



Rocky Intertidal Visitor Count at Cabrillo National Monument

Data Summary 2011

Natural Resource Data Series NPS/CABR/NRDS—2013/464



ON THE COVER

Visitors exploring the rocky intertidal area of Cabrillo National Monument.

Photograph by: National Park Service

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The National Park Service, Natural Resource Stewardship and Science office in Fort Collins, Colorado, publishes a range of reports that address natural resource topics. These reports are of interest and applicability to a broad audience in the National Park Service and others in natural resource management, including scientists, conservation and environmental constituencies, and the public.

The Natural Resource Data Series is intended for the timely release of basic data sets and data summaries. Care has been taken to assure accuracy of raw data values, but a thorough analysis and interpretation of the data has not been completed. Consequently, the initial analyses of data in this report are provisional and subject to change.

All manuscripts in the series receive the appropriate level of peer review to ensure that the information is scientifically credible, technically accurate, appropriately written for the intended audience, and designed and published in a professional manner.

This report received informal peer review by subject-matter experts who were not directly involved in the collection, analysis, or reporting of the data.

Views, statements, findings, conclusions, recommendations, and data in this report do not necessarily reflect views and policies of the National Park Service, U.S. Department of the Interior. Mention of trade names or commercial products does not constitute endorsement or recommendation for use by the U.S. Government.

This report is available from the MEDN Inventory and Monitoring Program website at <http://science.nature.nps.gov/im/units/medn/> and from the Cultural and Natural Resource Management Division at Cabrillo National Monument and the Integrated Resource Management Applications website at <https://irma.nps.gov>

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Executive Summary

Due to the sensitive nature of the rocky intertidal marine habitat, it is essential to have an accurate assessment of the number of visitors to this area in order to make informed management decisions. Protection efforts to prevent the removal of marine life and habitat by visitors are in effect, however, negative human impacts go beyond the obvious threats. Damage can be done simply by people being present and walking on the algal turf and other organisms. These data are necessary to assess visitor capacity in the preservation of the rocky intertidal and also to ensure a positive visitor experience.

Visitor count data were collected near the rocky intertidal habitat at Cabrillo National Monument January 2011 through December 31st, 2011. These data were collected using battery operated TrailMaster game counters on two separate trails in the coastal area of the park. The counters record an “event” every time an infrared beam is broken by visitors as they walk between the devices. A staff member downloaded the total number of events every two weeks and also replaced the batteries at the same time to ensure a continuous count. Calibration methods were used to increase accuracy in the overall method.

Between January 21st, 2011 and December 31st, 2011 total visitation for the rocky intertidal and coastal bluff area of the park is estimated at 214,000 visitors. This estimate is much higher than any previous estimates recorded for visitation in this section of the park. Prior to these data, the most recent method concluded an estimated count of 100,000 visitors per year in the rocky intertidal. It should be noted that these 2011 data include visitation on the coastal bluffs, whereas data from previous counting methods included only those visitors who were actually in the rocky intertidal.

These 2011 data show visitation was extremely high during the summer months, despite the lack of low-tides below 0.7 feet, which is considered the maximum tidal height for successfully viewing the intertidal life at Cabrillo National Monument. Visitation peaked in the afternoons on weekends and holidays, with some recorded visitation spikes during tides lower than 0.7 feet. This indicates a small percentage of local visitors are aware of changing tide levels. Overall, these data show the majority of visitors do not seem to be aware of the existence of tide charts, nor are they aware of seasonal changes to daytime tide levels. These data also indicate the number of visitors entering the park before it opens and after it closes, but neither is of great concern to resource managers at this time.

These data will be used as a baseline and to assist in developing management strategies to ensure the preservation of Cabrillo’s intertidal resources for the enjoyment of this and future generations, as mandated by the National Park Service Mission.

Acknowledgments

Several colleagues and volunteers assisted us in this effort. G. Geddis, and San Diego State interns B. Richardson and D. McKay, helped collect calibration data in the field. K. London provided the shorebird data. S. Kingston wrote the Excel macro we used for collecting calibration data. Our study was greatly improved by discussions with D. Pettebone, which including setup and calibration methods for the equipment. B. Becker and T. Huff engaged us in interesting discussions regarding the impacts of visitation on the rocky intertidal habitat at Cabrillo and our work is much improved because of it.

Introduction

Cabrillo National Monument (CABR) protects approximately 130 acres of rocky intertidal habitat. The rocky intertidal habitat is very sensitive to human visitation. Red algal turf communities, in particular, have been highly impacted by the large amount of human visitation to the tidepools (Engle and Davis 1996, Becker 2006, Huff 2006, Huff 2011). Due to physical conditions in the environment (e.g. wave exposure, salt water corrosion of metal structures), establishing trails would be extraordinarily difficult in rocky intertidal areas, so trampling impacts by human foot traffic is a big concern (Huff 2006). Human trampling has been shown to decrease diversity and density of rocky shore organisms (Huff 2011). In addition, further anthropogenic impacts may include removal of marine life, rocks, shells and sand (Zedler 1978).

Visitors come from all over the world to explore the intertidal area at CABR. It's a place of discovery where people can learn about marine life in its natural habitat. Whether visitors are frequent beachgoers, or are seeing the ocean for the first time, park staff believe CABR is a place where people fall in love with the ocean. Unlike offshore marine environments that may require the use of a boat, or SCUBA training, the rocky intertidal area is easily accessible. For the cost of park admission (\$5 for an entire week in 2012) visitors can drive to a parking lot within the park and take a short walk to the sandstone entrance. The park resides within the city of San Diego, which provides a large number of urban visitors an inexpensive and convenient way to learn about marine environments. The rocky intertidal area is frequently used by school children on field trips from inner city areas. Furthermore, the CABR rocky intertidal is valued as a scientific resource, because of its accessibility and diversity and also due to a steep visitation gradient along the shore (Becker 2006).

The rocky intertidal area is separated into three park designated zones or "visitation treatments" (Becker 2006 and Figure 1 of this report). Zone 1 has the most visitors as it is the entry area and is most easily accessible. It is necessary to go through Zone 1 to reach Zone 2 to the south. Zone 2 is only accessible on lower tide days. Zone 3 is south of Zone 2 and has been closed to the public as part of a management strategy since 1996. In a 15-Year review of rocky intertidal monitoring data at CABR, Becker (2006) credited these zones for making it possible to help distinguish between natural patterns and anthropogenic impacts. In 2006, Tonya Huff completed a study on trampling as part of her doctoral dissertation. Her research showed "...human trampling decreases the overall amount of algal turf and therefore decreases the amount of available habitat for associated invertebrates." Additional anthropogenic impacts related to visitation include the removal of living animals, collection of shells that serve as habitat and abuses such as prying of animals from rocks (Zedler 1978, Duran and Castilla 1989). Zedler (1978) noted, "There is no question that human caused mortality exists at CABR". She outlined unintentional abuses, which harm smaller life and more intentional harm, such as overharvesting in which a "...concentration of mortality on large individuals... alters size distributions of 'attractive' species" (Zedler 1978).

Preserving the rocky intertidal for future generations while providing for the inspiration, education and enjoyment of this and future generations requires continuous management effort. Since 1996, the Tidepool Protection Education and Restoration Program or (TPERP) has worked to balance preservation with the educational benefits of high visitation. Volunteers are staffed during low-tide months from approximately October to May. These Volunteers-In-Parks (VIPs)

receive interpretive training to help visitors achieve emotional connections with the marine resources, which assists in the protection of the resources. VIPs also report any observed violations to law enforcement. Monitoring of tidepool organisms has been conducted since 1990 to allow park scientists to study changes in the distribution, abundance or size classes of marine life in the area over time. The most recent results of this monitoring program can be found in the 20-year trend report (Pister et al., *in prep*). In addition, the southern-most portion of the rocky intertidal area (referred to as Zone 3 by park staff, Figure 1) has been closed to the public since 1996 to serve as a control area for this research, but also as an opportunity for undisturbed recruitment. Through these efforts CABR's rocky intertidal area is one of the most protected rocky intertidal areas in Southern California, relatively speaking (Roy 2003). Recent observations by park staff and volunteers have led to increased concerns about impacts from high visitation during the summer months. In addition, park staff realized they may be missing significant interpretive opportunities since their interpretive efforts are focused on the low tide season. During the summer, tides may not be low enough to explore the southern portions of the rocky intertidal area, or the mid-intertidal zone (a.k.a. mussel zone), but marine life, rocks and shells in the upper rocky intertidal are still exposed to some degree near the entrance to the rocky intertidal (Zone 1, Figure 1). In 2011 an exploratory summer volunteer staffing was begun as an extension of the regular TPERP program. VIP's and staff observed numerous incidents of marine life, rocks and shells being removed from the higher levels of the rocky intertidal area, leading them to infer the summer anthropogenic impacts may also be higher than previously considered.

Purpose and Scope

In order to understand visitation impacts, such as trampling and take, relative to other impacts like pollution, climate change, and ocean acidification, an accurate count of visitors is needed. In addition, counts during all months are needed to better understand visitor use and how to optimally deploy resources. Park staff installed TrailMaster game trackers to count visitors 24 hours per day, 7 days per week, 365 days per year. This estimate of visitation in the area will provide natural resource managers with information to make decisions about levels of protection and interpretation efforts necessary to preserve the environment and to improve opportunities for visitor experience in the coastal part of the Cabrillo National Monument. In this report, we answer the following questions:

1. How many people visit the coastal area of Cabrillo National Monument on a monthly and annual basis?
2. How does visitation correlate with factors such as tide level, days of the week, holidays and other park events?
3. How many people are visiting the coastal area of the park when it's closed and on which days? Does visitation before the park opens coincide with low tides?
4. How do these data relate to visitor count data taken during shorebird survey counts and other estimates? The methodology for the shorebird survey counts is different, but shows the different visitation levels in each of the three designated visitation zones during low tide.

Methods

Visitor Counts

The data for this report were collected using TrailMaster 1550 infrared trail counters on two separate trails (See Figure 1). Each trail leads to the rocky intertidal area of the park and begins at its own parking lot. Those lots are designated in the park as Lot 1 and Lot 2. One counter system was placed midway down the trail from Lot 1 toward the coastal access. The Lot 2 counter system was placed near the trailhead at Lot 2. All visitors to the rocky intertidal must pass one of these two points. The UTM coordinate (NAD83) for the Lot 1 Receiver is 11S 0477034 3614678 and the transmitter is 11S 0477035 3614672 (Figure 2). The Lot 2 Receiver is at UTM coordinate 11S 0477047 36151119 and the transmitter is located at 11S 0477049 3615120 (Figure 3).



