

Learning to Live with Off-Highway Vehicles: Lessons Learned from the Dixie National Forest

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Introduction

Nationwide, there are an estimated 446,000 miles of road on United States Forest Service (USFS) lands—four times that of any other public land management agency (USDA 2000; Havlick 2002). Most USFS roads were developed as part of a network to access timber on some 192 million acres of forested land during the past century (Forman et al. 2003). In recent years, operators of privately owned off-highway vehicles (OHVs), have adopted many of these roads and adjacent lands for recreational purposes. A 1995 survey revealed that 28 million adults identified OHV driving as one of their preferred recreational activities, a 44 % increase since 1983 (Cordell 1999). The OHV user group includes owners of the ever-increasing number of trucks and sport utility vehicles (SUVs), more than 2.3 million off-road motorcycles, and 3.9 million three- and four-wheeled all-terrain vehicles (ATVs) (Forman et al. 2003). According to an Oak Ridge National Laboratory study, OHVs traveled more than 27 billion off-road (unpaved) miles in the U.S. in 1997 (Davis et al. 1999). The trend of increased OHV use is expected to continue, due in part to population growth, advances in recreation equipment technology, expanded availability of information (internet/guidebooks), and increased accessibility to once-remote areas (Flather and Cordell 1995; USDI 2003).

The need for monitoring OHV impacts was recognized as early as 1972 and again in 1978 by the Nixon and Carter administrations, respectively. Executive Orders 11644 and 11989 mandated all federal land managers to immediately close off areas to OHV use where these vehicles were causing *considerable adverse effects*.³ Landscape fragmentation, soil erosion and compaction, reductions in air and water quality, and wildlife disturbance resulting from OHV use are well documented in relevant literature (Andrews and Nowak 1980; Webb and Wilshire 1983; Knight 1995, 2000; Hammitt and Cole 1998; Spellerburg 2002). In addition, management and user conflicts associated with OHV use have become increasingly contentious in recent years (Schubert 1999; Fisher and Blahna 2001; Nodal and Foti 2003). Despite having gained knowledge from a broad range of environmental and social studies related to OHV impacts over the past several decades, effective management of on-the-ground OHV use on public lands has yet to be fully realized. Quantifying overall resource impacts created by such a large user group over such vast expanses of land remains a somewhat daunting, albeit necessary endeavor to protect the resource base and minimize conflicts among the multiple uses of public lands.

In 2000, a collaborative effort between the Natural Resource Coordinating Council of Utah and the National Off-Highway Vehicle Conservation Council identified nearly 100 OHV “hotspots” throughout Utah. Twelve of these were areas among the five Dixie National Forest (DNF) ranger districts considered to be either at greatest risk of becoming or already proven to be of high concern for OHV management (Wagner 2002). The DNF contracted with Northern Arizona University (NAU) to conduct a systematic inventory of physical environmental impacts related to OHV use within these twelve hotspots. The physical impact assessment work focused on identifying baseline data regarding type, range, and extent of physical impacts in an efficient and feasible manner, with the goal of determining site variables appropriate for ongoing monitoring of OHV use. This paper provides an overview of the methods used to collect physical site variables associated with OHV use based on the DNF inventory, a proposed monitoring protocol for OHV areas, and a discussion, including implications, of observations made during this study with regard to OHV and road related policy in the Dixie National Forest.

Methods

To determine the best methodology for the project, the researchers at NAU conducted a review of literature related to OHV impact monitoring. Findings indicated a dearth of research related to landscape-scale approaches for

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³ According to the USFS Manual §2355.05 a “considerable adverse effect” is “that which is or may become irreparable because of the impossibility or impracticability of performing corrective or remedial measures.” The condition of “considerable adverse effects” can be based on physical and biological conditions, such as slope, vegetation, soil erosion and compaction; surface and subsurface hydrology, a site’s natural rehabilitative capability and lack of manpower or funding to mitigate damages caused by OHV (Schubert 1999).

monitoring OHV impacts. The NAU/DNF team chose to adapt other recreational monitoring protocols, based on the principles of “Limits of Acceptable Change,”¹ which provides the foundation for a range of recreational and campsite monitoring programs (Stankey et al. 1984; Hammitt and Cole 1998; Leung and Marion 1999). The result was the creation of a new impact monitoring protocol for OHV-related impacts in a southwest environment.

