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Effectiveness of Non-Geotagged Social Media Data for Monitoring Visitor Experience in a National Park in Japan

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Abstract: In the pursuit of sustainable national park management, park managers need to understand the interests and activities of their diverse visitors in order to conserve the natural environment and offer a better visitor experience. This study aimed to examine the effectiveness of using non-geotagged social media data from posts by park visitors for park management in comparison with geotagged data, which has been studied more extensively. We compared (1) visitors' sociodemographic characteristics between geotagged and non-geotagged social media users through an onsite survey in Nikko National Park, Japan, and (2) the content of geotagged and non-geotagged photos shared within the study area on X (formerly Twitter). Our results showed that visitors in their 30s and 40s and foreign visitors had a greater tendency to use geotags. Non-geotagged photos more frequently and deeply capture nature-based activities and interests, including activities on trails, such as mountain climbing and hiking, and an interest in diverse animals and plants and landscapes that are less accessible. These findings indicate that non-geotagged social media data may have less age and nationality bias and advantages over the more widely-used geotagged data in capturing various nature-based experiences offered by national parks. Leveraging both geotagged and non-geotagged data can enable park managers to implement sustainable practices catering to a broader range of visitor interests and activities, contributing to the overarching goal of sustaining the natural environment while also enriching the visitor experience within national parks.

Keywords: biodiversity; cultural ecosystem service; nature-based tourism; protected area; recreation; social networking service

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1. Introduction

National parks are often designated with the expectation that they will conserve ecosystems and offer recreational opportunities for people [1]. Additionally, people have been shown to benefit from improved health and well-being through recreational experiences [2,3]. These experiences can also cultivate conservation awareness and behavior [4]. Revenue from tourism can be utilized for the conservation of park resources [5]. Natural areas attracted special attention as being relatively safe and relaxing spaces during the COVID-19 pandemic when social distancing measures were implemented [6]. Due to these benefits, nature-based tourism in national parks has grown worldwide.

However, increases in the number of visitors to national parks can have positive and negative impacts on nature, such as the destruction of vegetation [7] and harmful health effects on wildlife [8]. The damage to nature and overcrowding by visitors can also deteriorate the quality of the visitor experience [9]. National parks need to be managed appropriately to offer diverse recreational opportunities for visitors while conserving the natural environment and avoiding conflicts among visitors. In order to achieve this, visitor monitoring to understand visitor preferences and activities is an important task for

sustainable park management [10]. Traditionally, information on national park visitors has been obtained from surveys such as face-to-face interviews and questionnaires [11]. These types of surveys, however, can be time-, money-, and labor-intensive and be limited by time and location constraints [12].

Social media data have drawn attention as a new data source in many social sciences [13] and conservation sciences [14]. Studies have shown them to be potentially useful and cost-effective information sources for understanding human–nature interactions [15,16]. People can share digital content on social media, including text, photos, video, and audio content. Many social media platforms allow users to geotag their posts using global positioning systems on their mobile devices [17]. Previous studies have demonstrated the effectiveness of digital content, particularly geotagged photos, to help understand visitors' recreational activities and temporal patterns [11], visitors' preferences for wildlife [10], and different cultural ecosystem services provided by a national park [18].

The present study, however, focused on non-geotagged content on social media to understand visitors' interests and behaviors for the following three reasons. First, using geotagged data could introduce bias, as younger social media users might geotag their posts more frequently than older users. For instance, the Institute for Information and Communications Policy (2014) reported that people in their 50s and 60s in Japan were less familiar with using geotags on their mobile devices than younger people [19]. Although social media data are already biased toward younger users [10,11], the use of geotagged social media data might further emphasize the characteristics of younger generations, including their interests and behaviors. Earlier research has reported that visitors' preferences for wildlife and landscapes differed depending on age [10,20]. Second, growing public concern about privacy in recent years could reduce the public availability of geotagged content on social media in the future. For example, Instagram, a major social media platform, has limited the ability to post and retrieve exact location information in order to protect user privacy. Third, despite the aforementioned considerations, there have only been limited studies on the effectiveness of non-geotagged social media data for visitor monitoring in national parks.

This study aimed to examine the effectiveness of using non-geotagged social media data for national park management. To this end, we compared (1) sociodemographic characteristics of national park visitors based on whether or not social media users were using geotagging and (2) visitors' interests and recreational activities based on whether or not their posts on social media were geotagged.

2. Materials and Methods

2.1. Study Area

The study area was the Oku-Nikko area of Nikko National Park in Tochigi Prefecture, Japan (36°83′ N, 139°53′ E) (Figure 1). This park was established in 1934, and its total area is 1149 km^2. It is one of the most popular national parks in Japan, ranking fourth in visitor numbers among all national parks in 2019 [21].

The Oku-Nikko area is located in the southwestern part of the park. The elevation ranges from approximately 1200 m to 2600 m, and the highest peak is Mt. Nikko Shirane (2578 m). The area features natural scenery such as marshes, lakes, waterfalls, and various plants and animals. The marshes were registered under the Ramsar Convention site as "Oku-Nikko-shitsugen" in 2005. Annual visitor numbers peak in autumn (September to November), when a colorful sea of autumn leaves attracts people to the area. The area has facilities for tourism services, such as visitor centers, parking lots, camping sites, and accommodations. Visitors to the Oku-Nikko area use the natural environment and these facilities to enjoy various recreational activities, such as mountain climbing, hiking, camping, bird watching, and fly fishing. Data communication services for mobile devices are generally available, with the exception of some spots.

