Understanding Visitor Flow and Patterns at Fort Larned National Historic Site

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EXECUTIVE SUMMARY

Project overview

The purpose of this research was to understand the temporal and spatial distribution of day visitor use at Fort Larned National Historic Site. Specifically, Fort Larned's infrastructure and layout changed with a new entrance road and parking lot in 2013. This has fractured the existing entrance and visitor experience. These changes may have made navigating the park confusing for some visitors. The use of GPS tracking devices has allowed researchers to observe where visitors are going, how long they stay in certain areas and understand patterns of use across different time periods at the park. This will allow managers to understand what is currently working, what is not and what demands are not being met by the everyday visitor.

General findings

- The average travel party consisted of 2.62 visitors
- The average time spent in the park was 1 hour and 38 minutes
- In general, time density analysis shows that use at the Visitor Center is heavily concentrated throughout the day at FOLS
- 5% of visitors did not visit the Visitor Center
- 5% of visitors used a social trail at the park
- Generally, travel party size does not affect time or use patterns at FOLS
- Analysis identified 3 areas that receive high traffic throughout all times of day and the year

General implications and recommendations

- Data collected for this study can serve as a baseline should use patterns, or use types shift in the future.
- Interpretive rangers could focus their efforts between the barracks, the bakery, and the shop to give interpretive talks throughout the day, as the density analysis shows heavy concentrated use throughout the day.

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Introduction and Rationale

Fort Larned National Historic Site (FOLS), was established as a National Historic Site in 1964 under Public Law 88-54178. This enabling legislation ensures "That, in order to commemorate the significant role played by Fort Larned in the opening of the West, the Secretary of Interior may acquire on behalf of the United States by gift, purchase, or other means not more than seven hundred and fifty acres of land, or interests in land, which comprise the site and remaining historic structures of Fort Larned, located in Pawnee County, Kansas, or which he deems necessary to accomplish the purposes of this Act, including nearby remains of the Santa Fe Trail."

The Organic Act of 1916 charges FOLS managers to protect natural, cultural and scientific values of the park. Knowing where visitors go and how much time is spent in specific locations (i.e., distribution) helps identify and evaluate resource impacts, facilitates the understanding of cause and effects, and provides insight into the prevention, mitigation, and management of visitors at FOLS. GPS Visitor Tracking (GVT) is a suitable tool to determine visitor travel patterns at FOLS. GVT is a process that involves distributing small GPS units, approximately the size of a computer flash drive, to visitors and recreationists at a protected area (White, Brownlee, Furman, & Beeco, 2012).

Using GVT allows for a direct measure of visitor spatial and temporal patterns, including use density and distribution (Beeco, Hallo, & Brownlee, 2014). Identifying where people visit, their travel routes, the quantity and timing of use, and the amount of time spent at these locations are some of the most basic and important visitor use data (Beeco et al., 2012; Beeco, Hallo, English, & Giumetti, 2013; Hallo et al., 2012). This spatial understanding of visitor use is particularly important for parks and protected areas because the distribution and density of visitor use influences biophysical and experiential impacts (D'Antonio et al., 2010; Hammitt & Cole, 1998; Manning, 2011). Consequently, GVT has been used in iconic and highly visited settings such as Yosemite National Park, Rocky Mountain National Park, and the Teton Range to measure frequency, timing, and intensity of use (D'Antonio et al., 2010). These three case studies found GVT was successful to help understand how visitor use is distributed spatially and temporally in park and protected areas. However, GVT has been underutilized to understand cultural and historical sites throughout the National Park Service.

Researchers and managers have not used GVT at FOLS to understand visitor use patterns. This study enables FOLS to understand baseline measurements of visitor use patterns.

Figure 1. Overview map of Fort Larned Nationnal Historic Site.

Methods

Intercepting Visitors

From October 2016 through July 2017, researchers used systematic random probability sampling (Vaske, 2008) to intercept FOLS visitors in the newly established visitor and staff parking lot southwest of the site. Sampling occurred on weekends and holidays to maximize the number of people available for the study and to understand differences in visitor use patterns. A pilot study was conducted in early October 2016 that determined GPS tracking of visitors an appropriate methods at FOLS. Approval for this study was obtained through the Kansas State University Institutional Review Board during the Fall 2016 semester.

Intercepted visitors voluntarily participated in the study and received a GPS unit to carry with them throughout their day. The researchers distributed one GPS unit per travel party, and the size of the travel party was also recorded (Figure 2). Researchers chose to use the Canmore GT-740FL Sport for GVT because in a study by White et al. (2012) the Canmore model was tested for accuracy against three other receivers (Garmin Oregon 600, GlobalSat DG-100, and GlobalSat DG-200) and the Canmore model was determined to be the most accurate. The Canmore GT-740FL also has extended battery capabilities. Additionally, the Canmore GPS unit is about the size of a computer flash drive, which easily fits into a pocket and is not bulky or heavy (Figure 3).

Figure 2 – Researcher distributing GPS unit to visitor onsite at FOLS

GPS units were configured to mark spatial waypoints and time stamps at 15-second intervals and all waypoints were recorded in decimal degrees. The researchers asked participants to return the GPS units at the end of their visit. GPS units were collected at the parking lot upon the visitors return to their mode of transportation.

