

Introduction

Recently the Chief of the USDA Forest Service identified four major issues facing National Forests: fire and fuel, invasive species, habitat fragmentation and unmanaged recreation (Bosworth, 2003). On unmanaged recreation, Chief Bosworth said, “The issue is this: Back when we had light recreational use, we didn’t need to manage it; but now that it’s heavier we do” (Bosworth, 2003, p. 7). The Chief cited off-highway vehicle (OHV) use as illustrative of unmanaged recreation. OHVs are motorized vehicles capable of traveling cross-country (in this designation are vehicles used off-road year-round, though winter use can be termed OSV, for over snow). OHV use has grown exponentially in recent years (Cordell, Teasley, Super, Bergstrom, & McDonald, 2002) increasing the need for management of this activity on public lands.

There are several OHV management issues of concern to Chief Bosworth and others. Included in these are: unplanned roads and trails, soil erosion, water degradation, habitat destruction, the spread of invasive species, conflicts between different recreational users, damage to cultural sites, and violations of sites sacred to American Indians (Bosworth, 2003; Bowles, 2001; Meyer, 2002; Troyer, 2003). Each of these issues is complex. For example, soil impacts commonly occur in this progression: abrasive loss of protecting surface vegetation and root mass, compaction and surface subsidence, hydraulic disruption, breakdown of soil structure, and soil particle erosion and deposition (Meyer, 2002). Further, these problems can lead to surface erosion or surface failure. Another example of the complexity of issues is social conflict. Social conflict has multiple definitions, but they generally include goal interference attributed to others (Jacob & Schreyer, 1980), a threat to a person or to their belongings (Keller, 1990), perceived differences in lifestyles (Ramthun, 1995), and perceived differences in style of enjoying the resource (Schuett & Hollenhorst, 1994; Watson, Williams, & Daigle, 1991). Further, conflict perceptions many vary

according to experience (Chavez, 1997) or activity orientation (Watson, Asp, Walsh, & Kulla, 1997), and is often asymmetrical (Hoger & Chavez, 1998; Watson, Williams, & Daigle, 1991).

Despite these complex issues, the Forest Service is committed to continued OHV use on public lands. Chief Bosworth said, “We want the American people to use their national forests and grasslands. It gives them a stake in the land. It gives them a sense of place. It helps them understand why we in the Forest Service are so passionate about the land—why we think it’s so worth protecting” (Bosworth, 2003, p. 7).

For example, managers of the Bureau of Land Management’s Imperial Sand Dunes (in California), recognize the positive aspects of OHV use at the same time that they are dealing with some criminal behaviors. Several newspaper reports described holiday weekend OHV activity in 2001 that resulted in two vehicular deaths, shootings, stabbings and numerous assaults. (Fisher, 2001; Kendall, 2001; McQuern, 2001; Mitchell, 2001; Renteria, 2001; Simon, 2001). Yet, managers quoted in the articles described OHV visitors as largely law-abiding and “family-oriented” (Mitchell, 2001; Renteria, 2001).

OHV issues are complex and require additional research attention. Of particular interest are the perceptions of the managers of OHV activity. They are the people most likely to understand the complex nature of OHV issues and to take the actions required for resolving or mitigating them. This study identifies the management problems and their respective strategies associated with OHV use on National Forests in California.

Methods

This study was based on a previous investigation addressing issues and actions related to mountain biking on Forest Service lands (Chavez, 1996b). The OHV managers were selected based on management of OHV areas on National Forest lands in California as identified by an internal USFS mailing list provided by Region 5. Each potential respondent on the list was contacted in October 2003 to verify current management of an OHV area. In cases where more than one respondent was responsible for a given area, respondents worked together to submit a single questionnaire. Some names were removed from the original list and others added to achieve a pool of respondents with knowledge of current conditions. The final list contained 60 contacts. Respondents represented 16 of the 18 National Forests in Region 5 plus the Humboldt-Toiyabe in Region 4.

To streamline the lengthy interview process, questionnaires were mailed electronically to managers in advance of the telephone interview. Managers were encouraged to prepare their responses in advance and to work together where appropriate. Interview length averaged approximately 40 minutes. All 60 contacts responded to the survey, yielding a total of 38 useable surveys.

