

Viewing Nature-Focused Livestreams And Subjective Well-Being: A Scoping Review

Rebecca L. Mauldin,¹ M. Christine Highfill,¹ Donna Schuman,¹ Stephanie Henderson,² and Keith A. Anderson³

¹School of Social Work, The University of Texas, Arlington, Texas, USA.

²Medical Center Library, University of Kentucky, Lexington, Kentucky, USA.

³Department of Social Work, University of Mississippi, Oxford, Mississippi, USA.

Abstract

Engaging with nature relates to psychosocial well-being; however, some people encounter barriers to experiencing nature. Nature-focused livestreams (NFLs) offer a relatively new pathway for engagement with the natural world, yet little is known about their association with individual well-being. This scoping review seeks to describe the state of the knowledge regarding NFLs and the well-being of adults. Searching 12 databases and one search engine in April 2022 and again in May 2023 and screening 1,645 unique potentially relevant evidence sources, the research team identified 10 articles that met inclusion criteria for population (adults over 18 years of age), concept (subjective wellbeing), and context (NFLs). Findings demonstrate emerging empirical support for the connection between viewing NFLs and subjective wellbeing. The most commonly reported outcome related to well-being was positive affect or uplifted mood (n = 7, 70%). Potential mechanisms that were identified indicated well-being was enhanced through connecting with nature or with other people. NFLs should be considered as a possible way to extend the well-being benefits of engagement with nature to individuals who are unable to leave their homes or who live in urban areas with limited access to nature.

Key Words: Well-being-Nature-Nature-focused livecam broadcasts-Nature-focused webcams

ngagement with the natural world has clear benefits for humans, including improved cardiovascular, neuroendocrine, and metabolic health indicators; lower cortisol and cholesterol levels; reduced risk for a wide variety of conditions and diseases; and longevity (Twohig-Bennett & Jones, 2018; Wen, Yan, Pan, Gu, & Liu, 2019; Yao, Zhang, & Gong, 2021). Psychological benefits associated with nature range from reduced depressive symptoms, anxiety, fatigue, anger, stress, and burnout to better quality of life and higher levels of happiness and other positive emotions (Capaldi, Dopko, & Zelenski, 2014; Corazon, Sidenius, Poulsen, Gramkow, & Stigsdotter, 2019; Daniels et al., 2022; Farrow & Washburn, 2019; Hansen, Jones, & Tocchini, 2017; McMahan & Estes, 2015; Wen et al., 2019; Yao et al., 2021). Experiences with nature are also associated with positive cognitive states, including improved attention, memory, and mental processes (Berman et al., 2012; Berto, 2005; Bratman, Daily, Levy, & Gross, 2015; Daniels et al., 2022).

Unfortunately, for many, it is difficult to have these beneficial experiences with nature. In modern times, people are increasingly disconnected from nature (Frumkin et al., 2017; Pergams & Zaradic, 2008). This disconnection is exacerbated for people confined to indoor spaces regularly, such as those working indoors or living in prisons, nursing homes, or other institutional settings (Snell, McLean, McAsey, Zhang, & Maggs, 2019) or who belong to marginalized groups in urban areas with inequitable access to the natural world (Langhans et al., 2023). Health problems or disability may also restrict people's ability to enter natural environments (Colley, Currie, Hopkins, & Melo, 2016; Donaldson, Wilkinson, Hurst, Perera, & Wedzicha, 2005). These obstacles to

engaging with nature physically make exploring alternate means of experiencing nature intriguing.

Innovations allowing humans to experience nature in new ways include still photography, videos, televised broadcasts, and closedcircuit television, graphics, memes, virtual reality, digital games, livestreaming, and nature-focused apps (Kahn, Severson, & Ruckert, 2009; Ratz & Conk, 2010; Silk, Correia, Veríssimo, Verma, & Crowley, 2021; Snell et al., 2019). These technologies can simulate nature and have the potential to explain, mediate, or augment it (Kahn et al., 2009). Encountering the natural world in these ways may increase access to the benefits of nature by allowing people to experience it from a variety of settings, circumstances, perspectives, and times (Snell et al., 2019; Zabini et al., 2020) and may also be beneficial for those living in urban settings with limited access to natural settings, for people with physical or health limitations, or in times of quarantine such as the recent COVID-19 pandemic (Lee, Filep, Vada, & King, 2022; van Houwelingen-Snippe, van Rompay, & Ben Allouch, 2020).

Like physical experiences with nature, virtual or online exposure to the natural world can also be beneficial. For example, people have reported happy memories, reduced stress, and feelings of optimism, hope, restoration, or joy when indirectly experiencing nature through media such as slideshows, virtual reality, or online digital images and video (Darcy, Taylor, Mackay, Ellis, & Gidlow, 2022; Lee et al., 2022; Valtchanov & Ellard, 2010). However, not all responses to online or digital exposure to nature have been positive. Kahn et al. (2009) found that although participants who looked at high-quality images of nature on a large plasma display reported feeling connected to nature and other humans, they experienced no more heart rate recovery from mild stress than those who looked at a blank wall. Other research participants have reported ambivalent feelings with exposure to digital nature such as sadness or frustration about being unable to visit locations in person or participate in the sensory experiences direct access to nature provides (Darcy et al., 2022; Kjellgren & Buhrkall, 2010).

Features of Online Platforms That Affect the Experience of Viewing Nature Online

The experiences associated with interacting with nature online are likely shaped by the features of the online platform. In their neo-ecological theory, Navarro and Tudge (2022) suggest several features of online platforms and systems that influence human behaviors and experiences in virtual environments. Some of these features are (1) synchronicity/asynchronicity, (2) publicness, (3) cue absence, and (4) anonymity (Navarro & Tudge, 2022). *Synchronicity* and asynchronicity refer to whether online content is available for consumption in real time (e.g., livestreaming) or with a time lag (e.g., watching prerecorded videos online or sharing photos by email). To the extent, virtual spaces allow people to meet others beyond their family and close friends for social or cultural purposes; they demonstrate the feature of *publicness*, which is indicative of larger, broader, and more diverse audiences or groups of online participants. Because online interactions may be devoid of nonverbal communication cues, the extent of cue absence on a platform is an important consideration. Some online communications, such as video conferencing, allow individuals to give and receive nonverbal cues. Emojis or other visual symbols can also provide cues. However, to a large extent, platforms or systems where communication is solely textbased will have a high degree of cue absence. Somewhat related to cue absence is the quality of anonymity. When the identities of online actors are anonymous, information about personal identities is not available or is limited to what the individuals on the platform choose to disclose. In online multiplayer nature games, the players' voices could afford some degree of nonverbal cues and reveal characteristics of personal identity to other players. In contrast, on platforms where users create their usernames, do not upload their photographs in their user profiles, and are limited to text-only communications, both anonymity and cue absence would be high.

