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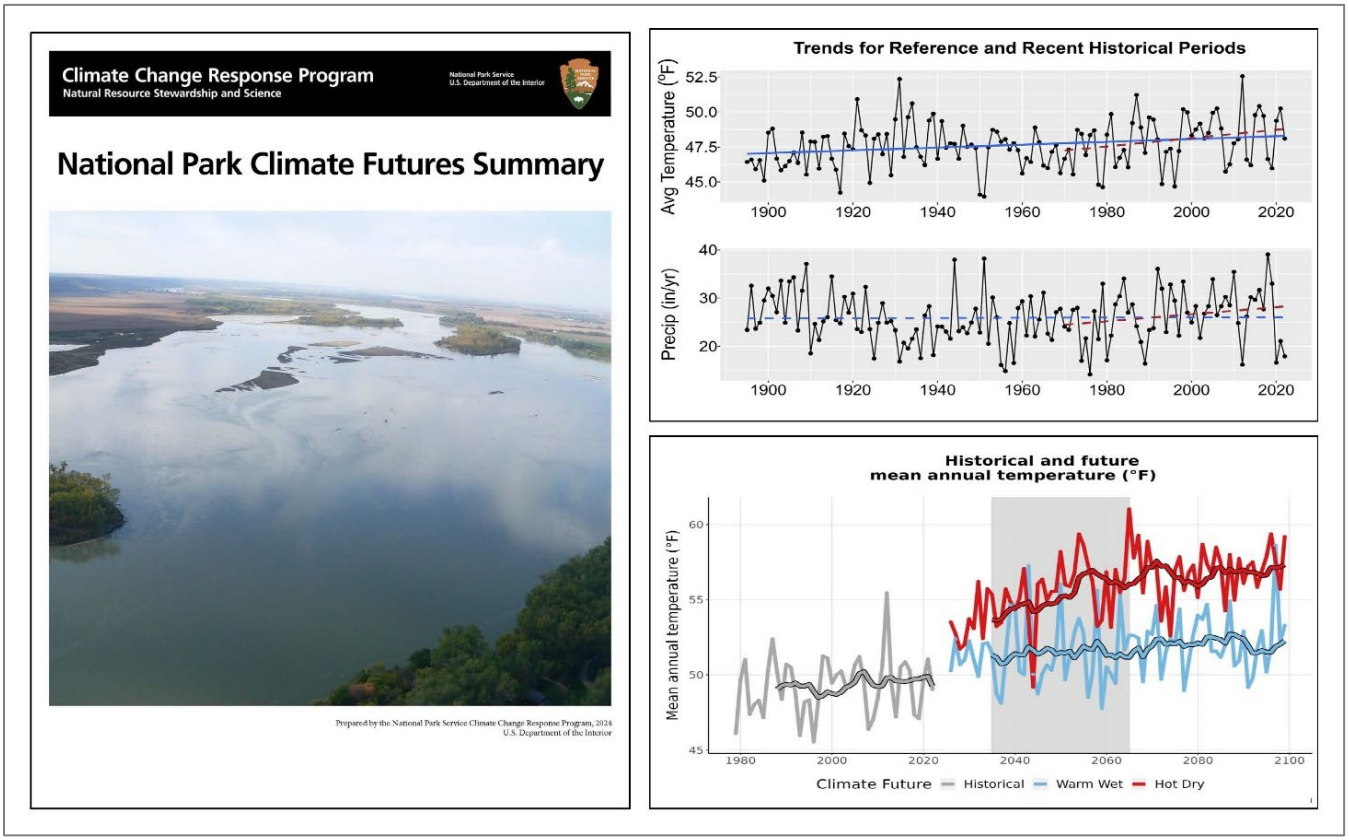
Assessing Park Staff Perceptions and Use of Climate Futures



Example of a Climate Futures Summary document cover and graphs.
NPS

Assessing Park Staff Perceptions and Use of Climate Futures

Science Report NPS/SR—2026/427

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Contents

Abstract

As climate change continues to impact national parks across the country, park staff require resources that identify potential future climate conditions so they can plan and manage despite uncertainty. The National Park Service (NPS) Climate Change Response Program (CCRP) provides parks with downscaled, park-specific, forward-looking climate change information—called climate futures—alongside guidance on using these projections to inform planning and decision making. CCRP staff partnered with social scientists at the University of Colorado Boulder to conduct semi-structured interviews with 24 NPS staff at five different park units actively engaged in planning processes. The goal of the study was to learn what park staff thought about the climate futures information, how they used it for planning, and how CCRP can improve information delivery. Based on interview findings, this report outlines recommendations that CCRP staff and collaborators can incorporate to improve climate futures reports and presentations. The intended audience for this report includes CCRP staff, as well as climate scientists and communications staff across the NPS and our sister agencies in the Department of the Interior and beyond who utilize climate data for planning.

List of Terms

CCRP: Climate Change Response Program

Climate future: A description of the physical attributes of climate that could plausibly occur at a specific place and time in the future. Typically, multiple climate futures are used to consider the range of ways climate could change (NPS 2021a).

CRPS: Cultural Resources Partnerships and Science

NPS: National Park Service

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Introduction

Climate change-related risks are already impacting parks across the country, and park staff require information to make informed management decisions in the face of uncertainty (NPS 2021b). Research shows that decision makers struggle with uncertainty around climate change (Abbott 2005). This holds true for staff within the National Park Service (NPS), who are responsible for navigating changing ecological conditions and uncertainty while safeguarding unique natural and cultural resources.

While uncertainty is an inherent component of planning for the future in parks, climate change increases the degree of uncertainty (i.e., how much is known or unknown about future climate conditions and related impacts on park resources) and makes it more difficult to reduce uncertainty (Walker et al. 2003). Addressing uncertainty in park planning does not mean eliminating it, but gaining confidence making decisions despite it (Brugnach et al. 2008).

The NPS provides guidance and resources for park staff to help them address uncertainty as part of *Planning for a Changing Climate* (NPS 2021b). One fundamental principle of climate-informed planning is examining multiple climate projections and actively considering a range of plausible future conditions. This allows parks staff to explore the implications of a range of future conditions and identify a portfolio of possible adaptation actions. This approach is more robust to the full spectrum of possible climate change impacts than planning for a single, expected future.

