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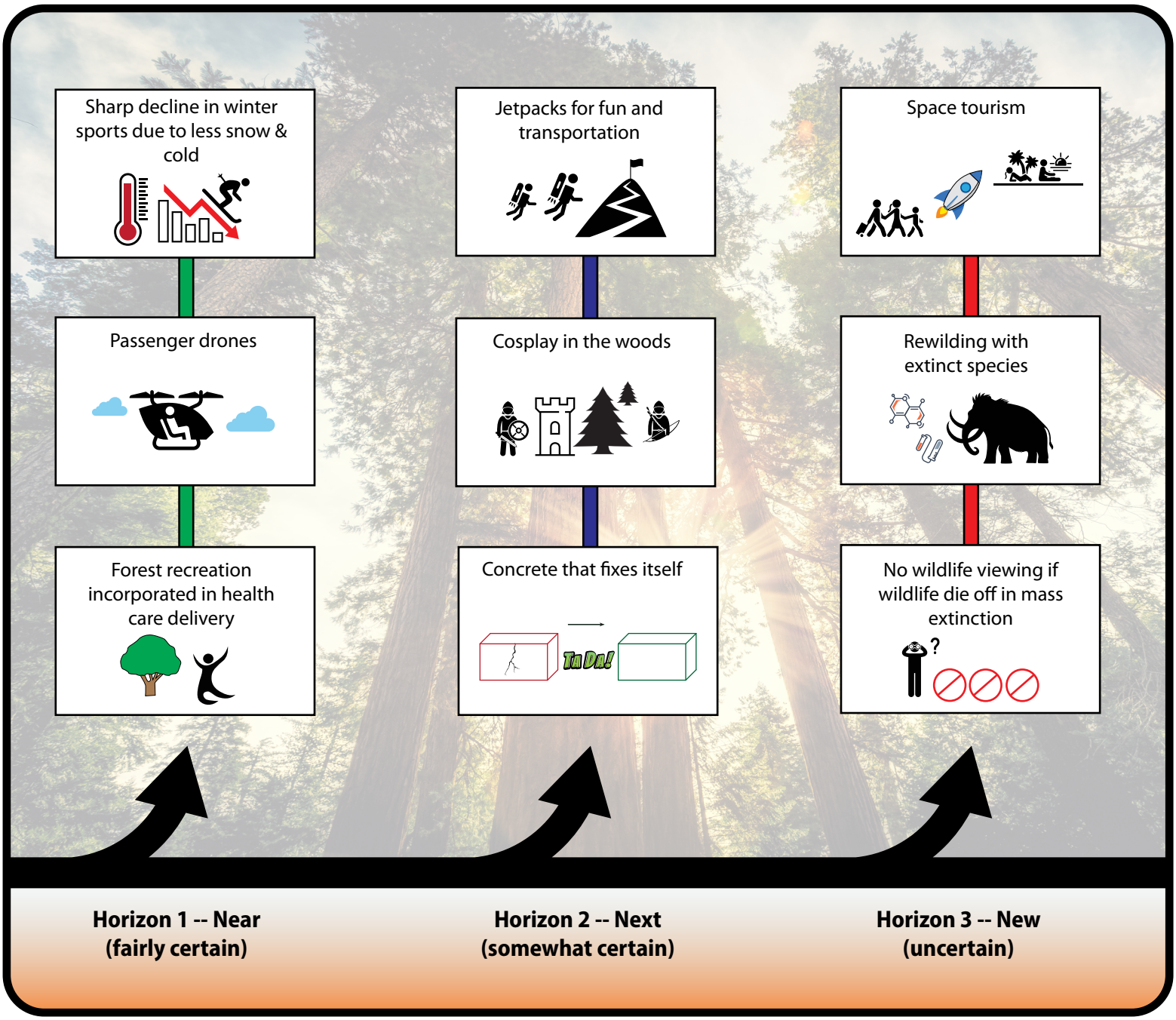
The Future of Recreation on Public Lands: A Horizon Scan

Lynne M. Westphal



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Abstract

This report provides a look at changes that could come to pass and impact recreation on public lands over the next 30 years. The data were over 700 horizon scan hits from our Forest Futures Horizon Scanning Project. Horizon scan hits are a useful early warning system. Horizon scan hits may be directly related to outdoor recreation (e.g., the decline of snow fall) or they may be indirectly related (e.g., the development of lab-grown meat). Because weak signals of change are as important as strong signals, a single scan hit is worthy of consideration, even if it stands alone. These horizon scan hits point to uncertainty and volatility in recreation activities on public lands. Some scan hits point to significant decline in traditional activities, while other scan hits point to increases. New activities are emerging, and there are many crosswinds in domains outside recreation that will impact delivery of recreation on public lands. Climate change is already implicated in recreation changes, from reduced snow fall, to human and animal migration, to reduced biodiversity. Other potential changes on the horizon include changing attitudes toward nature, a growing role for time in forests as a component of healthcare, electrification of many modes of travel, rising potential for augmented reality (AR) in outdoor recreation, the rise in passenger drones changing how people get to recreation sites, the potential for robots to assist with recreation management, and more. Therefore, there are many plausible futures for recreation on public lands. This makes planning more complicated, and the use of additional strategic foresight methods may help decision-makers think about the range of possible futures, and to plan for a preferrable future for outdoor recreation.

KEY WORDS: horizon scanning, strategic foresight, futures, recreation

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The Future of Recreation on Public Lands: A Horizon Scan

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EXECUTIVE SUMMARY

This report provides a look at changes that could come to pass and impact recreation on public lands over the next 30 years. The data were over 700 horizon scan hits from our Forest Futures Horizon Scanning Project (Hines et al. 2019). The data are archived in Westphal et al. 2022. Horizon scanning is fundamental to strategic foresight projects, gathering "scan hits": signals of potential change, sometimes weak signals, sometimes strong signals.

I culled through the 2,500 scan hits in our database at the time and pulled all that were relevant to outdoor recreation for analysis. These scan hits may be directly related to outdoor recreation (for example, the decline of snow fall due to climate change) or they may be indirectly related (for example, the development of lab-grown meat could reduce grazing which in turn could lead to grazing lands being available for recreation). Because weak signals of change are as important as strong signals, a single scan hit is worthy of consideration, even if it stands alone.

The scan hits were coded for horizon (near-term and fairly certain, much greater uncertainty and likely further off, and in-between), for broad social system categories (STEEP: social, technological, economic, environmental/ ecological, and political/policy), as well as for recreation subject areas, (e.g., activities, place).

Horizon scan hits are a useful early warning system, where a single scan hit can hold as much, even more, meaning than a dozen scan hits on the same topic.

I aimed to write this to be accessible and easy to read in sections. After discussing methods, I present a synthesis chapter. The chapters following that are by broad topic and are intended for the manager who wants to take a deeper dive into the scan hits for that topic. I marked surprising scan hits and also pulled out key points. Those key points are summarized here.

First and foremost, **the scan hits point to uncertainty and volatility in recreation activities on public lands.** Scan hits point to significant decline in traditional activities, while other scan hits point to increases. New activities are emerging, and there are many crosswinds in domains outside recreation that will impact delivery of recreation on public lands. Therefore, **there are many plausible futures for recreation on public lands.** This makes planning more complicated, and the use of additional strategic foresight methods (such as the futures wheel) may help decision-makers think about the range of possible futures, and plan for a preferrable future for outdoor recreation.

Climate change is already implicated in reduced snow fall and therefore reduced participation in snow sports. Some scan hits suggest **winter sports could disappear in the United States completely.** This would have significant repercussions for the Forest Service, other public land managers, and local economies dependent on winter tourism. The extent to which alternative recreation can replace snow sports is not known.

Climate change is expected to force the movement of many people within the United States and globally. **At least 13 million U.S. residents are expected to be displaced** by rising sea levels by the end of this century. This is just one impact of climate change; others are expected to push people to move as well. These climate migrants may move to rural areas, repopulating small towns, in turn changing who shows up to recreate on public lands.

Climate change is one force, among several, bringing about the "Sixth Mass Extinction." This mass extinction is underway, with the potential to result in "empty forests" due to loss of fauna. **There's no wildlife viewing without wildlife.** Some of the same forces are impacting fish: warming waters, browning waters, algae blooms, loss of habitat such as seagrass meadows, and more, all threaten fish. And, to state the obvious, without fish, there's no fishing.

Climate change isn't the only potential driver of changing rural populations. **Rural communities with public lands draw the creative class and digital nomads.** This influx of new workers, often drawn by opportunities to recreate outdoors in their community, can support economic well-being of some rural areas while adding more local recreationists.

There are changes in attitudes toward nature that will likely have an impact on recreation. Children are **showing fear of simple things in nature,** like pigeons. Some adults show increased fear, too. This rise in fear and discomfort in nature may curtail participation in outdoor activities or be a hurdle that must be overcome before people engage in outdoor pursuits. Further, research indicates that childhood engagement in outdoor activities fosters lifelong engagement (Asah et al. 2018), so childhood fear could lead to reduced outdoor recreation overall.

Numerous scan hits suggest **a growing role for time in forests as a component of healthcare.** Evidence is building (although not conclusive) about the many ways that time in nature generally, and forests particularly, improves human health, both physical and mental. Forests may become an integral component of our health care delivery system. Also health-related are the **advances in anti-aging technology** and health care, which **could produce a dramatic increase in elderly recreationists** who currently often age out of many outdoor recreation pursuits.

As human influence reaches the most remote places on earth, making no place "untrammeled" by humans, will the effort to preserve wild places be given up? **Are we seeing an end to wilderness?**

And, of course, there are numerous technological changes that will impact recreation on public lands:

- **Electrification of all travel is in development, and with it, (relatively) carbon neutral travel.** Development of electric jets, ferries, and other transportation indicates that the travel for pleasure may, in the not-too-distant future, no longer add to climate change-inducing greenhouse gas emissions. This could change the currently growing trend toward limiting travel to reduce climate change impacts.

- **Pokémon Go was just the beginning: augmented reality (AR) could transform some outdoor recreation.** Mirror World and other applications of AR could completely transform interpretation, heritage programs, and more. AR could also lead to new recreational activities, like cosplay, taking place on forests and in parks.

- **Passenger drones are in use elsewhere and may be coming here soon.** Where will they park? What are the equity impacts of such access? What will be the impacts to wilderness areas? How can wilderness air space be managed? What about drone visitor drop-offs to wilderness, like today's heli-skiing tourism?

Outdoor recreation is not immune to automation. Rec-robots are on the horizon. Robotics and other means of automation could have many applications to providing outdoor recreation, such as robot assisted search and rescue, perhaps automated routine tasks like trash management, checking trail status (for example, erosion or obstacles).

In sum, the future of outdoor recreation is unclear except that it will likely be quite different from today. While there are signals pointing to decline and dramatic change—like the loss of snow—there are other signals that suggest new and expanded outdoor recreation, from the possibility of new residents moving into inland rural communities to forest based augmented reality play. There *will* be outdoor recreation, we're human, after all. But the extent and type of that recreation may be quite different from that of today.

INTRODUCTION

Planning for an uncertain future is difficult. While planners and practitioners know that the future will be different from today, exactly what will change and what will be much the same is often unclear. Even known changes can have unknown impacts and effects. The field of Strategic Foresight, also known as Futures or Futures Studies, has a broad toolkit to look to the future and plan with these uncertainties in mind (Bengston 2019). Foundational to this suite of tools is horizon scanning (Bengston 2013). This is why, when the USDA Forest Service's Northern Research Station developed its Strategic Foresight research program, a horizon scanning system was one of the initial projects undertaken (Hines et al. 2019).

Horizon scanners look at wide-ranging sources to find signals of change for a given system, product, or other focus (see more detail below). These signals can be strong or weak signals of change, and they can be internal to the issue at hand, or, sometimes more importantly, they are signals from external domains. In our case, we were scanning for issues related broadly to forestry and the societal context in which forestry operates. The goal of horizon scanning is to develop a database of these signals of change—strong and weak, internal and external—in order to develop ideas of the range of possible forestry futures. This, in turn, informs policy makers, planners, and practitioners, allowing them to envision futures that they can plan for now, whether that planning aims at a specific future or tries to avoid or minimize negative possible future outcomes.

This report presents the results of an in-depth look at the recreation-related scan hits from our Forest Futures Horizon Scanning Project database (Hines et al. 2019). The next section discusses the horizon scanning process in more detail. This is followed by a description of the recreation scanning process and a brief discussion of methods. Then I turn to the substance of this report: the signals of change for recreation on public lands. An initial chapter synthesizes the potential impacts of the scan hits. Scenarios in this chapter paint word-pictures of what recreation on public lands could look like if some of these scan hits come to pass; I present four such scenarios to spark thinking about what could come to be, and how managers might need to adapt. Key point text boxes highlight scan hits that could have particularly significant impacts.

Key point: Keep an eye out for "Key Point" text boxes
These aim to help the busy reader take in the fundamentals and high impact potential change.

Subsequent chapters are topical "deep dives" into the scan hits. The first are recreation specific. The next chapters are grouped generally following the STEEP framework (social, technological, economic, environmental, and political/policy), a widely used analytic framework in strategic foresight to guide and sort scan hits (STEEP is discussed further below). The large green exclamation point indicates unexpected or surprising results. These chapters are useful for readers interested in the full range of scan hits relevant to a specific topic, such as winter sports, or wilderness, or health-related issues. Because any given scan hit may be relevant to two or more topics, there is some redundancy across these chapters.

Keep an eye out for the big green exclamation point in the detail chapters. It indicates unexpected scan hits, potential wild cards, or other disruptive potential change.

Horizon Scanning and the Forest Futures Horizon Scanning Project

The Forest Futures Horizon Scanning Project began in 2016. In partnership with the University of Houston Strategic Foresight program, the Forest Service's Strategic Foresight team developed an online database (hereafter referred to as Forest Futures database) to store scan hits. This system allowed tagging and annotating each scan hit and searching the entire database. The process is detailed in Bengston (2013) and Hines and colleagues (2019). The scanners for this project included people expert in forestry as well as faculty and students from the University of Houston Strategic Foresight program, other futurists, and a handful of other interested individuals. Most scanners are volunteers; none are full-time scanners.

It is important to look far and wide in a horizon scanning project. If only mainstream sources are used, weak signals of change will likely be missed. Therefore, scanners will look beyond news media outlets to blogs, industry newsletters, scientific journals, speculative writing, and more. An example of a weak signal of change for forestry in 1900 would have been the initial trials of Ford's horseless carriage (Sutton 2002). The evolution of the car and the road network cars require had profound impacts on public lands, allowing huge increases in visitation, and facilitated new recreational pursuits (car camping, leaf peeping, etc.). The trick is to catch today's equivalent of the car and other possible changes and explore the possible impacts of these signals of change. These signals are often weak when they first appear, making them a flicker in peripheral vision.

The items found are called "horizon scan hits," "scanning hits," or "scan hits." These are collected in a database and tagged for major theme and context. There is also a place for the scanner to add comments, which are especially helpful when the implication for forestry from a given scan hit may be two or three steps removed. These second and third order changes can have significant impacts, such as the effects of the advent of cars discussed above.

Scan Horizons

Scan hits are tagged for the specific topic area (for example, recreation, wood products, water) and also for two sets of categories used to classify all scan hits. First, and most important, are the horizon categories. Three horizons categorize a scan hit roughly by time, but more importantly by level of uncertainty (Curry and Hodgson 2008, Hines et al. 2019). Horizon 1 (H1) refers to a signal of change that is evident in the system today, or that is imminent. Therefore, the level of uncertainty regarding this change is low. H1 is now or near. Changes in snowfall and its impacts on winter sports are an H1 example related to public lands recreation. Horizon 3 (H3) are highly uncertain scan hits, the weak signals of possible change. These can seem laughable and weird (just as the car did when horse drawn buggies reigned). H3 scan hits are also typically the furthest out in terms of time, easily 20 or more years in the future (though they have the potential to happen quickly, too). These are the "new" ideas. The development of a drug that creates the same effects in the body as exercise is an example of a recreation-related Horizon 3 scan hit. Horizon 2 is, not surprisingly, in between. Horizon 2 scan hits are not yet visible in our day-to-day lives, but could happen soon, and the level of uncertainty is moderate. These changes are more likely, but not a given. They are "next" (Hines et al. 2019). In this report, I focus on Horizons 1 and 2, but will add relevant Horizon 3 scan hits to give a sense of the more "out there" possibilities of what might come to pass.

Scanning Horizons

Horizon 1 (H1): Imminent change, even underway. Low uncertainty. "Now or near".

Horizon 2 (H2):
Not seeing the change yet but could happen soon. Moderate uncertainty. "Next".

Horizon 3 (H3): Furthest out both in terms of likelihood as well as time (even decades). Uncertainty is high. These can appear far-fetched or fringe. "New".

STEEP categories

A second framework commonly used in Strategic Foresight research goes by the acronym STEEP. It is a categorization of broad contextual issues: social, technological, economic, ecological/environmental, and political/policy (Hines et al. 2019, Lum 2016). Each scan hit was coded to all relevant STEEP categories. For example, a scan hit about the health impacts due to climate change would be coded to ecological/environmental and social (health-related scan hits were coded to social). However, for our purposes here, I have grouped two of the STEEP categories into social: political/policy as governance, and economic issues. This grouping works here given the relatively sparse number of scan hits in these two topic areas.

A common principle in qualitative data analysis is to look at the preponderance of evidence to ascertain import (Miles et al. 2020). But when analyzing horizon scan hits, prevalence of the data can be misleading. Prevalent scan topics matter, but so do the rare ones. In fact, the rare scans might be the most important because they won't be on planners' radar yet but could signal substantial change to come. Therefore, in this report, I present signals of change that have appeared multiple times in the scanning process (such as the decline of winter sports) as well as weak signals of change that may only appear once but could spell major change for recreation on public lands (such as advances in jetpacks).

In this report, I present graphs showing the number of horizon scan hits in a given STEEP category. As described above, more doesn't necessarily mean more important. The proportion of numbers of scan hits has some meaning, but the difference between, for example, 40 or 50 scan hits on a topic is not particularly meaningful. In short: don't over interpret the numbers.

Not All "Hits" Are Fully Cited

Research using online and sometimes ephemeral sources, such as social media posts or a large set of newspaper articles, are included in this analysis but not necessarily cited. I have archived all of the scan hits used in this analysis, sorted by topic (Westphal et al. 2022). I do formally cite scan hits that are research articles, reports, or similar sources. However, most of the scan hits do not fall in this category and so will not be cited. But every point or claim I make in this report is backed by one or more scan hit and archived in the Recreation Scan dataset.

The Dataset: Recreation Scan Hits

For this project, I went through all existing scan hits in the Forest Futures database (about 2500 at the time) and added the "recreation" tag to existing scan hits not yet marked as related to recreation. This was an important step, adding several hundred scan hits to the "Recreation Scan Hit dataset" used for this research. Most scan hits that were directly related to recreation were already tagged as such (e.g., scan hits about camping or fishing). Scan hits that were indirectly related to recreation were rarely already tagged with recreation. An example is a scan hit on lab-grown meat catching on with consumers: if meat is cultured, or from a lab, there would be fewer cattle needing to graze on public lands, and therefore a chance to use some of these lands in other, potentially recreational, ways. This example is one of the longest chain of implications leading from the scan hit to the recreation impact but indicates the types of recreation-related scan hits coded to recreation.

In the summer and fall of 2019, a set of the horizon scanners were focusing on recreation on public lands for their scanning to support our work on this and related projects. These combined efforts resulted in 729 scan hits tagged as related to recreation when we started this analysis in February 2020. Enough time went by that, after the primary analysis was complete, I went back to the Forest Futures database to find any new recreation scan hits not yet represented in the analysis and added them to the Recreation Scan Hit dataset (that is, more on the decline of winter sports recreation data were not added while a scan hit about jetpacks was added; loss of snow was already well represented, jetpacks were not in the dataset up to that point). This added seven additional scan hits, for a total of 736.

Because the Recreation Scan Hit dataset does not store the entire text from the item a scanner finds (it stores links and notes), we needed to "scrape the web" for the full text. The scan hits that were not captured by the scrape (about 75 of the scan hits) were copied in manually. For the few scan hits with an inactive link, scanner notes from the scanning database were used for the analysis.

Coding

The Recreation Scan Hit dataset was uploaded into the qualitative data analysis software NVivo 11 (QSR International 2017). The coding was largely topic based (as opposed to theory-based that could be the focus in other qualitative data analysis). I coded for many different topic areas, some directly related to recreation (e.g., activities, recreation gear, tourism) and others that impact recreation (e.g., climate change, diversity, life stage, health, artificial intelligence, governance). Each scan hit was also coded to a STEEP category and the three horizons (see above). The final list of codes is in appendix.

After all scan hits were coded, I combined the topic-based codes into larger categories and used these to look for patterns regarding possible increases and decreases in recreation on public lands. These broader categories frame much of this report and include:

- Recreation activities combined into "traditional recreation activities" on public lands, including hunting, fishing, hiking, camping, and also less traditional or new activities such as stargazing and cosplay (fantasy play in costume, for example as Star Wars or anime characters).
- Recreation industry and management-related issues include a variety of topics outside of specific activities, such as recreation gear, safety/search and rescue, tourism, pets, and infrastructure.
- Place-related issues, such as private lands, special places, and rural development.
- Social issues, such as health, governance, diversity, generation cohorts, and environmental attitudes.
- Technology-related issues, such as the growth of augmented reality, social media, drones and autonomous vehicles, wood products such as bio-based jet fuel.
- Ecological issues, such as climate change, biodiversity, species of concern, restoration, and wildlife.

A recreation scan hit could have multiple codes, resulting in overlap. For example, there is a significant overlap for the codes for climate change, biodiversity, and wildlife-related issues. This is not surprising, given the impact of climate change on wildlife and the habitats upon which wildlife depend, and hence on biodiversity. Coding separately for these topics allows finding those issues that are distinct in each code domain, as well as the multi-faceted impacts suggested by some scan hits.

SYNTHESIZING THE RECREATION SCAN HITS: WHAT DOES THE FUTURE OF OUTDOOR RECREATION LOOK LIKE?

Recreation is important not just for enjoyment but for physical and mental well-being, learning, making social connections, and more. But how we recreate changes over time. While some recreational pursuits have deep roots, some fade away while new recreation activities emerge. The forces driving change are not only from inside the field of recreation, like the development of new gear, but also come from many societal domains, such as economic changes and technologies from other fields. In the introduction, I mentioned the impacts of the car on recreation on public lands. As cars became widely owned, the ability to travel was transformed, and with it came a rise in tourism in rural parks and forests. Recreational vehicles (RVs) were created at about the same time as cars (Fig. 1) and were popular in the 1920s and then again in the 1960s and beyond (Young 2018).

Figure 1.—One of the earliest RVs was the 1915 Conklin camper van, dubbed by some a "land yacht." Photo from U.S. National Archives

The economic climate in the United States in the 1920s and again after World War II also changed recreation on public lands. Both eras saw significant economic prosperity for some segments of society (Library of Congress, n.d.; Onley 2013). The post WWII era also saw a rise in vacation time and an expanded highway system. Collectively, these advances contributed to the rise in family road trips and exploration of national parks and forests (see papers in Selin et al. 2020).

The recreation-related horizon scan hits do not paint one, clear picture of what recreation may be like in 10 years, 20 years, or beyond. Instead, there are currents and crosscurrents, some weak signals and some strong signals of change. Some scan hits point to increases in outdoor recreation while others point to declines. And some scan hits will impact some geographic regions and leave others untouched, while others will impact the entire country. Therefore, the only thing that is fairly certain is the uncertainty of the future state of recreation. Thinking broadly about what may happen allows planners and managers to make decisions today to be more prepared for whatever future unfolds. Just as recreation in the 1920s, 1950s, and 1960s was affected by changes in economic, social, and other domains, the future of recreation will be as well. Possible changes in how we work, where we live, potential impacts from climate change, and more, will all shape recreation on public lands. This chapter synthesizes the recreation scan hits, whether they are from domains outside recreation, or are specific to recreation, tourism, and recreation management.

Key point: Highly uncertain future for recreation activities. The scan hits point to uncertainty and volatility in recreation activities on public lands. *Therefore, there are many plausible futures for recreation on public lands.* Many scan hits point to significant decline in traditional activities, while other scan hits point to increases. New activities are emerging. Change is what is certain.

Scan Hits Suggesting Increases and Decreased in Recreation Participation

I coded scan hits to "increased recreation" and/or "decreased recreation" if something in the scan hit suggested recreation on public lands might increase or decrease due to the change indicated. Many of the categories have scan hits in them that point to both increased and decreased recreation, but ecology-related scan hits largely point to decreased recreation while the technology-related scan hits largely point to increased recreation (Figs. 2, 3). This suggests paying ongoing attention to these scan hits to see which develop into trends and forces shaping recreation demands on public lands. Additionally, some scan hits are more likely to occur than others, or have a larger impact, so the number of scan hits pointing to increases or decreases in recreation do not tally up to indicate the most likely future. Instead, these point to a very uncertain future for outdoor recreation, one that could play out in many different ways.