Nature-Focused Livestreaming

The technology of interest for this scoping review is livestreaming. Livestreaming entails capturing and streaming a variety of video content (e.g., entertainment, education, religion) in real time to audiences at a distance using digital and online technologies (Chen & Lin, 2018; Qiu, Zuo, & Zhang, 2021). Livestreaming audiences participate in shared, synchronous experiences and-depending on the online platform-may also be able to communicate in real time using chat features or discussion boards (Qiu et al., 2021). Viewing livestreams has been associated with greater social support and relationships (Lee et al., 2022; Qiu et al., 2021), yet little is known about the specific effects of viewing nature-focused livestreams (NFLs).

NFLs are a fairly new application of technology for connecting with nature. These livestreams differ from other ways of experiencing or sharing nature online or digitally in their synchronicity; events witnessed in a nature livestream occur in real time and can range from the mundane to the surprising. Well-known examples of NFLs include the U.S. National Parks livecams and Africam, which focuses on wildlife in Africa. There are also clearinghouse organizations, or platforms, that provide access to multiple livestreams, such as Explore.org and the nature section of Webcamtaxi.com. NFLs are gaining popularity. Explore.org touted an increase of 85% in viewership of their virtual livestreams over 2 years (Granville, 2020). As nature webcams proliferate—at least 150 were installed in U.S. national parks alone as of 2019 (Gray & Wikle, 2021)—and as viewership increases, viewers can commune virtually with nature in real time.

Many websites and platforms devoted to NFLs allow viewers to direct message one another or post public messages on discussion boards or include other features that facilitate social connection, such as social media links or calendars of events allowing members to coordinate their viewing activities. Some have links to curated social media communities where viewers with specialized interests can interact across broader forums. These platforms can exhibit high publicness, especially when compared with viewing photos on websites without social features. The policies and guidelines of the platforms for NFLs can determine their degree of cue absence and anonymity. For example, viewers may have customized avatars to mask their identities or may be able to use emojis when commenting on discussion boards.

Current Study

Despite NFLs' increasing popularity and their potential to enhance viewers' well-being and social connectedness, much remains to be learned about their effects. To our knowledge, there has not been a comprehensive literature review on nature-focused livecam broadcasts and individual well-being. Lee et al. (2022) documented well-being outcomes in their review on the effects of watching webcams for virtual travel. However, webcam travel included content unrelated to nature (e.g., historic sites, city centers, resorts). To disaggregate the specific characteristics of naturefocused livestreaming from the effects of broader webcam travel, we focus this scoping review on only NFLs, which we define as (a) focused on natural environments (e.g., oceans, outer space) or animals and plants in the outdoors or zoos; (b) providing real time, live video feeds; and (c) available and accessible to the public through the internet. Our research aims to describe the state of the knowledge regarding NFLs and adults' well-being. To this end, we pose research questions (RQs) related to NFLs' viewers; broadcasters, broadcasts, and platforms; and well-being outcomes:

- RQ1: What are the characteristics of the viewers of NFLs?
- RQ2: What is the content of NFLs?
- RQ3: What are the characteristics of the broadcasters of NFLs?
- RQ4: What are the features (i.e., synchronicity/asynchronicity, publicness, cue absence, anonymity) of platforms that host NFLs?
- RQ5: What are the features of NFLs (e.g., narrated, scheduled programming, round-the-clock access)?
- RQ6: What well-being outcomes are associated with viewing NFLs?
- RQ7: Do the article's aims include identifying specific well-being outcomes?
- RQ8: What, if any, instruments are used to measure well-being and what are their documented psychometric properties?
- RQ9: What, if any, mechanisms are identified to explain the effects viewing NFLs on well-being?

Methods

Scoping reviews synthesize literature by mapping key concepts and summarizing available evidence to inform future research. We used the most recent enhanced guidance on scoping review frameworks (Colquhoun et al., 2014; Peters et al., 2020) for this research. Our Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews Checklist (Tricco et al., 2018) is available online Supplementary Data S1. Scoping reviews are exploratory by nature, aiming to map or explore the breadth of evidence on a topic (Munn et al., 2022). They are useful for examining emerging evidence in an unclear landscape that does not yet lend itself to the construction of specific RQs better answered using precise, systematic review methodology. Because the intended focus is on summarizing and describing the scope, diversity, and nature of research in a specific field, rather than on critically appraising the quality of included studies, scoping reviews do not include quality assessments as a standard practice, allowing for broader evidence mapping and identification of research gaps not subject to the methodological constraints of conducting a detailed quality assessment (Wake et al., 2020). According to Wake et al. (2020), because there is no assessment of methodological limitations or bias, scoping reviews do not yield synthesized answers to questions or implications for practice. Their value lies in identifying gaps in the literature, defining key terms, and providing an overview of the existing evidence on a topic. They may include quantitative, qualitative, and mixed methods research and gray literature, the diversity

of which cannot be assessed using a single set of quality criteria. As such, scoping reviews can guide future research directions, pointing to where more detailed research is needed, and laying a foundation for more focused reviews that would include quality assessments (Munn et al., 2022; Wake et al., 2020).

We conducted a preliminary search of the JBI Systematic Review Register, Campbell Collaboration, Web of Science, Google Scholar, and OSF registries for similar or equivalent projects. Finding none, we developed an *a priori* protocol for our scoping review (Highfill et al., 2022), registered on the Open Science Framework website (https://osf.io/wb74k). The research team adapted the protocol as needed (McKenzie, Brennan, Ryan, Thomson, & Johnston, 2022), such as adding a RQ about article aims after discovering articles that reported post hoc well-being outcomes.

Inclusion/exclusion criteria

We structured our inquiry using JBI's PCC framework: population, concept, and context (Peters et al., 2020). The *population* of interest was adults over 18 years old who viewed NFLs. The *concept* was subjective well-being, operationalized in the broadest, and most inclusive sense. From a theoretical standpoint, two different paradigms of well-being exist: the hedonic and the eudaimonic. The hedonic view posits that well-being consists of satisfaction with physical pleasure, mental pleasure, attaining goals, and achieving desired outcomes. The eudaimonic view focuses on meeting one's potential and living a virtuous and meaningful life (Diener & Sim, 2024). The *context* was NFLs, which for this review included livestreams of nature, geographical features, animals in outdoor environments or zoos, and other nonhuman natural phenomena. It excluded livestreams that were human-focused, private (i.e., not intended for a public audience), and broadcasts of household pets, companion animals, or events of human creation or origin (e.g., hunting).

Search strategy

The search strategy was designed to locate published and unpublished studies in any language without date limits. First, we conducted a limited search of PubMed, Web of Science, and Google Scholar to identify articles on the topic. From the articles found in this preliminary search, we used keywords in the titles and abstracts of relevant articles and the National Library of Medicine's Medical Subject Headings describing the articles to develop full search strategies for each database. Search strategies, including all identified keywords and index terms, were adapted for the databases Scopus (Elsevier), Web of Science Core Collection (Clarivate Analytics), and CINAHL (EBSCO) using the Polyglot Search Translator (Clark, Sanders, et al., 2020). Manual translation was performed for Psyclnfo (EBSCO), GenderWatch (Proquest), Ageline (EBSCO), Communication and Mass Media Complete (EBSCO), Sociology Database (Proquest), Agricola (EBSCO), and Newspaper Source (EBSCO). Sources of unpublished studies/gray literature were Google Scholar and ProQuest: Dissertations and Theses. The searches were conducted in April 2022 and again in May 2023 (see Search Strategy Tables of Highfill et al., 2022). After the resulting articles and documents were screened for inclusion, the reference lists of all included sources of evidence were screened for additional studies, and the corresponding authors of all included sources were contacted for additional relevant work to consider for inclusion.

