Low-Impact Recreational Practices: Assessing and Improving Wilderness User Knowledge, Behavioral Intentions, and Behavior

by

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(ABSTRACT)

The primary objective of this research was to examine knowledge levels of low-impact recreational practices and to explore the effectiveness of education in reducing impacting behavior among users of Shining Rock Wilderness. Wilderness users were found to have little low-impact knowledge, scoring only 59.7 percent correct on a 10-item multiple choice test. Knowledge of recommended practices regarding campsite selection, one of the most important low-impact behaviors, was much lower at 32.9 percent correct. These low scores are likely due to evolving agency low-impact recommendations and the complexity of the task regarding proper campsite selection behavior. Wilderness users had a moderately strong positive correlation between knowledge of campsite selection recommendations and intentions to select a wilderness campsite. The relationship between knowledge and and actual behavior observed in the wilderness and intentions and behavior appeared to be positive, but conclusions were limited by the small number of field observations.

Posters on proper campsite selection, tent placement, and use of backpack stoves rather than campfires were placed on trailhead signs to increase knowledge, foster appropriate intentions, and improve actual behavior. A field experiement with a control group (e.g., no educational posters) showed that the trailhead posters had little positive effect on knowledge or intentions, improving only one of the five tested knowledge items

and one of the three behavioral intentions. The posters improved fire building behavior, but not tent placement or campsite selection. Trailhead posters seem to be more effective at improving behaviors that do not require complex judgments about campsite impacts and wilderness use levels.

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Chapter One: Introduction

The 1964 Wilderness Act (Public Law 88-577) was passed by Congress and signed by President Lyndon B. Johnson to ensure that a portion of the United States remains unspoiled and in its natural condition for future generations. In writing this Act, Congress reflected the belief that, due to development and population pressures, only those areas which receive legal protection will remain in an unmodified state (Hendee, Stankey, & Lucas, 1990). The 1964 Act established a dual mandate for the people of the United States: wilderness areas should be used by the public, but must also be protected and preserved. The Act states that wilderness areas "shall be administered for the use and enjoyment of the American people in such a manner as will leave them unimpaired for future use and enjoyment as wilderness...." We must "provide for the protection of these areas" and "the preservation of their wilderness character", but also facilitate their public use.

The National Wilderness Preservation System (NWPS) today comprises an area approximately the size of the state of Montana -- over 92 million acres -- with nearly two thirds of its lands in Alaska (Hendee et al., 1990). The units range in size from the six acre Pelican Island Wilderness in Florida to the massive 9,078,675 acre Wrangell-St. Elias Wilderness in Alaska. There are a total of 492 wilderness units in the NWPS. The USDA Forest Service manages 367 of these areas (33 million acres); 42 are managed by the National Park Service (39 million acres); 71 by the Fish and Wildlife Service (totaling

over 19 million acres); and the Bureau of Land Management has 28 units (approximately one half million acres). The large wilderness acreage in Alaska was designated by the 1980 Alaska National Interest Land Conservation Act (ANILCA, Public Law 96-487). This law placed vast expanses of federal lands in the NWPS and protected such great wilderness areas as Wrangell-St. Elias, Gates of the Arctic, Noatak, and Arctic, each area totaling over five million acres. The total wilderness acreage in the lower 48 states is just over 35 million acres, with an average of 81,000 acres per unit. Only six states in the U.S. have no wilderness areas within their borders.

Recreation is by far the most popular and common use of wilderness. Hendee et al. (1990) reported that in 1985 wilderness recreation totaled more than 16 million visitor-days[1] and close to five million actual visits. The majority of this use occurs in U.S. Forest Service wilderness, with most of the remainder taking place in National Park Service wilderness (Hendee et al., 1990). U.S. Fish and Wildlife Service and Bureau of Land Management wilderness areas receive comparatively little use.

Types of wilderness recreational use are broad and varied. Hiking is very common -- users take short day trips, camp overnight, or sometimes stay several weeks. Horses, mules, and llamas are sometimes used in wilderness travel. Wilderness recreationists often focus their activities on the water -- many wilderness areas offer excellent opportunities for canoeing on lakes, streams, and rivers and for whitewater rafting. In wilderness one can find rock climbers, photographers, cross-country skiers, bird watchers and countless other types of recreationists. These trips are taken alone, with friends, family, organized groups, or with commercial outfitters (Hendee et al., 1990).

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[1] A visitor-day, or recreation visitor-day (RVD), has been the USDA Forest Service standard unit of recreational measurement since 1965. One visitor-day is equal to one person being present in the given area for 12 hours, or equivalent (e.g., two people for six hours, etc.).

Recreational activities inevitably have an effect on the wilderness resource; they impact the vegetation, soil, water, wildlife, and experiences of other users (Cole, 1986). This is the great paradox of the "use and preserve" mandate of the 1964 Wilderness Act. A wilderness, as defined in the Wilderness Act, is "an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions and which generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable...." Hendee et al. (1990) stated that this portion of the Act permits some impacts, but requires that the integrity of wilderness ecosystems be maintained and the evidence of man's presence be largely inconspicuous. Simply, wilderness ecosystems must be preserved and visitor experiences protected. Therefore, wilderness visitors and their impacts must be managed in such a way that the character of the wilderness environment is not compromised and visitor experiences do not suffer beyond some acceptable standard of quality.

It has been suggested that recreational impacts, while common in wilderness, are rarely a threat to the overall ecology of a given wilderness area (Hendee et al., 1990). Indeed, researchers have found, in measuring campsite impacts, that a very small portion of the overall wilderness area is ecologically impacted by recreationists. Marion (1984), in his study of ecological impacts resulting from recreational use of the Boundary Waters Canoe Area Wilderness, found that only .013 percent of the land area had been highly altered by recreationists (portage trails not included). Cole (1982a) found that only 1.3 percent of his study area, two popular subalpine lake basins in Oregon's Eagle Cap Wilderness, had been obviously impacted by recreational activities.

Depreciative behaviors and their resulting resource impacts can, however, pose a threat to wildlife, damage public property, cause a loss of aesthetic values, and increase wilderness maintenance costs (Roggenbuck, in press). Impacts to the wilderness re-

source can also reduce overall visitor enjoyment (Hendee et al., 1990). Because impacts can give the user the impression that the area is overused, they sometimes elicit more negative feelings than undesirable contacts with other recreationists. In their study of visitors to the Dolly Sods Wilderness in West Virginia, Vaske, Graefe, and Dempster (1982) found that resource impacts were a better predictor of perceived crowding than measures of expected, preferred, or reported contacts with other users. Reducing wilderness resource impacts, then, has the potential to substantially improve the experience of the visitor. Clearly, resource impacts resulting from the recreational use of wilderness cannot be ignored. Low-impact wilderness management strategies and techniques, then, are necessary for the maintenance of wilderness values.

Wilderness researchers often attribute inappropriate, impacting behavior to a lack of knowledge about accepted backcountry hiking and camping procedures (McAvoy & Hamborg, 1984; Robertson, 1981). Wilderness educational programs may thus be an effective means to improve low-impact behavior. In *Wilderness Management* (Hendee et al., 1990), Cole suggested that "education is one of the keys to reducing campsite impacts." In fact, many wilderness researchers agree with the theoretical assumption that there is a positive link between knowledge and appropriate behavior (Lucas, 1974; 1981; Lime & Stankey, 1971; Hendee et al., 1990). Robertson (1982) showed that there is a positive relationship between knowledge and self-reported behavior regarding low-impact practices.

The problem with raising knowledge to improve low-impact behavior is that recommendations on appropriate low-impact techniques have been constantly changing. USDA Forest Service educational programs, outdoor adventure wilderness courses (Petzoldt, 1974), and wilderness researchers (Lucas, 1981; Krumpe & Brown, 1982; Roggenbuck & Berrier, 1982) have all suggested low-impact behaviors which are now generally regarded as inappropriate by current research (Cole, 1989). These evolving

low-impact recommendations likely cause confusion among wilderness users -- a confusion which results in low knowledge levels and unnecessary impacts to the wilderness resource.

Presently, little is known about knowledge levels among wilderness users concerning low-impact practices, especially knowledge relating to those practices which have only recently been recommended by wilderness researchers. The few studies which have been conducted to determine low-impact knowledge levels (Dowell & McCool, 1986; Fazio, 1979; McAvoy & Hamborg, 1984) reveal little about the state of knowledge today because they each used different measurement instruments and addressed varying topics.

Researchers have been successful at using education to influence behavior in wilderness settings (Huffman & Williams, 1987; Krumpe & Brown, 1982; Roggenbuck & Berrier, 1982). This success is promising for those interested in raising knowledge in an attempt to affect low-impact behavior. These studies, however, dealt only with the distribution of wilderness users and did not focus on other low-impact practices. The one study which analyzed the relationship between knowledge and behavior regarding low-impact practices examined self-reported behavior rather than actual behavior (Robertson, 1982). In addition, Robertson did not attempt to influence behavior; rather, she just correlated knowledge levels with behavior.

The work conducted by Ajzen and Fishbein (1980) and Fishbein and Ajzen (1975) implies that there is a link between beliefs (knowledge), attitudes, behavioral intentions, and behavior. Intentions, they say, are the strongest predictors of behavior. Dowell and McCool (1986), in one of the few studies of this type regarding wilderness recreation, found that knowledge affects intentions concerning low-impact wilderness skills. It is of interest to wilderness researchers and managers, then, to examine more closely the intentions of users. Due to the dispersed nature of wilderness recreation, it is difficult to observe, study, and influence the actual behavior of the wilderness user. Since in-

tentions are so strongly correlated with behavior, and knowledge affects intentions, researchers and managers could alter behavior by improving intentions and raising knowledge levels.

In addition to intentions, users' previous experience visiting wilderness seems to play a role in their knowledge levels. Fazio (1979) and Ross and Moeller (1974) found a link between experience and wilderness knowledge. Researchers also have found that previous experience affects one's response to educational interventions (Krumpe & Brown, 1982; Lucas, 1981; Roggenbuck & Berrier, 1982).

Chapter Two: Problem Statement and Objectives

The overall goal of this study is to examine low-impact knowledge levels and to explore the effectiveness of education in reducing impacting behavior among wilderness users. Natural resource managers are concerned about the impacting behaviors of the wilderness user (Cole, Petersen, & Lucas, 1987). Some behaviors which are damaging to the wilderness resource may be the result of confusion among users concerning appropriate low-impact practices. A review of past literature reveals that low-impact recommendations have evolved since the inception of the National Wilderness Preservation System (Cole, 1989; Krumpe & Brown, 1982; Lucas, 1981; Petzoldt, 1974; Roggenbuck & Berrier, 1982). Recent research on appropriate campsite behavior and campsite selection has changed many recommended practices for reducing recreation-related wilderness impacts (Cole, 1989; Cole & Benedict, 1983). There is the need, therefore, to examine current knowledge levels among wilderness users of appropriate low-impact practices.

Education and information are considered appropriate and desirable means of increasing wilderness knowledge and affecting behavior concerning low-impact recreational practices (Fazio, 1979; Hammitt & Cole, 1987; Hendee et al., 1990; Lucas, 1982, 1983; Robertson, 1981, 1982; Roggenbuck & Berrier, 1982). There are, however, few empirical studies suggesting that education and information actually increase low-impact knowledge or affect intentions and behavior to act in a low-impacting fashion. There is

a need for an empirical study testing the effect of education on low-impact knowledge, intentions, and behavior.

Ajzen and Fishbein (1980) and Fishbein and Ajzen (1975) have posited a link between knowledge, behavioral intention, and behavior. This link is of special interest to wilderness managers because it implies that behavior can be influenced by increasing knowledge and fostering appropriate intentions. In addition, the link between previous experience visiting wilderness and knowledge should be further explored to help determine the nature of the relationship between experience and low-impact knowledge.

Given 1) the evolution of low-impact recommendations, 2) the paucity of empirical evidence demonstrating the relationship between education and low-impact knowledge, intentions, and behavior, 3) the importance of determining the nature of the relationship between knowledge, intentions, and behavior concerning low-impact practices, and 4) the possible effect of experience on low-impact knowledge; this study has the following objectives:

1. Determine the current level of awareness among wilderness users of appropriate and accepted low-impact practices.
2. Determine whether education and information can increase knowledge levels, foster appropriate intentions, and improve actual behavior concerning low-impact wilderness use.
3. Investigate the relationship between knowledge, behavioral intention, and behavior concerning low-impact wilderness practices.
4. Determine the effect of previous wilderness experience on awareness of low-impact practices.

Chapter Three: Literature Review and Hypotheses

Providing information and education are *appropriate* means of managing the wilderness visitor. The 1964 Wilderness Act states that wilderness areas "shall be administered in such a manner ... so as to provide ... for gathering and dissemination of information regarding their use and enjoyment as wilderness." Wilderness philosophers, managers, and researchers all feel that education maintains visitors' freedom of choice, an important wilderness value (Roggenbuck and Watson, 1986). Educational programs are, therefore, considered preferable to direct, regulatory management (Lucas, 1982; 1983), and are often used by wilderness managers (Hendee et al., 1990). Former Chief of the USDA Forest Service, R. Max Peterson, said wilderness management is "80 to 90 percent education and information and ten percent regulations" (Peterson, 1985). Education and information programs are also a form of management which do not alter the wilderness resource. Thus, they protect another sacrosanct value of wilderness: the preservation of naturalness.

Education as a form of wilderness management is also considered *desirable* by wilderness managers and users. Washburne and Cole (1983) reported that managers prefer education and information to other types of management. Education is often used by managers to influence where people go and what they do while visiting wilderness (Hendee et al., 1990). A majority of visitors to wilderness also desire information (Roggenbuck & Watson, 1986). Hendee et al. (1990) reported that wilderness

visitors are especially receptive to educational efforts because they tend to be more highly educated than the general public and because most users place a high personal value on wilderness and want to protect the resource and use it carefully. Information helps wilderness users achieve the type of experiences they are seeking and facilitates a deeper appreciation of the area (Hendee et al., 1990).

Another primary use of education is to increase wilderness visitors' knowledge of low-impact recreational practices (Hendee et al., 1990). In fact, education is often viewed by managers as the key to decreasing recreational impacts in the backcountry (Dowell & McCool, 1986). Most wilderness areas today have some type of low-impact educational program. Washburne and Cole (1983) reported that 60 percent of managers surveyed used information in an attempt to reduce recreational impacts. Although low-impact education has, for the most part, only been used to reduce depreciative acts in particular areas, managers also hope to create a low-impact ethic using informational programs (Hammitt & Cole, 1987). Brochures, maps, signs, visitor center interpretive programs, and personal contacts are used, then, in an attempt to raise knowledge levels among wilderness users (Brown, McCool, & Manfredo, 1987; Martin & Taylor, 1981).

Despite the convictions of managers and researchers that education increases low-impact knowledge, develops support for wilderness values and management, and improves behavior, there is scarce empirical evidence to support this contention. Research examining the link between education, knowledge, and behavior is rare (Hendee et al., 1990). Of the few studies which have investigated the effect of education on low-impact behavior, many examined practices (i.e., visitor dispersal in heavily used areas) which are now generally considered inappropriate. Also, not all researchers feel that education is a wilderness management panacea. Dustin (1985) and McAvoy and Dustin (1983) believe that education will not prevent problem behavior in outdoor recreation settings; the only way to motivate some visitors to behave appropriately is with rules, regulations and

coercion. Without further studies, however, neither Dustin and McAvoy's view nor the conviction that education is effective can be supported. Roggenbuck and Lucas (1987) expressed the need for more study of visitor knowledge of low-impact use. Are wilderness users well informed about low-impact recreational practices? Can impacts be reduced through education and increasing knowledge levels? What role do intentions and experience play in the education→knowledge→behavior construct?

Low-Impact Knowledge

Knowledge Levels

Fazio (1979) employed multiple choice tests to measure knowledge of low-impact camping techniques among visitors to Rocky Mountain National Park and the Selway-Bitterroot Wilderness. Overall knowledge levels among respondents were low. In this study, the effectiveness of various educational media at increasing knowledge was analyzed. Several of the educational interventions in the Selway-Bitterroot study were associated with increased knowledge levels, including contact with a wilderness ranger, brochures and maps, and trailhead signs. In the Rocky Mountain National Park study, interventions which effected a significant increase in knowledge included a slide exhibit combined with exposure to a trailhead sign, a slide exhibit combined with exposure to an educational brochure, and the slide exhibit alone.

McAvoy and Hamborg (1984) studied visitor knowledge of rules governing low-impact use of the Boundary Waters Canoe Area Wilderness. They developed a ten-item true/false test and found overall knowledge to be fairly high (mean = 8.19 out of a possible 10). Their true/false test did not contain a "don't know" option, leaving respondents no choice but to guess when they were unsure. Thus, one would expect a score of

five correct on the test if left to chance alone. The mean score of 8.19 suggests that most visitors had at least some low-impact awareness.

Dowell and McCool (1986) assessed changes in Boy Scouts' knowledge of low-impact skills resulting from exposure to the USDA Forest Service "Leave No Trace" educational program. The program significantly increased posttest scores on the low-impact skills quiz compared with those of the control group. Mean knowledge of skills was a 3.77 out of a possible 7.0 for the control group; this increased to 6.37 for those exposed to the program. Retention scores, taken one month later, were also statistically higher than pretest scores, although knowledge levels dropped somewhat. The mean retention score for the treatment group was 5.81. Overall, the "Leave No Trace" program had a significant effect on short and long term knowledge of low-impact wilderness skills.

Other studies which investigated knowledge levels among recreationists either did not examine low-impact knowledge specifically or did not investigate wilderness users. They are, therefore, not directly applicable to the purposes of this study.

Thus, there is insufficient evidence to draw conclusions about overall awareness of low-impact wilderness techniques. The above studies suggest a variation in knowledge levels among wilderness users, but even this conclusion is suspect due to the paucity of objective evaluations. Also, the different types of measurements used in these studies make it difficult to compare one with another. Finally, the above researchers developed their knowledge tests prior to the publishing of literature which outlines recently-accepted low-impact recommendations (e.g., Cole, 1989). Any contemporary knowledge test must reflect these new recommendations.

Evolving Concept of Low-Impact Practices

A major difficulty in the education of the wilderness user is the ever-evolving nature of low-impact recommendations. All the answers to the question, "What are the least impacting behaviors in wilderness?" simply have not yet been found. There has been widespread disagreement between researchers, managers, and users over which behaviors are acceptable (Roggenbuck, in press). This lack of agreement has caused inconsistencies in the low-impact information received by the wilderness user -- information provided by managers has not always agreed with techniques currently recommended by the latest research (Robertson, 1986). Cole's (1989) comprehensive state-of-knowledge review, *Low-Impact Recreational Practices For Wilderness And Backcountry*, indicates that many wilderness practices once thought to be acceptable are actually quite impacting to the environment. For example, a Forest Service brochure found in November, 1989 in a district office display counter of the Jefferson National Forest, recommends clearing a ten-foot wide area to bare soil and building a ring of rocks before constructing a campfire. These practices are in direct opposition to today's recommended low-impact techniques (Cole, 1989).

In The Wilderness Handbook, Petzoldt (1974), director of the National Outdoor Leadership School (NOLS), recommends digging a latrine for all in the party to use. In an emergency, he says it is acceptable to overturn a large rock and put feces in the depression underneath. In the section on pitching tents, no mention is made of placing the tent on the previously impacted area of the campsite, instead "... one must select a fairly large flat area ... a [tent] can be pitched on soft duff in thick timber..." (Petzoldt, 1974, p. 119). Finally, Petzoldt (1974) has a section on proper axemanship, tacitly implying that hatchets and axes are appropriate tools to use in wilderness.

The recommendations by Petzoldt highlighted above are directly contrary to Cole's (1989) low-impact suggestions, which are based on recent research. The proper method of disposing of human body waste is to bury it in a small cathole, not dig a latrine or simply place feces under a stone. The most appropriate place to pitch a tent is in the previously impacted area of the campsite. Axes and hatchets are unnecessary tools in wilderness because only dead and down wood that can be broken by hand should be used in fire building (Cole, 1989). Glaring inconsistencies like these make it painfully obvious that many low-impact educational messages being received by the user do not share widespread acceptance among wilderness researchers and managers.

More recent lay publications which discussed low-impact wilderness use include Hampton and Cole (1988), Hart (1977), and Waterman and Waterman (1979). The most recent of these (Hampton & Cole, 1988) contains use recommendations which are almost identical to those posed in Cole's (1989) state-of-knowledge review, and is therefore probably the best low-impact publication for wilderness users today.

The promotion of behaviors and practices which are now generally regarded as impacting to the wilderness resource has not been limited to lay publications and Forest Service brochures. Some apparently inappropriate practices were espoused by prominent wilderness researchers as recently as the early 1980s. Lucas (1981), Krumpe and Brown (1982), and Roggenbuck and Berrier (1982) all advanced the notion that dispersal of campers or hikers is an effective means of reducing wilderness impacts. These researchers suggested that resource and social impacts can be reduced through user dispersal. While the utility of dispersal strategies at reducing social impacts is not called into question, research has shown that user dispersal may actually cause more damage to the resource than it prevents (Cole, 1982a). User dispersal likely spreads impacts out over a broad area, whereas concentration reduces the spread of impacts and focuses damage on fewer areas. Dispersal strategies are only considered effective if the area is

very lightly used, vegetation types are resilient, and the agency has the ability to adequately educate visitors regarding low-impact techniques (Marion, 1991). Cole (1982a; 1989) and Cole and Benedict (1983), therefore, recommended camping on a moderately or well impacted campsite in all but the most lightly used wilderness areas in order to reduce site proliferation and impact.