Features of Cabrillo National Monument

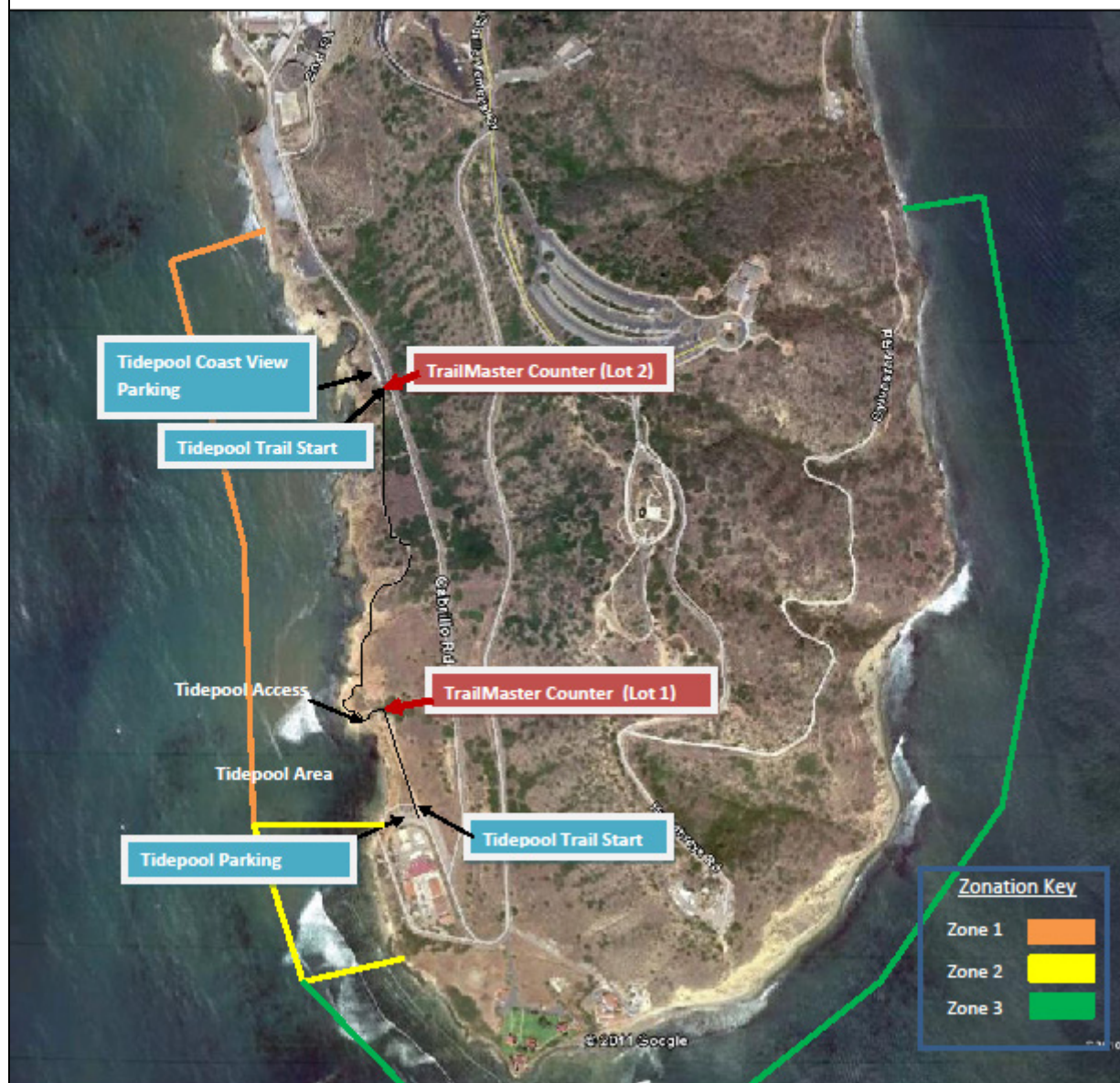


Figure 1: Coastal features of Cabrillo National Monument, including the location of TrailMaster counters and the 3 tidepool zones.



Figure 2. Parking lot 1 trail counter system at Cabrillo National Monument.



Figure 2. Parking lot 1 trail counter system at Cabrillo National Monument.

The trail counter systems at both the Lot 1 trail and the Lot 2 trails are positioned at the narrowest portion of the trail to achieve the most accuracy. Similar methods are currently used at Yosemite National Park for visitor use studies (Pettebone 2008). Each time a visitor walks

between the transmitter and the receiver the infrared beam is broken and is registered as a single “event”. The receiver saves these events and continues recording them 24 hours per day. All visitors who enter through the Lot 1 counter must also return to their vehicle through the Lot 1 counter, so all visitors must walk through the same beam twice. Visitors walking side-by-side frequently register as just one event resulting in an underestimate. Calibration is necessary to correct the data for this error. (See below)

Data were downloaded and batteries were changed approximately every two weeks throughout the year. The data for this report were collected using the TrailMaster DataCollector II. Any visitors walking along the trail during the download were noted and recorded manually. The TrailMaster receiver has a memory limit of 16,000 events and can operate for approximately three weeks on the battery charge. We determined that the data needed to be downloaded approximately every two weeks to ensure continuous counting. The data was transferred to a PC from the external device using the Statpack software, which is provided with the TrailMaster field equipment.

Calibration

Since the TrailMaster receivers often undercounted groups of visitors who pass by in close proximity to each other, calibration was necessary (Pettebone 2008). Park staff counted visitors walking past the counters from a short distance away (six meters). The counts were conducted in the afternoon, when visitation was higher and more likely to have a wider range of group numbers. These manual counts lasted from between one to two hours. The number of visitors passing the counter at any point in time was typed into an excel spreadsheet. A macro added a timestamp. People were considered a group if they were within one meter of each other when passing the counter. It is important to note that the manual counts were also subject to error, particularly with larger groups. The most difficult events for a human to count occurred when two groups passed each other at the point where they passed the Trailmaster. This entailed judging when multiple people moving in opposite directions were within one meter of each other and whether they were also passing the Trailmaster. Because of dense and sensitive vegetation the human observer had to make counts from an oblique angle to the Trailmaster, which made estimating the time at which people passed the Trailmaster slightly more challenging. The most difficult situation was when multiple lines of school children were coming and going at the same time. We also conducted manual counts in pairs for most of these counts so that one person could answer questions from curious visitors while the second person focused on counting. To the best of our knowledge the only factors affecting calibration were group size, the proximity of people within those groups, and the attentiveness of the human observer.

Calibration data were collected on three occasions at Lot 1 and a single time at Lot 2 (See Appendix). These manual counts and their time stamps were then compared to the TrailMaster counts and timestamps. On Tuesday April 5, 2011 149 groups were manually counted ranging in size from one to eleven people with a concluded undercount of 0.45. On Sunday April 17, 2011, the busiest calibration attempt, 409 groups were manually counted ranging in size from one to nine people with a concluded undercount of 0.51. In January 2012, when fewer visitors were expected, manual calibration counts were also performed. On Friday January 7, 2012 187 groups were manually counted ranging in size from one to seven people with a concluded undercount of 0.63. On Thursday January 20, 2012 50 groups were manually counted at Lot 2, ranging in size from one to four people for a concluded undercount of 0.27. The receiver

undercounted the number of people going through at Lot 1 by an average of 0.53 per person. The receiver undercounted the number of people going through Lot 2 by 0.27, thus we determined that TrailMaster counts must be multiplied by a factor of 1.53 at Lot 1 and 1.27 at Lot 2.

Since the counters cannot distinguish direction and everyone must pass them twice, the counts must also be multiplied by 0.5 to obtain a total at each tracker. Counts were summed between the two trackers to obtain totals for the entire site. All data were analyzed in Program R (R Core Team 2012).

Visitor Counts from Shorebird Surveys

Visitor count data are collected during park shorebird surveys, which take place on 50 randomly selected low-tide dates during visiting hours each year (Shorebird Protocol 2008). These data show only the visitors who are actually in the rocky intertidal area, below the coastal bluffs, for the total one-hour period of the survey. Approximately 15-20 minutes is spent counting birds and visitors in each zone. A more detailed description of these methods can be found in the CABR Shorebird Protocol 2008 (Protocol 2008). These data show how many visitors are distributed between zones during the time of the survey.

Results

After the corrections were made, we estimated the number of total visitors for the rocky intertidal and coastal bluff area of Cabrillo National Monument for the calendar year 2011 was 213,714 visitors (Table 1). There were an estimated total of 86,863 visitors when the tide was less than 2.0 feet and 42,370 when the tide was less than 0.7 feet, which is optimal viewing for this park. The highest single day of visitation was Friday November 25th, 2011 with 1,790 visitors. This was the day after Thanksgiving (Figure 4 and Table 2). There were a total of 525 visitors in the coastal area of the park prior to opening hours and 852 after closing hours in 2011. The total visitation for weekend days (Saturday & Sunday) was 94,681, or 956 people per day. The total number of visitors for combined weekdays (Monday through Friday) was 119,033, or 481 people per day (note, this number includes holidays falling on weekdays). The daily total visitor breakdown in Figure 4 shows the significant spike in visitation on weekends and holidays.

Table 1: Final 2011 total visitor count results after calibration and data correction. Total counts do not include 19 days of missing data (5.2%).

	2011 Total	Daily Average	Daily Max
Total Visitors	213713.7	617.7	1789.8
9am-5pm	211795.4	612.1	1785.9
Before Opening	525.1	1.5	29.6
After Closing	851.93	2.5	45.4
While Tide <0.7'	42369.5	279.7	1346.9
While Tide <2.0'	86863.1	311.3	1524.5
Weekdays	119032.9	481.9	1789.8
Weekend	94680.8	956.4	1558.7