Data management

We collated the citations identified in the database searches and exported them to EndNote 20 Citation Management Software (The EndNote Team, 2013) and used the Groups function in EndNote to sort references by database. Then, we copied the EndNote library and imported it into the SR Accelerator DeDuplicator (Clark, Glasziou, et al., 2020) for deduplication. We imported the resulting file back into EndNote and used its deduplication feature to remove additional duplicates and uploaded the export to Covidence for a final deduplication effort. We retained the original citation list and the resulting deduplicated lists as records of the deduplication process. We imported the final, deduplicated list of citations into JBI SUMARI software for the selection of evidence sources. After conducting the search again in May 2023, a member of our research team manually deleted duplicates within the search results and from the previous search.

Selection of evidence sources

Using the JBI SUMARI web-based application, three reviewers screened and selected evidence sources (Munn et al., 2019). Before screening, each reviewed the protocol's inclusion and exclusion criteria. Then, they conducted a pilot test, independently administering the criteria to a few titles and abstracts from the search results, comparing decisions, and conferring to ensure consistent application of the inclusion/exclusion criteria. Then, each of the remaining citations' titles and abstracts were screened by two reviewers. After the screening at the title and abstract level, potentially relevant sources were retrieved in full, and two reviewers carefully assessed the full text using the inclusion criteria.

The team resolved disagreements at each stage of the selection process through consensus among the three researchers during regular team meetings, which were held to review processes, discuss challenges, and make final inclusion determinations (Colquhoun et al., 2014). Some articles included NFLs in a broader category, such as "nature media" (Phillips, Wells, Brown, Tralins, & Bonter, 2023). If the team was able to find well-being results linked solely to livestreaming, the article was included, but otherwise excluded. Last, the team carefully considered the characteristics of public and live broadcasts when discussing the inclusion of articles. If the phenomenon being examined was not publicly available (as in Kahn et al., 2009, study of window displays) or was a videotape(s) of material that was initially livestreamed (e.g., the first study in Shively, 2023), the review team excluded the evidence source.

At each stage in the selection process, the team tracked the number of articles included and excluded, documenting reasons for exclusion at the full-text review stage. See the PRISMA flow diagram (Page et al., 2021) in Figure 1 for a summary of the selection process stages.

Data extraction and analysis

Three members of the research team created, piloted, modified, and adopted a data extraction spreadsheet for article characteristics and data charting. Original drafts of the data extraction tools were included in the published protocol (Highfill et al., 2022); the final data extraction tools are available as attached files in the Associated Project protocol's OSF webpage https://osf.io/wb74k). Using the data extraction tools, two independent reviewers extracted data from each article in the sample. The reviewers resolved disagreements by consensus. Article characteristics included author name(s); date of publication; author(s) affiliation, location, and discipline; funding source(s); reported conflicts of interest; type of report (e.g., quantitative, qualitative, gray literature); and if applicable, sample size and characteristics of human subjects research. Data charted included article aims, location(s) of livecams, location(s) of broadcast viewers, content of livestreams, characteristics of broadcasters, broadcast features, and well-being findings.



Fig. 1. PRISMA flow diagram for the scoping review.

After data extraction, two researchers conducted content analysis and thematic analysis of the data as recommended by Colquhoun et al. (2014). Content analysis was used to identify frequencies of article characteristics and charted data; thematic analysis identified themes for well-being outcomes.

Results

We identified 2574 articles through database searches. Thirtyseven additional articles were located using hand searching and citation chasing. We eliminated 1601 irrelevant and 966 duplicate articles, reviewing 44 full texts. After excluding 34 articles, the sample included 10 reports representing 10 studies and 10 lead authors.

Sample

Article topics included exploring webcam travel; evaluating a platform; discussing nestcams; considering human boredom and animal experiences; comparing online and onsite responses of viewers; describing viewer characteristics; examining relationships among viewers, animals, and technology; investigating how humans learn about animals; exploring the effects or benefits of viewing; and examining viewers' experiences. Table 1 presents detailed article characteristics.

Viewer characteristics (RQ1)

Viewer location (presented in Table 2 along with other findings) was based on information in the evidence sources related to a general description of the livestream viewers, not descriptions of the samples of the human subjects research (which are presented in Table 1). Many (n = 7, 70%) of the evidence sources described the location of the viewers, indicating a worldwide audience for the NFLs. Some reported a preponderance of viewers in the United States (Anderson, 2019), Australia (Blaer, 2023), or the United Kingdom (Jarratt, 2021).

Of those reporting sample descriptives from a research study (Blaer, 2023; Jarratt, 2021; Johnson-Pynn & Carleton, 2019; Searle, Turnbull, & Adams, 2023; Shively, 2023; Skibins, Das, & Schuler, 2022; Zhang & Xiao, 2023), all reported having a majority of participants who were female or who had at least a college education, and many samples skewed toward middle-aged to older adults (Blaer, 2023; Johnson-Pynn & Carleton, 2019; Shively, 2023; Skibins et al., 2022). In some of the studies, a majority of study participants watched the livestreams daily (Anderson, 2019; Johnson-Pynn & Carleton, 2019; Searle et al., 2023; Shively, 2023); however, two reported that only about 1/3 or fewer of the participants watched daily (Blaer, 2023; Jarratt, 2021). In

the two evidence sources reporting the duration of viewing sessions (Johnson-Pynn & Carleton, 2019; Shively, 2023), substantial portions of participants (i.e., 40–72%) indicated they watched for at least an hour.

Broadcast content and broadcaster characteristics (RQ2 and RQ3)

The broadcasts were made from locations across the globe including Australia, the United Kingdom, Kenya, the United States, Canada, and European countries. Broadcasts included a wide range of content from landscapes and curated wildlife environments (i.e., conservation center, safari park, or zoo) to views of specific animals in the wild. Specific content included the "penguin parade" from Phillip Island Nature Parks in Victoria, Australia (Blaer, 2023); peregrine falcon nests (Searle et al., 2023; Turnbull, Searle, & Adams, 2020); African wildlife (Shively, 2023); nests from a variety of bird species (Anderson, 2019; Beddington, 2020; Johnson-Pynn & Carleton, 2019); and bears (Skibins et al., 2022). In general, the articles provided scant information about the broadcasters other than the type of organization. The broadcasters (see Table 2 for details) varied and included a private forprofit business (Anderson, 2019), a private college (Johnson-Pynn & Carleton, 2019), a quasi-governmental agency (Jarratt, 2021), a research and conservation center (Shively, 2023), and zoos and aquariums (Beddington, 2020; Jarratt, 2021). Only one article (Skibins et al., 2022) reported the funding source of the broadcaster, which was a private foundation.

