

THE RELATIONSHIP OF RECREATION SPECIALIZATION TO THE SETTING PREFERENCES OF MOUNTAIN BICYCLISTS.

Timothy E. Hopkin

Outdoor Recreation Specialist, Henderson County Parks and Recreation, 801 Glover St., Hendersonville, NC 28792

Roger L. Moore

Assistant Professor, Department of Parks, Recreation and Tourism Management, Box 8004, North Carolina State University, Raleigh, NC 27695

This study gathered information about mountain bike use and users on unpaved trails in a Raleigh, North Carolina park. Specifically, it attempted to determine if levels of recreation specialization were related to the setting preferences of mountain bike users. The results offered partial support for the existence of a relationship between recreation specialization and preferences for various setting attributes.

Introduction

This study examined the setting preferences of mountain bikers for various off-road trail features. Specifically, this research looked at the different setting preferences reported by mountain bikers of different levels of activity specialization (Bryan, 1977 & 1979). Many different types of off-road trails are currently used by mountain bikers. Land managers and recreational planners, however, have limited knowledge of why mountain bikers choose to ride where they do. To understand why riders prefer certain trails, it is important to better understand their choices for various settings. With knowledge of these preferences, land managers will be better able to serve participants of this growing activity.

The increased popularity of mountain bikes has led to a greater presence of cyclists on unpaved trails and in backcountry areas. Near urban areas, cyclists often use local parks and undeveloped tracts of land for their off-road riding. The managers of these urban and suburban areas, however, are often wary of the presence of mountain bikers. Their cautiousness stems, in part, from fears that mountain bike use will increase user conflicts, erosion, and resource damage. These fears seem to be particularly pronounced near urban areas because parks and open spaces there are often heavily used. These fears and heavy use have led to many areas being closed to mountain bike use.

Lake Johnson Park in Raleigh, North Carolina is an example of an urban/suburban park that has become popular with mountain bikers. The 463 acre park is only 3 miles from North Carolina State University and has several large apartment complexes, numerous private homes, and a high school on its borders. It contains a combination of approximately seven miles of paved and unpaved trails which parallel the shore of a 148 acre lake. The trails most often used by mountain bikers are unpaved and lie along the southern edge of the lake. These trails offer bikers a variety of challenging rides that are easily accessible. However, the Raleigh Parks and Recreation Department has plans to pave certain trails presently popular with mountain bikers and is considering closing the unpaved trails in the park to mountain bike use.

The closure of Lake Johnson Park's unpaved trails to mountain bikers would displace these users to other areas, some of which already have or are considering having restrictions on mountain

biking. The Raleigh Parks and Recreation Department is aware of this fact, and is considering designating alternative areas for mountain bike use. At the present time, however, no research exists which identifies the preferences for various site attributes among mountain bike riders. The lack of such information poses a problem, as managers are not sure what types of areas would be most attractive to mountain bikers and how to best design the trails in those areas. If managers did know which specific site attributes were preferred by mountain bikers, areas which meet the needs of these users could be provided. If such areas were provided, the mountain bike community might be more inclined to obey restrictions and accept closures elsewhere. Previous research, however, indicates that participants in a recreational activity, are not homogeneous (Shafer, 1969). All mountain bikers are not likely to prefer the same settings for their riding. One variable that has been found to be related to setting preferences among recreationists is activity specialization (Williams and Huffman, 1986; Ewert 1985; Virden and Schreyer, 1988). If recreation specialization is related to the setting preferences of mountain bikers, such information would be an important consideration for planners attempting to provide suitable locations for mountain biking.

Related Literature

Mountain biking began in the mid 1970's in the hills of Marin County, California. Early riders started with beach cruisers and began to add components from road bikes. By adding multiple gears, wider tires, and cantilever brakes to beach cruisers, early mountain bikers found they could ride on the dirt roads and trails in the area. In 1982, the Specialized bicycle company introduced the Stumpjumper mountain bike, the first production mountain bike ever sold. With the introduction of this new bicycle, a new sport was introduced to the masses (Ker, 1991). Since that time, the number of mountain bike riders in the United States has risen to an estimated 25 million in 1992. Mountain bikes have become so popular that they now represent 81% of all bicycles sold in this country (National Off-Road Bicycle Association, 1992). The tremendous increase in popularity of this sport since the mid-70's has generated new challenges for land managers.

