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U.S. wilderness in the 21st century: A scoping review of wilderness visitor use management research from 2000 to 2020

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ABSTRACT

Now over twenty years into the 21st century, it is suggested that we are entering a new era of wilderness visitor use management (VUM). Yet, we lack a recent review of the literature assessing the latest research trends to advance wilderness VUM in a meaningful way. Accordingly, this research serves as both a review of the last twenty years of U.S. wilderness VUM research and a launching point into the next era. Our assessment adds to several previous benchmarks that demonstrate the progress of wilderness VUM research. This review evaluates trends in methodologies and themes of inquiry specific to VUM research in federally-designated wilderness over the past twenty years. The findings inform our discussion on emergent wilderness values and relevancy, approaches and settings of research, the evolving aspects of VUM in the wilderness, and the need for the synthesis of research across the National Wilderness Preservation System.

KEYWORDS

Wilderness; visitor use management; review

Wilderness in the United States is both a social construct and a specially designated area of federally-held land (Cordell et al., 2005). The 1964 Wilderness Act set up the framework for the National Wilderness Preservation System (NWPS). At the time of its passage, the NWPS comprised 54 wilderness areas totaling 9.1 million acres, all of which were administered by the U.S. Forest Service (Scott, 2005). Since 1964, the NWPS has grown to 803 wilderness areas totaling over 111 million acres, which are administered by the U. S. Forest Service (USFS), Bureau of Land Management (BLM), National Park Service (NPS), and the U. S. Fish & Wildlife Service (USFWS) (Riddle & Hoover, 2019). Visitation and desire for recreation in wilderness settings have grown in the past decade (USDA, 2020). In an age of increasing outdoor recreation on wilderness-designated lands, a high-quality visitor experience is one of the main components of wilderness character for visitor use management (VUM) (Landres et al., 2008, 2015).

Over the past twenty years, there have been advances in both wilderness VUM research and in VUM frameworks. As we move beyond the second decade of the 21st century, it is suggested that the human relationship with wilderness is changing and

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that we are entering a new era of wilderness management (Smith & Kirby, 2015; Stinson, 2017). Yet, there has not been a recent review of the literature synthesizing the latest studies and assessing trends in VUM research related to wilderness, which could advance wilderness VUM in a meaningful way. This research serves as both a review of the last twenty years of U.S. wilderness research and a launching point for research moving forward. This work adds to several previous benchmarks assessing the state of wilderness VUM research (e.g., Cole & Williams, 2012; Leung & Marion, 2000; Roggenbuck & Lucas, 1987). Specifically, this scoping review seeks to address the following research questions related to VUM research in the federally-designated wilderness from 2000 to 2020: (1) How are research items distributed across time and wilderness-administering agencies during this era; (2) What are the predominant data collection methodologies employed during this era; and (3) What major themes of research inquiry define this era?

Wilderness character and visitor use management

Visitor use "refers to human presence in an area for recreational purposes, including education, interpretation, inspiration, and physical and mental health" (IVUMC, 2016, p. 2). The 1964 Wilderness Act mandates that administering agencies "provide for the protection of these [wilderness] areas, [and] the preservation of their wilderness character" (The Wilderness Act of 1964, Public Law 88-577, 1964). Wilderness character has been described as the complex relationships and meanings of "biophysical, experiential, and symbolic ideals that distinguish Wilderness from other lands" (Landres et al., 2008, p. 6). Wilderness character is not clearly defined in the Act, and the meaning of wilderness character is debated, often to no solution, other than it is challenging to singularly define and has different meanings for different people (Watson, 2004).

The 1964 Wilderness Act defines wilderness as an undeveloped area of federal land where:

> The earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain. An area of wilderness is further defined to mean in this Act an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions and which (1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable; (2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation; (3) has at least five thousand acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition; and (4) may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value. (Wilderness Act of 1964, Public Law 88-577, Section 2c)

This definition of wilderness, in large part, inspired the articulation and definition of wilderness character in an interagency monitoring framework (Landres et al., 2008, 2015) used by the wilderness administering agencies as they aim to preserve wilderness character. The monitoring framework suggests that wilderness character consists of five qualities (Landres et al., 2015). First, *untrammeled* refers to "unhindered and free from the intentional actions of modern human control or manipulation" (Landres et al., 2015, p. 11). Second, *natural* refers to "ecological systems that are substantially free

from the effects of modern civilization" (Landres et al., 2015, p. 11). Third, *undeveloped* refers to "without permanent improvements or the sights and sounds of modern human occupation" (Landres et al., 2015, p. 11). Fourth, *solitude or primitive and unconfined recreation* refers to "recreation in an environment that is relatively free from the encumbrances of modern society, and for the experience of the benefits and inspiration derived from self-reliance, self-discovery, physical and mental challenge, and freedom from societal obligations" (Landres et al., 2015, pp. 11–12). Lastly, *other features of value* refers to "ecological, geological, or other features of scientific, educational, scenic, or historical value" (Landres et al., 2015, p. 12).

The first four qualities are said to exist in all wilderness areas and, therefore, monitoring these qualities is required by the administrators of wilderness units. The fifth quality is site-specific and is monitored only if it exists within a wilderness unit. While it is accepted that "splitting the legislative definition of wilderness into five rather distinct and tangible qualities imposes reductionist thinking on the fundamentally holistic concept of wilderness character" (Landres et al., 2015, p. 85), wilderness management is primarily motivated by the goal to protect, maintain and, to the greatest extent practicable, improve the five qualities of wilderness character.

