

FEEDING OF GOLDEN-MANTLED GROUND SQUIRRELS BY PARK VISITORS  
AT CRATER LAKE NATIONAL PARK

by

S. KENT SCHWARZKOPF

A RESEARCH PAPER

submitted to

THE DEPARTMENT OF GEOGRAPHY

in partial fulfillment of  
the requirements for the  
degree of

MASTER OF SCIENCE

May 1984

Directed by

Dr. Robert E. Frenkel

### Acknowledgements

At Crater Lake National Park, I would like to thank Jon Jarvis of the resource management staff for his seeing a need for a study of the park visitor-ground squirrel interaction at Rim Village as I simultaneously developed an interest in performing such a study. I also thank Jon and Ron Warfield, Chief Naturalist at Crater Lake, for their efforts in the preparation of signs and signposts for the study. At Oregon State University, I would like to express my appreciation to Don Field of the National Park Service Cooperative Park Studies Unit for the sociological guidance and financial support he gave to this pilot study. In the Department of Geography, I am thankful to my major professor, Bob Frenkel, for the interest and time he gives to helping his graduate students. Finally, I would like to extend my appreciation to Georgia Klimack and Dean Youngquist for the computer assistance they gave me.

Table of Contents

	Page
Acknowledgements.....	i
Table of Contents.....	ii
List of Figures.....	iv
List of Tables.....	v
List of Appendices.....	vi
Abstract.....	1
Introduction.....	1
Statement of Problem.....	5
Human Health Hazard.....	5
Damage to Vegetation and Soil.....	7
Philosophical Considerations.....	8
Study Objectives.....	10
Literature Review.....	12
Attitudes Toward Animals.....	12
Sex.....	13
Age.....	13
Animal Activities.....	14
Nonconsumptive Wildlife Use.....	14
Squirrel Feeding.....	15
Methods.....	16
Study Site.....	16
Observation of Visitors.....	18
Variability and Statistical Analysis.....	20
Interviews.....	21

	Page
Results and Discussion .....	22
Effectiveness of Signs .....	22
Length of Feeding Time .....	26
Eating and Feeding .....	28
Food Items Offered .....	30
Photography .....	31
Feeders by Sex .....	32
Feeders by Age .....	33
Party Composition .....	35
Interviews .....	36
Summary and Conclusion .....	37
References .....	39
Appendices .....	42

List of Figures

	Page
Figure 1. An example of the public perception of an appropriate interaction with the golden-mantled ground squirrel at Crater Lake National Park, as portrayed in a coloring book for sale at the concession gift shop at Rim Village.....	2
Figure 2. Rim Village at Crater Lake National Park, showing the layout, facilities, and location of the study site within rim area 1.....	4
Figure. 3. Text of the experimental signs used to deter squirrel feeding at the Crater Lake National Park study site: (a) squirrel-welfare sign, and (b) bubonic-plague sign.....	19

List of Tables

	Page
Table 1. Total number of visitors, squirrel feeders, and percent squirrel feeders at the Crater Lake National Park study site by survey date when no signs were displayed.....	23
Table 2. Total number of visitors, squirrels feeders, and percent squirrel feeders at the Crater Lake National Park study site by survey date when squirrel-welfare signs were displayed.....	23
Table 3. Total number of visitors, squirrel feeders, and percent squirrel feeders at the Crater Lake National Park study site by survey date when bubonic-plague signs were displayed.....	24
Table 4. Number and percent of individual squirrel feeders at the Crater Lake National Park study site by feeding duration class under three sign situations.....	26
Table 5. Comparison of individuals eating to individuals feeding squirrels and individuals not feeding squirrels under each of three sign situations at the Crater Lake National Park study site.....	28
Table 6. Number of squirrel feeders and individuals eating food with respect to the total number of visitors at the Crater Lake National Park study site during various time periods.....	29
Table 7. Squirrel feeders, by sex and sign situation, at the Crater Lake National Park study site.....	32
Table 8. Squirrel feeders, by age class and sign situation, at the Crater Lake National Park study site .....	33

List of Appendices

	Page
Appendix 1. Definitions of nine basic attitudes of Americans toward wildlife and the natural world proposed by Stephen R. Kellert.....	42
Appendix 2. Postulated attitude occurrence, behavioral expressions, and values and benefits, of ten basic attitudes of Americans toward wildlife proposed by Stephen R. Kellert.....	43
Appendix 3. Specific days, hours of observation, and weather conditions for each of the three sign situations at the Crater Lake National Park study site.....	44
Appendix 4. Total visitors, visitors eating, and squirrel feeders eating at the study site in Crater Lake National Park.....	45
Appendix 5. Food items offered to the squirrels at the Crater Lake National Park study site.....	46
Appendix 6. Feeding parties taking pictures of the squirrels under the three sign situations at the Crater Lake National Park study site.....	47
Appendix 7. Participation in squirrel feeding by groups and individuals under each of three different sign situations at the Crater Lake National Park study site.....	48

# FEEDING OF GOLDEN-MANTLED GROUND SQUIRRELS BY PARK VISITORS

## AT CRATER LAKE NATIONAL PARK

ABSTRACT: Interaction between the golden-mantled ground squirrel and park visitors at a highly visited portion of the Rim Village area of Crater Lake National Park was studied. Observations were made of the total number of visitors entering the area, age, sex, and group composition of visitors who fed the squirrels, type of food offered, how long visitors fed the squirrels, and whether the feeders were themselves eating or taking pictures of the squirrels. Approximately half of those visitors feeding squirrels were under the age of twenty. The effectiveness of signs in deterring visitor feeding was studied. A sign stressing the danger to humans of bubonic plague was twice as effective in deterring feeding as one emphasizing the welfare of the squirrel, and the latter sign was twice as effective in deterring feeding as having no sign at all.

### Introduction

America's national parks have been set aside for the dual purposes of preserving the park's plants, animals, and natural features and for providing for the enjoyment of those features by the general public. For many, if not most park visitors, coming into contact with a park's wildlife is a major goal of their visit. For some, this desire to interact with park wildlife leads the visitor to feed certain animals which show a willingness to approach them. To these individuals it seems "only natural" to feed animals wherever they find them (Figure 1). Indeed, their inclination to do so is encouraged by some zoological and wildlife parks, both public and private.

For the past several decades, at least, the feeding of wildlife by visitors to national parks has increasingly been considered a problem by many National



Visitors to Crater Lake National Park can see the beautiful deep blue lake and make friends with the golden mantled ground squirrels.

Figure 1. An example of the public perception of an appropriate interaction with the golden-mantled ground squirrel at Crater Lake National Park, as portrayed in a coloring book for sale at the concession gift shop at Rim Village.

Park Service personnel. Those aspects of the animal feeding problem which are most commonly voiced by the Park Service are the potential harm to wildlife, the threat to human health, and the damage which high-density wildlife populations can incur on local vegetation and soil. Although the Park Service has a prohibition and a fine (\$25.00) against wildlife feeding, such feeding continues at a seemingly unabated rate in many areas. In the Pacific Northwest, the feeding of wildlife, particularly the golden-mantled ground squirrel (Spermophilus lateralis), commonly occurs and is perceived to be a problem in at least three Park Service units: Crater Lake National Park, Olympic National Park, and Oregon Caves National Monument.