Prior to conducting the baseline inventory of the twelve DNF OHV hotspots, we developed a specific monitoring protocol by defining the study site and data collection format and designing the site assessment forms and a database system appropriate for storage/analysis of data collected.

Study Site. The DNF consists of approximately 2 million acres, which occupy a diverse transition zone between the Colorado Plateau and Great Basin geographical provinces of south central and southwestern Utah. This region of high mountain plateaus and steep canyons extends from the upper Sonoran Zone (5,000-6,800 ft.) to the Hudsonian/Alpine Zone (9,500-11,300 ft.) (USDA 1987).

The DNF officially recognizes 3,443.2 miles of roads within its jurisdiction.² Of these, 1,442 miles were located within the 260,520 acres of the twelve hotspots. Some OHV hotspot areas were reported to have road densities as great as 4.8 miles per square mile. As a guideline, the maximum density allowable in the current Dixie National Forest Land and Resource Management Plan was two miles of road per square mile (USEPA 2001b).

Data Collection Format

Utilizing Geographic Information System (GIS) maps from a 1998 DNF road survey, we identified roads within the twelve hotspots that traversed the greatest total area while intersecting with a high number of secondary roads, trails and meadows to inventory, thereby maximizing the effectiveness of time spent in the field. Based on the number of acres and miles of road within each hotspot, we determined the research route and estimated the number of field research days (or miles/day) and days within each hotspot (out of a total of 55 possible days). The research itinerary indicated a single field season, from May 1 to November 1, 2001.

The field researcher spent approximately one week in the field at a time. Research-related equipment and materials were selected to allow for ease of camping and traveling by ATV. The primary equipment included: an assortment of field maps (7.5 minute quadrangles, GIS road/OHV hotspot maps, and 1998 DNF travel map), Trimble GeoExplorer II® (Global Positioning System [GPS]/datalogger), digital camera, laptop computer w/ Trimble Pathfinder® and photo downloading software, tape measure, and road and site assessment forms.

NAU and DNF began meeting in Fall 2000 to clarify the type and amount of information needed to meet DNF's primary goals. The management goals pertaining to this study were defined as follows:

1. Identify the impacts of motorized recreation use on and off roads and trails to the forest infrastructure, soils, and vegetation.
2. Document OHV encroachment and boundary violations in wilderness areas, private in-holdings, and sensitive areas, and on non-motorized trails.
3. Identify areas where more intensive monitoring may be needed and plans need to be developed to protect resources.

In short, the goal was to create a baseline inventory of OHV use occurring in the twelve high use or “hotspot” regions of the forest by documenting the presence of motorized vehicle impacts on and off roads and trails along approximately 50% (721 miles) of the estimated 1,442 miles of existing roads within the hotspots.

The NAU/DNF team developed the idea of collecting data as a “dynamic stream of information.” This approach allowed the field researcher to follow multiple linear features, such as main roads, ways, or trails, from beginning to end and to obtain cross-sections of an OHV hotspot. While traveling along each linear feature, the researcher documented the presence of all OHV impacts adjacent to or intersecting it. In this way, the field researcher obtained a Rapid Site Inventory (RSI)³ of OHV impacts associated with each identifiable road, way, or trail throughout the hotspots. The RSI

¹ The basic tenets of “The Limits of Acceptable Change”(LAC) include: 1) Resource change in response to human use is inevitable and all site users are consumptive users, 2) How much change to the resource base permitted to occur in an area or on a site is a managerial decision, 3) LAC provides a framework within which decisions about the appropriate amount and extent of change to the resources is acceptable and, 4) Baseline data and follow-up monitoring on a regular basis are critical elements in determining resource changes in an area or on a site.

² The number of officially recognized roads often does not include logging skid roads, roads that have been permanently closed, and private or user created roads and trails. USFS has between 60,445 and 77,070 miles of such existing roads (USDA Forest Service 2000, Havlick 2000).

³ Rapid Site Inventory (RSI), a combination of rapid survey sample and census techniques, targets data collection methods geared toward conducting baseline assessments and establishing a site’s presence for future relocation and monitoring efforts. The primary focus of RSI is “capturing” or documenting *all* encountered impact sites within a given area or trail segment, using a minimal amount of time, usually less than 15-20 minutes

targeted data collection methods maximized the number of documented/inventoried sites possible in the shortest allowable time.

