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Research Article

Understanding visitor attitudes towards the timed-entry reservation system in Rocky Mountain National Park: Contemporary managed access as a social-ecological system

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ABSTRACT

Park and protected area (PPAs) management is often characterized by tightly interdependent social, ecological, and managerial dimensions that have increasingly been conceptualized as social-ecological systems (SES) to understand the complex interrelationships between these dimensions. Current trends of increasing visitation in U.S. National Parks have accentuated the complex interactions between the amount of recreation use, the quality of the visitor experience, ecological resource conditions, and the burden on management and the capacity of the setting. In order to manage visitor use in balance with desired social and ecological conditions and allocate opportunities for use in an equitable manner, several U.S. National Parks including Acadia (ME), Arches (UT), Glacier (MT), Rocky Mountain (CO), Shenandoah (VA), Yosemite (CA), and Zion (UT) are using advance-reservation or managed-access reservation systems. Rocky Mountain National Park (RMNP) implemented a Timed-Entry Reservation System (TEPS) which required visitors to place an online reservation for park access and allocated a fixed number of reservations per daily time period. RMNP managers employed the park's transportation system to target desired conditions and consequently moderate the flow of vehicles entering the park. We developed an email-based survey instrument to understand visitors' evaluations of their experience under the TEPS system and elicited their attitudes towards use-limiting strategies like TEPS. Our analysis found 78% of respondents reflected favorably on the TEPS managed-access park experience, although these attitudes are often value-laden and involve expectations about the conditions they experience. Our results provide a contemporary perspective on the assumptions in the rationing and allocation literature regarding the barriers and acceptability of these techniques for managing visitor use. Finally, we offer some insights and considerations from this analysis for managers considering similar managed-access strategies.

Management implications:

- Conceptualizing a national park and associated managed-access process social-ecological systems illustrates connections between the visitor use and ecological dimensions of protected areas.
- Managed-access reservations systems are a tool for management to balance recreation use alongside the resource conservation and management goals for the setting.
- This research reveals that Rocky Mountain National Park visitors are generally supportive of managed-access strategies, particularly for the safety of their experience and the sustainable management of ecological resource conditions for future generations' enjoyment.

1. Introduction

Contemporary discourse in recreation management literature often cites the increased demand for outdoor recreation (e.g., Balmford et al., 2015; Cordell, 2012) to provide context for the challenges managers of parks and protected areas (PPAs) face. This often serves to underscore

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the implications of increased visitor use on the social dimensions (i.e., visitor experience), disturbance to the ecological dimension (i.e., resource conditions), and increased burden on the managerial dimension (i.e., operations) of the setting. Because the social, ecological, and managerial dimensions of PPA management are so coupled and interdependent, the social-ecological systems (SES) theoretical framework (Blahna et al., 2020; Morse, 2020; Ostrom, 2009) has demonstrated utility for conceptualizing the complex and hierarchical nature of the relationships and interactions between the social and ecological systems and governance structures responsible for PPA management (Ferguson et al., 2022; Miller et al., 2022). In this study, we conceptualize PPA management through an SES framework that helps illustrate the dynamics and relationships between increased demand for recreation and the impacts and disturbance to the social and ecological conditions that visitors experience.

1.1. Crowds in the Commons

Over the past decade, several studies have highlighted and quantified trends of intensifying visitor use at many of the most visited national parks in the United States (Clark et al., 2019; Tenkanen et al., 2017; Wood et al., 2013). Visitation among the national parks in the inter-mountain region in 2019 was on average 129% greater than visitation in 2012, and more specifically 126% greater during the same time period in Rocky Mountain National Park (RMNP) adding an additional 1.44 million visitors (N.P.S., 2023a). However, these trends of increasing visitor use are not an entirely new phenomenon in recreation management, but rather an episodic and persistent challenge that requires managers to effectively balance visitor use with PPA capacities. Capacities in a recreation management context are defined as the "maximum amount of recreation use and resulting impacts that can be accommodated in a park or outdoor recreation area" or the "type and amount of visitor use beyond which desired environmental and experiential conditions are adversely affected" (Whittaker et al., 2011, p. 15). Inherent in these definitions of capacity are the relationships between the visitor experience, social conditions, and the desired ecological conditions which are the focus and context of the experience. While intensifying trends in visitor use to PPAs suggest an endorsement of the value of PPA settings, the individual and public benefits of wildland recreation, and the ecosystem services these settings provide for society, they can also contribute to perceptions of crowding and lead to visitor coping behaviors to contend with a diminished quality of the visitor experience (Manning, 2022). This response is particularly pronounced among visitors with highly developed ecological knowledge and preferences (D'Antonio et al., 2012). Using Ostrom's (2009) SES framework, visitor coping or displacement behaviors can be regarded as a form of self-organizing or collective action behavior by resource users precipitated by resource scarcity to contend with the trade-offs in ecological conditions and the visitor experience. Ostrom (2009) notes that while self-organizing behavior is one approach to averting the "tragedy of the commons" (Hardin, 1968), the efficacy and sustainability of these self-organizing behaviors are dependent on a range of resource system attributes and factors, such as the number of users of the system. Ostrom (2009) goes on to suggest that "long-term sustainability [of the SES] depends on rules matching the attributes of the resource system, resource units, and users" (p. 421) indicating that in some circumstances governance system rules for resource use may be necessary to avoid over-harvest when collective action is insufficient.

1.2. Rationing and Allocation in Wildland Recreation

Wildland Recreation research began to explore the relationship between visitor use and the effects of the social and ecological resource conditions in the 1970s when visitation to national parks (Lucas & Stankey, 1989) and wilderness areas (Fazio & Gilbert, 1974; Stankey, 1973; Stankey & Baden, 1977) was rapidly increasing. The principal concern with the intensifying use was that managers might increase development to these areas to accommodate the increased visitation which could fundamentally alter and or compromise the primitive character of wilderness (Hall, 2001). Research during this era began to explore the utility of use limits and rationing and allocation techniques and to understand how these approaches contribute to the ability of managers to balance recreation use with capacities. Rationing and allocation techniques are characterized as direct management strategies that place emphasis on regulating visitor behavior and limiting individual choice (Manning, 2022). Research evaluating the application of these techniques in wilderness contexts has suggested that direct management strategies should be secondary to indirect approaches because of the concern of imposing upon and burdening the visitor and thus adversely constraining opportunities for unconfined recreation. However, in PPA settings managed for more diverse opportunities, research suggests that direct management strategies including limits on use are perceived to be acceptable to many visitors (Martin et al., 2009), and can expand visitor freedom by reducing conflict (Dustin & McAvoy, 1984) and enhance aspects of the visitor experience (Frost & McCool, 1988). For example, in Glacier National Park, Frost and McCool (1988) found that regulations are most effective and viewed as acceptable by visitors when the rationale behind regulations is clearly articulated, additionally, visitors with more knowledge and experience with the setting are more likely to perceive the regulations as enhancing their experience.

The recreation ecology literature is perhaps the most critical and circumspect of the use of rationing and allocation techniques to manage resource and ecological conditions because of the non-linear, asymptotic relationship between recreation use and resource disturbance (Cole et al., 1997). This curvilinear relationship characterizes the initial use resulting in the greatest proportional disturbance while the rate of disturbance decreases with subsequent use (Cole, 1992), which suggests use-limitations provide little benefit to resource conditions unless the amount of use is dramatically reduced. Further, acknowledging the unpredictable nature of visitor behavior in response to management actions, rationing techniques implemented in one area can contribute to displacement behaviors with visitors traveling to new, low-capacity settings which can result in greater resource disturbance than if they recreated in their preferred setting (McCool, 2001). Despite the lack of theoretical grounding for use-limits and rationing techniques to address resource conditions, visitors to PPAs often support these strategies if they believe they are necessary to sustain resource conditions but tend to be less supportive of their use to address aspects of the social and visitor experience (Cole & Hall, 2008).