Crater Lake National Park provides an excellent example of the park visitor-ground squirrel problem. While other animals, especially the Clark's nutcracker (Nucifraga columbiana), are sometimes the recipient of food handouts from park visitors, casual observation indicates that the ground squirrel is the object of over three-fourths of the total wildlife feeding in the park. At Crater Lake National Park, ground squirrels are highly concentrated in the Rim Village area (Figure 2). Here, Huestis (1951) found their density to be 23 per acre within a 3-acre tract, in an environment which Gordon (1943) stated should support five squirrels per acre under natural conditions. Not coincidentally, it is this same Rim Village area where the greatest concentration of park visitors also occurs. Observations show that 90% of the traffic entering the park from the south enters the Rim Village area and that 74% of the traffic entering the park from the north enters the area (Shelby and Wolf 1981).

At the request of the park, which was preparing an integrated pest management plan for the ground squirrel at Rim Village in 1983, and out my own developing interest in the problem while serving as a seasonal naturalist there, a study of visitor interaction with squirrels was undertaken during the

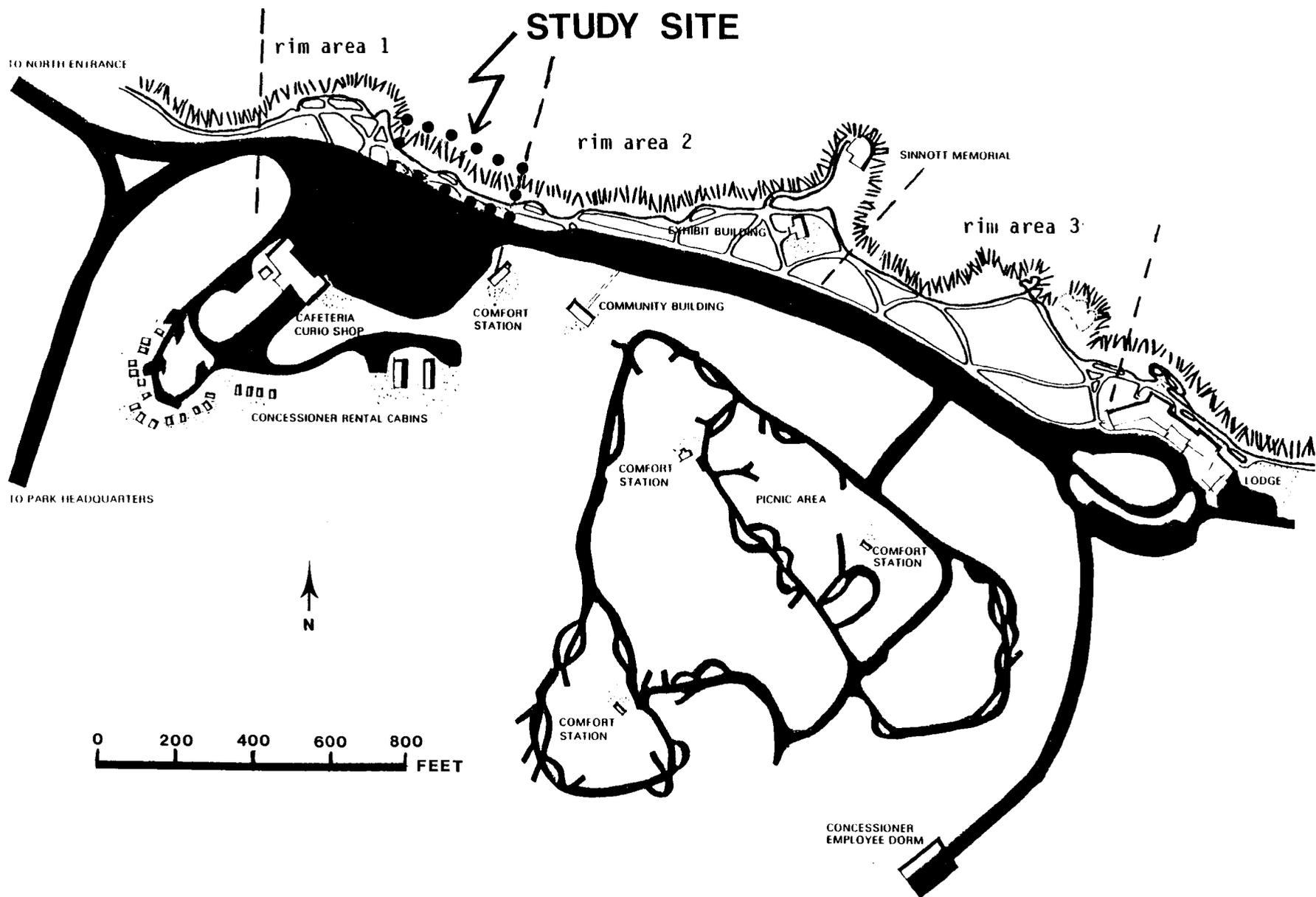


Figure 2. Rim Village at Crater Lake National Park, showing the layout, facilities, and location of the study site within rim area 1.

1983 summer season. The study's purpose was to characterize the feeding activity occurring in the Rim Village area and to evaluate ways by which human behavior might be modified so as to reduce this activity.

### Statement of Problem

#### Human Health Hazard

To park managers, the primary problem of the golden-mantled ground squirrel presence at Rim Village in Crater Lake National Park is the threat to human health. This threat is twofold: 1) the squirrel's presence in food preparation areas of the park concession at Rim Village contributes to unsanitary conditions, and 2) the squirrels potentially carry such diseases as bubonic plague, Rocky Mountain spotted fever, and relapsing fever, diseases which can be transmitted to humans either directly or through fleas and ticks which often infest the squirrels (Jarvis 1983a). The managers of Crater Lake National Park seem especially sensitive to these health problems because of the 1977 outbreak of a serious influenza-type illness which was traced to the contamination of the park's water supply and resulted in the unprecedented closure of the park to the public for a month-long period during the height of the visitor-use season.

All food service and lodging facilities at Crater Lake National Park can be found in the Rim Village area (Figure 2). It is this same area which artificially supports what is probably the greatest concentration of golden-mantled ground squirrels found in the park. This squirrel, unlike most other species of the park's wildlife, becomes readily conditioned to the presence of humans. According to Huestis (1951), young squirrels become accustomed to the presence of man within a few days after emergence, even to the point of later eating directly from a person's hand. The squirrel's lack of timidity in entering the cafeteria, dining room, and food-preparation areas at Rim Village

has been of considerable concern to park management (Jarvis 1983a). It is a particularly common occurrence for squirrels to be scrounging around and begging for food in the dining room of Crater Lake Lodge. In these and other facilities, park visitors and concession employees often succumb to the temptation to experience the park's wildlife by feeding and/or touching this "cute" rodent. The presence of the ground squirrels in Crater Lake's food-service facilities has often been noted as a deficiency in the health standards of the concession operation (Jarvis 1983a).

