No longer news that's fit to print? Climate change goes missing from national park newspapers

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ABSTRACT

Every year approximately 300 million Americans visit at least one of the over 420 units of the US National Park System. At many parks, visitors pass through an entrance gate where a ranger provides a map and newspaper for wayfinding and essential information, while at many others a map and newspaper are freely available at visitor centers and other locations. Surveys involving 19 units of the National Park System that are designated as "national parks" suggest that approximately 37% of their visitors use the newspapers provided to them, meaning that the newspapers reach more than 30 million visitors each year in these parks alone. We propose that park newspapers are well-placed but underappreciated assets for park managers to set an agenda communicating climate change to hard-to-reach audiences. Therefore, we conducted a series of analyses, focused on 17 parks that published newspapers on a near-annual basis from 2005–2022, to examine climate change coverage in them. We found that after the National Park Service (NPS) established its Climate Change Response Program in 2010, nearly 50% of newspapers covered climate change, but from 2017–2022 that proportion plummeted to 35%. We suggest that this decline—along with similar effects evinced in internal newsletters and NPS Climate Change Tweets—rendered a missing audience that could have been persuaded by climate communication but was never reached. We estimate this missing audience at more than 470,000 visitors if 2017–2022 merely met the standard of climate change coverage set in the six years prior. Finally, we conclude by encouraging NPS to include climate change coverage in their new mobile app—otherwise they risk missing another substantial audience—and we provide examples of what that could look like.

Topical Keywords: agenda-setting, agenda-cueing, climate change, national park, public engagement

Method Keywords: text analysis, linguistic analysis, LIWC, computational methods

INTRODUCTION

Along with informal science education outlets such as media programs, science fairs, and cooperative extension services, national parks offer a unique opportunity to communicate science information to large audiences (Schweizer, Davis, and Thompson 2013: 42–62). In 2022, the more than 420 units of the US National Park System welcomed more than 310 million visitors (National Park Service 2023). Such robust attendance at these sites provides a large potential audience for the National Park Service (NPS) to fulfill its mission "preserving the natural and cultural resources and values of the National Park System for the enjoyment, education, and inspiration of this and future generations" (National Park Service 2022).

Education initiatives abound in the NPS, ranging from interpretive displays and ranger-led naturalist programs inside parks to online resources available via the NPS website (Washburn 2020: 215–225). Common educational topics include parks history, plants, animals, and science, with climate change becoming a high-priority scientific topic in recent years given the unique threat it poses to precious natural sites (Gonzalez 2020: 188–210) and cultural resources. In 2010, NPS climate initiatives were formalized under the Climate Change Response Program Strategy, with "communicating to the public and our employees about climate change" as one of four areas of emphasis (National Park Service 2010). By 2012 the NPS Climate Change Action Plan acknowledged that "few organizations in the world have as powerful a position in which to make climate change real, immediate, and relevant for people" (National Park Service 2012). In 2016 NPS issued its *National Climate Change Interpretation and Education Strategy*, including a Climate Communication Brief recognizing that "NPS staff are ideally positioned to increase public understanding of climate change and its effects on parks" (National Park Service 2016a).

In less than a decade, the agency critiqued by the US Government Accountability Office in 2007 for "having not made climate change a priority" (USGAO 2007) had transformed to "incorporate climate change in all levels of planning" (National Park Service 2016b). Many parks included climate communication in their plans. Sites such as Crater Lake, Death Valley, Mount Rainier, and Olympic committed to use their park newspaper—typically distributed to visitors upon entry—to set a climate communication agenda among them.

Using agenda-setting as our theoretical framework, the present research addresses those efforts. We compare 656 newspaper issues from 2005–2022 to determine whether climate coverage varied between the six years prior to the Climate Change Response Program (2005–2010), the first six years of the program (2011–2016), and the six years following Donald Trump's election as US president (2017–2022). We suspect that the climate communication agenda promoted through the Climate Change Response Program diminished during the climate change-skeptical Trump Administration, and we propose that evidence for such a downturn represents a costly missed opportunity—an absent agenda that could have reached hundreds of thousands of persuadable visitors with essential climate communication.

SETTING AN AGENDA WITH CLIMATE CHANGE COMMUNICATION

Since its generative days in the 1970s, agenda-setting has proven a robust and expanding explanatory framework for news media's capacity to raise issue salience in the minds of public audiences (McCombs, Shaw, and Weaver 2014: 781–202; Perloff 2022: 469–499). Agenda-setting proposes that the placement, prominence, and length of news stories conveys the importance of specific topics to audiences (McCombs and Shaw 1972: 176–187). In other words, editorial decisions prime audiences to attach importance to issues that are above-the-fold or at the top of the broadcast, and in turn audiences embrace those topics as the most important issues of the time (Scheufele and Tewksbury 2007: 9–20).

Confirming the basic tenet of agenda-setting, increasing coverage of climate change over the past several decades has coincided with brief spikes in public concern about it (Egan and Mullin 2017: 209–227). Predictably, the issue then recedes in importance when electorally more pressing issues rise to the top of media coverage, such as 2008's Great Recession and 2022's inflation (*The Economist*/YouGov Poll 2021, 2022). This polling suggests that climate change follows a conventional issue-attention cycle, fading in and out of importance in voters' minds (Downs 1972: 38–50). Yet a recent Danish study illustrates the extent to which news media can drive attention toward the issue if covered consistently and emphatically (Damsbo-Svendsen 2022: 1–11). Over a six-month period in 2019, extensive coverage of the effects of climate change in the run-up to a national election produced a dramatic rise in issue salience among the public. In January 2019, roughly 20% of the public considered climate change the "most important problem" facing the nation; by June that number had jumped to 60%. These results suggest that the Danish media might have facilitated an *agenda cueing* effect, such that perceived volume of issue coverage played an outsized role shaping perceived importance of the issue.

Whereas classic agenda-setting centers *placement, prominence,* and *length* as pivotal heuristics that influence issue importance judgements, agenda cueing highlights *mere presence* as another consideration (Pingree and Stoycheff 2013: 852–872). Agenda cueing effects demonstrate that the mere presence of information about an issue makes it seem more important to an individual, even if they do not engage with actual issue content. For example, one 2018 study found that showing participants how frequently an issue was covered in the news influenced their perceived importance of the issue (Stoycheff et al. 2018: 182–201).

If the presence of agenda cues increases the perceived importance of a specific issue, it follows that the *absence* of agenda cues should have the opposite effect. Another 2018 study examined issue absence through the lens of "non-problem" cues and complacency (Pingree et al. 2018: 555–584). Participants who were shown a news coverage report suggesting that the most frequently

covered topics were non-problem issues—i.e., celebrities and sports—were more likely to agree with statements like "the problems we face as a nation these days aren't really that serious." The authors suggest that issue absence functions as its own unique cue conveying diminished problem importance to audience members—people infer that a problem is solved or at least less important than it once was if it recedes from coverage.

These recent experiments articulate issue presence and absence as important extensions to the original agenda-setting hypothesis. Those concepts are well-suited to the context of NPS climate communication. Multi-modal climate communication efforts could yield an agenda cueing cascade whereby a visitor perceives climate change as important just by seeing it communicated frequently during their visit. But if climate change is communicated rarely or not at all, visitors are less likely to perceive its importance and urgency.

Consider a hypothetical visitor to Glacier National Park in summer 2015. Preparing for their trip by browsing the park website at home, the visitor encounters text on the front page: "*Did you know? If current trends continue, some scientists predict that by the year 2030, Glacier National Park will not contain any glaciers and many of the park's smaller glaciers will melt even sooner*." Upon entering the park, the visitor is handed the Glacier Visitor Guide, where a two-page spread juxtaposing the stories "A Changing Climate" and "A Changing Landscape" awaits. Jostling among the crowds inside St. Mary Visitor Center, the visitor encounters a prominent display titled "Goodbye to the Glaciers." Leaving the foot traffic of the visitor center for the vehicular parade on Going to the Sun Road, the visitor then parks at an overlook 13 miles away. There, the remnants of Jackson Glacier are within view, but no visitor can snap the obligatory photo without seeing an interpretive display titled "Going Going Gone." In just these first few moments researching their visit and beginning their stay, this hypothetical visitor has been exposed to climate change text in five different locations, messages likely complemented by ranger talks, shuttle rides, and self-guided audio tours. Agenda cueing suggests that this visitor need not engage with the information; just by seeing that climate is covered, its importance should be clear.

If our hypothetical visitor waited until 2019, their experience would have been different. Climate change was absent in some places and diminished in others. The park website no longer featured climate language on its front page. The visitor center display was still there, but the two-page dual feature in the newspaper gave way to a one-page reprint of the new Jackson Glacier Overlook sign, titled "Losing a Namesake." That sign was accompanied by another new sign at the Overlook, titled "Changing with the Times," so it is not as if climate coverage disappeared entirely. However, this visitor's total climate communication exposure was nonetheless diminished: five unique climate communication "encounters" were replaced by only three, and the total number of words across those encounters dropped by almost 50%, from 2,216 in 2015 to 1,146 in 2019.[1] If this drop were mirrored at other potential climate communication interfaces, it seems reasonable to conclude that the agenda cueing potential of this national park visit was diminished.

Notably, the greatest decrease in climate change coverage in this hypothetical case study came from swapping out 2015's two-page, 1,761-word dual feature in the newspaper for 2019's one-page, 720-word reprint of an interpretive display. For researchers interested in whether climate change coverage decreased during the Trump Administration, this is a convenient finding. Engaging in such detailed and triangulated analysis as the case study above for multiple park units quickly becomes cumbersome if not impossible,[2] but if we assume newspaper coverage is a reasonable reflection of overall climate communication, the task becomes much easier. To that end, our examination of agenda-setting in NPS climate communication samples from park newspapers exclusively.