Platform and Broadcast Features (RQ4 and RQ5)

There was little consistency in the types of platform features that were discussed in the articles. Some (n = 4, 40%) indicated that the platforms had social media features that allowed viewers to message one another, post chats, or integrate with other social media platforms (i.e., Facebook, Instagram). One article noted that a substantial portion of the participants (28%) communicated with other viewers "outside the context of the…webcam" (Johnson-Pynn & Carleton, 2019, p. 4). Two articles (20%) reported that the platform provided additional content, including expert commentary, guest presenters, blogs, FAQs, and raffles for naming rights (Anderson, 2019; Blaer, 2023). One (10%) noted that the video content was downloadable (Beddington, 2020)) or reported that the platforms provided the opportunity for viewers to make donations (Blaer, 2023).

Of those reporting on synchronicity (n = 4, 40%), all indicated the platforms had opportunities for both real-time and lagged

| abic 1. Characteristics of Evidence Sources related to individe Focused Livecani Dioducasts and vien-deniu $(n - 13)$ | Well-Being (<i>n</i> = 13) | re-Focused Livecam Broadcasts a | Sources Related to Natur | ble 1. Characteristics of Evidence | able 1. |
|---|-----------------------------|---------------------------------|--------------------------|------------------------------------|---------|
|---|-----------------------------|---------------------------------|--------------------------|------------------------------------|---------|

| AUTHOR(S), YEAR | PEER REVIEWED? IF NO, TYPE | AUTHOR UNIVERSITY AFFILIATED? IF NO, TYPE | AUTHOR DISCIPLINE(S) | FUNDING? | CONFLICTS OF INTEREST? | QUANTITATIVE? | QUANTITATIVE SAMPLE SIZE | QUANTITATIVE SAMPLE CHARACTERISTICS | QUALITATIVE? | QUALITATIVE SAMPLE SIZE & DESCRIPTION |
|----------------------------------|----------------------------------|--|---|----------|---------------------------|---------------|-----------------------------|--|--------------|--|
| Anderson, 2019 | Yes | Yes | Social work | None | None | No | NA | NA | yes | Emails to broadcaster; size <i>n.r.</i> |
| Beddington, 2020 | News article | Newspaper | Journalism | n.r. | n.r. | No | NA | NA | no | NA |
| Blaer, 2023 | Yes | Yes | Tourism | Yes | None | Yes | 590 | 90% ♀; 67% age 40–69; 36% employed FT; 22% retired | yes | 62,495 YouTube and 10,780 Facebook posts |
| Jarratt, 2021 | Yes | Yes | Tourism | None | None | Yes | 277 | 69% ♀ | yes | 3 platforms |
| Johnson-Pynn & Carleton, 2019 | Yes | yes | Psychology; biology | None | None | Yes | 2930 | 89% ♀; 57% age 45–64; 87% ≥ college | yes | 2,039 Facebook posts from 883 people |
| Searle et al., 2023 | Yes | Yes | Geography | n.r. | n.r. | Yes | 455 | 68% ♀, 29% ♂, 3% non-binary | yes | 20 |
| Skibins et al., 2022 | Yes | Yes | Recreation | None | n.r. | Yes | 5582 | 65% ♀; 61% ≥ age 50; 87% from USA; 77% ≥ college | yes | 5582 respondents to open-ended questions |
| Shively, 2023 | Gray literature | Yes | Horticulture/ natural resources | n.r. | n.r. | Yes | 514 | 77% ♀;75% ≥ age 50; 59% grad. deg.; 73% > average income | no | NA |
| Turnbull et al., 2020 | Yes | Yes | Geography conservation/ development | n.r. | n.r. | No | NA | NA | yes | nestcam hosts; size <i>n.r.</i> |
| Zhang & Xiao, 2023 | Yes | Yes | Tourism | Yes | None | No | NA | NA | yes | 29, 55% female; ages 20–60; 66% from China; 93% ≥ college |

n.r., not reported; ♀, female; 𝔅, male; NA, not applicable; FT, full-time.

| Table 2. Overview of Key Findings for Sample of Evidence Sources of Nature–Focused Livestream Broadcasts and Well–Being ($n = 13$) | | | | | | | | | | | |
|--|---------------------------------|--|--|---|---|-----------------------------------|-----------------------------|--------------------------------------|--|--|--|
| | | | | | | OUTCOMES IDENTIFIED | | | | | |
| AUTHOR(S) | VIEWER LOCATION | LIVECAM LOCATION | BROADCAST CONTENT | BROADCASTER CHARACTERISTICS | AIMS INCLUDE IDENTIFYING SPECIFIC WELL-BEING OUTCOMES? | POSITIVE AFFECT/ UPLIFTED MOOD | RELAXATION/ REJUVENATION | KNOWLEDGE/ FASCINATION/ ESCAPE | | | |
| Anderson | 82% in USA | Rural Montana, USA | Osprey nest, ranch activities | Private guest ranch | No | | ~ | | | | |
| Beddington | Worldwide | Varies by platform including Netherlands, United Kingdom, USA | Bird nests; captive pen- guins, pandas, koalas, and jellyfish | Varies by platform, including zoos | No | 1 | | | | | |
| Blaer | 88% in Australia | Phillip Island Nature Parks, Victoria, Australia | Penguin parade | Not-for-profit conserva- tion organization | No | 1 | | | | | |
| Jarratt | 83% in the United Kingdom | Nature reserve and seaside in the United Kingdom | Wildlife, landscapes, zoos and safari parks, aquari- ums, pets | Varies by platform, includ- ing business improvement district | No | 2 | ~ | - | | | |
| Johnson-Pynne & Carlton | n.r. | Georgia, USA | Nesting bald eagles | College | No | | ~ | ~ | | | |
| Searle et al. | Worldwide | United Kingdom | Peregrine falcons | Varies including a church and conservationists | No | 1 | ~ | | | | |
| Shively | Worldwide | Mpala Research Center and Conservancy in Kenya | Animals in natural habitat | Research and conservation center | Yes** | | ~ | - | | | |
| Skibins et al. | Worldwide | Alaska, USA | Brown bears in Alaska | Recipient of private foundation funding | Yes* | ¥ | ~ | 1×4 | | | |
| Turnbull et al. | n.r. | United Kingdom | Peregrine falcons | n.r. | No | ~ | ~ | | | | |
| Zhang & Xiao | n.r. | n.r. | n.r. | n.r. | Yes** | ~ | | | | | |

n.r., not reported; *outcomes, quality of life, relaxation, and reduction of stress; **outcomes, psychological well-being.

communications (Anderson, 2019; Beddington, 2020; Blaer, 2023; Johnson-Pynn & Carleton, 2019). Articles rarely discussed cue absence, but when they did (n = 2, 20%), they reported medium to high levels of cue absence (Blaer, 2023; Johnson-Pynn & Carleton, 2019). Two (20%) reported on sites that were fully public (Blaer, 2023; Johnson-Pynn & Carleton, 2019), but others reported on sites restricted to members (Anderson, 2019) or multiple sites with varying degrees of publicness (Beddington, 2020). There was no consensus on levels of anonymity on the platforms among the articles that addressed anonymity (Beddington, 2020; Blaer, 2023; Johnson-Pynn & Carleton, 2019).