At the present time the greatest disease potential with regard to the ground squirrels at Crater Lake is the possibility that bubonic plague might be transmitted to park visitors. Rodents of all types, including ground squirrels, are natural carriers of plague, a bacteria Pasteurella pestis (Eskey 1938; Oregon State Health Division no date). Rodents may transmit plague to other animals and, on rare occasions, to man. The disease may be contracted either by the bite of an infected flea which has lived on the rodent or by direct contact with the tissue or fluid from an infected animal (Oregon State Health Division no date). Rodents do not necessarily die from the disease, and it is only a short time before a rodent's death that plague can be transmitted to a flea. Even when a flea contracts the disease, there is less than a 10% chance that it will transmit the disease to another organism (Eskey 1938). While the golden-mantled ground squirrel is certainly capable of carrying plague, none of the 236 squirrels examined by the Oregon Department of Health between 1960 and 1979 had fleas which were plague-positive (Jarvis 1983a).

Nevertheless, over the past decade, an increase in the presence of plague in Oregon has resulted in an increased transmission of the disease to carnivores and man. Of 424 carnivores sampled from around the state in 1978, 17% were found to have the disease. The highest incidence (46%) of

plague-positive carnivores occurred in Klamath County (Oregon State Health Division 1978), wherein lies most of Crater Lake National Park. While carnivores pose little threat to humans, the occurrence of plague among them indicates a high incidence of plague-infested rodents in Klamath County. Even though plague so far has not been a problem at Crater Lake, the potential for the disease is high (Jarvis 1983b). Oregon's first reported human death from plague occurred in 1934 (Oregon State Health Division no date). Since that time, two of the four cases of plague in Oregon which have resulted in death have occurred in Klamath County. Both of these deaths have taken place since 1980, the most recent being that of a nine-year old boy in Klamath Falls in June, 1983 (Forbes 1983; Jarvis 1983a).

#### Damage to Vegetation and Soil

The high population density of ground squirrels in the Rim Village area not only results in a greater potential health threat to the area, but also contributes to the loss of vegetation cover and soil. In some National Park Service areas, such as Lafayette Park in Washington, D. C., the high population density of squirrels has caused extensive damage to flowers and trees (Manski et al. 1981). While these types of damage have not been documented at Crater Lake, one can observe sizeable areas where squirrels are found burrowing which are devoid of vegetation.

At Crater Lake the most damaging effect of squirrel burrowing in the Rim Village area has been in reduced soil stability of the inner caldera wall. In contrast to what their small size might lead one to expect, golden-mantled ground squirrels have burrows which may extend over 100 feet in length. The width of squirrel tunnels varies from about two to four inches, and their depth averages six inches below the soil surface (Huestis 1951). The problems caused by the ground squirrels tunnel network is greatly compounded along the inner

caldera wall at Rim Village both by the high density of the squirrels in the area and by the slope of the wall, which exceeds 30 degrees. This steep slope causes squirrels scurrying across the caldera wall to set rocks into motion, which results in further down-slope erosion (Evans 1932). Whatever the source, the severity of the erosion in the Rim Village area has caused the Park Service to move back by several feet a rock wall used to keep visitors at a safe distance from the caldera edge. The instability and steepness of the caldera wall, combined with the attraction of the squirrels, have given park managers an additional safety concern in that park visitors cross the rock wall and a few proceed unsafely down the inner caldera slope to get closer to or further investigate the squirrels.

#### Philosophical Considerations

An additional aspect of the human-squirrel interaction at Crater Lake is the problem caused by artificial feeding of the squirrels. This aspect of the problem is most vigorously articulated by the park's naturalist staff, and it has both a biological and philosophical component. One point which is often voiced is that feeding of the squirrels makes them dependent on humans for their food. Such food is not always available when needed, being affected by such factors as the weather and the fact almost all animal feeding in the park seems to occur during a two-to-three-month period during the middle and late summer. It is feared that the squirrels will lose or never gain the ability to forage on their own for natural foods. According to Gordon (1943), the natural diet for the golden-mantled ground squirrel consists of seeds, berries, leaves, flowers, bulbs, a variety of insects, young birds and eggs, and carcasses. An additional concern is that such foods as popcorn, ice cream, and potato chips, which are often fed the squirrels, are not nutritionally good for them. It is also believed that much human food cached by the squirrels will decompose

considerably faster than natural foods.

From a philosophical point of view, the National Park Service has for the last several decades been emphasizing the importance of maintaining biotic populations in the parks in as unaltered condition as possible. This philosophy has expressed itself with the Crater Lake National Park staff in several ways, and the feeding of bears, small mammals, birds, and other wildlife is now actively discouraged.

Among the earliest examples of the National Park Service philosophy regarding the feeding of animals is a volume published by the agency in 1932 entitled Fauna of the National Parks of the United States (Wright et al. 1933). The authors suggest the following three policies for the interaction between animals and park visitors:

- 1) That presentation of the animal life of the parks to the public shall be a wholly natural one.
- 2) That no animal shall be encouraged to become dependent upon man for its support.
- 3) That problems of injury to the persons of visitors or to their property or to the special interests of man in the park, shall be solved by methods other than those involving the killing of the animals or interfering with their normal relationships, where this is at all practicable (Wright et al. 1933, 148).

As implied in the above policies, the authors believe the problem of wildlife feeding is not a wildlife problem; it is a people problem. The authors state that visitors look at animals in national parks as they do animals in zoos. They state that it is the duty of the naturalist branch of the Park Service to promote a "more sophisticated" idea of man-wildlife interaction, leading people from the "paler pleasure of feeding semidomesticated animals by hand" to the "greater fascination of (observing) wildlife in nature" (Wright et al. 1933, 80). They note that such educating of the public might take "several years" (Wright et al. 1933, 70).

Interestingly, such policies were not adopted at Crater Lake National Park until at least the mid-1950s. From the 1930s until the early 1950s, articles appearing in Crater Lake Nature Notes clearly show that park naturalists and other park employees were not discouraging the feeding or touching of wildlife, at least not the golden-mantled ground squirrel. Park rangers even contributed to the feeding of the squirrels (Day 1931). Feeding which occurred at Rim Village was stated to be an important part of visitors' park experiences (Day 1931; Clark 1932). Peanuts were apparently the most common item used, but it was also discovered that the squirrels liked everything from bacon and pancakes to watermelon and fig bars (Gordon 1943). Some of the squirrels were so well liked that they were given names (Day 1931; Clark 1932). A regulation against capturing the squirrels and taking them home for pets was only sporadically enforced (Day 1931; Huestis 1951). According to Huestis (1951), a biology professor and long-time seasonal naturalist at the park, "a certain number" of squirrels were captured and often kept successfully for several years by both park visitors and employees.

By 1960 park naturalists discouraged the feeding of the ground squirrels, but it was not a very active discouragement (pers. comm., Bruce Black, former Chief Naturalist, Crater Lake National Park, May 22, 1984). At least ten years ago, park managers began erecting signs at Rim Village informing visitors of the regulation against feeding squirrels and all park animals. These signs were located close to the current study site (pers. comm., Nancy Jarrell, seasonal naturalist, Crater Lake National Park, August, 1983). In recent years, the regulation against feeding squirrels has been vigorously enforced by some park naturalists and rangers at Rim Village.

#### Study Objectives

Thus, for a variety of reasons--the artificiality of feeding, the potential

harm feeding has for the squirrel, the damage caused by erosion and vegetation loss, and, most importantly, the human health threat--a concern grew among park managers to diminish the problems caused by the interactions of park visitors with the golden-mantled ground squirrel at Rim Village. In June, 1983, a management plan addressing the ground squirrel-people problem at Rim Village was written and approved (Jarvis 1983a). The aim of my study is to address two of several actions recommended for dealing with the problem: 1) to perform an observational study of the feeders and feeding activity at Rim Village and 2) to study the effect on park visitors of different types of signs concerning the problems of ground squirrel-people interaction and feeding activity at Rim Village.