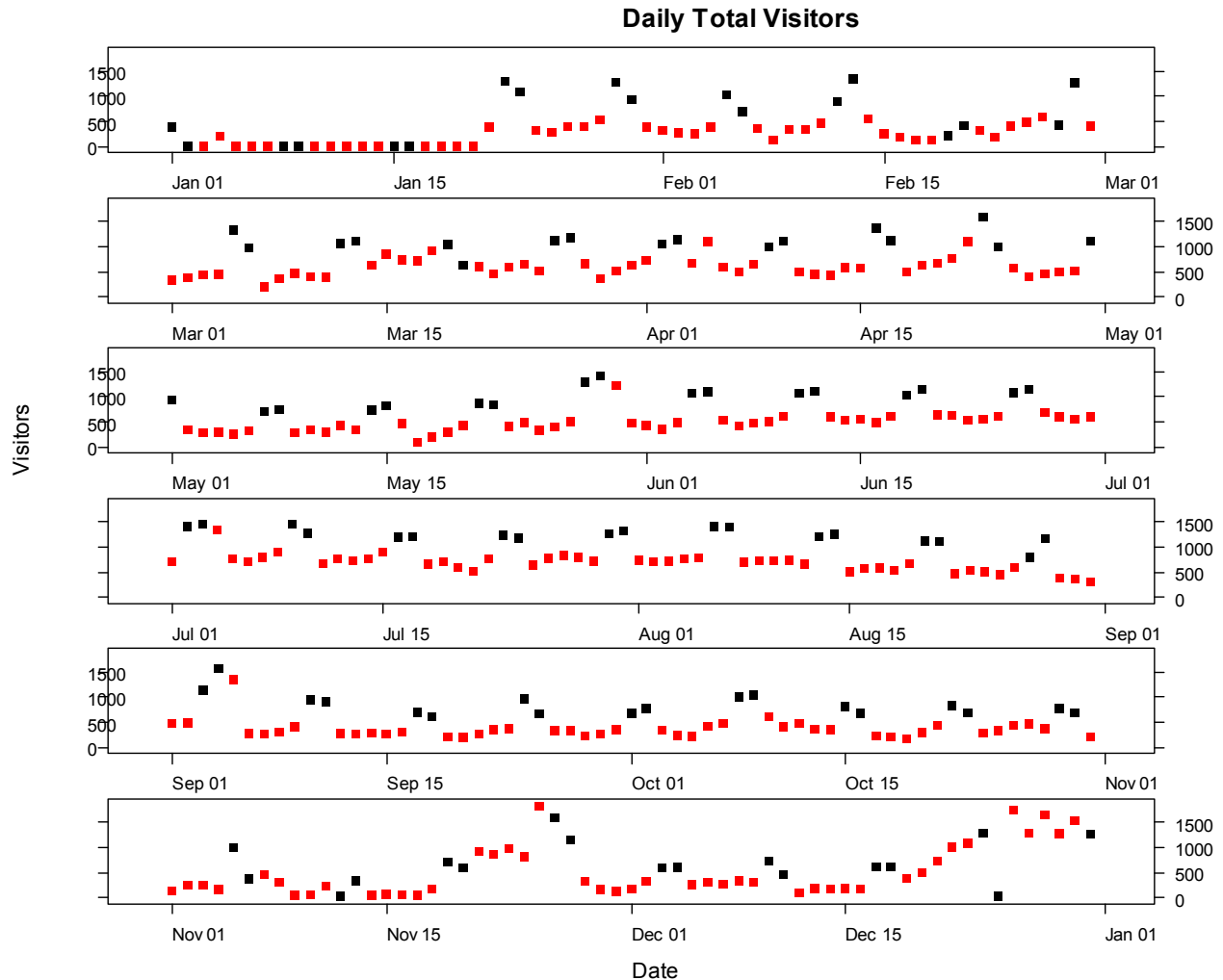


Figure 4: Number of visitors for each day in 2011. The x axis for each bar represents approximately two months. The black dots are weekend days (Saturday and Sunday) and the red dots are weekdays (Monday - Friday). Data were not collected from Lot 1 on Jan 1st-3rd. Data were not collected from Lots 1 or 2 from Jan 5th-20th due to equipment troubleshooting. The park was closed on December 25th, 2011.

This weekend visitation spike is consistent into the summer months when there are no tides lower than 0.7 feet during park hours. Visitation was at its highest near the Thanksgiving and Christmas holidays. These totals do not include data from Jan 1st-3rd at Lot 1, nor from Jan 5th-20th (which includes the popular Whale Watch Weekend and Intertidal Life Festival) at Lots 1 or 2, due to equipment troubleshooting.

Time of day seems to be the biggest indicator of visitation spikes on single days. Results of Saturday and Sunday visitation consistently show an increase in visitation to the coastal area of the park in the afternoons (Figure 5). These afternoon visitation spikes are consistent, regardless of tide levels (Figures 6 & 7).

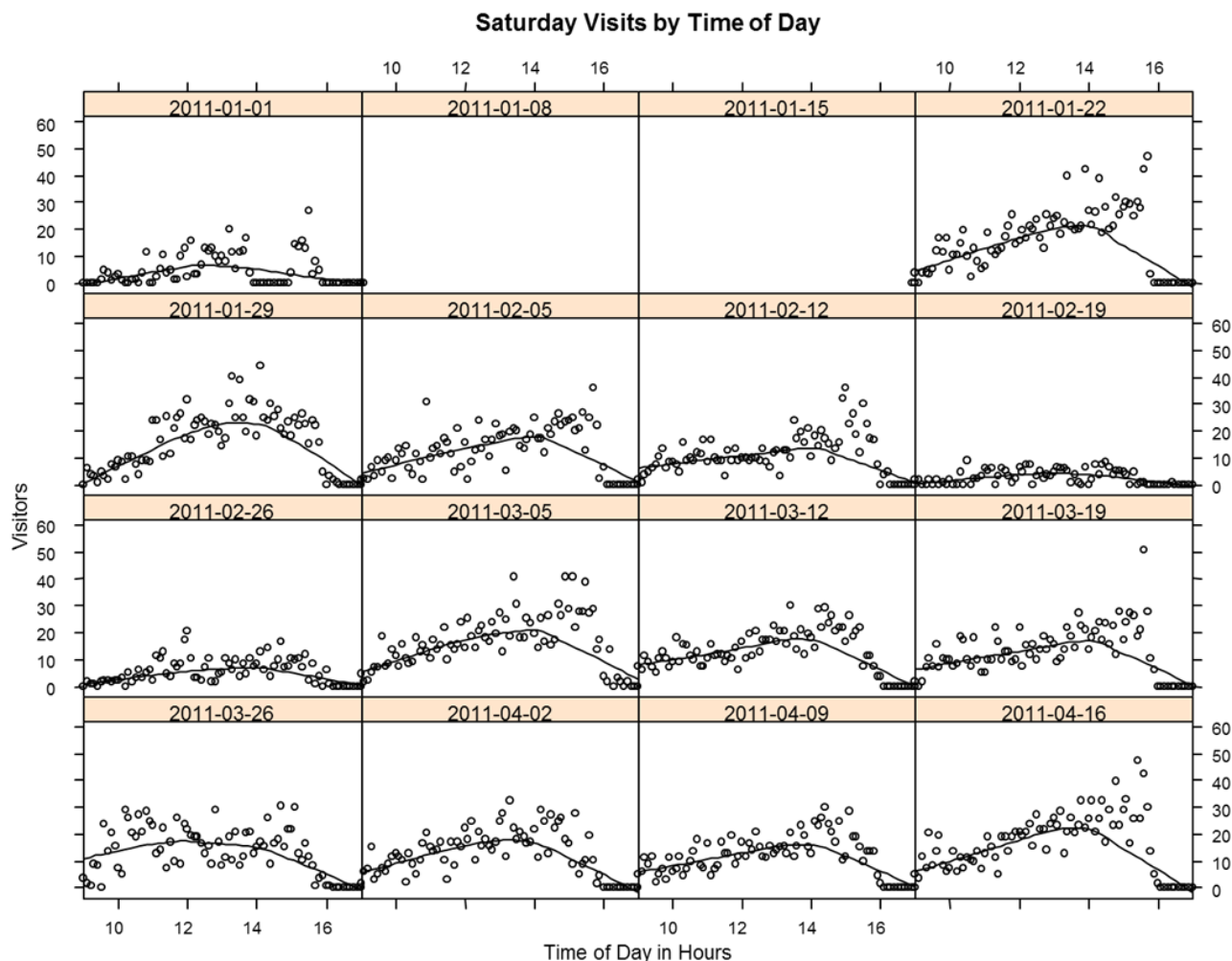


Figure 5: This graph shows the peak of visitation on Saturdays from January through April 16th. Dates are displayed above each panel. The x axis is time of day. The y axis is number of visitors per six minute interval indicated by circles. The intertidal area closes at 4:30pm, which results in the strong drop in visitors around that time. The black line in each panel represents a smoothed trend. Data were not collected from Lot 1 on Jan 1st-3rd, nor were they collected from Jan 5th-20th due to equipment troubleshooting. February 19th is reflective of a large winter storm.

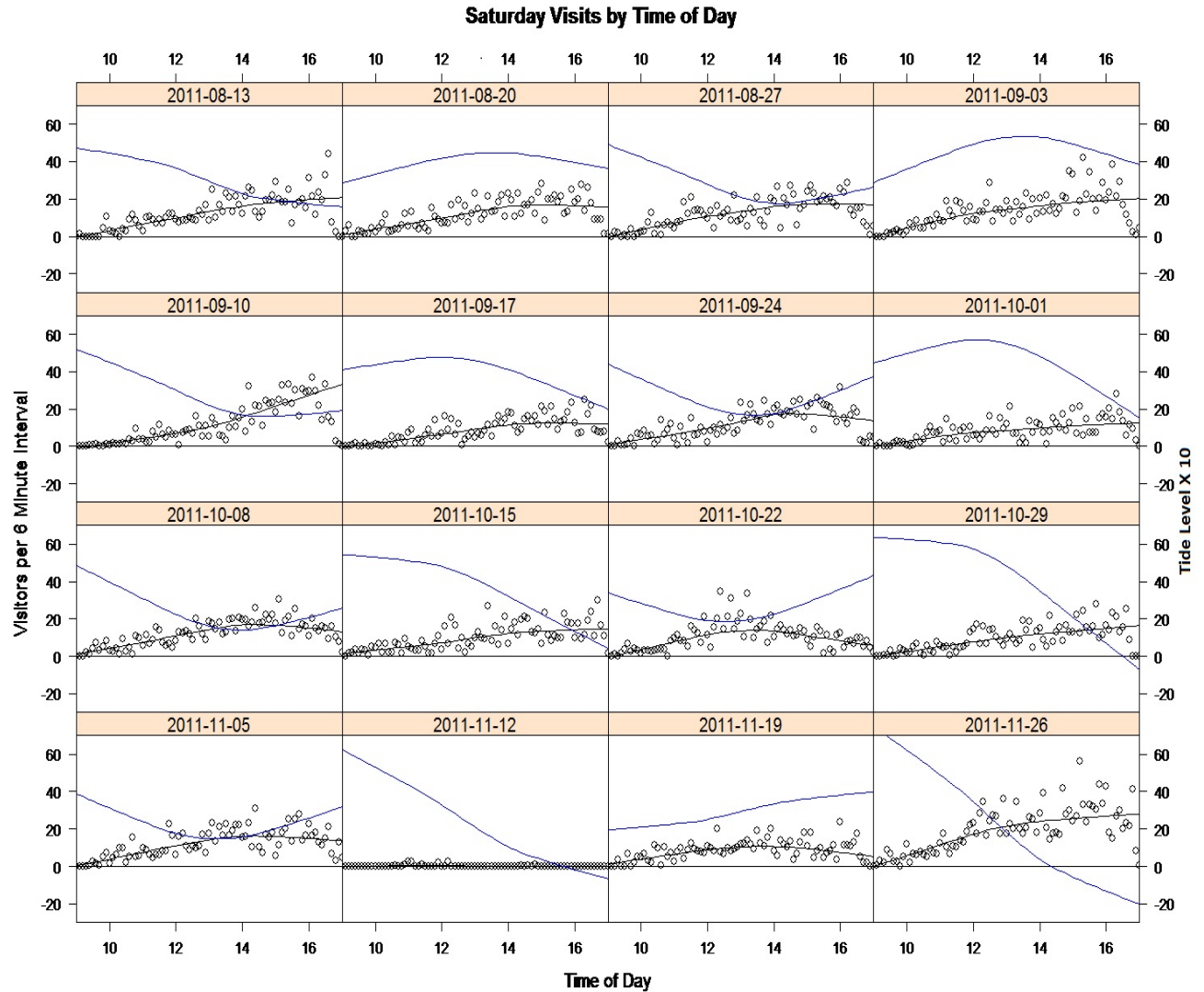


Figure 6: Visitation on Saturdays in relation to tidal height from August 14th through November 26th, 2011. The x axis is time of day. The y axis is number of visitors per six minute interval and the tide levels in tenths of feet. Dates are displayed above each panel. The curving black line in each panel represents a smoothed visitation trend and the circles represent the 6 minute visitation intervals. The blue line represents tide levels. No visitation time interval data were collected from Lot 1 on November 12th, 2011, due to equipment malfunction.

