Leisure Studies

ISSN: 0261-4367 (Print) 1466-4496 (Online) Journal homepage: www.tandfonline.com/journals/rlst20

# Time to feather the brakes? The datafication of leisure and concerns about mobility justice

Kimberly Coleman, Emily Reinhardt, Mary Alldred & Mark Baran

**To cite this article:** Kimberly Coleman, Emily Reinhardt, Mary Alldred & Mark Baran (28 Feb 2026): Time to feather the brakes? The datafication of leisure and concerns about mobility justice, Leisure Studies, DOI: 10.1080/02614367.2026.2637489

**To link to this article:** https://doi.org/10.1080/02614367.2026.2637489

LEISURE STUDIES
https://doi.org/10.1080/02614367.2026.2637489



# Time to feather the brakes? The datafication of leisure and concerns about mobility justice

Kimberly Coleman[a], Emily Reinhardt[b], Mary Alldred[c] and Mark Baran[c]

[a]Rubeninstein School of Environment and Natural Resources, University of Vermont, Burlington, VT, USA; [b]City of Plattsburgh, Plattsburgh, NY, USA; [c]Center for Earth and Environmental Science, SUNY Plattsburgh, Plattsburgh, NY, USA

**ABSTRACT**

The datafication of everyday activities, such as leisure, is increasing, and large user-generated datasets are now available from a range of sources, including social media and recreation trackers. These datasets may provide valuable insights about recreation trends and allow planners to make data-driven management decisions. However, some scholars have noted that these data sources tend to highlight the experiences and preferences of only the majority of users, under-counting the experience of underrepresented groups, and therefore potentially reinforcing inequities that already exist within recreation spaces and jeopardising mobility justice. To explore the potential opportunities and limitations of such data, we analysed 5 years of bike data collected in two counties in the northeastern United States via the activity tracking app, Strava. We sought to explore whether analysis of Strava data could support decision-making for an emerging management challenge, namely whether to allow e-bikes in certain recreation spaces. Our analysis revealed that while the data are useful for highlighting general spatial and temporal trends, the format of the data restricts the deeper analysis required to answer more complex questions about causal relationships and ensure mobility justice for all user groups.

**ARTICLE HISTORY**
Received 7 July 2025
Accepted 23 February 2026

**KEYWORDS**
Datafication; outdoor recreation; mobility justice; mountain biking; e-biking

## Introduction

The datafication of leisure, *i.e.*, turning leisure experiences into data, is growing, particularly as user-generated datasets from social media platforms are becoming more widely available to researchers and recreation planners (Flensburg & Lomborg, 2023). These datasets may offer a valuable opportunity for identifying and tracking trends in leisure, particularly outdoor recreation (Vilalta Capdevila et al., 2024). For example, millions of people around the world upload recreation activities to Strava with their phone or GPS device, and Strava Metro (a non-profit data service connected to Strava) provides aggregated and de-identified regional-level datasets to researchers and planners to support the development of bike- and pedestrian-friendly communities (Reinhardt et al., 2024). Given that outdoor recreation has surged in recent years and continues to grow,

**CONTACT** Kimberly Coleman kcolema@uvm.edu Rubeninstein School of Environment and Natural Resources, University of Vermont, Burlington, VT, USA

there is a need for scholarship and planning decisions that are 1) based on accurate and timely data, and 2) match the scale and extent of those recreation activities.

The datafication of leisure activities – such as Strava Metro datasets – may help address that need. However, some scholars have raised concerns that this datafication of leisure, and the subsequent policy and planning work that is informed by it, can exacerbate existing mobility injustices (Williams, 2023). For example, young men tend to be overrepresented in Strava Metro datasets, meaning that any policy or planning work informed by these datasets risks privileging that already dominant group. At the same time, Strava Metro datasets may reveal emerging trends in new recreation groups and thus be a tool for working towards equity. To explore this potential, this study will share an analysis of 5 years of geospatial data collected via Strava Metro from two counties in the northeastern United States. Using these two counties as case studies, we highlight the rise of a new technology, electric bikes, and the simultaneous increase in recreational biking among older demographic groups, suggesting an improvement in recreation access. Drawing from theory about mobility justice (Shakibaei & Vorobjovas-Pinta, 2024) and environmental justice for recreation (Rigolon et al., 2022) we illustrate the potential for user-generated recreation data to contribute to justice-informed recreation planning. This paper will make an important contribution to the literature on the datafication of leisure activities, as well as be of interest to those studying the global growth of outdoor recreation.

## Background

### *Digital leisure and the datafication of leisure activities*

Digital leisure, *i.e.*, any leisure activity that uses a digital device, is growing. For the purpose of this paper, we follow the World Leisure Organization (WLO)'s definition of leisure as 'the quest for satisfaction, pleasure, discovery and socialization' (World Leisure Organization, 2025). The WLO notes the following dimensions of leisure: recreation, the arts and culture, sport, festivals and celebrations, health and fitness, travel and tourism, and education. Digital leisure experiences, then, are highly varied and range from online gaming to virtual visits to parks and museums, to use of social media as entertainment (Asan & Zwiegelaar, 2025) and are pursued by individuals across the age spectrum (Chang et al., 2025; Hänninen et al., 2025). In addition to leisure activities that rely on a digital device, *e.g.*, participation in virtual sport and platforms such as Zwift (Reed et al., 2023; Sturm, 2020), digital leisure also includes the use of devices to record or augment traditional leisure activities, for example using a wearable device, such as a fitness tracking watch, to record bike rides. Because digital leisure is often occurring on platforms that track user data, engaging in digital leisure produces information that is collected, organised, quantified, and analysed for the purpose of generating knowledge, optimising services, and evaluating economic conditions (Flensburg & Lomborg, 2023). This 'datafication' of everyday experiences, including leisure activities, is now pervasive (Kennedy, 2018), including the datafication of recreational activities (Schwietering et al., 2024). Leisure researchers should pay attention to the datafication of leisure, particularly as leisure is increasingly occurring in a hyper-digitalised media environment (Lawrence & Crawford, 2022).

One way that leisure is subject to datafication is through individuals providing information about their recreation activities on social media, such as Flickr, Twitter (now X), Instagram, and Facebook, thereby creating large datasets of user-generated data (Pickering et al., 2023). This datafication provides an opportunity for decision makers. As people engage with social media to comment on everyday life, share photos, and document activities (Cope, 2015), they create large datasets that can be used to monitor recreationists and make decisions about recreation planning and management (Vilalta Capdevila et al., 2024). The datafication of leisure, specifically user-generated data, means decision makers can analyse larger volumes of information than are available through more traditional means (*e.g.*, visitor surveys, trail counters) (Leggett et al., 2017; Pickering et al., 2023), possibly allowing for more informed planning and management of recreation spaces.

Several scholars have suggested that user-generated data can support planning and management in a variety of contexts. Managers of parks and protected areas can use these data to understand where certain types of recreation are concentrated (Norman et al., 2019; Power et al., 2023; Rice, 2019). For example, researchers and land managers have examined geotagged data from Flickr to identify the public values and behaviours associated with a given landscape (Dunkel, 2015; Pickering et al., 2020). City planners have used geotagged tweets to map spatial inequities (Shelton et al., 2015) and cultural ecosystem services in urban parks (Johnson et al., 2019). Data from applications that include GPS-enabled activity trackers may be particularly helpful given that many outdoor recreationists now use digital tools (*e.g.*, Strava, AllTrails, Trailforks) to plan and navigate their activities (Schwietering et al., 2024).

