

Impact Monitoring and Restoration in Mount Rainier NP

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Each year about 2 million people come to Mount Rainier NP. Day hiking and camping are among the most popular activities; subalpine and alpine meadows are the most frequently visited destinations (Johnson et al, 1991). Almost 3/4 of all visitors go to Paradise, a beautiful subalpine meadow located on the main park road.

The Paradise area has been a popular attraction since 1915, when the road first was opened to automobiles (Martinson, 1966). Other subalpine areas, such as Spray Park, have been heavily used since the 1890s, when hundreds of tourists were guided in over mining roads (Martinson, 1966). This sustained level of heavy use has resulted in numerous bareground and/or severely eroded areas. To deal with this problem, Mount Rainier has developed a comprehensive system of impact monitoring and restoration. The program was developed first for the Paradise Meadows and now has been extended to the entire park.

Paradise Restoration

The Paradise meadows encompass approximately 389 ha (960 acres) and extend from 1,646 to 2,256 m (5,400' to 7,400') in elevation. Most of the meadow is within the subalpine parkland zone (Franklin and Dyrness, 1984), although a small portion is above treeline and is dominated by alpine vegetation. Park policy is to discourage off-trail hiking due to the fragility of the subalpine vegetation, but off-trail travel still persists, causing new impacts and perpetuating existing bare-ground impacts.

In 1986 the park began a large scale program to repair human-caused impacts in the meadow. The first step was to form an interdivisional committee to write a plan for protection and restoration of the meadow (Rochefort, 1989). Members of the committee were Doug Buehler (Interpretation), Mike Carneyu (Trails), Steve Gibbons, Rick Kirschner and Garry Olson (Ranger Division), Bob Elmore (Landscape Architect), and Regina Rochefort (Botanist, chairperson).

The plan was developed over a 3 year period; steps included field surveys of impacts, sociologic surveys regarding noncompliance and optimal control methods (Johnson and Swearingen, 1988), and development of a method to rate and rank impacts for restoration.

Impacts Documented

Field surveys in 1986 and 1987 documented 913 human-caused bareground impacts in the meadow. Approximately 89 percent were informal "social" trails. The remaining impacts (11%) were large bareground or trampled areas used as rest and/or view points. Impact dimensions are variable: lengths range from 0.5 to 1,500 m, widths from 0.1 to 25.6 m, and depths from 0.01 to 0.95 m.

The sociologic study, conducted by Darryll Johnson and Thomas Swearingen (U/WA CPSU), tested 7 sign texts, 2 types of barriers, and the influence of a uniformed NPS employee



Impact sites are stabilized with silt bars, ready for filling and revegetation.



Restoration crew is shown here installing stabilization bars or silt dams; the area in the foreground has been filled with gravel and will next be filled with soil.

on off-trail hiking. The authors also developed a profile of non-compliers.

The study showed that the standard sign text in use at that time (Meadow Repairs, No Hiking) was the least effective text tested. Both barriers were effective, but the yellow polypropylene rope was more effective than split rail fencing, perhaps because many visitors came from urban areas and equated ropes to area closures. The sociological study also indicated that the mere presence of a uniformed NPS employee reduced non-compliance to a negligible level, showing that visitors did indeed know they were expected to walk on maintained trails.

The study results led to revised regulatory sign texts within the meadow, additional interpretive signs in the meadow and visitor center exhibits, and increased meadow roves by Interpretive Rangers.

Restoration Rating Criteria

Restoration rating criteria were developed by the Paradise Plan Committee, Dr. William Rippe (OR/State/U), and Susan Fritzke (now at Yosemite NP), to quantify relative damage of each site and the potential for continued damage, and to produce a ranked list of all impacts for restoration. The rating is the product of 2 numeric values: soil erosion potential, and aesthetic or visual quality (Rochefort, 1990).

Seven factors are used to estimate soil erosion potential: vegetation type, soil texture, length of impact, depth of impact, width of impact, slope, and percent bare ground. Three factors are evaluated to determine the visual quality of the impact: distance from a developed trail, visibility, and accessibility. In addition, notations are recorded on a number of qualitative factors: safety hazards; presence of rare, threatened, or endemic species; laws or regula-

tions affecting the site; and potential impacts on aquatic or wildlife resources.