We propose that a decline in climate coverage in NPS newspapers could have spurred the conceptual opposite of *agenda cueing*: an *agenda absence* effect, such that climate change failed to resonate with potentially persuadable audiences because it never reached them in the first place. Investigative journalism suggests that the Trump Administration attempted to facilitate such an effect (EDGI 2018). Within the National Park Service, 92 links from the Climate Friendly Parks page were disabled in 2017–2018, while a battle ensued over the removal of words such as "anthropogenic" and "human activities" from a report projecting risks of sea level rise and storm surge at coastal parks (Zhang 2017; Shogren 2018a; Shogren 2018b). Elsewhere, nine members of the National Park System Advisory Board—a key external resource for climate recommendations—resigned in 2018 after Interior Secretary Ryan Zinke refused to meet with them in light of the agency's "new vision" (Diamant 2018: 5–11; Diamant 2023: 5–10).

These documented cases of silenced science pertain to obscure information sources such as government reports, websites, and external advisers, with capacity to set the public agenda that lies well upstream and tangential from communication directly with large audiences. We suggest that park newspapers are simple tools well placed to

reach wider and more pivotal audiences. Typically offered with maps as visitors enter any gated NPS site (and at visitor centers and other locations in these and many other parks), newspapers provide useful information for orienting to the parks. Estimates averaged across visitor use studies conducted at 19 parks since 2005 suggest that about 37% of visitors report using park newspapers during their visits (Table 1). Beyond visitor center information and hiking recommendations, these newspapers should also be considered a critical educational interface for communicating climate change to those who might not enter visitor centers, explore interpretive displays, or visit NPS websites where much of the Climate Change Response Program information is featured (Lahr 2017: 85).

FROM ENGAGING MULTIPLE AUDIENCES TO MISSING AUDIENCES ALTOGETHER?

In 2016, the Climate Change Response Program issued a Climate Change Communication Guide for employees. The guide highlights key general messages as well as specific talking points for 10 bioregions where climate impacts vary. It also introduces employees to audience segmentation using a popular approach developed by the Yale University Program on Climate Change (YPCC) (Davis and Thompson 2020: 53–71; Leiserowitz et al. 2023). YPCC conducts annual nationally representative surveys of climate change beliefs, behaviors, concerns, and involvement to segment audiences into "six Americas," from the *dismissive* and *doubtful*—audiences resistant to climate messages; to the *disengaged* and *cautious*—audiences who have not yet made up their mind or have not engaged much with climate messages; to the *concerned* and *alarmed*—audiences who are worried about climate change and support climate action.

We suggest that the *cautious* are the most crucial audience for climate communication because their opinions have not yet crystallized, so they could be receptive to climate action if well-designed messages reach them. The capacity to reach these specific audiences through a newspaper handed directly to them when they enter a national park is unique and significant; where else can climate communication reach millions of people primed to think about nature?

It follows then that every newspaper issue that includes *no* climate communication is a missed opportunity to

TABLE 1. Park surveys summary, percentage of visitors using newspaper.

	2005–2007	2008–2010	2011–2013	2014–2016	2017–2019
Acadia (ACAD)		29			
Bryce Canyon (BRCA)		60			
Congaree (CONG)			19		
Death Valley (DEVA)		60 62			
Denali (DENA)	27		34		
Everglades (EVER)		20 12			
Grand Teton (GRTE)		38			
Great Smoky Mtns (GRSM)		38 34			
Joshua Tree (JOTR)		40			12 11
Lassen Volcanic (LAVO)			36 23		
Mesa Verde (MEVE)			76		
Mount Rainier (MORA)			26		
Rocky Mountain (ROMO)		43	19		
Sequoia & Kings Cyn (SEKI)			49		
Shenandoah (SHEN)			31 29		
Wind Cave (WICA)		10			
Yellowstone (YELL)				21	
Yosemite (YOSE)	78	73			
Zion (ZION)	62 52				

Note. This table includes every survey in which visitors were asked whether they used the park newspaper or guide since 2005. Each cell including a number is a percentage estimate from a survey conducted within the corresponding three-year period (e.g., 78% of visitors reported using the Yosemite Guide in a 2005 survey). On average, 37% of visitors reported using park newspapers or guides across these surveys.

Surveys are available at the NPS DataStore, https://irma.nps.gov/DataStore/Search/Advanced, Reference Type "Project."

reach these audiences. Therefore, we suspect that the combination of perceived political pressure and five years without a Senate-confirmed NPS director (from 2017–2021 could have attenuated the ability to reach these audiences with climate communication embedded in newspapers. We propose that:

> H1: The proportion of national park newspapers featuring climate change was lower after Trump's election than in the preceding years.

If H1 is confirmed, it demonstrates that climate change was featured less on the agenda of newspapers communicating to external audiences at the individual park level. At a wider level, NPS also communicates with external audiences through Twitter accounts. Importantly for this study, the Climate Change Response Program Twitter account @ ClimateNPS provides a valuable data source that dovetails with individual park newspapers as another potential indicator of diminished climate communication with external audiences. To that end, we propose:

> H2: The Climate Change Response Program Twitter account @ClimateNPS tweeted less after Trump's election than in the preceding years.

H1 and H2 both examine external communication between NPS and the public, the interface we are most interested in because of its persuasive implications. However, internal communication *within* NPS is also important insofar as it helps set the tone within the organization. One such data source is Climate Change Response Program Newsletters. Published 101 times between 2009–2022, these newsletters are distributed primarily to NPS employees.[3] Upstream from the external communications we examine in H1 and H2, they are a useful indicator of the climate communication milieu behind the scenes. Therefore, we propose:

> H3: There was a decrease—i.e., fewer words—in Climate Change Response Program Newsletters in the years following Trump's election compared to the preceding years.

Finally, the apparent agenda-absence effect suggested by convergent evidence from H1 and H3 can be further examined by measuring the correlation between climate change coverage in internal newsletters and external newspapers (RQ1). Evidence of such a correlation cannot confirm causality but can at least suggest whether changes in internal and external communication are statistically associated with each other.

METHOD

Using NPS websites, the NPS History eLibrary (npshistory.com), and the Internet Archive Wayback Machine, we downloaded thousands of park newspapers from 2005–2022. We chose 2005 as the starting point for our analysis so we could divide the dataset into three equal periods: the six years prior to the implementation of the Climate Change Response Program (2005-–2010), the first six years of the Climate Change Response Program (2011–2016), and the last six years during which we expected a downturn in climate communication (2017–2022). We downloaded all available newspapers for the 63 National Park System units designated as national parks during those 18 years. Even in recent years, almost every park had at least one instance when a newspaper appeared to be published but is unavailable on the Internet, so we had to determine inclusion criterion for a valid database. We decided that any park which had three or fewer years with no available newspaper would be included. We chose three or fewer years so that a park could have, on average, only one missing year per each of the three six-year periods we were interested in.[4] Overall, 17 parks met these criteria (n = 656 newspapers; see Table 2).

Park-Level Analysis: Newspapers

We used Linguistic Inquiry and Word Count (LIWC) software (Boyd et al. 2022) to examine our hypotheses. LIWC is a widely used text analysis tool that searches texts and counts words according to categories of research interest called dictionaries. For example, the dictionary *first-person plural pronouns* counts each time a word such as "we," "us," or "our" is used in a text. For this study, we created a climate change dictionary based on terms used in two recent analyses of climate change language in social media and entertainment (Shah, Seraj, and Pennebaker 2021: 1–5; Giaccardi, Rogers, and Rosenthal 2022: 8). The dictionary includes 59 words/phrases relevant to climate change, such as "global warming," "carbon emissions," and "sustainability" (See Appendix A).

Mindful of the potential for Type II error, we used a "benefit of the doubt" approach that coded climate change coverage as a binary variable of "absent" (n = 377) or "present" (n = 279) in each newspaper. Given the critical nature of our analysis, we were more concerned about avoiding false negatives than including false positives. Of course, this means that a newspaper like winter 2022's *Death Valley Guide,* a false positive based on the phrase "conserves diverse historic sites and remarkable *biodiversity,*" is statistically equivalent to fall 2011's *Death Valley Guide,* which had an entire page devoted to climate change mitigation efforts. We are content with this tradeoff because it is more likely to overestimate climate coverage and challenge our hypothesis than underestimate coverage and undermine validity.

	Total Newspapers	# including Climate Words	% including Climate Words
Arches	16	8	50
Big Bend	22	10	45.5
Crater Lake	21	20	95.2
Death Valley	23	12	52.2
Glacier	23	16	69.6
Isle Royale	18	7	38.9
Lassen Volcanic	30	11	36.7
Mesa Verde	35	6	17.1
Mount Rainier	61	24	39.3
Olympic	31	11	35.5
Redwood	16	15	93.8
Rocky Mountain	42	7	16.7
Sequoia & Kings Canyon	82	12	14.6
Voyageurs	16	4	25
Wrangell—St. Elias	17	17	100
Yellowstone	52	47	90.4
Yosemite	151	52	34.4
Total	656	279	42.5

Note. Sequoia and Kings Canyon are separate national parks operated jointly with a shared newspaper, so we treat them as one unit in this research.

TABLE 2. Park newspaper summary and climate coverage.