Managers were asked to identify OHV management problems from a predetermined list of 26 items. Eight more items were added to the list by respondents in reply to an open-ended request for additional problems. The final list of 34 items included natural resource related problems such as soil erosion or trampling, problems concerned with social institutions such as alcohol use, and interpersonal relations problems including conflicts with other four-wheelers on the trails. A separate list of 59 strategies used to solve management problems (41 predetermined plus 18 contributed by respondents) included indirect management strategies (e.g., posters or signs), direct

management strategies (e.g., closing or limiting use), resource hardening techniques (e.g., specifying maximum grades of trails), and bridge building/collaboration strategies (e.g., personal contacts). For each management problem identified from the first list, respondents were asked to select the strategies they used to try to solve the problem from the second list. They were asked to identify which of the strategies they selected was “used most often” and which was “most effective” in solving each respective problem. They were also asked a series of Forest background questions about their OHV area, such as the number of miles of paved and unpaved roads (both open and closed to OHV use) and the number of OHV riders annually (see Appendix A for a copy of the survey instrument).

Results

Area Background Information

The areas had a median 0 miles of paved road open to non-highway legal OHV use (range of 0 to 49 miles), and a median 271 miles of unpaved road open to non-highway legal OHV use (range of 0 to 2265 miles). An average 43 miles of paved road were closed to non-highway legal OHV use (SD = 37), and a median 36 miles of unpaved road were closed to non-highway legal OHV use (ranged from 0 to 1,250 miles; Table1).

Table 1. Miles of paved and unpaved road open and closed to OHV use by Forest.

Forest	Number of Miles of Paved Road Open to OHV Use (n=37)	Number of Miles of Paved Road Closed to OHV Use (n=33)	Number of Miles of Unpaved Road Open to OHV Use (n=36)	Number of Miles of Unpaved Road Closed to OHV Use (n=33)
Angeles	0	5.00	291.00	194.00
Cleveland	0	56.00	28.00	202.00
Eldorado	19.50	299.00	1655.00	57.00
Humboldt-Toiyabe	0	0	700.00	200.00
Inyo	0	92.00	4465.00	0
Klamath	18.00	0	135.00	65.00
Lake Tahoe Basin	0	19.00	250.00	50.00
Los Padres	3.00	106.00	207.00	213.00
Mendocino	24.00	24.90	1219.00	426.00
Modoc	48.50	0	789.54	3.00
San Bernardino	0	no response	205.00	1250.00
Sequoia	5.50	198.00	868.00	470.00
Shasta-Trinity	12.00	160.00	120.00	0
Sierra	0	20.00	539.00	25.00
Six Rivers	0	243.00	1538.00	671.00
Stanislaus	1.00	86.00	666.00	36.00
Tahoe	1.00	96.50	655.00	5.00

Level of Activity

The median number of OHV riders annually (i.e., number of riders times number of rides annually) for these areas was 20,100 (range of 162 to 300,000; Table 2). Respondents reported that most use occurred during the summer (46%); with 24 percent reporting more use during the winter, and 27 percent reporting use to be equally distributed. About one-third (34%) reported the presence of concessionaires or nearby businesses that rented OHVs for use in their area. Of these, 54 percent offered only OSV use, while 39 percent rented vehicles year-round.

Table 2. Number of riders annually by Forest.

Forest	Riders Annually (number of riders times number of rides annually) (n=33)
Angeles	131,965
Cleveland	30,000
Eldorado	121,000
Humboldt-Toiyabe	60,000
Inyo	108,000
Klamath	8,100
Lake Tahoe Basin	21,000
Los Padres	354,162
Mendocino	128,798
Modoc	36,000
San Bernardino	212,000
Sequoia	18,300
Shasta-Trinity	24,000
Sierra	no response
Six Rivers	35,300
Stanislaus	192,000
Tahoe	120,100

Planning

All but one manager (97%) reported that their forest plan had provisions for OHV trails and opportunities, and most (61%) also had forest plans that considered the differences in use according to season. About half (47%) had completed surveys to show use patterns, documented impacts, or visitor impressions of OHV use.