To help park staff explore a range of future climate conditions, the NPS Climate Change Response Program (CCRP) provides downscaled, park-specific climate projections, and guidance on how to use them. To compile and synthesize this information—called climate futures—CCRP scientists generate 30+ downscaled climate models for each park. They then select two divergent model outputs that help park staff consider a broad range of future conditions. Climate futures summary documents for NPS units are available here: https://www.nps.gov/subjects/climatechange/climatefutures.htm. For more information about how climate futures are generated, see Runyon et al. (2020) and Lawrence et al. (2021).

In 2024, CCRP released climate futures summary documents for all park units in the contiguous United States and has significantly increased the number of climate futures presentations provided to parks in recent years. With this proliferation of climate futures information, CCRP wanted to identify how to improve climate futures reports and presentations based on what park staff think about the utility of climate futures products.

The goal of this study was to learn what park staff think about climate futures information, how they use it for planning, and how CCRP can improve information delivery. The intended audience for this report includes CCRP staff, as well as climate scientists and communications staff across the NPS and our sister agencies in the Department of the Interior and beyond who also utilize climate data for planning. As CCRP produces climate change information for all 420+ units of the national park system, and partner agencies and organizations are considering providing similar products based on

the NPS model, improving the clarity and utility of climate futures information has the potential to enhance climate-informed planning across a wide range of public land management areas.

CCRP partnered with the University of Colorado Boulder to design a study examining the following research questions:

1. What do park staff think about the format and delivery of climate futures information?
2. Is the content of climate futures information relevant and responsive to park needs?
3. Do park staff perceive climate futures information to be useful for decision making when facing uncertainty about future conditions?
4. What enables or hinders park staff use of climate futures information? What role might emotions play in park staff responses to climate futures information?
5. What barriers exist for climate-informed decision making by park staff?

The following sections of this report outline the study methodology and discuss key findings and associated recommendations for CCRP. Appendix A includes a copy of the interview guides.

Methods

Study Design and Sampling

To answer the research questions, we conducted in-depth, semi-structured interviews to gather qualitative data on NPS staff perspectives. Qualitative methods are appropriate when the research topic is relatively novel (i.e., the development and delivery of park-specific climate futures products released in 2024), and the research goal is to understand people's views on processes (i.e., how information is delivered) and meanings (i.e., how information is understood and used, Hesse-Biber and Leavy 2006). In-depth interviews provide the opportunity for study participants to discuss their perspectives at length and in their own words. Using a semi-structured format allows for flexibility, while simultaneously assuring comparability across interviews as all interviewees are asked the same questions (Hesse-Biber and Leavy 2006). This approach aligns with study aims, namely gathering insights for improving climate futures products, rather than trying to generalize staff perspectives on climate products across the entire NPS.

The sampling procedure for this study combined convenience and purposive sampling approaches. More specifically, the convenience sampling consisted of identifying five NPS units set to receive climate futures products in support of active planning efforts during the study period. Participating units included a national seashore, a national parkway, a national wild and scenic river, a national historic site, and a national monument. Four of the five units were actively developing Resource Stewardship Strategies (RSS), while one unit was working on a Preliminary Project Planning document in preparation for a comprehensive planning effort. Based on this sample, this study is especially valuable for shedding light on staff perceptions at smaller to mid-sized park units dealing with climate change challenges who have fewer staff and resources than larger park units to plan and implement adaptation actions. Within those five units, we utilized purposive sampling to identify and select individual participants from across a range of job types and responsibilities (e.g., superintendents, natural resources staff, cultural resources staff, visitor use staff and facilities staff). Prospective interviewees were identified from the list of park staff participating in the planning effort and were recruited via email. The names of individual parks and interviewees have been removed to protect confidentiality; quotes used in the report are referenced by a number randomly assigned to each interview.

Interview Protocol, Data Collection, and Data Analysis

To assess the utility of climate futures information for decision making (research questions 2–5, as listed at the end of the Introduction), each study participant was interviewed twice, both before and after they received climate futures information (i.e., before and after the climate futures presentation by CCRP staff). This allowed us to assess what park staff hoped to get out of the information and how they planned to use it, as well as what park staff thought about the information once it had been delivered, and whether they were able to use it in an active planning process. We interviewed twenty-four staff across the five parks, for a total of 47 interviews (one participant was only available for a post-interview). Interviews were conducted on a virtual meeting platform, Microsoft Teams, between summer of 2023 and spring of 2024 and averaged one hour in length. The study design, including

sampling procedure and interview protocol, were independently reviewed and approved by social scientists at the US Geological Survey and the University of Colorado, Boulder, as well as the University of Colorado's Institutional Review Board (University of Colorado IRB Protocol Approval #23-0323).

For all five parks, CCRP staff provided climate futures information in the form of a PowerPoint presentation delivered virtually via Microsoft Teams. However, the information shared with parks differed slightly across two rounds of data collection. Staff at the first three participating parks only received information via a PowerPoint presentation over Teams. Interviewees in the remaining two parks also received a climate futures summary document to accompany the presentation. CCRP staff provided the summary document via email after the presentation for one park and before the presentation for another park. Our interview protocol included questions for these two parks about perceived usefulness of the summary documents and the optimal timing for their delivery.

For all interviewees across both rounds of data collection, the first interview asked about current and past use of climate change information, comfort with finding and interpreting climate change data, climate information needs and challenges, and barriers to incorporating climate change into planning and decision making. The second interview probed study participants' perceived usefulness of the climate futures information and how it was presented, how they envisioned using the information for decision making, and any remaining information needs and barriers. Copies of both interview guides can be found in Appendix A. In both interviews, we asked study participants the same series of questions about their emotions surrounding climate change at the park, and whether the climate futures information influenced these emotions. We also asked interviewees about perceived risks from climate change, and how much complexity they think climate change adds to their role.