### *Strava and Strava Metro*

Strava is a fitness tracking app that accumulates large amounts of user-generated data, which allows managers to access information not available through traditional tracking methods, such as trail counters (Reinhardt et al., 2024; Wilkins et al., 2021). Strava now has over 100 million users in 195 countries (Strava Business, 2024), who record and upload GPS-tracks of their activities. Strava is popular among runners and cyclists, and users can self-report an activity as commuting or leisure. Along with recording the overall route a user takes in the course of their activity, Strava also records specific sections of GPS tracks, which allows users to determine the time it took to traverse a given segment. Users have the option to additionally record performance data, such as personal best times, heart rate, speed, and power output, if supported by the athlete's equipment (*e.g.*, heart rate monitors are needed to record heart rate).

Strava also has a social media component, which allows users to interact by giving each other 'kudos' (Strava's version of 'likes'), by creating 'challenges' in which groups of Strava users all work towards a shared goal (*e.g.*, cycling 1000 miles in one month), and by awarding 'King of the Mountain' or 'Queen of the Mountain' to the user with the fastest recorded time on a segment. Finally, Strava allows users to create routes through its mapping features and provides suggested routes for users based on routes that other users have taken. Although Strava is used to record more than just leisure activities, including commutes and training sessions by professional athletes, the majority of users

are recreational (Strava Business, 2024). The combination of physical activity and social media aspects makes Strava data interesting in the context of digital leisure. Individuals may have a wide range of reasons for using Strava, including performance, social reasons, or even reporting mileage in the case of bike couriers.

Strava Metro, a non-profit organisation associated with Strava, provides de-identified, aggregated data to researchers and decision makers to support planning efforts (Strava Metro, 2024). Strava Metro data have been used to inform the creation and implementation of transportation plans for cities across the globe (Robinson et al., 2024). For example, Rio de Janeiro, Brazil, used Strava Metro data to identify high-demand cycling corridors and to locate areas where bike lanes and safety infrastructure were needed (Blassel, 2025). In another example, researchers used Strava Metro data to estimate bicycle volume in the city of Charlotte, NC, USA (Lin & Fan, 2020). Strava Metro has also been integrated into policy and decision-making by Transport for London (TfL) in the United Kingdom, and by the Oregon Department of Transportation (ODOT) in the United States (Williams, 2023).

Although it is most commonly used in urban transportation settings, scholars have employed Strava Metro data to support rural recreation planning (Reinhardt et al., 2024), to evaluate the ecological impact of increased outdoor recreation (Schuett et al., 2024), to estimate how many individuals visit natural areas (Nelson et al., 2021), and to assess the economic value of recreation tourism (Lawson, 2018). In short, Strava Metro data are widely used by planners and managers, and that use is likely to grow in leisure contexts, given the increasing need for data-driven decision-making in both recreation and transportation spaces.

## *Leisure and mobility justice*

Social justice and leisure are inherently linked, as leisure relates to ecological degradation (*e.g.*, impacts of recreation), environmental injustice (*e.g.*, distributional injustice of access to green space), and embodied risk (*e.g.*, cycling among vehicles in congested urban spaces) (Evers, 2019; Lawrence et al., 2024). For example, leisure is linked to the process of gentrification, as the creation of and investment in parks and other recreation spaces encourage the movement of individuals into areas with more leisure opportunities (Mullenbach & Baker, 2020; Reinhardt et al., 2025). One framework for considering issues of social justice and leisure is mobility justice. Mobility justice is a theoretical framework that allows scholars and practitioners to question how mobility systems (*e.g.*, transportation systems, recreation spaces) can provide both freedom of movement and equal movement (Harada, 2023). Mobility justice recognises that these systems are the result of a global legacy of colonialism and oppression, and thus often serve to reinforce injustice (Sheller, 2018). Mobility justice encompasses a range of aspects of everyday life, including transportation, recreation, migration, and other sectors. Issues of mobility injustice occur on the individual scale (*e.g.*, if a person with disabilities cannot access public transportation), on the community scale (*e.g.*, if a city's transportation network prioritises motorists and is unsafe for bike commuters), and at the global scale (*e.g.*, if a nation limits movement across its borders in a way that negatively impacts certain groups of people) (Sheller, 2020).

Mobility justice impacts leisure and recreation because not everyone has equal access to recreation spaces (Powers et al., 2020; Rigolon et al., 2022). Recreation spaces (*e.g.*, parks, bike paths, community pools) are often not spatially distributed in a way that allows for equitable access (DeLuca, 2013; Shakibaei & Vorobjovas-Pinta, 2024; Suárez et al., 2020), and even within recreation spaces, infrastructure is often not created with all people in mind (Prytherch, 2022; Sturm & Rinehart, 2018). Furthermore, access can be impacted by cultural and social dimensions (Koppen et al., 2014)for example, if specific groups of people do not feel welcome in recreation spaces (Powers et al., 2024). As noted by Shakibaei and Vorobjovas-Pinta (2024), mobility justice needs to be considered in the context of recreation spaces.

Although user-generated data offer great potential for understanding how people access and use spaces (Cope, 2015), use of such data also presents the potential for the reinforcement of social inequities (Andrejevic, 2013; Taylor & Richter, 2017). Broadly, digital technologies have transformed leisure in myriad ways, in some cases reinforcing pre-existing inequities associated with the digital divide (Carnicelli et al., 2016). For example, online participation in leisure activities is only possible for those with reliable access to the internet. Further, datafication in general impacts different groups of people differently, and use of user-generated data can result in discrimination against groups whose preferences and wellbeing are not accounted for in the data used for decision-making (D'Ignazio & Klein, 2020; Gangadharan, 2012, 2017; Wilkins et al., 2021). Datafication of leisure reinforces inequalities between the data-rich and the data-poor (Hutchins, 2016). In the context of using Strava data for mobility planning, the data-rich individuals are those who have access to Strava and use it. The data-poor, *i.e.*, those without a cell phone or wearable device, or those who choose not to use Strava, may not be considered in the planning process because they are not represented in the data that are driving decision-making. Each individual platform that a recreationist might use comes with its own issues related to bias, quality, and usability of raw data (Heikinheimo et al., 2020). More research is needed to examine the exclusionary dynamics in digital leisure (Carnicelli et al., 2016); in particular, the increase in the datafication of leisure demands a research agenda, as use of such data has the potential to reshape sports, infrastructure, and commodification (Hutchins, 2019).

Some nascent work has been done to examine the application of Strava Metro data (Reinhardt et al., 2024; Vilalta Capdevila et al., 2024; Wilkins et al., 2021). Studies that compared Strava Metro data to other trail-counter methods found that Strava Metro data were better suited to documenting broad-scale spatial patterns in biking than pedestrian recreation (Lin & Fan, 2020; Vilalta Capdevila et al., 2024). Others questioned the implicit bias present in Strava Metro data (Creany, 2020; Robinson et al., 2024). Williams (2023) argued that 'Uses of commercial data such as Strava Metro will benefit and unfairly privilege those who are already highly mobile, and who may cycle out of choice, not necessity'. However, Strava Metro's (2024) stated goal is to 'make human-powered travel safe, accessible, and efficient for everyone'. Given that a failure to assess bias and identify potential sources of oppression could negatively impact aspects of mobility justice, reinforcing pre-existing social inequities, we argue that more work is needed to examine mobility justice in the context of leisure spaces.