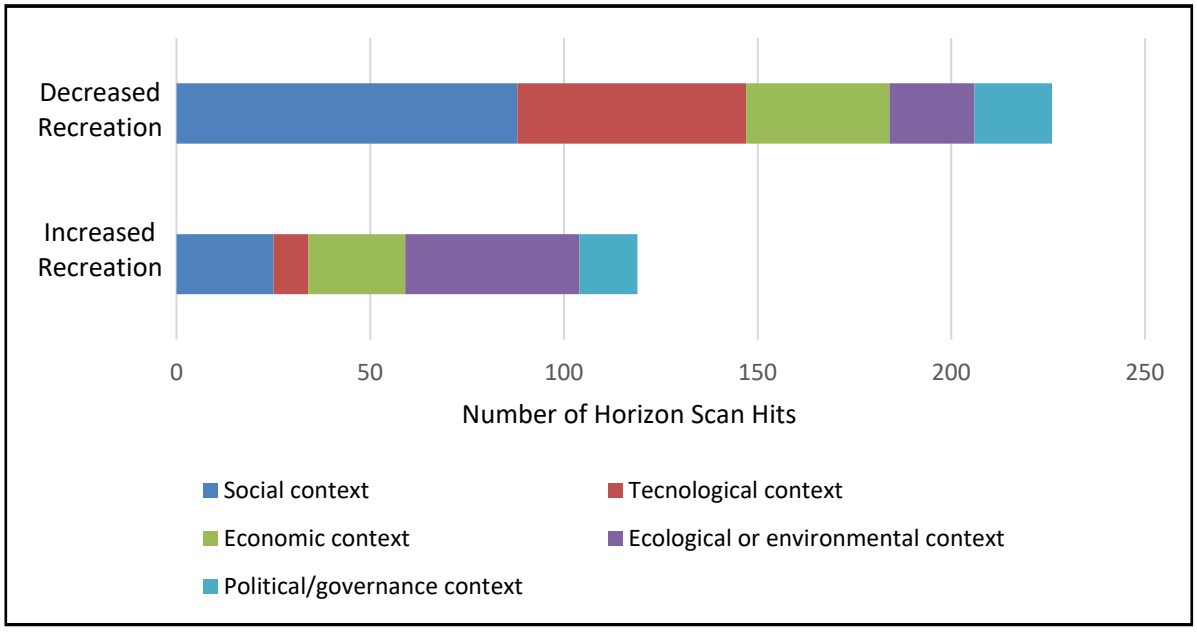

Figure 2.—STEEP category scan hits suggesting increased (top bar) and decreased (lower bar) recreation by STEEP categories. The number of scan hits does not signify the future most likely to occur.

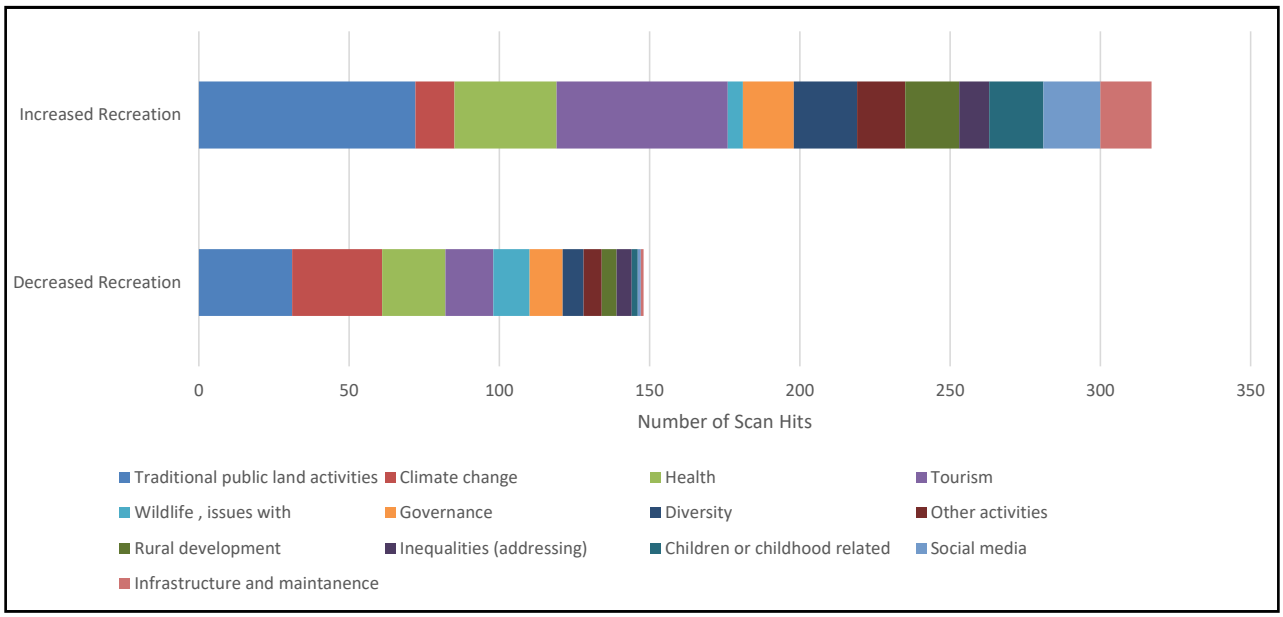

Figure 3.—STEEP categories coded with 10 or more scan hits suggesting increased (top bar) and decreased (lower bar) recreation. The number of scan hits does not signify the future most likely to occur.

Increased and Decreased Recreation by the Three Horizons

Along with the subject areas of the scan hits, it is useful to think about time horizon of possible changes. Recall that futurists use three horizons: Horizon 1 (H1) refers to a near-term change, or change we can already see starting to happen and therefore uncertainty is low—it is now or near; Horizon 2 (H2) refers to potential change that is more uncertain, and perhaps further off (10–20 years) or both, it is next; and Horizon 3 (H3) refers to a change that is more speculative and uncertain (even whacky-sounding) and therefore more likely to be 20 years or more in the future, it is new (Curry and Hodgson 2008, Hines et al. 2019).

Topic areas coded most often in "increased recreation" in Horizon 1 were tourism and health, tourism in Horizon 2, and health and urban in Horizon 3. It is worth noting that "tourism" is a broad category, with scan hits included in it that are also coded to many other topic areas, such as technology, economic issues, and generational cohorts. With regard to the STEEP categories, social and technological context were common across all three horizons, with economic context also common in Horizon 2 (Table 1). The topic areas coded most often in "decreased recreation" are health in Horizon 1, climate change for Horizon 2, and biodiversity, wildlife issues, and climate change for Horizon 3. With regards to the STEEP categories, the ecological/environmental context was important in all three horizons, with the social and economic context categories also coded often in Horizons 1 and 2 (Table 1).

Table 1.—Recreation scan hits coded to indicate increased or decreased recreation by horizon

	Increased Recreation	Decreased Recreation
Horizon 1 (now/near)		
Most coded topics	Health, tourism	Health
Number of scan hits	113	41
S Social	X	
T Technological	X	
E Economic		
E Ecological/Environmental		X
P Political/Policy		
Horizon 2 (next)		
Most coded topics	Tourism	Climate change
Number of scan hits	58	27
S Social	X	
T Technological	X	
E Economic	X	
E Ecological/Environmental		X
P Political/Policy		
Horizon 3 (new)		
Most coded topics	Health, urban	Wildlife issues, biodiversity, climate change
Number of scan hits	14	8
S Social	X	
T Technological	X	
E Economic		
E Ecological/Environmental		X
P Political/Policy		

Synthesizing the Horizon Scan Hits

As noted above, the scan hits do not paint a clear picture of the future for recreation on public lands, meaning that many different futures are possible. In the rest of this chapter, I'll synthesize the scan hits potential impacts on recreation on public lands, but this synthesis will not include all scan hits. All scan hits can be found in the subsequent detail chapters, organized by topic. Four scenarios at the end of this chapter further synthesize the scan hits in four stories of how recreation on National Forests in the Lake States might look in or around 2035.

Future of health and outdoor recreation

Outdoor recreation's role in health, especially general physical health, is nothing new (Qwynne Lackey et al. 2021, Rosenberger et al. 2009, Selin et al. 2020, Thomsen et al. 2014). Many people have walked, biked, or paddled (and more) for exercise as well as enjoyment for generations (Chamberlain et al. 2018). Others hunt, fish, and gather to bring healthy foods home to sustain themselves and loved ones. But the role of recreation on public lands in advancing health and well-being looks to be expanding in important ways. There are signals of change that could apply widely, across all regions of the country. The rise in forest bathing or ecotherapy is one of the signals of this change (Rappold and Dixon 2019, Wen et al. 2019, Yau and Loke 2020). The practice of forest bathing is growing yearly and is very much an H1 scan hit (now or near). Programs are increasingly offered in green spaces in the heart of urban areas to rural woods and parks. The research into why forest bathing is effective, while not conclusive on all possible impacts, is demonstrating effects for both physical and mental health. Researchers are investigating the impact of chemicals released by trees and other plants – called phytoncides – on specific health conditions (Putra et al. 2018, Roviello and Roviello 2021). Early results suggest that phytoncides may manage cytokines in the body, thereby controlling inflammation and other processes that results in pain and poor health. As these findings grow, programs like Nature Rx (Nature Rx, n.d.) may expand to include time in natural areas as a key component of treatment and preventative care for conditions beyond cardio conditioning and stress relief. The day may come where public lands are embedded in the health care delivery system, with trail maps indicating trails that are beneficial to specific health conditions.

Key point: An apple tree a day keeps the doctor away

Evidence is building about the many ways that time in nature generally, and forests particularly, improves human health, both physical health and mental health. Forests may become an integral component of our health care delivery system.

There are other health-related scan hits in our dataset, too. Aging has already changed, as embodied in the saying "60 is the new 40." Medical advances continue to add active years to people's lives, including genetic treatments, medications, and more that can slow the aging process, and manage diseases that once limited recreation options. These changes mean that older age cohorts will be more and more able to remain engaged in old favorite outdoor pursuits, and to try new activities as well. Similarly, scan hits point to a rise in adaptive technologies that mitigate the limitations of disabilities in getting outside to recreate. Exosuits and technology that restores vision are two examples.

Key point: The end to aging out of recreation?
Advances in anti-aging technology and health care could produce a dramatic increase in elderly recreationists who currently often age out of many outdoor recreation pursuits.

Universal healthcare—should it or similar changes occur—could increase the amount of outdoor recreation. Assurance of health coverage could encourage some people to try new activities and take greater risks (think rock climbing). If people try such activities without appropriate training it could lead to increased demand on search and rescue staff, as was seen during the spike in public-land recreation during the COVID-19 pandemic (Thompson 2021). Greater access to healthcare could also increase visitation because more people would be healthier with chronic conditions controlled or avoided (e.g., diabetes, chronic obstructive pulmonary disease), making poor health less of a limiting factor for outdoor play.

There is a potential feedback loop between health and time recreating outdoors—happiness. As happiness is studied in depth, the link between play, happiness, health, and overall well-being in a country is becoming clearer (Helliwell et al. 2020, Maddison et al. 2020). Additionally, time unplugged while recreating is useful in recharging one's work life and creativity. Combined, these scan hits add weight to the possible role public lands-based recreation can play in promoting health as well as individual and societal well-being.

But not every scan hit points to more recreation. Climate change impacts may also reduce engagement in outdoor recreation. Increasing heat waves, wildfire smoke, higher pollen counts, and other climate change impacts can all make recreating outdoors less safe, either causing new health problems, or increasing risk for people with preexisting health conditions. These issues can be of particular importance for people of color, who, as a group, experience poorer health overall, for a variety of reasons (Churchwell et al. 2020, Daniel et al. 2018).

Climate change impacts on outdoor recreation

While health-related scan hits largely point to increases in recreation, the climate change-related scan hits largely point to declines. Climate change impacts are already being felt, and scan hits point to many more impacts from climate change that could change public lands recreation in ways large and small. Precipitation patterns are already changing, and numerous scan hits suggest continued decline, even eventual loss, of snow in areas currently favorites for snow sports. This is an example of a scan hit that will have significant impacts in some regions, and few to no impacts in others. But in areas used to winter snow, and dependent on snow-sport tourism, this change could have serious repercussions. Several scan hits discuss the ski industry and its efforts to adapt to reduced snow by offering system-wide passes and advocating on behalf of climate-friendly policies, for example. One thing that is not clear is what, if any, activities would be satisfying alternatives to snow sports. Some places are trying mountain biking and zip lines when there isn't enough snow for skiing. With advances in augmented reality (AR; the real world enhanced with computer-generated images and information), could it be used to mimic aspects of winter, like creating a view of a snowy landscape where none exists?

Key point: Bye-bye snow, bye-bye happiness

Climate change is already implicated in reduced snow fall and therefore reduced participation in snow sports. Some scan hits say **winter sports could disappear** in the United States completely. This would have significant repercussions for the Forest Service and local economies.

Biodiversity decline is another impact linked in part to climate change, but also to other anthropogenic forces (e.g., agriculture, deforestation). Scientists point to a sixth wave of mass extinction, with some saying it is already underway, affecting both terrestrial and aquatic species. Birds especially are in significant decline, but so are other creatures like mountain goats and other charismatic megafauna. Changes in the climate are starting to produce shifts in where animals live. Some birds are already changing migration patterns. Studies show birds are moving up in montane ecosystems. Others are no longer migrating or migrating as far. One study created a map of feasible routes for species movement (McGuire et al. 2016), because more species movement is inevitable.

The ripple effects for recreation of biodiversity decline and changes in where the remaining animals live are many. Hunting and fishing, obviously, requires animals and any declines in species or numbers of individuals will reduce the quality of hunting, fishing, and birding and other wildlife viewing experiences.

Key point: NO lions or tigers or bears? Oh My!
Scientists predict the "sixth mass extinction" is underway, with the potential to result in "empty forests" due to loss of fauna. There's no wildlife viewing without wildlife.

Key point: Fish populations, and therefore fishing, are threatened
An array of changes has the potential to threaten fish populations: warming waters, browning waters, algae blooms, loss of habitat such as seagrass meadows threaten fish. Without fish, there's no fishing.

At the same time, new birds showing up in an area could boost birding in that region, at least temporarily. The change in where the animals are could also impact recreation economies established around specific species or activities (say big game hunting), sometimes positively, sometimes negatively.

Within the issue of biodiversity loss are issues specifically affecting fish and aquatic life: acidification, browning, warming, algae blooms, and more are all reducing fish populations. These issues are affecting fish populations, threatening extinction for some species, and generally threaten lower quality of fishing opportunities.

There is a growing movement suggesting rewilding as a solution to loss of biodiversity. Rewilding has a range of meanings, from planting abandoned lands with native species to efforts to bring back extinct species and their ecological effects (such as spreading seed) either by introducing mimics (e.g., elephants for woolly mammoths) or by using genetic tools to bring the actual species back.

As discussed above, climate change is prompting migration, and not just for animals. People are already moving because of climate change (see for example Kraker 2021), and climate migration is expected to be another significant impact of climate change. Scan hits suggest as many as 13 million Americans will move due to sea level rise alone. Other climate change impacts, such as heat waves, drought, floods, and wildfire, will prompt others to move, too. Where will climate migrants go? Might they repopulate currently depopulating rural towns? There is housing stock and infrastructure in place in many rural small towns, making absorbing an influx of new residents possible in many places. Additionally, scan hits report that most people say they'd prefer living in a rural area, making small rural towns a potential draw.

Key point: Climate migrants on the move, waves of migrants expected
At least 13 million residents of the United States are expected to be displaced by rising sea levels by the end of this century. This is just one impact of climate change; other changes will push people to move as well. These climate migrants may move to rural areas, repopulating small towns.

Tourism futures

Tourism is impacted by many different forces, from the economy to media to technological developments and more. There were many scan hits about social media postings on places to see, and the potential overcrowding and ecological impacts stemming from these posts, for example. And while there are some scan hits pointing to a decline in tourism—the trend in America to not take vacation time from work, and the current push to limit carbon footprints by reducing travel are two—many tourism-related scan hits pointed to increased tourism.

While social media is often cited for attracting damaging levels of visitation to tourist destinations such as Horseshoe Bend on the Colorado River in Arizona, it can also be a force for outreach to audiences often missed by many tourism and other outreach campaigns. Groups like Unlikely Hikers, Queer Nature, Blackpackers (there are many more) are using social media to network, encourage outdoor recreation across a wide range of folks, and to challenge the stereotype of who engages in these activities on public lands. Some of these groups also gather donated equipment which, along with the emerging use of gear lending libraries, provides the necessary gear to try an activity. This can solve two problems: people engaging in an activity unsafely due to lack of necessary gear are provided appropriate gear, and people are not stymied from trying something due to lack of funds.

One response to the increasing threat of climate change is "before it's too late" or "last chance" tourism. This is tourism motivated by the desire to see a place, an animal, or a landscape before it is gone or dramatically altered by climate change. Glaciers, some bird species, the arctic and other unique places susceptible to climate warming are the primary targets of last chance tourism.

Another shift in tourism patterns is the renewed focus on adventure and experience-oriented travel and a deemphasis on things as a focus for spending. This is a noted trend for millennials and younger generations, though is not limited to younger cohorts. Airbnb, Hipcamp, even KOA are adding experiences to their lodging offerings in an attempt to meet this new demand. With Millennials now the largest age cohort, and Gen Z also emphasizing experiences over things, this trend may continue into the foreseeable future.

There are other tourism trends grounded in generational differences. Millennials and younger generations are often interested in outdoor recreation, but also want a comfortable night's sleep. This could be a hotel or glamping yurt, a tiny house or an Airbnb, but it is not a camping pad, sleeping bag, and a basic tent. This changes the type of trip taken, with less backpacking and more day trips, less freeze-dried camp dinners and more restaurant meals.

Related to the interest younger generations have in combining comfort and outdoor recreation is a shift in who is buying RVs. No longer the domain of White retirees, RV ownership has become both more diverse and younger (The Economist 2017). Digital nomads sometimes take up van life, living where they wish in a small RV, working in the gig economy, as influencers, or in other highly portable work.

Key point: Ahhh, this bed is just right
Younger adults are less interested in tent camping and long-distance hiking, opting instead for day adventures and sleeping in a comfy bed instead of on a sleeping pad on the ground.

Key point: Not just your Grandpa's RV anymore
Buyers of RVs are younger and more diverse than in years past. In 2017, half of RV buyers were under the age of 45, and many more people of color are buying camper vans and other recreation vehicles. This is a significant demographic shift in the RV world.

Key point: Electrification of all travel is under development, and with it, (relatively) carbon neutral travel
Development of electric jets, ferries, and other transportation indicates that the traveling for pleasure may be possible in the not-too-distant future without significantly adding to climate change-inducing greenhouse gas emissions. This could change the currently growing trend towards limiting travel to reduce climate change impacts.

While there is a current movement to limit tourism and other travel due to the climate impacts of transportation, there may be a solution on the near-term horizon. Many scan hits pointed to developments in electric and other more climate-friendly transportation options. Electric jets, ferries, cars, and more are all in the works and could allow guilt-free travel to destinations across the world. Hydrogen and other fuels are also being explored. The likelihood is enough that scan hits proclaim electric transportation in the near-term future a given. Should this come to pass, it could unleash a pent-up demand in younger cohorts who might be limiting travel in an effort to limit negative climate impacts.

STEEP categories

Recall that horizon scanning uses the STEEP categories to organize scanning and ensure a wide range of possible influences are considered (STEEP = Social, Technology, Economic, Environmental/Ecological, and Political/Governance). In this report I have combined economic and governance issues into the social category, given the lower number of scan hits related to those two topics.

In the following pages, I discuss the scan hits not already covered above. Because of overlap in topics, some—like increasing diversity in outdoor recreation and the growing role of natural areas in ensuring human health and well-being—have already been covered.

Social

Climate migration is not the only potential population impact for rural America. There are many scan hits in our database about rural communities, including ones noting the rise of the creative class—not just artists, but a wide array of professions and pursuits—that are drawn to amenity-rich rural areas. Broadband access is often a requirement for the creative class to move to a community. The shifting work patterns for Millennials, and the post-COVID increased flexibility regarding work location, also mean that workers in some fields can live where they choose, including small town America.

This potential population shift will not affect all areas of the country equally. Climate change creates push factors (away from coastal areas, for example) while pull factors such as amenity rich rural areas will draw to more hospitable locations (such as the upper Midwest). Xu and colleagues (2020) estimate that the zone for healthy human habitat will shift north in the United States (Fig 4).

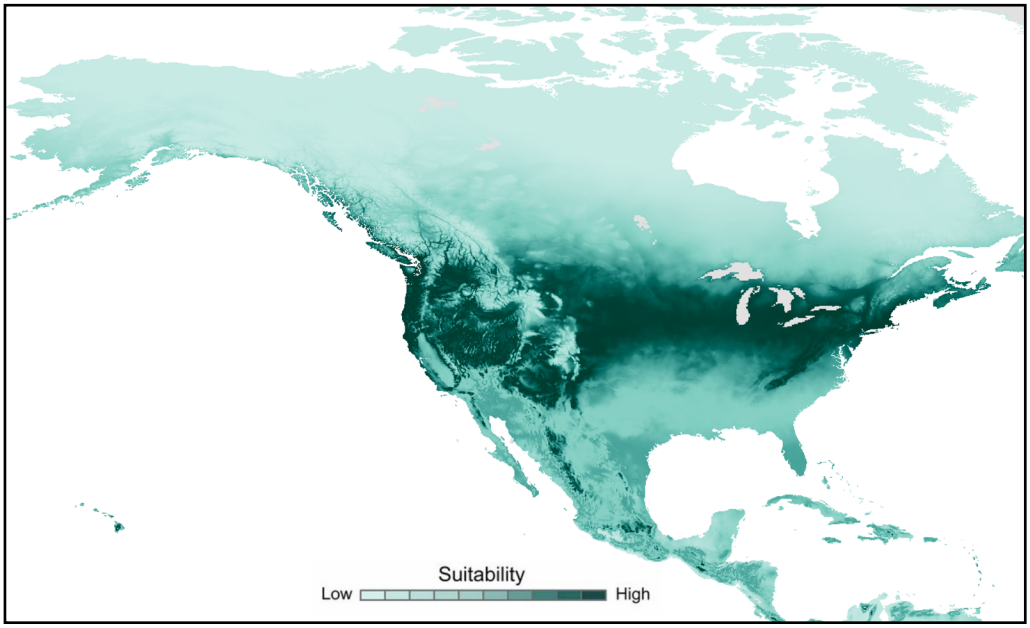

Figure 4.—Parts of the United States shown in dark green depict regions expected to be more hospitable for human habitation in 2070. Image adapted from Xu et al. 2020.

How does a potential influx of new residents to rural towns affect recreation on public lands? First, and most obvious, is there are simply more people to recreate. Newcomers may bring new attitudes toward nature, as well. One potential attitudinal shift is rooted in research findings of a steadily growing number of "mutualists" compared to "traditionalist" mindsets regarding nature. Traditionalists see the natural world as being for human use and consumption, while mutualists see a more peer-to-peer relationship between humans and nature. This could change the types of recreation pursuits people choose and could change what recreation infrastructure is needed. For example, mutualists may not choose hunting and fishing, but wildlife viewing could be popular. Counter to this, though, are signals such as the growing locavore movement – maintaining a diet consisting primarily of locally grown or produced food – which could induce some to take up hunting and fishing for the first time.

A wave of newcomers to rural communities that may also be newbies for some activities could pose safety concerns. The spike in recreation was underway already, and grew during COVID, with inexperienced recreationists flooding public lands, straining search and rescue operations (Thompson 2021).

Newly populous rural communities could also lead to greater economic stability, resulting in higher quality of life for the community as a whole.

There are serious signs pointing to reductions on outdoor recreation, especially for children. Research identified a growing play gap, with even small children responding that they "are too busy to play." Given the importance of play in childhood development, this gap can have serious repercussions. Children are also engaging less in free play outdoors, roaming less. This may be part of why researchers are seeing growing levels of biophobia—a literal fear of nature, even simple nature like a flock of pigeons at the park. Biophobia is increasing in adults, too. Fear of nature is an obvious hurdle to comfortably recreating on public lands.

Key point: Eeeek! Nature!!!

There is evidence of a ***rising fear of nature.*** Children are showing fear of simple things in nature, like pigeons. Some adults show fear, too. This rise in fear and discomfort in nature may curtail people participating in outdoor activities or be a hurdle that must be overcome before active engagement.

Countering these trends of reduced comfort in nature is an increase in nature-based play. This includes using tree trunks and other natural elements as playground equipment, and the creation of free-play zones in woods and other natural areas. Outdoor schools, in which children are outdoors year-round, are growing in number in the United States. Outdoor learning environments build confidence and comfort with being outside, potentially planting the seeds for engaging in outdoor recreation as these children grow up (Williams 2018).

With regards to older adults—Boomers and beyond—economic uncertainty poses a real threat to ongoing or reconnecting with outdoor recreation. Few older adults expect to be able to fully retire (reportedly only 17% said they expected to; Sehgal 2017), greatly limiting their opportunities to expand in outdoor recreation after child raising is done. The extent to which this economic precariousness will continue, and how it will interplay with medical advances that could expand Boomers outdoor recreation, remains to be seen.

Governance is a concept that covers all manner of decision-making and management approaches, inclusive of but not limited to formal governmental structures and processes. There are numerous scan hits about possible changes in the governance of forests and parks, with implications for recreation.

There are already signs of growing Indigenous control and co-management of forests and other lands in Tribal ceded territories. One example comes from the Blackfeet Nation and the tours they provide of either Glacier National Park (originally Blackfeet land) and of the Tribal lands adjacent to Glacier National Park. Tours from a Native perspective emphasize different information, such as relationships and traditions. Increased co-management of public lands could also reduce some forms of recreation in some areas, for example limiting rock climbing of rock faces sacred to a Tribe.

Also on the rise is the movement giving direct standing to elements of nature. One of the first instances of this was a river central to the Maori being given standing vis-à-vis New Zealand law. Voters in Toledo, Ohio, voted to give Lake Erie rights. Such changes could affect the kinds of recreation allowed, increasing the protections of lakes and rivers, forests, and prairies. The exact effects of this have yet to be seen, but have the potential to be significant, including potential ripple effects in recreation and recreation management.