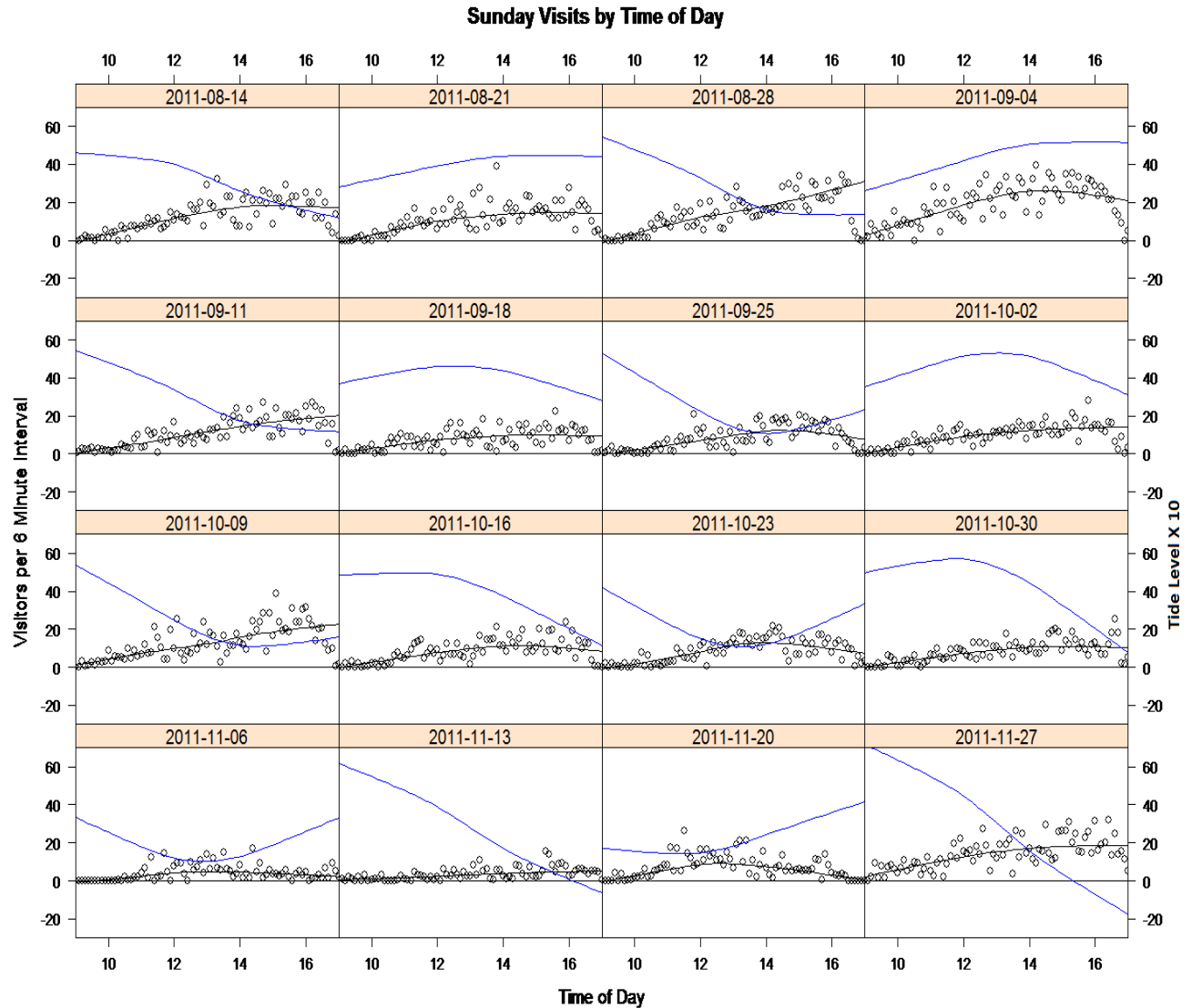


Figure 7: Visitation on Sundays in relation to tidal height from August 14th through November 27th, 2011. The x axis is time of day. The y axis is number of visitors per six minute interval and tide levels in tenths of feet. Dates are displayed above each panel. The curving black line in each panel represents a smoothed visitation trend and the dots represent the 6 minute visitation intervals. The blue line represents tidal level.

There are significantly more visitors in the coastal area of the park after closing time than prior to its opening (Figure 9). An average 1.5 people per day are in the coastal area of the park before 9am and an average 2.5 people per day are there after 5pm (Table 1). There are more likely to be people in this part of the park before 9am on Saturdays and Sundays as compared to any other day of the week (Figure 8). There are four dates when between 15 and 30 people were in the park (Figures 1 and 10). April 22nd was an organized park clean up event for Earth Day, but the reason for the pre-hours visitation on other listed dates is unknown.

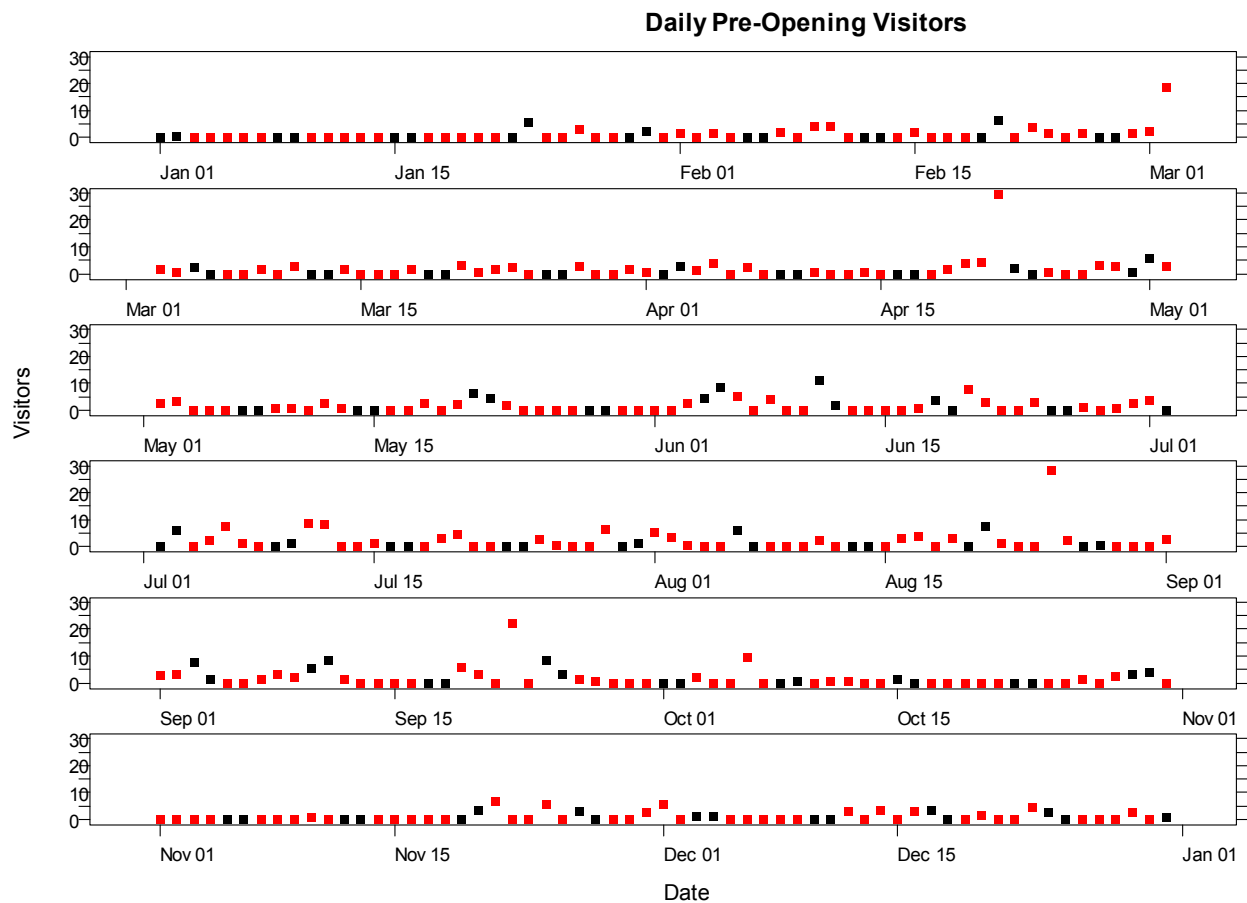


Figure 8: This graph shows the number of visitors in the coastal area of the park before it opens at 9am. Black dots represent weekend days (Saturday and Sunday) and red dots represent weekdays (Monday – Friday). Data were not collected from Lot 1 on Jan 1st-3rd, nor were they collected from Jan 5th-20th at either Lot, due to equipment troubleshooting.

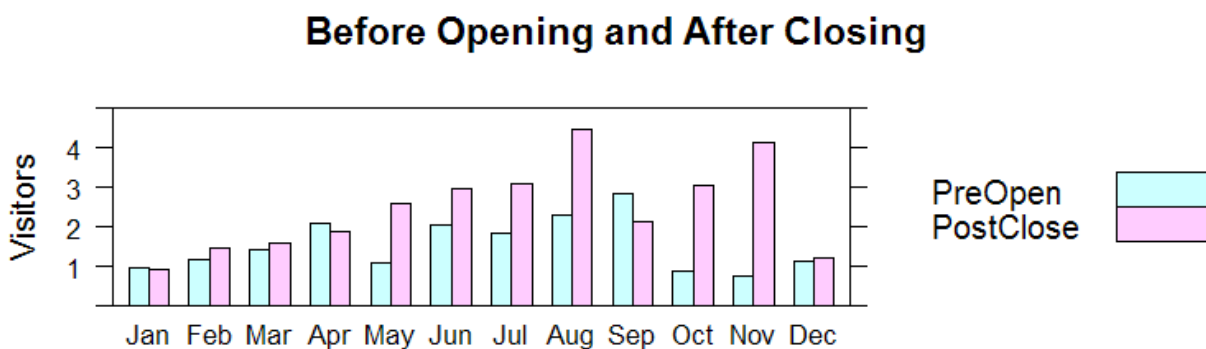


Figure 9: Average number of visitors per day before and after the park's open hours. The most after-hours visitation took place in the months of August and November. The most pre-hours visitation took place in September. Data were not collected at Lot 1 from Jan 1st-3rd, nor were they collected from Jan 5th-20th due to equipment troubleshooting.

