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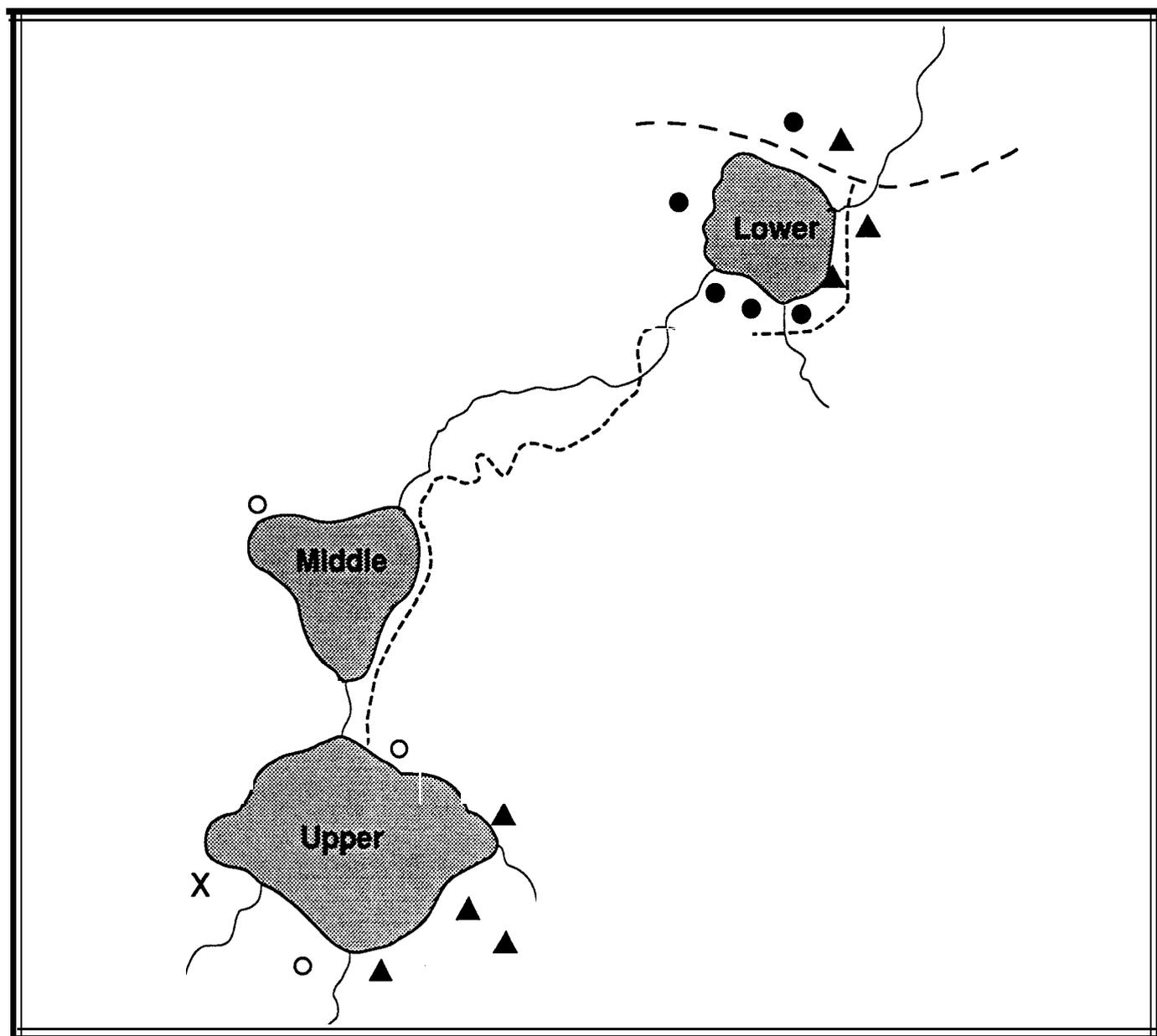
Research Paper

February 1993



# Campsites in Three Western Wildernesses: Proliferation and Changes in Condition Over 12 to 16 Years

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## ACKNOWLEDGMENTS

I am grateful for the early work of Sid Frissell in the Spanish Peaks and of field crews under the direction of Bob Lucas in the Selway-Bitterroot. Followup work in the Spanish Peaks was initiated by Susan Marsh, for which I am grateful.

## RESEARCH SUMMARY

Change in the number and condition of campsites was followed for 12 to 16 years in portions of three wildernesses: the Lee Metcalf and Selway-Bitterroot Wildernesses in Montana and the Eagle Cap Wilderness in Oregon.

The number of campsites increased markedly in all three areas: 53 percent in the Selway-Bitterroot, 84 percent in the Lee Metcalf, and 123 percent in the Eagle Cap. Existing campsites deteriorated in the Lee Metcalf. They remained relatively stable in the Selway-Bitterroot; site condition was not assessed in the original campsite survey in the Eagle Cap.

Campsite impact increased substantially, primarily because new campsites were developed-not because existing campsites had deteriorated. Problems of campsite proliferation have been most severe in places that receive regular camping use but where many potential campsites have never been used.

Managers need to focus more attention on reducing campsite proliferation. In popular places they need to discourage campers from developing new campsites, while rehabilitating "excess" sites and sites that have not been heavily impacted. In little-used places, they need to encourage campers to use sites that have not been used before, but only if campers are able to minimize their impacts. In such places, managers should attempt to rehabilitate all sites, whether they have been heavily impacted or not.

## CONTENTS

	Page
Introduction .....	1
Lee Metcalf Case Study .....	1
Methods .....	2
Results .....	2
Selway-Bitterroot Case Study .....	5
Methods .....	6
Results .....	6
Eagle Cap Case Study .....	9
Methods .....	10
Results .....	11
Discussion .....	12
Management Implications .....	13
References .....	14

# Campsites in Three Western Wildernesses: Proliferation and Changes in Condition Over 12 to 16 Years

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## INTRODUCTION

Those who visit wilderness may cause locally severe impacts, particularly on the vegetation and soil at campsites. Many campsites have lost virtually all ground cover vegetation and tree reproduction; organic soil horizons have been lost, and exposed mineral soil has been severely compacted (Cole 1987). More wilderness managers cite campsite deterioration as a problem than any of the other potential problems in wilderness (Washburne and Cole 1983). Management strategies addressing campsite deterioration range from attempting to reduce or redistribute use to attempting to modify camping behavior. In most wilderness areas, however, campsite management programs are more likely to treat symptoms rather than causes. Most management consists primarily of picking up litter, cleaning out firerings, and occasionally attempting to rehabilitate damaged sites.

Opinions differ about trends in wilderness conditions. Concerns that the wilderness is being "loved to death" have been around for decades. They have led some to assume that wilderness conditions are deteriorating. Others point to visitor-use statistics showing that wilderness use has declined recently, at least in some areas (Lucas 1989). If use is declining, conditions may be getting better rather than worse.

Although some information exists on campsite conditions in wilderness, few data are available on the changes in campsite conditions over time. Without such knowledge, it is impossible to evaluate the effectiveness of campsite management programs. A recent report by Cole and Hall (1992) described changes over time on campsites in the Eagle Cap Wilderness, OR, the Bob Marshall Wilderness, MT, and Grand Canyon National Park, AZ. These studies followed changes on established campsites over periods of 5 to 11 years. The only other such study reported changes over 9 years on seven open campsites in the Boundary Waters Canoe Area Wilderness, MN (Merriam and Peterson 1983).

The results of these studies present a complex picture of change on wilderness campsites. Some campsites improve, others deteriorate, and others remain relatively stable. Even on the same campsite, some

impacts may increase while others diminish. The overall trend in all four of these wilderness areas was one of slight deterioration on established campsites (Cole and Hall 1992; Merriam and Peterson 1983).

