MANAGING MOUNTAIN BIKE RECREATION AND USER CONFLICTS: A CASE STUDY ON MT. BAKER-SNOQUALMIE NATIONAL FOREST, WASHINGTON STATE

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by

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ABSTRACT

MANAGING MOUNTAIN BIKE RECREATION AND USER CONFLICTS: A CASE STUDY ON MT. BAKER-SNOQUALMIE NATIONAL FOREST, WASHINGTON STATE

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Increasing demand for mountain bike use and resulting conflict between user groups requires land management agencies to develop and test new management strategies. During summer 2006, a U.S. Forest Service recreation policy was evaluated which allows seasonal mountain bike access on alternate calendar days on the Middle Fork Trail in the Snoqualmie River watershed of Washington State's Mt. Baker-Snoqualmie National Forest. Evaluation of conflicts between hikers, mountain bikers, and stock users was conducted through administration of an on-site exit questionnaire to 233 trail users. Chi-square analysis suggests some conflict occurrence between hikers and bikers toward biker etiquette and speed, and between odd and even days and the width of trail and for etiquette. However, over 90% of respondents felt safe, had a high level of enjoyment, and experienced positive interactions with other trail users. This research provides insight into the success of a temporal separation policy and has potential application as a conflict management strategy for other recreation endeavors.

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CHAPTER I

INTRODUCTION

Research Problem

Land managers deal with how to best manage recreation opportunities on public lands by evaluating where and what types of recreation are appropriate for a particular environment (Cessford, 2003; Chavez, 1996a). Maintaining user satisfaction and safety while protecting the integrity of natural resources are just some of the challenges managers face today (Bowker & English, 2002; Chavez, 1996a; Moore, 1994; Schuett, 1997).

Mountain biking is one such recreation endeavor that is raising management concerns (Leberman & Mason, 2000; Ruff & Mellors, 1993; Schuett, 1997) including conflicts between user groups, environmental degradation, and trail access issues. Originating in the 1970s, mountain biking has become increasingly popular worldwide (Goeft & Alder, 2001; Leberman & Mason; Ruff & Mellors). By the end of 2005, the mountain bike community had an estimated 50 million participants in the United States compared to an estimated 76.7 million hiking participants. Single-track mountain biking, defined by the Outdoor Industry Foundation (2006) as biking on a dirt track less than 5 ft wide, has an estimated 39 million participants.

With increasing numbers of mountain bikers, public land managers are under pressure to provide mountain bike recreation opportunities, either on existing or new trails. Sharing trails is a common management strategy, and often preferred by land managers, because it has potential low costs, reduces environmental effects of creating

new trails, and increases use of an existing resource (Cessford, 2003). Recent studies have addressed problems and conflicts associated with mountain bikers sharing trails with other recreation users (Carothers, Vaske, & Donnelly, 2001; Cessford; Leberman & Mason, 2000).

The Mt. Baker-Snoqualmie National Forest in western Washington State (see Figure 1) is facing similar mountain bike conflict management concerns in the Middle Fork Snoqualmie River valley (see Figure 2). On August 27, 2005, the Snoqualmie Ranger District opened the Middle Fork Trail (No. 1003) (see Figure 3) to mountain bike access for a 3-year trial period. The 15-mi trail is open annually to hikers and seasonally open to stock use from July 1 to October 31. Mountain bikers have trail access on a seasonal basis from ~April 15 to October 31, on odd-numbered calendar days (i.e., the "every-other-day policy"). The actual opening date is dependent upon U.S. Forest Service (hereafter, Forest Service)-approved, sustainable trail conditions. This mountain bike policy is a result of the summer 2005 Forest Service approval of Preferred Alternative E within the Revised Environmental Assessment, Middle Fork Snoqualmie River Watershed Access and Travel Management Plan and Forest Plan Amendment #20 (United States Department of Agriculture [USDA] Forest Service, 2005b). Preferred Alternative E includes implementation of the every-other-day mountain bike policy for a 3-year trial period along with several other Middle Fork Snoqualmie River valley management policy changes.

The intended purpose of the every-other-day policy is to allow mountain bikers to enjoy part-time, restricted trail use while allowing original user groups, hikers and

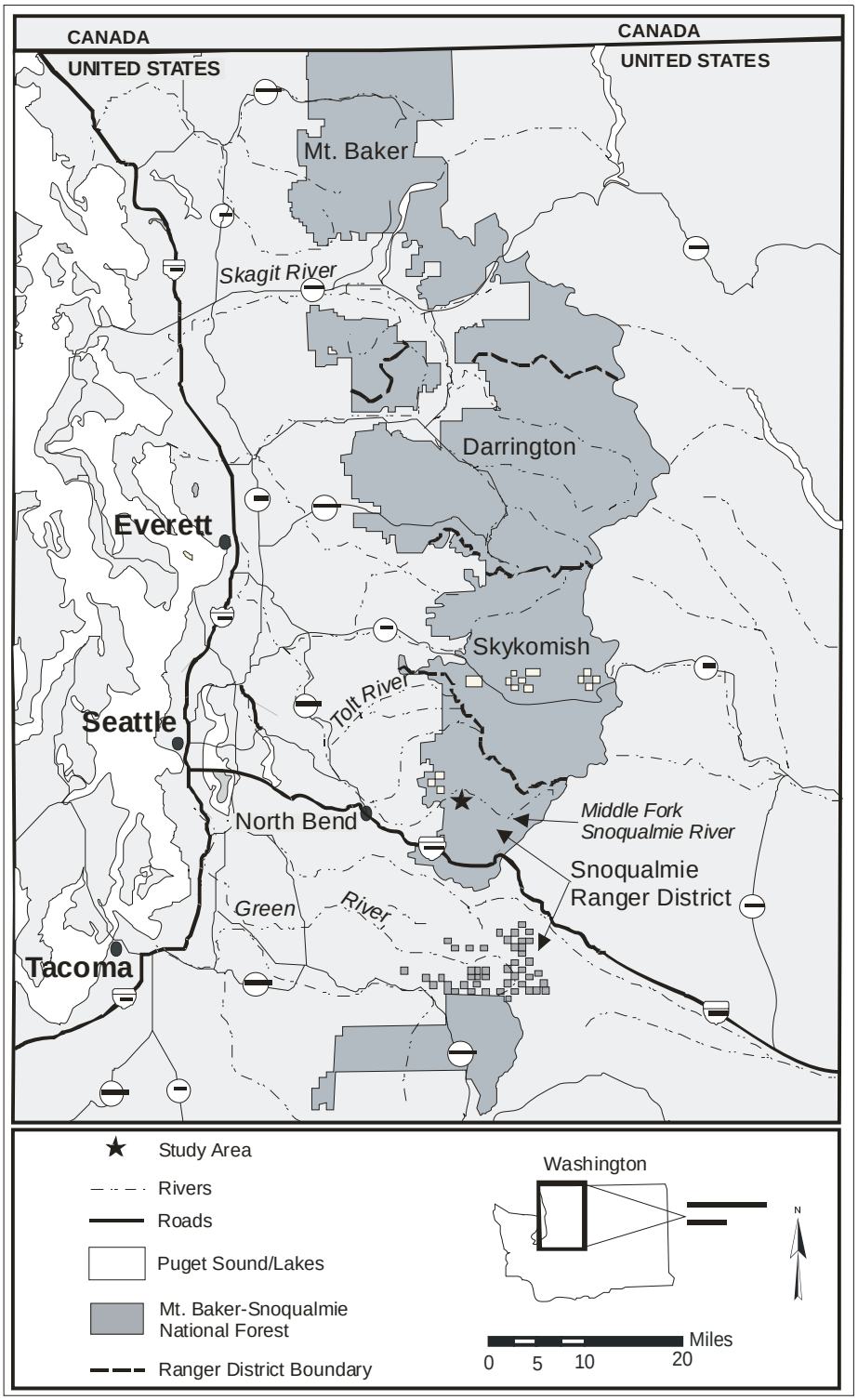

Figure 1. Mt. Baker-Snoqualmie National Forest, northwestern Washington. Source: USDA Forest Service (2005c).

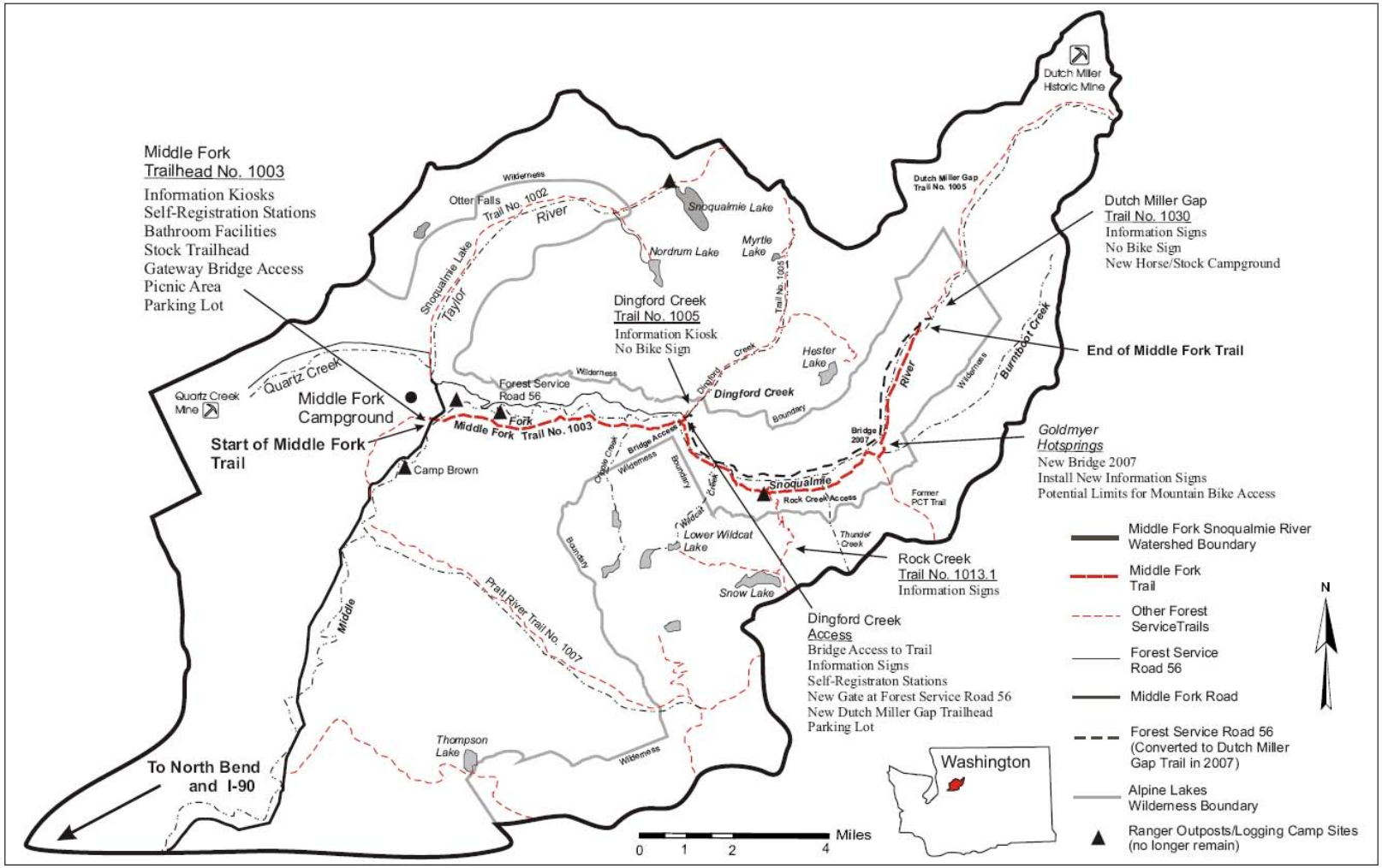

Figure 2. Middle Fork Snoqualmie River watershed. Adapted from National Geographic (2000).

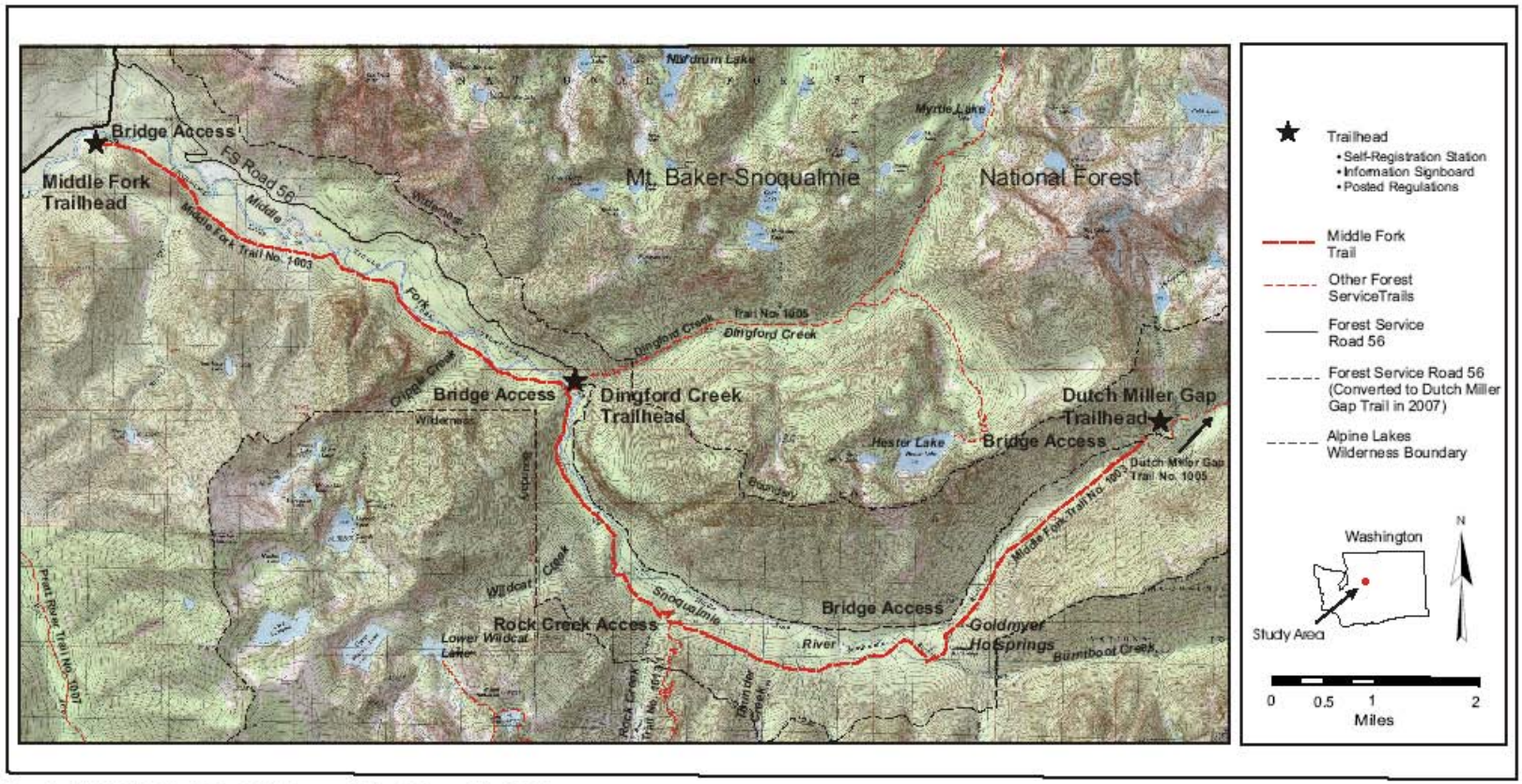

Figure 3. Middle Fork Trail (No. 1003). Source: National Geographic (2000).

stock users the option of selecting whether or not they will utilize the trail during mountain bike days. The introduction of mountain bikes on the Middle Fork Trail has raised the following questions: (a) Is mountain bike use a cause of conflict between user groups? and (b) Is the every-other-day policy a successful alternative to full time mountain bike use by minimizing conflicts between user groups?

Research Objectives

The main objectives of this research are to determine if sharing the Middle Fork Trail with mountain bike recreation causes conflict between user groups, and if so, to explore which management strategies would best mitigate for the type and degree of conflict occurring. To address these main objectives, this research aims to (a) estimate where and when high-use visitation occurs; (b) identify types and frequency of conflict occurrence encountered by trail users; (c) assess the seasonal, every-other-day mountain bike policy as an effective management strategy for the Middle Fork Trail based on the magnitude of conflict occurrence, trail user satisfaction, and policy preference; and (d) provide management recommendations and conflict mitigation strategies for significant conflict findings.

Significance

Land managers are exploring new recreation management strategies as visitation to public land increases and demand for more recreation opportunities persists. Often land managers implement recreation policies though lack resources to evaluate policy success. The every-other-day policy is one conflict mitigation strategy

that land managers are using to manage the recreation needs of different user groups while trying to ensure sustainable recreation areas. Specific findings from this case study will assist Mt. Baker-Snoqualmie National Forest personnel to evaluate mountain bike use on the Middle Fork Trail, thus better manage recreation resources for the area. This research provides a recreation conflict evaluation tool that can assist land management agencies in examining recreation conflict in a variety of settings. Ultimately, few trails have adopted an every-other-day policy; therefore, this case study provides insight into a conflict mitigation policy option and management strategies for other shared trail systems.

CHAPTER II

LITERATURE REVIEW

Many outdoor recreation activities occurring on public lands are becoming increasingly popular, thus creating management concerns (Chavez, 1996b; Chavez, Winter, & Baas, 1993; Hollenhorst, Schuett, Olson, & Chavez, 1995). Management concerns include where and when recreation should occur on public land. Previous research indicates several different factors may contribute to the cause of conflict between user groups on shared trail systems. An examination of previous recreation conflict research, conflict pertaining to mountain bike use, an overview of conflict analytical tools, and recreation conflict mitigation strategies provide the foundation for this case study's research in analyzing mountain bike use and user conflicts.

Recreation Conflict Research

Pressure to share recreation space on public land has increased. As a result of growing outdoor recreation popularity, potential conflicts between user groups require land managers to develop and implement new management strategies. Recreation conflicts may arise if recreation activities with different goals occur at the same time and place or for a variety of environmental, behavior, and social factors (Bury, Holland, & McEwen, 1983). Previous conflict research has evaluated conflict occurrence on shared public lands between a variety of recreation activities including rafting and kayaking (Schuster & Hammitt, 2000), skiing and snowboarding (Thapa, 2000), skiing and snowmobiling (Jackson, Haider, & Elliot, 2004), fishing and waterskiing (Gramann & Burdge, 1981), and mountain biking and hiking (Bjorkman,

1996; Carothers et al., 2001; Cessford, 2003; Chavez et al., 1993; Chavez, 1996a, 1996b; Goeft & Alder, 2001; Schuett, 1997).

Numerous studies have focused on explaining reasons behind conflict, although one single definition for recreation conflict is not available. Researchers have explored several types of conflict including conflict stemming from differences in social values, interpersonal conflict or goal interference (Bjorkman, 1996; Carothers et al., 2001; Bowker & English, 2002; Gramann & Burdge, 1981; Symmonds, Hammitt, & Quisenberry, 2000), perceived conflict, and reality conflict (Cessford, 2003).

Social value conflict occurs when two different recreation groups do not share similar philosophies towards an activity (Bjorkman, 1996; Carothers et al., 2001). For example, mountain biking is a relatively new recreation activity, and therefore, may be viewed by the hiking community as a nontraditional activity unfit for a natural setting (Carothers et al.). Social value differences may appear in the form of perceived or anticipated problems. Perceived or anticipated problems can create conflict without an actual interaction or encounter with the other recreation user. Social value conflicts can be caused by a negative perception or feeling towards another recreation activity (i.e., bikes do not belong in a natural setting), blame a user group for resource degradation (i.e., belief that bikes cause more damage than hiking), or fear of safety hazards (i.e., a speeding bike startling horses).

Conflicts may occur when an actual encounter with another trail user interferes with recreational goals or enjoyment. Gramann and Burdge (1981) define recreation

goal as “any preferred social, psychological or physical outcome of a behavior that provides incentive for that behavior” (p. 17). Recreation satisfaction can be a reflection on whether or not recreational goals are met (Bowker & English, 2002; Gramann & Burdge; Symmonds et al., 2000). For example, if an individual seeks solitude and encounters noisy recreation groups, user groups have different recreation goals, therefore, goal interference conflict may occur. Interpersonal conflict (i.e., goal interference), is also the physical interference one activity has on another (Carothers et al., 2001). Examples of interpersonal conflict occurrence are observation of poor behavior (i.e., rudeness), inappropriate trail etiquette (i.e., not yielding), or environmental damage (i.e., ruts in the trail).

Cessford (2003) explored the differences in perceived conflict and reality conflict. Perceived conflicts occur when recreation groups have conflicting views or philosophies. Perceived conflict is similar to social conflict in that conflict may occur without an actual encounter. Reality (i.e., actual) conflict, similar to interpersonal conflict or goal interference, occurs when a physical encounter creates a disagreeable situation for one or more of the recreation users (Cessford).