### Mountain biking and e-biking

One opportunity to examine Strava Metro's ability to address or reinforce issues of mobility justice is the question of electric mountain biking (henceforth referred to as e-biking). The popularity of mountain biking (both traditional mountain biking and e-biking) has boomed in recent years (Kuklinski et al., 2024; Reinhardt et al., 2025). This rapid growth has created a need for more and better information about who is riding and where, a need that could potentially be filled by Strava Metro data (Reinhardt et al., 2024). One question that many land managers are grappling with is whether to allow e-bikes on trail networks or to restrict them as motorised recreation. E-bikes provide increased recreation access to individuals with mobility issues, such as older individuals and people with disabilities or certain medical conditions (Cherrington, 2024; Ingram-Sills, 2023). Motivations for e-biking are similar to motivations for mountain biking in general and include spending time in nature and health and wellbeing (Cherrington & Brighton, 2024; Ingram-Sills, 2023). In short, allowing e-bikes on a trail network is one way to increase mobility justice, as it allows for more people to ride, allows people to ride longer than they might otherwise be able to ride, and allows people to ride further, thus accessing geographies they might otherwise be excluded from (Rérat, 2021).

Many trail networks do not allow e-bikes at all, and it is not uncommon for e-bikers to experience discrimination from other mountain bikers in areas where they are allowed (Cherrington, 2024). For example, Kingdom Trails, a mountain bike trail network located in Vermont in the United States, recently made the decision to allow e-bikes after years of debate (Heil, 2025). In an official statement released to elicit public comment, Kingdom Trails (Kingdom Trails, 2021) described the need to update their policy this way:

> We understand there are a number of pros and cons that need to be weighed. On the one hand, allowing eMTBs could broaden access for those with physical limitations due to age, illness and disability, supporting our commitment to equity and inclusion. Increased patronage could also directly benefit our community and the region. On the other hand, concerns could arise regarding faster speeds, user conflicts, injuries and liability, land impacts, and overcrowding.

Following the decision to allow e-bikes, a rash of negative public comments occurred. While some users expressed concern about safety and potential damage to the trails, others attacked e-bikers themselves, referring to e-bikes as 'garbage on our trails' and accused e-bikers of being 'lazy' and 'soft', forcing managers to justify the thinking behind their decision-making. What this example highlights is that complex or controversial management decisions can be supported through good data. Supporting e-bikes might be a tool for mobility justice, but to fully understand the impact, managers need data that demonstrate who is riding e-bikes, how e-bikes are impacting those riders' experience (*e.g.*, are they spending more time in nature? riding longer? spending more time with friends and family who also ride? experiencing positive benefits?). The goal of this paper is to examine whether Strava Metro data can be used to answer such questions and provide useful information to decision-makers in support of mobility justice. Specifically, we sought to explore whether we could use Strava Metro data to answer the following research questions (RQ):

- RQ1: Are recreationists over the age of 65 using e-bikes?
- RQ2: Has the prevalence of e-bikes changed over time?
- RQ3: Has the prevalence of riders over the age of 65 changed over time?
- RQ4: Are those using e-bikes riding longer than those on regular bikes?
- RQ5: Are those using e-bikes riding in different places than those on regular bikes?
- RQ6: Are those over the age of 65 riding in different places than younger riders?

These are questions that we have heard asked by land managers and trail advocacy groups, who must determine whether to allow or disallow e-bikes on trail networks that they manage. Thus, it is important to understand if Strava Metro could be a useful tool for improved decision-making. The goal of our analysis was to assess the feasibility of using Strava Metro data to answer these questions.

## Methods

We requested data for Caledonia County, Vermont, and Clinton County, New York from the Strava Metro portal and were able to access monthly user-reported bike ride counts for segments for the five-year period beginning on 1 January 2019 and ending on 31 December 2023. Both counties are in rural areas in the northeastern United States that experienced a growth in mountain biking following the Covid-19 pandemic (Reinhardt et al., 2025) and are actively investing in outdoor recreation infrastructure and rural economic development, giving us an opportunity to examine two geographic locations where planning and management are focusing on the growing number of cyclists (Elevating Outdoor Recreation, n.d.). Strava ride counts are aggregated into bins of five to protect individual user privacy. Importantly, activity types (pedestrian or bike) and demographic information (gender and age) are user-reported and not auto-generated by the app.

Data analysis and visualisation were conducted using R version 4.2.2, using the *tidyverse* library of packages for data reshaping and visualisation, and the *sf* package for spatial analysis (Pebesma, 2018; Pebesma & Bivand, 2023; Wickham et al., 2019). We were unable to explore whether riders aged 65 and older were using e-bikes due to the aggregation method Strava Metro uses to depersonalise data (RQ1). To determine whether the proportion of riders using e-bikes (RQ2) or over the age of 65 (RQ3) had increased over time, we computed total rides for each year and county and performed a simple linear regression to determine the rate of change over time for each factor. To explore our RQ4, we compared the length of bike and e-bike rides. Strava monthly summary data were first aggregated to determine the number of bike rides and e-bike rides associated with each road or trail segment, known in the Strava Metro data as an 'edge'. We then plotted the total number of rides that occurred on different length Strava edges as a frequency histogram. We compared the distribution of e-bike edge lengths to bike edge lengths for each county. To answer RQ5 and RQ6, we mapped average daily rides for bikes and e-bikes, as well as rides by users over the age of 65.

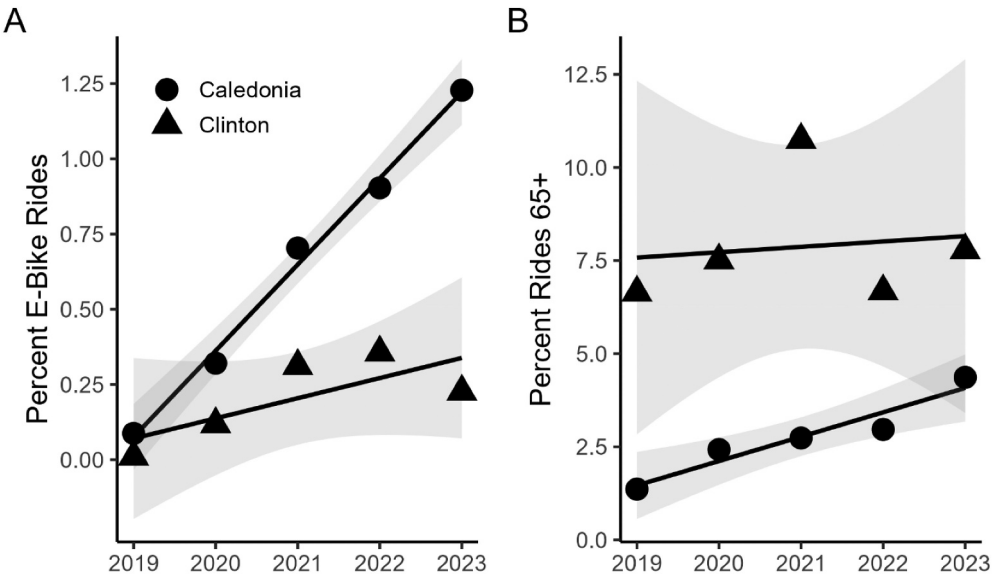


Figure 1. (A) Yearly e-bike rides as a proportion of all Strava bike and e-bike rides and (B) the proportion of rides by riders over the age of 65 in Caledonia County, VT and Clinton County, NY.

