

# Considerations for Monitoring Visitor Use in Wilderness

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## Introduction

The global pandemic of 2020 led to major increases in outdoor recreation across the United States. In response, recreation managers are searching for cost-effective ways to document use levels and track trends over time. This paper discusses considerations related to monitoring visitor use, synthesized from several key resources. The focus is solely on monitoring directly related to recreational use levels; other characteristics of wilderness conditions or impacts of recreation are not addressed. The companion document, “An Introduction to Visitor Use Monitoring Methods in Wilderness,” may also be of interest.

## Why monitor use?

Wilderness managers need objective information about visitation to support decisions about use management, facilities, resource/personnel deployment and other aspects of land management. Such information can help managers understand how use relates to resource impacts, evaluate facility capacity and design, identify problematic hot spots, track visitor compliance with regulations, and describe the social and economic importance of an area (Cessford & Muhar 2003; Hadwen et al. 2007). Data for these purposes can be provided by monitoring -- the routine, systematic, and documented collection of quantitative information about selected indicators. Good information about trends in use allows a proactive, rather than reactive, approach to addressing potential problems that may require changes in management (IVUMC 2019).

Monitoring is also critical for evaluating the effectiveness or unanticipated consequences of management decisions or actions after they have been implemented (IVUMC 2019). For example, if a limited use permit (quota) system is adopted, there may be displacement of visitor use and impacts, which can only be identified by monitoring use and conditions over time.

## What should you monitor?

A pitfall of many wilderness monitoring programs is that they involve collection of data about too many indicators, or about indicators that turn out not to be useful for directly informing management decisions. Indicators (sometimes also called “measures” or “variables”) are specific, measurable attributes that can be tracked consistently over time and space (IVUMC 2019). An initial decision in establishing a monitoring program is deciding what you want to measure. There are four general categories of potential information (Hadwen et al. 2007):

- Use levels (the number of people or groups)
- Where use occurs
- When use occurs
- Visitor activities or behaviors

Regardless of which category of information you want to collect, good indicators have several properties in common:

- They are meaningful and related to visitor use.
- They can serve as early warnings of substantial problems (e.g., if a parking lot at a formerly low-use trailhead fills to capacity on weekdays, this could signal a variety of problems, including exceeding facility capacity, resource impacts, and crowding).
- They can be measured reliably by different people; that is, two people observing the same situation would record the same data. For example, the number of cars in a parking lot can be counted more reliably than the number of people present around a lakeshore.
- They can be measured reliably over time. The instructions must be simple and clear enough that data collectors in different years would implement them in the same way.
- They can show change over time. For example, if you only count cars present within designated parking lots, you would not capture changes that occur if people start parking along roadsides because the parking lots are full.
- They are easy and/or cost-effective to monitor (e.g., parking lot car counts are much less expensive to conduct than encounter monitoring at interior destinations).
- They can serve other purposes besides tracking trends in use, generating data that can be used for other purposes. For example, some measures may fulfill requirements for Wilderness Stewardship Performance or Wilderness Character Monitoring.
- They make use of data already being collected. For example, if rangers are already recording information about compliance with voluntary or mandatory trailhead registration, this information can be used to calibrate the registration counts.

## How much data do you need, and do you need a random (representative) sample?

One of the most common questions people ask about monitoring is “how much data do I need to collect?” Unfortunately, there’s no simple answer, because it depends on how variable conditions are and how certain you need to be about your conclusions, among other things. The Interagency Visitor Use Management Council developed a framework and resources (2017 <https://ijw.org/visitor-use-management-framework/>) that introduces the concept of a “sliding-scale” of analysis. The upshot is that the level of effort and rigor in monitoring should be guided by four criteria: “the level of uncertainty about the issue, level of risk of impacts to resources and visitor experiences, degree of stakeholder involvement, and level of controversy/potential for litigation.” The higher the stakes on any of these criteria, the more important it is to have a robust set of data. In some cases, it’s quite clear that you do not need extensive amounts of data to determine that action should be taken.

- For example, if a staff member reports that there are so many cars parked along an access road that emergency access is blocked, you probably don’t need any more data than that to know that something needs to be done.

**“the framework’s sliding scale of analysis is emphasized to ensure that the investment of time, money, and other resources for a project is commensurate with the complexity of the project and the consequences of the decision.” (IVUMC)**

Another common question is whether it’s necessary to collect data using random sampling, or whether data collected through what’s called “convenience sampling” can suffice. Again, there’s no single answer, and the decision for any specific situation is affected by the same four criteria above.

