Changes On Campsites Along the Middle Fork and Main Salmon River, 1996 to 2009

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In order to assess ecological impacts associated with recreational use by boaters, campsite conditions are being monitored along both the Middle Fork and Main Salmon Rivers. Rapid inventory assessment techniques have been used on all campsites. In addition, more precise monitoring techniques (referred to as "benchmarking") have been applied on a representative sample of the campsites. This makes it possible to identify more subtle trends than is possible with the rapid assessments. In 1995-1996 about 10% of the campsites on the Middle Fork (11 campsites) and Main Salmon (13 campsites) were assessed. We picked every 10th campsite going downriver. Conditions on these sites were reassessed twice since then—in 2001-2004 and in 2008-2009. This report describes the changes that occurred over this 13-year period.

Methods

We adapted established techniques used to assess campsite impacts in terrestrial wilderness (such as Cole 1983, Cole and Hall 1992) to campsites along this wilderness river. Challenges in doing so included the large size of river campsites, the complex maze of social trails and satellite tent pads and difficulty in defining the edge of the camp. One edge is a river that fluctuates in height through the season. We quickly realized that, for groundcover parameters (such as vegetation cover), it would be impossible to assess the amount of impact that had already occurred. Normally, impacts to such parameters are assessed by comparing campsites with adjacent control sites, judged to be similar to the campsite prior to use. Good controls are lacking along these rivers, because any place with the characteristics of a campsite is a campsite. We did establish control sites (6 on the Middle Fork and 4 on the Main Salmon) but did not attempt to associate them with specific campsites.

On each campsite, we established one (or more) center point—a buried nail, located above high water and referenced to three distinctive features. Walking the campsite perimeter, we placed 15-25 flags at places where the boundary changed direction. Then, from the center point, we recorded azimuth and distance to each flag. Such measures are replicable and can be used to calculate campsite area (Marion 1995). We estimated the approximate area of any undisturbed vegetation within the campsite and subtracted these from the campsite area.

Within the campsite perimeter, delimited by straight lines drawn between flags, we estimated the proportion of the site in the following groundcover classes: vegetation, litter, mineral soil, sand and rock. For each live tree within campsite boundaries, we assessed tree damage as either none/slight, moderate (2 or more nails, numerous small trunk scars or exposed roots), or severe (numerous substantial trunk scars or girdled trunks or roots). We counted tree snags and "natural" stumps", as well as stumps clearly cut by recreationists. We counted the number of fire rings, ash piles, human waste sites,

and constructed structures or piles (including piles of firewood) and we quantified the volume of garbage, in liters.

We walked each user-created social trail that left the campsite perimeter. We mapped and measured the length of each trail, dividing each into segments according to the following condition classes: (1) worn, but with vegetation in the tread; (2) well-worn, with no vegetation in the tread; and (3) deeply worn, no vegetation and tread eroding. At each satellite site these trails accessed (usually a tent pad), we estimated area, as well as percent cover of vegetation, litter, mineral soil, sand, or rock.

Techniques for taking repeat measurements were generally identical to those used for the initial assessment. The original boundaries of the main camp were used, unless there was a compelling reason to believe that they had changed. This criterion was necessary because there were so many arbitrary decisions that needed to be made regarding site boundaries. Social trail systems were reassessed, as were the satellite sites.

On the control sites we established two 15 m long transects, parallel to each other and to the river and 2-10 m apart. The endpoints of each transect were permanently marked with buried nails. A 1-m^2 quadrat was placed each 2 m along each transect, for a total of 14 quadrats at each control site. The percent cover of vegetation, litter, soil, sand and rock were estimated in each transect. Changes on controls were primarily used to gain insight into how much change in groundcover conditions on campsites might reflect natural changes not related to camping activities.

Results for the Middle Fork

Eleven campsites on the Middle Fork were initially assessed in 1996 (Table 1). They were reassessed in 2002 or 2004 and again in 2009. In addition, conditions on six control sites were assessed in 1996, 2002, 2004 and 2009.

Table 1. Sample campsites on the Middle Fork Salmon River.

Campsite Name	River Mile
Gardell's Hole	2.4
Elkhorn	8.2
John's Camp	15.2
Pistol Creek	26.2
Sunflower Flat	32.6
Culver Creek	45.6
Hospital Bar	52.1
Pool	61.1
Little Pine	71.4
Last Chance	78.0
Tumble Creek	88.8

Campsite Conditions

The most notable characteristic of these campsites was their large size and their web of social trails and satellite sites. On the mean campsite, the main site was 882 m^2 in 1996 and satellite sites added another 203 m^2. There were over 317 m of social trails. These conditions can be compared with typical camp areas of 200 m^2 in the Eagle Cap

Wilderness, Oregon (Cole and Hall 1992) and 200-300 m^2 along several rivers in the eastern United States (Cole and Marion 1988). The larger sites are similar to the huge horse outfitter camps in the Bob Marshall Wilderness, Montana, where the combined area disturbed by cooking, tenting, and holding pack stock ranged from 400-10,000 m^2 (Cole 1983).

As notable as the huge area disturbed by camping is the degree to which these campsites are clean and lacking in tree damage. These impacts—the ones most responsive to visitors following Leave No Trace guidelines—are virtually absent. Most campsites had no evidence of fire-related impacts, no user-built structures, no evident human waste or toilet paper, virtually no garbage and no significant tree damage. In contrast, most campsites in terrestrial wilderness—if fires are permitted--will have fire rings (often more than one), ash piles and structures. Along several eastern rivers (Cole and Marion 1988), sites typically had evident human waste, more than 10 liters of garbage and more than 20 damaged trees.

Changes on Campsites Between 1996 and 2009

The size of campsites was relatively stable over the 13-year period. The mean size of the main camp declined, but the median size increased; fewer campsites increased in size than decreased (table 2). The campsites that experienced the largest increases in main camp size were Tumble Creek (227 m^2) and Culver Creek (101 m^2). The main camps that decreased most were Hospital Bar and Pistol Creek. Both of these sites were burned over, resulting in shifts in use patterns, particularly at Pistol Creek. Most of the groundcover on most main camps was sand or bare soil, depending on whether most of the site was above or below the high water line.

Table 2. Changes on the main camp, Middle Fork, 1996 to 2009.

	Area (m^2)	Sand (%)	Rock (%)	Bare (%)	Veget (%)	Litter (%)
Mean						
1996	882	27	12	34	14	13
2002/4	550	39	6	32	12	12
2009	820	26	17	34	12	12
Median						
1996	544	2	13	35	13	14
2002/4	522	35	3	35	14	13
2009	574	3	14	44	14	14
# of Sites, 1996-2009						
Decreased	7	2	2	3	2	3
Increased	4	3	6	3	4	4
Unchanged	0	6	3	5	5	5
Significance	0.34	0.87	0.47	0.97	0.46	0.78

None of the changes on the main camp were substantial and consistent enough to be statistically significant (paired t-tests, $p < 0.05$). Lack of statistical significance does

not mean that changes did not occur on the campsites that were assessed. The changes reported on the sample of campsites are real changes (although they are subject to some measurement error). Lack of statistical significance (the "significance" value in the table exceeds 0.05) means we have less than 95% confidence that we would find a change between 1996 and 2009 if we assessed all campsites on the Middle Fork.