There is an ongoing debate about whether to keep public lands public, or to privatize them instead. A common argument in favor of privatization is that private management will better and more flexibly meet the needs of recreationists. A common argument against is that public management maintains access for all, and guards against over development. One scan hit, an H3 scan hit, suggested dividing all publicly held lands among U.S. citizens, thereby jumpstarting wealth across society at large. This is a speculative scan hit, but should something along these lines come to pass, it would dramatically alter how outdoor recreation is provided.

Technology scan hits

Some of the tech-related scan hits have been discussed above, like the rapid electrification of nearly all mode of travel. But there are many more tech scan hits, and these mostly point to potential increases in recreation on public lands. These tech advances could change how people get to recreation sites, what they do there, and the infrastructure they expect to find – like connectivity.

Autonomous vehicles have been under development for quite some time now and have yet to make it to full deployment. Still, the expectation is that self-driving cars and trucks will be available soon. Self-driving RVs have already been prototyped by several companies. Self-driving vehicles, especially RVs, could change when people arrive at recreation sites, with recreationists perhaps traveling overnight and arriving rested and ready to play first thing in the morning.

Key point: A passenger drone in every driveway

Passenger drones are planned for the U.S. market by 2025. When this occurs, more public lands will become accessible for day trips. Parking, recharging, and other infrastructure may be demanded. What could be the impacts to wilderness areas? How can wilderness air space be managed?

Drones are another transportation transformation on the near-term horizon. When I started this project, passenger drones in the United States were more of an H2 scan hit, but rapid development in the field has shifted this to the H1—now or near—horizon. Any number of companies are working on passenger drones, from startups to companies like General Motors. Already in use as taxis in Dubai, and with rapid development in China, passenger drones are going to change how people arrive at recreation sites. It will also make more rural locations within day-trip range from urban areas. Parking, charging, noise control (especially in wilderness areas) will be issues for recreation managers to figure out.

Jetpacks are a trope in Futures work, a symbol not just of the future, but the future that doesn't quite ever arrive. But the Defense Advanced Research Projects Agency (DARPA) just invested significant funds to bring jetpacks to fruition (Tran 2021). Therefore, it is plausible to plan for jetpacks becoming a daily reality sometime in the next decade or so. Jetpacks could be used as transportation, say from parking lot to fishing hole, or even from home to the recreation site. But they also may become their own recreational activity, like hang gliding and parasailing. Like passenger drones, the consideration for recreation managers are noise, landing and takeoff locations, and other infrastructure requirements. Airspace management might become a recreation manager's priority as drones (both passenger and remote controlled) and jetpacks become readily available.

Robots are another technology that have made rapid advances. While not yet applied to outdoor recreation, the possibilities are very real. Robots are becoming more adept and facile and are being built with adaptive learning capabilities. Hyundai has prototyped an all-terrain robot, capable of climbing over fallen logs and other rough surfaces while maintaining a flat top. The developers envisioned this robot assisting in research or in search and rescue missions. It can be carried in and recharged by drone, enhancing its potential for backcountry use. Robots could be useful in maintenance, someday perhaps doing routine chores like trash collection, or by checking trails for necessary repairs. Exactly when and how robots will be used in outdoor recreation is to be seen, but the possibilities are many and potentially significant.

Key point: There's robots on them thar trails

Robotics and other means of automation will likely be applicable to outdoor recreation, such as robot assisted search and rescue, perhaps automated routine tasks like trash management, checking trail status (for example, erosion or obstacles).

Key point: Pokémon Go was just the beginning: AR could transform some outdoor recreation

Mirrorworld and other applications of augmented reality (AR) could completely transform interpretation, heritage programs, and more, by allowing emersion in the past. This could be watching, or building games that allow participation in lifeways, activities, and experiences of past peoples on a forest.

Digitized realities are with us already. Virtual reality (VR) allows us to play tennis in our living rooms, while augmented reality (AR) inserts new features into the real world. Pokémon Go was the early exemplar of popular AR applications. But what is on the horizon is particularly striking: Mirror World. Mirror World seeks to digitize the entire world so that the real world and its digital counterpart can interact (Kelly 2019). Should Mirror World come to pass, the implications for recreation are many. Heritage programs could transform, allowing visitors to live an afternoon within the life of a forest 100 years earlier, to fish with the first peoples, to live in an area, to watch a forest change overtime, from cutting over to the Weeks Act, to the reforestation they see today. Mirror World could also spur new ways to play in forests, perhaps with AR-enhanced cosplay, or entirely new games yet to be invented. Meanwhile, VR could allow visiting a forest from home, either to play, to learn, or in other ways interact with a distant forest. While this could reduce some visitation, it could also allow those unable to get to a forest to still "visit" and interact with the woods.

Another few scan hits point to a potentially dramatic change for routine maintenance: self-repairing concrete. Still proving itself in trials, several approaches to concrete that can fill its own cracks and holes are looking promising. This is potentially a near-term advance and would make maintenance of recreation infrastructure, from fishing piers, to steps, to parking curbs, a set-it-and-forget-it proposition for recreation staff. Not as awe inspiring as Mirror World, but potentially transformational, nonetheless.

Ecological scan hits

Many of the ecology-related scan hits were discussed above in the section on climate change, including the expected significant wave of extinctions and other biodiversity losses. But there are several more worth noting. One is the impact of groundwater pumping. The affect for recreation is third order—reduced groundwater affects streamflow which in turn affects fish habitat. But the extent of groundwater pumping across the United States makes this a widespread impact, if particularly affecting the West. This is compounded by warming temperatures being implicated in reduced streamflow, too.

An issue that is part ecological, part technological, are the impacts of humans on remote areas, on designated Wilderness. As human impacts clearly affect all places on earth, and when advances like passenger drones begin to take hold in remote areas, what becomes of formal, designated wilderness? Is it sustainable? Or is it reconsidered, perhaps in the context of growing Indigenous rights and control, as "wilderness" is not a construct shared by most Native Tribes?

Key point: An end to wilderness?

As human influence reaches the most remote places on earth, making no place "untrammeled" by humans, will the effort to preserve wild places be given up? (Wilderness Act of 1964)

Recreation on Public Lands in 2040: Scenarios Drawn from Prominent Horizon Scanning Hits

Scenarios are a commonly used technique in Strategic Foresight. Scenarios build stories of what the future could look like. They help "take a long view in a world of great uncertainty" (Schwartz 1996, p. 3), or, scenarios are stories that help rehearse the future (Schwartz 1996). There are many types of scenarios and methods to develop them (Bishop et al. 2007). I wrote these scenarios to help managers consider how the potential developments suggested by horizon scan hits could affect providing recreation on public lands. The scenarios tell the story of forest adventures by Janelle and her grade-school-age son Jaquon as they travel from their home in Milwaukee for adventures on a National Forest in the Lake States region (Fig. 5). These scenarios synthesize several themes in the scan hits:

- **Tech Rec**—Tells a story of ways that technological advances may change outdoor recreation.
- **Retro Rec**—Tells a story of a possible response to Tech Rec, a desire for old school, offline, low tech rec harkening back to the old days. But that doesn't mean new activities aren't pursued within Retro Rec.
- **Indi Rec**—Tells a story of recreation on public lands that are co-managed by Indigenous people.
- **Med Rec**— Tells a story of a future where public lands are part of our health care delivery system, with detailed health benefits of different trails and activities informing planning and delivery of recreation.

Climate change impacts are woven into each scenario.

These scenarios are not mutually exclusive, nor will one of them come to pass and the others not. Think of these as more like the recreational opportunity spectrum (ROS; Clark and Stankey 1979)—a forest or region could offer Tech Rec here and Retro Rec there, or combinations of these scenarios (and more) across a range of settings. Scenarios are helpful tools to think about what might be, how to prepare for it, or to steer to an alternate future.

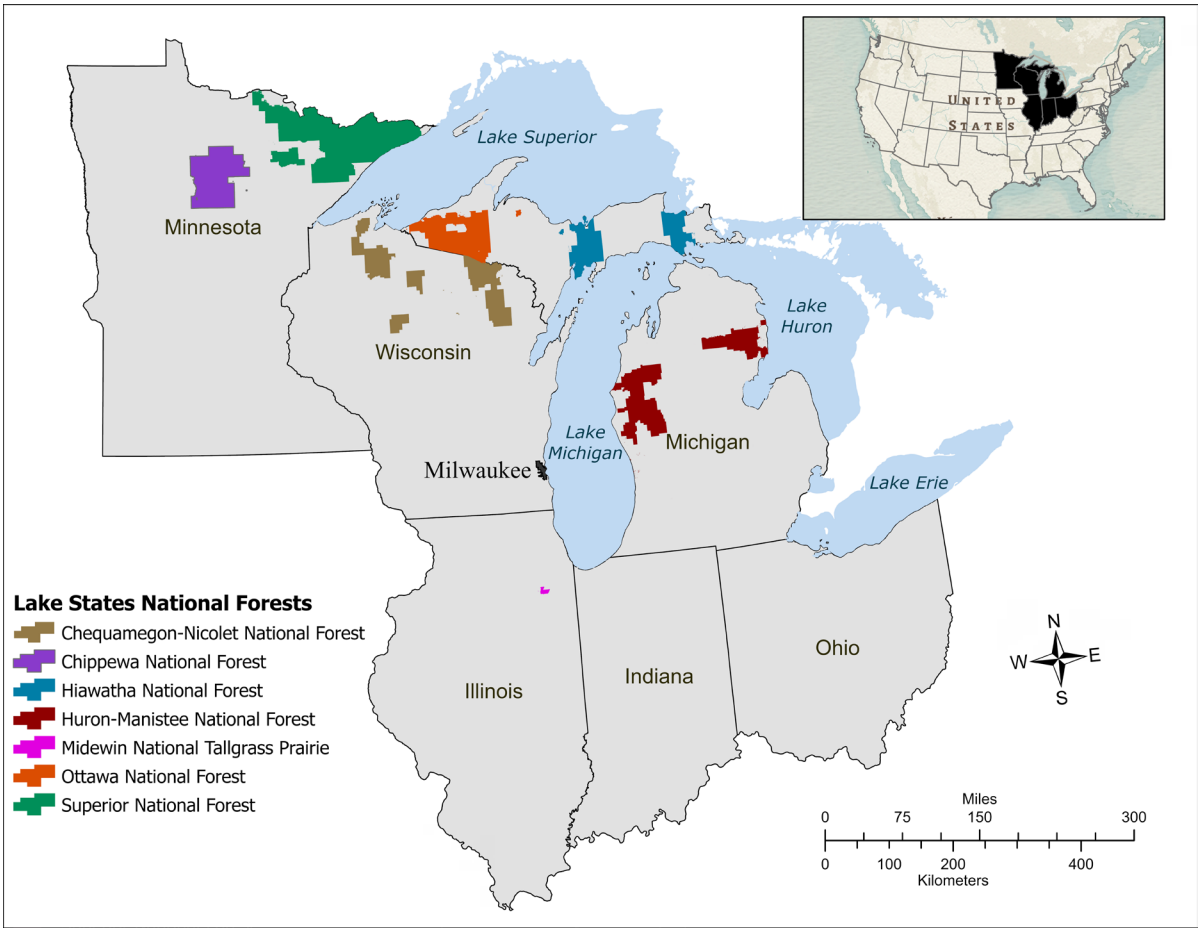

Figure 5.—Map of Lake States National Forests. Janelle and Jaquon live in Milwaukee and travel to various national forests for adventures

TECH REC

As Janelle went to check that her passenger drone had fully charged overnight, she contemplated where to go for the day. So many choices within reach from her Milwaukee home: the Huron Manistee? No, she'd gone there last weekend. But it'd been a while since she'd climbed the lighthouses of the Hiawatha. That's what they'd do today. And the drone port there was pretty good. Jaquon would like it, too, especially since he had a history report due soon and he was really into Great Lakes history. They'd have a blast.

Once loaded up with requisite picnic food and necessary gear, they took off, flying north over Lake Michigan, landing at the Hiawatha National Forest drone port in time for the lighthouse tour. They joined the group, donning their AR goggles along with the rest. The visuals were stunning, immersing Janelle and Jaquon into time centuries past, when the Ojibwe first came into the land looking for the prophesied place where food grew on water. The interpretive AR continued, moving on to the Voyageurs as they portaged and paddled across the Upper Peninsula in their huge canoes. Then life in the lighthouses was depicted, in all its lonely glory and hardships. The gale portrayed was stunning – it was amazing to realize they were actually warm and dry, not buffeted and sopping wet! Critical to shipping across the Great Lakes, the lighthouses and their keepers played an important role in the expansion of European settlements in the region. When the AR interpretive program was completed, Jaquon begged to buy access to the VR version to use at home. He wanted it so much he offered to do twice the chores at home to earn it. He was intent on learning all this history, and to one day live in a lighthouse himself. Someday. He had to finish grade school first, though. Maybe, he mused, he'd become a forest ranger so he could be around these lighthouses and huge trees all the time.

While Janelle and Jaquon picnicked on the sandwiches and apples they'd brought, a robot crew came to empty the trash bins. Janelle saw another robot team back from a trail reconnaissance. She'd volunteered once to view the footage these robots gathered to help guide the Forest staff in what trail segments needed maintenance work. Oh, wait, that was on the Chequamegon. These robot crews were everywhere!

Before heading off on a quick jaunt on a trail, Jaquon wanted to look at some of the new RVs in the campground. Several were the self-driving kind. He thought that could be fun, going to sleep in the RV and waking up in a new place in the morning, but would take the thrill of flying in the drone any day.

Janelle and Jaquon flew to another spot on the Hiawatha that had a favorite trail. Today they only had time for a short trek, but the trail went deep into backcountry. They were surprised when they landed to see a search and rescue (SAR) team coming out of the woods, with an injured hiker carried by an all-terrain robot. The SAR team had on exosuits, too, much to Jaquon's fascination. He asked as many questions of them as he could, but they were focused on getting the hiker to the hospital. But he was able to learn that they used the exosuits to reduce the risk to the SAR team and extend the range they could safely go. They also said they had the new jetpacks on order and were looking forward to trying them for future rescues. Now Jaquon had something new to add to his birthday wish-list. Make that two things. He couldn't decide what he wanted more, the jetpack or the exosuit. He figured his mother would be more likely to get him the exosuit. Maybe they could both get them, and then hike into that backcountry together next summer.

Retro Rec

Janelle's online ForestPlay MMORPG[1] friends had been buzzing all week: actual snow on the Superior National Forest! Enough to go snowshoeing or cross-country skiing. She'd snowshoed once, ages ago, but Jaquon had never been. In fact, had Jaquon seen snow? Dustings, yes, and hard frosts, but not a foot of new snowfall. Janelle was always amazed looking back at old family photos—snowmen and snow forts in the back yard! That'd never happen these days, they just didn't get the snow. Jaquon was in for a treat. Janelle couldn't wait to see the look on his face when he heard that kind of quiet you only get in the woods after a snowfall.

The Superior had a District designated for what they called "Retro Rec" – no hi-tech sports, no connectivity, just old-fashioned forest recreation. It provided a chance for folks to get out and recreate old school, with a compass instead of getting directions in smart goggles, where you hiked rather than fly your jetpack to the fishing hole. And you couldn't park your drone at the site, you had to park at a remote drone port and take a van to the Retro Rec site. They even mimicked a combustion engine in that van! It didn't really burn gas, but used a wood-based bio fuel instead. But still, Jaquon would be fascinated to see what engines used to be like. And the private drone port let a local earn a decent living, too.

The Retro Rec site, and other places too, had a lending library to let people try an activity before investing in gear. It made it so much easier to try new activities! Janelle had reserved snowshoes for her and Jaquon. They loaded the drone with their gear, some food, and a couple old-fashioned thermoses Janelle had inherited from her great-grandmother. She filled them with cocoa and hoped there would be a fire at the Retro Rec area to cozy up to after the snowshoeing.

The flight was beautiful. The snowfall was really pretty widespread, so the ground was white and glittery below them. They landed, grabbed their gear and boarded the van. Janelle was right – Jaquon was taken with the old-fangled engine. It was noisy! Once at the site, they picked up their gear. As they put on the snowshoes, they saw another group heading out into the woods. They were dressed up as the latest science fiction movie heroes and villains. Clearly, some cos play was afoot.

Before they took off, Jenelle and Jaquon listened in to a ranger telling a small group of recreationists about orienteering, including how to read the paper maps they had, and how to read the compass. The ranger also warned them to keep a close eye on the sky, to be sure they got back before dark. With no devices pinging the time, it was easy to lose track.

And off they set, into the snowy woods. Others had gone down this particular trail, so they didn't have to blaze the way, but they were the only ones on this segment at the moment. After they had gone several hundred yards in, Janelle signaled to stop. And she watched as Jaquon did, indeed, glow with awe at the silence that surrounded him in that snowy, old-school quiet, woods.

[1] Massively Multiplayer Online Role Playing Game

Indi Rec

This time Jaquon planned the trip. He was studying ecology in science class, and he wanted to go and learn on-site, from people whose lived experience of the land went deep. Jaquon told his Mom how forests managed by Indigenous peoples often have much higher levels of biodiversity, and that the closest place he knew of to visit was the Chippewa National Forest. The Leech Lake Band of the Ojibwe largely led management of this forest, building on a partnership begun with the Forest Service decades ago. Jaquon was curious about fish and was learning how so many fish populations had declined, or even been extirpated (Janelle smiled at how proud he was of knowing that word, and how to spell it) from previous habitats.

But fish were doing better on the Chippewa. The Leech Lake Band applied and adapted a lot of their traditional knowledge to keep many species alive in the lakes and streams of the forest. Jaquon picked a weekend where they could help with the fish stocking and habitat checks. Maybe not what some people thought of as recreation, but "fun" can look like lots of activities. And helping can be a lot of fun. And after the work was done, the Leech Lake folks were offering a chance to play lacrosse. Jaquon was excited to learn how to play that game. Janelle agreed that a weekend trip to the Chippewa National Forest was a great idea, so Jaquon sent in the registration to save their space for the weekend.

The day came, and they set off, the drone making it a short trip to the forest. They flew in Friday so they had a full weekend on the Forest. The Tribe and staff from the Great Lakes Fish and Wildlife Commission had arranged for the weekend activity, including shelter for the visiting guests—about 10 in all. They started Friday evening with a prayer giving thanks for the people, the forest, and all the nature relatives that call this forest home. Then they presented a history of the area, and Ojibwe lifeways, using AR. Jaquon was glad he'd remembered to pack their goggles.

The next morning, they set out to check on the fish. They walked through an area that had recently been burned, and the elder leading the event that day explained the role of fire in forest management, she also described how they prefer "leave a positive trace" instead of the "leave no trace" guideline so often suggested to forest recreationists. Jaquon imagined the people he "saw" in the AR program the night before, out here generations ago, using fire to shape the landscape. They got to the first lake for their work, and Jaquon and the others helped count fish species before releasing them back to the cold waters. Jaquon was fascinated with all the different shapes and colors of the fish, but the gapping mouths of large-mouth bass were the best—so funny looking! He imitated them until Janelle rolled her eyes and told him enough already.

Jaquon learned, too, that the Tribe limited certain types of activities in certain places. It got Jaquon thinking. It wouldn't be cool for someone to climb the Basilica near his house, so it made sense to not allow actions that disrespected important places on the forest, either. Jaquon noticed that the leaders didn't pepper them with facts like happened in school. Instead, they guided the work through stories shared about relationships between the plants, animals, and human beings, with relationships being central. He liked that, it felt right and made him aware of how much he loved his Mom and the time they spent in the forests.

Med Rec

Janelle was plotting a getaway with Jaquon and a friend of hers. Her friend was recovering from a severe illness, and Janelle wanted to help her feel better. She had contacted the public health staff at the Forest Service's Regional Office to find the best trails for her friend—the trails that were both easy enough for someone weakened from illness but that also had the specific plants and trees that emitted the chemicals that would help her friend heal. It was amazing what was possible now, more targeted than the general forest bathing of years past. The public health staff sent her the link to the app with the medical trail guide information.

So, Janelle knew which trails to look at, now she needed to check the weather conditions. It was spring, and the climate was, well, just weird. She checked the trails for which would have fewer effects from the smoke waves from the fires out west, and also have lower pollen levels. And flooding—needed to avoid that. Her friend was having a hard enough time breathing; she didn't need those stressors too. Janelle was thankful for the extra flexibility Universal Basic Income gave her and her friend—Janelle was still working, but she could be more particular about the jobs she took and take more time to help her friend, and to get out to the woods herself. The Happiness index sure improved when UBI was instituted! Not surprising, really, but the ripple effects were starting to show up, like drops in mental health issues nationwide.

Janelle had tried to get her mother to come along, too. But her Mom said she was "taking the exercise pill" so didn't need to be bothered with actual exercise anymore. Janelle was disappointed; she wasn't ready to trust that a pill could really produce the same benefits as exercise, even though the studies all said it was safe and effective. Besides, Janelle liked getting out to the woods with her son. She was glad he wasn't showing signs of biophobia like some of his friends. She wondered what their lives would be like if this fear of even simple, nearby nature defined their relationship to nature much longer.

With the right trail selected, the food packed, they set off. Janelle had a surprise for her friend: a special backpack designed to reduce the feel of the pack, reducing the strain of carrying it. Even packed light, a regular pack would have been hard for her friend these days. And if it was still too much, Jaquon would happily carry her pack for her.

Once they got to the Forest, and settled into their cabin, they set out for the trail. Janelle was always amazed at the range of people now using the trails: people with exosuits able to leave their wheelchairs behind, others who before would have been the "frail elderly" were fit and active by taking new drugs that slowed aging. Perhaps most astounding were the few folks with Geordie-style visors that restored their vision. She remembered her grandfather talking about that old Star Trek character, and here we were with some blind folks able to see and take to the trails.

Janelle dug out the long sleeves, tucked their pants into their socks, applied repellent. The tick- and mosquito-borne diseases were rapidly growing in number and prevalence. You had to plan ahead to protect yourself. But after all the prep, off they went, into the woods, down the trail, to enjoy the day and breathe in a little better health.

THE DEEP DIVE CHAPTERS

The previous chapter synthesized the recreation scan hit findings overall. Each of the following chapters takes a deep dive into horizon scan hits by topic area: recreation activities, recreation management and tourism, place-related issues, social issues (including economics and governance), technology issues, and ecological/environmental issues. Some of these topic areas are directly related to recreation, others are sources of outside influences on recreation—the STEEP categories. The scan hits in the synthesis (above) are included along with additional scan hits that add additional possibilities for the future of recreation. A single scan hit could be relevant in several topic areas, and so a scan hit may be discussed more than once.

These detail chapters are useful for a reader interested in a specific topic, such as fishing or climate change.

The green exclamation points indicate potentially high-impact change, should that scan hit come to fruition.

RECREATION ACTIVITY SPECIFIC SCAN HITS

There were many different recreational activities mentioned in the scan hits. I coded each individual activity, from hunting, to beekeeping, to just wandering. Then I categorized the activities into three broad groups: traditional public lands activities (the largest category by far), new activity for public lands (the smallest category), and other activities. The other activities' category (gardening, golf) is not discussed in this report because visitors rarely, if ever, engage in these activities on rural public lands.

Mainstay public lands recreational activities were also the one with the most scan hits suggesting declines: hunting and fishing, snow sports, wildlife viewing. But the three recreational activities with the most scan hits indicating a rise in activity are also common on public lands: camping, photography, and biking. And the recreational activities with possible significant declines also have scan hits suggesting the possibility of increased participation. Collectively, this suggests a fairly volatile future for many outdoor recreation activities, leaving recreation managers with considerable uncertainty on their planning horizons.

Traditional Public Lands Recreation Activities

The "traditional public lands recreational activity" category included obvious activities such as hunting, fishing, riding an all-terrain vehicle (ATV) or off-road vehicle (ORV), hiking, and camping. It also included stargazing, visiting interpretive sites, and gathering nontimber forest products. Of course, these activities can take place off of public lands, too, but they are the "bread and butter" of recreation on public lands. See the list (right) for the activities in this category.

Before getting to activity-specific scan hits, there are a number of scan hits that are relevant generally or across several outdoor recreation activities. I will discuss these before moving to activity-specific scan hits.

Biophobia—a fear of nature—in on the rise, and it is changing from its previous focus on fear of wild animals or other actual risks in nature. Psychologists are now seeing a shift to this fear being triggered by fairly ordinary events, like a noisy flock of birds. This change may stem from fears of having children be outside (stranger danger, etc.) so visitors have less experience with even ordinary nature. Whatever the cause, it impacts both children's and adults' comfort in natural areas, and discomfort will curtail people's taking up adventures in the outdoors.

Traditional public lands recreation activities included:

- **ATV/ORV**
- **backpacking**
- **biking**
- **boating**
- **camping**
- **climbing**
- **gathering, NTFPS**
- **hiking, walking**
- **horseback riding**
- **hunting & fishing**
- **interpretive sites**
- **photography**
- **picnic, BBQ**
- **snow sports**
- **stargazing - dark skies**
- **swimming**
- **volunteer**
- **water sports, other**
- **wildlife viewing**

Scientists see mass extinctions on the near-term horizon. This affects all types of animals, but birds are especially in decline, with one in eight threatened with extinction. Globally, farming, logging, and hunting are key drivers of extinction. Additionally, state wildlife managers see climate change and development threatening species, at the same time that the public interest in protecting wildlife is on the rise.

In an economic modeling study, downhill skiing, interpretive site visitation, hiking, and birding were expected to increase the most (FICOR, n.d.; White et al. 2016). *But* this study did not take climate change into account; climate data points to a sharp decline in downhill skiing due to decrease in snowfall, as well as climate change's negative impacts on birds. Hunting, snowmobiling, ORV riding, and fishing grew the least (but this model indicated some growth).