Mountain Bike Conflict Research

Since the 1980s, mountain bikers pursuing recreation opportunities on public land have increased (Outdoor Industry Foundation, 2006). The growing popularity of mountain bike recreation and associated management concerns on public land is worldwide. In the early 1990s, several conflict-related studies associated with mountain biking recreation have been explored, many focused on mountain biker and

hiker interactions. Research includes studies from the United States (Bjorkman, 1996; Carothers et al., 2001; Chavez, 1996a, 1996b; Hendricks, Ramthun, & Chavez, 2001; Hollenhorst et al., 1995; Schuett, 1997; Watson, Williams, & Daigle, 1991), Europe (Ruff & Mellors, 1993), Australia (Goeft & Alder, 2001), and New Zealand (Cessford, 2003; Leberman & Mason, 2000). Research indicates environmental and social conflicts tend to occur when public land resources and management policies are limited for mountain bike recreation (Ruff & Mellors; Schuett; Symmonds et al., 2000; Watson et al.).

Land managers in the United States have reported increased levels of conflicts between mountain bikers and hikers (Schuett, 1997; Chavez, 1996a). In a 1996 phone interview survey, Forest Service managers reported mountain bike management as a growing concern (Chavez, 1996a). As reported by 90 Forest Service respondents, 70% of the conflicts were between user groups, 59% were safety issues, and 58% were environmental damage (Chavez, 1996a). Similarly, research from United States' state parks found that 77% of park managers reported conflict between mountain bikers and other trail users; 56% of these conflicts were between mountain bikers and hikers (Schuett). Research conducted by Carothers et al. (2001) found that unacceptable behaviors (i.e., rude and discourteous) from mountain bikers were reported more often than were for hikers, suggesting one-sided (i.e., conflict caused by one user group, not both), interpersonal conflict. Another study, which focused on the positive and negative perceptions hikers have toward bikers, found that hikers who actually encountered a mountain biker had more positive opinions toward mountain bikers than

those hikers who did not encounter mountain bikers (Cessford, 2003), suggesting conflict was more perceived than actually encountered.

Encountered conflicts in a shared space may occur for a variety of reasons. Three general categories for recreation conflict include environmental issues, safety concerns, and/or social conflicts (Bjorkman, 1996; Bowker & English, 2002; Cessford 2003; Chavez, 1996a; Schuett, 1997: Webber, 2007). Specific sources of conflict may include trail damage, environmental impacts, inappropriate speeds or noise, poor trail etiquette, and altered recreation experiences (Bury et al., 1983; Carothers et al., 2001; Cessford; Goeft & Alder, 2001; Needham, Wood, & Rollins, 2004; Ruff & Mellors, 1993).

Environmental Conflict

Environmental conflict can be the result of observed resource degradation (Bjorkman, 1996; Cole, 1993; Goeft & Alder, 2001; Thurston & Reader, 2001). Conflicts may increase when there is a visual disturbance in the trail condition (Cessford, 2003). Increased use levels and/or poor trail design in a sensitive environment can contribute to the presence of environmental problems (Cessford; White, Waskey, Brodehl, & Foti, 2006). For example, Bjorkman (1996) found that steep, shaded, unvegetated slopes are most vulnerable to soil loss and disturbance with moderate to heavy mountain bike trail use. When a trail user observes the presence of user-induced trail damage such as tire tracks, horse tracks, or footprints in mud resulting in trail widening, erosion, and damaged vegetation, feelings of animosity may be directed toward the causal activity (see Figure 4).

Figure 4. Muddy conditions associated with weather and recreation use on the Middle Fork Trail. Source: USDA Forest Service (2006).

Behavioral and Social Conflicts

Conflict may result when inappropriate behavior occurs or social values differ (Carothers et al., 2001; Watson et al., 1991). Encountered behavioral conflict has been attributed to lack of trail user etiquette which interrupts another trail user's enjoyment (Carothers et al.). Poor trail user etiquette may include behaviors such as rudeness, inappropriate yielding to right-of-way (i.e., not allowing passage to others

on a narrow or crowded trail), and being too loud or too quiet (i.e., not warning others on blind corners) (Carothers et al.). Social values such as different lifestyles (i.e., socioeconomic differences), attitudes toward place attachment (i.e., sense of belonging or attachment to a place based on repeat visits or knowledge about a place) (Backlund & Williams, 2003; Clark, 2004), different recreation goals, or motivational differences (i.e., wildlife viewing, socializing, solitude, exercise), may be the underlying cause of conflict (Bjorkman, 1996; Watson et al.). Another social conflict, commonly found in wilderness conflict research, is the perception that a trail's carrying capacity is overextended (Symmonds et al., 2000). On overextended carrying capacity may be either biophysical (i.e., overuse diminishing environmental integrity) or social (i.e., experience interrupted by lack of solitude or increased noise levels). Therefore, social value differences or overcrowding may cause goal interference.

Safety Conflicts

Safety conflicts can be either a potential (i.e., feared by an individual) or an actual physical encounter. Mountain bikes startling horses or encountering hikers on blind corners are examples of conflict that can be either perceived or actual hazards (Carothers et al., 2001; Cessford, 2003; Moore, 1994; Schuster & Hammitt, 2000). Few reports of actual accidents occur between mountain bikers and other user groups (Chavez et al., 1993); however, research indicates that the existing fear of potential unsafe mountain bike encounters, such as high speeds and blind corners, may detract from the recreation experience (Chavez, 1996a; Watson et al., 1991).

Overview of Research Methods for Analyzing Conflicts

Common methods for collecting data to analyze the frequency of conflict occurrence between recreational groups include interviews, questionnaires, and researcher observation (Watson, Cole, Turner, & Reynolds, 2000). The following examples are some of the approaches that have been used based on whether the researcher wanted a sample of public opinion or targeted a specific user group (i.e., land managers or mountain bike club members). Indirect research approaches include off-site methods, where the researcher and respondent do not interact at the study site. Some methods that have been used include mailing questionnaires to one or more target user groups (Leberman & Mason, 2000), distribution of questionnaires via retail outlets (Goeft & Alder, 2001), and emailing questionnaires (Chavez, 1996b; Symmonds et al., 2000). Direct approaches include on-site survey methods, which involve researcher interaction with participants or observing behaviors at the study site. Methods include distribution of questionnaires or interviewing trail users as they exit a recreation site (Bowker & English, 2002; Carothers et al., 2001), contacting recreation users on-site and later mailing willing participants questionnaires (Gramann & Burdge, 1981; Watson et al., 1991), or observing recreation behavior within a given environment with little to no interaction between the researcher and observed individuals (Watson et al., 2000). Follow-up questionnaires via mail or telephone interview (Gramann & Burdge) or providing longer and shorter versions of a questionnaire (Bowker & English) are common approaches to increase response rates.

Research strategies often compare responses from different recreation groups to measure the level of satisfaction, perception, attitude, and/or observations of a recreation participant (Leberman & Mason, 2000; Needham et al., 2004). Both qualitative and quantitative approaches are used in interviews and questionnaires. Quantitative approaches often obtain Likert scale data when addressing satisfaction levels, trail preferences, and opinions toward management strategies. Scales used in previous conflict research have utilized a variety of response variables for extracting information including categories such as detracts/enhances experience, low/high satisfaction, like/dislike, low/high importance, good/poor conditions, or point rating systems (Bowker & English, 2002; Leberman & Mason; Symmonds et al., 2000; Watson et al., 1991). A common approach in mountain bike conflict research to analyze different recreation group preferences (Goeft & Alder, 2001; Schuett, 1997), and behaviors (Carothers et al., 2001) is to use a chi-square test. Depending on results, management strategies can be suggested or further explored to minimize conflict findings between recreation groups.

Recreation Management Strategies

As previously mentioned, conflict occurring between two or more user groups sharing a trail has the potential to reduce user satisfaction; therefore, management techniques that minimize conflict may assist in enhancing the recreation experience (Cessford, 2003; Chavez, 1996b; Moore, 1994; Needham et al., 2004). Mountain bike management is influenced by several factors. Depending on who manages the land and if a policy preexists, factors for determining appropriate management strategies

include the condition of the trail, numbers of preexisting trails, participation levels (Schuett, 1997), economic benefits (Fix & Loomis, 1998; Morey, Buchanan, & Waldman, 2002), and compliance from recreation users.

A shared space, or shared trail, is where multiple recreation activities occur at the same time in the same space. Chavez et al. (1993) suggest that conflict issues need to be identified and management strategies need to be tested. One common strategy managers implement to reduce conflict involves temporal separation between user groups. Additional management strategies may include posting appropriate signage, media coverage in local newspapers or trail guide books, interagency cooperation between land managers and interest groups, appropriate sustainable trail design and maintenance, and/or permit systems.

Few studies (Jackson et al., 2004) have tested the effectiveness of temporal separation in conflict mitigation. Examples of temporal separation may include seasonal, weekly, or daily restrictions for one or more participating recreation groups. Each of the following temporal policies may be used in conjunction with another to minimize conflict occurrence. Success for each of these policies depends on additional management strategies that promote user group cooperation.

Seasonal Policy

Seasonal policies permit user group access to a trail system only during seasons with sustainable trail conditions or restrict access during a season with high visitation to reduce overcrowding. The New Zealand Department of Conservation employs the latter policy on the Queen Charlotte Track, which is open year round to

hiking. A partial summer season closure, from December 1 to February 29, is enforced for mountain biking during peak-hiking visitation (Cessford, 2003; New Zealand Department of Conservation, 2007).

Weekly Policy

Weekly temporal policies separate user groups on weekends and weekdays. Weekends usually have higher visitation than weekday use; therefore, this policy is often implemented to reduce overcrowding. Winter recreation conflict between motorized and non-motorized (snowmobilers and skiers) groups at Chilkoot Trail National Historic Site, British Columbia, Canada, was evaluated to determine the effectiveness of weekend separation (Jackson et al., 2004). Motorized recreation was not permitted every third weekend. Research findings indicate that nonmotorized user satisfaction increased with user separation; however, motorized users indicated less support toward restrictions (Jackson et al.).

Daily Policy

Daily temporal policies separate user groups in two ways: complete separation of user groups or daily restrictions placed on one user group. This management strategy, known as an every-other-day policy or alternate day policy, permits a user group to access a shared trail on either odd or even calendar days. Examples of every-other-day policy implementation for mountain bikes are provided below.

Every-Other-Day Management Strategy

Few shared trails have implemented every-other-day management policies for mountain bikes. Implementation of an every-other-day policy can be difficult to

manage (Webber, 2007) due to community awareness, economic feasibility, and community support. Thus, very little research has looked into how effective the policy is for minimizing conflict between user groups.

Some popular recreation areas in the United States that utilize an every-other-day mountain bike policy include the Tahoe Rim Trail (2006), Nevada and the Big Water, Little Water, and sections of the Great Western trails in Mill Creek Canyon, Utah (USDA Forest Service, 2007). An example of successful every-other-day policy implementation is in Tsali Recreation Area, Nantahala National Forest, North Carolina. Complete separation of equestrians and mountain bikes occurs by alternating access days on different loop trails (Bowker & English, 2002; USDA Forest Service, 1999a; Webber, 2007). Bowker and English (2002) evaluated management practices and visitor satisfaction for the Tsali Recreation Area by conducting an on-site survey over a period of 13 months. Visitors ranked the horse/bike rotating day system high for performance. Only 12.3% of visitors at Tsali reported conflicts; however, most (7.5%) occurred with mountain bikers, and trends indicate mountain biking is growing in popularity (Bowker & English).

CHAPTER III

STUDY AREA

The study area, Middle Fork Trail (No. 1003) within the Middle Fork Snoqualmie River watershed, is in eastern King County, Washington State, approximately 30 mi east of Seattle. The Middle Fork Snoqualmie River watershed is situated between the north and south forks of the Snoqualmie River (see Figure 5).

Located approximately 8 mi northeast of Interstate-90 near North Bend, Washington, the 15-mi trail is managed by the Snoqualmie Ranger District, the southernmost of four land management districts within the Mt. Baker-Snoqualmie National Forest (Figure 1). Data were collected at the Middle Fork Trailhead, located on the 1:24,000 Lake Philippa, Washington, United States Geological Survey [USGS] (1989) quadrangle, in Section 28, Township 24 North, Range 10 East, Willamette Meridian. The trail is east-west oriented and follows the south bank of the Middle Fork River, while Forest Service Road 56 parallels the north bank (Figure 3). Physical and human geography elements for the Middle Fork Snoqualmie River watershed and, more specifically, Middle Fork Trail are provided below.

Geology and Geomorphology

The Middle Fork Snoqualmie River valley is part of the Cascade Mountain physiographic province (Livingston, 1971). Igneous rock of the Snoqualmie batholith covers the entire 154 mi^2 Middle Fork Snoqualmie River watershed (Figure 2) (Bretz, 1913; Livingston; USDA Forest Service, 2005a). The ~17 million-year-old batholith is continuous under Tertiary intrusive igneous rocks, volcanic, and metamorphic rock

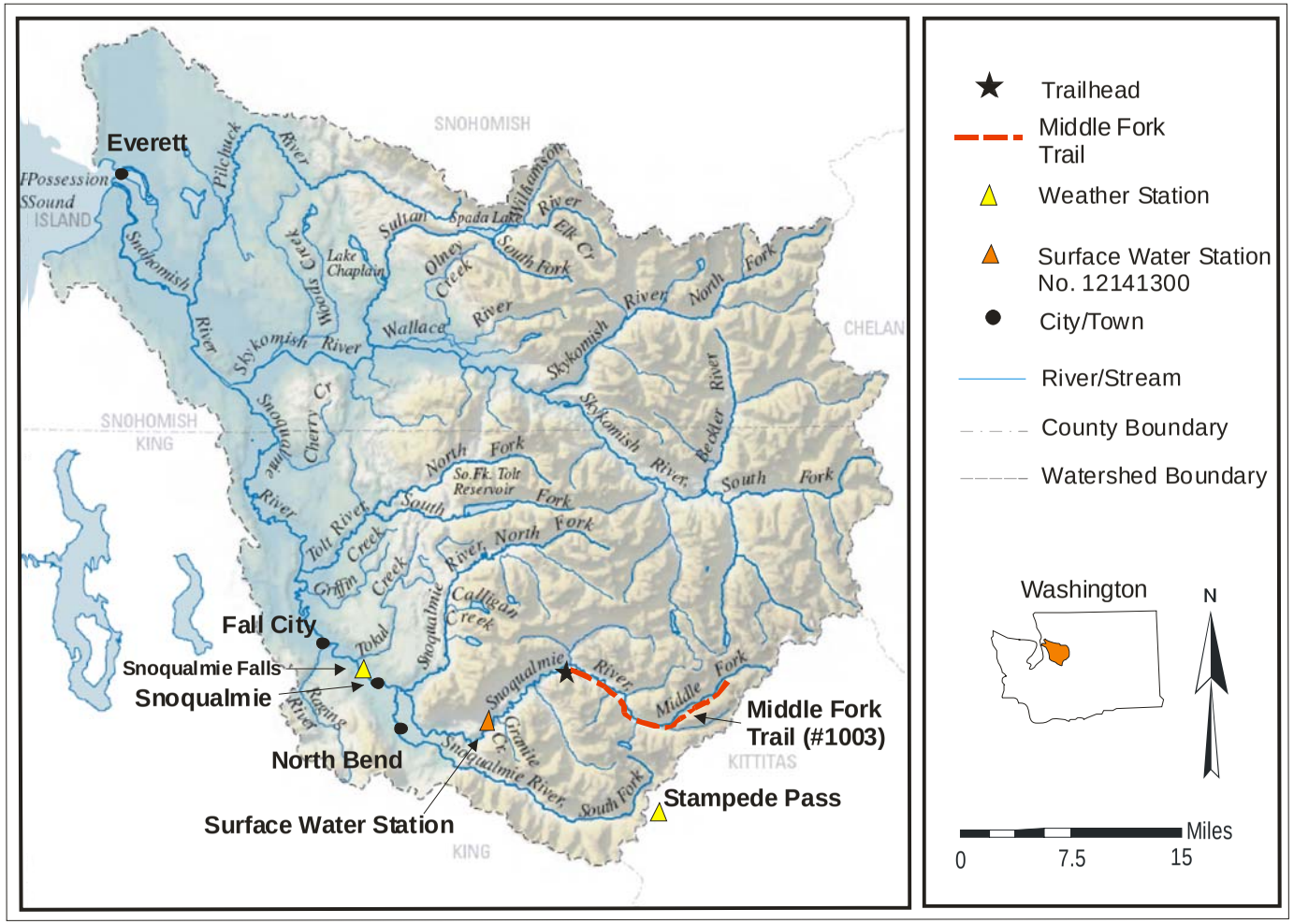

Figure 5. Snohomish River Watershed. Source: USGS (2007).

(Bethel, 2004; Livingston; Smith & Calkins, 1906; Tabor, Frizzell, Booth, & Waitt, 2000; Tabor et al., 1993). Alluvium, Holocene and Pleistocene in age, is found along the river corridor, while Pleistocene glaciolacustrine deposits (i.e., bedded silt and clay) are commonly found in the lower valley along the Middle Fork Trail (Tabor et al., 1993; Tabor et al., 2000).

The Middle Fork Valley was subjected to several advances and retreats of alpine glaciers as well as the Puget Lobe glaciation (USDA Forest Service, 1998). Approximately 18,000 to 15,000 years ago (Booth, Haugerud, & Troost, 2003), the Puget Lobe of the Cordilleran Ice Sheet was at its maximum position in the Puget Lowlands (Bethel, 2004; Booth et al.; Bretz, 1913; Porter, 1976). Rapid terminal recession and glacial volume loss occurred over the following 1,000 years (Porter). Glacial ice scour is evident in the Middle Fork valley by the presence of cirques at the heads of valleys and drainages and striations on bedrock exposures; however, much erosion was caused by subglacial fluvial processes (Bethel).

Several peaks including Garfield Mountain, Mt. Price, and Big Snow Mountain, have vertical relief up to 4,000 ft providing steep valley walls. The Middle Fork Trail gains approximately 1,800 ft of elevation over 15 mi, beginning at an elevation of 1,000 ft and ending at 2,800 ft at Dutch Miller Gap Trailhead (Figure 3).

Soils

Soils in the Middle Fork Snoqualmie River watershed are characteristic of mountains, foothills, terraces, flood plains, and till plains. Two main soil orders generally found along the Middle Fork Trail are entisols and spodosols (USDA Soil

Conservation Service, 1992). Common entisols include Arents and Udifluvents and common spodosols include the Rober, Grotto, and Index series.

Dominant soils along the south bank of the Middle Fork Snoqualmie River beginning at Middle Fork Trailhead to Dingford Creek are Arents, Rober, and Grotto series. Arents are moderately deep to very deep, moderately well drained to somewhat excessively drained soils found on terraces and drift plains from 0% to 8% slopes at 1,000 to 3,000 ft elevations. Rober loams are very deep, moderately well drained soils formed in volcanic ash and glaciolacustrine sediments found on mountain back slopes and plateaus on 0% to 30% slopes from 1,000 to 1,800 ft elevations. Grotto gravelly loamy sand is very deep, somewhat excessively drained soil formed in alluvium found on river terraces on 0% to 8% slopes from 1,600 to 2,800 ft elevations (USDA Soil Conservation Service, 1992).

Dominant soils from Dingford Creek to Dutch Miller Gap Trailhead along the south bank of the Middle Fork Snoqualmie River are Udifluvents and Index series. Udifluvents are very deep, well drained soils formed in alluvium on low stream terraces and drainage ways on 0% to 8% slopes from 1,300 to 2,500 ft elevations. Index series are deep to very deep, well drained soils formed in volcanic ash and pumice on 8% to 90% slopes from 2,200 to 3,600 ft elevation (USDA Soil Conservation Service, 1992).

Use and management of soils for recreation paths and trail development focus on wetness, slope, and the texture of the surface layer. Suitable horse and hiking recreation soils should be firm when wet and not dusty when dry. Soil properties of

Arents and Udifluvents are favorable for paths and trails with only slight recreation use limitations. Grotto and Index series are sandy, thus, creating moderate limitations that can be alleviated by proper path and trail planning, design, and maintenance. Rober series have severe limitations due to extreme slope (USDA Soil Conservation Service, 1992). In addition to soil suitability for hiking and horse recreation, the use of wheeled equipment on these dominant soils may cause excessive rutting when soil is wet, a moderate degree of puddling when soil is compacted, and a moderate degree of soil displacement or rutting may occur when soil is dry (USDA Soil Conservation Service).

Climate

Climate of the study area is influenced by the Pacific Ocean and north-south oriented Cascade Range. Heavy orographic precipitation, especially at higher elevations, is caused by the eastward flow and uplift of warm, marine air masses over the western Cascade Mountain range, producing a marine-type climate (Porter, 1976). Specific climate data are lacking for the Middle Fork Snoqualmie River Valley study site; however, estimates based on data collected by the Western Regional Climate Center at Snoqualmie Falls and Stampede Pass weather stations (Figure 5) may be used to represent climate across the study area (see Figure 6).

The Snoqualmie Falls weather station, representing the lower elevation section of the study area, is located ~17 mi southwest of the Middle Fork Trailhead (Figure 5). The 1971 to 2000 climate normal mean temperature for January was ~39 °F and ~63 °F for July. Mean annual precipitation is ~63 in., with peak precipitation of ~9 in.

