

# Twenty-Eight Years of Wilderness Campsite Monitoring in Yosemite National Park

Laurel Boyers  
Mark Fincher  
Jan van Wagtendonk

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**Abstract**—The research, resource management and wilderness staffs in Yosemite National Park recently completed the third 10-year cycle of a wilderness campsite impact monitoring program. Initial results indicate an overall improvement in conditions due to a strong restoration program, decreased use and increased visitor education. Lessons learned point to the necessity for ample and appropriate data collection and consistent techniques over time. This paper discusses the methodology and findings of this 28-year project.

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The lure of Yosemite has resulted in profound effects on both those who visit the park and the natural environments it encompasses. As John Muir said, “the galling harness of civilization drops off...” those who visit, but their very presence has also modified the landscape. Public land managers have long recognized that recreational use may pose pervasive and intractable threats to resources, but they have grappled with just how to measure, monitor and manage those impacts.

In the early 1970s, the research, wilderness and resource staffs realized the need to improve their understanding of how recreation affected ecosystems and the effectiveness of management. Over the course of the next 28 years, the staff undertook three wilderness-wide inventory and monitoring studies focusing on campsite impacts. Our objectives in this undertaking were three-fold:

- 1) Establish a baseline for natural conditions and variation;
- 2) Determine when, where and why significant change occurs, and track that change over time;
- 3) Understand the relationship of natural conditions, visitor experience, and wilderness resource management.

## Background

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Yosemite is one of the most heavily used wilderness areas in the National Wilderness Preservation System. Wilder-

ness recreational use peaked in 1975, with a record high of 219,000 visitor use nights (van Wagtendonk 1981). After dropping to a low of less than half that number in 1983, current trends show a leveling of use with a slight downward trend, fluctuating around 117,000 use nights in the past 10 years (National Park Service 1999) (Fig. 1). In the early 1970s, park managers were not fully aware of the magnitude and impact of the increasing hordes. A formal backcountry management district was established in 1973, with a small but dedicated staff to patrol trails, perform light maintenance and issue wilderness permits.

In 1973, Yosemite started restricting use by travel zones, determined from the area of the zone, the number of miles it contained, its ecological fragility and social density standards (van Wagtendonk 1986). Today, wilderness visitation is managed by a trailhead quota system, established in 1977 after extensive research on capacity and use (van Wagtendonk and Coho 1986). The quota system allows for spatial and temporal distribution of use (dispersed camping is allowed in most areas of the Yosemite Wilderness) and provides a means to limit access to areas exceeding appropriate levels of use. It also serves as an important educational tool, giving staff the opportunity to convey minimum impact regulations to visitors.

Increasing use and public complaints regarding impacts and crowding quickly made managers aware of the need for more information. The first survey of campsite impacts was made in 1972. Daniel Holmes and a team of 31 others formed the Wilderness Research Group through the University of California at Berkeley. In cooperation with the National Park Service, Holmes and his crew covered the more than 700,000 acres of the Yosemite backcountry, surveying almost every area receiving human use. Detailed descriptions and maps were made of more than 7000 campsites, over 800 miles of trail and all waterways that receive use (Holmes 1972).

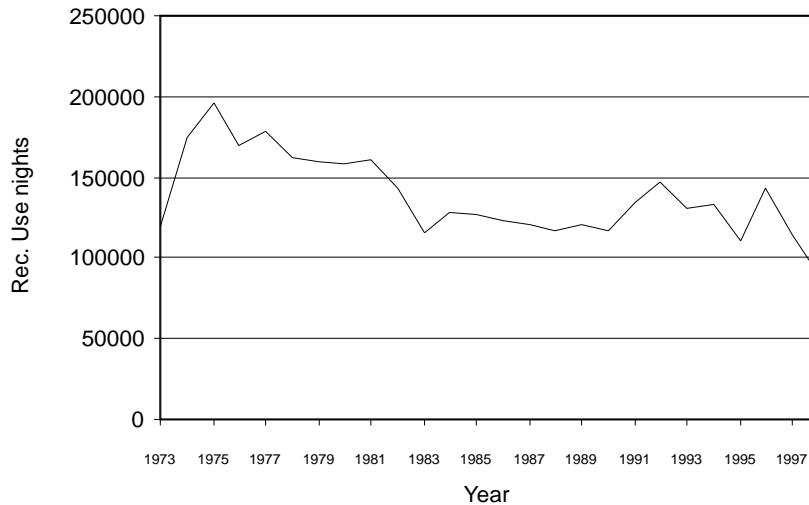
The primary objectives of the study were 1) To describe, both quantitatively and qualitatively, the range of visible environmental damage from users in the Yosemite Wilderness, and 2) describe the physical distributions of impact from those users.