States are creating offices to support outdoor recreation in recognition of the considerable contributions from recreation and tourism to local economies. Some states, such as New Mexico, are creating micro grants, lending libraries, and other mechanisms to support access to recreational activities that require equipment and transportation. New Mexico leaders were interested in addressing both equity issues and the desire to create the next generation of stewards.

Another current trend is academic programming that teaches college students different sports and provides recreation opportunities. These activity-based courses range from backpacking, to stand up paddle boarding, to rock climbing. Some offer training in safety and search and rescue, such as avalanche rescue. Even if the course trend fades, students in these courses now may persist in the activities they've experienced and may take up new outdoor recreation activities after college, creating a new cadre of recreation participants.

Lastly, using forests as healing environments is exploding in the United States and globally. Already commonly practiced in Japan and elsewhere in Asia, forest bathing, or ecotherapy, provides quiet emersion in natural areas with health outcomes as the goal. The health section discusses ecotherapy more fully, but offering ecotherapy in parks and forests currently may be a trend that will last and even get more specific as new research findings emerge.

Hunting and fishing

Hunting and fishing are not just traditional recreation activities for public lands, these activities conjure iconic images of people in wild spaces, rivers running through lives and land, providing for family and friends, time spent with elders learning the ways of other species. The scan hits related to hunting and fishing pointed to both increases and decreases in these activities. Water quality impacts, climate change, species loss, and other issues were identified in the scan hits as pressures leading to lower participation in hunting and fishing. Many fewer scan hits point to increases in hunting and fishing.

One trend documented in longitudinal research reflects changing values regarding the relationship between humans and animals. There is a consistent decline in people who hold "traditionalist" attitudes and an increase in the number who hold "mutualist" attitudes. Traditionalists view humans as dominant in nature while mutualists see animals (and perhaps other aspects of nature) more as peers, as deserving of the same rights as humans. This shift in values could reduce participation in hunting and fishing, or at a minimum suggests changes in how to engage with larger parts of the recreating public about these activities.

Water quality-related scan hits include the growth of the Gulf of Mexico dead zone, or the low-oxygen hypoxic area. Hypoxia kills aquatic life, thereby limiting both commercial and recreational fishing. Browning of surface waters is also on the rise due to some effects of climate change. Browning occurs when there is an increase in dissolved carbon and iron concentrations. Browning of surface water reduces fish productivity by reducing

light penetration, and so effects recreational fishing. Researchers suggest managing the surrounding landscape to reduce browning (Kritzberg et al. 2020).

Water *quantity* is an issue, too. Groundwater pumping reduces fish populations. Pumping groundwater accounts for as much as half of the reduction seen in stream flow in some areas, even drying up some streams altogether. Another climate change impact is seen in the Colorado River now—while previous flow reductions were due to reduced rainfall, now higher temperatures also contribute to reduced flow. Lower flows decrease water-based recreation and affect fish populations.

Scientists predict mass species die off in the coming years and decades, instigated by extreme summer conditions and other impacts of climate change. Fish die-offs will limit fishing and are expected to increase fourfold by late in this century. Scan hits also suggest the coming of the "empty forest"—empty and silent because animals are gone or at least so reduced, leaving wind and water the only source of sound. The effects on hunting are complex; hunting is thought to be speeding species decline in the tropics, and of course, species extinction reduces game for hunting.

Energy development contributes to climate change, including through the release of methane. Rising temperatures, in turn, negatively affect wildlife populations, leading to a decline in the quality of hunting, fishing, and wildlife viewing.

Climate change will likely produce these and other changes that reduce success in hunting and fishing, and therefore decrease participation in these activities. While some suggest that these declines may be offset by a rise in population (which means there are more people who might become hunters or anglers), the greater number of scan hits suggest hunting and fishing are likely to continue to *lose* participants. For example, the sale of hunting licenses shows a considerable decline in per-capita license sales, although in absolute numbers the decline is much smaller. This suggests that there is slow attrition in existing hunters and anglers and limited recruitment of new participants in these sports. This decline pinches state and local economies because license sales are fundamental to funding recreation and conservation programs.

The decline in license-sale revenue is expected to be acute by about 2030. Efforts at the "R3 strategies: recruiting, retaining, and reactivating" hunters and anglers aim to stem the losses. The locavore movement is sometimes used as an entry point for hunting and fishing. Still, license trends suggest Gen X and Millennials are not taking up hunting and fishing at the rates expected. Tax revenues on sale of fishing gear show a similar pattern. Some states are turning to specialized license plates, sales tax, and other revenue generating ideas.

Tribes and other native groups are exerting control of their native lands and are shoring up rights to access to nontribal lands (e.g., ceded territories). In some circumstances, such efforts will limit access by non-Natives for hunting and fishing. One example is in Canada where the Innu are claiming land that hosts an upscale camping and second home community popular for fishing.

Two scan hits point to possible significant change. First, new research indicates that, contrary to previous beliefs, fish feel pain. This could reduce interest in fishing and increase the trend toward vegetarian and vegan diets. Second is a finding currently specific to the California coast: red urchin behavior is changing, and urchins are destroying recreational fisheries, especially red abalone fisheries. It is thought the changes are linked to climate change, and that changes in animal behavior may become more prevalent with changing climates and systems.

While there are plenty of scan hits suggesting less hunting and fishing to come, there are also scan hits pointing in the other direction, to increased participation. Multi-sector support for actions such as designation of wild and scenic rivers indicates continued support for protecting the environment, and the recreational activities natural areas support. Support comes, in part, from the economic impact of outdoor recreation. One specific scan hit example was support for designating the Gila River in New Mexico a wild and scenic river.

Women and Hispanics are fishing more than ever before, from data reported in 2019 (Arvesen 2019). And with this are new groups like Brown Folks Fishing, an advocacy group that connects fishing to a common role of Indigenous peoples as water stewards. However, fly fishing specifically, did not show a diversification of its recreation participants.

A few other related scan hits:

- There's a new trend: magnet fishing. Metal detecting aficionados use their gear in rivers and streams to find and remove metal. The metal hunters get some cash and riverbeds get cleaned of debris.
- Outrider is a new service proving access to hunting, like Airbnb but for hunters and hunting. It was started by a transplant to Texas, a state with little public land for hunting. To what extent is private land the future of outdoor recreation?
- While fishing gear sales are in decline, guns and ammunition sales are on the rise. And the "locavore" movement is used to recruit new hunters.
- Warmer winters have one good impact: longer blue crab seasons in the Chesapeake Bay area, which is good news for crab fans.

Snow and winter sports

Snow sports are facing dramatic change. Climate change may obliterate skiing and other winter sports in the United States. The snow season is already a month shorter than in the 1980s (Hansmen 2021). The best expectation is for erratic winters, the worse expectation is for insufficient snow for skiing, snowmobiling, and other winter sports by the end of this century. New England is expected to be particularly hard hit. Nearly 200,000 jobs, billions in wages, and further billions in tax revenue are threatened.

The ski industry is responding in several ways. They have developed ski passes good at any ski resort in a chain. The industry is lobbying for effective climate change policies and is changing ski resorts to be more climate neutral. Some resorts have set a goal to be carbon neutral by 2050.

Similar effects are being seen in Europe, with glacial melt in the Alps occurring at a fast pace. Ninety percent of the remaining Alpine glaciers are expected to be gone by the end of this century.

But there are hints of what might replace existing snow sports, and some emerging winter sports. Biking is proposed as an alternative to some winter activities, with fat bikes able to handle the slush and other conditions of lengthening "shoulder" or nonpeak seasons. A new winter sport is forest skating. Skating on frozen paths through a winter forest landscape is popular in Canada, and a few paths exist in the United States. Forest skating requires sufficient cold for ice but is more amenable to intermittent cold than are snow sports. But there is hope for snow sports, too: in Copenhagen, a landfill has been constructed with a covering like a ski slope, and voilà: skiing without winter.

Another potential technical fix to the decline of snow comes from a company that specializes in refreezing tundra for oil companies (who depend on frozen tundra in order to drive trucks through the Arctic). Using refrigerated tubes inserted in the ground, this company keeps things cold. The scan hit is this: could the same technology be applied to winter sports, thereby saving winter in some locations?

Wildlife viewing

Several issues have the potential to substantially alter wildlife viewing. Primary among these (and mentioned above) is the expectation of massive extinctions, also known as the sixth mass extinction. Some predict "empty forests" as fauna decline. Birds are already facing massive rates of loss.

Climate change affects different animals in different ways. Birds can move more easily, and in mountain areas birds are documented to be moving to higher areas. This movement isn't necessarily good for the birds, as they are less adapted to the habitat at these higher levels. Freeman and colleagues (2018) found that almost all bird populations had declined significantly between 1985 and 2017, and a number had already gone extinct.

However, in the short- to mid-term, public lands in the United States may see an increase in bird diversity (Wu et al. 2018). Birds may take up residence in new areas, and this dispersal was modeled to outweigh extirpations. Birding is a popular activity, and bird populations are a draw for wildlife viewing tourism.

Charismatic "megafauna"—large animals such as bison and moose—are a draw for tourism. Some towns in the West have switched from extraction-based economies to recreation-based economies, and wildlife viewing is often a major draw for tourists. For some towns, an outdoor recreation focus with plenty of public lands is creating a population boom. Additionally:

- Shark tourism is on the rise. In Cape Cod, where seals have rebounded, sharks that prey on the seals are also on the rise.
- Bison are affected by hot climates, but not so much by hot years. The hotter the climate, the smaller the bison. Bison are also a key draw to numerous public lands.
- Airbnb hosts are now offering of animal experiences at some of their locations. Most of these Airbnb hosts are likely offering encounters with domesticated animals, but the approach could be applied to wildlife viewing as well.

And in Mexico, farmers have realized that fireflies are a draw. Farmers provide camping for tourists to see the fireflies that abound in the farmer's fields. Romance seekers and families with younger kids are key populations for firefly tourism.

And yet, wildlife viewing is also stressful for wildlife, more stressful than motorized sports (the behavior of birders, hikers, photographers can mimic predator behavior in a way that raises stress levels for wildlife). Therefore, unmanaged wildlife viewing can have negative repercussions for the animals.

Water sports: boating, swimming, andother water-based activities

There are a number of scan hits about water-based recreation. Water sports are being negatively impacted by blooms of blue-green algae. Climate change bringing increased precipitation and warmer waters, combined with aging sewer infrastructure, are likely factors in the increase in these harmful algae blooms. People and pets can be sickened or even killed from exposure to these algae.

Floating (also known as tubing) is increasing in popularity, and models suggest continued, but slower, growth.

Governments are taking steps to increase access to rivers. This includes encouraging some rivers being designated wild and scenic, or changing regulations that allowed landowners to limit river access through their property. The economic benefits of an outdoor recreation economy are often the impetus for these actions. Nonprofit and for-profit partners are also actively supporting the outdoor economy, and access to public lands for rafting and other activities.

Hawaii's coral reefs are in decline with projected economic losses from reef-based recreation estimated at over a billion dollars per year by 2050. Scan hits suggest that climate change actions would somewhat reduce the coral decline and loss in revenue but would not eliminate it.

Hiking, walking, and trail running

Unlikely Hikers is a social media account aimed at expanding the idea of who plays outdoors. They put the focus on presenting a more diverse range of hikers, rather than the narrow focus in most outdoor recreation photos of thin, super fit, White people. That stereotype can be limiting to those who want to hike but don't fit that profile. Social media supports a wide array of similar organizing and outreach efforts; Unlikely Hikers is just one organization among many with similar goals.

Other efforts to offer the opportunity to try an outdoor recreation activity include affinity groups providing access (e.g., Blackpackers), programs like the Santa Fe Mountain Fest that allows trying out trail running and other activities, and New Mexico's small grants and lending libraries for equipment, including hiking boots. Nepal launched an accessible hiking trail to provide recreation for people with mobility issues and to tap an underserved market.

A countertrend to increases in trail running and other activities in public lands is conflict with wildlife, especially bears and mountain lions. The speed and surprise of runners and bikers on trials can trigger an attack, and sometimes recreationists have collided with the animal. If trail running and related activities continue to grow, dangerous encounters with wildlife will also likely grow. Trail use can also disrupt animal behavior, causing animals to move away; biking especially has this affect. These encounters and behaviors also decrease time the animals are foraging, resting, and grooming—all behaviors critical to animal health.

Riding: bikes and horses

New types of bike trails are being created to offer new biking options. Some bike paths are built up in the tree canopy. Others are heated to allow easy winter biking. Some offer routes through rural areas, and education about the agricultural landscape the bikers are traveling through.

There are also signs of increasing conflict between land managers and bikers, such as desire for using unofficial trails made by bikers that are problematic from a land manager's perspective.

Scan hits on horseback riding were few; in fact, there were two. One was about a climate change effect that set up conditions where a type of worm that can infect horses and other animals infected a human horseback rider. The second deals with crowding in backcountry settings, with national forests implementing permit requirements to limit the number of trail users, including equestrians.

Camping and backpacking

Camping comes to social media. Apps like Hipcamp and Tentr (think Airbnb for camp sites) have taken off in recent years, providing not just camp sites but outdoor experiences for thousands. Across 300,000 campsites in Hipcamp alone, recreationists can find quiet retreats, working farms, and more. Many government camp sites are listed, but so are many on private lands. Offering up a site on private land provides income for rural landowners. Camping sites are popping up in new places, like floating inflatable tents to sleep on the water, other tents clinging to cliff sides, and some above the arctic circle. Others are building camping sites in the treetops.

Airbnb has expanded into providing experiences, including with animals. A Texas entrepreneur created an Airbnb-like business providing hunting opportunities, filling a gap given Texas' relatively low rate of public land available for hunting.

Farmers in Mexico realized they had a business opportunity in providing camping sites to tourists who would come to see the fireflies that abound in the farmer's fields. The sites are particularly popular with families with young children and romantic-site-seeking couples.

Recreation vehicles (RVs) are gaining popularity. Whether this is only a Horizon 1 trend that fades away or continues further into the future remains to be seen, but the current changes are substantial. RV buyers are often younger and more diverse now. RVs are smaller, less 5th Wheel, more camper van. But campers are also getting rugged, with 4x4 capability.

And coming soon are self-driving RVs; prototypes were developed in the past few years.

There is a push from the RV and campground industry to privatize campgrounds on public lands. Some argue this provides people with the facilities they desire, while others argue this negatively affects the nature of the experience on public lands.

Photography and art

Some places have become famous for photos. Antelope Canyon in Arizona is one such place; Horseshoe Bend, in the same state, is another. Visitation to Antelope Canyon, on Navajo land, grew so much that the Navajo now limit the numbers by regulating the tour companies that can take people to the canyon. It's a mixed bag: income and job opportunities for Navajo, but most visitors have limited interest in the Navajo history in the canyon and its meaning in Navajo culture.

The selfie is not new, but some see the perfect Instagram photo as a bane of natural areas. There are efforts to reduce geotagging to protect sensitive sites. Some sites close altogether after becoming overly popular and therefore having to manage crowding and site degradation. But there is a counter argument to the damage of the Instagram-driven life—

that social media provides an important avenue to participation by groups and individuals that have felt excluded from recreation on public lands.

And finally, artists are creating installations to draw people to natural areas and reinterpret these places for new audiences.

Climbing

Safety professionals are seeing a rise in climbers without sufficient skill and information, even with a surfeit of information available online, and they are seeing many new climbers trying climbs beyond their skill sets. Some climbing groups, such as the Colorado Fourteener Initiative, developed training materials about difficult mountains in an effort to reduce the risk to inexperienced climbers. Others are using Instagram and other social media to share more of their accident stories to communicate clearly about the risks of climbing.

Another risk for climbers is remote-controlled drones. Climbers report being buzzed by drones, startled, and thrown off balance. With drones allowed on most public lands (the National Park Service is the only federal land manager to ban them), the threat of drone interference is growing.

Other climbing scan hits:

- Ice climbing, and competition in this sport, is growing.
- Some colleges are offering outdoor recreation programming, including climbing. Montana State University, for example, offers "activity-based courses."
- There is some concern about climbing and other outdoor recreation considered as elite, as presented in the media, requiring expensive gear and distant travel. This perpetuates a sense of who belongs and who does not, in the outdoors and on public lands.

Gathering and nontimber forest products (NTFPs)

Gathering foods and medicines from the forest and other natural areas is an age-old tradition, but one with a growing popularity. Supported by several trends including the locavore movement, foraging and gathering is practiced from city parks to remote wild places. Parks and other public spaces are being planned with edible landscapes available for harvesting by nearby residents. In some cases, gathering NTFPs can contribute to local economies, either through barter or cash transactions. Gathering is also fundamental to lifeways and traditions in Tribes and in other communities. While gathering and foraging sometimes blurs the "recreation" line, it can be an important activity that is both enjoyable and sustaining.

Volunteering

Citizen science is a recreational activity for the citizen scientists and participation in it has been growing over time. Citizen scientists are contributing to studies of climate change. For example, the Smithsonian Museum of Natural History is using citizen-gathered gingko (*Ginko biloba*) samples to trace climate change impact. One business developed affordable dendrometers with an eye to building a network supplying data points for research data mining. Other examples include:

- The Faroe Islands offered a weekend of projects to help maintain the Faroe Islands with an exchange of volunteer labor for free accommodation.
- The "trashtag challenge" encouraged teens to post social media photos of themselves and the trash they collect at a natural area. Such challenges can go viral, spreading action and volunteering.

Technology is supporting an explosion of opportunities for citizen science. Much of this is controlled by researchers and their organizations, such as the Virtual Forest (Hufkens 2016), but some new groups are putting research in the hands of the engaged citizen. The group based in England, the Nappy (as in diaper) Science Gang is one example of this – empowering science and investigation to answer real-world questions. This is serious leisure in action.

Interpretative Sites

Visiting interpretive sites is expected to grow in the future, despite overall declines in per-capita recreation participation. Countervailing this idea of increased visitation to brick-and-mortar interpretive sites is the shift to online interpretation and field trips. Virtual visits like this can expose children and adults to distant locations they may not otherwise be able to visit.

Stargazing and Dark Skies

Dark skies are a tourism draw. National Geographic has developed the first ever outdoor planetarium in Quebec. Using AR, the planetarium overlays digital content to the view of the night sky. And an Illinois forest preserve has made lighting changes to be certified a "dark-sky park" by the International Dark-Sky Association. These are just a few examples of the trend to providing dark sky experiences.

Picnic, BBQ, food related

Restaurants have popped up providing unique dining experiences in the woods, such as eating high in the trees, or in a treehouse pod, and eating foods unique to the locale.

Off-road vehicles

"ATV experience zones" are being created in part to expand the market for these vehicles. ATVs and other off-road vehicles are part of the growth in "adventure tourism." Countering this is an economic analysis suggesting "off-roading" is one of the recreation activities expected to decline more than others.

New(ish) Recreational Activities for Public Lands

The scan hits mostly covered existing recreational activities on public lands, signaling possible growth in some, such as the dark skies movement. The scan hits also suggested three new or morphing activities: festivals, cosplay, and jetpacks.

Festivals and related

While festivals on public lands aren't new, festivals are now specifically celebrating the woods, with art installations, family friendly activities, environmental education, and social time with likeminded others.

Cosplay

The Brooklyn Botanic Gardens has found itself popular for cosplay—fantasy play in costumes. The setting, especially the Japanese garden area, supports specific anime-related cosplay. This use may spread to more remote public lands and could be a means of engaging new visitors to public lands.

Jetpacks

Jetpacks got a recent development boost with a major investment from DARPA. Jetpacks could become not just a transportation option, but a recreational activity in their own right. Like paragliding, jetpacks could be a fun and relatively affordable way to take to the skies. Jetpacking near wilderness areas could pose management problems.

Figure 6 on page 45 summarizes recreation activity-specific recreation horizon scan hits, categorized by scan horizon.

Recreation Futures Across Horizons: Recreation Activities

Horizon 3

H3 scan hits are highly uncertain, the weak signals of possible change. These can seem laughable and weird. H3 scan hits are also typically the furthest out in terms of time, easily 20 or more years in the future. These are the "new" ideas.

Horizon 2

H2 scan hits are in between. They are not yet visible in our day-to-day lives, but could happen soon, and the level of uncertainty is moderate. These changes are more likely, but not a given. They are "next".

Horizon 1

H1 scan hits refer to signals of change that are evident in the system today, or that are imminent. Therefore, the level of uncertainty regarding this change is low. They are now, or near (Hines et al. 2019).

Figure 6

RECREATION MANAGEMENT AND TOURISM SCAN HITS

This section covers scan hits related to possible changes in the business and management of recreation, and to tourism generally. Rather than trends in specific activities, these scan hits suggest possible changes in tourism, safety, infrastructure, recreation gear, transportation, and more. These scan hits point more to increased rather than decreased recreation. However, the scan hits that point to reduced recreation are strong signals, such as Americans' reduced vacation time and the effects of climate change.

Tourism

Scan hits suggesting a decline in tourism stem from American vacation patterns, climate change impacts, and more. Scan hits suggesting an increase in tourism include the impacts of social media, climate change solutions in development, and an increased societal focus on adventure and experiences.

Many Americans leave vacation time on the table, untaken, and most have far less vacation time (if any) than do workers in European countries. Millennials and younger generations are taking shorter vacations, which means more domestic travel than international. If these patterns continue, it could boost local tourism at the same time that overall tourism could decrease.

Climate change is already causing changes to tourism, with more to come. A warming climate is affecting water, reducing (and in other ways changing) fish populations, increasing the number and severity of toxic algae blooms, reducing stream flow. Oceans are rapidly acidifying. All of these, in turn, effect swimming, boating, and fishing—all draws for tourists. Ocean acidification alone is linked to a potential $1 trillion loss in revenue per year from tourism, fishing, and other ecosystem services (Secretariat of the Convention on Biological Diversity 2014). But the largest tourism effect on the horizon from climate change is the expected dramatic decline in snow fall. Some scan hits suggest that winter sports will disappear in the United States. The impact of this change would be huge, with snow sports currently contributing approximately $20 billion to the U.S. economy each year.

A final tourism impact suggesting less tourism overall is the call to simply stop any travel that can't be done by foot. That is, only carbon-free travel, utilizing bicycle, horse, canoe, etc., is promoted in order to reduce climate change impacts. Air travel is a major source of carbon and therefore a major contributor to climate change. However, there are also advances underway to reduce or eliminate the carbon footprint of commercial flight: electric jets, hydrogen fuel cell powered jets, and more are in development. Therefore, climate change induced reductions in tourism may be short- to mid-term while alternative modes of travel are developed. Once to scale, tourism could rise with clean transportation options to get from here to a new there one has never seen.

Additional tourism-related scan hits include:

- Social media content about dramatic places, different activities, van life, and more have changed visitation and tourism patterns. This has led to overcrowding and degradation in some locations, such as Horseshoe Bend and Antelope Canyon.
- Adventure travel and gaining experiences (rather than things) is a growing trend in the millennial generation and younger.

Safety, Including and Search and Rescue

Several factors emerged that speak to new issues in safety and search and rescue (SAR) in outdoor recreation. Some scan hits point to increased risk for recreationists, some point to increased ability to *take* risks, and others suggest changes for those who do the rescuing.

Lead in the scan hits that suggest a greater ability to accept the risks of outdoor recreation is the possibility of universal health care. Two of the possible effects are a simple increase in recreation because people are less concerned about being able to manage simple injury or illness, and increased engagement in high risk activities because health care costs from any accident or other mishap would be covered. Related to this is a new startup that issues "on demand accident insurance" available for purchase ahead of an adventure trip or outing.

Social media displays of dangerous recreational activities can have the effect of making that activity look safer than it is. This, in turn, can increase the number of people trying the activity without the preparation or skills needed, leading to more accidents and need for rescue.

Recreationists like through-hikers are carrying more high-tech gear that can help them stay safe or make them easier to find if rescue is required. Personal safety beacons are one example of such technology.

Rising temperatures and heat waves are increasing risk for recreationists and increasing the need for rescue from heat emergencies. As temperatures are expected to continue to climb, this added burden for search and rescue can be expected to remain or increase. Recreationists may not be prepared for the new heat-safety realities, increasing the demand on safety personnel. Additionally, heat stress effects more often strike immigrants and Hispanics. Over time, the added threats from rising temperatures may reduce the number of people interested in outdoor recreation. Further complicating matters is that the time between heat waves is decreasing, which adds stress to infrastructure, staff, and individual health, making everything more vulnerable to damage. A last impact of increased more heat is that it is also increasing the prevalence of chronic kidney disease, including a new variety of kidney disease linked to dehydration and heat exposure (University of Colorado 2019). So far, agricultural workers have been most effected, but this disease is linked directly to effects of climate change (University of Colorado 2019).

Therefore, this may signal a risk for outdoor recreationists as well, especially novices unfamiliar with basic safety precautions. This is one of the scan hits more likely to impact some regions more than others, with hotter and dryer areas presenting a higher risk.

People taking up residence on public lands due to lack of other housing options sometimes increase safety issues, for example by escaped campfires leading to large wildfire. Some of the residents also have health issues that call on local land management or SAR staff to address.

With increases in recreation such as trail running and riding, there are increased conflict with wildlife, especially bears and mountain lions. The speed and surprise of runners and bikers on trials can trigger an attack, and sometimes a recreationist has run into the animal. The safety issues are obvious, and potentially deadly, and any significant increase in incidents will raise demand on SAR resources.

A positive change in search and rescue is the ability of drones to help. Drones can be used to look for the missing, and can go into difficult terrain with ease, allowing more area to be searched with less effort. This reduces risk and stress on SAR staff, increasing the safety for these professionals and volunteers. In one instance, a drone was used in a sea rescue in Australia, with a drone delivering a safety raft to swimmers in need of rescue.