Almost all (92%) considered control of OHV use a forest resource management concern. In response to open-ended requests for comments, managers acknowledged increasing OHV use levels in their areas and several expressed concern for erosion and other negative impacts caused by OHVs on natural resources including water quality, wildlife, and aquatic vegetation as habitat. Others were concerned with the lack of regulations protecting natural resources and with increasing OHV entrance into designated wilderness. Some, however, felt that OHV use could be managed successfully and that it is the improper management of use that impacts negatively on the resource. OHV use was one of the top two issues for 40 percent of respondents. Some respondents mentioned that while OHV management was an important issue, other issues such as fire and timber ranked above it. Almost all (97%) reported that Forest Service staff had observed or received reports of OHV use on closed roads or trails that exclude motorized vehicles.

Management Problems

Respondents were asked a series of questions about problems related to OHV use. For each problem we asked if they had observed or received reports of the problem. Management problems were divided into those related to *natural resources*, *social institutions*, or *interpersonal relations*.

Natural resources. The *natural resource* problems identified most frequently were soil erosion/trampling (79%), soil erosion/compaction (58%), litter/trash on roads or trails (50%), litter/trash at trail access points (48%), graffiti or other vandalism (40%), and vegetation damage (40; Table 3). If a respondent noted that they had observed or received reports of *natural resource* related problems, then they were also asked if the problem differs by season. Soil erosion/trampling, for example, was reported by 22 respondents (76% of those identifying this issue) to differ by season, with about half noting the issue was observed or reported more during summer. Within the *natural resource* classification overall, about half the issues were most problematic during summer (e.g., soil erosion/compaction), while the others were most problematic in winter (e.g., noise and smoke), hunting season (e.g., destruction/defacing of historic resources), or breeding season (e.g., harassment of wildlife).

Table 3. *Natural resource* related management problems ranked by frequency observed or reported within category and seasonal differences.

Management Problem	Problem Observed/Reported n/percent	Differ by Season n/percent	How Differ by Season
<i>Natural Resources</i>			
Soil erosion/trampling	30/79%	22/76%	about half summer and half winter
Soil erosion/compaction	22/58%	12/60%	most said summer
Litter/trash on roads/trails	19/50%	11/58%	almost even fall, summer, winter
Litter/trash at trail access points	18/48%	3/17%	most said summer
Graffiti or other vandalism	15/40%	6/43%	most said summer
Vegetation damage	15/40%	8/53%	most said summer
Destruction/defacing of historic resources	11/29%	4/36%	hunting season and summer
Harassment of wildlife	6/16%	2/33%	breeding season
Noise and smoke*	3/8%	2/67%	more in winter
Reduction in size of habitat	1/3%	0/0%	
Injuries to or death of individual members of a species	1/3%	0/0%	
Dust near developed campgrounds*	1/3%	1/100%	no season identified
*Problem contributed by respondent(s)			

Social institutions. The *social institutions* problems are concerned with the violation of regulations, but not the consequences of the violations. The *social institutions* problems identified most frequently were four-wheelers going off established roads or trails (76%), OHVs going too fast (60%), lack of safetywear (55%), alcohol use (48%), and inexperienced drivers in difficult terrain (34%; Table 4). If respondents noted they had observed or received reports of *social institutions* problems, then they were also asked if the problem differs by season. Four-wheelers going off established roads or trails was reported by 14 respondents (52% of those identifying this problem) to differ by season, with most noting the problem was observed or reported more during the summer. About half of the *social institutions* problems were more problematic in summer (e.g., alcohol use) and about half were more problematic during winter (e.g., OHVs driving too fast).

Table 4. *Social institutions* management problems ranked by frequency observed or reported within category and seasonal differences.

Management Problem	Problem Observed/Reported n/percent	Differ by Season n/percent	How Differ by Season
<i>Social Institutions</i>			
Four-wheelers going off established roads or trails	29/76%	14/52%	most said summer
OHVs going too fast	23/60%	5/23%	most said winter
Lack of safetywear	21/55%	7/33%	most said summer
Alcohol use	18/48%	1/6%	summer
Inexperienced drivers in difficult terrain	13/34%	6/50%	most said summer
Large group of four-wheelers	8/21%	4/50%	most said summer
Dangerous drop-offs/mines	8/21%	3/38%	most said winter
Too many people at trail access points	6/16%	3/50%	winter
Wilderness trespass*	5/13%	0/0%	
Too many four-wheelers on roads or trails	2/5%	1/50%	hunting season
Dangerous driving routes	2/5%	1/50%	winter
Lack of safety flags	1/3%	0/0%	
Multiple land jurisdictions*	1/3%	0/0%	
Non-manageable wilderness boundaries*	1/3%	0/0%	
Lack of consistent funding*	1/3%	0/0%	
*Problem contributed by respondent(s)			