The suggested actions for Crater Lake's management plan for the squirrel-people problem at Rim Village were expanded and delimited into the following objectives for my study which were to

- 1) document the absolute and relative numbers of squirrel feeders in comparison to the total number of people entering the study site at Rim Village;
- 2) assess the effectiveness of different signs in altering the extent of animal feeding at Rim Village;
- 3) document the average length of time a park visitor feeds the squirrels within the study site;
- 4) document types of food being fed the squirrels, the frequency with which it is fed, and the source of food;
- 5) examine whether people who are feeding the squirrels are themselves eating;
- 6) describe the social/demographic characteristics of squirrel feeders at Rim Village in terms of sex, age, and group composition; and
- 7) gain a preliminary understanding of the animal-feeding backgrounds and motivations of park visitors at the Rim Village study site.

### Literature Review

Only within the past two decades have scientific studies dealt with the relationships between wildland visitors and wildlife (Ream 1979; Ream 1980; Kellert 1980; Kellert and Westervelt 1983). In 1980 Ream compiled a list of several hundred sources dealing with recreational impacts on wildlife, but noted that "much of the available literature is only peripherally concerned with man-wildlife interactions" (Ream 1980, 1). Most of the studies mentioned by Ream were biological, but she noted that since 1975, a budding interest in the sociological aspects of the man-wildlife relationship has developed (Ream 1979). Most studies--both biological and sociological--have concentrated on large mammals and birds. Few studies have dealt with small mammals. While several scientific studies briefly mention people-squirrel interactions, only two are known to give substantial attention to the subject.

### Attitudes Toward Animals

Regarding the general perceptions and attitudes of Americans toward animals, Stephen Kellert of Yale University has become a leading authority. In several reports written for the U. S. Fish and Wildlife Service between 1976 and 1983, Kellert detailed both the attitudes, behaviors, affection, and knowledge of adults and children toward animals and the activities Americans participate in relating to animals. Based on responses to a national survey, Kellert developed a typology of eight basic attitudes toward wildlife and the natural world: naturalistic, "ecologistic" (ecological), humanistic, moralistic, "scientistic" (scientific), utilitarian, "dominionistic," and negativistic. Appendices 1 and 2 define and postulate the occurrence of these attitudes in American society. He examined the attitudes and activities of the American populace with regard to nine demographic and cultural variables: sex, age, race, education, occupation, income, community size of childhood residence, community size of

present residence, and religious participation (Kellert 1978a; Kellert 1978b; Kellert and Berry 1980; Kellert and Westervelt 1983). Only two of the variables--sex and age--will be addressed in this review.

Sex. Adult females scored very high on the humanistic and moralistic scales, manifesting a particularly strong affection for pets. However, the lack of high ecological and naturalistic scores for women suggests that their concern for animals does not particularly apply to wildlife species or natural-habitat considerations. Males scored very low on the humanistic scale, viewing animals in a more detached manner. Much more than females, males were pragmatic in their relations to animals, as indicated by higher utilitarian and dominionistic scores. Males were also more naturalistic in their orientation toward wildlife (Kellert 1978a; Kellert and Berry 1980).

Among children, Kellert and Westervelt (1983) found that females had the highest humanistic scores of any demographic group. The strong affection of females for pets was reflected in 55% of them citing "loveable" animals as their preferred type of animal, in contrast to 22% of male children. The largest portion of male children (39%) cited "animals in the woods" as their favorite type of animal. Male children possessed greater factual knowledge, awareness, and concern for wild animals than female children.

Age. Kellert found age to be among the most significant factors in predicting a person's attitudes toward animals. He found a marked trend from more to less affection for both pets and wildlife with increasing age of adults. Nineteen-to-twenty-nine year olds were found to be very naturalistically, ecologically, and humanistically oriented, and they characteristically had low utilitarian scores. Those over 65 years of age were the most utilitarian and least naturalistic of any age group; they were also the most negativistic, an attitude scale indicating an active avoidance of animals due to dislike or fear.

Among children, Kellert and Westervelt (1983) found a decreasing preference for pets and an increasing preference for wildlife with increasing age. Second graders had the highest negativistic scores of any demographic group, leading the authors to question the widely held notion about the greater affinity and affection of younger children for animals. Second graders also had lower ecological and higher dominionistic scores than the older age groups measured. "Loveable" animals were nearly twice as preferred by 2nd and 5th graders (51% and 44%, respectively) as by 8th and 11th graders (Kellert and Westervelt 1983).

### Animal Activities

Nonconsumptive Wildlife Use. Over the past several decades, a shift of the American populace from consumptive to nonconsumptive wildlife use has occurred (Hendee 1969; Lime 1976; Allen, 1973; Aney and Cowan 1975). While the number of consumptive wildlife users (hunters and fishermen) in America is still increasing, the number of nonconsumptive users is increasing more rapidly (Lime 1976). In some parks, the chance to view or in some way interact with wildlife may be the most important reason for visiting the park; in others, it is an important supplementary benefit.

A study of adult wildlife users in Oregon found that 47% of the surveyed population hunted and/or fished, while 93% "viewed" wildlife in a wide variety of ways, including observation; photography; keeping wildlife pets; specimen collecting; bird feeding; nature study; painting; visiting fish hatcheries, zoos, and wildlife parks; and viewing wildlife vicariously by reading books on wildlife or viewing movies and television programs on wildlife (Faulkenberry and Cowan 1974; Aney and Cowan 1975). As reported by Aney and Cowan (1975), approximately one-third of the wildlife viewers surveyed in Oregon were "active" viewers (all nonvicarious wildlife viewers). Faulkenberry and Cowan (1974) found that 12% of the Oregonians surveyed had photographed wildlife in the preceding year, and 7%

had kept native wildlife pets during that period of time.

Squirrel Feeding. With the exception of birds and bears, very little research has been done on the subject of human feeding of wild animals. Besides Huestis' 1951 biological report on the golden-mantled ground squirrel at Crater Lake National Park, only two scientific studies are known to deal with the human feeding of squirrels. A study by Robinson and Cowan (1954) found that 9% of the food of the gray squirrel in Stanley Park, Vancouver, British Columbia, came from such "unnatural foods" as peanuts and bread. About one-third of the squirrels in their study quadrat made some use of artificial food sources, and a few of the squirrels depended almost entirely on handouts from park visitors.

The only study known to give its primary concentration to the human feeding of squirrels is a recent one undertaken at Lafayette Park, a National Park Service area in the District of Columbia. Here, park managers viewed the squirrels in the park as a problem primarily because their high density resulted in severe damage to cultivated flowers and trees. The density--9 to 20 per acre--was stated to be the highest reported in the literature (Manski et al. 1981; Manski 1982), though it is less than that reported for the golden-mantled ground squirrel at Rim Village in Crater Lake National Park--23 per acre (Huestis 1951). The amount of "supplemental food" which people fed the squirrels at Lafayette Park varied with the season of the year, from a low of 37% of all food items eaten in the spring to a high of 75% of all food items eaten in autumn. Winter observations were not taken. Peanuts accounted for half of the supplemental food eaten by the squirrels and 35% of all food eaten items eaten by them. Other food items which were fed the squirrels included English walnuts, chicken bones, bread, apples, and peach pits (Manski et al. 1981; Manski 1982).