A need for further study, coupled with an interest in assessing change over time, prompted the Yosemite Resource Management staff to resurvey the entire wilderness 10 years later. Between 1981 and 1986, Charisse Sydoriak and a varied team of mostly volunteers went back over those 700,000 acres, this time making more detailed studies and maps of 5,547 campsites and 1,048 miles of trail (Sydoriak 1986). The methodology used in this study was a slightly modified model of the system developed in Sequoia and

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Laurel Boyers is Wilderness Manager and Mark Fincher is Climbing Program Manager in Yosemite National Park, Box 577, Yosemite, CA 95389 U.S.A., e-mail: laurel\_boyers@nps.gov mark\_fincher@nps.gov. Jan van Wagtendonk is Research Forester, USGS, Western Ecological Research Center, Yosemite Field Station, El Portal, CA 95318 U.S.A., e-mail: jan\_van\_wagtendonk@usgs.gov



**Figure 1**—Recorded visitor use nights for Yosemite Wilderness, 1973 to 1998.

Kings Canyon National Parks by Parsons and McLeod (1980) and became known as the Wilderness Inventory and Monitoring System, or WIMS. WIMS measured eleven impact criteria: firewood availability, tree root exposure, visual obtrusiveness, vegetation density, vegetation composition, total campsite area, barren core, litter and duff, campsite developments, mutilations, and social trails. Descriptive information about the local environment was also recorded, including vegetation type and foundation, distance from water, crowding and management recommendation. Maps and photo documentation were done for each site. This information became an important tool for a newly formed restoration program in the Park.

Ten years passed, and understanding the value of the historic data on hand, the research, resources and wilderness staffs at Yosemite undertook WIMS 2, (or Son of WIMS as it was somewhat affectionately called) in 1992. The purpose of this study was to combine and replicate as much as possible of both previous studies from the 1970s and 80s to further evaluate the change in recreational impacts over time.

The scope of the project was reduced from its wilderness-wide approach, and 34 target campsites were selected. These sites needed to be dispersed throughout the Park and have been surveyed in both the Holmes 1972 study and the WIMS 1980s study. A variety of sites, including heavily used or stock camps, moderately used and lightly used or cross country camps were pulled from both sets of data. Both studies were evaluated for comparables, and a modified monitoring system was developed, rating the campsites with the same criteria used in both projects to the greatest extent possible. Two new criteria were added to address human waste and stock impacts, and two different techniques were used to quantify vegetation density. Detailed maps and photo sets were also completed, trying to match documentation from the 1980s, both spatially and seasonally.

In order to assess a larger picture of the extent of campsite proliferation and impacts, each area surrounding the target site was mapped and measured using a

two-prong condition-class rating. Using the lake basin, trail junction or defined area around each target site, surveyors rated and mapped every site in the area for: 1) developments (primarily fire rings) and 2) vegetation loss. These parameters were chosen because they were ecologically important and had been rated in both previous studies. This method gave managers an idea of the recreational “health” of an entire area and could be used to assess management actions such as restoration, closures and quotas, as well as make reasonable comparisons to the more extensive data from the previous 2 surveys. The monitoring of the WIMS 2 sites was completed in 1998, with the 34 target campsites evaluated and over 700 campsites recorded in the areas surrounding them.

## Data Analysis

Between 1972 and 1999, data were collected three times: Holmes, WIMS and WIMS 2. However, the methodology for data collection was changed part way through WIMS 2, resulting in four kinds of data. The post-change data for WIMS 2 is referred to as WIMS 2.1. Certain adjustments were needed to compare the data sets.

## Target Site Analysis

Comparing data from the different data sets was easy for the target site analysis because, with one exception, WIMS 2 used the exact same criteria as Holmes and WIMS. In that case, the mutilations score for WIMS 2 was divided into mutilations to rocks and soil and mutilations to vegetation.

