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Monitoring Visitor Use in Backcountry and Wilderness: A Review of Methods

Steven J. Hollenhorst **Steven A. Whisman** **Alan W. Ewert**

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Obtaining accurate and usable visitor counts in backcountry and wilderness settings continues to be problematic for resource managers because use of these areas is dispersed and costs can be prohibitively high. An overview of the available methods for obtaining reliable data on recreation use levels is provided. Monitoring methods were compared and selection criteria were developed based on units of measure, efficiency and affordability, validity and reliability, and compatibility with agency objectives. Using these selection criteria, some general recommendations of methods for monitoring visitor use in wilderness and backcountry were derived. Permit methods offer the benefit of obtaining extensive and accurate use data, but have high administrative costs and are inconvenient for visitors. Registration techniques provide extensive data and are particularly applicable where rationing use is not a management objective. Permit and registration techniques, however, do require considerable resources to validate for visitor noncompliance. Indirect counts with electronic or mechanical devices in combination with self-report surveys or self-registration meet most management and research needs by providing data on total use and meaningful information about the type of use. Proper study design controlling for sampling bias can make this combined approach an attractive alternative.

Retrieval Terms: visitor counts, visitor statistics, visitor use monitoring methods, wildland recreation, backcountry, wilderness

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Cover: A registration station on the Youghiogheny River in southwestern Pennsylvania is used to count boaters. (Photo: William Offutt)

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Contents

In Brief ...

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Most managers of public lands rely on informal estimates of recreational use, but the general consensus is that more reliable information about recreational use and users is required for effective management. In response to the pervasive need among resource managers to obtain reliable information about the amount and type of recreational use, we reviewed methods for monitoring backcountry and wilderness use. To assist managers in evaluating and selecting an appropriate method for monitoring visitor use, we developed some general selection guidelines.

When implementing a management plan, managers need to identify important goals and objectives, which will provide guidance for selecting a visitor use monitoring method. These goals and objectives can be used to choose the appropriate level of detail for the visitor use data to be obtained, from simple lists of activities to more rigorous sample or census counts. In general, sample counts provide the minimum level of detail needed to meet most management objectives.

We compared 13 alternatives for monitoring backcountry and wilderness use to establish general selection criteria. Comparisons were based on characteristics that managers should consider when evaluating monitoring methods, including the following: the type of use and visitor data obtained with the alternatives, whether calibration or validation for visitor noncompliance are needed, potential sources of bias, the extent to which managers have experience with the alternatives, and relative administrative and visitor costs. In our opinion, evaluating the alternatives by these general characteristics would enable managers to identify alternatives that best meet their needs.

Selecting an efficient and accurate method to estimate recreation visitor use can be difficult. The dispersed nature of recreational use in backcountry and wilderness areas exacerbates the problem. Methods for monitoring recreation visitor use that control for primary sources of bias may require a substantial investment on the part of the land management agency. On the other hand, easily administered methods usually generate unreliable data. Data that are of questionable reliability could impart an undesirable mix of hidden costs and problems if they form the basis for management decisions.

A monitoring method for most wildland applications must meet four basic requirements:

1. The method must generate data in the form of total recreation visits, total recreation visitor hours, or total recreation visitor days.
2. The method must be efficient, that is, implementing the method must be logistically practical and the costs affordable.
3. The method must provide a valid and reliable basis for establishing "primary purpose of trip."
4. The method must record use in visitor activity categories and subcategories used by the managing agency.

Several alternatives appear to meet these four requirements: agency issued permits, self-issued permits, visitor registration, and electrical or mechanical counting devices in combination with visitor surveys or visitor registration. Where permits are required for all visitors to an area, managers have access to accurate census level information. However, permit systems are costly to implement and enforce, and may diminish visitor freedom and spontaneity. Self-issued permits offer a lower cost alternative to agency-issued methods, but require enforcement resources and determination of compliance rates.

Next to informal convenient samples or professional judgments, visitor registration is the most common approach to visitor use monitoring. If non-compliance rates are determined, this alternative provides census level data as well as many of the benefits of permits, but with fewer administrative and visitor costs. On the other hand, substantial resources must be committed to registration programs to cover data collection, maintenance, and determination of compliance rates.

While well placed electrical and mechanical counters can provide inexpensive, census level data on total visitation, they give no indication of visitor type, activities, preferences, or other vital information. In contrast, the major problem with surveys is that while detailed visitor information can be obtained, total use cannot be estimated unless proper sampling procedures are used. In combination, however, these methods provide meaningful data that meet most management and research needs.

Resource managers continually need reliable information on recreational use to make sound management decisions. Every method for monitoring visitor use has inherent advantages and limitations. Improperly used they can produce expensive or, worse yet, misleading information. By providing a comparison of the visitor use monitoring methods currently available, and offering some general guidelines for selecting an appropriate method, this report should make the resource manager's job easier.