Figure 3. Canmore GT-740FL Sport GPS tracker used during this study

Data Management

The researchers first imported GPS tracking data into MS Excel where an initial cleaning of the data occurred following the procedures of White et al. (2012). The researchers then imported the cleaned data from MS Excel into ArcGIS, and finalized the cleaning process following procedures outlined by Beeco et al. (2013). Four cleaning considerations were used before deleting data points: 1) distance from former and next point, 2) physical feasibility (e.g. could humans actually be in that location), 3) acceptable level of error, and 4) pattern of GPS point trail (are the points consistent with human behavior). Once the data had been cleaned using the procedures from Beeco et al., (2013), the researchers clipped all the data to FOLS omitting data collected while crossing the bridge in the track maps, but leaving them for the time density maps Finally, the researchers used ArcCatalog to organize the data by day and travel party size.

Data Mapping

Researchers created the following maps: 1) a map displaying all tracks ; 2) a series of maps displaying tracks across all seasons stratified by travel party size; 3) a series of maps displaying the density of use by time of the day; 4) a map of visitors who did not visit the Visitors Center; and 5) a map of visitors who used the social trail north of the bridge connecting the parking lot to the site (social trail tracks were determined to be used after the visit)

Limitations

Research limitations should be considered when reviewing results of any study (Bryman, 2008). Limitations can be attributed to setting and context, measurement, sampling design, and a host of other factors (Vaske, 2008). Limitations should be noted when interpreting the results and implications from this study.

First, data collection relied on technology that may malfunction during the sampling period. Although the researchers minimized and identified this influence throughout data collection and analysis it is probable that some level of unidentified error exists in these measurements. For example, GPS receivers can struggle to receive a satellite signal when the receiver is underneath thick tree canopy or inside of a building, and if this is the case, the receiver will snap way points together with a straight line as a type of calculated guess made about the track. The cleaning procedures followed in this study and outlined by Beeco et al., (2013) helped identify and resolve such errors, but there is no way to perfectly clean for all multipath error. Consequentially, this data can serve the purpose as baseline measurements of visitor travel patterns. This study is easily repeatable, and although the data is considered basic in nature, it is highly important data that offers several layers of information.

Results

Descriptive Statistics

On site at FOLS, the research team physically approached 117 travel parties and 106 elected to participate in the study, yielding a 90.6% response rate. These travel parties represent approximately 337 visitors participating in the study. All GPS units distributed were returned to the researchers at the end of their stay. The average time spent in the park was 1 hour and 38 minutes with a maximum time of 4 hours and 40 minutes and a minimum of 7 minutes.

Table 1. *Stratification of sampling dates for distribution of GPS trackers*

Intercept date	Frequency	Percent
Sunday 10/16/16	8	7.6
Saturday 12/10/16	16	15.1
Saturday 5/13/17	10	9.4
Saturday 5/21/17	9	8.5
Saturday 5/27/17	21	19.8
Sunday 5/28/17	8	7.6
Saturday 6/3/17	9	8.5
Sunday 6/4/17	14	13.1
Saturday 6/24/17	11	10.4
Total	106	100.0

Table 2. *Travel party size statistics*

	Percent of travel parties
Small Group (1-2)	44.1
Medium Group (3-4)	39.8
Large Group (5+)	16.1
Total	100.0

Figure 4. Tracks collected for travel parties consisting of 1 to 2 people.

Figure 5. Tracks collected for travel parties consisting of 3 to 4 people.