## Results

We were unable to determine the number of riders 65 and over who used e-bikes due to the data aggregation method Strava uses to de-identify ride data and protect user privacy. We observed an increase in the prevalence of e-bike rides as a proportion of total rides in Caledonia County, VT (slope = 0.28, $p < 0.001$, $R^2 = 0.99$) and a similar but non-significant trend in Clinton County, NY (slope = 0.067, $p = 0.14$, $R^2 = 0.41$) between 2019 and 2023 (Figure 1A). This represents a 93% increase in the proportion of e-bikes in Caledonia County and a 96% increase in the proportion of e-bikes in Clinton County over a five-year period. We also observed an increase in the proportion of riders who identified as 65 or older in Caledonia County (slope = 0.65, $p = 0.01$, $R^2 = 0.89$), but no change in the proportion of riders 65 and older in Clinton County (slope = 0.14, $p = 0.83$, $R^2 = <0.01$) between 2019 and 2023 (Figure 1B). The change in ridership in Caledonia County equates to a 69% increase in bike use by riders older than 65 over a five-year period.

### *Spatial comparison of rides and e-bike rides*

The distribution of lengths of Strava edges ranged from 0 to 1.0 km, with no edges exceeding 1.0 km in length. Due to the aggregation method Strava uses to depersonalise ride data, we were unable to determine the total length of bike or e-bike rides. The distribution of Strava edge lengths was similar for bikes (Figure 2A) and e-bikes (Figure 2B), with the greatest number of rides associated with segments between 0 and 0.25 km in length. The pattern was similar between Caledonia and Clinton Counties despite the much greater number of total bike and e-bike rides in Caledonia County

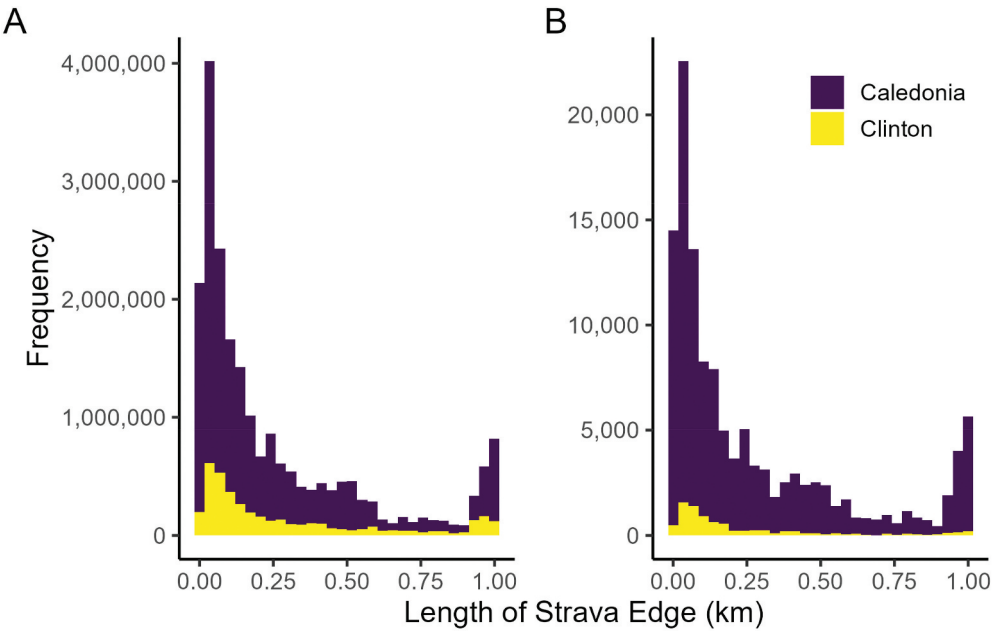


**Figure 2.** Frequency histogram showing (A) the total number of rides and (B) the total number of e-bike rides completed on Strava edges of various size classes in Caledonia County, VT and Clinton County, NY.

(Figure 2). We observed a secondary mode of ride frequencies between 0.9 and 1.0 km threshold, indicating an excess of observations near the 1.0 km threshold (Figure 2).

Spatial patterns in average daily bike rides in Caledonia County revealed biking throughout the county, with a significant hotspot near the Kingdom Trails biking trail network in Burke in the northeastern area of the county and a smaller western hotspot along Rt 2 in Danville (Figure 3A). Similarly, we observed biking throughout Clinton County, but with greater numbers of rides along the eastern side of the county adjacent to the Rt. 9 and Rt. 22 corridors and Lake Champlain, with the greatest number of rides between the city of Plattsburgh and the town of Peru in the southeastern corner of the county (Figure 3B). E-bike rides were more spatially constricted and typically were confined to high-bike-traffic areas like Kingdom Trails and roadways in Caledonia County (Figure 3C) and the Rt. 22 corridor connecting Plattsburgh and Peru in Clinton County (Figure 3D). The spatial pattern of bike rides completed by riders 65 and older was similar to high-bike-traffic areas identified for the complete dataset, with a greater distribution of rides throughout both counties relative to e-bike patterns (Figure 3E, F).

## Discussion

Our results highlight important discussion points that should be considered in the context of leisure and social justice, namely that as the datafication of leisure grows along with digital leisure, scholars and managers alike should be asking who is considered in the datasets that drive decision-making. Our findings demonstrate