VUM is an important component of preserving wilderness character, within the context of all five qualities. For instance, when considering the natural quality of wilderness character, managers need to consider how visitors may influence such conditions. As another example, intangible aspects, such as beauty and opportunities for challenge and self-discovery are important contributors to wilderness character and visitor experience (Putney & Harmon, 2003; Roggenbuck & Driver, 2000; Schroeder, 2007). Generally, the task of preserving wilderness character and managing visitors is challenging and complex, particularly as the meanings of the five distinct qualities are not fully agreed upon. Within the context of VUM, the complexity of preserving wilderness character is perhaps best represented when considering: (1) the ambiguity and lack of consensus surrounding solitude or primitive and unconfined recreation and (2) changing societal values and ecological threats.

The meaning of solitude and primitive, unconfined recreation

The wilderness quality that most specifically addresses VUM is the mandate, in part, to provide "outstanding opportunities for solitude or a primitive and unconfined type of recreation" (Wilderness Act of 1964, Public Law 88-577, Section 2c). Unlike the other four qualities, the Wilderness Act does not define the meaning of this phrase well, and researchers and managers have spent much effort attempting to define and interpret the phrase for the purpose of VUM. As Seekamp and Cole (2009) noted, within the context of the phrase and the individual terms (e.g., solitude), the "vagueness has been a source of contention regarding visitor management, as multiple interpretations of the terms exist" (p. 23). The lack of clarity related to this phrase is partly attributed to multiple and evolving, interpretations of individual terms. For instance, the meaning of solitude could include the absence of people or evidence of people (e.g., smoldering fires) (Hall, 2001; Seekamp & Cole, 2009), a psychological detachment from society (Hollenhorst & Jones, 2001) or, more contemporarily, the ability to "de-tether" from technology, such

as cell phones and internet service (Lang & Borrie, 2021). Additionally, there are discussions related to whether "solitude" is conceptually distinct from "primitive and unconfined," or if the terms are all synonymous (Engebretson & Hall, 2019).

Changing context for visitor use in wilderness

As recreation demand in wilderness grows, there are social-ecological changes that exacerbate the complexity of VUM. While there is increasing diversity in societal demographics, visitation to public lands remains largely White dominant (USDA, 2020). For wilderness, this is particularly apparent as most wilderness areas are distant from urban areas and lack infrastructure which is often preferred by communities of color (Chavez, 2009; Chavez & Olson, 2009; Hung, 2003; Johnson et al., 2004). Additionally, the concept of wilderness has been characterized as culturally biased toward able-bodied, White males (Corliss, 2019; Cronon, 1996; DeLuca & Demo, 2001; Merchant, 2003), and designated wilderness areas are associated with tribal dispossession and erasure (Corliss, 2019), early preservationists' ties to eugenics (Finney, 2014), systematic historic exclusion (Finney, 2014; Scott, 2014), and trauma related to narratives of lynching and murder (Johnson & Bowker, 2004; Scott, 2014). There are also shifting perceptions of how technology and social media communications are influencing visitor use and experiences (Martin, 2017). Yet, the question remains as to how wilderness and public lands can increase relevance, diversity, and inclusion into the future (Flores et al., 2018), to which partnering with social media groups, such as Latino Outdoors may provide some answers (Flores & Sánchez, 2020).

In addition to social changes and challenges, there are ongoing ecological changes that impact VUM. Many designated wilderness areas boast high biodiversity and remain vulnerable to invasive species and other ecological threats (Watson et al., 2016). Many of these threats can be exacerbated by increased visitation to wilderness areas. For example, visitors can serve as vectors for invasive species (Anderson et al., 2015), impact water quality through improper waste disposal (Hammitt et al., 2015), and lead to changes in wildlife behavior, especially for species not used to encountering humans (Fortin et al., 2016). Climate change poses a further challenge as changing ecological conditions influence the activities and timing of visitation (De Urioste-Stone et al., 2015). Understanding the interactions between social-ecological changes and the wilderness system is critical to VUM. Yet, there remains limited research examining many of these changes and limited discussion of how research can inform management and policy.

Wilderness visitor use management-focused research

The research focused on wilderness VUM has evolved and expanded in concert with the National Wilderness Preservation System (Cole & Williams, 2012). While much of the research concerning visitor use in the wilderness initially focused on answering fundamental questions about visitor motivations and the descriptive elements of wilderness trips (Cole, 2011; Cole & Williams, 2012), research has progressed to "more deeply explore [the] visitor experience as the thoughts, emotions, and physical feelings that

arise from visitors' activities, their physical and social context, and their focus of attention" (Cole, 2011, p. 68). Roggenbuck and Lucas (1987) provided the first and only empirical review of the wilderness VUM literature to date. Other non-systematic/scoping reviews have examined specific areas of the wilderness VUM literature, including recreation ecology (Leung & Marion, 2000; Marion, 2016), visitor experience (Cole, 2011; Cole & Williams, 2012), monitoring methods (Hollenhorst et al., 1992), planning (Krumpe, 2000), and use density in relation to the visitor experience (Cole, 2001).

Through their review of the wilderness VUM research published before 1987, Roggenbuck and Lucas (1987) identified five primary areas of research: "(1) basic demographic descriptions of visitors; (2) number and characteristics of visits; (3) motives for and benefits of use; (4) perceptions, attitudes, and behavior of visitors; and (5) trends and projections in use and user variables" (p. 205). More recent reviews of specific areas within wilderness VUM research (e.g., broader recreation ecology, campsite impacts) offer insight into major themes and findings. Concerning the ecological impacts of wilderness recreation, Marion (2016) reported that the most is known "about impacts to vegetation and soil, that knowledge about impacts to wildlife has increased significantly since 2000, and that research on impacts to water quality has lagged behind" (p. 369).