Results. A between-subjects ANOVA supported the hypothesis that climate coverage declined following Trump's election, $F(2, 653) = 4.98$, $p = .007$, partial $\eta 2 = .02$ (see Figure 1). Post-hoc tests using the Games-Howell method confirmed that there was a greater proportion of climate coverage in 2011–2016 ($M = 49.8\%$, $SD = .50$) than in 2017–2022 ($M = 35.1\%$, $SD = .48$), $p = .005$, $d = .30$. Climate coverage in 2005–2010 ($M = 42\%$, $SD = .49$) did not differ from either 2011–2016 or 2017–2022 ($ps > .22$).

Institutional-Level Analysis: Tweets and Newsletters

We compiled two complementary datasets to examine climate communication at wider levels than the individual park newspapers examined with H1. For H2, we used the Internet Archive Wayback Machine to count how many tweets the Climate Change Response Program posted prior to, during, and after the Trump Administration. For H3, we used the NPS website to download all 101 Climate Change Response Program newsletters since the first issue in August 2009.

Results. Simple tweet counts support H2. The @ClimateNPS account was launched in January 2015 and tweeted 133 times that year and 131 times in 2016. Across all four years of the Trump Administration, the account tweeted 74 total times (i.e., 18.5 times per year).[5]

There are two notable findings regarding Climate Change Response Program newsletters, both supporting H3. First, there is a dramatic effect of year on word count: from 2009–2016 ($n = 41$) the average newsletter included 3,831 words ($SD = 1348.92$), but from 2017–2022 ($n = 60$) the average newsletter only contained 654 words ($SD = 270.52$), $t(42) = 14.88$, $p < .001$, $d = 3.60$ (see Figure 2, Panel A). There is a clear qualitative explanation for this dramatic effect: after the final newsletter issued during the Obama Administration was published in January 2017, the format changed from a quarterly publication under the title "Climate Change Response Program Newsletter" to a near-monthly publication under the title "Climate Change Response Program Communications Corner." Since we would expect a more frequent publication schedule to result in fewer words per newsletter, we also examined total word counts across all newsletters published each year. We regressed that yearly word count on year of publication. The effect remained, $\beta = -.68$, $p < .01$, $R2 = .47$ (see Figure 2, Panel B). This effect confirms that, regardless of format changes—or maybe even because of them—fewer total words were published in Climate Change Response Program newsletters each year of the Trump Administration (and now Biden Administration as well) than in the years of the Obama Administration.

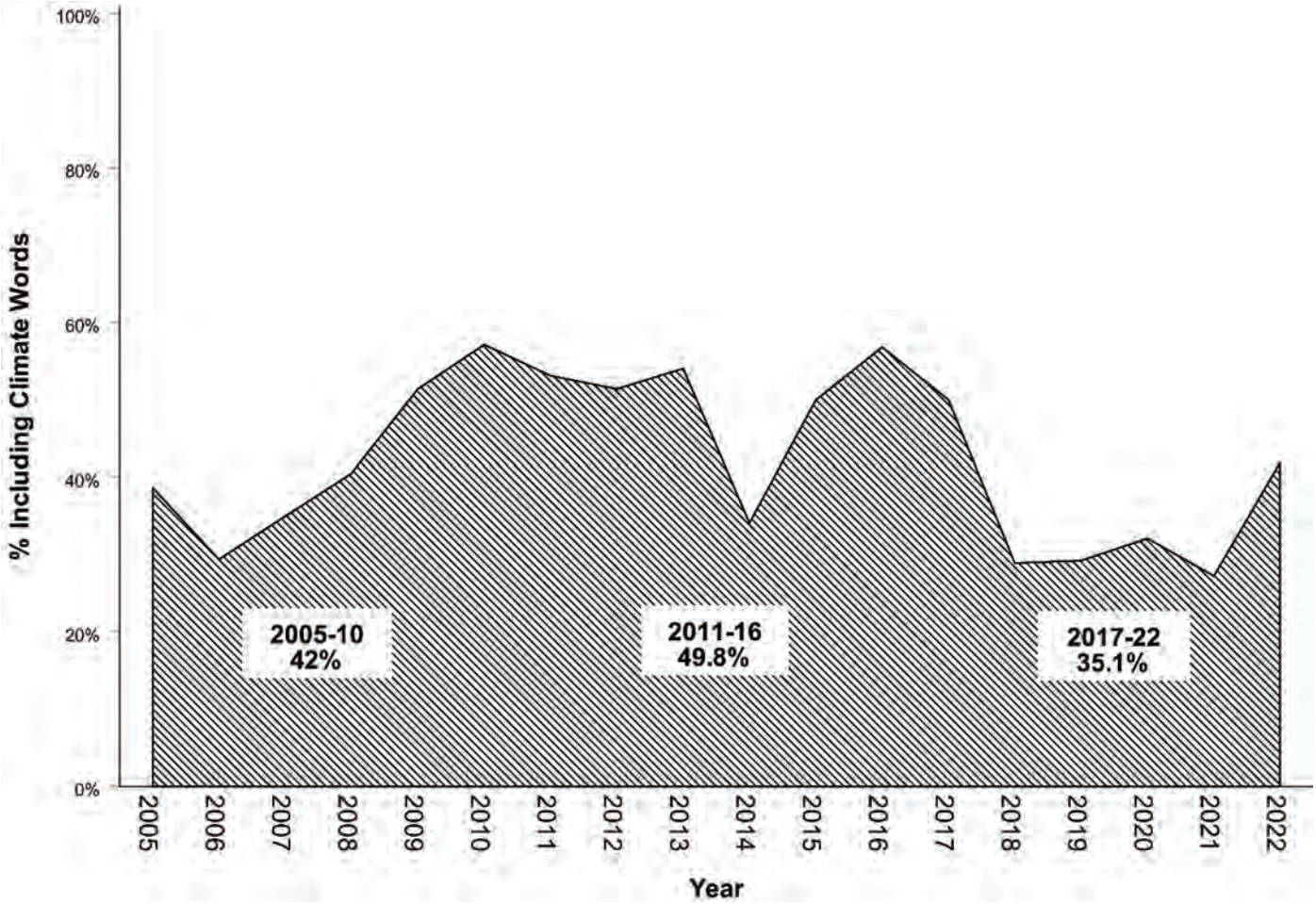


FIGURE 1. Proportion of park newspapers including climate change, 2005–2022.

LINKING PARK-LEVEL AND INSTITUTIONAL-LEVEL ANALYSIS

We proposed RQ1 to examine whether changes in internal and external communication were statistically associated with each other. Both the mean number of words per Climate Change Response Program Newsletter per year ($\beta = .65$, $p = .01$) and the total number of words summed across newsletters each year ($\beta = .71$, $p = .005$) were highly correlated with the proportion of park newspapers including climate coverage each year. In other words, although we cannot assert that decreases in newsletter climate content *caused* decreases in newspaper climate content, we at least know that the two variables are associated with each other.

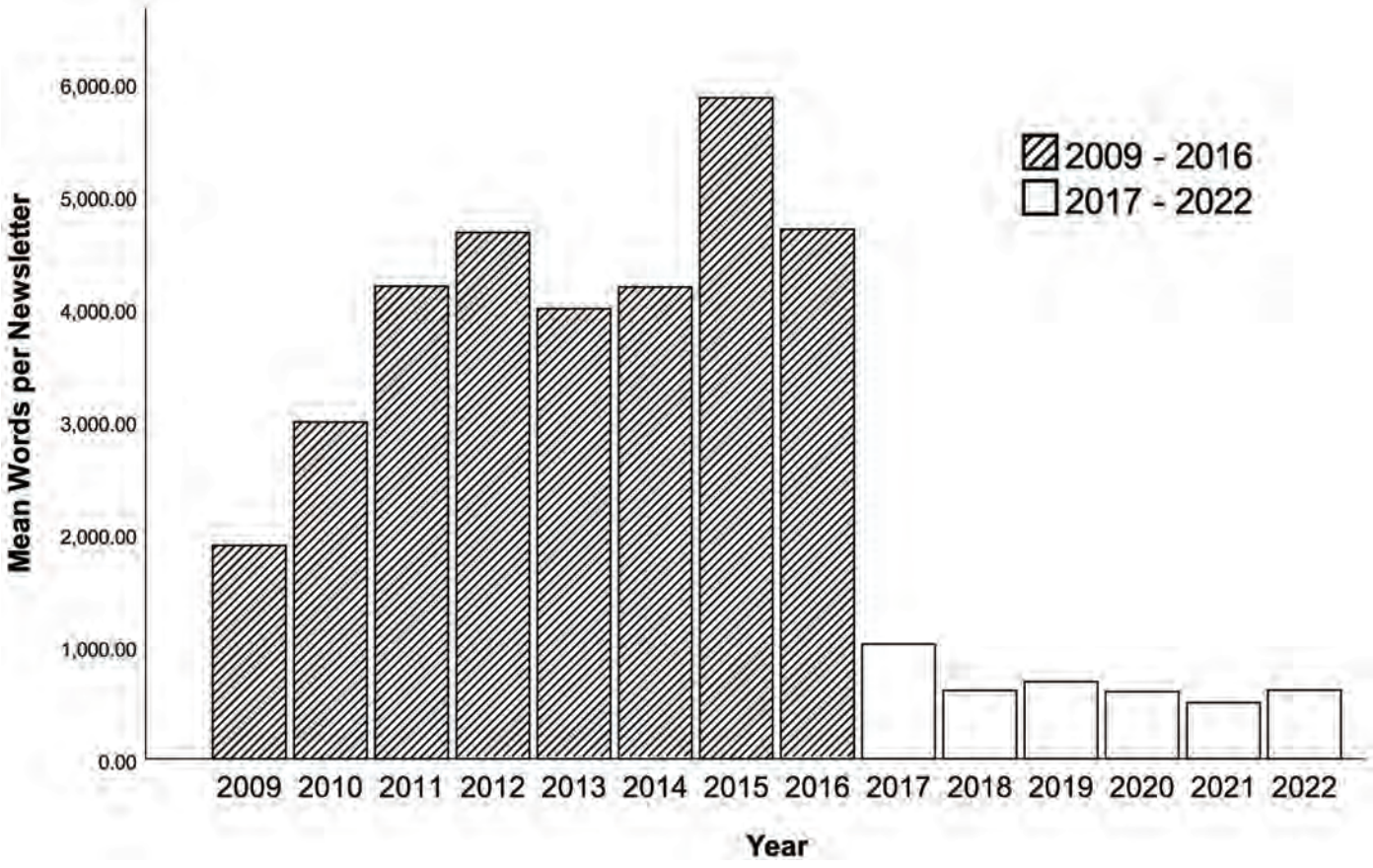
Data and analysis availability. SPSS data and syntax for all reported tests are available at the repository for this project, https://osf.io/3br4e/?view_only=fb72af0372184466af7a79732a3bd272