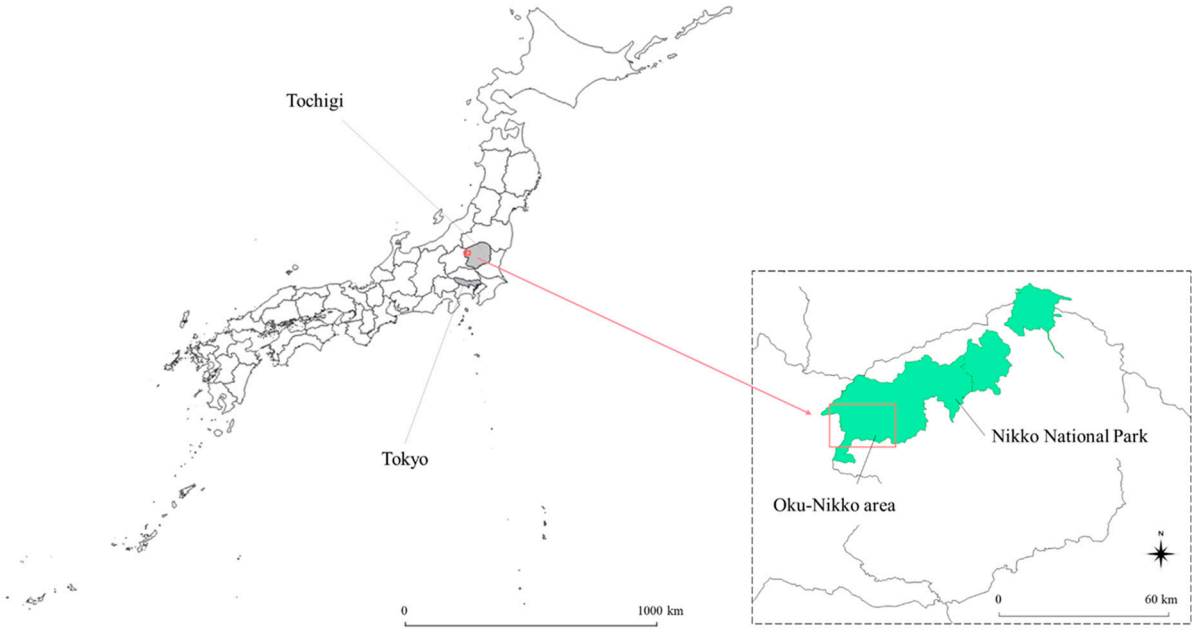

Figure 1. Location of the Oku-Nikko area of Nikko National Park, Japan.

2.2. Visitor Survey

2.2.1. Data Collection

We conducted a visitor survey by randomly approaching visitors at the following four locations to cover diverse visitors to the Oku-Nikko area from 25 October (Fri) to 28 (Mon) 2019 (Figure 2): Kegon Falls, a nationally famous waterfall in the southeastern zone; Akanuma, a primary starting point for hikes around the marshes in the central zone; Yumoto, a hot spring resort in the northern zone; Ryuzu Falls, another famous waterfall, located between the central and southeastern zones. The survey was available in both Japanese and English. The questions covered visitors' sociodemographic information (i.e., gender, age, place of residence, frequency of visit, and length of stay) and the usage status of social media (what social media platforms they used, whether or not they usually shared their travel experiences on social media, whether or not they usually geotagged their posts, and reasons why). The only open-ended question was the reason to use or not to use geotagging.

2.2.2. Statistical Analysis

We performed mixed-effects logistic regression analysis to assess which visitor attributes were related to the use of geotags among the visitors who would share their travel experiences on social media. The response variable was the use of geotags (use or not); the fixed effects were gender (0: male, 1: female), age group (six age groups from 10s to 60 and over), place of residence (0: domestic, 1: foreign), frequency of visit (0: first time, 1: repeat), length of stay (0: day trip, 1: overnight stay), and use of Twitter (0: not use, 1: use), use of Instagram (0: not use, 1: use), and use of Facebook (0: not use, 1: use); random effects were the four sampling locations. Among the six age groups, the 60-plus group was treated as the reference category for analysis. Twitter, Instagram, and Facebook were chosen because most respondents used at least one of the three platforms. Twitter was renamed X at the end of July 2023, although this paper continues to refer to it as Twitter since this was its name at the time of the study. As described in more detail below, we collected and analyzed only Japanese posts, meaning the above regression analysis was conducted twice: Once for all visitors (both Japanese and international) and secondly for Japanese visitors only, to connect the results of the visitor survey and Twitter analyses. The explanatory variable "place of residence" was omitted when analyzing only Japanese visitors. The statistical analysis was performed using R software version 4.3.0.

