Examining Visitor Spatial and Temporal Distribution at Fort Sumter

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Executive Summary

Project Overview

The purpose of this research was to understand the patterns of temporal and spatial distribution of visitors to Fort Sumter and the factors impacting those patterns. To understand these temporal and spatial patterns of visitors qualitative observations and GPS Visitor Tracking were employed. Data collection occurred over twelve days stratified by season in the winter, spring, and summer 2023. 969 individuals representing distinct travel parties participated in this study by voluntarily carrying a small GPS unit for the duration of their visit to Fort Sumter, and 935 GPS tracks were retained for analysis. Multiple analysis methods were used to reveal the following findings.

General Findings

- Summer visitors spent the least amount of time on Fort Sumter, choosing to head back to the ferry before the allotted time was over. Winter visitors also spent less time on the island than spring visitors who spent the most amount of time on Fort Sumter.
- Season also impacts how visitors spent their time on Fort Sumter, with spring visitors spending more time in less traveled areas than winter or summer visitors.
- The location of the ranger talk impacts how visitors spend their time and their movement patterns after the talk is completed.
- Visitors spend the vast majority of their time in the lower parade ground, the upper parade ground and the museum.
- Visitors spend much less time outside of the fort walls, north of Battery Huger, or near the Battery Huger turret south of the Gift Shop.
- There is no significant difference between the length of time visitors from Patriots Point spend on Fort Sumter before returning to the ferry compared to visitors from the Visitor Center.
- Patriots Point visitors spent an average of 77.5 seconds longer in the museum than visitors from the Visitor Center, and this finding extends to the first and third quartile where Patriots Point visitors spent 100 and 46.8 more seconds in the museum than visitors form the Visitors Center respectively.

- Visitors increase the time they spend in the museum when weather conditions are poor.
- There is no significant relationship between a participant's group size and the time they spend on Fort Sumter or how long they spend in each area.
- There is no significant relationship between whether or not a participant's group included children (under 18 years of age) and the time they spent on Fort Sumter or how long they spent in each area when controlling for the season of their visit.

General Implications and Recommendations

- As the season of one's visit was determined to be a significant factor in how a visitor spends their time at Fort Sumter, park managers should continue to consider the season when scheduling tours.
- Increased use of the museum by Patriots Points visitors compared to visitors from the Visitor Center suggests that there is a need to better reach visitors from Patriots Point with supplemental education and interpretive resources.
- The amount of outdoor interpretive signage (not the museum) greatly influenced how long visitors spent in that area. If managers desire to disperse use across the island, they may consider increasing interpretive signage in lesser used areas.
- While the most common opinion of the length of the tour shared with researchers was that an hour was too short, variation was expressed and found to exist in the GPS data with several participants expressing that an hour was too long and some individuals heading back well before their scheduled departure.
- Supplemental research is necessary to more accurately quantify visitors' preferred tour length.
- The data collected in this study may be used as a baseline for long term monitoring should visitor use patterns change for any reason including management action.

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Introduction and Rationale

Located roughly 3.5 miles into the Charleston Harbor, Fort Sumter, as a portion of the current day Fort Sumter and Fort Moultrie National Historical Park, first welcomed visitors in 1948 as a national historic site. Though Fort Sumter is a shell of its former self dating back to its initial foundation being laid in 1834, it was never entirely finished (e.g., armaments and interior not complete) when it was fired upon by Confederate batteries on April 12, 1861. As many consider the attack on Fort Sumter (which was occupied as a fortification of the U.S. government and its military) the starting point of the U.S. Civil War, hundreds of thousands visit the island to catch a glimpse of history and experience preserved artifacts. Travel to Fort Sumter is limited primarily to a concession-operated ferry fleet that delivers visitors to the island for their one-hour exploration of the fort. While on Fort Sumter, some attractions appear to have a higher demand than others.

Enabling legislation charges park managers at Fort Sumter and Fort Moultrie National Historical Park (FOSU) to protect natural and scientific values and resources of the park while providing public access and enjoyment. 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 Fort Sumter (Beeco, Hallo, & Brownlee, 2014). GPS Visitor Tracking (GVT) is a suitable tool to determine visitor travel patterns at Fort Sumter. 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 (Sharp et al., 2022; Sharp et al., 2019; White, Brownlee, Furman, & Beeco, 2012; 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 vital forms of visitor use data (Beeco et al., 2012; Beeco, Hallo, English, & Giumetti, 2013; Cai, van Riper, Johnson, Stewart, Raymond, Andrade, Goodson, & Keller, 2023; 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 ecological and social

conditions (D'Antonio et al., 2010; Hammitt & Cole, 1998; Manning, 2011). Consequently, GVT has been used in iconic and highly visited settings within the U.S., such as Denali National Park, Yosemite National Park, Rocky Mountain National Park, and the Teton Range, as well as internationally in various national parks (Choe, Lee, Choi, Kim, & Sim, 2023; Hardy & Aryal, 2020) to measure frequency, timing, and intensity of use. It has also been used at cultural sites (Sharp et al., 2019) and areas accessed by ferry (Peterson et al., 2020). Previous studies have found GVT was successful to help understand how visitor use is distributed spatially and temporally in park and protected areas. However, researchers and managers have not used GVT at Fort Sumter to understand visitor use patterns. This study enables Fort Sumter to identify and understand baseline measurements of visitor use patterns. Fort Sumter and Fort Moultrie National Historical Park has several planning efforts in progress, and it is essential to have current, precise information about its visitors.

Our research approach will strengthen management understanding of the visitor experience and use at Fort Sumter. Our research is guided by the steps and processes outlined in the Interagency Visitor Use Management Framework that identifies the interdependencies between the visitor experience, management expectations and directives, and resource conditions (IVUM, 2016).

This research has several key objectives in aiming to identify temporal and spatial distribution of visitors to Fort Sumter including:

a. How visitors choose to spend their 1-hour at the Fort before reboarding the ferry
b. Identify which activities/experiences visitors engage with or avoid
c. Demonstrate how visitors move throughout the fort
d. How spatial and temporal characteristics of visitor use varies by different user groups
e. If visitors congregate and/or concentrate in certain areas
f. How visitor use impact fort resources—both natural and cultural
g. How use patterns change when there are more visitors (closer to the ferry's capacity)

Methods

Intercepting Visitors

In the winter, spring, and summer of 2023, researchers used systematic random probability sampling (Vaske, 2008) to intercept Fort Sumter day-use visitors in four main locations; 1) Liberty Square (Visitor Center Dock), 2) Patriots Point, 3) on the ferry, and 4) at the fort (mainly used for observational data) (Figure 1). The different departure times of the ferry were also systematically sampled (Table 1). These locations were chosen because they are the only means of visitor access to the fort. The different locations were also sampled (primarily Patriots Point and Liberty Square) due to park managers' indication that visitors may have different experiences based on point of departure. For example, visitors departing from Liberty Square can go to the NPS visitor center before boarding the ferry. Whereas visitors departing from Patriots point have very little exposure to NPS messaging or opportunities to learn about the fort before their departure.

Table 1 Ferry Departure Times and Locations

Liberty Square	**Patriots Point**
Winter	
11:00 AM	1:00 PM
2:30 PM	
Spring	
9:30 AM	10:30 AM
12:00 PM	1:00 PM
2:30 PM	
Summer	
9:30 AM	10:30 AM
12:00 PM	1:00 PM
2:30 PM	3:30 PM*
4:00 PM*	

*ferry is a combined trip

Figure 1 Intercept locations for the administration of GPS data loggers

Table 2 below outlines the dates that visitors were intercepted during this study and the days during which qualitative observations were made at the fort. During the winter and spring sampling period, visitors were contacted at Liberty Square (1) and Patriots Point (2) and observational data was collected at the fort (4). Visitors were contacted while they waited in line to board the ferry. The summer data collection was conducted primarily on the ferry (3) after departing from either Patriots Point and Liberty Square. This was done in conjunction with input from park managers that we might have greater success in reaching more people (as visitors would not be actively trying to board the ferry). The following script was used to make an announcement to all ferry passengers upon boarding:

> *"Good morning/afternoon! My name is (insert researcher), I'm a graduate student at UGA and I'm here with my colleague (insert researcher) from Kansas State University. We are doing a research project on visitor movement here at Fort Sumter and we are looking for some volunteers. We're going to be coming around and handing out GPS*

loggers. They're about the size of a USB drive. You can just put it in your pocket and forget it's there. We will pick them up from you either before you get back on the ferry, or we'll find you on the way back. Thank you for your time, and we'll pass it over to Ranger (insert ranger)."

Table 2 Dates and locations of visitor intercepts and observations (observations conducted at the fort)

Dates	**Location(s)**	**Number of Loggers Administered (% of total administered)**
Research Trip 1 – January 12-15		
Thursday, January 12	Visitor Center Observations	3.74%
Friday, January 13	Patriots Point Observations	2.35%
Saturday, January 14	Visitor Center	7.59%
Sunday, January 15	Observations	7.70%
Research Trip 2 – March 31 to April 3		
Friday, March 31	Visitor Center Observations	4.39%
Saturday April 1	Visitor Center Observations	1.82%
Sunday, April 2	Patriots Point Observations	5.24%
Monday, April 3	Visitor Center	11.02%
Research Trip 3 – July 1 to July 4		
Saturday, July 1	Visitor Center Observations	15.19%
Sunday, July 2	Visitor Center Patriots Point Observations	1.71% 12.83%
Monday, July 2	Visitor Center Observations	15.08%
Tuesday, July 4	Visitor Center Patriots Point Observations	1.71% 9.63%

Intercepted visitors voluntarily participated in the study and received a GPS unit to carry with them throughout their visit. The number of visitors that declined to participate were recorded for the winter and spring data collection periods, but this could not be accurately recorded for the summer data collection since participants volunteered by raising their hands as researchers moved throughout the ferry. The researchers distributed one GPS unit per travel party, and the size of the travel party was also recorded. Researchers chose to use the Canmore GT-740FL Sport and the Canmore GT-730FL-S (which uses the same chipset simply in a different body) because in a study by White et al. (2012) the Canmore GT-740FL 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 and GT-730FL-S also have extended battery capabilities. Additionally, the Canmore GPS units are about the size of a computer flash drive, which easily fits into a pocket and is not bulky or heavy (Figure 2).

GPS units were configured to mark spatial waypoints and timestamps at 3-second intervals, and all waypoints were recorded in decimal degrees. During the winter and spring sampling periods, the researchers asked participants to return the GPS units at the end of their visit. During the summer sampling period visitors were asked to return the GPS units upon returning to their ferry or while on the ferry back to either Patriots Point or Liberty Square.

Figure 2 Canmore GT-740FL Sport GPS data logger used during this study

Data Management

The researchers first imported GPS tracking data into the CanWay desktop application and exported the tracks as GPX files. The researchers then imported the GPX files into ArcGIS Pro as point features and clipped to the extent of Fort Sumter and the dock (See Figure 3). The clip feature does not extend all the way to the ferry, and this was done in order to more easily differentiate between waypoints taken while on the ferry rather than the dock and island as signal quality in the ferry tends to be quite poor. A small number of point features were empty after clipping due to the participants either leaving the logger on the ferry, remaining on the ferry during the visit, or the logger putting itself into standby mode and not waking during their trip. After verifying that the GPX file was imported correctly and did not contain any usable data, the empty point features were removed from the sample. For point features from the same GPX file that covered multiple participant tracks, a Python script using the arcpy module was used to split point features into separate point features for the different participants. Next, another arcpy Python script was used to append to the point features visitor party information (group size, whether or not children were with the group, prior visitation, whether or not the participant had

visited the Visitor Center, and visitor satisfaction and likelihood to return) and trip data (departing location and the weather).

Figure 3 Polygon feature used to clip GPS track point features

The researchers 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 first and last points of each point feature along with other participant and trip attributes and were exported to a csv file for analysis. The total times were adjusted for all participants to account for the increased time to disembark the ferry for visitors in the Spring and Summer due to larger tour sizes. In order to find the adjusted time, the earliest point from each tour within the clip area was identified, and the difference between the timestamp of the last point for each participant and the timestamp of the earliest point for the tour was calculated. The total time visitors spent at Fort

Sumter before returning to the ferry was analyzed using two-sample t-tests, one-way Analysis of Variance (ANOVAs), or factorial ANOVAs, depending on the comparisons to be tested.

To display where visitors congregate, we created heat maps using ArcGIS Pro to estimate the kernel density of GPS Points. Kernel density is similar to other types of density or hot spot analysis within ArcGIS Pro that produce heat maps. However, there are several key differences between these analyses. Kernel density maps produce a smoothing effect that results in a clean display and is a non-parametric process in which each point is analyzed uniquely with no underlying distribution assumed (Silverman, 1986). Additionally, kernel density estimation focuses on locational data and does not need an associated attribute value like the Hot Spot Analysis tool does. Kernel density is most similar to point density (which Peterson et al. (2020) used to visualize visitor patterns at Cumberland Island National Seashore), but the method to estimate the point density for a given location is slightly different. In a point density analysis, the density value for a given location is equal to the number of points (all weighted equally) within a search radius divided by the area of the circle produced with that radius. In a kernel density analysis, though, the value of the points within the search radius are weighted and decreases as the distance to the point of estimation increases. This slight difference in calculation results in a smoothed map with a higher level of detail than what can be achieved using the Point Density tool.

In order to create these kernel density heat maps, the individual point features were merged into a single point feature, and the ‘Select by Attributes' tool was used to select desired groupings or subsamples of the data. We then used the Kernel Density tool within ArcGIS Pro. The Kernel Density tool allows for the inclusion of ‘barriers,’ which increases the path distance to the center of a kernel for a datapoint. The barriers used within this analysis (identified by physical barriers and features blocking movement at Fort Sumter) are displayed below in Figure 4.

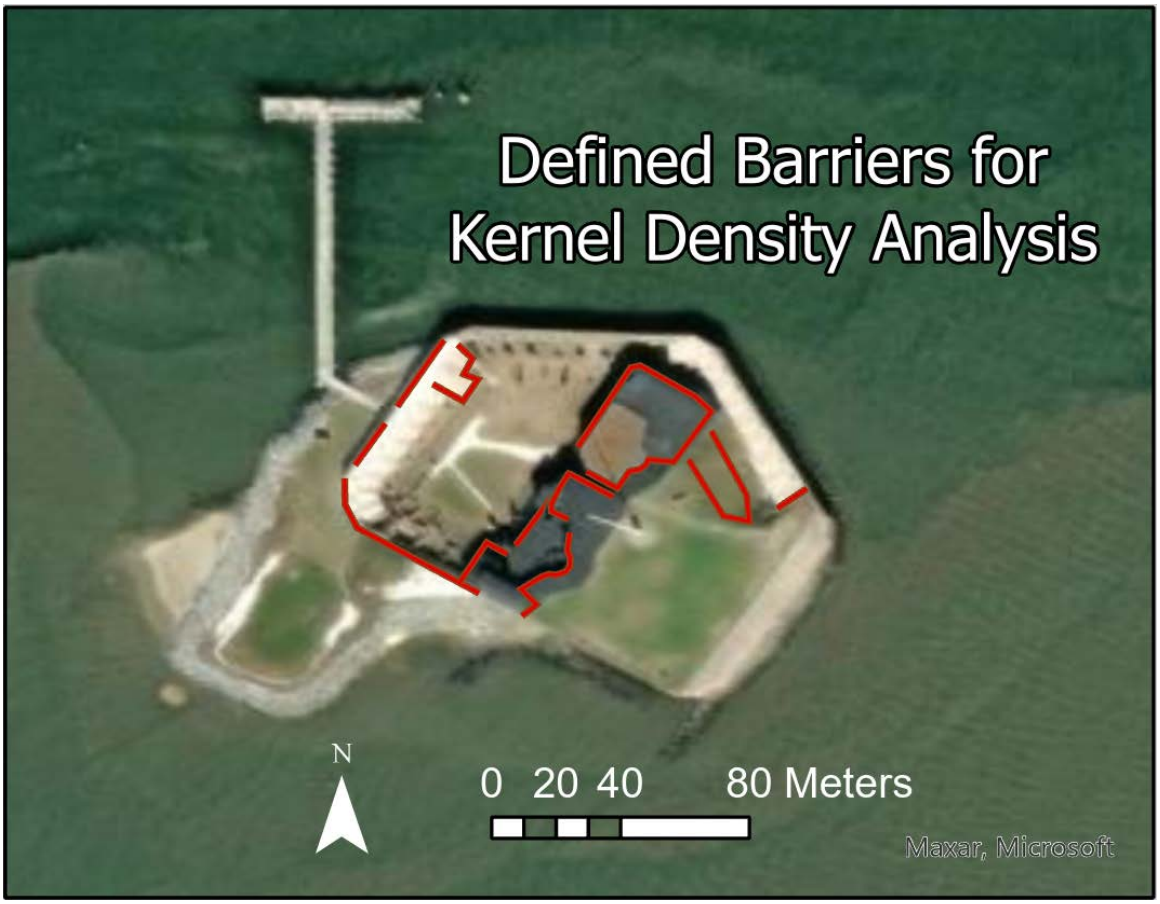


Figure 4 Line features used as barriers in Kernel Density Analysis

Creating Areas of Analysis

The researchers used visual analysis, the FOSU General Management Plan, input from managers at FOSU, and onsite research experiences at Fort Sumter to determine areas of analysis for the fort, which were used for specific area assessments. The fort was partitioned into nine areas (Figure 5):

- 1 – Entry/Exit - use getting on and off the ferry and those who might be stopping to take a picture of the Fort Sumter sign
- 2 – Fort Sumter Beach and Leach Field - use in the area outside the fort
- 3 – Lower Parade Grounds North – use related to interpretive programming
- 4 – Lower Parade Grounds South – use related to visitor use near the powder magazine and Officers Quarters and occasional interpretive programming

- 5 – Upper Parade Grounds Flag – use related to the upper parade grounds and the flag raising and lowering ceremony, also encompasses the bookstore
- 6 – Museum
- 7 – Battery Huger, south of the Gift Shop – use related to interpretive signage
- 8 – Upper Parade Grounds Interpretation – use related to visitors interactions with interpretive signage
- 9 – Right Face – use related to visitor movement from lower parade grounds to upper parade grounds

It should be noted that these areas are generally larger than what visitors can access on the ground (e.g., several case mates in Area 9 are cordoned off to the public due to cannon restoration work and the areas extend beyond the fort walls). This was done to ensure that all points were captured in an area since the error in the GPS units may place a participant slightly outside of where they could realistically be.

The researchers analyzed time spent in each area by first creating nine attribute fields representing each area in the point feature. Next, the Select by Location tool was used to identify points within each area and the attribute field representing that area was updated to indicate the point's location. Finally, an arcpy Python script was employed to summarize the total time each participant spent within the nine areas and exported the results to a csv file. It should be noted that the python script makes one key assumption for any time lost due to the logger entering standby mode or data lost in the cleaning process: if the point immediately before and the point immediately after the data loss are within the same area, then the script assumes that all missing time was spent within that area. When the point immediately before and immediately after the data loss is different, the script makes no assumptions as to the area where the missing time was spent. Using SPSS, the researchers employed two-sample t-tests, one-way analysis of variance (ANOVAs) tests, multiple one-way analysis of variance (MANOVAs) tests, multivariate regressions, and multivariate analysis of covariance (MANCOVAs) to the compare average time spent in each of the nine areas across variables such as the season, point of departure, group size, whether or not there were children in the group, temperature, wind speed, and tour size. Each statistical test was chosen carefully depending on the type of predictor variable being tested.

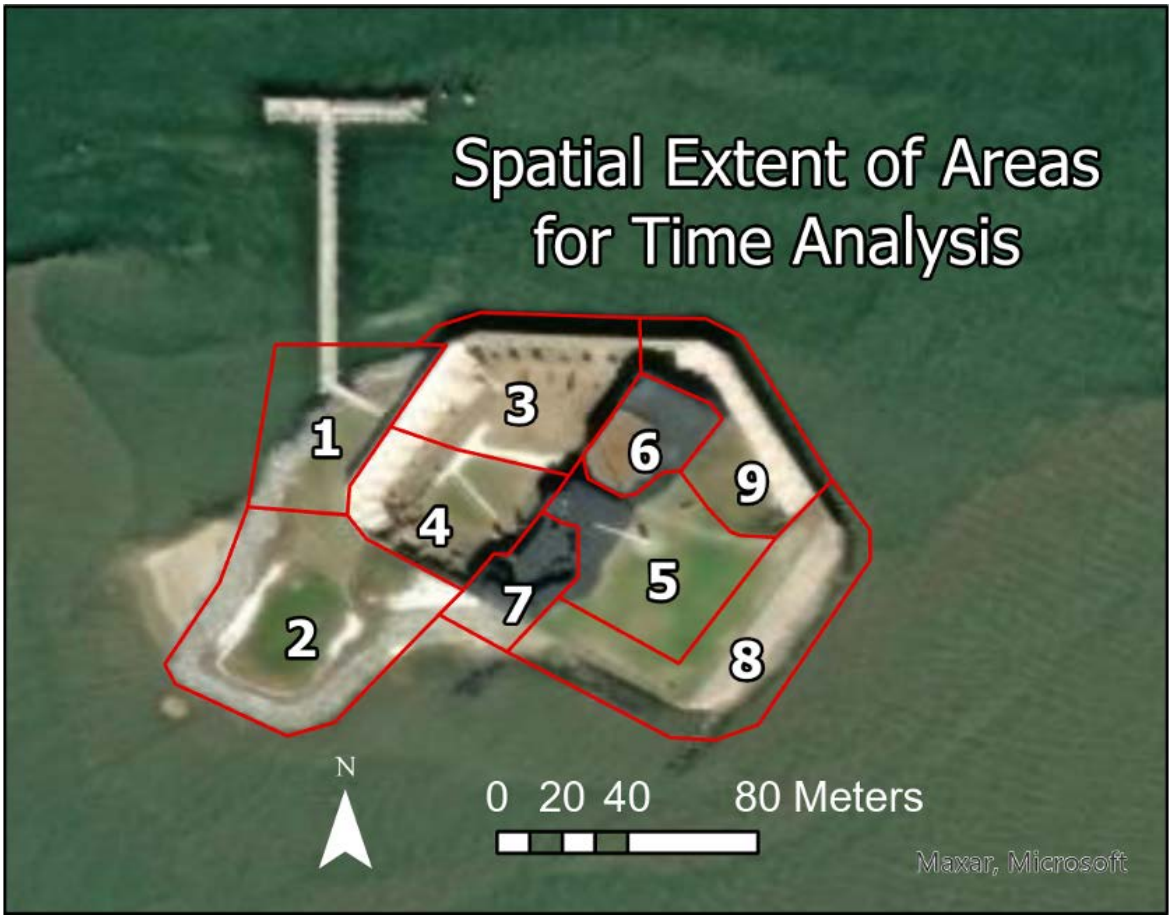


Figure 5 Area for analysis at Fort Sumter

Finally, to complement the quantitative and spatial analysis techniques, researchers also made qualitative observations while visitors were at Fort Sumter. Using a form to take notes (see Observational Grid in Appendix B), researchers noted the weather conditions, visited behaviors and focal points, any pertinent overheard conversations, and estimated the number of visitors attending a ranger talk. Only select trips to Fort Sumter were observed in the Winter and Spring, but qualitative observations were conducted for all tours during the summer data collection. Additionally, if an observational visit coincided with a tour where GPS data loggers were distributed, visitors would often volunteer their impressions to the researchers upon returning the data logger, and those impressions were likewise recorded.

After completing the data collection process, the observational forms were reviewed to ensure that observations matched the quantitative data. Particularly insightful observations from the qualitative data are described at the end of the Results section.

Limitations

All efforts were made to ensure that the results of this study are rigorous, in line with scientific standards and representative of the visiting population to Fort Sumter. However, a few possible limitations should be noted. The research team sampled visitors during three seasons at the park but did not sample during the Fall. Visitor contacts were stratified by different times of year, week and day to capture as wide a swath of the visiting population as possible, but it is conceivable we did not sample every type of group or individual that may visit the park. The partitioning of the fort into nine areas was done with extensive feedback from managers at the park and through researcher observations. The GPS data loggers used for this study can be accurate up to 2.5 meters, but error does exist. Thus, the partitioning of the fort into nine areas in such a geographically small area, may have led to some level of overlap between areas during the analysis.

Results

A total of 969 data loggers were distributed with 28 visitors refusing to participate. 2 data loggers were lost representing 6 tracks, and 28 additional tracks were removed from the sample due to logger malfunction or poor signal quality. Thus, 935 tracks total were recorded and used in the sample, resulting in a response rate of 90.7%. Table 3 below summarizes the sample.