Rationing and allocation techniques represent a range of strategies used to apportion visitor use in balance with site capacities and management goals and to provide those opportunities in a fair and just manner (Stankey & Baden, 1977). One of the techniques used to allocate recreation use is a reservation system which is among the most commonly employed techniques in public land management in the United States because of its appeal to a widely held perception of fairness in American culture for "first come first serve". Stankey and Baden (1977) expressed concerns about direct management approaches and rationing and allocation techniques and developed a matrix of criteria to evaluate the advantages, disadvantages, and efficacy to avoid sub-optimal outcomes. Stankey & Baden goes on to advise that these techniques should be focused on "reducing the physical and social impacts associated with use, rather than simply cutting back on use itself" (p. 15). Because of the implication that rationing techniques may ultimately limit public access to public lands, where rationing and allocation techniques have been implemented procedural justice considerations like visitor perceptions of equity, equality, and fairness have been considered an important metric of their performance (Shelby et al., 1989b). Several studies have approached this distributive justice aspect of rationing and allocation techniques and broadly report that while reservation systems most adversely affect trip spontaneity and visitors who are unable to plan ahead or those who have jobs with

irregular schedules that preclude long-term planning, they are generally highly acceptable to visitors (Shelby et al., 1989a; Stankey, 1973). Shelby et al. (1989a) evaluated visitor perceptions of the barriers, currencies, and costs associated with various rationing and allocation techniques and reported similar conclusions about long-term planning but noted that visitors "perceive their chances of success through a filter of adaptability. If a permit system appears to block access to those who do not control enough currency, they may find a way to gain more of that currency" (p. 143). Further, Shelby et al. (1989a) suggests that visitor perceptions of success and predicting which groups may be affected by these techniques are quite complex which may explain studies finding that even visitors unsuccessful at obtaining reservations or permits still view them as acceptable (Bultena et al., 1981; Cole et al., 1997). Consequently, reservation systems have a long history of use and offer PPA managers a tool to plan and allocate high-value recreation opportunities and experiences such as rafting the Colorado River of the Grand Canyon (Whittaker & Shelby, 2008) and hiking Half Dome at Yosemite (Pettebone et al., 2013).

In 1973 Rocky Mountain National Park (RMNP) was among the first national parks to implement a rationing and allocation permit system in response to high demand for backcountry camping use. RMNP began requiring visitors in the park's backcountry to obtain a permit and camp in designated sites in what was described at the time by Fazio and Gilbert (1974) as "the most restrictive permit system ever devised for the control of wilderness use" (p. 753), but what is now a commonplace practice for backcountry visitor management in the National Parks. Fazio and Gilbert (1974) concluded that concerns the permit system would spark public backlash were unsubstantiated and their findings corroborated Hendee and Lucas (1973) which suggested that these techniques were less controversial among visitors than initially expected. Fazio and Gilbert (1974) found that 86% of visitors who obtained a permit and 80% of visitors unsuccessful at obtaining a permit were still supportive of the permit system. More recently, RMNP visitor management has shifted its focus to the high-use, front-country Bear Lake Road Corridor where the park shuttle bus system improved transportation system conditions in the park but delivered more visitors to trailheads than the capacity those settings were able to accommodate (Lawson et al., 2011).

1.3. Rocky Mountain National Park TEPS

In 2016 in response to several years of substantial increases in visitation RMNP began implementing a temporary vehicle closure of Bear Lake Road during times of high use during the peak visitation months which redirected visitors to other areas of the park (Wesstrom et al., 2021). This management action achieved the goal of relieving some visitation pressure on this high-use area of the park but ultimately did not address the underlying imbalance of the recreation demand and supply of facilities and infrastructure to support that demand while maintaining high-quality visitor experience conditions the park manages for. In 2020, in response to the COVID-19 pandemic and concern for visitor and staff safety RMNP introduced the Timed-Entry Reservation System (TEPS), a managed-access reservation system, which required visitors to place a reservation through Recreation.gov (www.recreation.gov) and allocated a fixed number of reservations per hour to moderate the flow of vehicles entering the park. Although reservation systems are commonplace across public lands in the United States they are often used to allocate high-value experiences and high-visitor-use sites, however, managed access systems like TEPS in RMNP are among the first to be implemented at a whole PPA scale.

While there is a substantial corpus of recreation literature examining the effectiveness of rationing and allocation techniques as well as offering considerations for aspects of their efficacy, efficiency, and visitor burden, the context of many of the studies is designated *wilderness*[1] which is managed for different values, recreation opportunities, and visitor experiences than the front country settings in a national park. Further, park visitors, society, and culture at large have certainly evolved since early studies approached use-limiting strategies with deference for value-laden constructs like fairness, equity, and freedom which may hold different meanings or importance to park visitors today. Now, 50 years after Stankey (1973) explored how reservation systems affect visitors it is necessary to revisit some of these assumptions about how these systems operate to understand visitors' acceptability and perceptions of rationing and allocation techniques like managed-access reservation systems and to better understand the barriers these systems may present for visitors in the contemporary manifestation of the national park experience. Because of the novel implementation of this reservation system rationing and allocating access to an entire park, the RMNP TEPS system offers an opportunity to study a contemporary managed-access reservation system in consideration of the existing literature, its effect on the aspects of the visitor experience, and to understand what aspects of the visitor and their park experience shape or influence attitudes and evaluations of managed-access systems.

2. Methods

2.1. Study Area

Established as one of the earliest national parks in the USA in 1915, RMNP is situated among the southern Rocky Mountain Range along the continental divide approximately 50 miles northwest of Denver, Colorado (Musselman, 1971). The history of the area before the park extends back nearly 11,000 years and is located within the ancestral and traditional homeland of the Ute, Arapaho, and Cheyenne whose legacy is recognized in place names of mountains and topographic features throughout the park. RMNP protects more than 100,000 ha and receives approximately 4.5 million visitors (N.P.S., 2023c) who come to experience the park's scenic alpine lakes, tundra, and vistas as well as the unique flora and fauna such as Lodgepole Pine (*Pinus contorta*), Colorado Columbine (*Aguilegia coerulea*), Rocky Mountain elk (*Cervus canadensis nelsoni*), Pika (*Ochotona princeps*), White-tailed Ptarmigan (*Lagopus leucura*), and Cutthroat trout (*Oncorhynchus clarkii stomias*). The majority of visitor use within the park is temporally concentrated in the summer months between May and September and spatially concentrated in two main areas; Trail Ridge Road which climbs and crosses the continental divide at approximately 3,650 m, and the Bear Lake Road Corridor which is a highly developed area of the park that offers easy access to trailheads leading to alpine lakes and striking mountain vistas.