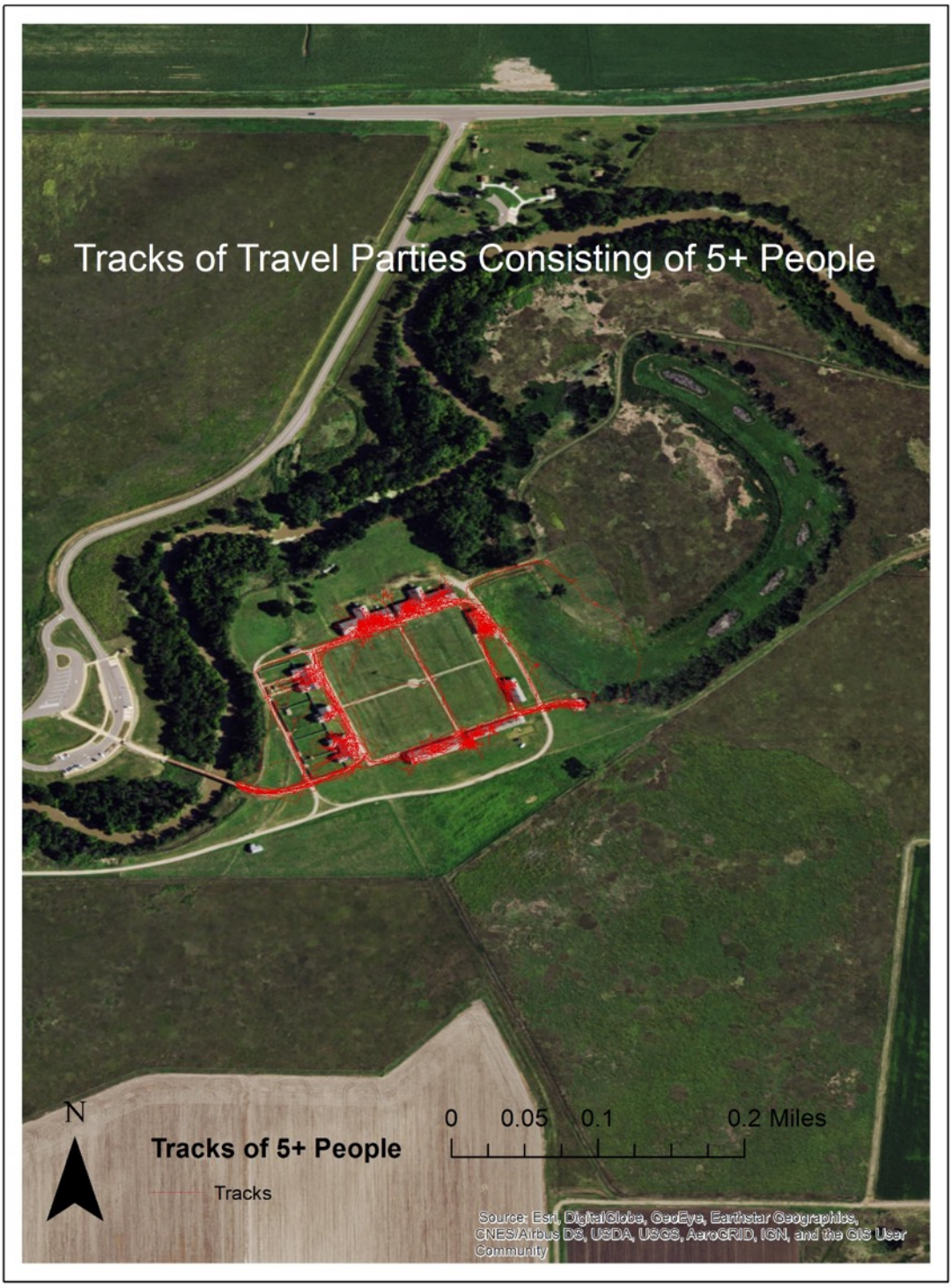

Figure 6. Tracks collected for travel parties consisting of 5 or more people.