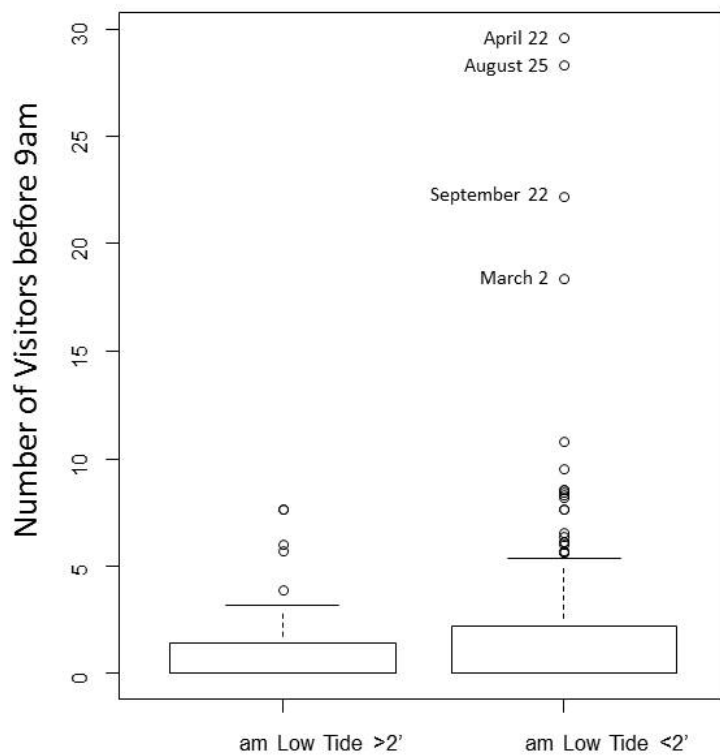


Figure 10. This figure shows the number of visitors entering the coastal area of the park prior to opening. The data were separated to show the number of visitors when the tide was greater than 2 feet. It also shows the number of visitors when the tide was lower than 2 feet. The four dates listed reflect days when between 15 and 30 visitors entered the park prior to opening. April 22nd was a park organized event.



Figure 11: Daily mean visitation by month during 2011. Data were not collected at Lot 1 from Jan 1st-3rd, nor were they collected from Jan 5th-20th due to equipment troubleshooting. The coastal area of the park received the most daily visitors in July with a mean of 800 people.

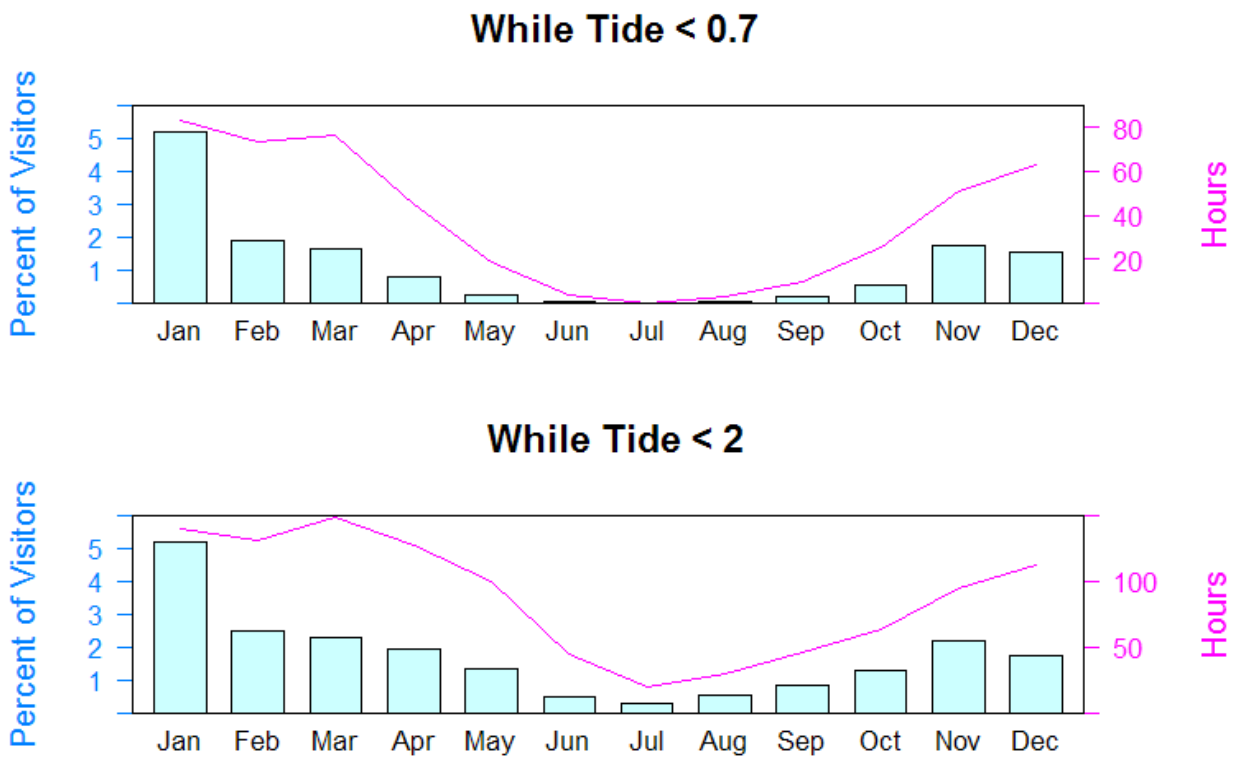


Figure 12: Percent of visitors during hours when tides were low. The top graph shows the percentage of visitors to the coastal area of the park during open hours when the tide is lower than 0.7 feet. The bottom graph shows the percentage of visitors to the coastal area of the park when the tide is lower than 2.0 feet. The pink line is the total number of hours the park was open during the respective lower tides. Data were not collected at Lot 1 from January 1st-3rd, nor were they collected from either Lot from January 5th-20th, 2011, due to equipment troubleshooting.

The shorebird survey data can't be directly compared to the new data collected in this 2011 report, but they are the only data the park has to determine numbers of visitors directly in the rocky intertidal area of the park on randomly selected low tide days. The shorebird survey data is also the only data available to assess number of visitors in each of the park established zones (Figure 13). These data are from the 2010-2011 season and are collected between October and April, so they are not directly comparable to the 2011 visitor count data in this report. However, the pie chart shows the established trend of the majority of visitors counted in Zone 1, followed by Zone 2 and Zone 3, which is closed to the public. Visitation in Zone 3 includes researchers and rangers conducting intertidal monitoring.

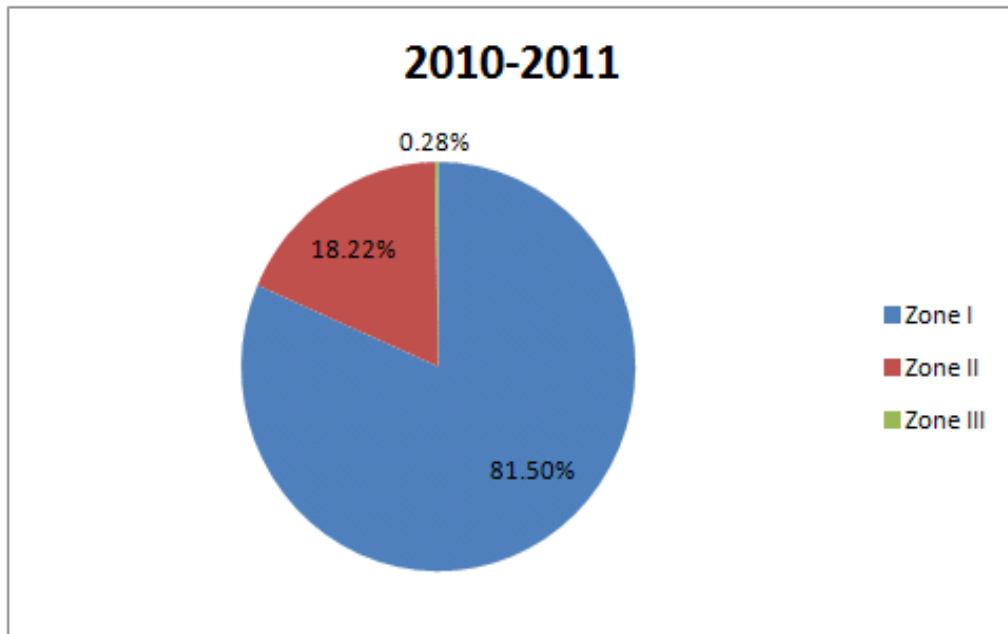


Figure 13: Percentage of visitors in each intertidal zone for the 2010-2011 season, determined from Shorebird Survey data. Note these data were collected on 50 separate days from October 6, 2010 through April 16, 2011.

Discussion

The 2011 total number of visitors to the coastal area of the park is not directly comparable to any previous visitor count estimates, due to the method of data collection and the timeframe of analysis for this report. However, our findings of 87,000 potential visitors to the rocky intertidal during tides lower than 2.0 feet are consistent with previous estimates. Our previous working estimate of 100,000 visitors was presented after data was extrapolated from the 1990-1992 rocky intertidal monitoring design study (Gary Davis, personal communication, but see Engle and Davis 1996). This method was explained by National Park Service scientist Gary Davis in a 2003 letter to former CABR Chief of Natural Resources Management and Science Andrea Compton. Davis said the 100,000 estimate slightly declined in the late 1990's, which is also consistent with findings in later estimates. In 2006, Bonnie Becker referred to work being done by Tonya Huff that used time lapse video cameras to study visitation and visitor behavior in the rocky intertidal at CABR. From this work Huff estimated a seasonal visitation total between 40,000-70,000 people in the rocky intertidal (Becker 2006). However, this estimate was not included in the publication of the study (Huff 2006).

In looking at overall visitation patterns at Cabrillo National Monument, a near total of 214,000 visitors to the coastal area of the park was generally unexpected as it is more than double the previous high end estimate (100,000). This total number is also missing 19 days of data, due to equipment malfunction, approximately 5% of the available days the park is open. However, the greater number is due in part to including visitors that stop at the top of the cliffs rather than limiting the estimate to visitors who enter the intertidal proper (see Figure 14). Total park visitation for 2011, which is estimated at the park's entrance station, was 813,351 (NPS Public Use Statistics Report 2011), which means 26% of all CABR visitors are exploring the coastal area of the park. Previously, we had no way of knowing what percentage of total park visitors utilized the coastal area of the park.

We were also surprised to learn the high number of visitors who explore the coastal part of the park, but do not enter the rocky intertidal portion, particularly in the summer (conservatively 59%). Park staff and volunteers have observed that many visitors are content to walk to the top of the sandstone cliffs and then stop, never actually entering the intertidal. Yet all these visitors are included in our total figure. This means the data must be parsed further to understand how many people are actually impacting the rocky intertidal by walking through it. Impacts to the rocky intertidal habitat are likely due to the 86,000 people who visit when tides are lower than 2.0 feet, but the total 214,000 figure is important for determining carrying capacity, for both ecological considerations as well as visitor experience (Figure 14).