RMNP first operationalized TEPS in the spring of 2020 in response to the COVID-19 pandemic out of concern for visitor and staff safety for the duration of the peak summer months of intensive visitation and continued this managed access reservation system through the same periods in 2021 and 2022. The TEPS system includes other broad visitor management goals to improve and maintain opportunities for high-quality visitor experiences and visitor safety, reduce crowding and congestion in high-use areas, manage the flow of vehicles and visitors in balance with infrastructure and capacities to maintain ecological resource conditions concordant with the National Park Service's (NPS) dual mandate. The Timed-Entry Reservation System, as opposed to Ticketed-Entry Reservation Systems used in some other US National Parks, rations the total number of visitors entering the park during the peak use hours of the day (i.e., between 9am and 3pm) and allocates a fixed number of reservations per daily time window to moderate the flows of vehicles entering the park throughout the day. In 2021, visitors were offered two TEPS reservation options, one to access the Bear Lake Road Corridor (from 5 a.m. to 6 p.m.), and a second to access the remainder of the park (from 9 a.m. to 3 p.m.). Before or after those peak use hours, no reservation was required to enter the park or the Bear Lake Road corridor.

2.2. Survey Development

We developed and operationalized a survey instrument in collaboration with RMNP management staff (OMB Control #: 1024-0224 / IRB Approval #: 12225). The survey items reflected descriptive and evaluative aspects of the visitor experience, which based on their experience, the RMNP staff indicated were the most managerially relevant and contributed to understanding the effects of the TEPS system on aspects of the visitor experience (Fig. S1, supplementary materials).

First, in order to explain and better characterize the visitor, the survey sought to understand visitors' motivations for their park visit and understand their relationship with the dimensions of place at RMNP. The motivations of the visitors were assessed using a modified Recreation Experience Preference (REP) (Driver, 1976) scale with multi-item indicators measuring seven latent constructs such as socialization, relaxation, nature immersion, and risk/adventure. Similarly, to understand visitors' relationship with dimensions of place, we included a multi-item indicator scale to measure the dimensions of place attachment, place dependence, and social bonding (Kyle et al., 2005; Williams & Roggenbuck, 1989; Williams & Vaske, 2003). Finally, to describe and characterize the visitor and their visit, respondents were asked questions about their visit to RMNP (i.e., length of visit, experience-use history at RMNP) and general socio-demographic questions (i.e., country/ZIP code, age, gender, group size and race/ethnicity).

Next, we identified three areas of focus to elicit evaluations of the TEPS system with respect to its effect on the general visitor experience, trip planning, and transportation conditions, as well as their attitudes toward rationing and allocation techniques. Indicators commonly used by the NPS (N.P.S., 2023b) to measure the quality of the visitor experience were included in the survey instrument to understand the effect of the TEPS system on respondents' evaluations of perceptions of crowding and conflict with other visitors, the adequacy of infrastructure and signage, the absence of litter / human waste and the ability to experience natural sounds. Because use-limiting strategies when framed to address and protect resource conditions are generally highly acceptable to visitors despite weak theoretical and empirical support to achieve those goals unless the use is dramatically reduced, we determined that perceptions of resource conditions to the visitor experience were important to measure in relation to evaluations of the TEPS system. To understand the importance of resource conditions to visitors' experiences, we developed a suite of common resource disturbances like the trampling of vegetation and feeding/approaching wildlife and asked the visitor how important the management of these disturbances was to their experience. In order to understand how visitors navigated some of the potential barriers to the TEPS system we measured visitors' evaluations of the experience of obtaining a reservation through the on-line reservation process (Recreation.gov), the availability of a reservation for their desired date/time, the quality of the information about the TEPS system on the park website, as well the quality of interactions with staff to provide assistance and offer alternative activities.

The TEPS system enables managers to ration the rate of private automobiles, and ultimately the number of visitors, entering the park during peak use periods to target the desired social and ecological conditions for visitor experience and resource protection. In order to understand the effect of the rationing of vehicle entry into the park and the transportation system in the park we included survey questions to measure visitor's expectations for the traffic conditions as well as the conditions they experienced, and how important transportation conditions were in shaping their visitor experience in the park.

The third area of focus for the survey sought to understand visitors' direct evaluations of the TEPS system, as well as to better understand respondents' preferences and level of acceptability of intensive visitor management practices under contemporary pressures and challenges. We developed a list of scenarios that juxtaposed a range of potential implications of high levels of visitor use with park resources and visitor experience conditions. Finally, a common practice with natural resource decision-making processes is to consider a range of alternative approaches that would address the management challenge at hand. The management staff at RMNP offered a variety of indirect and direct management strategies as alternatives to the TEPS system that we asked respondents to rank in order of their preference, offering managers a sense of the most broadly acceptable approaches.

2.3. Sampling Methods

RMNP staff queried records of visitor reservations through Recreation.gov and provided a list of TEPS reservations placed by RMNP visitors and the corresponding contact information. In total, the records contained approximately 610,000 email addresses and included metadata about the visit, including the date of the park visit and the date the reservation was placed, whether the reservation was canceled or confirmed, and the type of reservation (i.e., Bear Lake Road, or the rest of the Park). Because a census sampling strategy would produce a prodigious amount of data and in consideration of minimizing the burden on the visitor, we employed a stratified random sampling approach using the metadata variables listed above after filtering the list for unique email addresses. The email-based survey method, compared to traditional visitor intercept sampling methods, afforded the means to efficiently gather a robust sample of visitor attitudes towards TEPS with minimal sampling error. As such, during the calculations of the appropriate sample size, we selected tighter parameters for the confidence intervals (99%) and margin of error (3%) than would typically be selected for visitor intercept type sampling (e.g., 95%C.I., 5% m.o.e.) to produce a sample that is accurate and generalizable to the population of RMNP visitors.

The stratified sample targeted RMNP visitors who placed reservations between May and October during the summer of 2021 when the TEPS system was in effect. The sampling strategy was operationalized with two sub-samples among visitors who placed a reservation for park visits between the months of May through August and reservations during the months of September and October which correspond to peak and off-peak visitor use seasons. Finally, informed by expected response rates to other email-based survey instruments from Dillman et al. (2009) we assumed a 5% response rate for our May through August sub-sample, but following distribution and observing a higher than expected response rate, the expected response rate was increased to 10% for the September through October sample. The surveys were distributed through Qualtrics (Qualtrics, 2023) first to RMNP visitors from May through August in mid-October 2021 and then to visitors from September and October in mid-November to provide a similar separation between the park visit and the survey experience to minimize the effect of this time difference on survey responses. Following recommendations from Dillman et al. (2009), emails were distributed on Monday morning so that they would appear at the top of email inboxes, and a reminder email was sent to those who had not opened or completed the survey the following Monday. The metadata variables used to develop the stratified sample were embedded in the respondent's survey response so they could later be used to evaluate the generalizability of the sample and to be used as variables in the analysis. Following the data collection period, we replaced any personally identifiable information in the dataset with unique hexadecimal codes to protect the anonymity of the respondents in accordance with the Institutional Review Board (IRB) and Office of Management and Budget (OMB) data storage guidelines.

2.4. Statistical and Analysis Methods

Statistical analyses were conducted in Python using Pandas (McKinney, 2013), Sci-kit Learn (Pedregosa et al., 2012), SciPy (Virtanen et al., 2020), Statsmodels (Seabold & Perktold, 2010), MLxtend (Raschka, 2018), and visualizations were created using Seaborn (Waskom, 2021). The responses collected through Qualtrics were

downloaded and pre-processed to prepare responses to open-ended questions for analysis. The metadata variables included in the survey responses were summarized and used to create new variables related to the respondent and their visit, such as the difference in time (i.e., days) between when a respondent placed an order for a reservation through Recreation.gov and the date of their park visit. We used a ranked-choice instant runoff voting method with PyRankVote (Tingvold, 2019) to identify which alternative management strategies to TEPS would be acceptable to the majority of visitors, even if it was not their first choice. The instant choice runoff method takes the votes for the strategy with the least votes in each round and reallocates that vote to a respondent's next choice of the remaining alternatives until one strategy captures the majority (>50%) of votes.