DISCUSSION

We argue that the National Park Service can play a key role setting the agenda for climate change communication merely by including climate information in park newspapers. Complemented by interpretive displays, ranger talks, and other mainstays of climate change communication within parks, newspapers could facilitate an agenda cueing effect such that perceived volume of coverage might translate to greater issue importance among visitors. Indeed, in the first six years after the Climate Change Response Program was established in late 2010, 49.8% of newspapers in our sample contained at least some mention of climate change, while numerous other efforts to communicate climate change were undertaken simultaneously within park programs. However, newspaper coverage plummeted to 35.1% from 2017–2022, an unfortunate sign of regression at a time when parks experienced record visitation while accumulating disasters like wildfires and glacial retreat created an opportunity for effective climate communication. Instead, climate change was absent from the agenda and a sizable audience went missing.

How Big was the Missing Audience?

Science communication researchers recently developed a framework for identifying *missing audiences:* individuals interested in science who use a particular media platform



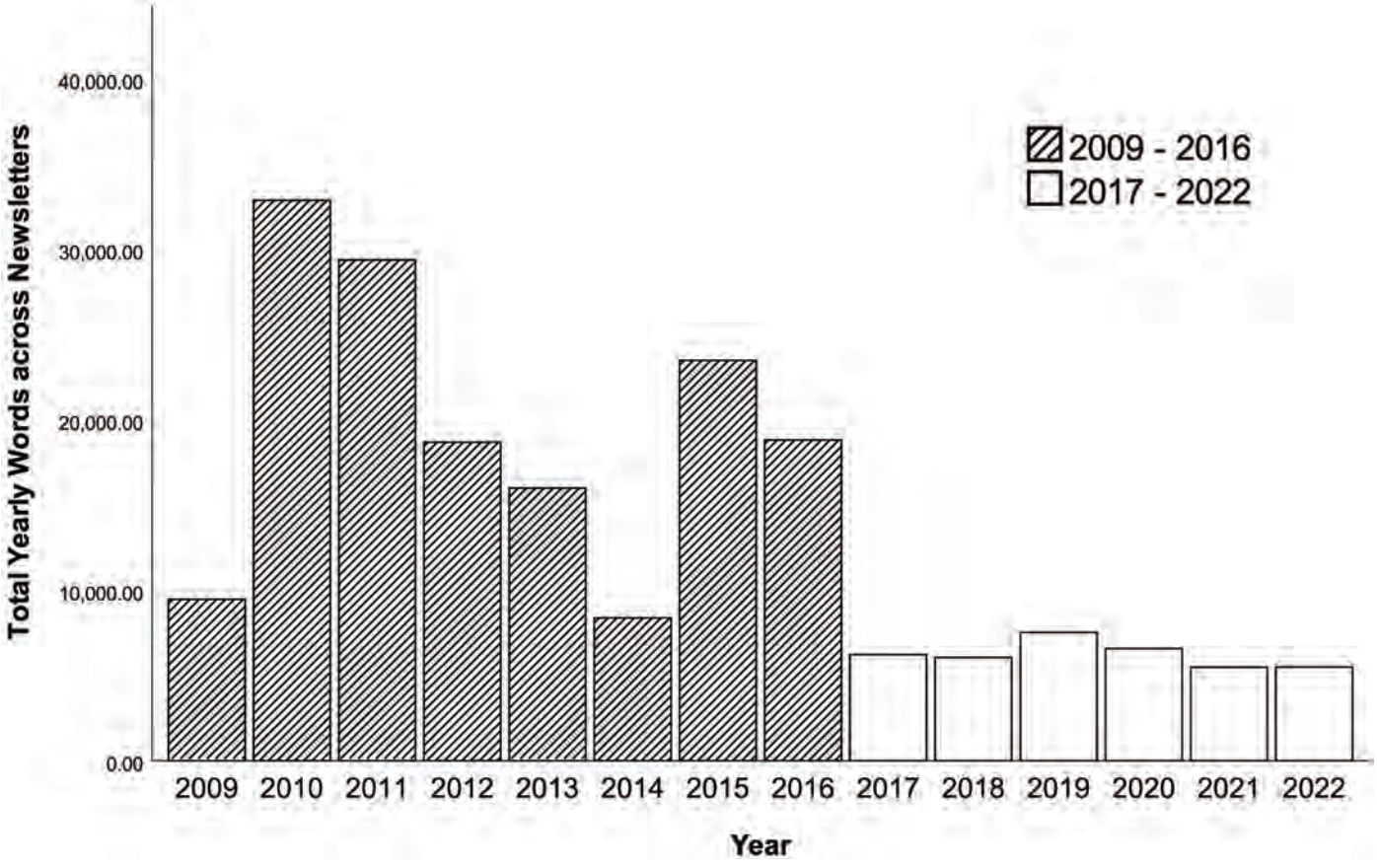


FIGURE 2, Panel A (above). Climate Change Response Program Newsletter word counts, mean words per newsletter.
FIGURE 2, Panel B (below). Climate Change Response Program Newsletter word counts, total yearly words across newsletters.

but for some reason do not engage with science on the platform (McCann et al. 2019: 137). Such research typically invokes survey methods to answer two questions: why did the interested audience not engage with science on the platform, and how big is that audience? We employ a similar framework: the media platform is park newspapers, the interest is climate communication, and the reason climate-interested visitors did not engage with such content in newspapers was the decline in climate coverage from 2017–2022. Therefore, there is one question left to answer: how big was the missing audience?

If we know how many visitors use park newspapers and how many are interested in climate change, we can estimate how big an audience NPS did not reach because of the decline in climate coverage from 2017–2022. Visitor use studies frequently measure these constructs. Conducted independently from NPS by university researchers using standard social scientific survey techniques, 30 such studies in 19 National Park System units designated as "national parks" since 2005 have asked visitors if they used park newspapers or guides during their visits. Responses vary from lesser-visited parks lacking entrance gates (e.g., Congaree, 19% of visitors) to global destinations where most visitors reported using the paper (e.g., Yosemite, 76% of visitors). Averaged across these 30 studies, 37% of visitors reported using park newspapers (see Table 1).[6] Likewise, five such studies have asked visitors if they would like to learn about climate change on a future visit; on average 14% reported such an interest.[7]

If we know from visitor use studies that 37% report using the newspaper and 14% said they would like to learn about climate change, and we accept that these data from a sample of 19 National Park System units accurately represent the 63 National Park System units designated as national parks, a series of calculations can estimate the missing audience. We know from official statistics that there were 516,962,055 visitors to these 63 parks from 2017–2022 (National Park Service 2023). If, as in 2011–2016, 49.8% of 2017–2022 newspapers had featured climate coverage, then this coverage would have had a maximum potential audience of 257,447,103 park visitors. However, because only 35.1% of 2017–2022 newspapers *actually* featured climate coverage, the actual maximum potential audience was 181,453,681 and the missing audience was 75,993,422 visitors. Of course, many park visitors were not visiting for the first time—a hypothetical visitor who read *Yosemite Guides* in both summer and fall 2019 should not count as two "missed" visitors—so we need to discount the size of the maximum potential audience to only include unique visits. A 2023 systemwide study suggested that 47% of national park visits are firsts (Otak 2023: 23), so we use this factor to further reduce the initial audience estimate to 35,716,908. To then estimate the missing audience, we simply multiply the three factors just outlined: (1) 37% of visitors use the newspaper; (2) 14% of visitors are interested in learning about climate change, and (3) 35,716,908 first-time visitors could not consume climate content in newspapers because it was not featured in as many papers as in 2011—2016. This equation renders a missing audience estimation of 1,850,136 first-time visitors interested in climate change who might have seen climate change coverage if it had been featured in the newspaper.

It is likely that most of the missing audience interested in learning more about climate change already has some opinion on the topic, so we need to add one more crucial factor to determine what we call the *missing effective audience,* or those who climate communication could both reach *and influence*. We use projections based on averaging the 2019 Yale Program on Climate Change Communication's Six Americas survey (Goldberg et al. 2020; 22% of those interested in climate change were *cautious*) and a 2011 Six Americas survey of 3,233 national park visitors (Davis and Thompson 2020: 66; 29% of those interested in climate change were *cautious*) to estimate 25.5% belong to the *cautious* group, interested in learning more about climate change but not yet having made up their mind about the topic. This yields a final missing effective audience of 471,785 visitors who could have been persuaded about climate change but were not exposed to coverage in park newspapers. In other words, if 2017–2022 park newspapers simply met the standard set during the previous six years, climate coverage could have persuaded a population the size of Miami, Florida.