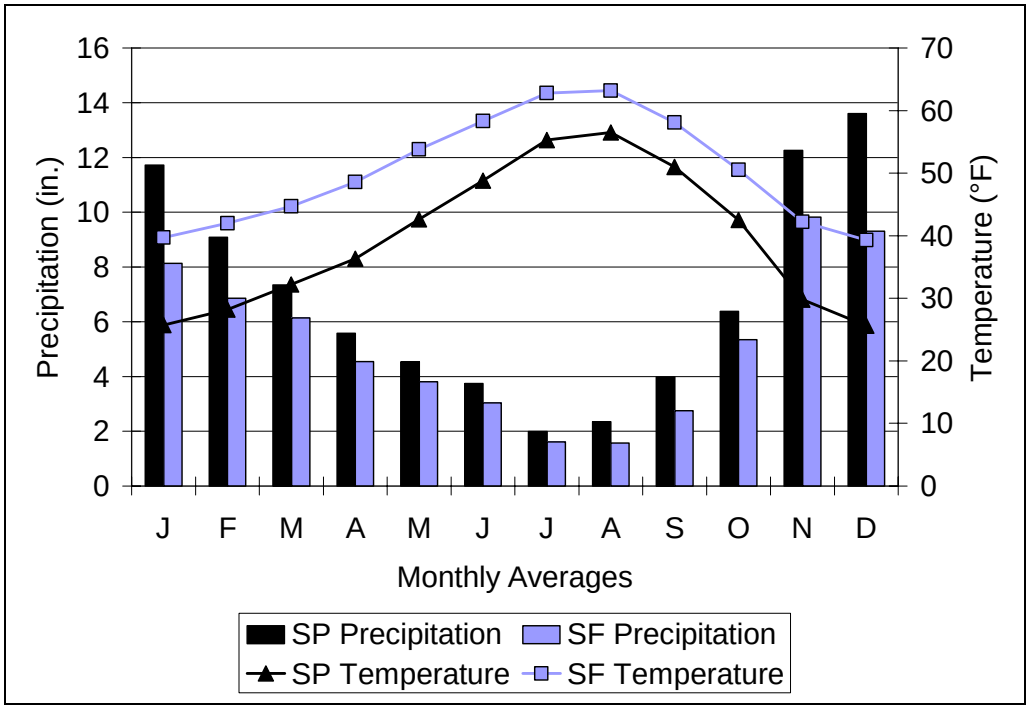

Figure 6. Climograph for Snoqualmie Falls (SF) and Stampede Pass (SP), Washington showing mean monthly precipitation and temperatures 1971-2000. Source: Western Regional Climate Center [WRCC] (2007a, 2007b).

occurring in November. Mean annual snowfall was 8.8 in., with peak averages in January at 2.4 in. (WRCC, 2007a).

The Stampede Pass weather station (Figure 5), representing the higher elevation section of the study area, is located at the crest of the Cascade Range approximately 7 mi south of the Dutch Miller Trailhead. Stampede Pass' 1971 to 2000 climate normal mean temperature for January was ~26 °F and ~55 °F for July. Mean annual precipitation was ~83 in., with peak precipitation of ~14 in. occurring in December. Mean annual snowfall, from 1971 to 1994 (insufficient data from 1994 to 2000) was 389 in. with peak averages in January at 75.5 in. (WRCC, 2007b).

Between October and April, direct precipitation and snow melt softens soils increasing potential for recreation-caused mud and rutting along the trail. In addition, snow may cover the upper portions of the trail as late as mid-May, restricting trail use to the lower 6 mi. High use visitation typically occurs from May through September.

Hydrology

Hydrologic processes within the Snoqualmie River watershed are influenced by area topography, climate, and substrate geology (Bethel, 2004). The Middle Fork Snoqualmie River has approximately 40 mi of main channel within its ~170 mi^2 watershed and drains westward from the Cascade Range entering the Snoqualmie River near North Bend (Figure 2) (Bethel; USDA Forest Service, 1998). From the confluence of the north, middle, and south forks, the Snoqualmie River joins the Skykomish River becoming the Snohomish River which continues to the Puget Sound in Everett, Washington (Figure 5).

The Middle Fork Snoqualmie River headwaters, at an elevation of approximately 5,500 ft, begin southwest of Mount Hinman near Chain Lakes and Dutch Miller Mines (Figure 2) and flow southwest to the Snoqualmie River confluence at an elevation of 400 ft. The river gradient drops ~10% for the first 10 mi, gradually lowering to a gradient of ~1% (Bethel, 2004; USDA Forest Service, 2005a). The Middle Fork Trail is located 10 mi below its headwaters, continuing 15 mi to the confluence of the Middle Fork Snoqualmie River with the Taylor River.

The USGS Middle Fork Snoqualmie River surface water station (No. 12141300) is located 780 ft above sea level near Tanner, Washington (Figure 5). A

mean annual discharge of ~1,234 cubic feet per second (cfs) showed from 1971 to 2000 (USGS, 2007). The highest mean monthly discharge occurred in May at 1,790 cfs, whereas the lowest mean monthly discharge of 409 cfs occurred in August (USGS).

Three main tributaries, Dingford Creek, Taylor River, and Pratt River, in addition to approximately 60 smaller tributaries and intermittent streams, flow into the Middle Fork Snoqualmie River (Figure 2) (USDA Forest Service, 2005a). Major perennial tributaries to the Middle Fork Snoqualmie River that cross the Middle Fork Trail, from either alpine lake or late season snowpack sources, include Cripple Creek, Wildcat Creek, Rock Creek, Thunder Creek, and Burntboot Creek (Figure 3). Along the 15-mi section of Middle Fork Trail, several unnamed intermittent and perennial streams drain across the trail causing trail users to seasonally ford these waterways.

Crossing perennial and intermittent streams along the Middle Fork Trail can be difficult during high stream flows. At times flows may completely prevent continued trail passage. Several bridges, boardwalks, and rock fords have been constructed where the trail crosses smaller intermittent streams and wetland areas, although more are needed.

Vegetation

Native vegetation within the study area is dominated by temperate coniferous forest (Franklin & Dyrness, 1988). The Middle Fork Trail is primarily in the western hemlock (*Tsuga heterophylla*) zone, which includes Douglas fir (*Pseudotsuga menziesii*), with lower limits of the silver fir (*Abies ambilis*) zone along the study

area's higher elevations (Franklin & Dyrness; Henderson, Lesher, Peter, & Shaw, 1992; Kruckeberg, 1991; USDA Forest Service, 1998). Climate and soil variations along the elevation gradient influence the forest plant associations (Henderson et al.). The main plants found along the Middle Fork Trail associated with western hemlock and silver fir zones include skunkcabbage (*Lysichitum americanum*), swordfern (*Polystichum munitum*), ladyfern (*Athyrium filix-femina*), devil's club (*Oplopanax horridum*), salal (*Gaultheria shallon*), Oregongrape (*Berberis nervosa*), vine maple (*Acer circinatum*), and huckleberry (*Vaccinium spp.*; Henderson et al.; see Figure 7).

Previous research has identified increased impacts to soils and surrounding vegetation as recreation use levels increase (Symmonds et al., 2000; Thurston & Reader, 2001). The Forest Service trail guidelines prescribe maintaining a trail corridor 8 ft wide and 10 ft high by removing vegetation and any windfall for optimal passage for hikers, mountain bikers, and stock users (USDA Forest Service, 1996, 2004). The Forest Service intends to have recreation activities remain on the maintained Middle Fork Trail to reduce impacts to surrounding vegetation and trail erosion; however, occasional unmanaged spur trails lead to fishing and undeveloped picnic sites along the river.

Wildlife

Forest wildlife along the Middle Fork Trail includes several common mammal, avian, and fish species. Large mammal populations include black bear (*Ursus americanus*), cougar (*Felis concolor*), bobcat (*Lynx rufus*), blacktail deer (*Odocoileus columbianus*), and elk (*Cervus elaphus*) (Kruckeberg, 1991; USDA Forest Service,

Figure 7. Vegetation encroaching on the Middle Fork Trail. Source: USDA Forest Service (2006).

2005a). Common smaller mammals include coyote (*Canis latrans*), Douglas squirrel (*Tamiasciurus douglasii*), mountain beaver (*Aplodontia rufa*), beaver (*Castor Canadensis*), marten (*Martes Americana*), deer mice (*Peromyscus maniculatus*), and other small rodents (Kruckeberg; Matthews, 1994). In addition, several populations of songbirds, aquatic fowl, and raptors can be found in the study area.

The Middle Fork Snoqualmie River contains populations of rainbow trout (*Oncorhynchus mykiss*), cutthroat trout (*Oncorhynchus clarki*), eastern brook trout

(*Salvelinus fontinalis*), mountain whitefish (*Prosopium williamsoni*), and various species of sculpin (*Cottus sp.*) (USDA Forest Service, 2005a). Snoqualmie Falls, a 268-ft geologic barrier (Bretz, 1913) located approximately 20 mi downstream from the Middle Fork Trailhead, prevents anadromous salmonids from migrating into the Middle Fork Snoqualmie River (USDA Forest Service).

The study area contains potential habitat for several endangered and threatened species listed by the United States Department of Fish and Wildlife and the Mt. Baker-Snoqualmie National Forest (United States Fish and Wildlife Service [USFWS], 2007; USDA Forest Service, 2005a). Current threatened and endangered species with potential habitat identified within the study area include marbled murrelet (*Brachyramphus marmoratus*), bald eagle (*Haliaeetus leucocephalus*), northern spotted owl (*Strix occidentalis caurina*), grizzly bear (*Ursus arctos horribilis*), and grey wolf (*Canis lupus*) (USDA Forest Service; USFWS).

Wildlife along the Middle Fork Trail provides for recreation viewing opportunities. The Middle Fork Trail provides trail access to popular catch and release fishing sites. In addition, seasonal hunting is popular within the study area as well as target shooting. As use levels increase along the Middle Fork Trail, wildlife recreation opportunities may conflict with recreation trail use. Safety issues regarding hiking, mountain biking, and hunting are discussed further in results.

Land Use

Prior to EuroAmerican settlement, the Snoqualmie Tribe inhabited the full length of the Snoqualmie River watershed, hunting and gathering above and below

Snoqualmie Falls (Hill, 1970). Snoqualmie Natives had villages near the mouth of current day Tolt River and Fall City (Prater, 1981). Significant religious and spiritual sites for the Duwamish and Snoqualmie Natives have been identified within the Middle Fork Snoqualmie watershed (USDA Forest Service, 1998).

Exploration of the Snoqualmie River valley by EuroAmericans began around the 1840s and 1850s. In 1854-1855, treaties of Medicine Creek and Point Elliot were signed by Native representatives (Hollenbeck, 1987). The Point Elliot Treaty recognizes tribal fishing and traditional rights within the Middle Fork Snoqualmie River watershed (USDA Forest Service, 2005a). By the late 1800s, mining and logging operations began in the Middle Fork valley, which inspired road development and recreation visitation.

Mining

In 1869, while the lower Snoqualmie River valley was being settled, farmed, and logged, Arthur Denny and several other men began prospecting for mineral deposits on the middle and south forks of the Snoqualmie River (Hollenbeck, 1987; Prater, 1981). The Denny Iron Mines Company formed in 1882 with the discovery of iron ore deposits (Hollenbeck). In 1908, patents were placed on Dutch Miller and Bahoster mining claims (Figure 2) at the head of the Middle Fork Snoqualmie River with the discovery of copper (Hollenbeck).

With the discovery of mineral deposits came the need to develop an efficient transportation route (Prater, 1981). The original route to reach the mines was via the Skykomish River and Necklace Valley; however, this route switched to the Middle

Fork Snoqualmie River after a few years (Chang, 1997; Hollenbeck, 1987). Approximately 30 years after initial mining exploration, a rough road had been developed as far up the Middle Fork Valley to Goldmyer Hot Springs (Figure 2), where a trail then continued another 11 mi to the Dutch Miller mining claims (Hollenbeck). Gold, silver, and copper prospecting operations continued into the late 1970s (R. Kirby, personal communication, March 5, 2007). However, the only major ore deposits removed were from the Quartz Creek Mine located above the mouth of the Taylor River (Figure 2). By the early 1990s, the Forest Service bought the mineral rights to Dutch Miller Mine. Today, only 18 small active mining claims remain, primarily for quartz crystal extraction (USDA Forest Service, 2005a).

Timber Industry

Logging throughout the entire Snoqualmie River Valley began in the late 1800s and peaked from 1905 to 1910 (Hollenbeck, 1987). Logging operations in the Middle Fork Valley up to Goldmyer Hot Springs began in 1928 when North Bend Timber merged with Wheeler-Osgood Corporation (Hollenbeck). Approximately 36 mi of road was constructed to support timber operations in the valley (USDA Forest Service, 1998), some of which extends beneath present day Forest Service Road 56 and the Middle Fork Trail (R. Kirby, personal communication, March 5, 2007).

Logging camps and Forest Service ranger outposts were present into the 1980s. Ranger outposts at Snoqualmie Lake and Rock Creek were closed in the 1940s (R. Kirby, personal communication, March 5, 2007); the Taylor River Ranger Station was last used in 1946 (S. Swain, personal communication, March 8, 2007); and Camp

Brown, built in 1927 for logging operations (USDA Forest Service, 1998), closed in 1974 (R. Kirby) (Figure 2). By 1967, the last timber unit beyond Dingford Creek had been logged (R. Kirby). Logging mills that supported logging above Pratt River and near Quartz Creek closed in the 1980s (R. Kirby; USDA Forest Service). Logging operations concluded in 1993 with ~14,275 acres of timber harvested in the watershed.

Forest Service Land Acquisition

The Pacific Northwest Forest Reserve in Washington State was set aside in 1893, which closed 2.5 million acres of forest to settlement and resource use. By 1897, a total of 8 million acres of forest reserves, first administered by the U.S. Division of Forestry, had been set aside in Washington State for public parks. Later that year, the Organic Act of 1897 permitted mining, agriculture, and timber harvesting on forest reserves (Hollenbeck, 1987). In 1905, the Department of Agriculture took over administration of all forest reserve land. In 1908, the Snoqualmie National Forest was established with boundaries extending from the Skagit River to Green River (Figure 1). Mt. Baker-Snoqualmie National Forest was established in 1973 by merging Snoqualmie National Forest and Mt. Baker National Forest (Hollenbeck). Lester Ranger District, one of five original Snoqualmie National Forest districts, was later renamed North Bend Ranger District in 1974. In 1997, the North Bend Ranger District merged with White River Ranger District to become the Snoqualmie Ranger District.

The Snoqualmie Ranger District manages 90,350 acres within the Middle Fork Snoqualmie River watershed, which includes 18 active mining claims, 11 historic

Forest Heritage Resource listed properties, 50,736 acres of designated Alpine Lakes Wilderness, and a variety of recreation opportunities (USDA Forest Service, 2005a). Of the remaining acreage within the watershed, ~640 acres are privately owned, 1,720 acres owned by Washington State or King County (USDA Forest Service).

Recreation

Within the Middle Fork Snoqualmie River Valley, early camping destinations included the Taylor River Campground, which closed in the early 1980s (D. Schrenk, personal communication, March 8, 2007), and undeveloped Dingford Creek Campground (R. Kirby, personal communication, March 5, 2007). Goldmyer Hotsprings and lodge, located on privately owned land, was developed in 1935 (Hollenbeck, 1987). The lodge no longer exists; however, Goldmyer Hotsprings remains a popular, independently owned recreation destination.

Today, the Middle Fork Snoqualmie River Valley is within close proximity to Seattle providing recreation opportunities for a diverse, urban population. The United States Census Bureau (2007) estimated the Seattle metropolitan area to have approximately 3 million people in 2000, an ~18.9% growth increase from 1990. The Middle Fork Snoqualmie River Valley provides recreation opportunities including dispersed and developed camping, horseback riding, hiking, fishing and hunting, kayaking, and biking. The Middle Fork Campground, a new developed camping facility, was established in 2006. The campground, along with 11 maintained trails, provides a foundation for recreation opportunities on National Forest land in the Middle Fork Snoqualmie River watershed.

The entire Middle Fork Trail, one of the 11 trails managed by the Forest Service, is located within 0.5 to 1 mi of congressionally designated Alpine Lakes Wilderness Area (Figure 3). The Alpine Lakes Wilderness Area accounts for ~56% of National Forest land in the Middle Fork Snoqualmie River watershed (USDA Forest Service, 2005a). Approximately 33 mi of maintained trail are located outside the Wilderness boundary (USDA Forest Service). Mountain bikes are prohibited within the Alpine Lakes Wilderness area.

Middle Fork Trail (No. 1003)

History

The Middle Fork Trail was part of the original Cascade Crest Trail (renamed the Pacific Crest Trail in the 1970s) that dropped into the valley via Red Mountain and continued east along the original Dutch Miller mining trail (Alpental, 2002). Due to safety concerns, the Cascade Crest Trail was relocated along the Snow Lake Trail, down Rock Creek Trail, then continued east on the Middle Fork Trail (Figure 2) (R. Kirby, personal communication, March 5, 2007). In 1968, Congress designated the Pacific Crest Trail as one of the first national scenic and historic trails in the National Trails System (National Trails System Act, 1968). In 1978, the Pacific Crest Trail was relocated via Snoqualmie Pass through Commonwealth Basin which is east of the study area (Alpental).

Recreation Issues on the Middle Fork Trail

During the Columbus Day storm of 1962, the upper portion of the Middle Fork Trail from Goldmyer Hot Springs to Dutch Miller Gap Trailhead washed away; trail

activities were diverted to Forest Service Road 56 (R. Kirby, personal communication, 2007). In the 1990s, the Snoqualmie Ranger District applied for several trail reconstruction grants from the Interagency Committee for Outdoor Recreation for trail repairs and to reconnect the trail from the washed out section to Dutch Miller Gap Trailhead. One grant mentioned trail construction that would accommodate hikers, saddle and pack animals, and mountain bikers (North Bend Ranger District, 1993). Access on the Middle Fork Trail was only permitted for hiking and stock use.

The occurrence of illegal mountain bike use on trails was an issue due to a lack of available mountain bike opportunities in the Middle Fork valley and surrounding areas. Prior to implementation of Alternative E within the Revised Environmental Assessment, Middle Fork Snoqualmie River Watershed Access and Travel Management Plan and Forest Plan Amendment #20, only 9.8 mi of trail permitted mountain bike access on National Forest land in the Middle Fork Snoqualmie River watershed (USDA Forest Service, 2005a). Portions of closed road segments converted to trail allowed mountain bike access within the Middle Fork Snoqualmie valley in the 1990s. Alternative E would increase seasonal mountain bike recreation opportunities to ~24 mi of single-track trail on Forest Service lands.

Several interest groups opposed the idea of allowing mountain bikes on the Middle Fork Trail. Letters sent to the Forest Service in opposition regarding mountain bike access included those from the Sierra Club, Snoqualmie Valley Trails Club, and Mountaineers (Mountaineers, 1995; Sierra Club, 1995; Snoqualmie Valley Trails Club, 1995). The Sierra Club claimed the Forest Service was neglecting to monitor

mountain bike effects on soil, vegetation, watershed, and wildlife functions as well as neglecting to post signs indicating the trail was closed to bikes (Sierra Club).

While others opposed mountain bikes on the Middle Fork Trail, the mountain bike community, including Seattle-based, nonprofit Backcountry Bicycle Trails Club (BBTC) and the International Mountain Bike Association (IMBA), were advocating mountain bike use on the Middle Fork Trail. BBTC is an advocacy group that works to "create and enhance mountain bike opportunities" (Backcountry Bicycle Trails Club [BBTC], 2007).

Several interest groups, including BBTC, Washington Trails Association, Sierra Club, and Middle Fork Outdoor Recreation Coalition (1995) got together to discuss mountain bike options in the Middle Fork Valley. In 2001, a letter was sent to the Forest Service signed by Alpine Lakes Protection Society, BBTC, Middle Fork Outdoor Recreation Coalition, and Washington Trails Association (2001) to show unified support for the mountain bike policy proposal within Alternative E.

Five alternatives were included in the Watershed and Access and Travel Management Plan and Forest Plan Amendment #20 (USDA Forest Service, 2005a). Alternative actions included major issues regarding decommissioning roads, access to private land and mining claims, and recreation access. In regard to mountain bike access on the Middle Fork Trail, Alternative A (no action) and Alternative C maintained the trail would remain closed to mountain bikes; Alternative B opened seasonal access from April 15 to October 31; and Alternative D maintained the first 6 mi of the Middle Fork Trail would remain closed to mountain bikes and the trail

would be open from Dingford Creek to Dutch Miller Gap trailhead (7.8 mi) from April 15 to October 31. Alternative E, the proposed action, opened mountain bike access on the Middle Fork Trail on odd calendar days from ~April 15 to October 31. For Alternatives B, D, and E, opening dates for mountain bike access would depend upon Forest service-approved, sustainable trail conditions. The USDA Forest Service (2005b) issued a Decision Notice and Finding of No Significant Impact for preferred Alternative E in April, 2005. On August 27, 2005, the 3-year trial period began allowing mountain bike access on the Middle Fork Trail on odd calendar days between April 15 and October 31 (Executive Order No. 06-05-FO-06-01, 2006), during which time user conflicts would be monitored (USDA Forest Service, 2005a).

2006 Middle Fork Trail Description

The Middle Fork Trail is considered easy for hikers, moderate for horses/stock, and difficult for mountain bikers based on trail topography, engineering, and soils. Three bridges provide trail access and permit trail users to select various recreation loops along the trail: the Middle Fork Gateway Bridge at Mile Point 0, Dingford Creek Bridge at Mile Point 6, and the uppermost bridge located at Mile Point 14. At Goldmyer Hotsprings, Mile Point 12, a fourth bridge will be constructed summer 2007 (USDA Forest Service, 2005a). Three trails, closed to mountain bike access, branch off the Middle Fork Trail and lead into the Alpine Lakes Wilderness Area, including Dingford Creek Trail (No. 1005), Rock Creek Trail (No. 1013.1), and Dutch Miller Gap Trail (No. 1030; Figure 3).