The authors of the Lafayette Park study differentiated between two types of people that fed squirrels: 1) "zoo keepers," individuals who regularly visited

the park out of concern for the squirrels well-being; and 2) "zoo visitors," commuters, tourists, and picnickers who fortuitously fed the squirrels for entertainment. The "zoo keepers," though numbering only six individuals, accounted for 90% of the supplemental food fed the squirrels. "Zoo visitors" made up the large majority of people feeding squirrels at the park, and while their interactions with squirrels were enjoyable, they were usually of short duration. It was the researcher's impression that when squirrels were active and visible in the park, they were the third most popular sight after the White House and park statues. The researchers felt that if squirrels were to be removed from the area as a management tool, such an action would have to be accompanied by simultaneous reduction of supplemental food in order to have a lasting effect (Manski et al. 1981; Manski 1982). They stated that squirrel relocation and prohibition of public feeding would deny park visitors "an important component of their park experience" (Manski et al 1981, 451) and suspected that such actions would be "intensely opposed if not legally challenged" (Manski et al. 1981, 452).

## Methods

### Study Site

Crater Lake National Park, one of America's oldest and most noted national parks, straddles the Cascades of southern Oregon. Its dominant feature, Crater Lake, lies in the approximate center of the park. Immediately surrounding the lake is a steep rim wall, rising from 500 to 2,000 feet above the lake level. Atop the rim, a road completely encircles the lake. Since early in the century, park development has occurred along the rim at the southern end of the lake. Here, at Rim Village, a lodge; food-service, gift-shop complex; exhibit buildings; and picnic area exist to serve park visitors.

Of the 400,000 to 500,000 visitors who come to the park annually, over 80% enter Rim Village (Shelby and Wolf 1981). Rim Village is accessible only from its western end, where roads from the north and south entrances of the park join together (Figure 2). About 100 yards past this road junction, at the entrance to Rim Village, visitors from the south have their first opportunity to view Crater Lake. Most Rim Village visitors, confronted by the lake on their left and a large imposing building on their right (the food-service, gift shop complex), stop between the two features to park in an expansive parking lot containing 159 spaces (Shelby and Wolf 1981). The concession building, consisting of a cafeteria, lounge, fountain, gift shop, and small convenience grocery, is visited by approximately 65% of Rim Village visitors. Paralleling the parking lot and the rim boundary is a relatively long and narrow lake-viewing area, approximately 650 feet in length and 30 to 70 feet in width. A low stone wall, built to keep visitors from approaching too close to the edge of the caldera, bounds the viewing area on the lake side. This viewing area, called "rim area 1" in Figure 2, contains small "islands" of low-growing vegetation--mostly shrubs and herbs--which are separated by paved walkways which bring the visitor to good viewpoints beside the stone wall. Approximately 70% of all visitors to Rim Village enter "rim area 1" (Shelby and Wolf 1981).

I selected the easternmost portion of rim area 1 in which to concentrate my work. The study site--approximately 250 x 30 feet--is bounded on the north by the caldera rim and on the south by the food-service, gift-shop parking lot. Its eastern boundary is on a perpendicular north of the comfort station at the eastern end of the parking lot and its western end is on a perpendicular to the point at which the stone wall curves sharply northwest (Figure 2). The study site was selected because of its easily identifiable boundaries and because of its heavy visitor use; probably no other area of comparable size along the Crater

Lake rim receives a greater concentration of visitors outside of their cars. Because lingering snow within the site limited visitor access until the first of August, 1983, the field portion of this study did not begin until that time.

### Observation of Visitors

My research during the summer of 1983 was a pilot study undertaken to provide preliminary data from which a more complete study utilizing a questionnaire could be designed. The pilot study relied primarily on the technique of direct systematic observation. (As defined by Clark (1977), direct systematic observation is the observation of directly observable, well-defined specific events and objects using a prearranged coding schedule). For 15 days (6 hours each day for 12 days, and 3 hours each day for 3 days) all visitors entering the study site were counted and recorded by the hour. Visitors who left the study area and reentered it were counted again. The number of persons feeding the squirrels were also counted and totaled by the hour. In addition, all visitors who were eating any food item within the study area were counted and totaled by the hour. In summary, the items observed for all park visitors entering the study site, by hour, were:

- 1) total number of individuals,
- 2) number of people feeding squirrels, and
- 3) number of people eating food themselves.

The majority of information regarding park visitors within the study site was limited to those persons which fed golden-mantled ground squirrels. This information primarily dealt with selected demographic characteristics of the squirrel feeders and particular aspects of the squirrel feeding activity, such as the type of food offered to the squirrels. More specifically, the information recorded, by hour, for all squirrel feeders within the study site was:

- 1) sex,
- 2) age class,
- 3) whether the person himself was also eating,

- 4) party composition,
- 5) the type of food item(s) offered the squirrels,
- 6) how long the party fed the squirrels, and
- 7) whether or not a party photographed the squirrels.

The first three of the above-enumerated observations were made for each individual squirrel feeder. Individuals were assigned to one of six age classes: under 6, 6-11, 12-19, 20-39, 40-59, and over 60. Observations 4, 5, 6, and 7 itemized above were made for each feeding party, not for each individual feeder. I also attempted to discern whether or not the food given to the squirrels originated at the concession; however, more often than not, this question was impossible to answer with any certainty. Casual observations of visitors were recorded as time permitted during survey periods.

A primary purpose of this study was to test the effectiveness of two types of signs in deterring park visitors from feeding squirrels. The text of the two signs is shown in Figure 3.

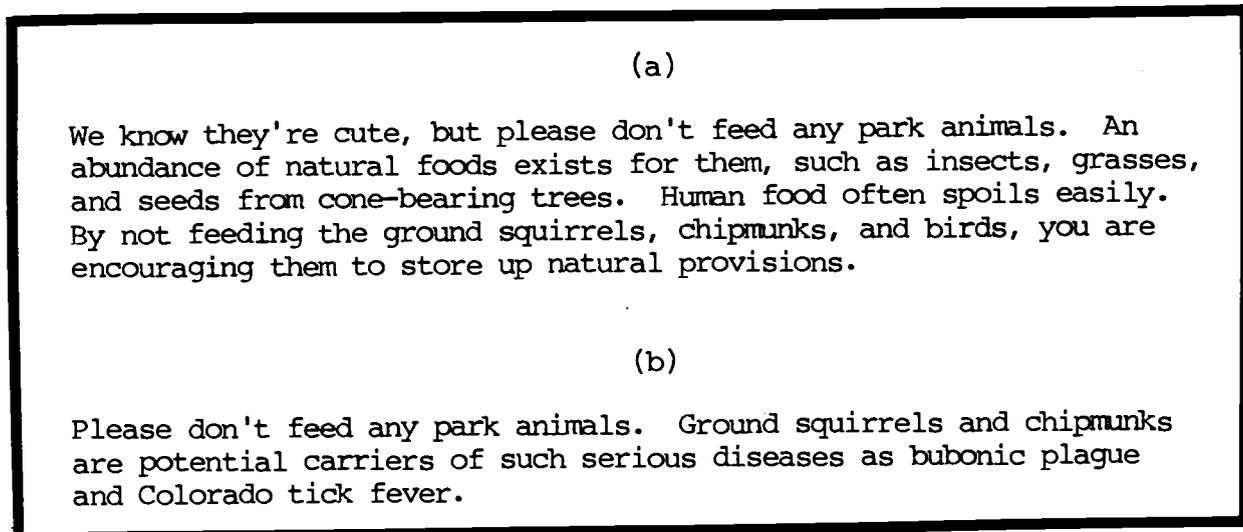


Figure 3. Text of the experimental signs used to deter squirrel feeding at the Crater Lake National Park study site: (a) squirrel-welfare sign, and (b) bubonic-plague sign.