Methods

Scoping literature review methodology

A scoping literature review was conducted to assess the breadth and major themes present in wilderness VUM research from 2000 to 2020 using the methodological guidance for scoping studies put forth by Arksey and O'Malley (2005) and Levac et al. (2010). This literature review methodology neither engages in meta-analysis nor includes an assessment of research quality, which distinguishes it from systematic reviews (Hanneke et al., 2017). Scoping reviews are uniquely equipped to assess the general "landscape" of a particular research area (Hanneke et al., 2017). In applying this methodology, we engaged in the five stage process outlined by Arksey and O'Malley (2005): identifying the research question, identifying relevant studies, study selection, charting the data, and collating, summarizing, and reporting the results.

Given our previously identified research questions, we outlined specific inclusion criteria to objectively determine the initial inclusion of relevant research items, keyword search terms, and mediums to be searched (see Levac et al., 2010). Inclusion criteria mandated that included research items must (1) be published in years ranging from 2000 to 2020, (2) be published in the English language, (3) contain a primary focus on VUM in U.S. federally-designated wilderness, and (4) be published not as commentary, editorial, or conference abstract. To ensure objectivity in research item inclusion decisions, VUM was defined using the agreed-upon definition presented by the Interagency Visitor Use Management Council (2016): "The proactive and adaptive process for managing characteristics of visitor use and the natural and managerial setting using a variety of strategies and tools to achieve and maintain desired resource conditions and visitor experiences" (p. 113). Importantly, peer review was not an inclusion criterion for this review. Given the applied nature of VUM research in the wilderness context, it is

Table 1. Defined keyword search terms.

VUM keywords	Wilderness keywords
"Visitor use"	"Wilderness"
"Outdoor recreation"	"Solitude"
"Wilderness visitors"	"Unconfined recreation"
"Use allocation"	
"User capacity" or "social carrying capacity"	
"Recreation ecology"	

Boolean search phrase: "wilderness" AND ("visitor use" OR "outdoor recreation" OR "use allocation" OR "user capacity" OR "social carrying capacity" OR "recreation ecology" OR "solitude" OR "unconfined recreation").

recognized that meaningful research in this area is also published as agency general technical reports, theses, or dissertations.

Guided by our research questions, we created a list of nine search terms for use in Boolean-based keyword search term (using words like AND, OR, NOT) inquiries of databases and journals (Table 1). These keyword search terms were selected with the intent of returning research items that pertained to both VUM and federally-designated wilderness. Following the guidance of Dean et al. (2017), we categorized our search terms between these two central tenets within our research questions.

Following the guidance of Arksey and O'Malley (2005) and Levac et al. (2010), we identified not only databases to be searched using these inclusion criteria, but also key journals that are known to publish wilderness VUM research. Identified databases included Google Scholar, USDA Treesearch, Aldo Leopold Wilderness Research Institute publication database, and the ProQuest Dissertations and Theses Database. Selected key journals included the *International Journal of Wilderness*, *Journal of Park and Recreation Administration*, *Journal of Outdoor Recreation and Tourism*, and *Journal of Leisure Research*. Using our keyword search terms, we queried each of these databases and journals using our defined Boolean search phrases.

Coding for research topics and findings

All research items that met the inclusion criteria were entered into a spreadsheet, and the following details were extracted from each research item and recorded following the methods outlined by Smith (2017): title, study year, publication outlet or type (e.g., *Journal of Leisure Research*, dissertation), whether the study was empirical or not, whether the study was field-based or not (if empirical), whether the study was qualitative or quantitative (if empirical), general data collection methodology used (if empirical) (e.g., mailback survey, semi-structured interviews), geographic location of the study [i.e., state(s) in the United States where the study took place], specific unit(s) name(s) [i.e., designated wilderness area(s)], Federal land management agency administering the unit (e.g., USFS), the research question(s) investigated, and a short summary of the results directly related to the research question(s).

Synthesis of research themes within the identified research items followed the methods of Smith (2017) and Major and Savin-Baden (2010). The spreadsheet of research items was coded thematically by the research team (i.e., the coauthors of this paper) using a three-step process. First, a random number generator was used

to select 30 research items, and independently, each member of the research team coded themes within the research question(s) into broad categories that captured the general area of study. Following the independent coding exercise, the research team discussed their respective themes and, collectively, developed a coding scheme for the research questions that captured the general themes of the study investigated (e.g., recreation ecology, visitor experience) (Major & Savin-Baden, 2010). For example, when there were differences in the themes, the researchers clarified the interpretation of each theme and then refined the definition based on the consensus of the group to strengthen inter-coder reliability. Second, the established coding scheme was then applied to the remainder of the spreadsheet; this task was divided equally among the research team, and in situations where the choice of a theme was questionable, the entire team would discuss it accordingly (Major & Savin-Baden, 2010).

For the final step, based on the established coding scheme for the research questions, the results of each research item were thematically coded with greater specificity within the research-question themes (Major & Savin-Baden, 2010). For example, for all research questions coded as "visitor experience," a member of the research team developed additional sub-themes that captured the broad range of specific topics related to visitor experience (e.g., "experiential dimensions or elements"). This step was divided equally among the research team, and finalization of the sub-themes was based on the collective discussion of the research team. The proliferation of these themes and sub-themes was then quantified in an evidence table (see Smith, 2017).

Results

Out of the 263 research items reviewed, 86% ($n = 225$) were empirical research items (i.e., involving data analysis) and of the empirical research items, 83% ($n = 186$) were field-based (i.e., involving data collection in a designated wilderness area). The majority of research items (72%, $n = 162$) applied quantitative methods, 16% ($n = 36$) applied qualitative methods, and 12% ($n = 27$) applied a mixed-methods approach.