The first author conducted and recorded all interviews via Microsoft Teams, transcribed them using *Rev* speech recognition software, and manually cleaned them for accuracy. The first author then coded transcripts using *NVivo* (version 14) qualitative data analysis software, with regular input from the second author, through a combination of inductive and deductive codes that identified and sorted key themes.

We include representative quotes from the interviews throughout the report to help illustrate key findings, and focus on findings that pertain across multiple parks unless otherwise noted.

Key Findings and Recommendations

This section highlights key insights from the data collection and analysis. The five numbered subsections below directly correspond with the five research questions described in the Introduction above. Each finding consists of a summary statement (numbered to correspond to the research question, i.e., Finding 1.2 is the second finding for the first research question), a narrative description, one or more illustrative quotes from the interviews, and a corresponding set of recommendations for improving climate futures.

Section 1: Climate Futures Format and Delivery

Finding 1.1: Overall, Park Staff Responded Well to the Combination of the Climate Futures Presentation and Summary Document and Preferred Receiving the Summary Document After the Presentation.

Park staff universally appreciated CCRP staff providing climate futures information, and also preferred the information being shared as *both* a presentation and summary document. One interviewee noted,

> *Whenever I've received information like this and just saw it in its format with no context around it, it was very hard for me to digest. And so to have someone who did the research who can read and digest and understand that information and then bring it to the team in layman's terms was very, very useful. (Interviewee 20)*

Staff from the three parks who did not receive a summary document in conjunction with the presentation mentioned they were not sure where to go to find and review the information shared, or how to access it again in the future. Some staff suggested that this might pose a barrier to their future use of climate futures information.

Staff at the park who received a climate futures summary document after their presentation responded very positively to this format. Staff appreciated having a document that summarized the information from the presentation and knowing that they could reference this document moving forward. All staff at this park knew that the summary document existed and most had taken the time to review the document after the presentation. One interviewee stated,

> *I liked the format, the way it was given, and even more so probably the information afterwards … I think for me personally, I liked the way it was presented because it raised questions that I wouldn't even have thought about and it helped me look at the summary document probably in different ways than I would've, had I had that document to begin with … I think there would have been [points of confusion] had I had it before [the presentation]. (Interviewee 16)*

Conversely, comments from staff at the park who received the summary document *before* the presentation suggest that this approach was not as helpful. More specifically, most staff had not reviewed the document at the time of the 2nd interview (after the presentation) and several did not

remember receiving the document or did not know it existed. In other words, receiving the climate futures summary document ahead of time may make it less likely that staff utilize it as a reference.

Recommendations:

- Continue to provide climate futures presentations and summary documents—park staff get more out of climate futures when they receive both formats
- Share summary documents with park staff after presentations

Finding 1.2: Park Staff Responded Positively to CCRP Staff and the Climate Futures Presentations. However, Park Staff Also Found the Presentations Too Dense and Technical.

Overall, park staff perceived the CCRP staff who gave the climate futures presentations very positively. Interviewees reported that the presenters had good communication skills, were highly knowledgeable, and spoke with expertise about the climate futures information. However, park staff also reported that the presentations were too dense and technical. One interviewee described the presentation as "information overload" (Interviewee 15). Another interviewee stated, "the speakers were really good and they were trying to not be so robotic which is nice. So they did bring in a little bit of human interactions, but it is a lot of information" (Interviewee 22).

Several interviewees indicated that the amount and technicality of the information posed a barrier to their ability to take it all in and grasp key messages. Interviewees mentioned not understanding how the information was relevant to them and their roles. One interviewee said, "I don't doubt the person's knowledge base. But there were times when I wasn't sure what key message I was supposed to receive" (Interviewee 5). An interviewee stated, "I think there was a little too much of the numbers. It was pretty hard to understand, well, what does that really mean? … after about five minutes of that I was kind of like [makes gesture of information going over head]" (Interviewee 14). Another interviewee offered the following suggestion for improving the digestibility of the presentations:

> *We live in the short attention span era … So I think it would be good to have breaks, not breaks, but participant engagement slides every 10 slides or just stop and open for a question. That [would have been] helpful. (Interviewee 8)*

Given that park staff consistently found the presentations challenging to track and digest, it could be beneficial to build in more discussion breaks and ensure that park staff are clear on key points and takeaways. Many of the findings and recommendations that follow relate to this overall sense that the presentations contain too much information.

Recommendations:

- Cut back on the quantity and technicality of the information shared in climate futures presentations
- Focus on key messages and use park examples that highlight relevance
- Build in more time for interaction and discussion with park staff to keep them engaged

- Consider using the climate futures presentation as a conversation with park staff and then share the bulk of the technical figures in the summary document

Section 2: Climate Futures Content

Finding 2.1: Park Staff Were Consistently and Pleasantly Surprised by the Geographic Scale and Specificity of the Climate Futures Information.

Park staff found the climate futures information to be at a finer spatial scale than they were expecting, and were pleasantly surprised by how specific the data was to their park. When asked what was memorable about the presentation, one interviewee stated, "The small size of the grids I thought was impressive. I honestly thought going in that it was all going to be data based outside of [park name] or just the bigger area" (Interviewee 11). Another interviewee stated,

> *I think he had actually gotten a lot more data relevant to our area than I thought would be in the presentation. I thought it would be a little more generic, but he actually had gotten quite a bit of information about our specific area, if not the park, at least our general area. So that was really helpful. (Interviewee 21)*

Recommendation:

- Continue to highlight that climate futures are park specific. This was perceived as one of the greatest benefits of the climate futures information compared to publicly available data and projections

Finding 2.2: Park Staff Struggled to Understand the Climate Futures Methodology, Specifically How the Projections Were Generated and Chosen.

Despite CCRP staff consistently explaining how climate futures are generated, some park staff struggled to understand, and therefore trust, the methodology. This lack of understanding applied to how the projections were generated, how the two scenarios were selected, and whether one scenario was supposed to be "better" than the other. One interviewee stated, "I was also thinking at the same time that how can we really predict that? So I don't know that it was explained enough that I was like, 'Oh yeah, I totally get it, it makes sense.' I think it was a little fuzzy on that part" (Interviewee 14). One interviewee misunderstood the purpose of using divergent scenarios and was instead looking for a "most likely" scenario, stating, "Looking at the scatterplot … there were seven models that identified it was going to get hot and dry, warm and dry. And there were, if I remember right, eight models that predicted it was going to be warm and wet. And so eight is better than seven" (Interviewee 16).