Further insight into main camp conditions and change over time can be gleaned from figures 1 and 2. Figure 1 shows boxplots for main camp area in 1996, 2004 and 2009. The boxes show the distribution of sites from the 25th to the 75th percentiles, with the median site portrayed as a line within the box. Fifty percent of the campsites have main camp areas within the range defined by the box; 50% have areas larger than the median; and 50% have areas smaller than the median. The "whiskers", the vertical lines at the end of the horizontal line, portray the 10th to 90th percentile campsites. Dots show the maximum and minimum main camp area. Figure 2 shows the mean proportion of each groundcover class (sand, rock, bare soil, vegetation and litter) on the main camp in 1996, 2004 and 2009.

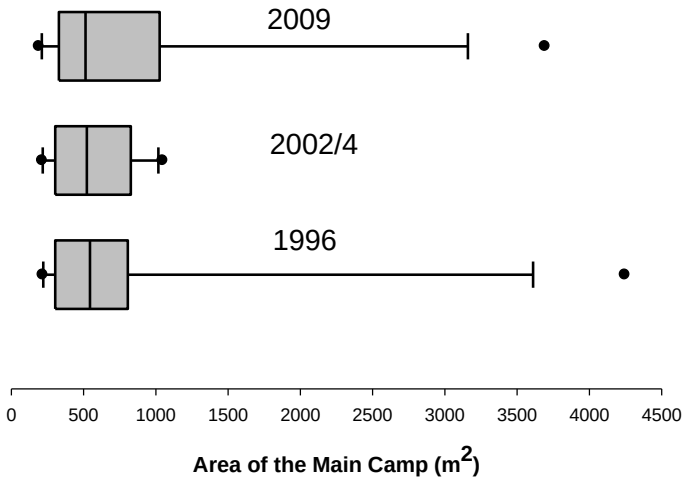

Fig. 1. Change in area of the main camp, Middle Fork, 1996 to 2009.

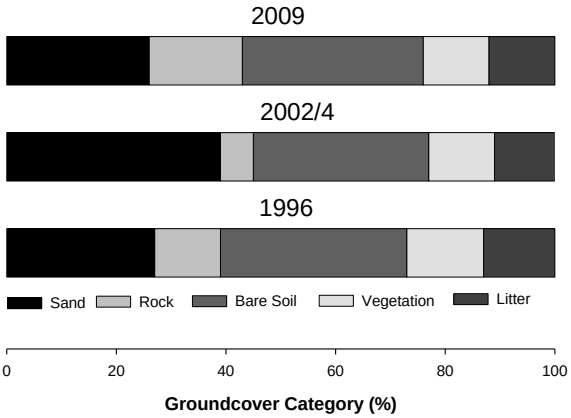

Figure 2. Change in groundcover of the main camp, Middle Fork, 1996 to 2009.

All of these campsites had satellite sites (usually small tent pads) connected to the main camp by social trails. In 1996, Hospital Bar and Little Pine each had 20 or more separate satellite sites; by 2009, the number of satellite sites on each had decreased to 14. The median number of satellite sites per campsite decreased between 1996 and 2009 and most campsites experienced a reduction in number of satellite sites (table 3 and figure 3). Most campsites also experienced a decrease in area of satellite sites (table 3 and figure 4). Only the decrease in number of satellite sites was statistically significant, however. The site with the largest increase in number of satellite sites was John's Camp (4 new satellites). Hospital Bar was the camp with the most satellite sites and the largest satellite area. Hospital Bar was the campsite on which satellite area decreased most, while Tumble Creek was the campsite on which satellite area increased most.

Table 3. Changes on satellite sites associated with each main camp, Middle Fork, 1996 to 2009.

	Number	Area (m^2)	Sand (%)	Rock (%)	Bare (%)	Veget (%)	Litter (%)
Mean							
1996	8.2	203	23	5	23	28	20
2002/4	7.7	144	36	5	20	13	26
2009	5.1	152	16	10	21	13	20
Median							
1996	5	126	17	3	19	22	18
2002/4	6	66	32	4	9	8	15
2009	4	41	0	4	20	11	23
# of Sites, 1996-2009							
Decreased	8	7	3	3	3	5	4
Increased	2	4	3	4	4	4	5
Unchanged	1	0	5	4	4	2	2
Significance	0.05	0.47	0.41	0.35	0.79	0.19	0.99

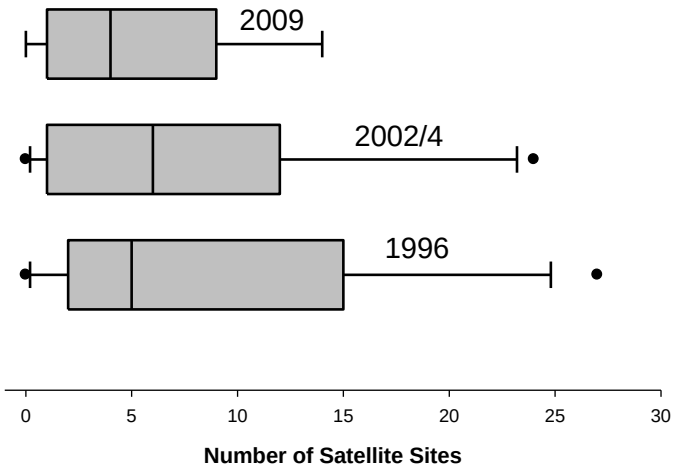

Figure 3. Change in the number of satellite sites per campsite, Middle Fork, 1996 to 2009.

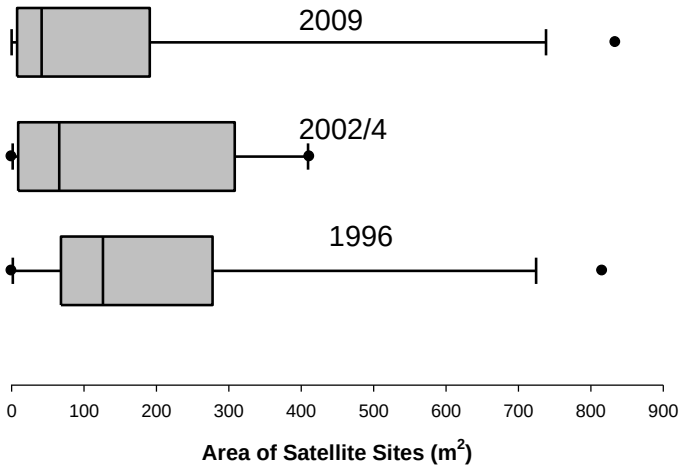

Figure 4. Change in total area of satellite sites per camp, Middle Fork, 1996 to 2009.

Compared to the main camp, more of the groundcover on satellite sites was vegetation and litter and less was sand and bare soil. This probably reflects less severe camping disturbance on the satellite sites. None of the groundcover categories changed significantly between 1996 and 2009 (table 3 and figure 5). This mirrors what happened on control sites, where groundcover categories did not change significantly over the period (Table 4).

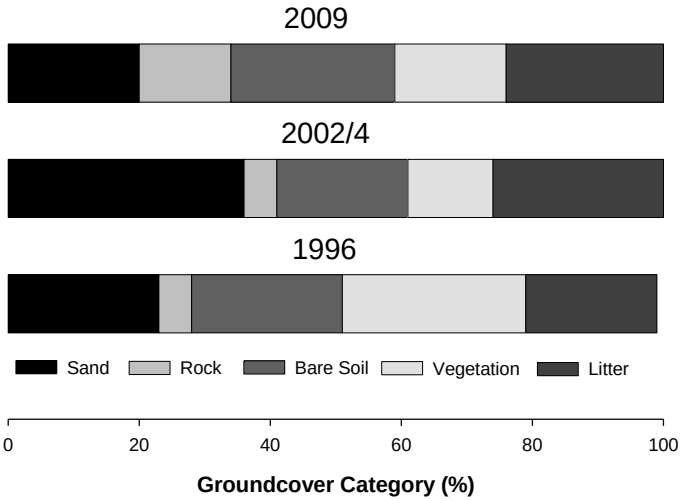

Figure 5. Change in groundcover of satellite sites, Middle Fork, 1996 to 2009.