Most articles (n = 6, 60%) indicated that multiple cameras were broadcasting on the platforms. The broadcasts typically came with sound (Anderson, 2019; Beddington, 2020; Johnson-Pynn & Carleton, 2019; Searle et al., 2023; Shively, 2023). Half (n = 5) reported round-the-clock access to the broadcasts (Anderson, 2019; Blaer, 2023; Johnson-Pynn & Carleton, 2019; Searle et al., 2023; Turnbull et al., 2020), at least during peak season for the broadcast content (Skibins et al., 2022; Turnbull et al., 2020), with scheduled programming reported in two (20%) articles (Anderson, 2019; Blaer, 2023).

Well-being (RQ6, RQ7, RQ8, and RQ9)

RQ6 asked: What well-being outcomes were associated with viewing NFLs? The evidence sources reported well-being-related outcomes along three major themes: Positive Affect/Uplifted Mood, Relaxation/Rejuvenation, and Knowledge/Fascination/Escape. Five articles (50%) had well-being findings related to relaxation and rejuvenation, and six reported findings related to novelty, fascination, escape, or increased knowledge (n = 6, 60%). Each of the article's well-being outcomes is denoted in the checklist section of Table 2.

Only a few (n = 3, 30%) of the evidence sources (Shively, 2023; Skibins et al., 2022; Zhang & Xiao, 2023) had an explicit aim related to identifying well-being outcomes (RQ7). In these three articles, well-being was measured with single items related to happiness and levels of stress (Shively, 2023), open-ended items on a questionnaire (Skibins et al., 2022), and using a facial reader as viewers watched the livecam broadcasts (Zhang & Xiao, 2023). The other articles reported well-being findings through qualitative methods (e.g., content analysis, analysis of open-ended survey items) as a post hoc finding, and none reported psychometric properties of their assessment instruments (RQ8).

Potential mechanisms (RQ9). Six (60%) articles identified at least one mechanism for why viewing NFLs led to well-being outcomes (Anderson, 2019; Beddington, 2020; Blaer, 2023; Jarratt, 2021; Searle et al., 2023; Turnbull et al., 2020). None of the sources used quantitative methods and statistical analyses to identify mediating variable(s) in models of well-being. All of these reported that it was through connecting with nature. Sometimes, this connection was in ways that would be impossible without the webcam. For example, Turnbull et al. noted, "nestcams...allow for interpersonal relationships to form between viewers and individual animals" (p. 6.7), and Searle et al. stated, "the cameras have the ability to break down barriers" (p. 204).

In addition, connecting to other humans through the platforms was identified in two of the articles (Anderson, 2019; Blaer, 2023) as a mechanism for enhanced well-being. Anderson (2019) reported on "a sense of rejuvenation and healing that comes from connecting with nature and connecting with each other" (p. 339). Blaer (2023)– who studied webcam travel more generally but reported specific well-being outcomes associated with viewing natural locations– wrote that changes in viewers occurred, "in part through building and engaging online communities and supporting a sense of connection to nature" (p. 47).

Discussion

This scoping review synthesized knowledge of NFLs and their association with adults' well-being. The findings show evidence for a link between viewing NFLs and well-being along dimensions similar to those associated with engagement with physical nature (Capaldi et al., 2014; Corazon et al., 2019; Daniels et al., 2022; Farrow & Washburn, 2019; Hansen et al., 2017; McMahan & Estes, 2015; Wen et al., 2019; Yao et al., 2021). This suggests that NFL viewing could be used to enhance well-being for adults, particularly when access to physical nature may be limited.

Our first RQ asked about the characteristics of the broadcast viewers. We found that the broadcasts had a global reach with a tendency toward Western audiences. Most lead authors were from the United States or the United Kingdom, which may have biased the results on viewership toward these two countries. Future research focusing on audiences from a broader variety of global locations is warranted. Most of the viewers tended to be well-educated and middle-aged or older. Although it is possible that other viewers could also report enhanced well-being associated with NFLs, additional research is needed with samples containing ample participants from a broad range of demographic groups.

The next two RQs focused on the content of broadcasts and characteristics of the broadcasters. Most articles reported on the content, which tended to be specific animals in natural or zoo habitats. Because both theory and empirical support indicate that different types of natural landscapes and exposure may have different effects on humans' social and emotional responses (Bratman et al., 2019; Snell, Graetz Simmonds, & Greenway, 2015; van Houwelingen-Snippe, van Rompay, de Jong et al., 2020), it is possible that the content of NFLs would also produce different social and emotional responses for viewers. As the body of evidence for well-being outcomes of NFLs grows, researchers may be able to identify how content impacts viewers.

In contrast to information on broadcast content, details about the broadcasters themselves were less available. Because there are a variety of online content creators with differing motivations (Blank, 2013; Munar & Jacobsen, 2014), it is reasonable to hypothesize that the characteristics of livestream broadcasters could influence the motivations and outcomes of NFL broadcasts. Providing information about broadcasters in future research should help build knowledge about the factors associated with well-being outcomes, specifically related to broadcaster type and motivation.

Regarding our fourth and fifth RQs related to the features of the platforms and the broadcasts, it was typical for the articles to provide descriptions of the broadcasts from the viewers' perspective (e.g., 24-h access; multiple cameras on a livestreaming website). However, less information was provided regarding the platforms on which the broadcasts were made available. Neo-ecological theory (Navarro & Tudge, 2022) suggests that the features of online platforms are important characteristics of the virtual systems in which individuals are embedded. Using the neo-ecological framework to report platform characteristics (e.g., synchronicity, publicness, anonymity, cue absence) in future research could provide valuable context for understanding and assessing how broadcasting platforms relate to viewers' experiences.

Our final three RQs concerned well-being outcomes for viewers of NFLs. In this study, the nature-based webcams were viewed as the vehicles or mechanisms that can potentially impact viewers' hedonic and eudaimonic well-being. We only found evidence for hedonic well-being outcomes; however, it is possible that eudaimonic effects exist but have not yet been examined. Regarding hedonic well-being, it is entirely plausible that individuals derive emotional benefits from engaging with the nature-based webcams, including a sense of pleasure and an emotional connection with flora and fauna and with their fellow viewers, particularly on platforms with chatrooms. In terms of eudaimonic well-being, individuals may derive meaning by watching nature-focused webcams, such as a sense that the world is larger than their own lives, a reckoning of their place in the world, and a better understanding of the meaning of their life within the context of the natural world.

Although each of the 10 articles in this review reported wellbeing outcomes, only a few (n = 3, 30%) had specific aims of examining well-being. These articles (Shively, 2023; Skibins et al., 2022; Zhang & Xiao, 2023) were published in 2020 or later, suggesting the recency of intentionally exploring how NFLs can improve wellbeing. Among all the articles, we found various psychosocial wellbeing outcomes associated with NFLs. None of the evidence sources explored physical benefits of viewing NFLs, such as those linked to engaging with the physical natural world (Twohig-Bennett & Jones, 2018; Wen et al., 2019; Yao et al., 2021). Neither did any evidence source explore how platform or broadcast features were associated with the effectiveness of viewing broadcasts to influence wellbeing. It is clear that research on this fairly new innovation for connecting with nature is in its infancy with the potential to examine many additional well-being outcomes and viewing contexts. Additional research is needed to help interrogate a full array of potential benefits and mechanisms of NFLs on well-being among different populations and in different contexts and circumstances. New studies using larger samples and quantitative methods could test theoretical frameworks that assert hypothesized mechanisms, including connecting with nature and others.