Interpersonal relations. The *interpersonal relations* items describe interactions among visitors, often involving conflicts within and between user groups. No item in the *interpersonal relations* classification appeared in the top ten problems overall, nor were any reported by more than one-quarter of the respondents. The *interpersonal relations* problems identified most frequently were those with hikers or backpackers on the trail (21%), with mountain bikers on the trails (18%), and with people on horseback on the trails (13%; Table 5). If a respondent noted that they had observed or received reports of *interpersonal relations* problems, then they were also asked if the problem differs by season. About half were most problematic during summer (e.g., with hikers/backpackers on the trails) and about half during winter (e.g., skiers/snowshoers) or spring (e.g., cattle on or near trails).

Table 5. *Interpersonal relations* management problems ranked by frequency observed or reported within category and seasonal differences.

Management Problem	Problem Observed/Reported n/percent	Differ by Season n/percent	How Differ by Season
<i>Interpersonal Relations</i>			
Conflicts with hikers or backpackers on the trails	8/21%	5/63%	most said summer
Conflicts with mountain bikers on the trails	7/18%	5/71%	most said summer
Conflicts with people on horseback on the trails	5/13%	3/60%	summer
Conflicts with other four-wheelers on the trails	2/5%	0/0%	
Conflicts with cattle on or near trails	2/5%	2/100%	spring
Conflicts with skiers/snowshoers*	2/5%	2/100%	winter
Conflicts with owners of private lands*	1/3%	1/100%	winter
*Problem contributed by respondent(s)			

Top ten OHV management problems. When management problems are ranked by frequency observed by or reported to resource managers those related to *natural resources* (e.g., soil erosion/trampling and soil/erosion/compaction) and *social institutions* (e.g., four-wheelers going off established roads or trails and OHVs going too fast) dominate the top ten (Figure 1).