CHAPTER IV

METHODS

Methods for data collection and analysis included four main components: (a) estimate Middle Fork Trail visitor use, (b) design and implement an on-site exit questionnaire administered to public trail users at the Middle Fork Trailhead, (c) analyze participants' responses to variables to determine type and frequency of conflict occurrence, and (d) discuss conflict management strategies and recommendations for the Middle Fork Trail. Data collection occurred from April 15 to November 1, 2006.

Visitor Use Estimation

To ascertain visitor use estimates and high use visitation dates, voluntary self-registration stations (see Figure 8) were used to gather data on the Middle Fork Trail from April 15 to October 31, 2006. Self-registration is a data collection technique where visitors voluntarily fill out a registration form upon entering a trail system, often used when other techniques are either too costly or less accurate (Watson et al., 2000). Self-registration is not a requirement to enter the trail system, therefore it is not enforced. Response rates and accuracy may vary depending on the location, visibility, and maintenance of the registration station as well as the design of the form (Watson et al.). Previous data collected from the Snoqualmie Ranger District indicate an 80% compliance with wilderness permits that are required when entering the Alpine Lakes Wilderness (USDA Forest Service, 1999b). However, compliance rates are usually

Figure 8. Self-registration station at Dingford Creek, Middle Fork Trail. Source: USDA Forest Service (2006).

higher for required permits than voluntary self-registration (Watson et al.); therefore, less than 80% compliance should be assumed for Middle Fork Trail self-registration.

The Forest Service provided four self-registration stations that were installed by April 15, 2006. Two stations were placed at the Middle Fork Trailhead, one was placed at Dingford Creek Trailhead, and one was placed at Dutch Miller Trailhead (Figure 3). The self-registration stations were strategically placed in trail access

locations where visitors would most likely commit to registration. Stations were adequately supplied with forms and pencils. All registration sheets, premarked with registration location, were designed to collect visitor information including date, zip code, number in party, destination, and type of recreation (see Appendix A). Registration forms were collected weekly from April 15 to November 1, 2006.

Information gathered from self-registration stations help to indicate where and when high use visitation occurs. In areas with high use visitation, the potential for user interaction, thus conflict, increases. Visitor use estimates help determine if use levels affect the types and frequency of conflict along different sections of trail. In addition, the visitation estimates provide baseline data that may be useful in making future management decisions as trail use and visitation levels fluctuate over time.

Design and Implementation of Questionnaire

An exit questionnaire is a common research tool for obtaining attitudes and preferences of participants in conflict-related research (Watson et al., 2000). Previous research has utilized on-site exit questionnaires and interviews to determine the frequency of conflict occurrence on shared trail systems (Bowker & English, 2002; Carothers et al., 2001; Cessford, 2003). The questionnaire designed and used to obtain respondent information on the Middle Fork Trail obtained quantitative data to analyze the sample population's observations of the trail environment and other trail user behaviors. Design and administration of the on-site exit questionnaire are explained in three parts: (a) instrument design, (b) sample and procedural techniques, and (c) respondent selection.

Instrument Design

The on-site exit questionnaire was the primary research tool for evaluating conflict on the Middle Fork Trail (see Appendix B). Design included content, layout, technical completion and approval, and a pilot study.

Content

A 3-page exit questionnaire was designed to collect data for analyzing frequency of conflict occurrence between user groups as well as obtain individual opinions on the every-other-day recreation management policy. The combination of interpersonal conflict, reality conflict, and goal interference were examined as sources of conflict on the Middle Fork Trail to determine any actual encountered conflicts. Two visitor satisfaction questionnaires, including Bowker and English's (2002) mountain bike survey for assessing trail users, preferences, conflicts, and management alternatives, as well as Watson and Cole's (1991) wilderness user preferences, social and resource conditions, and management options research questionnaire, were used as models. The goal was to produce a questionnaire with low visitor burden and obtain accurate responses (Creswell, 2003; Salant & Dillman, 1994). Content within the survey was categorized into four sections: (a) general respondent profile and demographic information, (b) trail experience and satisfaction, (c) recreation management policy, and (d) overall experience.

Section 1, general information, was designed to obtain basic demographic information and respondent's purpose for recreation. The survey included 12 questions pertaining to (a) gender, (b) age, (c) respondent residence, (d) years

recreating on the trail, (e) dual sport participation (participation in more than one activity), (f) size of group, (g) destination, (h) recreational activities, and (i) experiences sought (i.e., relaxation, exercise) while recreating for the day on the Middle Fork Trail.

Section 2, trail experience and satisfaction, contained questions pertaining to the respondent's observations of trail conditions and behaviors. First, respondents were asked to rate eight trail conditions. The eight variables were divided into two categories. The first category included four trail conditions and facilities: width of trail, information on trailhead signboard, condition of vegetation, and stream and bridge crossings. The Likert scale included excellent to very poor responses, with a sixth category for "did not notice." Second, respondents provided observations of user-induced trail conditions. User-induced trail conditions are conditions that may be linked to a particular user group. Respondents were asked if they noticed mud, horse manure, bicycle tire ruts, and stock tracks on the trail, using a five-category scale ranging from noticing too much to none, with a sixth category for "did not notice." Trail behavior variables included noise, speed, and etiquette. For obtaining information on trail user interactions and behaviors, respondents were asked to estimate the number of hikers, mountain bikers, and stock users they encountered. If the respondent encountered trail users, they were asked to generalize and rate other trail user behaviors using a five-category scale ranging from excellent to very poor, with a sixth nominal category for "did not notice."

Section 3, recreation management policy, described the terms of the Middle Fork Trail's every-other-day mountain bike policy. Respondents were asked if they knew of this policy prior to arriving at the Middle Fork Trail. If they had prior knowledge, they were asked to identify where they first heard about the policy. Then, respondents were provided like and dislike statements pertaining to mountain bike policy and asked to provide their opinions.

For Section 4, overall experience, respondents rated on a scale from 1 to 10 their perception of safety, enjoyment, and interactions with other trail users while recreating on the Middle Fork Trail. Finally, respondents noted if they encountered any Forest Service employees or volunteers during their visit at the Middle Fork Trail.

Layout

Effective questionnaire design is visually appealing, includes simple questions to encourage response accuracy, and is limited in length to obtain the maximum amount of information without losing respondent attention (Salant & Dillman, 1994). The Middle Fork Trail exit questionnaire was designed to meet these standards. The questionnaire was visually appealing by having four distinct sections. Key words were placed in bold type to ensure visibility. For simplicity and to ensure accuracy, questions were primarily close-ended and responses were provided in the form of numerical data, yes/no responses, and nominal categories (Dawis, 1987; Salant & Dillman; Watson & Cole, 1991). Length limitations were met by limiting the questionnaire to 3 pages, which took no longer than 10 min to complete.

Technical Completion and Approval

Prior to data collection, the USDA Forest Service Snoqualmie Ranger District reviewed and approved the questionnaire and permitted data collection on the Mt. Baker-Snoqualmie National Forest. The Central Washington University Human Subjects Review Committee approved the questionnaire design and administration procedures. Technical completion and approval by both the Forest Service and Central Washington University assisted in limiting bias within research design and questionnaire format.

Pilot Study

A pilot survey was conducted on May 27, 2006, to determine if any adjustments were necessary in the questionnaire design. This date was selected because it was the first available date of the season with shared trail use. During this pilot study, 17 questionnaires were administered to hikers and mountain bikers; stock users were not present. It was determined that the original 4-page questionnaire was too long and the nominal scale in section 2 was not easily understood by the respondents. Section 2 originally used nominal categories asking the respondents to indicate if trail encounters "detracted from" or "enhanced" their trail experience. The scale was adjusted to a nominal scale where respondents indicated whether or not trail encounters were "excellent to very poor" with an additional nominal category for "did not notice." The result was a 3-page questionnaire administered for the remainder of the project. The 17 pilot study questionnaires were not included in the final analysis.

Sample and Procedural Technique

The on-site exit questionnaire was administered on various weekend days from May 28 (Memorial Day weekend) to September 4, 2006 (Labor Day weekend). These dates as well as weekends were selected due to their expected high-use visitation. A stratified, random sample of 12 days was selected for administering the questionnaire. Six randomly selected odd and six randomly selected even days were selected. Odd weekend days included June 11, July 1, July 9, July 15, August 13, and August 19, 2006. Even weekend days included June 10, July 8, July 30, August 6, August 26, and September 2, 2006. For each sample date, I sat at the Middle Fork Trailhead next to the information kiosk with questionnaires, clipboards, and writing utensils and administered the questionnaire to trail users returning to the parking lot (see Figure 9).

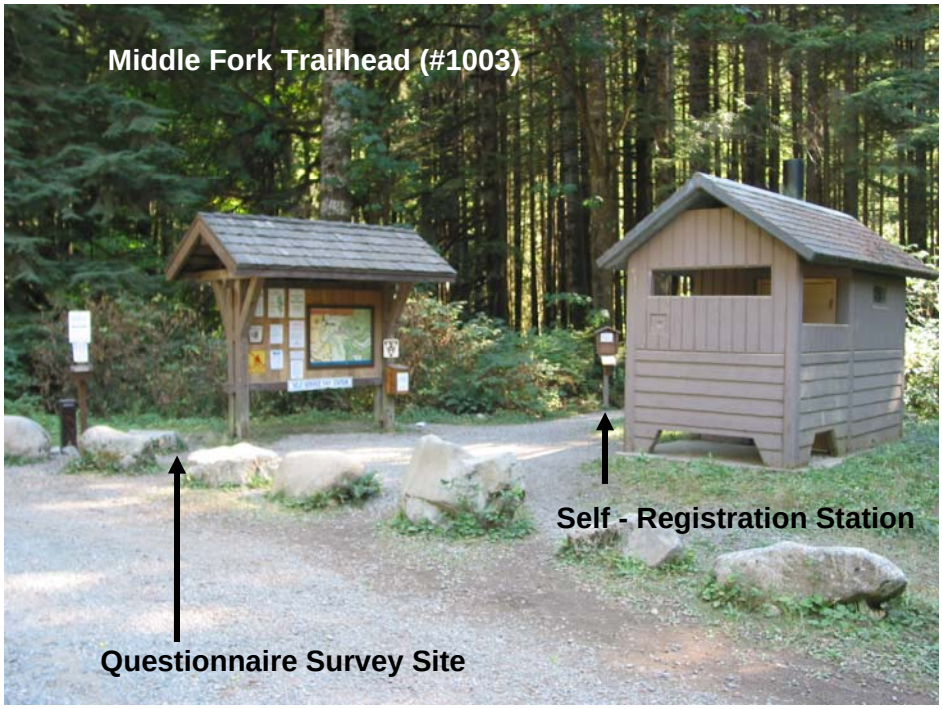

Figure 9. Middle Fork Trailhead survey site. Source: USDA Forest Service (2006).

The questionnaire was administered at the same time each day, between 10:00 a.m. and 4:00 p.m. In addition, weather was recorded for each sample day.

Respondent Selection

In compliance with Central Washington University Human Subjects Review Committee requirements, all trail users exiting were asked if they were at least 18 years of age, if they had previously taken the questionnaire, and if they were willing to voluntarily participate (see Appendix C). Volunteers were informed their responses would remain anonymous. Trail users were categorized into one of three user group categories: hikers, mountain bikers, and horse/stock handlers. A willing participant was handed a numbered, dated, and user-group-categorized questionnaire, which was completed independently. Each respondent interpreted the questions and responded accordingly. Independent question interpretation was selected to reduce researcher and respondent interaction bias, which can potentially occur from a researcher's response to an inquiry (Salant & Dillman, 1994).

Based on the chi-square contingency analysis and different nominal scales used in the questionnaire, the target respondent sample size was 200-300 (McGrew & Monroe, 2000). The purpose for asking all individuals exiting the trail to voluntarily complete the questionnaire was to obtain a sufficient sample size and to obtain observations from the public sector that utilizes the trail.

Descriptive and Quantitative Analysis

Descriptive analysis includes visitor use estimation, response rate percentages, and a visitor demographic summary. This information provides details about who

utilizes the trail system and for what reasons. The descriptive information also provides a comparison between the profiles of different user groups utilizing the Middle Fork Trail and compares any unique characteristics of trail users on the Middle Fork Trail to national recreation profiles.

A chi-square (χ^2) contingency analysis was conducted using STATISTIX® 7.0 (Analytical Software, 2000). Chi-square test requirements for this research were met through the use of ordinal and nominal data, raw frequency counts, and the randomly sampled population (McGrew & Monroe, 2000). Frequency counts in nominal categories were combined, if necessary, to ensure all cells had at least five expected frequency counts or no less than 20% of the cells contained less than five expected frequencies. The analysis was conducted only for those respondents who encountered and noticed a trail condition or behavior.

Chi-square testing is commonly used when questionnaire instrumentation is designed with nominal categories to analyze the relationship between recreation participation and conflict (Carothers et al., 2001; Cessford, 2003; Hendricks et al., 2001; Schuett, 1997). The two hypotheses tested were: (a) determine if a significant relationship exists between user group type and conflict occurrence, and (b) determine if a significant relationship exists between odd and even days and conflict occurrence.

Chi-square tests were used to analyze relationships pertaining to environmental conflict, behavior conflict, and opinions toward mountain bike policy. Data for visual observations of trail/environmental conditions and observed trail user behaviors were obtained using two different nominal scales: “excellent, good, average, poor, and very

poor" and "too much, a lot, expected amount, a little, and none." Three behaviors were analyzed including speed, noise, and etiquette. Respondents indicated if they observed "excellent, good, average, poor, and very poor" behaviors from other trail users. Only observed behaviors were analyzed; therefore, "did not notice" responses were not included in the chi-square analysis. Data were obtained on user group opinions toward mountain bike policy options by respondents indicating whether they agreed, disagreed, or were unsure about three opinion statements.

Significant chi-squares were calculated at a 95% confidence level, significance at $p = 0.05$. For significant relationships, Cramer's *V* relationship strength score was calculated using VassarStats® (2007). Cramer's *V* statistic identifies how dependent variables are on the independent variable. Cramer's *V* statistic was used to determine if the relationship's strength was weak (< 0.3), moderate (0.3 to 0.7), or strong (> 0.7).

Management Strategies

Conflict occurrence between mountain bikers and hikers focus land managers on alleviating problems by creating policies and management tools (Chavez, 1996a). In some instances, trails and public land areas have been closed to mountain bike where conflicts arise, although closing or restricting trail use is often unfavorable to the user group affected (Carothers et al., 2001). Mountain bike management policies depend on types of trails available and the participation levels for that particular area (Schuett, 1997). The Middle Fork Trail case study provided a unique opportunity to evaluate how effective the every-other-day mountain bike policy is in minimizing encountered conflicts between user groups.

Other management strategies for shared trails include appropriate communication and education (Chavez et al., 1993; Hendricks et al., 2001; Hollenhorst et al., 1995), proper trail design and maintenance (Symmonds et al., 2000), and cooperative programs between land management agencies, volunteers, and interest groups (Chavez, 1996b; Hendricks et al.; Moore, 1994). Strategies to alleviate environment and behavior conflict may include appropriate signage at trailheads, media coverage to ensure public understanding of current policy procedures, trail facilities engineered to withstand different user group needs (Chavez, 1996a), and/or increased law enforcement (Carothers et al., 2001). Management recommendations and conflict mitigation strategies are discussed for all significant findings from this analysis.

CHAPTER V

RESULTS AND DISCUSSION

The results and discussion are divided into three sections: (a) Middle Fork Trail visitation estimates and response rates; (b) descriptive statistics for respondent profiles, demographics, and use patterns; and (c) conflict analysis. Conflict analysis involved chi-square contingency analyses on environmental, behavior, and safety conflict variables and for trail user opinions toward three different temporal separation policies. Discussion provides insight into all significant chi-square results and identifies Cramer's *V* strength relationship scores. Furthermore, the discussion explores problems encountered with the project's research design and/or data and suggestions provide amendments for future research design.

Middle Fork Trail Visitation Estimation

Prior to administration of the questionnaire, Middle Fork Trail use visitation rates were unknown. Highest visitation was assumed to occur on weekends and at the most accessible point, the Middle Fork Trailhead. Visitor use estimates and sample population response rates are discussed below.

Visitor Use Estimates

A total of 4,184 trail users registered upon entering the Middle Fork Trail system from April 15 through October 31, 2006. The registered population included 3,657 hikers (87.4%), 502 mountain bikers (12.0%), and 25 stock users (0.6%) (see Table 1).

Table 1

Self-Registration for the Middle Fork Trail System

User group	Middle Fork[a]		Dingford[b]		Dutch Miller[c]		
	n	%	*n*	%	*n*	%	Total
			April 15-October 31, 2006				
Hiker	3,059	84	392	11	206	6	3,657
Biker	294	58	159	32	49	10	502
Stock	25	100	0	0	0	0	25
Total	3,378	81	551	13	255	6	4,184
			May 28-September 4, 2006				
Hiker	2,001	84	250	10	141	6	2,392
Biker	257	62	118	28	43	10	418
Stock	22	100	0	0	0	0	22
Total	2,280	81	368	13	184	6	2,832

Note. Values based on self-registration data collected at trail access locations. [a]Middle Fork Trailhead self-registration stations. [b]Dingford Creek self-registration station. [c]Dutch Miller Gap self-registration station.

Trail use data was collected and recorded from April 15 to October 31 to estimate use levels for the season in which mountain bikes have potential access on the Middle Fork Trail system. However, mountain bikes were not permitted access until May 27, 2006. Self-registration is variable in accuracy; therefore, it should be noted that overall trail use is most likely underestimated by at least 20%.

The registered population during administration of the questionnaire, May 28 to September 4, 2006, indicated that a total of 2,832 trail users accessed the Middle Fork Trail system (Table 1). The self-registration data from all sites indicated primary trail access was the Middle Fork Trailhead with 2,280 visitors (81%) entering the trail system at this point. Sixty-two percent of visitation occurred on weekends (Saturdays and Sundays, excluding holidays) and only 38% of visitation occurred on weekdays (see Table 2).

Table 2

Middle Fork Trailhead Weekday Versus Weekend Visitor Use Estimates From May 28 to September 4, 2006

	Weekdays		Weekends	
User group	*n*	%	*n*	%
Hiker	755	38	1,246	62
Biker	102	40	155	60
Stock	11	50	11	50
Total	868	38	1,412	62

Weekend trail use estimates at the Middle Fork Trailhead during the sampling time frame indicated 1,412 trail users entered the trailhead including 1,246 hikers (88.2%), 155 mountain bikers (11%), and 11 stock users (0.8%) (Table 2).

Approximately 55 % of total visitation occurred on odd calendar days, and 45% of visitation occurred on even calendar days (see Table 3). Higher visitation was expected on odd days since mountain bikers were allowed access.

Table 3

Middle Fork Trailhead Odd Versus Even Day Visitor Use Estimates From May 28 to September 4, 2006

User group	Odd		Even	
	n	%	*n*	%
Hiker	1,026	51	975	49
Biker	235	91	22	9
Stock	4	18	18	82
Total	1,265	55	1,015	45

Response Rates

A total of 294 trail users exited the Middle Fork Trailhead during 12 weekend sample days (see Table 4). An 80.6% response rate (237 of 294) was obtained by trail users who volunteered to complete a questionnaire. Four questionnaires were eliminated from the final analysis because of (a) an incomplete questionnaire; (b) a person under 18 years of age completed a questionnaire; and (c) two respondees were horseback riders, thus, the sample was too small to include in the statistical analysis.

Table 4

Summary of Questionnaire Response Rates for the Middle Fork Trail

Group	*N*	*n*	%
Hiker	211	160	75.8
Biker	81	73	90.1
Stock	2	0	0
Total	294	233	79.3

Note. *N* = trail users exiting the trailhead, solicited to complete a questionnaire. *n* = number of useable questionnaires.

The final analysis included 233 usable questionnaires, a 79.3% response rate (233 of 294) (Table 4). A total of 211 hikers exited the trail with 160 responding to the questionnaire, a 75.8% hiker response rate. A total of 81 mountain bikers exited the trail system with 73 responding to the questionnaire, a 90.1% mountain biker response rate. The sample population was expected to include more hiker responses than mountain biker since hikers have full-time access and mountain bikers have half-time trail access. Mountain bikers (90.1%) had an overall higher response rate than did hikers (75.8%). Because access to the Middle Fork Trail for mountain bikes is under a trial evaluation period, mountain bikers may have been more apt to participate in the questionnaire in order to provide positive feedback for retaining mountain bike trail access resulting in response bias. Finally, the total collected questionnaires included

148 odd day questionnaires (64%) and 85 even day questionnaires (36%). Higher response rates were expected on odd calendar days due to mountain bike trail access.

Five participants responded to the questionnaire on two different survey dates. To ensure accuracy, the data from the five repeat questionnaires pertaining to respondent demographics (Questions 1-6) was not included in visitor demographic descriptive and quantitative analysis (n = 228). However, data pertaining to environmental and behavior analysis from the repeat questionnaires were used in the quantitative analysis since trail experience may change from day to day. For each of the five repeat questionnaires, it was expected that responses would indicate that it was not their first time recreating on the Middle Fork Trail (Question 4), and that respondents were aware of both the every-other-day policy (Question 17) and stock use policy (Question 18) (Appendix B). All five responses were valid. On three repeat questionnaires, respondents indicated they had been recreating on the Middle Fork Trail 11 or more years. Two repeat questionnaires respondents indicated they had been recreating on the Middle Fork Trail for 1 to 2 years, which means they may have been first-time trail users when completing the first questionnaire, though this detail remains unknown because questionnaire responses are anonymous.

