
Monitoring and Estimating Visitor Use Levels at the Madrona Ranger Station

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Introduction

Visitation to Saguaro National Park has increased more than 50 percent since the 1988 GMP from 2,118,500 visits in 1990 to 3,424,000 in 1999. Park use is expected to continue to increase at about the same rate in the near future as Tucson attracts more visitors and residents. Last year, Saguaro National Park (SNP) was named by Tucsonans as the best place to take out-of-town guests to see the desert, and this trend is likely to continue. Within SNP there are many historic and cultural features that speak to past use and are worthy of preservation. The Madrona Ranger Station for example, has been an important part of the park history and operations for decades. Its role in the future will be expanded dramatically to include interpretation and resource protection as the population of the Rincon Valley grows and access to this part of the park is improved. The Chimenea Creek riparian corridor is likely to be a very popular destination for local residents and traditional visitors. The intensity of use the Madrona area will experience will dramatically increase. If the park is not able to maintain a residential and administrative site here, resources will be severely degraded and significant operational inefficiency will result. In addition, the corridor leading to the Madrona Ranger Station is shared between humans and wildlife. As the Arizona Trail and proposed adjoining trail systems continue to be developed, the threat to the natural resources surrounding Madrona and in particular to the wildlife is extreme. While preserving and expanding valuable wildlife habitat is one method to protect species diversity, controlling and monitoring visitor use is equally important. With neither of these methods in place, the threat to wildlife at the moment is very real.

The purpose of this report is to estimate the amount of visitor use that is currently occurring at the Madrona Ranger Station and in particular the Madrona pools. The following questions guide this study:

1. Where and to what degree are visitors currently using the Madrona Ranger Station and surrounding area?
2. What are the actual and projected peak visitation periods?
3. What seasonal time periods are sensitive in terms of human interactions on wildlife populations in Madrona Ranger Station and surrounding area?
4. What are the mitigation, protection and habitat restoration actions that can be used to reduce impact on wildlife and their associate habitat while allowing visitor access to the area?

Methods

The methodology for this study utilizes a combination of automated visitor counter pad devices in conjunction with observation. Automated technologies are used for deriving information on time of arrival at trailheads or key access points, movement patterns and overall numbers of visitors entering the Madrona Ranger station.

Three locations were selected to efficiently capture the majority of access and use temporal patterns.

- a. Located at the beginning of the trail to the pools above the Madrona Ranger Station, shortly after the water tank (WaterTank).
- b. Located along the Manning Camp Trail immediately west of the Chimenea Creek crossing. (Manning Camp Trail).
- c. Located at the Rincon Creek Trail, adjacent to the intersection point with the Ranger Station access road (Rincon Creek Trail).

All visitor monitoring data and wildlife information are entered into a database for analysis. Analysis is performed and presented below to understand the spatial patterns and intensity of human use. Once a restoration area is selected, more detailed monitoring will be undertaken to more accurately assess the type of use that is occurring.

How Many Visitors Entering/Exiting the Madrona Ranger Station?

STIL counter pads were used a Madrona Ranger Station to estimate the amount of visitor use that is occurring over a designated sampling period. To estimate visitor use levels using counter devices there are a set of steps that need to be followed. Due to some anticipated inaccuracies of the counting devices such as visitors not directly striking the pad and not being recorded, it is important to first calculate the average inflation factor that were used to calculate the total estimated use. The average inflation factor is usually expressed as a ratio. For example if the number of observed hikers over a designated sample period is 100 and the actual recorded counts are 68, then the monitor accuracy captured, expressed as a ratio is: $1/1.47 = 0.680$ or 68% of all users that passed by this location.

Given this inflation factor and other problems related to acquiring a representative sample, to estimate the total visitor use and compute an approximate 95% confidence interval (CI) for this value the following relationships are used: T is the total estimated use; N_S is the total number of days in the sampling period; n is the total days monitored; \bar{r} is the average ratio (inflation factor), t is the total monitor count; Var is the variance; SE is the standard error; B is bound; CI is confidence interval. The following formulas are used to calculate visitor estimates.