Change on established campsites is only one of the pieces of information needed to evaluate change in campsite condition. Campsite impact is a function of the number of campsites and the condition of those sites. If the number of campsites changes dramatically, the amount of campsite impact will change proportionally even if the condition of the original sites remains unchanged.

This study reports changes over time in the number and condition of all campsites within portions of three different wildernesses. Case studies were conducted in the Lee Metcalf and Selway-Bitterroot Wildernesses, MT, and the Eagle Cap Wilderness, OR. Periods between measurements were 16 years in the Lee Metcalf, 15 years in the Eagle Cap, and 12 years in the Selway-Bitterroot. Given the differences among study areas, the different methodologies used, and the differing periods of study, each case study will be reported separately.

## LEE METCALF CASE STUDY

The Spanish Peaks, in the Madison Range of southwestern Montana, was a 20,600-ha Primitive Area until 1983, when it became part of the 100,000-ha Lee Metcalf Wilderness. Accurate figures for visitor use are lacking, although the relative use of various trails and destination areas is known from a visitor survey (Lucas 1980) and systematic observations by rangers. Use is moderately low for wilderness (typical of a sparsely populated State like Montana) and is considered to have been relatively stable over the past 15 to 20 years. Parties with stock and hunting parties (many with stock) comprise a substantial minority of overnight users (Lucas 1980).

Most overnight visitors are attracted to several sub-alpine lake basins, located within a 1-day hike or ride of trailheads, at elevations of 2,000 to 2,750 m (fig. 1). Over the years, campsites have developed around more than 20 lakes in whitebark pine (*Pinus albicaulis*),



**Figure 1**—The Spanish Lakes basin in the Lee Metcalf Wilderness, MT.

subalpine fir (*Abies Zasiocarpa*), and lodgepole pine (*Pinus contorta*) forests and subalpine meadows. Most campsites have been created by users. Management intervention has been minimal. A largely ineffectual prohibition on overnight stock use at several lakes was lifted in 1983 when regular patrols by wilderness rangers began. A similarly ineffectual prohibition on camping within 60 m of lakes persists. The vast majority of campsites are still within 60 m of lakes; the terrain is such that there is often little possibility of camping farther away. Aside from one site that was closed to camping, managers have not attempted to control where visitors camp. Other management activities include informing users of low-impact camping practices, removing firerings, and picking up litter.

## Methods

In 1972, as part of a study to develop methods for judging campsite condition, Frissell (1978) inventoried all identifiable campsites around 10 subalpine lakes. Fifty sites were located around these lakes. Each was assigned a condition class rating, between 1 and 5, based on the amount of impact. These condition classes were:

1. Ground vegetation compressed temporarily, but not seriously injured. Minimal physical change (except simple fireplace) (fig. 2a).
2. Ground vegetation worn away in immediate vicinity of fireplace (fig. 2b).
3. Ground vegetation gone from around fireplace and in other parts of site. Humus and litter still present in most places (fig. 2c).
4. Bare mineral soil widespread. Tree roots exposed on surface (fig. 2d).

5. Ground cover almost nonexistent. Trees dying. Soil erosion occurring.

In 1988, these same campsites were resurveyed. Condition classes were assigned in a manner identical to 1972, except that no attempt was made to distinguish between class 4 and 5. These two classes are difficult to consistently distinguish. For this study, campsites rated class 4 or class 5 in 1972 are considered to be class 4. In addition, campsites that had not been present in 1972 were surveyed and rated.

These numerical ratings do not provide a lot of information about campsite condition. They are precise and repeatable estimates of condition, however. They are highly correlated with other independent measures of change such as percentage of vegetation loss and size of the campsite (Cole 1989). Therefore, these data do allow us to draw conclusions about changes in the number of campsites and their relative condition over this period.

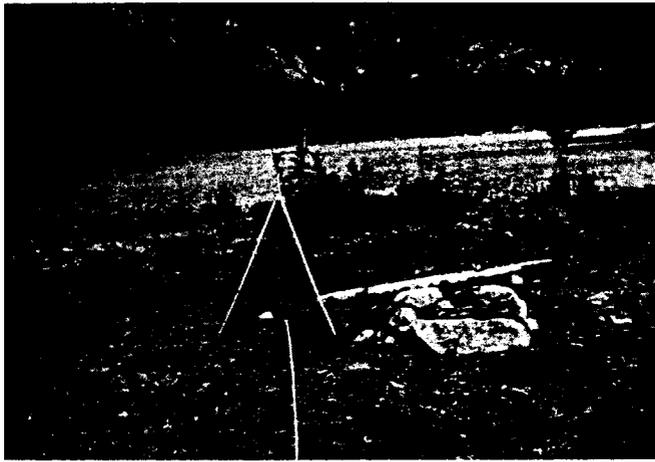
## Results

Between 1972 and 1988 the number of campsites around the subalpine lakes in the Spanish Peaks increased greatly. In 1988 we found 47 sites that had not been inventoried in 1972. In contrast, only five of the sites inventoried in 1972 could no longer be recognized as campsites in 1988. Consequently, the total number of sites increased 84 percent, from 50 sites in 1972 to 92 sites in 1988. While some of this increase may be a result of a more thorough survey in 1988, there is no doubt that campsites proliferated dramatically over this 16-year period.

Another significant change was the substantial deterioration of many of the original sites. In 1972, 12 of the 50 sites were class 4 sites (the highest level of deterioration). By 1988, another 12 of the original sites had deteriorated to this level. Not all sites deteriorated, however. Fourteen of the 50 sites improved; five of these improved so much they could no longer be recognized as campsites.

The likelihood that a site would deteriorate, improve, or stay the same varied with the site's level of deterioration in 1972. This is illustrated in the matrix in figure 3. Read down columns to determine the condition in 1988 of all campsites of a given condition class in 1972. For example, the data in column 2 indicate that of the 19 class 2 sites in 1972, seven had improved to class 1 by 1988, three remained class 2 sites, one deteriorated to class 3, and eight deteriorated to class 4. The condition of sites inventoried in 1988 but not in 1972 is shown in the column under a 1972 condition class of 0.

Most campsites with class 1 levels of deterioration in 1972 either disappeared or still had class 1 levels in 1988. In contrast, most class 2 and 3 sites changed substantially. These are sites that had lost vegetation



A



C



B



D

Figure 2- Examples of (A) condition class 1 site, (B) condition class 2 site, (C) condition class 3 site, and (D) condition class 4 site.

1988 Condition Class	1972 Condition Class					Total
	0*	1	2	3	4	
0*	0*	4			1	5
1	33	5	7	1		46
2	6	2	3		1	12
3	4		1	1		6
4	4		8	6	10	28
Total	47	11	19	8	12	97

\*Non-existent

Figure 3 -The number of campsites in each condition class in 1972 and 1988, Spanish Peaks portion of the Lee Metcalf Wilderness. Sites that were class 0 in 1972 were new sites in the 1988 study; sites that were class 0 in 1988 have disappeared since 1972. Sites within the diagonal dashed lines were stable during the period. Those above the line improved, while those below the line deteriorated.

but only at the center of the site (class 2) and sites that had lost most of their vegetation cover but retained their soil organic horizons (class 3). Seven of the 19 sites with class 2 levels of deterioration in 1972 had improved by 1988, while nine deteriorated. Only three remained unchanged. Of the eight sites with class 3 levels of deterioration in 1972, six had deteriorated, one had improved, and one remained unchanged. Class 4 is the highest impact rating in this study, so it is not possible to tell whether the 1972 class 4 sites deteriorated further. These sites have lost both ground cover and organic soil horizons. Only two of the 12 class 4 sites improved between 1972 and 1988.

