Study Goal and Objectives

The research team sought to develop and refine methods to automatically monitor trail use in national parks. The three primary objectives were to:

1. Evaluate several commercially available trail counters in typical National Park Service (NPS) settings.
2. Develop a general process for monitoring trail use, then apply the monitoring process in different park settings.
3. Summarize the trail use data into example reports for presenting information to decision makers.

We applied the monitoring process to two different national parks:

- **San Antonio Missions National Historical Park**: a linear urban park with several historic sites along the San Antonio River in Texas.
- **Guadalupe Mountains National Park**: a rural park in west Texas with a limited number of access points and a network of hiking trails.

Study Findings

**Automatic Trail Counters**

We identified numerous commercially available automated trail counters. The technologies used in the counters varied, as did the available features. Figure 1 shows a matrix developed to help practitioners identify the relevant technologies for counting pedestrians and bicyclists, both separately and together. Supplemental tables in the technical report identify the strengths and weaknesses of these counter technologies and their commercial availability.

The team confirmed through field evaluations of two passive infrared counters that they typically undercount actual trail use, most likely due to multiple people simultaneously passing through the counter zone. Because of this consistent undercounting, we adjusted the raw counts from our field data collection.
Although there were a few minor glitches, the two trail counters performed satisfactorily. When properly installed and maintained, these counters can reduce the long-term costs associated with manually monitoring park trails.

**Trail Monitoring Process**

We developed a generalized monitoring process (see Figure 2) and applied it to our two case studies. We provide extensive details and guidance for each of the nine monitoring steps in the full technical report.

Two principles are vital:

1. **Planning ahead** and identifying how trail use data will be used and by whom. The uses and users of the data influence many monitoring parameters.

2. **Emphasizing quality assurance** throughout the entire process, rather than only after data have been collected. For example, regular staff training and equipment testing, inspection, and calibration are essential to producing consistent data that meets user needs.
passive infrared sensor that we moved to different trails at two-week intervals. For busier trails, we counted trail use for longer than two weeks. Figure 3 shows typical installations in the two parks.

In each case study, we collected trail use data in the spring and summer of 2012. After downloading the raw data, we performed quality assurance by using automated criteria and then visually reviewing trail use patterns. We also adjusted the raw trail counts for undercounting. Finally, we summarized the trail use data into several different tables and charts to illustrate typical use levels and patterns.

Dashboard graphics are commonly used to provide the “big picture” on trail use. Figure 4 shows the average daily trail users (i.e., people walking, jogging, and riding bicycles) at several locations along the Mission Reach Trail in San Antonio.

**Table 1: Trail Use Counts**

<table>
<thead>
<tr>
<th>Location</th>
<th>Total</th>
<th>Southbound</th>
<th>Northbound</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roosevelt Park</td>
<td>353</td>
<td>171</td>
<td>181</td>
</tr>
<tr>
<td>Concepción Park</td>
<td>392</td>
<td>192</td>
<td>200</td>
</tr>
<tr>
<td>Pedestrians</td>
<td>172</td>
<td>82</td>
<td>90</td>
</tr>
<tr>
<td>Bicyclists</td>
<td>220</td>
<td>109</td>
<td>110</td>
</tr>
<tr>
<td>Southcross Blvd</td>
<td>279</td>
<td>137</td>
<td>142</td>
</tr>
<tr>
<td>N. of Military Dr.</td>
<td>94</td>
<td>48</td>
<td>46</td>
</tr>
</tbody>
</table>
Other data summaries can help illustrate trail use patterns. Figure 5 shows how Mission Reach Trail use varies by time of the day. More people use the trail in the evenings during the week. However, on weekends, overall use is higher in the morning, and there are more bicyclists than pedestrians on the weekend.

![Figure 5. Mission Reach Trail: Average Hourly Counts.](image)

Different patterns of trail use were seen at Guadalupe Mountains National Park (Figure 7). The number of hikers peaked during the midday. On the Guadalupe Peak Trail (which ascends to 8,751 feet, the highest point in Texas), trail use on Saturday was much higher than on weekdays or Sundays.

![Figure 7. Guadalupe Peak Trail: Average Hourly Counts.](image)

Figure 6 shows how Mission Reach Trail use varies throughout the year. The year-round use is fairly consistent, with some spikes in usage during special events (for example, charity events like the Mission Reach Bloom Boom). Also, trail use is typically higher on weekends, though some weekdays show high use when special events occur.

![Figure 6. Mission Reach Trail: Total Daily Counts.](image)

Figure 8 shows trail use during the spring season (March through May). As expected, trail use was much higher during Spring Break and on the weekends, Saturdays in particular.

![Figure 8. Guadalupe Peak Trail: Total Daily Counts.](image)

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