

137 Impacts and trade-offs of alternative transportation systems in U.S. National Parks

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Introduction

As climate change continues to become a serious threat to social and ecological systems, strategies to reduce emissions are becoming increasingly important. Many park and protected area management agencies have begun to seriously consider their role in contributing to, and possibly mitigating, climate change. The US National Park Service, for example, has attempted to reduce the emissions generated as a result of park visitation by implementing alternative transportation systems (ATS) at select national parks across the country. Those most commonly include voluntary or mandatory shuttle systems. Despite their promise of reducing emissions while also alleviating congestion and capacity issues, the implementation of ATS can have other consequences such as negatively affecting visitor experiences, resource conditions at attraction sites, and park budgets (Lawson et al., 2017; Manning et al., 2014). National park managers are consequently placed in the precarious position of having to consider the visitor experience, resource protection, and economic development (National Park Service, 2004). Balancing trade-offs between environmental, social, and economic interests is made more difficult given the lack of research which has taken a comprehensive approach to the implications of ATS. This research begins to fill this gap by systematically examining the primary and secondary impacts of ATS in US National Parks. By doing so, we provide managers and researchers with a holistic view on the topic, and point out the trade-offs that need to be considered when considering implementing or expanding an ATS.

Methods

We conducted an integrative literature review to explore previous literature on the topic, with the goal of developing a synthesis of impacts of ATS in park and protected areas. The assumption that ATS have impacts on environmental, social, and economic dimensions (Litman, 2007; Orsi, 2015)

served as the main conceptual structure. Accepted practices for conducting an integrative review (i.e., identification, analysis, and synthesis of the literature) served as the methodological structure (Torraco, 2005).

Our investigation of the literature used key word strings to search the online databases Scopus, ProQuest, the National Park Service IRMA Portal, and the US Department of Transportation’s Volpe Center’s publication page. The search was conducted in November and December 2020. Publications that met defined inclusion criteria were analyzed and a list of characteristics (impacts) was then developed to provide a holistic picture on the known impacts of ATS, as measured in previous literature. Several articles addressed more than one characteristic and were therefore included into more than one dimension that framed our analysis.

Table 1: Characteristics impacted by ATS and their potential secondary consequences

ATS	Characteristic	Environmental	Social	Economic
Environmental				
+	Emissions	x	x	x
+/-	Noise	x	x	x
+	Wildlife Disturbance	x	x	x
Social				
+/-	Visitor Experience	x	x	x
+	Nature Experience	x	x	x
+	Education/Interpretation	x	x	x
+/-	Visitor Diversity	x	x	x
+	Congestion/Traffic	x	x	x
+/-	Safety		x	x
	Crowding	x	x	x
-	Bus			
+/-	Site			
+/-	Trail			
	Parking	x	x	x
+	Trailhead/Attraction			
-	P&R			
+/-	Communities			
Economic				
+/-	Business Revenue/Visitor Spending		x	x
+	Local Employment & Commuting	x	x	x
+/-	User Fees		x	x
+	Partnerships	x	x	x
-	Capital Expenditure & Operating Cost			x

Results

A total of 46 peer-reviewed articles, management plans, case studies, technical reports, and operational evaluations, were included into the analysis. Our analysis generated detailed descriptions of documented impacts, how those impacts were measured, possible secondary consequences, and identified knowledge gaps. We found 16 individual documented impacts which varied in their directionality (positive, negative, neutral/inconclusive). These impacts are listed in Table 1. A total of 36 publications addressed social impacts, with the visitor experience being by far the most studied ($n = 35$) followed by congestion/traffic ($n = 15$), nature experience ($n = 12$), and capital expenditure and operating cost. Environmental and economic impacts were addressed by 10 and 23 publications respectively, with emissions ($n = 6$) as well as capital expenditure and operating cost ($n = 12$) most commonly being measured in those dimensions. We found the extent to which impacts of ATS were measured varied greatly, as did the extent to which secondary consequences of documented impacts were quantified or even discussed. Nearly all of the impacts we identified had at least one secondary consequence, with most having several. These secondary consequences are shown on the right side of Table 1.

Our analysis also highlighted several knowledge gaps, as for example, the impact of ATS on visitation.

Collectively, the analysis of documented impacts, secondary consequences, and knowledge gaps provides a framework through which managers can better understand the full scope of trade-offs between the environmental, economic, and social characteristics of their parks. "

Discussion

As park managers in the U.S. continue to grapple with rising visitation and rising temperatures, the analysis presented here provides a full state-of-the-science review to guide future management decisions. Results clearly demonstrate the complexity of the issue, and identify unique trade-offs that have to be considered in management decisions regarding the implementation of ATS. Impacts are not uniformly positive and ATS can potentially cause unforeseen consequences. Our analysis highlights the fact that impacts are highly interconnected with each other and can have further implications that may not be obvious at the first glance. It also identifies research gaps that need to be addressed in a more concerted way in the future. Doing so will help provide the science needed for park managers to make more informed decisions regarding the implementation or expansion of ATS.

References

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