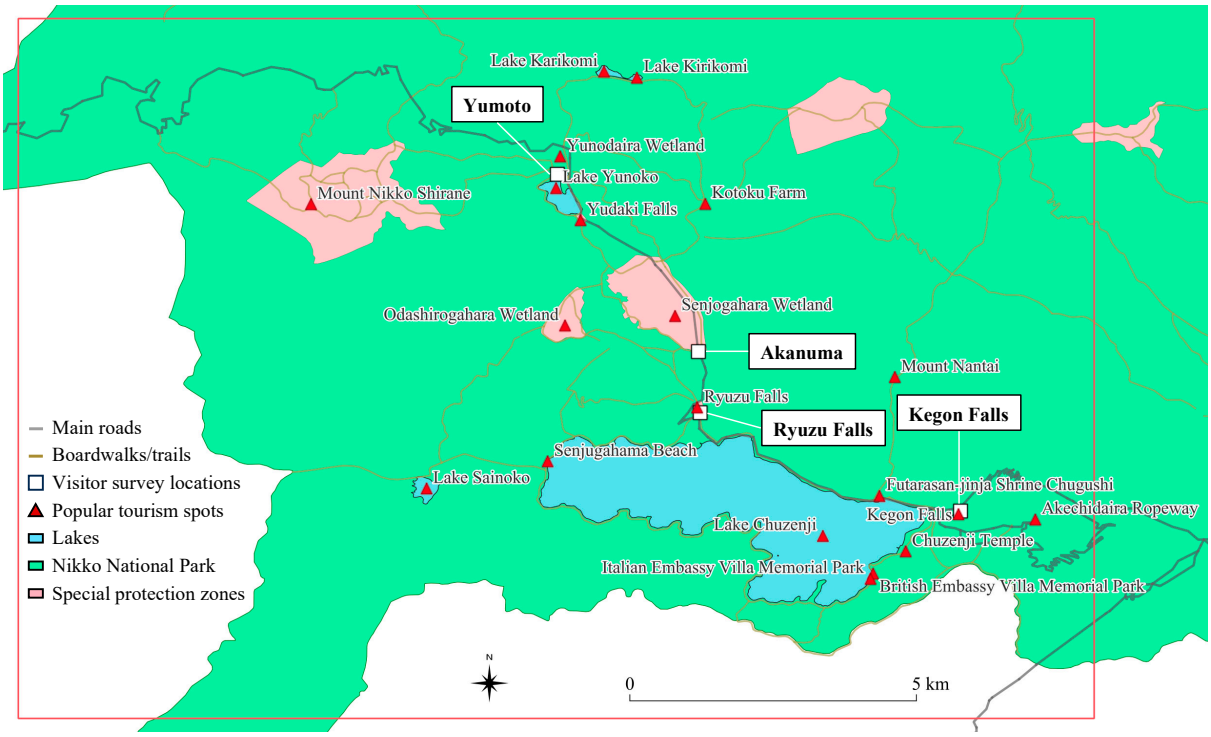

Figure 2. Locations of visitor surveys and popular tourism spots in the Oku-Nikko area of Nikko National Park, Japan.

2.3. Social Media Data

2.3.1. Data Source and Photo Collection

We used photos that were shared on Twitter in order to assess visitors' interests and recreational activities as represented on social media. Twitter was one of the major social media platforms used globally at the time of the survey, and the use of Twitter for this study allowed the collection of both geotagged and non-geotagged posts using the Twitter application programming interface (API).

Geotagged and non-geotagged posts were collected in the Oku-Nikko area from 1 September to 30 November 2019. We obtained geotagged posts within the bounding-box area defined by 36.698186 N, 36.834750 N, 139.318670 E, and 139.528918 E. Non-geotagged posts were obtained by searching for the unique names of 20 popular tourism spots in the Oku-Nikko area (Figure 2) alongside the general term "Oku-Nikko", to indicate this area, using the Boolean operator OR. Bots, advertisements, and posts without any photos were excluded from the obtained data. In addition, even if a non-geotagged post included a target tourism spot name, the content may not be related to the target area, the user may not have visited there, or the user may have shared an experience that did not happen in the target period. Therefore, we manually selected the posts that clearly expressed within the text the user's onsite experiences or impressions in the study area and period.

Although most of the foreign visitors we approached in our onsite survey responded in English, the mother tongue of more than 85% of them was not English. Given that many international visitors would be expected to post on social media in their own language, it would be challenging to execute the abovementioned procedures accurately in order to collect all international non-geotagged posts. The present study, therefore, focused on Japanese language posts for both geotagged and non-geotagged data.

2.3.2. Photo Content Analysis

Seven main categories were established to understand visitors' interests and experiences from Twitter photos: Recreational activity, natural landscape, animal/plant, historical object, local facility/infrastructure, food/drink, and others. Specific activities and land-

scape elements were then identified from the photos selected as "recreational activity" and "natural landscape", respectively. The extracted recreational activities were classified as driving, cycling, canoeing/boat riding, taking ropeway, mountain climbing/hiking, riding on a cruise ship, bathing in hot springs, camping/picnicking, fishing, or other. The extracted elements of the natural landscapes were categorized as mountain/forest, lake, autumn leaves, waterfall, marsh/wetland, or other. If multiple categories or subcategories were found in a photo, then all of them were recorded. The names of the species in the photos selected as animal/plant were also identified wherever possible.

The extraction of photo content was conducted manually and independently by three people, including two of the authors. The reliability of the manual extraction was tested by comparing the three independent sets of results using Fleiss' kappa. The resulting Fleiss' kappa score was 0.84, indicating almost perfect agreement between the three extraction results [22]. Therefore, we randomly selected and used one set of results.

3. Results

3.1. Visitor Survey Data

3.1.1. Relationship between Geotag Usage and Visitor Attributes

We received valid responses from 1148 visitors, of whom 565 indicated that they used social media. Among those social media users, 358 answered that they would share their travel experiences on social media. The percentages of males, domestic (Japan), first-time, and day visitors among those 358 users were 54.7%, 77.4%, 33.5%, and 53.6%, respectively. Instagram was the most popular platform (69.6%), followed by Facebook (60.3%), Twitter (48.9%), and other platforms (19.0%), while 66.5% used multiple social media platforms. Over half of the users (52.5%) indicated that they geotagged their posts.

Compared to people in the 60-plus group, people in their 30s and 40s tended to use geotags on their posts (Table 1). The place of residence was the most influential factor, with foreign visitors being more likely to use geotags than domestic visitors. There was no significant correlation between the use of geotags and gender, length of stay, frequency of visit, and choice of social media platform. No differences in these patterns were evident between the analyses of all visitors (Japanese and international) and only Japanese visitors.