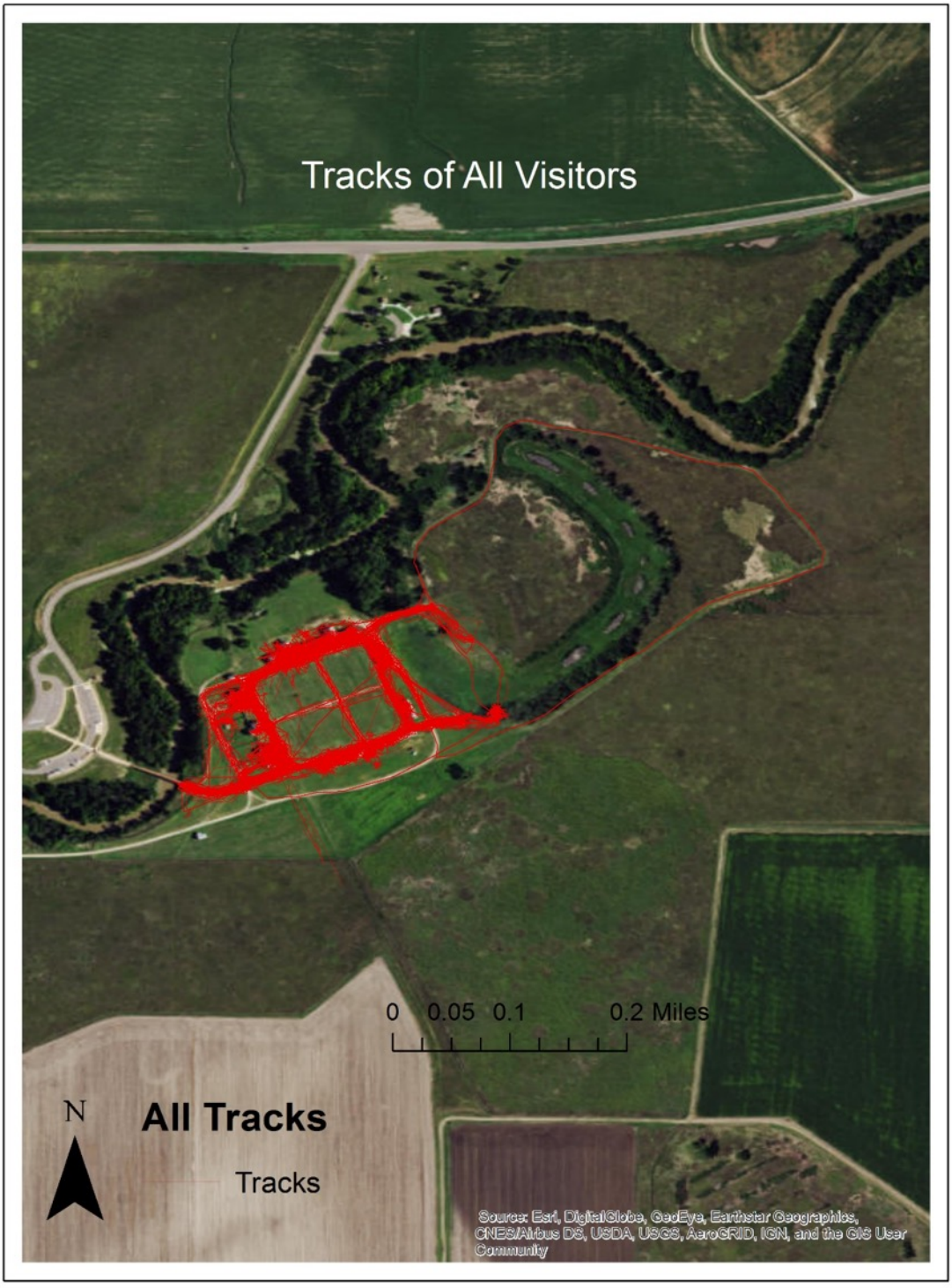

Figure 7. All tracks layered

Figure 8. Social trail tracks (trail along the river, immediately after crossing the bridge from the parking lot)

*Figure 9.*Tracks of Visitors who did not visit Visitor Center

Density Analysis

The researchers investigated point-density analysis at each hour.

The following figures display the specific areas of highest use during times of the day. This data can inform where and when to place interpretive staff for visitor interaction. The following density maps were created: density of all tracks by time of day: 10:00 AM (*figure 10)*, 11:00 AM (*Figure 11)*, 12:00 PM (*Figure. 12)*, 1:00 PM (*Figure 13)*, 2:00 PM (*Figure 14)*, 3:00 PM (*Figure 15)*, 4:00 PM (*Figure 16)*