Perhaps the low-impact recommendations which appear the most confusing to wilderness visitors are those which concern the selection of appropriate campsites. As mentioned above, some wilderness researchers have attempted in research studies to disperse users away from heavily used areas and popular campsites, while others have suggested that wilderness users camp in moderately or well impacted sites. Management agencies also tend to give conflicting information on whether dispersal or concentration is the most appropriate policy. Shenandoah National Park, Virginia, has a dispersal policy for its backcountry users. Great Smoky Mountains National Park, North Carolina, however, promotes backcountry camper concentration. How could two parks with such similar ecosystems and use pressures both be correct in their radically different approaches to impact management? Again, it may depend on whether the parks are focusing on social or resource impacts. Needless to say, the information being received by the user is conflicting and potentially confusing.

In addition, current low-impact recommendations concerning campsite selection are fairly complex. Cole (1989) suggested that, in a heavily used wilderness zone, campers should select a well impacted campsite. In a lightly used, remote zone of the wilderness, users should select a previously unused site. One should never camp in a lightly impacted site (Cole, 1989). These recommendations presuppose that campers can recognize a well impacted, lightly impacted, or unused site, and that they know if they are in a heavily or lightly used zone of the wilderness. Such is probably not the case.

Since there is scarce research on knowledge levels of low-impact wilderness techniques, and given that low-impact recommendations have evolved dramatically since the beginning of the National Wilderness Preservation System, this study seeks to determine low-impact knowledge levels of wilderness users, placing particular emphasis on the new recommendations posited by Cole (1989).

Research Question One:

What is the level of awareness among wilderness users concerning appropriate low-impact behaviors?

It is suggested that knowledge of low-impact practices which have only recently been espoused by wilderness researchers and which are very different from past recommendations will be low. Specifically, it is suggested that knowledge levels concerning the selection of appropriate campsites will be especially low, given the large body of conflicting information on this subject. There has been a recent change in what is considered appropriate campsite selection -- users are likely not to know what is an appropriate campsite or at best be confused about the issue. Also, recent campsite selection recommendations require skillful perceptual judgment about campsite impacts and wilderness use levels. It is expected that at present, campers will not be equipped with the necessary knowledge base to make appropriate judgments concerning campsite selection.

Research Question Two:

Will knowledge levels among wilderness users concerning the selection of appropriate campsites be significantly lower than knowledge levels relating to other aspects of low-impact wilderness use?

Educational Interventions

Trailhead signs and posters are often used by resource management agencies as a means of educating wilderness users about low-impact practices (Martin & Taylor, 1981). Indeed, trailhead signs are sometimes the only form of low-impact information received by users upon entry into a wilderness area. It is unclear, however, if these signs are an effective educational intervention. The results of the few studies which have examined the usefulness of trailhead signs at increasing knowledge are inconclusive.

Fazio (1979), in a study of 601 users of Idaho's Selway-Bitterroot Wilderness, discovered that trailhead signs placed at the edge of the wilderness were the most effective informational channel of all studied media. In correlating information channel with percent correct answers on a wilderness knowledge test (the test included questions on low-impact practices), the trailhead signs resulted in higher test scores than brochures, magazines, books, maps, or personal contact with a ranger.

In a similar study, Fazio (1979) found that users exposed to trailhead signs in the backcountry of Rocky Mountain National Park had the least improvement in knowledge of low-impact camping practices between mean pretest and posttest scores of any informational channel tested (N = 648). The difference between pretest and posttest scores was insignificant and was much lower than the improvement in knowledge exhibited by those individuals exposed to a slide show or an informational brochure.

In their study of 558 users of the Allegheny National Forest, Ross and Moeller (1974) found that campers who were exposed to posted signs had significantly higher scores on knowledge of rules than those who had not seen the signs. Those exposed to the signs scored an average of 54 percent correct on the knowledge test, compared to 44 percent for the visitors who had not seen the signs.

Olson, Bowman, and Roth (1984) attempted to use on-site signs, personal services, and brochures to raise knowledge levels of policies and practices at four Ohio state nature preserves. Although the signs did increase knowledge, they accounted for a much smaller gain from pretest to posttest than did the other interventions tested.

The overall effectiveness of trailhead signs at producing learning seems to depend on at least two factors. First, the sign must be noticeable and obtrusive if it is to be read. If a majority of hikers and campers do not stop to view and read the sign, it will not be sufficient to increase low-impact knowledge.

Second, the message content of an educational sign must be strong and simple. Weak, complex messages fail to produce learning. Geller (1989) suggested that if participants are given a sound rationale for the behavior change program, the desired response is more likely to occur. Since the ultimate goal of low-impact education is behavior change, there is the need for strong arguments and clearly worded information in visitor education programs. Ham (1984), in his study of recycling in forest campgrounds, found that poorly worded instructions greatly reduced program participation. He highlighted the need for concise, explicit messages.

Although research about the effectiveness of trailhead signs is mixed, they are more likely to be effective if clear, explicit, and obtrusively located. Therefore, the reported study attempted to make trailhead signs as visible as possible and tested for increases in learning resulting from this educational medium. The research question tested was as follows:

Research Question Three:

Will educational signs, located at wilderness trailheads, significantly increase wilderness users' knowledge of low-impact recreational practices?

Behavioral Intention

The observation and study of actual behavior in wilderness settings is extremely difficult; wilderness recreation is by definition low density. It would facilitate wilderness research if researchers could find a substitute for behavior that strongly predicts behavior but is easier to measure. Ajzen and Fishbein (1980) and Fishbein and Ajzen (1975) have suggested that there is a strong positive relationship between behavioral intention and behavior. This theorized link has additional important ramifications for wilderness managers because it means that behavior possibly can be influenced by altering intentions. The question then becomes, how to alter intentions? Dowell and McCool (1986), in their study of the Forest Service "Leave No Trace" educational program, found that Boy Scouts' knowledge of low-impact wilderness skills affected their behavioral intentions. Their educational treatments consisted of exposure to a low-impact booklet and/or a slide show. Those not exposed to the program scored a 33.1 out of a possible 45.0 on a Likert-scale behavioral intention test. Both interventions significantly improved Boy Scouts' behavioral intention scores (booklet = 38.9; slides = 37.4; booklet and slides combined = 37.7). Educational interventions, then, apparently can influence behavioral intentions concerning low-impact wilderness use, but more than one study is needed to clarify this relationship.

Despite the often confusing low-impact recommendations concerning campsite selection, choosing an appropriate wilderness campsite remains critically important in reducing resource impacts. Campsite impacts are of great concern to many backcountry and wilderness managers (Washburne & Cole, 1983). Natural conditions in the wilderness are often the most severely altered by the recreational use of campsites (Hendee et al., 1990). Because wilderness campers spend most of their time in their campsite, resource impacts tend to be focused on these areas. In addition, due to the

amount of time spent in the campsite, the condition of the site is likely very important in defining a high quality experience. Appropriate campsite selection, then, is a very important aspect of low-impact wilderness behavior.

Given the importance of wilderness campsite selection, and since behavioral intentions appear to play an important role in predicting the actual behavior of the wilderness user, the following research question was posited:

Research Question Four:

Will educational signs, located at wilderness trailheads, strengthen wilderness users' intentions to select an appropriate campsite?

Behavior

Several wilderness researchers have been successful at changing wilderness visitors' behavior with the use of education and information. Robertson (1982), relying on the assumption that knowledge is related to behavior, tested whether or not it is possible to improve low-impact behavior with education. In her study, knowledge was operationalized as the extent to which subjects were aware of USDA Forest Service recommended low-impact backpacking procedures. Results indicated that knowledge was the greatest predictor of self-reported behavior -- people who were aware of recommended conduct tended to say they acted accordingly. She concluded that education is a practical method for reducing the depreciative behavior of wilderness visitors.

Roggenbuck and Berrier (1982), in a study comparing the effectiveness of communication strategies in dispersing wilderness campers, found that both a simple educational brochure and the brochure plus a personal contact by a ranger were effective in dispersing campers from a heavily used meadow. Unlike Robertson's 1982 study, the authors in this experiment observed actual behavior, lending greater credibility to their

results. Roggenbuck and Berrier (1982) found the brochure's effectiveness to be especially stable across various segments of the camper population. They concluded that brochures are an inexpensive, attractive means for managers to contact and disperse wilderness users.

In their study of wilderness hikers in Yellowstone National Park, Krumpe and Brown (1982) found that a brochure with a simple flow chart containing information on trail attributes was effective in redistributing backcountry use. Fourteen percent of the control group -- those who did not receive the brochure -- chose to hike one of the lightly used trails listed in the flow chart. Thirty-seven percent of the hikers who did receive the brochure picked one of the suggested trails. This study strongly supports the claim that education can be an effective behavior management intervention in wilderness recreation settings.

Huffman and Williams (1987) extended the work of Krumpe and Brown (1982) by examining the effectiveness of user-friendly microcomputers at redistributing backcountry use in Rocky Mountain National Park. Basing their experiment on decision theory and communication principles, they found that a personal computer located in a visitor center was more effective than a brochure (similar to the one in the Krumpe and Brown [1982] study) at educating wilderness visitors and modifying their behavior. Sixty percent of those who used the informational computer selected a suggested trail, 38 percent of participants who received the brochure chose a targeted trail, but only 17 percent of the control group selected one of the trails. The authors suggested that the computer was more successful than the brochure at redistributing use because 1) the high technology represented by the personal computer was a great contrast to the rustic park environment and therefore tended to attract attention, 2) the computer allowed individuals the flexibility to consider trail characteristics in an order conducive to their own

decision-making strategies, and 3) the active involvement with the computer to aid in decision-making made it more likely to succeed than the passive nature of the brochure.

Finally, Lucas (1981) suggested that education programs can significantly redistribute wilderness use if the information is presented to visitors early in the location choice process.

The above studies clearly indicate that education and information can influence the behavior of the wilderness visitor. Most of these studies, however, dealt only with use distribution. There is some empirical evidence to suggest that education and information can affect other types of low-impact behavior, but these studies were not conducted in wilderness areas.

Vander Stoep and Gramann (1987) examined the effects of three personally-delivered messages on the amount of depreciative behavior committed by youth groups at Shiloh National Military Park. Message content was based on prosocial behavior theory. The treatments were as follows: an awareness of consequence message (AC); the AC message plus a resource protection message (RP); and the AC message, the RP message, and an incentive for helping protect the resource. Depreciative behavior was defined as any action which was damaging to the park's cultural resources. Actual behavior was observed using time-lapse photography. The authors found that each message was effective at reducing serious depreciative behavior by approximately 88 percent when compared to the control group.

Oliver, Roggenbuck, and Watson (1985) conducted a field experiment to determine the effectiveness of education at reducing impacts on a U.S. Army Corps of Engineers campground. The authors used two educational interventions -- a brochure and a brochure plus a ranger contact -- each with a message explaining the destructive effects of inappropriate behavior and describing specific ways in which visitors could help protect the resource. Both interventions helped deter litter and tree damage significantly when

compared to a control group, but the personal contact method was, as expected, the more effective of the two.

Education and information, then, have been effective at reducing depreciative behavior in outdoor recreation settings. Whether they can improve low-impact behavior in wilderness areas has not yet been determined. In particular, the effectiveness of wilderness trailhead signs at reducing impacting behavior has not yet been established.

Research Question Five:

Will educational signs, located at wilderness trailheads, improve wilderness users' behavior concerning low-impact recreational practices?

Knowledge, Behavioral Intention, and Behavior

Wilderness managers who are interested in reducing resource impacts are primarily concerned with influencing the behavior of the wilderness user. It is not knowledge, beliefs, intentions, or attitudes that directly cause wilderness impacts, it is behavior. This is why many researchers have devoted their attention to studying actual behavior (i.e., Huffman & Williams, 1987; Krumpe & Brown, 1982; Lucas, 1981; Roggenbuck & Berrier, 1982). It is far easier, nevertheless, to intervene to raise knowledge levels and foster appropriate intentions than it is to directly address behavior in wilderness. This is why wilderness managers attempt to increase low-impact knowledge in their efforts to affect the behavior of the user (Hendee et al., 1990). Can this method of altering behavior actually work? Is there really a direct relationship between knowledge, behavioral intention, and behavior?

Ajzen and Fishbein (1980), in their *Theory of Reasoned Action*, posit that the link between knowledge and behavior is more than a simple cause and effect relationship. Behavior, they suggest, can be explained by beliefs, attitudes, and intentions (Fishbein

& Ajzen, 1975). They contend that intentions are strong predictors of behavior. Intention is a function of attitudes, which in turn are affected strongly by beliefs. Beliefs then, are the foundation of this theoretical structure, because they ultimately play a role in how a particular person will behave (Fishbein & Ajzen, 1975). An individual's beliefs are developed on the basis of certain inference processes and from direct observation of information received from outside sources. Robertson (1986) suggested that knowledge and beliefs are related and implied that beliefs are the knowledge base which ultimately determine attitudes, affect intentions, and influence actions. If this is true, then individuals use knowledge they have gained to assess how to behave in certain situations.

Indeed, Robertson (1982) determined that visitor knowledge of low-impact practices significantly predicted their low-impact behavior. She found that out of a sample of 678 backcountry visitors to Oregon's Three Sisters Wilderness, knowledge explained 35 percent of the variation in self-reported behavior. Young and Kent (1985) further supported the *Theory of Reasoned Action* in their study of camping attitudes, beliefs, intentions, and behavior among 100 residents of a small Midwestern city. They found that camping intentions significantly predicted self-reported camping behavior ($R^2 = .59$). As mentioned previously, Dowell and McCool (1986) found that knowledge predicted behavioral intention.

Thus, it appears that knowledge predicts intentions (Dowell & McCool, 1986) which in turn predict actual behavior (Young & Kent, 1985). Knowledge can also act to predict behavior (Robertson, 1982), a link which theoretically exists through behavioral intentions (Ajzen & Fishbein, 1980; Fishbein and Ajzen, 1975). The following simple equation can help visualize this relationship:

Knowledge ≃ Behavioral Intention ≃ Behavior

Based on this theoretical relationship, the following research questions were developed:

Research Question Six:

Will there be a positive relationship between wilderness users' knowledge of appropriate low-impact practices and their intentions to act in a low-impacting fashion?

Research Question Seven:

Will there be a positive relationship between wilderness users' knowledge of low-impact practices and their actual behavior concerning low-impact wilderness use?

Research Question Eight:

Will there be a positive relationship between wilderness users' intentions to act in a low-impacting fashion and their actual behavior concerning low-impact wilderness use?

Past Experience

There have been few studies which have examined the link between previous wilderness experience and knowledge. Ross and Moeller (1974) surveyed 558 campers in the Allegheny National Forest and found that knowledge of rules governing the campground increased as familiarity with the recreation area increased. First time visitors scored an average of 48 percent correct on the knowledge test, those who made between two and four visits scored a 49, individuals who made five to ten visits scored a 50, and those visiting more than ten times scored a 61. Fazio (1979) found that first time visitors to the Selway-Bitterroot Wilderness received lower scores on a wilderness knowledge test than other users.

It makes intuitive sense to assume that individuals who are more experienced in wilderness will have higher levels of knowledge concerning low-impact practices. Many wilderness areas have adopted education programs in an attempt to inform visitors about low-impact use (Martin and Taylor, 1981). Presumably, the more times people

visit a wilderness area, the more often they will be exposed to low-impact information and the more they will learn.

Research Question Nine:

Will there be a positive relationship between users' previous experience visiting wilderness and their knowledge of low-impact wilderness practices?

Roggenbuck and Manfredo (1989) suggested that there is a negative relationship between wilderness experience and receptiveness to education. In other words, the first time visitor is more likely to respond to wilderness education and information than the experienced user. In support of this notion, a study conducted by Roggenbuck and Berrier (1982) found that novice campers dispersed more than other users from a popular meadow as the result of a "personal contact" educational treatment. Krumpe and Brown (1982) found that those with fewer years of experience backpacking in Yellowstone National Park were significantly more likely to select a trail listed in an informational brochure. Similarly, Lucas (1981) found that inexperienced users were more likely to select a particular trail based on an informational brochure than experienced visitors. Huffman and Williams (1986) discovered that more-experienced wilderness visitors use information differently than less-experienced visitors.

Research Question Ten:

Will inexperienced wilderness users gain more low-impact knowledge from an educational intervention than experienced users?

Chapter Four: Methods

Study Area

The study site for this research was Shining Rock Wilderness, an area of 18,500 acres located in the Pisgah National Forest of western North Carolina. The population studied was wilderness campers in the backcountry of Shining Rock during the summer and autumn of 1990. Sampling was accomplished by random selection of clusters of weekend-days and weekday-days. Within the weekend and weekday clusters, each of the area's seven trailheads, observable from four different locations, was sampled systematically with a random start (Figure 1). Wilderness users were contacted at the trailhead on a total of 58 days, which yielded a sample size of 244 campers.

Data Collection Instruments

Low-impact knowledge was measured using a ten-item multiple choice test which was administered at the trailheads. Knowledge questions were based on Cole's (1989) *Low-Impact Recreational Practices for Wilderness and Backcountry.* Questions addressed those low-impact practices which likely have the most significant effect on the wilderness resource: trail use, campsite selection in both heavily and lightly used wilderness zones, appropriate campsite behavior, tent placement, the need to limit campfires, disposal of

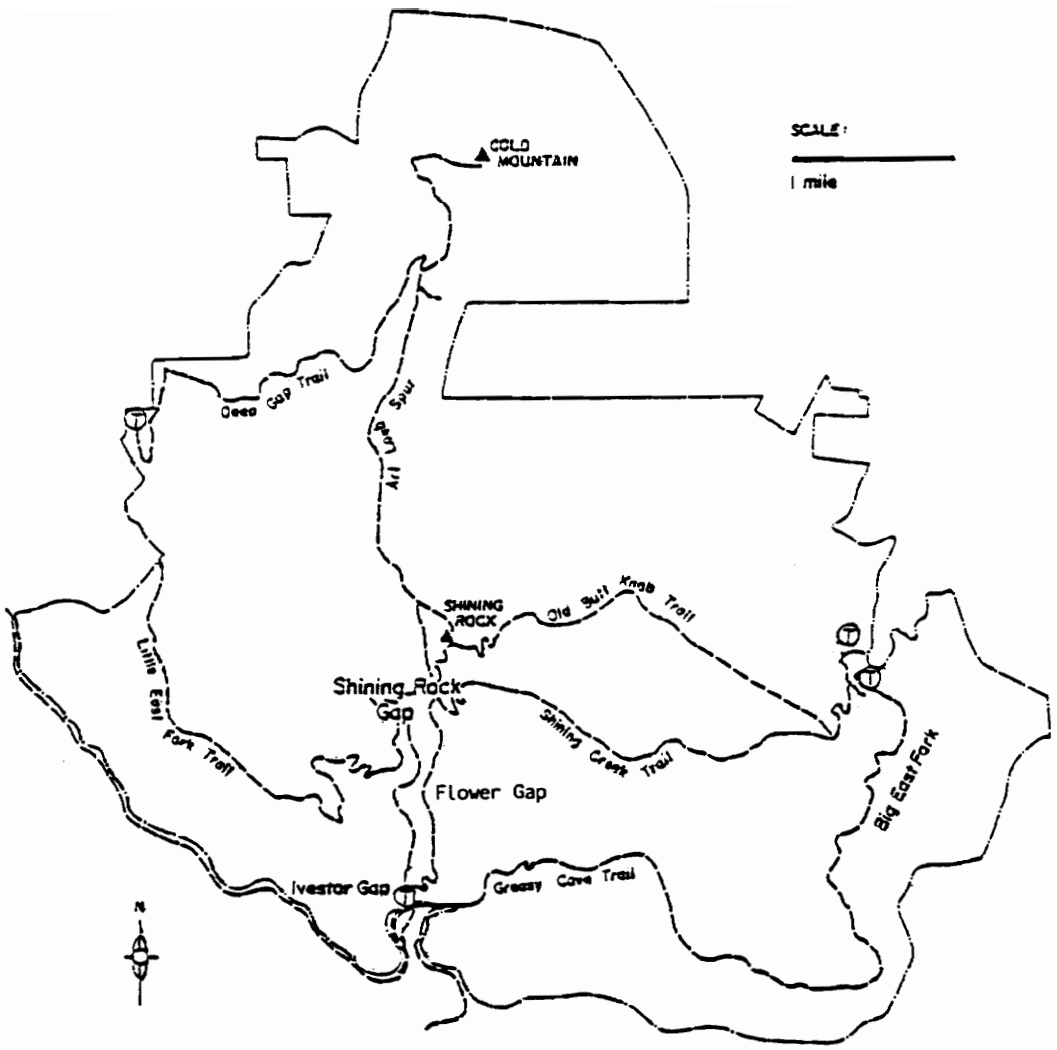

Figure 1. Shining Rock Wilderness

waste water, and disposal of human body waste (see Appendix A). To increase the validity of the measure, the test was evaluated by experts and pretested in the field.[2] Based on the pretest and evaluation, several items on the knowledge test were eliminated, some were changed, and others were added.