An additional technological advance that could help search and rescue is the use of exosuits to alleviate some of the strain and assist rescuers on arduous treks to find lost recreationists.

Infrastructure and Maintenance

Outdated storm water infrastructure can increase the likelihood of pollutants causing algae blooms that disrupt water-based recreation.

There are several research teams aiming to develop self-repairing concrete. None are in production yet but are proving themselves in tests. Should this come to pass, it could solve a routine problem in maintaining recreation infrastructure: crumbing concrete steps, piers, viewing platforms, and more.

Drone taxis already exist, and Airbus is working on flying cars. GM has two passenger drone prototypes they plan to have to market in 2025. It is likely that some recreationists will soon begin to arrive at public lands recreation sites by drone or other personal flying craft. What are the infrastructure needs for such vehicles?

A heated bike path in the Netherlands allows all-weather bicycle commuting. Perhaps where skiing is reduced for lack of consistent snow, this would allow safer biking through the extended shoulder season. Ice-free paths would also increase the accessibility for wheelchair and other device users.

The rise in RV use points to interest in more camping infrastructure. Not all RVers want camp site hookups, but many are interested in more camping infrastructure. Some suggest that privatization is the means to achieve the level of infrastructure, while others argue public lands should not be overly developed. Several scan hits explore possible reconfigurations of campsites and offerings, using different layouts, advanced technology like AR (augmented reality), and more.
Broader infrastructure changes may create new opportunities for recreation. One scan hit suggests that if the restructured energy grid proposed in the Green New Deal were implemented, it would have a secondary impact of creating a trail network from cities to rural areas by using transmission line corridors as trails.

Recreation Gear

Exosuits are already used for manufacturing to reduce injury on the job. Such wearable devices may one day assist recreationists as well, allowing more people to recreate, or to recreate longer in their lives. One scan hit highlights the efforts of a quadriplegic who was able to walk more than 100 miles with the use of an exosuit.

Other examples of new gear that makes outdoor recreation easier are:

- Backpacks designed to lighten the load.
- Personal safety beacons.
- Vision devices.
- Devices that predict oncoming seizures.
- Communication devices for ALS and patients of other debilitating diseases.
- Wearable cooling and heating devices.
- New designs of bike helmets, with a device not unlike a car's airbag, to prevent head and neck injury.

The rise of such gear is credited for increased hiking of the Pacific Coast Trail and other long-distance hiking, suggesting that other advances in gear may increase numbers of recreationists. Additionally, recreation gear and clothing brands are expanding size ranges to support recreationists of any body type and size, a step towards inclusivity in outdoor recreation.

Several initiatives are creating equipment lending programs to allow people to try a new outdoor recreation activity without concerns about cost. Because cost is a barrier for many, providing a means to try an activity is a step to increasing diversity in outdoor recreation.

Accessibility for Those with Disabilities

The technological advances described in the technology chapter are important for increasing access for people with mobility and other issues. Exosuits are likely to become more widely available and helpful to people with mobility and stamina issues, such as the use by a paralyzed man who was able to walk over 100 miles using the exosuit.

Other accessibility advances include:

- Communication devices help some people feel more comfortable being alone on the trail or in the woods.
- Video blogs (vlogs) of trails and recreation sites introduce people new to outdoor recreation to the possibilities, and can reduce uncertainty of the unknown, and provide information about accessibility requirements before arriving on site.
- Other technological advances currently underway assist ALS patients, detect epileptic seizures before they occur, and use AR to rectify vision issues.

This movement is just starting, and assistive devices will make many activities possible for many people currently limited by physical issues. Collectively, technology is increasing the range of people recreating and the activities they can undertake.

Transportation

Self-driving vehicles and personal flying transportation are the two dominant topics in transportation-related horizon scan hits. Self-driving cars already exist, of course, though they have not gained wide-spread use due to safety and other concerns. However, experts in the field see it as a matter of time. And self-driving vehicles won't stop with cars: self-driving RVs are already in the works.

Personal flying machines deserves a closer look. There are numerous efforts to develop vertical-take-off and-landing (VOLT) personal flying machines. Some prototypes resemble helicopters, some drones, some planes. Some developers are exploring hydrogen power cells, others are looking at electric power. But the amount of development suggests that in the foreseeable future, at least the wealthy will be able to travel further for both day and longer trips in their "flying cars." This could dramatically change the infrastructure demanded, and the number of recreationists, at public land recreation sites.

At the same time, nearly all aspects of transportation are electrifying—bikes, cars, trucks, semi-tractor-trailers, public transit, jet airplanes, trains, and ships. A Chinese company has tested electric passenger drones. Electric travel, and other non-fossil fueled travel options, are critical to sustainable tourism. Electrification also substantially changes infrastructure needs, including the need for charging stations.

There is a follow-on point to the rise in electric (and other alternative powered) transportation: reduced effects of climate change. If transportation and the energy grid change as much as some scan hits suggest, it would mean much less carbon and other greenhouse gases released into the atmosphere, which in turn reduces the climate change impact on forests and other public lands.

There is a small but growing call for eliminating car dependency, starting in cities. Should this take hold and grow, it could change the ways that people travel to public lands and could change the great American road trip.

Jetpacks may soon be available, too. Recreationists may use them as transportation, for example to get from the parking lot to a favorite fishing hole. And jetpacks could become a recreational activity in their own right.

Pets

Pets are threatened by several emerging pests and pathogens; two examples are new ticks carrying disease, and an increasing number of blue-green algae blooms that can be fatal to dogs.

The legalization of marijuana is having a surprising knock-on effect for dogs: veterinarians in Colorado are seeing more dogs that are high. The dogs eat feces deposited trailside, and enough THC remains in human feces to affect dogs.

At the same time, dog ownership is on the rise, as are businesses that cater to pet owners and pets. One example is a company that does more than just walk your dog; they take them on "an adventure," in this case often on public lands.

Other Topics: Privatization, Living on a Forest

Economic and health forces in our society are pushing people to live on public lands. This is a current and growing trend, one that, if it continues, will increasingly impact recreation, wildfire, and infrastructure. And, like the expanded expectations of city police, unhoused people living on forests set up forest employees to act as drug counselors, social workers, and in other roles for which they are not trained.

There are several scan hits regarding privatization. The nation of Cameroon privatized its forestry commission. Privatizing campgrounds and other facilities is currently trending upward in the United States. While this latter privatization trend is not new, if it continues, it could potentially create access and equity issues for accessing recreation lands.

Recreation- and Management-related Horizon 3 Scan Hits

Three recreation industry and management-related Horizon 3 scan hits are:

- Taking adventure tourism to new heights (pun intended) is the growth of sub-orbital and space tourism. Currently only an option on the near-term horizon for the very wealthy, space travel is growing and commercializing, and may shift public demand for the type of travel they undertake. What will be the impacts when tourists can choose between a national park or forest and going to the moon or mars?
- A single federal lands management agency? A scan hit suggests reducing confusion and duplication of staff and effort by combining all public land management into a single agency.
- Alternatively, another scan hit suggests dividing all federal public land among U.S. taxpayers, making it all private.

Figure 7 on page 53 summarizes recreation management-related recreation horizon scan hits, sorted by horizon.

Recreation Futures Across Horizons: Recreation Management

Horizon 3

H3 scan hits are highly uncertain, the weak signals of possible change. These can seem laughable and weird. H3 scan hits are also typically the furthest out in terms of time, easily 20 or more years in the future. These are the "new" ideas.

Horizon 2

H2 scan hits are in between. They are not yet visible in our day-to-day lives, but could happen soon, and the level of uncertainty is moderate. These changes are more likely, but not a given. They are "next".

Horizon 1

H1 scan hits refer to signals of change that are evident in the system today, or that are imminent. Therefore, the level of uncertainty regarding this change is low. They are now, or near (Hines et al. 2019).

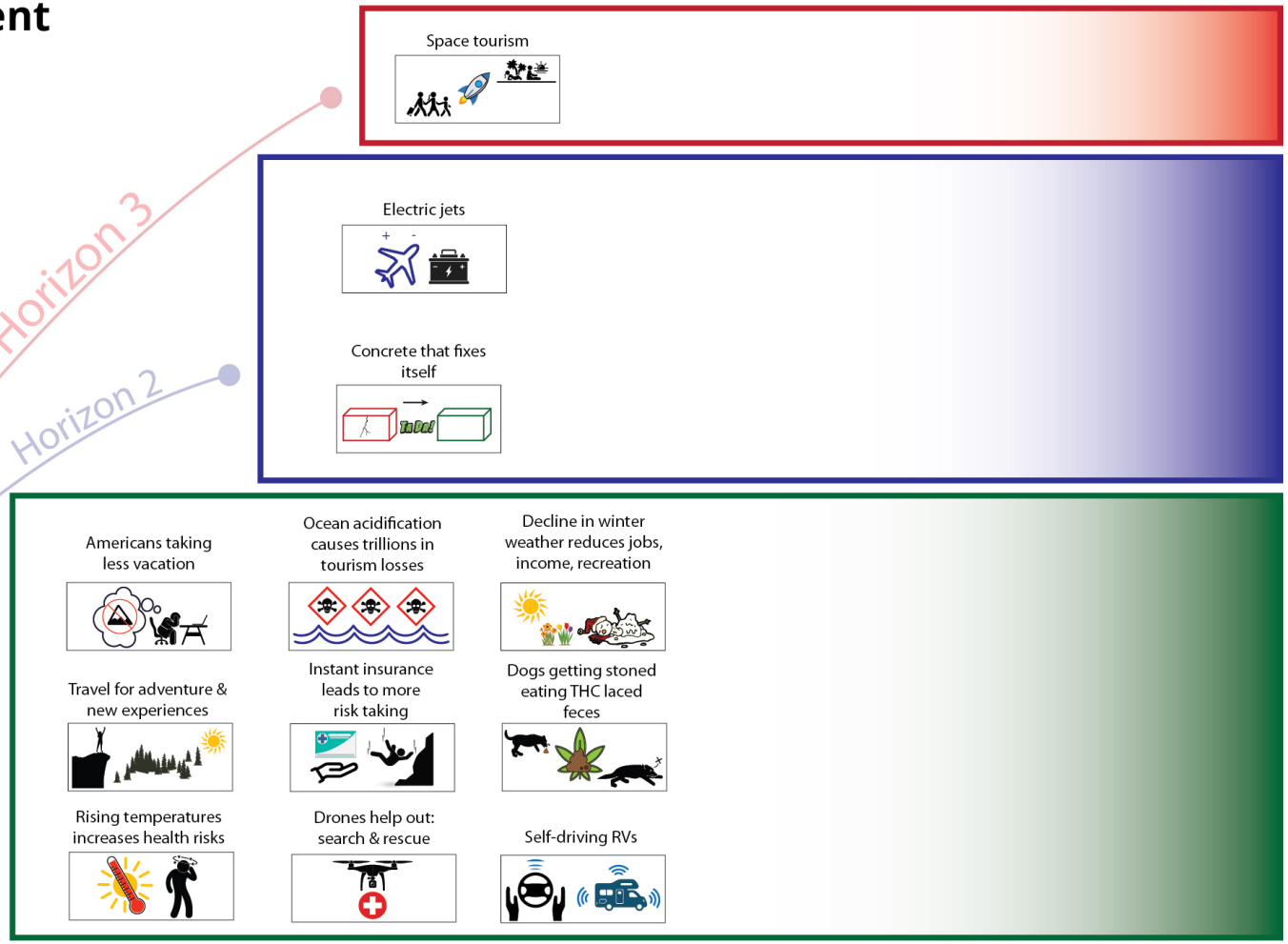

Figure 7

PLACE-RELATED SCAN HITS

"Place" is fundamental to recreation, and not only because recreation has to take place somewhere, but because the place itself can have deep meaning. Recreation scan hits related to place included hits regarding rural development, special places, agriculture, and wilderness. While many of the scan hits suggest increases in outdoor recreation, there are significant scan hits in this area suggesting decreases in recreation as well.

Rural Development

Competing ideas abound regarding the fate of rural communities. Will rural towns continue to shrink in population and decline, or will they rebound and maintain strong communities? Some scan hits suggest that the population decline in rural areas will only continue, pointing to the loss of rural hospitals and steadily declining population numbers as evidence. These scan hits see a continuation of today's trajectories for rural communities (Porter 2018). Others question the inevitability of rural community decline, while still others point to a possible rural resurgence (Hardy 2018). The rest of this section explores those scan hits.

A national survey indicates many people would prefer to live in rural areas, but feel the jobs are in urban areas (and not without reason, urban counties had nearly all of the job development from the Great Recession through 2017); only 12 percent favored living in a big city (while roughly 80 percent of Americans live in urban and suburban areas; Newport 2018). Public lands and outdoor activities are natural amenities that draw people to rural areas, and many states are capitalizing on this by creating offices that aim to grow the outdoor recreation market in their state. Some in the recreation industry support taxation of casino and gambling earnings to support environmental protection because a clean environment is fundamental to outdoor recreation. Growing internet capacity makes more types of work possible in rural areas, whether that is tech entrepreneurship, manufacturing, call centers, or welcoming digital nomad workers. Some rural counties with strong natural draws are growing, even growing rapidly, and grew while counties reliant on farming and mining shrank (Fifield 2018). Another scan hit points to the negative impact of the extractive energy industry on outdoor recreation, including recreationists changing their plans to avoid areas with such development. Any implementation of universal basic income (UBI) could be relevant here, too. Should UBI be implemented, it could change the economics of rural communities in major ways, allowing people to live where they wish instead of where they must. As indicated above, this could be in rural America, and could therefore repopulate some rural communities.

A few scan hits point to the importance and presence of bridging capital—a component of social capital that recognizes the strengths of bonds and relationships between people—as a key ingredient for strong rural communities (for more on social capital, see Perkins et al. 2002). Social capital is reflected in the local pride and community spirit that are key components of thriving rural communities and are built upon by those looking to "shrink smart" and maintain their communities. Some argue that supporting cities in turn helps rural areas because tax dollars and other resources get redistributed within a state. Rural communities have more entrepreneurs per capita, and these entrepreneurs have a different goal: rather than amassing wealth, they are interested in providing opportunity for their families; stability is often more important to them than growth.

The creative class—workers in business and management, healthcare, law, science and technology, as well as arts and entertainment—are largely concentrated in cities. While one might expect the next highest concentration would be in urban-proximate rural areas, this is not the case. Remote rural areas have the second highest proportion of creative class workers, and the creative class is growing faster in rural areas than urban. Given the shifts in work, in which many people can chose their location if there is sufficient internet connectivity, plus the desire to live in rural areas noted above, amenity-rich rural areas could see growth.

Climate migration is expected to become a significant force for population redistribution in the coming years, drawing comparisons to the dustbowl, the Great Migration, and the migration impacts of Hurricanes Katrina and Rita (Milman 2018). Sea level rise, heat waves, wildfire and other effects of climate change may all reshape population patterns in the United States. One of these impacts alone, sea level rise, is estimated to impel 13 million people to move from U.S. coasts by the end of this century (Milman 2018). The connection to rural development is this: towns that are currently losing population may see an influx, especially in the Midwest and Northeast, two areas expected to be the most livable as the climate changes (Fig. 4).

Land ownership patterns are changing, especially in the West, with wealthy individuals and families buying large swaths of lands—even millions of acres—and thereby changing the local economies and recreation patterns. Some limit or strictly regulate access for recreation that had been unfettered before. Some have bought ranches and are holding the land for future water rights and self-sufficiency options should climate change wreak havoc on society. The ownership consolidation leads to population decline, and with it, diminished services in rural communities (e.g., schools, health care, access to food). Collectively, the change in ownership and access has significant impacts on recreation, rural economies, and rural communities.

Alternatively, there are two counter trends regarding the effects of climate change on growing rural populations:

- At the same time that amenity-rich rural areas draw new residents and tourism dollars, climate change poses grave risks to economic development based on recreation. Discussed in detail in the section on climate change, reduced snowfall, decline in wildlife species, and other climate change impacts on natural environments can also negatively impact outdoor recreation.
- Housing development in the wildland urban interface (WUI) continues to grow, while the threat of wildfire grows exponentially. If limits are placed on development in the WUI, it could slow the type of growth discussed above: rural redevelopment built upon digital nomads working from home in amenity-rich rural areas.

Tribes and other Indigenous groups are developing businesses as guides to special places (such as Antelope Canyon) or national parks (the Blackfeet Nation provides tours of Glacier National Park from a Native perspective). Some suggest that Tribes can act as an anchor for rural development, including increasing access to health care and support for other basic needs, given the resources available to federally recognized Tribes. Some suggest this could provide benefit not only to Tribes, but to the surrounding rural communities as well. In Canada and Australia, Indigenous people are supported as guardians of rural lands. This helps support both the continuity of Tribal cultures and the resilience of rural landscapes.

Rural communities are already supporting the growing thirst for experiences, as seen in Airbnb Experiences, Hipcamp, and private landowners opening up their land for bike touring, hunting, and other outdoor pursuits. An added benefit of platforms like Tentr and Hipcamp is that they reach a younger, and often new, market for of outdoor enthusiasts. Rural areas have long hosted sporting events: dog sled races, ski races, and more. In Europe, one declining rural town stepped into the e-sports world, hosting a major e-sports (aka video gaming) competition. E-sports is growing exponentially, with colleges now offering support for competitors just as they do basketball and football players. Whether we see e-sport venues sprout in rural communities in the United States remains to be seen.

The growth in ecotherapy could be a boon to rural economic development too, with new spas, resorts, and similar businesses located near forests and other natural areas. In fact, a United Nations' group identified such opportunities as part of a set of new green jobs (UNECE 2018).

Dam removal is a component of revitalizing some rural towns. A free-flowing river provides more fishing, new economic development opportunities, and in other ways revitalizes an area. The United States has tens of thousands of dams, not all still needed, making dam removal another tool for the rural development toolbox.

Technology advances bring new options to rural communities, including self-driving buses to provide public transportation. These advances may also provide additional land for recreation: if laboratory-grown meat gains acceptance or popularity, it could dramatically reduce the need for grazing on public lands, allowing new uses of these lands. This would be felt mostly in the West, where grazing allotments are a significant use of federal lands.

Rural infrastructure, such as abandoned mine buildings, are being repurposed for uses such as server farms for blockchain and cryptocurrency, such as Bitcoin. In some instances, locals are not pleased, asserting negative impacts from the 24-7-365 rumble of servers and fans and other issues.

Special Places

Special places are important for recreation. Sometimes the specialness comes from intergenerational ties, or from awe-inspiring beauty, or from culturally important plants or animals being found there, or from other reasons important to the people that visit the place (Eisenhauer et al. 2000).

Special places, such as the now famous Antelope Canyon, or magnificent sites in Iceland, can draw the visits of thousands when they go viral on social media. Stories about Instagram posts causing places to be "loved to death" abound. In fact, some locales have asked Instagrammers to stop geotagging their posts in order to reduce crowding and its impacts. The crowds can cause ecological damage and can reduce the specialness of a place; sometimes the site is closed in response to overcrowding. Alternately, as in the case of Antelope Canyon, it has become an economic engine for the Navajo Nation. The canyon is on Navajo land and the Tribe has developed tourism guidelines and businesses.

Permits are being used to control access to favorite places, such as the Mount Washington Wilderness Area on the Deschutes National Forest. The goal is to preserve both the experiences and the site itself from the negative effects of overuse. Other places are investigating visitor management techniques to alert visitors to already-full parking lots or trail closures.

Climate change is affecting some special places, even threatening to destroy them (such as the barrier islands along the Atlantic coast of the United States). The redwoods of California are threatened by the changing climate, too, as they are susceptible to drought and wildfire. Yellowstone National Park may shift from forest to grassland as climate change progresses.

The specialness of a place may also help with maintaining it, as attempted when the Faroe Islands invited volunteers to come and stay for a weekend, while helping build viewpoints, putting up signage, and building paths to reduce erosion. Other tourists were not allowed this weekend and volunteers received room and board for their efforts. This approach might be successful in other unique settings.

What makes a place special isn't always based solely in what we see. Soundscapes are informing ecological research, adding details to assessments of fragile ecosystems. Soundscapes are also starting to reshape tourism. Finland and Japan both promote places with special sound qualities. A book, *Sonic Wonderland*, is one of several that presents unique soundscapes around the world, with the idea of traveling to hear unusual places.

Wilderness

"Wilderness" has several meanings, including U.S. public lands formally designated as wilderness (e.g., Mount Washington Wilderness Area on the Deschutes National Forest) under the Wilderness Act and, in day-to-day use, as wild lands that are largely intact and unaffected by human activities. Scan hits about wilderness reflect the range of meanings behind the word "wilderness."

Looking at wilderness broadly at the global scale, a number of scan hits point to the significant loss of wild places. Some question whether true wilderness even exists any longer given the rise of the Anthropocene—the epoch where earth is dominated by human activities and no place on earth is unaffected (Zalasiewicz et al. 2008). As human influence spreads to the most remote locations, what will be the impact for preservation of wilderness? Will it increase, or be given up? These scan hits indicate that the Amazon River region and sub-Saharan Africa have been losing the most wilderness due to agricultural, extractive, and other land-use pressures.

Turning to designated wilderness in the United States, climate change and biodiversity loss are having substantial impacts on existing wilderness. So, too, is increased visitation to wilderness areas that are relatively accessible, leading these sites to create new means to manage visitation, such as entry lotteries and permits. These efforts are established in part to protect the wilderness character of these popular wilderness areas.

Technological advances are also impacting wilderness. The growth of video-making and sharing apps have transformed wilderness into a more known quantity, reducing the mystique of the unknown. People planning a first visit, or those unable to hike the backcountry at all, can watch any of hundreds of online videos made by backpackers and others. These videos function as part guide book, part entertainment, and part advertisement, leading to increased visitation.

Drones piloted from the ground are already an issue in wilderness areas, and passenger drones will soon be on the market in the United States. Passenger drones are already in use as taxis in Dubai, and General Motors (GM) announced their passenger drone Cadillac at the 2021 Consumer Electronics Show. GM anticipates having this and another two-person drone to market by 2025. Other passenger drones are in development as well. How will the nonmotorized character of wilderness be maintained when passenger drones can fly over head? What about businesses building on the heli-skiing model to transport visitors to the middle of a wilderness area leaving them to hike out? A potential positive is in search and rescue: both passenger and ground-piloted drones have many advantages especially in the search part of search and rescue in wilderness areas.

Agriculture

Lab-grown meat and other agricultural changes, such as the growing acceptance of hydroponics and the growth of urban farms, could all lead to former agriculture or grazing land being available for other uses, including recreation. Lab-grown meat was first being tested around 2010, and in 2021 is available in restaurants in Singapore, while urban farming and hydroponics have become fairly widespread in the United States. These changes in food production have been slowly building, so rapid change in land use could be on a nearer-term horizon.

In addition to lab-grown meat, scan hits on growing ethical concerns for the animals' welfare and human health repercussions from consuming meat point to the possibility of reduced meat production and consumption, with potential land use change as a follow-on effect. Another trend towards reduced acreage in agriculture is the number of farmers going out of business, more in recent years than any time since the Great Depression.

Better targeting of the timing of fertilizer application can have significant water quality impacts, with follow-on impacts for recreation due to improved aquatic habitats. At the same time, though, groundwater pumping has greatly altered surface flows, even drying up streams. The application of fertilizer is a primary cause of the hypoxic area—"the dead zone"—in the Gulf of Mexico. The hypoxia affects recreation by reducing time the water is safe to enter (e.g., due to red tide) and killing off fish and other aquatic life and thereby negatively impacting the recreational fishing industry.

One twist in agricultural practices that can be of service to ecosystems is the harvesting of invasive species. One example is learning to prepare Asian carp (e.g., *Hypophthalmichthys nobilis*) to help reduce its numbers in the Mississippi River and its tributaries. Maybe a Carp Masters Classic to join the bass competition?

Place-related Horizon 3 Scan Hits

One of the most "out there" place-related scan hits is the one proposing floating cities in response to climate change and the need for new places for people to live as sea levels rise and land become inhospitable.

Figure 8 on page 60 summarizes place-related recreation horizon scan hits, sorted by horizon.

Recreation Futures Across Horizons: Place Related

Horizon 3

H3 scan hits are highly uncertain, the weak signals of possible change. These can seem laughable and weird. H3 scan hits are also typically the furthest out in terms of time, easily 20 or more years in the future. These are the "new" ideas.

Horizon 2

H2 scan hits are in between. They are not yet visible in our day-to-day lives, but could happen soon, and the level of uncertainty is moderate. These changes are more likely, but not a given. They are "next".

Horizon 1

H1 scan hits refer to signals of change that are evident in the system today, or that are imminent. Therefore, the level of uncertainty regarding this change is low. They are now, or near (Hines et al. 2019).

Figure 8

SOCIAL ISSUES SCAN HITS

The horizon scanning hits related to social issues included those on health, governance, diversity, generation cohorts, education, environmental attitudes and values, and more (which means this section reports on three of the five STEEP categories). Generation cohorts, health, governance, and diversity had some of the highest number of scan hits. Some of the most prominent issues are the increase in using time outdoors specifically to improve human health (e.g., forest bathing), an increase in Indigenous rights, shared stewardship, and other changes in governance of public lands.

Health

The health-related scan hits tended to suggest a possible increase in the amount of outdoor recreation. From greater understanding of health benefits from outdoor recreation, to advances in warding off aging, to technological solutions to failing joints, the health-related scan hits point to the possibilities of more people recreating longer through their lives, and in more ways than before, all while forests and parks may become part of society's health care infrastructure.