Descriptive Statistics for Respondent Profiles, Demographics, and Use Patterns

Gender

Gender associated to recreation use type on the Middle Fork Trail indicated hikers are 41% male and 59% female; mountain bikers were predominately male with 81% and only 19% female (see Figure 10). A chi-square analysis indicated a

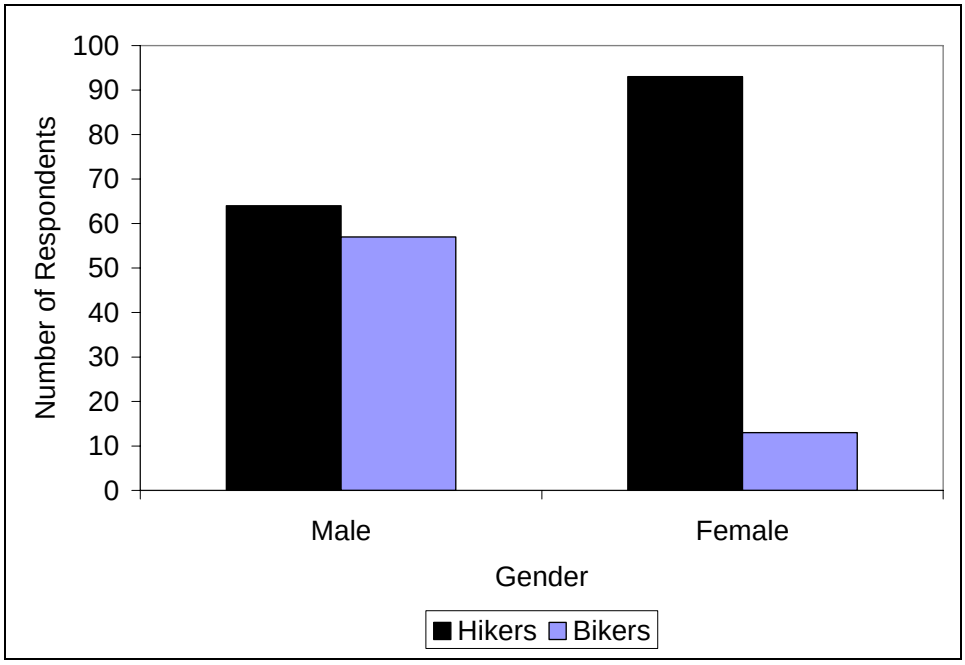

Figure 10. Gender of sample population on the Middle Fork Trail.

significant difference between user group and gender ($\chi^2 = 32.16$, $p = 0.0095$) (see Appendix D, Table D1). A moderate Cramer's *V* strength of relationship ($V = 0.38$) score was identified between observed frequencies for user group and gender. The Middle Fork Trail tends to have a slightly larger female hiking population compared to national statistics of 44% female and 56% male (Outdoor Industry Foundation, 2006). Previous research (Bjorkman, 1996; Carothers et al., 2001; Hollenhorst et al., 1995), as well as national statistics, indicate single-track mountain bike participation is predominantly male, which is similar to gender results for the Middle Fork Trail.

Age

No significant differences in age were determined between hikers and mountain bikers. The majority of Middle Fork Trail hikers (30%) and mountain

bikers (40%) are 26 to 35 years old (see Figure 11). These figures did not correspond with the Outdoor Industry Foundation (2006) research which found the majority of hikers (31%) to be 45+ years old and mountain bikers (36%) to be 16 to 24 years old in the United States. Differences in age from this research compared to the national study may be due to any number of differences in study area regional demographics such as general population age, income levels, and/or accessibility to trail systems.

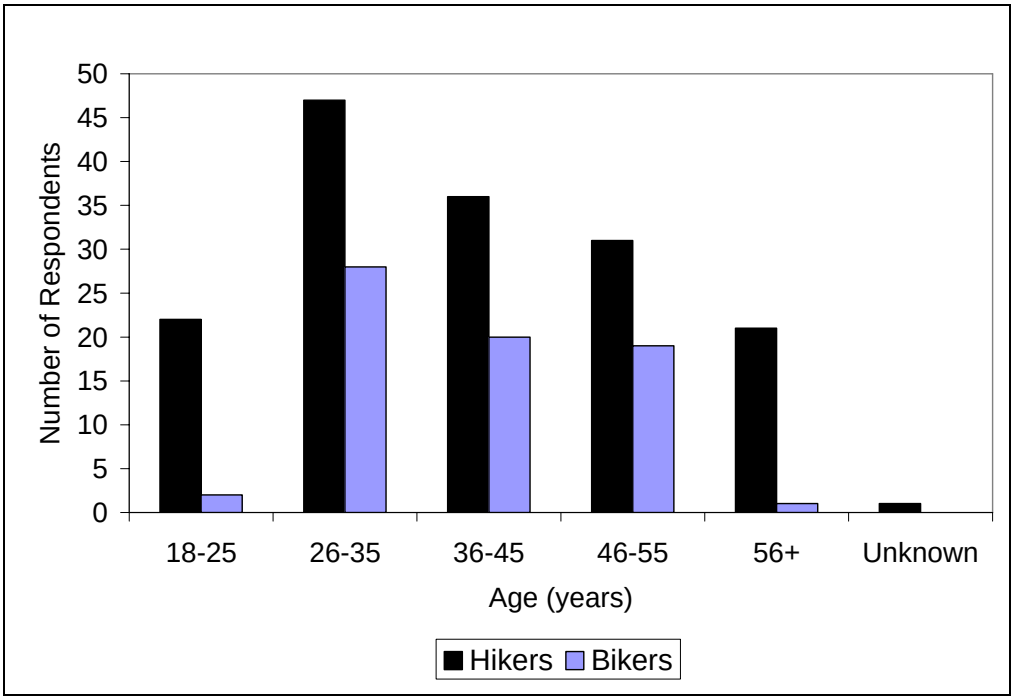

Figure 11. Age of sample population on the Middle Fork Trail.

Respondent Residence

Ninety-one percent of respondents were from the Puget Sound region (see Figure 12), which includes Snohomish, King, Pierce, and Kitsap counties. Three percent of respondents were from areas in Washington State outside of the Puget

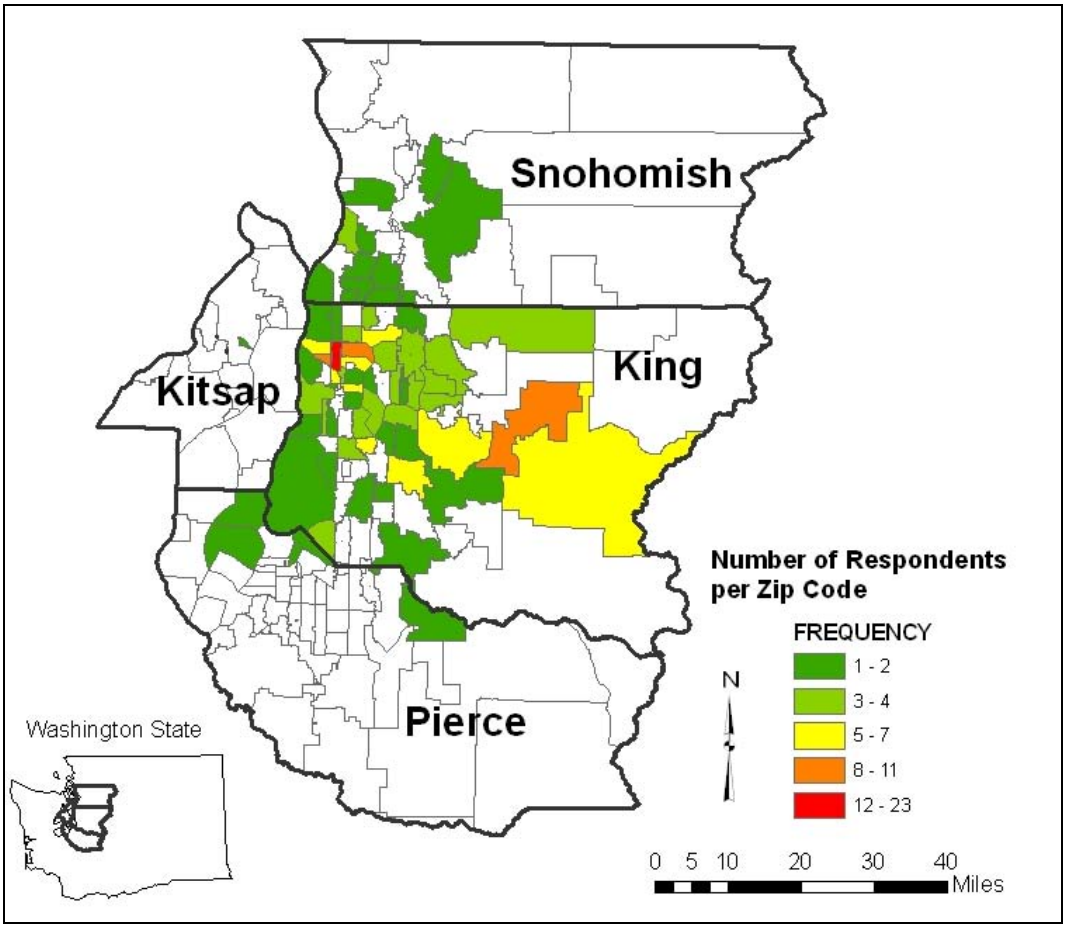

Figure 12. Middle Fork Trail sample population distribution by zip code for Snohomish, King, Pierce, and Kitsap counties.

Sound region, and 6% were from other states in the United States, ranging from Oregon to Pennsylvania. Eighty percent of respondents live in King County, indicating most people visiting the Middle Fork Trail live within a 2-hr drive from the trailhead.

Number of Years Recreating on Middle Fork Trail

No significant difference existed in number of years recreating on the Middle Fork Trail between hikers and mountain bikers. Data provided in Figure 13 illustrate

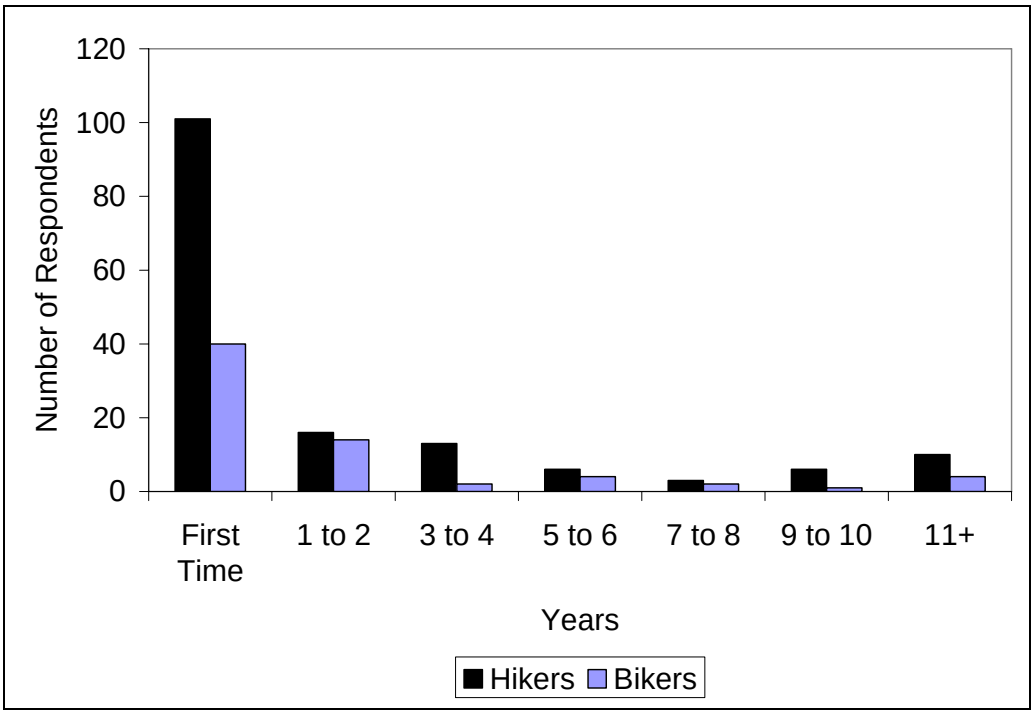

Figure 13. Number of years recreating on the Middle Fork Trail.

the number of years respondents have recreated on the Middle Fork Trail. Sixty-four percent of hikers were first time Middle Fork Trail visitors, 19% of hikers (30 of 160) had 1-4 years recreation experience on the Middle Fork Trail, whereas only 6.3% of hikers (10 of 160) had 11 or more years of recreation experience. Fifty-five percent of mountain bikers (40 of 73) were first time trail users, 22% of mountain bikers (16 of 73) had 1-4 years recreation experience on the Middle Fork Trail, and 9.6% of mountain bikers (7 of 73) had 11 or more years. High percentages of first-time trail use for both hikers and mountain bikers may be an indication that trail use is increasing on the Middle Fork Trail, with the increase in available recreation opportunities in the Middle Fork valley.

Dual Recreation Participation

Hikers and mountain bikers were asked if they also participate in hiking, biking, or horse riding/stock activities on other trail systems (see Figures 14 and 15). Carothers et al. (2001) found that hikers and mountain bikers are less likely to report problematic behaviors associated with their own recreation activity. In addition, the same study found that those who participate in both hiking and biking (dual sport participants) activities are less likely to notice unacceptable mountain biking behaviors (Carothers et al.).

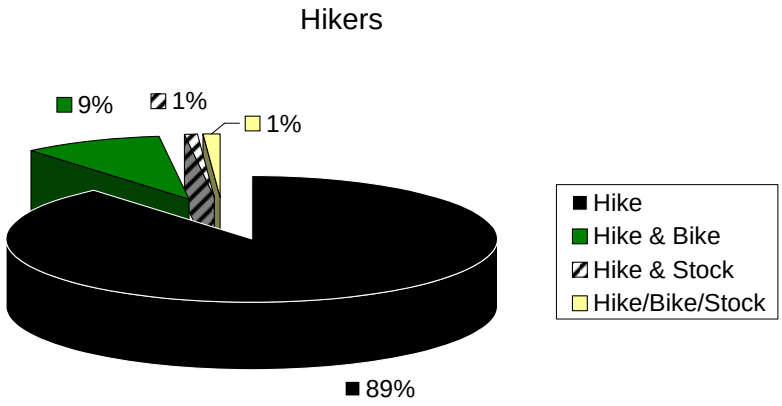

Figure 14. Hiker participation in other recreation activities.

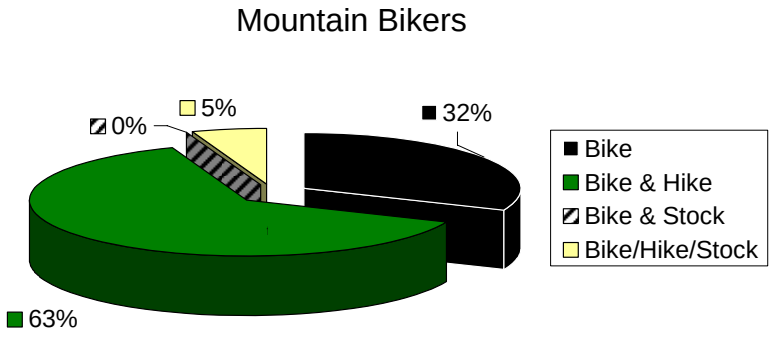

Figure 15. Biker participation in other recreation activities.

Eighty-nine percent of hikers indicated they only hike on other trail systems; 9% hike and bike; 1% hike and ride horses; and 1% hike, bike, and participate in horse/stock use. Approximately 32% of mountain bikers indicated they participate only in mountain biking activities on other trail systems; 63% bike and hike; and 5% bike, hike, and ride horses on other trail systems.

Group Size

No significant difference existed in group size recreating on the Middle Fork Trail between hikers and mountain bikers. All respondents were asked to indicate the group size they were recreating with on the Middle Fork Trail (see Figure 16). Group sizes ranged from solo outings up to nine per group. The most common response indicated that hikers (39%) and mountain bikers (30%) recreate on the Middle Fork

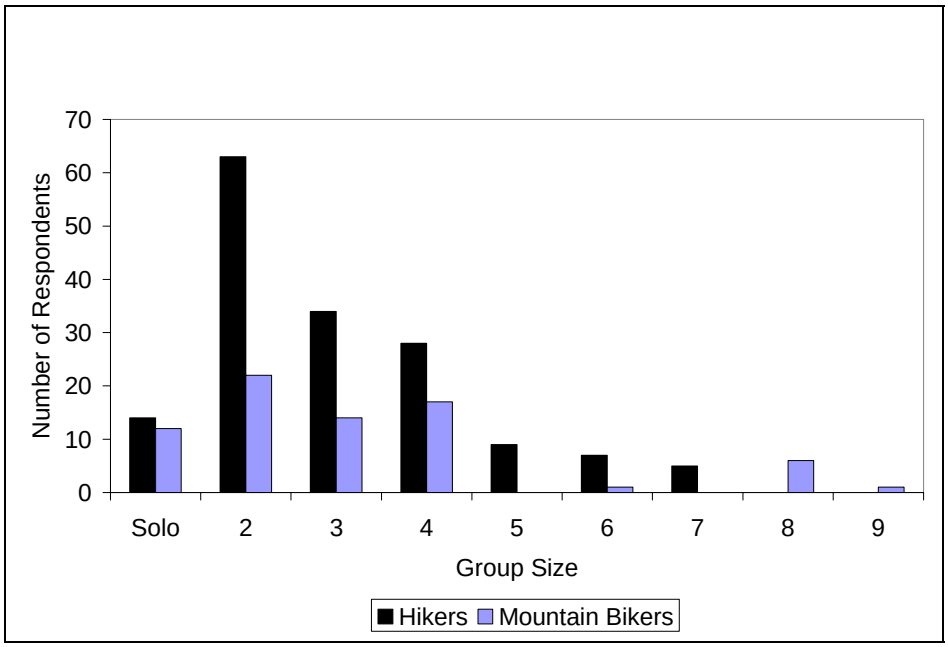

Figure 16. Size of group on the Middle Fork Trail.

Trail in pairs. Larger groups of mountain bikers may be due to organized events from local mountain bike organizations.

Recreation Destination

A significant difference existed in recreation destination between hikers and mountain bikers ($\chi^2 = 41.14$, $p < 0.0001$) (Appendix D, Table D2). A moderate Cramer's *V* strength of relationship ($V = 0.47$) score was identified between observed frequencies for user group and destination along the Middle Fork Trail. Respondents were asked to indicate their starting point and destination along the Middle Fork Trail. Ninety-nine percent of respondents (141 of 142) started at the Middle Fork Trailhead, only 1% of respondents (1 of 142) entered the trail at Rock Creek. Results indicated that 77% of respondents (110 of 142) only utilized the first 6 mi of trail (Middle Fork Trailhead to Dingford Creek). Fifteen percent of respondents (22 of 142) indicated that they recreated up to 12 mi, with only 7% of respondents (10 of 142) traveling the entire Middle Fork Trail (see Figure 17). Along the first 6 mi of Middle Fork Trail, 61% of hikers (54 of 88) traveled as far as first 3 mi, whereas 54% of mountain bikers traveled as far as 6 mi of trail. Six percent of hikers (5 of 88) and 9% of mountain bikers (5 of 54) traveled the entire 15 mi of trail.

Due to an open-ended question approach used on the questionnaire, analysis of trail user destinations was difficult to quantify. Only 142 responded by stating either miles or hours traveled one way or round trip, or provided a destination name that could be numerically quantified. Destination names included Dutch Miller Gap (~15 mi one way), Goldmyer Hotsprings (~12 mi one way), Thunder Creek (~10 mi one

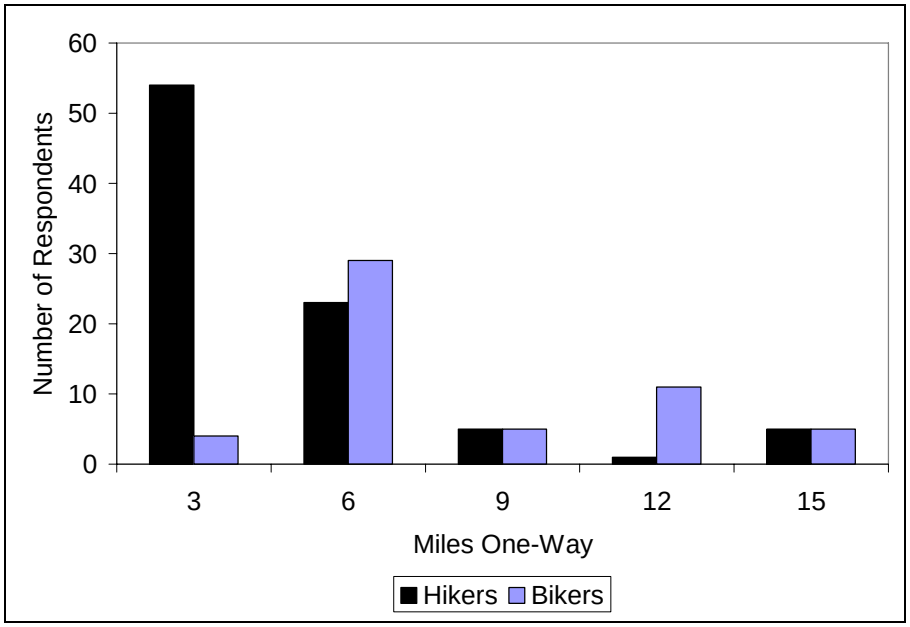

Figure 17. Recreation destination on the Middle Fork Trail.

way), Rock Creek (~9 mi one way), and Dingford Creek (~6 mi one way). Two of 142 respondents stated "end" as their destination. This was interpreted as the end of the trail (15 mi one way). Twelve of 142 respondents stated "loop" as their destination. Since the bridge at Dingford Creek provides the first loop option via Forest Service Road 56, this response was categorized as a 6-mi, one-way trip, and potentially underestimated use. Finally, 25 of 142 responses stated the number of miles or number of hours, but did not indicate one way or round trip. The responses were assumed to be one way, so as to not underestimate trail use, consequently underestimating conflict. The remaining 34% of responses (79 of 233) took on various immeasurable forms. Some of the common, unusable responses stated "no specific," "anywhere," "a few miles," or "out and back" destinations. Five percent of the questionnaires (12 of 233) did not provide a response.