Table 3 Sample size and response rate by date and time

Date and Time	Departure Point	Participants	Lost or Rejected Tracks	Refusals	Response Rate	Percent of Sample	Average Group Size	Percent with Children
1/12/2023								
11:00 AM	Visitor Center	17		1	94.4%	1.82%	2.53	11.8%
2:00 PM	Visitor Center	18		1	94.7%	1.93%	2.56	16.7%
1/13/2023								
1:00 PM	Patriots Point	22		1	95.7%	2.35%	2.95	4.5%
1/14/2023								
11:00 AM	Visitor Center	35	1	5	85.4%	3.74%	2.54	17.1%
2:00 PM	Visitor Center	36		3	92.3%	3.85%	2.67	30.6%
1/15/2023								
11:00 AM	Visitor Center	36		3	92.3%	3.85%	2.89	16.7%
2:00 PM	Visitor Center	36		3	92.3%	3.85%	2.53	8.3%
3/31/2023								
2:30 PM	Visitor Center	41	2		95.3%	4.39%	3.93	24.4%
4/1/2023								
9:30 AM	Visitor Center	17	1		94.4%	1.82%	2.53	11.8%
4/2/2023								
10:00 AM	Patriots Point	34	2	1	91.9%	3.64%	3.88	50%
1:00 PM	Patriots Point	15		2	88.2%	1.60%	4.47	53.3%

Date and Time	Departure Point	Participants	Lost or Rejected Tracks	Refusals	Response Rate	Percent of Sample	Average Group Size	Percent with Children
4/3/2023								
9:30 AM	Visitor Center	47	4	4	85.5%	5.03%	2.8	35.6%
12:00 PM	Visitor Center	23		1	95.8%	2.46%	3.5	36.4%
2:30 PM	Visitor Center	33	4	3	82.5%	3.53%	3.21	44.8%
7/1/2023								
9:30 AM	Visitor Center	48	1			5.13%	3.29	31.3%
12:00 PM	Visitor Center	48	1			5.13%	3.08	35.4%
2:30 PM	Visitor Center	46	3			4.92%	3.13	32.6%
7/2/2023								
10:30 AM	Patriots Point	48	1			5.13%	3.33	63.2%
1:00 PM	Patriots Point	40	1			4.92%	3.8	45%
3:30 PM	Patriots Point	32	1			3.42%	4.06	46.9%
4:00 PM	Visitor Center	16				1.71%	3.81	37.5%
7/3/2023								
9:30 AM	Visitor Center	48	1			5.13%	3.58	54.2%
12:00 PM	Visitor Center	46	3			4.92%	3.91	36.7%
2:30 PM	Visitor Center	47	2			5.03%	3.53	48.9%
7/4/2023								
10:30 AM	Patriots Point	48	1			5.13%	3.81	47.9%
1:00 PM	Patriots Point	27	2			2.89%	3.67	44.4%
3:30 PM	Patriots Point	15	3			1.60%	4.47	66.7%
4:00 PM	Visitor Center	16				1.71%	3.44	50%
TOTAL		**935**	**34**	**28**	**90.7%**	**100%**	**3.35**	**36.5%**

Analysis of Total Time on Fort Sumter

One of the primary questions instigating this research was the length of time visitors spend at the fort during their visit. Figures 6 and 8 through 11 below display the time visitors

spent at Fort Sumter before returning to the ferry through density diagrams. For figures with vertical lines, the line represents the mean time (in minutes) that that subsample spent on Fort Sumter. Additionally, the time is adjusted to the earliest point identified within the clip area for each ferry in order to account for the increased time to disembark from the ferry in the Spring and Summer months. This increased time to disembark in Spring and Summer is visualized with a box plot in Figure 7.

Figure 6 displays a histogram of the total adjusted time visitors spent at Fort Sumter before returning to the ferry with a density curve overlaid. In general, the data displays a slight left skew. For all participants in the sample, the mean time spent at Fort Sumter before returning to the ferry (again, adjusting to the earliest visitor arrival) is 49:46.9, with a standard deviation of 6:24.4. The median is less than a minute longer at 50:34.0.

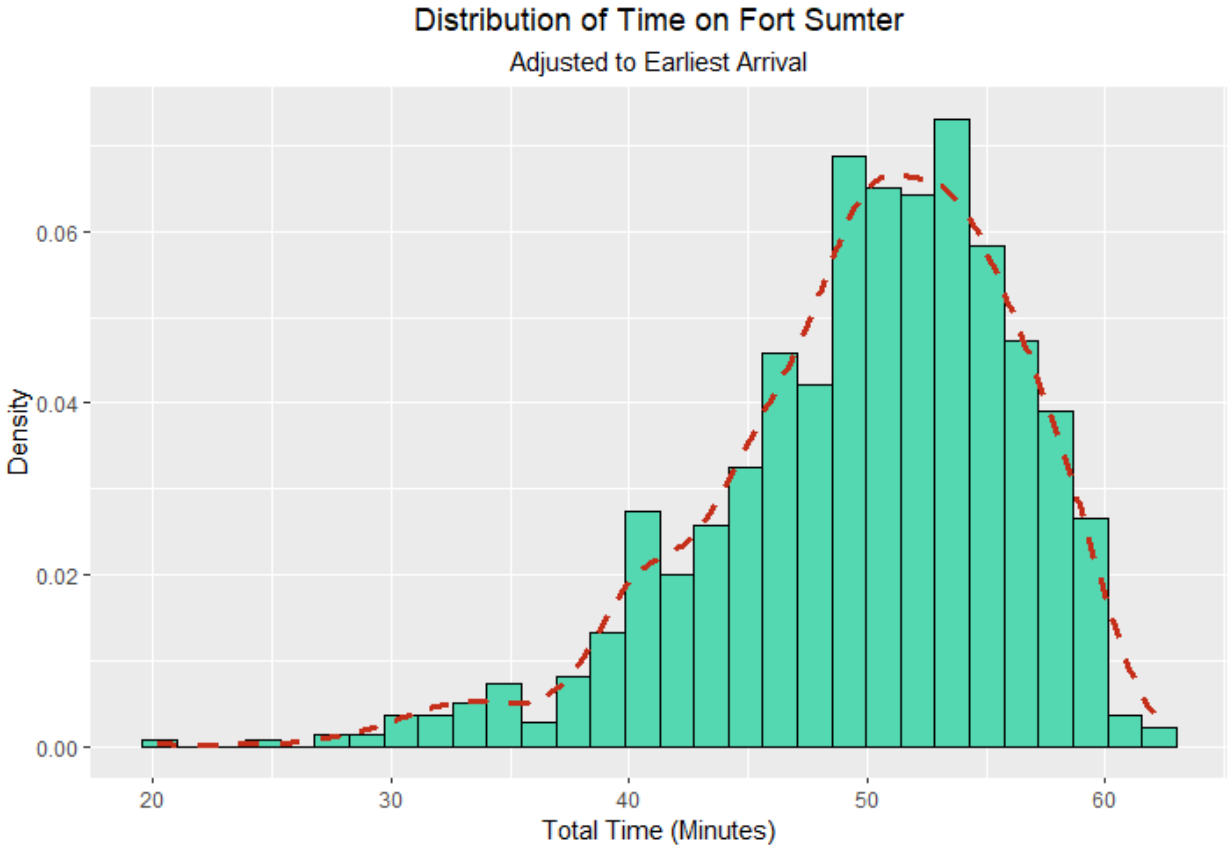


Figure 6 Histogram of time spent on Fort Sumter for all visitors

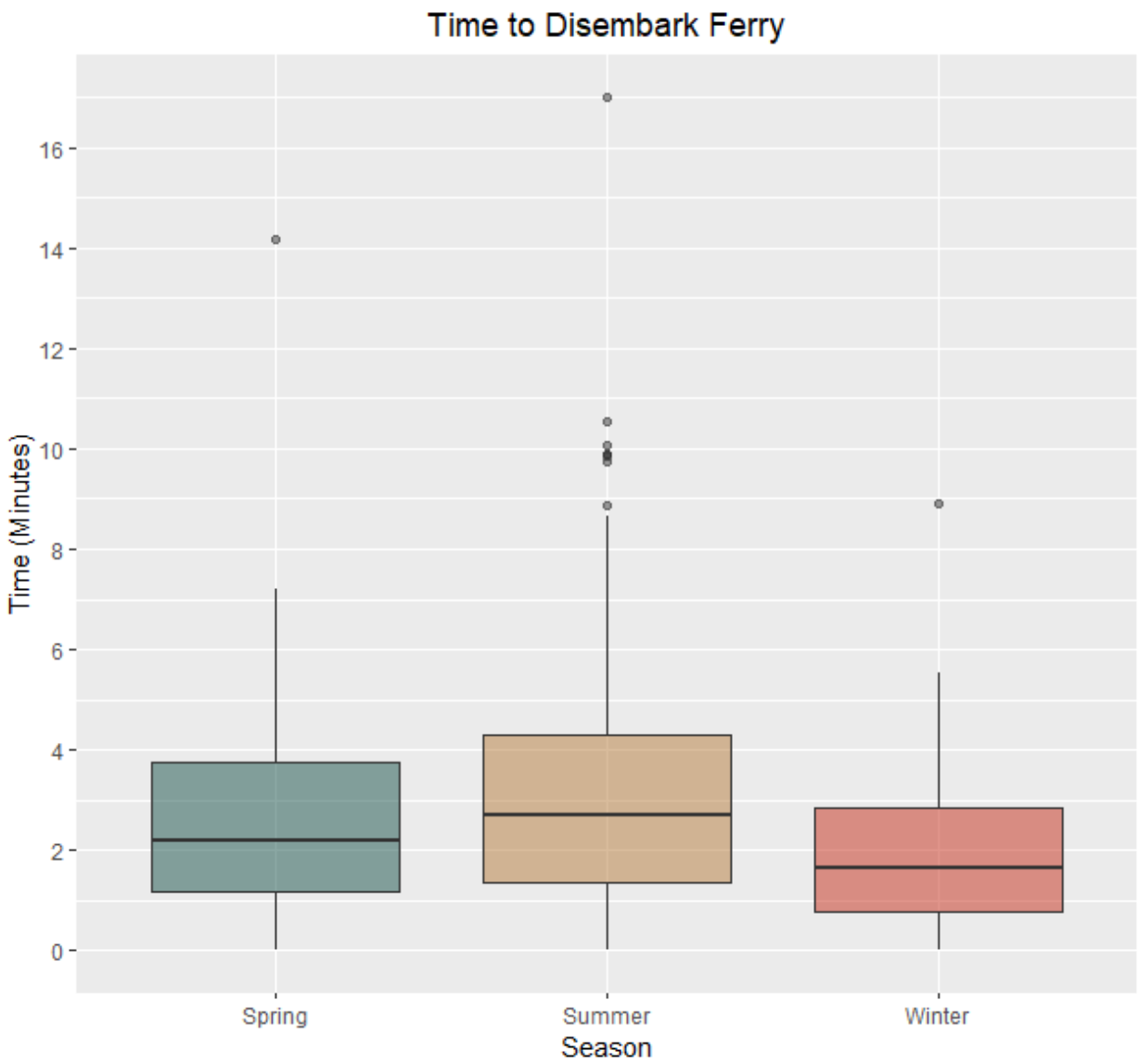


Figure 7 Box Plot of the time to disembark the ferry by season

Even after factoring in the additional time to disembark, season still plays a large factor in the total time visitors spend at Fort Sumter. Visitors in the spring spent the longest at the fort with an average of 52:27.6 (sd = 5:36.8). Visitors in the summer spent the least amount of time at the fort with an average of 48:10.2 (sd = 6:35.7), and visitors in the winter had an average of 51:11.8 (sd = 5:20.6). Comparing the total time of visitors with a one-way analysis of ANOVA results in an F-value of $F(2, 932) = 43.46$, corresponding to a p-value $< .0001$. This means that there is a significant relationship between the season of one's visit and how long they spend on the island.

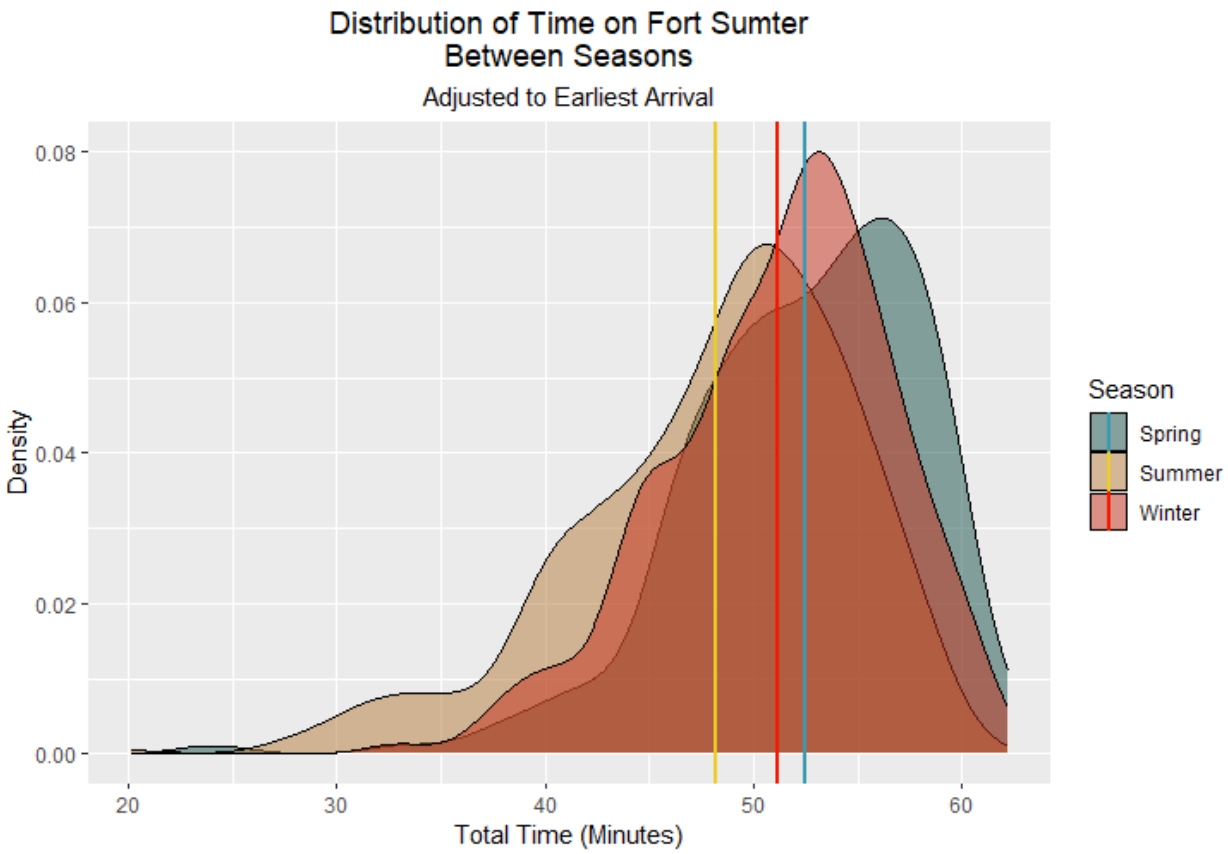


Figure 8 Density diagram of the time on Fort Sumter by season

One visitor attribute that was predicted to significantly impact the visitation to Fort Sumter was the point of departure. When considering just the length of time spent at the Fort before returning to the ferry, though, the density plots and means are nearly identical (as demonstrated in Figure 9). This is confirmed with a Welch's Two Sample t-test, resulting in a p-value of .73, signifying that there is not a significant statistical difference between visitors from Patriots Point and the Visitor Center in terms of the length of their visit. However, as is discussed later, there are differences in how that time is spent white at Fort Sumter, with the two groups spending more or less time in different areas. Initial results presented to park management indicated that there may be significant differences between the two groups, but that was likely due to a small sample size of Patriots Points visitors after the first data collection period. In fact, that trend seemed reversed after the second round of data collection in March and April, and the

distribution of time at Fort Sumter appears to be roughly equal for data collected in the summer. Figure 10 below displays these variations between departure locations across seasons.

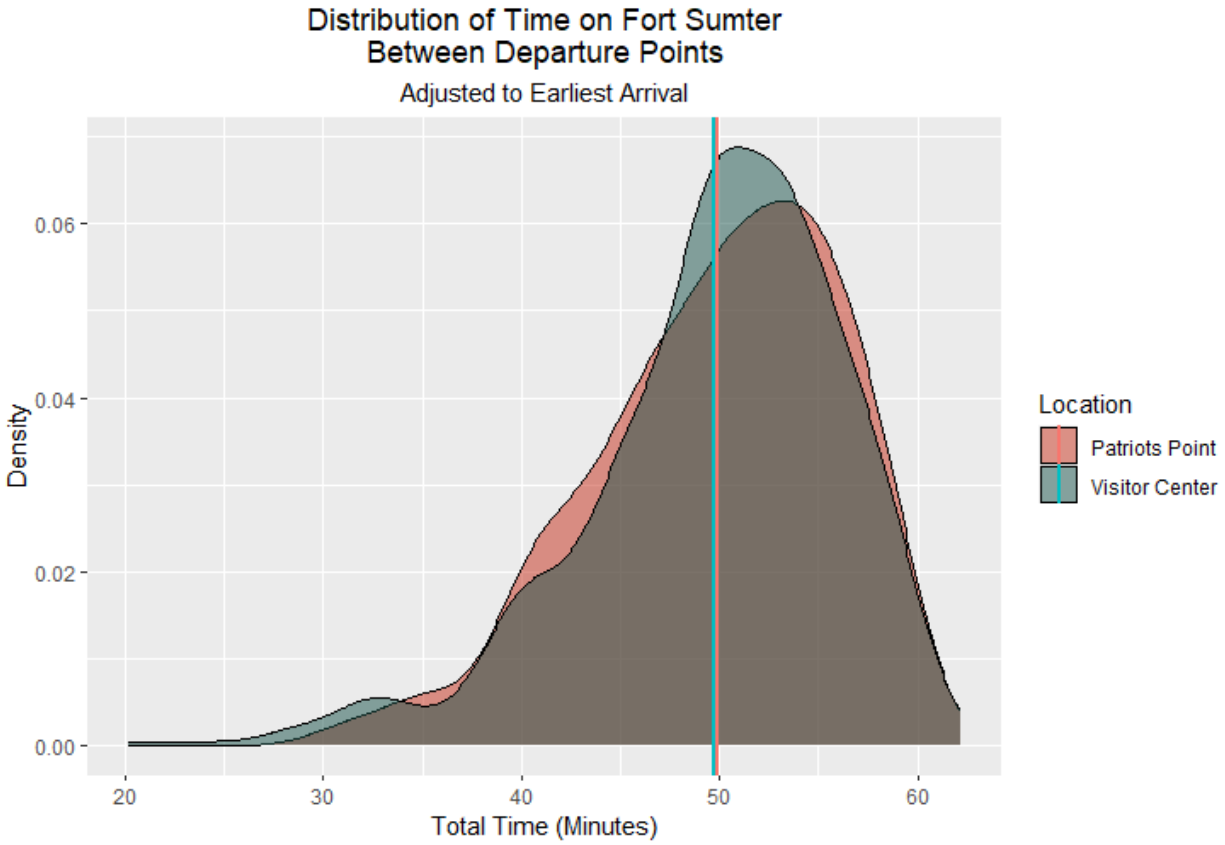


Figure 9 Density diagram of the time on Fort Sumter by point of departure

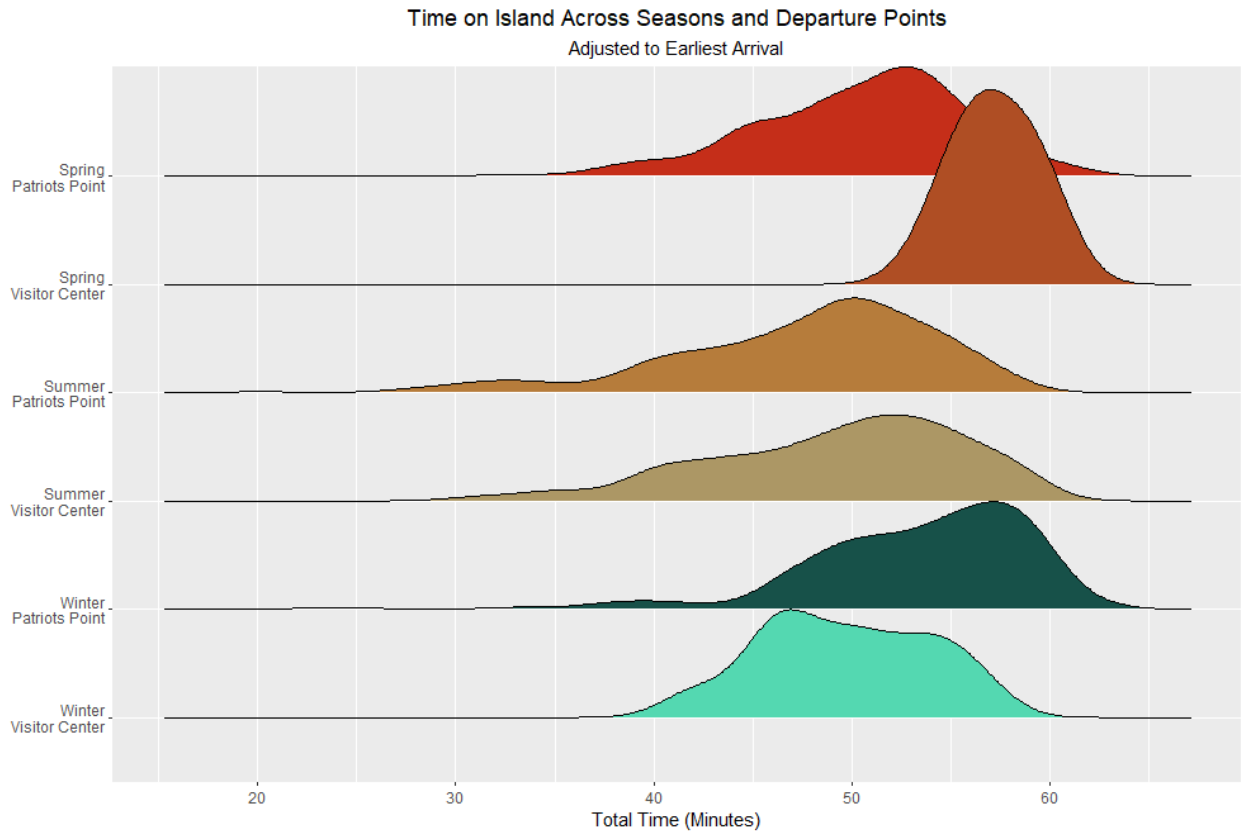


Figure 10 Density Diagram of the time on Fort Sumter by point of departure and season

Lastly, it was predicted that groups with children may behave differently than groups without children. When considering the time spent at Fort Sumter, a slight difference is observed between the two groups as groups with children spend slightly less time at the fort before returning to the ferry (49:07.6, sd = 6:06.2) than groups without children (50:10.9, sd = 6:26.2) as can be seen in Figure 11.

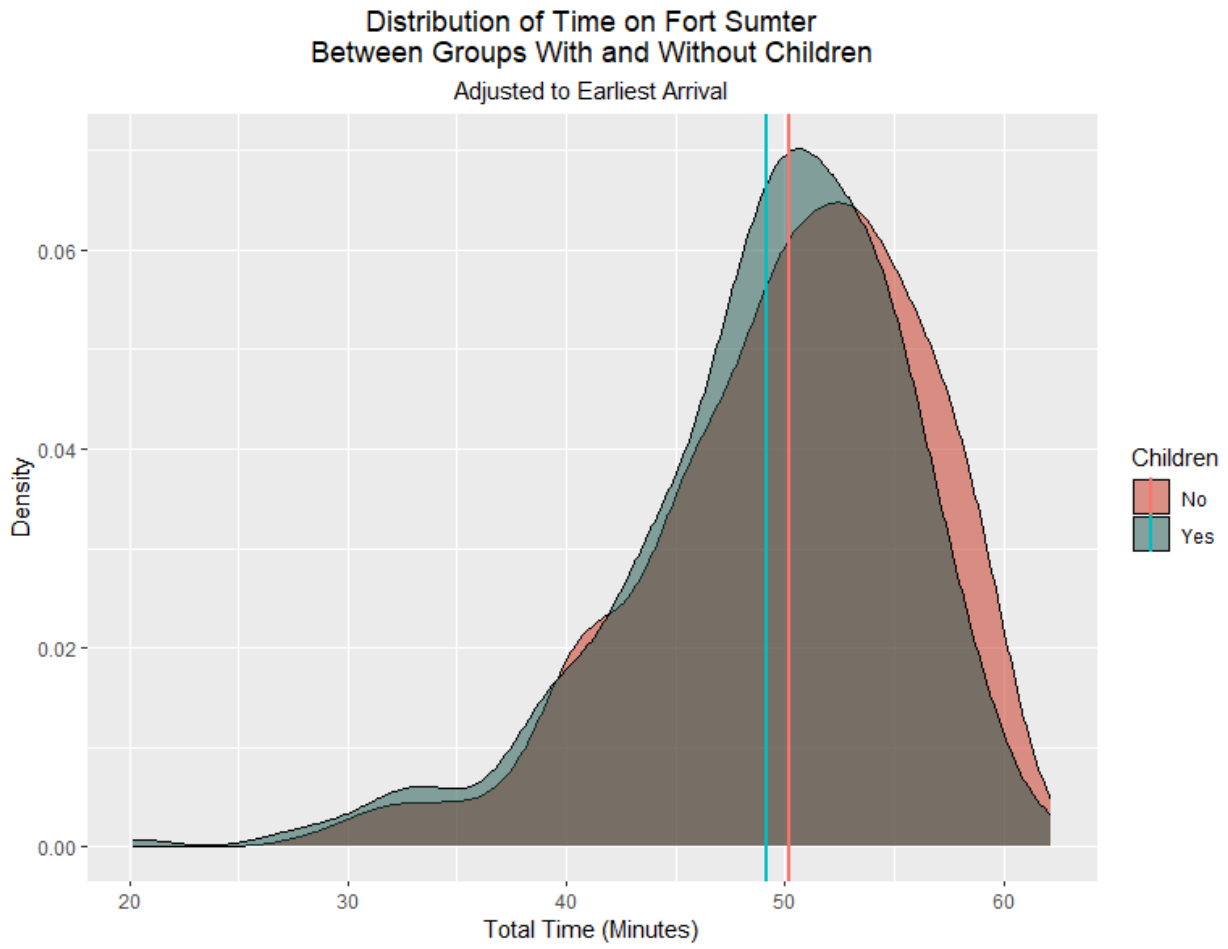


Figure 11 Density Diagram of time on Fort Sumter by groups with and without children

While this difference is statistically significant when tested with a two-sample t-test ($p = .017$), it is likely due to compounding factors. Considering that the proportion of groups with children increases substantially in the summer when the average total time at Fort Sumter is lowest, this difference may be attributed to seasonal variation rather than differences between groups. This is supported by a factorial ANOVA that tests for differences in groups with and without children while controlling for the season. The factorial ANOVA finds a significant main effect for season, $F(2, 912) = 45.125$, $p < .001$; however, there was no significant main effect for children in the group, $F(1, 912) = 1.293$, $p = .26$; and the interaction between season and children in the group was similarly not significant, $F(2, 912) = 1.153$, $p = .316$.