One of the currently burgeoning health issues is the rise of ecotherapy, also known as forest bathing (or, in Japanese, where it originated, shinrin yoku). The growing use of forests and other natural areas for therapy is backed by an increasing body of science (see Kotera et al. 2020, Yau and Loke 2020). Doctors are prescribing time in parks and the woods for both physical and mental health in children and adults. There is evidence that, along with the obvious potential for cardiovascular benefits from exercise outdoors, time in nature addresses depression, anxiety, attention-deficit/hyperactivity disorder (ADHD), high blood pressure and cortisol levels (that is, stress), and other conditions (Bezold et al. 2018). A major longitudinal study in Denmark shows correlations between growing up near green space and reduced adult mental illness, reductions between 15 and 55 percent (Engemann et al. 2019). Residential green space in childhood is associated with lower risk of psychiatric disorders from adolescence into adulthood (Engemann et al. 2019). Additionally, backcountry hiking has been shown to dramatically increase creativity. Practitioners can get certificates in forest bathing and provide guided sessions for interested people. Insurance is starting to cover forest bathing, and hospitals and spas are incorporating it into programming. Researchers are also investigating the effects of phytoncides—compounds emitted from plants into the air—on various illnesses including cancer, with results indicating positive effects for some conditions (Putra et al. 2018).

As the research on the health impacts of time in forests continues to develop, trails and other recreation locations may eventually be labeled as beneficial for specific ailments (this trail for depression and anxiety, this one for cancer). Ecotherapy or forest bathing programs may become standard offerings on public lands, which in turn could lead to public land agencies partnering more directly with, or even hiring, public health professionals.

Additional scan hits specifically related to children's health include:

- Cities and towns are building more playgrounds with tree trunks, boulders, and other natural play elements.
- Other cities and towns are opening nature play areas where children have unstructured play space and time in the woods or meadow, which in turn supports cognitive and emotional development in children.
- Research indicates that exposure to natural environments with higher biodiversity reduces asthma occurrence in children (Donovan et al. 2018).

Concern about kids playing freely outdoors is on the rise. Some say this has developed to a full-blown phobia—"biophobia," a fear of outdoor and natural places. The root of the condition is a fear of harm. Biophobia in parents will reduce not only their own, but potentially their children's recreation in outdoor places.

There is a play gap globally which, although it has different roots, has a similar impact on children's health as biophobia. Lack of unstructured play time affects the cognitive development of children, and this is exacerbated by the play gap, less and less time spent playing and instead pursuing only structured activities. Time to play has declined dramatically in just two decades, with even children reporting they are "too busy to play." Patterns developed in childhood affect recreation patterns as adults, suggesting a potential dramatic decrease in recreation in the years to come.

The World Happiness Report indicates, based on research across many countries around the world, that how people play in any society is key to happiness (Helliwell 2020). Happiness, in turn, is fundamental to health and with it, improved mood, productivity, and more. As attention to mental health increases, outdoor recreation on public lands may prove an effective component of efforts to raise happiness levels and overall mental well-being.

Another medical possibility in development is a pill that mimics the physical effects of exercise. This could make more people able to participate in outdoor recreation without the slow process of reconditioning in order to go out and play. It could also reduce outdoor recreation because people could take a pill to stay fit.

Exosuits have been used in industry and manufacturing for a while now but applied to recreation these devices could make participation in outdoor recreation a possibility for many currently unable to participate. These wearable robotics take the strain off of joints, ease lifting, and can even allow walking if one is not able to walk on one's own. Such was the case for a person paralyzed from the waist down who walked hundreds of miles with his battery powered exosuit.

Some scan hits point to changes with regards to vision:

- There are devices in development that will return vision to some who are blind, prototypes are already in use.
- All the time children are spending indoors is increasing the prevalence of near-sightedness. This, in turn, increases the likelihood of glaucoma and other vision diseases. But play outdoors increases the focal length used to see, and wards off developing nearsightedness, thereby being a solution to this problem.

Developments in health care and health policy may lead to more recreation, and to less fear of injury. Researchers are developing methods to manufacture artificial tissues with 3D printing to help heal sports injuries to bone and cartilage. At the same time, a shift to universal access, single payer, or related approaches to providing health coverage could decrease the risk of outdoor recreation, thereby increasing participation and perhaps increasing risk taking. Some argue that a single-payer approach would increase equity in health care, which would have additional repercussions with regard to who can get outdoors and recreate. This is not only from reduced worry about possible accidents while outdoors, but also addressing fundamental health issues that limit outdoor recreation (e.g., diabetes).

Social media posts of people recreating outdoors, often doing dangerous things or activities that require skill and training, raise concerns about desensitizing others to the inherent dangers when they see these activities again and again on their media feeds. This could increase the number of recreationists engaging in activities beyond their capability or preparedness, which in turn could result in injury and harm.

Climate models indicate a significant rise in life-threatening heat, including an increased number of, and intensity of, heat waves, which would obviously limit participation in outdoor recreation. Some models suggest that simply being outside will become dangerous in what are currently temperate climate zones. Heat waves are the number one cause of weather-related deaths, making a significant rise in their number a serious health threat. A rise in heat waves due to climate change is expected to hit the Great Lakes region by 2030 (University of Miami 2018). Rising temperatures require greater preparation from recreationists, and not all are aware of the requirements for safety.

Climate change is increasing the prevalence of some serious diseases, as evidenced by an "epidemic" of kidney disease among agricultural workers (Sorensen and Garcia-Trabanino 2019). Other diseases, like tularemia, are expected to increase from currently low rates to levels of concern. Disease-carrying insects and animals are spreading; mosquitos carrying dengue and ticks carrying a host of diseases, are becoming more common. The range of diseases are also expanding; as an example, the range of valley fever (*Coccidioidomycosis*) is expected to more than double by 2100. Suspicion that the Department of Defense weaponized ticks continues to surface, even leading to a call to investigate from the U.S. House of Representatives (Houser 2019). Whether founded in reality or not, suspicions

like this are enough to dampen interest in outdoor recreation. But some insects are being deployed to contain the spread of disease. MosquitoMate (Lexington, KY) developed a system whereby laboratory-raised mosquitos are used to carry a deadly-to-mosquitos bacterium found in nature to tiger mosquitos that carry many of the common diseases.

Wildfire and smoke have considerable impacts on human health, especially on respiratory health. Wildfires are increasing, even in once frozen areas, like the Arctic. This increase in wildfire means there is yet more smoke to induce health issues in more people. Scientists are tracking the development of "smoke waves" that can bring the ill effects of smoke to people far from the fires.

Pollen counts from trees and grasses are also on the rise, again due to a warming climate. Hay fever and related conditions can limit sufferer's outdoor activities, thereby reducing demand for outdoor recreation. This could be a geographically wide-ranging impact.

Air quality remains poor in pockets of America, often especially affecting the health of low income and African American populations. The long-term health effects could reduce ability to participate in outdoor recreation activities near home or on national forests and other rural public lands. This would slow efforts to provide equitable services across the full population of the United States.

More homeless people are turning to forests for shelter, camping in both established and dispersed camp sites. Some of these campers require support and services that public land managers are unable to provide. The increased camping by people without permanent homes is, in some cases, leading to conflict and increased violence and will likely negatively impact recreation in the area. While currently prevalent in the West, depending on economic changes, this could become a more widespread phenomenon.

Governance

How public lands are managed is not a static, unchanging process. Numerous scan hits suggest change in the management approach and process at all levels. Common in these changes are new partnerships between different organizations. Complicating this are the scan hits indicating an erosion of trust in government, due in part to policy experts being seen as disconnected from the economic realities many Americans face. This erosion of trust may lead to difficulties in managing public lands and increases the difficulties in building effective governance partnerships.

Governance: includes, but is not limited to, formal government. Governance is "…a social function centered on steering human groups toward mutually beneficial outcomes and away from mutually harmful outcomes" (Brondizio et al. 2009, p. 255).

At the global scale, some groups call for international commitment to protect forests in the face of climate change, over-hunting, and other actions that threaten forests and wildlife upon which humans depend. That is, these groups argue, the solution isn't just in lowering climate emissions but rests instead in global cooperation in planning for the long run. Others point out that such plans need to be connected to sub-national levels, too, in order to be effective. Programs like Reducing Emissions from Deforestation and forest Degradation (REDD+) are criticized for not having effective connections across international to local scales.

Universal basic income comes up often in horizon scanning. If implemented, UBI could impact public land management in at least two primary ways: (1) it could stabilize rural incomes in such a way that there is less pressure to base decisions on the public land management on what sustains local economies, and (2) people could have more time for leisure and recreation.

Indigenous people across the globe are taking action for, and gaining rights to, their homelands, and to manage or co-manage public lands. This has tremendous import for the Forest Service given that Tribes have specific rights to much of the land managed by the Forest Service. Co-management of public lands has already begun in some place, such as the Chippewa National Forest and Leech Lake band of the Ojibwe Nation's co-management of the Chippewa National Forest. The Blackfeet Nation's efforts to develop its own National Park adjacent to Glacier National Park is another example, as is the Blackfeet Nation's tours of Glacier National Park, narrated from a Native perspective. If co-management continues to expand, the majority of federal public lands could, in the end, be managed in this manner. These efforts not only reinforce the autonomy of Tribal nations, but also can serve as economic development strategies for Tribes, with benefits to Tribes and surrounding communities. Tribes are also actively managing tourism and recreation on their Nations, exemplified by the Navajo Nation management of tours to the now famous Antelope Canyon.

Outdoor recreation is a major economic driver, and state and local governments are taking steps to capitalize on this fact to benefit local economies. Some governments are also grappling with equity issues regarding access to outdoor recreation. Solutions include development of high level staff and offices to manage and promote outdoor recreation, and the development of funds and equipment-lending libraries to facilitate various activities.

The Forest Service has already implemented some changes to permitting hiking and camping in popular wilderness areas, in order to mitigate ecological damage. Such visitor management programs could expand where demand for outdoor recreation continues to climb. This is underway across all levels of government. Public land managers are working

with partners to develop technology and mechanisms to control visitation numbers to ensure protection of the public lands while also ensuring a quality recreation experience and reduced frustration. A project just underway in Colorado's Routt County enables alerting recreationists to full parking lots and closed trails before they arrive on site.

There are private businesses and industry groups, such as the National Parks Hospitality Association, lobbying to privatize public campgrounds and other facilities. These groups suggest they can better meet new demands, such as spaces for larger RVs with full amenities. Others question this, with concerns regarding the nature of the experiences on public lands and how commercial such experience should be.

The lack of diversity in public-land visitors and management staff could, in the end, have long-term impacts for public lands in general. Some argue that lack of awareness across our diverse society will translate to lack of caring, and so public lands may be lost to development. Those with this view argue for effectively diversifying staff and visitors in order to meet equity goals and build a broad base of support for public lands.

Adding complexity to an already complex topic, rights have recently been granted to lakes, rivers, and other natural entities around the globe. This trend has been increasing in the last few years. If it continues, it will bring significant changes to land management, but exactly what that will look like has yet to be seen. When governance systems include not just people and their organizations, but also entities representing rivers, lakes, and forests, the complexity of decision-making and planning is increased. One futurist imagined a time when campers negotiate *directly with a camp site* through an artificial intelligence bot[2] to make a camping reservation.

Diversity

Most of the scan hits in this category pointed to the barriers that currently limit recreation for non-dominant cultural groups, but also highlighted different steps being taken to remove these barriers. That is, most of the diversity scan hits were Horizon 1. Affinity groups, use of technology including social media, and efforts by different companies are part of the proposed solutions to diversifying those who recreate on public lands.

It is not uncommon for people of color to encounter additional barriers to participation in outdoor recreation, including trepidation about being alone outdoors, and a lack of social support in these endeavors. Some scan hits point to depiction of outdoor recreation as requiring fancy, high-tech, and expensive gear, accessing remote places, and other signs a writer called "the disturbing bro-ification of outdoor recreation" (Johnson 2019). Messages such as this can signal that public-lands recreation is for a limited group of elite who have the time and funds to recreate this way.

[2] An autonomous program on the internet or another network that can interact with systems or users.

The refrain that social media generally, and Instagram in particular, is ruining natural areas is called out by some as racially biased. The argument is that, instead, social media is making the outdoors less the domain of the White middle class (or the "bro-ification" described above), that social media can be a force for diversifying participation in outdoor recreation.

Numerous affinity groups and individuals are emerging, such as Latino Outdoors, Pattie Gonia (a hiking drag queen), Queer Adventure Storytelling, Unlikely Hikers, Blackpackers, and Outdoor Afro. These groups and individuals are using social media and other outreach to engage new audiences with know-how, encouragement, and positive messages about outdoor recreation being open to all. Many of these groups also sponsor walks and hikes, camping and climbing, and other outdoor activities for both novices and for experienced outdoors people. These programs may be starting to achieve the desired diversification effect, because a recent market study found a substantial increase in the number of women and Hispanics taking up fishing (Recreational Boating & Fishing Foundation, n.d.).

One component of the social media presence from groups like Wild Diversity, Unlikely Hikers, and others, is a change in language from land-dominating phrases (e.g., "crushing" a mountain) and acknowledging the Native peoples who lived in a place before European settlement. Hashtags and other content highlight the Tribes on whose land outdoor recreation takes place.

Some additional scan hits:

- Equipment lending libraries funded by states or other entities are growing in number, allowing people to try an activity without first investing heavily in gear.
- Women are more likely to work while on vacation and feel the need to hide it. This translates to less recreation, and less recouping from time on vacation.
- Air pollution and heat-related illness impact Black and Hispanic residents more than other groups. The poor health outcomes limit participation in recreation activities, which could exacerbate the low participation rates in some outdoor recreation activities.
- A sign of increased diversity is the rise of RV purchases by minority buyers, as well as younger people. RVs are no longer the domain of the retired, White middle class.
- More companies are committed to expanding access to the outdoors. Hipcamp and KOA are just two such organization in the scan hit database.

Generational Cohorts

Numerous scan hits suggest changes for different age groups such as children, teens, Millennials, and the elderly. These are discussed below by generation cohort. Note that Gen Z includes children, teens, and some young adults and discussion of issues related to this generation are divided across these categories.

Children, childhood related, and teens

Children are spending significantly less time roaming outdoors, due not only to the draw of the digital world, but to concerns about safety. Some see a rise of "biophobia" in children, where simple things like a bird squawk can produce an anxious reaction. The lack of outdoor play time adds to the obesity problems faced by many children.

Research indicates the importance of childhood exposure to nature for many reasons, including increasing likelihood of engaging in outdoor recreation as adults (Asah et al. 2018), but many factors can limit the opportunity for children to play in natural settings. One scan hit pointed to a role for technology: the ability to go on virtual field trips to experience native habitats and natural areas without the need for buses and bug spray.

In contrast to use of technology, a growing number of schools hold classes entirely outdoors. Washington was the first state in the United States to license outdoor preschools. Outdoor schools were growing before the COVID-19 pandemic, but ramifications of the pandemic may speed adoption of the practice. Largely aimed at preschool and early grades, outdoor schooling keeps children outside in all types of safe weather—cold and rain are no obstacles. Teachers report children being comfortable and curious about nature, engaging with it deeply via pine cones, mud, and more.

Play, especially unstructured play, has been decreasing for many children as structured activities and expanded schoolwork take more time. One scan hit reports on a coalition of businesses and nongovernmental organizations (NGOs) to foster more play, that they call "the rocket fuel for childhood development" and cite a growing, and global, "play gap" (Brodin et al. 2019). They found that one-fifth of children stated they were "too busy to play."

Within the broader realm of play is nature play. Nature play is taking hold and growing—but is not new, more a resurgence. Providing unstructured play opportunities in natural areas and providing natural play equipment such as tree trunks for climbing, fosters imaginative play which in turn is important to a child's cognitive development (Taylor and Kuo 2006). Such play also fosters comfort in nature settings. Other approaches to introducing children to outdoor recreation are special days for visiting local public lands where NGOs or staff offer the chance to try new things, even things as simple as riding a bike, and programs to help adults feel comfortable letting children play freely outdoors. Other programs aim to provide overnight experiences for all children in a country, in part to foster a greater understanding of the importance of the environment and biodiversity.

Additional scan hits include:

- A company is building AR games to enhance play on playgrounds, and these have been shown to enhance cardiovascular benefits of children's play. Similar apps could be a means to introduce children to public lands.
- A study points to stereotype-busting findings about youth: crime and risky behaviors have decreased significantly compared to earlier generations (Males 2017). Diversity has increased significantly, as has an expectation of living in a society that is diverse and respects diversity.
- Teens are also adept at using social media to encourage engagement with nature. The #trashtag trend in the middle of the 20-tens was one example: teens encouraged cleanup of local natural areas by posting before-and-after cleanup pictures on Instagram and other media, using the hashtag #trashtag.

Younger adults—Gen Z, Millennials, and Gen X

The older component of the Gen Z (born 1997 to 2021) cohort and many Millennials (born 1981 to 1996) are comfortable in the gig economy and seek work that allows flexibility and follows their passions. They are digital natives, used to technology intersecting with and enabling their daily life. The recreation connections are that these workers are often able to choose where they live, including opting for van life—more than half of RV buyers in 2017 were under 45—or settling in smaller cities and towns with access to public lands. They are also likely early adopters of recreation technology, like advances in AR or site reservation options like Hipcamp. But it isn't all good news: freelancers are much more likely to work while on vacation and to not "unplug." Research is clear: unplugging is important to rejuvenating and coming back to work refreshed and energized.

Some scan hits specifically advise that Millennials and younger generations can best be reached by building on their digital native-ness and by "gamifying" outdoor experiences. Gamifying builds on earlier crazes like geocaching, or Pokémon Go. Some scan hits suggest this could expand economic growth for small businesses catering to digital natives exploring the outdoors. It could also be used by public land managers to reach new and diverse recreationists.

Other scan hits point to younger adults being more interested in "done in a day" outdoor recreation rather than longer backpacking-type outdoor recreation. This is reflected in gear sales: more day packs than back packs, more light weight boots than heavy duty hiking boots. It points to a real shift in recreation patterns, with a desire to end the day with a hot meal and a comfortable bed.

Older adults

Horizon scanning hits in this section conflict rather than tell a unified story of how the future may unfold. Some point to increased recreation by older adults, some point to declines. But all of these scan hits can help managers think about and plan for potential future changes in recreation by the older generation cohort in America, including Boomers (born between 1946 and 1964) and older.

Discussed in the health section, numerous scan hits point to different means to slow or even end aging. We're already seeing the effects of improved health care increasing quality of life ("60 is the new 40") but some of these scan hits go much further, suggesting that aging can be stopped altogether. Such a change is not likely to happen soon (if ever), but the search for such possibilities could yield benefits that extend good health and vitality for an aging population. People age out of recreation activities, and this may change as the effects of these health and technological advances add years to people's ability to engage in favorite outdoor recreation pursuits.
Another scan hit indicates that people return to hiking as they age and hiking itself is a gateway activity to other outdoor pursuits. Opportunities to hike close to home appear to be key in renewed engagement in the activity.

Scan hits suggesting a decline in outdoor recreation among the older crowd largely rest on economic uncertainty. While polling shows great variability in individual's confidence in their ability to retire, one survey suggests as few as 17 percent of respondents thought they'd be able to afford to retire (Sehgal 2017). The reasons are many, including lingering impacts of the Great Recession and health care costs. One impact of this is the trend of retirees traveling in RVs to where seasonal work is available. Some of that work is for online retailers, sometimes it is serving as a campground host. But all of it is work rather than the full retirement many had hoped for. If this trend continues, and retirement declines, the demands for outdoor recreation, especially in the post-retirement/prefrail-elderly years, will decline. Whether this will be a long-term trajectory, or reflects current economic inequities that may change, is unknown.

A well known trend shows in these scan hits, too: the aging of forest land owners. The aging of forest owners leads to land being sold or passed down in the family. Often, private forests are adjacent to public lands and are part of the mix offering outdoor recreation. Examples include hunting camps, other retreats and lodging, and trails. These offerings sometimes connect with recreation offerings on public lands. Major changes in ownership could affect recreation, potentially pushing recreationists to public lands if private offerings decline.

Environmental Attitudes and Values

There are not a significant number of scan hits in this category, but they could nonetheless have significant impacts on recreation. The decrease in outdoor time affects the development of environmental attitudes for both children and adults. "Biophobia"—the literal fear of nature—is growing. While this fear used to be of actual threats, for example

large wild animals, now simple things in nature like a noisy flock of birds can trigger fear in some children. These reactions suggest that biophobia is both becoming more prevalent and is changing.

Research indicates that outdoor recreation had little connection to environmental and conservation attitudes (Dunlap and Heffernan 1975). Instead, these attitudes seem to be linked more to identity: where one lives, gender, incomes, education levels.

A trend in environmental attitudes continues: there is a consistent decline in the number of people who identify as "traditionalists" and an increase in the number who identify as "mutualists." Traditionalists tend to view humans as dominant in nature while mutualists believe that animals (and perhaps other aspects of nature) deserve the same rights as humans. This values shift could impact the types of recreational activities people engage in, with probable reductions in hunting as well as the management steps they support. Data on decline in the sale of hunting licenses bears this out.

Several studies point to prevailing attitudes assigning gender to different pro-environmental behaviors. For example, bringing reusable bags to the grocery store is seen as feminine, while caulking windows is seen as masculine. These types of attitudes may affect recreational choices as well and could inform outreach and marketing activities for different recreational activities on public lands.

Education

Education-related scan hits suggest a number of trends that could increase outdoor recreation:

- Research suggests that children and adults are interested in a wide variety of experiences in nature, not just adventure or ecological learning. Beauty, quiet, peace, challenge, and other experiences are important for many. This suggests a pluralistic approach to outdoor education and engagement to meet the broadest array of interests and outcomes desired.
- Education can support citizen science and other engagement. Research points to four keys to success: focus on local environments, collaborate with scientists and resource managers, include action, and measure and report outcomes.
- Tourism is increasingly offering learning opportunities. Airbnb and Hipcamp are two lodging/camp site rental apps that also offer experiential learning options. This trend is expected to continue and grow.
- Before the COVID-19 school-from-home imperative, sites were already starting to offer virtual field trips. Digital (e.g., via zoom or similar systems) field trips and related efforts can expose children to more landscapes not easily visited, and thereby spark an interest in exploring outdoor settings near and far.

- Outdoor schools are on the rise. More popular in Europe that the United States, the trend has started to take hold in America, too; there are now over 250 such schools in the United States. Typically aimed at younger children, outdoor schools spend nearly all day, regardless of weather, outdoors. Practitioners claim that the children become more confident and stronger emotionally, while also developing deeper ties with the natural world. This could lead to children who grow up to be avid outdoor recreationists.

And one scan hit suggests a possible decline in recreation: the significant decline in time for play in the lives of children in industrialized countries, due in large part to the rise in homework and structured educational activities. This lack of play negatively affects cognitive and emotional development of children.

Social Connections and Support

Scan hits regarding social networks were few, but meaningful.

Solitude is often portrayed as the pinnacle of time outdoors, which some suggest can deter some people from engaging in outdoor recreation. Depicting time in nature as also a social activity may assure children and adults that venturing into nature can be about connection, family and friends time, not just rugged individualism or solo time to find oneself.

Adults who share their love of nature with children also (if unsurprisingly) spend more time in nature themselves, indicating a reciprocal relationship. Cross-generational programming was reported as a way to encourage children's engagement with nature while also developing stronger intergenerational relationships. This includes supporting mentoring relationships beyond parent-child relationships.

Work Force

The nature of work is changing, some call this the fourth industrial revolution. The pace of this change and its outcomes are both uncertain. Will automation make worse problems some see in the current pattern of uneven returns to capital and labor? Or will it provide more rewarding jobs? Many in the field of automation foresee greater inequality resulting from these impending changes. The implications for outdoor recreation are secondary impacts of these workforce changes, but there will be implications and ripple effects.

As robotics increased use of artificial intelligence (AI), and other forces lead to changes in the economic structure of our society, the need for many full-time workers may decrease (and could spur implementation of a universal basic income). This would allow for more time recreating. One study looked at how much time is needed in work-like pursuits to maintain a sense of purpose and mental stability: about 8 hours per week was all that was needed (Kamerāde et al. 2019).

Studies indicate that counties with more public land have more income and jobs than counties with fewer acres of public land. But the jobs are often freelance, gig type work with less stability. Additionally, a recreation economy is more than just guides and gear sales. Any recreation town needs people in the trades, too, so a "recreation economy" has ripple effects beyond jobs directly tied to recreation.

Social Issues-related Horizon 3 Scan Hits

There is one Horizon 3 scan hit that is particularly dramatic: Scientists are at work on a pill to slow or even stop aging. Researchers have already developed a drug cocktail effective at doubling the lifespan of test worms. Of course, humans are not worms, but this scan hit is not based solely on theory. A 2019 conference on "undoing aging" had 500 attendees. If human healthy lifespan doubles or more, the implications for recreation could be significant.

Figure 9 on page 74 summarizes social issue-related recreation horizon scan hits, sorted by horizon.

Recreation Futures Across Horizons: Social Issues

Horizon 3

H3 scan hits are highly uncertain, the weak signals of possible change. These can seem laughable and weird. H3 scan hits are also typically the furthest out in terms of time, easily 20 or more years in the future. These are the "new" ideas.

Horizon 2

H2 scan hits are in between. They are not yet visible in our day-to-day lives, but could happen soon, and the level of uncertainty is moderate. These changes are more likely, but not a given. They are "next".

Horizon 1

H1 scan hits refer to signals of change that are evident in the system today, or that are imminent. Therefore, the level of uncertainty regarding this change is low. They are now, or near (Hines et al. 2019).