Limitations

Some limitations are inherent to the scoping review method, but these do not diminish its intended purpose—to map existing literature on a broad topic, identify the key concepts, the evidence available, and any gaps, as well as inform future research. For example, the lack of a quality assessment as found in systematic reviews and meta-analyses means that scoping reviews do not evaluate the rigor of the evidence sources. We intentionally did not include an assessment of methodological rigor because our goal was to map the existing literature, not evaluate it (Tricco et al., 2018). Another example is the use of broad operational definitions to gather as broad a sample of evidence sources as possible. In our case, we used a broad definition of well-being. Although our scoping review may lack some specificity, we purposely kept our definition of wellbeing broad to allow for the inclusion of a wide range of well-being outcomes. Although this scoping review was conducted in a systematic and rigorous way, it is possible that relevant studies may have been overlooked. Although our search strategy included articles published in any language, we found only articles in English, and most of the samples were from the English-speaking world, which likely limits generalizability. Many participants in most of the studies in this review were university-educated women who viewed NFLs daily. These sample characteristics may further reduce the ability to generalize to other populations. Highlighting the demographic skew of the studies is an important scoping review finding pointing to the need for additional research.

Conclusion

NFLs have promise for bringing the benefits of the natural world to a variety of audiences and potentially improve the lives of those who cannot leave their homes or live far from natural environments. To the extent that viewing NFLs confers positive emotional, psychological, and social benefits, access to the broadcasts should be equitable across socioeconomic and geographic groups. Additional research is needed to better understand the effects of viewing these broadcasts, especially to examine the results of diverse broadcast content and platforms among a diverse viewership and to include potential physiological benefits. As knowledge about NFLs continues to grow, researchers, practitioners, and broadcasters alike can gain valuable insights and tools to provide the most beneficial content and delivery to a wide array of audiences worldwide.

Authors' Contributions

R.M., C.H., D.S., and K.A. conceived the ideas and designed methodology. S.H. and C.H. collected the data. R.M., C.H., and D.S. analyzed the data. R.M. led the writing of the article. All authors contributed critically to the drafts and gave final approval for publication.

Author Disclosure Statement

The authors have no conflicts of interest to report.

Funding Information

The authors have no funding to report.

Supplementary Material

Supplementary Data S1

REFERENCES

Anderson, K. A. (2019). The virtual care farm: A preliminary evaluation of an innovative approach to addressing loneliness and building community through nature and technology. Activities, Adaptation & Aging, 43(4), 334-344; doi: 10.1080/ 01924788.2019.1581024

- Beddington, E. (2020. Watch the birdie: Why birdcams are the new box sets. The Guardian. Retrieved from: https://www.theguardian.com/environment/2020/ apr/26/watch-the-birdie-why-birdcams-are-the-new-box-sets
- Berman, M. G., Kross, E., Krpan, K. M., Askren, M. K., Burson, A., Deldin, P. J., Kaplan, S., Sherdell, L., Gotlib, I. H., & Jonides, J. (2012). Interacting with nature improves cognition and affect for individuals with depression. *Journal of Affective Disorders*, 140(3), 300–305; doi: 10.1016/j.jad.2012.03.012
- Berto, R. (2005). Exposure to restorative environments helps restore attentional capacity. *Journal of Environmental Psychology*, 25(3), 249–259; doi: 10.1016/j .jenvp.2005.07.001
- Blaer, M. (2023). Interactive webcam travel: Supporting wildlife tourism and conservation during COVID-19 lockdowns. *Information Technology & Tourism*, 25(1), 47–69; doi: 10.1007/s40558-023-00242-3
- Blank, G. (2013). Who creates content? Stratification and content creation on the Internet. Information, Communication & Society, 16(4), 590–612; doi: 10.1080/ 1369118X.2013.777758
- Bratman, G. N., Anderson, C. B., Berman, M. G., Cochran, B., de Vries, S., Flanders, J., Folke, C., Frumkin, H., Gross, J. J., Hartig, T., Kahn, P. H., Kuo, M., Lawler, J. J., Levin, P. S., Lindahl, T., Meyer-Lindenberg, A., Mitchell, R., Ouyang, Z., Roe, J., Scarlett, L., Smith, J. R., van den Bosch, M., Wheeler, B. W., White, M. P., Zheng, H., & Daily, G. C. (2019). Nature and mental health: An ecosystem service perspective. *Science Advances*, 5(7), eaax0903; doi: 10.1126/sciadv.aax0903
- Bratman, G. N., Daily, G. C., Levy, B. J., & Gross, J. J. (2015). The benefits of nature experience: Improved affect and cognition. *Landscape and Urban Planning*, 138, 41–50; doi: 10.1016/j.landurbplan.2015.02.005
- Capaldi, C. A., Dopko, R. L., & Zelenski, J. M. (2014). The relationship between nature connectedness and happiness: A meta-analysis. *Frontiers in Psychology*, 5, 976; doi: 10.3389/fpsyg.2014.00976
- Chen, C.-C., & Lin, Y.-C. (2018). What drives live-stream usage intention? The perspectives of flow, entertainment, social interaction, and endorsement. *Telematics and Informatics*, 35(1), 293–303; doi: 10.1016/j.tele.2017.12.003
- Clark, J., Glasziou, P., Del Mar, C., Bannach-Brown, A., Stehlik, P., & Scott, A. M. (2020). A full systematic review was completed in 2 weeks using automation tools: A case study. *Journal of Clinical Epidemiology*, 121, 81–90; doi: 10.1016/ j.jclinepi.2020.01.008
- Clark, J. M., Sanders, S., Carter, M., Honeyman, D., Cleo, G., Auld, Y., Booth, D., Condron, P., Dalais, C., Bateup, S., Linthwaite, B., May, N., Munn, J., Ramsay, L., Rickett, K., Rutter, C., Smith, A., Sondergeld, P., Wallin, M., Jones, M., & Beller, E. (2020). Improving the translation of search strategies using the Polyglot Search Translator: A randomized controlled trial. *Journal of the Medical Library Association: JMLA*, 108(2), 195–207; doi: 10.5195/jmla.2020.834
- Colley, K., Currie, M., Hopkins, J., & Melo, P. (2016. Access to outdoor recreation by older people in Scotland. Retrieved from: https://www.gov.scot/publications/ access-outdoor-recreation-older-people-scotland/
- Colquhoun, H. L., Levac, D., O'Brien, K. K., Straus, S., Tricco, A. C., Perrier, L., Kastner, M., & Moher, D. (2014). Scoping reviews: Time for clarity in definition, methods, and reporting. *Journal of Clinical Epidemiology*, 67(12), 1291–1294; doi: 10 .1016/j.jclinepi.2014.03.013
- Corazon, S. S., Sidenius, U., Poulsen, D. V., Gramkow, M. C., & Stigsdotter, U. K. (2019). Psycho-physiological stress recovery in outdoor nature-based interventions: A systematic review of the past eight years of research. *International*