Table 4. Changes on control sites, Middle Fork, 1996 to 2009.

	Sand (%)	Rock (%)	Bare (%)	Veget (%)	Litter (%)
Mean					
1996	0	6	4	56	33
2002	0	5	9	43	43
2004	0	5	10	42	43
2009	0	5	14	49	33
Median					
1996	0	6	3	58	34
2002	0	6	2	41	50
2004	0	5	2	44	45
2009	0	5	6	50	27
1996-2009 Change:					
Decreased (# of sites)	0	3	0	4	1
Increased (# of sites)	0	0	3	1	3
Unchanged (# of sites)	6	3	3	1	2
Significance	NA	0.21	0.16	0.42	0.97

When both main camp and satellite sites are considered together, the largest camps were Little Pine, Hospital Bar and Tumble Creek; the smallest were Sunflower Flat, Pool and Last Chance. Overall, conditions were remarkably stable. Median campsite area declined from 671 m^2 in 1996 to 538 m^2 in 2002/2004 (table 5 and figure 6), but differences were not statistically significant. More campsites decreased in area than increased; the burned over Hospital Bar and Pistol Creek camps were the ones that decreased most in area. Tumble Creek increased most in area, with Culver Creek and Pool also increasing.

Table 5. Changes on the entire campsite, main camp and satellite sites, Middle Fork, 1996 to 2009.

	Area (m^2)	Sand (%)	Rock (%)	Bare (%)	Veget (%)	Litter (%)
Mean						
1996	1085	28	11	32	16	14
2002/4	693	37	6	31	12	13
2009	971	28	16	31	12	13
Median						
1996	671	17	12	33	15	14
2002/4	598	31	4	34	14	14
2009	538	15	14	41	14	15
# of Sites, 1996-2009						
Decreased	7	3	2	4	4	5
Increased	3	5	5	4	2	6
Unchanged	1	3	4	3	5	0
Significance	0.39	0.80	0.42	0.82	0.29	0.63

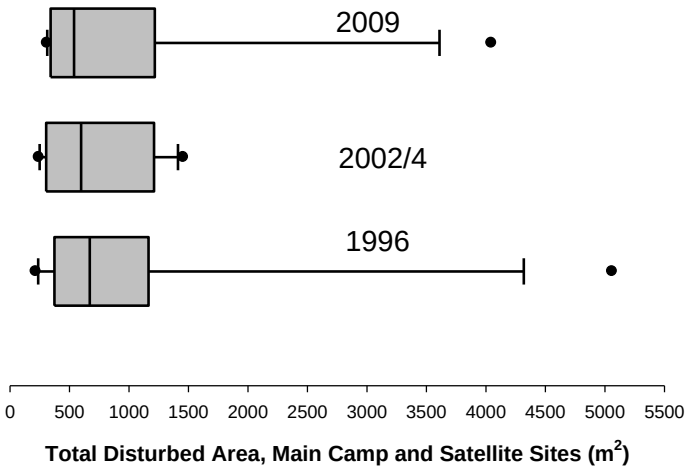

Figure 6. Change in total area of the camp, main camp and satellite sites, Middle Fork, 1996 to 2009.

For the entire campsite, both main camp and satellite sites, none of the changes in groundcover categories were statistically significant (table 5). The decline in vegetation that occurred on campsites was smaller than the decline that occurred on control sites. The most sizeable change was an increase in rock (figure 7). It is not clear whether this reflects a natural change or is a result of recreation use.

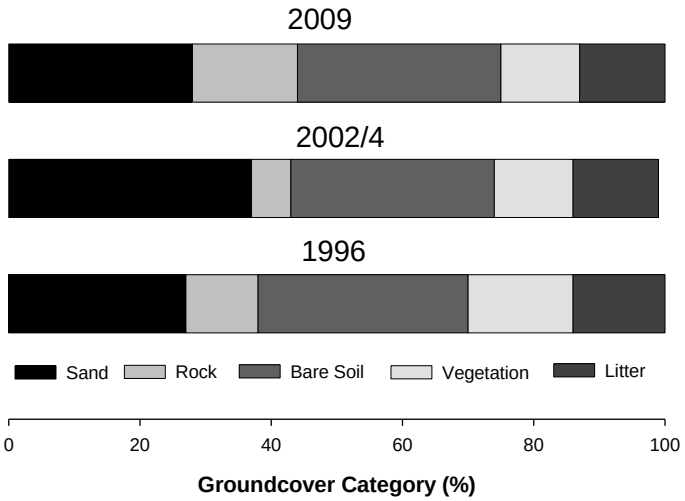

Figure 7. Change in groundcover of the total site, main camp and satellite sites, Middle Fork, 1996 to 2009.

We assessed various attributes of the "cleanliness" of these campsites—the number of firerings, the number of ashpiles, the number of built structures or firewood piles, the number of instances of improper human waste disposal and the volume of garbage. All of these attributes were highly changeable, being largely eliminated each time the river rangers patrol the river. All of these attributes were found in low quantities and did not differ significantly between the two observation times (table 6 and figure 8).

Table 6. Changes in cleanliness of the campsites, Middle Fork, 1996 to 2009.

	Firerings (#)	Ashpiles (#)	Structures/ Piles (#)	Human Waste (#)	Garbage (l)
Mean					
1996	0	0.5	0.7	0.2	0.01
2002/4	0.1	0.1	0.8	0.2	0.07
2009	0	0.1	0.5	0.1	0.09
Median					
1996	0	0	0	0	0.01
2002/4	0	0	1	0	0.01
2009	0	0	0	0	0.01
# of Sites, 1996-2009					
Decreased	0	1	3	2	0
Increased	0	1	1	1	3
Unchanged	11	9	7	8	8
Significance	NA	0.46	0.27	0.59	0.15

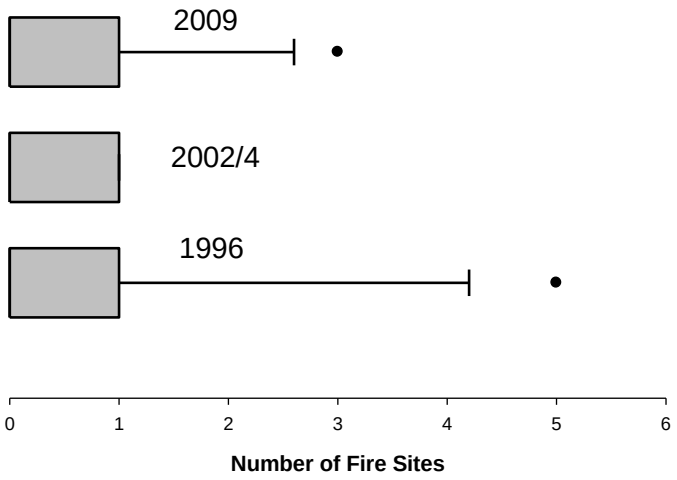

Figure 8. Change in the number of fire sites per campsite, Middle Fork, 1996 to 2009.