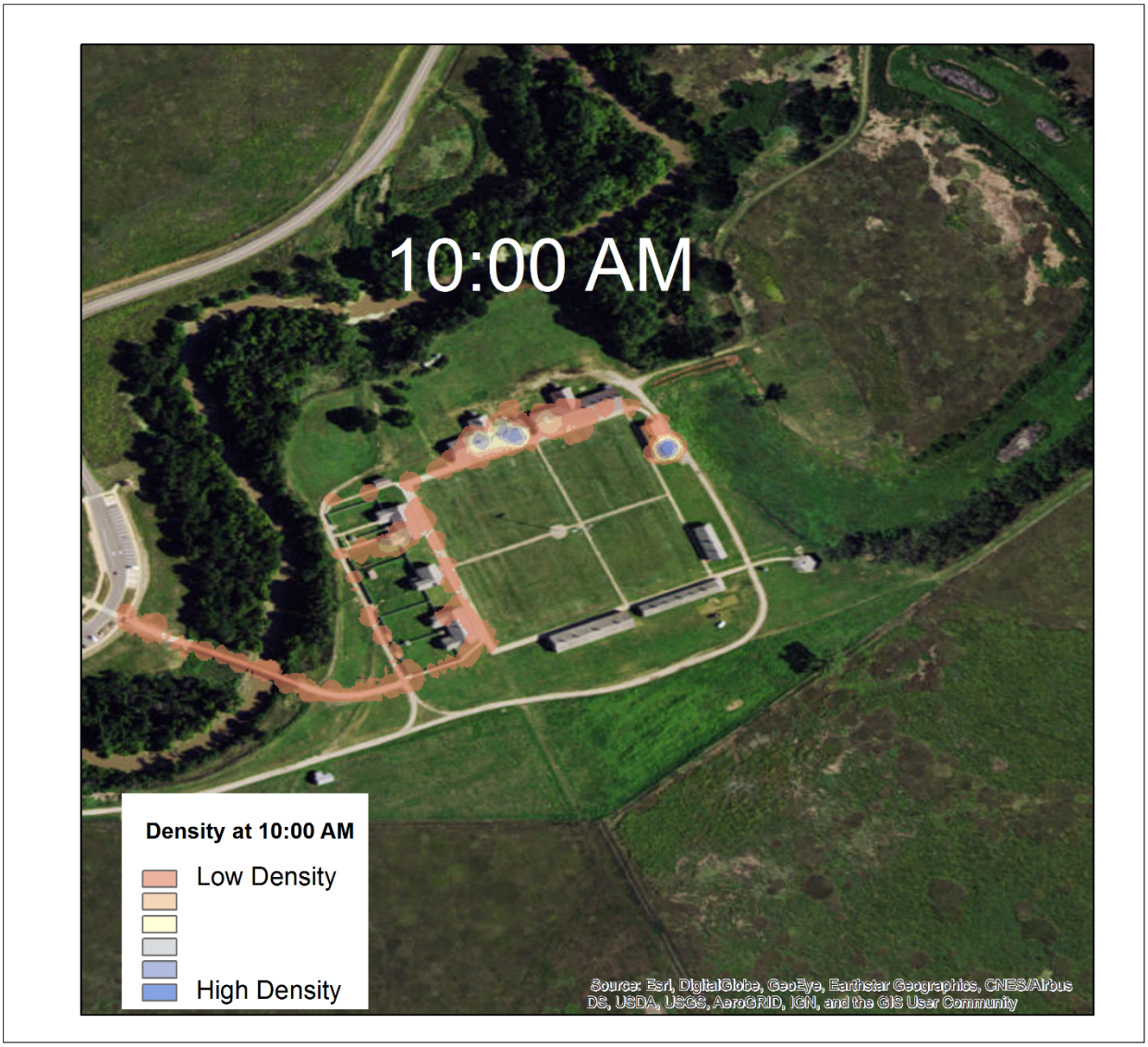

Figure 10. Density at 10:00 AM

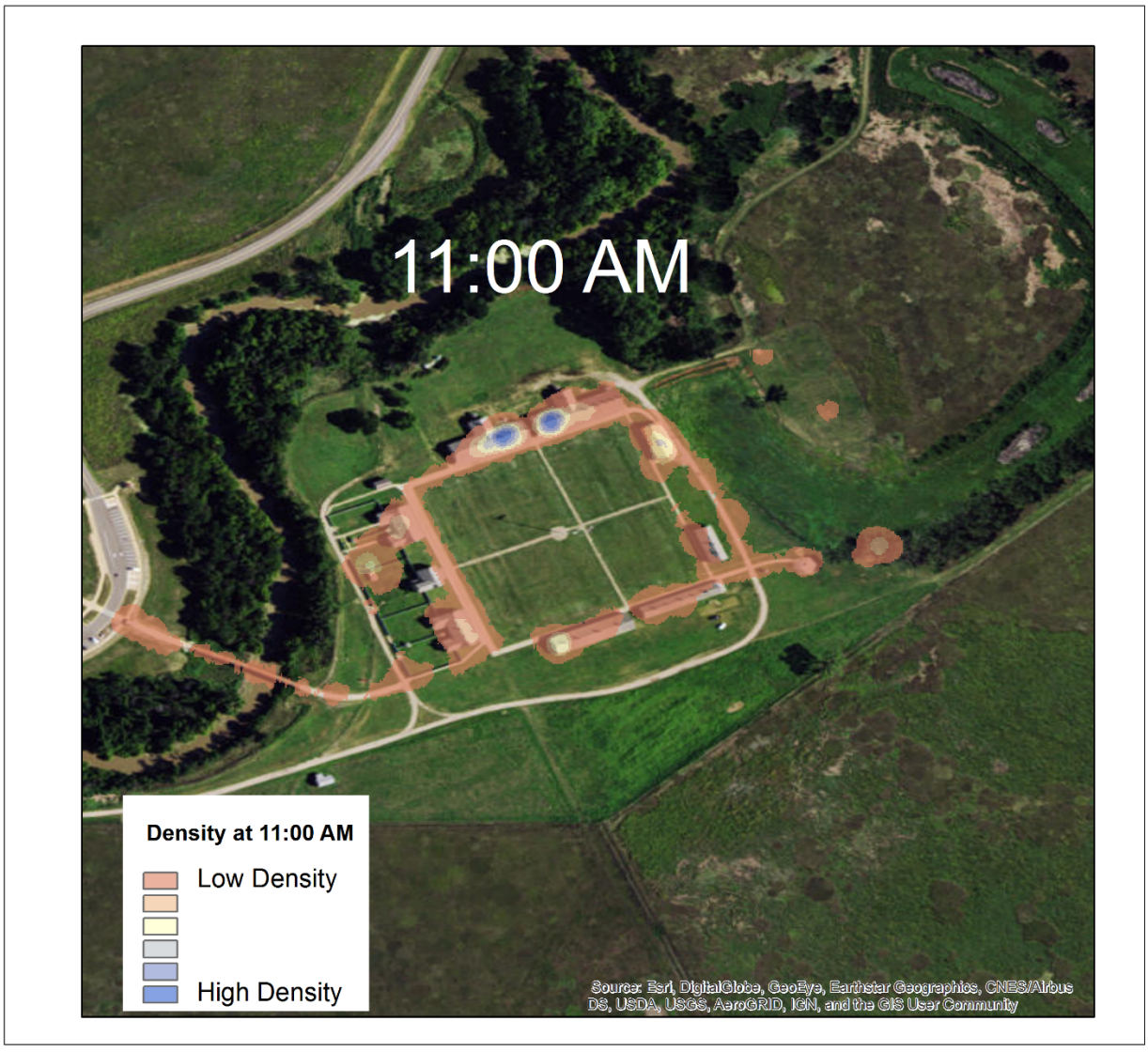

Figure 11. Density at 11:00 AM

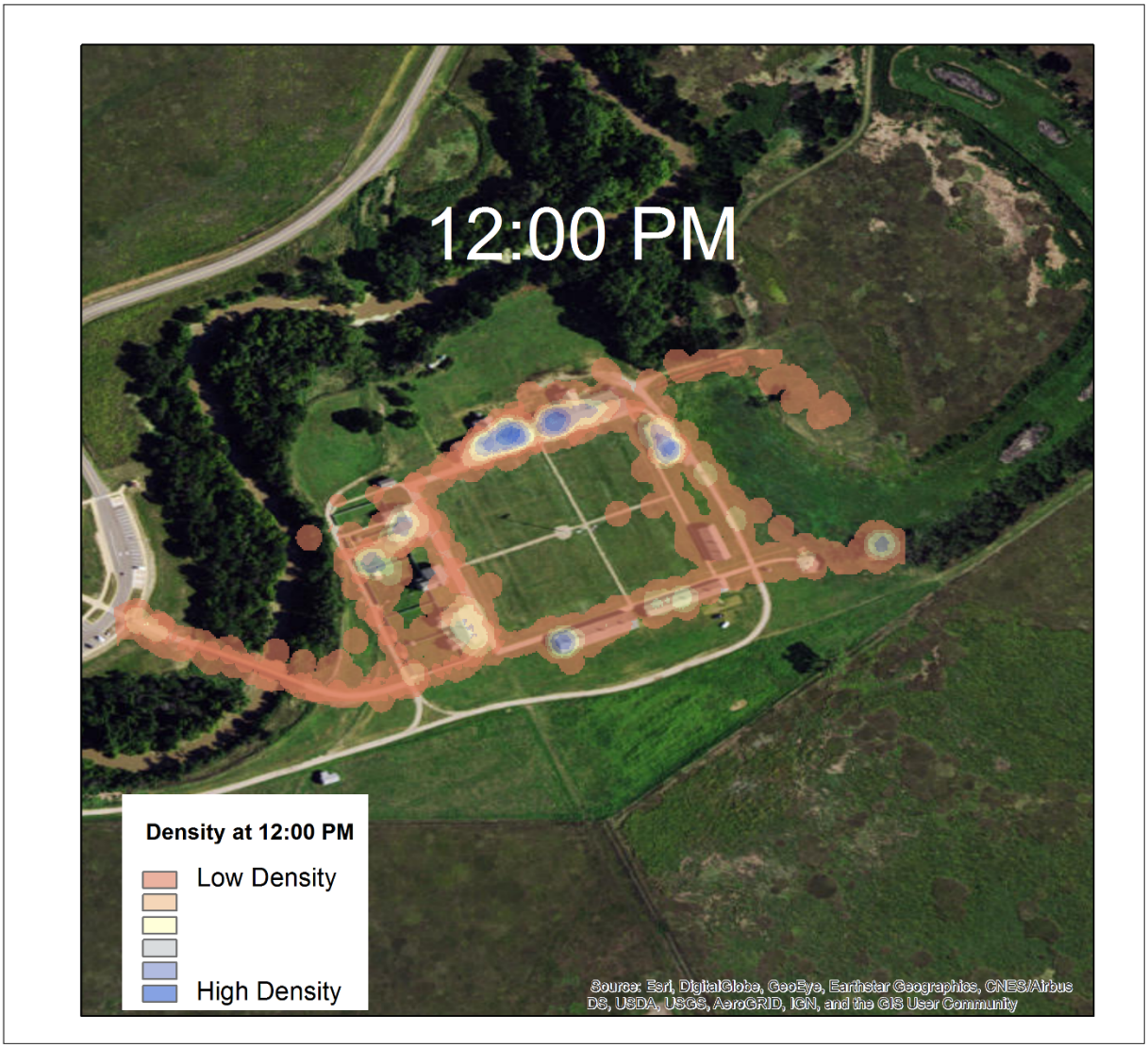

Figure 12. Density at 12:00 PM

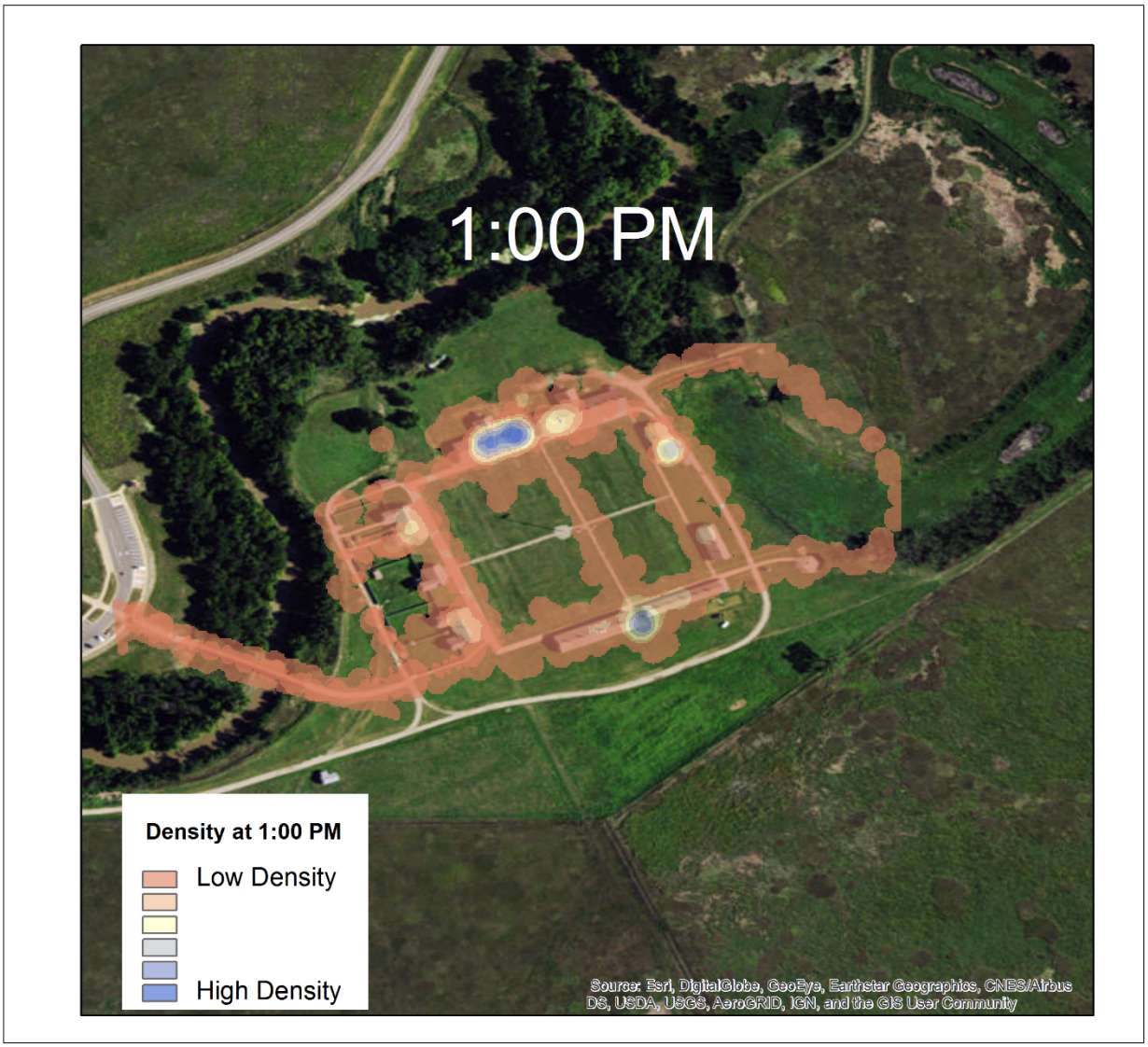

Figure 13. Density at 1:00 PM

Figure 14. Density at 2:00 PM

Figure 15. Density at 3:00 PM

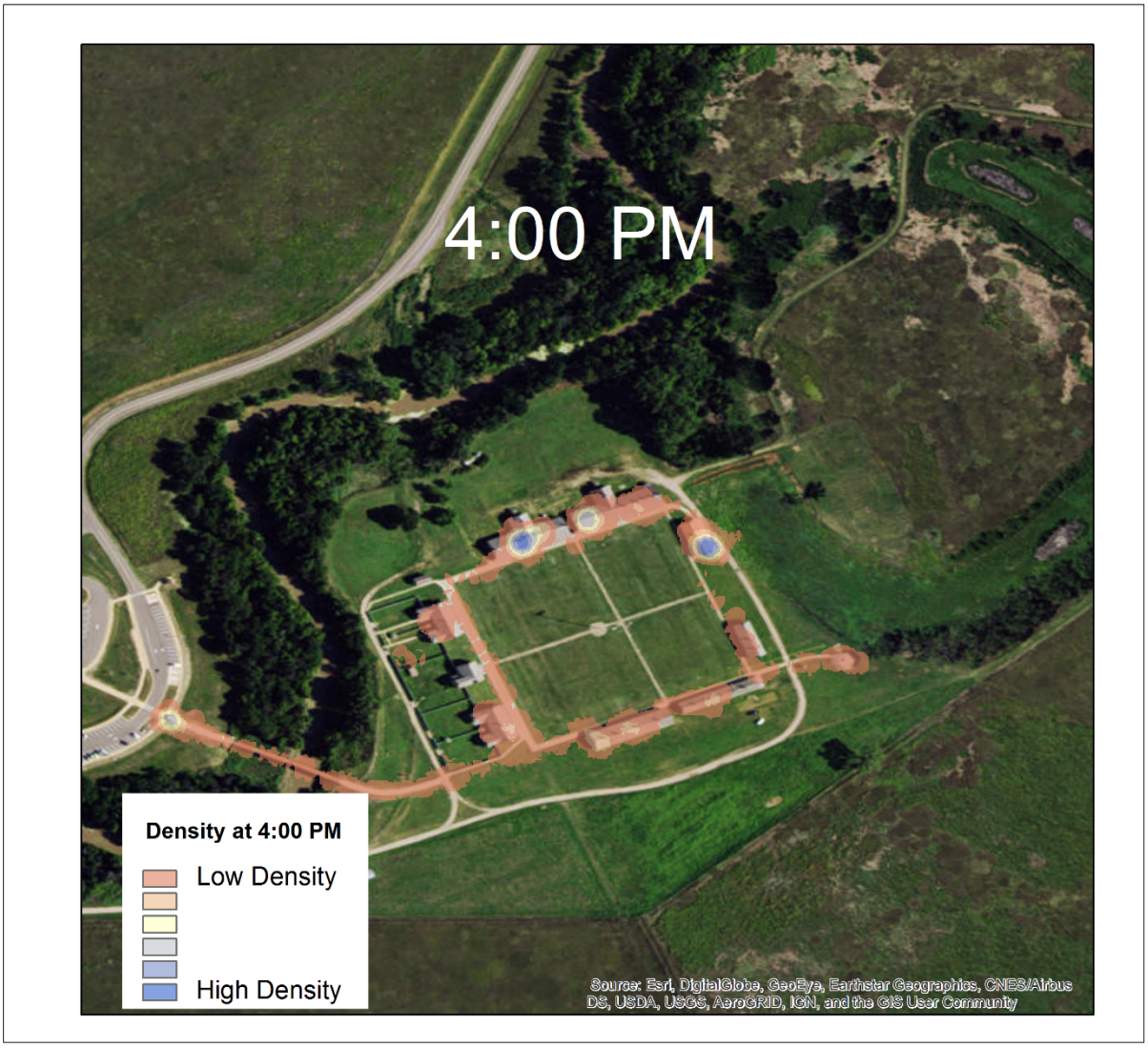

Figure 16. Density at 4:00 PM

Santa Fe Trail Ruts Cameras

Just five and a half miles from Fort Larned, another historical site is available to visitors. The Santa Fe Trail Ruts are a visual remnant of what once was a major reason for the Fort's existence, the Santa Fe Trail. For over fifty years, the wagon trail was a gateway to the west, spanning the almost seven hundred miles from Independence, Missouri to Santa Fe, New Mexico. What is left of this once prolific trail are overgrown, but still visible, ruts.

The data gathered for this area was limited due to the theft of the parking lot camera. Data was only gathered until late November 2016. To gather this data, a human behavior camera (HBC) was stationed at the top of the observation deck, facing the parking lot (Figure 17).