Limitations of the Study

Absent qualitative evidence such as interviews with park managers, it is difficult to prove that pressure from the Trump Administration caused the 2017–2022 downturn in climate change communication. Our data merely describes that there was a downturn while building a theoretical case that political pressure—either perceived or actual—might have been a factor. Indeed, it is possible that there was no explicit pressure, but rather it was the mere perception of a climate-skeptical opinion milieu among administration leadership that caused the downturn. This is a distinct possibility given what we know about Trump's disputes with NPS after his inauguration (Higdon 2020: 120). After White House staff pressured NPS leadership in a dispute over photographs of the crowd size, one can imagine that agency employees might hesitate communicating climate change while answering to a climate-skeptical administration, even if there was no direct pressure on that particular topic (see Matthes, Knoll, and von Sikorski

2018: 3–33; cf. Hunter 2017). Further research including interviews with park employees could probe this possibility and deepen the narrative about what precipitated the decline from 2017–2022.

It is also possible that the 2017–2022 downturn was completely unrelated to political pressure, perceived or actual. One such decline happened in 2014, when coincidental exclusions of climate words in the Mount Rainier, Olympic, Redwood, and Yosemite newspapers contributed to the obvious "valley" displayed in Figure 1. There was a confluence of peculiarities in 2014. It was the only year between 2009 and the present that the Redwood newspaper excluded a "Climate Friendly Parks" panel. It was the only year during the period 2009–2019 with no climate mentions in the Olympic newspaper. It was also the beginning of Mount Rainier's steady decline in climate words that continues to this day. And at Yosemite, language that regularly referred to a "new climate change exhibit" at the Yosemite Conservation Heritage Center in 2013 and 2015 (four out of five references in each year included that phrase) instead referred to "historical exhibits" in four out of five newspapers published in 2014.

To probe this anomaly further, we examined the residuals from a quadratic logistic regression of climate words on newspaper year. In 2014, the observed probability of climate mentions (34%) was 15% lower than the predicted probability, the largest such deviation in the entire dataset. Of course, this analysis does not eliminate the possibility that the 2017–2022 decline could indicate a similar anomaly, but it seems unlikely such a phenomenon would persist for six years. We therefore suggest that the 2014 and 2017–2022 declines demonstrate qualitatively different phenomena.

Despite the decline in official NPS climate communication, there were channels through which such content still proliferated with associations to NPS during the Trump Administration. For example, alternative social media accounts (e.g., @ALTUSNPS) purporting to be park rangers and seasonal employees gained popularity in early 2017. These accounts were created in response to an incident in which a former Badlands National Park employee posted climate change information that was quickly deleted from the official Badlands Twitter account (Repanshek 2017). Many of these alternative accounts continued to share climate information for months following the incident. The extent to which those accounts compensated for the decline in official communication is beyond the scope of this research but is an important consideration that would add nuance to the findings we describe.

Other limitations concern the 30 visitor studies from which we drew our "37% use the newspaper" statistic. While 27 such studies were conducted between 2005–2013, only three were conducted in the decade since. Likewise, these studies simply ask visitors if they used the newspaper during their visit; there is no qualitative or quantitative account describing what was read. Decisions about where to include climate change communication in the newspaper and language choices within stories could have a significant impact, given what agenda-setting and framing research suggests (Scheufele 2014: 13585–13592). Therefore, these studies should be considered useful but insufficient proxies for examining how visitors interact with park newspapers, especially in recent years with less data. Future studies should examine framing and agenda-setting effects through the lens of language and design choices in park newspapers and mobile app modules (see Appendix B).

Moving Forward: Push vs. Pull Communication and the Potential Reach of the NPS App

We would be remiss to not credit NPS for its many efforts to communicate climate change since establishing the Climate Change Response Program in 2010. Interpretive displays, specialty brochures, and ranger programs communicate climate change to millions of visitors while at parks. Volumes of online materials, free training sessions, and youth internships offer climate engagement opportunities outside of park boundaries (see Beissinger et al. 2016; Thompson and Houseal 2020). These programs and materials demonstrate great progress integrating climate change communication with the NPS mission over the last decade.

Unfortunately, the reach of these programs and materials could be limited by their nature as *pull communication*, such that audiences must choose to interact with them—that is, "pull" them towards the self—based on curiosity or perceived alignment with their values (Schmitt 2018: 1–5). In contrast, park newspapers qualify as *push communication,* literally placed into the hands of visitors upon entering a park. This qualitative difference is central to our argument because push communication is well positioned to reach audiences that might not walk to an interpretive display about retreating glaciers or attend a ranger talk about migrating mammals. After all, in 2016 studies at Yellowstone and Arches a mere 1–3% of visitors said they wanted to learn about climate change on a future visit to those parks (Resource Systems Group Incorporated 2017; Resource Systems Group Incorporated 2018; cf. Schweizer, Davis, and Thompson 2013: 56). How does NPS reach the other 97–99%? Perhaps in a newspaper placed directly into their hands.

Of course, it is not sufficient to simply hand a newspaper to a visitor. The content must also pique their interest enough that they read it. Park managers are advised to use combinations of climate communication strategies to reach qualitatively different audiences (National Park Service 2014). Whereas an *alarmed* visitor might eagerly read a story about carbon reduction strategies at a park, *cautious* visitors might ignore such dry scientific information. Striking images and captivating stories might find more success with this hard-to-reach audience (Roser-Renouf et al. 2023). One such example can be found in a summer 2022 Crater Lake full-page feature. A story describing a ranger's discovery of an algae bloom is juxtaposed with striking photos of green filaments invading the lake's pristine blue water, and a graph depicting increasing water temperatures over time helps readers visualize how the lake's rising temperature might have played a role. The story grabs attention with visuals, personalizes the story with quotes, and uses chronological storytelling to maintain reader interest.

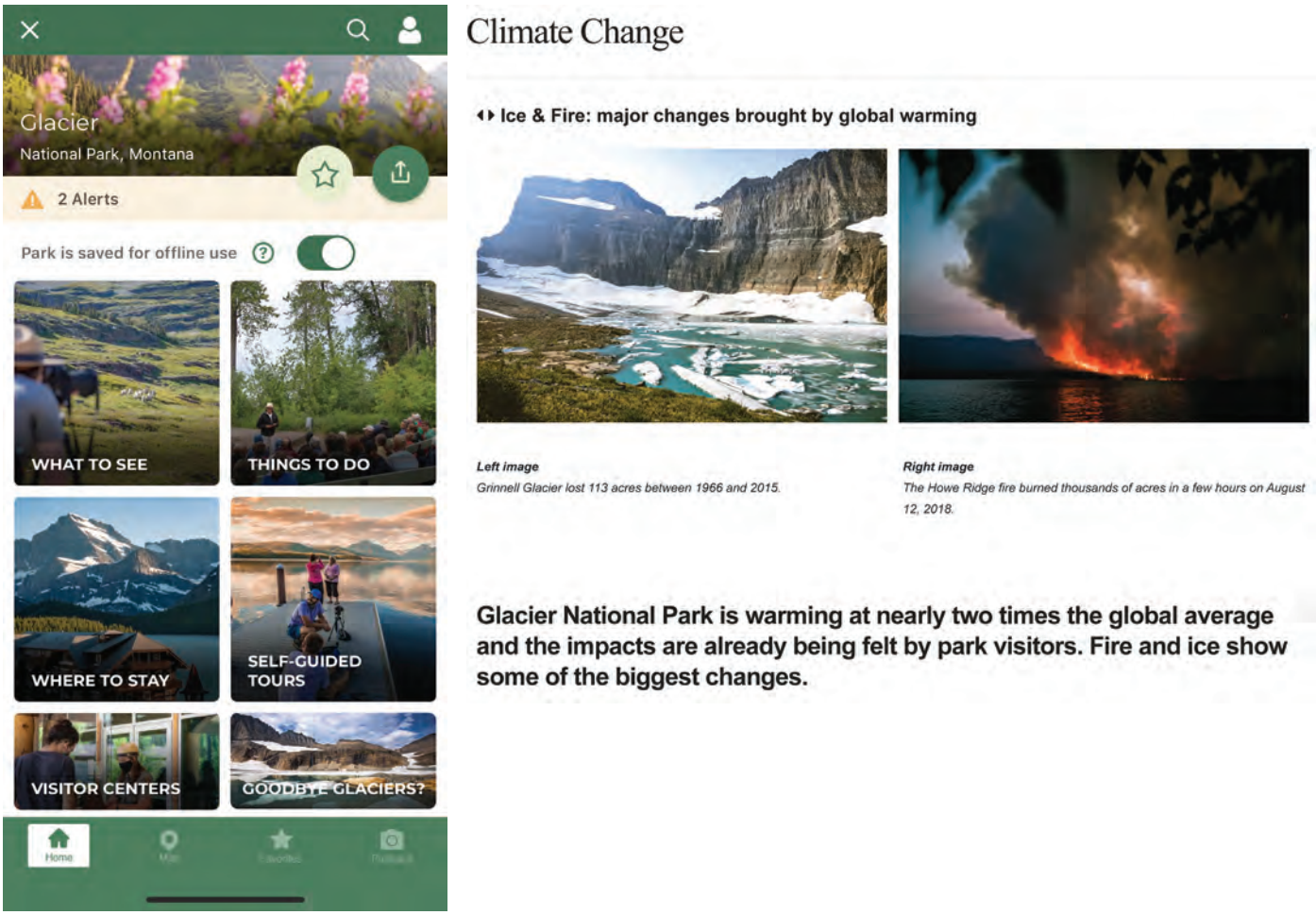
We therefore suggest that park managers heed our call to increase climate coverage in newspapers while following the agency's guidelines for reaching multiple audiences.