Table 1. Odds ratios for variables of mixed-effects logistic regression models explaining visitor inclination to use geotags when sharing travel experiences on social media.

	Fixed Effect	**All Visitors (Japanese and International)**		**Only Japanese Visitors**	
		Odds Ratio	**95% CI**	**Odds Ratio**	**95% CI**
	Intercept	0.241	0.078–0.748	0.348	0.113–1.075
Attribute	Gender (male, 0; female, 1)	0.817	0.505–1.321	0.679	0.398–1.158
	Age group				
	10s	1.781	0.456–6.956	1.264	0.275–5.816
	20s	1.999	0.853–4.685	1.816	0.713–4.628
	30s	**3.360**	**1.380–8.183**	**3.378**	**1.243–9.181**
	40s	**3.589**	**1.433–8.987**	**2.956**	**1.104–7.916**
	50s	1.505	0.638–3.550	1.389	0.562–3.432
	Place of residence (Japan, 0; international, 1)	**3.705**	**1.821–7.539**		
	Frequency of visit (first-time, 0; repeat, 1)	0.998	0.565–1.761	0.807	0.430–1.512
	Length of stay (day trip, 0; overnight trip, 1)	1.479	0.927–2.360	1.232	0.740–2.053
Social media used	Twitter (not use, 0; use, 1)	0.995	0.600–1.650	0.793	0.460–1.368
	Instagram (not use, 0; use, 1)	1.581	0.929–2.691	1.717	0.956–3.086
	Facebook (not use, 0; use, 1)	1.310	0.809–2.121	1.563	0.918–2.661

Bold values indicate odds ratios with 95% confidence intervals, not including the value 1.0.

3.1.2. Reasons for Using or Not Using Geotags on Social Media

We categorized the open-ended responses on why visitors chose whether or not to use geotags (Tables 2 and 3). The most common reason for using geotags was that doing so helped them remember where they had been and what they did there. For example, some users said that geotagging was useful for them to remember where they hiked or took photographs of beautiful scenery. Other major reasons were that using geotags enabled them to share their travel experiences with someone more clearly and to indicate more precisely which places they recommend. A certain number of visitors who used geotags said they had no particular reason for doing so. Major responses on the reasons not to use geotags included "no particular reason," privacy concerns, and not knowing how to use geotags. One notable reason related to the conservation of natural ecosystems was "do not want the habitat of wild birds to be identified."

Table 2. Reasons for visitors to use geotags when sharing their travel experiences on social media.

Answer	Number of Respondents
It helps me remember where I have been and what I did there	60
It enables me to share my travel experiences with someone more clearly	39
Do not have a particular reason	29
It enables me to tell someone clearly which places I recommend	26
Other	23
No response given	15

Table 3. Reasons for visitors not to use geotags when sharing their travel experiences on social media.

Answer	Number of Responses
Do not have a particular reason	49
Privacy concerns	49
Do not know how to use geotags	19
Not necessary	10
Too much work to set it up	9
Use text including hashtags to show where I visit instead of geotags	8
Concerned about limited battery life	3
Do not want the habitat of wild birds to be identified	3
Other	6
No response given	15

3.2. Social Media Data

3.2.1. Geotagged and Non-Geotagged Photo Content

In total, 217 visitors posted 552 geotagged photos in the study area during the study period (Figure 3). Major photo content was natural landscape (63.9%), recreational activity (22.6%), and local facilities/infrastructure (21.6%) (Figure 4). The most common landscape element was mountain/forest (63.5%), followed by lake (33.7%), autumn leaves (26.1%), and waterfall (25.2%) (Figure 5), and the most common recreational activity was driving (48.0%), followed by cycling (15.2%) (Figure 6).