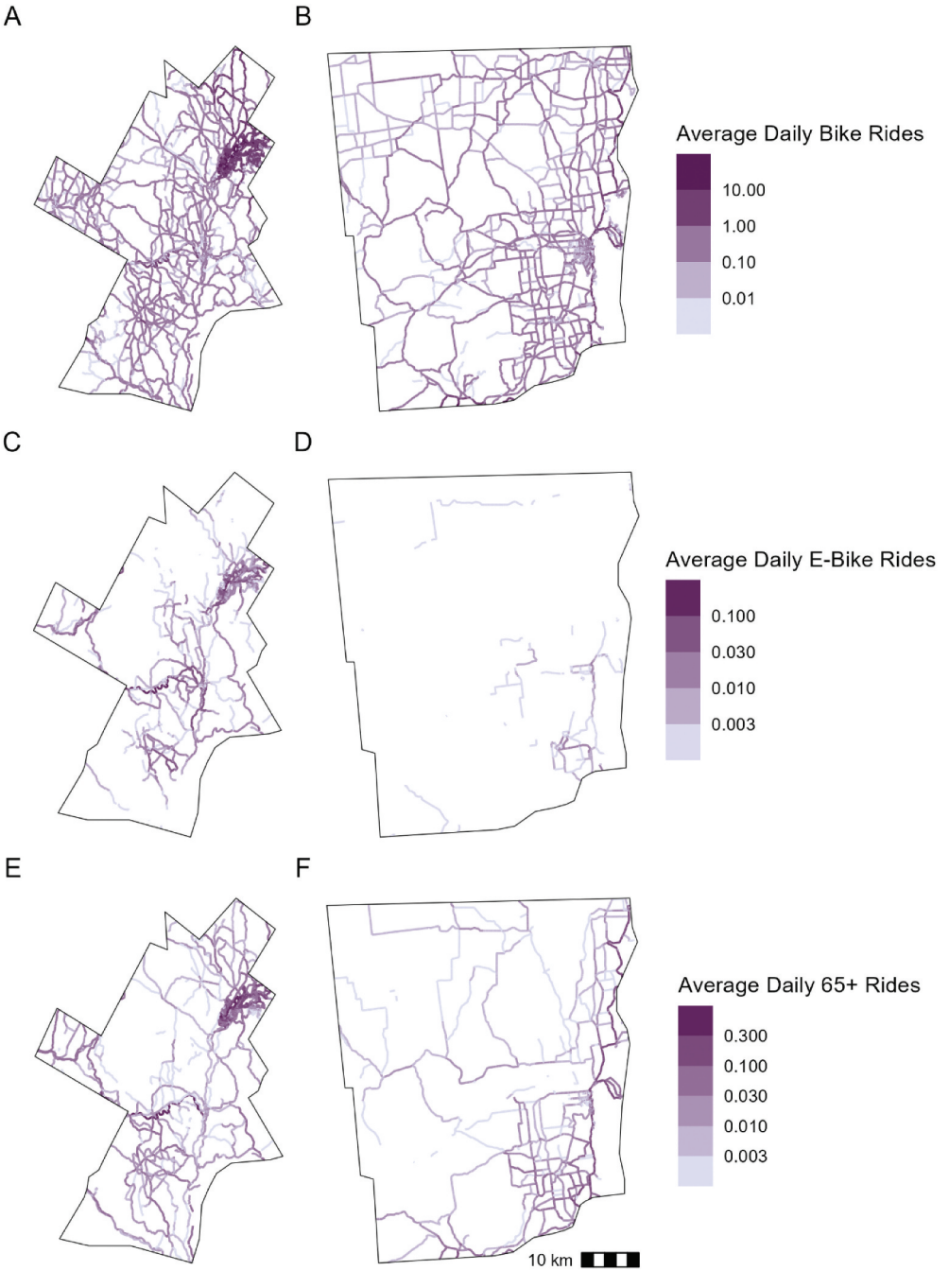


**Figure 3.** Average daily number of bike rides (A, B), e-bike rides (C, D), and total rides of riders over 65 (E, F) for edges in Caledonia County, VT (A, C, E) and Clinton County, NY (B, D, F) recorded in Strava between 2019 and 2023.

**Table 1.** Usability of Strava Metro data for answering research questions.

| Research Questions | Usability of Strava Metro Data |
|---|---|
| RQ1: Are recreationists over the age of 65 using e-bikes? | Strava Metro data cannot answer this question |
| RQ2: Has the prevalence of e-bikes changed over time? | Strava Metro data show an increase in e-bike users |
| RQ3: Has the prevalence of riders over the age of 65 changed over time? | Strava Metro data show an increase in users over the age of 65 |
| RQ4: Are those using e-bikes riding longer than those on regular bikes? | Strava Metro data cannot answer this question |
| RQ5: Are those using e-bikes riding in different places than those on regular bikes? | Strava Metro data allow researchers to visualize differences in spatial patterns |
| RQ6: Are those over the age of 65 riding different places than younger riders? | Strava Metro data allow researchers to visualize differences in spatial patterns |

that the Strava Metro data were useful for partially answering four of our research questions but are not sufficient to explore all of them, particularly the questions that addressed causal relationships and issues related to mobility justice. Table 1 (below) details which research questions we were able to explore using Strava Metro data and which ones we were unable to address given the limitations of the data. In the following sections, we describe those limitations in detail, as well as discuss the mobility justice implications of using Strava Metro data for planning and management efforts.

Strava Metro data may be helpful for answering questions about population changes over time, such as our research questions about the prevalence of e-bikes and the prevalence of riders over 65 (Table 1). However, those trends come with important caveats. Although the data show an increase in both e-bike use and the proportion of riders over the age of 65, it is unclear if these trends reflect a change in the bike-riding community or a change in the Strava user base. Strava is growing as a platform, adding more users every year (Strava Metro, 2024), and thus the demographic trends could reflect new Strava users rather than new e-bikers or new riders over 65. At best, it is possible that the Strava user base is becoming more representative of the biking community. To determine what the data reflect (new Strava users or new riders), we would need a second source of information, such as bike counters or trail intercept surveys, to confirm who is riding. While there have been other studies that have attempted to validate Strava Metro data using trail counters (Reinhardt et al., 2024), similar efforts outside of trail networks have shown a discrepancy between Strava and manual counts (Lin & Fan, 2020). Further, we contend that validation efforts would be challenging in a location like Clinton County, NY, where riders appear to be concentrated on rural route corridors rather than parks and trail networks that are well-suited to trail counters.

As detailed in the results section, we were unable to answer RQ1 and RQ4 using Strava Metro data. This is due to the nature of the data provided to researchers and practitioners by Strava Metro. There are several characteristics of Strava Metro data that impact its usability for answering our research questions. As noted above, the data are provided as de-identified ride data in bins of five (see methods and results sections above for more details) to protect user privacy (Strava Metro, 2024). Although Strava Metro reports rides by gender and age category, provides total ride counts, and provides total e-bike ride counts, grouping rides into bins of five eliminates the potential to parse whether specific demographics groups are using e-bikes. Practically, this means that we were unable to determine if recreationists over

the age of 65 are using e-bikes (RQ1). A related challenge is that Strava Metro provides segments with edge lengths that are a maximum of 1 km. Each ride is made up of multiple segments, but because there is no way to identify and connect segments within a given ride, we were unable to look at complete rides. Although we could not reconstruct complete rides, we could visualise where particular user groups – e-bike riders and riders over 65 – were biking and compare patterns across groups (see Figure 3). This analysis addresses RQ5 and RQ6, with the caveats discussed above regarding the population of Strava users. Given that scholars have suggested that e-bikes could be a tool to increase mobility justice for older recreationists in terms of allowing them to ride longer, more, and into more remote *(i.e.* previously inaccessible to them) areas (Cherrington, 2024; Ingram-Sills, 2023), insights about these trends would have been useful for answering managers' questions.

Our findings suggest that Strava Metro data can be useful as one tool for determining the general spatial distribution of recreationists (in our case bikes and e-bikes) along roads and trails and can also allow for the exploration of temporal trends in spatial distribution and general demographics of recreation. However, the data fall short of permitting the comparison of trends (*e.g.*, cannot correlate the growth of riders over 65 with the growth of e-bikes) and understanding the full trips taken. Although these broad-scale trends are certainly helpful for managers, the nature of these data also presents potential issues in terms of mobility justice, as the data sets do not allow researchers to explore how specific groups of people might be experiencing recreation spaces. Rather, the data and trends are most reflective of the majority. For example, in our data sets, there were considerably fewer people using e-bikes, especially in Clinton County, NY. If recreation managers or transportation planners were to make decisions based on Strava Metro data, it would surely favour the majority (in our case traditional bike riders) and would risk potentially reinforcing circumstances that exclude accessibility for certain groups, as is the case with datafication of other aspects of everyday life (Andrejevic, 2013; D'Ignazio & Klein, 2020; Taylor & Richter, 2017). Given that mobility injustice occurs when systems of oppression limit individuals' movements (Harada, 2023; Sheller, 2020), we assert that Strava Metro data are insufficient for dismantling these systems.