The two signs will be referred to in the remainder of this paper as the squirrel-welfare sign and the bubonic-plague sign. As evident in the above

figure, a source of variability between the two signs is that the squirrel-welfare sign is twice the length of the bubonic-plague sign. Casual observation, however, seemed to indicate that the length did not keep visitors at the study site from reading the squirrel-welfare sign. Three situations were examined: display of the squirrel-welfare sign, display of the bubonic-plague sign, and display of no signs as a control. When signs were displayed, four signs of the same type were slanted for ease in reading on one-to-two-foot-high posts within the study site at highly visible locations a few feet north of the rock wall. Observations were performed for six hours for five days for each of the signs. For the control situation, with no signs, observations were made for six hours for two days, and three hours for three days. For information on the specific days and hours of observation for each sign situation, see Appendix 3. This appendix also briefly notes the weather for each observation day.

#### Variability and Statistical Analysis

Because this research was intended to be only a pilot study and because of time limitations for observation, the study has some significant drawbacks. One statistical drawback was that observation days were not selected randomly. However, daily variability in visitor characteristics under the three sign situations was partially controlled by having approximately half of the study days be pre-Labor Day and the remainder post-Labor Day. (It is common in many national parks for the total number of visitors to decrease after Labor Day, but for the percentage of older visitors to increase.) Likewise, under each of the three sign situations, approximately half of the study days were weekdays, with the remainder on weekends. As previously noted, the number of hours observed under each of the sign situations was not always six; in addition, the hours of observation varied slightly each day beginning as early as 10 am and as late as 12 noon.

Other sources of variability also existed. Weather variability on the study

days was relatively low, with the skies clear on all but one day and the temperatures moderate to warm (high temperatures varied from 58 °F to 74 °F on all but two days). The two exceptions to clear, relatively warm weather were both days on which the squirrel-welfare signs were posted (see Appendix 3). Another source of variability was with the squirrels themselves: casual observation clearly indicated that as the season progressed, a definite trend occurred with the squirrels becoming less timid and more aggressive towards approaching and climbing upon visitors in search of a handout. Finally, observer variability may also have existed, since on two of the fifteen observation days, another National Park Service employee volunteered to observe. Observers were not in uniform and acted as nonobtrusively as possible, resulting in very few visitors expressing an awareness that they were being observed. To discern the maximum effect of the signs, uniformed park rangers and naturalists were asked to stay away from the vicinity of the study site during observation times.

The data gathered by observation are displayed in tables, and analysis is limited to such descriptive statistics as absolute and relative frequencies, means, and ranges. The results do not lend themselves to hypothesis testing, since, with one exception (people who were eating), no observations were made on the non-squirrel feeding population at the study site.

### Interviews

Fourteen interviews of groups (more than one person) feeding the squirrels were undertaken in late August and early September. The interviews were made for the purpose of gaining a greater insight into the motivations and backgrounds of squirrel feeders than that obtained solely from the observation process. Such information was to be used to design a questionnaire for a more complete study. No interviews were conducted with non-squirrel-feeding visitors. The following general questions were asked during most of the interviews:

- 1) What prompted you to feed the ground squirrels?
- 2) How important is feeding the squirrels to your visit to Crater Lake?
- 3) Was feeding the squirrels a spur-of-the-moment action or did you plan to feed them before you arrived at Rim Village?
- 4) Is this your first visit to Crater Lake? If so, did you feed park animals on previous visits?
- 5) Have you visited other national parks? Which ones? Did you feed park animals there?
- 6) Have you fed wild animals at zoos, aquariums, wildlife parks, or other locations?
- 7) Do you have any pets or farm animals? What kinds?
- 8) Are you from a city, town, or rural area?
- 9) Did you know you are not supposed to feed any park animals?
- 10) Do you have any suggestions as to what park managers might do to keep people from feeding the squirrels here?

Interviews were conducted during all three sign situations. Groups interviewed were not randomly selected, but it was my intention to interview as diverse a selection of group-types as possible. The interviews lasted from fifteen to thirty minutes, their length reflecting the interest which the interviewees expressed in the subject. Most, but not all, questions were asked to each group. Even on days when the signs were posted, most groups were very cooperative and open in their responses. Only one group refused an interview. Though the interviews may suggest some tendencies, the small sample size, lack of control, and lack of statistical sampling preclude attaching a great deal of weight to their findings.

## Results and Discussion

### Effectiveness of Signs

Probably the most important finding of the entire study, especially from the viewpoint of park managers, concerns the effectiveness of different signs in deterring park visitors from feeding ground squirrels at the Rim Village study site. The sign noting the danger of contracting bubonic plague and other diseases was almost twice as effective in deterring feeding as the sign which emphasized that the squirrel's natural foods were better for them than human

food. The latter sign, in turn, was found to be twice as effective in keeping visitors from feeding the squirrels as no signs at all. Tables 1, 2, and 3 summarize the results.

Table 1. Total number of visitors, squirrel feeders, and percent squirrel feeders at the Crater Lake National Park study site by survey date when no signs were displayed.

Day (Date)	Observation Duration (hr)	Visitors (No.)	Feeders (No.)	Percent Feeders
Tues (8-9)	3	424	46	10.8
Sun (8-14)	3	421	81	19.2
Tues (8-16)	3	378	50	13.3
Fri (9-16)	6	421	53	12.6
Sat (9-17)	6	712	45	6.3
Total	21	2,356	275	11.7
Daily Mean	---	---	---	12.4
Hourly Mean	---	---	---	11.8

Table 2. Total number of visitors, squirrel feeders, and percent squirrel feeders at the Crater Lake National Park study site by survey date when squirrel-welfare signs were displayed.

Day (Date)	Observation Duration (hr)	Visitors (No.)	Feeders (No.)	Percent Feeders
Sun (8-21)	6	735	36	4.9
Sun (8-28)	6	845	67	7.9
Tues (8-30)	6	575	37	6.4
Fri (9-9)	6	452	24	5.3
Mon (9-12)	6	462	17	3.7
Total	30	3,069	181	5.9
Daily Mean	---	---	---	5.6
Hourly Mean	---	---	---	5.6

Table 3. Total number of visitors, squirrel feeders, and percent squirrel feeders at the Crater Lake National Park study site by survey date when bubonic-plague signs were displayed.