At one park, several interviewees expressed concerns about the grid cell used to generate the projections. One interviewee explained this, stating,

> *And then also a sticking point with me, with the data, was they only took one little snippet and ran the models … but since we are such a long linear park, our weather in [place name] can be very different than the weather by [place name] … And so I struggled with that. (Interviewee 11)*

CCRP might expect similar questions and concerns from large parks, linear parks like national rivers and trails, and parks with multiple, geographically dispersed units.

Recommendations:

- Emphasize that climate futures tell us what might happen, not what will happen, and explain how considering divergent climate futures helps address uncertainty about how future conditions might play out
- Consider incorporating narrative building and/or creative naming of the climate futures to help park staff understand they are the basis for building divergent scenarios of how the climate might change
- Be prepared to explain why climate projections for an entire park are based on a single climate grid cell, discuss benefits and drawbacks to this approach, and potentially help park staff access additional projections if needed

Finding 2.3: Acceptance and Use of Different Climate Futures Hinges in Part on How Well Projections Align with Lived Experiences at the Park.

The default climate futures output presentations and summary documents differentiate between projections using a standardized naming convention meant to contrast between the two projections. That naming convention most often contrasts a "Hot Dry" projection with a "Warm Wet" projection. Importantly, the names of the projections are meant to contrast with one another, not current climate conditions. When discussing the "Hot Dry" and "Warm Wet" scenarios, staff often noted whether or not these projections aligned with their lived experiences and anecdotal observations. Acceptance, trust, and use of the scenarios appeared to rely in part on how well the scenarios aligned with staff experiences and observations. Some staff found it validating when the scenarios aligned with conditions they had experienced. One interviewee stated,

> *I think what sticks out in my brain is when he was showing us all of the graphs and there was a lot of different ones, but when he was kind of summarizing what the recent data has shown, it is very much of like a, oh yeah, that's what I see around here too … So the data that he was showing definitely reinforced in my head of like, oh yeah, I wasn't just crazy thinking that five years ago was a lot more rainy. (Interviewee 23)*

Conversely, staff questioned climate futures that did not align with what they have seen at the park. One interviewee stated, "It just was a little [much] to wrap my head around imagining this area—instead of being a wet hot, be a dry, like the area drying out" (Interviewee 9).

Staff acceptance of a given climate future also influenced how they indicated they would use the information. For example, when asked if they would use both the "Hot Dry" and "Warm Wet" climate futures for a planning decision, multiple interviewees said that they would pick the projection that aligns more closely with their observations and experiences. One interviewee said they would pick the "Hot Dry" projection because, "based on my observations in the last year-and-a-half, and in talking with the staff, it seems to be trending more towards the "Hot Dry'" (Interviewee 16). Another

interviewee from a different park said that they would pick the "Warm Wet" projection because, "it's always consistently been humid" (Interviewee 4).

Recommendations:

- Emphasize during the presentation that the naming of the projections is relative to the other projections (e.g., the "Hot Dry" climate future just means that the future will look hotter and drier compared to other projections, not that the area is expected to "dry out")
- Consider asking park staff how the projections do or do not align with their own observations; this could be an entry point to discuss why projected conditions may vary from lived experiences, but should still be taken seriously

Section 3: Climate Futures Utility

Finding 3.1: Park Staff Thought of a Variety of Uses for Climate Futures Information, Ranging from Specific and Near-Term Uses to Hypothetical Future Uses.

Overall, park staff responded positively when asked if they thought they would use the climate futures information in park planning and decision making. When asked how they envision using climate futures information, many park staff did not have specific, near-term uses in mind, or even uses related to the planning effort in which they were currently engaged. Rather, they discussed more general uses. For example, one interviewee thought they would use the information to help justify taking certain management actions in the future, stating,

> *When I need to back up a concern or a reason why I'm like, we should do it this way or we need to enact these measures because of our concerns of climate change. And when someone's like, 'why?', I am like, 'because of this data that was presented to us,' that is when I would [use] it. (Interviewee 9)*

Relatedly, staff at a different park stated that the climate futures information can aid their general management of historic resources at the park but did not have a specific example or use case to share.

Some park staff did identify specific uses of the information. Staff at one park brought up decisions around siting and developing new trails as well as the maintenance of existing trails and park infrastructure. For example, one interviewee from that park discussed how the information can help address questions related to both new and existing infrastructure, stating,

> *What are those effects [of extreme precipitation] going to be on park infrastructure? How is that going to affect what we already have and our maintenance of it? Or do we really want to build more things in a certain way if maybe similar things in that area aren't doing well already, why are we going to add more that we're just going to have to maintain? … We know right now our [collections] building has all sorts of issues because it's a retrofitted old building. But how is that going to play into it when our environment outside is potentially going to be more humid and we need to be controlling temperature and relative humidity in our collection space? Because that's what we're legally obligated to try to do, to protect the things that we have in the collection. (Interviewee 23)*

At another park, one staff member stated that they would use the information for the ongoing rehabilitation of the heating and cooling systems in a historic structure.

Several parks also discussed using the climate futures information for communication with park visitors and the public. Interviewees at one park said they see themselves incorporating the climate futures information into interpretive programming around climate change and flooding in a highly visited but flood-prone area. One interpretive staff member at another park stated that they plan to use the climate futures when adding information to the park's public website.

Recommendations:

- Provide guidance, as needed, for using climate futures information in the context of specific planning efforts
- Ask park staff and planners if they need help using climate futures information in the context of the specific planning effort that they are undertaking (e.g., an RSS or Preliminary Project Planning)
- Consider asking during the climate futures presentation how park staff see themselves using the information
- If parks are planning to use climate futures for communication with the public, ask if they need assistance preparing information for external audiences, and potentially recommend they connect with the CCRP communications team

Finding 3.2: Park Staff Wanted More Information Connecting Climate Futures to Park-Specific Resources and Decisions.