Kernel Density Analysis

Figure 12 below displays the kernel density of all tracks collected, and Figures 13 through 15 show the kernel density of tracks collected for each season. As stated previously, kernel density is a method for producing a highly detailed, smoothed heat map. It estimates the density of points for any given location by decreasing the weighted value of the points within a search radius as the distance to the point of estimation increases. The kernel density for each map is displayed using a geometric interval which classifies the densities into stretched intervals that increase with as the kernel density increases. In order to visualize the greatest degree of variation within each map, a unique geometric interval was used. As a result, one should examine the legend carefully when comparing the results between different maps. Additionally, since the kernel density is dependent on the number of points within the search radius of the kernel, maps displaying smaller sub samples will have lower densities. For example, of the maps displayed in Figures 12 through 15, the highest density can be found in the map displaying the data from all visitors and the lowest peak density is found within the map of just the winter visitors, which was the season with the fewest participants.

The kernel density maps displaying the seasonal variation in visitor concentrations (Figures 13 through 15) visualize the patterns identified through the MANOVA summarized in Table 4. What is particularly revealing in Figures 13 through 15 is the increased kernel density and time spent in Area 6 (the museum) during the summer. Figures 16 through 19 alternatively visualize this difference through a series of pie charts.

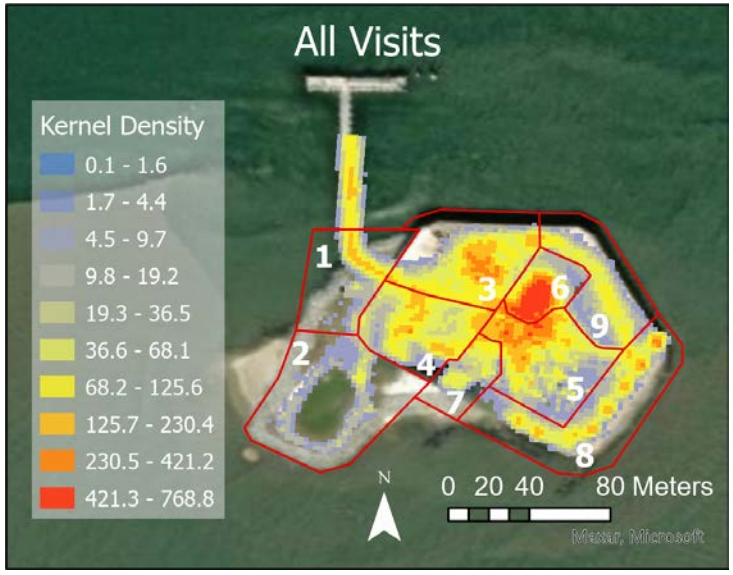


Figure 12 Kernel Density of all participants

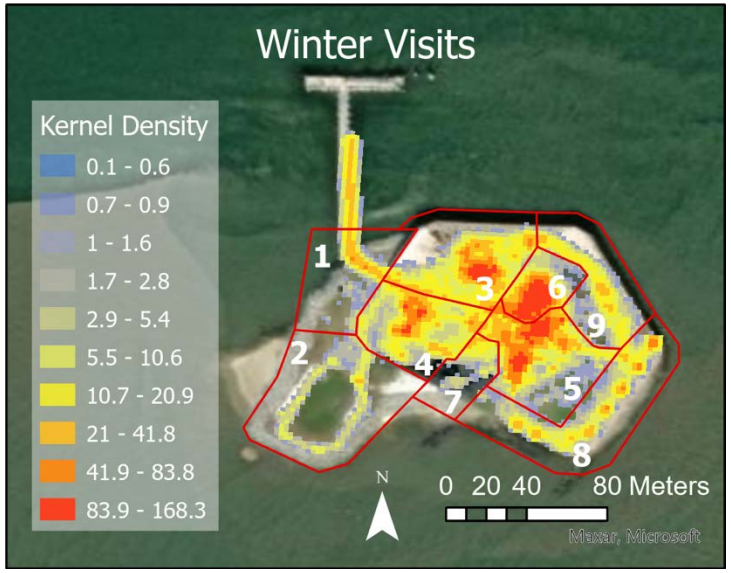


Figure 13 Kernel Density of participants visiting in the winter

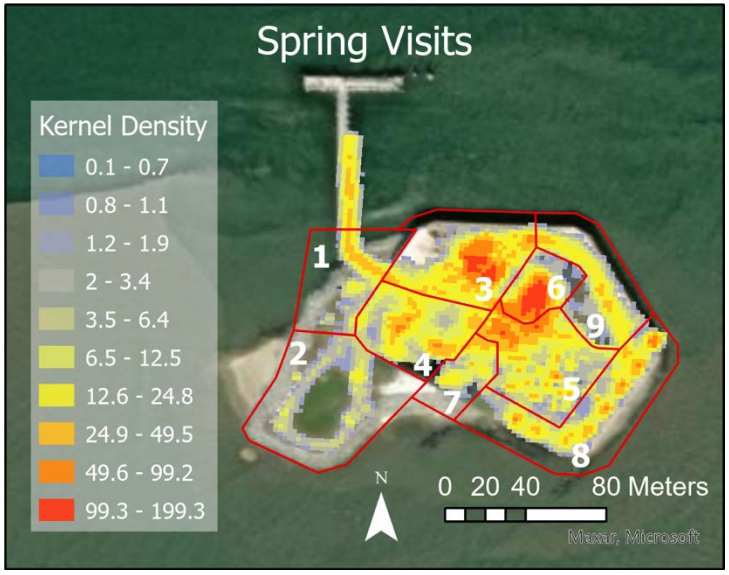


Figure 14 Kernel Density of participants visiting in the spring

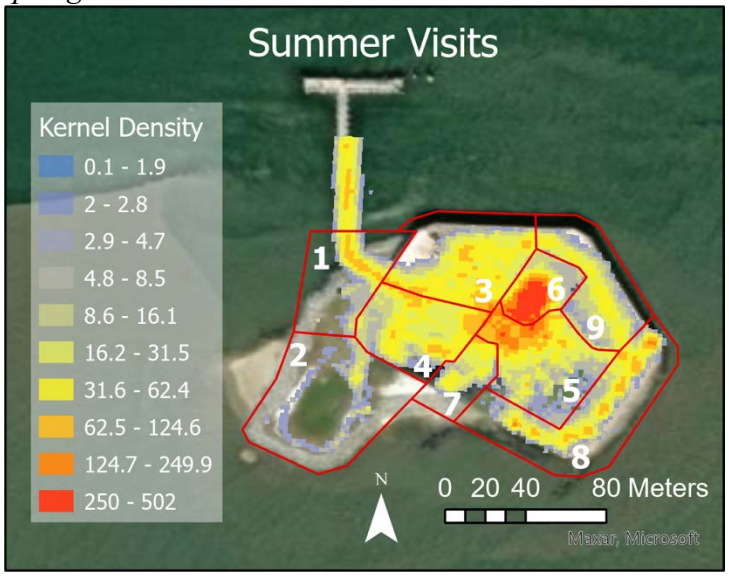


Figure 15 Kernel Density of participants visiting in the summer

Areas

Area 1 – Entry/Exit

Area 2 – Beach and Leach Field

Area 3 – Lower Parade Grounds North

Area 4 – Lower Parade Grounds South

Area 5 – Upper Parade Grounds Flag Pole

Area 6 – Museum

Area 7 – Battery Huger South of Bookstore

Area 8 – Upper Parade Ground Interpretation

Area 9 – Right Face

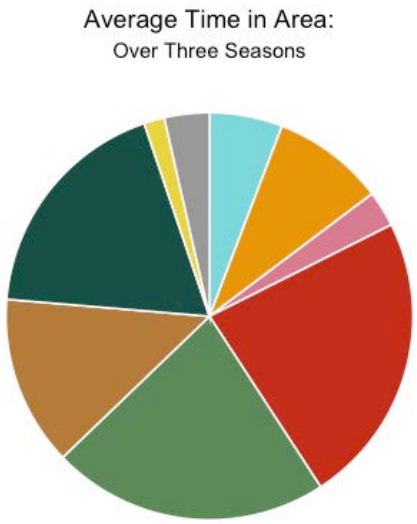


Figure 16 Pie Chart displaying the total average time spent in each area.

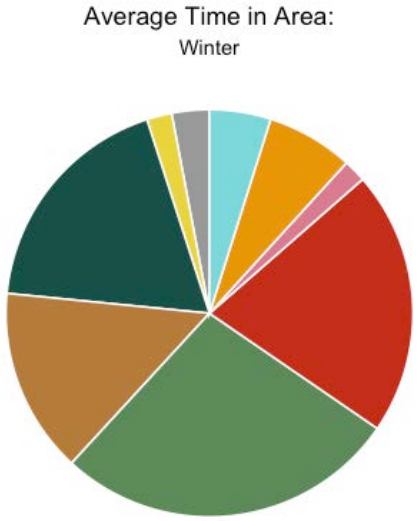


Figure 17 Pie Chart displaying the average time spent in each area during the winter.

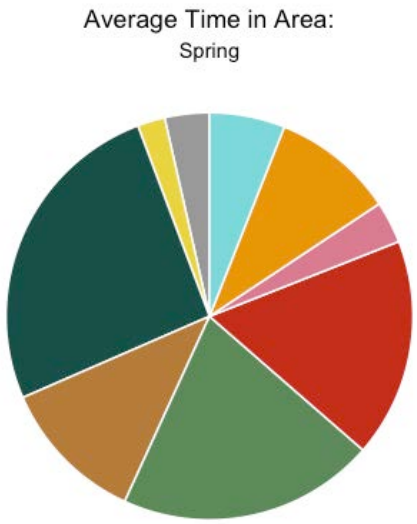


Figure 18 Pie Chart displaying the average time spent in each area during the spring.

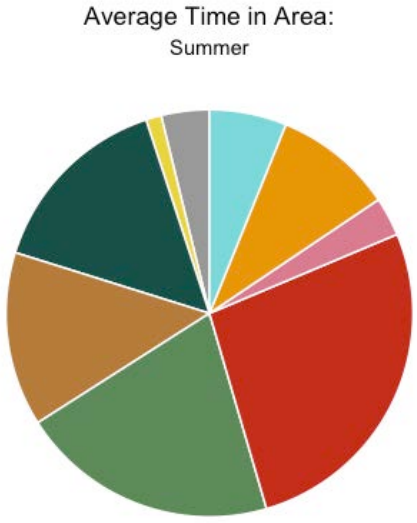


Figure 19 Pie Chart displaying the average time spent in each area during the summer

	Total	Winter	Spring	Summer
Area 1	1:35 (3.56%)	1:25 (2.98%)	2:08 (3.54%)	2:18 (3.82%)
Area 2	0:44 (1.64%)	0:57 (2.00%)	1:19 (2.19%)	0:45 (1.23%)
Area 3	8:15 (18.47%)	8:45 (18.46%)	15:28 (25.80%)	9:08 (15.13%)
Area 4	6:02 (13.51%)	6:58 (14.72%)	6:59 (11.63%)	8:22 (13.85%)
Area 5	9:50 (22.02%)	12:55 (27.28%)	12:15 (20.43%)	12:23 (20.50%)
Area 6	10:22 (23.22)	9:57 (21.01%)	10:26 (17.39%)	16:12 (26.82%)
Area 7	1:16 (2.85%)	0:51 (1.80%)	2:00 (3.33%)	1:52 (3.08%)
Area 8	3:59 (8.93%)	3:16 (6.90%)	5:49 (9.69%)	5:43 (9.46%)
Area 9	2:35 (5.80%)	2:18 (4.86%)	3:36 (5.99%)	3:42 (6.12%)

Areas

Area 1 – Entry/Exit

Area 2 – Beach and Leach Field

Area 3 – Lower Parade Grounds North

Area 4 – Lower Parade Grounds South

Area 5 – Upper Parade Grounds Flag Pole

Area 6 – Museum

Area 7 – Battery Huger South of Bookstore

Area 8 – Upper Parade Ground Interpretation

Area 9 – Right Face

Figures 20 and 21 display the kernel densities for the two departure points, Patriots Point and the Visitor Center at Liberty Square. While there are differences between the two, these differences are most likely due to the increased proportion of Patriots Point visitors sampled during the summer data collection (leading to increased use of the museum/Area 6) and the different locations that ranger talks were conducted between the departure point samples. Table 5 considers the Ranger Talk locations, but still finds significant differences in the time spent in Areas 5 and 6 between the two departure points.

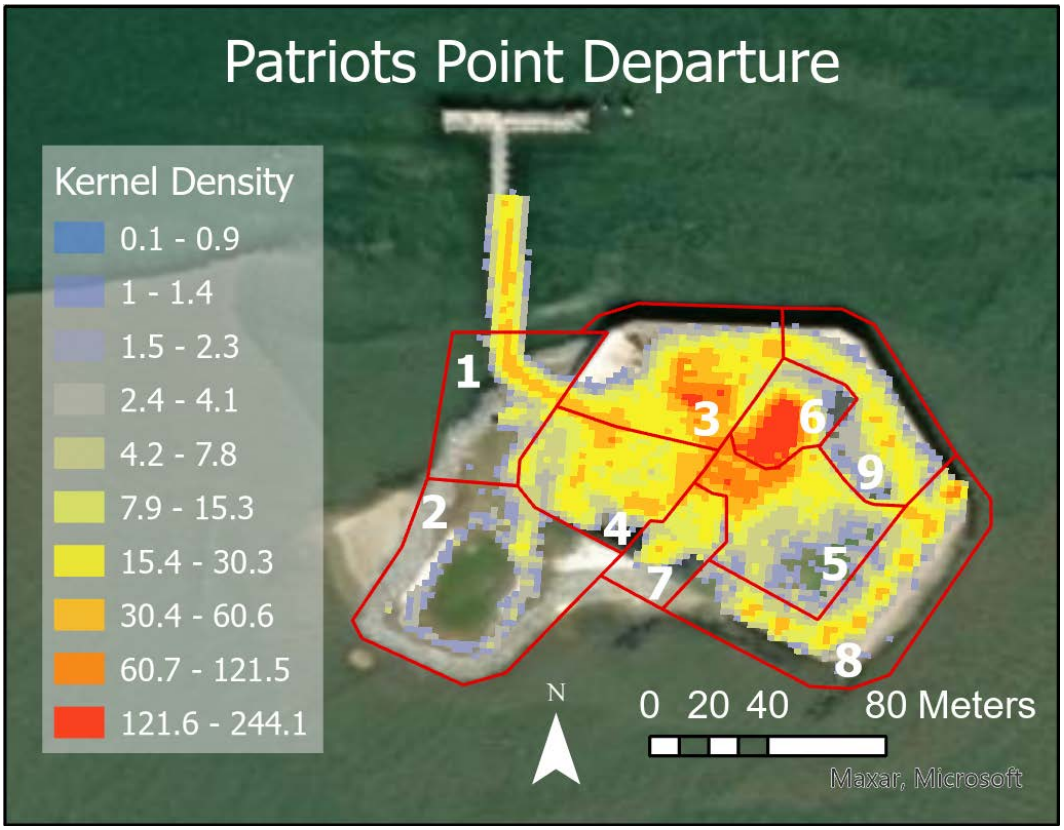


Figure 20 Kernel Density of participants arriving from Patriots Point

Areas

Area 1 – Entry/Exit

Area 2 – Beach and Leach Field

Area 3 – Lower Parade Grounds North

Area 4 – Lower Parade Grounds South

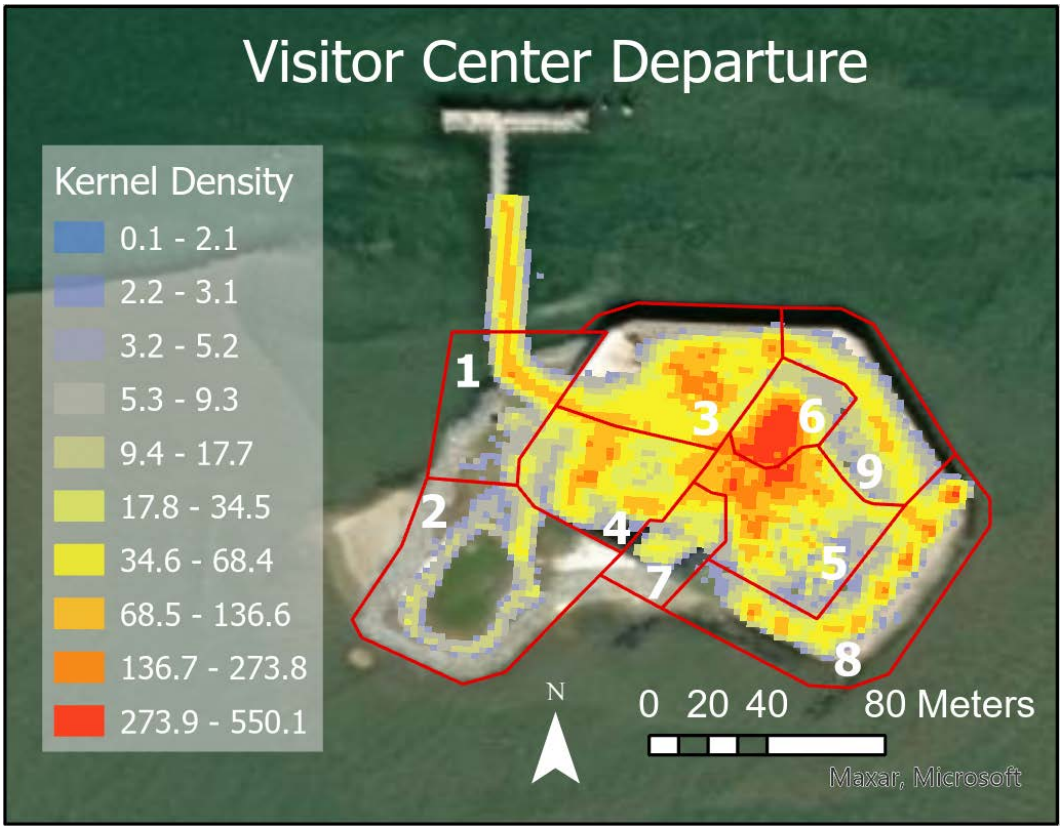
Area 5 – Upper Parade Grounds Flag Pole

Area 6 – Museum

Area 7 – Battery Huger South of Bookstore

Area 8 – Upper Parade Ground Interpretation

Area 9 – Right Face



Areas

Area 1 – Entry/Exit

Area 2 – Beach and Leach Field

Area 3 – Lower Parade Grounds North

Area 4 – Lower Parade Grounds South

Area 5 – Upper Parade Grounds Flag Pole

Area 6 – Museum

Area 7 – Battery Huger South of Bookstore

Area 8 – Upper Parade Ground Interpretation

Area 9 – Right Face

Figure 21 Kernel Density of participants arriving from the Visitor Center

The location of the ranger talk at the beginning of a participants' visit to Fort Sumter acts as a strong attractor to the specific area of the talk. The ranger talks are held primarily in Area 5 and Area 3 and occasionally in Area 4. Additionally, for some trips to the island, a talk is given on the ferry in lieu of a ranger talk on the island. Figures 22 through 25 show the kernel densities of the entire trip where there was no ranger talk on Fort Sumter, the ranger talk was held in Area 5, the ranger talk was held in Area 4, and the ranger talk was held in Area 3. Additionally, Figures 26 through 29 show the kernel densities for trips based on the ranger talk location but the kernel densities were generated using just the first twenty minutes of participants' visits to Fort Sumter. Similarly, Figures 30 through 33, 34 through 37, 38 through 41, and 42 through 45 continue to compare the impacts of talk location on movement patterns for the 20th through 29th minute, 30th through the 39th minute, 40th through 50th minute, and the 50th minute until departure respectively.

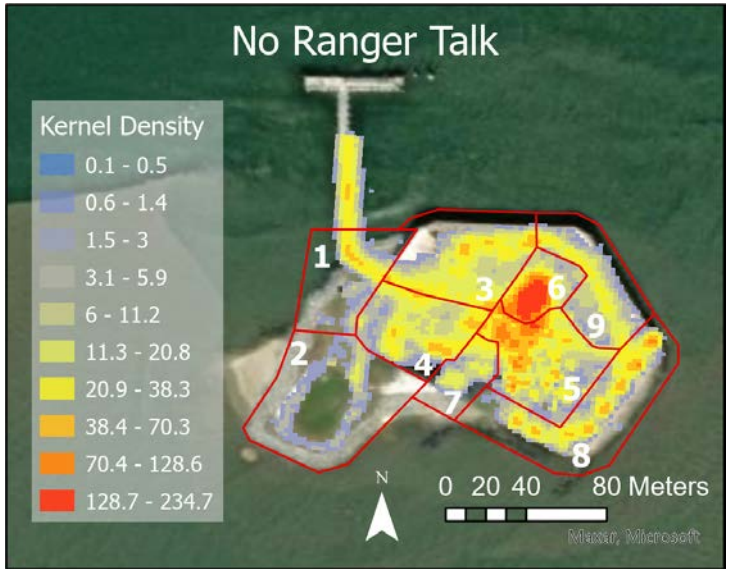


Figure 22 Kernel Density when no ranger talk is given on Fort Sumter

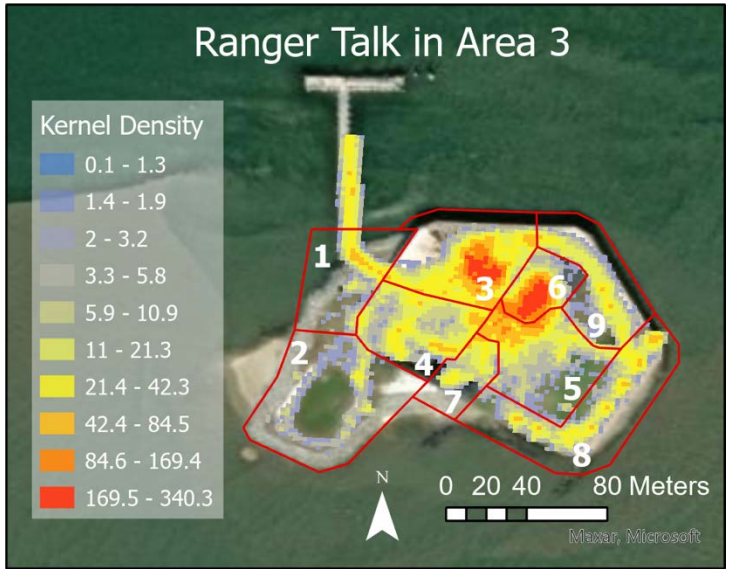


Figure 23 Kernel Density when the ranger talk is given in Area 3

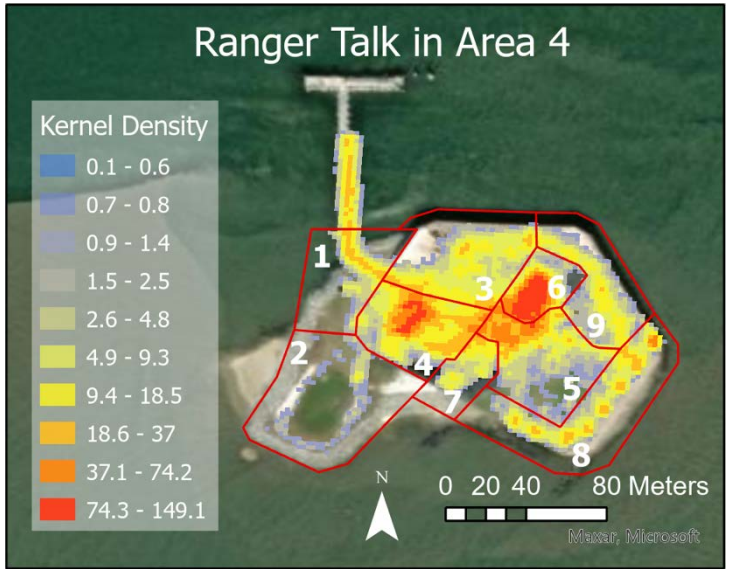


Figure 24 Kernel Density when the ranger talk is given in Area 4

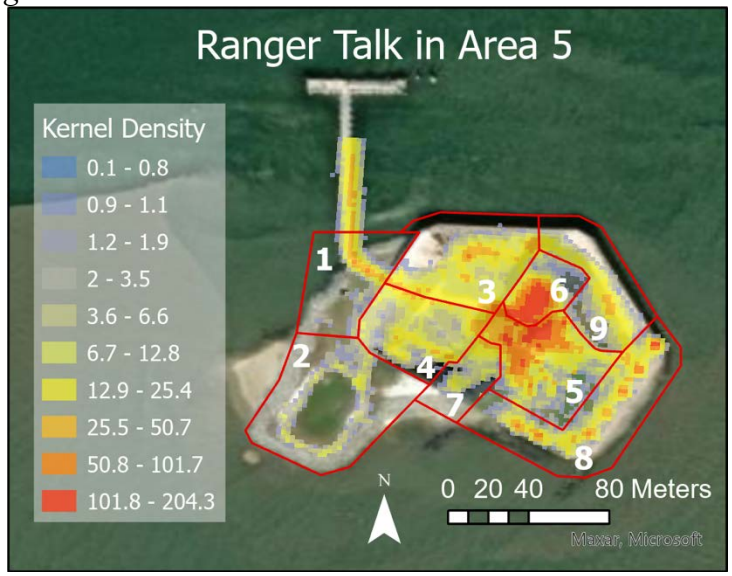


Figure 25 Kernel Density when the ranger talk is given in Area 5

Areas

Area 1 – Entry/Exit

Area 2 – Beach and Leach Field

Area 3 – Lower Parade Grounds North

Area 4 – Lower Parade Grounds South

Area 5 – Upper Parade Grounds Flag Pole

Area 6 – Museum

Area 7 – Battery Huger South of Bookstore

Area 8 – Upper Parade Ground Interpretation

Area 9 – Right Face

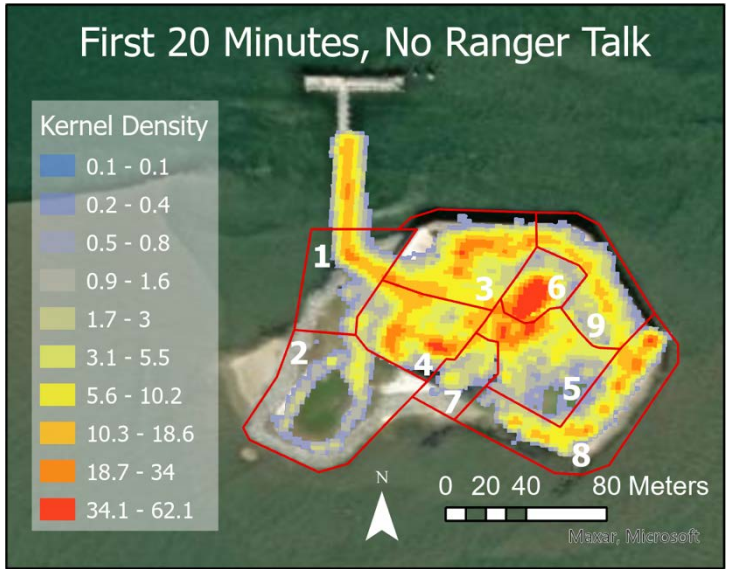


Figure 26 Kernel Density of the first twenty minutes when no ranger talk is given on Fort Sumter