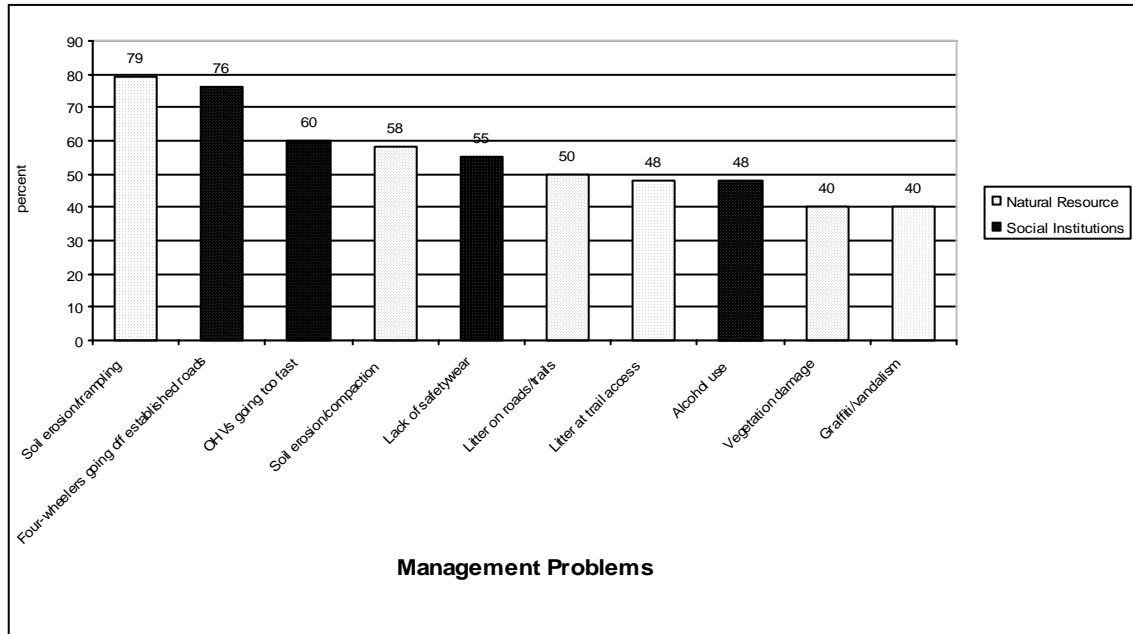


Figure 1. Top ten management problems observed or reported, ranked by percent

Management Strategies

The management strategies are divided into those which *indirectly* impact recreation visitors, those that *directly* impact recreation visitors, *resource hardening*, and *bridge building* or collaboration (Chavez 1996a).

Indirect strategies. The *indirect* strategies used by most respondents across all management problems were posters or signs (68%), bulletin boards (50%), user ethics (46%), brochures (40%), maps (39%), trail use recommendations (27%), etiquette (27%), and other educational materials (27%; Table 6).

Table 6. *Indirect* strategies in rank order of frequency used by respondents across all management problems, within category (n=307).

<u>Strategy</u>	<u>n</u>	<u>Percent</u>
Posters or signs	209	68
Bulletin boards	153	50
User ethics	140	46
Brochures	123	40
Maps	121	39
Trail use recommendations	84	27
Etiquette	83	27
Other educational materials	82	27
Trail descriptions	58	19
Local newspaper article	38	12
Public service announcements	22	7
Additional/matching funding*	3	1
Manufacturers' stickers on ATVs*	1	<1

*Strategy added by respondent(s)

Direct strategies. The *direct* strategies used by most respondents across all management problems were law enforcement (77%), close or limit use (31%), relocate or designate OHV trails (21%), provisions for special use permits (16%), organized events to do trail maintenance (13%), and seasonal closures (13%; Table 7).

Table 7. *Direct* strategies in rank order of frequency used by respondents across all management problems, within category (n=307).

<u>Strategy</u>	<u>n</u>	<u>Percent</u>
Law enforcement	237	77
Close of limit use	94	31
Relocate or designate OHV trails	66	21
Provisions for special use permits	50	16
Organized events to do trail maintenance	40	13
Seasonal closures	40	13
Non-issuance of outfitter/guide/event permits	26	8
Users ride in dispersed patterns	25	8
Separate trails	18	6
Separate user groups	13	4
Making repairs as soon as located*	12	4
Alternate between user groups	6	2
Picking up litter*	6	2
Using OHV trail crews to maintain trails*	2	<1
Voluntary sound tests*	2	<1

*Strategy added by respondent(s)

Resource hardening strategies. The *resource hardening* strategies used by most respondents across all management problems were staging areas with parking facilities (19%), drain dips (17%), artificial tread (13%), designated campsites (9%), and specification of maximum grade on trails (9%; Table 8).

Table 8. *Resource hardening* strategies in rank order of frequency used by respondents across all management problems, within category (n=307).

<u>Strategy</u>	<u>n</u>	<u>Percent</u>
Staging areas with parking facilities	57	19
Drain dips (reversal of grade)	51	17
Artificial tread (e.g., geofabric with sand and gravel)	41	13
Designated campsites	29	9
Specification of a maximum grade on trails	27	9
Lengthened trails to disperse riders	20	7
Barricades/barriers*	13	4
Trail design*	12	4
Flexible water bars	7	2
Restricting direction of events to one (i.e., either uphill or downhill)*	5	2
Trail maintenance *	3	1
Rolling dips/dog bones*	2	<1
Minimum grade on trails	1	<1
Overflow parking and staging areas*	1	<1

*Strategy added by respondent(s)

Bridge building strategies. The *bridge building/collaboration* strategies used by most respondents across all management problems were personal contacts (84%), volunteer patrols (38%), adopt-a-trail programs (32%), local OHV club meetings (32%), maintain trail with local groups and volunteers (31%), partner with different groups (24%), and meetings with state OHV groups (16%; Table 9).

Table 9. *Bridge building* strategies in rank order of frequency used by respondents across all management problems, within category (n=307).