The NAU/DNF team developed five site assessment forms to collect the dynamic stream of information along the identified main roads, ways, and trails. Used together, these forms accurately captured the location, type, and severity of adverse OHV-related impacts on the resource base. The forms were based on a framework for previously developed RSI forms created by NAU for use in Grand Staircase-Escalante National Monument and Zion and Saguaro National Parks.

Initial Road Assessment

Data collection was begun using the primary form, an open-ended Road Assessment form, for each linear segment traveled. The researcher collected relocation information at the beginning of the route, including: the OHV hotspot number, USFS road identifier number, GPS coordinates, and a digital image of the route. The Road Assessment form also required a running tally, from beginning to end, of special attractions and human impacted areas encountered along the route such as: pull-outs and OHV staging areas, cultural resource sites, view points, water access and crossings, and campsites and boundary violations.

The remaining four secondary site assessment forms were designed to document the presence of specific qualities/impacts of sites, namely: Open Area/Meadows, Signed Hike/Bike/Horse Trails, Unsigned OHV Road/Trails, and Signed/Designated OHV Road/Trails. The field researcher conducted appropriate secondary site assessments as encountered the traveled route. A Road Assessment was considered complete only after the researcher had reached the route's end or traveled well outside the established OHV hotspot area, and had tallied all secondary assessment forms, attractions, and other human impacted areas as well as collected final GPS coordinates and a digital image of the road's end. At the end of each Road Assessment, all related secondary site assessment forms were filed together with the primary Road Assessment form.

Secondary Site Assessments

Each secondary site assessment form—Open Areas/Meadows, Signed Hike/Bike/Horse Trails, Unsigned OHV Roads/Trails, and Signed/Designated OHV Roads/Trails—included individual relocation information of GPS coordinates, USFS road identifier number, digital images, and specific site attributes. Site attributes included: trail depth and width measurements, soil surface conditions classifications (rutting/erosion gullies, exposed rock etc.), estimated percentage of vegetation loss on road/trail surface as compared to vegetative cover adjacent to area, types of trail use/misuse, and the observed presence/non-presence of: noxious weeds, trail hazards, campfires, localized tree/shrub damage, sanitary waste, litter, vandalism, cryptobiotic soil impacts, and rock formation impacts. Information on cultural evidence and impacts (cultural dwellings, cultural artifacts, and rock art/historic inscriptions) was also noted. At the end of each form was space for additional field comments regarding individual site impact and relocation documentation.

Data Analysis and Storage

After each field session, the researchers input data sets from the handwritten forms into an Access 2000 database. Digital photos were downloaded to a network server as .jpeg files and renamed with the corresponding road and site ID numbers. GPS coordinates were downloaded from the datalogger or laptop computer to a network server using Trimble Pathfinder® software. In Trimble Pathfinder® the .ssf rover files were differentially corrected via corresponding DNF base station¹ files and renamed as .cor files once corrected. The .cor files were then exported as ArcView shape (.shp) files for GIS applications. All files (Access database, corrected GPS coordinates, and related photos) combined to generate a single new GIS data layer for the larger DNF/GIS database, thus allowing for immediate access and sharing of all inventory information between NAU/DNF.

Results

The premise of this applied research project was to develop a method and to collect a baseline data set or RSI of OHV related impacts within each of the twelve hotspots for future monitoring and comparison. We accomplished this by recording general descriptive site characteristics, digital photos, and GPS coordinates to aid in the future re-location of all sites. Statistical comparisons of the data collected are limited and incomplete until the areas and roads included in this inventory are revisited as part of an ongoing monitoring program. The results of this study, therefore, are useful primarily as a base for future presence vs. non-presence of OHV impacts, and as a gauge for management to realize the extent of

per site. This method allows for a greater number of sites to be inventoried with fewer site specific variables than a typical multiple-parameter monitoring program (Cole 1983; Hammitt and Cole 1998).

¹ [on-line] at: <http://www.fs.fed.us/database/gps/cedarcty.htm>

impacts already present. For example, future monitoring efforts will provide a comparative view to determine whether OHV impacted sites are present in areas of the forest where none were found during the 2001 inventory. This would allow managers to make inferences about the spread of OHV impacts throughout the forested hotspots and eventually to use the results in making informed decisions regarding OHV use within the forest.