The REP and Place Attachment scales were evaluated for scale reliability, consistency, and sampling adequacy before conducting a principle components exploratory factor analysis to reduce the dimensions of the REP and Place Attachment scales. The factor analysis of the REP scale was performed using a minimum residual method and varimax rotation, and the number of latent factors was determined by interpretation of a scree-plot and eigenvalue scores. We performed a principal components dimension reduction on the place attachment scale to force the multi-item indicators of the dimensions of place attachment (i.e., place identity, place dependence, social bonding) into a single component solution for each dimension. We developed a multiple linear regression model to understand what aspects of the visitor characteristics, experience, and attitudes influence perceptions of the TEPS system on the visitor experience. The model used visitors' evaluations along a five-point Likert scale of whether the TEPS system improved or detracted from their experience as the response variable and included 65 predictor variables from the dataset that were considered potentially relevant to attitudes towards managed-access including the characteristics of the visitor and the visit characteristics (i.e., number of visits to RMNP, the month of visit, duration of visit, etc.), as well as their evaluations of the visitor experience and conditions they experienced. To perform variable selection preserving as much information in the dataset as possible by keeping partially completed responses with missing values, we used a multivariate imputation by chain equation (MICE) technique, which creates a series of regression models to predict missing values based upon responses to other variables (Azur et al., 2011). Next, we used a sequential stepwise feature selection technique (Raschka, 2018) with all possible permutations of the predictors to identify the most parsimonious yet interpretable model that explained the greatest proportion of variance (r^2). After the final model and corresponding predictors were identified, the regression was performed on the original, nonimputed data, omitting the partial responses with missing values.

3. Results

3.1. Sample Descriptive Statistics

The response rate to the survey for the May–August subsample was 18. 9% and the September–October subsample 15. 9%, resulting in a collective response rate of 17.5%. Approximately 99% of the respondents who opened the link in the study invitation email agreed to participate in the study, which yielded a total of 9,684 responses. We received 37 replies to the survey invitation email that provided feedback with critiques about the length of the survey instrument (n = 12), regarding concerns about TEPS restricting access (n = 10), dissatisfaction with how RMNP operationalized the TEPS system (n = 8), and comments sharing local perspectives (n = 3) and other general comments about the park (n = 5).

We performed a Chi-square goodness-of-fit test on the survey strata variables to determine if the sample follows the same distributions as the population from the email list used to invite participants (Franke et al., 2012). Goodness-of-fit tests returned statistically significant p-values for the number of reservations a respondent placed (χ^2(4,N = 9,9162) = 372.27, p<.001, φ = 0.076), the month of the park visit (χ^2(5,N = 9,162) = 67.68, p<.001, φ = 0.032), and whether the date of the reservation was a weekday or weekend (χ^2(1,N = 9,162) = 20.47, p<.001, φ = 0.018). The type of reservation a visitor placed (i.e., Bear Lake Road, or Park Only) was the only non-significant result, (χ^2(1,N = 9,162) = 0.61, p = 0.434, φ = 0.003). Given the large sample size and its effect on the interpretation of p-values (Lin et al., 2013), we also examined the Phi(φ) effect sizes and found all significant results had Phi values below the thresholds for small effect sizes, suggesting that the observed proportions differ only marginally from the expected proportions. Furthermore, we plotted the data and found that the patterns of the sample followed the distributions of the population very closely and were determined to be representative of the population of visitors to RMNP in the summer of 2021 who obtained permits through Recreation.gov. We summarized the demographic profile of the survey respondents (Table 1) and determined the average age of respondents was 54.1 years old, the median age 58 years, with 51.7% of the respondents identifying themselves as female, and 89.6% reported white as their race/ethnicity.

The majority of respondents (61.1%) obtained a reservation for Bear Lake Road and the remaining 38. 9% of the visitors obtained a

Table 1
Descriptive statistics of survey respondent socio-demographic and visit characteristics (n = 9,684).

Variable	Category	Percent of Sample
Age	18–24	2.3%
	25–34	10.1%
	35–44	13.3%
	45–54	13.2%
	55–64	20.4%
	65–74	19.5%
	75–100	3.4%
Gender	Female	51.7%
	Male	45.5%
	Prefer not to say	2.2%
	Prefer to self-describe	0.4%
	Non-binary/ third gender	0.2%
Race/Ethnicity	White	89.6%
	Other	3.3%
	American Indian or Alaska Native	2.8%
	East Asian/Asian American	2.1%
	South Asian/Indian American	1.4%
	Middle Eastern/Arab American	0.4%
	Black/African American	0.3%
	Native Hawaiian/ Pacific Islander	0.1%
Reservation Count (number of reservations placed per email)	1	27.5%
	2–10	66.7%
	11–20	4.6%
	21–50	1.2%
	51–95	0.04%
Previous RMNP Visits	1	3.7%
	2–3	9.1%
	4–8	15.1%
	9–15	15.2%
	16–20	8.1%
	21–70	25.0%
	71+	22.4%

reservation for the park only. Approximately a quarter of respondents placed only one reservation through Recreation.gov for a RMNP visit, but most of the respondents (66. 7%) placed between 2 and 10 reservations throughout the summer. The survey respondents were from 17 countries including the United States, and all 50 US states and the District of Columbia were represented in the sample. The top five U.S. states of the respondents to the survey were Colorado (24.9%), Texas (7.61%), Illinois (3.95%), Missouri (3.48%), and California (3.2%) (Fig. 1).

After obtaining a TEPS reservation through Recreation.gov, 98.15% of the respondents visited RMNP in 2021 and 32.2% of respondents indicated it was their first visit to RMNP. The remaining 67.8% of respondents were asked to report the frequency of previous visits to RMNP, and more than 50% of those respondents indicated they visited RMNP 21 or more times prior to their visit during the summer of 2021 (Table 1). When asked about the duration of their visit, 37. 6% of the respondents reported staying most of the day, 28.8% multiple days, 25.8% a few hours, and 7.8% a full day in the park.

The number of days between when a respondent obtained a TEPS reservation and their park visit was on average 27 days (SD = 20), while the median difference was 32 days. However, this distribution was highly positively skewed, with the mode a difference of 1 day (Fig. 2). Approximately 26.3% of survey respondents placed a reservation the day prior to their visit, 99% of whom listed the United States as their primary country of residence, and 2.2% obtained a permit on the day of their visit. We evaluated the correlation between the difference in reservation order and park visit and responses to a variable that measured whether the TEPS system improved or detracted from their experience and found a very weak yet significant relationship, $r_s(8625) = 0.059$, $p < 0.001$. Among the respondents, 60.7% obtained a reservation for the high-use Bear Lake Road Corridor and 70.4% of the respondents indicated that they visited the Bear Lake Corridor during their visit presumably before or after the reservation period had ended.

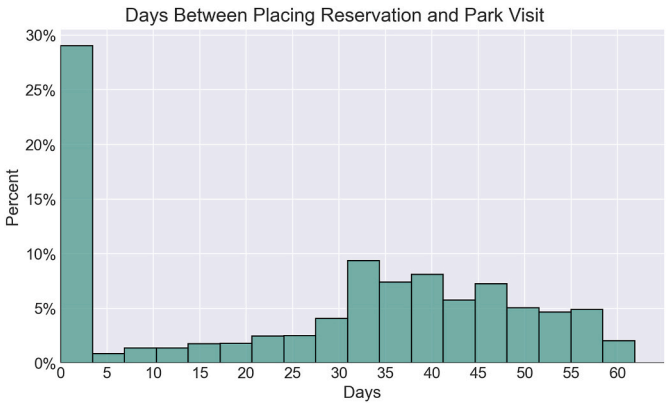

Fig. 2. Distribution of the difference in days between when respondents placed an order for a TEPS reservation, and the date of their park visit (n = 9,163).