<u>Strategy</u>	<u>n</u>	<u>Percent</u>
Personal contacts	259	84
Volunteer patrols	113	38
Adopt-a-trail program	99	32
Local OHV club meetings	98	32
Maintain trail with local groups and volunteers	96	31
Partner with different groups	73	24
Meetings with state OHV groups	49	16
Workshops	41	13
Partner with OHV shops	27	9
Committees with different groups	23	8
Education programs*	10	3
Trail safety evaluation form	8	3
Joint clean-ups with other agencies*	1	<1
Working with local law enforcement *	1	<1
Mine safety evaluation form*	1	<1
Help form regional office and state*	1	<1
Finding out from users and environmentalists where trails should be*	1	<1

*Strategy added by respondent(s)

The top ten management strategies used by respondents across all management problems were *indirect* (poster or signs, bulletin boards, user ethics, brochures, and maps), *bridge building* (personal contacts, volunteer patrols, and local OHV club meetings), and *direct* (law enforcement and close or limit use).

Strategies Used Most Often and Perceived as Most Effective

For the six top ranked management problems (named by 50% or more of respondents) those strategies identified as “used most often” and “most effective” were dominated by those in the *bridge building/collaboration* category (Table 10). In four of the top six management problems, the same strategy category (*bridge building/collaboration*) was ranked first as “used most often”, and was ranked first in four of the six as “most effective.” Where these categories differed within a management problem (e.g., lack of safetywear) *bridge building/collaboration* ranked second. Here, *indirect* strategies were identified as “used most often” and *direct* strategies were named “most effective.”

Table 10. Management problems ranked by frequency, strategies ranked by percent within category identified as “used most often” and “most effective”

Soil erosion or trampling		Four-wheelers going off established roads or trails		OHVs going too fast		Soil erosion or compaction		Lack of safetywear		Litter or trash on roads or trails	
most often	most effective	most often	most effective	most often	most effective	most often	most effective	most often	most effective	most often	most effective
Bridge Building	Bridge Building	Direct	Direct	Bridge Building	Bridge Building	Bridge Building	Bridge Building	Indirect	Direct	Bridge Building	Bridge Building
Direct	Direct	Bridge Building	Bridge Building	Indirect	Direct	Indirect	Direct	Bridge Building	Bridge Building	Indirect	Indirect
Indirect	Resource Hardening	Indirect	Indirect	Direct	Indirect	Direct	Resource Hardening	Direct	Indirect	Direct	Direct
Resource Hardening	Indirect		Resource Hardening	Resource Hardening	Resource Hardening	Resource Hardening	Indirect				

Shaded management problems are Natural Resource-Related
 Unshaded management problems are Social Institution

Seasonality of Strategies

We examined seasonality of the strategies used for the management problems that were identified by at least by 25 percent of the sample (Table 11). More likely to change seasonally were strategies for lack of safetywear (67%), soil erosion/trampling (55%), destruction/defacing of historic resources (55%), soil-erosion compaction (43%), and graffiti or other vandalism (43%). Many report changes are need for winter (e.g., destruction/defacing of historic resources) and hunting seasons (e.g., lack of safetywear). Less likely to change seasonally were strategies for OHVs going too fast, four-wheelers going off-trail, vegetation damage, alcohol use, and litter or trash at trail access points.

Table 11. Percent reporting a problem and percent identifying seasonal management changes are used.

Problem	Percent Reporting Problem	Seasonal Strategy Change Percent & Season
Soil erosion/trampling	79	55, summer
Four-wheelers going off-trail	76	19, hunting
OHVs going too fast	60	17, winter
Soil erosion/compaction	58	43, summer, winter
Lack of safetywear	55	67, hunting
Litter or trash on roads or trails	50	32, hunting, winter
Alcohol use	48	22, hunting
Litter or trash at trail access points	48	22, winter, hunting
Graffiti or other vandalism	40	43, summer
Vegetation damage	40	20, hunting
Inexperienced drivers in difficult terrain	34	30, winter
Destruction/defacing of historic resources	29	55, winter

Other Results

In Appendix B we provide the intersection of problems and strategies. For example, if OHVs going too fast, is the issue of concern to you (identified as Problem 12), then check the Table of Contents for Problem 12 and you'll find the page number (in Appendix B) where you can find out how many respondents have observed or received reports of OHVs going too fast, what strategies they use to slow down OHV riders, the strategies that are used most often, and what strategy is perceived to be most

effective for Problem 12. You will also find information about how problems and strategies to slow OHV riders differ by season. This information is available for all 34 problems identified in this study.