Realistically, though, resources often prohibit the implementation of a true random sample of observations. Fortunately, there are many instances in which convenience sampling can be extremely valuable.

- For example, if a 20-vehicle trailhead is monitored on a pleasant weekend in the summer, and it is less than half full, it seems unlikely that there is much value to collecting additional data at this site, because it's unlikely to receive more use during less desirable times. In this case, carefully timing the monitoring visit to occur at what is the peak use time is extremely efficient.

The important thing is to think through the types of conclusions you want to be able to make with your data, as in the two examples above. If you can make a strong case that a convenience sample will generate defensible conclusions, you may not need a random sample of data. Nevertheless, the more you can establish that your convenience sample is likely to be a valid representation of overall conditions, the stronger your interpretations will be. For example, if you conduct encounter monitoring with observations from across the months of the high use season, you will be more sure that you have an accurate understanding of conditions than if you only collected encounter data early or late in the season.

One useful way to think about monitoring, especially when resources are limited, is to conduct it in phases, with initial, more superficial monitoring serving as an “early warning” system that could trigger more in-depth monitoring in a subsequent phase, depending on the results obtained. A good example of this is the USFS national minimum protocol for monitoring solitude in wilderness. The minimum protocol only requires 10 days (5 weekdays and 5 weekend days) of monitoring in a limited number of monitoring areas, and it allows for data collected as a convenience sample. This is often not enough data to draw confident conclusions about typical conditions in a location, when use can vary tremendously from month to month and across weekdays and weekend days. However, it can provide important screening data to suggest where more data are (and are not) needed.

- For instance, if a trail is monitored on five peak weekend days, and there are hardly any visitors, a strong case can be made that there is no problem and no additional data are needed.
- On the other hand, if an observer encounters more than 100 visitors on each of the five weekdays at a site, and more than 500 visitors on each of the five weekend days, and the monitoring dates are well distributed throughout the use season, a good case can probably be made that there is a problem that needs to be addressed immediately, without requiring additional data.

Between these two extremes, there will be situations where the data from the national minimum protocol cannot permit confident conclusions about visitation; for instance the data may show great variation in encounter rates across the 10 monitoring sessions. In such cases, if it is necessary to generate more confident conclusions about conditions, additional data from randomly sampled dates may be required.

## Who should do monitoring?

Data for monitoring can be contributed by many individuals, and it is worth considering how you could partner with other USFS staff or volunteers to collect information. While all protocols require some training to ensure they are applied consistently, some are quite easy to grasp with very little training.

- Can recreation maintenance staff count vehicles parked along specific sections of roads during their daily duties visiting trailheads?

- Can trail crews designate someone to track encounters while on patrols in wilderness?
- Are there local volunteers who would enjoy counting cars at trailheads in exchange for a parking permit?

If you will be asking other people to collect data, it's important to review the data as they come in, to catch any errors or gaps early. Also, you will need to develop a procedure for storing the data (for example, asking volunteers to take photos of their data sheets and upload them to Pinyon) and have a plan for entering data that people record on paper forms.

## What should be captured in protocols and documentation?

All monitoring, even simple convenience sampling approaches to counting cars in parking lots, should have a written monitoring protocol that describes all decisions made related to the time and place of data collection and rules for measuring each indicator, along with data collection sheets. Broom and Hall (2008) provide a checklist of elements that should be included (or considered for inclusion) in documentation, and the IVUMC provides several examples of data forms in its Monitoring Guidebook.

**“When creating written protocols for replicability, for both simple and complex monitoring, it is extremely important to include detailed assessment protocols for field staff use, including measurement definitions, procedures, and, if necessary, diagrams, photographs, and quality assurance protocols. The goal is to provide a high level of measurement consistency and precision (both over time and between different data collectors) so that measurements largely reflect real changes in resource conditions rather than measurement error.” (IVUMC)**

If your goal is to evaluate trends over time and space, it's critical to collect ancillary data that permit you to standardize measures for aggregation and comparison. This means you need to record things like the time of day, duration of observation periods, and specific geographical areas. To know what other data you need to record, it can be helpful to state your measures as specifically as possible, by thinking of them as variables you will analyze and present in tables or graphs. For example, you might want to monitor encounter rates along a wilderness trail. When reporting the data, you might envision a table showing the average number of encounters with other groups per hour along the 3-mile segment of trail from Trailhead A to Lake Z. To present the data this way requires that observers document encounters on this segment of trail separately from encounters on other segments of trail, and it requires them to record the amount of time spent on the trail. As another example, you might want to show a graph of the highest daily number of cars parked at a popular trailhead on Saturdays in July and August. To present the data this way requires that you have an observer at the trailhead at the peak use time on every Saturday in July, and it also might suggest that you should collect information about weather on observation days, to help explain any variations observed.