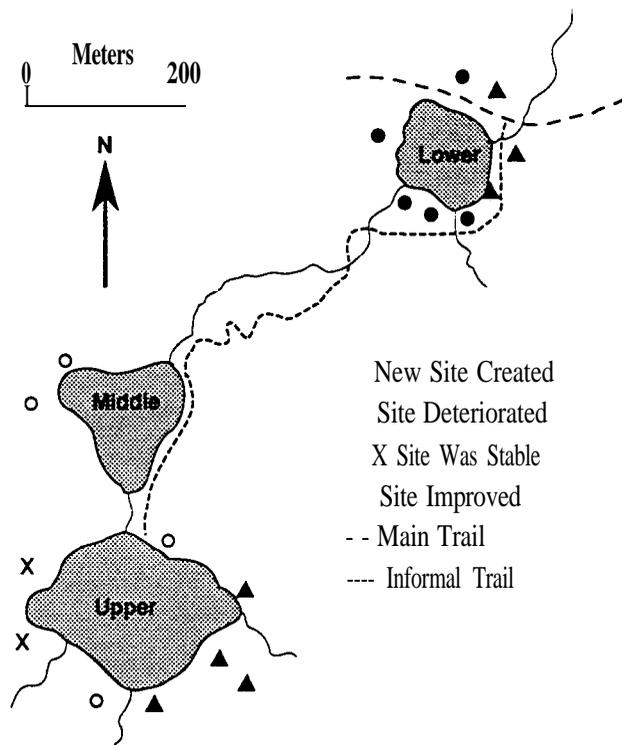
Of the 47 new campsites, more than 80 percent (39) are within 60 m of lakes. These sites are too close to the lakes to be legal. Therefore, the increase in new sites was not a result of campers attempting to comply with regulations.

Of the 47 new campsites, more than two-thirds (33) are class 1 sites (fig. 3). These sites probably have not been regularly used. Four of the 47 new sites deteriorated to class 4 during the 16 year period. Another 10 sites are in an intermediate condition. Judging from the continued deterioration of sites that had intermediate levels of deterioration in 1972, these sites are the most likely to deteriorate in the near future.

A partial survey of campsites was conducted in 1983. Results suggest that most of the change between 1972 and 1988 had already occurred by then. Between 1983 and 1988, the major noticeable change was the successful rehabilitation of a number of campsites. Several class 2 sites, where further use was eliminated, virtually disappeared. Firerings and trash were removed, compacted soil was scarified (loosened), and barren soil was revegetated. Persistent elimination of newly built firerings also reduced the rate at which new campsites were established. Maintenance at frequently used sites has resulted in more esthetically pleasing sites and, for some sites, reduced the area of disturbance. Nevertheless, some sites have continued deteriorating to class 4 levels.

Campsites changes varied greatly, depending on the lake. For example, all five campsites at Lower Jerome Rock Lake deteriorated and three new sites were created (fig. 4); one new site is now condition class 4. Site rehabilitation efforts by rangers were largely ineffectual. This contrasts greatly with changes at Middle and Upper Jerome Rock Lakes. Here, four of the six original sites improved and none deteriorated. Four new campsites were created, but all were class 1 sites. On lightly impacted campsites, rehabilitation was quite effective.

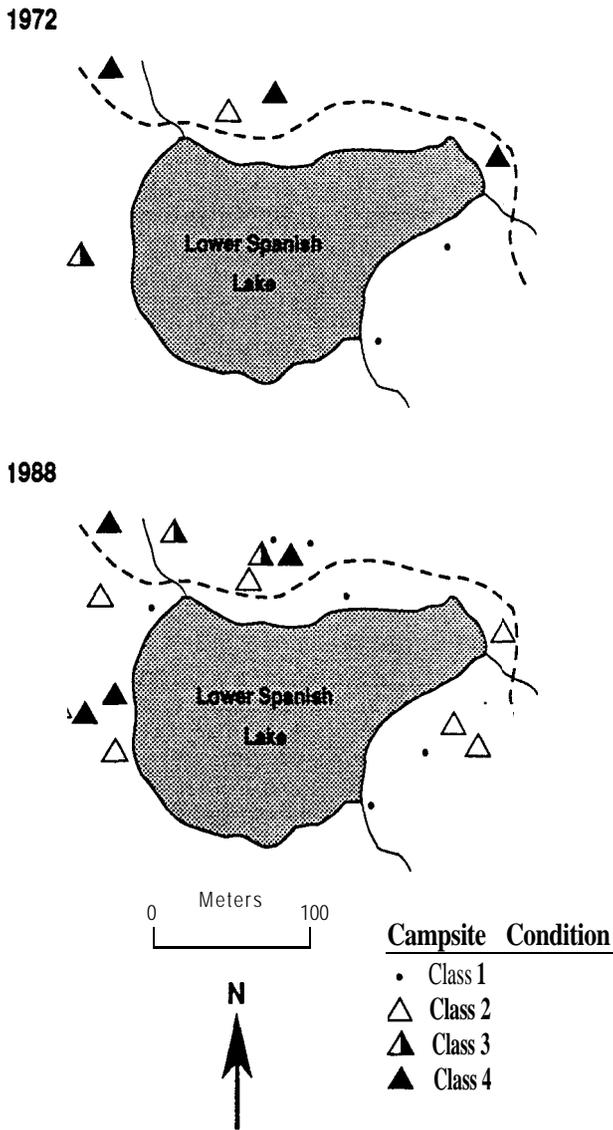
Four basic patterns of change can be distinguished. At a few lakes, such as Middle and Upper Jerome Rock Lakes, no campsites deteriorated dramatically. New



**Figure 4**--Changes in campsite condition around the Jerome Rock Lakes, Lee Metcalf Wilderness, MT, between 1972 and 1988.

campsites may have developed, but they were usually class 1 sites with minimal impacts. In some places, the number of sites was reduced and the condition of some remaining sites was improved by rehabilitating newly created sites and by informing visitors about low-impact camping practices. This pattern occurred only at the most infrequently visited lakes. The patterns of change were very different at popular lakes. New sites have proliferated at the lakes that were most popular in both 1972 and 1988; conditions on existing sites, meanwhile, have been relatively stable. For example, in 1972 Lower Spanish Lake had seven campsites, three of which had deteriorated to class 4. In 1988 the lake had 23 sites, of which four had deteriorated to class 4 (fig. 5). At lakes that appear to have become much more popular over the last two decades the original sites deteriorated and new campsites were created. Lower Jerome Rock Lake is an example of this type of lake.

The fourth pattern is one of a lake with a few high-impact sites, with little change in either the number of sites or their condition. This occurred at popular lakes where the number of available campsites is limited by topography or management efforts to confine camping to certain sites. At Mirror Lake (fig. 6), management successfully eliminated use of a class 4 site in a lush meadow and diverted that use to two existing forested sites. Those sites deteriorated to condition



**Figure 5-** The number and condition of campsites around Lower Spanish Lake, Lee Metcalf Wilderness, MT, in 1972 and 1988.

class 4, but virtually all evidence of the former meadow site has disappeared. Two other sites disappeared as well. This is an illustration of the recuperative abilities of lush meadows; forested sites probably would not have been capable of such rapid recovery (Cole 1987).