We also assessed the magnitude of camper-inflicted damage to each tree on the main camp. The "slightly-damaged" category also includes trees that were not damaged at all. This category decreased, although the decrease was not statistically significant (table 7 and figures 9 and 10). Tree damage was minimal compared to the damage that typically occurs on wilderness campsites away from the river. Changes resulted more from wildfire and management response than from recreational use.

Table 7. Changes in tree damage on the campsites, Middle Fork, 1996 to 2009.

	Slightly Damaged (#)	Moderately Damaged (#)	Severely Damaged (#)	Stumps (#)	Damaged Trees (%)
Mean					
1996	9.1	0.9	0.1	1.1	9
2002/4	6.1	0	0.1	0.2	14
2009	4.3	0.9	0.4	1.4	26
Median					
1996	5	0	0	0	3
2002/4	1	0	0	0	0
2009	1	0	0	0	0
# of Sites, 1996-2009					
Decreased	5	3	0	0	1
Increased	0	3	2	2	5
Unchanged	6	5	9	9	5
Significance	0.10	1.00	0.19	0.19	0.16

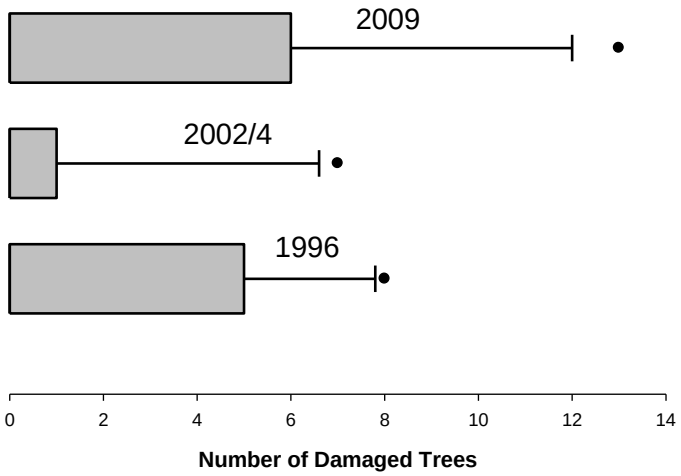

Figure 9. Change in number of damaged trees per campsite, Middle Fork, 1996 to 2009.

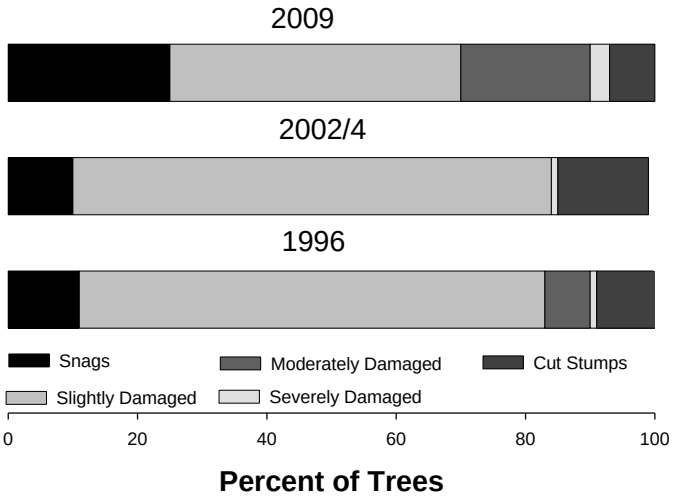

Figure 10. Change in tree damage, Middle Fork, 1996 to 2009.

All of these camps had social trails connecting the main camp to tent pads, toilet sites, the river, etc. Elkhorn, Hospital Bar, and Little Pine all have more than 20 social trails. The number of social trails decreased significantly between 1995 and 2009; the total length of trails also decreased but not significantly (table 8, figure 11 and figure 12). Substantial decreases occurred on the Little Pine and Tumble Creek camps, although in the case of Tumble Creek, this resulted from an expansion of the camp and satellites.

Table 8. Changes on social trails associated with campsites, Middle Fork, 1996 to 2009.

	Number	Length (m)	Class 1 (%)	Class 2 (%)	Class 3 (%)
Mean					
1996	17.2	317	47	42	10
2002/4	14.3	279	24	59	17
2009	11.8	261	42	42	15
Median					
1996	22	257	45	44	8
2002/4	12	298	20	64	14
2009	8	136	43	46	18
# of Sites, 1996-2009					
Decreased	6	5	7	6	2
Increased	3	5	3	5	5
Unchanged	2	1	1	0	4
Significance	0.05	0.21	0.50	0.97	0.28

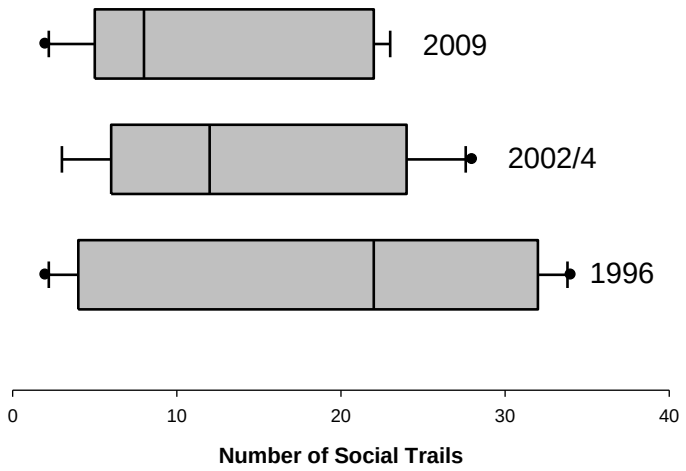

Figure 11. Change in the number of social trails per campsite, Middle Fork, 1996 to 2009.

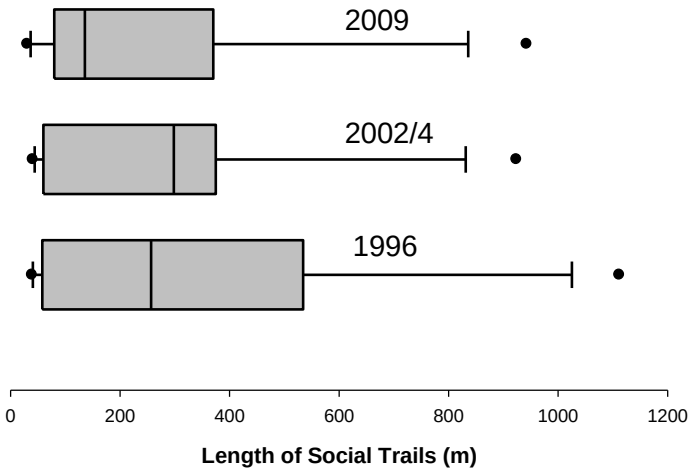

Figure 12. Change in the total length of social trails per campsite, Middle Fork, 1996 to 2009.

The proportion of the trail system given a class 1 rating (the lowest level of impact) decreased between 1996 and 2009, while the proportion given a class 3 rating (deeply incised) increased (table 8 and figure 13). Neither change was statistically significant, however. Moreover, such a change likely reflects recovery of class 1 trails that are no longer used (a result of the decrease in number of trails).