Introduction

Visitor use monitoring is essential to sound wilderness and backcountry management (Chilman and others 1990; Lucas 1990; Roggenbuck and Lucas 1987; Watson 1990; Watson and others 1987). The information that managers obtain by monitoring is useful for a variety of purposes, from day-to-day management decisions to empirical defense in court cases or decision appeals (Chilman and others 1990). In addition, merely knowing the socio-demographics of the current visitor is not sufficient to predict future participation patterns (Stockdale 1989). As such, periodic or continuous monitoring efforts can provide managers with accurate visitor use information upon which sound decisions can be made.

Monitoring is the repeated measurement of specific phenomena or conditions over time (Chilman and others 1990). Visitor use monitoring in wilderness or backcountry areas involves assessing the amount of use as well as social conditions. Determining the amount of use, use trends, characteristics of use and users, and the qualities of the experience (e.g., opportunities for privacy and solitude) can provide important information for managers.

Federal land managing agencies have been estimating and reporting recreational use for many years. However, detailed studies and statistical analysis have apparently been conducted only in the last few decades, following passage of the Multiple Use and Sustained Yield Act of 1960 and publication of the 27-volume report of the Outdoor Recreation Resource Review Commission in 1962 (Saunders 1982). With a prevailing perception that rough approximations of visitor use were inadequate as a basis for management planning, emphasis of early research on recreation in wilderness and backcountry areas was on the accuracy of the use estimates produced (Watson and others 1987).

Research of this nature declined from the late 1970's into the 1980's for several reasons (Roggenbuck and Lucas 1987). Interest may have waned as a result of the perception that the topic had been adequately dealt with, even though important questions remained. A shift from basic descriptions of use and users to the understanding of individual and social meanings and benefits of recreation may have also contributed to the decline.

A need for further study in the area of visitor use estimation remains. Trends in use and user characteristics have been relatively unstudied, coverage of the wilderness system and its use has been uneven, and managers still feel a need for good profiles of users (Roggenbuck and Lucas 1987). Similarly, the relationship between visitor use and impacts on resources such as vegetation and soils has ushered in a renewed interest in use estimation research. Resource impact studies often include measures of the amount, time, and type of use.

Finally, as the controversy between amenity and commodity uses of wildland resources intensifies, the need to accurately quantify visitor use will become increasingly important. Backcountry and wilderness visitors may value wildland resources in ways that are often overlooked or poorly represented when resource allocations are made. Having accurate estimates of visitor use may indeed be useful in allocating resources to their highest-valued uses.

While methods for monitoring visitor use of large wildland areas have been developed, the prevailing approach seems to be informal and casual observations. In 1980, systematic monitoring methods were used in less than half of the areas in the National Wilderness Preservation System (NWPS) (Washburne and Cole 1983). Recent evidence indicates that this situation persists, at least in the eastern United States (Whisman 1990). Implementing more accurate monitoring methods is viewed as subsidiary to more urgent management problems such as inappropriate vehicle use, budgetary constraints, overuse or abuse of some sites, visitor education, private inholdings, and uncontrollable access points (Watson and others 1987). We suggest that implementing reliable visitor use monitoring methods would help managers deal with many of these problems. Recognizing the inadequacy of current visitor use statistics, a recent study by the U.S. General Accounting Office (1989, p. 64) concluded:

> ...baseline inventory information and accurate statistics on use need to be developed for each designated wilderness area so management can assess trends in resource conditions and use. This information could be used... to initiate changes in the manner in which wilderness is used, and it would be more acceptable to users as a basis for restricting certain uses.

Counts of visitors are used for many purposes in a variety of wildland situations. Simple presence-or-absence information suffices to study spatial and temporal patterns of use, but reliable measures of total use levels are needed to track changes in biological or social conditions. Many of the standard methods used provide estimates of density and overall numbers of users, even when less elaborate methods might answer research or management questions. This practice results in needless monitoring costs. Perhaps even worse (and more common) are situations in which density or overall use estimates are determined by methods that are inadequate for these purposes (e.g., determining total visitor days from casual observations). The costs associated with using fallacious data as a basis for management decisions are inestimable. Given this situation, it is desirable to assess the suitability of the various methods available for monitoring visitor use in wildland settings.

This report presents a comparative overview of available alternatives for monitoring recreational visitor use, thereby providing resource managers with a consolidated resource to assist them in selecting methods best suited to their specific monitoring needs. As such, the focus is on methods for determining the numbers of wilderness or backcountry visitors and their characteristics, as opposed to techniques for assessing the experiential qualities of their visit.