Behavioral intention was measured by showing pictures of a prototypical campsite under different levels of impact to the study participants (see Appendix B). The four 7" x 10" color sketches, each of the same campsite displaying an increasing degree of recreational impact, were modeled after Cole and Benedict's (1983) campsite impact classification system and their sketches depicting each campsite impact class. The levels of impact included pristine/unused, lightly impacted, moderately/well impacted, and severely impacted. Subjects were asked to: 1) choose the picture which depicts the site in which they would most like to camp, and why, 2) choose the picture which depicts the site where they would camp if trying to minimize their impact in a heavily used wilderness zone, and why, and 3) choose the picture which depicts the site where they would camp if trying to minimize their impact in a lightly used wilderness zone, and why.

Behavior was measured by discreetly observing the activities of wilderness campers at Shining Rock Gap and Flower Gap, areas of Shining Rock Wilderness which are popular camping locations. Prior to conducting behavior observations, forty-three campsites in the Shining Rock Gap and Flower Gap vicinities were numbered, tagged, and classified according to their level of impact. Based on Marion's (1991) campsite condition class assessment procedure, sites were classified as pristine/unused, lightly impacted, moderately/well impacted, or severely impacted. This classification method

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[2] Experts who reviewed the knowledge test included: David N. Cole, Project Leader, USDA Forest Service Intermountain Research Station; Jeffrey L. Marion, Regional Research Scientist, U.S. Department of the Interior National Park Service; Alan E. Watson, Research Social Scientist, USDA Forest Service Intermountain Research Station; Joseph W. Roggenbuck, Associate Professor of Forestry, and Daniel R. Williams, Assistant Professor of Forestry, Virginia Polytechnic Institute and State University.

closely resembles Cole and Benedict's (1983) campsite impact classification system and is an adaptation for backcountry areas in the East. Campers were approached by USDA Forest Service wilderness rangers and Virginia Polytechnic Institute and State University research assistants and asked for their names and addresses to be used for survey purposes. While collecting this information, the observers unobtrusively noted and later recorded: 1) the identification number of the site in which the party was camped, 2) the location of the tent in relation to the impacted area of the campsite, and 3) whether or not the group had, has, or will have a campfire (see Appendix C). Observers approached campers in the evening, a time when they were most likely to have a campfire. Indicators which observers used to detect the presence of past or future campfires included: smoking embers in the fire ring, blackened pots gathered around the fire ring, piles of wood and kindling near the fire ring, and the collection of firewood by campers. A total of 163 party behavior observations were completed.

Wilderness experience was operationalized using experience use history (EUH) questions included in the Shining Rock Wilderness Visitor Survey (Roggenbuck & Stubbs, 1990). This larger and more comprehensive survey evaluated characteristics of wilderness visits and visitors in Shining Rock. EUH questions included measures of how often and when the respondent visited Shining Rock Wilderness, how often and when the respondent visited other wilderness areas, and how many other wilderness areas the respondent visited.

Educational Intervention

To test the effectiveness of low-impact education, posters were placed at the three most heavily used trailheads on approximately fifty percent of the sampling days. The posters, representing the study's educational treatment, contained information on ap-

propriate campsite selection, tent placement, and the need to limit wilderness campfires (see Appendix D). These subjects were also addressed in the knowledge test in order to be able to draw conclusions about the relationship between the educational intervention and low-impact knowledge. In addition, the behaviors recommended on the posters were identical to the ones observed in the backcountry, enabling us to study the relationship between the treatment and behavior. Control was the time during which no posters were displayed.

The posters were made clear, explicit, and succinct by placing the primary message in large, bold letters at the top of the sign (i.e., **"Campfires Harm The Wilderness"**). Beneath this message was a list of statements giving the rationale for the recommended behavior. Illustrations depicting appropriate campsite selection and tent placement were also placed on the posters to ensure message clarity. In order to portray the appropriate campsite selection intentions and behavior, the campsite selection poster contained pictures nearly identical to the illustrations shown to campers on the behavioral intention test (based on Cole and Benedict's [1983] sketches depicting each campsite impact class).

To ensure visibility of the educational messages, the posters were located away from other USDA Forest Service trailhead bulletin boards. Posters were attached to signs which were located approximately one-quarter mile down the trail from the trailhead. The signs were placed immediately adjacent to the trail, facing toward travellers coming into the wilderness from the parking area; no information other than the reported low-impact messages was present on the signs.

After taking the knowledge and behavioral intention tests, respondents were also asked 1) if they had seen and 2) if they had read a USDA Forest Service Shining Rock Wilderness brochure which was available at the visitor center. This brochure contained a map of the Shining Rock area and detailed information about low-impact wilderness

use. The low-impact information closely followed Cole's (1989) recommendations and was judged by experts to be of excellent quality.[3]

The visitor contact scheme, depicting contact and poster locations and sample sizes for each population, is shown in Figure 2.

Data Analyses

Knowledge

For the purposes of data analysis, participants' responses were coded as either *correct* or *incorrect* on their knowledge test.[4] The test was then scored to reflect the percentage correct out of the total number of items answered. Therefore, knowledge items which were skipped by respondents were not averaged into the mean. So, it was possible to answer fewer than ten questions and still receive a score of 100 (i.e., eight questions correct out of eight answered was considered to be a score of 100; seven correct out of eight yielded a score of 87.5). Those individuals who answered fewer than seven questions were removed from of the analysis. Simple descriptive statistics were used to analyze overall low-impact knowledge levels among Shining Rock Wilderness campers, including the computation of means, standard deviations, and frequency distributions and histograms.

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[3] Experts who reviewed the brochure included: Jeffrey L. Marion, Joseph W. Roggenbuck, and Alan E. Watson.

[4] The test was designed so that there was a single best answer per question.

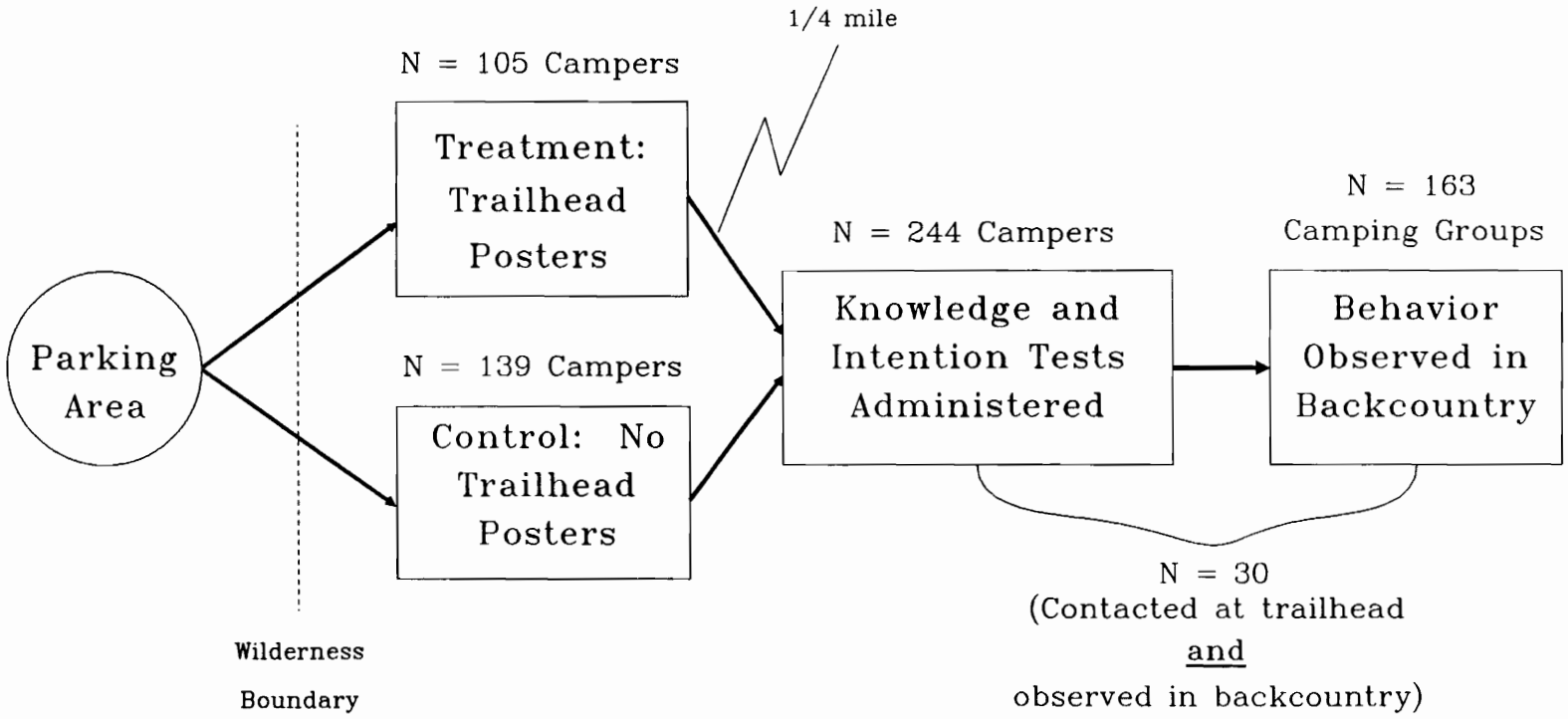

Figure 2. Visitor contact scheme for Shining Rock Wilderness.

Knowledge of site selection and non-site selection items was computed like overall knowledge. Site selection knowledge consisted of the number correct out of the total number of site selection questions answered. There were a total of three site selection items (Questions 3, 4, and 10) on the knowledge test, so that answering all three correct was scored as 100, two correct as 66.6, etc. Similarly, knowledge relating to subjects other than site selection was scored to reflect the percentage correct out of the seven non-site selection items. Again, the highest possible score was 100. A paired comparisons t-test was employed to determine whether knowledge of appropriate campsite selection was significantly different from knowledge concerning other aspects of low-impact wilderness use.

A simple t-test was used to determine whether overall knowledge was affected by the treatment (in other words, was the mean score on the knowledge test greater for those individuals under treatment or control?). Several 2 x 2 chi-square tests were employed to look for for significant relationships between the treatment and individual knowledge items relating to the subject matter on the posters. Kendall's tau measure of association was used to determine the strength of those relationships found to be significant.

Behavioral Intention

For each behavioral intention item, a variable was created for which answers were coded as either *appropriate* or *inappropriate*. All decisions as to what constituted an appropriate or inappropriate campsite were based on Cole (1982a), Cole (1989), and Cole and Benedict (1983). For intention item one, in which respondents were asked where they would most like to camp (no mention was made of answering in the context of reducing impacts or of the level of use of the wilderness zone), the moderately/well

impacted site was considered the appropriate answer.[5] Any other choice was coded as inappropriate. Similarly, the moderately/well impacted site was considered the appropriate answer for intention item two, where respondents were asked to choose the picture of the site in which they would most like to camp if trying to minimize their impact in a heavily used wilderness zone. For behavioral intention question three, where campers were asked to choose the picture of the site where they would camp if trying to minimize their impact in a lightly used wilderness zone, there was not one single best answer. Either the pristine site or the moderately/well impacted site was considered an appropriate response, while the severely and lightly impacted sites were coded as inappropriate.

Frequency distributions and histograms were used to describe overall behavioral intentions concerning the selection of appropriate wilderness campsites. To estimate the effect of the treatment on behavioral intention, 2 x 2 chi-square analyses were conducted, and again Kendall's tau correlation coefficient was used to determine the strength of relationships found to be significant.

Behavior

Each of the three behaviors observed were coded as either *appropriate* or *inappropriate*. Placing one's tent on the impacted area of the campsite was considered appropriate behavior; placing one's tent off or away from the impacted area of the site was considered inappropriate behavior. If respondents chose a moderately/well impacted campsite, they were coded as having behaved properly; if they chose a pristine, lightly

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[5] According to Cole (1989) and Cole and Benedict (1983), one should choose this type of campsite whenever possible.

impacted, or severely impacted site they were coded as having behaved inappropriately.[6] If respondents did not have a campfire at the time of the behavioral observation, they were coded as having behaved appropriately. If they did have a fire at the time of the contact, their behavior was coded as inappropriate. If behavior observers saw no indication of past campfires (using the parameters discussed earlier in this chapter), subjects' behavior was coded as appropriate, but if there were indications they had had a fire, their behavior was coded as inappropriate. Similarly, if observers recorded no evidence of future campfires (again using the parameters discussed earlier), the behavior was considered appropriate; if evidence existed that the party would have a fire, their behavior was coded as inappropriate. For those instances where the behavior observers indicated they were unsure if the party had had or would have a fire, that particular observation was not considered in the campfire analysis.

Several 2 x 2 chi-square analyses, using Kendall's tau to evaluate the strength of association, were used to determine the significance of relationships between treatment and behavior concerning tent placement, site selection, and wilderness campfires.

Knowledge, Behavioral Intention, and Behavior

To evaluate the relationship between overall knowledge and behavioral intention, simple t-tests were used to compare the mean knowledge scores of respondents with correct versus incorrect answers on intention items. Also, 2 x 2 chi-square analyses were conducted to assess relationships between individual knowledge items and their corre-

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[6] Since the study areas, Shining Rock Gap and Flower Gap, are heavily used zones of the heavily used Shining Rock Wilderness, choosing a moderately/well impacted campsite was considered appropriate behavior (see Cole, 1989).

sponding behavioral intention items. Again, Kendall's tau measure of association was used to determine the strength of any relationships found to be significant.

Due to the small number of individuals who were contacted at both the trailhead and found in the backcountry, no attempt was made here to generalize to the entire population of Shining Rock Wilderness users about the relationship of knowledge and behavioral intention with behavior. There were only 30 individuals for which data on knowledge, behavioral intention, and behavior was available (see Figure 2 on page 33). Therefore, statistical inference tests were not conducted. Instead, to describe these relationships, Pearson and Kendall's tau correlation coefficients were computed between behavior items and the corresponding knowledge and intention items. These results should be considered preliminary and exploratory.

Past Experience

Seven EUH variables were included in the 1990 Shining Rock Wilderness Visitor Survey (Roggenbuck and Stubbs, 1990). The response format of some of these items was of an interval nature; others were ordinal. Therefore, the first step was to use one-way analysis of variance (ANOVA) and simple linear regression to test for relationships between the seven individual EUH items and overall low-impact knowledge.

Comparing these EUH variables individually to low-impact knowledge and behavioral intention, however, may not be very informative because experience is likely a multidimensional construct (Watson & Niccolucci, 1991). The seven EUH items included in the Shining Rock Wilderness Visitor Survey were believed to represent several unique dimensions of past experience. The challenge was to verify these unique dimensions, and then find a practical, useful method to classify people on the basis of the significant experience dimensions. Watson and Niccolucci (1991) suggested that the

statistical procedures of factor analysis could aid researchers when trying to examine EUH measures in such a fashion.

The objective of factor analysis is data reduction, or finding and characterizing underlying patterns in a data set (Harman, 1976). Factor analysis performs both analytical and descriptive functions. It is analytical in that it examines the correlations among each item in a scale and then reveals unique underlying dimensions or factors which explain the most variance in the scale. In other words, how can each of the seven EUH variables be grouped to most accurately reflect the various dimensions of the overall EUH construct? Factor analysis is descriptive in that it assigns factor loadings to individual variables within each factor. In this way, one can identify scale items which define or "load highly" on each dimension. Hence, the most important EUH item in each factor could then be uncovered.

The seven EUH questions in the Shining Rock Wilderness Visitor Survey were submitted to a factor analysis[7] to determine the unique experience dimensions tapped by the items. From the results of the analysis, the one item which most typified the factor (given its factor loading) was used as illustrative of that EUH dimension. This procedure yielded three factors and one EUH item which best represented each factor.

By dividing responses into two groups along the median, the three resulting EUH items were then used to create a typology in which respondents were coded as either "high" or "low" in experience for each of the three selected variables. Hence, respondents could fall into one of eight possible typology categories: "High High High", "High Low High", "Low Low High", etc. One-way analysis of variance (ANOVA) was then employed to test the relationship between EUH type and overall knowledge.

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[7] Factor analysis used was principal factor with iteration and orthogonal varimax rotation.

Fisher's Least Significant Difference (LSD) comparison test was used to further explore the nature of any significant relationship between experience and overall knowledge.

To determine whether users' EUH affects gains in knowledge brought about by an educational treatment required testing for an interactive effect between EUH and the treatment. To do this, two factor analysis of variance was employed.

Chapter Five: Results

Low-Impact Knowledge

Overall Knowledge

Figure 3 addresses Research Question One and depicts the distribution of knowledge quiz scores among Shining Rock Wilderness backpackers. Out of a sample size of 244, only 0.4 percent of the sample (one individual) received a perfect score on the quiz, and only 1.6 percent of respondents scored in the 90-99 percent range (Figure 3). Only 35.6 percent of the respondents scored a 70 percent or higher. Approximately 65 percent of respondents scored between 50 and 79 percent correct. The greatest number of respondents scored in the 60-69 percent range. Nobody scored below ten percent correct (Figure 3). For all respondents, the mean quiz score was 59.7 percent correct.

Score distributions for individual quiz items are shown in Table 1. Respondents scored extremely well (in the 90 percent range) on questions one and two, which concerned trail use (see Appendix A). On the other hand, the respondents scored poorly on questions relating to selection of wilderness campsites, scoring 46.7, 16.2, and 37.0 percent correct on questions three, four, and ten, respectively (Table 1). The other area of knowledge about which respondents received low scores addressed the destructiveness of wilderness campfires; only 16.4 percent of the respondents answered this question

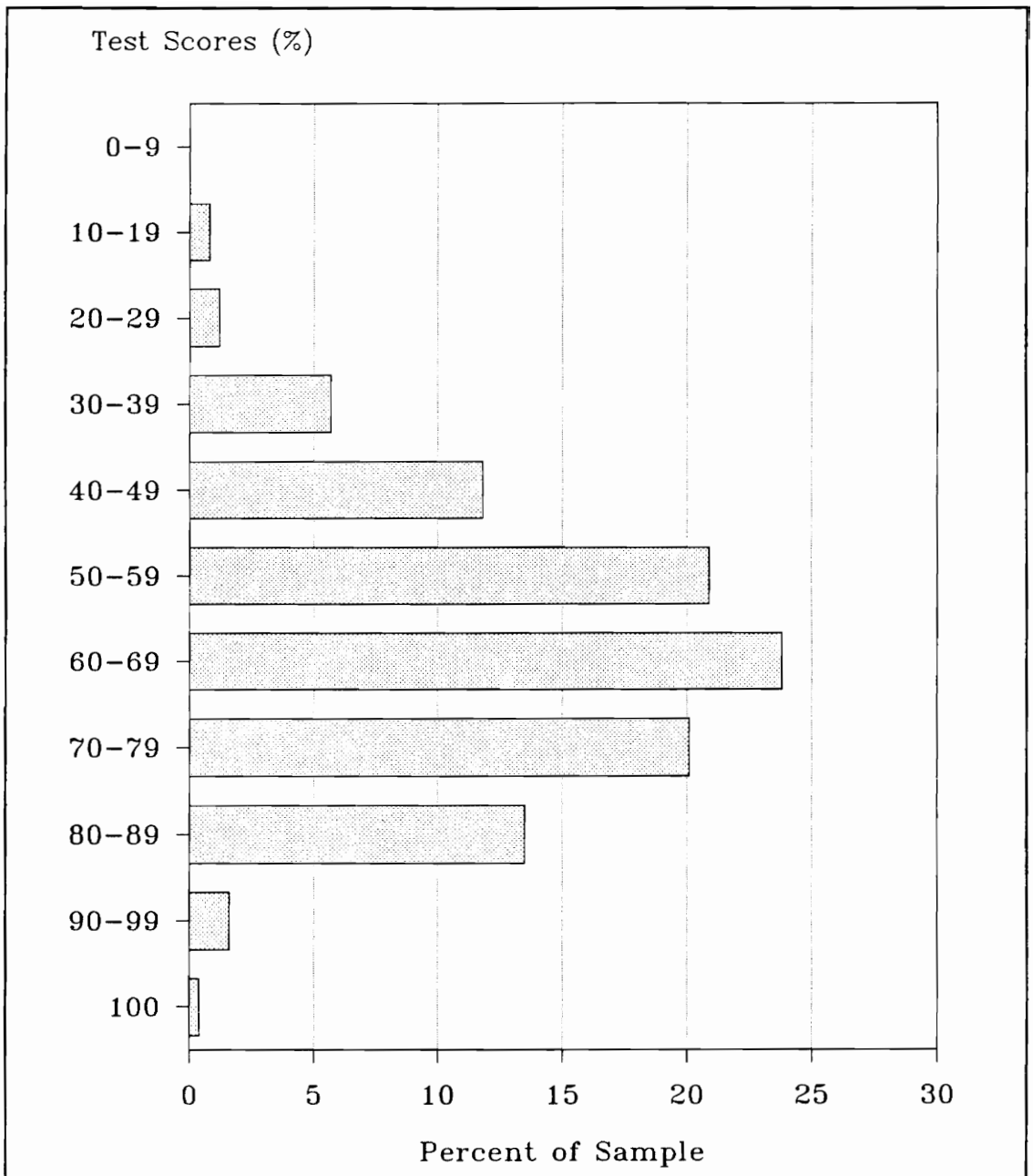

Figure 3. Distribution of scores on low-impact knowledge test (N=244, mean=59.7).