While park staff found the climate futures information useful, many stated that they hoped to receive more information and guidance on tying the projection data to specific park resources and decisions. The largely generic examples of uses of the information provided by park staff (Finding 3.1 above) may be a reflection of these unmet needs. When asked if they found the information useful, one interviewee responded, "I think it's relevant in creating a mindset of digging in, that looking at this type of information in the future is important … currently in its format, it's good in reminding people to think about these kinds of things … But I think for specifics, it wouldn't be as helpful" (Interviewee 20). Another interviewee at a different park expressed a similar thought, stating that they would have appreciated more information applying the projection data to on-the-ground park decisions:

> *How do we then use this in our management decisions and in our planning process? He's just presenting, here's the data that we see, here's the graphs. So maybe some practical examples of how maybe other parks or other places have thought of, we're going to be dealing with a lot more downpours and wetter years. What is that landscape impact to a place that has trails and a place that has visitor interactions? … maybe some of those kind of scenario examples of how do we use that data when we're talking about project planning? (Interviewee 23)*

Another interviewee struggled with the divergent nature of the two selected scenarios and was unsure what to do with the information. This individual stated, "The scenarios that were outlined for [park name] were two very different scenarios. One that was drought and one that was a lot of rain. And so I think going deeper into how do you plan for two polar opposite options would be very helpful" (Interviewee 20).

When asked about remaining information needs after receiving the climate futures information, many park staff highlighted questions or needs that apply the projection data to park resources and decisions. Examples of unanswered questions included:

> *Should we put in effort trying to restore oak savannah given projected future climate conditions?*
>
> *Should we continue our removal of red cedar and ash trees?*
>
> *What will mulberry tree health look like under these scenarios?*
>
> *What do these projections mean for our diminishing water table?*
>
> *Will climate change disrupt bat birthing schedules at the park?*
>
> *What is an appropriate level of risk to accept for infrastructure and building decisions?*

These unanswered questions indicate that park staff are still in need of guidance and information that connects climate futures to park resources and decisions. One interviewee shared the following suggestion for how to better address these questions during climate futures presentations:

> *There was a great portion of the presentation where field staff who were onsite could have a chance to identify issues that they thought would be issues in the future, current issues and issues that they thought would occur in the future. I think it might be more useful to ask that question beforehand. And then those specific scenarios that are on the minds of the staff onsite can be addressed in the presentation. I think if it would've been known by the presenters beforehand, that [the water table] is a really concerning issue, then that could have been something that they looked into and addressed specifically in the presentation. (Interviewee 20)*

Findings 3.3 and 3.4 below build off this general desire by park staff for more information about how climate futures could inform planning and decision-making.

<u>Recommendations:</u>

- Share relevant examples of applying projection data to management decisions at other parks that may be facing similar questions or decisions
- If time allows, ask before or during the climate futures presentation about specific park needs and questions and seek to apply climate futures information to these needs

Finding 3.3: Some Cultural Resources Staff Struggled to Connect Climate Futures Information to Their Work.

Some cultural resources staff (across multiple parks) struggled to connect climate change and climate-related risks to cultural and historic resources. One staff member, when asked how they see themselves using the climate futures information, stated, "I think part of it is just understanding the ecological side of it, where I'm cultural, so that's what I know" (Interviewee 22). This individual perceived the information to be relevant to the "ecological side" of park management, but did not connect the information to their role overseeing cultural resources.

Other cultural resources staff did see the relevance of climate futures information to their work, but did not think that the presentation contained enough information tailored to the kinds of resources they manage. One such interviewee stated,

> *What about me? … I was of course looking at this through the lens of, okay, so how is this all going to affect cultural resources? And I felt like in the presentation it was very obvious this was how climate change would affect our natural resources, but the cultural resource aspect was less discussed. And I mean, I could review all this and obviously if I really think it through, I could then come to some conclusions about, okay, so if this happens, then this, then this, and here's how it'll affect the historic house in my park or whatever. But I think it would've been helpful to touch on the cultural resources side a little bit too … just give a few examples. (Interviewee 6)*

Recommendations:

- More explicitly connect climate futures information to cultural resources management; this could include sharing examples of how other parks have used climate futures to inform cultural resources planning and management
- Connect park staff with Cultural Resources Partnerships and Science (CRPS) climate change experts and resources as needed

Finding 3.4: Park Staff Hoped Climate Futures Information Would Include More Guidance for Decision Making by Suggesting Specific Actions to Take and When.

Several park staff expressed, both before and after the climate futures presentation, that they hoped the information would tell them what specific management actions to take and when. One interviewee stated, "I was looking for more of the 'pull the trigger' type document. This is more of the justification to pull the trigger document" (Interviewee 18). When asked to elaborate on what they meant by "pull the trigger," this individual explained that they were looking for specific management recommendations tied to specific climate conditions. They provided an example, stating, "If we hit this many days in a row of hot weather, we've got to start considering instead of replacing with wood shingles, maybe replace with some type of other manmade material that can take the longer cycles of heat, that kind of stuff" (Interviewee 18). Another interviewee stated that they were hoping to receive "a roadmap of sorts" that could "help us decide where we need to focus our efforts. And are we hitting the mark? Are we missing the mark?" (Interviewee 14).

Recommendation:

- Continue to emphasize in presentations that climate futures provide information about how the climate might change in the future (i.e., climate exposure), but that park staff will have to use their expertise to determine how climate change will impact focal resources and assets (i.e., climate sensitivity and vulnerability)

Section 4: Climate Futures Emotions

Finding 4.1: Generally, Climate Futures Information Increased Park Staff Perceptions of Risk and Complexity.

Park staff were asked both before and after climate futures presentations what level of risk climate change poses for their park. They were also asked how much complexity climate change adds to their work. Staff perceived greater climate risk and job complexity after climate futures presentations. When asked to explain why risk perceptions increased after the presentation, one interviewee stated,

> *Talking through not only the scenarios of how different the climate could look in the future, but also just talking about current planning challenges and current concerns around the changing climate. Having those conversations opened my mind up a little bit more to what was happening. (Interviewee 20)*

When asked how climate futures information made them feel, some park staff indicated the information *increased* hopefulness because it made them aware of new information and ongoing efforts within the National Park Service to address climate change.