Unlike other outdoor recreation activities such as boating, hiking, and fishing, mountain biking has received little research attention. Existing studies have focused on backcountry areas and tended to examine user conflicts involving mountain bikers or resource impacts caused by mountain bikes. For example, two USDA Forest Service studies examined safety concerns related to mountain biking on the Santa Barbara Front trails in California. As part of the study, meetings were held with representatives from four primary user groups of the trails: hikers, equestrians, mountain bikers, and Sierra Club members. Although various problems and solutions were discussed, none were agreed upon. A subsequent survey of the users of the Front trails led researchers to recommend that no action needed to be taken with regard to limiting mountain bike access. Instead, they suggested that managers improve safety for trail users through increased signage and user education. Both studies also showed no increases in trail erosion rates due to mountain bikes (USDA Forest Service, 1987 & 1989).

A study by Seney (1990) on the relative impacts of hiker, horse, mountain bike and motorcycle use on trails showed that trail damage by mountain bikers was not significant. In a preliminary study on the effects of mountain bike, foot, and horse traffic on exposed soil and soil compaction, McEween (1992) concluded that horse and mountain bike traffic appeared to show higher patterns of erosion than those of hikers in Ohio's Shawnee National Forest. The study also found that the impacts of horses and mountain bikes appeared to be very similar. Watson, Williams and Daigle (1991) looked at the extent of conflict between mountain bikers and hikers in the Rattlesnake National Recreation Area near Missoula, Montana. They compared hikers and bicyclists in terms of environmental meaning, perceptions of similarity, and conflict. The findings indicated that hikers generally expressed greater feelings of conflict than bicyclists. The conflict expressed, however, did not always affect

recreational experience or lead to specification of objectionable behavior. The findings did suggest that techniques, such as user education, could be used to reduce conflicts among area users. They found that cyclists considered themselves more similar to hikers than vice versa and suggested that this might be due to the fact that some bicyclists saw themselves as hikers who were using bicycles to gain quicker access to backcountry areas. The study also speculated that less specialized bicycle riders and hikers did not go into certain areas of the Rattlesnake National Recreation Area until they had developed a higher level of specialization and, therefore, a greater appreciation for the environment.

Most recently, Hollenhorst, Schuett & Olsen (1993) examined the characteristics, preferences, and attitudes of mountain bikers using national forests in West Virginia, California, and Texas. Data for the project was gathered using on-site surveys and focus group interviews. They found that mountain bikers in the national forests tended to be young, highly educated, affluent males from urban areas. "Mountain bikers overwhelmingly preferred off-road conditions, spending approximately 68% of their time on trails and abandoned roads" according to the authors (p. 26). A majority (66%) of respondents were day visitors and many reported participating in related activities such as day hiking, car camping, backpacking, and photography while visiting national forests. Mountain biker's attitudes and preferences were also examined. Although riders expressed an interest in taking chances, they did not perceive mountain biking to be dangerous. The three top reasons for mountain biking were found to be: Enjoyment/Fun/I love it; Physical/Exercise; and Nature/Environment. Access, impacts, and conflict were the most important issues and problems facing mountain biking in National Forests according to those surveyed.

The need for research on the characteristics of mountain bikers, conflicts with other users, commercial opportunities, and community development potential resulting from bicyclists has been recognized by two different USDA Forest Service Research Stations (Magill, 1992). These stations are currently beginning research which they hope will provide managers with information to guide planning and decision making regarding mountain biking. However, no past research has focused on urban or suburban mountain biking areas and very little is known about which site attributes mountain bikers prefer.