Table 1. Response to low-impact knowledge quiz.[a]

Question	Percent Response		N
	Correct	Incorrect	
1	95.9	4.1	244
2	91.4	8.6	243
3	46.7	53.3	242
4	16.2	83.8	240
5	77.4	22.6	243
6	74.5	25.5	243
7	16.4	83.6	201
8	65.8	34.2	243
9	66.1	33.9	242
10	37.0	63.0	235

[a]See Appendix A for knowledge quiz items.

(number seven) correctly. Finally, Table 1 reveals that respondents scored moderately well on questions relating to tent placement, appropriate campsite behavior, and waste disposal (questions five, six, eight, and nine, respectively).

Site Selection Items vs. Others

Figure 4 depicts the distribution of knowledge scores of those items which relate to the selection of appropriate campsites (Questions 3, 4, and 10 - see Appendix A). Out of a sample size of 244, only 1.6 percent of respondents, or four individuals, scored 100 percent correct on the site selection items (Figure 4). Twenty-seven percent of respondents scored between 50 and 70 percent correct. The greatest number of respondents, 40.2 percent, scored in the 30-39 percent correct range. The remaining 31.1 percent scored below ten percent correct. For all respondents, the mean score on site selection items was 32.9 percent correct.

Respondents scored much higher on knowledge of items not relating to site selection (Figure 5). Approximately 64 percent of the respondents scored a 70 or higher. Only 0.8 percent of respondents (two individuals) scored in the 0-9 percent correct range, while 10.2 percent received a perfect score. The greatest number of respondents scored in the 80-89 percent range (28.2 percent). For all respondents, the mean score on non-site selection items was 71.1. Again, the sample size was 244.

Thus, in answer to Research Question Two, knowledge levels among Shining Rock Wilderness campers concerning the selection of appropriate campsites were lower than their knowledge of other low-impact practices. A paired comparisons t-test indicated that this difference was indeed significant (Figure 6; $N = 244$, $t = 19.429$, $p < .0001$). As expected, respondents had a significantly higher level of knowledge on those subjects not relating to the selection of wilderness campsites.

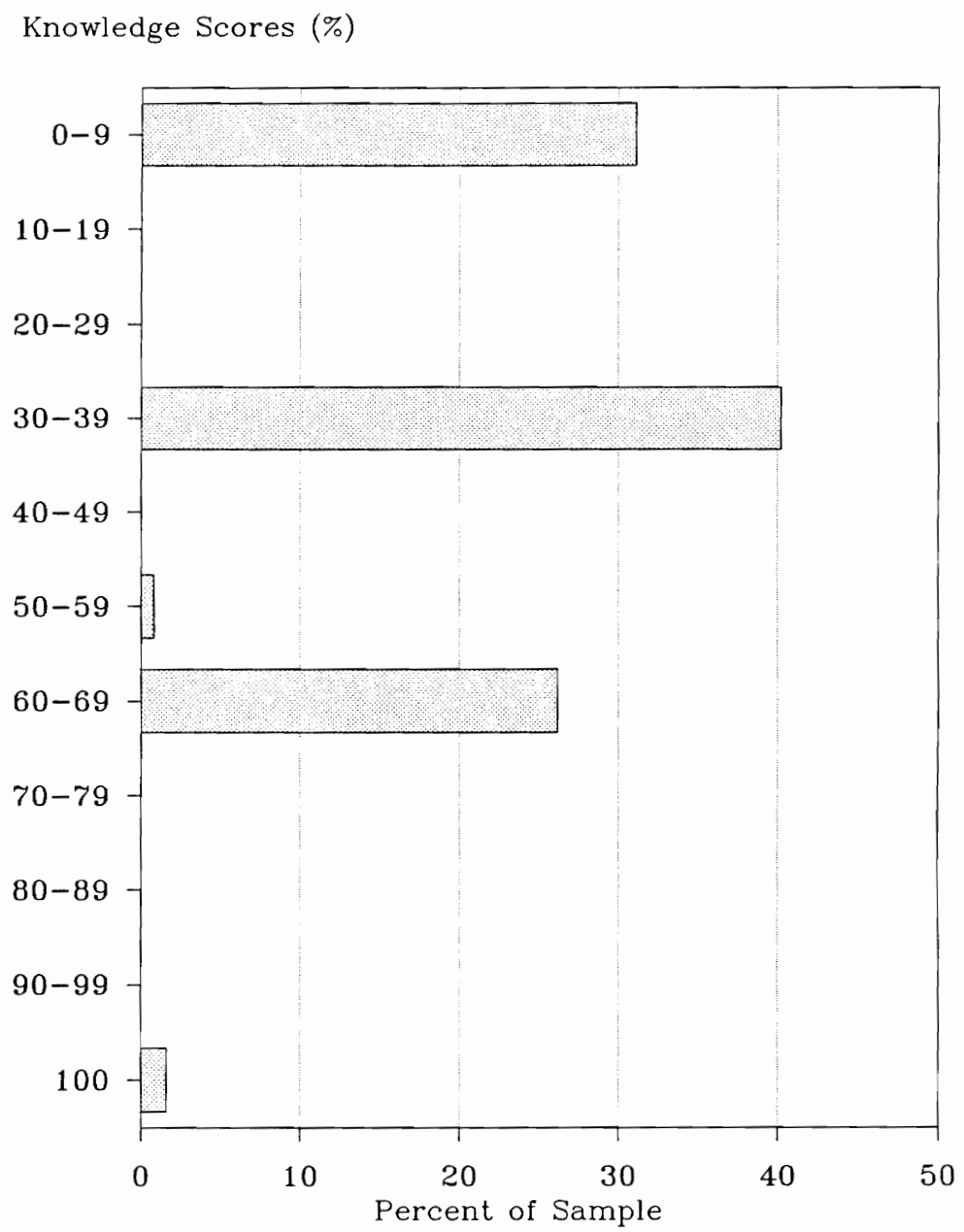

Figure 4. Distribution of scores on knowledge relating to the selection of appropriate campsites (N=244, mean=32.9).

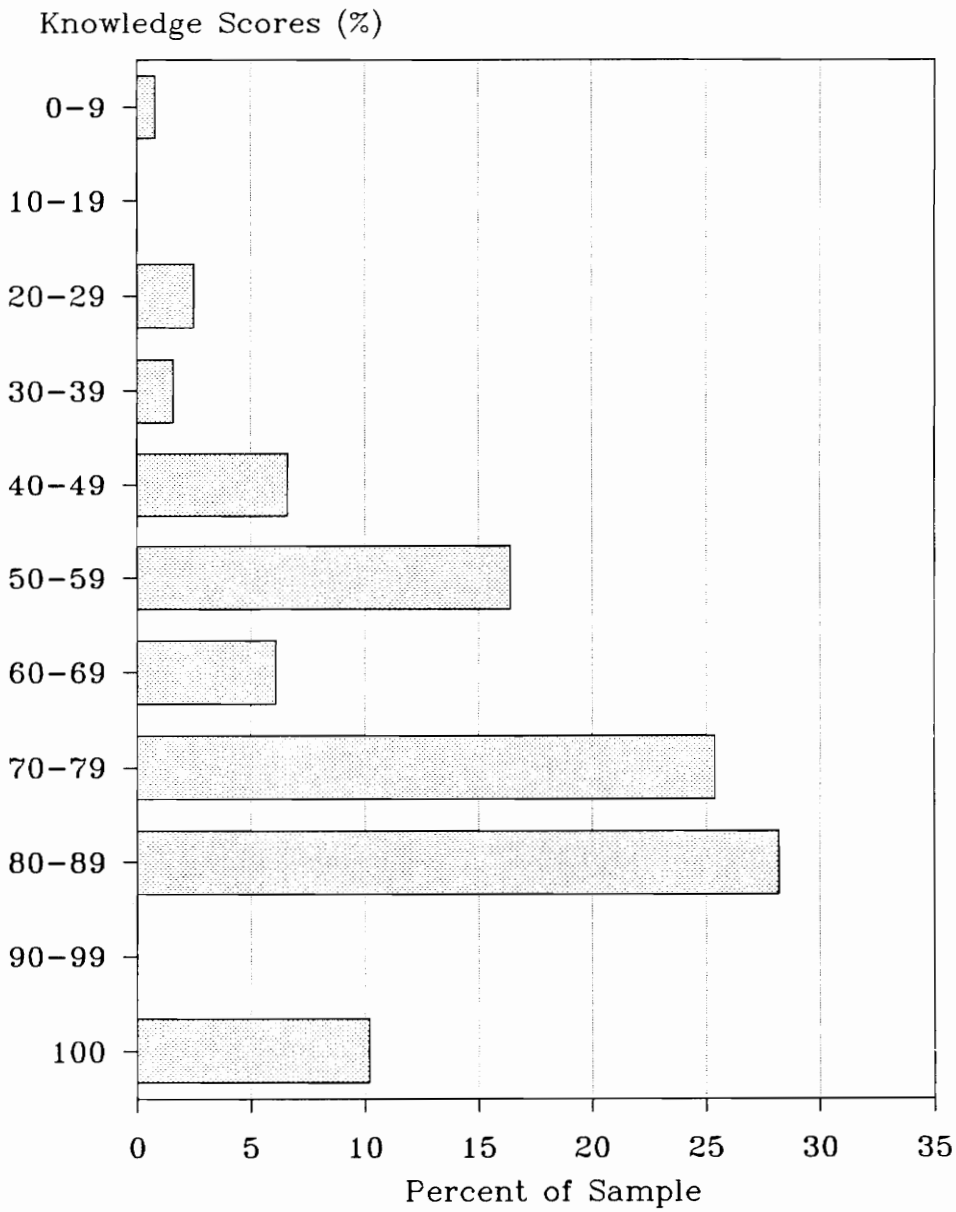

Figure 5. Distribution of scores on knowledge relating to subjects other than site selection (N=244, mean=71.1).

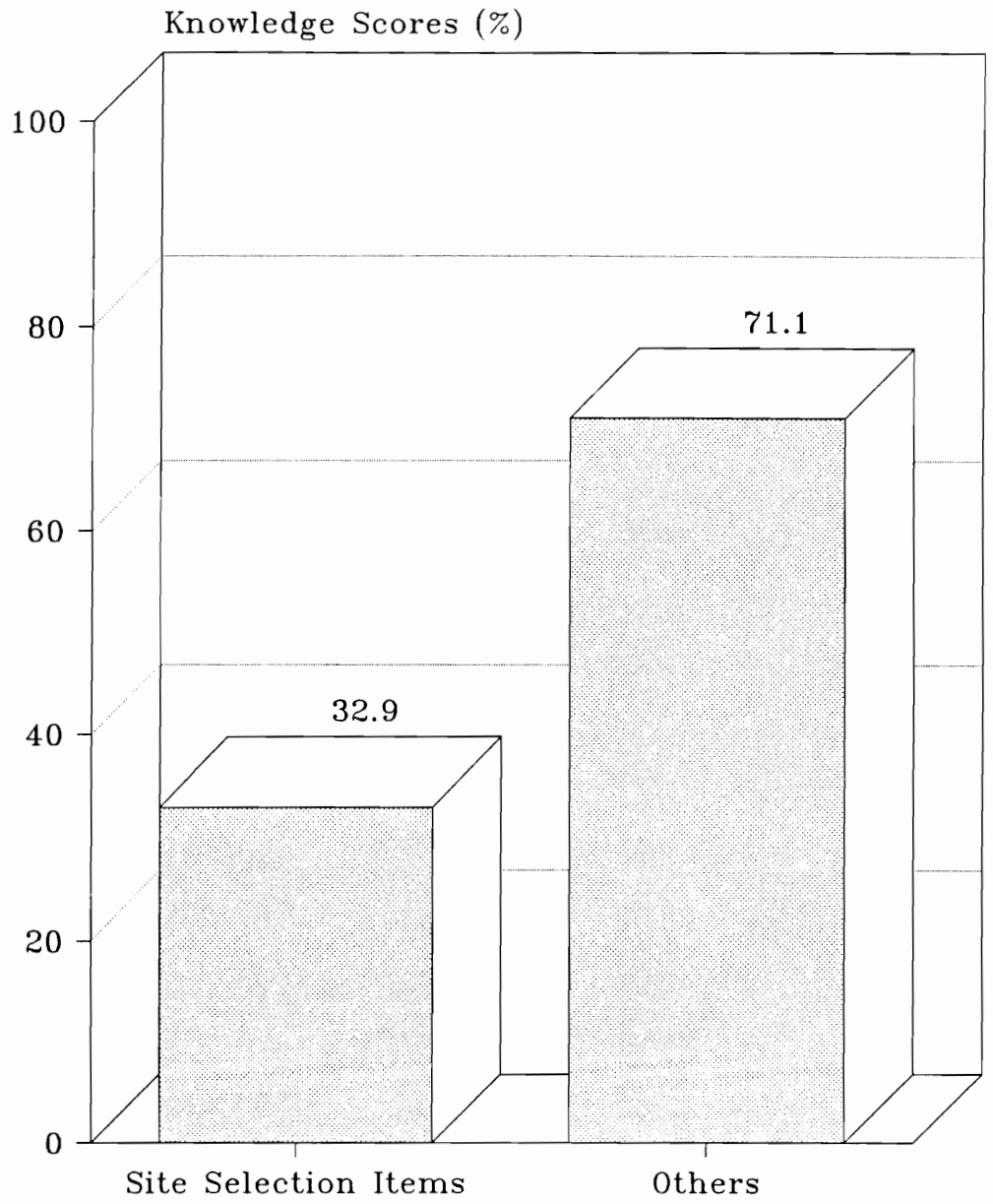

Figure 6. Mean scores on low-impact knowledge test: site selection items vs. others (different at $p<.0001$).

Effect of Education on Knowledge

There is not sufficient evidence to support the notion that clear, concise, educational signs, located at wilderness trailheads, will significantly increase wilderness users' knowledge of low-impact practices (Research Question Three). Figure 7 shows that, although overall knowledge scores were higher for the treatment group (mean = 61.1) than the control group (mean = 58.7), the difference was not significant ($t = 1.148$, $df = 242$, $p = .252$, $N = 244$).

Five of the knowledge quiz questions (e.g., Questions 3, 4, 6, 7, and 10 -- see Appendix A) contained subject matter treated in the educational signs; of these, only one had a significant relationship with the treatment (Table 2). A chi-square analysis indicated that question ten, which concerned the selection of appropriate places to camp (unlike the other two site selection items, this question did not ask the respondent to answer in the context of whether the area was heavily or lightly used), had a significant relationship at the .05 level with the treatment (Table 2). The relationship was fairly weak, however, as evidenced by the Kendall's tau statistic of .153. As is the case with all 2 x 2 chi-square models, the degrees of freedom for this table is one.

The other four knowledge questions which were relevant to the educational signs did not have a significant relationship with the treatment at the .05 probability level. Question 3, which addressed campsite selection in heavily used wilderness zones, produced the following statistics for the chi-square model when tested against treatment: chi-square = 1.066, $p = .302$ (Table 3). Question four concerned campsite selection in lightly used wilderness zones. When tested against the treatment, the model revealed that chi-square = .450, $p = .502$ (Table 4). When comparing the treatment with question six, which addressed tent placement, results indicated that chi-square = .568, $p = .451$ (Table 5). Finally, question seven, which concerned the damaging effects of campfires,

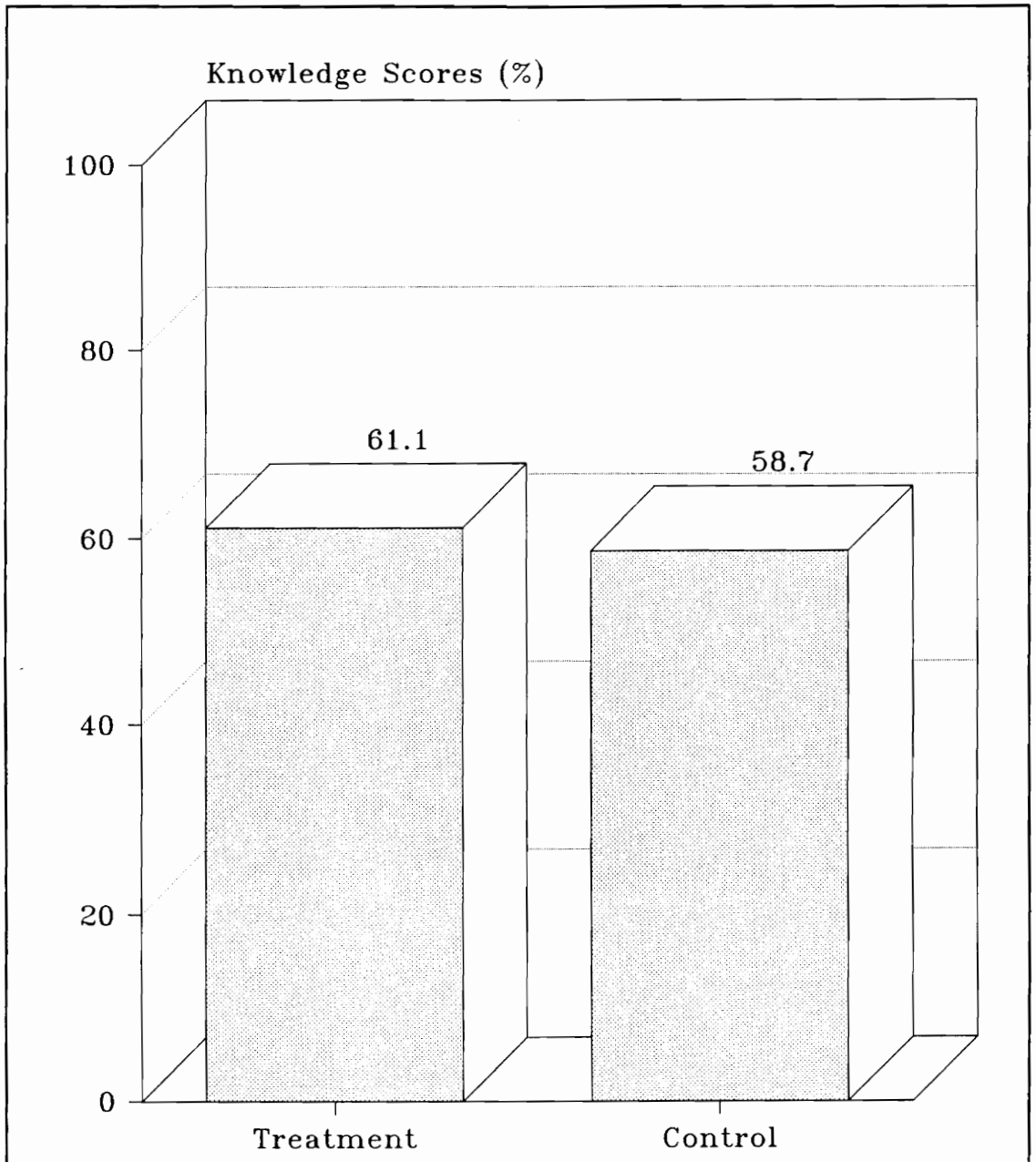

Figure 7. Mean scores on low-impact knowledge test: treatment vs. control (no difference: p=.2523).

Table 2. A chi-square test for the effect of treatment - educational trailhead signs - on increasing wilderness users' knowledge of appropriate places to camp.

	Treatment N (col. %)	Control N (col. %)	Row Totals N (%)
Correct Response	46 (45.5)	41 (30.6)	87 (37.0)
Incorrect Response	55 (54.5)	93 (69.4)	148 (63.0)
Column Totals	101 (43.0)	134 (57.0)	N=235

Chi-square=5.519, p=.019, Kendall's tau=.153

Table 3. A chi-square test for the effect of treatment - educational trailhead signs - on increasing wilderness users' knowledge of appropriate campsite selection in heavily used wilderness zones.

	Treatment	Control	Row Totals
	N (col. %)	N (col. %)	N (%)
Correct Response	53 (50.5)	60 (43.8)	113 (46.7)
Incorrect Response	52 (49.5)	77 (56.2)	129 (53.3)
Column Totals	105 (43.4)	137 (56.6)	N=242

Chi-square=1.066, p=.302

Table 4. A chi-square test for the effect of treatment - educational trailhead signs - on increasing wilderness users' knowledge of appropriate campsite selection in lightly used wilderness zones.

	Treatment	Control	Row Totals
	N (col. %)	N (col. %)	N (%)
Correct Response	15 (14.4)	24 (17.6)	39 (16.3)
Incorrect Response	89 (85.6)	112 (82.4)	201 (83.7)
Column Totals	104 (44.3)	136 (56.7)	N=240

Chi-square=.450, p=.502

Table 5. A chi-square test for the effect of treatment - educational trailhead signs - on increasing wilderness users' knowledge of appropriate tent placement.