## Area/Campsite Class Analysis Using Adjusted Data

WIMS 2 measured the number of campsites and their condition class in each area. In order to assess change in

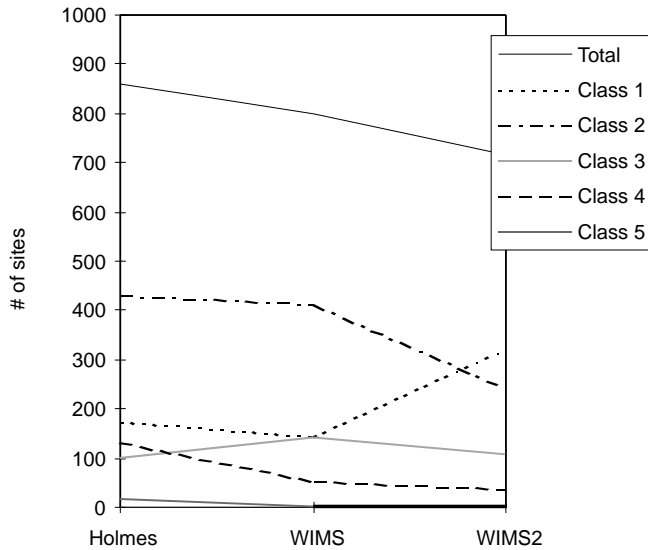


Figure 2—Change in number of sites by class.

these sites over time, an attempt was made to directly compare the data from all data sets. To accomplish this, the data from Holmes, WIMS and WIMS 2.1 were adjusted to match the criteria for the five condition classes for WIMS 2. Condition classes ranged from barely discernible (class 1) to heavily developed and impacted (class 5).

### Damage Total Calculation

In an effort to produce a single number that roughly describes the cumulative amount of impact to an area due to campsites, WIMS 2 field personnel considered the relative impact of a site of each condition class. The result of this consideration was the following: A class 2 site causes twice as much impact as a class 1 site, a class 3 site causes three times as much impact as a class 1 site, a class 4 site causes six times as much impact as a class 1 site, and a class 5 site causes 18 times as much impact as a class 1 site.

### Area Campsite Class Analysis Using Original Data

The condition-class data were also considered in their original form so they could be compared to the verbal descriptions for each condition class and to allow comparisons of how that verbal description of the mean condition class changed over time. Unfortunately, no composite condition class numbers or corresponding verbal descriptions have been found for the original WIMS data, so this comparison is of limited value.

## Results and Discussion

### Campsite Class

From Holmes to WIMS 2, the number of sites decreased 17%. Between the Holmes and WIMS surveys, class 3 sites

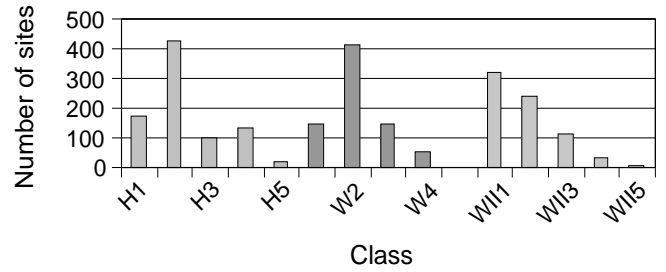


Figure 3—Number of sites by class.

increased, while all other classes decreased. Between the WIMS and WIMS 2 surveys, class 2, 3, and 4 sites all decreased substantially, while class 1 sites increased 124% (Fig. 2).

The increase in class 1 sites occurred during the period when restoration of campsites was a priority for management. Much of this increase is probably due to sites that have been restored but are still discernible. Some of them may also be single-use sites that were established when sites near water were removed by management (Fig. 3).

The number of sites considered undesirable (classes 3, 4 and 5) decreased 41% (Fig. 4). The damage total decreased 43% (Fig. 5).

Restoration crews worked in seven of the 34 areas surveyed and significantly reduced impacts. Between WIMS and WIMS 2, in those areas not visited by the restoration crews, the number of sites increased 16% , mostly due to an increase in class 1 sites. (Figs. 6 and 7).

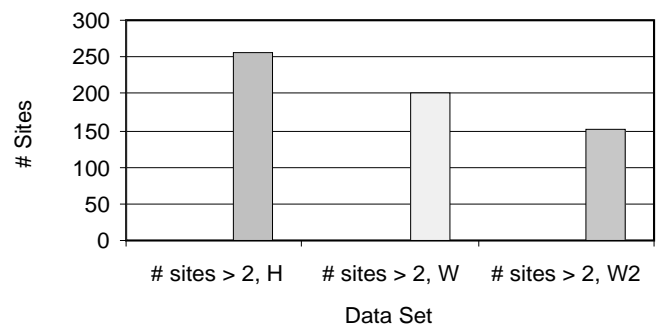


Figure 4—Number of sites considered undesirable.