For the majority of interviewees, however, climate futures information contributed to feelings of hopelessness, overwhelm and/or depression. When explaining why, one interviewee stated, "I feel a little less hopeful now that I know the fuller range of impacts to the park. I'll say the presentation was helpful as a reality check, but it was kind of a depressing reality check if I'm being honest" (Interviewee 6). One interviewee stated that the presentation brought on feelings of dread and a lack of control over large-scale mitigation actions, which made them think "why bother" with doing anything at all (Interviewee 21). This sentiment represents a key difference between interviewees—some felt depressed and also felt a lack of agency in their ability to make a difference, while others felt depressed but maintained a sense of agency at the individual or park level. Another interviewee explained why they felt depressed, but also a sense of agency:

> *What about the presentation stood out? It was depressing. That was kind of my takeaway from the whole thing. It's hopeless and depressing to think about where things can be headed and what we can do about it. We're basically in a role where we can only respond to what's going to happen. But … we have the ability to help educate people about things that we can do to mitigate some of these issues just by what we do in our everyday life and our practices. So yeah, I'm hopeful that we can help educate people, but it certainly felt depressing watching the whole thing because I was just like, wow, this is the doomsday kind of feel going through that. (Interviewee 14)*

Another interviewee at the same park shared similar sentiments about the presentation being depressing, while also emphasizing the importance of focusing on what parks can do:

> *I was kind of a little bit depressed afterwards … I think maybe if the presentation kind of had a tone of there's still agency that we can have, not necessarily having hope for the sake of having hope, because that might be a little bit preachy or you might roll your eyes at it. But I think really emphasizing that the park can't control climate change, but we have a fair amount of agency to influence what ultimately happens. … And I think that might make people feel a little bit more empowered. (Interviewee 13)*

Recommendation:

- Help park staff retain a sense of agency to adapt to climate change; strive to integrate positive messaging, when possible, and include case studies and success stories

Section 5: Barriers to Use of Climate Change Information

Finding 5.1: Park Staff Face a Number of Other Barriers That Hinder Climate Change-Informed Planning and Decision Making.

Park staff mentioned a number of barriers, unrelated to the climate futures presentation, that hinder climate-informed planning and decision making. These barriers represent other key considerations park staff must navigate in addition to scientific uncertainty.

First, staff repeatedly brought up the institutional challenges of staff shortages and turnover. Interviewees mentioned staff shortages specifically as a barrier to *proactively* addressing climate risks. One interviewee explained that, "[A challenge is] having the capacity to plan. And it comes down to staffing. We are short staffed, and when you're short staffed, it's hard to plan … We want to plan these things, but sometimes we're forced to be more reactionary" (Interviewee 1). Other park staff noted they had not been at the park long enough to know if climate change had been incorporated into prior management decisions. This lack of institutional knowledge made it challenging to pursue long-term climate adaptation. This was described by one interviewee as "a big consistency problem" (Interviewee 20). Another interviewee stated,

> *I definitely would say with the changeover of management … If you don't have long-term staff or if you're acting staff, that can be difficult because they're not going to want to make most of [those decisions]. Most people don't want to make long-term decisions for a place they're not going to be forever. (Interviewee 9)*

Staffing was correlated with interviewee emotions. Staffing shortages were frequently mentioned to explain why park staff did not feel hopeful. Conversely, park staff cited their team or colleagues as a primary reason for feeling hopeful. One interviewee stated, "What I know about government employees … is that they're good at what they do and they're confident and professional and know how to evaluate, assess, analyze, adapt, and overcome" (Interviewee 3).

Other related challenges included broader politics and policy decisions that affect parks. Park staff noted that funding and staffing challenges can be exacerbated by shifting federal policies and budgets, which are outside of NPS control. Shifts in political and budgetary priorities—coupled with existing challenges due to staff turnover—can hinder long-term action. One interviewee stated, "being able to have the governmental continuity to bear the resources required to do those kinds of things probably isn't going to be strong if we look at the big picture over longer time spans" (Interviewee 13). This challenge also influenced whether or not park staff felt a sense of agency. This same interviewee went on to say, "I just know that the park has limited agency to act on this big topic that is climate change" (Interviewee 13).

Staff at several parks also mentioned challenges associated with coordinating with neighbors both inside and outside of government. Many parks overlap a variety of jurisdictions and share boundaries and management responsibilities with a number of entities. For example, the national wild and scenic river unit and national parkway unit both traverse multiple states and require significant coordination with other federal agencies and tribal partners. One interviewee explained this dynamic, stating,

> *We [manage across] two states, and so we have our federal regulations, but then we also have the state regulations. And both those states have different rules … And then the water levels are so dependent on what the [other federal agency] wants to do, and that is completely out of our control. (Interviewee 11)*

Park staff indicated that coordination challenges across jurisdictions can exacerbate a sense of futility. When asked why, one interviewee responded:

> *I'm probably more of a pessimist … And it has to do with, oddly enough, it doesn't have to do with climate change in and of itself, it has to do with the disparate interests of competing jurisdictions. And that creates probably the likelihood of outcomes that may or may not be to the benefit of the park. (Interviewee 5)*

This also impacted whether park staff felt a sense of agency. Several interviewees mentioned feeling uncertain about what they could realistically do at the scale of their park. When asked if any actions were being taken to address reduced water levels at one park, a staff member stated, "We own one mile of the river, how could we?" (Interviewee 17).

<u>Recommendations:</u>

- Remember that scientific uncertainty is just one of the challenges park staff face when planning for climate change; help park staff consider climate information within the context of other park priorities, challenges, and characteristics
- Consider asking whether park staff perceive barriers to acting on climate change information and discuss ways to take action within the context of these challenges

Study Limitations and Future Research Opportunities

While providing useful insights into park staff perceptions of climate futures information, there are some study limitations worth noting. First, we utilized a convenience sample of parks based on which parks received climate futures presentations and reports during the study period. The parks do represent different types of units (a national seashore, a historic site, a national monument, a national river, and a national parkway) and come from three different NPS regions, but are not representative of all units within the broader national park system. Specifically, this sample did not include any units with a National Park designation. That said, only 63 of over 430 NPS units have been designated as National Parks. Therefore, other types of units represent a large proportion of the national park system. This suggests focusing on the perceptions of staff at other types of park units who are dealing with the same climate challenges as National Parks, but may have fewer resources, is a worthwhile endeavor as these units may need more support in understanding and utilizing climate information.