	Treatment	Control	Row Totals
	N (col. %)	N (col. %)	N (%)
Correct Response	80 (76.9)	101 (72.7)	181 (74.5)
Incorrect Response	24 (23.1)	38 (27.3)	62 (25.5)
Column Totals	104 (42.8)	139 (57.2)	N=243

Chi-square=.568, p=.451

also had an insignificant relationship with the treatment: chi-square = .363, p = .547 (Table 6).

Those individuals who claimed to have seen the Forest Service brochure and those who said they had read the brochure both displayed a much higher level of knowledge of low-impact practices than those who did not. Respondents who said they had seen the brochure scored an average of 65.4 on the knowledge test; those who had not seen the brochure scored a 54.2 (Figure 8). The mean knowledge score for the respondents who said they had read the brochure was 66.6, whereas those who had not read it received a mean score of 56.1 (Figure 9). Direct causality between brochure information and knowledge levels can not be drawn, however, due to the lack of an experimental design for this portion of the reported study. The author could not control the distribution of the brochure; the population of respondents who read it was not a random sample. Therefore, perhaps only wilderness visitors who were highly knowledgeable about low-impact practices sought out and read the brochure. Nevertheless, the brochure seems helpful, and a more controlled study is needed to further verify the effectiveness of this particular educational intervention.

Behavioral Intention

Evidence in response to Research Question Four, which asked whether low-impact educational signs (the treatment) will strengthen wilderness users' intentions to select an appropriate campsite, is inconclusive. The chi-square model in Table 7 shows that the treatment did not have a significant effect upon users' intentions to select an appropriate campsite in a heavily used wilderness zone (chi-square = 1.714, p = .191). The treatment also did not significantly affect campers intentions to select an appropriate site in a lightly used wilderness zone (Table 8; chi-square = .040, p = .841). The treatment did,

Table 6. A chi-square test for the effect of treatment - educational trailhead signs - on increasing wilderness users' knowledge of the damaging effects of campfires.

	Treatment N (col. %)	Control N (col. %)	Row Totals N (%)
Correct Response	18 (18.0)	15 (14.9)	33 (16.4)
Incorrect Response	82 (82.0)	86 (85.1)	168 (83.6)
Column Totals	100 (49.8)	101 (50.2)	N=201

Chi-square=.363, p=.547

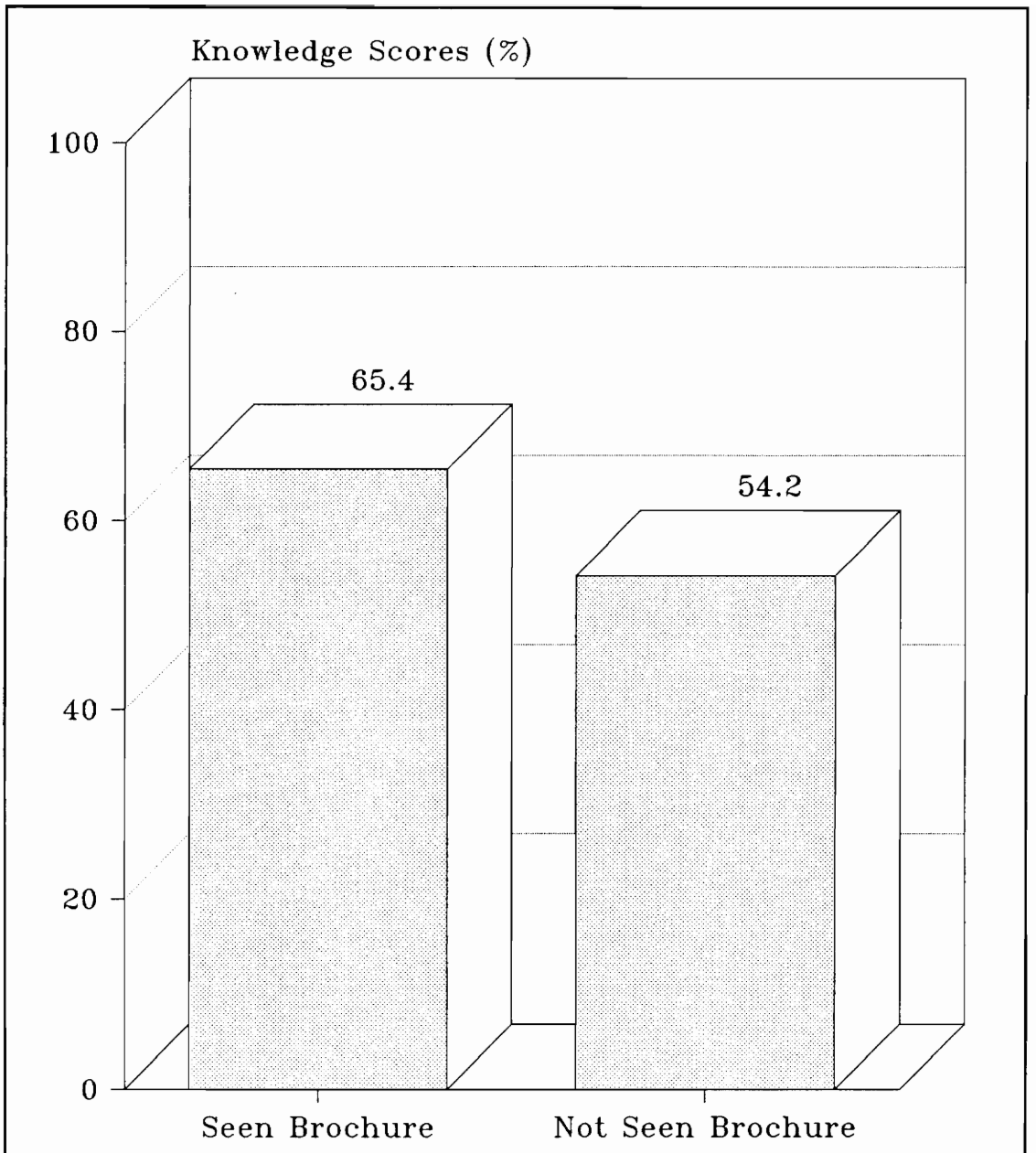

Figure 8. Mean scores on low-impact knowledge test: seen brochure vs. not seen brochure.

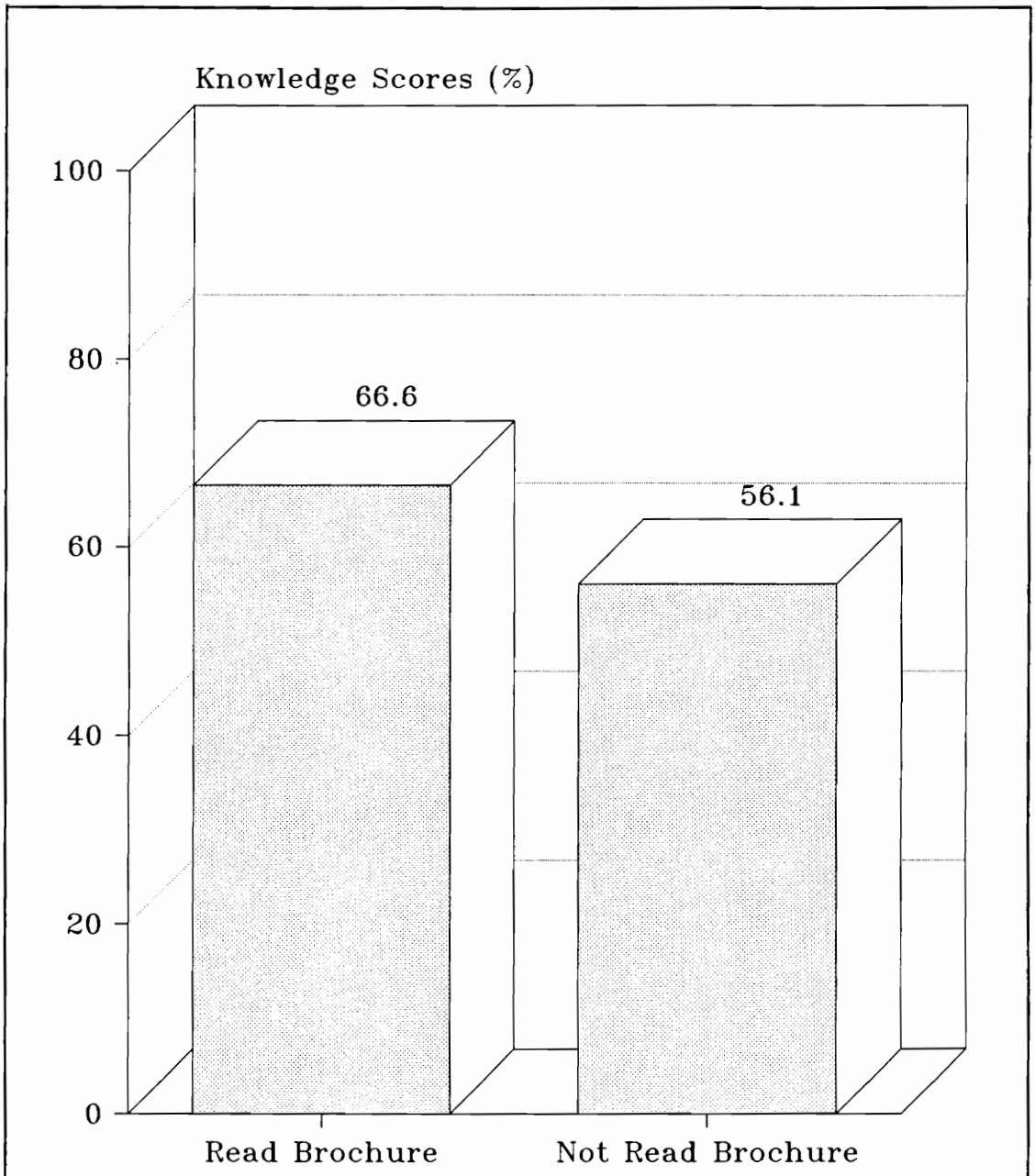

Figure 9. Mean scores on low-impact knowledge test: read brochure vs. not read brochure.

Table 7. A chi-square test for the effect of treatment - educational trailhead signs - on improving wilderness users' intentions to select an appropriate campsite in a heavily used wilderness zone.

	Treatment N (col. %)	Control N (col. %)	Row Totals N (%)
Appropriate Intention	51 (48.6)	42 (39.6)	93 (44.1)
Inappropriate Intention	54 (51.4)	64 (60.4)	118 (55.9)
Column Totals	105 (49.8)	106 (50.2)	N=211

Chi-square=1.714, p=.191

Table 8. A chi-square test for the effect of treatment - educational trailhead signs - on improving wilderness users' intentions to select an appropriate campsite in a lightly used wilderness zone.

	Treatment N (col. %)	Control N (col. %)	Row Totals N (%)
Appropriate Intention	43 (42.2)	42 (40.8)	85 (41.5)
Inappropriate Intention	59 (57.8)	61 (59.2)	120 (58.5)
Column Totals	102 (49.8)	103 (50.2)	N=205

Chi-square=.040, p=.841

however, have a significant effect on the first measure of behavioral intention (Table 9). This was the question in which subjects were asked to choose the picture of the site in which they would most like to camp. The question made no mention of answering in the context of reducing impacts, nor did it specify how frequently used the depicted wilderness area was (see Appendix B). Answers to this question were recoded as if the moderately/well impacted site was the appropriate response.[8] As evidenced by the chi-square model in Table 9, the effect of treatment on behavioral intention was significant beyond the .001 level (chi-square = 12.222, $p < .001$). The strength of the relationship was moderate (Kendall's tau = .241). In this case, then, the posters helped foster appropriate low-impact intentions.

Behavior

There are mixed results regarding research question number five; certain behaviors were significantly affected by the educational trailhead signs, others were not.

The selection of appropriate wilderness campsites was not significantly affected by the treatment. Of the 43 campsites in the Shining Rock Gap and Flower Gap areas, seven (16.3 percent) were classified as pristine, 19 (44.2 percent) were classified as lightly impacted, 14 (32.6 percent) were moderately impacted, and three (6.9 percent) were severely impacted. Each of these campsites was coded as an appropriate or an inappropriate place to camp.[9] Thus, 32.6 percent of the campsites were considered appropriate

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[8] This answer was judged correct because Cole (1989) and Cole and Benedict (1983) recommended that campers use this type of site where possible.

[9] Since the study areas are heavily used zones of Shining Rock Wilderness, moderately/well impacted sites were considered appropriate camping spots; all others were considered inappropriate.

Table 9. A chi-square test for the effect of treatment - educational trailhead signs - on improving wilderness users' intentions to select an appropriate campsite.

	Treatment N (col. %)	Control N (col. %)	Row Totals N (%)
Appropriate Intention	42 (40.0)	19 (18.1)	61 (29.0)
Inappropriate Intention	63 (60.0)	86 (81.9)	149 (71.0)
Column Totals	105 (50.0)	105 (50.0)	N=210

Chi-square=12.222, p<.001, Kendall's tau=.241

places to camp. Campers chose these moderately/well impacted sites 49 percent of the time. The chi-square analysis used to test the relationship between appropriate/inappropriate site selection and the treatment is displayed in Table 10. This relationship was insignificant at the .05 level (Table 10; chi-square = .735, p = .391).

Similarly, the treatment did not improve behavior concerning tent placement. Indeed, the chi-square model suggests that the treatment had a significant effect in the wrong direction. The trailhead posters urged wilderness campers to place their tent on the previously impacted area of the campsite -- this is considered appropriate behavior. As Table 11 shows, those individuals who received the treatment were significantly *less* likely to have behaved appropriately by placing their tent on the previously impacted portion of the site. The model was significant at the .05 level (chi-square = 4.043, p = .044), but the relationship was weak (Kendall's tau = -.161).

In eliciting appropriate behavior regarding wilderness campfires, the educational trailhead signs had a highly positive effect. The treatment contained a message urging campers not to build a fire. Behavior observers first determined whether or not campers had a campfire at the time of contact. A chi-square test indicated that the treatment had a significant effect at the .05 level on this variable (Table 12; chi-square = 5.144, p = .023, Kendall's tau = .180). Approximately 82 percent of the individuals approached by observers under treatment conditions did not have a campfire (e.g., appropriate behavior) at the time of contact, whereas only 66.3 percent of the campers under control were behaving appropriately (Table 12). Observers then recorded whether or not wilderness campers appeared to have previously had a campfire (this was determined using the parameters discussed in Chapter Four). This variable was significantly affected by the treatment at the .01 level (Table 13; chi-square = 7.155, p = .007). About 87 percent of the users who received the treatment appeared not to have had a campfire earlier in their stay, while only 67.7 percent of the individuals under control behaved appropri-

Table 10. A chi-square test for the effect of treatment - educational trailhead signs - on improving wilderness users' behavior to select an appropriate campsite.

	Treatment N (col. %)	Control N (col. %)	Row Totals N (%)
Appropriate Behavior	37 (52.9)	40 (46.0)	77 (49.0)
Inappropriate Behavior	33 (47.1)	47 (54.0)	80 (51.0)
Column Totals	70 (44.6)	87 (55.4)	N=157

Chi-square=.735, p=.391

Table 11. A chi-square test for the effect of treatment - educational trailhead signs - on improving wilderness users' behavior to select an appropriate tent location.

	Treatment	Control	Row Totals
	N (col. %)	N (col. %)	N (%)
Appropriate Behavior	37 (52.9)	59 (68.6)	96 (61.5)
Inappropriate Behavior	33 (47.1)	27 (31.4)	60 (38.5)
Column Totals	70 (44.9)	86 (55.1)	N=156

Chi-square=4.043, p=.044, Kendall's tau=-.161

Table 12. A chi-square test for the effect of treatment - educational trailhead signs - on improving wilderness users' behavior to limit the use of present campfires.

	Treatment N (col. %)	Control N (col. %)	Row Totals N (%)
Appropriate Behavior	60 (82.2)	57 (66.3)	117 (73.6)
Inappropriate Behavior	13 (17.8)	29 (33.7)	42 (26.4)
Column Totals	73 (45.9)	86 (54.1)	N=159

Chi-square=5.144, p=.023, Kendall's tau=.180

Table 13. A chi-square test for the effect of treatment - educational trailhead signs - on improving wilderness users' behavior on limiting the use of previous campfires.

	Treatment	Control	Row Totals
	N (col. %)	N (col. %)	N (%)
Appropriate Behavior	55 (87.3)	46 (67.7)	101 (77.1)
Inappropriate Behavior	8 (12.7)	22 (32.3)	30 (22.9)
Column Totals	63 (48.1)	68 (51.9)	N=131

Chi-square=7.155, p=.007, Kendall's tau=.234

ately (Table 13). The strength of this relationship was moderate (Kendall's tau = .234). Finally, observers determined if campers were planning to have a fire at a later time (again, this was determined using indicators mentioned in Chapter Four of this report). Even though 50 percent of the users under treatment gave indications of behaving appropriately, while only 37.5 percent under control did so, this relationship was not significant at the .05 level (Table 14; chi-square = 1.90, p = .168).

Perhaps the most revealing test of the effect of treatment on fire building behavior would be a composite variable which encompasses the above three observed behaviors. If a group did not have a fire at the time of contact **and** they did not have a fire prior to the contact **and** they were not making preparations to have a fire sometime in the future, it could be said with a greater degree of reliability that these individuals did not exhibit fire building behavior during their stay in the study area. A composite variable was created, therefore, which was coded as "no fire" only if all three of the above fire variables were negative. The effect of the educational treatment on this composite variable was then tested. Table 15 indicates that the educational trailhead signs did have a positive significant effect at the .05 level on the composite fire building variable (chi-square = 5.807, p = .016, Kendall's tau = .191). In other words, those individuals who viewed the trailhead signs were significantly more likely to have not had a campfire at the time of the behavior observation, prior to the observation, and after the observation. Approximately 53 percent of the campers who received the treatment behaved appropriately with respect to overall fire building, whereas only 34.5 percent of individuals under control conditions behaved appropriately (Table 15).

Table 14. A chi-square test for the effect of treatment - educational trailhead signs - on improving wilderness users' behavior to limit the use of future campfires.

	Treatment	Control	Row Totals
	N (col. %)	N (col. %)	N (%)
Appropriate Behavior	28 (50.0)	24 (37.5)	52 (43.3)
Inappropriate Behavior	28 (50.0)	40 (62.5)	68 (56.7)
Column Totals	56 (46.7)	64 (53.3)	N=120

Chi-square=1.90, p=.168

Table 15. A chi-square test for the effect of treatment - educational trailhead signs - on improving wilderness users' behavior to limit the use of past, present, and future campfires.

	Treatment	Control	Row Totals
	N (col. %)	N (col. %)	N (%)
Appropriate Behavior	39 (53.4)	30 (34.5)	69 (43.1)
Inappropriate Behavior	34 (46.6)	57 (65.5)	91 (56.9)
Column Totals	73 (45.6)	87 (54.4)	N=160

Chi-square=5.807, p=.016, Kendall's tau=.191

Knowledge, Behavioral Intention, and Behavior

There is evidence to support the contention that knowledge of low-impact practices relates to wilderness users' intentions to act in a low-impacting fashion (Research Question Six), but there are also some results to the contrary. Figure 10 depicts the comparison between overall low-impact knowledge among subjects who displayed intentions to select an appropriate campsite in a heavily used wilderness zone (mean knowledge = 62.7) and overall low-impact knowledge of subjects who displayed intentions to select an inappropriate site in the same zone (mean knowledge = 56.6). The difference between these two groups was significant at the .01 level ($t = -2.786$, $df = 209$, $p = .0058$, $N = 211$). The difference between overall knowledge of individuals who displayed intentions to select an appropriate campsite in a lightly used wilderness zone (mean knowledge = 61.1) with knowledge levels among campers who displayed intentions to select an inappropriate site in the same zone (mean knowledge = 57.9) was not as great (Figure 11). Although those campers who exhibited the correct intention in this case displayed higher levels of knowledge, this difference was not statistically significant ($t = -1.399$, $df = 203$, $p = .1631$, $N = 205$).