Digital leisure will only continue to grow, and, as it does, so too will the datafication of those leisure experiences. That information will likely be used by a range of individuals and organisations to tailor experience, sell products, and design new platforms and systems for leisure. We predict that managers will increasingly look to these large sets of user-generated data (like Strava Metro) to gain insights that can inform planning and management decisions in both rural and urban contexts. This trend is already evident in previous studies about user-generated data in recreation spaces (Norman et al., 2019; Power et al., 2023; Rice, 2019; Vilalta Capdevila et al., 2024). More specifically, managers – as well as researchers – are using the data available to them, *i.e.*, those sources that have academic APIs. However, those available sources may not be the most representative (Williams, 2023). We caution that the recreation community should 'feather the brakes' – a mountain biking term that means to slow down in a modulated way – and be more critical of where we get our data and who is represented in it. Relatedly, we caution that the widespread use

of these data can set a precedent that big, quantitative data sets are needed to justify resources and access for minoritized people. We suggest that researchers, managers, and planners should think carefully about the mobility justice implications of the data they use, and consider a mix of data sources, including outreach to relevant stakeholders. Otherwise, a reliance on user-generated data could risk reinforcing issues of mobility injustice. Further, although our work did not focus on user compensation, we agree with Hutchins (2016) that monetising data harvested from unpaid users may be exploitative. We focus primarily on the datafication of recreation in this paper; however, our findings have implications for sport, health and fitness, and travel, as well as the related disciplines that address transportation.

Further, because we recognise that the datafication of leisure will almost certainly grow despite our cautions, we call on leisure researchers to conduct new scholarship that examines who is represented in these datasets, who is excluded, and how the use of such data serves to preference certain groups of individuals and exclude others in a variety of contexts. We assert there is a moral imperative for leisure scholars to explore these issues. Although research is emerging on these topics (e.g. Lawrence, 2025), this is a relatively nascent area of scholarship, with many opportunities for fruitful examination. Our work looked specifically at cycling and Strava, and we encourage other researchers to consider the implications of datafication in other digital leisure activities, such as online gaming and social media. How is the growth of digital leisure and the subsequent datafication of leisure leading to exclusion in leisure spaces? In what ways can digital leisure and datafication be used as tools for justice and inclusion? More work is needed by scholars to address these questions, and we encourage the development of a research agenda in this area. In short, scholars of leisure studies should pay attention to the datafication of leisure, specifically with an eye towards issues of social justice.

## Conclusion

Access to recreation spaces is a mobility justice issue, and, as the datafication of leisure continues, planners, managers, and researchers alike need to consider the implications of relying on large, user-generated datasets to inform decision-making. While such datasets, like the ones we examined from Strava Metro, may be useful for understanding general spatial and temporal recreation trends, they also may be limited in their ability to help us understand causal relationships and explore the experiences of underrepresented groups. In our case, data from Strava Metro were insufficient to explore the growth of e-biking and whether e-bikes allow older individuals (over 65) to ride longer or to areas that they had not previously been able to access. Using such data without a critical examination could risk reinforcing systems of oppression that already exist in recreation spaces, therefore threatening mobility justice for certain user groups. Given the limitations of these data, we caution that researchers and decision makers should critically evaluate user-generated data sources before relying on them for decision-making and should consider combining diverse data sources to avoid reifying mobility injustices. We additionally encourage leisure scholars to pursue research that examines the justice implications of the growth of both digital leisure and the datafication of leisure.

## Disclosure statement

No potential conflict of interest was reported by the author(s).

## Funding

This study was supported by Northeastern States Research Cooperative through funding made available by the USDA Forest Service. The conclusions and opinions in this paper are those of the authors and not of the NSRC, the Forest Service, or the USDA.

## Notes on contributors

*Kimberly Coleman* is an Associate Professor in the Rubenstein School of Environment and Natural Resources at the University of Vermont, where she direct the Parks, Recreation and Tourism Program.

*Emily Reinhardt* is a Planning Technician for the City of Plattsburgh, NY.

*Mary Alldred* is an Associate Professor in the Center for Earth and Environmental Science at SUNY Plattsburgh. She is an aquatic biogeochemist and data scientist who specializes in restoring ecological function to wetland ecosystems.

*Mark Baran* is a GIS Instructional Support Technician in the Center for Earth and Environmental Science at SUNY Plattsburgh in Plattsburgh, NY.

## References

Andrejevic, M. (2013). *Infoglut: How too much information is changing the way we think and know*. Routledge.

Asan, K., & Zwiegelaar, J. (2025). Digital leisure use and psychological well-being among recreation management students: The mediating role of social media engagement. *Journal of Hospitality, Leisure, Sport, & Tourism Education*, *37*, 100570. https://doi.org/10.1016/j.jhlste.2025.100570

Blassel, N. (2025, January 7). *Análise cruzada: Dados do Strava e Ciclovias no Rio de Janeiro*. Observatório da Bicicleta. https://observatoriodabicicleta.org.br/analise-ciclovias-rj/

Carnicelli, S., McGillivray, D., & McPherson, G. (Eds.). (2016). *Digital leisure cultures*. Routledge. https://doi.org/10.4324/9781315666600

Chang, L.-C., Kono, S., & Huang, F.-H. (2025). Does digital leisure relate to subjective well-being in later life? Examining roles of enjoyment, social support, and capitalisation. *Leisure Studies*, 1–17. https://doi.org/10.1080/02614367.2025.2462096

Cherrington, J. (2024). Electric Mountain Bikes, Ableism, and 'Enwheelment' in Outdoor Leisure. *Tourism Cases*, tourism202400031. https://doi.org/10.1079/tourism.2024.0031

Cherrington, J., & Brighton, J. (2024). 'My body was no longer a problem': Electric mountain biking, disability, and the cultural politics of green exercise. *Transactions of the Institute of British Geographers*, *50*(3), e12715. https://doi.org/10.1111/tran.12715

Cope, M. (2015). Commentary: Geographies of digital lives: Trajectories in the production of knowledge with user-generated content. *Landscape and Urban Planning*, *142*, 212–214. https://doi.org/10.1016/j.landurbplan.2015.08.009

Creany, N. E. (2020). Kudos and K.O.M.'s: The effect of Strava use on evaluations of social and managerial conditions, perceptions of ecological impacts, and mountain bike spatial behavior - ProQuest [Dissertation]. Utah State University. https://www.proquest.com/docview/2457901644?pq-origsite=gscholar&fromopenview=true&sourcetype=Dissertations%20&%20Theses

DeLuca, J. R. (2013). Submersed in social segregation: The (re)production of social capital through swim club membership. *Journal of Sport & Social Issues*, *37*(4), 340–363. https://doi.org/10.1177/0193723513498605

D'Ignazio, C., & Klein, L. F. (2020). Data feminism. In *Data feminism*. The MIT Press. https://doi.org/10.7551/mitpress/11805.001.0001