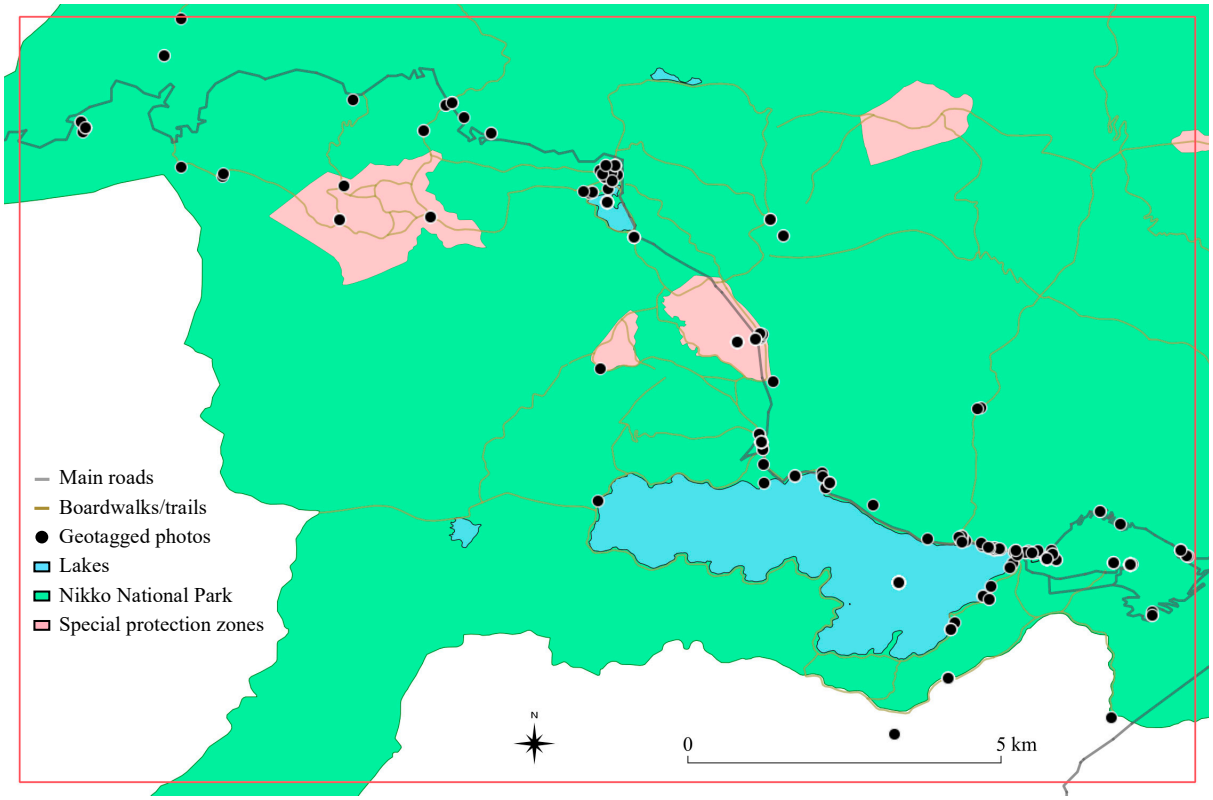

Figure 3. Locations of geotagged photos posted on Twitter within the Oku-Nikko area in autumn 2019.

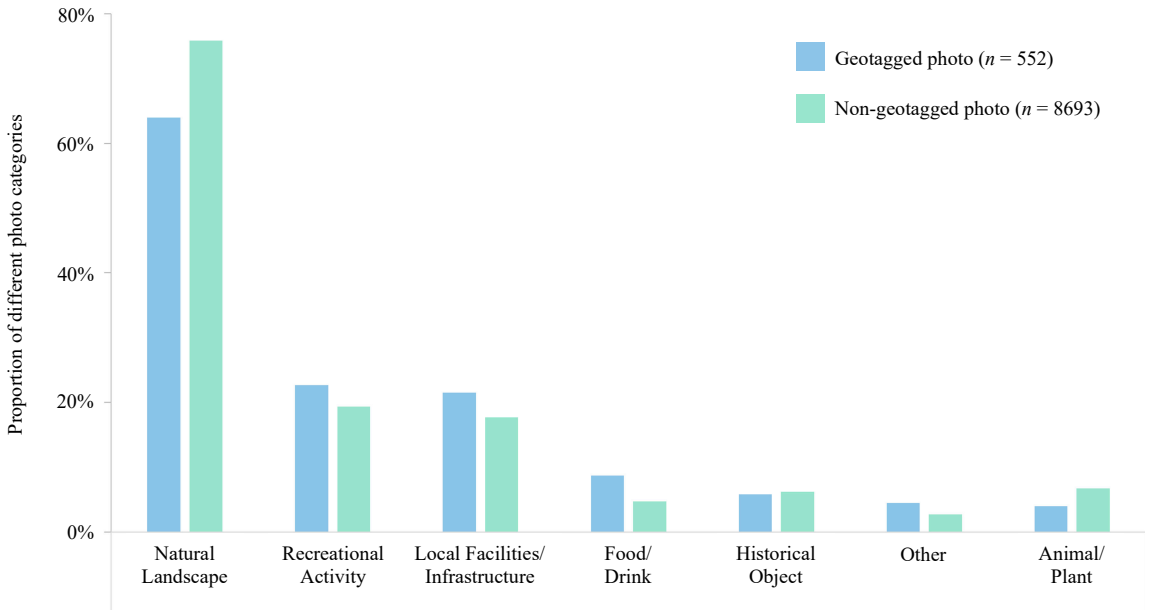

Figure 4. Proportions of seven main categories of photos shared by visitors on Twitter within the Oku-Nikko area in autumn 2019.