The responses, "round trip" or "hours," were converted into miles one way to determine the sections of trail traveled. Estimated distances traveled on the Middle Fork Trail for hikers were based on an average hiking speed of ~2 mi/hr. Mountain bike distance traveled per hour is difficult to estimate because mountain biker speeds may vary depending on rider experience and trail difficulty. Since the trail is considered difficult for mountain bike use, 2 mi/hr was used for all destination calculations.

Based on the quantitative approach and categorization rationale by use of one-way estimation, the distances traveled are most likely overestimated. To address this problem in future research, there are three approaches that may result in a better representation of trail use. The first approach would be to replace the open-ended destination question with a more quantitative method, for example, provide a scale indicating hours or miles traveled in one direction. Another approach would be to provide various destination options and prompt the respondent to select the furthest destination reached. Finally, a more quantitative approach in collecting destination information via self-registration at trail access points might provide a better overview of use along the trail.

Activities Pursued

Hikers and bikers were asked to indicate the main activities they pursued during their visit to the Middle Fork Trail (Appendix C). Respondents selected anywhere between one and eight activities from multiple options provided on the questionnaire. The top three activities hikers pursued were hiking (147 of 160),

walking the dog (37 of 160), and berry picking (10 of 160). Mountain bikers indicated their main activity was mountain biking (73 of 73), with only one to five responses in each of the following categories: climbing, walking the dog, hiking, berry picking, swimming, and trail running. It was expected that each user group would indicate that their main activity was the one in which they were participating. However, other activities that hikers and mountain bikers indicated they pursue are similar, such as walking the dog and berry picking.

Experiences Pursued

No significant differences exist between experience and user group type. Respondents were asked to indicate the top three experiences they were seeking while recreating on the Middle Fork Trail. Hikers and mountain bikers pursued the same five experiences. Hikers and mountain bikers indicated their top five experiences were exercise, be with family friends, nature appreciation, relaxation, and exploration of a new place, in that order (see Figure 18). The most common experience sought was exercise, as indicated by 85% hikers (136 of 160) and 84% mountain bikers (61 of 73). Seventy-seven percent of hikers (123 of 160) and 74% of mountain bikers (54 of 73) selected to be with family and friends, 57% of hikers (91 of 160) and 66% of mountain bikers (48 of 73) selected nature appreciation, 44% hikers (71 of 160) and 51% of mountain bikers (37 of 73) selected relaxation, and 38% of hikers (61 of 160) and 33% of mountain bikers (24 of 73) selected explore a new place.

Previous research indicates that recreation goals and experiences tend to differ between hikers and mountain bikers. Bjorkman (1996) found that hikers tend to

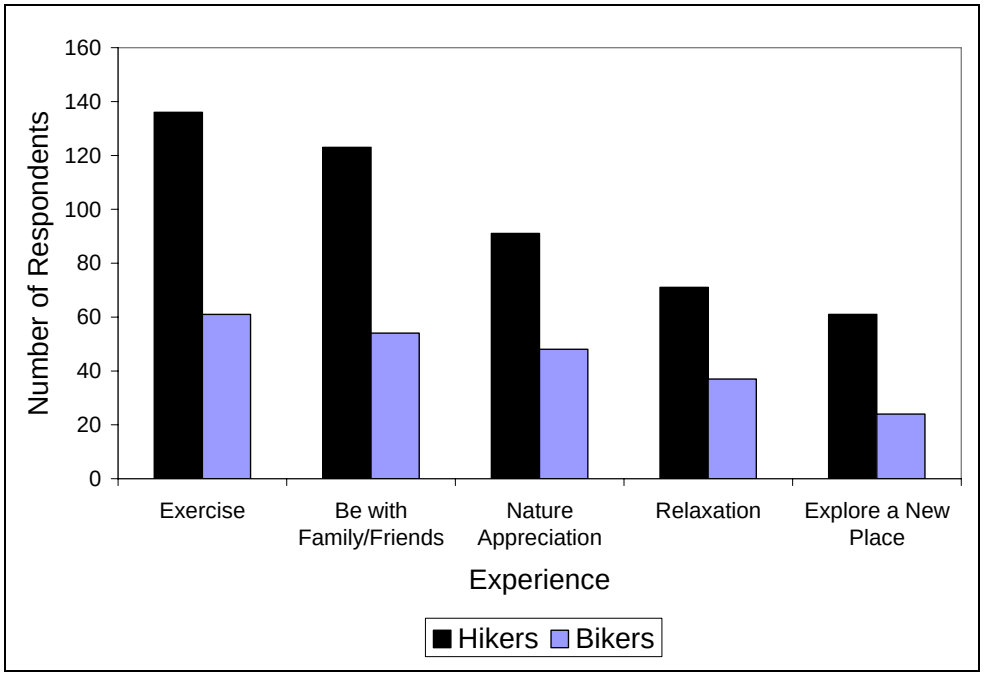

Figure 18. Top five experiences sample population pursued on the Middle Fork Trail.

pursue more nature experiences, while mountain bikers tend to pursue exercise. The results from the Middle Fork Trail study indicate that goals and preferences tend to be the same between hikers and bikers; therefore, goal interference should be less.

One problem with this dataset included the lack of consistency respondents had in following instructions. Each respondent was asked to mark only 3 experiences they were seeking. Respondents selected from 1 to 10 experiences out of 14 possible choices. Some experiences may be overrepresented by those respondents who selected over three experiences. In addition, a rank-order system was not part of the instructions. Ranking might change the level of importance, as determined by a user group. These problems may be remedied by including rank-order instructions on the questionnaire so respondents provide more detailed information.

Conflict Analysis

Environmental Conflict

Eight environmental conflict variables were divided into two categories. The first category included trail conditions and facilities. Respondents were asked to indicate if they observed "excellent," "good," "average," "poor," or "very poor" conditions for the width of trail, information on signboard, vegetation, and stream/bridge crossings. The second category included four potential user-induced trail conditions. Respondents were asked to indicate if they observed "too much," "a lot," "expected amount," "a little," or "none" for four conditions, including mud on trail, horse manure, bicycle tire ruts, and horse/stock tracks. For all eight trail conditions, an additional category for "did not notice" was provided. Only observed trail conditions were analyzed, therefore, "did not notice" responses were not used in the environmental conflict analysis.

Hiker and Mountain Biker Trail Condition Analysis

No significant chi-square relationships were determined between hiker and mountain biker observations for the four variables in the trail conditions and facilities category. Hikers reported "excellent" and "good" conditions 82% for the width of trail, 66% for information on signboard, 92% for vegetation, and 95% for bridge and stream crossings (see Appendix E, Table E1). Mountain bikers reported "excellent" and "good" conditions 88% for the width of trail, 68% for information on signboard, 89% for vegetation, and 89% for bridge and stream crossings (Appendix E, Table E2). Six percent or less of hikers and mountain bikers observed any "poor" or "very poor"

conditions. Insignificant results and general observations for "excellent" and "good" trail conditions and facilities suggest a lack of conflict occurrence. Since the four trail conditions and facility variables are not "user-induced" trail conditions, the insignificant differences in user group observations was expected.

Questionnaire data were insufficient to perform a chi-square contingency analysis for all four user-induced trail conditions. The main problem with this dataset was the scale. In all cases, too few observations were in the "too much" and "a lot" categories. Remaining categories could not be combined for an appropriate chi-square analysis due to too few observations within individual categories. Regardless whether an appropriate number of observations were provided in each category, "expected amount" is an ambiguous measurement. For example, a respondent may have observed too much mud on the trail, but "expected that amount" due to recent rain. For analysis purposes, "expected amount" results cannot determine positive or negative observed conflict since it is a neutral term. To resolve this problem in future analyses, the "expected amount" category could be replaced with a more quantitative approach such as "average amount" or "some." However, most hikers observed "little" or "no disturbance" for mud on the trail (88%), horse manure (95%), bicycle tire ruts (79%), and horse/stock tracks (92%) (Appendix E, Table E3). Most mountain bikers also observed "little" or "no disturbance" for mud on the trail (71%), horse manure (84%), bicycle tire ruts (88%), and horse/stock tracks (95%) (Appendix E, Table E4). Only 8% or fewer hikers and 7% or fewer mountain bikers observed "too much" or "a lot" of user-induced trail disturbance.

Odd and Even Day Hiker Trail Condition Analysis

Chi-square contingency analyses were performed for hiker observations of odd and even days for all four trail condition and facility variables. One significant chi-square relationship ($\chi^2 = 8.94$) was observed between odd and even days for the width of trail (see Table 5). No significant chi-square relationships were determined for information on the signboard, vegetation, and bridge/stream crossings.

Table 5

Hiker Response to Trail Width on the Middle Fork Trail

Day	Number responses	Excellent (%)	Good (%)	Average/poor (%)
Odd	78	32	45	23
Even	82	55	33	12

Note. $\chi^2(2, N = 160) = 8.94, p = 0.0115$.

Appendix D, Table D3, shows details of the two-sample chi-square test results for condition of trail width. A weak Cramer's *V* strength of relationship ($V = 0.24$) score was identified between observed frequencies on odd and even day for the width of trail.

The strongest differences occurred in the individual chi-square cells for the "excellent" category, followed by the "very poor to average" combined category. Overall, 32% of hikers (25 of 78) observed the width of trail to be excellent, which was less than expected ($\chi^2 = 2.44$) on odd calendar days, whereas 55% of hikers (45 of

82) reported an excellent width of trail, which was more than expected ($\chi^2 = 2.32$) on even calendar days. Twenty-three percent of hiker very poor to average observations were more than expected ($\chi^2 = 1.39$) on odd days and 12% of very poor to average (10 of 82) observations were less than expected ($\chi^2 = 1.32$) on even days. This suggests a slight increase of conflict occurrence for odd calendar days when mountain bikers are present. However, overall percentages indicate that the majority of hikers (82%) observed a good to excellent width of trail condition suggesting that the majority of hikers did not observe negative differences between odd and even calendar days.

Significant difference in observed frequencies between odd and even calendar days and the width of trail did not determine whether the trail is too wide or too narrow. In the case that the trail was perceived to be too wide, it may be related to hikers associating trail width expansion to mountain bike use, since mountain bikers may be encountered on odd calendar days. If the trail was perceived as too narrow, this may result in conflict occurring due to difficulty passing others on the trail, which may indicate a safety conflict. Further research is needed to determine why the trail width was observed differently on odd and even calendar days.

For the condition of signboard information, hiker observations were mostly "good to excellent" for odd (62%) and even (67%) calendar days, with 7% or fewer "poor to very poor" observations (Appendix E, Table E5). For the condition of vegetation along the trail, 88% odd and 96% of even calendar day observations were "excellent" and "good." Only one observation of "poor" vegetation condition occurred on an even calendar day. Finally, 95% of bridge/stream crossing conditions

were observed as “excellent or good” for odd and even calendar days with 1% or fewer “very poor to average” conditions observed. The lack of significant differences in observed frequencies for odd and even calendar days and the general report that over 80% of conditions were “good” to “excellent” suggests that conflict does not occur for those three variables. For the signboard information conditions, suggestions for improvement are provided in education and communication recommendations.

Chi-square tests could not be conducted for all four user-induced trail condition variables, including observed mud on trail, horse manure, bicycle tire ruts, and horse/stock tracks, due to the same problems with the scale that occurred with hiker and mountain biker trail condition analysis. However, based on observed frequencies, hikers tend to observe little to no user-induced trail condition disturbances for both odd and even days (Appendix E, Table E6).

Behavior Conflict

Two separate chi-square analyses were conducted for observed frequencies of encountered and noticed behaviors of other trail users. The first was to determine if a significant difference existed between hiker and mountain biker observations of other trail user behaviors. A second chi-square contingency analysis was conducted on hiker observations of other hiker behaviors on odd calendar days, hiker behaviors on even calendar days, and mountain biker behaviors on odd calendar days. A chi-square analysis could not be conducted for mountain biker behaviors on even calendar days since too few mountain bikers were encountered. It should be noted, however, that mountain bikers are not permitted on even calendar days; therefore, any mountain

biker presence on an even calendar day is considered a form of conflict. Respondents were asked to indicate if they encountered other trail users. If they did encounter other trail users, they were asked to indicate if their general observation was for "excellent," "good," "average," "poor," or "very poor" behaviors from that user group. An additional category for "did not notice" was provided. If they did not encounter or did not notice a behavior, the responses were not used in the analysis. The three behaviors examined were (a) speed, (b) noise, and (c) etiquette.

Hiker and Mountain Biker Behavior Analysis

Hiker behavior. A total of 229 respondents, 98% of hikers (156 of 160) and 100% of mountain bikers (73 of 73), stated they encountered hikers during their recreation visit to the Middle Fork Trail. Three chi-square analyses were conducted for hiker speed, noise, and etiquette. No significant relationships were determined for the three hiker behaviors. Eighty-seven percent of hikers and 84% of mountain bikers observed hiker speeds to be "excellent" or "good," with only one observation from another hiker of "poor" hiker speed (Appendix E, Tables E7 and E8). Eighty-eight percent of hikers and 90% of mountain bikers observed hiker noise levels to be "excellent" or "good," with no observations for "poor" noise levels. Ninety-six percent of hikers and 93% of mountain bikers observed hiker etiquette as "excellent" or "good," with no observations for "poor" etiquette. Since no significant relationship existed between hiker and mountain biker observed frequencies of hiker behaviors, and hikers were generally observed as having "excellent" behavior, hiker behavior is likely not a source of trail conflict.

Mountain biker behavior. Only 144 respondents, 45% of hikers (75 of 160) and 95% of mountain bikers (69 of 73), encountered mountain bikers on the Middle Fork Trail. Significant relationships were determined between hiker and mountain biker observations of mountain biker speed and etiquette. No significant relationship was determined for mountain biker noise.

A significant chi-square relationship ($\chi^2 = 11.54$) was determined between hiker and mountain biker observations for mountain biker speed (see Table 6).

Table 6

Group Response to Mountain Biker Speed on the Middle Fork Trail

Group	Number responses	Excellent (%)	Good (%)	Average/poor (%)
Hiker	70	40	47	14
Biker	66	68	27	5

Note. $\chi^2(2, N = 136) = 11.54, p = 0.0031$.

Appendix D, Table D4, shows the two-sample chi-square results for mountain biker speed. A weak Cramer's *V* strength of relationship (0.29) score was identified between hiker and mountain biker observations of mountain biker speed. The strongest differences occurred in the individual chi-square cells for the "excellent" category, followed by the "very poor to average" combined category. Overall, 40% of hikers (28 of 70) observed mountain biker speeds to be excellent, which was less than expected ($\chi^2 = 2.44$), whereas 68% of mountain bikers (45 of 66) observed excellent

mountain biker speeds, which was more than expected ($\chi^2 = 2.59$). Fourteen percent of hikers (10 of 70) observed mountain biker speeds to be poor to average, which was more than expected ($\chi^2 = 1.64$), whereas 5% of mountain bikers (3 of 66) observed poor to average speeds from other mountain bikers, which was less than expected ($\chi^2 = 1.74$). These results suggest that hikers observe more poor to average speed from mountain bikers than mountain bikers notice from other mountain bikers, indicating a potential one-sided conflict.

These results do not indicate if the poor to average speeds were too fast or too slow. Further research is needed for this determination. If mountain biker speeds are being observed as too fast when traveling downhill or around blind corners, a safety conflict may be an issue. If mountain biker speed is being perceived as too slow, for example, bikers traveling uphill (Middle Fork Trail is considered difficult for mountain bikers) are not yielding to hikers or trail runners, a behavior conflict may be the issue. However, most hikers (86%) and mountain bikers (95%) observed good to excellent speeds, suggesting most respondents did not find speed to be a conflict.

No significant relationship was determined for hiker and mountain biker observed differences for mountain biker noise behavior. In general, 89% of hikers and 94% of mountain bikers observed good to excellent mountain biker noise levels (Appendix E, Tables E7 and E8). Four percent of hikers indicated “poor” noise levels from mountain bikers, whereas no “poor” levels were observed by other mountain bikers. These results generally indicate that mountain bikers are utilizing appropriate noise levels; however, the “poor” noise levels indicated by hikers could occur for a

couple reasons. If the noise levels are too loud, it may indicate goal interference (i.e., disturbing solitude), thus creating conflict. If the noise levels were too quiet, for instance a mountain bike approached a hiker without warning, a safety conflict may have occurred. However, based on the lack of significant findings and general response, few conflicts should occur due to mountain biker noise behavior.

A significant chi-square relationship ($\chi^2 = 6.93$) was determined between hiker and mountain biker observations for mountain biker etiquette (see Table 7). Appendix

Table 7

Group Response to Mountain Biker Etiquette on the Middle Fork Trail

Group	Number responses	Excellent (%)	Good (%)	Average/poor (%)
Hiker	72	51	36	13
Biker	67	70	27	3

Note. $\chi^2(2, N = 139) = 6.93, p = 0.0313$.

D, Table D5, shows the two-sample chi-square results for mountain biker etiquette. A weak Cramer's *V* relationship score (0.22) was identified between hiker and mountain biker observations of mountain biker etiquette. The strongest differences in observation occurred in the individual chi-square cells for the "poor to average" category, followed by observed differences in the "excellent" category. Fifty-one percent of hikers (37 of 72) observed excellent etiquette, 70% of mountain bikers (47 of 67) observed excellent etiquette from other mountain bikers. Thirteen percent of

hikers (9 of 72) observed poor to average etiquette from mountain bikers, which was more than expected ($\chi^2 = 1.91$), whereas only 3% of mountain bikers (2 of 67) observed poor to average etiquette, which was less than expected ($\chi^2 = 2.06$). Fifty-one percent of hikers (37 of 72) observed excellent mountain biker etiquette, which was less than expected ($\chi^2 = 0.97$), whereas 27% of mountain bikers (18 of 67) observed excellent mountain biker etiquette, which was more than expected ($\chi^2 = 1.05$).

These results indicate that hikers tend to observe more poor to average trail etiquette from mountain bikers than mountain bikers observe of themselves. The types of etiquette influencing these results are not known and may contain elements associated with speed and noise. Types of etiquette that may be related to conflicts with mountain bikers are discussed in further research and management recommendations. However, most hikers (87%) and mountain bikers (97%) observed good to excellent etiquette from mountain bikers, suggesting most respondents did not find overall etiquette of mountain bikers to be a behavior conflict.

Hiker Response to Odd and Even Day Behavior Analysis

Respondents on odd calendar days encountered more trail users than on even calendar days (see Table 8). Ninety-nine percent of respondents (146 of 148) encountered other hikers on odd days, 98% of respondents (83 of 85) encountered other hikers on even days. Ninety-three percent of respondents (137 of 148) encountered mountain bikers on odd days and 8% of respondents (7 of 85) encountered mountain bikers on even days.

Table 8

Number of Trail Users Encountered on Odd and Even Calendar Days on the Middle Fork Trail

	Hiker		Biker	
Day	*n*	%	*n*	%
Odd	146	99	137	93
Even	83	98	7	8

In general, hikers observed speeds as "excellent" and "good" for 84% of hikers on odd calendar days, 90% of hikers on even calendar days, and 85% of mountain bikers on odd calendar days (Appendix E, Table E9). Hikers observed poor speeds for 1% of hikers on odd days, 0% for hikers on even days, and 1% of mountain bikers on odd days. Since no significant differences in observations of odd and even day speeds were identified and most speeds were observed as "excellent" or "good," few speed conflicts should exist.

Hikers observed noise behaviors as "excellent" and "good" for 84% of hikers on odd calendar days, 93% of hikers on even calendar days, and 88% of mountain bikers on odd calendar days. Hikers did not observe any poor noise behaviors from hikers and only from 4% of mountain bikers on odd calendar days. No significant differences occurred for noise behaviors on odd and even days. Therefore, noise behaviors are likely not a source of conflict.

A significant chi-square relationship ($\chi^2 = 10.18$) was identified for hiker observation of other trail user etiquette on odd and even calendar days (see Table 9).

Table 9

Hiker Response to Odd and Even Day Etiquette on the Middle Fork Trail

Group	Number responses	Excellent (%)	Good (%)	Average/poor (%)
Hiker (odd)	71	48	45	7
Hiker (even)	71	63	35	1
Biker (odd)	65	49	37	14

Note. $\chi^2(2, N = 207) = 10.18$, $p = 0.0375$.