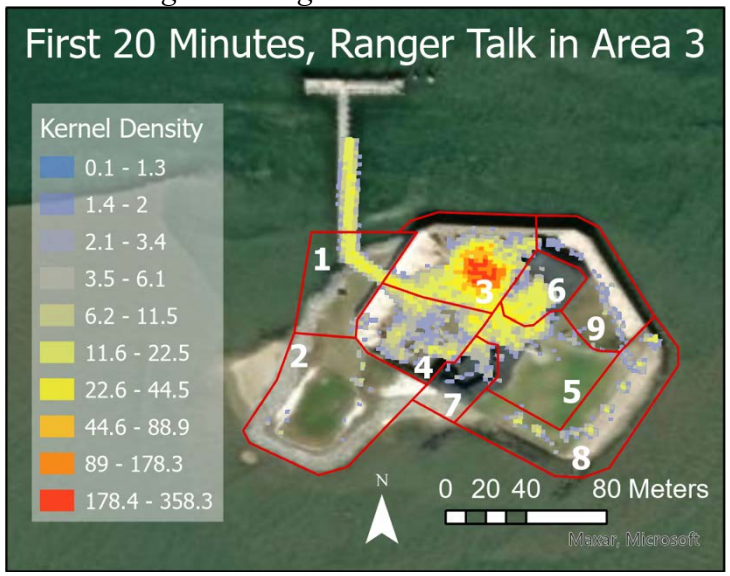


Figure 27 Kernel Density of the first twenty minutes when the ranger talk is given in Area 3

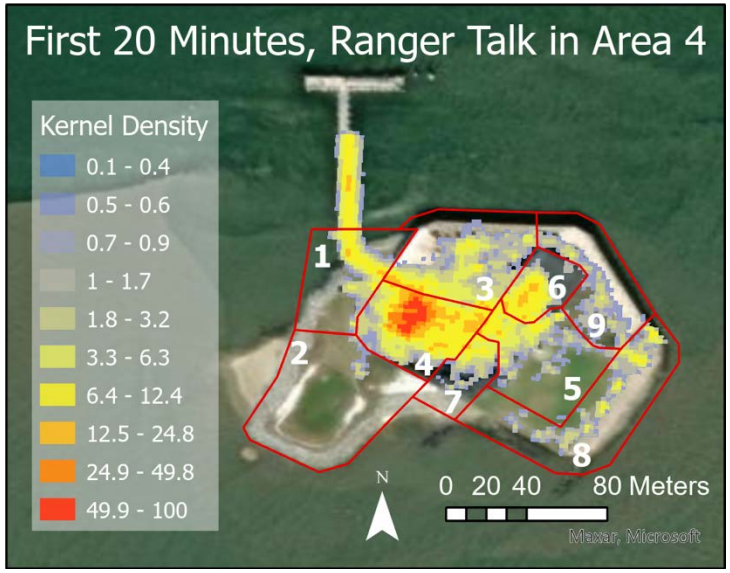


Figure 28 Kernel Density of the first twenty minutes when the ranger talk is given in Area 4

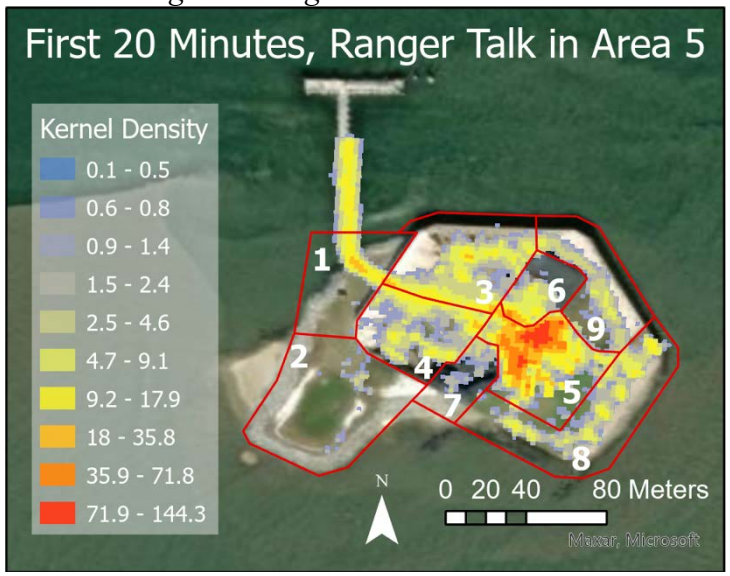


Figure 29 Kernel Density of the first twenty minutes when the ranger talk is given in Area 5

Areas

Area 1 – Entry/Exit

Area 2 – Beach and Leach Field

Area 3 – Lower Parade Grounds North

Area 4 – Lower Parade Grounds South

Area 5 – Upper Parade Grounds Flag Pole

Area 6 – Museum

Area 7 – Battery Huger South of Bookstore

Area 8 – Upper Parade Ground Interpretation

Area 9 – Right Face

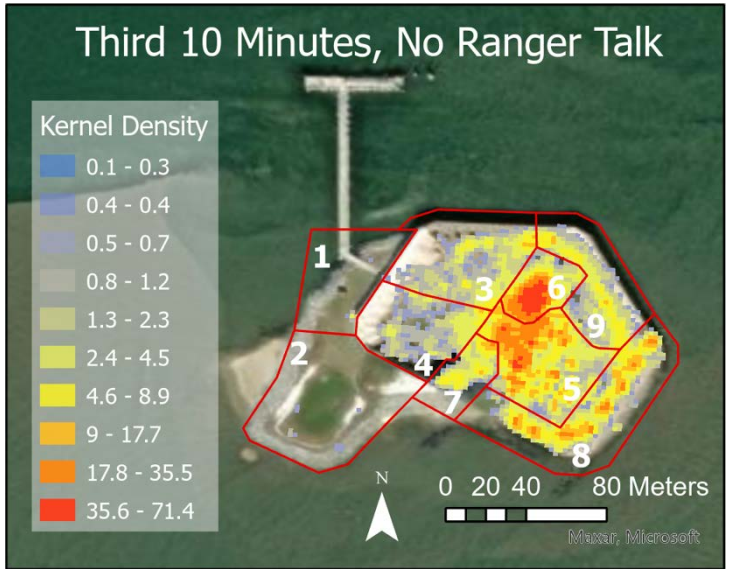


Figure 30 Kernel Density of the 20th-30th minutes when no ranger talk is given on Fort Sumter

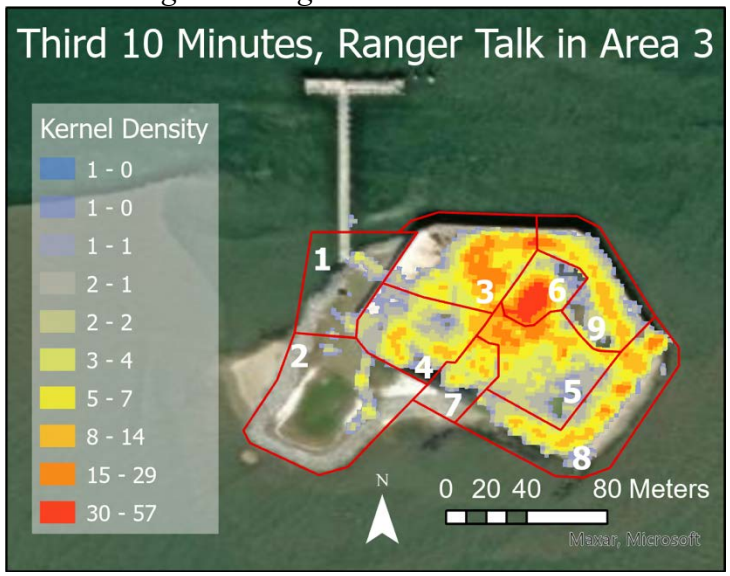


Figure 31 Kernel Density of the 20th-30th minutes when the ranger talk is given in Area 3

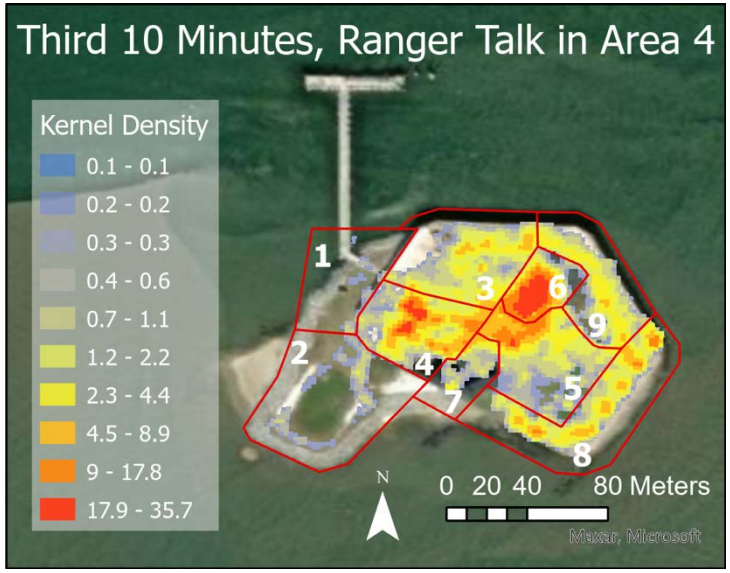


Figure 32 Kernel Density of the 20th-30th minutes when the ranger talk is given in Area 4

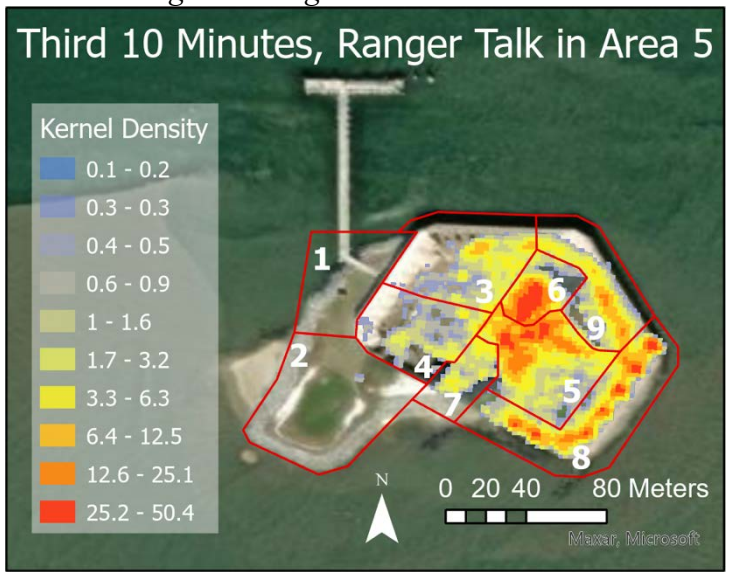


Figure 33 Kernel Density of the 20th-30th minutes when the ranger talk is given in Area 5

Areas

Area 1 – Entry/Exit

Area 2 – Beach and Leach Field

Area 3 – Lower Parade Grounds North

Area 4 – Lower Parade Grounds South

Area 5 – Upper Parade Grounds Flag Pole

Area 6 – Museum

Area 7 – Battery Huger South of Bookstore

Area 8 – Upper Parade Ground Interpretation

Area 9 – Right Face

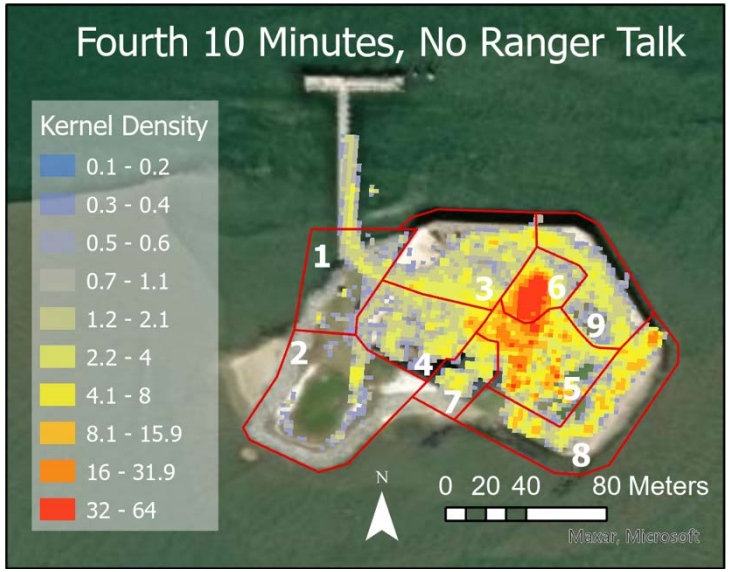


Figure 34 Kernel Density of the 30th-40th minutes when no ranger talk is given on Fort Sumter

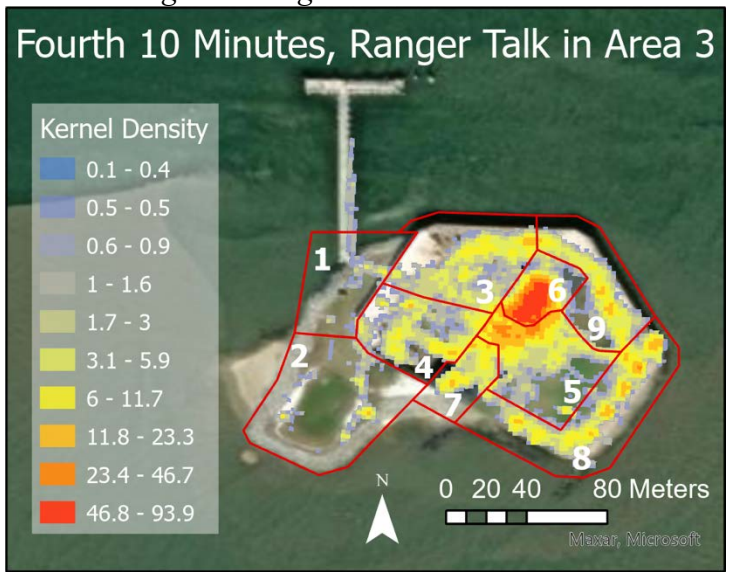


Figure 35 Kernel Density of the 30th-40th minutes when the ranger talk is given in Area 3

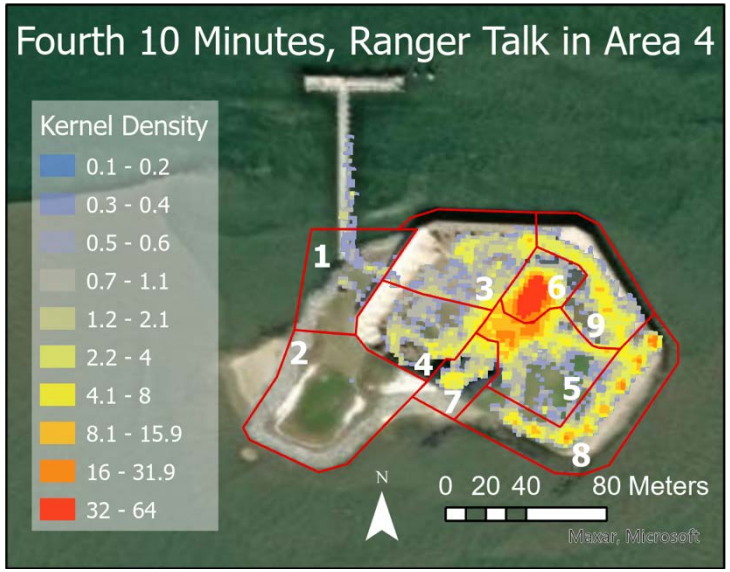


Figure 36 Kernel Density of the 30th-40th minutes when the ranger talk is given in Area 4

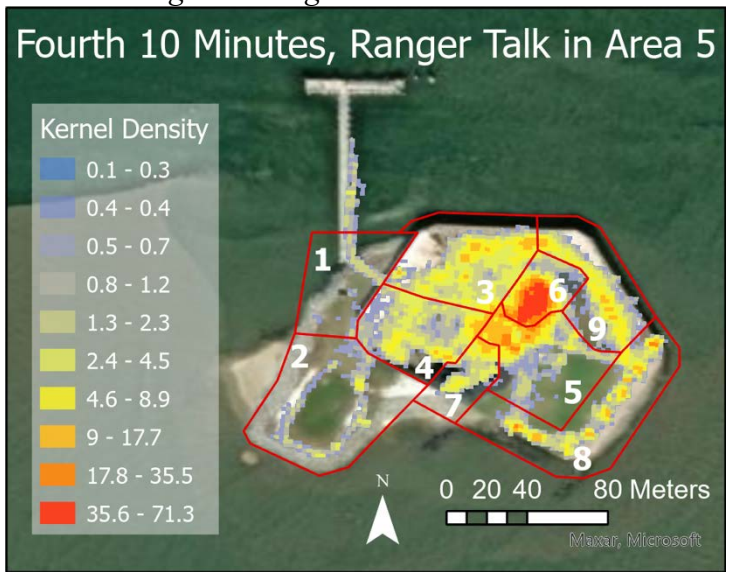


Figure 37 Kernel Density of the 30th-40th minutes when the ranger talk is given in Area 5

Areas

Area 1 – Entry/Exit

Area 2 – Beach and Leach Field

Area 3 – Lower Parade Grounds North

Area 4 – Lower Parade Grounds South

Area 5 – Upper Parade Grounds Flag Pole

Area 6 – Museum

Area 7 – Battery Huger South of Bookstore

Area 8 – Upper Parade Ground Interpretation

Area 9 – Right Face

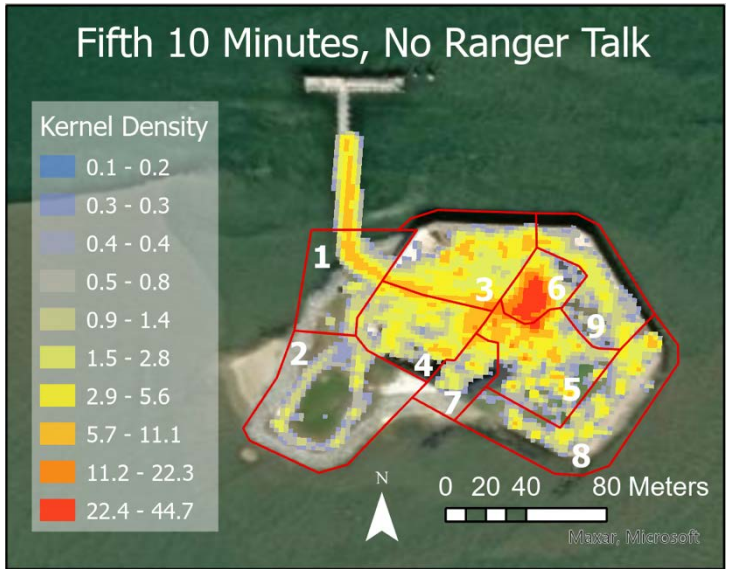


Figure 38 Kernel Density of the 40th-50th minutes when no ranger talk is given on Fort Sumter

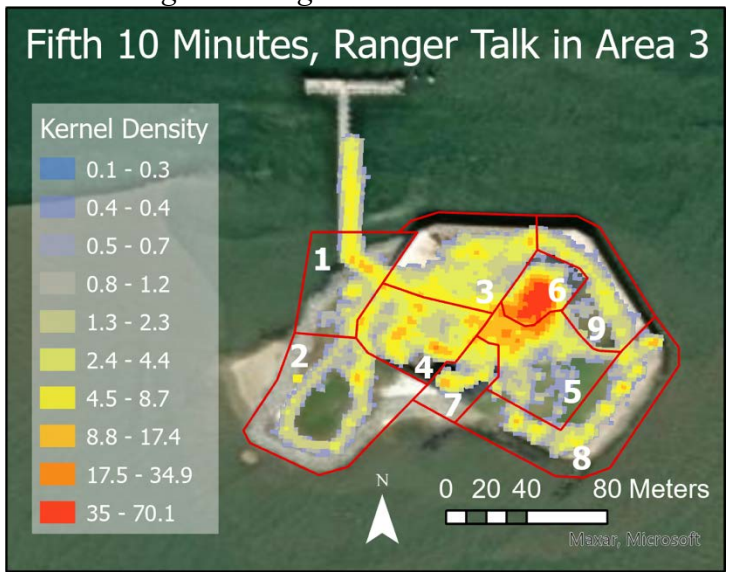


Figure 39 Kernel Density of the 40th-50th minutes when the ranger talk is given in Area 3

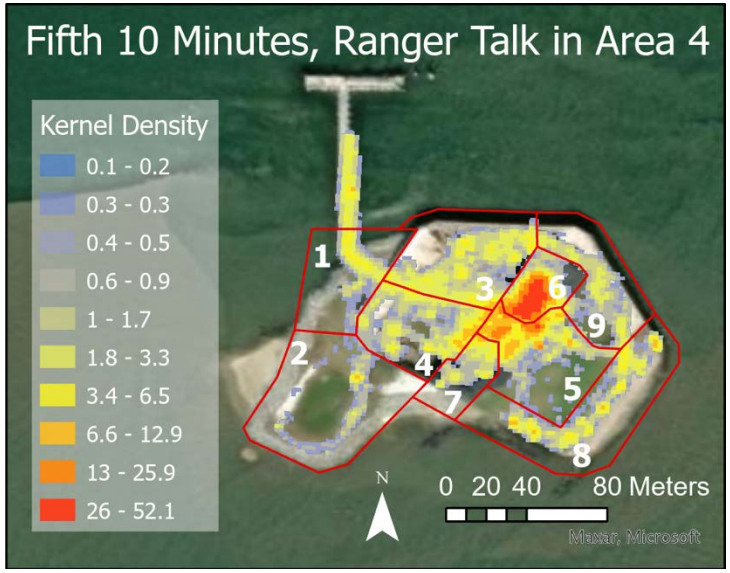


Figure 40 Kernel Density of the 40th-50th minutes when the ranger talk is given in Area 4

