User Created Trail Impacts – Literature Review

USFS Red Rock District - 2014

KEY POINTS

1) **The Red Rock District lies within an environmental region that is highly susceptible to user created trail damage**
2) **The placement of a trail relative to the soils and topography is the predominant factor in its sustainability.**
3) **Horses, hikers and mountain bikers create separate and unique types of damage to a trail.**

- **Trail location/placement has a much higher influence on soil erosion than trail user type.**
    - "Using statistical analysis they (researchers) found that about one third of total sediment mobilization could be attributed to the various user groups, and the remaining two thirds attributed to the solid texture and the slope of the sample trail plot." (Wilson and Seney, 1994).
    - "Early users widen and deepen trails much more than later users. This suggests managers can limit unplanned compaction and vegetation damage by appropriately planning and building the trail in the first place.

- **The environmental conditions in the southwest (Arizona/New Mexico) make the region highly susceptible to trail damage resulting from various user groups.**
    - "Maximum trail width and incision were greatest in the Arizona/New Mexico region, perhaps due to environmental features such as erodible soils and sparse trailside vegetation, higher use, and/or user behavior." (White et al. 2006).

- **Hikers/walkers and mountain bikes create their own unique impacts, however, the cumulative degree of impact they each exert on the land is similar.**
    - "Research to date has indicated that the degree of impacts from mountain bikes, relative to those of walkers who have their own unique forms of impacts, appear to be similar." (Weir, 2000).
    - "Hiker and bicycle plots were not significantly different from each other." (Seney/Wilson 1994).

- **The varying factors of weight, energy output, and swath all contribute to the total land impact of a specific user.**
    - Land Impact = ((weight + output acceleration) x swath) (York, 2000).

- **The rolling action of a wheel over a trail tread CAN increase the sheer strength of the tread and help it resist erosion; however, the skill of the rider is paramount in the equation. The riding style of a novice biker can often cause significant damage via skidding/sliding down grades or around turns. In-expert riders descending steep slopes often break and skid, causing ruts which funnel water and damage tread.**

- "Repeated passes by bicycles…tend to compact the soil of a trail tread. Vertical compaction tends to push particles closer together, thereby increasing shear strength. An increase in shear strength of the soil will have greater ability to resist erosive forces." (Weir, 2000).
- "Wheel-driven vehicles can check their speed by using braking mechanisms integral to the vehicle, without necessarily applying a shearing force to the soil surface. Though again, operator skill and decisions can influence this, as in the case of a novice mountain biker skidding downhill." (Weaver, 1978).
- "Wheels apply shearing force to the ground either during acceleration or braking." (Cessford, 1995).

- **Although similar in cumulative impact, hikers tend to produce marginally more sediment than mountain bikes through the unique shearing force that walking produces.**
  - "the feet of a hiker damage trails and vegetation in two distinct phases. First the heel applies compaction in the first part of the step. Second the toe applies shearing forces as it rotates through the step. This shearing (force) accounted for the greatest share of a human foot's damage." (Quinn et al., 1980).
  - "They found that users on foot make more sediment available than do users on wheels." (Seney/Wilson 1994).

- **Mountain bikes can create unique damage due to the long, continuous swaths of wear they apply to the soil, which can cause water to channelize and form gullies. Hikers to not exert this specific impact.**
  - "because wheeled vehicles create long, continuous swaths of wear, they may be more prone to "channelizing" the soil (the creation of gullies through which water can easily flow). Wear caused by feet create discontinuous pockets of disturbance less likely to result in such gullies." (Keller, 1990).

- **Grasses are the most resilient vegetation type to trampling and the impacts of hiking and mountain biking tend to be short-term with fast recovery after use is halted.**
  - "gramanoids appear to have the greatest resistance and recovery capacity among plant forms." (York, 1997).
  - "both hiking and mountain biking impose fairly similar short-term damage and…vegetation recovers quickly once either use is halted." (Thurston and Reader, 2001).

- **Under some circumstances, horses can be more damaging to the soils than hikers, causing higher sediment yields and higher rates of soil bulk density reduction. In the Sedona area the hoof action of horses tends to break the hardened and protective trail tread surface, creating sediments that can be washed away with rain. In addition, the weight of the horse and rider on rocky trail surface tends to pop out and displace rocks, creating more loose material for rain to wash away.**
  - "Horse traffic resulted in statistically higher sediment yields (the primary indicator of trail deterioration) than either hiker or llama traffic…Horses can cause at least four times as much impact to trails under the conditions simulated in this experiment…In addition, under dry trail conditions horse traffic caused significant reductions in soil bulk density (a measure of how compacted the soil is)." (DeLuca and Cole, 1998).

"On level ground horseback riders cause the most damage and hikers the least." (Weaver and Dale, 1978) (*STUDY DID NOT INCLUDE MOUNTAIN BIKES*)

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