Figure 14: An aerial image of the coastal bluffs and rocky intertidal at Zone 1 during a high tide. Many visitors remain along the coastal bluffs and do not enter the intertidal area.

Our data show visitation is highest on weekends and holidays (Table 1 & Figure 4). Visitation is also higher in the afternoon than in the morning (Figure 5). These results for 2011 are consistent with Huff's research which reported, "Significantly greater numbers of visitors were seen on weekends versus weekdays and in the afternoon versus morning" (Huff 2006). Additionally,

visitation peaks do not correlate with times of low tide (Figures 6 & 7). This is also consistent with previous research that showed lower tides do not attract significantly more visitors (Zedler 1978 & Huff 2006). Observationally in 2011 most visitors were unaware of the existence of tide charts, which is also consistent with previous informal surveying (Huff 2006).

July was the busiest month of the year in the coastal area of the park in 2011 (Figure 9). The low tide during park hours in July does not fall much lower than 2.0 feet, further indicating these visitors are not planning their visits around the low tide. This information is very useful, because until very recently park staff generally ignored interpreting these resources in the summer time. The high level of visitation in the summer months suggests that we expand our focus and efforts on engaging visitors in the coastal areas of the park during the summer months.

In this report, weather data were not analyzed, but low visitation on stormy weekend days in February suggest bad weather can override all other visitation drivers (Figure 5). San Diego has a relatively mild Mediterranean climate. Visitors seem to have a low tolerance for inclement weather; however, these conditions occur relatively infrequently.

Daily visitation was highest on average in the summer, but the highest individual visitation days can occur at any time of year (Table 2). In fact, none of the six highest days of visitation occurred in the summer. November 25th, 2011, the day after Thanksgiving, was the highest single day for visitation with a total of 1,790 visitors to the coastal section of the park. Other high visitation days were April 23rd, 2011 with 1,559 visitors and September 4th, 2011 with 1,549 visitors. April 23rd was the day before Easter, an NPS Fee Free Day and was also Jr. Ranger and Earth Day. September 4th was the Sunday before Labor Day. The entire week between Christmas and New Year's is also consistently high (Figure 6).

Our data also illustrate the before and after hours use of the coastal area of the park. There were more visitors in this part of the park after it closed (at 5:00 PM) than before it opened (at 9:00 AM). An estimated total of 525 pre-hours visitors to the coastal area over the course of the year does not cause extreme concern for resource managers, but is something important to monitor. April 23rd, the day of highest pre-opening visitation was a park sponsored trash clean up event. However, the following day was not and also had a high number of pre-opening visitors. After hours use is much higher at 852 visitors, but 719 of them were here between 5pm and 6pm, which we believe may be visitors who are simply slow to leave the intertidal area (Table 1). After 6pm, 133 people were counted in the coastal part of the park, presumably after closed signs were posted. Further analysis reveals most pre-hour visits take place on Saturday and Sunday mornings and is somewhat evenly spread throughout the year, while visitation after hours is more likely to occur in the summer months, when daylight hours extend past closing (Figure 9).

The motivation for visitors to come see the intertidal is varied. Exploration, followed by solitude and relaxation were the top reasons for visiting the intertidal according to a 1997 visitor survey at CABR (Beck 1997). Learning about marine life was ranked third at 42% of respondents (Beck 1997). However, this survey was only conducted during optimal low tides, so visitors may have a different motivation for visiting the area when the tides are unsuitable for intertidal viewing. Repeating this survey is one of the goals of park management. In numerous instances, visitors have told staff that it was just one more place to explore in the park, which they just happened to visit on that particular day, regardless of tide levels (B. Phillips personal observation). CABR is

a popular place to bring out-of-town visitors to see an overview of the San Diego downtown skyline. Once at the park, a short drive (~1 mile) down to the rocky intertidal on the west side of the peninsula is convenient for most visitors to get a view of the ocean from the west side of the Point Loma peninsula. The park's proximity to San Diego's Lindbergh Field Airport, makes it the first stop for many out-of-town visitors (B. Phillips, personal observation), which might also account for the number of visitors who arrive in attire that is not always appropriate for an intertidal experience.

Table 2. This table shows the six highest visitation days in the rocky intertidal and coastal areas of CABR during 2011. No data was collected for the low tide days in January that may have exceeded some of these dates, including Whale Watch Weekend, an annual event. The park was closed on December 25th, 2011.

DATE	VISITORS	LOW TIDE & TIME
(#4) April 23 rd , 2011	1,559 <i>(Saturday before Easter & Jr. Ranger Day/Earth Day)</i>	0.0 feet @ 8:51am
(#6) September 4 th , 2011	1,549 <i>(Sunday before Labor Day)</i>	2.8 feet @ 8:07am
(#1) November 25 th , 2011	1,790 <i>(Friday after Thanksgiving)</i>	-1.7 feet @ 3:22pm
(#5) November 26 th , 2011	1557	-1.4 @ 4:08pm
(#2) December 26 th , 2011	1689 <i>(Monday after Christmas)</i>	-1.2 @ 4:34pm
(#3) December 28 th , 2011	1588	-0.2 @ 5:43pm

As mentioned in the methods section of this report, the counting equipment was not 100% accurate. Not included in this report is the undercounting of those children who fall under the infrared beam, or may be carried in a parent's arms. Additionally, leashed dogs are allowed in the rocky intertidal area and also might be counted in this system, depending on their height. Shorebird surveys and intertidal monitoring suggest dogs are a very small constituency (Becker 2006). This method also does not count the number of people who drive down to the parking lots and never get out of their car, or simply stand at the edges of the parking lot, but do not walk down the trail where the counters are placed. There are three parking lots that provide coastal access and it is not uncommon for them to fill up on weekends and holidays. Rangers must occasionally close the road leading to the tidepools to prevent traffic jams. At this time, it's not possible to report how many people might have entered the coastal part of the park, but were turned away, due to overcapacity in parking. There is also the possibility of an over-count on an anecdotally observed small number of park visitors who may return to their vehicles more than

once on a single visit to this area of the park (e.g. because they forgot their sunscreen). Finally, these data include park staff and volunteers. These sources of error are likely to contribute a negligible fraction to the overall totals and we do not believe they could alter our conclusions. It is these authors' best knowledge that no other continuous 24 hour counting method has been used for this area of the park for this length of time. As a result, these data are the most accurate and most current data available for visitation numbers in the coastal area of the park, which includes the rocky intertidal.

These data will be used as a baseline to help determine visitor impacts and visitor use capacity. It is well documented that large numbers of people can have significant ecological impacts on natural resources, especially rocky intertidal (Zedler 1978, Engle and Davis 1996, Becker 2006, Huff 2006, Sagarin et al. 2007, Huff 2011). Human trampling can affect the structure and diversity of invertebrate communities inhabiting intertidal algal turfs (Huff 2011). This is not a new development. Human activity has led to significant and widespread declines in body sizes of rocky intertidal gastropod species in southern California for the last 100 years (Roy et al. 2003). Roy et al. found declines in body sizes in snail species not known to be targeted for human consumption, implying that managers and conservation scientists were unaware of the true scope of human consumptive activities or that other direct human impacts were involved. Anthropogenic impacts aside from harvesting include pollution, animal and shell collection and a host of other abuses not excluding the kicking, or prying of attached animals off of rocks for simple curiosity, and in one specific example, the cutting of surfgrass with a machete (Zedler 1978). Such removal caused great devastation to the CABR tidepools before protection efforts began in 1996. Rangers and volunteers still encounter visitors removing shells and living animals regularly (B. Phillips personal observation).

In order to find the balance between visitation and preservation of rocky intertidal resources, it is necessary for managers be able to answer how much capacity a resource can ecologically stand with a growing population of people who utilize coastal areas as a primary location for recreation. In a recent survey performed in Southern California, 61% of responders said "the beach" was the last natural area they visited revealing the beach as a highly valued location to visit (Anderson 2012). San Diego County's population is well over 3 million (US Census Bureau 2010). There are two aspects to the capacity question at CABR. First, how many people can the rocky intertidal withstand before suffering impairment or unacceptable impacts (Becker 2006)? The other aspect is how many people can visit a resource before they become a direct impact to other visitors' experience (Manning 2007)? The latter definition is referred to as carrying capacity among park managers and is different than the ecological definition of the term. It is important to realize, though, that the number of people needed to impact or impair rocky intertidal habitat may well be lower than the number of visitors needed to negatively impact other visitors' experience (or vice-versa, Manning 2007). When considering ecological impacts to rocky intertidal these 2011 data suggest resource managers must be concerned with the 70,000-86,000 people who explore this area, but the entire 214,000 visitors to the coastal area need to be considered for visitor experience. Furthermore, park staff should consider carefully whether emphasizing that park visitors should visit when the tide is low would increase visitor impacts to the intertidal habitat proper. Theoretically, if most visitors who are not coming during low tide were convinced to visit during a low tide, the number of people impacting the intertidal organisms would more than double, even though total visitation to the coastal area remains constant.

Many rocky intertidal areas along the west coast of North America experience high visitation. But the timing of low tides during daylight hours varies greatly. Shorelines north of northern California experience fantastic low tides during daylight in the summer months, when visitors are more likely to visit. The opposite is true in southern California, when daylight low tides occur in the winter. We predict that the proportion of impacts due to visitors to a given rocky intertidal will be greater when daytime low tides coincide with greater visitation.

It's clear that more people would visit the coastal area of CABR on the busiest days if they could. All three coastal parking lots frequently fill to capacity on the busiest days and during special events. Many vehicles are forced to circle or avoid the area for lack of additional parking. As mentioned, park staff closed the road to reduce traffic pressure on these days. Therefore, the highest visitation days seen in 2011 are likely the upper limit, due to parking availability at this time. If parking spaces were to ever increase, something that has been considered in the past, the visitation to the area would also likely increase. It is not clear at this time what impacts additional visitation would have on the two aspects of visitor capacity mentioned above. Shuttles are used during an annual special event at the park (Whale Watch Weekend and Intertidal Life Festival in January). When shuttles are used the coastal parking lots remain closed. One goal of this study is to compare the number of visitors accessing the coastal area when shuttles are used compared to when cars are allowed. Unfortunately Whale Watch Weekend in 2011 occurred during the time when our equipment was not operating. The question remains an important one for 2012.