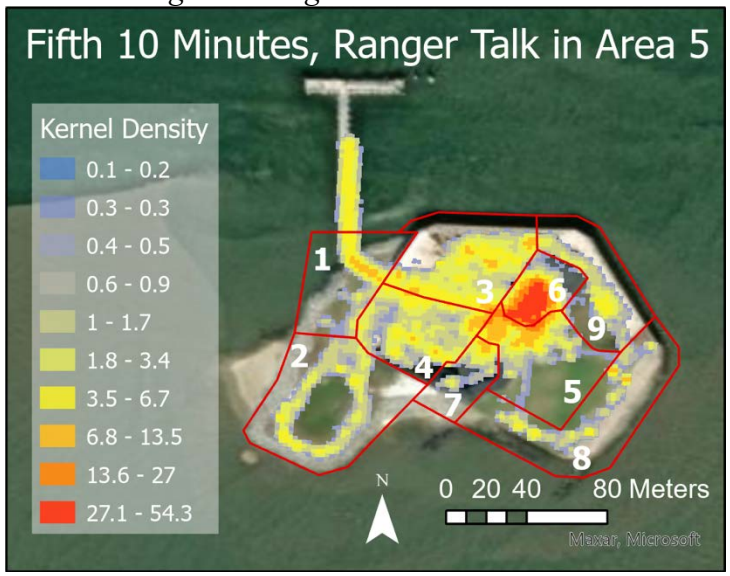


Figure 41 Kernel Density of the 40th-50th minutes when the ranger talk is given in Area 5

Areas

Area 1 – Entry/Exit

Area 2 – Beach and Leach Field

Area 3 – Lower Parade Grounds North

Area 4 – Lower Parade Grounds South

Area 5 – Upper Parade Grounds Flag Pole

Area 6 – Museum

Area 7 – Battery Huger South of Bookstore

Area 8 – Upper Parade Ground Interpretation

Area 9 – Right Face

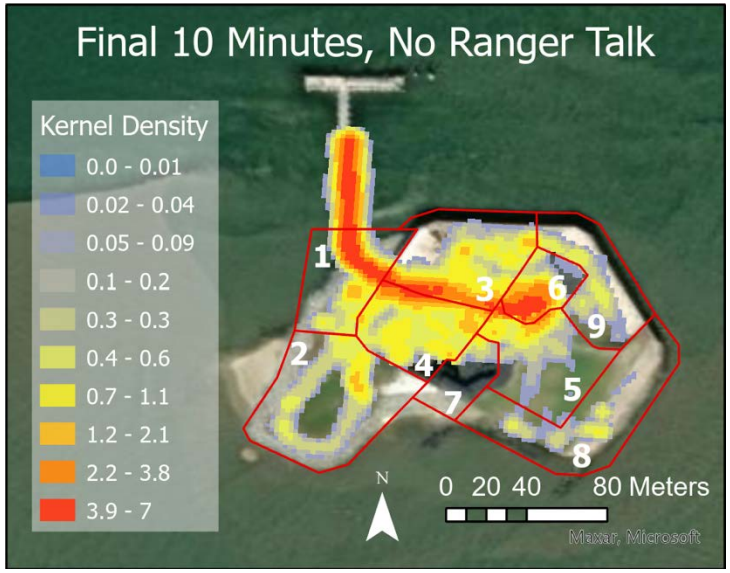


Figure 42 Kernel Density of the final 10 minutes when no ranger talk is given on Fort Sumter

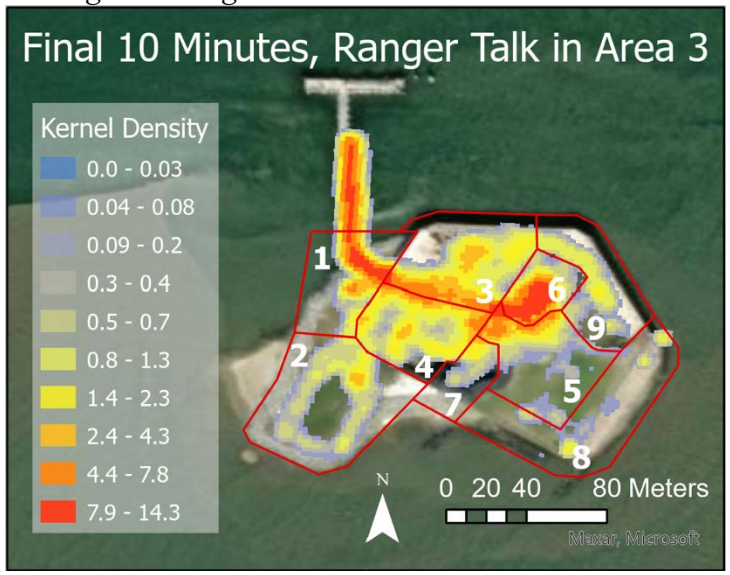


Figure 43 Kernel Density of the final 10 minutes when the ranger talk is given in Area 3

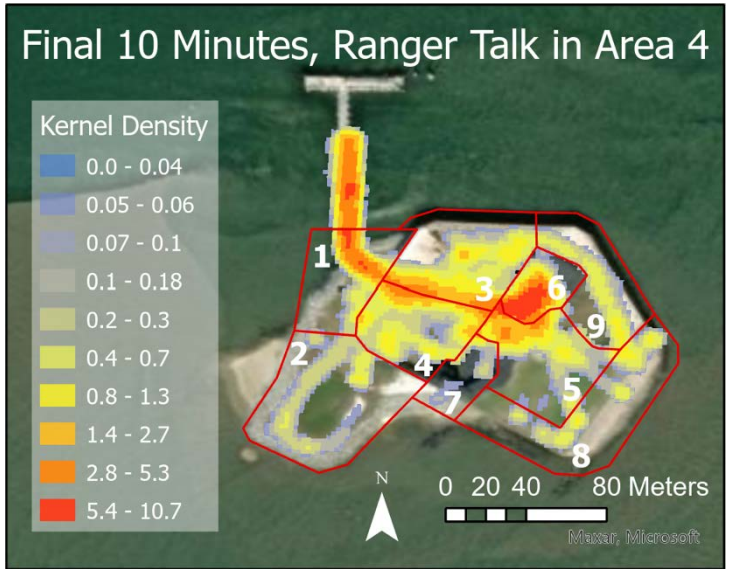


Figure 44 Kernel Density of the final 10 minutes when the ranger talk is given in Area 4

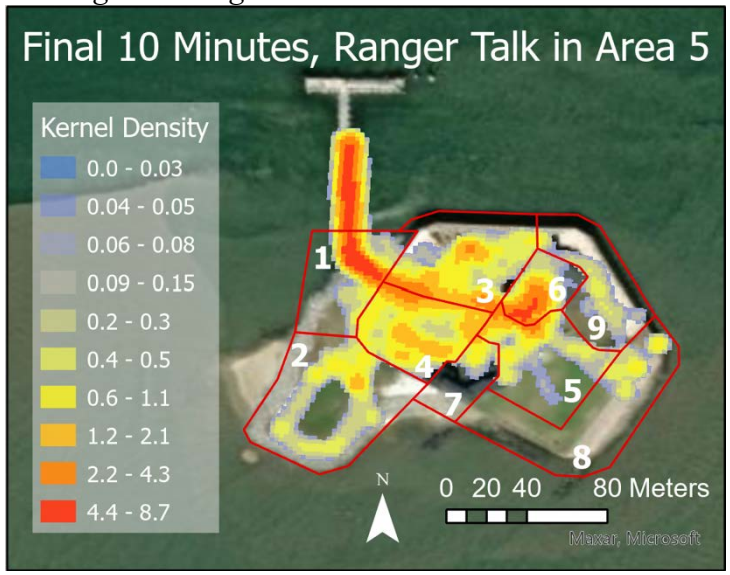


Figure 45 Kernel Density of the final 10 minutes when the ranger talk is given in Area 5

Areas

Area 1 – Entry/Exit

Area 2 – Beach and Leach Field

Area 3 – Lower Parade Grounds North

Area 4 – Lower Parade Grounds South

Area 5 – Upper Parade Grounds Flag Pole

Area 6 – Museum

Area 7 – Battery Huger South of Bookstore

Area 8 – Upper Parade Ground Interpretation

Area 9 – Right Face

Analysis of Time Spent in Each Area Across Various Factors

Tables 4 through 12 below display comparisons in the mean time spent in each area across season, departure location, group size, whether children were in the group, whether there was a ranger talk, weather conditions (i.e., temperature, cloud cover, and wind speed), and tour size. It should be noted that since more ranger talks occurred at the beginning of the visit to the island, we focused on the last 40 minutes for these analyses. The mean comparison analyses presented in Tables 4 though 11 were undertaken using MANOVAs, followed by ANOVAs, and then Bonferroni pairwise comparisons. The tour size was analyzed using a multivariate regression. The Bonferroni method was utilized given it is the most stringent pairwise test helping to control for Type 1 errors (identifying statistically significant differences that occur by chance) within the ANOVA models. In so doing, instead of considering the alpha level of p = .05, the Bonferroni method corrects this by dividing .05 by the total number of dependent variables examined. In each case, there were nine dependent variables (i.e., time spent in nine areas) and the corrected alpha level was p = .006. What this means is that ANOVA test results (displayed on the far right column in each of the following tables) are only deemed statistically significant if the observed p value is less than .006. The superscripts within each of the rows (i.e., in each area) indicate where specific pairwise comparisons are statistically significantly different when there are more than two groups. The effect of tour size on individual areas similarly utilized the adjusted alpha level of p = .006 to protect from type 1 errors.

Time in area differences across season

The first MANOVA was conducted to determine if time visitors spent in each park area differed across the three seasons of data collection (Table 4). The overall MANOVA was significant, so we can move on to see if each of the nine ANOVA models were significant at the p = .006 level. Six (e.g., Areas 2, 3, 4, 5, 6, and 7) of the nine models reflected significant differences.

With few exceptions (i.e., Areas 4 and 6), spring visitors spent the most time in each area. Looking closer at pairwise comparisons, we see that summer visitors spent significantly less time in Areas 2, 3, and 5 than did those in the winter and spring seasons. In Area 4, winter visitors spent significantly more time there than did summer visitors. In Area 6, the opposite was true, in

that summer visitors spent significantly more time there than winter visitors. Finally, in Area 7, spring visitors spent significantly more time there than either winter or summer visitors.

Table 4 Time spent in each area during the last 40 minutes across three seasons of data collection[a]

	Means[b]			ANOVA results[c]	
Areas	*Winter*	*Spring*	*Summer*	*F*	*p*
Area 1	49.30	58.50	48.96	3.02	.049
Area 2	43.97[d]	49.95[e]	23.68[d,e]	9.39	<.001
Area 3	220.40[f]	240.24[g]	183.62[f,g]	9.98	<.001
Area 4	197.24[h]	180.23	149.24[h]	6.65	.001
Area 5	446.82[i]	494.53[j]	309.56[i,j]	40.34	<.001
Area 6	528.59[k]	438.26	555.71[k]	7.75	<.001
Area 7	39.92[l]	78.06[l,m]	55.47[m]	7.88	.001
Area 8	157.84	212.99	167.44	4.52	.011
Area 9	112.94	138.58	105.51	4.96	.007

[a] MANOVA model: Wilks's $\Lambda = 0.78$, $F(2, 932) = 13.49$, $p < .001$
[b] Time spent is reported in seconds
[c] Significance determined at $p = .006$ level
[d-m] Same letter in row indicates significant mean difference

Time in area differences across departure location

A second MANOVA was undertaken to see if the time spent in each area differed based on whether they left for Fort Sumter from either Patriots Point or Liberty Square (Table 5). Though the MANOVA was significant, only two of the nine ANOVA models were significant (i.e., indicating there was a significant difference in time spent based on departure location). Given we were looking at only two departure points, no superscripts are found in any of the rows. That said, we can see that visitors departing from Liberty Square spent a statistically significantly longer amount of time in Area 5. The opposite was true for Area 6, where visitors from Patriots Point spent a statistically significant longer amount of time. This supports the prediction that visitors from Patriots Point may spend more time in the museum because they were not able to visit the museum in the Visitor Center prior to their visit.

In order to verify that this difference is in fact due to the departure location and not a result of the increased proportion of Patriots Point participants in the summer sample and increased use of the museum by summer visitors, a factorial ANOVA was employed. The factorial ANOVA found a significant main effect for departure location, $F(1, 929) = 5.759$, $p = .017$; there was similarly a significant main effect for the season, $F(2, 929) = 4.017$, $p = .018$;

lastly, the interaction was not significant, F(2, 929) = 1.542, p = .214. However, it should be noted that this difference, while statistically significant, only results in an average difference of 77.5 seconds between the two groups. The difference the third quartile of the time spent in the museum between the two groups is smaller yet with a difference of 46.8 seconds, but the difference between the first quartile of the two groups is slightly larger with a difference of 100 seconds.

Table 5 Time spent in each area during the last 40 minutes across departure location[a]

	Means[b]		ANOVA results[c]	
Areas	*Patriots Point*	*Liberty Square*	*F*	*p*
Area 1	48.28	52.42	1.39	.238
Area 2	25.13	37.69	4.45	.035
Area 3	192.09	209.41	2.11	.146
Area 4	167.23	166.14	0.01	.929
Area 5	338.81	398.36	8.36	.004
Area 6	577.79	500.22	8.77	.003
Area 7	64.67	54.01	2.28	.132
Area 8	177.16	174.95	0.02	.882
Area 9	113.69	114.88	0.02	.898

[a] MANOVA model: Wilks's $\Lambda = 0.97$, $F(1, 933) = 2.86$, $p = .002$
[b] Time spent is reported in seconds
[c] Significance determined at .006 level

Time in area differences across group size

A similar test was conducted to examine if time visitors spent in each area was different across four group sizes (i.e., solo traveler, with partner, 3-4 people in a group, and 5 or more in a group) (Table 4). Though neither the MANOVA or ANOVA models were statistically significant at the p = .006 level, we did note some differences in the amount of time spent in Areas 1 and 4. Participants in groups of five or more stayed significantly longer in Area 1 than those in groups of 3-4 people. Solo travelers stayed a significantly longer amount of time in Area 4 than each of the other three categories of group sizes.

Table 6 Time spent in each area during the last 40 minutes across group size ranges[a]

	Means[b]				ANOVA results[c]	
Areas	*Solo Traveler*	*With partner*	*3- 4 People*	*≥ 5 people*	*F*	*p*
Area 1	68.77	50.24	46.41[d]	59.45[d]	3.76	.011
Area 2	66.00	32.06	32.39	37.42	1.47	.223
Area 3	242.12	202.09	196.00	219.09	1.16	.323
Area 4	268.27[e,f,g]	162.73[e]	164.47[f]	164.51[g]	3.17	.024
Area 5	373.15	401.24	361.23	356.61	1.59	.191
Area 6	379.92	514.90	520.73	583.78	2.85	.036
Area 7	71.62	55.57	59.16	55.17	0.28	.837
Area 8	159.31	184.55	179.59	150.51	1.12	.341
Area 9	109.92	116.72	114.72	107.64	0.20	.896

[a] MANOVA model: Wilks's $\Lambda = 0.959$, $F(3, 924) = 1.42$, $p = .075$
[b] Time spent is reported in seconds
[c] Significance determined at $p = .006$ level
[d-g] Same letter in row indicates significant mean difference (despite MANOVA and ANOVA models not significant)

Time in area differences based on children in group

A fourth MANOVA was undertaken to determine if the time that visitors spent in each area differed as to whether they had children with them or not (Table 5). None of the MANOVA, ANOVA, and pairwise comparisons were found to be statistically significantly different between those with and without children in their group. Anecdotally, those without children spent more time in Areas 3, 5, 6, 8, and 9. Those with children spent more time in Areas 2, 4, and 7. Time spent in Area 1 was nearly identical for those with and without children.

Table 7 Time spent in each area during the last 40 minutes across groups without children and groups with children[a]

	Means[b]		ANOVA results[c]	
Areas	*No Children*	*Children*	*F*	*p*
Area 1	51.00	51.23	0.90	.914
Area 2	33.07	36.19	0.45	.640
Area 3	208.59	195.18	0.92	.398
Area 4	163.05	175.24	1.46	.232
Area 5	393.49	355.76	1.97	.140
Area 6	529.51	516.85	0.47	.232
Area 7	51.40	65.42	3.41	.034
Area 8	187.08	156.18	2.36	.095
Area 9	116.53	112.33	0.45	.638

[a] MANOVA model: Wilks's $\Lambda = 0.974$, $F(1, 916) = 1.78$, $p = .067$
[b] Time spent is reported in seconds
[c] Significance determined at $p = .006$ level

Time in area differences based on ranger talk

Following the MANOVA protocol, the next test we ran was to see whether the presence of a ranger talk during the visit had any bearing on the length of time spent in each area (Table 8). The MANOVA model was significant, so we looked further at ANOVAs to determine that five of the nine models were statistically significant ($p < .006$). Those who had a ranger talk during their visit stayed significantly longer in four of the five areas (i.e., Areas 3, 4, 6, and 9) than those who did not. Despite not having a ranger talk, those in Area 5 stayed longer than those who did.

Table 8 Time spent in each area during the last 40 minutes for tours with and without a ranger talk on the island[a]

	Means[b]		ANOVA results[c]	
Areas	*No Talk*	*Talk*	*F*	*p*
Area 1	49.74	51.76	0.32	.571
Area 2	22.19	38.68	7.51	.006
Area 3	165.67	219.89	20.69	<.001
Area 4	124.93	183.33	22.87	<.001
Area 5	478.16	340.80	45.16	<.001
Area 6	462.03	548.50	10.68	.001
Area 7	49.97	60.16	2.03	.154
Area 8	167.49	178.91	0.57	.449
Area 9	88.24	125.20	15.91	<.001

[a] MANOVA model: Wilks's $\Lambda = 0.88$, $F(1, 933) = 14.22$, $p < .001$
[b] Time spent is reported in seconds
[c] Significance determined at $p = .006$ level

Temperature

A sixth MANOVA was undertaken to determine if visitors to each area differed across three categories of temperature (60° or colder, 61° - 84°, and 85° or warmer) (Table 9). With the exception of two areas (i.e., Areas 1 and 6), significant mean differences were found across every area at the $p = .006$ critical level. Visitors spent more time in Area 2, when it was between 61° and 84° than when it was 85° or warmer. Visitors spent more time in Areas 3, 8, and 9 when it was between 61° and 84° than when it was either 60° or cooler or at least 85°. Visitors spent more time in Area 4 when it was 60° or cooler than when it was at least 85°. Visitors spent less time in Area 5 when it was at least 85 degrees (as opposed to the other two temperature groupings). When it was between 61° and 84°, visitors spent double the amount of time in Area 7 than when it was 60° or cooler.

Though temperature did not have a statistically significant bearing on time spent in Areas 1 and 6 (based on the ANOVA model for each), it should be noted that when it was between 61° and 84°, visitors

spent longer amounts of time in Area 1 than when it was at least 85°. The opposite was true for Area 6; people spent more time there when it was at least 85° as opposed to when it was cooler than 85°.

Table 9 Time spent in each area during the last 40 minutes across three outside temperatures (Fahrenheit)[a]

	Means[b]			ANOVA results[c]	
Areas	*≤ 60°*	*61°- 84°*	*≥ 85°*	*F*	*p*
Area 1	45.45	56.90[d]	48.24[d]	4.22	.015
Area 2	34.41	48.15[e]	21.71[e]	10.01	<.001
Area 3	189.08[f]	240.44[f,g]	178.60[g]	14.54	<.001
Area 4	205.28[h]	170.21	150.36[h]	5.72	.003
Area 5	475.78[i]	433.12[j]	304.13[i,j]	30.40	<.001
Area 6	504.75	488.92[k]	559.08[k]	3.80	.023
Area 7	33.36[l]	69.12[l]	55.10	6.94	.001
Area 8	138.00[m]	208.03[m,n]	160.72[n]	7.89	<.001
Area 9	105.53[o]	136.95[o,p]	98.55[p]	9.23	<.001

[a] MANOVA model: Wilks's $\Lambda = 0.79$, $F(2, 932) = 13.24$, $p < .001$
[b] Time spent is reported in seconds
[c] Significance determined at $p = .006$ level
[d-p] Same letter in row indicates significant mean difference

Weather

A seventh MANOVA was conducted to see if time spent in each area differed across five weather conditions (i.e., cloudy, mostly cloudy, partly cloudy, sunny, and thunder) (Table 10). As with the previous test, the MANOVA model was significant as were seven of the nine ANOVA models. Differences were not found in times spent in Areas 2 and 9. Visitors spent more time in Areas 1, 4, and 7 when it was thundering as opposed to the other four weather conditions. The opposite was true for Areas 5 and 8; folks spent significantly less time there when it was thundering as opposed to the other weather conditions. However, these differences are attributable to park staff closing the upper parade grounds while thunderstorms were present in the vicinity. Visitors spent significantly less time in Area 3 when it was sunny compared to when it was cloudy. Somewhat similarly, visitors spent significantly less time in Area 6 when it was sunny relative to when it was cloudy, mostly cloudy, or partly cloudy.

Table 10 Time spent in each area during the last 40 minutes across five weather conditions[a]

	Means[b]					ANOVA results[c]	
Areas	*Cloudy*	*Mostly Cloudy*	*Partly Cloudy*	*Sunny*	*Thunder*	*F*	*p*
Area 1	49.04[d]	47.95[e]	54.27[f]	49.40[g]	88.65[d,e,f,g]	5.14	<.001
Area 2	38.40	28.25	29.64	34.05	67.26	1.63	.165
Area 3	239.22[h]	220.09	223.10	184.23[h]	163.68	4.39	.002
Area 4	230.71[i,j,k]	150.26[i,l]	154.09[j,m]	152.78[k,n]	254.35[l,m,n]		8.06
<.001							
Area 5	328.51[o,p]	340.26[q,r]	368.47[s]	431.67[o,q,t]	146.58[p,r,s,t]	10.91	
<.001							
Area 6	574.13[u]	619.28[v]	553.34[w]	455.54[u,v,w]	597.52	8.20	<.001
Area 7	50.69[x]	46.56[y]	58.17[z]	56.66[aa]	148.35[x,y,z,aa]	7.41	<.001
Area 8	151.44[ab]	205.08[ac]	198.29[ad]	175.16[ae]	0.00[ab,ac,ad,ae]	7.43	<.001
Area 9	125.69	124.37	132.19	104.49	69.39	2.84	.023

[a] MANOVA model: Wilks's $\Lambda = 0.81$, $F(4, 930) = 5.56$, $p < .001$
[b] Time spent is reported in seconds
[c] Significance determined at $p = .006$ level
[d-ae] Same letter in row indicates significant mean difference

Wind speed

A final MANOVA was undertaken to determine if the time visitors spent in each area was impacted by three wind speed classifications (i.e., 5 mph or less, 6-9 mph, and 10 mph or more) (Table 11). Though the MANOVA model was significant, only two ANOVAs were significant ($p < .006$). When the wind was 6-9 mph, visitors spent longer in Area 5 as opposed to when it was either less than 6 mph or greater than 10 mph. When the winds were in excess of 10 mph, visitors spent significantly less time in Area 7 than when the wind was slower.

Table 11 Time spent in each area during the last 40 minutes across three wind speed ranges (miles per hour)[a]

	Means[b]			ANOVA results[c]	
Areas	*≤ 5 mph*	*6-9 mph*	*≥ 10 mph*	*F*	*p*
Area 1	58.54	47.78	51.15	2.08	.126
Area 2	25.35	25.27	40.33	3.71	.025
Area 3	191.09	194.53	212.22	1.46	.232
Area 4	166.62	145.10	177.27	3.20	.041
Area 5	271.80[d,e]	474.41[d,f]	358.54[e,f]	26.07	<.001
Area 6	577.54	525.20	509.89	1.74	.177
Area 7	76.24[g]	68.66[h]	46.90[g,h]	7.15	.001
Area 8	150.77	199.34	169.46	2.90	.056
Area 9	106.06	108.88	119.40	0.91	.403

[a] MANOVA model: Wilks's $\Lambda = 0.91$, $F(2, 932) = 5.12$, $p < .001$
[b] Time spent is reported in seconds
[c] Significance determined at $p = .006$ level
[d-h] Same letter in row indicates significant mean difference

Tour Size

To examine the impact that the number of visitors in each tour has on the time that visitors spend in each area, a multivariate regression was conducted. Multivariate regressions, in the same way that MANOVAs test the significance of an independent variable on several dependent variables using multiple ANOVAs, multivariate regressions test the significance of more than one linear regression models using the same predictor variable on multiple dependent variables. The results of this multivariate regression are presented in Table 12 below. The beta values (B) in the table represent the coefficient of the predictor variable (tour size) within the regression model. For every increase of one additional visitor in the tour, the predicted response would be an increase or decrease of seconds equal to the coefficient. The intercept is the model's theoretical value of time spent in the zone if the tour size was 0, and so while it does not provide any additional insight on its own, it is useful for estimating the predicted time an individual would spend within a zone with a given tour size.