General Characterizations and Findings

Between May 1 and November 1, 2001, we completed 118 Road Assessments (589.9 miles) along linear features, such as main roads, ways, or trails, and inventoried the presence of physical impacts related to OHV use. During this time we completed 889 secondary site assessment forms, characterizing: 48 Signed Hiking/Biking/Horse Trails, 172 Open Area/Meadows, 654 Unsigned OHV Trails, and 15 Signed/Designated OHV Trails that intersected with or were adjacent to one of the 118 routes. The study documented a significant network of OHV accessible roads and trails on the DNF, with evidence of recent and continuing OHV use on all 118 inventoried routes. The evidence garnered from either visible tracking or actual OHV encounters by the field researcher, also documented OHV use on >95% of the 889 secondary survey assessment sites. Of the inventoried 118 routes, 21 were classified as levels 3 and 4 (maintained for low-clearance vehicles), and 97 were or contained sections characterized as level 2 (minimally maintained, high clearance vehicle or 4-wheel drive recommended).

The field researcher noted major physical impacts that related to OHV use, including: trail depths >9 inches and trail widths averaging >10 feet, consistent trail rutting along inventoried routes from 3 to 6+ inches, severe hill and switchback impacts in steep areas from vegetative and soil losses, observed shrub/tree damage adjacent to 61% of trails and intersections from cross-country travel, and multiple trailing and trail widening to avoid severely mudded/potholed areas in all use areas. Where roads and trails had been closed to OHVs, the field researcher observed numerous violations. Roads closed with simple mounds/berms and/or log obstacles were easily negotiated. The closure feature was often incorporated as a recreational jump, and appeared to have rarely succeeded in detouring OHV use. Two areas of concern identified as needing more intensive management and additional monitoring as a result of this initial baseline inventory were Signed Hiking/Biking/Horse Trails, and Open Areas/Meadows.

A surprising finding of the study was the high number of Signed Hiking/Biking/Horse Trails (42 of 48) with evidence of OHV encroachment and related impacts. Some trails, by faulty design/planning, were found to be maintained and/or created with a “trail cat”¹ or small bulldozer, often of similar width to an ATV. Consequently, OHV encroachment on the trails was easily accomplished by ignoring or removing management-placed signs and accessing the trail. In other instances, there was evidence that OHV users had taken extensive measures to access non-motorized trails, by moving large boulders, removing posts, chain-sawing trees and logs, or purposefully negotiating terrain to create a new trail around management-placed and/or natural barriers to OHV traffic. Associated impacts of OHV encroachment to Signed Hiking/Biking/Horse Trails were: creation of additional trails on lands adjacent to trailheads, high occurrences of non-compliance with management (>85%), vandalism to signage/kiosks etc. (>25%), widening of single-track trails (>50%), excessive soil and tree/shrub damage (>50%), and higher than average presence of on-site litter.

Open Areas/Meadows showed consistent impacts from OHV off-road or cross-country travel. Of the 172 inventoried, 92 contained multiple trailing throughout the open area or meadow—quite often the result of short-cutting and exploration of an area. Once tracks are present, other users generally follow suit, resulting in new, user-created trails (Weaver and Dale 1978). Another impact noted with Open Areas/Meadows was the presence of “play areas,” which are areas containing several human constructed features normally associated with an established dirt-bike or motor-cross racetrack. These play areas were generally larger than one acre and contained multiple trails with sharp turns, berms, jumps and “kickers,” pits, “whoop-dee-doo,” and other features. Thirteen play areas were encountered along the 118 inventoried routes. Open Areas/Meadows with play areas had high vegetation loss and soil compaction in localized areas and a number of isolated trees with exposed root damage, which was observed to have caused higher rates of mortality compared to adjacent treed areas.

Discussion and Implications

Based on initial inventory results, observations, and the review of available literature, some actions are available to land managers to work toward more sustainable OHV use. Policy revisions addressing methods of road closure, limiting motorized cross-country travel, and establishment of monitoring programs to evaluate the effectiveness of such actions should prove effective strategies for better managing OHV use.