Interviewees came from a variety of roles within parks (including leadership, natural resources, cultural resources, facilities, interpretation, and planning), however the sample is not representative of all NPS job series. Furthermore, the number of interviewees and their roles varied across parks based on the number and availability of staff at a given park. In addition, four of the five parks were working on the same plan type, a Resource Stewardship Strategy. Interviews with park staff engaged in different types of planning efforts may have yielded different insights into the utility of climate futures information.

As such, future studies could include different types of parks, parks from additional regions, and parks working on different plan types. Future research could seek perspectives from park staff in different job series who may have different insights into whether climate futures information is accessible and useful. Since this study asked participants about the utility of climate futures information within a few weeks of receiving it, future research could also follow-up to assess whether and how climate futures information was ultimately included in final plans and/or whether adaptation actions were implemented. Follow-up research could provide useful insights into how CCRP can better support parks to ensure that sharing climate futures information translates into actual climate-informed plans.

Finally, in the context of park management in an era of climate change, scientific uncertainty is only one aspect of a manager's decision space, which also includes other internal (e.g., worldviews, culture) and external (e.g., institutional context, social feasibility) factors (Clifford et al. 2022). Interviewees in this study indicated that these other factors are also relevant to their ability to incorporate climate change into park decision-making. Future research could dig deeper into the institutional context and social feasibility aspects of climate adaptation planning in particular.

Conclusion and Summary of Recommendations

This study examined what park staff think about the content, format and delivery of climate futures information. It also explored whether and how staff intended to use climate information in planning and decisions, and identified potential barriers to effectively incorporating climate change into planning. Finally, this study highlighted how climate futures interact with emotions and other challenges park staff encounter when planning for climate change.

The recommendations that follow fall into two categories: practices that CCRP is doing well and should continue; and practices that CCRP could improve in the future. In the former category, CCRP should continue to provide park-specific climate futures, continue to participate in planning processes, and continue to provide examples of effective adaptation planning and action. These were all practices that park staff found helpful.

In the latter category of areas for improvement, CCRP could consider ways to simplify presentations and help park staff view climate futures as projections of what *might* happen, not predictions of what *will* happen. CCRP could focus more on a few key graphs in presentations, and include additional figures in summary documents.

If CCRP can cultivate better understanding of, and trust in, climate futures information, park staff are more likely to use it in planning processes. CCRP could also try to better connect climate futures to specific park characteristics and resources and provide case studies from similar parks.

Finally, climate change can be an emotional topic for park staff to discuss, particularly because it interacts with other challenges like park staffing in ways that can lead to a sense of futility. To address this, CCRP could focus on communicating climate change information in ways that encourage agency. One approach could be sharing case studies and success stories from other parks. CCRP could also acknowledge that barriers other than scientific uncertainty and a lack of climate information pose serious challenges to adaptation, and work with park staff to focus on actions within their control.

Recommended Practices to Continue

- **Continue to provide climate futures presentations and summary documents:** park staff get more out of climate futures when they receive both formats; share summary documents with park staff after presentations
- **Continue to highlight that climate futures are park specific:** this was perceived as one of the greatest benefits of the climate futures information compared to publicly available data and projections
- **Continue to explain that the naming of climate futures is relative to the other scenarios, not the present:** consider asking park staff how the projections do or do not align with their own observations

- **Continue to explain that climate futures provide information about how the climate might change in the future (i.e., climate exposure), but that park staff will have to use their expertise to determine how climate change will impact focal resources and assets (i.e., climate sensitivity and vulnerability):** provide examples of adaptation actions implemented by other parks, ideally dealing with similar resources and climate impacts
- **Continue to share relevant examples of applying projection data to management decisions at other parks:** if time allows, ask before or during the climate futures presentation about specific needs and questions and seek to apply the climate futures information to these needs

Recommended Practices to Improve

- **Cut back on the quantity and technicality of the information shared in climate futures presentations:** focus on key messages and use cases that highlight relevance
- **Build in time for interaction and discussion with park staff to keep them engaged:** consider using the climate futures presentation as a conversation with park staff and share additional figures and tables in summary documents
- **Emphasize that climate futures tell us what might happen, not what will happen:** explain how considering divergent climate futures helps address uncertainty about how future conditions might play out
- **Consider incorporating narrative building and/or creative naming of the climate futures:** this may help park staff understand they are the basis for building divergent scenarios
- **Be prepared to explain why climate projections for an entire park are based on a single climate grid cell:** be ready to discuss benefits and drawbacks to this approach, and help park staff access additional projections if needed
- **Consider asking park staff how the projections do or do not align with their own observations:** this could be an entry point to discuss why projected conditions may vary from lived experiences, but should still be taken seriously
- **Ensure that park staff know how to use climate futures information in the context of their specific planning effort:** consider asking during the climate futures presentation how park staff see themselves using the information; if parks are planning to use climate futures for communication with the public, recommend they connect with the CCRP communications team
- **More explicitly connect climate futures information to cultural resource management:** this could include sharing Cultural Resources Partnerships and Science (CRPS) resources
- **Help park staff retain a sense of agency to adapt to climate change:** strive to integrate positive messaging, when possible, and include success stories
- **Remember that scientific uncertainty is just one of the challenges park staff face:** help park staff consider climate information within the context of other park priorities, challenges,

and characteristics; consider asking whether park staff perceive barriers to acting on climate change information and discuss ways to take action

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Appendix A: Interview Guides

PRE Interview

Role Questions

What is your job title?

What does your role entail?

What types of decisions do you have to make in this role?

Decision Questions

What is your role in the planning/decision process the park is working on right now?

Why is the park working on this plan/decision? What do you hope to accomplish?