Formulas for Calculating Visitor Use Estimates

$$\text{Step 1) } T = (N_S/n) * (\bar{r}) * (t)$$

$$\text{Step 2) } \text{Var}(\bar{r}) = \text{SE}[(\bar{r})]^2$$

$$\text{Step 3) } \text{Var}(T) = (N_S/n)^2 * (t)^2 * \text{Var}(\bar{r})$$

$$\text{Step 4) } B = 2 * \sqrt{\text{Var}(T)}$$

$$\text{Step 5) } \text{CI} = T \pm B$$

The following is an example of how to calculate visitor use estimates for Site X. If a counter was installed and 100 visitors were observed traveling across the pad over a specified sampling period. All times were recorded for these observations and the data from the counters were downloaded and compared to the observed data. The actual count from the counter was 68. A value can be computed for this comparison and expressed as a ratio such as $1/1.47 = 0.680$ or expressed another way, 68% of all users that passed by this location were captured on the counter. Using the total number of sample days for the entire study was 75, the total number of days of actual monitoring was 55, and the standard error for the monitor is 0.189, using the total monitor visitor count over the monitoring period of 5000, an estimate of visitor use can be calculated. Given these parameters the following calculations were made to estimate visitor use at the 95% confidence level.

$$\text{Step 1) } (75/55) * (1.47) * (5000) = 9,996$$

$$\text{Step 2) } (.189)^2 = (0.0357)$$

$$\text{Step 3) } (75/55)^2 * (5000)^2 * (0.0357) = 1,659,157$$

$$\text{Step 4) } 2 * \sqrt{1,659,157} = 2 * 1288 = 2,576$$

$$\text{Step 5) } 9,996 \pm 2,576 = 7,420, 12,572$$

The total estimate use for Site X was 9,996 and approximately 95% confident that the true total number of visits is between 7,420 and 12,572.

Estimated Use Levels at Madrona Ranger Station

Table 1 illustrates the beginning and ending of the sampling periods, the number of days the counters actually recorded data, the total number of monitoring days in the sampling period, the number of arrivals from the all counters and counts/day. The actual visitor days can be calculated by dividing the number of arrivals by two to more closely reflect double counting of visitors who entered and exited the

area. So rather than double count, the arrivals are divided in half. This does not guarantee the visitors who entered the area exited from the same location, but it does provide a more realistic picture of actual visitor use numbers. Visitors accessing the area using the pedestrian gate from X9 or traveling off trail up the Chimenea Creek were not counted. These routes account for an unpredictability in total visitor counts and a consistent undercount represented in the *Number of Arrivals* column. Table 1 provides an assessment of the number of visitors who arrive or depart from the Madrona Ranger Station. The sampling period began January 3, 2004 and continued on through April 12, 2005. Monitoring is still ongoing. The total number of days that counters were actually in the field varied from 432 on the Manning Camp Trail to 212 at the water tank. The total number of visitors that were recorded entering or exiting Madrona Ranger Station again varied from the Manning Camp Trail (602) to as little as 62 on the Rincon Creek Trail.

| Location | Begin | End | Number of Monitoring Days (n) | Total Number of Days (Ns) | Number of Arrivals | Counts/Day |
|--------------------|-----------|-----------|-------------------------------|---------------------------|--------------------|------------|
| Manning Camp Trail | 2/5/2004 | 4/12/2005 | 189 | 432 | 602 | 3 |
| Water Tank | 9/12/2004 | 4/12/2005 | 101 | 212 | 477 | 5 |
| Rincon Creek Trail | 2/4/2004 | 4/12/05 | 186 | 433 | 62 | 0 |

Table 1: Counter data for Madrona Ranger Station for 2004

| Location | Sampling Period | | 95% Confidence Level | | |
|--------------------|-----------------|-----------|-----------------------|-----|------|
| | Begin | End | Estimated Visitor Use | Low | High |
| Manning Camp Trail | 2/5/2004 | 4/12/2005 | 1011 | 710 | 1312 |
| Water Tank | 9/12/2004 | 4/12/2005 | 736 | 547 | 925 |
| Rincon Creek Trail | 2/4/2004 | 4/12/05 | 106 | 79 | 133 |

Table 2: Visitor Use and associated estimate within the 95% confidence level

Estimated visitor use levels were calculated taking into account error rates in the counter pads and in recording visitors, the discrepancy between the number of monitoring days and the number of actual days the counters were in operation. Table 2 illustrates these use estimates. Using the calculations described previously, estimates vary between 1011 on the Manning Camp Trail to 106 on the Rincon Creek trail. Given this estimate use level, low and high estimates were calculated at the 95% confidence levels that range between 710 and 1312 for Manning Camp Trail. The Rincon Creek Trail in contrast to the other two trails is used such a small amount that the upper use estimates are 133 visitors.