Methods

A combination of on-site interviews and follow-up mail surveys were used to gather data for this study. Data collection took place during the months of January, February, and March, 1993. The data was collected during systematically scheduled trips of park trails designed to represent different times of day and all days of the week. One trip around the lake was made during scheduled weekdays and two trips (one morning and one afternoon) were made on scheduled weekend days to capture the far heavier use that occurred on weekends. During each trip, interviewers on mountain bikes attempted to intercept and interview every mountain biker on the unpaved trails. Interviews took approximately two minutes each and were used to gather basic use information and to acquire the user's name and address so a follow-up mail survey could be sent. A total of 54 interview trips around the lake were conducted. Each person interviewed was sent a copy of the mail survey within five days of their visit. A slightly modified Dillman approach was used which incorporated two follow-up mailings to nonrespondents (Dillman, 1978).

Level of activity specialization was the independent variable for this study. A series of five questions were asked related to this concept. These questions were: "How long have you been riding Mt. Bikes?," "How many times in the last 12 months did you ride your Mt. Bike off-road?," "When you ride your Mt. Bike off-road how long do you usually ride?," and "About how much is your mountain bike(s) and all your mountain bike equipment worth? (Please include all your mountain bike gear e.g., pump, helmet, car rack, clothes, etc.)." The fifth question asked "How would you rate yourself as a participant in the sport of Mt. Biking?" and was rated on a seven-point Likert-type scale where "1" indicated

"novice" and "7" indicated "expert." An additive index of activity specialization for mountain biking was created from these five questions by standardizing the responses to each using Z-score transformations (Virden, 1986). These Z-scores were then summed to form an index score for each respondent.

Mountain bikers' preferences for various setting attributes were used as the dependent variables for analyses. Preferences were operationalized by asking respondents to rate the desirability of various trail attributes in the mail questionnaire. They were asked, "Listed below are some of the characteristics that many people consider desirable for trails. Please consider each characteristic and circle the number that best indicates how desirable or undesirable it is to you when you select a place to ride." A list including 18 physical trail setting characteristics followed. After each attribute there was a nine point Likert-type scale ranging from "1" for "extremely undesirable" to "9" for "extremely desirable." The eighteen physical attributes to be examined were identified through interviews with members of local mountain bike organizations. These attributes included: "winding trail," "hills," "fast downhill sections," "natural surroundings," "technical sections," "single track trails," "rolling/undulating sections," "long distance," "technical descents," "log crossings/obstacles," "creek crossings," "rocky sections," "loop trails," "muddy sections," "bridge crossings," "long straight sections," "level grades," and "smooth trail surfaces." Descriptive statistics were used to describe the characteristics of mountain bikers surveyed and their preferences. Correlation analyses were used to examine the relationships between activity specialization and the preferences for each of the setting attributes.

Results

A total of 141 mountain bikers were interviewed along the trails. Five users were under 16 years of age and were not mailed written questionnaires. Of the 136 mountain bikers who received mailed questionnaires, 102 (75%) responded. The characteristics of these users and their trail use are summarized in Table 1. In general, the mountain bike users of Lake Johnson Park were young, male, college-aged students who lived near the park. These users visited the unpaved trails approximately every week for about two hours and reported that convenience, closeness, and challenge were the main reasons for riding there. The users were predominantly single with incomes under \$20,000 and most rode their bikes from their homes to the park.

Table 1. Characteristics of trail users.

Young males (mean age 23.2)
Average household income of less than \$20,000
Marital status = single
Ride at park frequently (mean 35.3 times in 12 months)
Average ride time of 2 hours
Live between 1 - 3 miles from the park.
Occupation = student