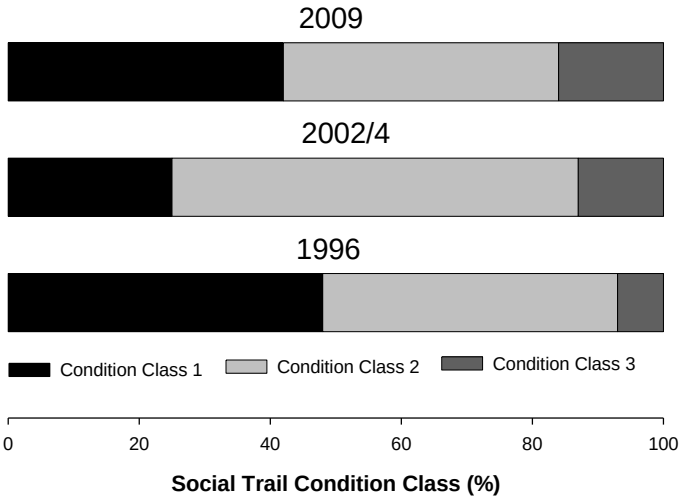

Figure 13. Change in the condition class of social trails, Middle Fork, 1996 to 2009.

Results for the Main Salmon

Thirteen campsites on the Main Salmon were initially assessed in 1995 or 1996 (Table 9). They were reassessed in 2001 or 2002 and again in 2008. In addition, conditions on four control sites were assessed.

Table 9. Sample campsites on the Main Salmon River.

Campsite Name	River Mile
Fawn Creek	56.6
Lower Devil's Teeth	59.6
Big Squaw	64.3
Sandy Hole	70.2
Magpie Creek	76.1
Bargamin Creek	78.5
Twin Snags	84.0
Ruff Creek	89.3
Five Mile Creek	99.2
South Fork	103.2
Warren Bar	107.5
California Creek	117.5
Johnson Creek	122.8

Campsite Conditions

Like the Middle Fork campsites, the most notable characteristic of these campsites was their large size and their web of social trails and satellite sites. On the mean campsite, the main site was 1182 m^2 in 1996 and satellite sites added another 110 m^2. There were over 112 m of social trails. Main Salmon campsites are typically even larger than Middle Fork sites, although they have fewer satellite sites and social trails. Although vegetation cover is sparse on these campsites, vegetation was probably sparse on these sites prior to recreation use. The typical site is mostly sand and rock below the high water line. Such substrates are highly durable. They can be frequently used without substantial impact.

Changes on Campsites Between 1996 and 2008

The size of campsites was relatively stable over the 12-year period. Both the mean and median size of the main camp declined slightly, and a few more campsites decreased in size than increased (table 10 and figure 14). The campsites that experienced the largest increases in main camp size were Lower Devil's Teeth, California Creek and Johnson Creek. Increases reflected sand deposition after high water years more than recreation use. The main camps that decreased most were South Fork and Twin Snags, both of which received little use from the floaters on the Main Salmon. South Fork camp also burned in 2000. Most of the groundcover on most main camps was sand and rock, in 1996, 2002 and 2008 (fig. 15). Between 1996 and 2009, sand increased significantly (paired t-tests, $p < 0.05$) and rock decreased significantly.

Table 10. Changes on the main camp, Main Salmon, 1996 to 2008.

	Area (m^2)	Sand (%)	Rock (%)	Bare (%)	Veget (%)	Litter (%)
Mean						
1996	1182	49	21	9	14	7
2001/2	1154	53	21	12	5	8
2008	1160	64	10	9	7	10
Median						
1996	905	53	15	3	5	3
2001/2	837	59	16	3	3	3
2008	715	80	14	0	3	3
# of Sites, 1996-2008						
Decreased	7	3	7	7	5	2
Increased	5	7	1	2	1	5
Unchanged	1	3	5	4	7	6
Significance	0.72	0.02	0.03	0.97	0.10	0.25

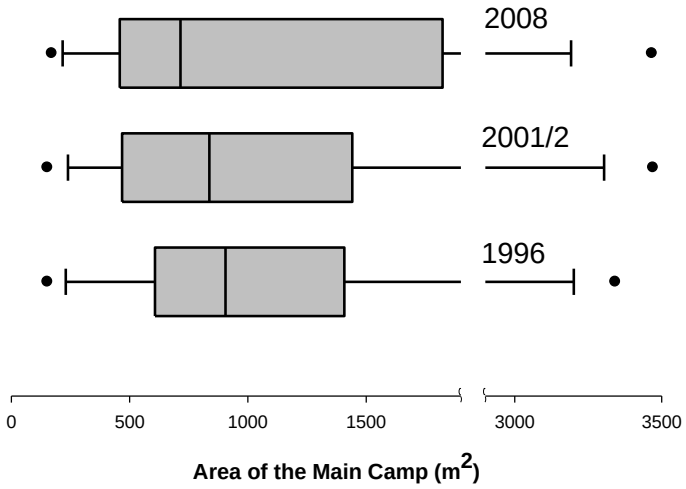

Figure 14. Change in area of the main camp, Main Salmon, 1996 to 2008.

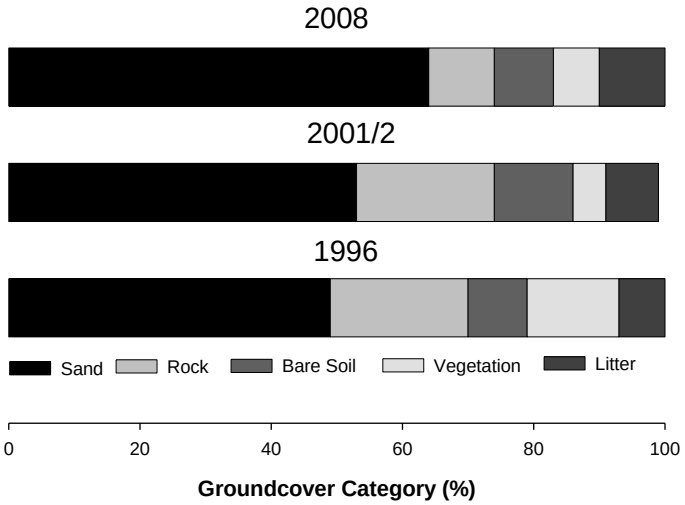

Figure 15. Change in groundcover of the main camp, Main Salmon, 1996 to 2008.

All but one of these campsites (Johnson Creek) had satellite sites in 1996; the satellite site at Twin Snags disappeared between 1996 and 2008. Although the median number of satellite sites per campsite was unchanged between 1996 and 2008, seven campsites experienced a reduction in number of satellite sites (table 11 and figure 16). Satellite area also decreased, although not significantly (table 11 and figure 17). Bargamin Creek was the camp with the most satellite sites and the largest satellite area. Bargamin Creek was the campsite on which satellite area decreased most, while South Fork was the campsite on which satellite area increased most.

Table 11. Changes on satellite sites associated with each main camp, Main Salmon, 1996 to 2008.

