ENVIRONMENTAL IMPACTS OF HUMAN ACTIVITY ASSOCIATED WITH GEOCACHING

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ABSTRACT

Geocaching, a high-tech treasure hunt that couples using handheld global positioning system (GPS) devices with hiking, is becoming an increasingly popular outdoor activity, drawing a wide-range of participants from all age groups. Because the activity is largely participant-created and run, there is little oversight for how geocaching is monitored and controlled, including environments like open spaces and along hiking trails. Many participant-created caches are placed off-trail, and often enough, in environmentally-sensitive areas. This paper begins with the development of geocaching through the advent of GPS and discusses past research involving recreational ecology and environmental impact. From the insight from these related reports, guidelines for participating in the activity of geocaching are developed, for cache placers and cache seekers alike.

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INTRODUCTION

The introduction of Global Positioning System usage for the general public has triggered a great interest in a broader range of application for the technology. Geocaching has been edging into the mainstream as a modern outdoor activity that incorporates GPS with hiking to invigorate the human thirst for adventure. Geocaching involves utilizing handheld GPS receivers to find small containers in an ongoing high-tech treasure hunt on both local and global scales. Everyday users can place caches, record the location's coordinates, and post that information online for others to find and seek out the caches. The purpose of the activity is not necessarily to obtain the "treasure" within the containers, but rather to take people to places where they would not otherwise find themselves.

Many caches are placed in natural locations off of hiking trails in parks, reserves, open spaces, or in protected habitats. The environmental impact of such activity is rarely discussed as to how areas surrounding the cache can be affected due to human influence. The reality is that geocaching is an activity with little oversight or particular guidelines for cache placement or for cache seekers. Through a literature review of studies aimed at understanding the human impact of other outdoor recreational activities on particular environments, this report seeks to derive an analysis of geocaching's impacts on cache sites' immediate environment and surrounding areas. Additionally, this report will develop guidelines for cache placement and participating in the activity with mitigated impact.

HISTORY OF GEOCACHING

Development of the Global Positioning System

The origin of the Global Positioning System, formally known as NAVSTAR GPS traces back to exclusive United States military in the latter half of the 20th century. The primary purposes of the Department of Defense's development of the technology were twofold: for precise weapon delivery and to provide a unified navigational system that would combine varying technology already being explored within different branches of the military (Pace et al., 1995). The Navy and Air Force had been developing their own navigational systems simultaneously during the late 1960s. By the 1970s, the military began developing a compromise system combining the best elements of both programs: the signal structure and frequencies from the Air Force's 621B program, and the satellite orbits of the Navy's Timation system (Pace et al., 1995). The emerging system that would undergo testing during the next couple of decades would become what is known today as NAVSTAR GPS.

The system is composed of 24 satellites orbiting several thousand miles above the earth, completing their orbits around the earth every 12 hours. Radio broadcasts from these satellites are picked up from receivers on the ground to triangulate their location (James, 2009). Reception from four satellites provides information to the receivers in four dimensions: latitude, longitude, altitude, and time, with the latter determine by atomic clocks on board the satellites.

The importance and functionality of NAVSTAR GPS was realized when it was extensively utilized in a combat situation during Operation Desert Storm in the Persian Gulf from 1990-1991. GPS aided coalition forces to proceed through difficult desert

environment conditions including frequent sandstorms, few paved roads, no vegetative cover, and few natural landmarks (Pace et al., 1995). In addition to great navigational advantage, GPS also enhanced other operations including precision bombing, artillery fire support, and search-and-rescue missions (Pace et al., 1995). GPS became a valuable technology attributed to US success during Operation Desert Storm and helped to demonstrate the wide-spectrum of uses that GPS could boast, which would soon be employed beyond military exclusivity.

Civilian Usage of GPS

The technology for GPS improved through military testing and usage, and the value for the system became realized for nonmilitary purposes as well. Surveying became one of the first GPS markets to emerge, influenced after a 1984 decision by the Department of Commerce's National Oceanic and Atmospheric Administration (NOAA) to allow more open use of GPS data (Pace et al., 1995).

A big trigger that opened up GPS for more general use was actually a tragic event in the skies. President Ronald Reagan opened up GPS to nonmilitary use in 1983, after a passenger plane that had mistakenly flown into Soviet airspace was shot down by Soviet fighter jets, killing all on board (James, 2009). For security reasons, the military intentionally scrambled GPS satellite signals using Selective Availability that could only be removed by receivers that had decryption keys (Hegarty & Chatre, 2008). In 2000, President Bill Clinton announced that practice would stop and civilian demand for GPS products skyrockets as GPS became nearly ten times more accurate literally overnight (James, 2009). Today, GPS provides two services: one for civilian use referred to as Standard Positioning Service (SPS) and one only available to authorized users referred to

as Precise Positioning Service (PPS) (Hegarty & Chatre, 2008). SPS, which consumer GPS receivers use, including handheld hiking GPS receivers often used for geocaching, have an accuracy of up to 13 meters, 95% for horizontal positioning and 22 meters, 95% for vertical positioning (Hegarty & Chatre, 2008).