General Comments. At the end of the interview we asked respondents if they had any other comments about OHV use. More than 50 comments are found in Appendix C. These are grouped into comments related to depreciative behavior, education, funding, land issues, law enforcement, limitations, maps, policy, politics, process, regulations, use levels, and other.

Discussion

OHV management problems of concern to Chief Bosworth and others (Bosworth, 2003; Bowles, 2001; Meyer, 2002; Troyer, 2003) were examined for national forest lands in California. Some of those same problems were identified by the managers interviewed for this study; specifically these were soil erosion and habitat destruction.

Identified as the management problems faced by at least half the OHV managers on National Forests in California were soil erosion/trampling, four-wheelers going off-road, OHVs going too fast, soil erosion/compaction, lack of safetywear, and litter or trash on roads or trails. Half of these were *natural resource* issues and half were *social institutions* problems. Many OHV management problems were thought to differ by season. Identified as more problematic in the summer were soil erosion/compaction, litter/trash at trail access points, graffiti or other vandalism, four-wheelers going off established roads or trails, alcohol use, and conflicts with people on horseback. Identified as more problematic during winter were noise and smoke, OHVs going too fast, too many people at trail access points, dangerous driving routes, and conflicts with skiers/snowshoers.

The managers did not identify *interpersonal relations* or conflict between recreational users at high levels of frequency, however, some conflicts were evident (mostly between OHV riders and hikers and backpackers, and between OHV riders and mountain bike riders), and these could be some of the most difficult to mitigate.

The study identified various strategies that have been used to resolve or mitigate problems. The most frequently mentioned *indirect* strategies were poster or signs, bulletin boards, user ethics, brochures, and maps. The most frequent *direct* strategies were law enforcement, close or limit use, relocate or designate OHV trails, and provisions for special use permits. The most frequent *resource hardening* strategies were staging area with parking facilities, drain dips, artificial tread, and designated campsites. The *bridge building* strategies used most frequently were personal contacts, volunteer patrols, adopt-a-trail program, local OHV club meetings, and maintain trail with local groups and volunteers.

Unlike a national study of mountain bike management where indirect actions were used most often (Chavez, 1996a, b), strategies used most frequently by National Forest OHV managers in California are *bridge building/collaboration*. Of the *bridge building/collaboration* strategies, described as “used most often” and “most effective,” personal contacts dominated. There may be budgetary constraints to implementing a strategy of personal contacts namely funding, personnel, and training.

The use of strategies differed by season. Winter season strategy changes were used for OHVs going too fast, inexperienced drivers in difficult terrain, and destruction/defacing of historic resources. Hunting season strategy changes were needed for four-wheelers going off-trail, lack of safetywear, and vegetation damage.

Future Research

Additional research studies are needed. An expansion of this study at a national level would further address Forest Service Chief Bosworth’s concerns about OHV use. Other research topics might include the value of volunteer patrols and partnerships for reducing conflict or resource damage, and trail construction tools to alleviate resource damage. More research into bridge building/collaboration successes would be quite useful as would studies of communication techniques.

Limitations

Limitations of the study stem from difficulties in identifying all members of the study population, namely persons responsible for managing OHV areas on California National Forests. Our goal was not to survey all OHV managers, but to represent all OHV areas within the geographical confines of the state.

OHV areas are not organized according to ranger district. They often bridge ranger districts and sometimes management responsibilities within those districts are further divided into OHV and OSV. Therefore, managers and their respective contact information such as telephone numbers and email addresses cannot be identified according to the ranger district organizational structure. Furthermore, Forest Service personnel responsible for OHV management hold a variety of positions and titles so requests for participation in the survey cannot simply be directed to whomever holds a given position on the Forest. As stated in the Methods section of this report, potential respondents were contacted based on an existing internal Forest Service mailing list. While this list was a good beginning, it was far from complete in terms of reaching the goal of geographic coverage of the entire state. To the best of our knowledge, a comprehensive list of OHV areas and persons responsible for their management is not available at this time.

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