### SELWAY-BITTERROOT CASE STUDY

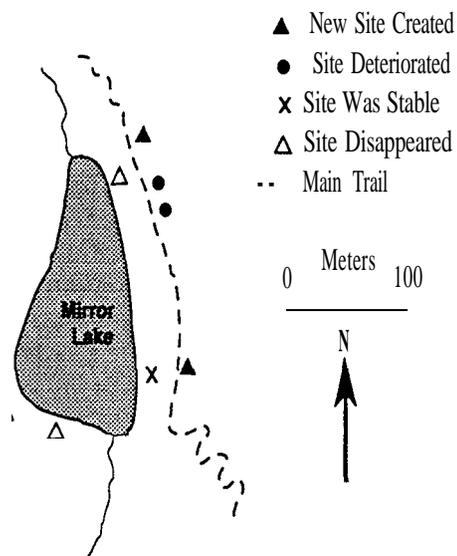
The Selway-Bitterroot Wilderness is a 541,000-ha area straddling the Idaho-Montana border. A series of steep, narrow canyons in its northeastern portion drain the eastern slope of the rugged Bitterroot Mountains. These canyons, among the more heavily used places in the wilderness, are located within an hour of Missoula, the largest city in the region. Three canyons were studied-Bear Creek, Big Creek, and Sweeney

Creek. The trail systems follow Bear and Big Creeks, climbing gradually to cirque lakes 10 to 15 km from the trailhead (fig. 7). Elevations range from about 1,200 m at the trailheads to about 2,400 m at the highest lakes. The Sweeney Creek trail starts high above the creek, at an elevation of 1,750 m. It ascends rapidly to 2,300 m and then follows the contour to the lakes at its head.

Most overnight visitors are attracted to the cirque basins. This is where most of the campsites are located. Most campsites are in forests of whitebark pine, subalpine fir, Engelmann spruce (*Picea engelmannii*), and lodgepole pine, although a few are in subalpine meadows. A number of sites are located along the trails in the canyon bottoms at lower elevations. Again, most sites are forested. Flat sites suitable for camping are scarce, particularly in the canyon bottoms.

Accurate figures for visitor use are lacking, although a visitor survey established relative use levels for various trails (Lucas 1980). Use is moderately low for wilderness (typical of a sparsely populated State like Montana) and is reported to have declined over the past 10 to 15 years. Overnight use is probably lower than in the Spanish Peaks portion of the Lee Metcalf Wilderness. Parties with stock and hunting parties (many with stock) comprise a substantial minority of overnight users (Lucas 1980).

Few attempts have been made to alter the amount or distribution of visitor use, or to influence visitor behavior. The major exception was an attempt to temporarily close seven campsites around Big Creek Lake to allow them to recover. These closures, largely ineffectual in eliminating use or promoting recovery, lasted



**Figure 6-** Changes in campsite condition around Mirror Lake, Lee Metcalf Wilderness, MT, between 1972 and 1988.

Figure 7- (deleted due to poor image) South Fork and Pearl Lakes in the Big Creek drainage of the Selway-Bitterroot Wilderness, MT.

from 1973 until the early 1980's (Cole and Ranz 1983). The primary management actions taken elsewhere have included placement of posters promoting low-impact recreation practices on trailhead bulletin boards and occasional ranger patrols.

## Methods

Beginning in 1975, all campsites in these three drainages were located and studied. The inventory was completed in 1977, the baseline year for future comparisons. At each campsite, panoramic photographs were taken from a central location. In addition, vertical photographs of 1-m<sup>2</sup> quadrats were taken and observations about ground cover conditions were recorded at various distances along radial transects. Attempts to extract useful data on campsite condition from the photographs were generally frustrating, both because of sample design and because of poor definition in the photographs.

Certain information could be derived from the photographs and observations. Frissell condition class ratings, between 1 and 4, were easy to assess, as they are based on the extent of vegetation loss and mineral soil exposure--changes that were readily apparent in the

photographs and observations. The number of firings was noted on forms, as was the extent of tree damage. The size of the devegetated central portion of the site could be estimated by examining the vertical photographs, but these estimates are probably not very accurate.

In 1989, all campsites in these three drainages were located and each site was assigned a Frissell condition class rating. In addition, a detailed monitoring form developed by Cole (1983,1989) was filled out. This form, widely used to monitor wilderness campsites, provides quick estimates of nine different types of impact, including tree damage, size of the barren central portion, and number of firings. Thus it was possible to assess change in (1) number of sites; (2) Frissell condition class rating; (3) size of the barren core; (4) extent of tree damage; and (5) number of firings. In addition, more detailed and precise information about campsite conditions was collected to assess current conditions and to allow trends to be assessed in the future.

## Results

Pooling the data for all three drainages, the number of campsites increased substantially between 1977 and 1989. We found 43 sites in 1989 that had not been inventoried in 1978. Only six of the sites inventoried in 1977 had disappeared by 1989. Consequently, the total number of sites increased 53 percent, from 70 sites in 1977 to 107 sites in 1989. This increase was similar to that in the Lee Metcalf Wilderness, but less pronounced.

In contrast to the Lee Metcalf, the condition of most of the original sites did not deteriorate between 1977 and 1989. There were 12 class 4 sites in both 1977 and 1989. Only five sites deteriorated substantially (enough to move to the next highest condition class). Sixteen sites improved substantially; six of these improved so much they were no longer recognizable as campsites. The vast majority of the 1977 sites--49--were relatively stable. It is important to remember, however, that this rating system cannot detect deterioration of class 4 sites. Analysis of repeat photographs taken in 1989 suggests that many class 4 sites deteriorated over the period. Nevertheless, the deterioration of existing sites was clearly less dramatic than in the Lee Metcalf.

The likelihood that a site would deteriorate, improve, or stay the same did not vary with the site's level of deterioration in 1977 (fig. 8). Regardless of the level of deterioration in 1977, most sites were stable. More sites improved than deteriorated. This also contrasts with the Lee Metcalf results.

Of the 43 new campsites, almost two-thirds (27) are class 1 sites. They have probably never been used regularly. One newly developed site deteriorated to

		1977 Condition Class					
		0*	1	2	3	4	Total
1989 Condition Class	0*		4	2			6
	1	27	6	2			35
	2	9	1	17	5	1	33
	3	6		2	17	2	27
	4	1			2	9	12
Total		43	11	23	24	12	113

\*Non-existent

**Figure 8-** The number of campsites in each condition class in 1977 and 1989, Selway-Bitterroot Wilderness, MT. Sites that were class 0 in 1977 were new sites in the 1989 study; sites that were class 0 in 1989 have disappeared since 1977. Sites within the diagonal dashed lines were stable during the period. Those above the line improved; those below the line deteriorated.

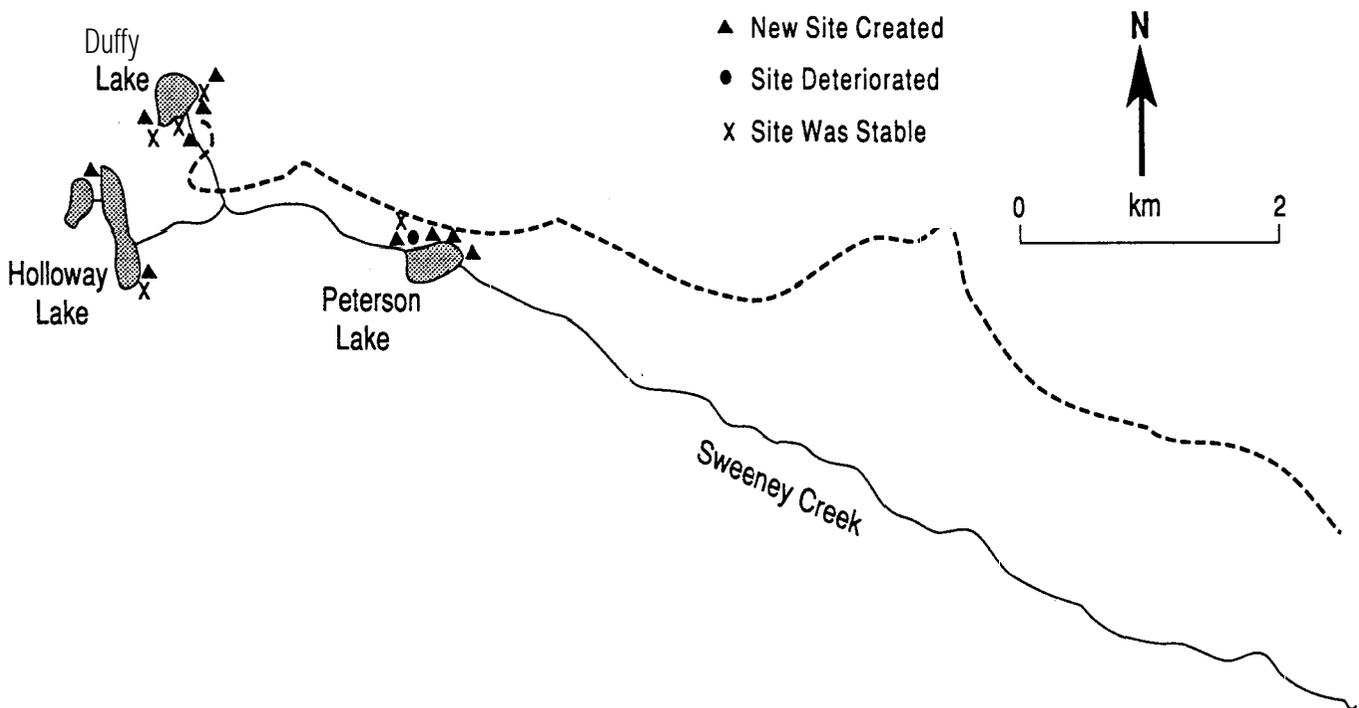
class 4 in less than 12 years. Fifteen new sites are in intermediate condition (class 2 or 3).