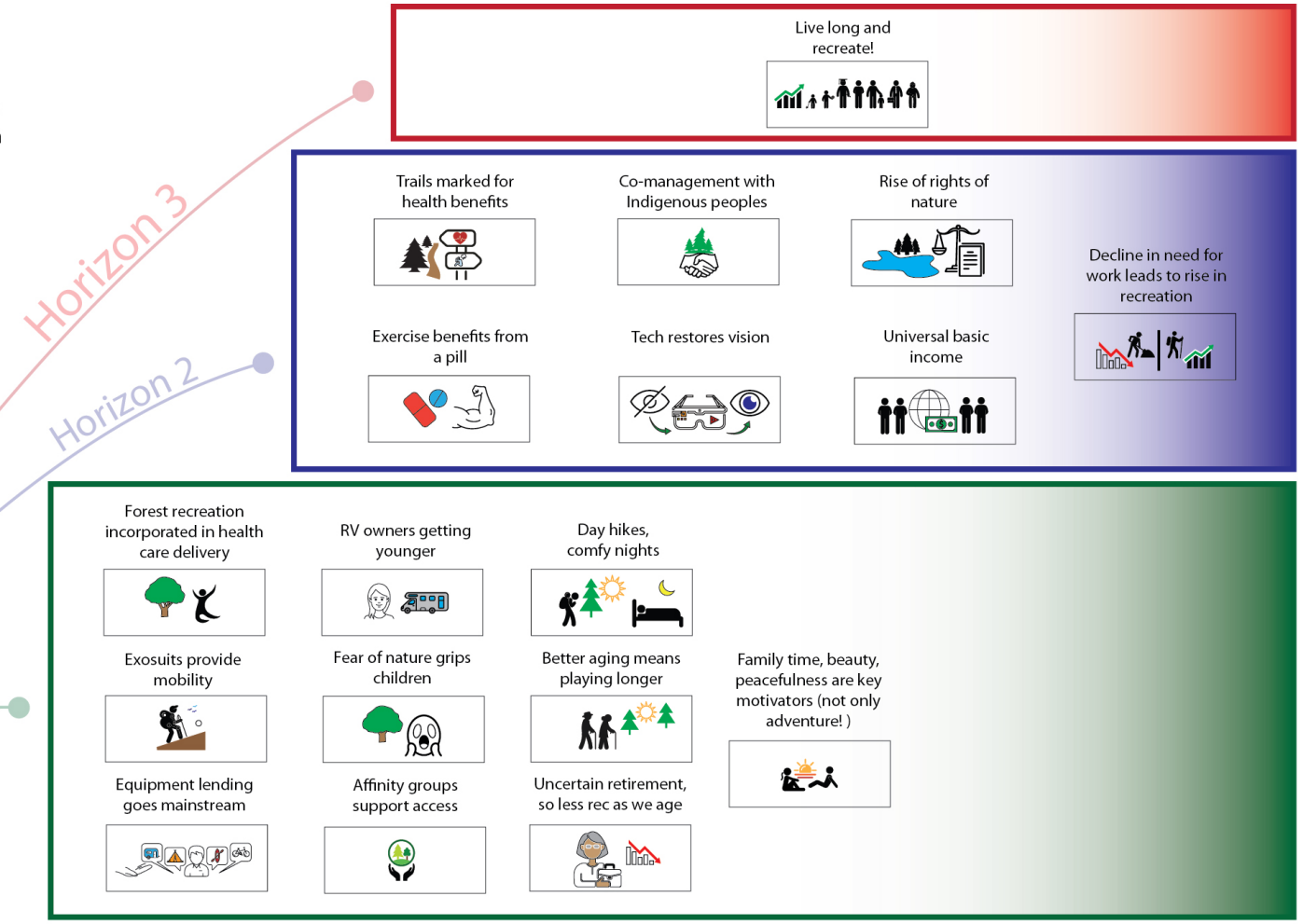

Figure 9

TECHNOLOGY SCAN HITS

Technology has transformed recreation repeatedly in the past, and changes seen on the near, mid, and far horizon suggest many more tech-related changes to come. Social media is already having a large influence on recreation, while other technologies such as AR remain tantalizingly close, but not yet realized. Drones, self-driving vehicles, robots, exosuits, jetpacks, and more all promise future transformations of many aspects of recreation, from the play itself to provision of facilities and search and rescue. Unlike other categories reported, technology almost entirely pointed toward increases in recreation.

Social Media

Social media gets a lot of attention for its negative impacts on public lands, with Instagram posts and influencers dramatically increasing visitation at some places. Horseshoe Bend is a case in point, where visitation has risen from 4,000 in 2012 to 2 million in 2019, pushing the nearby city of Page, AZ, to put millions into parking lots and restroom facilities to handle the sudden increase in tourists (Jennings 2019, Knepper 2017). Some places have closed for visitation once overrun by visitors, as happened in Iceland when pop star Justin Bieber filmed a music video from a previously seldom-visited canyon. The increased visitation intensifies foot-traffic damage to fragile areas, increases parking congestion and related air quality issues, and in other ways strains places and the infrastructure to support visitation. Some locations, such as Jackson Hole, WY, started a campaign against location-specific geotagging in social media posts in an effort to limit crowding at specific sites visited by influencers with large followings.

Social media loves the selfie, which can be dangerous when people take risks to get the best photo, sometimes injuring themselves or even dying (e.g., by falling over a cliff edge). Social media posting raises concerns that the social pressures and anxiety about how one is perceived online creates situations where the desire to post to social media can erode the quality of an outdoor experience (Jennings 2019). The sharing of photos on social media is also exacerbating a trend in expectations of seeing wildlife or other nature spectacles such as the northern lights on every outing (Lasdun 2019). Others suggest that seeing a place or activity enough on social media can reduce the perceptions of risk, thereby increasing the number of people visiting or trying the activity without the needed training or preparation (Scott 2016). This leads people to try climbing "fourteeners" in Colorado, ski the backcountry, or other challenging outdoor activities not aware of the risk they are taking. Research supports this, with Meshi et al. (2019) finding impaired decision-making in those with higher levels of social media use. Yet the flip side is also possible: GoPro® (GoPro, Inc., San Mateo, CA) video camera footage of hiking trails on vlogs can allow preparation for a hiking trip like never before. Add in GPS units, digital maps, and other technology assists, and some of today's novice hikers can study a route and its potential pitfalls before setting off.

Social media can be a force for good regarding recreation on public lands, too. Social media use is ubiquitous for Millennials and younger generations. Unlikely Hikers, and the coalition this group helped form, Diversity Outdoors, helps connect younger people with outdoor recreation while challenging stereotypes about who recreates where. There are many such groups that exist solely in social media, or that make extensive use of social media, including Outdoor Afro, Brown Environmentalist Media Collective, Latino Outdoors, Queer Nature, and Blackpackers. Individuals are also pushing boundaries of the old norms of what public lands recreationists look like, reaching new audiences, and inviting people who may not have felt welcomed before to recreate outdoors. Pattie Gonia, a drag queen and hiking enthusiast, is but one example of individuals focusing on inclusivity in outdoor recreation. Collectively, these individuals and groups reach hundreds of thousands of followers, breaking the stereotypes of outdoor recreation being the bastion of the "white and wealthy" post by post, picture by picture (Gregory 2019). Recreation managers face issues of ensuring safety, training, and providing a welcoming experience for diversifying clientele.

In other cases, the rise of social media can offer economic opportunity, as in the case of Antelope Canyon. This oft-photographed slot canyon is on Navajo land, and the Tribe has supported Native-owned tour companies thereby supporting livelihoods on the reservation as well as providing tours that can teach about the history and meaning of the land (while also providing opportunities for the perfect photo of the light coming through from above in the slot canyon).

Social media is also being used in advertising, as in a beer company's running essentially a treasure hunt for beer and providing clues via social media, and the clothing company Tentree's media campaign to plant a tree in Indonesia for every 10 likes of their post.

Related to social media are several apps that support outdoor recreation. Key among these are apps like Hipcamp and Tentr, both facilitate finding camp sites on private and public lands. Hipcamp, like Airbnb, has added experiences to their lodging offerings, noting that guests like contact with animals and the nearby natural areas, and guided experiences are often welcome. Other apps offer a way to make platonic friends with whom to travel.

Other apps can offer real-time assistance for travelers. "Be My Eyes" connects blind and low vision users with sighted volunteers by smart phone, allowing the sighted volunteer to answer questions or provide other guidance to the blind person, such as reading a sign, checking expiration dates, etc. "Sidekick" offers translation and local travel tips like where to get the best coffee or local delicacy.

Artificial Intelligence, Augmented and Virtual Reality

Artificial Intelligence (AI) relates to machine learning to accomplish a range of things from performing basics tasks to thinking to recognizing and responding to emotion (Joshi 2019). This may be robots or computers trained to conduct data analysis of images, and other applications of learning-by-algorithm. There are many implications, including for jobs and recreation options. With regard to jobs and the workforce, AI is expected to reduce some jobs, especially low skilled, repetitive jobs, while other jobs will likely be created to develop and manage AI processes.

Wearable technology uses AI and is developing in ways to assist athlete's performance. Some scan hits suggest that wearable tech will become standard in sports. Would it be possible to have a wearable device that would notify responders if backcountry recreationists needed help, like "OnStar" for hikers? Additionally, AI is being integrated into technology, such as exosuits, to customize equipment and devices more to the wearer, allowing better support for movement and activity.

AI is also being harnessed to help manage natural areas. One version of this is using AI to monitor coral reefs and identify rare corals amidst common ones. Adapted to forestry, such techniques could spot invasive species before they spread widely or could detect trail erosion or infrastructure weaknesses without human staff to identify these and other problems. Sensors, microphones, and cameras are already installed in a Massachusetts nature area with AI identifying wildlife by sound. The goal is data to help improve protection of wildlife and understanding climate change impacts.

AI is starting to power governments. Estonia is an early adopter, going virtual for nearly all governmental activities. One aspect of this is storing individual medical information in a blockchain, which allows access to it anywhere and easy tracking of who else has access to one's data. This could be a boon for search and rescue efforts, far beyond the emergency information tapped into a smart phone's emergency health information app. But the efforts go further, with facial recognition used for allowing entry—currently to buildings and subways, but maybe someday to campgrounds and inns? This takes online camp site reservations to a much higher, more complicated level, especially considering the biases and other problems currently built into AI applications such as facial recognition (Mehrabi et al. 2022).

AR and VR? What's the Difference?

Augmented Reality (AR):

The overlay of a digital world on the real world seen through a device like a smartphone or goggles. Think Pokémon Go, one of the early widespread applications of AR.

Virtual Reality (VR):

Virtual reality is a computer simulation of a real environment. Like AR, often experienced with the use of goggles or other visual interfaces with a computer.

Artificial intelligence is just one aspect of emerging technologies that can dramatically affect recreation. Augmented reality and virtual reality could also be transformational. Current uses of AR already abound:

- Simulating changes to a forest landscape (could be done for recreation areas).
- Art and spoken word performances in parks.
- Pokémon Go increasing park visitation.
- Playground experiences that increase physical activity.
- Minecraft™ and other games are utilizing AR, e.g., Minecraft with "Minecraft Earth."
- Creating an outdoor planetarium in Quebec.

Meanwhile, VR is:

- Being used to depict pollution or other human impacts on wild areas.
- Simulating hiking trails while on your treadmill.
- Providing "rides" at campgrounds.
- Digitally including real forests into VR programs to facilitate virtual leaf peeping and in other ways tracking seasonal change.

VR may also be useful in promoting understanding of environmental challenges and issues, even if it never quite develops to providing real-world like detail immersion in natural settings. Researchers are developing VR games and documentaries in order to build on VR's capacity to enhance empathy and understanding of complex environmental issues (Fauville et al. 2020). VR developers are also creating virtual forests and fields where you can play, toss sticks, and come back to the same environment you left, tossed sticks and all. This forest environment includes AI-controlled wildlife and can simulate huge landscapes for solo or shared exploration.

AR has the potential to be engaging for Millennials and younger generations, and can provide micro-economic development opportunities in tourism areas, assuming AR follows some of the patterns of geocaching and other early entries to "tech+rec."

"Mirror World" is foundational to a wide expansion of AR experiences in real life. Mirror World is an effort to digitize real environments, with a goal of someday having massive amounts of the Earth's environments in digitized form, and available for seamless interaction in augmented reality (Kelly 2019). Pokémon Go is an early application of this technology. Mirror World could become crowd sourced, with enthusiasts adding areas not yet digitized. The technology allows adding totally new elements to a real world situation, such as a blue whale swimming outside a high-rise window, or interaction with imaginary characters like in Pokémon Go.

Mirror World technology could transform some traditional activities on public lands. Imagine interpretation of forests, showing through Mirror World AR what the forests were

like before European arrival, through harvesting and the Weeks Act, and then through regeneration to the present day. Imagine depicting voyagers portaging from Lake Superior to a Mississippi-bound Northwoods River. Or the migration of the Ojibwe from territories in the northeast of the current United States through the Great Lakes region to current-day homelands around Lake Superior. And these are just the traditional activities. Mirror World and other AR also open up new possibilities such as hosting Comic-Con-like events with fans playing out fictional stories in real forests, and many other possibilities yet to be imagined. Mirror World and related AR technologies might also be useful in public engagement around planning for future recreation investments and choosing current management actions.

To use AI/AR on forests, you need connectivity. There are a number of new approaches to providing this. Drones that can be stationary over a forest and provide connectivity are already being tested. Scientists are developing sensors that use electricity inherent in nature to run them. Some are looking at using animals to carry mobile hotspots, including reindeer to provide connectivity for the Sami people in northern Finland.

Some outdoor gear retailers are experimenting with near field communication (NFC) tags. NFC tags can be used before and after purchase to provide detail about the product and its use, watch videos of the gear being used that allow users to upload pictures of themselves using the gear, and more. This ongoing interaction between customer and company could be adapted for use by government agencies providing outdoor recreation, perhaps showing what the trail is like at a fork in a trail, or allowing registration at backcountry camp sites, or facilitating search and rescue connectivity.

Last, forestry is showing up in video games, like Firewatch, where players choose photos to take and conversation topics between the lead character and a forest ranger (Suellentrop 2016).

Drones

There are two general categories for drones: those that function like remote-control aircraft, and passenger drones. Both exist today, although the remote-controlled type is currently more common. Both are seeing advances and have implications for the future of outdoor recreation.

Remote-controlled drones

Drones are becoming ubiquitous, with licensing by Federal Aviation Administration (FAA) of more than 175,000 commercial drones in 2018 alone. This does not count amateur drones, and the total number of drones is expected to continue to grow exponentially over the next few years. Drones are advancing in their capabilities and equipment they can carry. For example, drones assisted in saving swimmers at a beach in Australia. In this case, the drone was able to deliver a safety raft for the swimmers to use. In other cases, drones fly over large areas and use remote-sensing technology, including

cameras, to search for lost people. This application of drones would be useful in natural disaster response, too, as well as monitoring visitor numbers and behaviors in order to tailor recreational offerings. Recreationists can also use drones to scan the terrain if lost, or to choose their route.

Drones are also used for plant care, including tending crops, as well as for tree planting where drones can outpace human efforts at reforestation. This could expand to maintenance of recreation sites, delivery of materials to remote locations, and other recreation-maintenance tasks. Drones, when specially designed to minimize disruption, are useful in tracking, photographing, and managing wildlife and endangered species. Drones can also monitor for poaching. These wildlife management applications are important to numerous recreation activities. These remote-controlled cameras don't just make for better nature calendar photos, they are also useful for research, such as better photos of threatened species to aid in tracking and counting the remaining populations. Scientists have also discovered new species, especially marine life, with remote cameras.

Drones can beget additional infrastructure. One example is the use of poles equipped with Wi-Fi, power, and landing space that could line a highway or other place. These poles can direct drones, recharge them, and more. There are also robots being developed (see the robot section below) that can be deployed and recharged via drone.

But drones can be a serious problem, too. One scan hit reports a climber nearly falling after being startled by a drone flying by. The scan hit reports any number of other times that buzzy drones have negatively impacted someone else's recreation, from skiing to rafting and more. Drones can be noisy and therefore could bother wildlife as well as recreationists. Noise can be more than a bother for wildlife; it can disrupt feeding and rest, cause adults to leave young unprotected, and in other ways disrupt and endanger wildlife (Bendel 2018). The U.S. National Park Service has strict limitations on drone use, banning them in nearly all parks (U.S. National Park Service 2017) but it is difficult to enforce. Drones have collided with helicopters and interfered with wildfire fighting (National Interagency Fire Center, n.d.).

Passenger drones

The next major advance in drones will be the wide-scale deployment of passenger drones, sometimes called VOLT, for vertical takeoff and landing taxi. Dubai already has passenger drone taxis, capable of carrying a single passenger. A Chinese company has tested electric passenger drones. GM has announced plans for two-passenger drones coming to market in the mid 2020s. Uber is investing in passenger drone technology, and new companies are emerging in the field in the United States, Europe, and Asia. Boeing and other companies are developing self-driving small planes.

Passenger drones and VOLT vehicles will allow recreationists to day trip to more public lands. They will need landing places and parking. They may need recharging facilities. Public lands with designated wilderness may see difficulties maintaining nonmotorized experiences if drones are flying overhead. And, of course, drones might crash or in other ways cause injury to people and animals. This dramatic shift in transportation will require new thinking to safely accommodate.

Robots

The primary means by which robots may increase outdoor recreation is as a byproduct of automation. Robots are expected to reduce the need for humans to work many types of jobs, from routine labor like stocking shelves to jobs requiring higher skill like manufacturing or waiting tables. Such a change will likely trigger ripple effects throughout society, such as a possible implementation of a Universal Basic Income or other means to offset the overall reduction in need for human workers. Recreation is likely to increase regardless, either as a means to meet basic needs (e.g., hunting, fishing, and foraging for food) or because basics are met and people have more time for fun and hobbies.

Not all robots will replace humans, some are designed as co-workers, dubbed "cobots." Some assist small business owners unable to find workers, even learning to joke with English speaking restaurant diners in the mountains of Nepal. Other robots are designed for pet care, including picking up poop behind your pooch. Imagine a robot cleaning up popular trails so feces along the trail doesn't cause problems. These problems are already being seen. Veterinarians in Colorado, one of the early adopters of legalized marijuana, are seeing stoned dogs, which they think is happening as dogs eat feces alongside trails, feces with enough THC in it to harm the dog.

Robots will soon be capable of some jobs that support recreation, such as trail maintenance and garbage collection. But scan hits point to robotic applications for other work, too, such as law enforcement and search and rescue. For example, Hyundai has a prototype all-terrain robot with a flat platform that can carry an injured person to a pick-up location, and several cities, including Huntington Beach, CA, and Dubai, have deployed robot police officers.

Robots are also part of gear advances, such as smart suitcases and robotic exosuits. Gear like this may make recreation possible for some who can't now engage. Exosuits could also assist in complicated search and rescue operations, reducing the strain on human SAR teams.

Autonomous Vehicles and Jetpacks

Self-driving cars have been in the news for years now, and while there are glitches to overcome, there is every expectation that the glitches *will* be overcome, and autonomous vehicles will transform how we get around. Self-driving cars may expand the number of visitors to public lands, just as the invention of cars did in the 1900s. Traveling further for day trips would be possible, because the car can drive there and back while the people rest, play games, eat, etc. Developers are working on technology that make automated vehicles that brake for animals, thereby alleviating one of the potential problems of autonomous vehicles on public lands.

Self-driving technology is not limited to cars. There is a prototype self-driving recreation vehicle. Such a vehicle could allow a camper to leave home after dinner, sleep on the way, and arrive at their destination in the morning ready to park and go play. No more endless "are we there yet" from the back seat. Buses can also be autonomous, driving routes in a city or in a park or forest. This could enhance mobility within a recreation area, increasing access for people without vehicles.

But it is not just a self-driving vehicle that companies are envisioning. Toyota imagines a self-driving store, bringing retail to consumers wherever they are. The selection would be modest but targeted to the region. Forgot your sunscreen? No worries, the store will be there in a jiff.

Jetpacks have long been a symbol of the future, and the frustration of anticipating cool new gadgets that never quite seem to materialize. But jetpacks might become a reality in the not-too-distant future. DARPA, the defense research group, is investing in jetpack technology. If this advance follows previous DARPA supported inventions, such as the internet, jetpacks may be in the hands of civilians for work and play. Jetpacks could make reaching a favorite fishing hole or hunting spot faster and easier. They could provide transportation options for people with mobility issues. Jetpacks could become a recreation activity of their own, not unlike off road vehicles and snowmobiles.

Geoengineering

There were two geoengineering scan hits with relevance to recreation. First are efforts to change weather patterns by geoengineering. China is developing this technology now, aiming to increase rainfall. This is a complex issue, but the recreation implications rest in any systematic use of geoengineering to change precipitation, thereby renewing streams, and perhaps snow fall. But there is opposition and concern about these approaches, signaling that widespread application is years off, and potentially fraught with conflict within and between countries.

The second geoengineering scan hit looks at the use of a system of buried tubes to keep permafrost frozen. The original application is for oil and gas exploration in the Arctic. But could such systems be applied to preserve winter and winter sports in some places? Will shrinking snow cover lead to support for such dramatic—and expensive—approaches to maintaining access to snow sports?

Technology-related Horizon 3 Scan Hits

Not surprisingly, it is technology that has the most in the way of "far out" scan hits. Here are a few:

- Upload is not just a sci-fi TV show, there is a startup already in place to upload your brain to the cosmic internet.
- Transhumanists see the day that humans are part technology, with an initial step being brain implants that would allow sending the "wish you were here" postcard telepathically.
- Engineers in several countries are looking for ways to use leaves to create energy that can then run equipment for camping, habitat monitoring, and more.

Figure 10 on page 84 summarizes technology-related recreation horizon scan hits, sorted by horizon.

Recreation Futures Across Horizons: Technology

Horizon 3

H3 scan hits are highly uncertain, the weak signals of possible change. These can seem laughable and weird. H3 scan hits are also typically the furthest out in terms of time, easily 20 or more years in the future. These are the "new" ideas.

Horizon 2

H2 scan hits are in between. They are not yet visible in our day-to-day lives, but could happen soon, and the level of uncertainty is moderate. These changes are more likely, but not a given. They are "next".

Horizon 1

H1 scan hits refer to signals of change that are evident in the system today, or that are imminent. Therefore, the level of uncertainty regarding this change is low. They are now, or near (Hines et al. 2019).

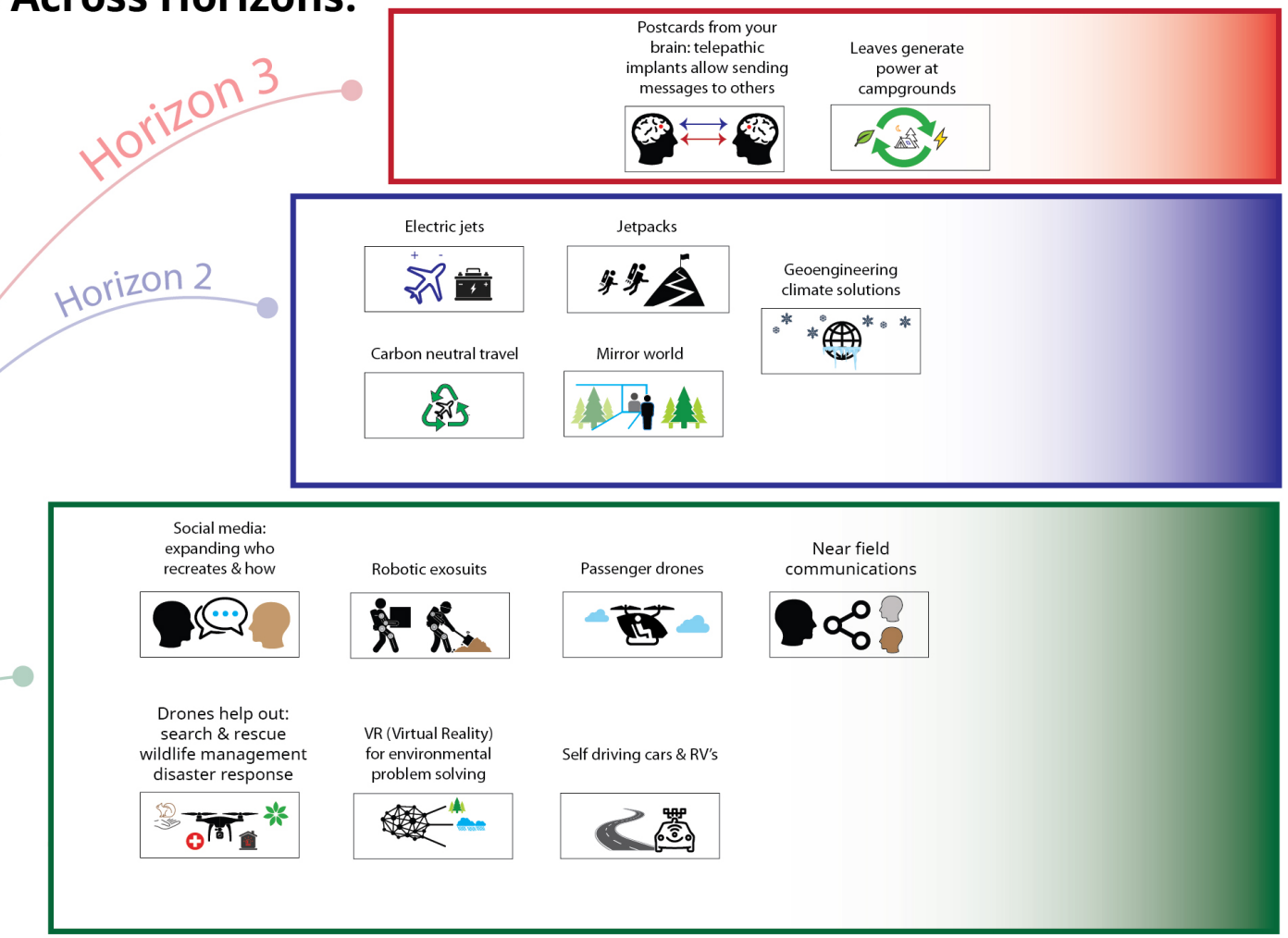

Figure 10

ECOLOGY SCAN HITS

The horizon scanning hits broadly related to ecological issues touched on climate change, wildlife issues, wildfire, water, pollution and degradation, and other issues. Some issues are combined in the discussion below in order to reduce redundancy. There are many more ecology-related scan hits suggesting a decline, even a significant decline, in recreation than there are scan hits suggesting an increase in recreational activity. Dramatic changes in winter weather, in water regimes, in species diversity and dispersal can all impact recreation quantity and quality. Impacts will vary by geography and ecosystem.