Characteristics of Methods for Estimating Visitor Use

Standard Units of Measure

Three units of measure are generally recognized for the purpose of estimating and reporting dispersed recreation use. A *recreation visit* (RV) is generally defined as a visit to an area by an individual for the purpose of engaging in any outdoor recreation activity. A *recreation visitor hour* (RVH) is a total of 60 continuous, intermittent, or simultaneous minutes in which a recreation activity is engaged in. A *recreation visitor day* (RVD) is derived from any combination of the number of visitors and the length of time engaged in an activity that comprises a total of 12 hours. Unlike RV, RVH and RVD do not indicate the number of individual visitors to an area. To date, no standard-ized unit of measure has been universally adopted among the federal land management agencies.

Study Objectives and Sampling Detail

Every study of recreation visitor use should begin with a statement of objectives. These objectives should be derived from the overall management goals in a specific area and should guide the selection of not only the units of measure, but also of the appropriate level of sampling detail.

Three levels of sampling detail are recognized: lists, sample counts, and census counts. Following is a description of the levels of sampling detail that can be obtained and the study objectives addressed by each (*table 1*).

Lists

Lists simply record all visitor types detected in an area, and are useful for accomplishing three basic study objectives: (1) the distribution of visitor types in a given area; (2) use diversity--the number of different types of visitors using a given recreation area; and (3) areas visited--the number or percentage of sites used by a particular visitor type.

Sample Counts

Sample counts refer to systematic, standardized efforts to enumerate the level of use by observing or counting a sample of the total visitor population. In addition to the three study objectives described above for lists, sample counts can give information about the relative proportions of different visitor types, and can be used in analyzing use trends, assessing the effects of use density, estimating total use, and evaluating population fluctuations.

Determining annual and seasonal use trends assumes that the delectability of visitors is constant from year to year or from season to season, and that the intensity of the sampling effort is sufficient to develop reliable use estimates. Likewise, studies of successional use trends record how areas change over time with respect to environmental conditions, social conditions, types of recreation use, or all of these. These studies require temporal comparisons of recreational use levels as environmental and social conditions change.

The quantitative concept of visitor use density and the related qualitative concept of crowding are frequently studied factors in outdoor recreation research. Accurate values for recreation density require knowledge of the actual population size in a given area, and are related to population fluctuations (the numerical increase or decrease of recreational use levels),

Sample counts can also be used to determine total visitation, which is usually reported in total recreation visits, total recreation visitor hours, or total recreation visitor days. Several assumptions must be met when using sample counts to estimate total visitation:

1. No visitor in the sample area is missed.
2. All visitors are correctly classified.
3. No visitor moves in or out of the sample area in response to the observer before being detected.
4. No visitor is counted more than once.
5. Visitor detections are independent events.

Unadjusted sample counts, such as trail registration records, may suffice for use trend analysis. On the other hand, estimates of total numbers of visitors, population fluctuations, and density depend upon sophisticated sampling techniques that adjust for the delectability of the visitor and characteristics of the area sampled. For example, in the case of trail registration, deriving adjusted sample counts involves correcting for visitor noncompliance. Rates of noncompliance are developed from systematic observations or other reliable methods.

Table 1--*Study objectives and required levels of sampling detail*

	Sampling detail			
Study objective	List	Unadjusted sample[1]	Adjusted sample[2]	Census
Use distribution	XX[3]	X	X	X
Use diversity	XX	X	X	X
Areas visited	XX	X	X	X
Annual use trends		XX	X	X
Seasonal use trends			XX	X
Successional use trends			XX	X
Effects of density[4]			XX	X
Total visitation[4]			XX	X
Population fluctuations				XX

[1]Unadjusted counts do not permit an estimate of total visitation or density.

[2]Adjusted counts compensate for differences in area sampled and for differences in detectability of different visitor types. Adjusted counts consequently result in estimates of total numbers sampling and density.

[3]XX shows the least costly level for the study objective.

[4]Estimation of total visitation and density are possible using sophisticated sample counts, providing a cost-effective alternative to obtaining these measures using censuses.

Census Counts

With census counts, all visitors in an area are detected and counted. Virtually all study objectives can be achieved using census methods, although detecting and counting every visitor is often impossible or impractical, especially in wildland areas where use is dispersed. Census counts, however, may be preferred in the following situations: when all access points are identifiable and observable, when permits indicating the number of visitors per party are mandatory and enforced, or when field observers can accurately count all visitors in the area at a given time. The assumptions that must be met for census counts are the same as for sample counts, but they must be applied across the entire census area.

Effects of Bias

Bias is the deviation of a statistical estimate of a parameter from the true value of the parameter (Verner 1984). Bias can be introduced by the observer. For example, the acuity, alertness, experience, knowledge, and even the number of observers can result in a certain amount of bias. The ruggedness of the terrain and the amount of vegetation in the study area can also be sources of bias.

Bias can also be introduced by factors associated with the study design. Factors such as sample selection (e.g., random, stratified random), site location, size of the sample area, sample timing, duration of the sampling period, and frequency of sampling can all affect estimates drawn from a sample (Verner 1984). Bias occurs when sampling procedures fail to account for cycles in recreation use (e.g., changes from one hour to the next, from one day of the week to another, and throughout the use season). Also, random influences such as weather, publicity for the site, and competing attractions complicate the task of estimating visitor use (Lucas 1963).