The first step in managing OHV use is to formulate a consistent, comprehensive transportation plan that clearly identifies roads, ways, and trails, both open and closed, to OHV use. Of the 155 national forests, 39 currently use a road

¹ “trail cat” is a generic term used for one of the several brands of miniature, steel tracked backhoes and bulldozers designed to work in tight spaces and recently becoming more popular with trail maintenance and construction.

closure policy wherein all roads, ways, and trails are *closed* to motorized travel *unless posted open* (Schubert 1999). The remaining forests use exactly the opposite strategy, wherein all roads, ways, and trails are deemed *open* to motorized travel *unless posted closed*. A consistent road closure policy throughout the USFS, from forest to forest and district to district, is vital to eliminate confusion and assist OHV users in making better informed decisions about areas in which they are permitted to travel.

In 2001, at the time of the OHV baseline inventory, the DNF was operating on a 1986 Forest Land and Resource Management Plan policy which designated all roads, ways, and trails *open unless posted closed*. It became apparent to managers that they were wasting a great amount of time, money, and resources in continually replacing vandalized or missing “closed to motorized vehicles” and “NO ATV” signage near trailheads of Signed Hike/Bike/Horse Trails, closed roads, and other areas where OHV encroachment was occurring. Illegal removal of signage by OHV users was commonplace. Moreover, sign removal by the user group essentially reopened many posted-closed routes, allowing for continued OHV use until managers were able to re-post closure signs. Additionally, where closure signs had been removed, management had little recourse to pursue violators.

From a management standpoint, it appears that a policy of *closed unless posted open* is an improvement over the other. For example, where a majority of roads and trails require seasonal closures due to spring runoff and soil erosion, closures are more easily implemented if management has only to decide which select routes are *open*, that is, which routes were designed and maintained so as to accommodate OHV travel. In this case, there would no longer be incentive for removal and vandalizing of the posted signs and all OHV users caught traveling routes not posted as *open* would be in clear violation of forest policy.

In 2002, as per our recommendation, the DNF changed to a *closed unless posted open* policy in one high-use portion of the Cedar City ranger district (DNF-D2) as part of the “Duck Creek-Swains Access Management Project” (USEPA 2002). Further, we recommended updating the 2004 Land and Resource Forest Management Plan to adopt a consistent forest-wide *closed unless posted open* policy.

In addition to a clear closure policy, we recommended that the 2004 Plan should also revisit its “off-road and cross-country” travel policy with regard to OHV use. Current off-road and cross-country travel designations allow “open” or unrestricted OHV travel in approximately half or 1 million acres of the forest. Areas restricting motorized travel, known on the Dixie as L1 and L2,¹ often lack distinctive boundaries, which has presented a large problem because OHV users unknowingly travel into more sensitive locations and create trails and adverse impacts in these restricted areas. The recommended change in this policy would reflect the need for more responsible OHV use by ending all off-road and cross-country travel of motorized vehicles. This would serve to decrease the occurrence and proliferation of user-created Unsigned OHV Trails and subsequently minimize the loss of vegetation, soil erosion/compaction, and other adverse effects associated with unplanned roads and trails, especially in Open Areas/Meadows.

To address OHV impacts, we recommended that agency policy must provide the impetus for collection of baseline data on public lands *before* OHV use occurs. Special attention should be paid to locations where OHV travel will be permitted that are bordered by sensitive areas (such as meadows) or routes that present desired technical challenges for OHV users (hiking trails, steep hill climbs, riparian areas, and stream crossings) where significant impacts may occur from OHV use. Once OHV use is established in an area, regularly scheduled monitoring of physical impacts over time is essential in protecting the resource base. Such monitoring provides the premise for management to act if comparative analysis indicates that the resource is experiencing considerable adverse effects.

As a result of the study, the Dixie National Forest will now conduct ongoing monitoring of OHV impacts on the 118 inventoried routes, with the goal of revisiting each route on a two- to three-year rotation. The OHV monitoring program will focus on determining whether OHV use expands to new areas based on presence/non-presence of impacts, and if present OHV impacts become notably more severe over time. Additionally, the DNF is considering conducting social surveys of both OHV and other forest user groups within the five DNF ranger districts. The DNF anticipates that this information, in conjunction with ongoing physical impact monitoring, will allow for a balance of continued forest access to OHV users, while protecting both the needs and management preferences of non-motorized user groups, and the land itself.

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¹ L1—Use limited to routes and travel shown on the map, L2—Opportunities and restrictions vary in these areas. Cross-country travel is limited to snowmobile use with “ample” snow cover (Dixie Travel Map 1998).

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