However, we also acknowledge that some parks have stopped distributing printed newspapers altogether. In 2021, NPS released a mobile app that could replace those newspapers if park managers elect to do so.[8] The app provides another opportunity to communicate climate change if such coverage is promoted. Otherwise, the app could become another missed opportunity to reach millions of visitors. Given that the app website claims that "rangers continue to add more ways for you to experience each of our parks through the NPS app," we hope that one of those additions is a climate tile featured prominently alongside essential information such as "Things to Do," "Visitor Centers," and "Self-Guided Tours" (National Park Service 2021).[9] Figure 3 provides a mock-up for Glacier National Park, and additional mock-ups are provided in Appendix B.

CONCLUSION

In 2015, the University of California, Berkeley held a summit convening leading minds in conservation to chart a course for managing the next 100 years of the National Park Service through turbulent environmental change. A year later, the National Park System Advisory Board's Education Committee met in the aftermath

FIGURE 3. The Glacier App with a mock-up tile linked to the climate change page on the current Glacier National Park website.



of the 2016 election to discuss how educators and interpreters might shepherd their programs through political headwinds. These parallel meetings yielded edited volumes rife with ideas to meet the twin challenges of environmental degradation and a political thicket, such as the promise of parks to engage different segments of the public with climate science (Beissinger et al. 2016; Thompson and Houseal 2020). One chapter in the volume from the Berkeley meeting recommends that "research in the parks could be publicized with pride …[it] could be a conversation starter that leads visitors to a deeper understanding of the park and its surroundings" (Turner et al. 2016: 94). Another suggests that NPS, by "providing venues for people who come willingly, with interest, [has] a window of opportunity to help raise the consciousness of the public about big challenges and to get them involved" (Oldfather et al. 2016: 221). We concur, and what better way to proudly publicize that research, start the conversation, and raise public consciousness than with simple media that reach tens of millions of visitors each year? Whether in newspapers or apps, we implore park managers to center climate in their communication agendas and rectify the costly neglect that set in after the election of Donald Trump.

ENDNOTES

1. These word count estimates are based on TripAdvisor photographs and Glacier National Park newspapers from summer 2015 and summer 2019.
2. Triangulating climate coverage through readily available YouTube videos, TripAdvisor photos, news stories, and other sources is likely much more difficult at less popular parks than it was for our examination of Glacier.
3. As per the Climate Change Response Program Newsletter website, "The NPS Climate Change Response Program newsletter primarily serves an internal NPS audience, but anyone can sign up to receive the emailed newsletter."
4. We recognize that the choice to include newspapers with only three missing years could be considered arbitrary, so we also conducted four supplementary analyses with different inclusion criteria—two with more restrictive criteria than those featured in the main text, and two with less restrictive criteria. Substantive conclusions from all four of these analyses were no different than the analysis following in the main text. See Appendix C for further details.
5. We could not determine exact tweet counts for each year of the Trump Administration, but the Wayback Machine archived the @ClimateNPS account on the dates of both Trump's and Biden's inaugurations, so we could still determine the total number of tweets from 2017–2020.
6. An August 2023 systemwide study estimated that 53% of visitors use park brochures or newspapers (Otak 2023: 32). We chose our more conservative estimate of 37% because the surveys we examined separated "park brochure" use from "newspaper and guide" use, whereas brochures and newspapers were conflated in the 2023 study.
7. 2016 Yellowstone: 1%. 2016 Arches: 3%. 2012 Sequoia/Kings Canyon: 36%; 2011–2012 Congaree: 30%; 2010 Rocky Mountain: ~1% (part of a blanket group of "other topics" at 4%). Please note that a separate study estimated the percentage wanting to learn more about climate change at 68% (Schweizer, Davis, and Thompson 2013: 42–62). We chose to use the more conservative 14% figure to avoid overestimation.
8. However, we caution park managers to consider a gradual transition to app-exclusive communication unless the app becomes considerably more popular. A recent systemwide study estimated that only 13% of visitors used the app in 2022 (Otak 2023: 23).
9. A recent call to communicate geoheritage using the app echoes our suggestion (Tormey 2022: 75–83).

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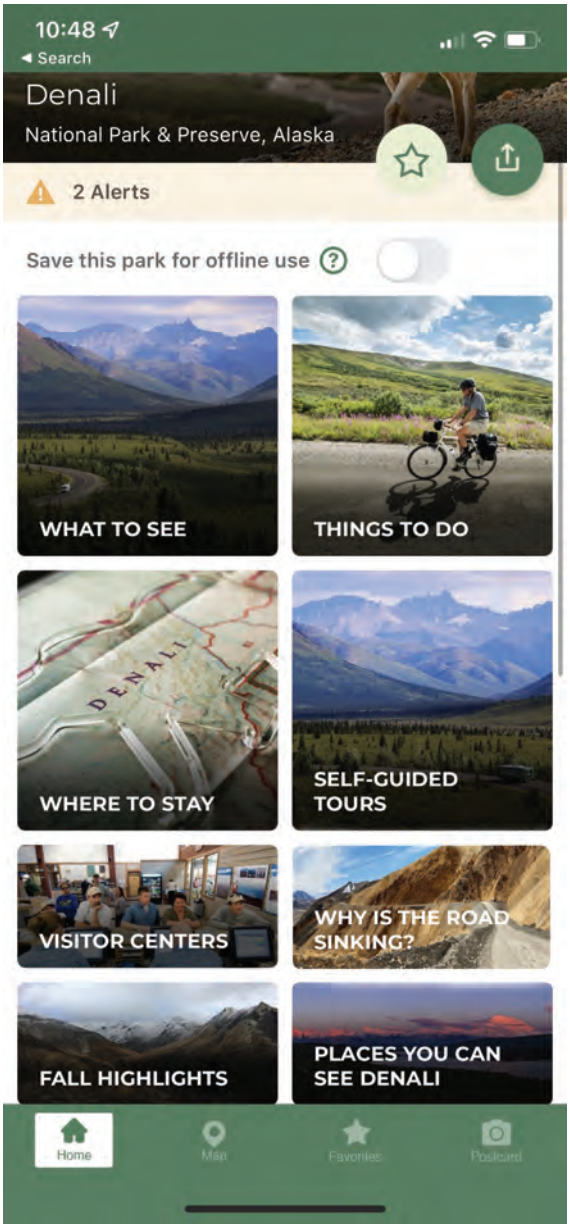
APPENDIX A. CLIMATE CHANGE DICTIONARY

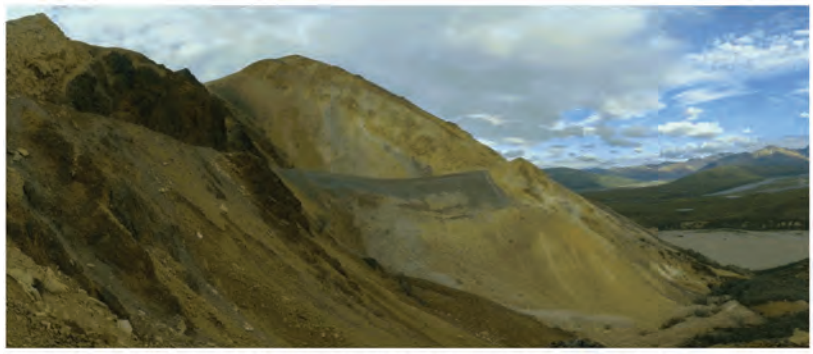
biodiversity
carbon capture
carbon emission*
carbon footprint*
carbon neutral
carbon tax*
care about the planet
ch4 emission*
ch4 level*
changing climate
clean energy
climate ch*
climate disaster*
climate emergency
climate justice
climate migration
climate refugee*
climate science
climate solution*
climate warming
co2 emission*
co2 level*
decreasing snow*
deforestation
drier summer*
dying planet
el nino
energy efficient
fossil fuel industry
fossil fuel*
fracking
global warming
gone ext*
green energy
greenhouse effect
greenhouse gas*
hotter summer*
ice caps
increasing temp*
melting glaciers
melting ice c*
microplastic
ocean pollution
ozone layer
plastic pollution
reduce emission*
reduce footprint*
reducing emission*
reducing essential habitat*
reducing our carb*
reforestation
renewable energy
save the planet
sea level r*
sixth ex*
solar energy
solar panel*
sustainability
wind energy

APPENDIX B: NPS APP MOCK-UPS

The following screenshots capture the front pages of four different NPS app modules. We edited an "Amenities" tile from the app to simulate what climate change coverage could look like if featured on different park modules. Adjacent images are from NPS pages that app tiles could link to.

PHOTO B.1. Denali National Park and Preserve: Why is the road sinking?