Of course, there are ways of reducing bias. Increasing the sample size generally reduces the effects of bias. If the amount of bias is unknown but constant, increasing the sample size will also improve accuracy from both temporal and spatial perspectives (Verner 1984). Randomization will account for bias related to study design, and standardization in sample design and observer training are also suggested.

Types of Counting Methods

There are three principal categories of methods for monitoring recreational visitor use: (1) self-counting, (2) direct-counting, and (3) indirect-counting methods. These methods are often used in concert to maximize the accuracy of visitor use estimates.

Self-Counting Methods

Information obtained through self-counting methods is provided by the recreationist. Examples of self-counting methods include voluntary visitor registration, agency-issued permits, and self-issued permits.

Voluntary Registration

One self-counting technique that has received considerable attention, particularly in wilderness and backcountry areas, is voluntary visitor registration (Echelberger and others 1981; Leatherberry and Lime 1981; Leonard and others 1980; Lucas 1975; Lucas and others 1971; Petersen 1985). Registration stations are installed at entry points and visitors are asked to complete a short form or card when entering or leaving the area *(figure 1)*. A problem with this method, however, is that not all people register, resulting in differential detection rates for various user types and understated levels of use (Lucas 1975). Registration compliance rates can also be inconsistent among different user types and areas, ranging from as high as 89 percent (James and Schreuder 1972) to as low as 20 percent (Lucas 1983).

(Brett Hagerty)

Figure 1--A voluntary self-registration system is used to count visitors in the Dolly Sods Wilderness, Monongahela National Forest, West Virginia. To account for noncompliance, conversion factors are often employed to obtain a more accurate estimate of visitor use.

Several studies have focused on ways to improve visitor compliance with self-registration. Registration station design, location, and frequent maintenance, as well as public education efforts, could boost compliance rates (Lucas 1975, 1983). Petersen (1985) found that design and location were important factors influencing compliance.

Permits

Since compliance at self-registration stations can be highly variable, agency-issued and self-issued mandatory permits have often been promoted (Hendee and Lucas 1973; Lucas and Kovalicky 1981). Mandatory permit methods have generally been employed where the amount of use is controlled to keep visitation levels from exceeding social and biological carrying capacities (Leonard and others 1980). Permits are often required on rivers, in many National Park backcountry areas, and to a lesser extent in Forest Service wilderness and primitive areas. Use of permits in wildland areas, however, appears to have decreased since the 1970's. As with voluntary self-registration, visitor compliance rates must be validated (Leonard and others 1980).

Many of the studies regarding compliance rates of self-registration and mandatory permit methods have attempted to identify user characteristics or other factors influencing compliance. Such factors as method of travel, length of stay, party size and composition, recreation activity, time of day entering the area, season, weather, and access point can all affect compliance rates (Leatherberry and Lime 1981; Lime and Lorence 1974; Lucas 1975; Lucas and Kovalicky 1981; Petersen 1985).

To account for noncompliance, managers often employ noncompliance conversion factors to obtain a more accurate estimate of visitor use. Ideally, these conversion factors are developed using direct or indirect counts of compliance for different visitor characteristics (e.g., visitor type, area visited, season of use). The estimate of visitor use is then adjusted accordingly.

Direct-Counting Methods

Direct-counting methods entail one or more methods whereby information on numbers of visitors, and visitor characteristics and behaviors, are observed first-hand or by direct contact with visitors. Methods include direct observation census and sample counts, manually operated ground-level or aerial photography, direct aerial observation, interviews, and mail or phone surveys (James 1971).

Direct Observation

Random direct observation of backcountry visitors was perhaps the first monitoring method implemented in the field, and was commonly used in backcountry settings before mechanical devices were developed in the late 1960's (Leonard and others 1980). In these settings, sampling designs that account for temporal use fluctuations (e.g., day of the week, weekend or holiday, season) can render direct field sampling a practical method for obtaining accurate use estimates. This method, however, can be perceived by the visitor as obtrusive and inappropriately invasive, particularly if accompanied by interviews (Leonard and others 1980).

While various techniques have been developed using direct field observation, most are apparently best suited for developed sites such as campgrounds (Schreuder and others 1975; Tombaugh and Love 1964; Wagar 1964), scenic overlooks and wayside parks (James and Quinkert 1972; Schreuder and others 1975), or municipal recreation settings (Tyre and Siderlis 1979). Since these settings are relatively small, visitors can be accurately counted instantaneously or over a relatively short time period. This technique alone is impossible or prohibitively expensive in wilderness and backcountry areas where use is widely dispersed.