	Number	Area (m^2)	Sand (%)	Rock (%)	Bare (%)	Veget (%)	Litter (%)
Mean							
1996	4.8	110	25	5	21	31	18
2001/2	4.0	73	31	6	19	12	33
2008	3.7	74	24	7	15	15	22
Median							
1996	3	41	19	3	5	27	13
2001/2	3	32	35	3	8	10	24
2008	3	36	4	3	10	14	14
# of Sites							
Decreased	7	7	3	5	6	9	3
Increased	3	6	5	5	5	3	5
Unchanged	3	0	5	3	2	1	5
Significance	0.06	0.12	0.94	0.49	0.51	0.05	0.25

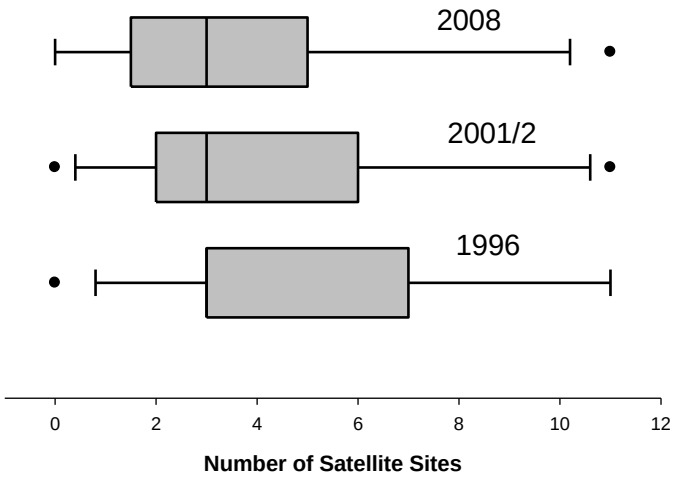

Figure 16. Change in the number of satellite sites per campsite, Main Salmon, 1996 to 2008.

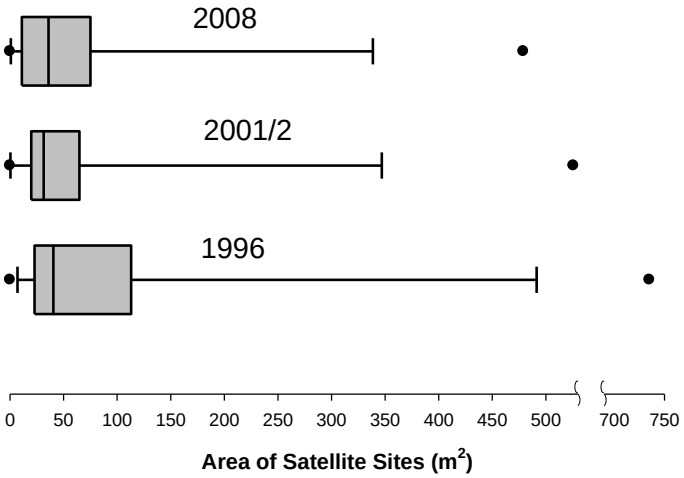

Figure 17. Change in total area of satellite sites per camp, Main Salmon, 1996 to 2008.

The satellite sites are more likely than the main camp to be located above high water. Consequently, less of the groundcover is sand and rock. Vegetation cover on satellite sites declined significantly between 1996 and 2008 (table 11 and figure 18). However, the decline in vegetation cover was not much greater than occurred on undisturbed control sites (table 12). This suggests that more of this change was a result of climatic fluctuation (extended drought) than recreational use.

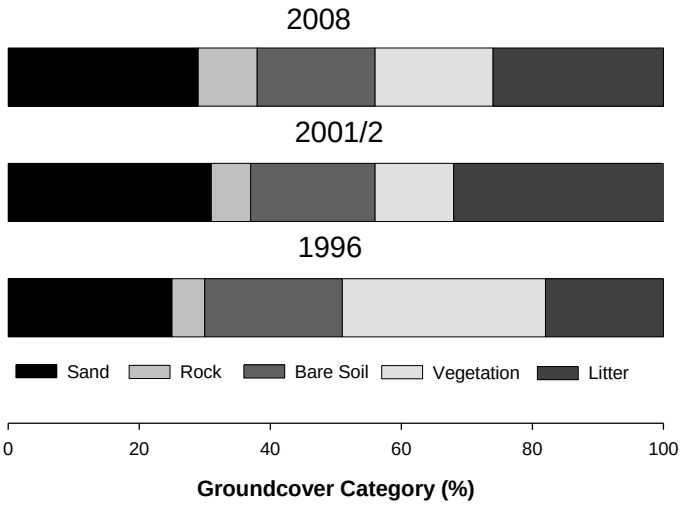

Figure 18. Change in groundcover of satellite sites, Main Salmon, 1996 to 2008.

Table 12. Changes on control sites, Main Salmon, 1996 to 2008.

	Sand (%)	Rock (%)	Bare (%)	Veget (%)	Litter (%)
Mean					
1996	13	7	10	43	29
2001/2	24	6	4	31	36
2008	36	10	1	34	20
Median					
1996	5	6	2	42	31
2001/2	27	6	<1	27	38
2008	36	9	0	31	14
# of Sites, 1996-2008					
Decreased	0	1	2	3	2
Increased	3	3	0	1	2
Unchanged	1	0	2	0	0
Significance	0.18	0.26	0.35	0.11	0.51

When both main camp and satellite sites are considered together, the largest camps were California Creek, Warren Bar and Lower Devil's Teeth; the smallest were Ruff Creek, South Fork and Sandy Hole. Lower Devil's Teeth increased most in area, while South Fork and California Creek decreased most. The changeableness of conditions is reflected in the fact that California Creek was the camp that increased most between 1996 and 2002. Changes on campsites reflect changes in river regime more than recreational use. Overall, conditions were remarkably stable. Median campsite area declined from 929 m^2 in 1996 to 804 m^2 in 2008 (table 13 and figure 19), but differences were not statistically significant.

Table 13. Changes on the entire campsite, main camp and satellite sites, Main Salmon, 1996 to 2008.

	Area (m^2)	Sand (%)	Rock (%)	Bare (%)	Veget (%)	Litter (%)
Mean						
1996	1292	49	20	9	13	8
2001/2	1178	55	22	10	6	7
2008	1201	66	10	8	6	10
Median						
1996	929	51	15	3	13	4
2001/2	861	56	23	3	3	4
2008	804	75	14	3	4	4
# of Sites, 1996-2008						
Decreased	11	1	7	6	7	1
Increased	2	9	1	3	0	6
Unchanged	0	3	5	4	6	6
Significance	0.34	0.01	0.02	0.60	0.03	0.28

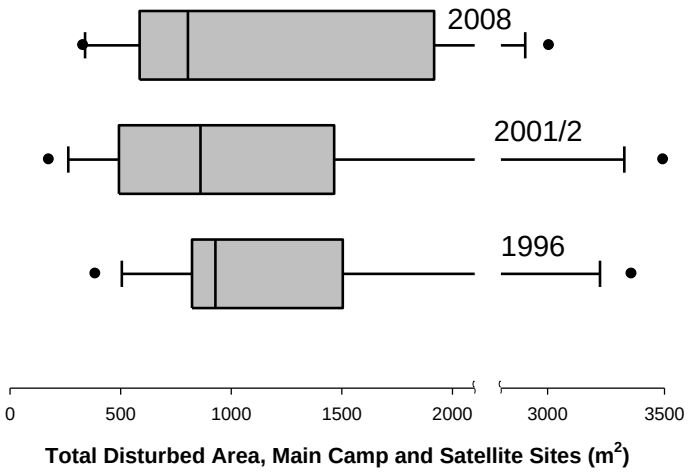

Figure 19. Change in total area of the camp, main camp and satellite sites, Main Salmon, 1996 to 2008.

For the entire campsite, both main camp and satellite sites, sand increased significantly over the 12-year period, while rock and vegetation cover decreased significantly (table 13 and figure 20). Again, these changes likely reflect deposition of sand after high water years. Moreover, the magnitude of these changes was similar to some of the changes that occurred on undisturbed control sites (table 12).

