

1997 VISITOR IMPACT AND MONITORING PROGRAM TRANSECT SUMMARY BRYCE CANYON NATIONAL PARK

Introduction

Bryce Canyon National Park has recorded increases in visitation of about 10% per year over the past decade. In 1993, the park had an annual visitation of over 1.6 million people. The majority of visitors tend to frequent the more prominent overlooks such as Sunrise, Sunset, Inspiration, Bryce Point, Farview, and Rainbow Point. Due to this high visitation, the overlooks are heavily affected by foot traffic, especially in areas where people choose not to stay on established trails.

In the spring of 1994, transects were established in different areas of high general public use. The transects were established to collect information that would help park managers understand impacts of heavy visitor use on the natural environment of overlooks. Prior to this, the park did not have a monitoring program to determine visitor impacts on vegetation or soils. Measuring parameters such as vegetation cover, bare ground, and soil compaction in areas of heavy, moderate, and light visitor use enables us to establish trends in human-caused impacts. Understanding these trends and causes can help determine effective actions for mitigating the impacts. Transect readings in areas differing in amounts of human usage will allow comparison and determination of "acceptable" impacts.

Methods

Ten transects were established along the main amphitheater. The transects were laid out parallel to the rim, enabling measurement of trails to and from the rim. Two of these transects were located in areas with little or no impact to serve as a control of what a natural or non-impacted area would be.

Each transect is 100 meters in length with plots (Dabenmeier square measurements) established at 5 meter increments, giving 20 plots per transect. Readings were estimated and recorded for percent cover of grass, forb, shrub, litter, and bare area using Dabenmeier codes. Trees or woody material were not recorded since people do not tend to walk on them.

Soil penetrometer (compaction) measurements were also taken at 5 meter increments. Soil penetrometer measurements were not taken in 1997. Penetrometer measurements tell us how much the soil has been compacted by foot traffic or other causes.

Social trails crossing the transect were recorded at the first and last point of intersection. For example, if a trail is first encountered at 15'3" and last encountered at 16'5" it would be recorded with these measurements. This provided us with an actual measurement of bare area due to social trails along the transect. We considered a social trail to be three or more sets of footprints on the same route or a distinct path developed. Designated (hardened) trails were measured and included in the calculations. Although these designated trails were established by the park, they still represent "bare ground", where vegetation does not exist. The width of a designated trail generally is a constant, unless changed by the park.

In 1994, transects were established and read once in the spring, before heavy visitation, and again in the fall, as the visitation began to lighten. In 1995, all transects were read twice except for the Sunrise Point transect, which could not be re-located. The Sunrise Point transect was replaced in the fall and an additional transect was established in the Swamp Canyon Connecting Trailhead area. In 1996 and 1997, all 11 transects (9 study and 2 control transects) were read once in the spring.

Results and Discussion

In 1995, the percent cover of bare ground increased 2.79% over 1994 measurements (Table 1). In 1996, the percent cover for bare ground increased an additional 10.57%. However, the 1996 increase in bare ground may not accurately reflect an increased vegetation loss. Instead, this increase may be due to an over estimation since the total percent cover for the study and control transects were 119.49% and 132.81%, respectively. The over estimation of the 1996 total percent cover was due to new data collection personnel.

In 1997, there was a small increase in bare ground from 1996 of 0.09%. If compared to 1995 figures there is an increase of bare ground by 11.47%. This indicates that even with the over estimation in 1996 that there is a trend toward an increase in bare ground. Since 1994, there has been a 14.26% increase in bare ground, with a 8.02% decrease in organic materials

Table 1. Average Annual Percent Cover for Study and Control Transects.

Study Transects									
	Percent Cover							Percent Cover	
Year	Grass	Forb	Shrub	Litter	Bare	Totals		Organic	Bare
1994	6.35	3.68	18.36	24.10	38.31	90.80		52.49	38.31
1995	6.04	2.51	19.80	21.43	41.10	90.88		49.78	41.10
1996	3.60	1.23	23.92	39.07	51.67	119.49		67.82	51.67
1997	2.90	1.78	18.60	21.19	52.57	97.04		44.47	52.57
Three Year Average	4.72	2.30	20.17	26.45	45.91	99.56		53.64	45.91
Control Transects									
	Percent Cover							Percent Cover	
Year	Grass	Forb	Shrub	Litter	Bare	Totals		Organic	Bare
1994	22.59	7.97	29.88	32.97	5.19	98.60		93.41	5.19
1995	26.75	7.47	31.53	28.16	4.44	98.35		93.91	4.44
1996	11.06	1.56	31.94	68.06	20.19	132.81		112.62	20.19
1997	7.25	2.06	29.38	38.75	18.81	96.25		77.44	18.81
Three Year Average	16.91	4.77	30.68	41.98	12.16	106.50		94.34	12.16

When comparing the study transects to the control transects there is a noticeable difference in amount of bare ground (Table 1). The four year average for bare ground for the study and control transects were 45.91% and 12.16%, respectively. However, in 1997, the average percent for bare ground actually decreased by 2.22% in the control transects. Again, these figures include the over estimated 1996 data, however it is important to note that the study transects, on average, have over four times the amount of bare ground as do the control transects.