Surveys

Survey sampling is another method of estimating dispersed recreation use levels. Lucas and Oltman (1971) overviewed the methods of survey sampling wilderness visitors and described personal interview, mail questionnaire, and other methods of obtaining representative information about recreationists. Also addressed were possible sources of bias such as unrepresentative sampling lists and effects of nonresponse.

Visitor survey methods have been used to assess visitor characteristics, attitudes, and use patterns in wilderness and other backcountry areas (Lucas 1980, 1985). Direct contact with visitors, registration lists, outfitter guest lists, or permit data were used as sources from which survey samples were taken.

Survey methods are often used in combination with direct observation methods. This approach was used on the Lower Salmon River in Idaho to ascertain the number of visitors, visitor distribution, preferences, and opinions (Rawhouser and others 1989). The approach is attractive because it is applicable to other similar areas with minor modification, and provides the desired information at minimal cost.

Cordon Sampling

Cordon sampling, or sampling use in an area that is essentially enclosed, has been used to obtain use estimates in backcountry areas accessed by roads. The method basically involves establishing roadblocks such that questionnaires can be administered or interviews can be conducted with recreationists as they exit the area. The disadvantages of this method are that it is costly and inconvenient for visitors, and that it is applicable only in areas with limited and controllable access roads.

Photography

Using ground-level photography to obtain dispersed use estimates has been attempted. Hogans (1978) compared three photographic techniques to assess their potential for determining selected social data of recreationists in motorized vehicles on forest roads. While good results were obtained for identifying vehicles, assessing the number of people, group composition, and recreation activity was difficult.

Aerial photography has shown promise as an aid in study design. Using aerial photography before ground based sampling techniques can yield estimates of variance that can be used to predetermine sample size (Becker and others 1980). While good estimates of use levels and use distribution can be obtained with

aerial photography, it does not provide detailed information on visitor characteristics and preferences.

Aerial photographic methods have been applied primarily in studies of water based recreation activities because virtually all visitors can be detected under discernible and easily followed flight paths. Becker and others (1980) focused on recreational use of the Lower St. Croix Wild and Scenic River, while James and others (1971) used aerial photography along with direct counts, vehicle counts, and interviews on two lakes in Deschutes National Forest to obtain reliable recreational use levels.

Indirect-Counting Methods

Indirect-counting methods generate simple counts of recreational use levels using electrical and mechanical counting devices, self-activated or time-lapse photography, and remote sensing techniques (James 1971). Unless these methods are coupled with other self-counting or direct-counting methods, or use photographic techniques, they provide little if any information about user characteristics and behaviors. Indirect methods have been applied extensively in backcountry settings where the level of traffic on selected trails can be used to estimate total visitor use.

Counting Devices

The devices used to make indirect counts of visitors can include pressure plate and photoelectric trail counters, photographic equipment, and electronic or pneumatic vehicle counters. Early in the development of indirect-counting methods, trail counters were tested as a means of validating self-registration stations, as opposed to using costly uptrail direct observation (James and Schreuder 1972; James 1971). More recently, pressure plate and photoelectric trail counters, and photographic equipment triggered by trail counting mechanisms have been used to determine visitor registration compliance (Echelberger and others 1981; Leatherberry and Lime 1981; Leonard and others 1980; Lucas 1983; Lucas and Kovalicky 1981).

The total counts obtained with these mechanisms were generally accurate and served as the basis for calculating percentage of visitor compliance. Also, the counters used in conjunction with the photographic equipment yielded such information as method and direction of travel, group size, and type of user (e.g., day vs. overnight) (Leonard and others 1980). With photographic surveillance, however, certain legal questions emerge such as invasion of visitor privacy. Precautions like setting photographic equipment slightly out of focus are recommended when using this technique (Echelberger and others 1981; Leonard and others 1980).

Electronic and pneumatic-tube type vehicle counters have been used to assess visitor use in backcountry areas with dispersed use, and developed areas accessed by roads, such as campgrounds, picnic areas, scenic overlooks and wayside parks, and boat docks. In large backcountry areas, the traffic counters are placed on access roads and calibrated with other self-, direct-, or other indirect-counting methods to yield estimates of dispersed recreation use. Studies that have tested this approach generally recommend that after initial calibration, traffic counter records alone can be used to estimate total use for a subsequent 3- to 5-year period, provided that no major use trend or management change occurs (Saunders 1982). At developed recreation sites, counting devices placed at entrances and exits to obtain vehicle or axle counts, coupled with direct counts of the number of visitors, have been used to estimate use (James and Henley 1968; James and Quinkert 1972; McCurdy 1970; Tombaugh and Love 1964; and Wagar and Thalheimer 1969).