Dunkel, A. (2015). Visualizing the perceived environment using crowdsourced photo geodata. *Special Issue: Critical Approaches to Landscape Visualization*, *142*, 173–186. https://doi.org/10.1016/j.landurbplan.2015.02.022

Elevating Outdoor Recreation. (n.d.). *Northern Forest Center*. Retrieved November 11, 2025, from, https://northernforest.org/our-work/advancing-rural-economy/elevating-outdoor-recreation/

Evers, C. W. (2019). Polluted leisure. *Leisure Sciences*, *41*(5), 423–440. https://doi.org/10.1080/01490400.2019.1627963

Flensburg, S., & Lomborg, S. (2023). Datafication research: Mapping the field for a future agenda. *New Media and Society*, *25*(6), 1451–1469. https://doi.org/10.1177/14614448211046616

Gangadharan, S. P. (2012). Digital inclusion and data profiling. *First Monday*. https://doi.org/10.5210/fm.v17i5.3821

Gangadharan, S. P. (2017). The downside of digital inclusion: Expectations and experiences of privacy and surveillance among marginal internet users. *New Media and Society*, *19*(4), 597–615. https://doi.org/10.1177/1461444815614053

Hänninen, R., Korpela, V., & Pajula, L. (2025). The paradoxes and pragmatics of digital leisure in later life. *Leisure Studies*, *44*(1), 65–78. https://doi.org/10.1080/02614367.2023.2271194

Harada, T. (2023). Mobility justice and sustainable futures. *The Australian Geographer*, *54*(4), 425–431. https://doi.org/10.1080/00049182.2023.2271615

Heikinheimo, V., Tenkanen, H., Bergroth, C., Järv, O., Hiippala, T., & Toivonen, T. (2020). Understanding the use of urban green spaces from user-generated geographic information. *Landscape and Urban Planning*, *201*, 103845. https://doi.org/10.1016/j.landurbplan.2020.103845

Heil, G. (2025, June 10). *The best MTB destination in the northeastern USA has finally opened its trails to e-bikes*. Singletracks Mountain Bike News. https://www.singletracks.com/mtb-trails/the-kingdom-trails-have-finally-opened-to-e-bikes/

Hutchins, B. (2016). Tales of the digital sublime: Tracing the relationship between big data and professional sport. *Convergence the International Journal of Research into New Media Technologies*, *22*(5), 494–509. https://doi.org/10.1177/1354856515587163

Hutchins, B. (2019). *Mobile* media sport: The case for building a mobile media and communications research agenda. *Communication & Sport*, *7*(4), 466–487. https://doi.org/10.1177/2167479518788833

Ingram-Sills, L. (2023). The motivations, identities, and environmental sensibilities of contemporary e-mountain bike users. In J. Cherrington (Ed.), *Mountain biking, culture and society* (1st ed., pp. 49–62). Routledge. https://doi.org/10.4324/9781003361626-5

Johnson, M. L., Campbell, L. K., Svendsen, E. S., & McMillen, H. L. (2019). Mapping urban park cultural ecosystem services: A comparison of Twitter and semi-structured interview methods. *Sustainability*, *11*(21), 6137. https://doi.org/10.3390/su11216137

Kennedy, H. (2018). Living with data: Aligning data studies and data activism through a focus on everyday experiences of datafication. *Krisis | Journal for Contemporary Philosophy*, *38*(1), 18–30. https://doi.org/10.21827/krisis.38.1.37184

Kingdom Trails. (2021, May 26). *eMTB policy review*. https://www.kingdomtrails.org/emtb-public-decision-process

Koppen, G., Tveit, M. S., Sang, Å. O., & Dramstad, W. (2014). The challenge of enhancing accessibility to recreational landscapes. *Norsk Geografisk Tidsskrift - Norwegian Journal of Geography*, *68*(3), 145–154. https://doi.org/10.1080/00291951.2014.904399

Kuklinski, K. P., Coleman, K. J., Leahy, J. E., Perry, E. E., Reinhardt, E., & Briccetti, L. (2024). Scoping the lines: Assessing the mountain biking research terrain and calling for a holistic scholarship agenda. *Journal of Outdoor Recreation and Tourism*, *46*, 100748. https://doi.org/10.1016/j.jort.2024.100748

Lawrence, S. (2025). From Cosmopolis to Claustropolis: Accelerated culture and the case for a claustropolitan sociology of leisure. *Leisure Studies*, 1–17. https://doi.org/10.1080/02614367.2025.2607490

Lawrence, S., & Crawford, G. (2022). Towards a digital football studies: Current trends and future directions for football cultures research in the post-COVID-19 moment. *Leisure Studies*, *41*(1), 56–69. https://doi.org/10.1080/02614367.2021.1948595

Lawrence, S., Hill, J. M., & Mowatt, R. A. (Eds.). (2024). *Routledge handbook of sport, leisure, and social justice*. Routledge, Taylor & Francis Group.

Lawson, M. (2018, April 4). *Measuring whitefish trail use*. Headwaters Economics. https://headwaterseconomics.org/economic-development/trails-pathways/whitefish-trail-use/

Leggett, C., Horsch, E., Smith, C., & Unsworth, R. (2017). *Estimating recreational visitation to federally-managed lands*.

Lin, Z., & Fan, W. (David). (2020). Modeling bicycle volume using crowdsourced data from Strava smartphone application. *International Journal of Transportation Science and Technology*, *9*(4), 334–343. https://doi.org/10.1016/j.ijtst.2020.03.003

Mullenbach, L. E., & Baker, B. L. (2020). Environmental justice, gentrification, and leisure: A systematic review and opportunities for the future. *Leisure Sciences*, *42*(5–6), 430–447. https://doi.org/10.1080/01490400.2018.1458261

Nelson, T., Ferster, C., Laberee, K., Fuller, D., & Winters, M. (2021). Crowdsourced data for bicycling research and practice. *Transport Reviews*, *41*(1), 97–114. https://doi.org/10.1080/01441647.2020.1806943

Norman, P., Pickering, C. M., & Castley, G. (2019). What can volunteered geographic information tell us about the different ways mountain bikers, runners and walkers use urban reserves? *Landscape and Urban Planning*, *185*, 180–190. https://doi.org/10.1016/j.landurbplan.2019.02.015

Pebesma, E. (2018). Simple features for R: Standardized support for spatial vector data. *The R Journal*, *10*(1), 439. https://doi.org/10.32614/RJ-2018-009

Pebesma, E., & Bivand, R. (2023). *Spatial data science: With applications in R* (1st ed.). Chapman and Hall/CRC. https://doi.org/10.1201/9780429459016

Pickering, C., Olafsson, A. S., & Hansen, A. S. (2023). Editorial for special issue of the journal of outdoor tourism and recreation on social media and other user created content for outdoor recreation and nature-based tourism research. *Social Media and Other User Created Content for Outdoor Recreation and Nature-Based Tourism Research*, *44*, 100727. https://doi.org/10.1016/j.jort.2023.100727

Pickering, C., Walden Schreiner, C., Barros, A., & Rossi, S. D. (2020). Using social media images and text to examine how tourists view and value the highest mountain in Australia. *Journal of Outdoor Recreation and Tourism*, *29*, 100252. https://doi.org/10.1016/j.jort.2019.100252