More evidence in support of the relationship between knowledge and intention arises when comparing specific knowledge items with campers' intentions to select appropriate campsites. A chi-square analysis indicated that knowledge question three, which concerned the selection of campsites in a heavily used wilderness zone, had a significant relationship at the .001 level with subjects' intentions to select an appropriate site in a heavily used wilderness zone (Table 16; chi-square = 35.901, $p < .001$). In other words, respondents who knew which site was the least impacting place to camp in a heavily used zone usually intended to stay in this same type of site. The Kendall's tau measure of association suggests the relationship between knowledge and behavioral in-

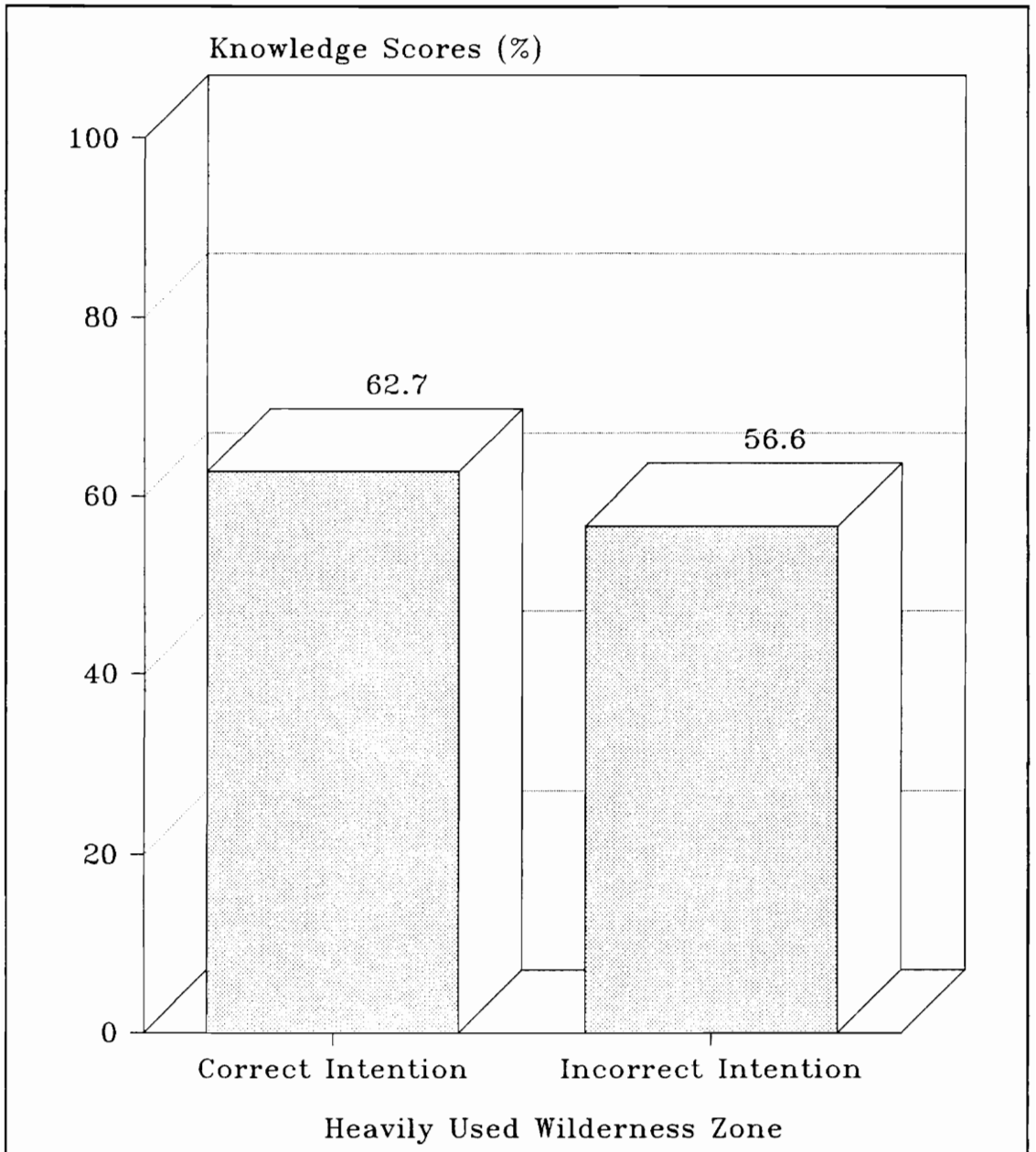

Figure 10. Mean scores on low-impact knowledge test: correct intention vs. incorrect intention (different at p=.0058).

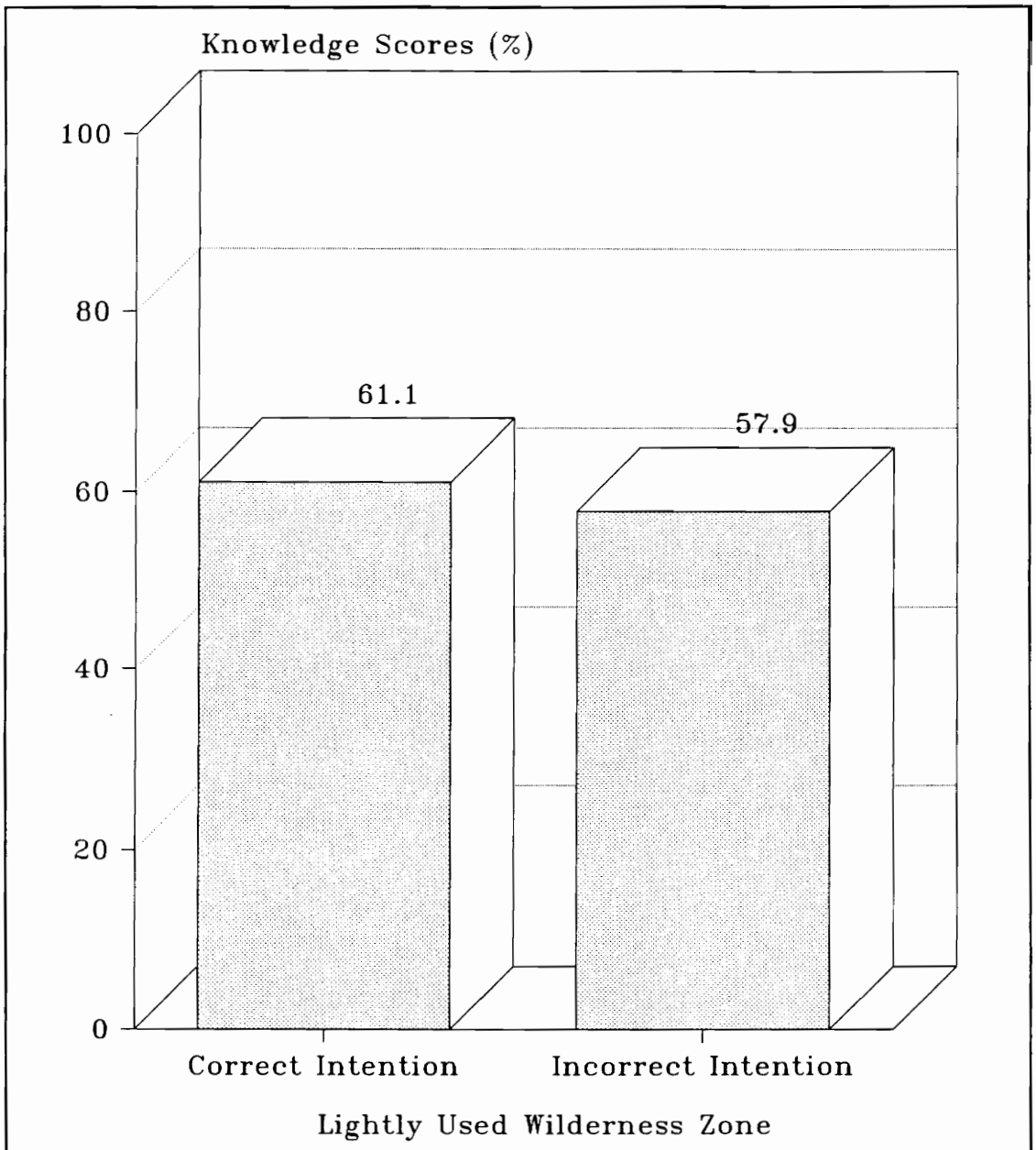

Figure 11. Mean scores on low-impact knowledge test: correct intention vs. incorrect intention (no difference: p=.1631).

Table 16. A chi-square test for the effect of knowledge of appropriate campsite selection in heavily used wilderness zones on subjects' behavioral intentions to select an appropriate campsite in a heavily used wilderness zone.

	Correct Response	Incorrect Response	Row Totals
	N (col. %)	N (col. %)	N (%)
Appropriate Intention	64 (66.7)	29 (25.4)	93 (44.3)
Inappropriate Intention	32 (33.3)	85 (74.6)	117 (55.7)
Column Totals	96 (45.7)	114 (54.3)	N=210

Chi-square=35.901, p<.001, Kendall's tau=.413

tention in this instance was moderately strong (.413; Table 16). Similarly, there was a significant relationship between low-impact knowledge concerning the selection of appropriate places to camp in a lightly used wilderness zone -- knowledge question number four -- and subjects' intentions to camp in an appropriate site in the same zone (Table 17). As the chi-square model in Table 17 indicates, the effect of knowledge on behavioral intention was again highly significant (chi-square = 13.434, $p < .001$). The strength of this relationship was moderate (Kendall's tau = .257). The general knowledge question relating to site selection (Question 10, which made no mention of heavily or lightly used wilderness zones) also had a significant relationship with behavioral intention (Table 18). This knowledge question was compared with the first behavioral intention item in which no mention was made of answering the question in terms of reducing impacts or of heavily or lightly used zones (also a more general question). Table 18 indicates that this relationship was significant at the .05 level (chi-square = 4.569, $p = .033$). The strength of the relationship in this instance, however, was fairly weak (Kendall's tau = .151).

Very few camping parties in Shining Rock Wilderness who were contacted at the trailhead, where they were given the knowledge and behavioral intention tests, were also located and observed in the backcountry. Due to this low sample size ($N = 30$), statistical inference tests on this population could not be conducted with a reasonable degree of confidence. Therefore only mean scores and Pearson's and Kendall's tau correlation coefficients were computed on this particular data set. It cannot be said, then, that these results represent findings for the entire population of Shining Rock Wilderness campers, nor can these results be used to adequately answer research questions seven or eight.

Figure 12 represents the relationship between overall mean knowledge and each of the behavior variables. Of the six behavior variables, four had a positive relationship with knowledge. Figure 12 shows that campers who exhibited appropriate behavior

Table 17. A chi-square test for the effect of knowledge of appropriate campsite selection in lightly used wilderness zones on subjects' behavioral intentions to select an appropriate campsite in a lightly used wilderness zone.

	Correct Response N (col. %)	Incorrect Response N (col. %)	Row Totals N (%)
Appropriate Intention	21 (72.4)	63 (36.2)	84 (41.4)
Inappropriate Intention	8 (27.6)	111 (63.8)	119 (58.6)
Column Totals	29 (14.3)	174 (85.7)	N=203

Chi-square=13.434, p<.001, Kendall's tau=.257

Table 18. A chi-square test for the effect of knowledge of appropriate campsite selection on subjects' behavioral intentions to select an appropriate campsite.

	Correct Response	Incorrect Response	Row Totals
	N (col. %)	N (col. %)	N (%)
Appropriate Intention	29 (38.2)	30 (24.0)	59 (29.4)
Inappropriate Intention	47 (61.8)	95 (76.0)	142 (70.6)
Column Totals	76 (37.8)	125 (62.2)	N=201

Chi-square=4.569, p=.033, Kendall's tau=.151

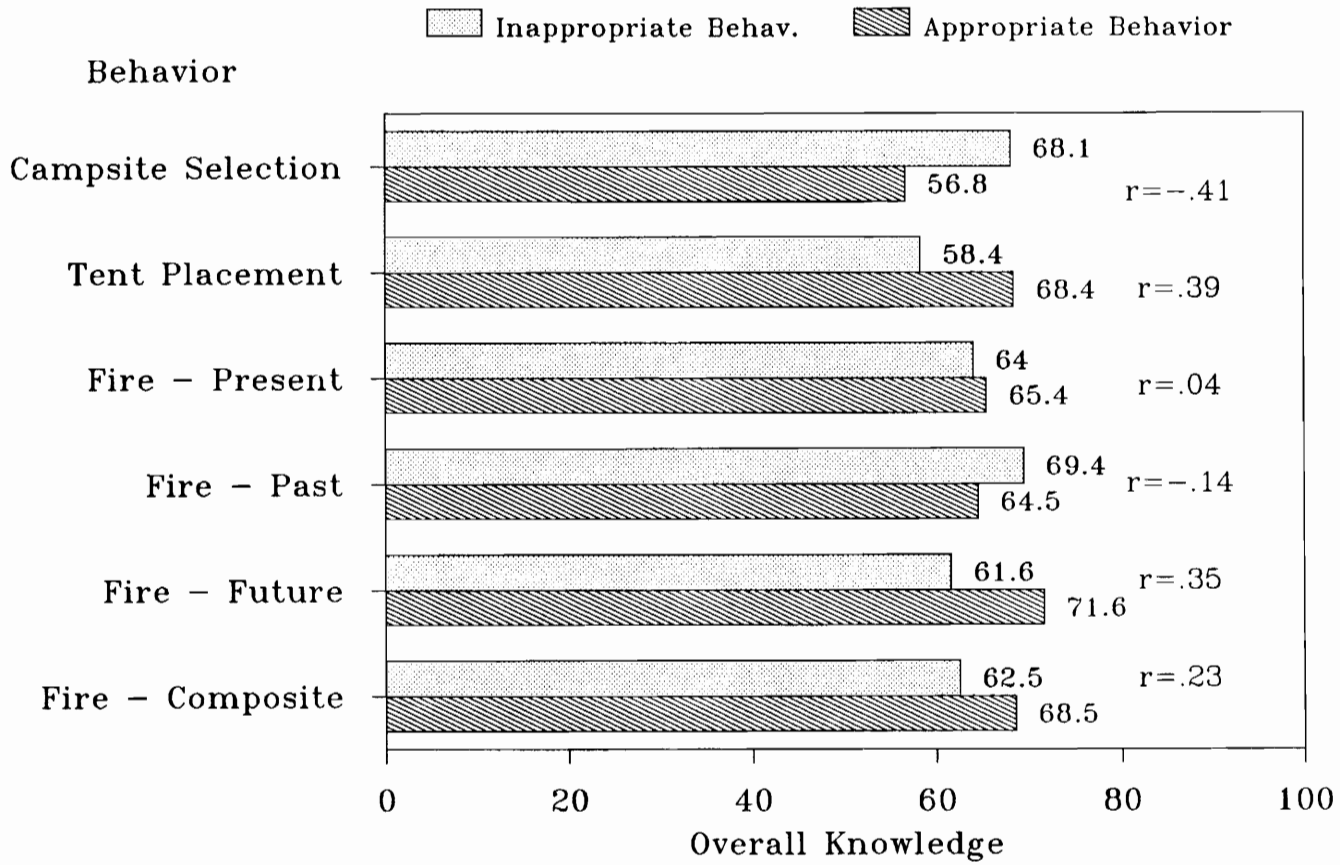

Figure 12. Relationship between overall knowledge and behavior.

concerning tent placement scored ten percent better on the knowledge test. The Pearson's correlation coefficient for this relationship was r = .39. Those displaying appropriate behavior concerning the existence of a campfire at the time of contact scored 1.4 percent better in knowledge than those exhibiting inappropriate behavior (Figure 12; r = .04). Campers exhibiting appropriate behavior regarding the existence of future campfires scored ten percent better than users behaving inappropriately (Figure 12; r = .35). Figure 12 shows the difference between knowledge levels to be six percent on the composite fire variable, with those individuals behaving appropriately scoring higher (r = .23).

On two of the behavior variables, selection of appropriate campsites and the existence of previous campfires, campers who behaved appropriately scored worse on their knowledge test than those exhibiting inappropriate behavior. The difference in knowledge scores in the campsite selection variable was 11.3 percent (Figure 12; r = -.41). The difference in the previous campfire variable was 4.9 percent (Figure 12; r = -.14)

Kendall's tau correlation coefficients were used to determine the relationship between behavior and individual knowledge items. Of the six studied behavior variables, five had a positive correlation with their corresponding specific knowledge items. The relationship between knowledge and behavior regarding tent placement generated the following statistic: Kendall's tau = .33. The correlation between knowledge and behavior concerning the presence of current campfires was a Kendall's tau of .20. Correlating the past campfire variable and specific knowledge showed that Kendall's tau = .20. The relationship between the future campfire variable and knowledge was fairly strong: Kendall's tau = .54. Finally, the correlation between the composite fire variable and knowledge was moderately strong: Kendall's tau = .41.

Again, the behavior variable which was negatively correlated with knowledge was campsite selection. The Kendall's tau coefficient correlating behavior concerning site selection and knowledge of site selection was -.17.[10]

Subjects' behavioral intentions to select an appropriate campsite in a heavily used wilderness zone were compared to their behavior to choose an appropriate campsite in such a zone. The correlation was negative: Kendall's tau = -.27. When comparing campsite selection behavior with the more general behavioral intention item, where no mention was made of answering the question in the context of reducing impacts or of how frequently used the depicted wilderness area was, the correlation was positive: Kendall's tau = .17.

Past Experience

One-way analysis of variance and simple linear regression determined that none of the seven EUH variables from the Shining Rock Wilderness Study had a significant effect on knowledge at the .05 level. This suggests that the EUH variables considered alone do not explain enough of the variance in knowledge to have a significant effect. Because EUH is likely a multidimensional construct, it was decided to further analyze the relationship between past experience and knowledge using the typology method discussed in Chapter Four of this report.

Table 19 depicts Shining Rock Wilderness EUH items, the three factors found by the factor analysis, each item's factor loadings, and the amount of variance explained

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[10] The knowledge item used in this correlation was the question testing campers' knowledge of campsite selection in a heavily used wilderness zone. The study areas, Shining Rock Gap and Flower Gap, are heavily used zones of Shining Rock Wilderness. It would not make sense to correlate knowledge of site selection in a lightly used zone with behavior in a heavily used zone.

Table 19. Items and factor loadings of the experience use history scale in Shining Rock Wilderness.[a]

Variables	Factor Loadings		
	Factor 1	Factor 2	Factor 3
Years since first visit to Shining Rock.	.889	-.072	.123
Number of previous visits to Shining Rock.	.795	-.007	.412
Years since first visited any other wilderness.	.787	.154	-.316
Total number of other wilderness areas visited.	.244	.826	-.264
Number of visits to any other wilderness in past twelve months.	-.104	.769	.206
Number of visits to Shining Rock in past twelve months.	.157	-.038	.803
Typical number of visits per year to any wilderness.	-.123	.541	.598
Variance explained by each factor (eigenvalue).	2.151	1.596	1.400

[a] Factor analysis used was principal factor with iteration and orthogonal varimax rotation.

by each factor. "Years since first visit to Shining Rock" was chosen to represent factor 1 because it loads most highly on this EUH dimension (Table 19; factor loading = .889). Factor 2 can be represented by "Total number of other wilderness areas visited", since it loads most highly on this dimension at .826. Finally, "Number of visits to Shining Rock in past twelve months" loads most highly on factor 3 at .803 and is therefore considered the best indicator of this factor (Table 19). Thus, the analysis has uncovered three unique experience dimensions, each with highly loaded items which can serve to represent the distinct dimensions of the EUH construct.

Research question nine asked whether experience use history helps predict knowledge. Table 20 indicates that the ANOVA test was significant at the .05 level -- there appears to be a relationship between EUH and low-impact knowledge ($F = 2.08$, $p = .048$). Determining the exact nature of this relationship, however, is difficult. Table 20 shows the sample size, mean, and standard deviation of low-impact knowledge for each of the typology categories. This table also shows the results of Fisher's Least Significant Difference (LSD) comparison test. This test indicates three typology groupings in which the EUH types within the groups do not differ from each other at the .05 level: {HLH, LHH, LLH, HHL, HHH, HLL}, {LHH, LLH, HHL, HHH, HLL, LHL}, and {HLL, LHL, LLL}.

The statistical test for differences among the three typology groupings is, however, unclear due to overlap in knowledge scores among the three groups (Table 20). Therefore, it becomes necessary to look at individual pair-wise differences among the EUH types. When this is done, it becomes clear that the group with the lowest experience (e.g., the "Low Low Low" group) has a significantly lower knowledge score (52.9%) than did the group with the highest prior wilderness experience (e.g., the "High High High" group, with a knowledge score of 62.4%). The "Low Low Low" group also has significantly lower knowledge than does any of the EUH groups with high experience

Table 20. One way analysis of variance to test for the relationship between experience use history and overall low-impact knowledge.[a]

Typology				Overall Knowledge		
X_1	X_2	X_3[b]	LSD Groups	N	Mean	Standard Deviation
H	L	H[c]		25	66.6	15.8
L	L	H		17	66.0	13.9
L	H	H		13	65.8	10.5
H	H	H		32	62.4	13.8
H	H	L		26	61.8	16.0
H	L	L		12	62.6	13.3
L	H	L		34	58.0	14.8
L	L	L		23	52.9	19.6

[a] F-value=2.08, p=.048, df=7, 174

[b] X_1="Years since first visit to Shining Rock"
X_2="Total number of other wilderness areas visited"
X_3="Number of visits to Shining Rock in past twelve months"

[c] H=high experience
L=low experience

on two of the three experience dimensions. However, those groups with the highest experience were frequently not different in knowledge from those groups which were low in experience on two experience dimensions. For example, the LSD typology grouping with the highest knowledge scores included six EUH types, two of which were low on two of three wilderness experience categories. Therefore, the effect of past experience on knowledge of low-impact practices is not easily interpretable.

This study's educational treatment appears to have had no interactive effect with experience to influence knowledge (Research Question Ten). Table 21 indicates that the two factor ANOVA was not significant at the .05 level ($F = .29$, $p = .956$). Therefore, it does not appear from this analysis that knowledge gains resulting from an educational treatment among inexperienced wilderness users are any greater than knowledge gains among experienced users.