The multivariate regression model found a significant effect of tour size on time spent in areas with a Wilks Lambda = .931, $F(9, 925) = 7.638$, $p = < .001$. However, not all individual regression models found a significant relationship between the tour size and the time spent in an area. Specifically, only Areas 5, 6, and 9 had significant effects, and the size of the effect is relatively small. For the area that boat total has the greatest impact (Area 6—the museum), the model's predicted difference between the first (225) and third (306) quartile is just 60.264 seconds.

Table 12 Effect of tour size on time spent in each area

		Parameter Estimates[a]			
Areas	*Parameter*	*B*[b]	*Std. Error*	*t*	*p*
Area 1	Intercept	57.326	6.360	9.013	<.001
	Tour Size	-0.24	0.024	-1.000	.318
Area 2	Intercept	55.300	10.808	5.116	<.001
	Tour Size	-0.082	0.040	-2.045	.041
Area 3	Intercept	260.608	21.561	12.087	<.001
	Tour Size	-0.217	0.080	-2.704	.007
Area 4	Intercept	205.676	22.118	9.299	<.001
	Tour Size	-0.151	0.082	-1.832	.067
Area 5	Intercept	219.986	37.122	5.926	<.001
	Tour Size	0.617	0.138	4.468	<.001
Area 6	Intercept	716.977	47.265	15.169	<.001
	Tour Size	-0.744	0.176	-4.230	<.001
Area 7	Intercept	52.226	12.830	4.071	<.001
	Tour Size	0.019	0.048	0.402	.688
Area 8	Intercept	181.231	27.045	6.701	<.001
	Tour Size	-0.022	0.101	-0.215	.830
Area 9	Intercept	167.114	16.653	10.035	<.001
	Tour Size	-0.202	0.062	-3.264	.001

[a] Multivariate Regression model: Wilks's $\Lambda = .366$, $F(9, 925) = 7.638$, $p < .001$
[b]Coefficients are reported in seconds

As the tour size generally increased throughout the data collection into the summer, a multivariate analysis of covariance (MANCOVA) was conducted to test for the effect of tour size on the time spent in the different areas while controlling for temperature using the same grouping of temperatures that was used in the MANOVA presented in Table 9. The results of that test were significant with a Wilks Lambda = .927, $F(9, 923) = 8.098$, $p < .001$ for tour size and are similar to the multivariate regression in that the effect on tour size for the models for areas 5, 6, and 9 were statistically significant. The effect of the temperature when controlling for tour size had similar effects on the time spent in an area as was found in the MANOVA in Table 9, resulting in a Wilks Lamba = .781, $F(18, 1844) = 13.477$, $p < .001$.

Interestingly, for Area 6, while the effect of the tour size is still significant, the difference between large groups in the spring and summer can largely be attributed to the difference in temperature. The MANCOVA predicts an increase of the time spent in the museum of 78.913 seconds from groups that visited while the temperature was between 61 to 84 degrees to those that visited while the temperature was 85 degrees or hotter. Further, the *B* for the effect of tour size when controlling for temperature increases slightly to -0.806. Given these two effects, the impact of tour size when it is hot, while statistically significant, does not result in a difference in real behavior of visitors. For the median tour size while it is between 61 to 84 degrees (267 visitors) to when it is hot (297 visitors), the predicted time that a visitor would spend in the museum increases from 481.318 seconds to 536.051 seconds. Figures 46 and 47 below display the impact that these two factors have on the time spent in Area 6. As the temperature was treated as a categorical variable, it is displayed with a box plot, and the effect of tour size is displayed with a scatter plot and fitted with a regression line.

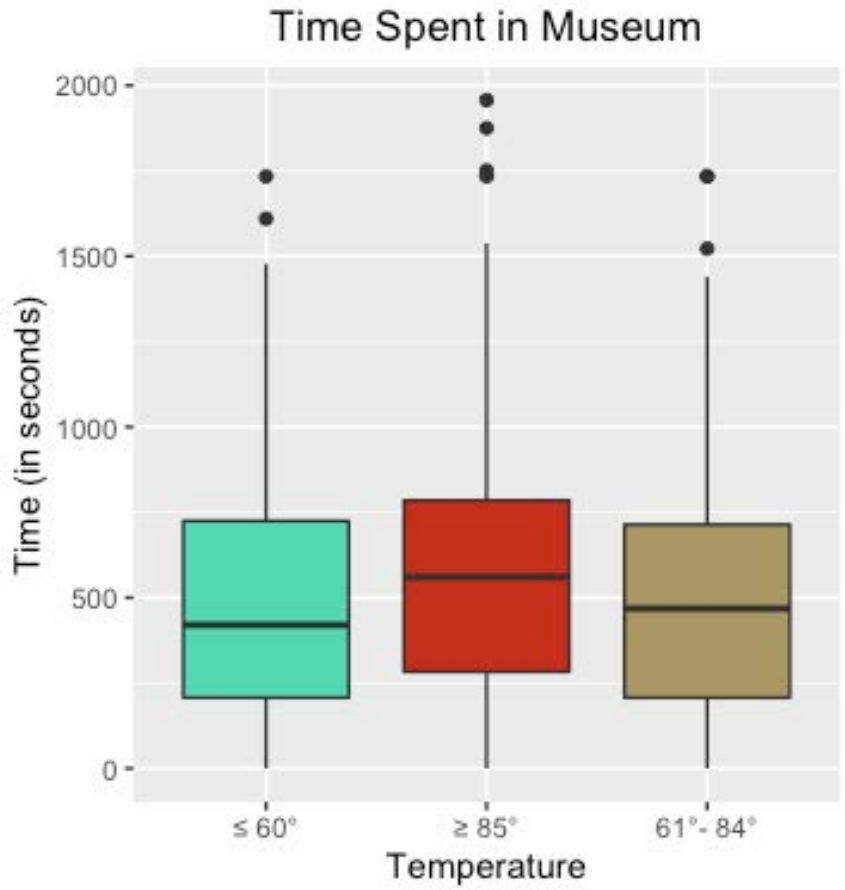


Figure 46 Boxplot displaying the time spent in Area 6

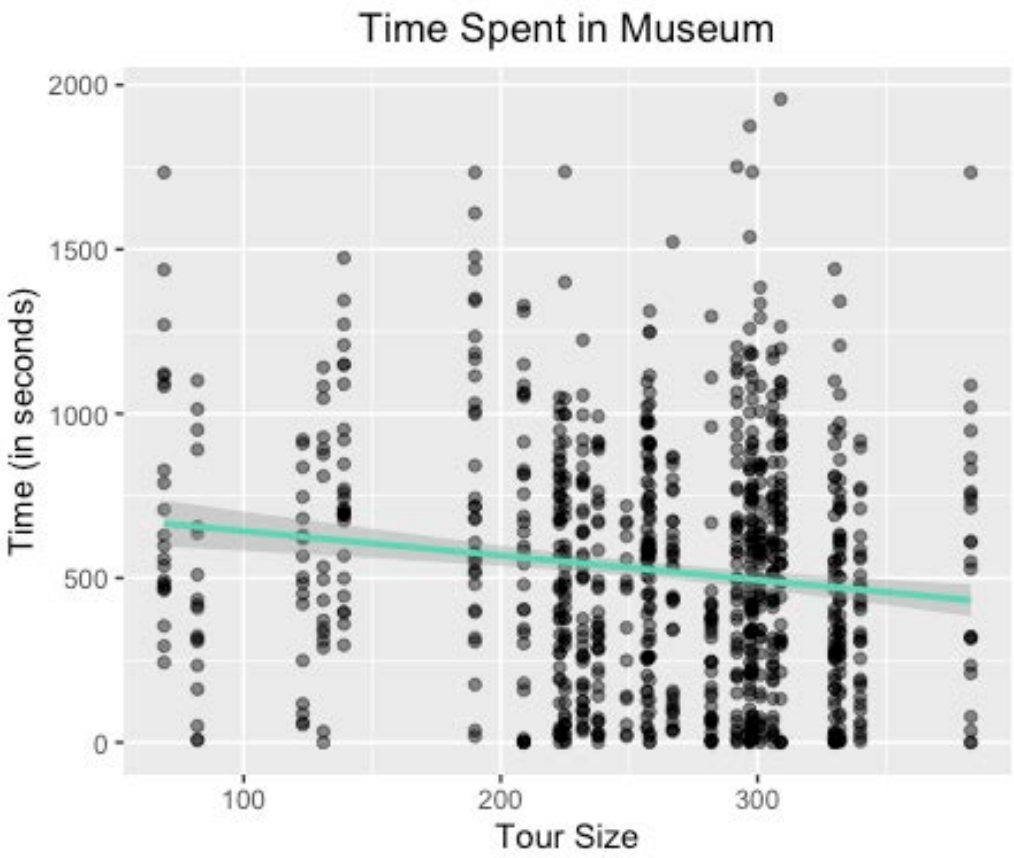


Figure 47 Plot displaying the relationship between tour size and time spent in Area 6 with a fitted regression line

Qualitative Observations

As was seen in the quantitative data, the location of the ranger talk was a strong attractor for visitors to Fort Sumter during the first 15-20 minutes of their experience. During trips where there was a ranger talk, the majority of visitors attended the talk. Only after the talk is finished do the majority of visitors disperse to other parts of the fort. The notable exception to this is the tendency for some visitors to walk around Area 8 during the talk if the ranger talk is held in Area 5. After the talk (if one was conducted on the island), many visitors head straight to the museum. For example, on April 2nd at the 1:00 PM tour, one researcher only counted two visitors in the museum five minutes after arriving while a ranger was presenting their talk around the flag pole in Area 5. Twenty minutes after arrival and once the talk finished, that number increased to 40 and continued to increase to 65 at the 35-minute mark.

Additionally, the visitors tend to linger in the same area once the talk is finished, but they are less likely to be in the same area at later points than if the ranger talk was held in a different area. Figures 26 through 37 above display this pattern quite well, where there are higher densities in the ranger talk area through minute 30 but after which the densities decrease relative to maps of other ranger talk locations for the same time segment. One observation that may help to explain why visitors may linger in an area after the ranger talk is that there were generally a few groups that wished to ask the ranger some questions after the talk. Similarly, some rangers punctuated their talks by inviting visitors to follow them to take a closer look at some nearby feature of interest, like the fingerprints of slaves left in the bricks of the fort.

The weather played a significant factor in the movements of individuals, particularly for visitors in the winter and summer data collection periods. During the first three days that the research team visited the fort in the winter, the wind was particularly strong (between 14-21 mph). On January 14th when it was 50° and wind speeds around 17 mph, it was noted that several groups were overheard discussing heading to the museum to warm up and get out of the wind. Interestingly, although January 15th was the coldest day of the whole data collection at 39° but wind speeds around 10 mph, researchers noted that visitors were more broadly dispersed across the fort than they had been during previous visits. This suggests that high wind speed may be a greater factor in determining visitor movements than temperature alone in cooler weather.

However, when weather is warmer, wind speed does not impact visitor behavior to the same degree. Visitors on April 1st experienced wind speeds upwards of 25 mph, but the temperature at that time was between 70° and 73°. Both researchers present noted that visitors dispersed relatively evenly after arriving for the 1 pm tour (there was no ranger talk on the island during that tour). The only notable distinction that day was that fewer individuals in Areas 5 and 8 spent time viewing the scenery, and if they were in those areas, they tended to focus on reading interpretive signage. This adds additional clarity to the MANOVA tests regarding temperature and wind speed above. While both may significantly impact the time spent in an area, at cool and colder temperatures, wind speed is the dominating factor.

Similarly, visitor behaviors were noted to be different during the hot and humid weather of the summer data collection period. The summer data collection had temperatures in the mid and upper 80s and relative humidities between 65-80%. Visitors in the summer, regardless of the day or tour, all were attracted to the museum to a much greater degree than the other months due to the air conditioning. Researchers overheard multiple interactions between visitors where they indicated their intention to go into the museum specifically for the air conditioning. One visitor said they intended to go there "to rest." While the multivariate regression found that increased tour sizes was statistically associated with fewer people in the museum, this effect did not lead to less crowded conditions within the museum during the summer as visitors sought air conditioning. Several times during the summer, researchers counted greater than 75 people in the museum. The researchers noted that not only did visitors seek air conditioning in the museum, visitors in the lower parade grounds in Areas 3 and 4 often sought shade. Several rangers even located their talks in Area 4 during particularly sunny and hot tours so that more visitors would be able to stand under the shade and sit on the benches. If individuals were out in the sun during these trips, they were more likely to be next to a feature such as a canon or interpretive sign. Additionally, it was noted that visitors in Area 5 commented on the breeze experienced on the upper parade ground that could not be felt in Areas 3 and 4.

One side effect of the majority of visitors seeking shade during the summer months was that as the interpretive rangers and volunteers went to locations where the majority of the people were, the researchers noted a slight increase in visitor behaviors like climbing on canons as the result of this decreased oversight. During one tour where the ranger talk was conducted in the shade in the lower parade grounds, one visitor was able to walk around the top of the fort walls

beginning at the northeast corner of the fort, and they were only noticed by a volunteer as they approached the west face.

During several tours in July when there was no formal ranger talk held at the fort, rangers nevertheless drew small crowds during the July 1st 12:00 PM tour, the July 3rd 12:00 PM tour, and the July 3rd 2:30 PM tour. These small crowds were between 15-40 individuals and grew over time as other visitors took notice. During tours that did not include a formal ranger talk on the island but the talks were presented on the ferry instead, it was noted twice that visitors voiced their opinion (either in earshot of the researchers or directly to the researchers) that they wished there was a presentation to help orient the visitors.

The largest concern voiced to the researchers while visitors returned their GPS data loggers was that there was not enough time. One visitor on the April 2nd 1:00 PM tour stated, "There's not enough time to see everything in the museum". When visitors returned their data loggers to the researchers as they boarded the ferry on Fort Sumter during the spring and summer data collections, researchers noted five individuals expressly stating that they needed more time. However, there was variability in this response. For example, during the July 3rd 2:30 PM tour, one visitor was heard asking a member of their group "What are you supposed to do here for an hour?" just fifteen minutes after arriving. Similarly, another visitor on the January 13th 1:00 PM tour was overheard stating that they had "time to kill" with 20 minutes remaining before the ferry departed the island.

While few visitors had visible mobility issues or aids that kept them from experiencing every area of Fort Sumter, access did prove to be an issue for some visitors, and the researchers noted several instances of visitors inquiring about the wheelchair elevators to be told that they were not working at the time. The lack of a men's bathroom at the fort proved to be an inconvenience for several individuals and resulted in decreased time on the island for visitors who needed to return to the ferry during their visit, with one visitor overheard stating that walking back to the ferry "takes a lot of time." Additionally, one group of visitors noted that the ferry lacked an accessible bathroom despite the Park Service website indicating that they (ferries departing from the Visitor Center) were accessible. This discrepancy was due to the ferry from Patriots Point (which does not have an accessible bathroom) servicing the 4:00 PM tour from the Visitor Center in July. Lastly, researchers noted several instances where visitors had difficulty

with wayfinding. This was particularly salient to visitors near the stairs leading to Area 9 from Area 5. Visitors voiced concern to their group members that they were unsure if Area 9 would connect with Area 3 stating “If we go down those stairs, will we have to come back up? …Let’s just go down the way we came” and avoiding Area 9 as a result. While this may be a minor inconvenience for some visitors, those with mobility issues may avoid exploring parts of Fort Sumter as a result.

Discussion

The purpose of this research was to understand the temporal and spatial distribution of day visitor use at Fort Sumter. Specifically, the travel patterns of visitors on the island were the primary focus of this investigation. Data collection occurred during the Winter, Spring, and Summer of 2023. During this time, 969 visitors participated in the study by voluntarily carrying a small GPS unit during their day trip to the fort. After appropriate data cleaning and processing, 935 visitor GPS tracks were retained for analysis. The results of this study provide many points for discussion and management implications.

Several factors were identified that had a statistically significant impact on both the time that visitors spent at Fort Sumter before returning to the ferry as well as the areas that they spent time in during their tour. For both the total time spent at the Fort and the time spent within the defined areas, the season and weather heavily impact a visitor's behavior during their tour. Additionally, only slight differences between the two points of departure (Patriots Point and Liberty Square) were identified when conducting pairwise analysis of time spent in areas between the two groups. Likewise, group characteristics (group size and inclusion of children in the group) did not tend to significantly impact overall visitor behavior. It must be noted, though, that this method only allows for the observation of one participant in a group, so within group variations and dynamics are beyond the scope of this study.

Kernel density analysis indicated that the majority of visitors typically started their tour in the area where the ranger talk was held. After the talk, visitors tended to linger in the same area or would then proceed to the museum before investigating the other areas of the fort. Additionally, the kernel density analysis helps display that many of the visitors remaining on the island past the 50^{th} minute are spending their time within the museum.

A wealth of information was discovered regarding how long visitors stay in specific areas of the island, and the percentage of visitors who are spending time in various areas of the island. Sectioning the island into areas enabled the research team to compare the travel patterns of each area. While general travel patterns were found to be similar across all seasons, significant differences were found through MANOVA analysis, with six of the nine areas showing statistically significant seasonal variation. An interesting and intuitive finding was that when

high winds or higher temperatures are present visitors use the museum for longer periods of time. This indicates that while many visitors may spend an extended period of time in the museum due to the quantity of historical and cultural resources found there, it is likely used as a way to shelter from harsh weather conditions. This finding was supported through qualitative observation.

Creating the different areas was particularly beneficial in aiding detailed analysis of highly visited areas. The detailed analysis further validated that the main areas visitors frequented and spent their time were inside the museum, and on the upper parade grounds and along the perimeter on the east side of the island. Conversely, visitors spent much less time in areas that were not directly accessible from the main path bisecting the lower parade ground the main staircase to the upper parade ground. Areas 2, 7 and 9 saw exceedingly little visitor use. Area 2 is outside the fort walls and may not offer much for the visitors to see. Visitors may use Areas 7 and 9 less because they are unaware of how to access them or are wary of possibly needing to backtrack to leave the area.

Visitation to Fort Sumter is a rather quick trip, governed by the ferry times, and there are many resources to visit during the one-hour tour. Most travelers attend the ranger talk and then explore the island afterward without a predetermined route. While this data is noisy, it can be simplified through density maps and statistical tests. As applied in this study, GVT is able to determine what factors relate to increased time spent in certain areas and the time spent on the island before returning to the ferry. While it is relatively easy with this method to identify factors that pull visitors to certain areas such as the ranger talks, interpretive signage, and protection from weather (be it shade, wind cover, or air conditioning), it is much more difficult to identify factors that push visitors (e.g., the level at which crowding deters visitors).

As basic as the GVT concept is, it is an exceedingly useful tool for understanding 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 concessioner needs.

Long Term Monitoring of Visitor Use

Need and Background for Monitoring Visitor Use

The Interagency Visitor Use Management Framework (2019) recommends that managers and researchers monitor indicators of quality and associated thresholds. Thresholds are minimally acceptable conditions identified by park staff to ensure desired conditions for the area are maintained and achieved. However, if monitoring data suggests that conditions are approaching or exceeding thresholds, or even activating triggers, then responsible parties should consider taking management action. Management actions can include a variety of practices, including use limits, spatial or temporal redistribution of use, protection of the site from further impacts (e.g., site hardening), expansion of facilities or services, and educating visitors in an attempt to reduce impacts. Monitoring of these indicators and their relationship to established thresholds and triggers needs to be a continuing process conducted by NPS staff. Alternatively, an external entity, such as a university or local school near the park familiar with the site and methods, or volunteers can conduct the monitoring.

This project did not have as an explicit goal to establish indicators or threshold for visitor use at Fort Sumter. However, the data collected and presented in this report is the first step towards the development of indicators and their associated thresholds.

Monitoring is the Key to Maintaining Desired Conditions

This study provided data for the park to better understand patterns of use at Fort Sumter. However, the collection of these data may be the least complicated part of the process; what to do with it once collected, is just as important. Therefore, it is suggested that this study be repeated on a 5-10 year basis to identify possible trends in visitor use. Although it is not the goal of this report to create more work (i.e other duties as assigned), this monitoring effort does need a champion. This could be a park manager, this could be a volunteer, this could be in partnership with an external organization, or some combination of all of the above. Also, researchers recommend the development of indicators and thresholds. Critically, the information that these are based on (e.g., correction factors for counting, relationships between variables) must be updated through a thorough and intensive visitor use study at a 5 to 10-year interval (or as needed based on changing conditions). This follow up study can be conducted by an external

entity, such as a university familiar with the site and methods as part the Cooperative Ecosystems Studies Unit (CESU).

Monitoring Protocol Suggestions

We recommend monitoring the number of visitors and visitor patterns to understand which areas of the fort are regularly visited and which areas lack visitors or visitor engagement. This information will be useful for designing interpretive signage and programs to disperse visitors more broadly. Monitoring visitor numbers can be done using a combination of counters, trail cameras and/or GPS data loggers. We recommend TrafX counters (https://www.trafx.net/), Bushnell trail cameras (https://www.bushnell.com/) and Canmore data loggers, however, staff should use the makes and models they are most familiar with. Data from counters require less processing than images from cameras and data loggers in order to see trends in use, but counters also provide less detail than images and GIS (e.g. group sizes, equipment to identify type of visitor, species).

1. Identify the areas and data of interest for monitoring.
2. Determine the time-period for monitoring to establish a monitoring period. Researchers and managers often monitor visitor experience during peak use periods.
3. Deploy and position the equipment based on manufacturer recommendations.
4. If the monitoring period presents non-typical conditions (e.g., unusually high rain, extreme temperatures, historical event), then monitoring personnel should prolong the monitoring period to capture "typical" visitor patterns. At the end of the data collection period, personnel facilitating the monitoring should download the data. Monitoring personnel should visually inspect the data for extreme cases or questionable cases, which may later be deleted if necessary. Following, monitoring personnel should record the counts per time and day in a spreadsheet, image analysis software (e.g. TimeLapse or Digikam) or ArcGIS. Monitoring personnel should calculate the hourly averages and maximum counts, and numerically compare the results to the baseline information presented in this report.

In addition to monitoring visitor use, we recommend surveying visitors after changes are made (e.g. increased signage, ferry variations) to determine how effective those changes are.

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Appendix A: Data Logger Tracking Form

Fort Sumter Site Contact Form – GPS Visitor Tracking

Date and Time: _____ Weather Condition: _____ Location: Visitor Center Patriots Point

Researcher: _____ Number Who Refused to Participate: _____

Pass Out						Pick Up			
GPS Logger #	Group Size	Children? (Y/N)	Repeat Visitor?	# Times Prior	Visit Visitor Center?	GPS Logger #	Satisfaction? 1-5	Likelihood to Return? 1-5	Comments?