In terms of activity specialization, the mountain bikers surveyed were varied. Most respondents were relatively new to the sport of mountain biking with an average of just over two years experience. Over 50% of the respondents had been riding mountain bikes for 24 months or less. There was a group (8.8%) of respondents, however, who had been riding mountain bikes for more than five years. In terms of self-rated skill, almost half (49%) of respondents rated themselves as above an intermediate level (> 4) on a 7-point scale. The average skill level of the respondents was 4.2, while the level of skill most frequently reported was 5 (38.2%). Only 5 (4.9%) respondents rated themselves as novices. On average the respondents reported that they had been mountain biking 68.6 times in the past twelve months. This represents more than one ride per week. All respondents reported that they rode for at least one hour every time they went mountain biking. The average time spent riding was over two hours (128.6 minutes) per outing. Only 6.0% of the respondents stated that they rode for three and a half hours or longer. The average dollar value of respondent's bike(s) and

equipment was \$1127.45. The highest value reported was \$7500. The responses to the above 5 questions were combined into an index to serve as the study independent variable. The resulting index had relatively high internal consistency as indicated by a Standardized Cronbach's Alpha reliability coefficient of .71 (see

Table 2). After Z-score transformation to control for differences in the ranges and units of each question, the Z-scores were added to form the final index of activity specialization. The index ranged from -7.06 to 11.60. The mean value for the specialization index was 0.02.

Table 2. Reliability analysis for activity specialization index.

Specialization Item	Item Mean (n=99)	Corrected Standard Deviation	Alpha Item-Total Correlation	If Item Deleted
Months of mountain bike riding experience	28.6	22.7	.46	.66
Self-rated skill level ¹	4.2	1.2	.58	.61
Rides taken in past 12 months	68.6	61.8	.52	.63
Duration of average ride in minutes	128.6	45.7	.32	.71
Dollar value of equipment	\$1,127.45	\$1,017.48	.44	.67
Standardized Item Alpha (Total Index)				.71

¹ Mean calculated based on categories of "Novice 1" (coded "1") through "Expert 7" (coded "7")

Respondents' preferences for each of 18 trail setting attributes were the study dependent variables and were measured on a 9-point scale where "1" was "extremely undesirable" and "9" was "extremely desirable." The 18 features are shown in order of decreasing preference in Table 3. All trail attributes which received a mean score greater than "5" on the 9-point scale were classified as "desirable" while those attributes with means less than "5" were considered "undesirable." When ranked, 15 of the 18 trail attributes were found to be desirable and the remaining 3 undesirable.

The most desirable trail attribute according to respondents was the presence of "winding trail" with a mean score of 8.1. "hills," "fast downhill sections," and "natural surroundings" all received means scores of 7.9, indicating that these features were very desirable as well. The respondents rated features such as "log crossings/obstacles," "creek crossings," "rocky sections," and "muddy sections" as somewhat less desirable with scores ranging between 7.1 and 6.1. The only feature which drew a near neutral (5) response was "bridge crossings" with a mean of 5.5. The three features which received undesirable scores (means < 5) from the respondents were, "long straight sections," "level grades," and "smooth trail surfaces." These features received mean scores of 4.4, 4.3, and 4.2, respectively. Features that described the technical aspects of the trail ("technical descents," "creek crossings," "rocky sections," "log crossings," etc.) were ranked lower than features describing the trail itself ("winding trail," "hills," "natural surroundings," "single track," etc.).

The purpose of this study was to determine if there was a relationship between the level of activity specialization and the preferences for various setting attributes among mountain bikers. This relationship was examined separately for each of the 18 attributes using correlation analyses. The results of these analyses are presented in Table 3. Level of specialization was significantly (.05 level) related to preferences for six of the trail attributes. Specialization was positively and significantly related to preferences for "fast downhill sections," "technical sections," "single track trails," "technical descents," and "log crossings/obstacles." Preferences for "level grades" were negatively and significantly related to level specialization. The relationship of specialization and preferences for "muddy sections" was also negative and approached significance ($p = .054$).

Discussion

This study found substantial mountain bike use at Lake Johnson Park. The finding that most users were young, male, college-aged students who lived near the park was not surprising. However the finding that users visited the unpaved trails more than once a week on average was not expected. It appears that the heavy mountain bike use at this park is due more to a small core of heavy users than to a large population of infrequent visitors.