Journal of Environmental Research and Public Health, 16(10); doi: 10.3390/ ijerph16101711

- Daniels, S., Clemente, D. B. P., Desart, S., Saenen, N., Sleurs, H., Nawrot, T. S., Malina, R., & Plusquin, M. (2022). Introducing nature at the work floor: A nature-based intervention to reduce stress and improve cognitive performance. *International Journal of Hygiene and Environmental Health*, 240, 113884; doi: 10.1016/j .ijheh.2021.113884
- Darcy, P. M., Taylor, J., Mackay, L., Ellis, N. J., & Gidlow, C. J. (2022). Understanding the role of nature engagement in supporting health and well-being during COVID-19. International Journal of Environmental Research and Public Health, 19(7).
- Diener, E., & Sim, J. H. (2024). Happiness/Subjective well-being. In A Scarantino (Ed.), Emotion theory: The Routledge comprehensive guide. Cambridge: Routledge.
- Donaldson, G. C., Wilkinson, T. M. A., Hurst, J. R., Perera, W. R., & Wedzicha, J. A. (2005). Exacerbations and time spent outdoors in chronic obstructive pulmonary disease. *American Journal of Respiratory and Critical Care Medicine*, 171(5), 446–452; doi: 10.1164/rccm.200408-10540C
- Farrow, M. R., & Washburn, K. (2019). A review of field experiments on the effect of forest bathing on anxiety and heart rate variability. *Global Advances in Health* and *Medicine*, 8, 2164956119848654–2164956119848657; doi: 10.1177/ 2164956119848654
- Frumkin, H., Bratman, G. N., Breslow, S. J., Cochran, B., Kahn, P. H., Jr, Lawler, J. J., Levin, P. S., Tandon, P. S., Varanasi, U., Wolf, K. L, & Wood, S. A. (2017). Nature contact and human health: A research agenda. *Environmental Health Perspectives*, 125(7), 075001; doi: 10.1289/EHP1663
- Granville, A. (2020. Coronavirus: How to get a hungry hippo in your living room. Retrieved April 23, 2023 from: https://www.stuff.co.nz/travel/news/121022199/ coronavirus-how-to-get-a-hungry-hippo-in-your-living-room
- Gray, E. S., & Wikle, J. S. (2021). Using webcam video feed to measure and evaluate national park recreation patterns. *Journal of Park and Recreation Administration*, 39(1); doi: 10.18666/JPRA-2020-10496
- Hansen, M. M., Jones, R., & Tocchini, K. (2017). Shinrin-Yoku (forest bathing) and nature therapy: A state-of-the-art review. International Journal of Environmental Research and Public Health, 14(8); doi: 10.3390/ijerph14080851
- Highfill, M. C., Mauldin, R. L., Anderson, K. A., Schuman, D. L., & Henderson, S. M. (2022). Nature-focused livecam viewing and well-being in adults: A scoping review protocol. https://osf.io/wb74k
- Jarratt, D. (2021). An exploration of webcam-travel: Connecting to place and nature through webcams during the COVID-19 lockdown of 2020. *Tourism and Hospitality Research*, 21(2), 156–168; doi: 10.1177/1467358420963370
- Johnson-Pynn, J. S., & Carleton, R. (2019). Webcams and websites inspire conservation of the American bald eagle. *Ecopsychology*, 11(4), 236–242; doi: 10.1089/ eco.2019.0021
- Kahn, P. H., Severson, R. L., & Ruckert, J. H. (2009). Technological nature and the problem when good enough becomes good. In M Drenthen, J Keulartz, & J Proctor (Eds.), *New visions of nature: Complexity and authenticity* (pp. 21–41). Springer.
- Kjellgren, A., & Buhrkall, H. (2010). A comparison of the restorative effect of a natural environment with that of a simulated natural environment. *Journal of Environmental Psychology*, 30(4), 464–472; doi: 10.1016/j.jenvp.2010.01.011
- Langhans, K. E., Echeverri, A., Daws, S. C., Moss, S. N., Anderson, C. B., Chaplin-Kramer, R., Hendershot, J. N., Liu, L, Mandle, L, Nguyen, O., Ou, S. X., Remme, R. P., Schmitt, R. J. P., Vogl, A., & Daily, G. C. (2023). Centring justice in conceptualizing and

improving access to urban nature. *People and Nature*, 5(3), 897–910; doi: 10.1002/pan3.10470

- Lee, S. M. F., Filep, S., Vada, S., & King, B. (2022). Webcam travel: A preliminary examination of psychological well-being. *Tourism and Hospitality Research*, 24, 329–337; doi: 10.1177/14673584221145818
- McKenzie, J. E., Brennan, S. E., Ryan, R. E., Thomson, H. J., & Johnston, R. V. (2022). Chapter 9: Summarizing study characteristics and preparing for synthesis. In T. J Higgins, J Chandler, M Cumpston, T Li, M. J Page, & V Welch (Eds.), Cochrane handbook for systematic reviews of interventions version 6.3. Cochrane. https://training.cochrane.org/handbook/current/chapter-09
- McMahan, E. A., & Estes, D. (2015). The effect of contact with natural environments on positive and negative affect: A meta-analysis. *The Journal of Positive Psychology*, 10(6), 507–519; doi: 10.1080/17439760.2014.994224
- Munar, A. M., & Jacobsen, J. K. S. (2014). Motivations for sharing tourism experiences through social media. *Tourism Management*, 43, 46–54; doi: 10.1016/j .tourman.2014.01.012
- Munn, Z., Aromataris, E., Tufanaru, C., Stern, C., Porritt, K., Farrow, J., Lockwood, C., Stephenson, M., Moola, S., Lizarondo, L., McArthur, A., Peters, M., Pearson, A., Et Jordan, Z. (2019). The development of software to support multiple systematic review types: The Joanna Briggs Institute System for the Unified Management, Assessment and Review of Information (JBI SUMARI). International Journal of Evidence-Based Healthcare, 17(1), 36–43; doi: 10.1097/XEB.000000000000152
- Munn, Z., Pollock, D., Khalil, H., Alexander, L., McInerney, P., Godfrey, C., Peters, M., & Tricco, A. (2022). What are scoping reviews? Providing a formal definition of scoping reviews as a type of evidence synthesis. *JBI Evidence Synthesis*, 20(4), 950–952; doi: 10.11124/jbies-21-00483
- Navarro, J. L., & Tudge, J. R. H. (2022). Technologizing Bronfenbrenner: Neoecological Theory. *Current Psychology (New Brunswick, N.J.)*, 1–17; doi: 10 .1007/s12144-022-02738-3
- Page, M. J, McKenzie, J. E, Bossuyt, P. M, Boutron, I, Hoffmann, T. C, Mulrow, C. D, Shamseer, L, Tetzlaff, J. M, Akl, E. A, Brennan, S. E, Chou, R, Glanville, J, Grimshaw, J. M, Hróbjartsson, A, Lalu, M. M, Li, T, Loder, E. W, Mayo-Wilson, E, McDonald, S, McGuinness, L. A, Stewart, L. A, Thomas, J, Tricco, A. C, Welch, V. A, Whiting, P, & Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ (Clinical Research ed.)*, 372, n71; doi: 10.1136/bmj.n71
- Pergams, O. R. W., & Zaradic, P. A. (2008). Evidence for a fundamental and pervasive shift away from nature-based recreation. *Proceedings of the National Academy* of Sciences of the United States of America, 105(7), 2295–2300; doi: 10.1073/ pnas.0709893105
- Peters, M. D., Godfrey, C., McInerney, P., Munn, Z., Trieco, A. C., & Khalil, H. (2020). Chapter 11: Scoping reviews (2020 version). In E Aromataris & Z Munn (Eds.), JBI Manual for Evidence Synthesis. JBI. 10.46658/JBIMES-20-12
- Phillips, T. B., Wells, N. M., Brown, A. H., Tralins, J. R., & Bonter, D. N. (2023). Nature and well-being: The association of nature engagement and well-being during the SARS-CoV-2 pandemic. *People and Nature*, 5(2), 607–620; doi: https://doi .org/10.1002/pan3.10433
- Qiu, Q., Zuo, Y., & Zhang, M. (2021). Can live streaming save the tourism industry from a pandemic? A study of social media. *ISPRS International Journal of Geo-Information*, 10(9), 595. https://www.mdpi.com/2220-9964/10/9/595
- Ratz, J. M., & Conk, S. J. (2010). Use of wildlife webcams: Literature review and annotated bibliography. US Department of the Interior, US Geological Survey: https://pubs.usgs.gov/of/2010/1306/pdf/OF10-1306.pdf

