

1998 VISITOR IMPACT AND MONITORING PROGRAM TRANSECT SUMMARY

BRYCE CANYON NATIONAL PARK

Introduction

In 1997, Bryce Canyon had an annual visitation of over 1.68 million people (up from 1.60 million in 1993). 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 visitor 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 the determination of an "acceptable" level of impact.

Methods

In 1994, 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 transects representing natural, non-trammeled areas.

Each transect is 100 meters in length with plots (Dabenmeier square measurements) established at 5 meter increments, (from 0 to 95 meters,) 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 and logs were not recorded since people do not tend to walk on them.

Soil penetrometer (compaction) measurements were also taken at 5 meter increments. Penetrometer measurements tell us how much the soil has been compacted by foot traffic or other causes. Soil penetrometer measurements were taken in 1994-1996, but were not taken in 1997 or 1998.

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 each 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 was not read because it could not be 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, all eleven transects (nine study and two control transects) were read once in the spring. In 1997 and 1998, the eleven transects were each read once in mid-July.

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%. 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%. However, in 1998, the percent of bare ground decreased by 11.67% from the previous year. This decrease does not fit with the overall trend toward an increase in bare ground. It is possible that the decrease in bare ground was due to yet another new group of data collectors, or the fact that total percent cover for the five years of the study ranges from 90.80% to 119.49%. However, even when the percent cover has been standardized, the averages for percent bare area still show a general trend toward slightly increasing bare ground within the study transects, (Table 2).

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
1998	2.90	2.57	17.50	28.49	46.43	97.89		51.46	46.43
Five Year Average	3.86	2.02	19.96	27.55	47.87	101.25		53.38	47.87
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
1998	7.44	3.44	26.81	47.81	14.75	100.25		85.50	14.75
Five Year Average	15.02	4.50	29.91	43.15	12.68	105.25		92.58	12.68

Table 2. Standardized Percent Cover for Study Transects.

Study Transects									
	Percent Cover							Percent Cover	
Year	Grass	Forb	Shrub	Litter	Bare	Totals		Organic	Bare
1994	6.99	4.05	20.22	26.54	42.19	100.00		57.81	42.19
1995	6.65	2.67	21.79	23.58	45.23	100.00		54.79	45.23
1996	3.01	1.03	20.02	32.70	43.24	100.00		56.76	43.24
1997	2.99	1.83	19.16	21.84	54.17	100.00		45.83	54.17
1998	2.97	2.62	17.88	29.10	47.43	100.00		52.57	47.43
Five Year Average	4.52	2.46	19.81	26.75	46.45	100.00		53.55	46.45

When comparing the study transects to the control transects there is a noticeable difference in amount of bare ground (Table 1). The five-year average for bare ground for the study and control transects were 47.87% and 12.68%, respectively. It is important to note that the study transects, on average, have almost 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 thousands 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. The total distance of all trail intersections is called the trail length for that transect. In 1994, the average total trail length for the study transects was 19.19 meters (Table 3). This increased to 25.06 meters in 1998. While there are only five years of data available, the general trend seems to be towards a slight increase in average trail lengths with the exception of a small (5.48%) decrease in 1996 and a huge increase (75.48%) in 1997. The large increase in 1997 seems incongruous with the data collected

Table 3. 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	39.62	75.48%	106.48%
1998	25.06	-36.75%	30.60%
Five Year Average	26.07		

during other years and could be attributed to different researchers collecting the data and how they interpreted what actually constituted a trail. Or, there may have been more scattered footprints within the bare areas due to more people walking through the bare areas or wet soil which caused footprints to remain visible for an extended period of time. Overall, since 1994 there has been a 30.60% increase in trail length along the study transects. No trails were observed along the control transects since these transects are not located near heavy visitor use areas.

A third measurement taken during the first three years of 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. The most notable finding of the penetrometer survey was that the three-year average of soil compaction was 31.96% greater in the study transects than the control transects.

The data collected also showed that the soil compaction does not change as much from year to year as from spring to fall. Bryce Canyon NP has over 200 freeze-thaw cycles per year. These freeze-thaw cycles help reduce soil compaction, particularly when the soils are moist during the winter and early spring months. Because of this year to year recovery in soil compaction, a decision was made not to continue taking penetrometer readings.