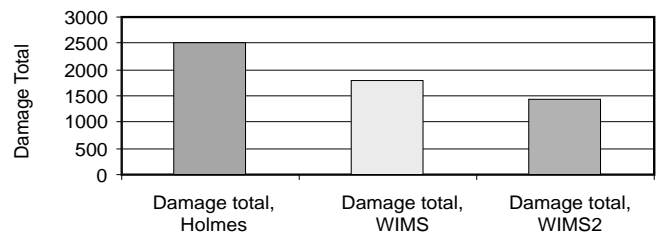


Figure 5—Damage total.

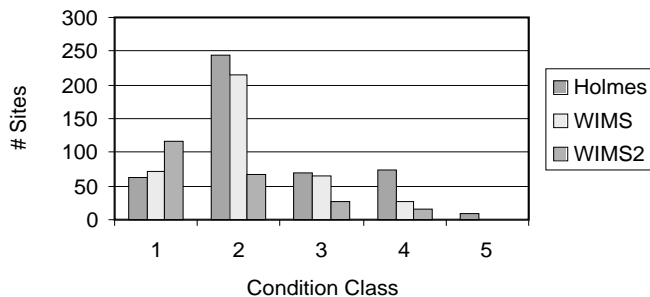


Figure 6—Number of sites by class, restored areas.

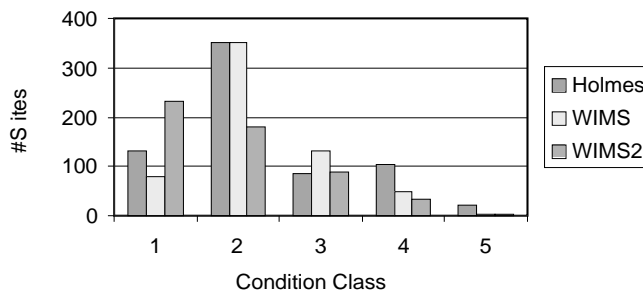


Figure 9—Number of sites by class, trail area.

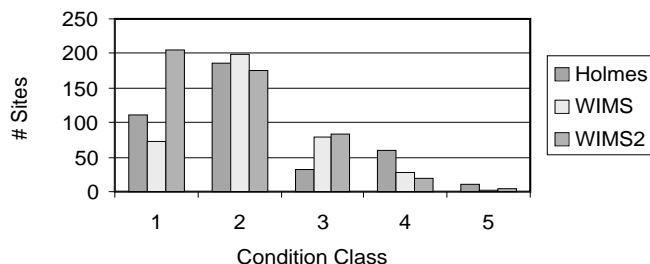


Figure 7—Number of sites by class, unrestored areas.

The cross-country camping areas were an exception to the general trend of reduced impacts. Between WIMS and WIMS 2, the average condition class remained the same, while the total number of sites increased 22%. This increase is probably due to two factors: 1) Full-time restoration crews have worked only in trailside areas, and 2) wilderness patrol rangers spend very little time in the cross-country areas (Figs. 8 and 9).

## Campsite Impacts

Three criteria from Holmes and nine criteria from WIMS were repeated during WIMS 2 at the 34 target sites. Between WIMS and WIMS 2, root exposure, firewood scarcity and access trail impacts all increased significantly. In the WIMS survey, these three criteria had the lowest scores. Vegetation density impacts also increased significantly (Fig. 10).

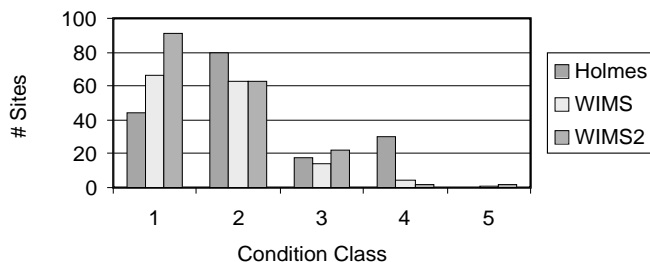


Figure 8—Number of sites by class, cross country areas.

## Management Implications

It is clear that management efforts are reducing the impacts of campsites in the Yosemite Wilderness. Now that formal restoration crews have completed work in the most impacted areas, it will be vital to monitor and maintain those areas. Although the total number of class 1 sites increased, some previously recorded class 1 sites disappeared over the decade between surveys. It is extremely important that these restored sites are kept from further use and have time to heal.