Where are you in the planning/decision-making process? What comes next?

Perceptions of the Environmental System and Climate-Related Risks, Past Information and Knowledge Use

On a scale of 1–5 how much of a risk do you think climate change poses to [park]?

- Add if needed: 50-year time horizon, 1 means no risk and 5 means catastrophic risk
- What makes you say [number]?

How have you seen [park] be affected by the impacts of climate change?

- Probe: What impacts/hazards?
- Is work happening to address these impacts?
- What cultural/natural/built resources are most at risk?

Has climate change affected previous decisions and management at the park?

- What kinds of decisions?

Have previous planning efforts used climate change data or resources?

- What data or resources have you used?
- Were you successful in incorporating this information?
- What about them was useful / not useful?
- Have you received any climate model information?
- When? In what format?

On a scale of 1–5 how hopeful do you feel about the future at [park]?

- Add if needed: 50-year time horizon, 1 means no hope and 5 means extremely hopeful
- What makes you say [number]?

Planning Behaviors and Beliefs

On a scale of 1–5, how much complexity do you think climate change adds, or will add, to your work?

- Add if needed: 50-year time horizon, 1 means no complexity and 5 means extreme complexity
- What makes you say [number]?
- What are some of the challenges to understanding and addressing climate change?
- Is uncertainty due to climate change a challenge you encounter?
- How have you addressed uncertainty when it comes to climate change? What might help you address it better?

Do you face other barriers, such as budget, time or lack of institutional support, in incorporating climate change into park plans and decisions?

How are your role or responsibilities changing due to climate change?

On a scale of 1–5, how confident are you that the actions the park takes will effectively enable the natural/cultural/built resources of [park] to adapt to the impacts of climate change?

- Add if needed: 50-year time horizon, 1 means no confidence and 5 means extremely confident
- What makes you say [number]?

How confident are you that the park has the climate change data or resources needed for this plan/decision?

- What information do you feel like you still need to confidently incorporate climate change into your decision?

Wrap-Up Questions

Is there anyone else at the park or in the region who is involved with the RSS that I should speak to?

When would you like to schedule your interview after the climate futures presentation?

POST Interview

Decision Updates

Can you give me an update on the planning process/decision that [park] has been working on?

- Is the plan/decision process complete?
- Are you on track to meet your deadlines? Has the timeline changed?
- Has your role in the planning/decision process changed? If so, how?

Any updates in the aftermath of the climate change presentation? Has climate change information been brought into the process?

- Tell me about how climate change was brought into the planning/decision process
- Do you see yourself incorporating the information you received into future planning/decision making?
- When would be a good time to check back in about your use of the information?
- What climate information was shared? By whom?
- Any other information/tools that factored into the plan?

Climate Futures Product

Now I'm going to ask you some questions specifically about the climate futures product and how you used it for your plan/decision.

- What was memorable about the climate futures product? Did anything stand out?
- Overall, was [climate futures product] information useful for your plan/decision?
- What could have made it more useful or relevant?

When we last talked, you mentioned that you and others at the park still had questions about [insert climate question from pre-interview]. Did [climate futures product] help address your questions about those issues, or change your understanding of climate change and the risks it poses to [park]? How so?

What steps (if any) have you taken to incorporate this information into your planning work? What next steps will you take?

- How might your plan/decision have been different without the climate futures product?

What information was new? Was there anything in particular that you learned?

Was the format and presentation of the product useable?

- Probes: format as report/webinar/workshop, narrative vs. numbers vs. figures

Was the presentation of the information clear?

- Did the amount of information ever feel overwhelming? Were there areas where you would have liked more detail?
- Were there any areas where you felt confused or lost?

How confident are you that the park now has the climate change information needed for this plan/decision?

- What needs remain for you to confidently address the risks from climate change in your work and planning?
- What barriers remain?

Scientific Uncertainty

What did you think about the [climate futures product(s)] including two climate scenarios?

- Was that helpful? Did it make sense?
- Did you use both scenarios or focus on one? If so, how did you decide?
- How did the product help you think about uncertainty for your plan/decision?
- Did [climate futures product] change how you think about planning for uncertainty?

How confident do you feel planning for a future that may look different from the past?

Report

Did you get a chance to look at the climate futures summary document before the climate change presentation / since the climate change presentation?

Before

- Were there any points of confusion when you looked through the summary document? Did you have any questions?
- Did the presentation address or answer those questions?
- Was it helpful to have gotten the summary document before the presentation? Would it have been more useful to receive it after you'd heard the presentation?
- Is the format of the summary document useful/understandable? Do you think it's a resource you'll go back to and reference?
- Any recommendations on how to improve the climate futures summary document?

After

- Were there any points of confusion when you looked through the summary document? Did you have any questions?
- Was it helpful to receive the summary document after the presentation? Would it have been more useful to have it before you'd heard the presentation?

- Is the format of the summary document useful/understandable? Do you think it's a resource you'll go back to and reference?
- Any recommendations on how to improve the climate futures summary document?

Understanding of Environmental System and Climate-Related Risks

In our last discussion, I asked you the following question: on a scale of 1–5, how much of a risk do you think climate change poses to [park]. You said X. Did the climate change presentation change your thinking on that? Has your answer changed?

- If yes: what do you think contributed to you changing your response? Did the climate futures product play a role?

What impacts and resources do you plan to prioritize moving forward? Why?

In our last discussion, I asked you the following question: on a scale of 1–5 how hopeful do you feel about the future at [park]. You said X. Has your answer changed?

- If yes: what do you think contributed to you changing your response? Did the climate futures product play a role?

Planning Behaviors and Beliefs

In our last discussion, I asked you the following question: on a scale of 1–5, how much complexity do you think climate change adds, or will add, to your work. You said X. Has your answer changed?

- If yes: what do you think contributed to you changing your response? Did the climate futures product play a role?

In our last discussion, I asked you the following question: on a scale of 1–5, how confident are you that the actions the park takes will effectively enable the natural/cultural/built resources of [park] to respond to the impacts of climate change. You said X. Has your answer changed?

- If yes: what do you think contributed to you changing your response? Did the climate futures product play a role?

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