Articles by year

The number of research items published per year during the period of interest ranged from 4 (2019) to 37 (2000) (Figure 1). The year 2000 represents an outlier in this respect, as the majority of the research items published during the year are the products of the *Wilderness Science in a Time of Change* conference (Cole et al., 2000). Similar annual spikes in the publication are attributable to the publication of VUM-focused wilderness conference proceedings, including the *Visitor Use Density and Wilderness Experience Workshop* (2001) and the *Wilderness Visitor Experience Workshop* (2012). Excluding these outliers, there remains a noted uptick in research items from 2009 to 2013, followed by a decline from 2013 to 2017.

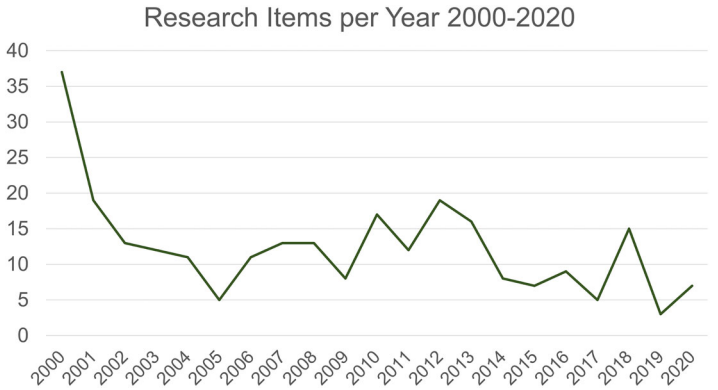

Figure 1. Number of research items per year (2000–2020).

Table 2. Distribution of research items across wilderness-administering agencies.[+]

	Research items		Wilderness areas administered or co-administered*		Acres of administered wilderness	
Administering agency	*n*	%	*n*	%	*n* (millions)	%
Bureau of Land Management	3	1.5	260	32.4	9.9	8.9
National Park Service	70	34.6	61	7.6	44.3	39.7
U.S. Forest Service	114	56.4	448	55.8	36.7	32.9
U.S. Fish & Wildlife Service	7	3.5	71	8.8	20.7	18.5
Multiple Federal Agencies	8	4.0	—		—	
Total	202		803		111.6	

*Some wilderness areas are administered by multiple federal agencies.
[+]59 research items were not focused on a specific wilderness area or series of wilderness areas.

Management agency

Table 2 contains results concerning the distribution of research items across the four agencies that administer wilderness. BLM- and USFWS-administered wilderness is substantially under-represented when comparing the amount of research items focused on their respectively administered wilderness areas and the number and acreage of wilderness areas administered by the agencies. However, this underrepresentation may be due to the absence of recreation in the BLM and USFWS missions. The USFS is nearly perfectly represented concerning the number of wilderness areas administered, yet over-represented concerning total acreage administered. The NPS presents opposite trends in representation, compared to those of the USFS.

Research themes and sub-themes

Table 3 shows the results of the major themes and sub-themes of research items. A research item could be coded to more than one theme. Additionally, within each theme, a research item could be coded to more than one sub-theme. Consequently, the frequencies exceed the total amount of research items. The following sections describe the content within each theme and sub-theme.

Table 3. Research themes and sub-themes.

Theme	Sub-theme	*n*	%
Visitor experience		108	41
Research focused on emotional and behavioral facets of the wilderness experience (e.g., place research, motivations, conflict), and preferences for settings and/or conditions.	Crowding and high use	23	21
	Motivations, attitudes, behavior, outcomes, and values	22	20
	Experiential dimensions and elements	18	17
	Conflict, stress, constraints, and coping	16	15
	General preferences for settings and conditions	13	12
	Resource impacts from humans and natural processes	13	12
	Tradeoffs between "qualities" of wilderness character	11	10
	Place research	8	7
	Relationships	6	6
	Soundscapes, or viewsheds	5	5
Wilderness character		49	19
Research focused on traditional wilderness values as described by the 1964 Wilderness Act.	Natural	25	51
	Solitude or primitive and unconfined recreation	24	49
	Untrammeled	12	24
	Undeveloped	11	22
	Other features of ecological, geological, scientific, educational, scenic, or historical value	8	16
Visitor use		48	18
Research focused on how visitors move through wilderness, such as behavior patterns of where people choose to travel, increasing use, and high visitation.	Travel patterns	23	48
	Recreation volume	20	42
	Visitor demographics and characteristics	18	38
Planning and policy		48	18
Research focused on management and policy, including regulations, planning, management options, policies, policy alignment, and manager perspectives.	Support for management action	16	33
	Wilderness system as a whole	9	19
	Program and policy assessments	8	17
	Conceptual frameworks and implementation of frameworks	8	17
	Risk assessment and prioritization	4	8
	Conflict resolution and stakeholder engagement	4	8
Recreation ecology		39	15
Research focused on the environmental impacts resulting from recreational activities. Items within this code were focused on non-human subjects, such as soil, vegetation, and wildlife.	Campsite impacts	21	54
	Vegetation impacts	14	36
	Soil impacts	11	28
	Trail impacts	5	13
	Restoration	5	13
	Water impacts	4	10
	Wildlife impacts	4	10
Methodology		34	13
Research focused on developing or testing different methodological approaches.	Modeling	8	24
	Spatial analysis and impact monitoring	8	24
	Indicator and standard development	8	24
	Visitor count methods	7	21
	Visitor surveys and communication	5	15
Relevancy and additional values		33	13
Research focused on values of wilderness not explicitly represented in the 1964 Wilderness Act.	Underrepresented wilderness user or cultural minorities (non-Native American)	11	33
	Other or miscellaneous (education, place-specific values, value differences among age cohorts, and values in wilderness compared to just adjacent)	9	27
	Spirituality	8	24

(*continued*)

Table 3. Continued.