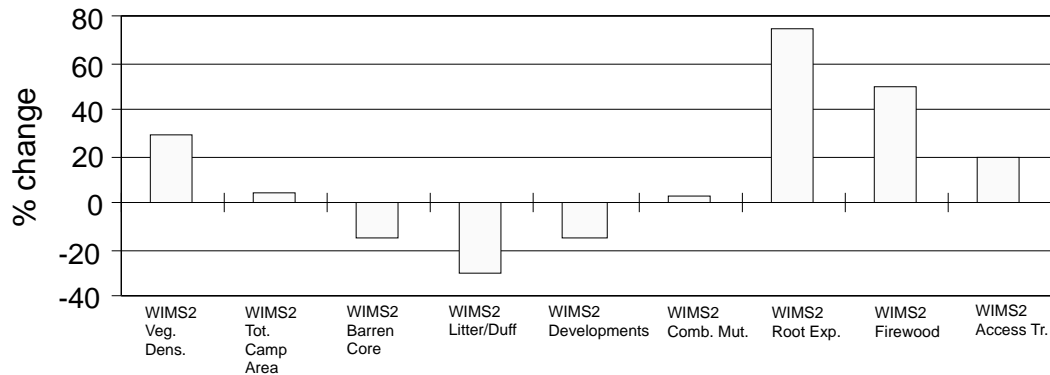
Continued educational and restoration efforts will be needed to sustain the reduction in class 3, 4, and 5 sites. Requiring stock groups to use designated sites is being considered as well.

Our monitoring system would explain more about the effects of our management actions if we had differentiated between “healing” class 1 sites and new, single-use class 1 sites. Further monitoring is needed to determine if the increase in class 1 sites was caused by the systematic removal of sites near water and trails, or by other management actions.

In addition, a more focused approach to campsite restoration, concentrating on the complete removal of single-use sites and the continued reduction of larger sites, may reduce the increase of class 1 sites. This work can be accomplished by individuals such as the patrol rangers or volunteers rather than large groups.

More patrols and restoration efforts are needed in the cross-country areas. The increase in the number of sites in these areas is of particular concern, due to the sensitivity of lightly used areas to small amounts of change and the importance of keeping the trail-less areas in a more pristine condition. Banning campfires in the cross-country areas is being considered.

The increase in root exposure, firewood scarcity and access trail impacts are potentially worrisome and warrant close monitoring. These impacts, on average, are currently below the threshold that would trigger a change in management action for the Park as a whole. In one area, however, an immediate management action was implemented to close an area to campfires, based on survey information. Additional areas will be watched closely for continued change. These impacts are cumulative and only get worse with continued use. The decrease in vegetation densities is also of concern because it indicates increased trampling and potential soil



## Impacts

Figure 10—Percent change in impacts.

compaction, which may lead to more serious ecological impacts.

## Lessons Learned

It is vital that we monitor the changing conditions of our resource. The baseline data recorded almost 30 years ago have been invaluable, creating a picture of the status of our wilderness before we actively began managing it. If you haven't recorded baseline conditions yet, start tomorrow. Do it in a way that is scientifically sound; covers all significant bases, not just those you are worried about now; and make sure the results can be replicated.

To be efficient, it is imperative that you determine the pertinent questions. Data glut is a danger, but so is going to all the time and effort to get to a site and not recording information that would be valuable. For example, we could not determine the effectiveness of our educational/regulatory message about camping 100' from water because we neglected to measure distance from water in the WIMS 2 study.

After deciding what to monitor, define or quantify the parameters very thoroughly. While it is important to measure some indicators precisely, many can be measured quickly but appropriately if the parameters and rating criteria are well quantified. This was a particular problem with the Holmes data, as it was unclear just what the descriptors meant: How far from a campsite did you look at firewood availability, or what was a "large" fire ring?

Once you settle on a system, try to stick to it. The WIMS crew spent an entire summer "truthing" their system and then started recording the data that were kept. The WIMS 2 process changed the method of determining vegetation densities mid-study, complicating comparisons. It was difficult to analyze the Holmes data because WIMS used such a different system. Try to fine-tune your system before you start.

Monitoring, especially using the adjective classes, primarily shows trends that indicate when more research is needed. The mid-point value is really the only thing you can measure, which serves as a gross filter to identify which fine filter actions will be appropriate. Monitoring does not answer all management questions, but it does indicate trends or warning flashes that need to be looked at more closely.

Mapping and locating sites become increasingly important over time. Photo documentation should be done as a series narrowing in on the site, and GPS is the tool we wish could have been used in the 1970s and 80s. All is lost if you can't find the site.

And finally, perhaps the most important message: Use it now, but keep doing it. Yosemite needs to start Grandson of WIMS, or WIMS the Third, in 2000 to 2010 to continue our assessment over time. This is particularly important to track the trends we are seeing now, to appraise the effectiveness and longevity of efforts such as expensive restoration projects, and to continue assessing the appropriateness of management of this wild and important resource.

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