When assessing visitor impacts on vegetation it is important to measure attributes directly related to the visitor. Measuring percent cover of organic matter (grass, forbs, shrubs, and litter) and bare ground may not truly reflect impacts directly attributed to visitors on vegetation, particularly from year to year. Other environmental factors, such as, fire, weather (annual rainfall, erosion, and temperature), and wildlife (numbers of and types of herbivores) may decrease organic matter and/or increase in bare ground.

To show that the trampling effect of hundreds of visitors was the primary cause of vegetation loss, and perhaps to mitigate the environmental effects and/or observer biases, all social trails that traversed the transects were measured from the first and last point of intersection. In 1994, the average total trail length for the study transects was 19.19 meters, and in 1995, this increased an additional 24.49% to 23.89 meters (Table 2). However, in 1996 there was a 5.48% decrease in trail length. Again in 1997, there was an increase an additional 16.08% to 26.21 meters. Overall, since 1994 there has been an 36.58% increase in trail length along the study transects, which equates to a 9.15% increase per year. No trails were measured along the control transects since these transects are not located near heavy visitor use areas.

Table 2. Average Trail Length for Study and Control Transects.

Study Transects			
	Total Trail	Percent Change From	
Year	Length (m)	Prior Year	1994
1994	19.19		
1995	23.89	24.49%	
1996	22.58	-5.48%	17.67%
1997	26.21	16.08%	36.58%
Three Year Average	21.89		
Control Transects			
	Total Trail		
Year	Length (m)		
1994	0.00		
1995	0.00		
1996	0.00		
1997	0.00		

A third measurement taken during this study was penetrometer readings. These measurements were taken to determine whether social trails increase soil compaction, and if soil compaction continues to increase annually along the study transects. This measurement was not taken in 1997 due to lack of complete equipment. Also, it was determined that the soil compaction does not change as much from year to year as from spring to fall. In 1997, the study was only completed one time during the summer.

When comparing 1994 to 1996, soil compaction increased 5.85% in the study transects (Table 3). Of more interest is that soil compaction has increased 15.14% in the control transects. A more applicable indicator of visitor impacts is that the three year average of soil compaction for the study transects are compacted 31.96% more than the control transects.

Bryce Canyon NP has over 200 freeze-thaw cycles per year. These freeze-thaw cycles (nivation) help reduce soil compaction, particularly when the soils are moist during the winter and early spring months. However, we can not ignore that soil compaction does have an adverse impact on vegetation. When soils become compacted, seeds can not penetrate the surface to establish themselves. Also, compacted soil absorb less water, which is critical for the survival of vegetation, therefore increasing the potential for erosion. Once erosion begins, the nutrient rich top soil is removed and vegetation is unable to establish themselves. This vicious cycle will continue until erosion control measures are taken and soil genesis occurs.

Table 3. Average Penetrometer Reading for Study and Control Transects.

Study Transects			
Year	Penetrometer Readings	Percent Change From Prior Year	
1994	9.92		
1995	10.30	3.83%	
1996	10.50	1.94%	5.85%
Three Year Average	10.24		
Control Transects			
Year	Penetrometer Readings	Percent Change From Prior Year	
1994	7.73		
1995	6.64	-14.10%	
1996	8.90	34.04%	15.14%
Three Year Average	7.76		

Management Implications

It is important to keep in mind that no scientific statistical analysis has been performed on the data and that only 4 years of data has been collected. As noted with the 1996 data set some observer bias has been introduced into the study since data was collected by different resource management personnel from year to year. Additional data sets (at least five to eight years) need to be collected before any trends can be determined.

This monitoring program is an important study of visitor impacts on vegetation. This program may not demonstrate a trend of a certain amount vegetation loss per year due to visitor impacts. The vegetation impacts may have peaked. If this is true then this monitoring program may be more important in determining which mitigating actions (rope barriers, wooden barriers, small rock walls, etc.) are more effective at reducing visitor impacts. Also, when mitigating actions are taken, this monitoring program will provide baseline data to determine how quickly vegetation recovers in impacted areas.

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