Theme	Sub-theme	*n*	%
	Technology	5	15
	Native American values	4	12
	Traditional practices (e.g., subsistence, land management)	4	12
Stewardship		22	8
Research focused on ethical intentions or behavior supporting and improving conservation of wilderness resources.	Education and social learning	8	36
	Leave-no-trace	7	32
	Factors leading to support for wilderness protection	7	32
	Behavior related to protecting the resource	5	23

Visitor experience

One hundred and eight (41%) of the 263 research items included in this review explored the visitor experience. The analysis of visitor experience research items yielded several sub-themes of study, which can roughly be categorized into two broad areas. First, several subthemes focused on exploring the psychological aspects of the wilderness experience, including facets of the cognitive hierarchy (e.g., motivations, attitudes, behaviors, outcomes, and values) (20%, $n = 22$) (Kil et al., 2014), and the dimensions (e.g., escape, challenge) and influential elements of the wilderness experience (18%, $n = 17$). Several research items also explored the wilderness experience within the context of goal-interference (e.g., visitor conflict, stress, constraints, and coping) (15%, $n = 16$), place attachment (7%, $n = 8$), and relationships to wilderness (6%, $n = 6$). Often, research items related to the wilderness experience broadly, but several research items also focused on specific aspects of the wilderness recreation experience, such as solitude and unconfinement. Additionally, multiple research items considered the impact of technology on risky behavior and the wilderness experience through feminist lenses.

Second, several subthemes encompassed research that assessed preferences for settings and/or conditions and were often more applied in support of wilderness management. These research items are split into those focusing on preferences for a broad or specific social, environment, and managerial settings (12%, $n = 13$). Of the items focusing on preferences, the most common topic was the assessment of crowding and high use (23%, $n = 21$), followed by research items specifically aimed at understanding perceptions of impacts from humans (e.g., litter, rock climbing bolts) or natural processes (e.g., fire) (12%, $n = 13$). Several research items (10%, $n = 11$) focused on the tradeoff between particular qualities of wilderness character, namely the solitude and the unconfined aspects of wilderness recreation, as well as naturalness and trammeling. Lastly, a limited number of research items focused specifically on soundscapes or viewsheds (5%, $n = 5$).

Wilderness character

Forty-nine (19%) of the 263 research items included in this review dealt directly with themes of wilderness character referred to in the Wilderness Act of 1964. These articles included themes that aligned with each of the five wilderness character qualities defined by Landres et al. (2008, 2011) through their analysis of the Wilderness Act: natural,

undeveloped, untrammeled, providing opportunities for solitude or primitive and unconfined recreation, and having other features of ecological, geological, scientific, educational, scenic, or historical value (commonly referred to as the "fifth quality of wilderness character"). Research concerning opportunities for solitude or primitive and unconfined recreation (49%, $n = 24$) provided particular emphasis on the impacts of air traffic, smartphone technology, and management actions focused on limiting use and recreationists' freedom. Additional research in this area examined what solitude and unconfined recreation mean to various user groups, including emerging wilderness users. Research concerning the natural character of wilderness (51%, $n = 25$) examined anthropogenic impacts on ecological and geological features in the wilderness, such as soundscapes, native species, or naming geographic features.

Research concerning the untrammeled character of wilderness (24%, $n = 12$) weighed how management actions to control and mitigate impacts from wildland fire, climate change, and invasive species might influence the unhindered and "wild" elements of wilderness. Research concerning the undeveloped character of wilderness (22%, $n = 11$) examined the impacts of both recreational installations (e.g., fixed climbing gear) and historic land uses and structures (e.g., agriculture and abandoned mining camps) on the undeveloped, primeval qualities of wilderness. Finally, research concerning the other features (or fifth quality) of wilderness character (16%, $n = 8$) examined this fifth quality in concert with each of the other four wilderness character qualities, exclusively. Therefore, no research items examined the fifth quality by itself, or in relation to just one or two other qualities.

Visitor use

Forty-eight (18%) of the 263 research items included in this review strongly incorporated and explored themes of wilderness visitor use. As opposed to evaluative research focused on the visitor experience, wilderness visitor use research is generally described as descriptive in nature—examining how visitors make use of and move through wilderness. Additionally, visitor use research often includes exploration of *who* is using wilderness. The research was observed to be relatively equally distributed across three themes. Wilderness travel pattern research (48%, $n = 23$) had a particular focus on distance traveled and time spent in wilderness and recreation site selection. Recreation volume research (42%, $n = 20$) focused primarily on identifying the densest used areas within a wilderness or a series of wildernesses and visitor behavioral responses to dense use conditions. Research concerning wilderness visitor demographics and characteristics (38%, $n = 18$) tended to focus on the latter, with a major emphasis on comparing visitor use of day and overnight users. Additional research, spanning each of these themes, sought to examine visitor use longitudinally within a given wilderness.

Planning and policy

Forty-eight (18%) of the 263 research items included in this review were coded as focusing on planning and policy related to VUM. Research items focused on support for management action were the most common (33%, $n = 16$). Many of these research items assessed visitors' perceptions and level of support for different management

actions in the wilderness, such as regulations to mitigate crowding, use of fees, camping regulations, and fire management. The second most common theme (19%, $n = 9$) included research items that focused on the NWPS as a whole and included research on trends with resource monitoring, campsite inventories, and permit systems. Program and policy assessments (17%, $n = 8$), such as the Recreation Fee Demonstration Program, Search and Rescue, and the National Environmental Policy Act were also common as well as studies on conceptual frameworks (e.g., LAC, VERP) and implementation of frameworks (17%, $n = 8$). Many of the studies on conceptual frameworks focused on the Recreation Opportunity Spectrum as well as identifying and assessing indicators and standards. Some less-common themes included studies on risk assessment and prioritization (8%, $n = 4$) and conflict resolution and stakeholder engagement (8%, $n = 4$). Risk assessment largely focused on areas that are vulnerable to environmental impacts and how to prioritize areas for management. Conflict resolution and stakeholder engagement research items often focused on a specific recreation subgroup or a local community near the wilderness area to assess for potential conflict and differing perspectives.