Appendix D, Table D6, shows the two-sample chi-square results for odd and even day etiquette. A weak Cramer's *V* relationship score (0.16) was identified for etiquette from hikers on odd days, hikers on even days, and mountain bikers on odd days. The strongest differences in observation occurred in the individual chi-square cells for the "poor to average" category from hikers on even days and mountain bikers on odd days, followed by observed differences in the "excellent" category for hikers on even days. Only 7% of hikers (7 of 71) observed poor to average etiquette from other hikers on odd days, which was the expected amount, 1% of hikers (1 of 71) observed poor to average etiquette from hikers on even days, which was less than expected ($\chi^2 = 3.34$), and 14% of hikers (9 of 65) observed poor to average etiquette from mountain bikers on odd days, which was more than expected ($\chi^2 = 3.91$). Forty-eight percent of

hikers (34 of 71) observed excellent etiquette from other hikers on odd days, which was slightly less than expected ($\chi^2 = 0.44$), 63% of hikers (45 of 71) observed excellent etiquette from hikers on even days, which was more than expected ($\chi^2 = 1.26$), and 49% of hikers (32 of 65) observed excellent etiquette from mountain bikers on odd calendar days, which was slightly less than expected ($\chi^2 = 0.23$). These percentages suggest that most hiker observations of etiquette are good to excellent, with a slight increase of poor to average etiquette occurring on odd calendar days over even calendar days. Since more observations of poor to average etiquette occurred on odd calendar days from both hikers and mountain bikers, this may be an indication that conflict is not one-sided. These results imply that some behavior conflict may exist when hikers and mountain bikers share trail use.

All respondents were asked to rank their overall experience encountering other trail users on the Middle Fork Trail using a scale from 1 to 10 (1 = very poor encounters to 10 = excellent encounters) (see Table 10). Ninety-five percent of all respondents (222 of 233) had good to excellent encounters (ranking 8 to 10) with other trail users. Four percent of respondents (8 of 233) ranked average encounters (from 4 to 7) and only 1% of respondents (2 of 233) ranked very poor encounters. Ninety-four percent of hikers (149 of 159) ranked good to excellent encounters and only 6% of hikers ranked poor to average encounters. One hundred percent of mountain bikers (73 of 73) ranked good to excellent encounters. Of the 10 poor to average rankings, hikers indicated 6 occurred on odd days and 4 occurred on even days. In addition

Table 10

Encounters With Other Trail Users on the Middle Fork Trail

	Ranking		
Group	1 to 3	4 to 7	8 to 10
Hiker	2	8	149
Biker	0	0	73

Note. 1 to 3 = poor, 4 to 7 = average, 8 to 10 = good to excellent.

to ranking encounters with other trail users, respondents were asked to rate their overall enjoyment on the Middle Fork Trail using a scale from 1 to 10 (1 = very poor experience to 10 = excellent experience) (see Table 11).

Table 11

Overall Experience on the Middle Fork Trail

	Ranking		
Group	1 to 3	4 to 7	8 to 10
Hiker	1	13	145
Biker	0	2	71

Note. 1 to 3 = poor, 4 to 7 = average, 8 to 10 = good to excellent.

The majority of respondents had an excellent to good experience, with 94% of the respondents (216 of 233) ranking from 8 to 10, 6% of respondents (15 of 233) ranking an average experience from 4 to 7, and less than 1% of respondents (1 of 233) ranking a poor experience from 1 to 3. Ninety-one percent of hikers (145 of 159) ranked a good to excellent experience and 9% of hikers (14 of 159) ranked poor to average experience on the Middle Fork Trail. Ninety-seven percent of mountain bikers (71 of 73) ranked a good to excellent experience and only 3% of mountain bikers (2 of 73) ranked an average experience. Of the 14 poor to average hikers' experiences, 9 occurred on odd days and 5 occurred on even days. Two mountain biker average rankings were on odd days.

Safety Conflict

All respondents were asked to rank how safe they felt on the Middle Fork Trail on a scale from 1 to 10 (1 = very poor to 10 = excellent) (see Table 12). The majority

Table 12

How Safe Trail Users Felt on the Middle Fork Trail

	Ranking		
Group	1 to 3	4 to 7	8 to 10
Hiker	2	10	148
Biker	1	3	69

Note. 1 to 3 = poor, 4 to 7 = average, 8 to 10 = good to excellent.

of respondents felt safety was good to excellent on the Middle Fork Trail, with 93% respondents (217 of 233) ranking from 8 to 10, 6% of respondents (13 of 233) felt that safety was average, ranking from 4 to 7, and 1% of respondents (3 of 233) felt safety was poor, ranking from 1 to 3. Ninety-three percent of hikers (148 of 160) indicated safety was good to excellent, while 8% of hikers (12 of 160) felt safety was poor to average. Ninety-five percent of mountain bikers (69 of 73) indicated safety was good to excellent, while 5% of mountain bikers (4 of 73) indicated safety was poor to average. Of the 12 poor to average hiker rankings, 6 occurred on odd days and 6 occurred on even days. The four poor to average mountain biker rankings all occurred on odd days.

Respondents were asked if they heard or encountered persons using firearms to determine if the safety responses were linked to a presence of firearms (see Table 13). Ninety-two percent of respondents (215 of 230) did not encounter or hear firearms.

Table 13

Trail Users Who Heard or Encountered Firearms on the Middle Fork Trail

	Yes		No	
Group	*n*	%	*n*	%
Hiker	6	4	151	96
Biker	9	12	64	88

Only 7% of respondents (15 of 230), 6 hikers and 9 mountain bikers, heard firearms while recreating on the Middle Fork Trail. Among the few respondents who heard or encountered firearms, 14 ranked overall safety at a high level (8 to 10), whereas 1 respondent ranked an average feeling of safety. These results suggest that the presence of firearms did not likely cause respondents to feel unsafe.

Based on the majority of respondents indicating safety was excellent while recreating on the Middle Fork Trail, few safety conflicts should exist between trail users. However, significant findings for environmental and behavior conflict may be related to safety conflict occurrence. For example, the combination of poor to average observations of trail width on odd calendar days with observations of inappropriate etiquette from both hikers and mountain bikers on odd calendar days may be a concern for safety conflict and are addressed in the Management Recommendations and Further Research sections.

Mountain Bike Policy

In general, mountain bikers were more aware of the access and restriction policies pertaining to use on the Middle Fork Trail than were hikers. Ninety-three percent of mountain bikers (68 of 73) and only 23% hikers (36 of 160) were aware of the every-other-day policy prior to arriving at the trailhead. Only 18 hikers on odd and 18 hikers on even calendar days were aware of the every-other-day policy prior to recreating on the Middle Fork Trail. The majority of mountain bikers indicated they learned about the every-other-day policy from the Internet, whereas hikers learned about the policy from either trailhead access points, the Internet, or other locations not

provided on the questionnaire (Appendix B). Very few respondents, 8% of hikers (13 of 160) and 23% of mountain bikers (17 of 73), were aware that horse and stock use was permitted seasonally from July 1 to October 31.

A chi-square contingency analysis was conducted on hiker and mountain biker preferences pertaining to three policies concerning mountain bike use on the Middle Fork Trail. Respondents were asked to indicate if they agreed, disagreed, or were unsure of their opinion regarding three questions: (a) Did you like the every-other-day mountain bike policy? (b) Do you want the trail closed to mountain bikes? or (c) Do you want the trail open full time for mountain bike access? Significant chi-square results were identified for all three policies between hiker and mountain biker responses toward the every-other-day policy, closing the trail to mountain bikes, and opening the trail full time to mountain bikes. Cramer's *V* relationship strength score identified moderate relationships.

Every-Other-Day Policy Analysis

A significant chi-square relationship ($\chi^2 = 23.42$) was determined between hiker and mountain biker opinion for the every-other-day policy (see Table 14). Appendix D, Table D7, shows two-sample chi-square results for the every-other-day policy. A moderate Cramer's *V* relationship score (0.33) was identified between hiker and mountain biker opinion about the every-other-day policy. The strongest differences in observation occurred in the individual chi-square cells for the "unsure" category, followed by observed differences in the "yes" category for favoring the opinion. Twenty-nine percent of hikers (43 of 149) were unsure if they liked the

Table 14

Group Response to Policy Statement: I Like the Every-Other-Day Policy

Group	Number responses	Yes (%)	No (%)	I don't know (%)
Hiker	149	56	15	29
Biker	71	83	15	1

Note. $\chi^2(2, N = 220) = 23.42, p < 0.0001$.

policy, which was more than expected ($\chi^2 = 5.85$), and only 1% of mountain bikers (1 of 71) were unsure, which was less than expected ($\chi^2 = 12.27$). Fifty-six percent of hikers (84 of 149) like the every-other-day policy, which is less than expected ($\chi^2 = 1.70$), whereas 83% of mountain bikers (59 of 71) like the every-other-day policy, which is more than expected ($\chi^2 = 3.58$). Fifteen percent of hikers (22 of 149) and 15% of mountain bikers (11 of 71) did not like the policy. Hiker and mountain biker opinion percentages suggest the majority of respondents favor the every-other-day policy. Yet, in general, more hikers tended to be unsure about their opinions toward the every-other-day policy than mountain bikers.

Close the Trail to Mountain Bike Analysis

A significant chi-square relationship ($\chi^2 = 42.07$) was determined between hiker and mountain biker opinion about closing the trail to mountain bikes (see Table 15). Appendix D, Table D8, shows two-sample chi-square results for opinions on closing the trail to mountain bike access. A moderate Cramer's *V* relationship score

Table 15

Group Response to Policy Statement: I Would Like the Middle Fork Trail Closed to Mountain Bikes

Group	Number responses	Yes (%)	No (%)	I don't know (%)
Hiker	149	26	58	26
Biker	71	0	100	0

Note. $\chi^2(2, N = 220) = 42.07, p < 0.0001$.

(0.44) was identified between hiker and mountain biker opinions on closing the trail to mountain bikes. The strongest differences in observation occurred in the individual chi-square cells for mountain biker opinions. Twenty-six percent of hikers (38 of 149) favored closing the trail to mountain bikers, which was more than expected (χ^2 = 5.84), whereas 0% of mountain bikers (0 of 71) favored closing the trail, which was less than expected (χ^2 = 12.26) and was the strongest chi-square. Fifty-eight percent of hikers (86 of 149) did not think the trail should be closed, which was less than expected (χ^2 = 3.89) and 100% of mountain bikers (73 of 73) did not want the trail closed to mountain bikes, which was more than expected (χ^2 = 8.16). These percentages clearly indicate that all mountain bikers and most hikers do not want the Middle Fork Trail closed to mountain bike access. These results also suggest that a significant difference in opinion occurs between hikers and mountain bikers and, not surprisingly, indicate that mountain bikers are completely opposed to closing the trail to mountain bike access.

Full-Time Mountain Bike Access Analysis

A significant chi-square relationship ($\chi^2 = 45.71$) was determined between hiker and mountain biker opinion about opening the trail to full-time mountain bike access (see Table 16). Appendix D, Table D9, shows the two-sample chi-square

Table 16

Group Response to Policy Statement: I Would Like the Middle Fork Trail Open Full-Time to Mountain Bikes

Group	Number responses	Yes (%)	No (%)	I don't know (%)
Hiker	148	11	67	22
Biker	73	53	33	14

Note. $\chi^2(2, N = 221) = 45.71, p < 0.0001$.

results for opinions on full-time mountain bike access. A moderate Cramer's *V* relationship score (0.45) was identified between hiker and mountain biker opinions on opening the Middle Fork Trail to full-time mountain bike access. The strongest differences in observation occurred in the individual chi-square cells for the "yes" or favored category, followed by observed differences in the "no" or opposed category. Eleven percent of hikers (17 of 148) were in favor of full-time mountain bike trail use, which was less than expected ($\chi^2 = 11.21$), whereas 53% of mountain bikers (39 of 73) indicated that they were in favor of full-time mountain bike access, which was more than expected ($\chi^2 = 22.72$). Sixty-seven percent of hikers (99 of 148) did not want the trail open to full-time mountain bike use, which was more than expected ($\chi^2 = 3.36$),

whereas 33% of mountain bikers (24 of 73) did not want full-time mountain bike access, which was less than expected ($\chi^2 = 6.81$). The number of mountain bikers stating they did not want full-time mountain bike access was surprising since it is a restrictive measure for their user group. However, this may be an indication that mountain bikers expect a natural separation between hikers and mountain bikers over time, thus the majority of hiker use migrates toward even calendar days. Future evaluation would be necessary to determine if this separation occurs and if opinions about the policy change over time.

The percentage results indicate hikers are less likely than mountain bikers to favor opening the trail to full-time mountain bike use, while mountain bikers indicate more favorability for full-time mountain bike trail use. However, all three significant chi-square results may be an indication that hikers and mountain bikers favor the every-other-day policy as a trail access compromise.

CHAPTER VI

CONCLUSION, MANAGEMENT RECOMMENDATIONS, AND FURTHER RESEARCH

Conclusion

From May 28 to October 31, 2006, 233 questionnaires were collected from trail users at the Middle Fork Trailhead, where 84% of visitors enter the trail system. Trail visitation was highest on weekends, with 88.2% hiker, 11% mountain biker, and 0.8% stock use visitation. Slightly higher trail use occurred on odd calendar days (55.5%) than on even calendar days (45.5%).

Two significant chi-square results were identified with moderate Cramer's *V* strength relationship scores between user group type for gender and recreation destination. Response data pertaining to visitor profiles and demographics found that hikers tend to have a more evenly distributed male and female population compared to mountain bikers, which tended to be predominately male. Hikers and mountain bikers were primarily 26 to 35 years of age; from King County, Washington; and were visiting the Middle Fork Trail for the first time. The majority of both groups recreated in pairs along the first 6 mi of the Middle Fork Trail. The majority of hikers (89%) participate only in hiking activities on other trail systems, while the majority of mountain bikers (63%) participate in hiking and mountain biking activities. Hikers and mountain bikers indicated that they seek the same types of experiences when recreating on the Middle Fork Trail.

Seven significant chi-square results were identified for data pertaining to environment, behavior, and policy opinion, with weak to moderate Cramer's *V* strength relationship scores. Two significant relationships were identified between mountain biker and hiker observed behaviors for mountain biker speed and etiquette. These findings indicate hikers observe more inappropriate behaviors from mountain bikers than mountain bikers observe of other mountain bikers, therefore suggesting conflict is one-sided. No significant relationships were identified for hiker behaviors. Two significant relationships were also identified between odd and even days for the width of trail and trail user etiquette. These results suggest more conflict is observed on odd calendar days, when mountain bikers are present, than on even calendar days. The observed frequency of behavior conflict for etiquette occurred for both hikers and mountain bikers on odd calendar days, thus conflict mitigation is needed for both hikers and mountain bikers for shared trail use. Finally, three significant relationships were identified between hiker and mountain biker opinion toward all three different policies. Percentages suggest the majority of hikers and mountain bikers prefer the every-other-day policy over closing the trail to mountain bikes or full-time mountain bike access. This research concludes with access recommendations for the Middle Fork Trail, conflict mitigation for significant findings, and further research needs.

Management Recommendations

A primary objective of this research was to determine the type and frequency of conflict occurrence encountered by users of the Middle Fork Trail. Three types of conflict (trail etiquette, speed, and the width of trail) were deemed significant and are

discussed throughout the recommendation process. Access, trail design, and education and communication recommendations are provided.

Access Recommendations

Testing management strategies for mountain bike use on shared-use trails is an important step for determining appropriate use within a recreation area (Chavez et al., 1993). Previous research has found that hikers and mountain bikers are generally positive toward shared trail use (Cessford, 2003). Based on the findings from this research, continued mountain bike access on odd calendar days on the Middle Fork Trail is recommended. The majority of respondents felt safe, had a high level of enjoyment, experienced positive interactions with other trail users, and favored the every-other-day policy over closing or opening the trail full time to mountain bikes. Four significant results were identified pertaining to either environmental conflict or behavioral conflicts; however, mitigation strategies are available.

Based on few encountered environmental and behavioral conflicts during the dates in which this research was conducted, it is recommended that the Middle Fork Trail be open to mountain bikes from May 28 to September 4. Self-registration numbers indicate that most trail use occurs on and between these dates; therefore, trail user interactions and conflict occurrence will likely decrease outside of this date range. However, a recommendation for mountain bike access outside of this date range is beyond the scope of this research. Further research is needed to evaluate soil conditions and determine if the current trail engineering standards can support sustainable trail conditions as early as April 15 and as late as October 31.

This research was not able to address the location of conflict occurrence on the Middle Fork Trail; therefore, further research is needed to determine if significant results for conflict occurrence are spatially oriented. Again, since few conflicts were observed, it is recommended that mountain bikes be permitted access on the entire 15-mi trail. An alternative to mountain bike access on the entire 15-mi trail is to restrict mountain bike access beyond Goldmyer Hotsprings (Figure 3). This alternative is recommended for consideration because (a) Goldmyer Hotsprings is a popular destination for all trail users, and an overnight option would still be available for mountain bikers since a new bridge would provide access to Forest Service Road 56 on even calendar days; (b) a larger buffer would be created between the Alpine Lakes Wilderness Area boundary and mountain bikers; (c) education and enforcement resources are already stretched thin within a large management area, therefore, a shorter trail system would increase Forest Service outreach capabilities; and (d) volunteer opportunities for trail maintenance and education are more accessible at lower portions of the trail.

Most trail use occurs within the first 6 mi of trail; increased trail use on the lower 6 mi of Middle Fork Trail may lead to increased trail user interactions and conflict. It should be noted that Forest Service Road 56 will become permanently closed at Dingford Creek Trailhead as of summer 2007. This road closure will make the upper 9 mi of trail even less accessible, potentially increasing trail use on the lower 6 mi. The self-registration and the questionnaire data results pertaining to trail use destination indicated that the upper 9 mi of trail had significantly lower visitation,

which means fewer user group interactions. It is recommended that use levels continue to be monitored after Forest Service Road 56 is closed and access opportunities adjusted if new conflicts arise.

Trail Design Recommendations

A significant relationship was identified between odd and even days for the width of trail. A distinction between whether the trail was too wide or too narrow was not determined in this research. However, trail design recommendations are suggested to provide for shared trail use and conflict mitigation.

Environmental conflict may be reduced by using trail engineering strategies that prevent resource damage (Chavez, 1996b; Webber, 2007). Designing a trail system appropriate for shared use between mountain bikers and other trail users may include tread hardening (i.e., apply gravel or mineral soil) and appropriate design that reduces erosion, rutting, and mud (Chavez, 1996b; Goeft & Alder, 2001; Webber). The Middle Fork Trail is utilized by hikers, mountain bikers, and stock users; therefore, single-track tread should measure ~24 in. wide. In addition, the trail corridor dimensions should measure ~8 ft wide and ~10 ft high to provide for safe stock passage (USDA Forest Service, 1996, 2004). It is recommended that the Middle Fork Trail tread and corridor be reviewed to meet these specifications and maintenance occur annually.

Width of trail and speed conflict on the Middle Fork Trail may be reduced by maintaining an appropriate tread and corridor width, tread hardening to reduce mud and erosion, installation of user-friendly obstacles to reduce inappropriate speeds, and

reduction of steep sections of trail. It is recommended that a thorough trail condition survey be conducted, focusing on trail width and tread sustainability. By hardening the trail tread, thus reducing the presence of ruts and mud, user groups are more apt to stay on the trail. Goeft and Alder (2001) and White et al. (2006) found that avoiding steep downhill sections on mountain bike trails may help reduce erosion, incision, and other soil disturbances. Reducing steep downhill sections of trail may also reduce inappropriate downhill speeds. Installation of switchbacks may reduce steep downhill grades. IMBA suggests construction of rolling-contoured trails, with 10% or less grade.

Significant findings indicated that mountain biker speeds of poor to average were observed more than expected. However, whether or not the speeds were too fast or too slow was not determined. Assuming speeds were too fast, which creates potential behavior and/or safety conflicts, four trail design strategies are recommended to manage and reduce mountain biker speed (Webber, 2004, 2007): (a) add corral points, which are staggered trail obstacles such as rocks, logs, or trees; (b) install chokes, which involves strategic placement of trail obstacles to slightly narrow the trail just prior to an area where speeds need to be reduced; (c) create turns from left to right to increase difficulty levels; and (d) alter the tread texture, which may involve creating rough tread to slow riders or smooth tread to prevent accidents.

When installed obstacles are clearly visible to an approaching mountain biker, speeds are often reduced to avoid the obstacle, and trail challenge is increased. Appropriate speed-controlling barriers should be installed in a fashion that provides

safe maneuverability for all trail users. The Middle Fork Trail contains some speed controlling features; however, it is recommended that during an annual review of trail conditions, an evaluation be conducted to determine if new barriers are needed. Finally, if mountain biker speeds were too slow, improved etiquette strategies are discussed in the Education and Communication Recommendations section.

Education and Communication Recommendations

Behavioral conflicts include hiker and mountain biker etiquette and mountain biker speed on the Middle Fork Trail. Hikers and mountain bikers need to be educated about trail etiquette to reduce such conflict. General etiquette guidelines need to address both user groups, with an emphasis in mountain biker etiquette. Appropriate forms of trail user etiquette are to be polite, yield to others (hikers yield to horses, bikers yield to horses and hikers), stay on the designated trail, remain in control, respect natural resources, use appropriate noise levels, maintain appropriate speeds, follow Leave No Trace guidelines, and follow all posted rules and regulations (Hollenhorst et al., 1995; Webber, 2007). The specific types of inappropriate trail etiquette were not identified; therefore, educational conflict mitigation strategies should encompass these general etiquette guidelines for all user groups.