Impacted sites are ranked numerically, but if the impact affects one of the qualitative factors, it can be raised to the top of the prioritized list during annual, interdivisional reviews. All field data are entered into a computer data base (dBase program, which can be run on any IBM compatible computer), developed by Dr. Richard Frenzel. The computer data base calculates numeric rating values of each impact and prints reports of numeric values, qualitative factor notations, and the supplies required for restoration of individual sites (e.g. soil and gravel volumes, numbers of greenhouse plants). The program also contains modules for entering reports on restoration efforts (supplies used, hours spent, costs, materials, etc.) and monitoring results.

Restoration Methods

Restoration of individual impacts involves 6 steps: scarification, stabilization, filling, revegetation, site protection, and monitoring (Rocheft, 1990). Many sites have become compacted and must be scarified to enhance root penetration and water percolation. Impacts deeper than 3 cm require stabilization to impede downhill movement of soil. Wood or rock silt bars are installed as subsurface erosion control structures.

Following stabilization, the site is filled to the grade of the adjacent undisturbed area. Fill material consists of 3 components: rock, gravel, and topsoil. All topsoil is purchased from outside the park but specifications require it to be approximately the same soil texture, pH, and organic matter content as that of native soils. Soil is steam sterilized to prevent importation of exotic seeds.

Once the site has been filled to grade, it is revegetated, using 3 techniques: seeding, trans-

planting, and natural revegetation. Most sites in Paradise are seeded and planted rather than allowed to revegetate solely by natural means. All seeds are collected as close to the impacted site as possible, to maintain the genetic integrity of the site. Transplants are either salvaged from within the impacted site prior to filing, or grown in the park's greenhouse from seeds or plant stock collected in close proximity to the impacted site (Davis, 1991).

Mount Rainier NP has completed restoration of 35 social trails; an additional 24 sites have been partially completed. Restoration over the past 6 years has cost \$810,000 and required 24,404 workhours. Approximately 30 percent of this cost has been personnel wages; the remainder has been for supplies, materials, and private helicopter use. The work has required 645 m³ of soil, 260 m³ of gravel, 137 m³ of rock, and 29,150 greenhouse and/or salvaged plants.

Park-wide Applications

Impact surveys in Paradise began in 1986 and were completed in 1987. In the winter of 1987, it was decided to expand the impact monitoring program to Spray Park. Paradise methods were revised and further tested in Spray Park. These methods now are used systematically to survey management zones within the park's Wilderness as funding permits. Impact monitoring is carried out on alpine areas by Rocheft; subalpine and forested areas are monitored by Natural Resource Specialist Barbara Samora. Currently 11 of the park's 22 alpine zones and 5 of the 33 subalpine zones have been inventoried (1,591 total impacts). Impact data are used both to direct restoration efforts and to develop Limits for Acceptable Change (LAC) standards within the park's Wilderness. Currently LAC standards have been revised for 8 alpine zones, 1 alpine camp, and 2 subalpine zones based on impact surveys (e.g.

revised limits on numbers of camping parties/night).

All impacts are entered into 1 data base and restoration efforts are directed at the highest priority impacts. Restoration plans are developed by a variety of personnel, depending on the size of the impact. Small projects are the responsibility of the area ranger; larger projects have been planned by the Botanist or an interdivisional committee.

Pam Griffin supervises restoration crews that work on large projects such as those now underway in Paradise, Spray Park, and Sunrise. Implementation of large projects also rely on substantial support from trail crew and roads personnel. Protection and monitoring of restored areas is a shared responsibility of Ranger, Interpretive, and the Planning and Design and Natural Resource divisions.

Rocheft, Botanist at Mount Rainier NP, is pursuing her Ph.D. at U/WA; Gibbons is a Natural Resource Specialist in the NPS Pacific Northwest Regional Office as well as National Natural Landmarks Coordinator.

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