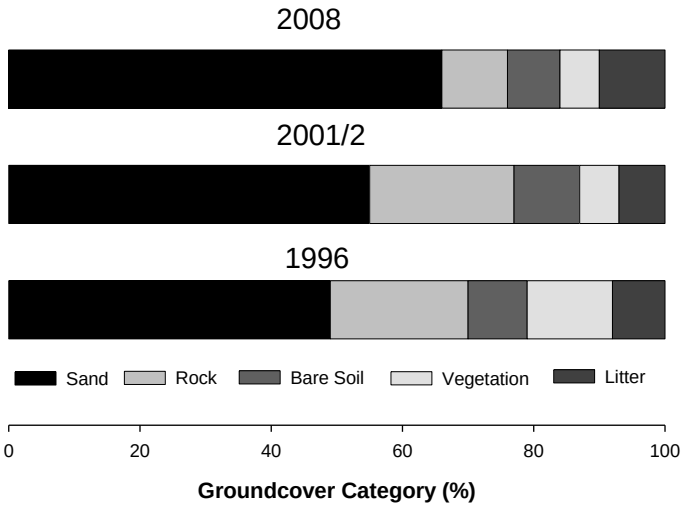

Figure 20. Change in groundcover of the total site, main camp and satellite sites, Main Salmon, 1996 to 2008.

The attributes of "cleanliness" that we assessed were highly changeable, being largely eliminated each time the river rangers patrol the river. All of these attributes were found in low quantities and did not differ significantly between the two observation times (table 14 and figure 21).

Table 14. Changes in cleanliness of the campsites, Main Salmon, 1996 to 2008.

	Firerings (#)	Ashpiles (#)	Structures/ Piles (#)	Human Waste (#)	Garbage (l)
Mean					
1996	0.2	0.6	0.3	0.2	0.5
2001/2	0.1	0.1	0.8	-03	0.3
2008	0.2	0.2	0.6	0.2	0.2
Median					
1996	0	0	0	0	0.3
2001/2	0	0	1	0	0
2008	0	0	0	0	0
# of Sites, 1996-2008					
Decreased	1	5	3	2	6
Increased	1	2	5	2	2
Unchanged	11	6	5	9	5
Significance	1.00	0.17	0.55	1.00	0.23

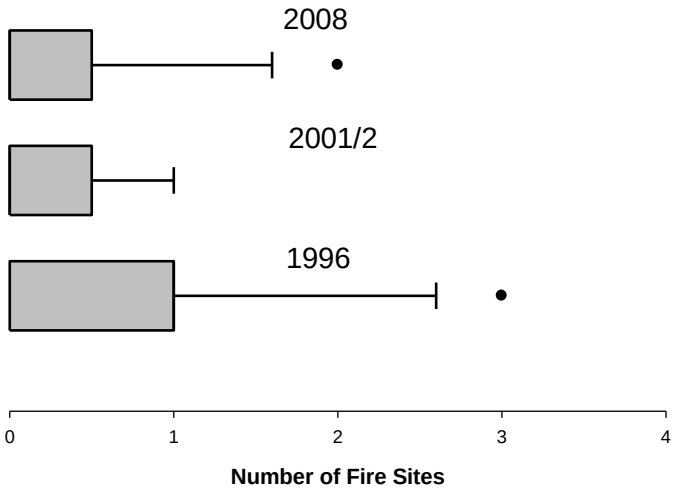

Figure 21. Change in the number of fire sites per campsite, Main Salmon, 1996 to 2008.

Tree damage was also minimal compared to the damage that typically occurs on wilderness campsites away from the river and did not change significantly between 1996 and 2008 (table 15 and figures 22 and 23).

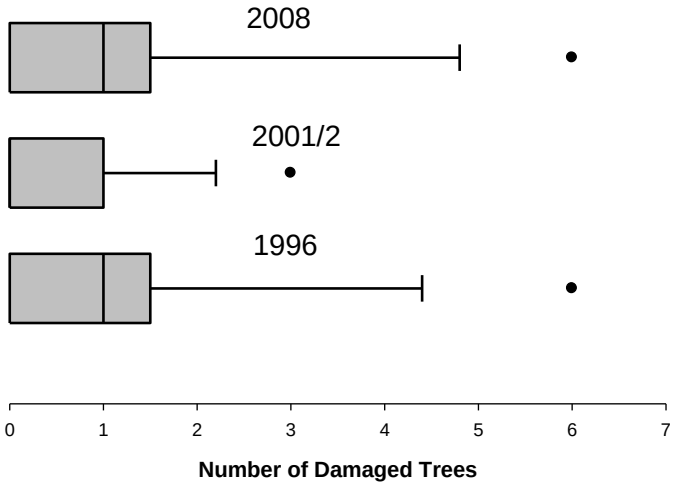

Figure 22. Change in number of damaged trees, Main Salmon, 1996 to 2008.

Table 15. Changes in tree damage on the campsites, Main Salmon, 1996 to 2008.

	Slightly Damaged (#)	Moderately Damaged (#)	Severely Damaged (#)	Stumps (#)	Damaged Trees (%)
Mean					
1996	3.0	0.5	0.2	0.3	23
2001/2	3.2	0.2	0.2	0.2	22
2008	2.5	0.7	0.2	0.3	32
Median					
1996	1	0	0	0	15
2001/2	2	0	0	0	13
2008	2	0	0	0	25
# of Sites, 1996-2008					
Decreased	6	0	1	2	2
Increased	2	2	1	2	3
Unchanged	5	11	11	9	8
Significance	0.34	0.17	1.00	1.00	0.24

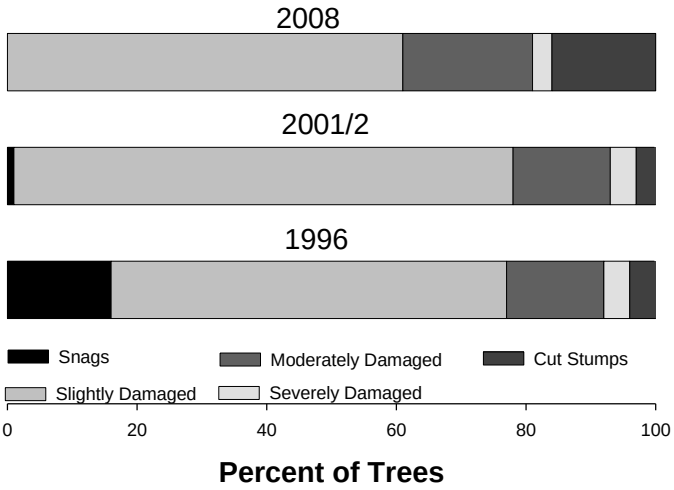

Figure 23. Change in tree damage, Main Salmon, 1996 to 2008.

All of these camps, with the exception of Johnson Creek, had social trails in 1996; the social trail at Twin Snags disappeared between 1996 and 2008. The camps with the most social trails are Magpie Creek, Bargamin Creek and Warren Bar. Although the number and length of social trails did not change significantly between 1996 and 2008 (table 16), the number and length of social trails did increase on a number of sites, including some of the sites that had many trails in 1996, such as Lower Devil's Teeth and Warren Bar (figures 24 and 25).

Table 16. Changes on social trails associated with campsites, Main Salmon, 1996 to 2008.