A detailed analysis of all counter data can be found in Figures 1 thru 4. Figure 1 illustrates the visitor use levels at Madrona Ranger Station throughout the entire sampling period. February 2004 is clearly the month that received the most frequency of use, with over 170 visits to the Madrona Ranger Station. As would be expected, when the desert begins to heat up in March and April, visitor use levels begin to decline, tailoring off to less than 30 visits in the month of August. This climate driven visitation pattern is repeated in the spring of 2005. This is a recreation visitation pattern commonly seen in arid or semi-arid environments. Comparing the outputs for each counter can provide an estimate of the differences between administrative and other public use. Researchers and administrative trips using the Manning Camp Trail on route to Manning Camp can account some of the use intensity in 2004.

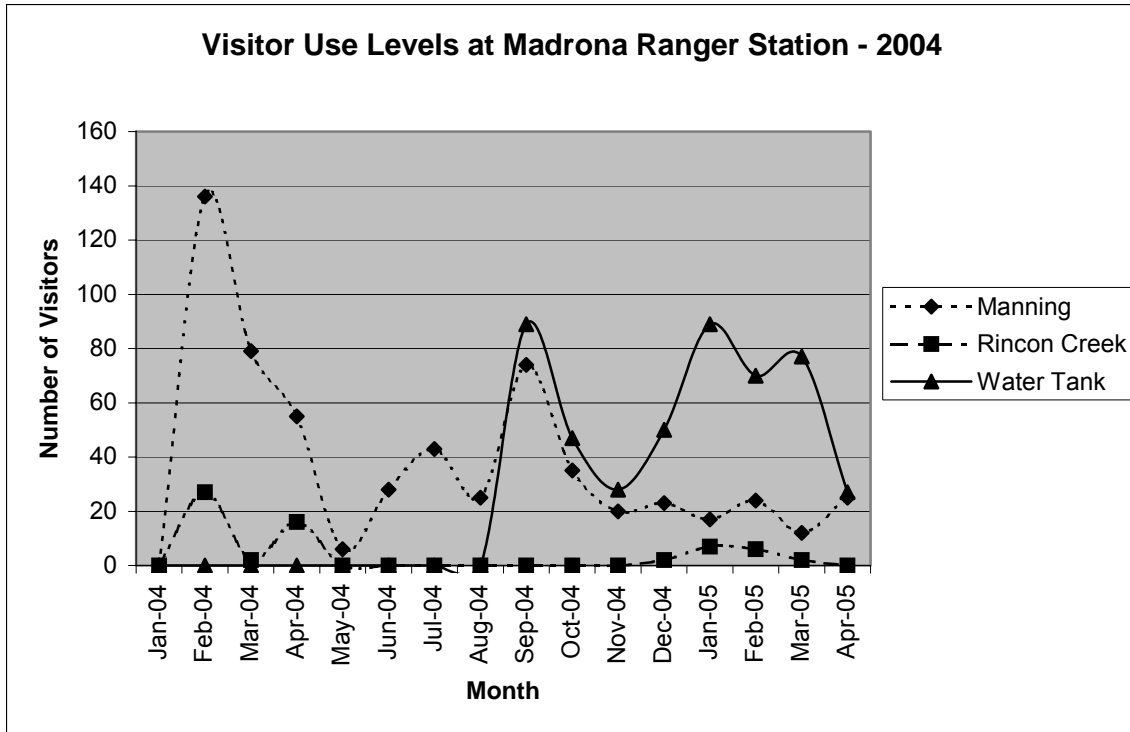


Figure 1 – Visitor use levels by Month for the sampling period

Figure 2 provides an assessment of the visitor use levels presented by weekday. Of interest, midweek is a time when the heaviest use levels are observed on the Manning Camp Trail. The heavy use on Wednesdays can be explained by administrative and research trips coming and going during that day. The Water Tank Trail shows a similar use increase over the weekend. The water tank trail is likely the destination choice for recreation users of the Madrona Ranger Station. These distinct use patterns show spatial and temporally unique use of the area by user types.