Research Limitations, Problems, and Suggestions

It is important to keep in mind that no scientific statistical analysis has been performed on the data and that only five years of data have been collected. Any attempt to assess trends is limited because of the limited data. Additional data sets (at least three to five years) need to be collected before any trends can be determined.

Some observer bias has been introduced into the study because different resource management personnel collected data from year to year. As noted above, the percent coverage for 1996 averaged well over 100 percent, (119.49% for the study transects and 132.81% for the control transects). This can be remedied by keeping a close watch on total vegetation percentages while collecting the data. Observer bias may also have played a part in the trail intersection lengths in 1997.

While the research methodology is fairly straight forward, there are a few areas where data collection can vary from year to year. Beginning and ending points of each transect are set, however, terrain, shrubs and wind can make it difficult to set the 100 meter tape exactly straight between the two points. Therefore, Dabenmeier square readings can be taken in slightly different places each year. In order to make reading more consistent from year to year, a few steps should be added to the methodology. An attempt should be made to do the VIMP at the same time each year. Transect readings should preferably be taken on calm days. Because the terrain rises and dips, the 100 meter tape should not be stretched taut, but instead be laid on the ground where possible or draped on top of shrubs. The transects vary in length from 90 to 100 meters, but the last reading on each transect should be at 95 meters even if the last reading extends beyond the end of the transect. In the past, some transects had only 19, rather than 20 Dabenmeier square readings, which may alter yearly averages slightly. Throughout the study, trail length measurements have been taken in feet and then converted to meters to compare yearly data. It would be advisable to change the data collection procedures and field recording sheets to allow for the collection of trail length in meters

rather than feet.

When reviewing trail length data, it is interesting to note that trail length varies from year to year with what appears to be a general trend towards trail length increase. Yet many questions remain unanswered. Are the current trails becoming wider? Are more trails being developed? Are areas with scattered footprints turning into defined social trails? At this time, trails are defined as anything from three sets of footprints to paved park trails. It may help clarify trends in visitor impacts if trails were categorized as "scattered footprints," "well defined social trails," and "designated park trails."

Management Implications

This monitoring program is an important study of visitor impacts on vegetation. The program may not demonstrate a trend of a certain amount vegetation loss per year due to visitor impacts. Instead, 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.

An example of the effects of mitigating actions occurred in 1998 on transect 7-7 near Inspiration Point. In early July 1997, a string barrier was erected along the trail to Inspiration Point. Prior to this, many visitors had cut from the trail through the native vegetation to the parking lot. The 1997 VIMP recorded a total of seven separate trails intersecting the transect for a total of 25.30 meters. The average trail length for this transect from 1994 - 1997 was 18.58 meters. In 1998, there was only one trail crossing the transect for a total length of 1.22 meters. However, the amount of bare ground only decreased slightly (from 45.88% to 42.38%) indicating that while footprints were no longer visible on old social trails, the vegetation has yet to recover. A permanent wooden fence is planned to replace the current string barrier, providing an excellent site for studying the recovery rate of vegetation.

Transect 6-6 near Sunset Point has also shown decreased trail length due to fencing. Total trail length in 1994 was 29.26 meters. This went down significantly in 1995 to 12.31 meters. A note on the data collection sheet from 1995 suggests that this change was due to "blocking 5 trails with pine limbs." The total trail length increased again in 1996 to 23.01 meters. During the summer of 1996, secondary fencing was placed along the designated trails from the parking lot to Sunset Point. By 1998, the only trails crossing the transect were three designated park trails with a total trail length of 9.14 meters.

Several observations were made while doing transect 9-9 at Swamp Canyon. While the pulloff is designated as parking for the Swamp Canyon / Sheep Creek Connecting Trail, it is used much more often as an overlook than a trailhead. However, the position of the parking is not located next to the overlook, but about thirty yards to the north. This means that visitors are making numerous social trails to get to a place on the rim where they can see the canyon. In addition, the Swamp Canyon / Sheep Creek Connecting Trail is indistinguishable from the social trails. Some social trails were blocked off with logs and the Connecting Trail was lined with a few rocks following the VIMP in

1998. However, placing a small sign to indicate the Connecting Trail would probably reduce some confusion. In addition, the entire pullout should be evaluated before beginning road construction in the area. Since people are using the pullout as an overlook, it may be more appropriate to move the parking area to the south so it is adjacent to the view. Otherwise, fencing the parking area, but providing access to the view and the Connecting Trail with designated trails would reduce the numerous social trails and trampling of vegetation in the area. ✓

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