Recreation ecology

Thirty-nine (15%) of the 263 research items focused on ecological impacts from wilderness recreation or recreation ecology. Campsite impact monitoring was by far the most studied (54%, $n = 21$) aspect of wilderness recreation ecology in the last twenty years. Based on this review, campsite research can be grouped into three dominant categories: (1) campsite inventory and monitoring methods, (2) campsite impacts, and (3) longitudinal impact studies (comparing multiple years of impact monitoring). Other research related to campsites included impacts from stock, vegetation restoration, and the depletion of woody debris for campfires. Aside from wilderness campsite research, other primary topics for recreation ecology research were impacts on vegetation (e.g., trampling) (36%, $n = 14$), soil (e.g., compaction) (28%, $n = 11$), trails (e.g., compaction, braiding, development, and intensity of social trails) (13%, $n = 5$), restoration (e.g., techniques for effective restoration of vegetation) (13%, $n = 5$), wildlife (e.g., avoidance behavior) (10%, $n = 4$), and water quality (e.g., water quality impacts from stock waste) (10%, $n = 4$). Impacts on specific ecological aspects were often studied in conjunction with each other and with campsites (e.g., research items examined vegetation and soil impacts in the context of campsites).

VUM methodology

Thirty-four (13%) of the 263 research items included in this review were coded as focusing specifically on methodologies of wilderness VUM research. The most popular themes of research items included modeling (24%, $n = 8$), spatial analysis and impact monitoring (24%, $n = 8$), and indicator and standard development (24%, $n = 8$). Many of the modeling and scenario research items involved simulation models to estimate patterns of use, cost modeling, and modeling to assess relationships with place attachment and meaning. Spatial analysis was used to map the quality of wilderness character, campsite conditions, and vegetation cover. Additionally, a couple of research items

focused on pollution sources and impacts that relate to ecological integrity. Studies on indicators and standards tended to focus on the different environmental and social dimensions, identification of indicators, and how to assess standards that support wilderness character, experiences, and ecological resources. Studies focused on visitor count methods (21%, $n = 7$) and visitor surveys and communication (15%, $n = 5$) were also common. Methods for visitor counts were assessed on efficacy and efficiency as well as comparing different tools and sources of information. Visitor surveys were discussed by how best to intercept visitors and collect data and testing different survey instruments and tools. Several research items were assigned to a miscellaneous category as they focused on specific aspects, such as soundscapes, destination information, and the management-by-objectives approach.

Relevancy and additional values

There was a small amount of research that explored aspects of wilderness outside of the five qualities of wilderness character. These aspects of wilderness are relatively new to wilderness research and are relevant to wilderness VUM, especially for nontraditional or underserved wilderness users. Thirty-three (13%) of the 263 research items included in this review dealt with themes of additional or alternative relevant values of wilderness. Research that highlighted relevant qualities of wilderness beside the five qualities of wilderness character were included in this theme. Within research on additional or alternative relevance, seven themes emerged: underrepresented wilderness user or cultural minority values (non-indigenous groups), indigenous values, traditional subsistence values, urban-proximate values, technology, spirituality, and "other" or "miscellaneous." Much of the research on additional, relevant values (42%, $n = 15$) deals with nontraditional wilderness users, such as cultural minority groups, LGTBQ + communities, people with disabilities, and the corresponding constraints to visiting and exclusionary aspects of wilderness, such as systemic racism. Most of the exclusionary issues and constraints research were related to cultural, racial, and ethnic groups. The research on Native American communities was distinctly different from other cultural groups. Research on Native American groups (12%, $n = 4$) indigenous to areas later designated as wilderness, often included themes of traditional practices, subsistence, cultural identity, and place meaning.

The next most prolific research topic was spirituality (24%, $n = 8$) which often characterized wilderness as a place where visitors had spiritual experiences, and that people value wilderness for providing outstanding opportunities to have spiritual experiences. Research on technology (15%, $n = 5$) often sought to understand the role of technology in the wilderness. Wilderness provides an opportunity to disconnect from technology that has traditionally been seen as antithetical to the wilderness. However, as technology increasingly becomes a part of people's lives, it plays an increasingly large role in how people navigate in the backcountry, mitigate risk, and connect to the wilderness.

One of the largest categories within relevancy/additional values is "miscellaneous" (27%, $n = 9$). There were several unique and important areas of research within this category, however, there were usually only one to two items for each of these sub-themes which were deemed too fine-grained for the purpose of this review. Important areas of

research within the miscellaneous category include place-specific values (unique to each context), generational differences in values, education, and public values inside designated wilderness *vs.* just adjacent to the wilderness area. Only two research items explore themes specific to wilderness relevance held by the broader public. Both of these items focused on how to increase relevance through education for current and future generations.

Stewardship

Twenty-two (8%) of the 263 research items included in this review were related to stewardship of wilderness; these research items focused, broadly, on themes related to visitors and the protection of the wilderness resource. The Leave No Trace (LNT) subtheme (32%, $n = 7$) included research items that either assessed and tested knowledge of LNT principles or explored attitudes about acceptance and appropriateness of LNT principles. Within the education and social learning subtheme (36%, $n = 8$), several research items evaluated the influence of visitor education, engagement, and/or knowledge sources (e.g., public meetings, bulletin boards, social appeals, magazine readership) on behaviors in the wilderness, level of knowledge of best practices, and support for wilderness management. These education and social learning research items, in some instances, compared the influence of different visitor education campaigns on different user groups. Research items investigated the factors that led to support for wilderness protection (32%, $n = 7$), either within the context of wilderness designation and protected areas broadly or more specific management actions. The research items coded within the sub-theme on behavior related to protecting the resource (23%, $n = 5$) focused on understanding factors that led to compliance with best practices and the connection between place attachment and wilderness values with undesirable behavior.