Climate Change

This section will report on climate change by theme, including many of the biodiversity and water-related scan hits (Note that biodiversity scan hits overlapped with climate change and wildlife, and will be reported in those sections rather than on its own; similarly, water-related scan hits will be reported in other topic areas in order to reduce redundancy in this report.)

Of the ecology-related scan hits, climate change had the most scan hits, and, more importantly, was by far the strongest signal pointing to decreased recreation on public lands: 30 scan hits pointed to decreased recreation while 13 suggested an increase in recreation. Six topics had 20 or more shared scan hits with climate change: traditional public land recreation activities, lower quality recreation, wildlife issues, tourism, biodiversity, and governance.

Key to understanding the effects of climate change is to recognize it is already occurring and having substantial and wide-ranging impacts (Mora et al. 2018). Climate change is already exacerbating natural disasters, and these impact human health and infrastructure daily. Scan hits point to this intensifying in the near- to mid-term future, suggesting immediate steps are needed to develop new standards for infrastructure, including recreation infrastructure, such that they are resilient and adapted to current and future effects of climate change.

An economics-based study of recreation trends, when adding climate change impacts to the models, predict reduced total recreation participants as well as reduced days of participation for many recreation activities by 2030, although expected future population growth and increases in income are anticipated to partly offset declines due to climate change (FICOR, n.d.).

Contrary to the report cited above, demographers expect to see continued population decline in the United States as birth rates continue to fall. This may be upended by climate migration. Climate change is projected to make large swaths of the globe inhospitable to human life, and these areas are currently heavily populated (i.e., Central America, southeast Asia; Lustgarten 2020). Exactly where people will go is unknown, but this is expected to be the largest human migration ever to have taken place (Lustgarten 2020).

The recreation impact stems from new populations having different recreation interests, perhaps repopulating areas that currently face dwindling populations and economies, such as rural towns proximate to national forests, or potentially putting housing pressure on undeveloped land. There is great uncertainty in how, and how quickly, this will unfold. There is little uncertainty that it will unfold.

Some scan hits suggest that a complete change in the economic system is necessary to combat climate change and improve quality of life. From this perspective, growth is no longer the key focus for economic policy and goals. This is one of the few climate change-related scan hits that suggest a possible upturn in recreation, if this approach is taken to address climate change. The reasoning is reduced focus on economic growth leads to more time and focus on quality of life, including recreation. Some countries and municipalities are already putting some of these principles into practice, such as trials of a Universal Basic Income. Alternatively, some scan hits see recreation opportunity hidden in the possibility of funding climate adaptation and mitigation efforts, with well paying jobs leading to increased leisure time and options. One scan hit suggested that a redesigned electric grid could also create a nationwide trail system connecting urban and rural areas.

Snow and winter sports

Decreases in snow cover are expected to lead to significantly less skiing and other winter sports. Snow sports are some of the highest expenditure sports, indicating a negative ripple effect for local economies would be likely. This is already underway, making this a Horizon 1 scan hit.

Various research studies in our scanning database indicate:

- Snow season is already 34 days shorter than in the 1980s (Zeng et al. 2018).
- Winter recreation seasons will shorten by 50 percent by 2050 (Wobus et al. 2017).
- Variability of when snow will fall and how much will fall is also changing significantly (Marshall et al. 2019).

With snow sports and related tourism currently responsible for about $20 billion annually in the United States economy, the loss of snow means a big hit for recreation-dependent economies. Tens of thousands of jobs are threatened. Some new activities (mountain biking, zip lines) may make up some of the shortfall by offering different recreation opportunities.

However, some scan hits are predicting not just a decline, but a loss of snow sports such as skiing and snowboarding. Vermont and New Hampshire are mentioned specifically, with substantial impacts likely for the Green and White Mountain National Forests. Of the 103 ski resorts in the Northeast, only about half are expected to be viable by 2050. Similar declines are underway in the West. It's worse in Europe, with glaciers melting at precipitous rates.

Because of the uncertainty regarding snowpack, some marketing changes are already taking place and are expected to increase, such as companies offering a single pass for all ski areas in their holdings. This approach allows the pass holder to ski where the snow is and not be limited to a specific ski area.

Some in the ski industry are also making changes to become carbon neutral, and thus help protect winter sports by reducing climate change. Studies suggest broader actions to limit greenhouse gas emissions could have a meaningful impact on the shortened seasons, both delaying and reducing the overall impact on the decline of winter and snow.

One scan hit suggested a possible technological fix: a company that specializes in refrigeration methods is doing a booming business with oil companies drilling in Alaska. This company sells equipment to keep the permafrost frozen, burying refrigerating tubes in the permafrost. Could this or similar technology be used in stopping the decline of snow and winter sports?

Another effect of climate change is melting glaciers, and the impacts of this are many. Glacier melt can change water flows in mountain areas, effecting lakes and thereby fish and other aquatic life. This, in turn, can impact fishing and potentially other water-based recreation.

A less obvious impact of melting glaciers is the loosening of rocks and boulders as ice melts. These can fall on climbers and hikers, increasing the risk of these activities.

Water

Climate modeling suggests frequent and extreme change in temperatures and water cycles, experienced in back-to-back heat waves, stressing available water as well as agriculture. Several scan hits discuss the effects of warming water, which is happening at record levels. Warmer waters tend to be lower in dissolved oxygen and may increase the toxicity of some compounds. These lead to fish die-offs, which are projected to double in northern temperate lakes by the middle of the century. Even more die-offs are expected in southern lakes. Rivers will also see reductions and changes in fish populations. Browning of water is another impact to water quality. Browning occurs from dissolved organic carbon and other processes. By reducing light penetration, browning impacts fish populations and reduces regeneration. All of these changes would substantially reduce the quality of fishing for anglers.

Human actions have reduced genetic diversity in animals, especially fish. This reduces the species ability to adapt to environmental changes. Recreation impacts to fishing and other aquatic recreational activities could be most pronounced, as the genetic changes are most significant in fish.

Warmer temperatures are also reducing water levels in the Colorado River. This portends significant impacts to tourism and recreation, such as impacts on rafting, fishing, and other recreation activities. What is new in this scan hit is that the lower water levels are tied not to less precipitation, but, for the first time, to higher temperatures (Udall and Overpeck 2017).

Peak summertime phytoplankton bloom intensity has increased by 68 percent, but these results to do not track with temperature, precipitation, or fertilizer use. This causes problems simply by overgrowth (e.g., shutting down municipal water systems) or from toxic phytoplankton (Ho et al. 2019). Climate change is suspected in the increased outbreaks of toxic phytoplankton such as blue-green algae, which is toxic to both humans and pets. It can kill dogs and seriously sicken humans who swim in effected waters. Because the effects of blue-green algae can lead to disability and even death, the impacts on water sports could be substantial.

Oceans are changing in significant ways, too. Seagrass meadows are globally threatened. These meadows are critical for water quality and clarity, fish and other sea creature habitat (in Florida they provide 70 percent of nursery habitat). Therefore, there are expected impacts for fishing, and for human health via impacts on diet, due to the loss of seagrass meadows. Other impacts on ocean wildlife and biodiversity are discussed below.

Biodiversity

Because of the overlap between biodiversity and wildlife, I will report here on systems and processes rather than individual species. Species-specific wildlife issues are reported below.

Just as humans are moving due to climate change, animal and plant species are also on the move. While not all changes will be negative, the effects will be wide ranging. One study mapped feasible routes for species migration, which may be useful for National Forests and others in planning for future wildlife populations (Hausheer 2016).

Data indicate that parks are warming faster than other areas. Are national forests, too? Warming more rapidly will speed the major impacts for landscapes and wildlife.

Solar geoengineering—systems to change how much solar energy enters earth's atmosphere in order to limit climate change—is gaining interest. The impacts of solar geoengineering on biodiversity could be significant. When implemented, it could be beneficial to biodiversity because it could lessen the need for species to move to adapt to climate change. However, if the geoengineering is subsequently stopped, the resulting change could require species to move quickly ("increase velocity", in the jargon of the field), and so would increase the threats to biodiversity.

Citizen science's popularity could be useful in addressing biodiversity issues. Volunteers could monitor and in other ways help as a cadre of service workers across the globe. They could plant trees, protect wetlands and rivers, test water quality, and more. These steps

would help directly address climate change and environmental degradation. This type of volunteering is sometimes called "serious leisure" and is a form of recreation in and of itself (Stebbins 2006).

One suggested approach to address wildlife and habitat decline is rewilding (Perino et al. 2019). Rewilding has come to mean allowing for more wildlife through land abandonment and reintroduction of some species. It is growing in popularity, in part because it addresses the limitations climate change puts on attempts to restore historical assemblages (the focus of traditional ecological restoration). Rewilding instead focuses on allowing natural processes to unfold, such as the presence of apex predators, rather than targeting specific species assemblages.

Health

Climate change effects are expected to impact human health in a number of ways and are expected to lessen the demand for outdoor recreation. Climate change is increasing the range and number of disease-carrying insects, such as mosquitoes and ticks, leading to more illness and fear of illness, thereby potentially limiting recreation participation. In addition to the growing ranges of disease-carrying insect, the range for fungal infections, such as valley fever, is expected to double this century. Other new diseases and conditions are already cropping up, such as worms and other parasites infecting swimmers. As discussed above, climate change is expected to increase blue-green algae blooms, which are toxic to humans and especially to pets. Because the effects of blue-green algae can lead to disability and even death, the impacts on water sports could be significant.

One biotech startup wants to address mosquito-borne illness. MosquitoMates (Lexington, KY) deploys laboratory-raised mosquitoes to carry a fatal-to-mosquitoes bacterium to wild mosquitoes to control populations and the spread of disease. This and other approaches may be developed for a wider range of vectors and diseases.

Climate change is also contributing to a decline in people's mental health and well-being. Health care practitioners see this as a significant impact of climate change. Recreation effects could be multi-faceted. Depression, for example, is known to limit motivation to engage in daily life activities. However, as discussed in the health section, spending time in nature is gaining traction as a treatment for many health issues, including depression, anxiety, and other mental health problems.

Tourism

There are many ways that climate change can directly or indirectly impact tourism. Melting glaciers, increased wildfire, and more all impact tourism. The scan hits point to both increased and decreased tourism, indicating a higher level of uncertainty and variability in tourism futures.

Increased wildfire—a byproduct of climate change—reduces outdoor recreation and tourism. Severe fire seasons have already reduced tourism to Montana, with monetary losses in the hundreds of millions. Smoke also impacts recreation, limiting hunting and fishing and outdoor fitness activities.

"Last chance tourism" results from concerns that it is now or never to visit some places, given the effects of climate change. Last chance tourism can be seen in many places, from the Arctic to the low-lying islands and atolls of the Pacific and Indian Oceans. Glaciers are a frequent location for this type of travel.

Related to last-chance tourism is the rise in "overtourism": essentially, massive crowding at some sites. Social media, Instagram in particular, drives up visitation at some locations. Horseshoe Bend near the Grand Canyon is one example, and Iceland recently closed a location due to over visitation after a celebrity posted about their visit. To counteract these trends, nations such as Norway and some organizations are developing sustainable tourism guidelines, aiming to reduce the ecological and climate impacts of tourism.

Some suggest that if a traveler can't get to a destination by sustainable means, they should not go. Given younger generations focus on climate action, more tourism and recreation decisions may be made based on the sustainability of the destination and travel to it.

However, there are scan hits that suggest rapid development of sustainable travel options. Developments in electric vehicles will improve recreation opportunities and accessibility, such as electric bikes, electric leisure craft, electric ferries, even electric jets are in development. This means that most places will likely be accessible by sustainable means of transportation. "Where there is innovation there is hope" says one scan hit (Liebreich 2018). Electrification and other clean transportation allow the benefits of travel without the current climate change costs, where transportation makes up 14 percent of emissions globally (Liebreich 2018).

Wildlife Issues

There are many impacts of climate change on biodiversity and wildlife (discussed above but also included here). Because wildlife is key to outdoor recreation (hunting, fishing, viewing, and more), impacts of climate change on biodiversity matters to recreation. The scan hits in this area suggest changes from the macro scale to individual species.

At the broadest scale are the scan hits suggesting that mass extinction is highly likely by the end of the century, and, with it, effects on wildlife and ecosystems that will have repercussions for recreation. Climate changes combined with other impacts (hunting, wildlife trade) could lead to similar effects in forests, dubbed "empty forests," with trees but little to no wildlife. In some cases, forests may change over to savannah.

While impacts from human development and deforestation are the leading cause of dwindling wildlife, climate change also negatively impacts forest dwelling wildlife. This becomes a negative feedback loop as these animals, by keeping the forest ecosystem healthy, contribute to carbon storage in forests. Therefore, a decline in wildlife further exacerbates climate change and also negatively impacts a key forest-based recreational activity. Other wildlife-related scan hits suggest:

- Hunting is implicated as having a negative impact on carbon storage (Krause and Reinhardt Neilsen 2019).
- Methane releases and the rise in global temperatures lead to wildlife losses, such as pikas (Ochotona spp.), and a resulting loss of tourism and recreation funding (tourism, licenses, taxes, etc.).
- Charismatic megafauna, such as mountain goats, are threatened by anthropogenic change.
- Seventy-five percent of neotropical primates are in decline or threatened, according to Hochberg (2017).

While wildlife as a whole is expected to decline, birds are already in crisis. Many signs point to the overwhelming decline of bird populations. Agriculture is a lead cause, with logging, invasive species, and hunting as additional causal factors. For birds, climate change may mean shifting habitats, and some protected areas (parks and forests) may see new bird populations showing up. And some birds may stop migrating and become year-round residents if winter conditions are tolerable. This could lead to an increase in, or shift in patterns of, birding. This is not to imply that birds will adapt to all climate impacts. Other studies indicate that nearly all bird species are in decline, nearly all have shifted habitat (such as shifting to a higher elevation), and other changes. Other birds that were already at the ends of habitat spectrums are gone, part of the early edge of the wave of mass extinction expected by the end of the century.

There is strong public support for conservation generally and hunting and fishing specifically. A challenge is the extent to which funding for wildlife is tied to the sale of licenses. Overall, hunting and fishing are in decline while other outdoor recreation activities like cross-country skiing and wildlife viewing are on the rise. However, most recreation can negatively impact wildlife, even silent sports. In fact, silent sports can have more negative effects on wildlife than motorized activities (Larson et al. 2016).

Other wildlife-related scan hits:

- Seal conservation success in Cape Cod has led to an increase in sharks, and in tourism to see the sharks. Could the same happen with other apex predators?
- Tourism focused on experiences, including with animals and wildlife, has deep roots, but takes on new dimensions now, like Airbnb's Animal Experiences and related opportunities.

- As grassland climates get hotter, bison are likely to get smaller. A study found that the hotter the climate, less bison weighed. This is indicative of the type of change that might be seen in grasslands as temperatures increase.
- More bugs with more illness are coming. Asian longhorned ticks (*Haemaphysalis longicornis*) are one example, and are already killing livestock, deer, and other wildlife in the United States.
- Animals, specifically amphibians and reptiles, are stressed by the rapidly changing patterns in rainfall and temperature.

As discussed in the section on water, but equally important to biodiversity, is the effect humans are having on genetic diversity in animals, especially fish. Human impacts are reducing genetic diversity, which in turn reduces species' abilities to adapt to environmental changes. In terms of recreation, this reduces fishing and wildlife viewing in both quality and quantity.

Ocean wildlife is also impacted by a changing climate:

- The North Atlantic right whale (*Eubalaena glacialis*) is no longer observed calving every year, and its numbers have been dwindling. Wildlife movement patterns are changing. Recreation impacts are to wildlife viewing and fishing.
- Red urchins are expanding territory along California's coast and are wreaking havoc on marine ecosystems. This is affecting recreation, for example, by closing the red abalone fishing season, which has contributed over $40 million to the local economy.
- Hawaii's coral reefs are predicted to be essentially gone by the end of the century, with substantial impacts to recreation, tourism, and associated economic benefits (Thomasy 2019).
- A positive impact from climate change is a longer and more productive blue crab season due to warmer winters in and around the Chesapeake Bay. More recreational crabbing as a result. Will this happen in other fisheries?

Pollution and Degradation

Numerous scan hits suggest impacts to recreation due to pollution and environmental degradation.

Air quality remains poor in low income communities, predominantly in African American rustbelt communities, exacerbating health disparities for the poor and for Black Americans. This may limit participation in outdoor recreation because of chronic illness such as asthma and chronic obstructive pulmonary disease (COPD). Existing research shows the importance of exposure to outdoor recreation and nature play as children to support lifetime participation in these activities (Asah et al. 2018). Therefore, the impacts of the burden of poor air quality could have a long-term ripple effect because fewer children may be introduced to outdoor recreational pursuits.

There are several scan hits regarding degradation of oceans. Ocean acidification affects ocean wildlife, and by one estimate may cost $3 trillion a year by 2100 in lost tourism, fishing, and more (Secretariat of the Convention on Biological Diversity. 2014). The growing "dead zone" in the Gulf of Mexico is not a brand new issue, but it is ongoing and impacts marine-based recreation due to die-offs and red tide restrictions on beach use.

Groundwater pumping has reduced stream flow by up to 50 percent over the last 100 years. This effects streams and rivers and reduces fishing and other river-based recreation opportunities. As climate changes increase, groundwater pumping may also increase, exacerbating this effect.

Magnet fisher folk are making a few bucks while cleaning rivers. Using strong magnets, these "anglers" are removing metal objects from riverbeds to sell for scrap. The end result is a cleaner riverbed, a recreational activity in and of itself, and improved conditions for other river-based recreation. But the activity is not currently regulated, and unintended consequences are possible.

Related to last chance tourism and the Instagram selfie posts in unique natural areas is the movement to take selfies at toxic—pretty, but toxic—sites. Such is the case at a Siberian lake that is stunningly turquoise in color due to calcium salts and other metal oxides in this power plant ash pit. Efforts to reduce visitors seems only to have attracted more.

Ecology-related Horizon 3 Scan Hits

Two Horizon 3 scan hits related to ecology are:

- Floating cities are under development. Such cities on the seas offer advantages to infill development in existing cities, by creating some marine habitat (artificial reefs) rather than destroying it. Some argue floating cities could be a useful component of addressing climate change.
- Advances in genetics could allow bringing back extinct species, even dinosaurs. Some advocates of rewilding argue that bringing back some species would help reestablish functioning ecosystems negatively impacted by development and climate change.

Figure 11 on page 94 summarizes ecology-related recreation horizon scan hits, sorted by horizon.

Recreation Futures Across Horizons: Ecology Related

Horizon 3

H3 scan hits are highly uncertain, the weak signals of possible change. These can seem laughable and weird. H3 scan hits are also typically the furthest out in terms of time, easily 20 or more years in the future. These are the "new" ideas.

Horizon 2

H2 scan hits are in between. They are not yet visible in our day-to-day lives, but could happen soon, and the level of uncertainty is moderate. These changes are more likely, but not a given. They are "next".

Horizon 1

H1 scan hits refer to signals of change that are evident in the system today, or that are imminent. Therefore, the level of uncertainty regarding this change is low. They are now, or near (Hines et al. 2019).

Figure 11

CONCLUDING COMMENTS

The many horizon scan hits analyzed for this report raise myriad issues and possibilities, sometimes these issues conflict, sometimes they agree. These many differing ideas point to one certainty: there are many possible futures of recreation on public lands. There are no given outcomes. This inherent uncertainty and volatility suggest the usefulness of applying additional strategic foresight techniques to plan now for these various possible futures. Recall that horizon scanning is a foundation of strategic foresight, but many other methods have been developed to help make sense of these signals of change. For example, the futures wheel or a backcasting process could further explore implications of some of these possible changes, allowing managers to make choices to move toward—or steer away from—some possible future outcomes. The scenarios presented could also be useful in planning for future recreation programs and opportunities.

Climate change impacts drive many of the uncertainties highlighted in these scan hits: when and where will people move because of climate change? Will we not only repopulate some rural towns, but also take to the seas and the stars for places to live? Will we see the effects of mass extinction in our lifetimes, and with it changes in many wildlife-related recreational activities? How much longer will skiers be able to head to the slopes in the United States?

Other questions raised by these recreation-relevant scan hits include:

- We already see a burgeoning role for time in nature in keeping people healthy and fit, physically and mentally. Will public lands' recreation managers work closely with public health professionals, primary care providers, and others as a part of a healthcare delivery system? Will public lands and land managers be called upon to manage for species and ecosystems that provide key health benefits?
- What new recreational activities will emerge, with constituents demanding access to public lands to pursue? Many of these possibilities come from technological advances: passenger drones, jetpacks, AR-facilitated play or interpretation programs, or "visits" to a recreation site through virtual reality, from the comfort of home. Will forest managers be trading traditional conflicts between motorized and nonmotorized recreators for new types of conflicting uses and users?
- How will technology change recreation management? Robots assisting with trail maintenance, exosuits enhancing stamina for search and rescue teams, and self-repairing concrete reducing the maintenance backlog, are all possible if these scan hits come to be.
- How will rural communities change? Will the work-from-home phenomena speed the movement of the creative class to some rural areas? Will climate change bring new residents? Or force more depopulation of rural areas as here-to-fore solid recreation jobs are lost with a changing climate?

- How will recreationists themselves change? Will medical advances continue to make recreation possible where currently it is limited, such as for the very old or those with serious mobility issues? As Gen Z and the generation behind them age into deciding recreation activities for themselves, what will they ask of public lands? Will they seek more and different activities? Or will fear of nature, or familiarity with other recreation options, preclude their opting for recreation on public lands? Current trends suggest increased diversity in who recreates where, challenging the rugged individualist stereotype.
- Will the growing movement to provide rights to nature continue to spread? If the growing demand for rights and sovereignty of native peoples also grows, how public lands are managed, and by whom, may change in significant ways.

The pending changes are many, and some could be influenced by plans and decisions made today. So the question is this: what is the future we want in which to live, work, and play? Deciding on this will take work, creativity, and vision on the part of today's public land managers and of those who turn to public lands for recreation, respite, and relaxation.

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APPENDIX

The code tree below shows the coding structure from the database in NVivo (QSR International 2017). Not every code listed below is discussed in the report.

Horizon 1 2 3
- H1
- H2
- H3

STEEP
- Ecological or environmental context
- Economic context
- Political context
- Social context
- Technological context

Quality of recreation
- Higher quality
- Lower quality

Recreation - change in rate
- Decreased recreation
- Increased recreation

Activities
- New for public lands
  - art
  - Cosplay
  - festivals and related
  - jetpack
- Other activities
  - beekeeping
  - driving
  - gardening
  - golf
  - play, general
  - playgrounds
  - running
  - scouting and related groups
  - sports generally
- Traditional public land activities
  - ATV and ORV
  - backpacking
  - biking
  - boating
  - camping
  - climbing
  - gathering, nontimber forest products
  - hiking
  - horseback riding
  - hunting fishing
  - interpretive sites
  - photography
  - picnic, BBQ, dining related
  - snow sports
  - stargazing - dark skies
  - swimming
  - volunteer
  - walking
  - wandering
  - water sports, other
  - wildlife viewing

Ecology related
- Biodiversity
- Climate change
- Forests
- Invasives
- Natural hazards (other than fire)
- Pollution and degradation
- Research and data collection
- Restoration
- Soundscapes
- Species of concern
- Water, hydrologic, rain
- Wildfire
- Wildlife

Place related
- Agriculture
- Landuse conflicts
- Private lands
- Rural development
- Special places
- Urban

- Wilderness
- Wildland-urban interface

Recreation related

- Access to nature
- Accessibility
- Earning a living
- Infrastructure and maintenance
- Living on the forests
- Local visitors
- Outreach
- Pets
- Privatization
- Recreation gear
- Recycled reused material
- Safety and search and rescue (SAR)
- Tourism
- Transportation
- Visitor management

Social issues, various

- Beauty
- Citizen engagement
- Diversity
    - African American, Black
    - Asian
    - gender
    - general
    - Hispanic
    - Indigenous
    - LGTBQ+
    - size, body positivity
    - White
- Ecoterrorism
- Education
- Environmental Justice
- Emotion and related
    - connection
    - discomfort
    - disdain
    - despair
    - fear
    - frustration anger
    - happy
    - loneliness
    - love affection
    - magical
    - mutualist traditionalist
    - nostalgia
    - solitude
    - spiritual
    - trust
- Environmental attitudes values
- Generation cohort
    - adult
    - elderly
    - older adults
    - other adult (not elderly)
    - younger adults
    - children or childhood related
    - future generations
    - teens
- Governance
- Health
- Imagination
- Inequalities(addressing)
- Law enforcement
- Poverty
- Quality of Life
- Rights
- Social network or support
- Work force

Technology related

- AI, AR, VR
- Autonomous vehicles
- CRISPR (gene editing)
- Data and privacy
- Digital currency
- Drones
- Exosuits
- Geoengineering
- Robots
- Social media
- Space travel
- Wood products

Colorado
R9 specific

Northern Research Station

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