Changes differed between drainages. The most pronounced changes occurred in the Sweeney Creek drainage, the most lightly used of the three. In 1977 the drainage had only seven campsites—two class 1 sites, two class 2 sites, one class 3 site, and two class 4 sites. The three sites with pronounced impacts (classes 3 and 4) were at Duffy Lake, Peterson Lake, and the spring 3 km from the trailhead.

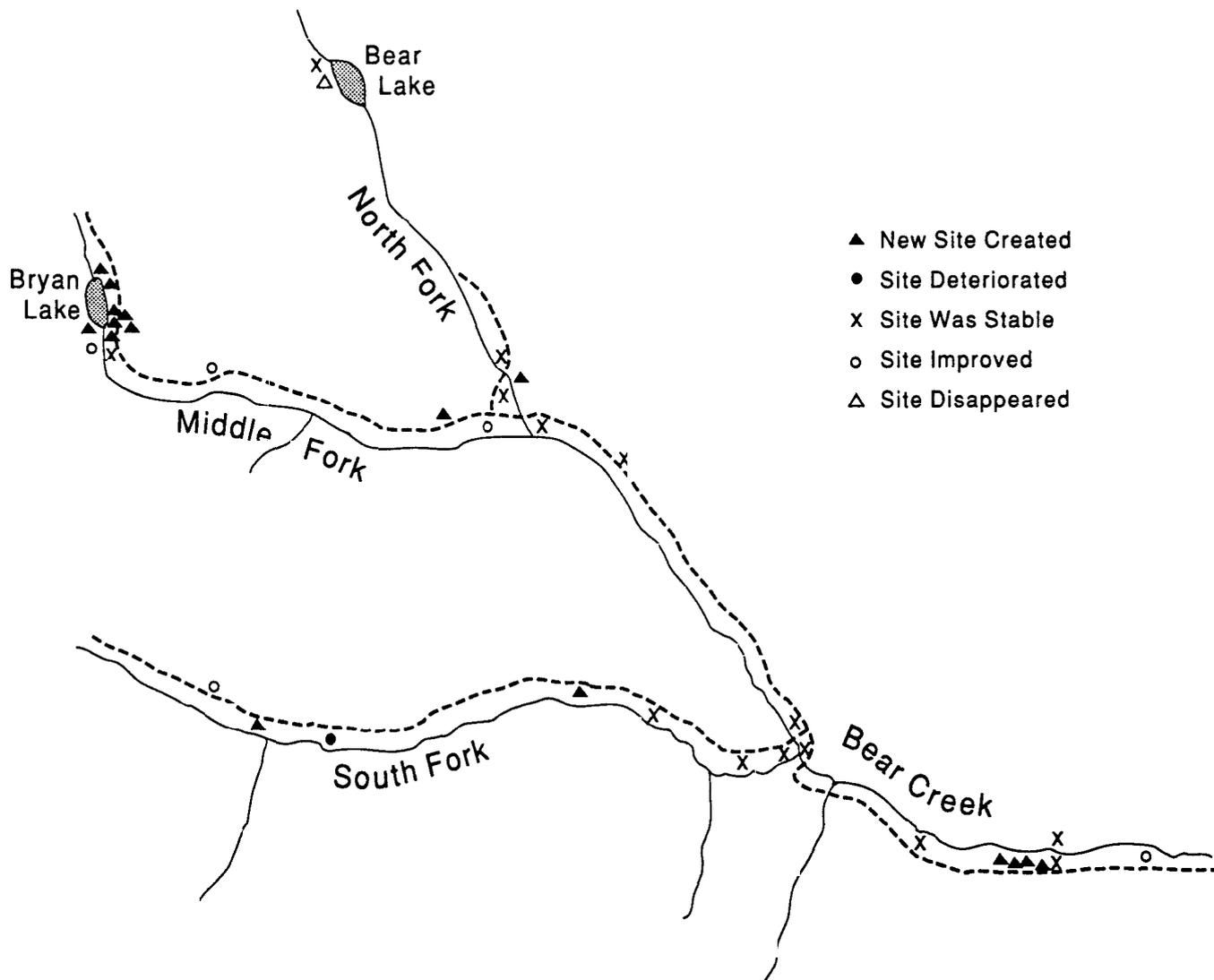
By 1989 the number of campsites had increased to 17—nine class 1 sites, three class 2 sites, one class 3 site, and four class 4 sites (fig. 9). Peterson Lake the first destination—now has three sites with pronounced impact. The number of sites at each lake increased, from two to six at Peterson Lake, from three to seven at Duffy Lake, and from one to three at Holloway Lake.

Most of the original sites were relatively stable. One site deteriorated substantially (at least one condition class); no sites improved substantially. Subtler changes could be identified from photographs and estimates of the barren core area. The three sites that were most heavily impacted in 1977 had less vegetation cover and a larger barren core in 1989. Two of these sites also had substantially more tree damage. The four sites that were lightly impacted in 1977 had more vegetation cover in 1989.

The Bear Creek trail received about 30 percent more use in the mid-1970's than the Sweeney Creek trail (Lucas 1981). In 1977 the Bear Creek drainage



**Figure 9** -Changes in campsite condition in the Sweeney Creek drainage, Selway-Bitterroot Wilderness, MT, between 1977 and 1989.



**Figure 10** -Changes in campsite condition in the Bear Creek drainage, Selway-Bitterroot Wilderness, MT, between 1977 and 1989.