Day (Date)	Observation Duration (hr)	Visitors (No.)	Feeders (No.)	Percent Feeders
Sat (9-3)	6	1,091	40	3.7
Sun (9-4)	6	1,039	41	3.9
Tues (9-6)	6	623	11	1.8
Thurs (9-8)	6	508	12	2.4
Sun (9-11)	6	628	26	4.1
Total	30	3,889	130	3.3
Daily Mean	—	—	—	3.2
Hourly Mean	—	—	—	3.3

As seen in the above tables, the percentage of total feeders to total people within the study site was 11.7% using no signs (Table 1), 5.9% using the squirrel-welfare signs (Table 2), and 3.3% using the bubonic-plague signs (Table 3). Similar percentages result when either daily or hourly means are calculated. Examining the ranges of the daily percentages of feeders to total people entering the study area under each sign situation further confirms that a real difference exists in the effectiveness of the three sign situations. As seen in the above tables, the highest percent feeders (3.9%) on an individual day using the bubonic-plague signs is only slightly higher than the lowest daily percent feeders (3.7%) using the squirrel-welfare signs, and the highest daily percent feeders (7.9%) under the squirrel-welfare signs is surpassed by all but one daily mean (6.3%) using no signs at all. In absolute numbers, it was found that 275 individuals fed the squirrels during 21 observed daytime hours with no signs posted, 181 persons fed them during 30 observed hours with the squirrel-welfare signs posted, and 130 persons fed them during 30 observed hours with the bubonic-plague signs posted. Under the no-sign situation, the higher

means on the three days with only three hours of observation suggest that the five-day hourly mean and the total percent feeders are more representative of the population of squirrel feeders than the five-day daily mean.

The pilot study also showed that under each of the sign situations, the percentage of visitors feeding squirrels was greater on weekends than on weekdays. The difference was greatest and most consistent with the bubonic-plague signs (3.9% on weekends compared to 2.1% on weekdays). Interestingly, even on the two poor-weather days, the percentage of feeders to total visitors was approximately the same as on good weather days (6.4% and 5.3%).

The results of this pilot study strongly indicate that signs can have a significant effect in altering the behavior of park visitors; in this case, in deterring them from feeding squirrels. The results also give strong evidence that the wording of the sign used can determine how effectively visitors are deterred from feeding park wildlife. This data suggest that signs can limit, though not stop, the violation of a park regulation by park visitors.

It is my belief that the sign which emphasized the danger of contracting bubonic plague and other diseases was most effective because it posed a threat the squirrels have for humans. The sign's effectiveness was probably increased by the circumstance that most people have heard of bubonic plague and are aware of its seriousness. A few groups of visitors who read the sign were overheard commenting on the death of the boy in Klamath Falls from plague earlier in the summer. Interestingly, based on casual observation, quite a few visitors incorrectly thought that contracting rabies was the greatest health threat of the squirrels.

The sign emphasizing that natural foods were better for squirrels than human foods dealt with the negative impact of feeding on squirrels. The findings of the pilot study seem to suggest that people are more likely to alter their

behavior when they become aware of a threat to their own health as opposed to the health of another animal.

No other studies are known to exist which deal with the effect of signs in altering the extent of wildlife feeding by park visitors. Other studies, however, have dealt with the effect of altering visitor behavior with regard to auto traffic patterns (Brown and Hunt 1969) and trail traffic patterns (Ormrod and Trahan 1982).

Length of Feeding Time

The impact of the signs on feeding activity at the study site is still more apparent when one examines the length of time park visitors feed the squirrels (Table 4).

Table 4. Number and percent of individual squirrel feeders at the Crater Lake National Park study site by feeding duration class under three sign situations.\*

Signs	Total No. Feeders	Feeding Duration Class				
		≤5 min No. (%)	6-10 min No. (%)	11-15 min No. (%)	16-20 min No. (%)	≥21 min No. (%)
None**	211	66 (31.3)	69 (32.7)	38 (18.0)	22 (10.4)	16 (7.6)
Squirrel Welfare	176	70 (39.8)	47 (26.7)	20 (11.4)	27 (15.3)	12 (6.8)
Bubonic Plague	128	52 (40.6)	34 (26.6)	24 (18.8)	6 (4.7)	12 (9.3)
Total	515	188 (36.5)	150 (29.1)	82 (15.9)	55 (10.7)	40 (7.8)

\* Each individual squirrel feeder within a group was assigned a single feeding time.

\*\* On one of the days with no signs present, the length of time visitors fed squirrels was not observed.

As seen in Table 4, when no signs were present, the greatest percentage of

visitors (32.7%) fed the squirrels from six to ten minutes, whereas when the squirrel-welfare or bubonic-plague signs were present, the greatest percentage of squirrel feeders (39.8% and 40.6%, respectively) participated in feeding for five minutes or less. The results shown in Table 4 indicate that the type of sign did not affect the duration of feeding, though the presence of either sign reduced the feeding time. For both the squirrel-welfare and bubonic-plague signs, the number of visitors who fed the squirrels peaked sharply at two minutes; however, with no signs, the number of visitors who fed the squirrels peaked sharply at eight minutes. Thus, there is evidence that the presence of deterrent signs not only limited the number of people who fed the ground squirrels, but it limited the amount of time (and therefore the amount of food) which people fed them.

The effect of the presence of signs on the duration of feeding diminishes for those visitors who fed the squirrels for more than ten minutes, suggesting that die-hard squirrel feeders aren't affected by attempts to deter them. When squirrel-welfare and bubonic-plague signs were displayed, between 33% and 34% of the squirrel-feeding visitors participated in the activity for more than ten minutes. With no signs displayed, 36% of them fed squirrels for more than ten minutes. The longest any group was observed feeding squirrels was 46 minutes. The length of time which visitors fed the squirrels under any of the sign situations is somewhat high, since all members of a group were assigned the length of time from when the first group member started feeding to when the last group member stopped feeding.

I speculate that the shorter feeding duration when signs were displayed is because visitors recognize that they are doing something that park authorities frown upon. It is also possible that the feeding time may have been limited by the cooler weather on the days when the signs were present (Appendix 3).

## Eating and Feeding

As one might suspect, no relationship appears to exist among the three sign situations and the number of people eating within the study site (Appendix 4). The mean percentage of eaters under all three sign situations varies from 6.4% to 8.3%. These findings show that a relatively low percentage of park visitors use the study site for the purpose of eating. Casual observation indicated that the overwhelming majority of people eating within the study site were only snacking, not eating full meals.

However, the data do show a relationship among the three sign situations and the percentage of squirrel feeders who are themselves eating (Table 5).

Table 5. Comparison of individuals eating to individuals feeding squirrels and individuals not feeding squirrels under each of three sign situations at the Crater Lake National Park study site.

Signs	Visitors Feeding Squirrels*			Visitors Not Feeding Squirrels		
	Number of Visitors	Visitors Eating	Percent Visitors Eating	Number of Visitors	Visitors Eating	Percent Visitors Eating
None	251	65	25.9	2,081	130	6.2
Squirrel Welfare	159	49	30.8	2,888	165	5.7
Bubonic Plague	122	53	43.4	3,759	197	5.2
Total	532	167	31.4	8,728	492	5.6

\* Fifty-four visitors feeding squirrels were not characterized as to whether they were eating food themselves.

With no signs present, 25.9% of the squirrel feeders were themselves eating; with the squirrel-welfare signs up, 30.8% of the feeders were themselves eating; and with the bubonic-plague signs present, 43.4% of the feeders were themselves eating. No explanation is given for this trend.