3.2. Visitor Experience

Respondents were asked to evaluate a suite of indicators designed to measure the quality of their experience, and included items that may enhance or detract from the experience. Responses to these indicators suggest generally positive evaluations of the visitor experience under TEPS, with means between 3 and 4 for items evaluating the adequacy of site facilities and infrastructure and opportunities to experience solitude, and lower means for statements about undesirable impacts and behaviors of other visitors and negatively phrased statements about trail and resource conditions (Table S1).

In addition, respondents were asked to indicate how important management of disturbances of the resources, such as trampled vegetation, erosion, water quality, and improper disposal of human waste was to their experience. The mean of responses across the disturbances was 4.2 measured along a five-point Likert scale, which indicates a high degree of importance to the visitor experience (Table S2). To test the assumption that visitors are supportive of rationing and allocation practices when they perceive them to protect resource conditions, we constructed a simple linear model using these resource disturbance variables as predictors and an evaluation of the TEPS system as the response variable. Although this model returned a statistically significant result, the relationship between these resource importance variables and attitudes towards the TEPS system was very weak ($R^2 = 0.033$, $F(7, 7814) = 39.37$, $p \leq .001$).

3.3. Planning and Traffic

The respondents were then asked to consider the extent to which a variety of transportation-related conditions affected their park experience, including congestion on roads, scenic overlooks, and entrance stations, as well as the availability of parking and the park shuttle bus. The mean of the responses to these conditions ranged from 1.45 to 2.61 on the five-point Likert scale, falling between "not at all" (1) and

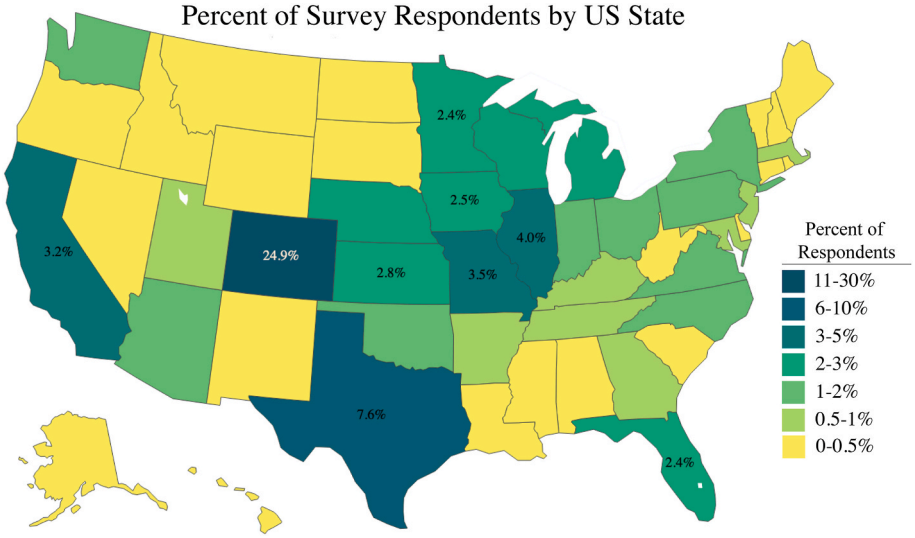

Fig. 1. Percent of survey sample responses from U.S. States The states with the ten highest frequencies within the sample are annotated with the percentage of the total sample from the state (n = 8,007).

"moderately" (3) (Table S3). The conditions the respondents reported that had the greatest impact on their experience included the inability to obtain a permit for the desired entrance time ($\overline{X}$ = 2.61, SD = 1.55), traffic congestion at entrance stations ($\overline{X}$ = 2.50, SD = 1.22), and parking congestion/shortages ($\overline{X}$ = 2.39, SD = 1.23). Additionally, respondents were asked how the conditions they experienced compared to their expectations, as well as the effect of those conditions on their experience. The responses to these questions were jointly visualized to illustrate the relationships between the responses to traffic expectations and the impact on the visitor experience (Fig. 3). Approximately 20.6% of respondents indicated that the traffic they experienced was somewhat or far more than what they expected, while only 10.1% of respondents indicated the conditions they experienced had very much or extremely detracted from their experience.

3.4. Attitudes Towards TEPS, Use Limits, and Management Alternatives

Respondents were asked a series of questions to understand the effects of the TEPS system on their park experience, specifically whether on the whole the TEPS system improved or detracted from their experience. We subsetted the responses of respondents who had visited RMNP prior to 2021 and could compare these visits with their experience in the TEPS park. Among these return visitor respondents, approximately 76% indicated that their park experience under the TEPS system was about the same, somewhat better or much better, and nearly half reported that their experience was somewhat better (24.1%), or much better (21.0%) (Fig. 4).

We sought to better understand visitor attitudes towards managed-access strategies, and the conditions or circumstances that the respondents believed justified and acceptable to implement such management actions (Table 2). Broadly, respondents were generally supportive of managed-access strategies to address the effects of crowding on emergency response ($\overline{X}$ = 4.05, SD = 1.05) and park upkeep and maintenance ($\overline{X}$ = 3.67, SD = 1.09), and for the protection of park resources for future generations' enjoyment ($\overline{X}$ = 4.01, SD = 1.08). However, respondents' level of agreement with some scenarios was more variable, such as mitigating the effects of crowding on park facilities ($\overline{X}$ = 3.51, SD = 1.19), preserving opportunities for solitude ($\overline{X}$ = 3.38, SD = 1.18), as well as to manage the availability of parking ($\overline{X}$ = 3.38, SD = 1.24). Overall, we found that the respondents reported favorable attitudes towards managed-access strategies and largely rejected the notion that managed-access strategies were unacceptable ($\overline{X}$ = 2.07, SD = 1.18) for RMNP.

We prompted respondents to rank in the order of their preference potential alternatives to TEPS that park management might consider to address visitor experience and resource management challenges. The ranking of preferences for these alternatives was evaluated in the form of votes in a ranked-choice instant runoff until one alternative captured the majority of support. In the first round, limiting the number of automobiles captured 35.5% of votes, followed by a Bear Lake Road/Longs Peak Permit (14.2%), a temporal zoning strategy (13.5%), extending the park shuttle system (12.8%). After five rounds, limiting the number of automobiles captured the majority of support (>50%) among visitors with 54.0%, followed by Extending the Visitor Shuttle (23.4%), and a Bear Lake Road and Long's Peak Permit (22.6%) (Fig. 5).

Finally, we developed a multiple linear regression model (Table 3) to understand what aspects of the visitor and the visitors' experience influence perceptions of whether the TEPS system improved or detracted from their RMNP experience. The final regression model included 13 predictors and explained 43.1% of the variance in the responses (Adj. R^2 = 0.431, $F(13, 3671) = 215.8$, $p < 0.001$). We found no statistically significant relationships between the TEPS evaluations and dimensions of Place Attachment or the latent REP factors. Instead, the five most important predictors in the model were whether a respondent believed managed-access strategies should never be imposed ($\beta = -0.229$, $p < 0.001$), if their desired entrance time was unavailable ($\beta = -0.180$, $p < 0.001$), the ease of obtaining a permit ($\beta = 0.173$, $p < 0.001$), if they believed managed-access was justified to provide trailhead parking ($\beta = 0.136$, $p < 0.001$), and finally their expectations for the amount of traffic in the park ($\beta = -0.111$, $p < 0.001$).