Communication between land managers and trail users is essential in reducing conflicts among user groups and preventing conflict-caused trail closures (Chavez et al., 1993). Posters, signs, brochures, and other educational materials should be made available to the public to communicate appropriate recreation behaviors, etiquette, and current regulations (Chavez, 1996b; Gonzalez & Otero, 2002).

Four education and communication strategies recommended for the Middle Fork Trail include the use of signs, brochures, patrolling, and increasing Forest Service partnerships with local mountain bike and hiking organizations. For signs and brochures, information made available should include appropriate trail etiquette, current rules, regulations, recreation restrictions/closures (including a current calendar for odd/even day regulations), volunteer opportunities, and alternative recreation opportunities in the Middle Fork Valley. Information should be provided at trailheads about alternative trails that permit mountain bike access on even calendar days and nearby trail alternatives for hikers and horse/stock users who want to avoid mountain bikers on odd calendar days.

Education materials should be made available at all trail access points, local Forest Service visitor information centers, and online. Most respondents learned about the every-other-day policy from information available at the trailhead or Internet sources; therefore, educational outreach should focus on utilizing these sources. The brochure should provide an in-depth review of shared trail use on the Middle Fork Trail, emphasizing the importance of appropriate trail etiquette, and clearly outlining seasonal trail use restrictions. This information should be available year round.

At any trail junction along the Middle Fork Trail where mountain bikes and/or stock are restricted, either leading into designated wilderness or other agency-imposed restriction, signs should be posted indicating closed access (Figure 3). Signage areas include Dingford Creek Trailhead, Rock Creek Trail, and either Goldmyer Hotsprings or Dutch Miller Gap Trailhead, dependent upon the Forest Service access decision.

Chavez (1996b) recommends developing partnerships between land managers and interest groups to increase cooperation and volunteer efforts. The Forest Service depends on a combination of a seasonal workforce, interagency partnerships, and volunteers working together to alleviate problems associated with environmental damage and user conflict on the Middle Fork Trail. Research by Hendricks et al. (2001) suggest that volunteer mountain bike patrollers contacting other mountain bikers is an effective form of encouraging appropriate behaviors and etiquette on shared trail systems. Currently a volunteer mountain bike patrol program is being developed for the Middle Fork Trail. IMBA has training and educational resources available for promoting a volunteer mountain bike patrol program. It is recommended that the Forest Service continue to develop and utilize a volunteer patrol program. Multiple benefits from volunteers include enhancing visitor experiences, promoting trail stewardship, assisting land managers in monitoring trends and educating the public, and providing backcountry expertise (Webber, 2007).

Further Research

This research provided a foundation for evaluating general types of conflicts. Further research is needed to identify specific sources of conflict and the effectiveness of conflict mitigation strategies suggested by this research. Over time, the Forest Service should question whether the every-other-day policy remains effective with changing environmental conditions and use levels. Measures should be taken to ensure available alternatives are provided for hikers, mountain bikers, and stock users.

The every-other-day policy can be difficult for land managers to enforce. More research is needed to determine the economic feasibility required for a land management agency to provide education and enforcement. Monitoring cooperation and compliance with the every-other-day policy is necessary to determine if the policy remains effective. In addition, the every-other-day policy should be reevaluated after a few years of mountain biker use to determine whether the policy remains preferred by hikers and mountain bikers.

Chavez et al. (1993) explored mountain bike management issues among USDA Forest Service and BLM managers and noted that site specific management should take into consideration trail proximity to urban populations, soils conditions, and climate. This project provided basic information about Middle Fork Trail's close proximity to a growing metropolitan population, marine and mountain-influenced climate, soils easily impacted with recreation use, and late season stream flows. More research is needed to determine if a connection exists between environmental conflict and the physical geography factors and use levels. An improved scale pertaining to user-induced trail conditions and location of conflict occurrence is needed within the questionnaire. In addition, further research is needed to examine whether or not weather patterns influenced response data.

Finally, this research was limited from May 28 to September 4, 2006. Further research is needed beyond these dates to monitor trail use levels and conflicts. Trail use estimates remain unknown seasonally between November 1 and April 14. Conflicts and impacts may or may not be occurring during unmonitored seasons.

Further research is needed to identify the number of mountain bikers "poaching" trail use during off-season restrictions, and to monitor impacts caused by winter mountain bike use.

Based on this research, the recommendation is for continued mountain bike access on odd calendar days. As conflict between user groups, resource damage, and use levels fluctuate over time, it is further recommended that recreation monitoring continue and adjustments be made to management strategies for new or increased levels of conflict that occur on the Middle Fork Trail.

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APPENDIXES

Appendix A

Self-Registration Form

Date	Zip Code	# in Party	Destination	Activity		
				Hike	Bike	Horse
Example: August 21, 2006	98045	2	Wildcat Creek	X		

Appendix B

Middle Fork Trail Visitor Satisfaction Questionnaire

Survey # _____ Date _____ H-------B-------S

Section 1: General Information and Demographics

1) Gender: □ Male □ Female

2) Age: □ 18 - 25 □ 26 – 35 □ 36 – 45 □ 46 – 55 □ 56 +

3) What is your residence zip code: _____

4) Was this your first time recreating on the Middle Fork Trail?
□ Yes (*If Yes, skip to Question #6*) □ No

5) How many years have you been recreating on the Middle Fork Trail?
□ 1 – 2 □ 3 – 4 □ 5 – 6 □ 7 – 8 □ 9 – 10 □ 11+

6) What activities do you participate in on other trail systems? *Please check all that apply.*
□ Hiking/walking/jogging □ Mountain Biking □ Horse/Stock Use

7) Size of group you are recreating with today (*If solo, mark 1*)? _____

8) What was your trip starting point today? _____

9) What was your trip destination? _____

10) Did you hear or encounter a person(s) discharging firearms? □ Yes □ No

11) What were the main activities you participated in on the Middle Fork Trail today?
Check as many as apply.

□ Mountain biking	□ Hiking	□ Mushroom gathering
□ Fishing	□ Horseback riding	□ Goldmyer Hotsprings
□ Climbing	□ Stock (goats, llamas)	□ Kayaking
□ Hunting	□ Backpacking/camping	□ Rafting
□ Berry picking	□ Trail running	□ Walk the dog
□ Swimming	□ Other (specify)_____	

12) What experiences were you seeking from the Middle Fork Trail today?
Please check up to 3 boxes.

□ Exercise	□ Solitude	□ Nature appreciation
□ Be with family/friends	□ Challenge	□ Explore a new place
□ View wildlife	□ Meet new people	□ Develop new skills
□ Relaxation	□ Break the regular routine	□ Education interests
□ Try new activity	□ Other (specify) _____	

Section 2: Your Trail Experience and Satisfaction

Trail Conditions

13) What did you think of the Middle Fork Trail conditions and facilities?

CONDITION:	**Excellent**	**Good**	**Average**	**Poor**	**Very Poor**	**Did NOT Notice**
Width of Trail	□	□	□	□	□	□
Information on Signboard	□	□	□	□	□	□
Condition of Vegetation	□	□	□	□	□	□
Stream/Bridge Crossings	□	□	□	□	□	□

CONDITION:	**Too Much**	**A Lot**	**Expected Amount**	**A Little**	**None**	**Did NOT Notice**
Mud on Trail	□	□	□	□	□	□
Horse Manure	□	□	□	□	□	□
Bicycle Tire Ruts	□	□	□	□	□	□
Horse/Stock Tracks	□	□	□	□	□	□

The Human Environment

14) Did you encounter hikers, walkers or joggers today? □ Yes □ No (*Skip to Question 15*)

14a) Approximately how many hikers did you encounter today? _____

14b) How was the behavior of other hikers, walkers or joggers today?

BEHAVIOR:	**Excellent**	**Good**	**Average**	**Poor**	**Very Poor**	**Did NOT Notice**
Speed	□	□	□	□	□	□
Noise Levels	□	□	□	□	□	□
Trail Etiquette	□	□	□	□	□	□

15) Did you encounter mountain bikers today? □ Yes □ No (*Skip to Question 16*)

15a) If yes, approximately how many mountain bikers did you encounter today? _____

15b) How was the behavior of other mountain bikers today?

BEHAVIOR:	**Excellent**	**Good**	**Average**	**Poor**	**Very Poor**	**Did NOT Notice**
Speed	□	□	□	□	□	□
Noise Levels	□	□	□	□	□	□
Trail Etiquette	□	□	□	□	□	□

16) Did you encounter horse/stock users today? □ Yes □ No (*Skip to Question 16*)

16a) If yes, approximately how many stock users did you encounter today? _____

Horses_____ # Riders_____

16b) How was the behavior of other horse/stock users today?

BEHAVIOR:	**Excellent**	**Good**	**Average**	**Poor**	**Very Poor**	**Did NOT Notice**
Speed	□	□	□	□	□	□
Noise Levels	□	□	□	□	□	□
Trail Etiquette	□	□	□	□	□	□

Section 3: Recreation Management Policy

As of August 2005, a new recreation policy on the Middle Fork Trail allows limited mountain bike access for a 3-year trial period. Mountain bike access is open only on odd calendar days (i.e. 1, 3, 5, etc.) from April 15th – October 31st, with the opening date dependent upon satisfactory trail conditions.

17) Were you aware of the every-other-day mountain bike use policy before you arrived at the Trailhead?

□ Yes □ No

17a) If "Yes", where did you first learn about the new policy? *Please mark 1 box*.

□ Forest Service Station/Ranger
□ Posters and signs at Middle Fork Trailhead/Access points
□ Mountain Bike Guidebook (title or author) _____
□ Internet site (name) _____
□ Advocacy group or organization (name)_____
□ Other _____

18) Were you aware that a horse and stock use policy for the Middle Fork Trail is from July 1 – October 31?

□ Yes □ No

19) The following statements relate to the new Middle Fork Trail recreation policy. Please provide your opinion for the following statements:

19a) I like the every-other-day mountain bike access policy.	□Yes	□No	□I don't know
19b) I would like the trail closed to mountain bikes.	□Yes	□No	□I don't know
19c) I would like the trail open full time for mountain bikes.	□Yes	□No	□I don't know

Section 4: Overall Experience

On a scale of 1 – 10, how you would rate the following: (*1 = very poor, 10 = excellent*)

20) Overall, how safe did you feel while recreating on the Middle Fork Trail today?..... #_____

21) Overall, how would you rate your encounters with other trail users today?..... #_____

22) Overall, how enjoyable was your experience on the Middle Fork Trail today?..... #_____

23) Did you encounter any Forest Service employees or volunteers during your trip?

□ Yes □ No

23a) If "Yes", who: *Please check as many as you encountered*.

□ Mountain Bike Ranger □ Backcountry Ranger □ Volunteer Range
□ Trail Crew □ Volunteer Trail Crew □ Ranger in a vehicle
□ Other _____

Thank you for your participation.

Additional Comments:

Appendix C

Questionnaire Introduction

Hello, my name is Carla Jellum. I am a graduate student from Central Washington University conducting a survey of trail user satisfaction. This is a Resource Management Master's thesis project. The survey is a three-page questionnaire and should take no more than 10 minutes of your time. All material will be kept confidential and anonymous.

1) Are you 18 years of age or older?

- If the answer is "No," respond: Thank you for your time and I hope you enjoyed the trail.
- If the answer is "Yes," continue with following question.

2) Have you already been asked or completed this survey during a previous visit?

- If the answer is "Yes," respond: Would you like to complete the survey again?

- If the answer is "No," respond:

3) Would you be willing to help by volunteering to answer some questions about your trail experience today?

- If the answer is "No," respond: Thank you for your time and I hope you enjoyed the trail.
- If the answer is "Yes," proceed with the questionnaire.

<u>General Survey Information</u>

Survey #'s:_____ Date: _____

Time: _____ Weather: _____

Total # of Users Exiting Trail: _____ Mountain Bikes _____

Hikers

_____ Stock Handlers/ _____ Stock

TOTAL Trail Users Exiting _____

Additional General Comments/Observations:

Appendix D

Two-Sample Chi-Square Test Results

Table D1

Chi-Square Results for Gender and User Group Type, Middle Fork Trail

Group and frequency	Male	Female
Hiker		
Observed	64.0	93.0
Expected	83.69	73.31
χ^2	4.63	5.29
Mountain biker		
Observed	57.0	13.0
Expected	37.31	32.69
χ^2	10.39	11.86

Note. $\chi^2(1, N = 227) = 32.16$.

Table D2

Chi-Square Results for Recreation Destination and User Group Type, Middle Fork Trail

Group and frequency	Miles		
	3	6	9 to 15
Hiker			
Observed	54.0	23.0	11.0
Expected	39.25	35.19	19.83
χ^2	5.55	4.22	3.93
Mountain biker			
Observed	4.0	29.0	21.0
Expected	18.75	16.81	12.17
χ^2	11.61	8.83	6.41

Note. $\chi^2(2, N = 142) = 41.14$.

Table D3

Chi-Square Results for Day and Width of Trail, Middle Fork Trail

Day and frequency	Width of trail		
	Excellent	Good	Average/poor
Odd			
Observed	25.0	35.0	18.0
Expected	34.13	30.23	13.65
χ^2	2.44	0.75	1.39
Even			
Observed	45.0	27.0	10.0
Expected	35.88	31.77	14.35
χ^2	2.32	0.72	1.32

Note. $\chi^2(2, N = 160) = 8.94$.

Table D4

Chi-Square Results for User Group and Mountain Biker Speed, Middle Fork Trail

Group and frequency	Mountain biker speed		
	Excellent	Good	Average/poor
Hiker			
Observed	28.0	32.0	10.0
Expected	37.57	25.74	6.69
χ^2	2.44	1.53	1.64
Mountain biker			
Observed	45.0	18.0	3.0
Expected	35.43	24.26	6.31
χ^2	2.59	1.62	1.74

Note. $\chi^2(2, N = 136) = 11.54$.

Table D5

Chi-Square Results for User Group and Mountain Biker Etiquette, Middle Fork Trail

	Mountain biker etiquette		
Group and frequency	Excellent	Good	Average/poor
Hiker			
Observed	37.0	26.0	9.0
Expected	43.51	22.79	5.70
χ^2	0.97	0.45	1.91
Mountain biker			
Observed	47.0	18.0	2.0
Expected	40.49	21.21	5.30
χ^2	1.05	0.49	2.06

Note. $\chi^2(2, N = 139) = 6.93$.

Table D6

Chi-Square Results for Day and Etiquette, Middle Fork Trail

	Etiquette		
Group and frequency	Excellent	Good	Average/poor
Hiker (odd)			
Observed	34.0	32.0	5.0
Expected	38.07	27.78	5.14
χ^2	0.44	0.64	0.00
Hiker (even)			
Observed	45.0	25.0	1.0
Expected	38.07	27.78	5.14
χ^2	1.26	0.28	3.34
Mountain biker (odd)			
Observed	32.0	24.0	9.0
Expected	34.86	25.43	4.71
χ^2	0.23	0.08	3.91

Note. $\chi^2(4, N = 207) = 10.18$.

Table D7

Chi-Square Results for User Group and Every-Other-Day Policy Opinion, Middle Fork Trail

	Like the every-other-day policy?		
Group and frequency	Yes	No	Unsure
Hiker			
Observed	84.0	22.0	43.0
Expected	96.85	22.35	29.80
χ^2	1.70	0.01	5.85
Mountain biker			
Observed	59.0	11.0	1.0
Expected	46.15	10.65	14.20
χ^2	3.58	0.01	12.27

Note. $\chi^2(2, N = 220) = 23.42$.

Table D8

Chi-Square Results for User Group and Closing the Trail Opinion, Middle Fork Trail

	Close trail to mountain bikes?		
Group and frequency	Yes	No	Unsure
Hiker			
Observed	38.0	86.0	25.0
Expected	25.74	106.33	16.93
χ^2	5.84	3.89	3.84
Mountain biker			
Observed	0	71.0	0
Expected	12.26	50.67	8.07
χ^2	12.26	8.16	8.07

Note. $\chi^2(2, N = 220) = 42.07$.

Table D9

Chi-Square Results for User Group and Full-Time Mountain Bike Access Opinion, Middle Fork Trail

	Full-time mountain bike access?		
Group and frequency	Yes	No	Unsure
Hiker			
Observed	17.0	99.0	32.0
Expected	37.50	82.37	28.13
χ^2	11.21	3.36	0.53
Mountain biker			
Observed	39.0	24.0	10.0
Expected	18.50	40.63	13.87
χ^2	22.72	6.81	1.08

Note. $\chi^2(2, N = 221) = 45.71$.

Appendix E

Conflict Response Percentages

Table E1

Hiker Response to Environmental Conflict Variables: Trail and Facility Conditions, Middle Fork Trail

Condition	Number responses	Excellent (%)	Good (%)	Average (%)	Poor/ very poor (%)
Width of trail	160	43.5	38.5	13.5	3.5
Signboard information	145	26	40	28	6
Vegetation	157	45	47	7	1
Bridge/stream crossings	159	74	21	4	1

Note. "Did not notice" responses not included.

Table E2

Mountain Biker Response to Environmental Conflict Variables: Trail and Facility Conditions, Middle Fork Trail

Condition	Number responses	Excellent (%)	Good (%)	Average (%)	Poor/ very poor (%)
Width of trail	73	54	34	11	1
Signboard information	69	27	41	25	7
Vegetation	72	46	43	11	0
Bridge/stream crossings	72	60	29	7	4

Note. "Did not notice" responses not included.

Table E3

Hiker Response to Environmental Conflict Variables: User-Induced Trail Conditions, Middle Fork Trail

Condition	Number responses	Too much/ a lot (%)	Expected (%)	A little (%)	None (%)
Mud	146	3	29	33	35
Horse manure	119	8	7	40	45
Bike ruts	109	7	14	41	38
Stock ruts	88	3	5	33	59

Note. "Did not notice" responses not included.

Table E4

Mountain Biker Response to Environmental Conflict Variables: User-Induced Trail Conditions, Middle Fork Trail

Condition	Number responses	Too much/ a lot (%)	Expected (%)	A little (%)	None (%)
Mud	71	1	28	51	20
Horse manure	62	6	10	68	16
Bike ruts	68	0	12	54	34
Stock ruts	56	0	5	43	52

Note. "Did not notice" responses not included.

Table E5

Hiker Response to Environmental Conflict Variables: Trail and Facilities for Odd Versus Even Days, Middle Fork Trail

Condition	Number responses	Excellent (%)	Good (%)	Average (%)	Poor/ very poor (%)
		Odd calendar days (n = 78)			
Width of trail	78	32	45	18	5
Signboard information	72	18	44	31	7
Vegetation	77	39	49	12	0
Bridge/stream crossings	78	67	28	5	0
		Even calendar days (n = 82)			
Width of trail	82	55	33	10	2
Signboard information	73	33	34	27	5
Vegetation	80	51	45	3	1
Bridge/stream crossings	81	80	15	9	1

Note. n = observed frequencies. "Did not notice" responses not included.

Table E6

Hiker Response to Environmental Conflict Variables: User-Induced Conditions for Odd Versus Even Days, Middle Fork Trail

Condition	Number responses	Too much/ a lot (%)	Expected (%)	A little (%)	None (%)
		Odd calendar days (n = 78)			
Mud	72	3	25	44	28
Horse manure	60	7	3	47	43
Bike ruts	56	4	25	41	30
Stock ruts	41	3	7	24	66
		Even calendar days (n = 82)			
Mud	74	4	32	22	42
Horse manure	59	10	10	34	46
Bike ruts	53	11	2	42	45
Stock ruts	47	4	2	41	53

Note. n = observed frequencies. "Did not notice" responses not included.

Table E7

Hiker Response to Behavior Conflict Variables, Middle Fork Trail

Behavior	Number responses	Excellent (%)	Good (%)	Average (%)	Poor/ very poor (%)
		Other hikers (n = 156)			
Speed	134	45	42	12	1
Noise	135	48	40	12	0
Etiquette	142	56	40	4	0
		Mountain bikers (n = 75)			
Speed	70	40	46	13	1
Noise	71	47	42	7	4
Etiquette	72	51	36	10	3

Note. n = observed frequencies. "Did not notice" responses not included.

Table E8

Mountain Biker Response to Behavior Conflict Variables, Middle Fork Trail

Behavior	Number responses	Excellent (%)	Good (%)	Average (%)	Poor/ very poor (%)
		Hikers (n = 73)			
Speed	69	51	33	16	0
Noise	71	62	28	10	0
Etiquette	73	64	29	7	0
		Other mountain bikers (n = 69)			
Speed	66	68	27	5	0
Noise	67	64	30	6	0
Etiquette	67	70	27	3	0

Note. n = observed frequencies. "Did not notice" responses not included.

Table E9

Hiker Response to Behavior Conflict Variables for Odd Versus Even Days, Middle Fork Trail

Behavior	Number responses	Excellent (%)	Good (%)	Average (%)	Poor/ very poor (%)
		Hikers on odd days (n = 76)			
Speed	67	45	39	15	1
Noise	67	45	39	16	0
Etiquette	71	48	45	7	0
		Hikers on even days (n = 80)			
Speed	67	45	45	10	0
Noise	68	52	41	7	0
Etiquette	71	63	35	2	0
		Mountain bikers on odd days (n = 68)			
Speed	63	37	48	14	1
Noise	64	44	44	8	4
Etiquette	65	49	37	11	3

Note. n = observed frequencies. "Did not notice" responses not included.