These data will be used to assist in scheduling of staff and volunteers to allow for a greater visitor experience, including the expansion of TPERP and other interpretive efforts into the summer months. Also, from the standpoint of visitor experience, park staff in the Visitor Center report frequent questions from visitors about the rocky intertidal and that many visitors are disappointed in the summer when they learn the tidepools will remain mostly underwater. There is growing awareness that CABR is now heavily used for both natural and cultural experiences, even though it was initially established as an historical park. CABR's easy access, location within a large city, availability to a diverse audience and inexpensive cost make it very relevant to the National Park Service's recent Call to Action Report (CTA 2011). The coastal area of CABR currently satisfies at least four CTA goals, including urban access to natural resources, outdoor hiking for health, assisting in the creation of the next generation of stewards and encouraging scholarly pursuits by providing an environment where Ph.D. candidates can conduct scientific research. In addition, these data highlight the necessity for Law Enforcement presence in this part of the park and can assist in deploying resources during highest visitation times.

CABR staff members are continuing the collection of these data in 2012 and will do additional analysis at the end of the 2012 calendar year. The two years of data will be compared to confirm visitation patterns. Initial work is also being done to prepare for future visitor use surveys to better gauge visitor use capacity in relation to a positive visitor experience in the coastal area of the park. Additionally, further manual counts may be done to confirm percentage of these coastal visitors who specifically enter the rocky intertidal area of the park. The shorebird survey data may also be compared to the visitor count data in an effort to find that information. Finally, our calibration methods will be refined to increase our accuracy. Additional calibration is needed for Lot 1 in 2012 and additional calibration for Lot 2 will also be performed for future reports.

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Appendix A: Calibration Data

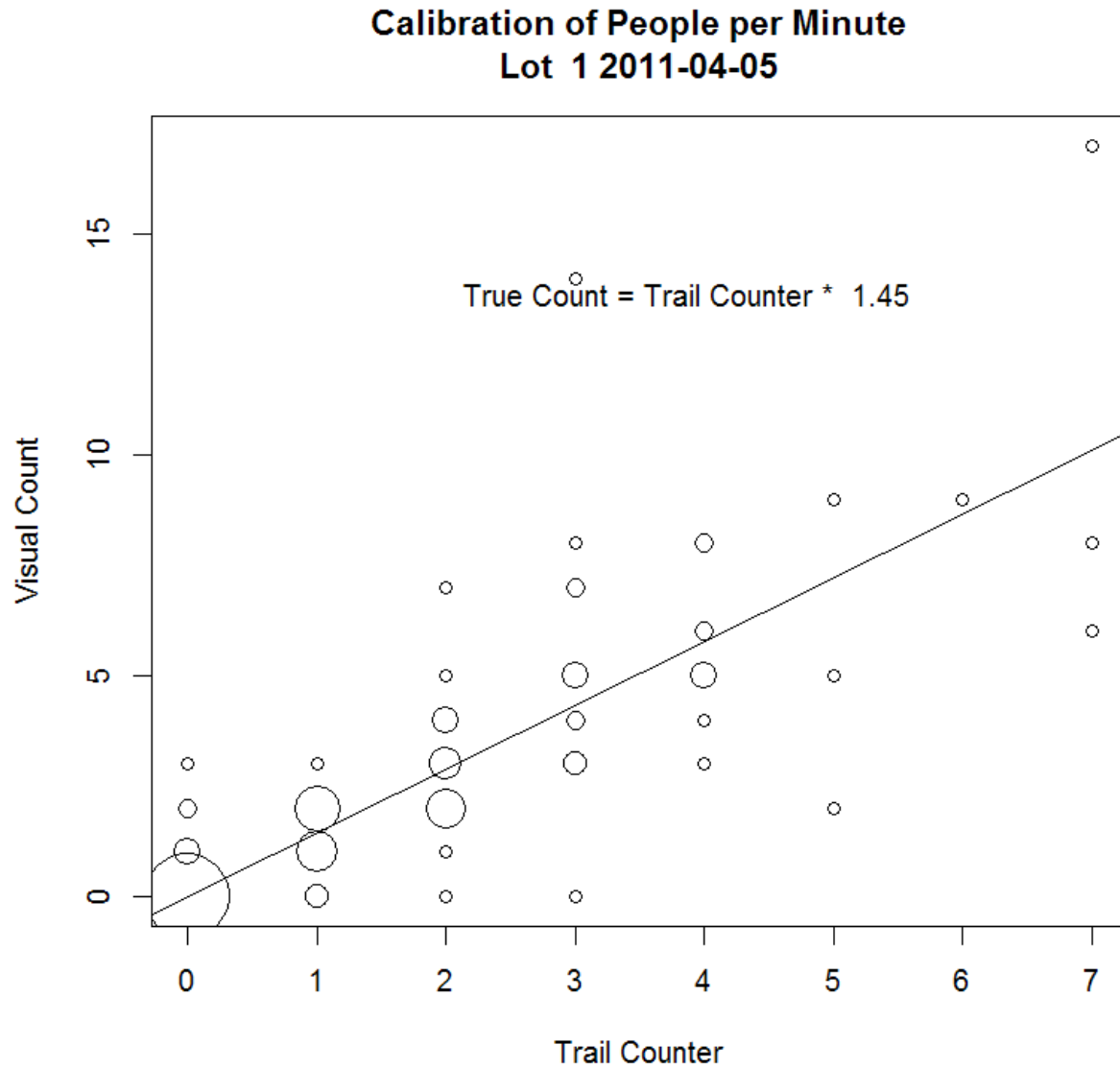


Figure A-1: A manual count of 149 groups, ranging in size from one to 11 people were counted over a two hour period on April 5, 2011. The manual data were compared to the TrailMaster data, which showed an undercount of 0.45.

**Calibration of People per Minute
Lot 1 2011-04-17**

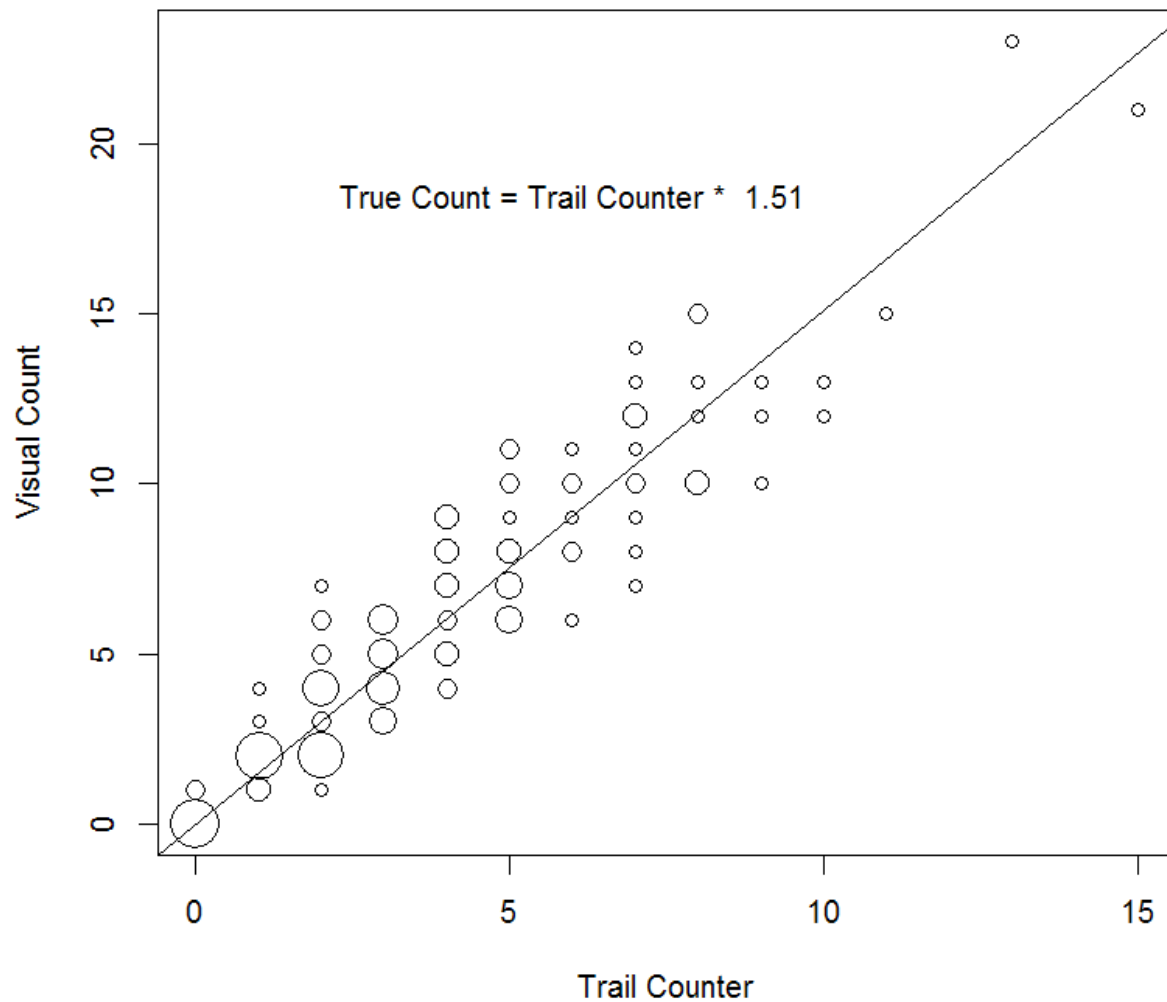


Figure A-2: A manual count of 409 groups, ranging in size from one to nine people were counted over a two hour period on April 17, 2011. The manual data were compared to the TrailMaster data, which showed an undercount of 0.51.