The Evolution of Geocaching

As GPS satellite accuracy improved for civilian use, the technology in consumer receivers dropped in production costs and soon gained great momentum in consumer markets. The removal of Selective Availability for civilian GPS receiver devices allowed greater accuracy, and exploration for uses of the enhanced technology expanded. One of the forerunners of early geocaching was a computer consultant named Dave Ulmer. He sought to test the accuracy of the satellites by placing a container in some forested area near Portland, Oregon for others to find, which he within a day of the government's announcement of the removal of Selective Availability (Groundspeak, 2005, para. 4). He recorded and posted the coordinates of that container, filled with prizes and a log book, to an online community with the one rule of taking something and leaving something (Schlatter & Hurd, 2005). That rule helped to ensure that the activity could be ongoing. Within days, people responded with stories of their own experiences finding Ulmer's "stash" using their own GPS receivers (Groundspeak, 2005, para. 7). Ulmer named this activity as "The Great American GPS Stash Hunt," but it was later renamed to "geocaching," as first coined by another member of a budding mailing list of emerging container coordinates, to stem the negative connotations of the word "stash" (Groundspeak, 2005, para. 4).

Originally, geocaching had a limited following due to the slow adoption of the new technology, as is often true with other emerging technology. In September 2000, a web developer named Jeremy Irish launched a website he named *geocaching.com,* with the hopes of creating a standardized system for tracking caches and opening up the activity to a broader audience (Groundspeak, 2005, para. 15). *Geocaching.com* has evolved to become the geocaches' community source for cache information, posting coordinates, and a budding user community, and has been successful in creating an identifiable brand for the activity.

One of the contributing factors for geocaching to become a more mainstream outdoor activity has been its draw to take people to places that they normally would not visit otherwise. Geocaches can take ordinary places and create surprising finds for visitors (Heffernan, 2009). Often enough, the locations where geocaches are placed can have historical or environmental interest associated with them and allow for people to learn something new about a particular place, even in their own neighborhoods. It is this issue of the combination of geocaching and placement within environmentally sensitive areas that is the subject of the rest of this paper.

PAST STUDIES ON RECREATIONAL ECOLOGY RELATED TO ENVIRONMENTAL IMPACT

Definitions

Geocaching can be unofficially grouped with the larger genre of *recreational ecology*, so it is appropriate to begin a study of geocaching impact with a general understanding of this term. Recreational ecology studies the environmental impact of outdoor recreation and management of such activities (Monz et al., 2010). Another term that loosely fits with geocaching is *ecotourism*. Mary Haney (1999) aptly defines ecotourism as

> travel to fragile, pristine, and usually protected areas that strive to be low-impact and (usually) small scale. It helps to educate the traveler; provides funds for conservation; directly benefits the economic development and political empowerment of local communities; and fosters respect for different cultures and human rights. (p. 7)

Although Haney's definition comes from a background of studying this subject in the context of environmental tourism in developing nations, the term can still apply to geocaching in broader uses.

Factors Attributed to Impact

Several factors have been identified that affect changes in environment along trails. One prominent factor is trampling by hikers. Trampling is a widely studied mechanism for environmental disturbance because the effects are visibly noted. Studies have shown that trampling has both direct and indirect impacts, on both soil and vegetation. Soil compaction is a direct impact associated with tramping, which results in decreased pore space, runoff, and leads to indirect impacts like soil erosion, and eroded soils from such events can cause increased turbidity in water bodies or sedimentation

impacts to aquatic organisms (Monz et al., 2010). To help with impact analysis attributed to trampling, a standardized experimental protocol has been developed. For the U.S., indices are available for 28 vegetation types (Pickering et al., 2010), which is useful for management practices in recreational ecology.

To mitigate the effects of trampling or to avoid badly eroded and altered trails, hikers and other trail visitors have contributed to trail widening or creating a secondary trail, resulting in increased vegetation loss or expanded disturbance area (Monz et al., 2010). Often enough, hikers can stray from formally developed trails to reach areas of interest, and disturbance can stretch far from a localized corridor. Greater impacts can be noted along these *social* trails due to lack of professional design, construction, and maintenance (Monz et al., 2010).

Environmental factors have also been identified that attribute to whether an area can sustain outdoor recreation including hiking and geocaching. Vegetation characteristics like resistance and resilience are factored into how much a trail can tolerate recreational traffic (Monz et al., 2010). Soil morphology also plays a significant role. Low-grade, well-drained soils with developed organic (O) horizons tend to withstand recreational impact (Monz et al., 2010).