Table 21. Two factor analysis of variance to test for the interactive effect of an educational treatment and experience use history on overall low-impact knowledge.[a]

Typology				Overall Knowledge		
X_1	X_2	X_3[b]	Treatment[c]	N	Mean	Standard Deviation
H	H	H[d]	T	17	63.1	13.5
			C	15	61.6	14.6
H	L	H	T	7	67.1	15.0
			C	18	66.4	16.5
L	H	H	T	4	65.0	12.9
			C	9	66.2	10.1
H	H	L	T	11	64.3	17.9
			C	15	59.9	14.8
L	L	H	T	10	66.1	16.3
			C	7	65.9	10.8
H	L	L	T	4	66.4	10.9
			C	8	60.7	14.7
L	H	L	T	14	60.0	15.2
			C	20	56.7	14.8
L	L	L	T	12	50.0	19.1
			C	11	56.2	20.6

[a] Effect of interaction: F-value=.29, p=.956, df=7

[b] X_1="Years since first visit to Shining Rock"
X_2="Total number of other wilderness areas visited"
X_3="Number of visits to Shining Rock in past twelve months"

[c] T=treatment
C=control

[d] H=high experience
L=low experience

Chapter Six: Summary and Discussion

Low-Impact Knowledge

In response to Research Question One, overall knowledge of low-impact use practices was found to be fairly low among wilderness campers (mean = 59.7). This is probably due, in large part, to the evolving nature of low-impact recommendations. Respondents scored the lowest on those areas of knowledge which have evolved most dramatically over the years -- knowledge of campsite selection and knowledge of the destructiveness of wilderness campfires. On the other hand, respondents performed quite well on knowledge of appropriate trail use, an area of low-impact knowledge which is fairly intuitive and seems to have changed very little in recent decades.

Respondents scored over twice as high on knowledge relating to non-site selection items as they did on items relating to campsite selection. This great difference, which was highly significant, offers positive support for Research Question Two and is likely due to the confusing, conflicting, and complicated low-impact messages being received by wilderness users. Wilderness researchers have suggested differing views on appropriate campsite selection. National parks and national forests differ from unit to unit in their site selection recommendations. Even if wilderness users were receiving consistent messages concerning this important aspect of low-impact camping, the information they

must assimilate is complicated. People cannot always judge if a campsite is lightly or moderately impacted or if they are in a heavily or lightly used wilderness zone.

The educational trailhead signs had only a small effect on low-impact knowledge (Research Question Three). Four of the five knowledge items tested did not have a significant relationship with the treatment, nor did the treatment have a significant effect on overall knowledge. These results support other researchers (i.e., Fazio, 1979) who have found that trailhead signs are not sufficient by themselves to increase wilderness users knowledge of low-impact practices. Given that every effort was made to make the signs highly visible, concise, and explicit, their failure may be due to the fact that this type of communication medium is simply not powerful enough to raise the knowledge of a significant proportion of wilderness users. Of course, it is also possible that subjects did not see the signs, did not read the signs, or perhaps did not assimilate the signs' content.

Behavioral Intention

As with knowledge, the educational trailhead signs were of limited utility in effecting a change in behavioral intention (Research Question Four). Trailhead signs had a significant effect on one of the measures of behavioral intention, while the two others were unaffected. Again, rather than this ineffectiveness being the result of the content or location of the signs (the signs were obtrusive and their message content was clear and explicit), it is possible that trailhead signs in general are not an adequate means of strengthening behavioral intentions concerning low-impact practices. It is also possible that the behavioral intention under study, choosing appropriate wilderness campsites, is too complex a matter to be influenced by this type of educational intervention. Perhaps

trailhead signs would be more effective at influencing intentions which require fewer cognitive judgments, like limiting wilderness campfires.

Behavior

Research Question Number five asked whether educational signs can improve wilderness users' behavior concerning low-impact recreational practices. In this study, the signs effected a change in behavior concerning one of the three observed behaviors: campfire building. The treatment significantly reduced the existence of past and present campfires, but appeared to have no significant effect on the future campfire variable. The most important variable, nevertheless, is that which includes past **and** present **and** future campfires. This variable was significantly influenced by the treatment. Nearly twenty percent more individuals under treatment displayed appropriate behavior in regard to this composite campfire variable than did individuals under control.

The selection of appropriate wilderness campsites, on the other hand, was not influenced by the treatment. The chi-square test indicated no significant relationship between trailhead signs and site selection. In light of the confusing nature of low-impact recommendations concerning site selection, and the results in this study that indicate there are extremely low levels of knowledge concerning the selection of appropriate campsites, this finding is not surprising. This is a complex subject about which Shining Rock Wilderness campers know little; it is reasonable that it would take more than a trailhead sign to influence site selection behavior.

As with campsite selection, the treatment had no positive effect on tent placement. There is no plausible explanation as to why the treatment had a significant effect in the opposite direction than expected. It could be suggested that the educational signs had a reactive effect in which campers attempted to do the opposite of what was asked of

them. This scenario, however, is not likely. If one poster caused a reactive effect, the other two which were located on the same sign would probably have done the same. This did not happen. It is also possible that many campers never had the opportunity to behave appropriately regarding tent placement. Campsites classified as pristine and many classified as lightly impacted had no obvious spot which was impacted and thus appropriate for a tent. Therefore, it was a *fait accompli* that campers who chose these sites would behave inappropriately when placing their tent. This still does not explain, however, why there was a negative relationship between treatment and behavior. Hence, this relationship is most likely due to chance correlation and should be considered with skepticism.

The question must be asked, why did the educational trailhead signs have a positive effect on campfire building behavior but not on campsite selection or tent placement? Certainly the building of a campfire is the most discrete of these behaviors; one either builds a campfire or does not build a campfire. Both tent placement and site selection, however, can be interpreted in several ways. With tent placement, one must decide where the impacted area of the campsite is; this is not always easy, especially in meadow environments like Shining Rock Gap and Flower Gap. As stated earlier, site selection depends on whether one is in a heavily or lightly used zone of the wilderness, and the user must be able to identify sites that are in various stages of impact. Campfire building is very "black or white", but the various shades of grey associated with tent placement and site selection can obviously confuse the wilderness visitor. Thus, one of several scenarios probably occurred concerning the trailhead posters in Shining Rock Wilderness: either the campers refused to read and/or process the information pertaining to tent placement and site selection because it appeared to be too complex, or they processed the information but then failed to act appropriately because they were unclear as to what the appropriate behavior should be, or they simply chose to ignore the in-

formation because they were more interested in finding an aesthetically pleasing campsite and a level tent spot than they were in minimizing their impact on the environment. Regardless of which of these scenarios was more common, it appears that, based on the success of the "no fires" message, educational posters are more effective at influencing discrete behaviors which require few case-by-case judgments.

Knowledge, Behavioral Intention, and Behavior

Research question six asked whether knowledge predicts behavioral intention. There is fairly strong support indicating a positive relationship between wilderness users' knowledge of appropriate low-impact practices and their intentions to select an appropriate campsite. One of two t-tests employed suggests a relationship between overall knowledge and measures of behavioral intention, while all three chi-square models indicate that knowledge of appropriate campsite selection significantly affected users' intentions to select appropriate campsites. In some cases, measures of association showed these relationships to be fairly strong. These are important findings when taken in the context of Ajzen and Fishbein's (1980) *Theory of Reasoned Action*, which suggests that specific intentions are strong predictors of specific behaviors. The reported study supports the hypothesis that knowledge affects intentions; therefore, one should be able to influence behavior by raising knowledge levels.

Unfortunately, results correlating knowledge and behavioral intention with actual behavior cannot answer research questions seven and eight because of a low sample size. It would be a violation of statistical assumptions to attempt to generalize these results to the entire population of Shining Rock visitors. Nevertheless, correlation coefficients can be used to analyze the particular group of campers which was contacted at both the trailhead and in the backcountry.

Within the population of campers who were contacted at the trailhead (individuals who were given knowledge and behavioral intention tests) and whose behavior was also observed in the backcountry, there seems to be a positive relationship between low-impact knowledge and actual behavior. Four of the six studied behaviors correlated positively with overall low-impact knowledge, while five of the six behaviors correlated positively with their corresponding specific knowledge item. Again, this apparent link between knowledge and behavior suggests that increasing users' knowledge of a particular topic will improve their behavior concerning that subject.

One should note that, of the two behavior variables which had a negative relationship with overall knowledge, campsite selection was the most negatively correlated. Individuals who behaved inappropriately scored over ten percent better on their knowledge test than those who behaved appropriately. When comparing behavior to specific knowledge, campsite selection was the only behavior which correlated negatively with knowledge. Thus, in this group of campers, site selection is the one behavior which obviously does not have a positive relationship with low-impact knowledge. This serves to further highlight the confusing nature of site selection recommendations. While campers may be knowledgeable about appropriate campsite selection, they become confused when it is time to actually select a site, or the inverse, they may not know which site they are supposed to choose, but somehow end up selecting an appropriate one anyway.

Results comparing behavioral intention to behavior are inconclusive (Research Question Eight). One of the tested intention items correlated negatively, the other positively. Ajzen and Fishbein (1980) and Fishbein and Ajzen (1975) suggested that the correlation between specific intentions and specific behaviors should be high. The failure of the reported study to produce similar results is likely due to the design of this particular portion of the study. The test given at the trailhead measured the intentions of

specific individuals, whereas observers in the backcountry recorded group behavior. If the individual(s) contacted at the trailhead were not the party leaders, they may have had little say in where their party chose to camp. Hence, there would have been little or no opportunity for their intentions to have been manifested in actual behavior.

Past Experience

In response to Research Question Nine, results suggest there is a relationship between low-impact knowledge and previous experience visiting wilderness. Table 20 on page 81 shows that EUH had a significant effect on knowledge at the .05 level. It appears that individuals with low experience on all EUH dimensions have low knowledge. Beyond this, the EUH results are not easily interpretable and therefore inconclusive. Intuitively, one would guess that the more experience people have visiting wilderness, the more often they will be exposed to low-impact education programs. They therefore should likely have more knowledge, unless the content of educational messages is changing across time.

One other possible experience-knowledge relationship is suggested in Table 20 on page 81. Note that the two typology groupings with the lowest mean knowledge scores, LHL and LLL, both contain low EUH scores in the categories pertaining to experience visiting Shining Rock specifically (e.g., they are both "Low" in "Years since first visit to Shining Rock" and "Number of visits to Shining Rock in past twelve months"). Meanwhile, the typology group with the highest mean knowledge, HLH, contains high EUH scores in both Shining Rock categories. These typology categories, which fall into significantly different groupings, imply that something about visiting Shining Rock specifically, regardless of other areas visited, acts to increase one's low-impact knowledge. The system of low-impact education in place in Shining Rock -- perhaps the informa-

tional brochures and seasonal wilderness rangers -- may be a more effective educational intervention than that established in nearby wilderness areas where Shining Rock respondents would also likely have visited. It has already been mentioned that the low-impact information on the Shining Rock map/brochure was judged by experts to be of excellent quality. Perhaps the information on this brochure has been assimilated by Shining Rock Wilderness visitors over repeated visits, causing their low-impact knowledge to be greater than those who have not visited Shining Rock often or who have only visited other areas where the brochure does not exist. Of course, this is only speculation since the effectiveness of the USDA Forest Service education program in Shining Rock has not been evaluated, but further study of this topic could help answer the question of whether or not there is something uniquely effective about the low-impact educational program in Shining Rock Wilderness.

Krumpe and Brown (1982), Lucas (1981), and Roggenbuck and Berrier (1982) conducted studies which indicated that inexperienced users will be more receptive to educational efforts than experienced users, yet the study reported here failed to support this claim. Results indicate that inexperienced users are no more responsive to the low-impact educational intervention than experienced users (Research Question Ten). This discrepancy in findings may be due in part to the way in which EUH was analyzed in the reported study. An examination of Table 21 on page 83 reveals that the cell sizes of the two factor ANOVA are so small that the test had little statistical power. Also, this study had different content in its educational treatment than did Krumpe and Brown (1982), Lucas (1981), and Roggenbuck and Berrier (1982). These researchers dealt primarily with use distribution, whereas the reported study attempted to educate users about issues which are likely more confusing and more difficult to learn.

Statistical Significance vs. Practical Significance

Too often it seems that outdoor recreation research produces results which mean little or nothing to managers in the field. Just because certain results are statistically significant does not necessarily mean that they will be useful to natural resource managers and planners. To be of use, findings must be *practically* as well as statistically significant. Imagine, for example, a t-test to determine whether low-impact knowledge differs between two different groups of wilderness campers. Suppose the results indicate the test to be significant with a p-value of .045, where one population has a mean knowledge score of 75.0 while the other has a mean score of 73.0. Should this two percent difference in low-impact knowledge make any actual difference in how a ranger attempts to manage the different user groups? Probably not. Granted, one of the goals of research is to contribute to a widening body of knowledge and to establish building blocks upon which future studies can be based, but the most important goal of USDA Forest Service sponsored research is to aid managers in the field. If this precept is forgotten, the usefulness of research becomes limited to theory building and testing or the design of future research. It is of paramount importance, therefore, to report not only statistical significance but practical significance when discussing the results of a study. It is this practical significance which is of concern to natural resource managers.

Implications for Management

The management implications of this study are numerous. First, the low scores on the low-impact knowledge test suggest that managers must revise, update, and improve education programs in Shining Rock and perhaps in other wilderness areas. The low test

scores are likely due to the evolving nature of low-impact recommendations; low-impact education programs should evolve with these changing recommendations.

Managers should pay special attention to those recommendations which involve the selection of appropriate campsites. Campers scored a 32.9 percent correct on knowledge questions relating to site selection, but scored 71.1 percent correct on other items (see Figure 6 on page 46). In other words, scores were over twice as high on subjects not relating to site selection. This difference is practically as well as statistically significant. Based on these results, managers should place special emphasis on site selection issues in their low-impact wilderness education programs, especially given the importance of campsite selection in reducing overall wilderness impacts.

The exploratory test of the Shining Rock Wilderness map/brochure indicated that respondents who had seen and/or read its information scored over ten percent better on their knowledge test than those who did not. This difference also has managerial significance. Although the population sampled in this case was not random, and it is not known with certainty the causal nature of the relationship between the brochure and low-impact knowledge, it is nevertheless suggested that Shining Rock Wilderness managers continue to use this brochure and that other managers adopt a similar one. Approximately 49 percent of respondents said they had seen this brochure, 34 percent indicated they had actually read the low-impact information contained inside. The brochure is available only at the USDA Forest Service visitor center in the Pisgah National Forest. Perhaps if the brochure was available at the trailheads, or if a use permit system was instituted through which the brochure could be more widely distributed, low-impact knowledge levels would be raised and impacts would decrease.

Perhaps the most promising result for natural resource managers concerns the effect that the educational trailhead posters had on fire building behavior. Campfires damage wilderness both aesthetically and ecologically; successful attempts at decreasing

the number and frequency of these fires can reduce wilderness resource impacts. Almost twenty percent more groups under treatment conditions displayed appropriate behavior concerning fire building than under control (see Table 15 on page 68). This means that there were twenty percent fewer groups building campfires in the study area of Shining Rock Wilderness when the trailhead posters were displayed than when they were not. *This is a practically significant difference which could potentially have a large positive effect on the overall condition of the area.* Again, these important results support Huffman and Williams (1987), Krumpe and Brown (1982), and Roggenbuck and Berrier (1982), who found that education can influence actual behavior. These studies, however, dealt only with the effect of education on use distribution. The reported study is unique in that education was used to influence actual behavior concerning several other forms of low-impact recreational practices.

It should be pointed out that, although the "no fires" message had a practically and statistically significant effect on overall fire building behavior, only 53.4 percent (see Table 15 on page 68) of those camping groups who were observed behaved appropriately under treatment conditions. Thus, almost half of the Shining Rock Wilderness groups who camped in the study area had a campfire despite the presence of the educational treatment. Although the trailhead signs are a good start toward influencing fire building behavior and reducing impacts, managers and researchers still have much work to do before all users behave appropriately.

Finally, evidence to suggest that knowledge relates to behavioral intention concerning low-impact practices also has ramifications for managers. Ajzen and Fishbein (1980) showed that there is a direct link between intentions and specific behaviors. Since the reported study implies that knowledge influences intentions, wilderness managers should indirectly be able to influence behavior by increasing low-impact knowledge. The knowledge→intention→behavior link gives managers a light-handed, non-authoritarian

method to alter the behavior of the wilderness user and further promotes the notion that low-impact education programs should be improved, expanded, and updated.

Recommendations for Future Research

Due to the evolving nature of low-impact recommendations -- an evolution which incomplete -- researchers must periodically monitor the state of low-impact knowledge among wilderness users. Based on the results of these studies, managers would be able to modify low-impact education programs to fit the current status of knowledge among users.

The failure of the educational trailhead signs to have a practical effect on low-impact knowledge raises the question of what type of educational media will be most effective at increasing knowledge. An examination of various types of educational interventions at increasing knowledge relating to currently recommended low-impact techniques is, therefore, necessary. Researchers have found that brochures (Roggenbuck and Berrier, 1982), simple flow charts (Krumpe and Brown, 1982), user-friendly micro-computers (Huffman and Williams, 1987), slide shows (Dowell and McCool, 1986; Fazio, 1979), and personal contact with a wilderness ranger (Roggenbuck and Berrier, 1982) can be effective educational interventions. These interventions should be tested to determine if they can increase knowledge of recently recommended low-impact recreational practices. Based on exploratory tests, the USDA Forest Service Shining Rock Wilderness brochure should be tested for its effectiveness at increasing low-impact knowledge.

More information is needed on the relationship between educational trailhead signs and behavior. The posters in the reported study had a practically significant effect on a discreet, clearly-defined backcountry behavior: whether or not user groups build a

campfire. This leads to the question of what other behaviors trailhead posters can influence. Can educational signs only influence simple, discrete behaviors? Were the other behaviors in the reported study too complex to be influenced by trailhead signs, or would a different message on the posters have been sufficient to change even campsite selection behavior? Answers to these questions will help resource managers improve their low-impact educational programs.

The reported study contained an insufficient sample size to draw adequate conclusions about the relationship of knowledge and intentions to behavior, but it seems fairly certain from this research that knowledge predicts intentions. Therefore, researchers should focus on the nature and strength of the relationships between knowledge and behavior and intentions and behavior. Understanding these relationships more thoroughly will help managers decide how best to modify the behavior of the wilderness visitor. If there turns out to be a strong positive relationship between knowledge and behavior, managers can influence behavior by increasing low-impact knowledge; if not, other methods of behavior management will be needed.

Study Limitations

A few limitations of this study must be taken into consideration. First, due to time constraints during on-site contacts, the knowledge test was not designed to cover every aspect of low-impact use, only those deemed by experts and the author to be of great importance. The test, nevertheless, was designed to be as broad as possible, covered many aspects of low-impact wilderness use, and is possibly the best test of low-impact knowledge yet implemented in a wilderness area. Second, there is no way to determine if the educational trailhead signs were ineffective at increasing knowledge because they were misunderstood, because users simply did not read them, or for some other reason.

In retrospect, it would have been informative to have asked users if they had read the signs, or to have discretely observed whether camping parties stopped to view them. Third, the measure of behavioral intention used in this study focused on the selection of appropriate campsites. It has been shown that this is a convoluted, confusing issue and therefore probably should not have been the only intention measured. Fourth, the low number of campers who were observed in the backcountry and also contacted at the trailhead made statistical inference tests on the relationship between knowledge and behavior and between intentions and behavior impossible. Finally, the relationships between knowledge and behavior and between intentions and behavior are difficult to quantify because this study tested individual knowledge and intentions, whereas group behavior was observed. Many factors account for the way in which a group behaves; it is difficult to say whether or not an individual's knowledge and intentions correlate very highly with the behavior of a group of which he is a member.

Literature Cited

Ajzen, I. & Fishbein, M. (1980). *Understanding attitudes and predicting social behavior.* Englewood Cliffs, NJ: Prentice-Hall.

Brown, P. J., McCool, S. F., & Manfredo, M. J. (1987). Evolving concepts and tools for recreational user management in wilderness: A state-of-knowledge review. In R. C. Lucas (Compiler), *Proceedings -- National Wilderness Research Conference: Issues, State-of-Knowledge, Future Directions* (pp. 320-346). Gen. Tech. Rep. INT-220. Ogden, UT: USDA Forest Service, Intermountain Research Station.

Cole, D. N. (1982a). Controlling the spread of campsites at popular wilderness destinations. *Journal of Soil and Water Conservation*, 37(5), 291-295.

Cole, D. N. (1982b). Wilderness campsite impacts: Effect of amount of use. Research Paper INT-284. Ogden, UT: USDA Forest Service, Intermountain Research Station.

Cole, D. N. (1983). Assessing and monitoring backcountry trail conditions. Research Paper INT-303. Ogden UT: USDA Forest Service, Intermountain Research Station.

Cole, D. N. (1986). Resource impacts caused by recreation. In *A Literature Review: The President's Commission on Americans Outdoors* (Management pp. 1-12). Lamar Alexander, Commission Chairman. Washington, D.C.

Cole, D. N. (1989). Low-impact recreational practices for wilderness and backcountry. Gen. Tech. Rep. INT-265. Ogden, UT: USDA Forest Service, Intermountain Research Station.

Cole, D. N. & Benedict, J. (1983). Wilderness campsite selection - what should users be told? *Park Science*, 3(4), 5-7.