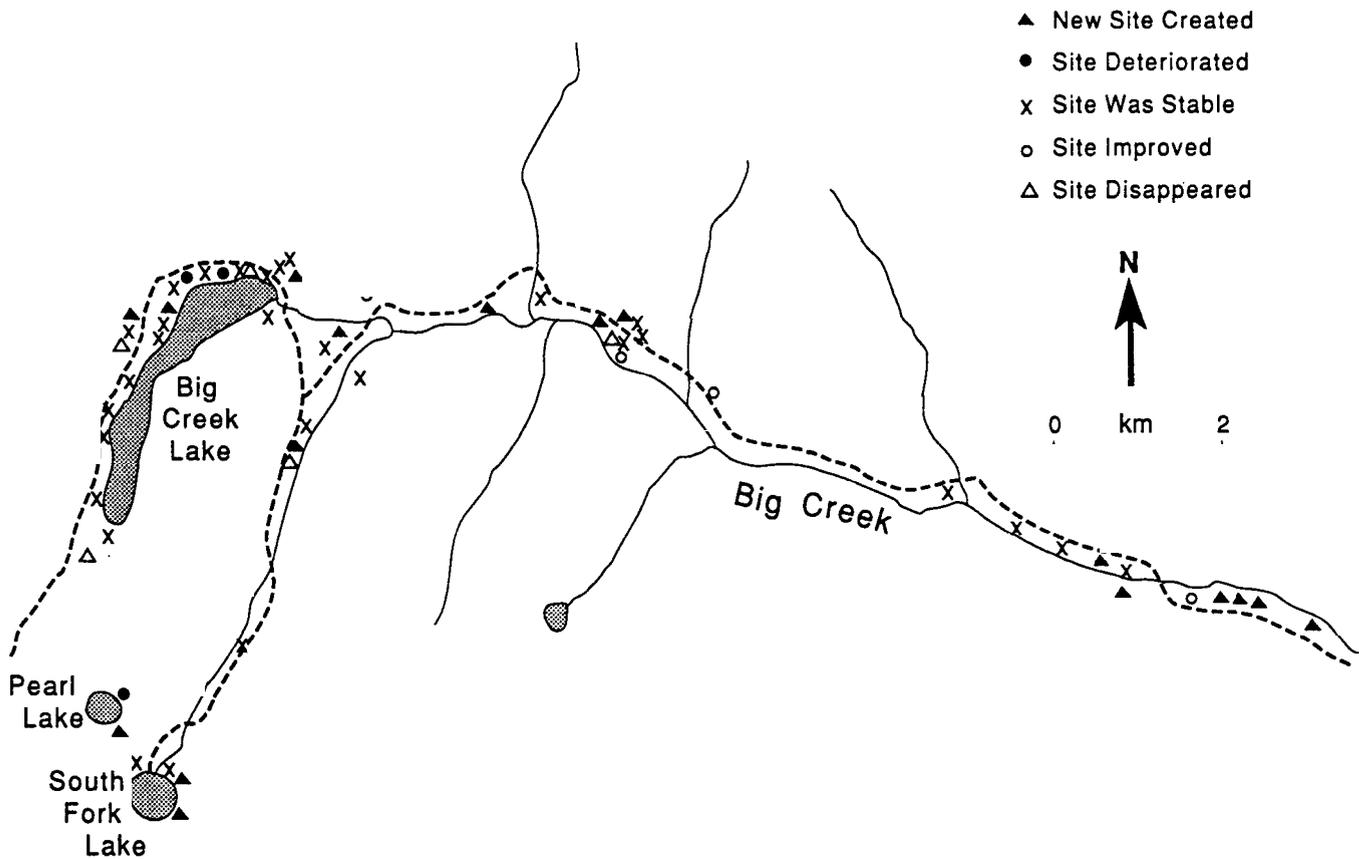
had 21 campsites. This large number of sites results from a number of factors including (1) twice the trail mileage as in the Sweeney Creek drainage and (2) the trail's following the creek, which provides easy access for camping. In 1977 there were only two campsites at each of the two lakes in the drainage. There were four class 1 sites, seven class 2 sites, seven class 3 sites, and three class 4 sites in the drainage. The class 4 sites were the two sites at Bryan Lake and one site close to the junction of the Middle and North Forks of Bear Creek.

By 1989 the number of campsites had increased from 21 to 36-15 class 1 sites, 13 class 2 sites, seven class 3 sites, and one class 4 site (fig. 10). At Bryan Lake, the number of campsites increased from two in 1977 to 10 in 1989. Four new campsites developed at a scenic swimming hole about 2 km from the trailhead.

The increase in campsite impact resulting from this proliferation of sites was partially offset by improved

conditions on many of the original campsites. Of the 21 original sites, only one deteriorated substantially (at least one condition class), while six improved substantially, one so much that it disappeared. In contrast to the deterioration of sites in the Sweeney Creek drainage, two of the three sites in Bear Creek that were most heavily impacted in 1977 had more vegetation cover and a smaller barren core in 1989. However, tree damage increased at two sites because stock were tied to trees and four sites had more firerings.

The Big Creek trail is the most heavily used of the three; in the mid-1970's it received almost twice as much use as the Bear Creek trail (Lucas 1981). In 1977 the Big Creek drainage had 42 campsites. Half of these were found along the 3-km shore of Big Creek Lake-the primary destination of most overnight visitors. In 1977 there were five class 1 sites, 14 class 2 sites, 16 class 3 sites, and seven class 4 sites. Of the 23 sites with pronounced impact (classes 3 or 4), 13



**Figure 11** -Changes in campsite condition in the Big Creek drainage, Selway-Bitterroot Wilderness, MT, between 1977 and 1989.

were at Big Creek Lake and another four were at a popular camping place-Teepee Rock-about 10 km from the trailhead.

By 1989 the number of campsites had increased to 54-11 class 1 sites, 17 class 2 sites, 19 class 3 sites, and seven class 4 sites (fig. 11). This increase was much smaller than in the other two drainages. Most of the new sites appeared close to the trailhead and at the infrequently visited lakes-Pearl Lake and South Fork Lake. At Big Creek Lake-the most heavily used place in any of the drainages-the number of campsites did not increase. Earlier, the number of campsites at the lake had increased from 15 in 1973 to 22 in 1980. This increase was the result of new campsites created next to ones that had been closed to use but had not recovered (Cole and Ranz 1983). These closed sites were reopened in the early 1980's given the lack of success with closures. Currently, virtually every desirable place to camp has become an identifiable campsite. This is true at Big Creek Lake and virtually everywhere along the Big Creek trail system.

Conditions on many of the original sites improved. Of the 42 original sites, three deteriorated substantially (at least one condition class), while 10 improved substantially-five improved so much that they disappeared. Photographs show that 17 of the original

campsites had more vegetation cover in 1990 than in 1977. Most of this vegetation, however, consisted of exotic species. Tree damage increased substantially at nine campsites because stock were tied to trees. Vegetation cover increased at seven of these sites. This shows that improper handling of stock can cause further deterioration even on sites used so infrequently that ground cover is increasing. At Big Creek Lake two sites deteriorated substantially, but four sites improved substantially or disappeared.

### EAGLE CAP CASE STUDY

The Eagle Cap Wilderness is a 145,000-ha area in the Wallowa Mountains of northeastern Oregon. Its most popular destinations are a series of sub-alpine lakes located in the north-central portion. We selected two of the most popular drainages for study-Hurricane Creek and the West Fork of the Wallowa River. This study area includes the Lakes Basin, the most popular destination in the wilderness (fig. 12). Trails to this area begin at elevations of about 1,450 m. They climb gradually along creeks through midelevation forest before climbing more steeply to reach the lakes about 15 to 20 km from the trailheads. There are 13 named lakes in the headwaters of the drainages at elevations between 2,100 and 2,500 m. Several



**Figure 12-** (deleted due to poor reproduction) Moccasin Lake, one of the popular lakes in the Lakes Basin, Eagle Cap Wilderness, OR. )

other cirque lakes are located up steep trails that leave the main trail 5 to 8 km from the trailheads. Most campsites are located close to these subalpine lakes; however, a number of sites are scattered along the valley bottoms, particularly in areas close to trail junctions.

Accurate visitor use figures are lacking. Use is probably somewhat above average for wilderness. Use is certainly several times as high as in the two Montana study areas. The amount of use has probably been relatively stable over the past 15 years. Parties with stock and hunting parties (many with stock) visit the area, but they comprise a smaller proportion of the overnight use than they do in the Montana areas.

Management intervention has been greater here than in the two Montana study areas. In the mid-1970's, management consisted of little more than an occasional wilderness patrol. During the late 1970's, camping was prohibited within 60 m of lakes. Visitor education was stressed (Bradley 1979) at trailheads and in the backcountry. Visitors were encouraged to

avoid heavily used places and to avoid camping on heavily impacted sites. They were also shown how to build a low-impact campfire. Rangers attempted to revegetate a number of closed campsites. In the late 1980's, regulation increased, but the number of wilderness rangers and educational efforts declined. Lakeshores remained closed to camping and campfires were prohibited around many lakes; however, compliance with both regulations was low.