## Managing and analyzing data

It's easy to devote time and energy to collecting data, but equal focus needs to be placed on how you will manage and analyze the data. These issues need to be considered up front, as they have the potential to impact how data are collected. One obvious issue is whether to collect data on paper forms or electronically. There are many advantages to using apps on mobile devices (such as ArcGIS's Survey

123 or Field Maps). These applications eliminate the inefficiency of transferring data from paper to electronic form, and it is easy to build in data checks to reduce the rate of errors. However, you may need to have both paper and electronic versions available, depending on who is collecting data and whether they have access to mobile devices.

**“ArcGIS Survey123 is a complete, form-centric solution for creating, sharing and analyzing surveys. Use it to create smart forms with skip logic, defaults, and support for multiple languages. Collect data via web or mobile devices, even when disconnected from the Internet. Analyze results quickly, and upload data securely for further analysis.”**

**“ArcGIS Field Maps is an all-in-one app that uses data-driven maps to help fieldworkers perform mobile data collection and editing, find assets and information, and report their real-time locations. ArcGIS Field Maps is the go-to field app, powered by field maps, that streamlines the critical workflows field personnel use every day. Because it is built on ArcGIS, everyone—whether in the field or the office—will benefit from using the same data.” (ESRI)**

- As data are being collected, it’s important to check for errors, especially early in the season. It should be clear who has responsibility for this, so it doesn’t get overlooked.
- For data analysis, simple Excel spreadsheets generally work well.
  - Be sure to include a worksheet with metadata (including data dictionary).
  - Always keep a copy of the raw data, clearly marked, before transforming any data during analysis.
  - Be sure that the analysis you conduct treats missing data as missing, not as zero values.
  - An incredibly useful resource is provided by Broman & Woo in their article “Data organization in spreadsheets.”
  - Aggregate measures related to visitor use can easily be affected by the intensity of monitoring activity. (E.g., all else being equal, the number of violation notices issued will be higher when there are more law enforcement patrols.) Often, this can be addressed by standardizing the aggregate values for measures by an appropriate measure associated with the amount of effort expended. For instance, you could calculate the number of violation notices per hour, rather than the total per season, which would let you confidently compare data across years.

As you interpret your findings to reach conclusions, it’s important to consider them with a critical point of view that doesn’t just accept findings at face value. Many things can happen during monitoring that influence the specific results in random or unpredictable ways. Some examples of things to keep in mind include the following:

- Were there any systematic biases in the way data were collected that might affect interpretation or conclusions?
  - For example, if volunteers monitored encounters at interior lakes in a wilderness during day trips, their data on campsite occupancy might underestimate overnight use,

because they were collecting data in the middle part of the day, rather than in the evening.

- For example, if wilderness rangers routinely spend more time in remote areas than typical visitors, their experiences are likely to suggest lower levels of congestion than are experienced by more typical visitors.
- For example, if a rec tech visits trailheads in a particular order each day, car counts from the sites visited first probably don't reflect peak use at those sites.
- Were there any unforeseen circumstances that might have affected some data points?
  - For example, was the weather particularly cool or hot during some monitoring sessions?
  - Were trailhead registers empty for a week, resulting in zero values for those days?

## Resources

- Short, accessible description of the [Interagency Visitor Use Management Framework and resources \(2017\)](#)
- The [Interagency Visitor Use Management Council's Monitoring Guidebook](#) has the following:
  - Overview of monitoring, with emphasis on indicators, measures, and "triggers" (standards)
  - Guidance for implementation
  - Processing and use of data
  - Variety of examples and data forms
- Leggett, C., Horsch, E., Smith, C., & Unsworth, R. 2017. [Estimating recreational visitation to federally-managed land](#). Report prepared for the Office of Policy Analysis, US Department of Interior.
  - Provides an overview of how use data are collected by federal land management agencies nationally.
  - Assesses the practicality of using social media data, cellular activity data, and remotely sensed data.
  - Provides some useful recommendations.
- [USFS National Minimum Protocol for Solitude Monitoring](#)

## References

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