4. Discussion

4.1. Reflections on the Evolution of Rationing and Allocation

The literature focused on rationing and allocation techniques extends back nearly fifty years when researchers and PPA managers began to contend with the implications of intensifying visitor use on resource conditions and the social conditions of the visitor experience. This literature acknowledges the limitations and challenges of these strategies that can be philosophically controversial, and in some cases antithetical to the concept of PPAs on public lands (Behan, 1974; Hendee &

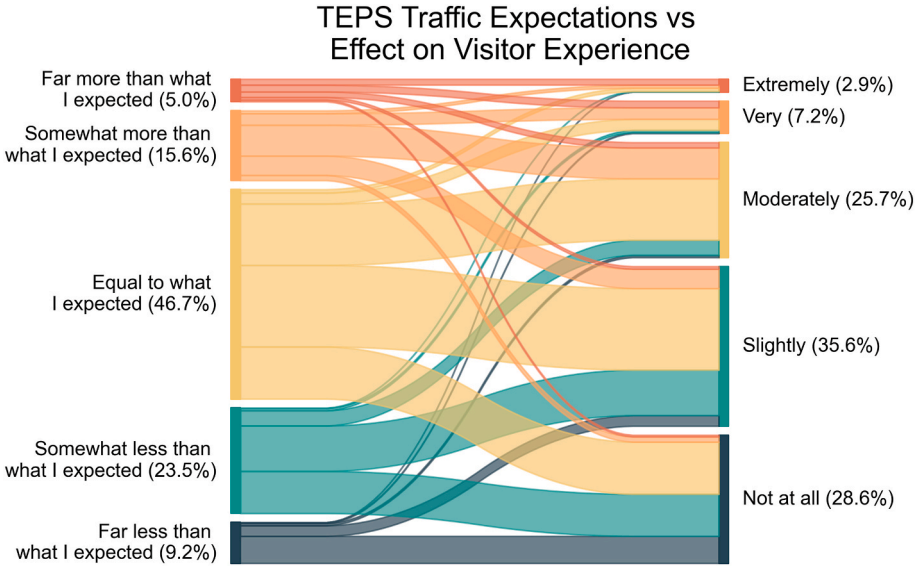

Fig. 3. Flow diagram of the relationship between survey respondents' traffic expectations (Left) and the effect of the conditions they experienced on their park experience (Right) (n = 8,771).

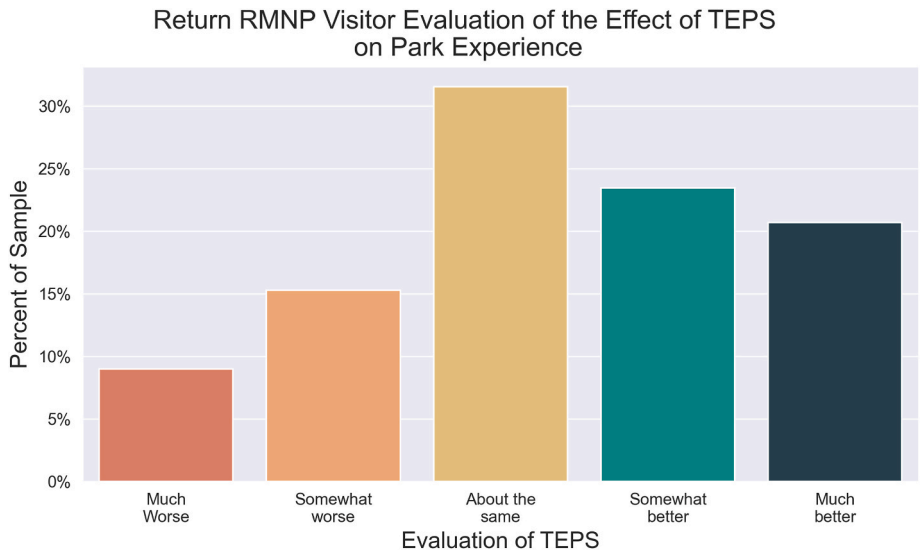

Fig. 4. Distribution of return RMNP visitors' evaluations of whether the TEPS system improved or detracted from their experience on the whole (n = 5,508).

Table 2
Descriptive statistics for responses to the level of acceptability of managed-access strategies to address a range of management scenarios, and resource and visitor experience conditions. The Likert response scale measuring agreement ranged from (1) Strongly disagree to (3) Neither agree nor disagree to (5) Strongly agree.

Statement	$\overline{X}$ (Mean)	SD
If emergency response is delayed by crowding and congestion	4.05	1.05
If visitor-caused resource impacts impair future generations' enjoyment	4.01	1.08
If crowding and congestion impairs Park upkeep maintenance	3.67	1.09
If facilities (i.e., restrooms,VCs) are overwhelmed	3.51	1.19
If opportunities for solitude are lost	3.38	1.18
If trailheads are so busy no parking is available	3.38	1.24
There should never be managed-access, even if use is high	2.07	1.18

Lucas, 1973, 1974), and theoretically antithetical to sustaining resource conditions despite the support of the public they garner when framed to do so (Cole et al., 1997; Cole & Hall, 2008; Hall, 2001). Much of this literature has been focused on applications of these techniques in backcountry and wilderness settings which are managed with different philosophies that prescribe specific wilderness experience opportunities and values for resource management and conservation objectives. Additionally, the early rationing and allocation discourse was often framed through and influenced by Hardin's (1968) *Tragedy of the Commons* (e.g., Dustin & McAvoy, 1980). Through the work of Ostrom (2007, 2009), Ratzlaff (1969), and Berkes et al. (2002) our understanding of natural resource systems shifted when framed as social-ecological systems that link the actors, relationships, interactions, and feedbacks which shape the system's outcomes. This study offers several insights into the contemporary use of a managed-access reservation system at the PPA scale and structures the results through a social-ecological systems framework to assess the diverse implications of the TEPS system at RMNP.

4.2. Rationing and Allocation Practices Beyond Wilderness

While visitor attitudes towards rationing and allocation practices are generally favorable (Bultena et al., 1981; Watson, 1993), some studies

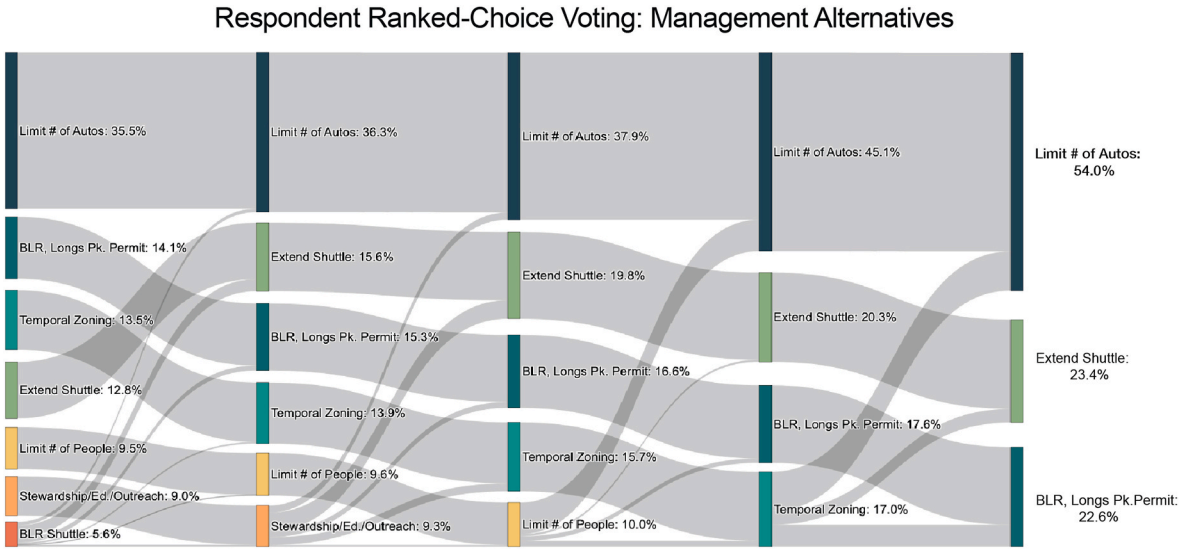

Fig. 5. Flows of ranked-choice votes for management alternatives to TEPS. Limiting the number of automobiles remains consistently the most favorable choice throughout the rounds, but extending the shuttle, while initially less favorable becomes more acceptable to respondents throughout the rounds (n = 7,308).

