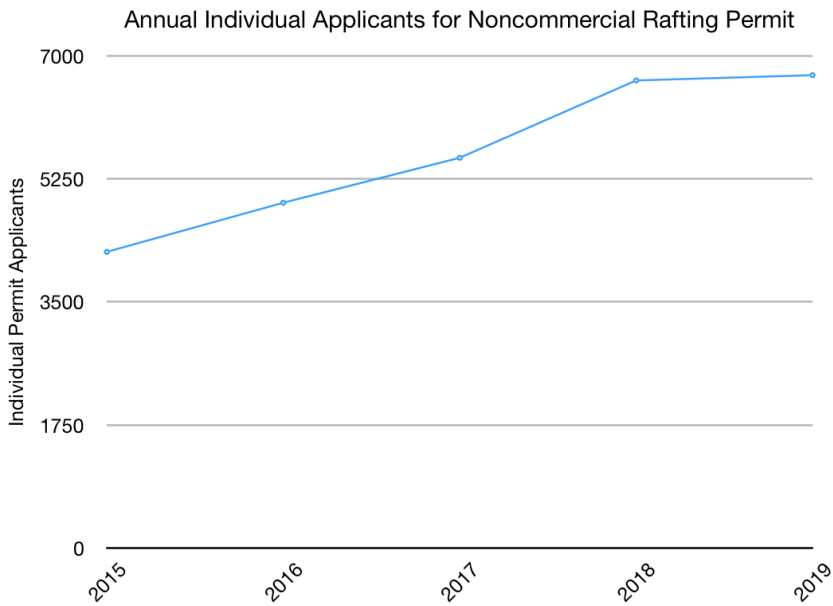

Annual Individual Applicants for Noncommercial Rafting Permit

**Appendix 2: Personal Communication with Steve Sullivan, Permits Program Manager for GCNP**

From: Steve_Sullivan@nps.gov
To: ejoldach@ucdavis.edu
Date: 21 February 2020

Hi Eliza,

Thanks for your email and questions. This is a great social-ecological topic! You asked how well I feel our new weighted lottery system is working, how I see it fulfilling the NPS mission, and if there are other important indicators I am tracking or considering tracking regarding this. I'm happy to share some quick thoughts. The statistics you looked at help with a quantitative assessment. The observations I provide below are more on the qualitative side. I'm sure you well know that both add value.

From what I am seeing and experiencing speaking with the public and seeing the effects of our weighted lottery system, my answer to your question is that our weighted lottery system is working extremely well. I will elaborate a bit, but first I want to commend you for linking your question to the NPS Mission: "The National Park Service preserves unimpaired the natural and cultural resources and values of the National Park System for the enjoyment, education, and inspiration of this and future generations." You are smart to focus in on our mission because it does get to the heart of what we are doing here. I see three general, key indicators in the NPS Mission: 1) preserve unimpaired, 2) enjoyment, education, and inspiration, and 3) this and future generations, and I'll touch on all three.

**Preserve Unimpaired**

Preserving the physical environment was a key part of the development of our 2006 Colorado River Management Plan and Weighted Lottery System. The foundation for determining appropriate levels of overall use included looking at number, size, distribution, and expected lifespan of camping beaches, and looking at number, types, and conditions of natural and cultural resources. Here is a quote from page viii of our EIS:

> "The planning team concluded that no single standard could be used to calculate carrying capacity for recreational use in the river corridor. Rather, it is necessary to consider the interaction of all the factors, including user-days, the number of trips and people in the canyon at one time, and the amount of user discretionary time, and how they affect resources and visitor experience."

Basically, our system recognizes that high use levels can be sustained when users willingly participate in treating the canyon well, when use limits and rules are wisely set and enforced, and when emerging environmental needs are adequately addressed. Much of the measurement for success comes from observations along the river and in what the NPS hears back from our users.

You specifically keyed into the weighted lottery system – Besides awarding trips according to the established limits, I believe the key preservation role our weighted lottery system plays is in ensuring the educational component takes place – something I see every day and makes a real difference to the preservation in the canyon. And in comparison to our old, waitlist system, it is clear to me that the overall public frustration level is also way down. I mention this because I believe when people are frustrated, they tend to take it out on those around them as well as on the environment around them. This also bumps into enjoyment, so I'll transition to that now.

**Enjoyment, Education, and Inspiration**

One of the successful things our weighted lottery system has accomplished is to reduce the time between when an applicant applies to win a launch date and when they hear that they were successful (or unsuccessful). Our old, waitlist system required people to be on a waitlist for many years, jump through yearly hoops if they wanted to remain on the list, and not participate on more than 1 other trip if they wanted to remain on the waitlist. The resulting extremely long weight combined with tight rules resulted in a tremendous amount of public frustration and quite a bit of negative feelings toward the NPS at Grand Canyon. This was almost completely eliminated by replacing that system with a weighted lottery system.

I believe almost everyone understands the benefit of drawing straws when many desire a prize but only a few prizes can be awarded, and our weighted lottery system works on that principle. It also favors those who have not been successful recently and leaves flexibility for adjusting what trip members can participate on an awarded trip. I think it also helps that we are extremely transparent with respect to posting detailed statistics about every lottery and about overall use each year. You mentioned looking at some of my statistics – here is a link to the most recent version posted very recently: the 2019 Backcountry and River Statistics.

I believe one of the best indicators of satisfaction is that many unsuccessful applicants at least know someone who was successful at obtaining a trip. And negative public correspondence about our system is now almost non-existent.

**This and Future Generations**

This last one is often included in the NPS within the first two, but I have called it out here specifically to point out something I think is important. I believe one of the problems with the old, waitlist system was that it was displacing use by future generations with unsuccessful, displaced users from previous generations. By the end of the old waitlist system, a new member wanting a desirable launch date could anticipate waiting 27 years to get the trip they desired. I think of who I was 27 years ago and also at who I will be in 27 years, and I can't imagine my interests either way would be the same. Contrast this with our current, Weighted Lottery system where all currently interested applicants have a real chance at winning. In this newer system I can apply today for a trip next year and know within a couple weeks whether I won (and I can begin planning) or not (so I can make other plans). My wait on a "system" is relatively minimal, and that, I believe, makes a huge difference to satisfaction. If users are more satisfied, then they will tend to treat other users better and treat the environment better without displacing future generations. Thus, this is a major increase in service.

**Areas for Improvement**

I mentioned earlier the importance of having the system be flexible enough to address and make adjustments for unanticipated or emerging needs. One example of how our system did this is how we obtained permission through our adaptive management process to be allowed to make unused noncommercial launches available as additional launches within the following year. This helps alleviate any concerns about trips going unused due to no-shows and late cancellations. I believe this kind of flexibility to be able to make adjustments for unanticipated or emerging needs is extremely important, and I am sure we will use it in the future to address other needs as we become aware of them and can dedicate the time needed to fixing them.

I hope these thoughts and observations help. Thanks again for taking the time to write and ask your questions. Good luck with your PhD work!

Sincerely,
Steve Sullivan

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