	Number	Length (m)	Class 1 (%)	Class 2 (%)	Class 3 (%)
Mean					
1996	5.9	112	47	46	7
2001/2	6.1	121	25	65	11
2008	6.2	136	17	71	11
Median					
1996	4	89	46	51	0
2001/2	3	71	21	64	2
2008	4	97	7	66	0
# of Sites, 1996-2008					
Decreased	5	6	12	2	1
Increased	6	7	0	10	4
Unchanged	2	0	1	1	8
Significance	0.74	0.34	0.01	0.09	0.44

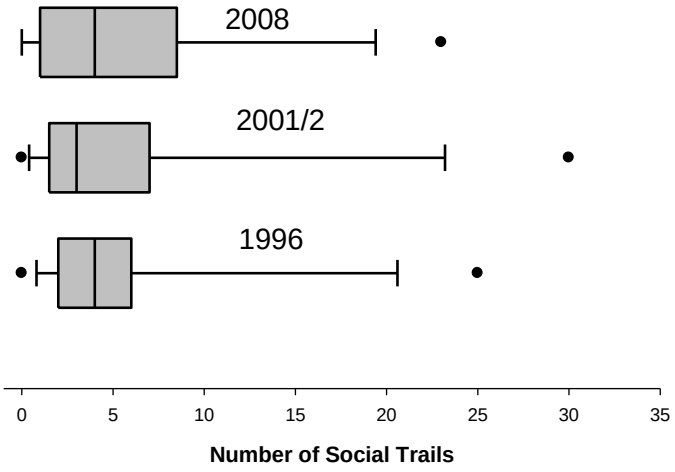

Figure 24. Change in the number of social trails per campsite, Main Salmon, 1996 to 2008.

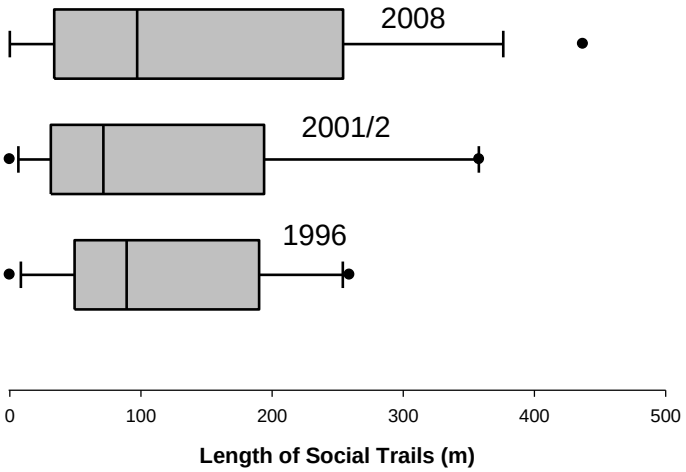

Figure 25. Change in total length of social trails, Main Salmon, 1996 to 2008.

The most consistent increase in impact, between 1996 and 2008, was deterioration in the condition of the social trails. The proportion of the trail system given a class 1 rating (the lowest level of impact) decreased significantly (table 16 and figure 26). The proportion of both class 2 and class 3 trails increased, although these increases were not statistically significant.

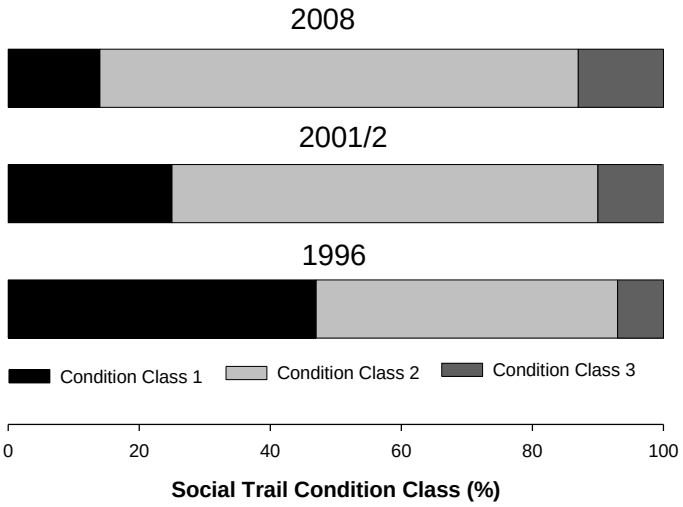

Figure 26. Change in the condition class of social trails, Main Salmon, 1996 to 2008.

Conclusions and Implications

Results for the period of 1996 to 2008/9 were largely similar to those for the period of 1996 to 2002/4. Most campsites were relatively stable over this 13-year period. Indeed differences between 1996 and 2008/9 were generally less than differences between 1996 and 2002/4 or between 2002/4 and 2008/9. There was some evidence from both river segments that total area of disturbance might be decreasing slightly, primarily a result of a reduction in the use and number of satellite sites dispersed away from the main camp area. On the Middle Fork, there was also some evidence of a decrease in social trailing, a trend not evident on the Main Salmon. Although generally stable and perhaps improving slightly, these campsites remain highly disturbed.

As noted after the 2002/4 assessment, these results illustrate four points about recreation impacts and management along popular rivers like the Middle Fork and Main Salmon Rivers. First, use levels—and therefore impact potential--are extremely high. Use and impact would be even higher if management had not restricted use. Without proper management and visitor behavior, popular campsites can degrade severely. Even with proper management, certain types of impact will inevitably be severe.

Second, campsite conditions are strongly affected by the type of use these rivers receive. In particular, the large size of many groups results in extremely large campsites. Large groups cannot be accommodated in a small centralized campsite. They spread out over a large central site and--more problematically—disperse to satellite tent sites above the high water line, creating a web of trails. Moreover, sites above high water have vegetation and soil that is more seriously impacted by trampling. Impact here is longer lasting because higher terraces are not "rejuvenated" by frequent floods. Impacts above high water and the proliferation of satellite sites and trails is more problematic on the Middle Fork than on the Main Salmon. Education and regulations should promote concentrating use on the main camp area and below high water to the extent possible.

Third, on high volume rivers, extensive beach deposits below high water create highly durable camping surfaces. This favorable attribute compensates substantially for the high impact potential of heavy use by large groups. River managers might consider limiting group size such that tent sites are unnecessary above the high water mark.

Finally, Leave-No-Trace education and behavioral restriction (firepan and porta-potty requirements) are readily accepted by river floaters. Their implementation has succeeded in nearly eliminating the impacts that are most responsive to behavioral characteristics. Campfire remains and improperly disposed waste have largely disappeared along rivers. Such efforts should be continued. Frequent river patrols are also highly effective in removing evidence of the infrequent aberrant behavior that does occur (littering, campfires, etc.).

We had expected that changes on these campsites would be minimal, given the high durability of the camping surfaces, the success of the use limitation, Leave No Trace and river patrol programs, and the fact that these campsites have been established for a long time. Nevertheless, this "benchmarking" campsite monitoring program is essential to ensuring that impacts do not slowly and imperceptibly increase over time. The rapid assessment techniques applied to all of the campsites are not precise enough to accurately portray the relatively minor shifts in condition that occurred on these campsites between 1996 and 2009. The benchmarking should be continued as a supplement to the rapid assessments that have been made on all campsites. It only needs to be done every five

years (or so). It requires 3-4 people and each of the two river segments can be done on a single trip of about 9 days or two shorter trips. This is a small investment, given the tremendous value of this recreational resource.

Acknowledgments

Much of the original impetus for the benchmaking program came from Peter Kola and Tony Botello, with assistance from Linda Hagedorn. Field assistance provided by many river patrolers is appreciated.

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