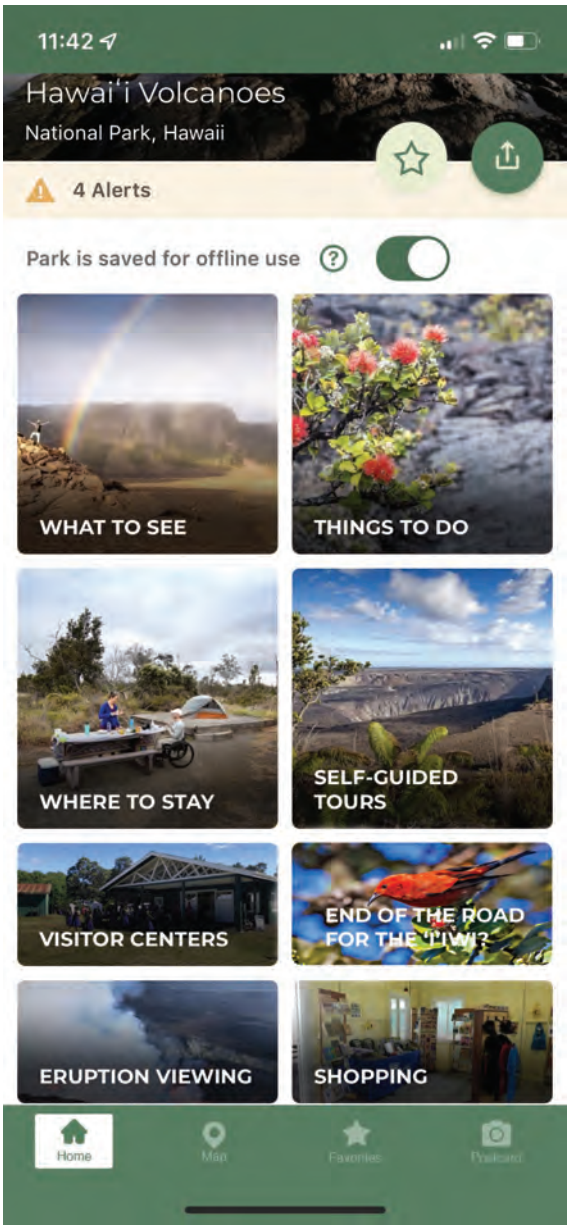
Time lapse of the Pretty Rocks slump, from July 21 to August 25, 2021. In this time, the road displacement was ~6.5 meters (21 feet)
NPS Geology Team

Climate Change as Causal Agent

Based on climate data from 1950 to 2010, Denali National Park has experienced a temperature increase of 7.7°F ± 2.0°F (4.3°C ± 1.1°C) per century, the highest of all national parks (Gonzales, et al, 2018). A recent shift in mean annual temperatures in the area to near 32°F (0°C) (Swanson et al., 2021) combined with heavy rainfall events is believed to be causing permafrost to thaw, resulting in the recent acceleration of many landslides in Denali. In the case of Pretty Rocks Landslide, climate change has likely taken a problem previously solved by minor road repairs and made it difficult to overcome with short-term solutions. Temperature and precipitation increases are likely to continue, and the rate may worsen, over the coming decades.

While these changes were predicted by modelers (Rupp and Loya, 2009), the magnitude of the change has been greater than expected. For example, the area where Eielson Visitor Center is located (Mile 66 [km 106]) reached an average mean annual temperature of 32.4°F (0.2 °C) from 2015-2019 (Sousanes, 2020); this exceeds the temperature of 29.8°F (-1.2°C) projected for 2040 by Rupp and Loya (2009).

PHOTO B.2. Hawai'i Volcanoes National Park : End of the road for the 'I'iwi?



The park is expected to become drier and hotter by the end of the century

Future Climate Change in Hawaii Volcanoes National Park

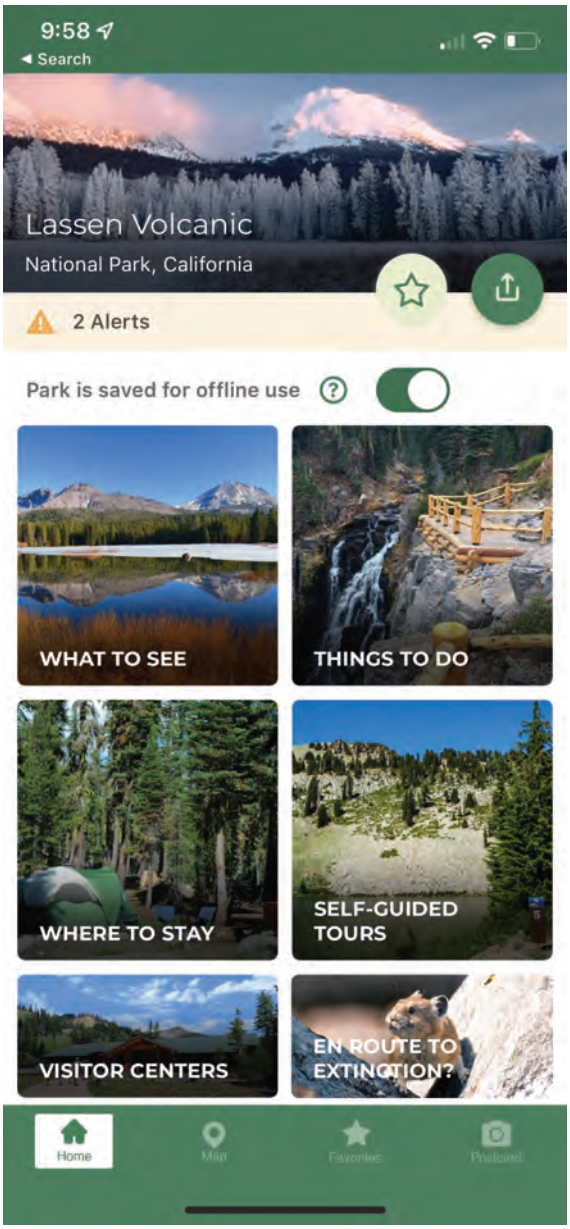
Future rainfall extremes for both the low and high emissions scenarios for Hawai'i Island are shown in Figure 1. For the low emissions scenario, Hawaii Volcanoes National Park (HAVO) is projected to see a moderate, 7% (-4 inch) decline in average annual rainfall by the end of the century. The driest projections are for the windward (eastern) areas of the park. For the high emissions scenario, HAVO is projected to see a 38% (22 inch) reduction in rainfall. In this scenario, pronounced drying is projected for both windward and leeward (western) areas and most pronounced low elevations (<5000 ft) across the park. For temperature (Figure 2), accelerated warming is expected under both future scenarios. For the low emissions scenario, end-of-century average temperatures across the park are projected to be 3.4°F warmer than temperature today. For the high emissions scenario, average temperatures across the park are projected to be 7.1°F warmer. For both scenarios the highest warming rates are projected for the highest elevations. For example at the Mauna Loa unit (~10,000 ft), an additional 4.0°F to 8.6°F of warming is projected under the low and high emissions scenarios respectively.

Figure 3: Picture of the endemic scarlet 'I'iwi in Hawai'i Volcanoes National Park. At present 'i'iwi are restricted to elevations above 5,000 ft where the disease vector mosquito for avian malaria is absent. 'I'iwi are present at low densities relative to most species across the park.
NPS Photo/J Wei

Why is This Important? A Range of Impacts Across the Park

Future changes in temperature and rainfall will undoubtedly affect the plant and animal species that reside in the park. As the climate becomes warmer and drier a range of impacts are expected including dramatic range shifts of native and non-native species, increased wildfire risk, expansion of disease and increased risk of extinction. It is also important to understand that climate change is not just a future scenario, as many of these impacts are being realized today. The primary threat to native Hawaiian forest birds is avian malaria, which is transmitted by the bite of non-native mosquitoes. In the past, low temperatures at high elevations created disease free forest refuges. However, environmental warming allows the mosquitoes to move further upslope thus reducing the area of safe habitat and resulting in population declines. Current climate based population models predict approximately 1/3rd of all Hawaiian honeycreepers will lose more than 90% of their current range by 2080. The iconic 'I'iwi (Figure 3) now only persists in a narrow band of forest between mosquito range and sparsely forested sub-alpine lava flows of Mauna Loa. In the absence of significant intervention, many native Hawaiian species will suffer major population declines or extinction due to increasing risk from avian malaria during the 21st century. Understanding how climate is projected to change is critical to an effective management response that incorporates a wide range of adaptation options to promote healthy ecosystems. Land managers are working to build climate resilient native ecosystems by excluding invasive species, partnering with researchers to investigate strategies for reducing mosquitoes on a landscape scale, seed banking, and restoring rare plant species across the ecological range. Actions such as these, combined with new innovative approaches and working with our partners beyond park boundaries, will increase the potential that our native plants and animals will persist for future generations.

PHOTO B.3. Lassen Volcanic National Park: En route to extinction?



Effects on Wildlife

Changes in wildlife can impact animal habitat and individual species' ability to thrive within the park. Projected increases in fire frequency could expand shrubland and reduce mixed conifer forest, altering habitat for plants and wildlife. Research highlights vulnerabilities to warmer temperatures and increased drought in a number of park animals including owls, frogs, fish, bats, owls, and rodents.

Northern spotted owl (*Strix occidentalis caurina*) habitat could be reduced by potential changes in forest cover due to wildfire, bark beetle infestations, and shifts in flora and fauna within habitats (biome shifts). Field research found that survival of young northern spotted owls in California, Oregon, and Washington was most highly correlated to low winter temperature and precipitation.

The **Cascades frog** (*Rana cascadae*) is highly vulnerable to increased mortality due to drought. Drying ponds and meadows can strand eggs, tadpoles, and adult frogs. Surveys in the park haven't found the Cascades frog since 2008.

Coldwater fish are vulnerable to loss of suitable habitat due to potential warming of streamwaters.