Appendix B: Observational Grid

Observational Grid: Fort Sumter			
Date:	**Visitor focal points of note (e.g waysides, fort features, etc.)**	**Overheard Conversations**	**Behaviors of note**
Time frame:			
Observer			
Weather			
% Listening to Ranger Orientation:			
Other Notes:			

Appendix C: Power Point Presentation

Project Overview

Project Objectives

- Understand the temporal and spatial distribution of visitors at Fort Sumter
  - How visitors choose to spend their 1-hour at the fort
  - What activities/experiences they engage with or avoid
  - What routes they take during their visit
  - How party characteristics impact visitor use
  - If visitors congregate/concentrate in certain areas

Project Overview

Methods

- Three visits between January 2023 and July 2023
- GPS data loggers handed out to visitors at Liberty Square and Patriot's Point
- Size of the party and whether children are in the group were noted
- Non-intrusive observational notes taken
- Two satisfaction questions asked upon return of GPS loggers

The Numbers

969
Participants

935
Tracks Used in Analysis

90.7%*
Response Rate

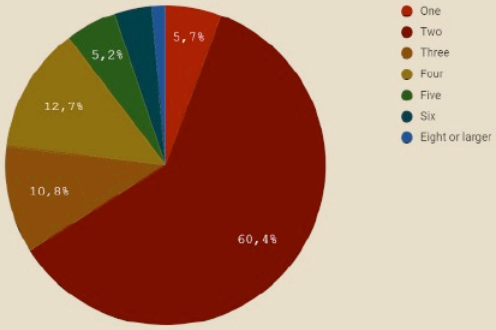
28*
Refusals

3.35
Average Group Size

36.5%
With Children

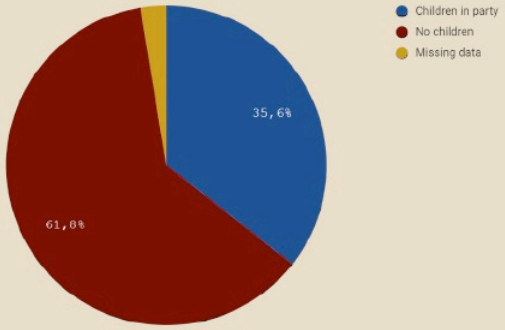
Results

Average Group Size

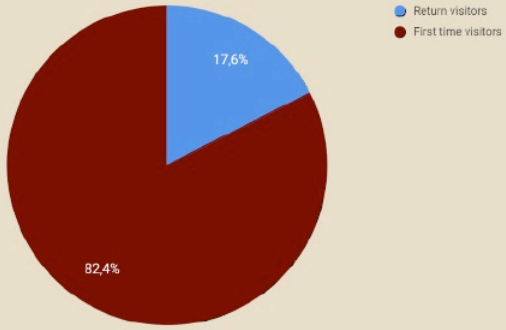


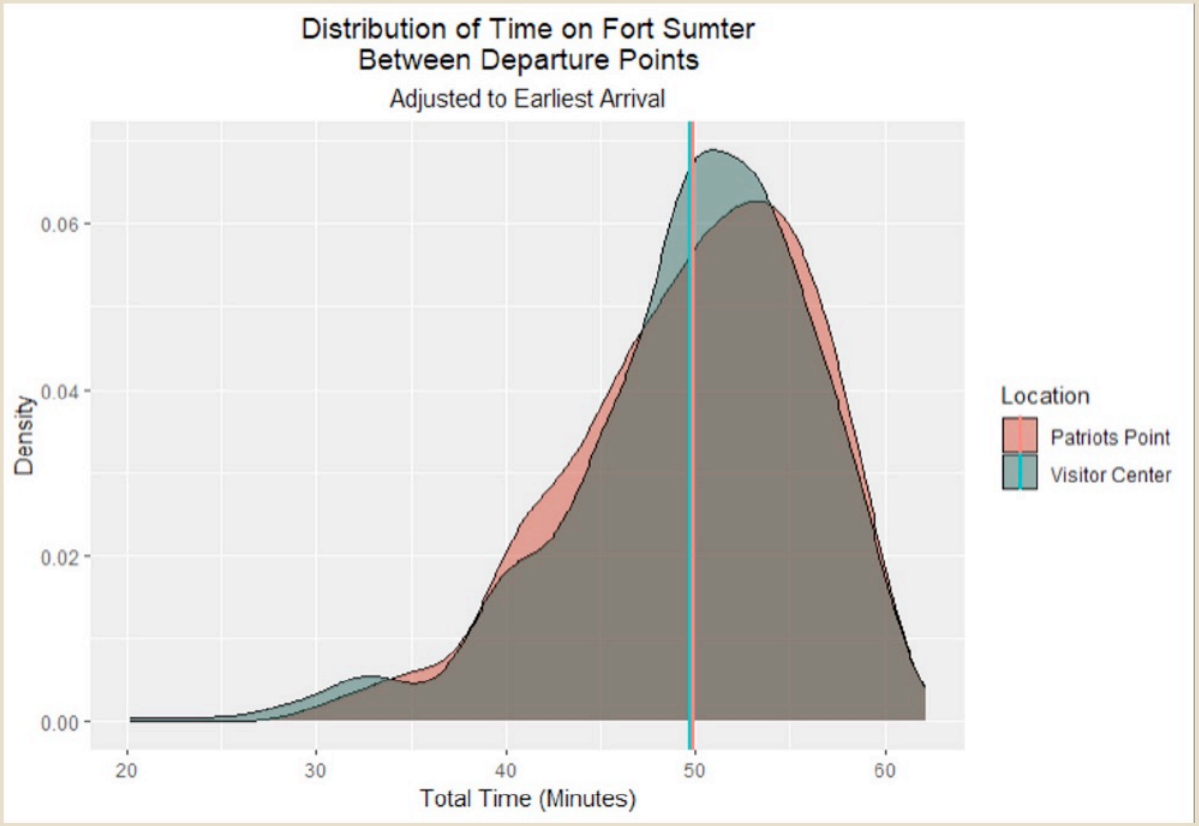
Return Visitors

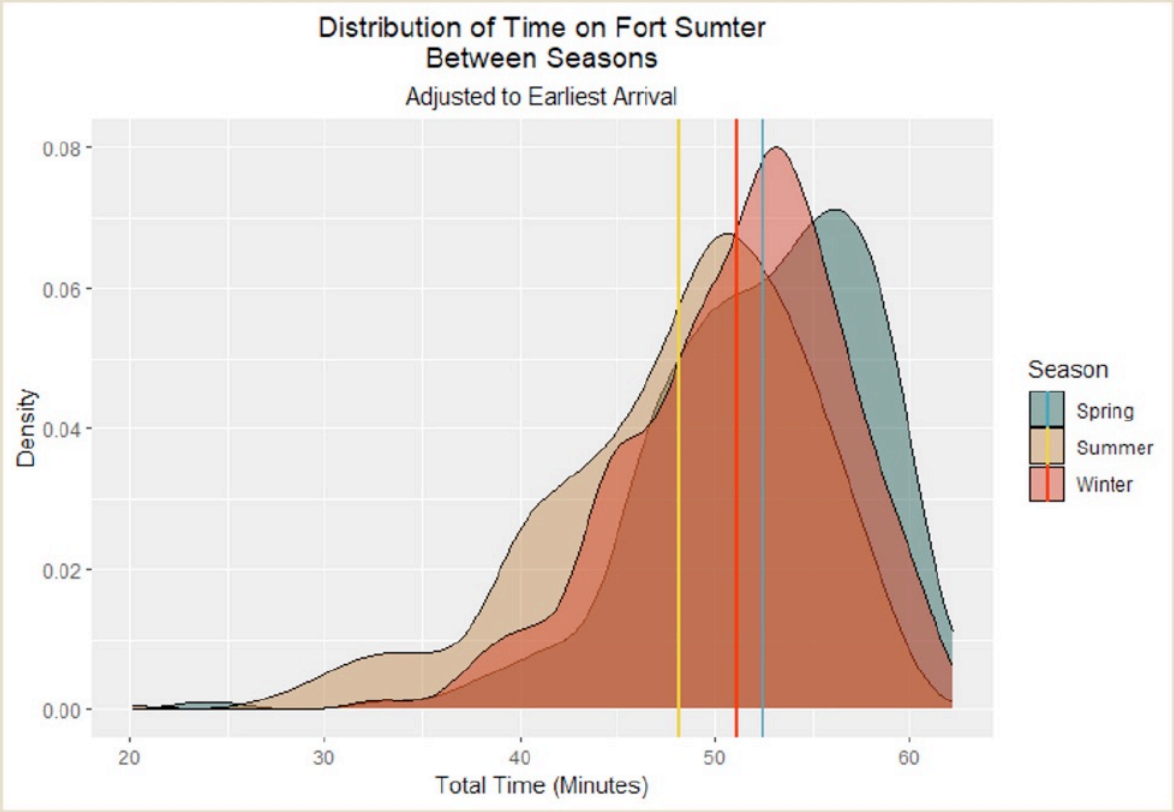
April and July only



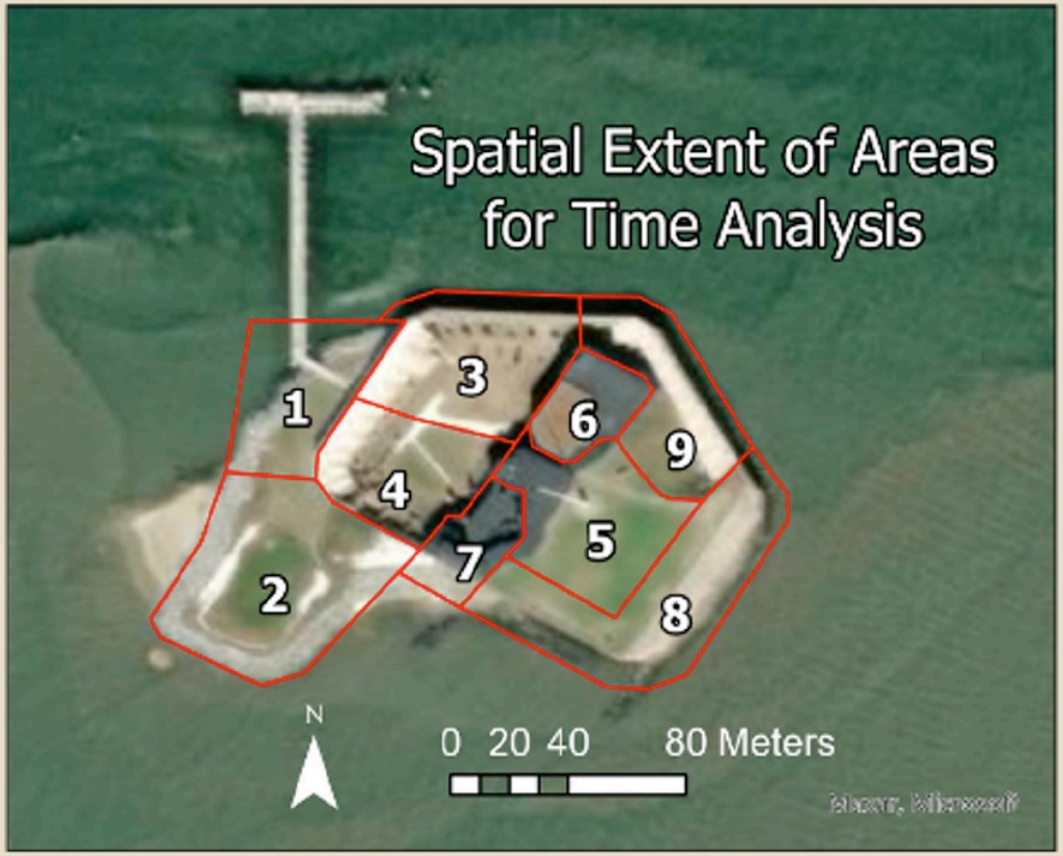
% with children




Distribution of Time on Fort Sumter
Between Departure Points
Adjusted to Earliest Arrival
Density
0.06
0.04
0.02
0.00
20
30
40
50
60
Total Time (Minutes)
Location
Patriots Point
Visitor Center


Distribution of Time on Fort Sumter
Between Seasons
Adjusted to Earliest Arrival
Density
0.08
0.06
0.04
0.02
0.00
20
30
40
50
60
Total Time (Minutes)
Season
Spring
Summer
Winter

1 – Entry/Exit
2 – “Natural Area”
3 – Lower Parade Grounds North (LPGN)
4 – Lower Parade Grounds South (LPGS)
5 – Upper Parade Grounds Flag (UPGF)
6 – Museum
7 – Battery Huger
8 – Upper Parade Grounds Interpretation (UPGI)
9 – Right Face



1 = Entry/Exit
2 = Natural Area
3 = LPGN
4 = LPGS

Average Time in Area: ***Winter***

5 = UPGF
6 = Museum
7 = Battery
8 = UPGI
9 = Right Face

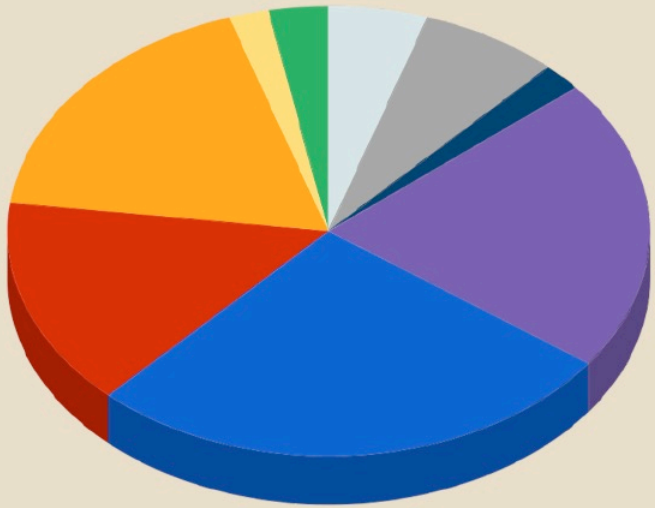
Area 1
01:25 average minutes in area (2.98%)

Area 2
00:57 average minutes in area (2.00%)

Area 3
08:45 average minutes in area (18.46%)

Area 4
06:58 average minutes in area (14.72%)

Area 5
12:55 average minutes in area (27.28%)



Area 6
09:57 average minutes in area (21.01%)

Area 7
00:51 average minutes in area (1.80%)

Area 8
03:16 average minutes in area (6.90%)

Area 9
02:18 average minutes in area (4.86%)

1 = Entry/Exit
2 = Natural Area
3 = LPGN
4 = LPGS

Average Time in Area: ***Spring***

5 = UPGF
6 = Museum
7 = Battery
8 = UPGI
9 = Right Face

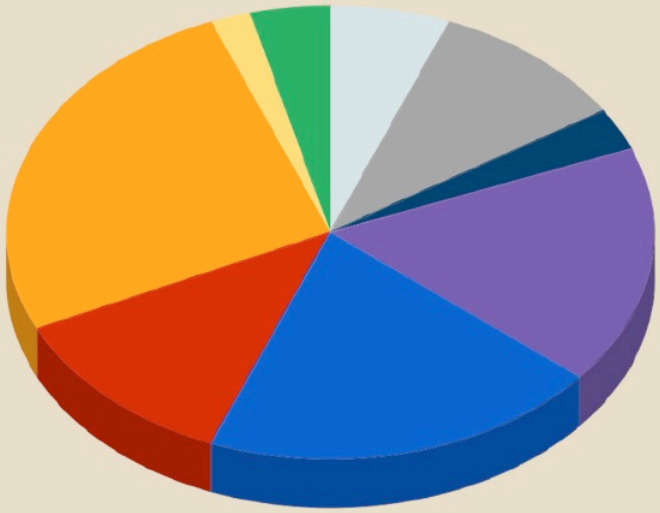
Area 1
02:08 average minutes in area (3.54%)

Area 2
01:19 average minutes in area (2.19%)

Area 3
15:28 average minutes in area (25.80%)

Area 4
06:59 average minutes in area (11.63%)

Area 5
12:15 average minutes in area (20.43%)



Area 6
10:26 average minutes in area (17.39%)

Area 7
02:00 average minutes in area (3.33%)

Area 8
05:49 average minutes in area (9.69%)

Area 9
03:36 average minutes in area (5.99%)

1 = Entry/Exit
2 = Natural Area
3 = LPGN
4 = LPGS

Average Time in Area: ***Summer***

5 = UPGF
6 = Museum
7 = Battery
8 = UPGI
9 = Right Face

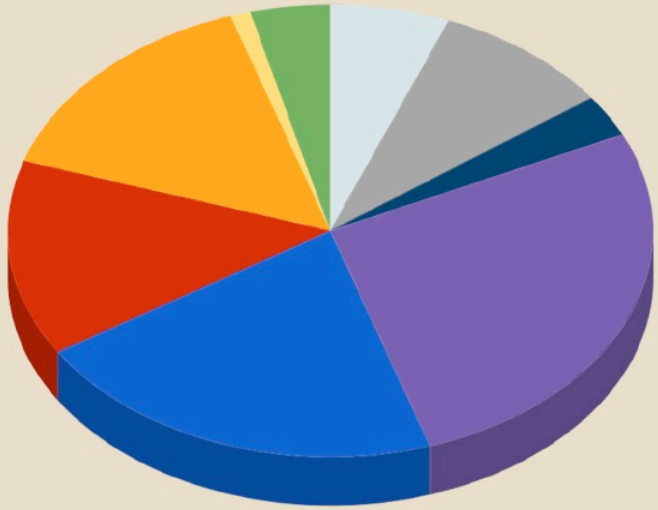
Area 1
02:18 average minutes in area (3.82%)

Area 2
00:45 average minutes in area (1.23%)

Area 3
09:08 average minutes in area (15.13%)

Area 4
08:22 average minutes in area (13.85%)

Area 5
12:23 average minutes in area (20.50%)



Area 6
16:12 average minutes in area (26.82%)

Area 7
01:52 average minutes in area (3.08%)

Area 8
05:43 average minutes in area (9.46%)

Area 9
03:42 average minutes in area (6.12%)

1 = Entry/Exit
2 = Natural Area
3 = LPGN
4 = LPGS

Average Time in Area: ***Across three seasons***

5 = UPGF
6 = Museum
7 = Battery
8 = UPGI
9 = Right Face

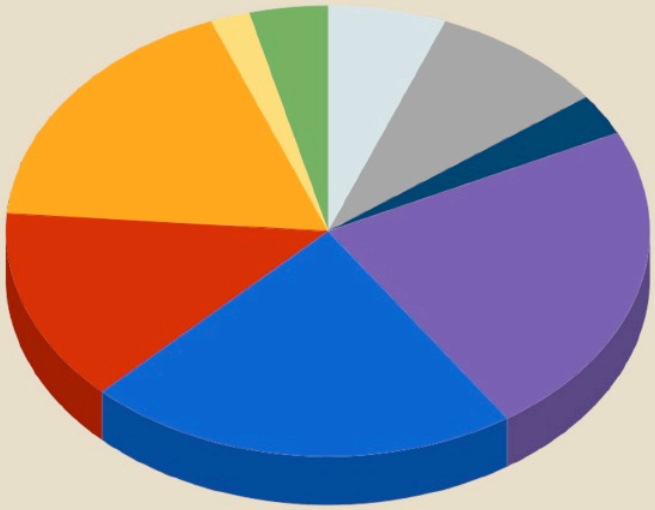
Area 1
01:35 average minutes in area (3.56%)

Area 2
00:44 average minutes in area (1.64%)

Area 3
08:15 average minutes in area (18.47%)

Area 4
06:02 average minutes in area (13.51%)

Area 5
09:50 average minutes in area (22.02%)



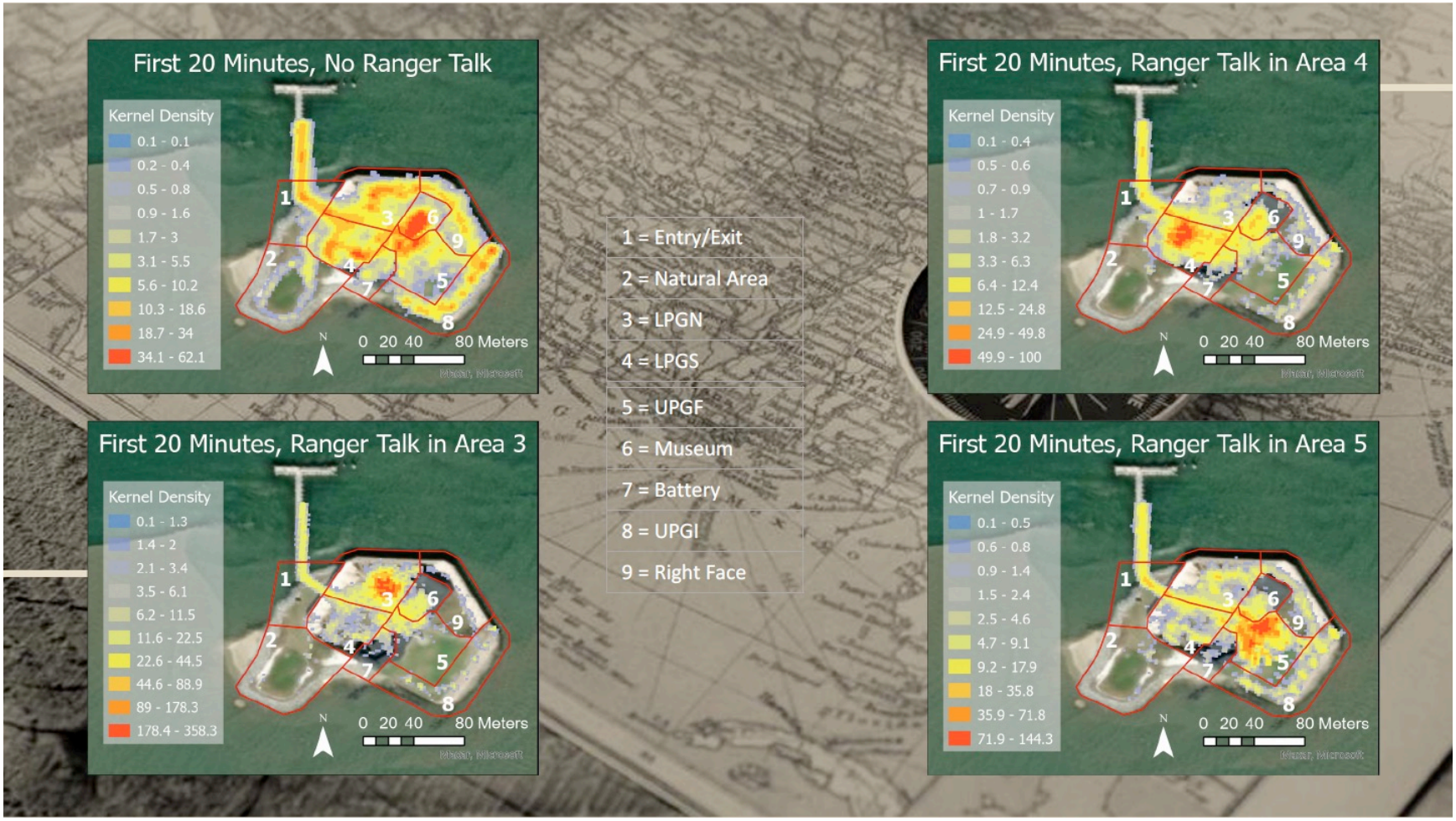
Area 6
10:22 average minutes in area (23.22%)

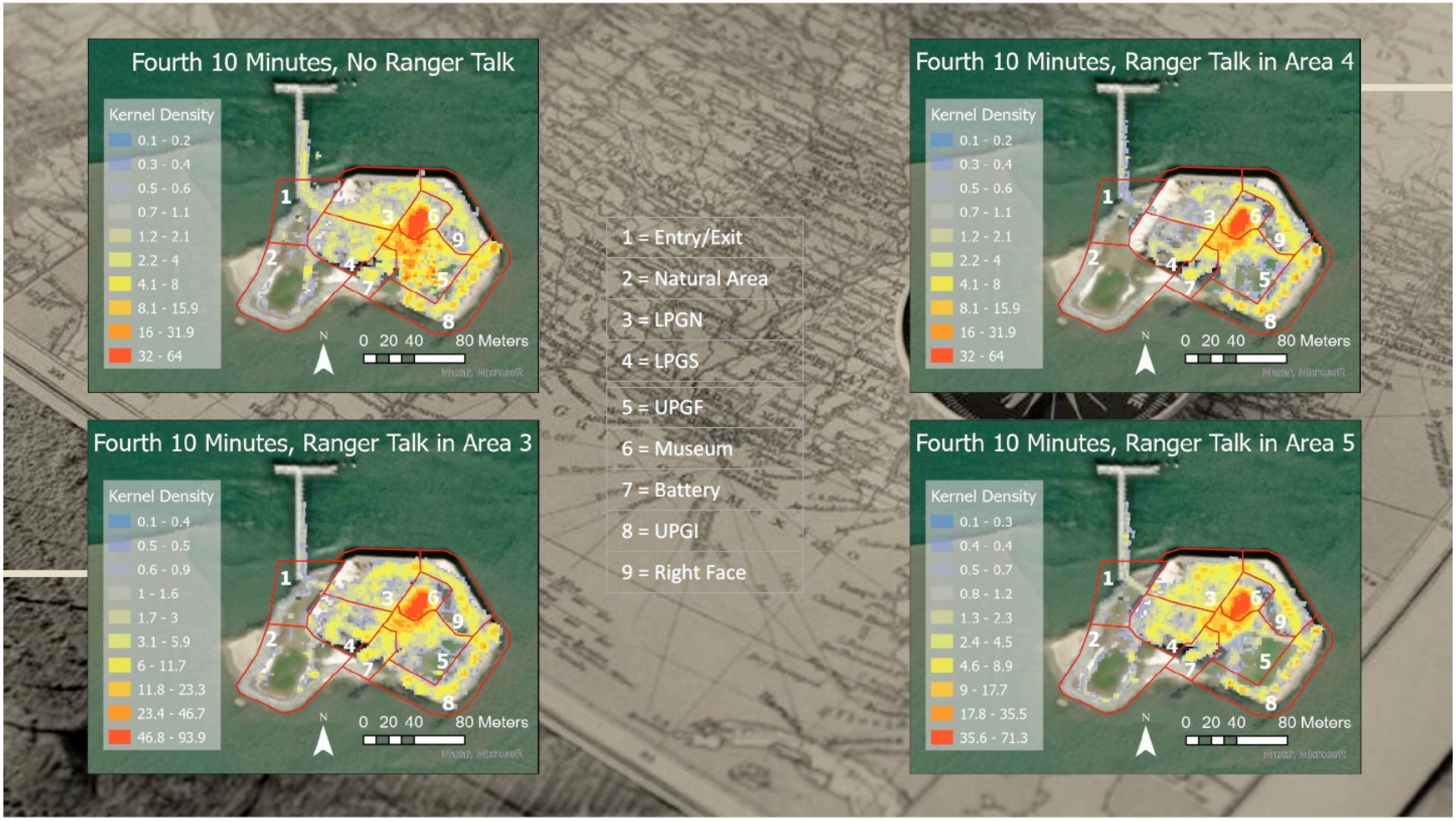
Area 7
01:16 average minutes in area (2.85%)