NATURE-FOCUSED LIVESTREAMS AND WELL-BEING

- Searle, A., Turnbull, J., & Adams, W. M. (2023). The digital peregrine: A technonatural history of a cosmopolitan raptor. *Transactions of the Institute of British Geographers*, 48(1), 195–212; doi: 10.1111/tran.12566
- Shively, R. (2023). The interface of wildlife and nature tourism. Retrieved from: https://hdl.handle.net/2097/42971
- Silk, M., Correia, R., Verissimo, D., Verma, A., & Crowley, S. L. (2021). The implications of digital visual media for human-nature relationships. *People and Nature*, 3(6), 1130–1137; doi: 10.1002/pan3.10284
- Skibins, J. C., Das, B. M., & Schuler, G. (2022). Digital modalities, nature, and quality of life: Mental health and conservation benefits of watching bear cams. *Human Dimensions of Wildlife*, 28, 218–232; doi: 10.1080/10871209.2021.2024629
- Snell, T. L, Graetz Simmonds, J., & Greenway, A. P. (2015). Ecopsychology and evolutionary psychology: Implications and limitations of habitat selection theory. *Ecopsychology*, 7(2), 96–103; doi: 10.1089/eco.2014.0053
- Snell, T. L., McLean, L. A., McAsey, F., Zhang, M., & Maggs, D. (2019). Nature streaming: Contrasting the effectiveness of perceived live and recorded videos of nature for restoration. *Environment and Behavior*, 51(9–10), 1082–1105; doi: 10.1177/0013916518787318
- The EndNote Team. (2013). EndNote [computer program]. Clarivate: Philadelphia.
- Tricco, A. C., Lillie, E., Zarin, W., O'Brien, K. K., Colquhoun, H., Levac, D., Moher, D., Peters, M. D. J., Horsley, T., Weeks, L., Hempel, S., Akl, E. A., Chang, C., McGowan, J., Stewart, L., Hartling, L., Aldcroft, A., Wilson, M. G., Garritty, C., Lewin, S., Godfrey, C. M., Macdonald, M. T., Langlois, E. V., Soares-Weiser, K., Moriarty, J., Clifford, T., Tunçalp, Ö., & Straus, S. E. (2018). PRISMA extension for scoping reviews (PRISMA-ScR): Checklist and explanation. *Annals of Internal Medicine*, 169(7), 467–473; doi: 10.7326/m18-0850%m 30178033
- Turnbull, J., Searle, A., & Adams, W. M. (2020). Quarantine encounters with digital animals: More-than-human geographies of lockdown life. *Journal of Environmental Media*, 1(1), 6.1–6.10; doi: 10.1386/jem_00027_1
- Twohig-Bennett, C., & Jones, A. (2018). The health benefits of the great outdoors: A systematic review and meta-analysis of greenspace exposure and health outcomes. *Environmental Research*, 166, 628–637; doi: 10.1016/j.envres.2018.06 .030
- Valtchanov, D., & Ellard, C. (2010). Physiological and affective responses to immersion in virtual reality: Effects of nature and urban settings. *Journal of Cyber-Therapy & Rehabilitation*, 3(4), 359–373.
- van Houwelingen-Snippe, J., van Rompay, T. J. L., & Ben Allouch, S. (2020). Feeling connected after experiencing digital nature: A survey study. International Journal of Environmental Research and Public Health, 17(18); doi: 10.3390/ ijerph17186879

- van Houwelingen-Snippe, J., van Rompay, T. J. L., de Jong, M. D. T., & Ben Allouch, S. (2020). Does digital nature enhance social aspirations? An experimental study. International Journal of Environmental Research and Public Health, 17(4); doi: 10.3390/ijerph17041454
- Wake, E., Atkins, H., Willock, A., Hawkes, A., Dawber, J., & Weir, K. (2020). Telehealth in trauma: A scoping review. *Journal of Telemedicine and Telecare*, 28(6), 412–422; doi: 10.1177/1357633x20940868
- Wen, Y., Yan, Q., Pan, Y., Gu, X., & Liu, Y. (2019). Medical empirical research on forest bathing (Shinrin-yoku): A systematic review. *Environmental Health and Preventive Medicine*, 24(1), 70; doi: 10.1186/s12199-019-0822-8
- Yao, W., Zhang, X., & Gong, Q. (2021). The effect of exposure to the natural environment on stress reduction: A meta-analysis. Urban Forestry & Urban Greening, 57, 126932; doi: 10.1016/j.ufug.2020.126932
- Zabini, F., Albanese, L., Becheri, F. R., Gavazzi, G., Giganti, F., Giovanelli, F., Gronchi, G., Guazzini, A., Laurino, M., Li, Q., Marzi, T., Mastorci, F., Meneguzzo, F., Righi, S., & Viggiano, M. P. (2020). Comparative study of the restorative effects of forest and urban videos during COVID-19 lockdown: Intrinsic and benchmark values. International Journal of Environmental Research and Public Health, 17(21), 8011. https://www.mdpi.com/1660-4601/17/21/8011
- Zhang, A., & Xiao, H. (2023). Psychological well-being in tourism live streaming: A grounded theory. *Journal of Hospitality & Tourism Research*, 0, 109634802211495; doi: 10.1177/10963480221149595

Address correspondence to: Rebecca L. Mauldin School of Social Work The University of Texas at Arlington 501 W. Mitchell, Box 19129 Arlington, TX 76019 USA

E-mail: rebecca.mauldin@uta.edu

Received: January 29, 2024 Accepted: August 14, 2024