Transport of different organisms by hiking has also been observed and studied. Foreign plants can be spread by hikers passing on trails to places that would be relatively untouched by direct human interaction. Weeds are easily spread by socks and shoes, which can pick up large amounts of seed (Pickering et al., 2010). These transported native plants can replace undistributed native vegetation, which can migrate away from their original growth along the trails (Monz et al., 2010). This becomes a self-sustained

impact because the spread of weeds can continue even after human interaction has ceased (Pickering et al., 2010).

Additionally, there is evidence that certain pathogens can be transported by human activity along trails. In the United States, the spread of a highly invasive water mold, *Phytophthora*, and specifically the species *Phytophthora ramorum*, which causes sudden oak death, has been associated with hiking trails with high visitation. In a sampling of children's shoes that had been through a protected area of California, 40% contained traces of *Phytophthora ramorum* (Pickering, et al., 2010). This plant pathogen was noted to only survive within a short 24-hour period on dry soil, supporting the relationship that hiking had with its short term or localized dispersal (Pickering, et al., 2010). The ease of spreading of these invasive species proves a challenge for monitoring and managing visitor interaction with protected and pristine environments.

GEOCACHING-SPECIFIC IMPACT MITIGATION

The budding research into the field of recreational ecology and ecotourism provides much insight to be applied to geocaching. An important aspect of studies such as these is that they are beneficial for management practices of heavily trafficked environments along hiking corridors, which geocaching often utilizes. Groundspeak and the company's website *geocaching.com* has helped to consolidate geocaching into a more uniform and standardized activity. As such, the issue of stewardship for environments where geocaching can take place has been raised and discussed. An informal program called "Cache In, Trash Out" (CITO) is promoted to all who participate in geocaching. With CITO in mind, geocachers are encouraged to be respectful of the environment where a cache is placed. This slogan, if consistently married with geocaching as proper etiquette, will help the general public with impact awareness.

But it may take more than just an honor system for geocaching-specific impact mitigation to be more realized. In general, hiking enthusiasts exhibit a second nature when it comes to leaving things as they were before they came, but the growth of geocaching has opened up hiking to many who are not familiar with proper outdoor recreational rules. Moreover, geocaching, by its nature, would violate the simple rule of "Leaving No Trace" because caches remain planted after people pass through. Scott Silver, the Executive Director for Wild Wilderness, an advocacy group promoting public awareness of conserving National Forests, argues "whether you consider a geocache box as litter or a semi-permanent stash, the practice is against national park and forest regulations" (Blouin, 2008).

Additionally, variability for what constitutes proper geocaching etiquette exists from particular locations, agencies and organizations that manage or own land. Some locations, like national parks, will require that applications be filled out for permits to place caches (Schlatter & Hurd, 2005). The Nebraska Game and Parks Commission has tailored guidelines specifically for geocaching, such as what containers are allowed for caches and what contents may be placed in them (Schlatter & Hurd, 2005).

The NPS review for GPS-based activities recognizes that variability exists and management for geocaching often happens on a case-by-case basis. This is dependent upon the individual park's resources, values, mission, impact tendencies, and the staff's ability for management (National Park Service [NPS], 2009). The NPS allows authority for park superintendents to prohibit geocaching according 36 CFR sections 1.5 and 1.7 if the activity disturbs park resources or to limit the activity to designated areas, according to 36 CFR 1.5 (NPS, 2009). Park superintendents also have the authority for permit issuance for the means of proper management, if necessary (NPS, 2009). It is important to note that the NPS does not discourage geocaching within national park areas, as long as the activity can be carefully monitored and managed, and that geocachers respect the park-specific rules. The NPS is keen on promoting geocaching if it enhances visitor interest and furthers the park's mission statement.

Apart from national parks with more direct oversight and management options, mitigating geocaching impact in open spaces and along hiking trails can become a difficult and tedious task. Since consumer GPS receivers plant cache seekers only in general areas and not right upon the cache site, it would be difficult to control how seekers scour off-trail locations. Awareness and education before cache seekers embark

on trails will be particularly useful. Posted signs at trail heads and entrances that specifically address geocaching activities can provide the public with printed awareness of proper outdoor recreational etiquette, including CITO and other area-specific rules and guidelines. As Groundspeak has become the prime authority for geocaching, increased responsibility on the company's part must grow for impact awareness associated with geocaching. A more prominent link on *geocaching.com* that addresses and recommends mitigation measures for hiders and seekers may be beneficial. A reward system for cache owners who take maintenance of their caches seriously may increase interest in how caches are impacting their surroundings.

CONCLUSION

Much research has been conducted in regards to human impact caused by ecotourism, with many studies focused exclusively on hiking, an outdoor recreational activity that geocaching falls under. Hiking impact, from spread of invasive species, vegetation alteration, and erosion, is a real issue to account for, and budding interest into recreational ecology and ecotourism will spur more mitigation measures to develop. This short report has demonstrated that further research must be undertaken related to geocaching impact to provide greater insight to how to properly manage this activity, from the individual level to state and agency levels, while still promoting the pairing of GPS technology and outdoor recreation as an enjoyable and even educational experience.

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