Increasing dryness (aridity) can reduce **bat** reproduction. Their small body size and large surface area puts them at greater risk of dehydration, compared to other mammals.

Increased temperature and precipitation could increase the risk of **plague in rodents** in the park up to 80% by 2050, double the current risk.

Warming temperatures may substantially reduce habitat for **Belding's ground squirrel** (*Urocitellus beldingi*).

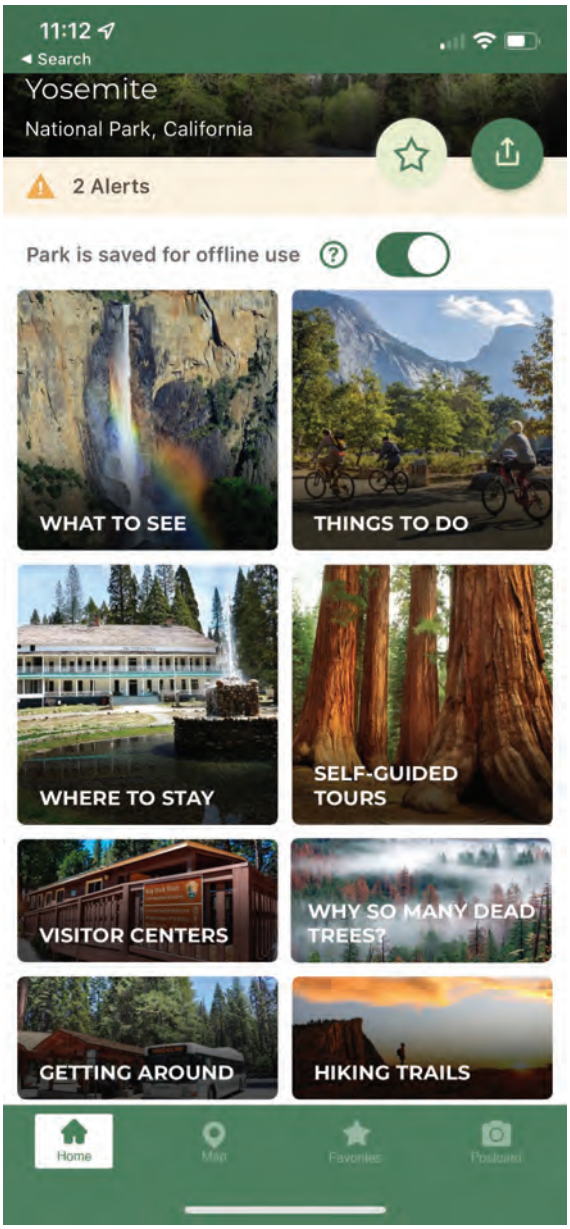
Pikas in Peril?

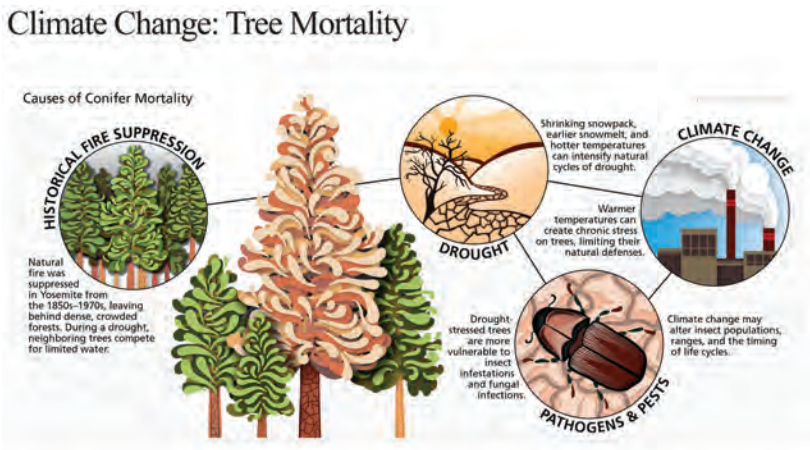
The **American pika (Ochotona princeps)** has a high body temperature and relies on crevices and cavities in rocks to provide cover and cool shade. **Long-term monitoring in 8 national parks** suggests that pika populations will decline and possibly go extinct in several parks by the end of the century as a result of decreasing habitat connectivity, increased temperatures, and altered precipitation.

Surveys in Lassen Volcanic suggest its numerous connected boulder fields and lava flow habitats may offset the stresses of climate change, and allow pikas to persist. Research shows that the number of pika within the park is supported by the arrangement and connection of habitat patches, rather than elevation. Although Lassen Volcanic is predicted to get warmer in the coming decades, models suggest that the population will increase by expanding into nearly all potential habitat (talus and lava). View **results of pika monitoring between 2011-2016 within Lassen Volcanic**.

Top to bottom: A northern spotted owl, a Cascades frog, and an American pika.
Top to bottom: NPS/Wayne Steffes; NPS/ORCA; USFS/Shane Jeffries

PHOTO B.4. Yosemite National Park: Why so many dead trees?





"Traffic, deadlines, health, car trouble…" What things in life causes you stress? For trees in Yosemite, that list might look more like "Water, bugs, disease, and my 100 closest neighbors." California lost 142 million trees between 2012 and 2018 due to the combined impacts of many different stress factors, compounded by climate change. Forest health is particularly significant because growing vegetation serves the crucial role of removing carbon from the atmosphere and storing it in living ecosystems. Rising rates of tree death across the western US decrease the capacity of forests to store carbon, increasing the magnitude of global climate change.

APPENDIX C. SUPPLEMENTARY ANALYSES USING DIFFERENT INCLUSION CRITERIA

Because the choice to include newspapers with only three missing years could be considered arbitrary, we conducted four sets of supplementary analyses with different inclusion criteria—two with more restrictive criteria than those featured in the main text, and two with less restrictive criteria.

We first ran the most restricted analysis where we only included parks with at least one newspaper published each year. Only six parks remained after this restriction (Isle Royale, Lassen Volcanic, Mount Rainier, Sequoia/Kings Canyon, Yellowstone, and Yosemite). A between-subjects ANOVA still supported the hypothesis that climate coverage declined following Trump's election, $F(2, 391) = 5.66$, $p = .004$, partial $\eta^2 = .03$. Post-hoc tests using the Games-Howell method confirmed that there was a greater proportion of climate coverage in 2011–2016 ($M = 50.4\%$, $SD = .50$) than in 2017–2022 ($M = 31.5\%$, $SD = .47$), $p = .006$, $d = .39$. Climate coverage in 2005–2010 ($M = 34.8\%$, $SD = .48$) was also lower than in 2011–2016, $p = .03$, $d = .32$, but did not differ from 2017–2022, $p > .83$.

We then conducted a slightly less restrictive analysis where we included all parks with two or fewer years of missing newspapers. This analysis included the aforementioned six parks along with eight more (Big Bend, Crater Lake, Death Valley, Olympic, Redwood, Rocky Mountain, Voyageurs, and Wrangell-St. Elias). A between-subjects ANOVA still supported the hypothesis that climate coverage declined following Trump's election, $F(2, 579) = 4.40$, $p = .013$, partial $\eta^2 = .02$. Post-hoc tests using the Games-Howell method confirmed that there was a greater proportion of climate coverage in 2011–2016 ($M = 50\%$, $SD = .50$) than in 2017–2022 ($M = 35.2\%$, $SD = .48$), $p = .01$, $d = .30$. Climate coverage in 2005–2010 ($M = 42.9\%$, $SD = .50$) did not differ from either 2011–2016 or 2017–2022, $ps > .27$.

Our third supplementary analysis was less restrictive. In addition to the 17 parks included in the main text—all of which had three or fewer years with missing newspapers—we added three more units designated as national parks that each had four years of missing newspapers (Glacier Bay, Indiana Dunes, and Joshua Tree). A between-subjects ANOVA still supported the hypothesis that climate coverage declined following Trump's election, $F(2, 712) = 5.35$, $p = .005$, partial $\eta^2 = .02$. Post-hoc tests using the Games-Howell method confirmed that there was a greater proportion of climate coverage in 2011–2016 ($M = 51\%$, $SD = .50$) than in 2017–2022 ($M = 36.8\%$, $SD = .48$), $p = .005$, $d = .29$. Climate coverage in 2005–2010 ($M = 40.9\%$, $SD = .49$) did not differ from either 2011–2016 or 2017–2022, $ps > .07$.

Finally, our least restrictive analysis included all parks with six or fewer years of missing newspapers, adding Bryce Canyon, Canyonlands, Carlsbad Caverns/Guadalupe Mountains (treated as a single park for the purposes of this analysis), Grand Teton, and Shenandoah. A between-subjects ANOVA still supported the hypothesis that climate coverage declined following Trump's election, $F(2, 836) = 4.63$, $p = .01$, partial $\eta^2 = .01$. Post-hoc tests using the Games-Howell method confirmed that there was a greater proportion of climate coverage in 2011–2016 ($M = 50.2\%$, $SD = .50$) than in 2017–2022 ($M = 38\%$, $SD = .49$), $p = .01$, $d = .25$. Climate coverage in 2005–2010 ($M = 41.4\%$, $SD = .49$) did not differ from either 2011–2016 or 2017–2022, $ps > .08$.

Across all four of these supplementary analyses, as well as the analysis featured in the main text, the substantive conclusion remains: climate coverage in national park newspapers declined following Trump's election, such that it was featured to a statistically lesser extent in 2017–2022 than it was in 2011–2016. Whether examining six parks publishing newspapers every year since 2005 or 25 parks with less consistent publication schedules, the results appear robust with respect to a variety of inclusion criteria.