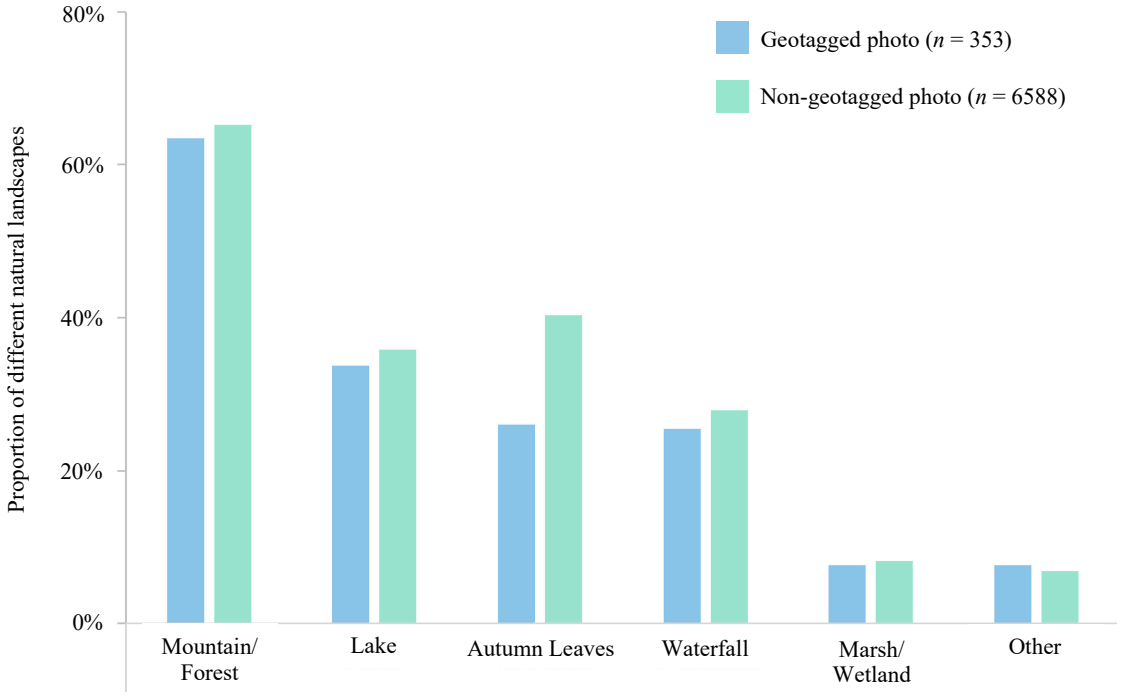

Figure 5. Proportions of natural landscapes of photos shared by visitors on Twitter within the Oku-Nikko area in autumn 2019.

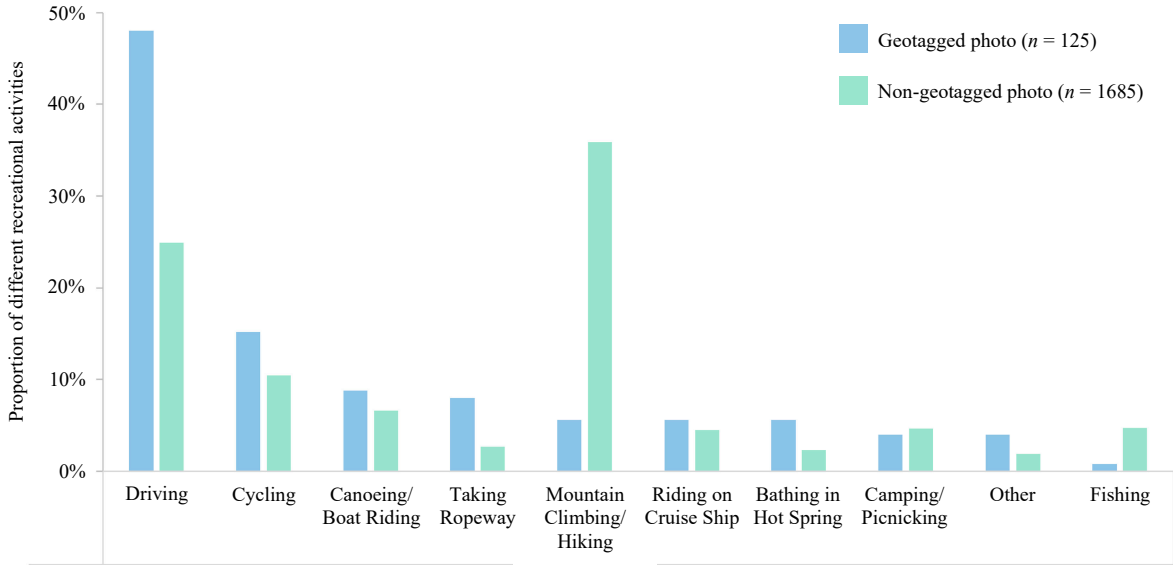

Figure 6. Proportions of recreational activities of photos shared by visitors on Twitter within the Oku-Nikko area in autumn 2019.

We collected 8693 non-geotagged photos from 2706 visitors. Natural landscape was the most common category (75.8%), followed by recreational activity (19.4%) and local facilities/infrastructure (17.7%) (Figure 4). The most common landscape element was mountain/forest (65.2%), followed by autumn leaves (40.3%), lake (35.8%), and waterfall (27.9%) (Figure 5). The most common recreational activity was mountain climbing/hiking (35.9%), followed by driving (24.9%) and cycling (10.4%) (Figure 6).

3.2.2. Biodiversity and Landscape Captured by Geotagged and Non-Geotagged Photos

Although the percentages of animal/plant photos did not largely differ between geotagged and non-geotagged photos (Figure 4), what the two types of photos represent in the category was substantially different (Tables 4 and 5). Geotagged photos only captured mammals (i.e., monkeys and deer), whereas non-geotagged photos captured a wide variety of species, including birds (at least 22 species), fish (at least six species), mammals (five species), and insects (at least one species). Plants identified in the geotagged photos were only two tree species; meanwhile, various species were identified in the non-geotagged photos, including trees (at least seven species), herbs (at least 21 species), fungi (at least five species), and moss (at least one species).

Table 4. Animal species captured by geotagged and non-geotagged photos on Twitter within the Oku-Nikko area in autumn 2019.