The preferences for the various setting attributes provided an interesting look at the likes and dislikes of mountain bikers. Winding trails, with a mean score of 8.1 on a 9-point scale, was the feature Lake Johnson Park mountain bikers preferred the most. The thrill of turning and constantly changing direction seemed to be very appealing. At Lake Johnson Park, the unpaved trails wind constantly along the lake's shore, in and out of trees, and up and down hills. "Hills," "fast downhill sections," and "natural surroundings" were nearly as desirable (7.9) for riders at the park.

When a trail winds and is characterized by as many obstacles and challenges as the unpaved trails at Lake Johnson Park, the abilities of even the most skilled riders are tested. The specialized riders at Lake Johnson Park also seemed to prefer the challenge and convenience of the park. This preference for challenging areas helps explain why "single track trails", which are narrow one lane paths, were rated so high (7.6). "Single track trails" typically contain features such as "hills," "technical sections," and "fast downhills," which, when combined with "winding trails," definitely provide specialized riders with the type of terrain which challenges and tests their skills. As mountain bikers become more skilled, the ability to handle varying terrain increases. This fact was supported by responses to open-ended questions about why the respondents ride mountain bikes and why they ride at Lake Johnson Park. The responses to both these questions indicated that challenge was important. Additionally, Lake Johnson Park provides challenging terrain which is conveniently located. Significantly, the only other local areas (Falls Lake and Schenck Forest) which provided these types of desirable features have been closed to mountain bikers.

Table 3. Preferences for trail attributes and Pearson correlation coefficients between the specialization index score and the importance of trail attributes.

Attributes	Mean ¹ Preference Score	Standard Deviation	Two-tailed Pearson r	probability	n
<i>Desirable Attributes</i> ²					
Winding Trail	8.1	0.9	.149	.150	101
Hills	7.9	1.2	.179	.082	101
Fast Downhill Sections	7.9	1.3	.312	.002	101
Natural Surroundings	7.9	1.4	.044	.670	101
Technical Sections	7.8	1.3	.298	.004	101
Single Track Trails	7.6	1.6	.391	.000	101
Rolling/Undulating Sections	7.5	1.2	.039	.710	101
Long Distance	7.4	1.3	.141	.174	101
Technical Descents	7.4	1.5	.353	.000	101
Log Crossings/Obstacles	7.1	1.8	.249	.014	101
Creek Crossings	7.0	1.	-.097	.350	101
Rocky Sections	6.8	1.7	.013	.900	101
Loop Trails	6.7	1.8	.001	.990	100
Muddy Sections	6.1	2.4	-.199	.054	101
Bridge Crossings	5.5	1.6	-.067	.516	100
<i>Undesirable Attributes</i> ²					
Long Straight Sections	4.4	1.9	.057	.582	101
Level Grades	4.3	1.8	-.233	.030	100
Smooth Trail Surfaces	4.2	2.0	.184	.074	101

¹ Means calculated using categories of "Extremely Undesirable 1" (coded "1") through "Extremely Desirable 9" (coded "9").

² Items with ratings > 5 on the scale were considered desirable and those < 5, undesirable.

Riders at Lake Johnson Park rated natural surroundings as highly desirable. The unpaved trails at the park are scenic, passing through the most beautiful sections of the park with striking views of the lake. This type of setting is rare in such urban surroundings. The preference for riding in natural surroundings is consistent with previous research (Watson, Williams, and Daigle, 1991) which suggests that mountain bikers often seek the same opportunities to enjoy backcountry areas as hikers do. Many mountain bikers appear to be looking for remote natural areas in which to enjoy their chosen activity. The unpaved trail at Lake Johnson Park definitely has all of the features which riders reported to be most desirable. The park's unpaved trails are characterized by a winding single track trail with hills and various technical sections such as "log crossings," "rocks," "logs" and "mud." In addition, all of this is found in a conveniently located natural setting along the edge of the lake.