Figure 17. Camera position facing the Santa Fe trails ruts parking lot.

The HBC was set on a time-lapse to shoot every fifteen minutes from the hours of 6am to 8pm. However, a snapshot of use has shown that this area is seldom used. Over a two-month span (Oct-Nov.), twenty-seven people had visited the area, for a total of eighteen vehicles. Figure 18 is a representative photo from the parking lot camera.

Figure 18 – Representative picture form the Santa Fe trail ruts parking lot camera

Another HBC was set up underneath the viewing platform facing the ruts (Figure 19). This camera was deployed from Jan 3 to June 12, 2017. This camera was set to understand if visitors were going onto the ruts and exploring them. During this time frame 11 people were seen on the ruts, ranging from 1-4 people in a group. Figure 20 is a representative picture from the camera placed under the viewing platform.

Figure 19 - Camera position facing the Santa Fe trails ruts.

Figure 20 - Representative picture form the Santa Fe trail ruts camera

Discussion

The purpose of this research was to understand the temporal and spatial distribution of day visitor use at Fort Larned National Historic Site. Specifically, use patterns of visitors as they enter the park to ensure that their experiences are being fulfilled despite changes in park infrastructure. Data collection occurred during fall and winter of 2016 and spring and summer of 2017, thus representing a full year of data collection. During this time, 106 travel parties participated in the study by voluntarily carrying a small GPS unit during their day trip to the park. After appropriate data processing and analysis, results of this study provide many points for discussion and management implications.

Analysis revealed that visitors *typically travel in a clockwise direction once they entered* the park (after crossing the bridge from the parking lot) stopping at officers row then proceeding to the visitors center, the barracks, the hospital, the shops, and the bakery. The post cemetery received moderate use compared to other attractions on the clockwise loop visitors used to travel. Visitors consistently stop at the arsenal, the commissary, and the quartermasters storehouse.

Time density analysis indicates that visitor use is consistent at the Visitor Center throughout the day. The barracks and the hospital receive consistent visitor use throughout the day, as well as the shops and the bakery. Visitors who did not make use of the Visitors Center did not make their way to the shops, the bakery, the new commissary, or the blockhouse.

Most visitors use a route that takes them to the left upon entrance of the park from the bridge to the visitors center, and they continue clockwise throughout their visit. However, the density maps revealed that the commissary and the quartermaster buildings were less visited than the northern side of the park.

As basic as the GVT concept is, it is an important tool to understand visitor travel patterns in a park. These tracks can be used as baseline measures. This study can be repeated in future years to see if travel patterns have changed. Furthermore, the tracks can be used to inform numerous types of management decisions, such as infrastructure needs, ranger presence needs, conservation needs, and concessionaire needs.

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Appendix A

Fort Larned National Historic Site Contact Form – GPS Visitor Tracking

Date:_____ Weather Condition:_____

Number Who Refused Participation: _____

Researcher	Unique ID#	GPS Tracker#	Time	# In Party	Children? (Y/N)	Comments?

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