Discussion

Settings and approaches to research

As noted by Cole (2001), much of the research concerning wilderness is applied to aid managers in their planning processes. The persistent applied nature of wilderness VUM research is clearly shown in our study results, with 71% of research items deriving from field-based research in designated wilderness. Additionally, our results reveal an interesting distribution of quantitative (72%), qualitative (16%), and mixed-methods (containing both quantitative and qualitative analysis; 12%) research. The portion of research items applying qualitative and mixed methods from 2000 to 2020 is fairly consistent with the findings of Pickering et al. (2018), who examined social science-focused research items presented at seven Managing and Monitoring Visitors in Recreational and Protected Areas conferences from 2002 to 2014, finding that qualitative and mixed-methods analyses were applied in 14 and 10% of research items, respectively. A more-dated study of 2,868 research items published in twelve major tourism journals from 1994 to 2004 found that 19% of items applied a qualitative approach, while just 6% applied a mixed-methods approach (Ballantyne et al., 2009). While previous reviews of wilderness VUM research note the importance of qualitative and mixed-methods

research, Cole (2001), for example, cites just two research items that demonstrate these merits. We surmise that the significant growth of qualitative and mixed-methods wilderness VUM research is likely the result of an increased effort to further rigorous qualitative research in the leisure sciences (Rose & Johnson, 2020).

Our research illuminates additional trends in methodologies including how recreational impacts are assessed in the wilderness. The majority of research items (54%) focus on campsite impact monitoring which includes campsite inventory and monitoring methods, campsite impacts, and longitudinal impact studies. Yet, the overemphasis on campsite monitoring may limit our understanding of other critical aspects of recreation ecology (e.g., water and wildlife), and the interconnectivity of wilderness impacts associated with visitor use. This overemphasis on campsite impacts may be particularly important in the future with the exacerbation of threats to wilderness ecosystems from invasive species, degraded water quality, climate change, and human-wildlife conflicts (e.g., Anderson et al., 2015; De Urioste-Stone et al., 2015; Fortin et al., 2016; Hammitt et al., 2015; Watson et al., 2016). Some research items have addressed growing anthropogenic impacts and the management implications of increasing wildland fire (e.g., Sánchez et al., 2016), other effects of climate change (e.g., Halstead et al., 2001; Hill et al., 2000), and non-native and invasive species (e.g., Hall & Davidson, 2013). As impacts of climate change progress, there is value in future research continuing to examine the effects of the rapidly changing ecological systems within the wilderness and the implications for visitor experience and management.

While methodologies applied in wilderness VUM research appear to be diversifying and expanding, the distribution of research across agencies appears rather unchanged. Roggenbuck and Lucas's (1987) review of wilderness VUM research highlighted that "Past research on use and users has focused primarily on National Forest wilderness [*sic*], with limited coverage of National Park areas. There have been virtually no published research items on [U.S.] Fish and Wildlife Service and Bureau of Land Management-managed wilderness [*sic*]" (p. 237). Wilderness VUM research occurring in national parks has increased in recent decades; yet, our findings reveal little overall diversification across agencies since this 1987 baseline, with just 1.5 and 3.5% of research items focusing on BLM- and USFWS-managed wilderness, respectively. This noted gap in agency diversity has also been documented specifically in wilderness recreation ecology research (Leung & Marion, 2000) and may be influenced by the differing missions of public land agencies related to recreation.

This focus on wilderness research in national forests and national parks presents several significant implications. First, the agencies administering wilderness within the NWPS steward distinct landscapes and geographies (Glicksman, 2014). For instance, the lands administered by the BLM are largely composed of the "leftover" public domain lands of the American West, whereas the NPS largely administers lands identified within the federal public domain as the "crown jewels" of the American landscape (Glicksman, 2014). Second, despite the common mandate of the Wilderness Act across the NWPS, agencies manage wilderness in distinct ways (Zellmer, 2014). For instance, differences in management have been documented between the BLM and the USFS, finding that variations arise from agency culture, policy, judicial treatment, and varying physical characteristics across the two agencies' lands (Glicksman, 2014). Importantly,

these differences in landscape, geography, and management lead to distinct recreation patterns (Zellmer, 2014). While the missions differ across public land agencies, a failure to produce a body of wilderness VUM research representative of the NWPS may result in an incomplete, or inaccurate, narrative concerning the present state of wilderness recreation.

Supporting management decisions with research

Research in the last 20 years has highlighted the multifaceted and nuanced context of the visitor experience and of the actions to manage these experiences. Yet, if management actions do not reflect the complex relationships visitors have with wilderness, then stewardship of the resource may fall short. This assertion is supported by stewardship research in the past 20 years, which has focused on understanding the factors that lead to support of wilderness protection and management (e.g., Ghimire et al., 2015; Zajchowski & Brownlee, 2018), as well as that which influences behavior related to protecting the wilderness resource (e.g., Lukins, 2018; Pomeranz, 2011). Some research items specifically focused on the efficacy of different educational programs on different user groups (e.g., Seekamp 2006), and Gunderson et al. (2000) suggested that education programs would benefit from moving beyond instructing visitors about best practices to emphasizing the societal value of wilderness. However, our review does not highlight progress in expanding education programs to align with the increasing diversity and inclusion in wilderness settings.