## **Methods**

Campsites in the study area were first inventoried from 1973 to 1975. The only information collected then was the location of each site and the number of firerings there. In 1990, campsites were resurveyed. Current conditions were assessed, using both Frissell's condition class rating and the more detailed monitoring form (Cole 1983). The only trend data that can be derived from the two inventories are the change in the numbers and distribution of campsites.

## Results

In 1975, 336 campsites were found along the trail corridors and in the lake basins in the two drainages. Most sites (75 percent) were located around the lakes. Ten lakes had at least 10 campsites each. Mirror Lake had the most campsites, 42; Horseshoe Lake had 38.

In 1990, we found 748 campsites in the same areas. The number of campsites more than doubled (a 123 percent increase) in 15 years. The proportion of sites located around the lakes increased to 83 percent. There were still 10 lakes with at least 10 campsites. However, four lakes now had more than 50 campsites each, including the popular Mirror Lake with 144 campsites.

Campsites proliferated to varying degrees in different locations (table 1). The trail corridors had the lowest campsite densities in 1975. The number of campsites along trail corridors increased just 42 percent over 15 years. In 1990, the mean campsite density along trail corridors was still only 0.27 campsite/ha. Campsites are widely dispersed along trails, with clusters of sites in only a few places.

In contrast, the number of campsites at the seven high-use lakes within the Lakes Basin more than doubled (a 134 percent increase) over 15 years. In 1990, campsite density around these lakes exceeded two sites per hectare. Campers have disturbed virtually every suitable site. Many clusters of sites are so dense that it is difficult to tell where one site ends and another begins.

Five less popular lakes-Echo, Billy Jones, Razz, Pocket, and Prospect-had intermediate campsite

densities in 1975. Campsite proliferation was particularly pronounced at these lakes, increasing 233 percent over 15 years. These lakes had almost 3.5 campsites in 1990 for every site in 1975. Campsite densities at these lakes in 1990 exceeded densities at the high-use lakes in 1975.

Although increases in campsite density were most pronounced at the low-use lakes, impact levels on these sites were seldom high (table 1). At about one-half of the sites, a firering was the principal impact (condition class 1). Only 6 percent of the sites had lost vegetation cover over a large area (condition class 3). No sites had substantial exposure of mineral soil (condition class 4). Campsite disturbance has spread greatly, but so far, the disturbance is not severe.

Although campsite densities now are only moderately higher at high-use lakes than at low-use lakes, the impact levels are substantially higher. Even at the high-use lakes, 39 percent of sites have minimal long-term impact (condition class 1); however, 24 percent of the sites have lost vegetation cover over a large area (condition class 3) and another 18 percent also have substantial exposure of mineral soil (class 4). The 144 campsites with pronounced impacts (classes 3 and 4) nearly equals the total number of campsites in 1975 (147 sites).

The campsites along the trail corridors also contribute to the impact camping has had in this area. However these campsites have deteriorated less than those around the lakes. Fifty-seven percent of the sites along trail corridors have class 2 or 3 levels of impact, compared to 44 percent of the sites at the high-use lakes.

**Table 1-** Campsite density, campsite condition, and change in number of campsites for high-use lakes, low-use lakes, and trail corridors<sup>1</sup>

Statistic	Campsite location		
	High-use lakes	Low-use lakes	Trail corridors
Number of campsites			
1975 (number)	147	21	79
1990 (number)	344	70	112
Change (percent)	134	233	42
Campsite density			
1975 (sites/ha)	0.91	0.52	0.20
1990 (sites/ha)	2.13	1.73	0.27
Campsites (1990) that are:			
Class 1 (percent)	39	51	31
Class 2 (percent)	20	43	27
Class 3 (percent)	24	6	30
Class 4 (percent)	18	0	12

<sup>1</sup>High-use lakes were the seven major lakes in the Lakes Basin-Mirror, Moccasin, Crescent, Craig, Douglas, Lee, and Horseshoe. Low-use lakes were Echo, Billy Jones, Razz, Pocket, and Prospect. Trail corridors were areas along the Hurricane Creek and West Fork Wallowa River trails, from trailheads to the Lakes Basin and Frazier Lake, respectively. Site densities were based on estimates of the area of the basin around each lake and, for the trail corridors, an area extending 60 m on either side of the trail.

The relatively low number of class 1 sites suggests campers are less likely to "pioneer" new sites in these locations; plenty of suitable sites have never been used. The relative paucity of class 4 sites may reflect environmental conditions as well as the level of use. The trail corridor sites are at lower elevations, where organic horizons are generally thicker. Sites with thick organic horizons can withstand substantial use before mineral soil is exposed.

## DISCUSSION

The dramatic increase in the number of campsites in all three study areas was the primary finding of this study. If these study areas are typical of other wilderness areas-and there is little reason to suspect they are not-campsite impacts may have increased substantially at other wilderness areas over the past 10 to 15 years. The primary reason impact has increased is the creation of new campsites, although the condition of some established sites has deteriorated. Previous research on established wilderness campsites indicated a trend of slight deterioration (Cole and Hall 1992), suggesting deterioration of existing campsites may not be a major problem. However, these results clearly show that when the impact of new campsites is considered as well, impact has increased greatly during the past 10 to 15 years.

Campsites proliferated more in some places than others, but there was no simple explanation for the variation. Proliferation was most pronounced in the Eagle Cap and least pronounced in the Selway-Bitterroot. This would suggest that proliferation was most severe in the most heavily used areas. Within the Eagle Cap, however, proliferation was most severe at lightly used lakes. Among the drainages in the Selway-Bitterroot, the most severe proliferation occurred in the most lightly used drainage--Sweeney Creek. Within the Sweeney Creek drainage, however, campsites proliferated the most at the two most-frequented destinations-Peterson and Duffy Lakes. Within the Big Creek drainage, campsites did not increase at the most-frequented destination-Big Creek Lake. If there is any pattern at all to these results, proliferation appears to have been greatest in places with moderate use, rather than at heavily used places or places that are seldom visited.

Theoretically, campsite density should be a function of at least four variables-amount of use, site selection behavior, management interventions, and the number of suitable campsites. Density should increase with increasing use, "site-pioneering" by campers, encouragement of pioneering by management, and the number of potential campsites. Density should decrease with decreasing use, a tendency for campers to select existing campsites, discouragement of pioneering by management, closure and obliteration of campsites by

management, and a decrease in the number of potential campsites.

Density should also be a function of the years of recreational use; however, the influence of time is difficult to predict. For example, in a situation where site pioneering is common and management intervention is minimal, density should increase over time. Campsites would be created more rapidly than they disappeared. However, density should decrease over time in a situation where site pioneering is rare and managers are rehabilitating sites.

An increase in any of these factors theoretically would increase site density, as was observed in the three study areas. The limited data available suggest, however, that use has not increased substantially (with the probable highly localized exceptions of a few of the lakes that were lightly used in the 1970's). Moreover, there has not been an increase in the number of sites suitable for camping. In fact, once all potential campsites have been used, additional proliferation is impossible. This may explain why campsites did not increase at Big Creek Lake.

The only factors left to account for observed increases in site density are (1) a change in site selection behavior; (2) a change in management; and (3) time, with new sites being created by campers faster than old sites are eliminated. Each of these factors probably has contributed to proliferation. The Eagle Cap was the only wilderness that had a highly active management program. Managers promoted site pioneering behavior through educational programs and regulations prohibiting camping along lake shores and rehabilitated campsites. Since rehabilitation was not very successful (Cole and Hall 1992), the net effect of the management actions probably was an increase in camp site density. In the other two areas, management presence was probably insufficient to influence site density. In these places-the wilderness areas where proliferation occurred but was less pronounced-increases in density could be the result of an increase in site pioneering behavior or could simply reflect the passage of time given relatively passive campsite management.