Cole, D. N., Petersen, M. E., & Lucas, R. C. (1987). Managing wilderness recreation use: Common problems and potential solutions. Gen. Tech. Rep. INT-230. Ogden, UT: USDA Forest Service, Intermountain Research Station.

Dowell, D. L. & McCool, S. F. (1986). Evaluation of a wilderness information dissemination program. In R. C. Lucas (Compiler), *Proceedings -- National Wilderness Research Conference: Current Research* (pp. 494-500). Fort Collins, CO. Gen. Tech. Rep. INT- 212. Ogden, UT: USDA Forest Service, Intermountain Research Station.

Dustin, D. L. (1985). Managing human behavior in outdoor recreation settings: The ultimate answer. In D. Dustin (Ed.), *The Management of Human Behavior in Outdoor Recreation Settings*, (pp. 39-45). Institute for Leisure Behavior: San Diego State University, CA.

Fazio, J. R. (1979). Communicating with the wilderness user. University of Idaho, Forestry, Wildlife, and Range Experiment Station. Bulletin No. 28.

Fishbein, M. & Ajzen, I. (1975). *Beliefs, attitudes, intentions, and behavior: An introduction to theory and research.* Reading, MA: Addison-Wesley.

Geller, E. S. (1989). Applied behavior analysis and social marketing: An integration for environmental preservation. *Journal of Social Issues*, 45(1), 17-36.

Ham, S. H. (1984). Communication and recycling in park campgrounds. *Journal of Environmental Education*, 15(2), 17-20.

Hammitt, W. E., & Cole, D. N. (1987). *Wildland recreation: Ecology and management.* New York: John Wiley & Sons.

Hampton, B., & Cole, D. N. (1988). *Soft paths: How to enjoy the wilderness without harming it.* Harrisburg, PA: Stackpole Books.

Harman, H. (1976). *Modern factor analysis* (3rd ed. rev.). Chicago: University of Chicago Press.

Hart, J. (1977). *Walking softly in the wilderness.* San Francisco, CA: Sierra Club Books.

Hendee, J. C., Stankey, G. H., & Lucas, R. C. (1990). *Wilderness management.* Golden, CO: Fulcrum Publishing.

Huffman, M. G., & Williams, D. R. (1987). The use of microcomputers for park trail information dissemination. *Journal of Park and Recreation Administration*, 5, 35-46.

Krumpe, E. E., & Brown, P. J. (1982). Redistributing backcountry use through information related to recreation experiences. *Journal of Forestry*, 80(6), 360-362.

Lime, D. W., & Stankey, G. H. (1971). Carrying capacity: maintaining outdoor recreation quality. In. *Recreation Symposium Proceedings* (pp. 171-184). Upper Darby, PA: USDA Forest Service, NE Forest Experiment Station.

Lucas, R. C. (1974). Forest Service wilderness research in the Rockies. *Western Wildlands*, (Spring), 5-12.

Lucas, R. C. (1981). Redistributing wilderness use through information supplied to visitors. Research Paper INT-277. Ogden, UT: USDA Forest Service, Intermountain Research Station.

Lucas, R. C. (1982). Recreation regulations -- when are they needed? *Journal of Forestry*, 80(3), 148-151.

Lucas, R. C. (1983). The role of regulations in recreation management. *Western Wildlands*, 9(2), 6-10.

Marion, J. L. (1984). *Ecological changes resulting from recreational use: A study of backcountry campsites in the Boundary Waters Canoe Area Wilderness, Minnesota.* Unpublished Ph.D. dissertation, University of Minnesota, St. Paul.

Marion, J. L. (1991). Results from the application of a campsite inventory and impact monitoring system in eleven wilderness areas of the Jefferson National Forest. USDA Forest Service, Jefferson National Forest and USDI National Park Service, Mid-Atlantic Region. Blacksburg, VA: Virginia Polytechnic Institute and State University, Dept. of Forestry.

Martin, B. H. & Taylor, D. T. (1981). *Informing backcountry visitors -- a catalog of techniques.* Gorham, NH: Appalachian Mountain Club.

McAvoy, L. H. & Dustin, D. L. (1983). Indirect versus direct regulation of recreation behavior. *Journal of Park and Recreation Administration*, 1(3), 13-17.

McAvoy, L. H. & Hamborg, R. (1984). Wilderness visitor knowledge of regulations: A comparison of visitor contact methods. *Journal of Interpretation*, 9(1), 1-10.

Oliver, S. S., Roggenbuck, J. W., & Watson, A. E. (1985). Education to reduce impacts in forest campgrounds. *Journal of Forestry*, 83(4), 234-236.

Olson, E. C., Bowman, M. L., & Roth, R. E. (1984). Interpretation and nonformal education in natural resources management. *Journal of Environmental Education*, 15, 6-10.

Peterson, R. M. (1985). National Forest dimensions and dilemmas. In M. Frome (Ed.), *Issues in wilderness management*, (pp. 36-52). Boulder, CO: Westview Press.

Petzoldt, P. (1974). *The wilderness handbook*. New York: W.W. Norton & Co.

Robertson, R. D. (1981). *An investigation of visitor behavior in wilderness areas.* Unpublished Ph.D. dissertation, University of Iowa, Iowa City.

Robertson, R. D. (1982). Visitor knowledge affects visitor behavior. In D. W. Lime (Tech. Coord.), *Forest and river recreation: Research update*, (pp. 49-51). St. Paul: University of Minnesota Misc. Publ. 18.

Robertson, R. D. (1986). Conceptualizing recreation behavior: An examination of the Fishbein-Ajzen model as a framework for wilderness education. Presented at the National Symposium on Social Science in Resource Management, Corvallis, OR, Oregon State University, May 12-16, 1986.

Roggenbuck, J. W. In press (1992). Use of persuasion to reduce resource impacts and visitor conflicts. In M. Manfredo (Ed.), *Influencing human behavior: Theory and applications in recreation and tourism.* (pp. 151-211). Champaign, Il: Sagamore Publishing Inc.

Roggenbuck, J. W. & Berrier, D. L. (1982). A comparison of the effectiveness of two communication strategies in dispersing wilderness campers. *Journal of Leisure Research*, 14(1), 77-89.

Roggenbuck, J. W. & Ham, S. H. (1986). Use of education and information in recreation management. In *A Literature Review: The President's Commission on Americans Outdoors* (Management pp. 59-72). Lamar Alexander, Commission Chairman. Washington, D.C.

Roggenbuck, J. W. & Lucas, R. C. (1987). Wilderness use and user characteristics: A state-of-knowledge review. In R. C. Lucas (Compiler), *Proceedings -- National Wilderness Research Conference: Issues, State-of-Knowledge, Future Directions* (pp. 204-245). Gen. Tech. Rep. INT-220. Ogden, UT: USDA Forest Service, Intermountain Research Station.

Roggenbuck, J. W. & Manfredo, M. J. (1990). Choosing the right route to wilderness education. In D. W. Lime (Ed.), *Managing America's Enduring Wilderness Resource*, (pp. 103-112). Proceedings of the 1989 National Wilderness Management Conference, Minneapolis, MN, September 11-14, 1989.

Roggenbuck, J. W. & Stubbs, C. J. (1990). Study plan and progress report -- changes in wilderness visits, visitors, and preferences: Shining Rock Wilderness. Report submitted to USDA Forest Service, Missoula, MT, Intermountain Research Station. Blacksburg, VA: Virginia Polytechnic Institute and State University.

Roggenbuck, J. W. & Watson, A. E. (1986). Providing information for management purposes. In D. L. Kulhavy & R. N. Conner (Eds.), *Proceedings of the Conference on Wilderness and Natural Areas in the East, a Management Challenge*, (pp. 236-242). Nacogdoches, TX: Stephen F. Austin University.

Ross, T. L. & Moeller, G. H. (1974). Communicating rules in recreation areas. Research Paper NE-297, Upper Darby, PA: USDA Forest Service, Northeastern Forest Experiment Station.

Vander Stoep, G. A., & Gramann, J. H. (1987). The effect of verbal appeals and incentives on depreciative behavior among youthful park visitors. *Journal of Leisure Research*, 19(2), 69-83.

Vaske, J. J., Graefe, A. R., & Dempster, A. (1982). Social and environmental influences on perceived crowding. In *Proceedings of the Wilderness Psychology Group Conference*, (pp. 211-227). Morgantown, WV: West Virginia University.

Washburne, R. F. & Cole, D. N. (1983). Problems and practices in wilderness management: A survey of managers. Research Paper INT-304, Ogden UT: USDA Forest Service, Intermountain Research Station.

Waterman, L. & Waterman, G. (1979). *Backwoods ethics: Environmental concerns for hikers and campers.* Boston, MA: Stone Wall Press.

Watson, A. E. & Niccolucci, M. J. (1991). Empirical methods of defining past experience dimensions for wilderness recreation. Missoula, MT: USDA Forest Service, Intermountain Research Station.

Appendix A: Knowledge Test

(The correct answer is circled for each question)

II. Listed below are ten multiple choice questions about your knowledge of how to use and protect the wilderness. Be sure to answer every question. Give the best answer for each question.

1. When traveling on existing trails, which of the following is the best way to minimize vegetation damage and trail erosion?

(A) walk single file and keep to the main path
B. walk two abreast on the trail
C. walk off the trail to avoid muddy areas
D. walk off the trail to avoid rocks
E. walk around tree limbs that have fallen across the trail

2. On an established wilderness trail it is appropriate to:

A. shortcut a switchback if it is convenient for your party
B. shortcut a switchback if a shortcut trail already exists
C. shortcut a switchback when traveling downhill
D. shortcut a switchback if the slope is not too steep
(E) none of the above

3. In heavily used locations of Shining Rock Wilderness, like Shining Rock Gap, where would be the best site to camp in order to minimize your impact on the wilderness environment?

A. a lightly impacted site (ground vegetation worn away only around the firering or center of activity; no tree damage)
B. a severely impacted site (soil erosion, exposed tree roots, tree damage, and multiple firerings are present)
C. a severely impacted site next to a stream
D. a site with no evidence of previous use
(E) a moderately impacted site (ground vegetation worn away on most of site, but decomposing leaves and needles present on much of site)

4. In remote, lightly used locations of Shining Rock Wilderness, like the Cold Mountain area, where would be the best site to camp in order to minimize your impact on the wilderness environment?

A. a lightly impacted site (ground vegetation worn away only around the firering or center of activity; no tree damage)
B. a severely impacted site (soil erosion, exposed tree roots, tree damage, and multiple firerings are present)
C. a moderately impacted site next to a stream
(D) a site with no evidence of previous use
E. one should not camp in remote, lightly used zones of wilderness areas

5. Which of the following is a low-impact behavior while at your campsite?

A. building temporary benches by moving rocks and logs
B. playing radios
C. digging ditches around tents
D. building a rock firering
(E) none of the above

6. When camping at an established wilderness campsite, where should one place a tent?

A. in the forest, out of sight of the campsite
B. on the vegetation at the edge of the campsite
C. along the spur trail to the campsite
(D) on the impacted area of the campsite
E. all of the above

7. Which of the following wilderness camping practices generally creates the most adverse visual and ecological impacts?

A. playing a radio
(B) building a campfire
C. allowing your dog to run loose
D. using a brightly colored pack or tent
E. littering

8. To reduce water pollution in wilderness areas you should:

A. bathe only in swiftly moving streams
B. use biodegradable soap when washing in streams
C. use sand and pebbles to wash dishes in streams
(D) bathe, wash dishes, and dispose of waste water away from streams
E. you should not ever bathe or wash dishes in the wilderness

9. Which of the following is generally the most appropriate means of disposing of human body waste (human feces)?

(A) dispose of feces in a small hole excavated in the mineral soil
B. deposit feces on top of ground and cover with a large stone
C. dig a latrine (pit) for your party to use
D. cover your feces with toilet paper
E. none of the above

10. You should <u>never</u> camp in which of the following areas?

A. next to a stream
B. in a direct view of a trail
C. on a lightly impacted campsite
D. on a location with fragile vegetation
(E) all of the above

Appendix B: Behavioral Intention Test

Behavioral Intention

I. We are interested in how you select campsites in the wilderness. Here are four sketches of campsites that you might find in Shining Rock Wilderness. Each sketch has a different number (1, 2, 3, or 4). Please look at all four sketches and answer the following questions:

A. In which of these four sites would you most like to camp? Choose one.

1 2 3 4

Why did you choose this one? _____

_____

_____

B. If these four sites were located in a heavily used zone of Shining Rock Wilderness, like Shining Rock Gap, which would you choose to camp in if you were trying to minimize your overall impact on the environment? Choose one.

1 2 3 4

Why do you think selecting this site would minimize your impact?

_____

_____

_____

C. If these sites were located in a remote, lightly used location of Shining Rock Wilderness, like the Cold Mountain area, which would you choose to camp in if you were trying to minimize your overall impact on the environment? Choose one.

1 2 3 4

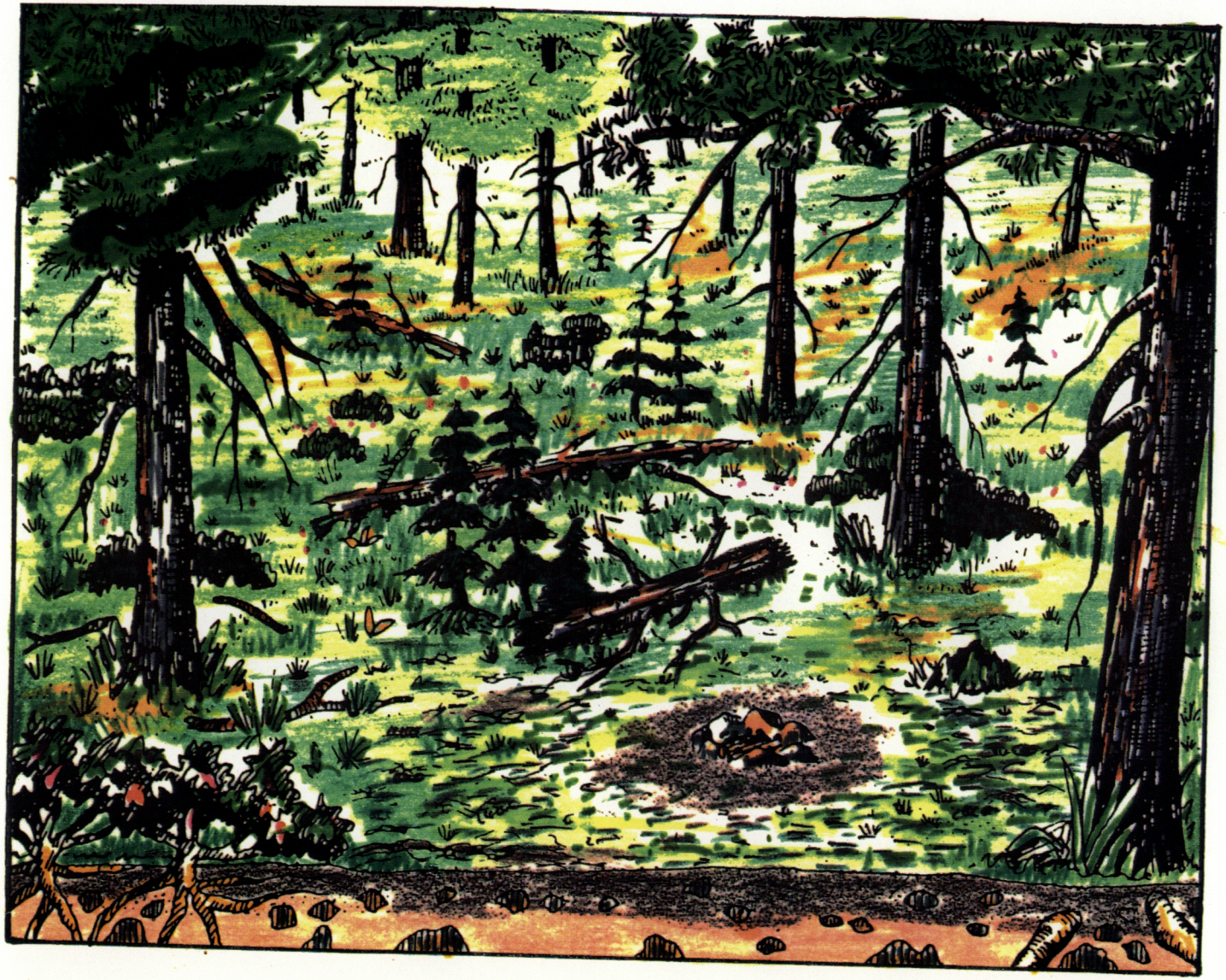
Why do you think selecting this site would minimize your impact?

_____

_____

_____

2



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Appendix C: Behavioral Observation Form

Behavior Report-Shining Rock Study
(Wilderness Ranger Form)

Date_____ Time (24 hour clock)_____

I. Campsite Selection (where group is camped)

1. Campsite Id Number:_____

II. Tent Placement

1. Indicate type of ground cover where tent is placed (check one)
   a. On bare ground_____
   b. On ground covered with duff (crushed leaves & needles)_____
   c. On meadow vegetation_____
   d. On ground vegetation in the forest_____

2. Indicate degree of previous impact where tent is placed (check one)
   a. On a previously impacted area of the campsite_____
   b. Off or away from the previously impacted area of the campsite_____

   (Note: If the size of the campsite is being increased by the placement of the tent, then the tent is <u>off</u> the previously impacted area. Therefore, check b)

III. Campfires

1. Does group currently have a campfire? Yes_____ No_____

2. Is there evidence that group had or will have a campfire?

   a. <u>Had</u> a campfire? Yes_____ No_____ Unsure_____

   (Note: Blackened pots sitting around the firering suggests group had a campfire)

   b. Will have a campfire? Yes_____ No_____ Unsure_____

   (Note: Pile of firewood next to firering or group collecting firewood suggests group will have a campfire).

Appendix D: Trailhead Posters

Campers - Select Your Wilderness Campsite Carefully

Use this campsite selection guide:

How does use relate to campsite damage?

- Impacts occur quickly, under conditions of light use
- Once moderate impacts have occurred, more use often causes little additional damage

Pristine Site

Use Only In Lightly Used Wilderness Zones
- Site shows no previous use
- Use only with extreme care
- Use a stove, not a wood fire
- Keep party size small
- No repeat use

Lightly Impacted Site

Do Not Use
- Ground plants gone from center of campsite
- Leaves usually cover campsite
- Little or no bare ground present
- Site will deteriorate rapidly with more use

Moderately Impacted Site

Use Whenever Possible
- Ground plants gone from most of site
- Crushed leaves usually cover most of ground
- Bare ground common at center of campsite
- More use will cause little additional impact

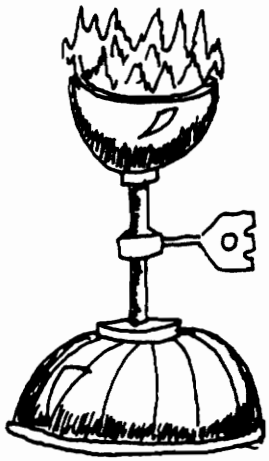
Severely Impacted Site

Do Not Use -- Allow Site To Rest
- Ground plants gone from entire site
- Bare ground exists on most of site
- Soil erosion evident
- Tree roots exposed
- Saplings and tree limbs cut down

Campfires Harm The Wilderness

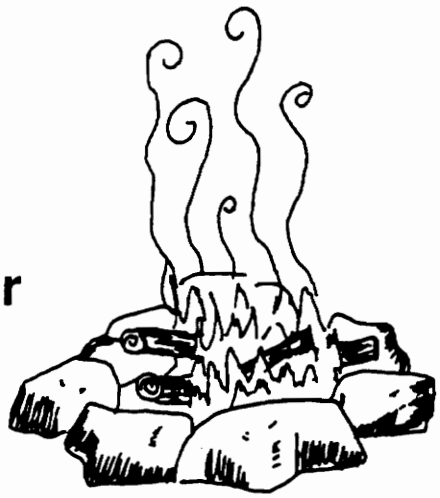
Campfires create the most adverse visual and ecological impacts of any backcountry camping practice .

Firewood Collection:
- tramples plants
- removes nutrients from the forest
- creates unwanted paths
- destroys animal homes



Use a Stove

Campfires:
- raise the risk of forest fires
- sterilize the soil
- encourage soil compaction around the fire
- blacken rocks and leave piles of ash



Avoid Building Fires Whenever Possible

Campers - Select Your Tent Spot Carefully

Wilderness campsites are impacted areas

-Camping destroys plants and compacts soil

In high use wilderness zones:

- contain the area of your impact
- place tent on already disturbed spot
- avoid increasing size of campsite
- avoid crushing seedlings and wildflowers

Right

Wrong

Vita

Christopher John Stubbs was born in Charlottesville, Virginia on September 21, 1965. He graduated from Western Albemarle High School in Crozet, Virginia in 1983. That year, Chris began attending the University of Virginia and received a Bachelor of Arts degree in Government and Foreign Affairs in 1987. From 1989-1991 he attended Virginia Polytechnic Institute and State University where he received a Master of Science degree in Forestry with a concentration in wildland recreation planning and management and was employed as a graduate research assistant. Chris is currently employed as a research specialist by the same institution.