Some research items focused on the NWPS as a whole (e.g., Cole, 2003; Cole & Wright, 2004; Griffin et al., 2007); yet the majority of research items focus on a specific wilderness unit. The limited research on the NWPS in relation to VUM suggests that overall wilderness VUM research is struggling to overcome jurisdictional and disciplinary barriers. Without focusing on the system scale, the integration and synthesis of VUM research will be hindered along with how this research can inform policy decisions. The unique aspects of the NWPS (e.g., the inclusion of multiple agency jurisdictions) may contribute to barriers to synthesizing research, sharing data, and connecting research to managerial decisions that are consistent across the system. Thus, researchers and wilderness professionals are left with a dilemma of how to research the unique aspects of wilderness sites while also applying systems thinking. Bridging this divide across scales of research and translating research into policy and practice is a priority for wilderness VUM research to move forward in the next 20 years.

Changing values and relevancy

Research over the past 20 years reinforces the insight that wilderness "means different things to different people" (Watson, 2004, p. 5). This emerging trend challenges the establishment of an *appropriate* set of conditions and experiences. Traditional wilderness character research had a dominant focus on opportunities for solitude and unconfined recreation (e.g., Cole, 2011; Cole & Williams, 2012), preferences for a variety of ecological, experiential, and managerial conditions (e.g., Lawson et al., 2006; Pierce & Manning, 2015), and tradeoffs between solitude and confinement (e.g., Cole & Hall,

2008; Hall & Davidson, 2013; Seekamp & Cole, 2009), without finding consensus around a singular set of conditions. Additionally, only four research items engaged with the "fifth quality" of wilderness, encompassing ecological, geological, scientific, educational, scenic, or historical values. As noted by Stelson et al. (2020), these frequently overlooked values are central to the designation of wilderness and the visitor experience.

With more culturally diverse groups emerging as potential wilderness users (Flores & Sánchez, 2020), younger and more diverse generations may have different perceptions of the wilderness experience (Smith & Kirby, 2015). For example, research items that specifically examined cell phone use (e.g., Dustin et al., 2019), overflights (e.g., McKenna et al., 2016), and limiting use (e.g., McCool, 2001) may yield different findings depending on demographics. For example, Latino populations generally prefer to recreate in social groups and use social media to learn about recreation opportunities (Flores & Kuhn, 2018). Despite administering agencies' goal to make the wilderness more relevant to a changing and diversifying public, there is limited research on diverse values and relevance. Only two research items focused on wilderness relevance specifically for future generations (Chavez, 2000; Gunderson et al., 2000). Neither of these research items embraces the inclusion of emerging and potentially different values and preferences of a diverse American public. Some research items did examine wilderness through a cultural lens and predominantly focused on traditional practices, such as subsistence (e.g., Dear & Myers, 2005; Watson et al., 2011), spirituality (e.g., Borrie et al., 2012; Heintzman, 2012), and constraints and/or exclusionary aspects of wilderness areas (e.g., Bond, 2007; Green et al., 2007). Thus, there is a critical need for more research to explore the demographics of emerging wilderness users and understand their values, preferences, and constraints in relation to wilderness.

Conclusions

The challenges of managing visitor use in wilderness continually evolve with the social-ecological contexts that surround these areas, such as climate change, species migration, increasing day-use, increasing access to information through technology, growing racial and ethnic diversity, and the increasing popularity of wilderness recreation. This scoping review has found that wilderness research in the past 20 years covered the substantial ground with research methodologies and topics. Future wilderness research should continue monitoring previously popular areas of study (i.e., campsite degradation and restoration, perceptions of crowding, and differences among day and overnight users), while also responding to the changing world that wilderness is a part of and address emerging areas of interest and concern. We recommend that future wilderness research explore a greater diversity of wilderness areas, the role of climate change in the visitor experience, stewardship implications for the NWPS as a whole, and relevancy to a diverse public and the alternative, emerging wilderness values that result.

This comprehensive scoping review is subject to limitations. First, research items are limited to designated wilderness areas in the United States. Future research could expand the scope to include non-designated or nonfederal wilderness and other countries that have protected areas with similar wilderness attributes. Second, the review

includes largely empirical research and could be expanded to conceptual papers or editorials on specific wilderness topics. Third, the review includes research items from the past twenty years, but a more comprehensive scoping review could include previous decades and further build on this review in the future to assess for ongoing changes in trends. Lastly, while we reviewed the main findings of research items to identify themes and sub-themes, it was outside the scope of the review to assess in-depth trends and inconsistencies within each sub-theme and across research items. Future research on specific themes that emerged from this review can provide a more comprehensive analysis of research findings.

This scoping review of U.S. wilderness research in the 21st century contributes to our understanding of trends in geographic settings, methodologies, and focus areas and themes. This is the only recent review on this topic area, fulfilling a large gap in wilderness research and informing critical needs for future research. Managers in wilderness settings and across the NWPS can utilize this review to better understand what has been studied in their respective wilderness-protected areas and prioritize research for the future. This review may be particularly helpful for wilderness areas that are largely lacking research and these findings can provide justification for resources to support research in the future. For any field of research to expand in breadth and depth, there is a need to assess spatial and temporal trends in addition to the foundational and emerging focus of research. Our scoping review offers a critical first step and can provide guidance for VUM wilderness research in the 21st century.

Author contributions

All authors contributed equally to the production of the manuscript.

Authors' note

The term "wilderness" used throughout this manuscript and the topics discussed refers to congressionally-designated, federally-administered wilderness areas.

Disclosure statement

No potential conflict of interest was reported by the authors.

Ethics Statement

This paper did not require ethics approval as it was a scoping review.

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