The magnitude of the recent increase in number of campsites suggests that an increase in site-pioneering behavior has occurred. In the Spanish Peaks, for example, the number of new campsites created between 1972 and 1988, a period of relatively stable use, almost equals the number created during the many decades of increasing use that preceded 1972. Site densities at some low-use lakes currently exceed the densities that existed at high-use lakes in the mid-1970's, even though use levels are thought to have been stable since the mid-1970's. These changes are too dramatic to simply reflect the passage of time. They suggest that campers today are much more likely to pioneer a new campsite than they were 15 to 20 years ago.

Proliferation appears to be less of a problem along trail corridors than at destination areas. Sites located along trails are used frequently enough to keep them from recovering, but campers are less likely to "pioneer" a new site there. Visitors may be more content to camp wherever they end up so long as they have to stop short of their destination; they appear more inclined to establish new campsites once they reach their destination. Campsites did proliferate in a few places along trail corridors in the Selway-Bitterroot and Eagle Cap. These problem areas were generally destinations in their own right-popular swimming holes and trail junctions.

This interpretation suggests that campsite proliferation over the past 10 to 15 years is primarily a result of (1) an increase in site-pioneering behavior, in many cases with the encouragement of management, and (2) passive management programs that do little to attempt to decrease the number of campsites. These problems tend to be more severe in more heavily used places. But as campsite density increases, fewer potential campsites have never been used. Consequently, the risk of proliferation may be relatively low at very heavily used places because they have few suitable sites that have never been used. This appears to be true now at the most heavily used lakes in all three study areas. The places most at risk today are the regularly used destination areas with numerous potential campsites that have never been used.

## MANAGEMENT IMPLICATIONS

Campsite proliferation is a highly significant problem that demands more attention from wilderness managers. Its primary causes appear to be passive campsite management programs and an increasing tendency for campers to pioneer new sites. If site-pioneering behavior has increased in recent decades, managers face a formidable challenge in attempting to reverse this trend. Ironically, this problem stems in part from management attempts to avoid overcrowding and overuse by dispersing use. Some brochures and books describing low-impact camping techniques have also encouraged campers to pioneer new sites.

This study suggests that two keys to reversing campsite proliferation and deterioration are to change site-selection behavior and to develop more active campsite management programs. Attempts to influence how visitors behave while camping are also important. These three components of an effective campsite management strategy are needed throughout wilderness areas; however, determining which behaviors to encourage and which strategies to emphasize when managing campsites depends on whether the destination areas are popular or little used.

In popular destination areas, site proliferation results from visitors camping on too many different sites.

When an area first begins to be used, camping alters a few sites in prime locations. These sites quickly lose their vegetation cover (becoming class 3 sites). Unless they have thick organic soil horizons, they will also lose organic soil horizons (becoming class 4 sites). New sites develop whenever campers pass over existing sites to pioneer new sites. Some of these new sites are not used regularly, so they will not deteriorate below class 1 or 2. Many of these sites will be used regularly; they will deteriorate substantially, often to class 4. Without management, this process will continue in the most popular destination areas until all prime campsites have deteriorated and many more sites have been severely impacted than necessary.

In popular places, managers' objective should be to minimize the number of campsites. Campsite choice needs to be limited to a small number of appropriately located sites. Site pioneering needs to be eliminated. This can be accomplished by adopting some sort of designated campsite program or, perhaps, by simply encouraging use of established campsites. It is also important to encourage proper disposal of human waste and discourage use of the limited supplies of firewood.

Rangers and maintenance crews should have two objectives in managing individual campsites: (1) to keep "sanctioned" sites clean, attractive, and as small as possible and (2) to eliminate unnecessary campsites. Site rehabilitation programs should begin with elimination of all class 1 and 2 sites in the area. These sites should recover relatively quickly. Once these sites have been rehabilitated, maintenance crews will have to remain vigilant about breaking up tierings and other evidence of new sites as they develop. They also can begin selectively rehabilitating class 3 or 4 sites that are poorly located or are not needed to handle use in the area. In areas with substantial day-use, all use of these sites will have to be curtailed, not just camping.

In little-used places, site proliferation is more a problem of visitors camping too frequently on certain sites than of visitors camping on too many sites. In such places, impact on individual campsites should remain negligible as long as use is dispersed among a substantial number of sites. Problems develop when only a few sites attract the most use, causing unnecessary deterioration. Sites may proliferate if campers fail to remove evidence of their stay; failure to scatter firerings is the primary problem.

Managers' primary objectives in little-used places should be to avoid allowing any campsites to be substantially impacted and to minimize evidence of use on all sites. There is no need to allow campsites to deteriorate to class 2 or 3. Site-pioneering behavior is desirable, as long as campers use low-impact practices. Visitors should be encouraged to select a previously unused site for camping, preferably a site that

can tolerate disturbance. They should be encouraged to disperse tents, activities, and traffic routes so that no parts of the site are trampled excessively. Of most importance, they should be convinced to minimize and camouflage all evidence of their stay, particularly if they have a campfire.

When managing individual campsites, rangers and maintenance crews should try to eliminate all evidence of campsite use at all sites. They might begin by eliminating the most severely impacted campsites. The sooner use of these sites is curtailed, the more quickly they will recover. The ultimate goal, however, is to rehabilitate all impacted sites and then remain vigilant about breaking up all firerings and other evidence of new sites when they develop.

It is not always clear whether a specific destination area should be managed as a popular or a little-used area. There are no tested criteria for making this distinction. Information on use levels at destination areas, particularly estimates of the maximum number of parties present at one time, are critical. Probably any area where it would be highly unlikely to find anyone camping would best be treated as a little-used area. Probably any area where it would be highly unlikely not to find anyone camping would best be treated as a popular area. The challenge is deciding how to treat the intermediate areas. One option is to attempt to use a compromise approach. This might involve leaving a few well-impacted sites in prime locations while encouraging low-impact use of dispersed sites elsewhere. Site and use characteristics can also influence decisions about campsite management strategies. Managing a destination as a popular area becomes increasingly necessary as the area becomes more fragile, as the number of suitable campsites decreases, as the amount of use increases, and as the impacts caused by groups increase. For example, places that are frequented by large groups, groups with stock, and relatively inexperienced campers--groups that tend to cause substantial impact might best be managed as popular places, even if use is not extremely high.

Although the proliferation of campsite impact has been dramatic over the past 10 to 15 years, most new campsites are not yet severely impacted. Campsite impact could be substantially reduced with a modest increase in management. For example, one-half of the campsites in the two Montana wilderness areas and in the low-use portions of the Eagle Cap are class 1 sites. Careful elimination of firerings at these sites, along with some minimal site rehabilitation, could quickly eliminate these sites, cutting the number of campsites in half.

This is the first study to report on trends in campsite number over time. The patterns of campsite deterioration and proliferation that were found corroborate

earlier predictions (Cole 1982). Such predictions and their own experience have led the managers of many National Parks and certain popular Forest Service wildernesses, such as the Boundary Waters Canoe Area Wilderness, to allow camping only at designated sites (Marion and Sober 1987; Washburne and Cole 1983). The results of these studies demonstrate the consequences of failure to actively manage campsites in wilderness. They also illustrate the importance of basing a campsite management program on knowledge about the type and pattern of use and impact in different camping locations.

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Changes in the number and condition of campsites were monitored for 12 to 16 years in portions of the Lee Metcalf, Selway-Bitterroot, and Eagle Cap Wildernesses. The number of campsites increased by 53 to 123 percent, indicating that campsite impacts have increased greatly. Suggestions for reducing campsite impacts are provided.

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KEYWORDS: ecological impacts, trends, Montana, Oregon, damage

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