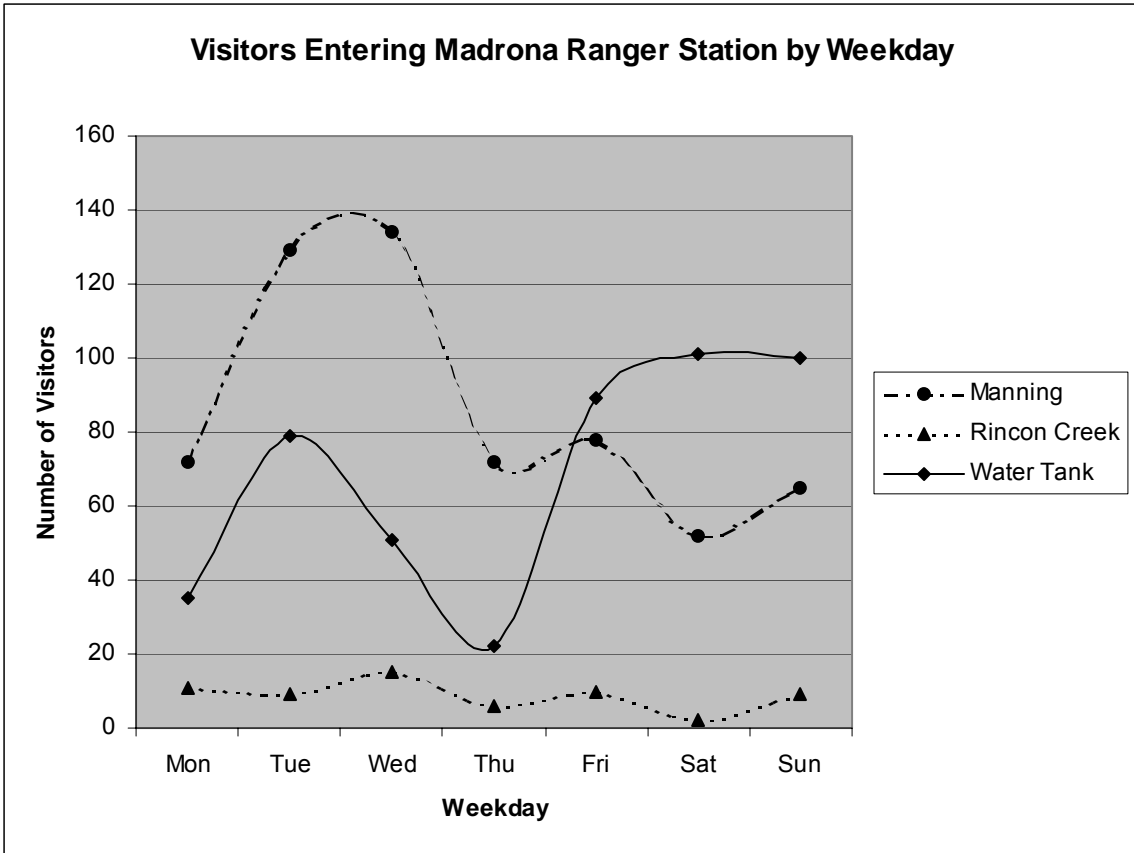


Figure 2 – Visitor use levels by Weekday for the sampling period

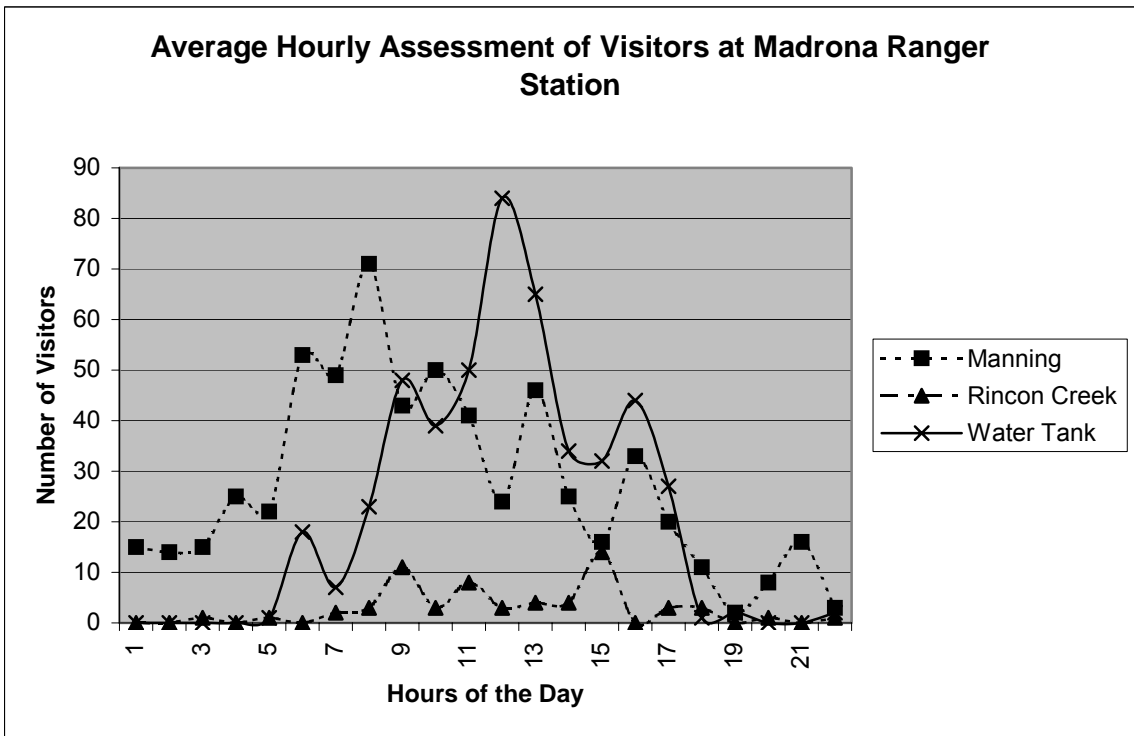


Figure 3 - Hourly Assessment of Visitor use levels for the sampling period

Perhaps the most interesting finding of this study is the distribution of visitor use over a day. Figure 3 provides an assessment of the hours of the day on the average throughout the sampling period that visitors are using the Madrona Ranger Station.

The Manning Camp Trail in Figure 3 reveals a pattern of use commonly seen in arid environments where there is a clear pattern of early morning arrivals, peaking midmorning and then dropping off mid afternoon. Unusual is the amount of use occurring between the hours of four and eight to ten o'clock at night. While most visitors would be leaving the area during the hot times of the day, this resurgence of visitation can be explained by users that prefer to exit the area later in the evening when it is cooler to travel. The Water Tank Trail shows a distinct pattern with use peaking mid day. This contrary use pattern could be linked to the; seasonal pattern of early spring use so that midday temperatures are not a factor, the destination appeal as a cool spot midday, or the amount of time it takes to access the ranger station area for recreation users. Because is it difficult to diferentiate a variety of visitor use types, one cannot say for sure what type of visitation is occurring at this time of day.

Summary

It is clear from an examination of the visitor use data presented in this report that the Madrona Ranger Station is experiencing a noticeable amount of use even though it is not officially open to the public. The estimated visitor use levels for this area provide a baseline for examining the seasonal pattern and intensity of use by visitors to the area. It is clear that a percentage of visitor use levels can be accounted for by administrative and research trips but what is not known is how much of that use is