Classification	Species	Number of Geotagged Photos	Number of Non-Geotagged Photos
Mammal	*Macaca fuscata*	3 (1)	10 (6)
	Cervus nippon	2 (2)	12 (10)
	Felis silvestris catus	0	4 (3)
	Ursus thibetanus japonicus	0	2 (2)
	Martes melampus	0	1
Bird	*Anas* spp.	0	11 (11)
	Saxicola torquata	0	10 (5)
	Sitta europaea	0	6 (3)
	Dendrocopos leucotos	0	5 (3)
	Uragus sibiricus	0	3 (3)
	Haliaeetus pelagicus	0	2 (2)
	Podiceps nigricollis	0	2 (1)
	Lanius bucephalus	0	2 (1)
	Tarsiger cyanurus	0	2 (1)
	Pyrrhula pyrrhula	0	1
	Aegithalos caudatus	0	1
	Carpodacus roseus	0	1
	Phalacrocorax carbo	0	1
	Cinclus pallasii	0	1
	Regulus regulus	0	1
	Streptopelia orientalis	0	1
	Motacilla cinerea	0	1
	Certhia familiaris	0	1
	Parus minor	0	1
	Motacilla alba	0	1
	Anthus hodgsoni	0	1
	Kaniska canace	0	1
	Other	0	2 (1)
Insect	Dragonfly	0	9 (8)
	Other	0	3 (2)
Fish	*Salvelinus fontinalis*	0	14 (9)
	Oncorhynchus nerka	0	7 (3)
	Salvelinus namaycush	0	6 (3)
	Oncorhynchus mykiss	0	4 (3)
	Salmo trutta	0	1
	Hypomesus nipponensis	0	1
	Other	0	5 (5)
Visitor's pet	*Canis lupus familiaris*	0	22 (11)
Museum exhibit	*Cryptobranchoidea* sp.	0	1

Values in parentheses indicate the number of people posting the photos.

Table 5. Plant species captured by geotagged and non-geotagged photos on Twitter within the Oku-Nikko area in autumn 2019.

Classification	Species	Number of Geotagged Photos	Number of Non-Geotagged Photos
Tree	*Acer* spp.	5 (5)	195 (155)
	Betula platyphylla	1 (1)	25 (22)
	Sorbus commixta	0	17 (16)
	Pinus spp.	0	6 (6)
	Cunninghamia lanceolata	0	1
	Malus baccata var. *mandshurica*	0	1
	Rubus crataegifolius	0	1
Herb	*Gentiana scabra* var. *buergeri*	0	10 (5)
	Phragmites australis	0	7 (6)
	Swertia bimaculata	0	7 (5)
	Spiraea salicifolia	0	6 (3)
	Geranium yesoense var. *nipponicum*	0	4 (3)
	Aster ageratoides Turcz. var. *ageratoides*	0	3 (2)
	Parnassia palustris	0	3 (2)
	Leucosceptrum japonicum	0	3 (1)
	Solidago virgaurea var. *asiatica*	0	2 (2)
	Adenophora takedae	0	1
	Aster microcephalus var. *ovatus*	0	1
	Cimicifuga simplex	0	1
	Cirsium oligophyllum var. *nikkoense*	0	1
	Cirsium purpuratum	0	1
	Impatiens noli-tangere	0	1
	Maianthemum dilatatum	0	1
	Ranunculus nipponicus var. *submersus*	0	1
	Scirpus wichurae	0	1
	Tricyrtis latifolia f. *nikkomontana*	0	1
Fungus	*Phycomyces* sp.	0	2 (1)
	Hygrophoraceae sp.	0	1
	Mycena sp.	0	1
	Psathyrellaceae sp.	0	1
	Rickenella fibula	0	1
	Other	0	15 (5)
Moss		0	2 (2)
Other		11 (9)	100 (76)

Values in parentheses indicate the number of people posting the photos.

The percentages of marsh/wetland photos, an element identified within the natural landscape category, were almost the same in the geotagged and non-geotagged photos (Figure 5); however, we found that the two types of photos captured different kinds of marsh. There are two famous marshes in the Oku-Nikko area: "Senjogahara Wetland," which is located by a main road, and "Odashirogahara Wetland," which has lower accessibility from the road (see Figure 2). A typhoon in October 2019 temporarily flooded the Odashirogahara Wetland. This relatively rare event transforms the scenery from a marsh to the appearance of a lake, hence, being referred to as "Odashiro-ko" (with "ko" meaning lake). While there was only one photo of Odashirogahara Wetland and no photo of Odashiro-ko (lake) among the 27 geotagged photos classified as marsh/wetland, there were 167 photos of the Odashirogahara Wetland and 101 photos of Odashiro-ko among 541 non-geotagged photos classified as marsh/wetland.

4. Discussion

4.1. Differences in Visitor Attributes between Geotagged and Non-Geotagged Social Media Users

Our results showed that privacy concerns and the lack of technical knowledge regarding social media settings were major reasons for people not using geotags when sharing content. This is consistent with earlier reports that users' privacy concerns and low technical knowledge make it more difficult to monitor visitors based on the GPS function in visitors' mobile devices [23,24]. We also found that visitors in their 30s and 40s were more likely to share their travel experiences using geotags than visitors in their 50s and over 60s. Previous studies have shown that older people were more concerned about privacy on social media than younger generations [25,26]. The Institute for Information and Communications Policy (2014) also reported that people in their 50s and 60s in Japan were less familiar with how to implement location information on their mobile devices [19]. These differences between age groups in terms of privacy awareness and technical knowledge would affect the use of geotags. On the other hand, there was no significant difference in the use of geotags between people in their teens and 20s versus people in their 50s and 60-plus. As the number of adolescents harmed on social media has increased in Japan in recent years [27], there has been a rise in educational efforts to enhance youth awareness of the safe use of the Internet [28]. An international survey on social media literacy conducted in France, Japan, Singapore, South Korea, the United Kingdom, and the United States also reported that participation in literacy training on social media was particularly high for people in their teens and 20s in all those countries [29]. Such efforts may have had the desired effect of raising privacy awareness among people in their teens and 20s, which might explain our result.