Table 3
Summary of linear regression model predicting response variable measuring whether the TEPS system improved or detracted from the visitor experience.

Predictors	B	SE	95% CI		β	t	p
			LL	UL			
Intercept	2.296	.18	1.95	2.64	-	13.056	<.001
Managed Access: Never justified	-.230	.02	-.26	-.20	-.229	-13.631	<.001
Desired reservation time unavailable	-.138	.01	-.16	-.11	-.180	-11.326	<.001
Ease of obtaining a reservation	.163	.02	.13	.20	.173	9.616	<.001
Managed Access: Trailhead and parking	.130	.02	.10	.16	.136	8.349	<.001
Expectations for park traffic	-.137	.02	-.18	-.09	-.111	-5.885	<.001
Quality of TEPS info	.108	.02	.07	.14	.095	5.912	<.001
Expectation of the number of other visitors	-.094	.02	-.14	-.05	-.073	-3.891	<.001
Number of reservations placed	.123	.03	.07	.18	.060	4.609	<.001
Visited Bear Lake	.136	.03	.07	.20	.052	3.961	<.001
Managed Access: Opportunities for solitude	.047	.02	.02	.08	.047	3.105	.026
Previous park visitation	.036	.01	.02	.06	.044	3.296	.001
Staff helpfulness	.063	.02	.02	.11	.038	2.682	.007
Expectations for finding parking	.034	.01	.01	.06	.033	2.515	.012

Note: $Adj.R^2 = 0.431$,$F(13,3671) = 215.8$, $p < 0.001$.

have found more mixed support (Cole & Hall, 2012) attributed to the rationing technique employed and the behaviors or use being rationed which contribute to the notion that managers might face opposition by these techniques (Hall, 2001). The respondents in this study broadly indicated support for use-limiting strategies to protect park resources, minimize impacts on managerial operations, and protect the quality of the visitor experience and largely reported positive evaluations of the TEPS system on their experience. This suggests some support for the argument by Dustin and McAvoy (1984) as well as Frost and McCool (1988) that some regulations and intensive management strategies in PPA settings may enhance aspects of the experience among visitors. Further, the difference in contexts between wilderness and the high-use, developed, front-country settings of the national parks might also contribute to the high level of support for TEPS we observed and may be a function of the difference in visitors' attitudes and expectations for the recreation experience and the acceptability of direct management strategies. In the context of a social-ecological system, Ostrom (2009) suggests the relationship between the number of users and the size of the resource system are important attributes to understand when self-organization and collective action may be sufficient to avoid undesirable system outcomes and where governance system rules might be warranted when collective action is insufficient. Further, where visitors are unable to self-organize or effectively cope with high levels of visitor use, governance systems can play a critical role in coordinating this use in a manner that is more sustainable and produces desirable outcomes with respect to the quality of the visitor experience and resource conditions.

4.3. Management Actions Underpinned by Resource Protection

We conceptualized the visitor experience as a function of the social, managerial, and ecological conditions and elicited respondents' evaluation of their RMNP experience along these dimensions under the TEPS managed-access system. The mean responses of the social and ecological indicators of the visitor experience were generally positive assessments of their experience under TEPS with some exceptions of persistent visitor management challenges such as visitor-wildlife interactions. Further, respondents indicated that the quality and management of resource conditions were highly important to their experience in the park. Interestingly, we found weak relationships between respondents' perceptions of the importance of management of recreation-related resource disturbances and their evaluations of the TEPS system but found the strongest support for use-limiting strategies was to protect resource conditions, similar to other studies in the literature conducted in wilderness settings (Cole & Hall, 2008). So while respondents acknowledged the importance of management of resource conditions to their experience and PPA settings, the relationships between the management of those disturbances and the TEPS system were more opaque to respondents. This aligns with several studies that have found that PPA visitors are capable of articulating the effect(s) of resource disturbances on their experience (Farrell et al., 2001; Lynn & Brown, 2003; Manning et al., 2004; Monz, 2009), but their ability to identify and link those disturbances to ecosystem stressors and responses and management of the setting (Monz et al., 2010) can differ substantially from the perspectives of management and recreation ecologists (Van Riper et al., 2010). Furthermore, visitors effectively place a high degree of trust and responsibility in PPA managers to protect and conserve ecological resources, even when this may involve more direct and intensive visitor use management of these areas.

4.4. Using Transportation Systems to Target Desired Conditions

Visitor transportation in RMNP, and by extension many aspects of the visitor experience, is centered around personal vehicles to experience and access various areas of the park. Fundamentally, TEPS targets the desired conditions for the visitor experience and resource protection by rationing the rate of visitors entering the park in private automobiles. This provides management the opportunity to utilize the system of park transportation, as Lawson et al. (2017) concisely stated, "to deliver "the "right" number of visitors in the "right" places at the "right" times" p.106, which has historically presented a challenge at RMNP, particularly in the Bear Lake Road corridor (Wesstrom et al., 2021). Visitors' responses to the evaluations of traffic conditions under TEPS generally indicated low impacts on their experience in terms of parking shortages, traffic congestion, and shuttle bus wait times and access, and visitors' expectations for traffic conditions were generally aligned with the traffic conditions they experienced. These positive evaluations of traffic conditions suggest the TEPS system is effective towards realizing the desired social conditions and may ameliorate some concerns about potential unintended feedbacks of the system displacing visitors to other areas of the park and surrounding PPAs (McCool, 2001; Wesstrom et al., 2021). While the personal vehicle is the mode of transportation used by the majority of visitors when prompted to rank preferences for alternative management strategies to TEPS nearly 70% of respondents supported limiting the number of automobiles in the park or expanding the park shuttle bus service. This finding is perhaps the most interesting result of this study, which potentially signals a shift in contemporary visitor expectations for the national park experience that is more receptive toward intensive management of automobiles and alternative transportation modes. In concluding remarks, Lawson et al. (2017) suggest that a more systematic and sustainable alternative to the conventional demand-driven approach can use transportation as a tool to manage visitor use according to the desired visitor experience and resource conditions, like managed-access under TEPS, that integrates the dynamics and relationships between the social and ecological systems of PPA management.