**Calibration of People per Minute
Lot 1 2012-01-07**

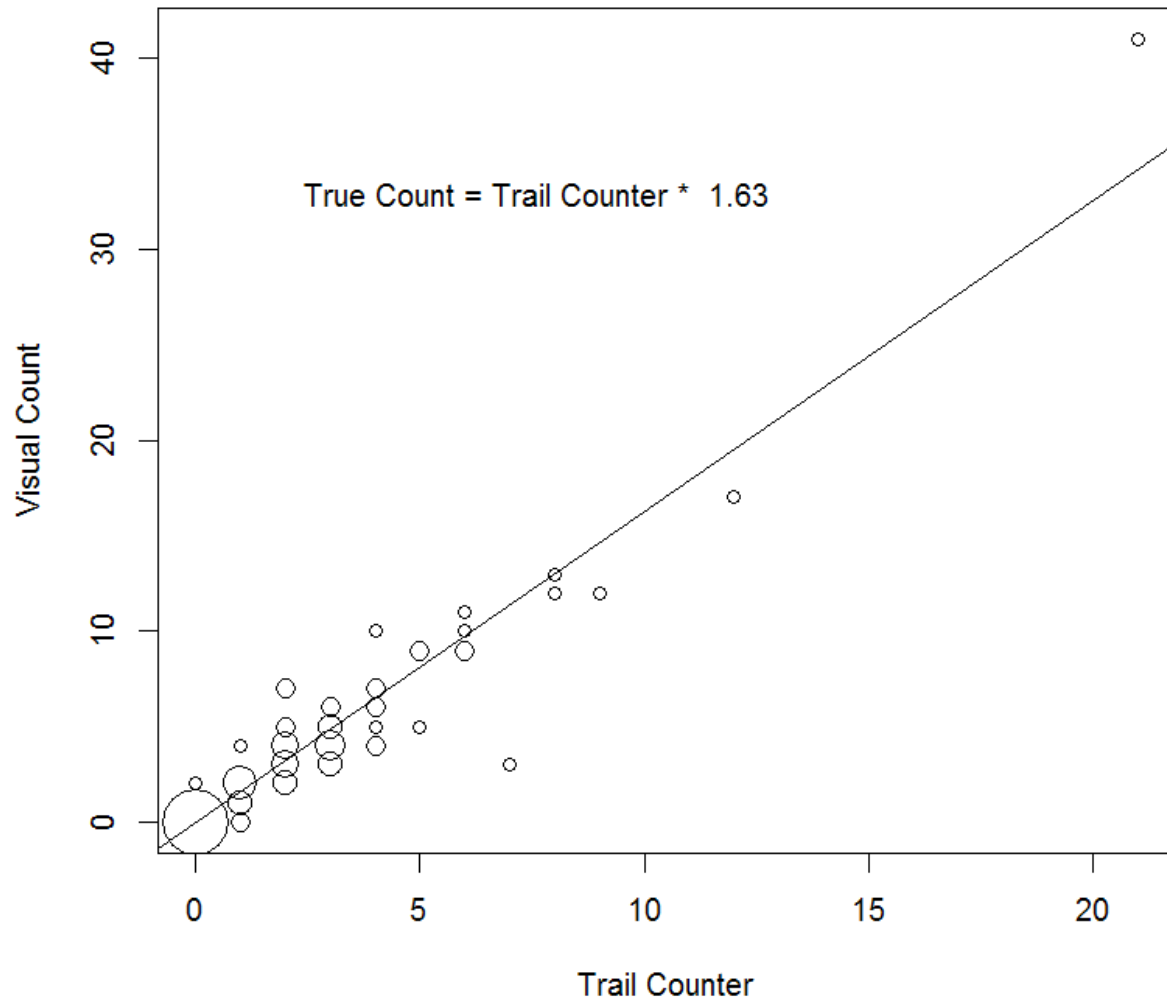


Figure A-3: A manual count of 187 groups in a 90 minute time period, ranging in size from one to seven people were counted over a two hour period on January 7, 2012. The manual data were compared to the TrailMaster data, which showed an undercount of 0.63.

**Calibration of People per Minute
Lot 2 2012-01-20**

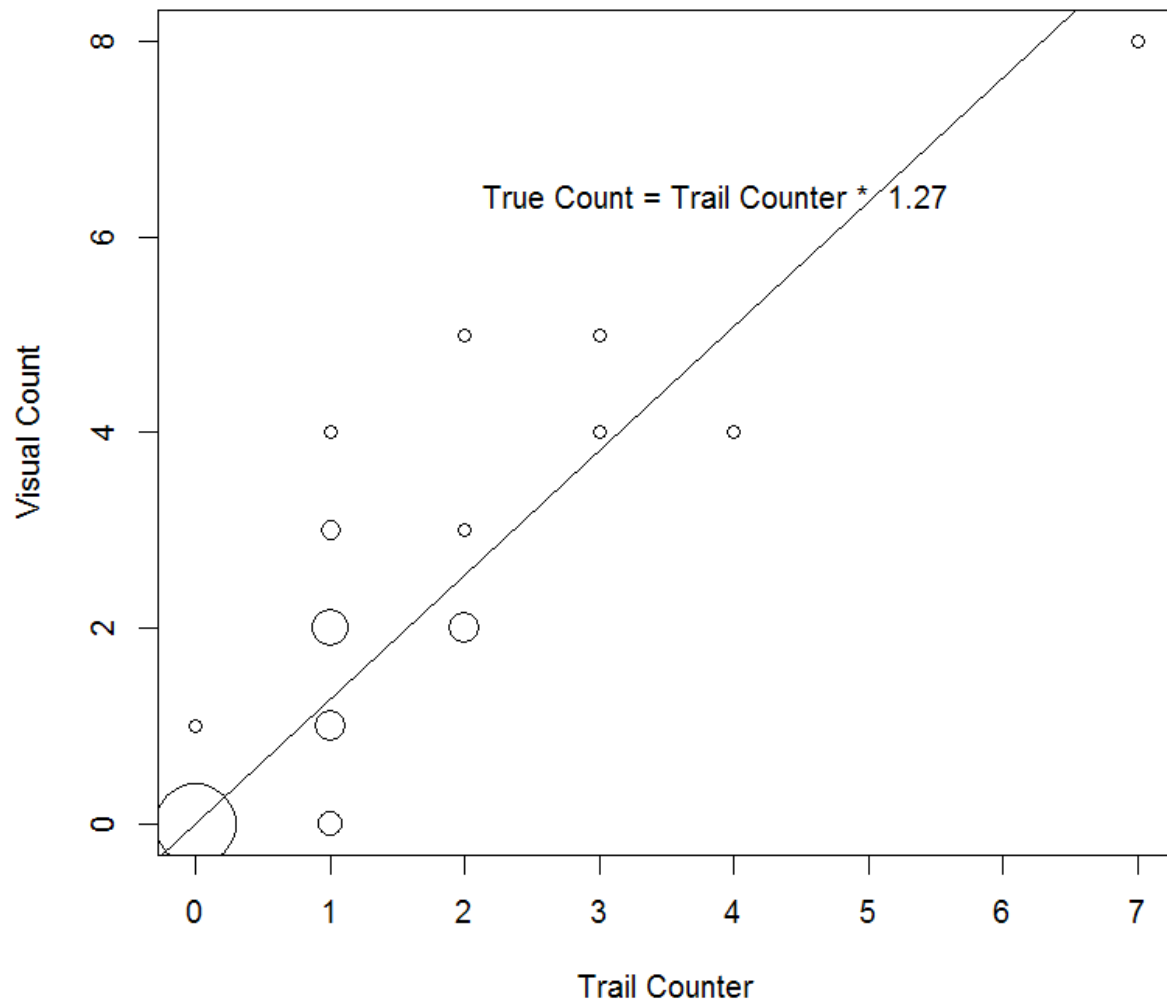


Figure A-4: A manual count of 50 groups, ranging in size from one to four people, were counted over a one hour period on January 20, 2012. The manual data were compared to the TrailMaster data, which showed an undercount of 0.27.

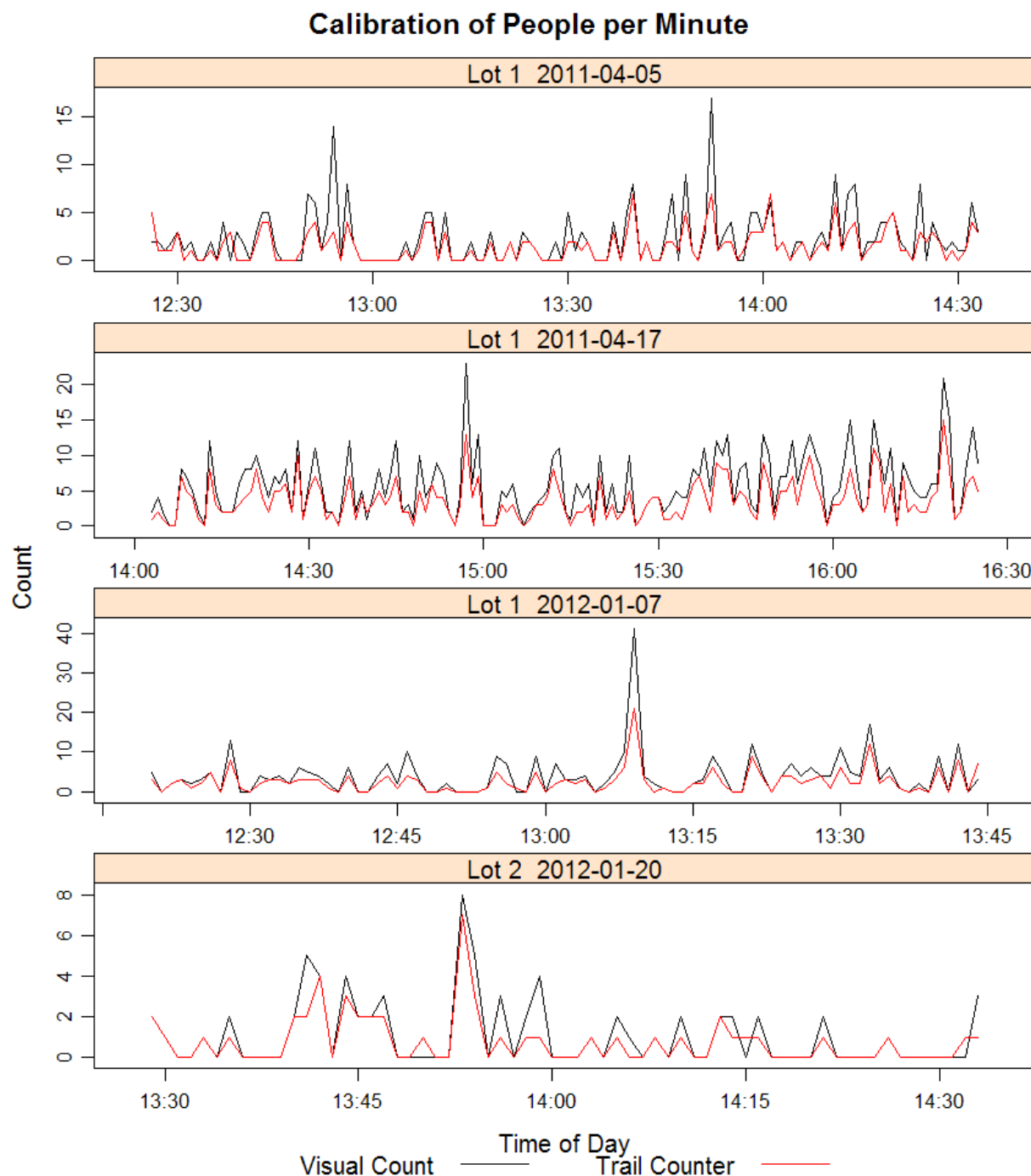


Figure A-5: A manual count of visitor groups on January 20, 2012 as compared to the TrailMaster data. The black line is the manual, visual count. The red line is the TrailMaster count. The comparison begins at the start of the black line on the left side of the graph.

Calibration Estimates and 95% Confidence intervals (2.5% - 97.5%)

Table A-1: Calibration estimate table for each sample and averages for each Lot. Additional calibration will be conducted in 2012 for both the Lot 1 and Lot 2 devices.

Location	Date	Estimated People per Count	95% C. I.
Lot 1	05-April-2011	1.45	(1.32 - 1.57)
Lot 1	17-April-2011	1.51	(1.46 - 1.57)
Lot 1	07-January-2012	1.63	(1.53 - 1.72)
Lot 2	20-January-2012	1.27	(1.14 - 1.40)
Average Lot 1		1.53	(1.49 - 1.58)
Average Lot 2		1.27	(1.14 - 1.40)