Remote Sensing

Remote sensing is another indirect-counting technique that can be used in recreation visitor use studies and wildland resource management. Methods include satellite and high altitude aircraft imagery. Assessments of photographic sensing methods showed that recreation areas and related facilities are discernible with small scale photographs (1:120,000), but accurate counts of vehicles and people require much larger scales (Aldrich 1979). Scales of at least 1:2000 were recommended for counts of people. Few applications were described for nonphotographic remote sensing techniques. With advancing technology, however, remote sensing techniques may become increasingly useful in visitor use studies.

Selecting a Method for Monitoring Visitor Use

Comparing Alternatives

In all, we identified 13 different alternatives for estimating wilderness or backcountry visitor use (*table 2*). These methods differ in terms of complexity, costs, level of accuracy, and the detail of the information they yield. Land managers must weigh these factors when selecting a monitoring method that will optimally serve their management objectives.

Several factors were used to compare each method (*table 2*).

Principal means of obtaining data refers to the data collection procedures. *Type of use data* and *type of visitor data* indicate the type of visitor use information and visitor characteristics that can be obtained by each method. *Calibration/validation required* indicates the need to adjust for visitor noncompliance or to calibrate counting techniques (e.g., determining the number of people per vehicle when using traffic counters). *Sources of bias* that must be controlled are also identified, along with managers' *experience to date with the system.* The extent of current usage is identified as "limited" (practiced in less than 5 percent of areas), "moderate" (practiced in 5 to 20 percent of areas), and "frequent" (practiced by more than 20 percent of areas).

In determining *costs to visitors,* we assumed that costs are highest when freedom of choice and action are compromised by regulations and restraints on the visitor's experience. The most costly alternatives are those that make demands on a visitors'

Table 2--*Alternative methods for monitoring visitor use of wildlands*

Method	Type of system	Comparison Criteria: Principal means of obtaining data	Type of use data	Type of visitor data	Calibration/ validation required?	Sources of bias	Experience to date with system	Costs to administrators	Costs to visitors
1. Voluntary self-registration	Self	Registration at trailhead or uptrail stations.	Visits, length of stay, party size, mode of travel, activity, date.	General demographics and behavior.	Yes--validation for non-compliance (method 4, 7, 10, 11).	Noncompliance, inaccurate information reported on registration form.	Frequent use in Forest Service and National Park Service wilderness and backcountry.	Low to moderate. Data collection and station resupply. Recalibrate every 3-5 years.	Low to moderate. Visitors register as entering area. Minimal time constraints.
2. Self-issued permit,	Self	Sell-issued from trailhead or uptrail stations.	Visits, length of stay. party .size, mode of travel, activity, date.	General demographics and behavior.	Yes--validation for non-compliance (method 4. 7, 10, 11) and enforcement.	Noncompliance, inaccurate information reported on permit firm.	Frequent use at water-based sites. Moderate use in wilderness and backcountry	Moderate. Permit collection and station resupply, Periodic enforcement.	Low to moderate. Permits must be obtained before entering. Enforcement increases costs.
3. Mandatory permits	Self, Direct	Obtained at ranger stations, visitor centers, by mail, or from cooperators.	Visits, length of stay, party size, mode of travel, activity, date.	General demographics and behavior.	Yes--validation for non-compliance (method 4, 7, 10, 11) and enforcement.	Noncompliance, inaccurate information reported on permit form.	Frequent use at water-based sites or where use rationing measures are in effect.	Moderate to high. Extended hours and staff needed to issue permits and enforce. Detailed record keeping.	Moderate to high. Permits must be obtained in advance. Limits spontaneity.
4. Random direct field observation	Direct	Obtrusive and unobtrusive observation.	Visits, party size, mode of travel, activity, date.	None, requires additional survey method.	No--if property designed and conducted.	Unobserved visitors, incorrect classification of visitors or activity, double counting. use fluctuations.	Moderate use in developed sites. Limited use in dispersed areas.	Moderate to high. Substantial staff on sampling days. Design difficulties.	Low to moderate. Visitors contacted oil-site. Costs increase with obtrusiveness of method.
5. Convenient direct field observation	Direct	Obtrusive and unobtrusive observation.	Visits, party size, mode of travel, activity, date.	None, requires additional survey method.	Not applicable.	Unproportionate sampling, unobserved visitors, incorrect classification of visitors or activity, use fluctuations.	Frequent use in both developed and dispersed areas.	Low to moderate. Staff make observations while performing other duties.	Low to moderate. Visitors observed on-site. Costs increase with obtrusiveness of method.
6. Periodic regional mail or phone survey	Direct	Random sample of visitors or general population by phone or mail survey.	Visits, length of stay. party size, mode of travel, activity. date, frequency.	Detailed demographics and behavior.	Yea—requires extrapolation to individual sites,	Inadequate sampling, low response rates, inaccuracy of self-reported information.	Moderate use in a variety of areas for diverse study objectives.	Moderate. Study design, implementation, data analysis.	Low. Contacts made off-site.