The three features which mountain bikers considered undesirable on average, were "long straight sections," "level grades," and "smooth trail surfaces." These three features typically describe areas such as forest access roads and non-technical bike trails. Areas for mountain biking which are characterized by these undesirable features generally provide little challenge to riders. Lake Johnson riders seemed to be looking for a challenge. This fact was supported by the responses to the open-ended question about why respondents mountain biked. In their responses, respondents reported that challenge was an important reason for riding off-road. This was consistent with the findings of Hollenhorst et al., (1993). This apparently contributed to specialized mountain bikers disliking areas which feature long, straight, smooth, level trails. No doubt some mountain bikers may find areas with these features enjoyable for riding, however the riders surveyed at Lake Johnson Park did not. Riders at Lake Johnson Park used trails which were long, straight, level, and smooth (i.e., the paved trails and nearby paved bike path) primarily as a means to access the more desirable unpaved trails.

The second objective of this study was to determine whether activity specialization was related to preferences for various setting attributes. In the correlation analyses of the riders' levels of specialization and preferences, significant relationships were found to exist between 6 of the 18 features and level of

specialization. Five of these attributes, "fast downhill sections," "technical sections," "single track trails," "technical descents," and "log crossings/obstacles" were positively related to specialization. All these features typically make a trail more challenging and difficult to ride. This would perhaps explain the appeal of such attributes to specialized riders.

The one significantly and negatively related feature was "level grades". Flat trails typically are not as challenging as rolling and undulating trails. Unlike flat trails, it is much easier to generate speed on trails which are rolling and undulating. This point is especially true if the trail is fairly straight and smooth. Interestingly, both the attributes "smooth trail surfaces" and "long straight sections" were positively related to specialization, perhaps indicating that more specialized riders are more interested in the thrill of speed. This possible desire for speed is consistent with the finding that fast downhill sections were extremely desirable overall, receiving one of the second highest mean scores (7.9).

Two of the features ("muddy sections" and "creek crossing") which were desirable to mountain bikers overall were negatively related to specialization in the correlation analyses. In addition, one feature, "muddy sections," approached significance at the .05 level ($p=.054$). In other words, as riders' levels of activity specialization increased, they found these attributes less desirable. One possible reason for these negative relationships may have to do with the value of the riders' equipment. As riders become more specialized they tend to ride more expensive and sophisticated bikes. In order to protect their investment and limit unnecessary wear and tear, more specialized riders may prefer to avoid sections with mud and water. Since these specialists ride more often they may not want to spend the time cleaning their equipment after every ride. It may also be possible that more specialized riders are more environmentally conscious and understand the negative environmental impacts associated with mud and water and the possible restrictions that might be placed on riding as a result of these impacts. In certain areas the presence of mountain bikers is most evident by the tracks they leave in the mud and on either side of water crossings. This notion that specialists might be more environmentally aware is consistent with previous studies (Williams and Huffman, 1986; Kauffman

and Graefe, 1984). Similarly, less specialized riders may see the riding of "muddy sections" and "water crossing" as a way of getting dirty and looking more experienced than they really are.

Implications to Management

This study's most important management implication has to do with the information it provides about mountain bikers' preferences for various attributes of riding areas. The knowledge of which trail attributes attract mountain bike riders should help land managers better understand the needs of this growing group of recreationists. This understanding is essential for effectively managing existing mountain biking areas, planning for new mountain bike trails and managing mountain bike use in areas where such use could have negative impacts. By providing trails which better reflect the preferences of mountain bikers managers can enhance the recreation experiences of this growing group of customers. By providing trails in appropriate areas that are at the same time inherently appealing to mountain bikers, managers can more effectively steer riders away from sensitive resources or conflict prone areas. This more indirect "luring" of riders to appropriate areas can help minimize the need to resort to heavy-handed regulations and enforcement that may foster ill feelings and require expensive on-site management efforts.

The results of this study also suggest that mountain bikers of different levels of specialization prefer different types of areas for their riding. More specialized riders prefer more challenging and technically difficult areas. Managers that provide only one type of trail may not be meeting the needs of large groups of riders and potential riders of their trails. By knowing what riders of different levels of specialization prefer, managers can provide a variety of alternate trails that could better meet the needs of the whole spectrum of mountain biker riders and thereby maximize the recreation satisfaction their areas provide.