recreation or public use. What is interesting is that this use is not consistent throughout the year but peaks in February and dramatically tapers off in the summer months. This is important when examining the type of wildlife that frequents the area and the potential for disturbance and displacement during important mating or nurturing times.

Most importantly the Madrona Ranger Station is being used or at least humans are traveling to or through this destination. Significant is the fact that the area is not formally open to the public, yet it is experiencing a relatively high degree of use. Likewise important is the late afternoon and evening use that is being observed in the data. Whether this is local resident use or others that have found access to the pools this is important to consider in the long-term management and protection of the area. More work needs to be done to examine this trend.

This report has provided an initial view of the spatial/temporal patterns of visitor use that the Madrona Ranger Station and associated pools receive. Monitoring work will continue during 2004-2005 to capture more specific information on type of use that is occurring along these trails. As park management begins to evaluate the importance of the Madrona Ranger station and the associated ecological integrity of the pools, understanding the frequency and intensity of visitor use will become critical. High intensity and frequency of visitor use has the potential to have severe impact on the pools and surrounding area. More detailed studies need to be undertaken to examine this issue. As the planning continues in examining public access to the pools, monitoring needs to be expanded to ensure the protection of the area remains a priority.

Literature Cited

Titre, J. M. Bates & R. Gumina. 2004. Boulder Open Space & Mountain Parks (OSMP) Use Estimation and Visitor Survey Study for the Chautanuqua Study Area. Final Report For the Boulder Open Space & Mountain Parks. Boulder, CO. March, 2004. Pgs. 48.