7. Periodic on-site survey	Direct	Random sample surveyed or interviewed on-site.	Visits, length of stay, party size, mode of travel, activity, date, frequency.	Detailed demographics and behavior.	No--if properly designed and conducted.	Inadequate sampling, low response rates, inaccuracy of self-reported information.	Frequent use in both developed and dispersed areas.	Moderate to high. Study design, implementation data analysis, staff allocation and training.	High. Contacts made on-site impose time constraints. Management obtrusiveness.
8. Cordon sampling	Direct	Visitors surveyed at check point on access roads when exiting.	Visits, length of stay, party size, mode of travel, activity, date,	Detailed demographics and behavior.	No--if properly designed and conducted.	Unobserved access points, use fluctuations in response to road blocks, double counting.	Limited use in large areas with limited access roads.	High. Staff allocations high on sampling days. Sampling may be cumbersome.	Moderate to high. Visitors required to stop when leaving the area, imposes on visitor time.
9. Aerial Observation	Direct	Tallies recorded during random flight transects.	Visits, use density, activity.	None, requires additional survey method.	Yes--should be coupled with ground-based method (1, 2, 3, 4, 7, 8).	Inadequate flight transects, incorrect visitor classification, use fluctuations, visual obstructions,	Moderate use at water-based sites. Limited use in wilderness and backcountry.	Moderate to high. Study design, hiring and training pilots and observers, airplane costs, data analysis.	Low. Visitors not directly contacted. Impacts increase with the number of overflights.
10. Time lapse or triggered ground level photography	Indirect	User behavior and numbers extracted from photographs.	Visits, party size, mode of travel, activity, date, length of stay.	None. requires additional survey method.	No--if properly installed and maintained.	Unobserved access, equipment failure, double counting, inaccurate visitor classification.	Frequent use at water-based sites. Limited use in wilderness and backcountry.	Moderate. Costs for equipment, installation, photo Interpretation.	Low to moderate, Presence of equipment may diminish resource. Concerns for visitor privacy.
11. Electrical or mechanical trail counter	Indirect	Total trail use recorded by counters.	Visits.	None, requires additional survey method.	No--if properly installed and maintained.	Unobserved access points, equipment failure, double counting.	Frequently used in wilderness, backcountry and where data on total visits is sufficient.	Low. Equipment upkeep and data collection recommended at 2-week intervals.	Low. Visitors are usually unaware of counters. Visitor costs depend on obtrusiveness of validation.
12. Aerial photography	Indirect	Photos taken on random flight transects.	Visits, use density, activity.	None. requires additional survey method.	Yes--should be coupled with ground-based method (1, 2, 3, 4, 7, 8).	Inadequate flight transects, incorrect visitor classifi-cation, use fluctuations, visual obstructions.	Moderate use at water-based .sites. Limited use in wilderness and backcountry.	Moderate. Costs for equipment, installation, photo interpretation.	Low. Visitors not directly contacted. Impact, increase With number of overflights.
13. Pneumatic or electrical traffic counter	Indirect	Total counts of vehicles entering or exiting; calibration with some other method allows estimation of use.	Vehicle counts, visits, length of stay, party size, mode of travel, activity, date (depending on calibration).	None, requires additional survey method,	Yes--should be coupled with ground-based method (1, 2, 3, 4, 7, 8).	Double counting, inaccurate axle counts (i.e., trailers), conversion of vehicle counts to RV, RVH, or RVD.	Frequent use in roaded areas with identifiable access points.	Low to moderate. Costs increase when coupled with other methods for calibration or more detailed information.	Low to moderate. Used alone, costs are minimal. Visitor costs depend on validation scheme used.

time or diminish their experience on-site, as opposed to methods that do not constrain visitor actions. When evaluating costs to visitors, several factors must be considered including effects on freedom of choice, obtrusiveness of the method, when and where visitors will be affected, and the number of visitors affected. Although it is difficult to define *costs to administrators*, particularly in dollar terms, some general assessments for each method are given based on budgetary requirements, ease of application, and validity of findings.

Guidelines for Selecting Monitoring Methods

Choosing an efficient and reasonably accurate method to estimate recreation visitor use is a difficult task for any resource manager. The dispersed nature of the recreational use of backcountry and wilderness only serves to exacerbate the problem. Estimation methods that control for primary sources of bias can be expensive or logistically prohibitive. Adopting these methods would require a substantial investment on the part of the land management agency.

On the other hand, methods that are relatively inexpensive and easy to administer generally yield unreliable data. Basing management decisions on questionable data could result in an undesirable mix of hidden costs and management problems.

While there are no clean and easy solutions, key requirements must be met in most situations. We formulated four questions that allowed us to determine whether each of the alternative monitoring methods meets the basic requirements necessary for most wilderness and backcountry conditions. Using a "fatal flaw" approach, we rejected methods that failed to meet one or more of the basic criteria. By evaluating the alternative monitoring methods by these questions, viable alternatives emerge.