Foreign visitors were more likely than Japanese visitors to share their travel experiences using geotags. This result is supported by a Ministry of Internal Affairs and Communications report (2020), which found that people in Japan were more concerned than in other countries, such as China, Germany, and the United States, about providing personal data (including location information) to companies via web services [30]. Moreover, international visitors might tend to see their new experience in a foreign country as more special than domestic visitors [31]. This tendency might drive their desire to keep details to aid memory and share details with friends and family, which would be facilitated using geotags, as indicated in Table 2. Such psychological factors might also influence the inclination of foreign visitors to use geotags. Kajikawa et al. (2023) reported that foreign visitors in the Oku-Nikko area posted more on Facebook and Instagram, whereas Japanese visitors posted more on Twitter [32]. Although our regression model did not capture statistically significant differences in geotag usage between the three platforms, the odds ratios indicated a tendency that is consistent with their report.

4.2. Differences in Photo Content between Geotagged and Non-Geotagged Data

Overall patterns in visitors' activities and interests, as depicted in the photos, were similar for both the geotagged and non-geotagged data. However, the non-geotagged data contained a relatively high number of nature photos, such as in the natural landscape and animal/plant categories, whereas geotagged data contained more artificial objects, such as local facilities/infrastructure and food/drink. Looking into more details about the content revealed different patterns between the two types of photos more clearly. Recreational activities that utilize main roads, such as driving and cycling, were shared more in geotagged photos. Figure 3 also shows that geotagged photos were concentrated around the main roads. In contrast, non-geotagged photos provided more insight into nature-based activities that utilize trails, such as mountain climbing/hiking, than geotagged photos. In addition, compared to geotagged social media users, non-geotagged social media users were interested in a wide variety of animals and plants and a unique event at the relatively remote marsh in the study area (Odashiro Lake, as mentioned above).

Over the past few decades, people worldwide (especially children) have reportedly had fewer opportunities to experience nature [33]. This means that in the past, children may

have been more likely to interact with nature than today. Experiences of nature are known to motivate people to experience nature again, and this motivation sometimes remains even for decades [34,35]. Given these previous findings, one could say that older people may tend to experience nature more deeply than younger people. In fact, in a national park in South Africa known for opportunities to observe large mammals, there was a correlation between increasing age and the tendency to be interested in also observing minor birds and plants [10]. In peri-urban areas, characterized by cultural and river landscapes in the Netherlands and Switzerland, older people aged 55–65 preferred marshland landscapes that were not easily accessible [20]. In Japan, people in their 50s and 60s were the age groups that most preferred mountain climbing and hiking as leisure activities [36]. Therefore, age-related differences in interactions with nature might affect differences between geotagged and non-geotagged data in terms of content.

As another possibility, user awareness of environmental conservation might influence content differences between geotagged and non-geotagged data. In our study, some visitors expressed awareness about the conservation of bird habitats. When sharing animal or plant photos on social media, using geotags means that users provide their own locations and the locations of the animal or plant habitats. This situation could easily result in illegal hunting and collecting. In order to avoid this, some people choose not to geotag their posts on social media.

4.3. Implications

Previous studies have examined the effectiveness and limitations of social media data for visitor monitoring based on the analysis of geotagged data. Younger visitors to national parks tend to share their nature experiences on social media more frequently than older visitors [10,11,32]. In other words, using social media data could have limitations in capturing older visitors' natural experiences. Komossa et al. (2020) reported that social media data could not successfully capture preferences for relatively inaccessible landscapes, such as marshlands, which are popular among older visitors [20]. However, this study demonstrated that non-geotagged social media data can be used to understand older visitors' nature experiences, including their recreational activities and interests further. In addition, our finding that visitors' interests (including a wide variety of animals and plants) were better captured by non-geotagged than by geotagged data, indicates that non-geotagged data can also be a valuable data source for assessing biodiversity and ecosystem services, particularly cultural services. Furthermore, as shown in this study, non-geotagged data provide much more information than geotagged data (e.g., number of photos) [37]. Thus, our study suggests that using non-geotagged data could be essential in accruing social media data for research and analysis.

4.4. Challenges

We obtained non-geotagged posts on Twitter by searching for the unique names of popular tourism spots in the Oku-Nikko area and then conducting additional manual screening, as mentioned in the Methods. This procedure, however, is not a generally applicable or comprehensive method compared to obtaining social media data using geotags. The collection of relevant non-geotagged data, including posts in multiple languages, is a major challenge and merits further study. However, in the case of the present study, we believe that we collected enough non-geotagged data to examine its effectiveness in the study area meaningfully and demonstrate its potential for use in visitor monitoring. There would be merit in future studies examining various types of national parks in other countries in order to improve a general understanding of the effectiveness of non-geotagged social media data for research. Finally, for this study, we manually classified texts and photos that had been posted on Twitter in order to assess the effectiveness of non-geotagged data accurately; however, for practical purposes, it might be possible for such classification work in the future to be automatically processed using, for example, machine learning.

5. Conclusions

The aims of this study were to examine the effectiveness of using non-geotagged social media data from park visitors for national park management by comparing (1) sociodemographic differences between users based on whether or not they were using geotags and (2) differences in recreational activities and interests based on whether or not posts were geotagged. We found that visitors in their 30s and 40s and foreign visitors had a greater tendency to use geotags. Non-geotagged photos more frequently captured nature-based activities and interests by older visitors, including activities on trails, such as mountain climbing and hiking, and an interest in diverse animals and plants and in landscapes that are less accessible.

While geotagged social media data have been widely used in the past, our findings suggest that non-geotagged data may have less age and nationality bias and may have advantages in capturing user content relating to various nature-based experiences offered by national parks. By embracing both geotagged and non-geotagged data, park managers and administrators can foster a more sustainable approach, ensuring that management practices resonate with a broader demographic and encompass a diverse range of nature-based experiences. Such an integrated approach would align with the overarching goal of sustaining the natural environment while enriching the visitor experience within national parks.

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