It was also significant that the mountain bike use at this park was found to be mainly due to a small core of heavy users. A small core of dedicated users should be easier to inform and work with than a large number of less frequent visitors. If this is true of other off-road riding areas, this has important implications for how managers can communicate with and influence their mountain bike visitors. Finally, this study reminds us that mountain biking is not just a backcountry activity. It is important in small urban/suburban parks and open spaces as well. Due to the proximity of these areas to where people live, managers of these areas must anticipate increased use by mountain bikers and plan accordingly.

Literature Cited

Bryan, H. 1977. Leisure value systems and recreation specialization: The case of trout fishermen. *Journal of Leisure Research*, 9(3), 174-187.

Bryan, H. 1979. Conflict in the Great Outdoors. Sociological Studies No. 4. Bureau of Public Administration, University of Alabama, University, Alabama.

Dillman, D. A. 1978. *Mail and Telephone Surveys - The Total Design Method*. New York: John Wiley and Sons.

Ewert, A. 1985. Why people climb: The relationship of participant motives and experience level to mountaineering. *Journal of Leisure Research*, 17(3), 241-250.

Hollenhorst, S. J., Schuett, M. A., & Olsen, D. 1993. An examination of the characteristics, preferences, and attributes of mountain bike users of the national forest: A preliminary analysis. USDA Forest Service, Pacific Southwest Research Station.

Kauffman, R. B. & Graefe, A. R. 1984. Canoeing specialization: Expected rewards and resource related attitudes. In *Proceedings of the 1984 National River Recreation Symposium*. October 31-November 3, Baton Rouge, LA.

Ker, S. 1991, December. Who really invented the mountain bike? *Mountain Bike Action*, pp. 106-108.

Magill, A. W. , Mountain Bicycling in the Urban-Wildland Interface. Presented at the Symposium on Social Aspects and Recreation Research: Ontario, Canada, February 19-22, 1992. USDA Forest Service, Pacific Southwest Research Station, General Technical Report PSW-GTR-132.

McEween, D. N. 1992. The effects of mountain bike, foot, and horse traffic on exposed soil and soil compaction: A class project. A paper presented at the Wilderness Education Association, Fall Creek Falls State Park, TN.

National Off-Road Bicycle Association, 1992. Off-Road Demographics. Information sheet printed by the National Off-Road Bicycle Association, Colorado Springs, CO.

Seney, J. 1990, August. Erosional impacts of hikers, horses, motorcycles and mountain bikers on mountain trails. Paper presented at the Association of American Geographers, Toronto, Canada.

Shafer, E. L., Jr. 1969. The average camper who doesn't exist. USDA Forest Service Research Paper NE-142. Northeastern Forest Experiment Station, Upper Darby, PA.

USDA Forest Service 1987. "Kepner-Trego Analysis" Mountain bicycle situation on Santa Barbara Front trails. Santa Barbara Ranger District.

USDA Forest Service 1989. "Kepner-Trego Analysis" Mountain bicycle survey update. Santa Barbara Ranger District.

Viriden, R. J. 1986. The Effects of Recreation Specialization and Motivations on the Environment Setting Preferences of Backcountry Hikers. Unpublished doctoral dissertation, Utah State University, Logan.

Viriden, R. J., & Schreyer, R. 1988. Recreation Specialization as an Indicator of Environmental Preferences. *Environment and Behavior*, 20(6), 721-739.

Watson, A. E., Williams, D. R., & Daigle, J. J. 1991. Source of conflict between hikers and mountain bike riders in the Rattlesnake NRA. *Journal of Park and Recreation Administration*, 9(3), 59-71.

Williams, D. R., & Huffman, M. G. 1986. Recreation specialization as a factor in backcountry trail choice. In: *Proceedings, National Wilderness Research Conference: Current Research*, Fort Collins, CO, July 23-26, 1986. USDA Forest Service, Intermountain Research Station, General Technical Report INT-212.