1. Does the method generate data in the form of total recreation visits, total recreation visitor hours, or total recreation visitor days?

In most situations, managers and researchers are interested in estimating total use of an area, usually in the form of recreation visitor hours (RVH) and recreation visitor days (RVD). To estimate these totals, data must provide the detail of an adjusted sample count or census. In addition, if information is desired on total use, population fluctuations, or density, procedures that rely on census or adjusted sample counts are required. Total visits, visitor hours, or visitor days estimated from convenient samples are subject to biases that jeopardize their reliability.

2. Is the method efficient? That is, will implementing the method be logistically practical, and are the costs affordable?

Determining the costs and benefits of the various methods is difficult, somewhat subjective, and situation-specific. Many factors must be considered, including costs to both visitors and the administering agency. Costs can be economic, social, or environmental. For example, implementing mandatory permits may provide the best use estimates, but the costs of administration, enforcement, and loss of visitor freedom and spontaneity might make the alternative unacceptable.

3. Does the method provide a valid and reliable basis for establishing "primary purpose of trip"?

In most cases, especially at the federal level, estimates must be reported in the form of "primary purpose of trip" (i.e., recreation activity engaged in for the largest amount of time during the visit). The primary purpose of a recreation visit is a subjective judgment best established by the individual visitor. Methods that categorize visitors based on what an observer thinks is the primary reason for visiting would result in a high rate of incorrect classifications, and therefore would be inadequate. Assuming it were possible to use some overt, observable, and behavioral measure of the primary purpose of the trip, we question whether even trained observers could make this assessment reliably.

When used alone, methods that rely on observers or mechanical or electronic devices to determine primary purpose of trip are inadequate. It may be possible, however, to use one of these methods in concert with a self-report survey or self-registration method to obtain both total use estimates and a meaningful basis for categorizing visitors by their primary purpose of trip.

4. Does the method generate visitor use data in activity categories and subcategories used by the managing agency?

Some of the methods are not precise enough to categorize visitors by specific activity categories or subcategories. For instance, pneumatic traffic counters do not provide information on the number of visitors per vehicle or the characteristics of their visit (e.g., day visit, overnight visit). Trail counters provide accurate information on the number of visitors that pass by, but little else. Again, these methods are adequate only if used with a self-report survey, voluntary registration, or direct observation method that provides a meaningful indication of recreation activities.

Summary and Recommendations

Our assessment of the 13 methods using the four requirements needed in most situations led us to select four alternatives that generally will be sufficient. These include (1) agency issued permits, (2) self-issued permits, (3) voluntary self-registration, and (4) indirect counts combined with self-report surveys. Where all visitors to an area are required to obtain a permit from the managing agency, accurate census level information is available. Vital information such as primary purpose of trip, length of stay, number of people per party, mailing address, and other information of management concern can be elicited on the permit form. If compliance and reporting truthfulness are concerns, these data should be cross checked against field observations. If more detailed visitor information is needed, mailing lists of visitors for survey samples can be generated from permit data.

The disadvantages of agency-issued permits are the costs of implementation and enforcement, along with diminished visitor freedom and spontaneity. Self-issued permits are a lower cost alternative, but they too require enforcement; and determination of visitor compliance demands a considerable effort on the part of the managing agency.

Next to informal estimates based on convenient samples or professional judgments, voluntary visitor registration is the most common approach to visitor use monitoring. If visitor use estimates are adjusted for noncompliance rates, the technique provides census level data as well as many of the benefits of permit methods, but with fewer costs to visitors. On the other hand, considerable costs are associated with administering registration methods. An apparent misconception is that once registration stations are constructed, the system will run itself. In fact, substantial resources must be committed to registration programs to cover data collection, maintenance, and determination of visitor compliance rates.

While well-placed electrical and mechanical trail counters can provide inexpensive, census level data on total visitation, they give no indication of visitor type, activities, preferences, or other vital information. In contrast, the major problem with surveys is that while detailed visitor information can be obtained (e.g., primary purpose of trip, length of stay), total use cannot be determined unless sophisticated and sometimes costly sampling procedures are used. In combination, however, these methods provide meaningful data that meet most management needs.

When using a combination of indirect counters and self-report survey methods, several sources of bias must be minimized. Measures must be taken to assure equal detection of all visitor types with the counters, and to reach all visitor types equally with the survey. To minimize costs to visitors, many studies have collected only addresses or phone numbers on-site, followed by a more detailed mail or telephone survey.

Counting devices on trails or access roads must be placed either at all access points or by some stratified random sampling strategy that accounts for daily, weekly, and seasonal differences in visitor use, and in trail or road conditions. Survey data can then be used to determine primary purpose of trip, length of stay, number of visitors per vehicle (if vehicle counters are used), and other needed information. After an initial calibration study, counting devices alone may suffice for 3 to 5 years, providing that use levels do not change appreciably during this period.

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