4.5. TEPS Drivers, Dynamics and Considerations

We explored some of the potential barriers of the TEPS system which

we suspected might differ from early studies conducted before the advent of the internet and the ubiquity of internet-connected devices. Stankey (1973) and Shelby et al. (1989a) both expressed concerns that visitors unable to plan ahead for their visit would be adversely affected by advanced reservation systems. While most visitors placed reservations to RMNP a month or more ahead of their visit when they became available on Recreation.gov, nearly 30% of respondents placed a reservation the day prior or the day of their park visit. This distribution is very similar to the National Park campsite reservations in Walls et al. (2018) which were made available 180 days prior instead of 60 days but were also booked through Recreation.gov. We found no statistically significant relationships between when a reservation was placed and evaluations of the TEPS system. Rather, what we find is that attitudes about TEPS and managed access systems are more nuanced and value-laden.

The results of the multiple linear regression model suggest that what influences visitor attitudes most about the TEPS system are philosophies and values about public lands and the right for the public to enjoy them. Visitors who believed rationing and allocation techniques were never appropriate had the most critical attitudes toward the TEPS system. How reservations are allocated and distributed by these systems is also important to visitors. Visitors who reported ease of obtaining a reservation had positive attitudes about the TEPS system, however, if visitors were unable to obtain a reservation for their desired entrance time their attitudes were more critical of the TEPS system. This underscores the importance of "allocation" in rationing and allocation techniques and how reservations are distributed. By setting a proportion of the reservations available a month or more in advance of a park visit and setting aside a proportion of reservations that become available the day prior and the day of a park visit these systems could accommodate visitors with varying preferences for planning, flexibility, and spontaneity. Next, visitor attitudes about the TEPS system involve certain expectations about the conditions they experience during their visit. When the amount of other vehicles and traffic in the park a visitor experienced exceeded their expectations, attitudes towards the TEPS system were more critical. Similarly, visitors who believed rationing and allocation techniques were appropriate to ensure the availability of trailhead parking had positive attitudes towards the TEPS system. Taken together, these results suggest that how these managed-access systems are operationalized and the social, managerial, and ecological conditions visitors experience are influential in shaping visitor perceptions and attitudes.

The focus of this study was to elicit visitor feedback about the TEPS system and offer insights into the contemporary use of managed access reservation systems but also acknowledge the limitations in the generalizability of the sample and results that apply only to visitors who visited Recreation.gov for a TEPS reservation. Notably, this omits feedback from visitors who were unable, or unwilling to obtain a reservation through Recreation.gov and chose not to visit the park because of the TEPS system. Although there is evidence in the literature that suggests the general population of visitors may differ from those who obtain permits or reservations, given the high proportion of returned visitors there may be similarities in attitudes towards and experience with the setting, as well as perceptions of the TEPS system (Watson, 1993). Nevertheless, we recognize the importance of understanding the procedural justice implications of these managed-access systems which warrant further study.

5. Conclusion

After recognizing a pattern of increasing intensity of visitor use during the peak summer months, RMNP initiated an adaptive management process to help maintain and achieve desired resource and visitor experience conditions. To better understand the nature and relationships between park transportation systems and infrastructure, resource conditions, and the visitor experience RMNP initiated a program of research into park transportation systems (Lawson et al., 2011, 2017; Taff et al., 2013) and its effects on ecological conditions and the visitor experience (Monz et al., 2016). In 2016 RMNP employed a strategy of temporary vehicle closures of Bear Lake Road for portions of the day during the high-use summer months (Wesstrom et al., 2021) when congestion and conditions warranted. An important attribute of adaptive management strategies involves organizational learning that incorporates new information to monitor and evaluate the effectiveness and effects of management strategies and consider when to explore alternatives. TEPS might be viewed as an evolution of this process in response to these management challenges, and this study provides empirical data for the acceptability of managed-access strategies among visitors and the effects on their experience. Subsequent stages of the adaptive management process require continued monitoring and evaluation of the relevant indicators of the TEPS system in order to adjust (i.e., expand or reduce) its use according to various temporal scales (i.e., seasonal and daily) and visitation trends.

Although the focus of this study was the visitor survey, important questions remain about the effects of the TEPS system on the ecological dimensions of PPA social-ecological system. As Shelby et al. (1989a) suggests when visitors lack an allocation "currency" they find ways to compensate or "game" the system, and in the case of the TEPS there was some evidence of visitors entering the park prior to or after the hours of the day which required a reservation (Creany & Monz, 2022). This visitor coping behavior may represent an important change in the temporal and spatial behavior of visitor use and further study may be warranted to better understand the effects on flora (Willard et al., 2007) and fauna (Gutzwiller et al., 2017; Lewis et al., 2021; Taylor & Knight, 2003; Wisdom et al., 2018) together with more broad scale stressors of climate change on PPAs (Fisichelli et al., 2015; Monz et al., 2021) and anthropogenic disturbances (e.g., nutrient cycles (Baron et al., 2021) and plastics (Brahney et al., 2020; Forster et al., 2023)).

This research offers some insights into perceptions and evaluations of a managed-access reservation system and presents signals in contemporary PPA contexts that both complement and differ from the conclusions in the literature published more than fifty years ago which may require revisiting. For example, we found weak relationships between enduring recreation research concepts such as place attachment and motivations and assessments of TEPS and instead found that visitors' expectations for the park experience and values involving protected area use and access moderate or influence perceptions of the TEPS system. Given the apparent disconnect among respondents between TEPS and resource management, this suggests that outreach and interpretation programs should, as McCool (2001) advises, clearly communicate the relationships between the management action, resource conditions, and the PPA experience to visitors to illustrate their rationale and benefits for the PPA social-ecological system.

In the modern era with the near ubiquity of smartphones and the internet, obtaining a reservation likely presents less of a barrier to visitor spontaneity (Stankey & Baden, 1977) given the similarities with Walls et al. (2018) in the distributions and surge in reservations placed a day prior to the visit. Future studies might offer some insights into variations in allocation strategies, for example, how many days in advance and the proportion of reservations made available along with other techniques to reduce barriers among under-served populations such as older visitors and those with little or no access to the internet.

We would also like to underscore the importance of the justice, equity, diversity, inclusion, and access considerations of these managed-access systems which require further study to understand their effects not only among overnight campers (Rice, 2022) but also on the broader population of National Park visitors. Nevertheless, there may be a plausible argument that these managed-access systems may offer some benefits to considerations of equity and inclusion by providing the uninitiated visitor, who lacks previous experience and thus what types of conditions they might expect in these settings, an opportunity to enter and experience the park with the desired conditions managers have established for the setting. Further, there are some empirical data that

suggest managed-access systems can increase access, such that because of the TEPS system coordinating visitor behavior and daily temporal patterns of visitation the total visitation was consistent with and at times exceeded visitation levels in prior years without the TEPS system (Creany & Monz, 2022, N.P.S., 2023a).

Alternatively, prior to the managed-access reservation systems, the high levels of visitor use often led to the closure of large areas (i.e., Bear Lake Road) or entrances and the entire PPA (i.e., Arches National Park, Utah). This calls into question what visitor "freedom" means in these circumstances and the need to consider and evaluate the normative assumptions regarding the national park visitor experience and values that shape PPA management. Ultimately, all management actions and decisions involve a degree of trade-offs where some goals, ideals, and values are constrained by others. Where value-laden concepts like freedom and access are invoked, PPA managers, visitors and the public should engage and deliberate on the qualitative meanings and importance of these concepts in the contemporary era of PPAs that considers these trade-offs amongst the broader dynamics of the PPA social-ecological system.

CRediT authorship contribution statement

Noah Creany: Formal analysis, Investigation, Methodology, Software, Writing – original draft. **Christopher A. Monz:** Conceptualization, Project administration, Writing – review & editing. **Scott M. Esser:** Funding acquisition, Project administration, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The data that has been used is confidential.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jort.2024.100736.

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