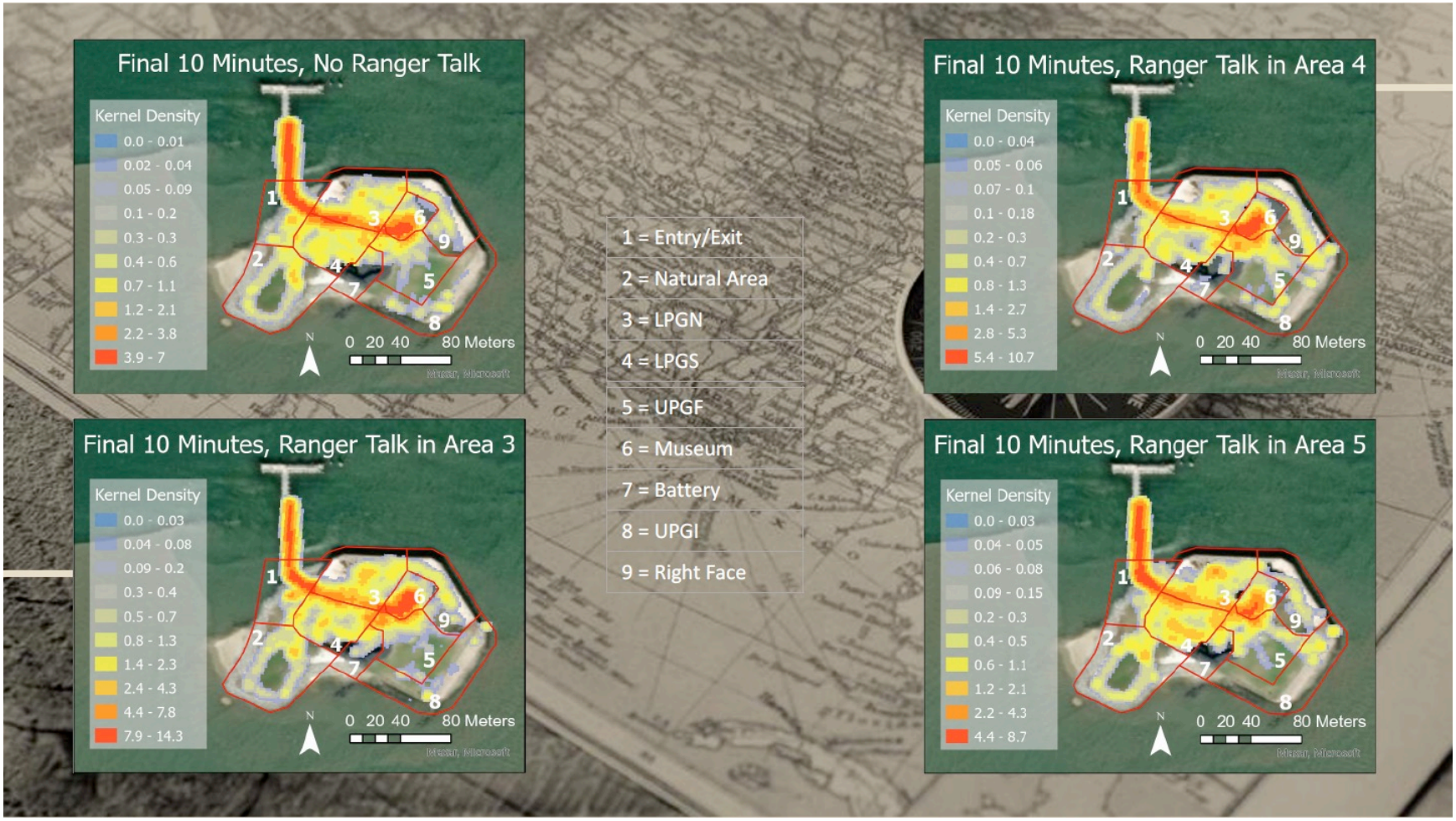
Area 8
03:59 average minutes in area (8.93%)

Area 9
02:35 average minutes in area (5.80%)


Kernel Density
Winter Visits
Kernel Density
0.1 - 0.6
0.7 - 0.9
1 - 1.6
1.7 - 2.8
2.9 - 5.4
5.5 - 10.6
10.7 - 20.9
21 - 41.8
41.9 - 83.8
83.9 - 168.3
N
0 20 40 80 Meters
Spring Visits
Kernel Density
0.1 - 0.7
0.8 - 1.1
1.2 - 1.9
2 - 3.4
3.5 - 6.4
6.5 - 12.5
12.6 - 24.8
24.9 - 49.5
49.6 - 99.2
99.3 - 199.3
N
0 20 40 80 Meters
Summer Visits
Kernel Density
0.1 - 1.9
2 - 2.8
2.9 - 4.7
4.8 - 8.5
8.6 - 16.1
16.2 - 31.5
31.6 - 62.4
62.5 - 124.6
124.7 - 249.9
250 - 502
N
0 20 40 80 Meters
1 = Entry/Exit
2 = Natural Area
3 = LPGN
4 = LPGS
5 = UPGF
6 = Museum
7 = Battery
8 = UPGI
9 = Right Face


First 20 Minutes, No Ranger Talk
Kernel Density
0.1 - 0.1
0.2 - 0.4
0.5 - 0.8
0.9 - 1.6
1.7 - 3
3.1 - 5.5
5.6 - 10.2
10.3 - 18.6
18.7 - 34
34.1 - 62.1
N
0 20 40 80 Meters
First 20 Minutes, Ranger Talk in Area 4
Kernel Density
0.1 - 0.4
0.5 - 0.6
0.7 - 0.9
1 - 1.7
1.8 - 3.2
3.3 - 6.3
6.4 - 12.4
12.5 - 24.8
24.9 - 49.8
49.9 - 100
N
0 20 40 80 Meters
First 20 Minutes, Ranger Talk in Area 3
Kernel Density
0.1 - 1.3
1.4 - 2
2.1 - 3.4
3.5 - 6.1
6.2 - 11.5
11.6 - 22.5
22.6 - 44.5
44.6 - 88.9
89 - 178.3
178.4 - 358.3
N
0 20 40 80 Meters
First 20 Minutes, Ranger Talk in Area 5
Kernel Density
0.1 - 0.5
0.6 - 0.8
0.9 - 1.4
1.5 - 2.4
2.5 - 4.6
4.7 - 9.1
9.2 - 17.9
18 - 35.8
35.9 - 71.8
71.9 - 144.3
N
0 20 40 80 Meters
1 = Entry/Exit
2 = Natural Area
3 = LPGN
4 = LPGS
5 = UPGF
6 = Museum
7 = Battery
8 = UPGI
9 = Right Face


Fourth 10 Minutes, No Ranger Talk
Kernel Density
0.1 - 0.2
0.3 - 0.4
0.5 - 0.6
0.7 - 1.1
1.2 - 2.1
2.2 - 4
4.1 - 8
8.1 - 15.9
16 - 31.9
32 - 64
N
0 20 40 80 Meters
Fourth 10 Minutes, Ranger Talk in Area 4
Kernel Density
0.1 - 0.2
0.3 - 0.4
0.5 - 0.6
0.7 - 1.1
1.2 - 2.1
2.2 - 4
4.1 - 8
8.1 - 15.9
16 - 31.9
32 - 64
N
0 20 40 80 Meters
1 = Entry/Exit
2 = Natural Area
3 = LPGN
4 = LPGS
5 = UPGF
6 = Museum
7 = Battery
8 = UPGI
9 = Right Face
Fourth 10 Minutes, Ranger Talk in Area 3
Kernel Density
0.1 - 0.4
0.5 - 0.5
0.6 - 0.9
1 - 1.6
1.7 - 3
3.1 - 5.9
6 - 11.7
11.8 - 23.3
23.4 - 46.7
46.8 - 93.9
N
0 20 40 80 Meters
Fourth 10 Minutes, Ranger Talk in Area 5
Kernel Density
0.1 - 0.3
0.4 - 0.4
0.5 - 0.7
0.8 - 1.2
1.3 - 2.3
2.4 - 4.5
4.6 - 8.9
9 - 17.7
17.8 - 35.5
35.6 - 71.3
N
0 20 40 80 Meters


Final 10 Minutes, No Ranger Talk
Kernel Density
0.0 - 0.01
0.02 - 0.04
0.05 - 0.09
0.1 - 0.2
0.3 - 0.3
0.4 - 0.6
0.7 - 1.1
1.2 - 2.1
2.2 - 3.8
3.9 - 7
N
0 20 40 80 Meters
Final 10 Minutes, Ranger Talk in Area 4
Kernel Density
0.0 - 0.04
0.05 - 0.06
0.07 - 0.1
0.1 - 0.18
0.2 - 0.3
0.4 - 0.7
0.8 - 1.3
1.4 - 2.7
2.8 - 5.3
5.4 - 10.7
N
0 20 40 80 Meters
1 = Entry/Exit
2 = Natural Area
3 = LPGN
4 = LPGS
5 = UPGF
6 = Museum
7 = Battery
8 = UPGI
9 = Right Face
Final 10 Minutes, Ranger Talk in Area 3
Kernel Density
0.0 - 0.03
0.04 - 0.08
0.09 - 0.2
0.3 - 0.4
0.5 - 0.7
0.8 - 1.3
1.4 - 2.3
2.4 - 4.3
4.4 - 7.8
7.9 - 14.3
N
0 20 40 80 Meters
Final 10 Minutes, Ranger Talk in Area 5
Kernel Density
0.0 - 0.03
0.04 - 0.05
0.06 - 0.08
0.09 - 0.15
0.2 - 0.3
0.4 - 0.5
0.6 - 1.1
1.2 - 2.1
2.2 - 4.3
4.4 - 8.7
N
0 20 40 80 Meters

Seasonal Differences

1 = Entry/Exit
2 = Natural Area
3 = LPGN
4 = LPGS
5 = UPGF
6 = Museum
7 = Battery
8 = UPGI
9 = Right Face

Table 4 Time spent in each area during the last 40 minutes across three seasons of data collection[a]

	Means[b]			ANOVA results[c]	
Areas	*Winter*	*Spring*	*Summer*	*F*	*p*
Area 1	49.30	58.50	48.96	3.02	.049
Area 2	43.97[d]	49.95[e]	23.68[d,e]	9.39	<.001
Area 3	220.40[f]	240.24[g]	183.62[f,g]	9.98	<.001
Area 4	197.24[h]	180.23	149.24[h]	6.65	.001
Area 5	446.82[i]	494.53[j]	309.56[i,j]	40.34	<.001
Area 6	528.59[k]	438.26	555.71[k]	7.75	<.001
Area 7	39.92[l]	78.06[l,m]	55.47[m]	7.88	.001
Area 8	157.84	212.99	167.44	4.52	.011
Area 9	112.94	138.58	105.51	4.96	.007

[a] MANOVA model: Wilks's $\Lambda = 0.78$, $F(2, 932) = 13.49$, $p < .001$
[b] Time spent is reported in seconds
[c] Significance determined at $p = .006$ level
[d-m] Same letter in row indicates significant mean difference

- Spring visitors tend to spend most time in each area; summer visitors tend to spend least time in each area.
- Summer visitors spent significantly less time in Areas 2, 3, and 5 than winter and spring visitors.
- Winter visitors spent significantly more time in Area 4 than summer visitors.
- In Area 6, the opposite was true; summer visitors spent significantly more time than winter visitors.
- In Area 7, spring visitors spent significantly more time than either winter or summer visitor.

Departure Location Differences

1 = Entry/Exit
2 = Natural Area
3 = LPGN
4 = LPGS
5 = UPGF
6 = Museum
7 = Battery
8 = UPGI
9 = Right Face

Table 5 Time spent in each area during the last 40 minutes across departure location[a]

	Means[b]		ANOVA results[c]	
Areas	*Patriots Point*	*Liberty Square*	*F*	*p*
Area 1	48.28	52.42	1.39	.238
Area 2	25.13	37.69	4.45	.035
Area 3	192.09	209.41	2.11	.146
Area 4	167.23	166.14	0.01	.929
Area 5	338.81	398.36	8.36	.004
Area 6	577.79	500.22	8.77	.003
Area 7	64.67	54.01	2.28	.132
Area 8	177.16	174.95	0.02	.882
Area 9	113.69	114.88	0.02	.898

[a] MANOVA model: Wilks's $\Lambda = 0.97$, $F(1, 933) = 2.86$, $p = .002$
[b] Time spent is reported in seconds
[c] Significance determined at .006 level

- Visitors departing from Liberty Square spent a statistically significantly longer amount of time in Area 5.
- The opposite was true for Area 6; visitors from Patriot's Point spent significantly more time than visitors from the Liberty Square.

Group Size Differences

1 = Entry/Exit
2 = Natural Area
3 = LPGN
4 = LPGS
5 = UPGF
6 = Museum
7 = Battery
8 = UPGI
9 = Right Face

Table 6 Time spent in each area during the last 40 minutes across group size ranges[a]

	Means[b]				ANOVA results[c]	
Areas	*Solo Traveler*	*With partner*	*3- 4 People*	*≥ 5 people*	*F*	*p*
Area 1	68.77	50.24	46.41[d]	59.45[d]	3.76	.011
Area 2	66.00	32.06	32.39	37.42	1.47	.223
Area 3	242.12	202.09	196.00	219.09	1.16	.323
Area 4	268.27[e,f,g]	162.73[e]	164.47[f]	164.51[g]	3.17	.024
Area 5	373.15	401.24	361.23	356.61	1.59	.191
Area 6	379.92	514.90	520.73	583.78	2.85	.036
Area 7	71.62	55.57	59.16	55.17	0.28	.837
Area 8	159.31	184.55	179.59	150.51	1.12	.341
Area 9	109.92	116.72	114.72	107.64	0.20	.896

[a] MANOVA model: Wilks's $\Lambda = 0.959$, $F(3, 924) = 1.42$, $p = .075$
[b] Time spent is reported in seconds
[c] Significance determined at $p = .006$ level
[d-g] Same letter in row indicates significant mean difference (despite MANOVA and ANOVA models not significant)

- In Area 1, persons in groups of five or more stayed significantly longer than those in groups of 3-4 people.
- In Area 4, solo travelers stayed a significantly longer amount of time than each of the other three groups.

Children's Attendance Differences

1 = Entry/Exit
2 = Natural Area
3 = LPGN
4 = LPGS
5 = UPGF
6 = Museum
7 = Battery
8 = UPGI
9 = Right Face

Table 7 Time spent in each area during the last 40 minutes across groups without children and groups with children[a]

	Means[b]		ANOVA results[c]	
Areas	*No Children*	*Children*	*F*	*p*
Area 1	51.00	51.23	0.90	.914
Area 2	33.07	36.19	0.45	.640
Area 3	208.59	195.18	0.92	.398
Area 4	163.05	175.24	1.46	.232
Area 5	393.49	355.76	1.97	.140
Area 6	529.51	516.85	0.47	.232
Area 7	51.40	65.42	3.41	.034
Area 8	187.08	156.18	2.36	.095
Area 9	116.53	112.33	0.45	.638

[a] MANOVA model: Wilks's $\Lambda = 0.974$, $F(1, 916) = 1.78$, $p = .067$
[b] Time spent is reported in seconds
[c] Significance determined at $p = .006$ level

- Overall, no statistical significant differences noted in time spent in any of the areas. Though:
  - Those without children spent slightly more time in Areas 3, 5, 6, 8, and 9.
  - Those with children spent slightly more time in Areas 2, 4, and 7.
  - Time spent in Area 1 was nearly identical for those with and without children.

With and Without Ranger Talk Differences

1 = Entry/Exit
2 = Natural Area
3 = LPGN
4 = LPGS
5 = UPGF
6 = Museum
7 = Battery
8 = UPGI
9 = Right Face

Table 8 Time spent in each area during the last 40 minutes for tours with and without a ranger talk on the island[a]

	Means[b]		ANOVA results[c]	
Areas	*No Talk*	*Talk*	*F*	*p*
Area 1	49.74	51.76	0.32	.571
Area 2	22.19	38.68	7.51	.006
Area 3	165.67	219.89	20.69	<.001
Area 4	124.93	183.33	22.87	<.001
Area 5	478.16	340.80	45.16	<.001
Area 6	462.03	548.50	10.68	.001
Area 7	49.97	60.16	2.03	.154
Area 8	167.49	178.91	0.57	.449
Area 9	88.24	125.20	15.91	<.001

[a] MANOVA model: Wilks's $\Lambda = 0.88$, $F(1, 933) = 14.22$, $p < .001$
[b] Time spent is reported in seconds
[c] Significance determined at $p = .006$ level

- Those who had a ranger talk during their visit stayed significantly longer in Areas 3, 4, 6, and 9.
- Those who did not have a ranger talk stayed longer in Area 5.

Temperature Differences

1 = Entry/Exit
2 = Natural Area
3 = LPGN
4 = LPGS
5 = UPGF
6 = Museum
7 = Battery
8 = UPGI
9 = Right Face

Table 9. Time spent in each area during the last 40 minutes across three outside temperatures (Fahrenheit)[a]

	Means[b]			ANOVA results[c]	
Areas	*≤ 60°*	*61°- 84°*	*≥ 85°*	*F*	*p*
Area 1	45.45	56.90[d]	48.24[d]	4.22	.015
Area 2	34.41	48.15[e]	21.71[e]	10.01	<.001
Area 3	189.08[f]	240.44[f,g]	178.60[g]	14.54	<.001
Area 4	205.28[h]	170.21	150.36[h]	5.72	.003
Area 5	475.78[i]	433.12[j]	304.13[i,j]	30.40	<.001
Area 6	504.75	488.92[k]	559.08[k]	3.80	.023
Area 7	33.36[l]	69.12[l]	55.10	6.94	.001
Area 8	138.00[m]	208.03[m,n]	160.72[n]	7.89	<.001
Area 9	105.53[o]	136.95[o,p]	98.55[p]	9.23	<.001

[a] MANOVA model: Wilks's $\Lambda = 0.79$, $F(2, 932) = 13.24$, $p < .001$
[b] Time spent is reported in seconds
[c] Significance determined at $p = .006$ level
[d-p] Same letter in row indicates significant mean difference

- Visitors spent more time in Area 2, when it was 61° - 84° than when it was 85° or warmer.
- Visitors spent more time in Areas 3, 8, and 9 when it was 61° - 84° than when it was either 60° or cooler or 85° or warmer.
- Visitors spent more time in Area 4 when it was 60° or cooler than when it was 85° or warmer.
- Visitors spent less time in Area 5 when it was 85° or warmer.
- When it was 61° - 84°, visitors spent twice as long in Area 7 than when it was 60° or cooler.
- Though not significant, it should be noted that:
  - When it was 61° - 84°, visitors spent longer amounts of time in Area 1 than when it was 85° or warmer.
  - When it was 85° or warmer, visitors spent longer amounts of time in Area 6 compared to when it was cooler than 85°.

Weather Conditions Differences

1 = Entry/Exit
2 = Natural Area
3 = LPGN
4 = LPGS
5 = UPGF
6 = Museum
7 = Battery
8 = UPGI
9 = Right Face

Table 10 Time spent in each area during the last 40 minutes across five weather conditions[a]

	Means[b]					ANOVA results[c]	
Areas	*Cloudy*	*Mostly Cloudy*	*Partly Cloudy*	*Sunny*	*Thunder*	*F*	*p*
Area 1	49.04[d]	47.95[e]	54.27[f]	49.40[g]	88.65[d,e,f,g]	5.14	<.001
Area 2	38.40	28.25	29.64	34.05	67.26	1.63	.165
Area 3	239.22[h]	220.09	223.10	184.23[h]	163.68	4.39	.002
Area 4	230.71[i,j,k]	150.26[i,l]	154.09[j,m]	152.78[k,n]	254.35[l,m,n]	8.06	<.001
Area 5	328.51[o,p]	340.26[q,r]	368.47[s]	431.67[o,q,t]	146.58[p,r,s,t]	10.91	<.001
Area 6	574.13[u]	619.28[v]	553.34[w]	455.54[u,v,w]	597.52	8.20	<.001
Area 7	50.69[x]	46.56[y]	58.17[z]	56.66[aa]	148.35[x,y,z,aa]	7.41	<.001
Area 8	151.44[ab]	205.08[ac]	198.29[ad]	175.16[ae]	0.00[ab,ac,ad,ae]	7.43	<.001
Area 9	125.69	124.37	132.19	104.49	69.39	2.84	.023

[a] MANOVA model: Wilks's $\Lambda = 0.81$, $F(4, 930) = 5.56$, $p < .001$
[b] Time spent is reported in seconds
[c] Significance determined at $p = .006$ level
[d-ae] Same letter in row indicates significant mean difference

- Visitors spent more time in Areas 1, 4, and 7 when it was thundering as opposed to the other four weather conditions.
- The opposite was true for Areas 5 and 8; folks spent significantly less time there when it was thundering as opposed to the other weather conditions (differences are likely attributable to park staff closing the upper parade grounds while thunderstorms were present in the vicinity)
- Visitors spent significantly less time in Area 3 when it was sunny compared to when it was cloudy.
- Visitors spent significantly less time in Area 6 when it was sunny relative to when it was cloudy, mostly cloudy, or partly cloudy.

Wind Speed Differences

1 = Entry/Exit
2 = Natural Area
3 = LPGN
4 = LPGS
5 = UPGF
6 = Museum
7 = Battery
8 = UPGI
9 = Right Face

Table 11 Time spent in each area during the last 40 minutes across three wind speed ranges (miles per hour)[a]

	Means[b]			ANOVA results[c]	
Areas	*≤ 5 mph*	*6-9 mph*	*≥ 10 mph*	*F*	*p*
Area 1	58.54	47.78	51.15	2.08	.126
Area 2	25.35	25.27	40.33	3.71	.025
Area 3	191.09	194.53	212.22	1.46	.232
Area 4	166.62	145.10	177.27	3.20	.041
Area 5	271.80[d,e]	474.41[d,f]	358.54[e,f]	26.07	<.001
Area 6	577.54	525.20	509.89	1.74	.177
Area 7	76.24[g]	68.66[h]	46.90[g,h]	7.15	.001
Area 8	150.77	199.34	169.46	2.90	.056
Area 9	106.06	108.88	119.40	0.91	.403

[a] MANOVA model: Wilks's $\Lambda = 0.91$, $F(2, 932) = 5.12$, $p < .001$
[b] Time spent is reported in seconds
[c] Significance determined at $p = .006$ level
[d-h] Same letter in row indicates significant mean difference

- When the wind was 6-9 mph, visitors spent longer in Area 5 as opposed to when it was either less than 6 mph or greater than 10 mph
- When the winds were in excess of 10 mph, visitors spent significantly less time in Area 7 than when the wind was slower.

Qualitative Observations

- Visitors in the summer, regardless of the day or tour, were all attracted to the museum to a much greater degree than the other months due to the air conditioning.
- Additionally, summer visitors often sought shade in Areas 3 and 4.
- During tours that did not include a formal ranger talk on the island, it was noted twice that visitors were heard wishing there was a presentation to help orient the visitors.
- The largest concern voiced to the researchers while visitors returned their GPS data loggers was that there was not enough time.
- Conversely, several visitors believed that an hour was more than enough time (e.g. "What are you supposed to do for an hour")
- The lack of a men's bathroom at the fort proved to be a notable inconvenience for several individuals, including at least one visitor that could not access the bathroom on the ferry.
- Researchers noted several instances where visitors had difficulty with wayfinding. Visitors voiced concern to their group members that they were unsure if Area 9 would connect with Area 3 stating "If we go down those stairs, will we have to come back up? …Let's just go down the way we came" and avoiding Area 9 as a result.

Qualitative Observations

- The location of the ranger talk was a strong attractor for visitors to Fort Sumter during the first 15-20 minutes of their experience.
- The visitors tend to linger in the same area once the talk is finished.
- But less likely to be in the same area at later points than if the ranger talk was held in a different area.
- Some rangers punctuated their talks by inviting visitors to follow them to take a closer look at some nearby features of interest.
- On cold and windy days, several groups were overheard discussing heading to the museum to warm up and get out of the wind.
- Conversely on cold days with little wind, visitors were more broadly dispersed across the fort than they had been during previous visits. This suggests that high wind speed may be a greater factor in determining visitor movements than temperature alone in cooler weather.

General Findings

- Summer and Winter visitors were more likely to return to the ferry early compared to Spring visitors, with Summer visitors spending the least amount of time on the island.
- Spring visitors were more likely to visit the less traveled areas.
- The location of the ranger talk impacts how visitors spend their time and their movement patterns after the talk is completed.
- Visitors spend the vast majority of their time in the lower parade ground, the upper parade ground, and the museum.
- Visitors spend much less time outside of the fort walls, north of Battery Huger, or near the Battery Huger turret south of the Gift Shop.

General Findings

- There is no significant difference between the length of time visitors from Patriots Point spend on Fort Sumter before returning to the ferry compared to visitors from the Visitor Center
- Patriots Point visitors spend an average of 77.5 seconds longer in the museum than visitors from the Visitor Center.
- Visitors increase the time they spend in the museum when weather conditions are poor.
- There is no significant relationship between a participant's group size and the time they spend on Fort Sumter or how long they spend in each area.

Implications and Recommendations

- As the season of one's visit was determined to be a significant factor in how a visitor spends their time at Fort Sumter, park managers should continue to consider the season when scheduling tours.
- Increased use of the museum by Patriots Points visitors compared to visitors from the Visitor Center suggests that there is a need to better reach visitors from Patriots Point with supplemental education and interpretive resources.
- The amount of interpretive signage in an area greatly influences how long visitors spend in that area. If managers desire to disperse use across the island, they may consider increasing interpretive signage in lesser used areas.

Implications and Recommendations

- While the most common opinion of the length of the tour shared with researchers was that an hour was too short, variation was expressed and found to exist in the GPS data. Supplemental research is necessary to more accurately quantify visitors' preferred tour length.
- The data collected in this study may be used as a baseline for long term monitoring should visitor use patterns change for any reason including management action.