Power, D., Lambe, B., & Murphy, N. (2023). Trends in recreational walking trail usage in Ireland during the COVID-19 pandemic: Implications for practice. *Journal of Outdoor Recreation and Tourism*, *41*, 100477. https://doi.org/10.1016/j.jort.2021.100477

Powers, S. L., Lee, K. J., Pitas, N. A., Graefe, A. R., & Mowen, A. J. (2020). Understanding access and use of municipal parks and recreation through an intersectionality perspective. *Journal of Leisure Research*, *51*(4), 377–396. https://doi.org/10.1080/00222216.2019.1701965

Powers, S. L., Mowen, A. J., & Drogin Rodgers, E. B. (2024). Belonging and welcomeness in state and community parks: Visitation impacts and strategies for advancing environmental justice. *Geoforum*, *157*, 104149. https://doi.org/10.1016/j.geoforum.2024.104149

Prytherch, D. L. (2022). Reimagining the physical/social infrastructure of the American street: Policy and design for mobility justice and conviviality. *Urban Geography*, *43*(5), 688–712. https://doi.org/10.1080/02723638.2021.1960690

Reed, J., Dunn, C., Beames, S., & Stonehouse, P. (2023). E'Ride on!': The zwift platform as a space for virtual leisure. *Leisure Studies*, *42*(2), 188–202. https://doi.org/10.1080/02614367.2022.2088836

Reinhardt, E., Coleman, K. J., Baran, M., Perry, E. E., & Alldred, M. (2024). Chasing informed decisions: A research note on the potential for Strava to support rural recreation planning. *Journal of Park & Recreation Administration*. https://doi.org/10.18666/JPRA-2024-12457

Reinhardt, E., Coleman, K. J., Perry, E. E., Alldred, M., & Leahy, J. E. (2025). "We have some growing pains": Developing a New regional recreation conflict Model through examination of the growth of mountain biking. *Society and Natural Resources*, *38*(8), 1–19. https://doi.org/10.1080/08941920.2025.2466170

Rérat, P. (2021). The rise of the e-bike: Towards an extension of the practice of cycling? *Mobilities*, *16*(3), 423–439. https://doi.org/10.1080/17450101.2021.1897236

Rice, W. L. (2019). Detailing an approach for cost-effective visitor-use monitoring using crowd-sourced activity data. *Journal of Park & Recreation Administration*. https://doi.org/10.18666/JPRA-2019-8998

Rigolon, A., Fernandez, M., Harris, B., & Stewart, W. (2022). An ecological model of environmental justice for recreation. *Leisure Sciences*, *44*(6), 655–676. https://doi.org/10.1080/01490400.2019.1655686

Robinson, P., Johnson, P., & Vernooy, M. (2024). Strava metro data: How can urban planning leverage crowdsourced fitness activity data? *Canadian Planning and Policy/Aménagement et Politique Au Canada*, *2024*(1), 90–108. https://doi.org/10.24908/cpp-apc.v2024i1.16889

Schuett, E., Adams, A., Voorhis, N., Sirch, M., & Donisvitch, S. (2024). Recreation impacts on dimensions of Northeast regional forest health. *Forest Ecosystem Monitoring Cooperative*. https://doi.org/10.18125/wc8g53

Schwietering, A., Steinbauer, M., Mangold, M., Sand, M., & Audorff, V. (2024). Digitalization of planning and navigating recreational outdoor activities. *German Journal of Exercise and Sport Research*, *54*(1), 107–114. https://doi.org/10.1007/s12662-023-00927-1

Shakibaei, S., & Vorobjovas-Pinta, O. (2024). Access to urban leisure: Investigating mobility justice for transgender and gender diverse people on public transport. *Leisure Sciences*, *46*(5), 639–657. https://doi.org/10.1080/01490400.2021.2023372

Sheller, M. (2018). Theorising mobility justice. *Tempo Social*, *30*(2), 17–34. https://doi.org/10.11606/0103-2070.ts.2018.142763

Sheller, M. (2020). Mobility justice. In M. Büscher, M. Freudendal-Pedersen, & S. Kesselring (Eds.), *Handbook of research methods and applications for mobilities* (pp. 11–20). Edward Elgar Publishing.

Shelton, T., Poorthuis, A., & Zook, M. (2015). Social media and the city: Rethinking urban socio-spatial inequality using user-generated geographic information. *Special Issue: Critical Approaches to Landscape Visualization*, *142*, 198–211. https://doi.org/10.1016/j.landurbplan.2015.02.020

Strava Business. (2024). *What makes a typical Strava user?* https://business.strava.com/blog/what-makes-typical-strava-user

Strava Metro. (2024). *Strava metro FAQ*. https://metro.strava.com/faq

Sturm, D. (2020). Fans as *e-participants*? Utopia/dystopia visions for the future of digital sport fandom. *Convergence the International Journal of Research into New Media Technologies*, *26*(4), 841–856. https://doi.org/10.1177/1354856520907096

Sturm, D., & Rinehart, R. E. (2018). Home of (or *for* ?) champions? The politics of high-performance/elite and community sport at New Zealand's home of cycling. *Leisure Sciences*, *40*(7), 711–722. https://doi.org/10.1080/01490400.2018.1534628

Suárez, M., Barton, D. N., Cimburova, Z., Rusch, G. M., Gómez-Baggethun, E., & Onaindia, M. (2020). Environmental justice and outdoor recreation opportunities: A spatially explicit assessment in Oslo metropolitan area, Norway. *Environmental Science and Policy*, *108*, 133–143. https://doi.org/10.1016/j.envsci.2020.03.014

Taylor, L., & Richter, C. (2017). The power of smart solutions: Knowledge, citizenship, and the datafication of Bangalore's water supply. *Television & New Media*, *18*(8), 721–733. https://doi.org/10.1177/1527476417690028

Vilalta Capdevila, T., McLellan, B. A., Loosen, A., Forshner, A., Pigeon, K., Jacob, A. L., Wright, P., & Ehlers, L. (2024). Advancements in monitoring: A comparison of traditional and

application-based tools for measuring outdoor recreation. *PeerJ*, *12*, e17744. https://doi.org/10.7717/peerj.17744

Wickham, H., Averick, M., Bryan, J., Chang, W., McGowan, L., François, R., Grolemund, G., Hayes, A., Henry, L., Hester, J., Kuhn, M., Pedersen, T., Miller, E., Bache, S., Müller, K., Ooms, J., Robinson, D., Seidel, D.Spinu, V. … Woo, K. (2019). Welcome to the tidyverse. *Journal of Open Source Software*, *4*(43), 1686. https://doi.org/10.21105/joss.01686

Wilkins, E. J., Wood, S. A., & Smith, J. W. (2021). Uses and limitations of social media to inform visitor use management in parks and protected areas: A systematic review. *Environmental Management*, *67*(1), 120–132. https://doi.org/10.1007/s00267-020-01373-7

Williams, S. (2023). Datafication of cycling: Tensions between cycling policy and mobility justice [Dissertation]. University of Brighton. https://cris.brighton.ac.uk/ws/portalfiles/portal/41111473/PhD_Datafication_of_Cycling_vFinal_01_03_23.pdf

World Leisure Organization. (2025). *About us | world leisure organization*. https://www.worldleisure.org/about-us/