Prior to the pilot study, it had been hypothesized that the majority of

people feeding the squirrels were also eating food themselves. However, the results of the study show that, averaging all three sign situations, only 31.4% of the squirrel feeders within the study site were also themselves eating food. But, more importantly, when the percentage of squirrel feeders who eat (31.4%) is compared with the percentage of non-squirrel feeders who eat (5.6%), one sees that squirrel feeders are over five times as likely to be themselves eating food as are non-squirrel feeders. Thus, there appears to be a strong positive correlation between people who eat at the study site and people who feed squirrels there.

Table 6 shows the hourly variation at the study site between the number of people feeding squirrels and the number of people eating.

Table 6. Number of squirrel feeders and individuals eating food with respect to the total number of visitors to the Crater Lake National Park study site during various time periods.

Time Period*	Hours of Observ. (No.)**	Feeders (No.)	Eaters (No.)	Total Vis. (No.)	Feeders/Total Vis. (%)	Eaters/Total Vis. (%)
10:00 am - 12:30 pm	17	116	121	2,036	5.7	5.9
12:00 noon - 2:30 pm	30	265	262	4,024	6.6	6.5
2:00 pm - 4:00 pm	26	200	269	3,043	6.6	8.8
3:30 pm - 6:00 pm	13	43	105	1,102	3.9	9.5

\* Time periods overlap because of varying starting times.

\*\* Five additional hours of observation at the study site were included outside of the specific study days under the three sign situations.

Averaging the results from all sign situations, the greatest percentage of individuals who fed squirrels at the study site (6.6%) occurred between noon and 4 pm, while the greatest percentage of total people eating at the site (about 9%)

occurred between 2 pm and 6 pm. The percentage of people feeding the squirrels and the percentage of people eating food themselves are approximately equal between 10 am and 2:30 pm, while later in the afternoon, the percentage of people eating becomes significantly greater as the percentage of people feeding squirrels begins to decrease. No explanation is attempted for these hourly variations in the number of people feeding the squirrels and those eating food themselves. The results indicate that park managers should concentrate their efforts in deterring people from feeding the squirrels between the hours of noon and 4 pm.

#### Food Items Offered

Food items which were fed the ground squirrels are itemized in Appendix 5. Peanuts were the item most frequently offered to the squirrels, accounting for 20.5% of all items offered. (This percentage includes all types of peanuts--shelled and unshelled, salted and unsalted.) Bread and crackers were the next most frequently offered food items, accounting for 15.8% and 13.4% of the total items, respectively. Only three other items made up more than 5% of the food items fed the squirrels: popcorn (9.2%), ice cream cones (6.8%), and sunflower seeds (6.3%). Potato chips, candy, corn chips, cheetos, and cheerios accounted for an additional 18.7% of the food items offered. Other items, including fruit, pretzels, french fries, cookies, cigarette butts, and native vegetation, accounted for less than 10% of the food items park visitors offered squirrels. Several precautionary remarks should be made about these results. They do not represent the quantity of food given to the squirrels. Also, the actual number of people feeding the squirrels some of the items is high, since each person in a feeding group was assumed to have offered all of the food items offered by any other member of that group.

It was not possible to accurately determine what proportion of food items came from the concession's cafeteria, fountain, or convenience grocery across

the parking lot. The only food items which probably came exclusively from the concession were popcorn and ice cream cones, both of which were frequently offered to the squirrels. However, of the other food items which made up more than 1% of the total items fed the squirrels, almost all were available at the concession, primarily at the convenience grocery, where small, inexpensive packages were sold. Neither the grocery nor any other part of the concession contained signs mentioning the regulation against feeding animals. Employees of the grocery reported to the author that park visitors regularly indicated that they planned to use their food purchases to feed the squirrels, but rarely would the employee indicate they were not permitted to feed park animals.

As with the Rim Village study, peanuts were the most common food item offered to squirrels at Lafayette Park in Washington, D. C. However, the other food items offered to squirrels at Lafayette Park differed greatly from the present study; for example, bread made up only 1% of the items offered (Manski et al. 1981).

### Photography

Averaging the results from all three sign situations, 41.7% of the parties which fed squirrels contained at least one individual who took pictures of the squirrels (Appendix 6). The variability which existed among the three sign situations is probably due to a small sample size of 283. Comments overheard during the observation periods lead me to believe that many--though not the majority--of individuals fed the squirrels primarily to get a good picture of them. Every day, photographers were observed expressing frustration at the squirrels' rapid movements, which must have resulted in many pictures containing blurred squirrels or no squirrels at all.

In other studies, Kellert (1980) reported that during a two-year period, 42% of Americans participated in animal photography, more than half of it directed toward wildlife subjects. Kellert also found that animal photography

was an infrequent activity for two-thirds of those who participated.

Faulkenberry and Cowan (1974) found that 12% of Oregonians had photographed wildlife in the preceding year. In the Lafayette Park study in Washington, D. C., "many" park visitors were observed photographing gray squirrels at times in which they were active (Manski 1982).

### Feeders by Sex

Somewhat surprisingly, the results of this study indicate that squirrel feeders at the Rim Village study site are almost evenly distributed among the sexes (Table 7). Averaging the results from all three sign situations, 47.6% of those persons feeding the ground squirrels were male and 52.4% were female. Males responded slightly more positively to both the squirrel-welfare and the bubonic-plague signs than did females, though the difference may merely be due to sampling error. As indicated earlier, no observations were made on persons not feeding squirrels on any of the demographic characteristics examined (sex, age, or party composition).

Table 7. Squirrel feeders, by sex and sign situation, at the Crater Lake National Park study site.

Signs	Males		Females	
	Number	(Percent)	Number	(Percent)
None	136	(49.5)	139	(50.5)
Squirrel Welfare	83	(45.9)	98	(54.1)
Bubonic Plague	60	(46.2)	70	(53.8)
Total	279	(47.6)	307	(52.4)

The results presented contrast with the findings of Kellert (Kellert and Berry 1980; Kellert and Westervelt 1983). The strong affection for pets and pet-like animals which Kellert found in female adults and children led me to

expect that considerably more females would have fed the squirrels than males. From casual observation, it seems that many park visitors considered the squirrels as pet-like animals, since quite a few persons, mostly children, wanted to take them home as pets. During the study at Rim Village, females appeared to be more readily attached to the squirrels than males, as the former quite frequently said of the squirrels: "They're so cute." The strong naturalistic and ecological orientation in males which Kellert found (Kellert and Berry 1980; Kellert and Westervelt 1983) would have been expected to lead to a lower percentage of male feeders than occurred in the Rim Village study. Kellert's findings would be more in line with the current study if it were found that the total number of people entering the study site were predominantly male (a fact which is not known, since this study did not ascertain characteristics of the non-feeding population).

#### Feeders by Age

As shown in Table 8, this study found that more than half of all squirrel feeders at the Rim Village study site were under 20 years old.

Table 8. Squirrel feeders, by age class and sign situation, at the Crater Lake National Park study site.

Signs	Age of Squirrel Feeders (Years)					
	≤ 5 No. (%)	6-11 No. (%)	12-19 No. (%)	20-39 No. (%)	40-59 No. (%)	≥ 60 No. (%)
None	30 (10.9)	61 (22.2)	48 (17.5)	93 (33.8)	26 (9.5)	17 (6.2)
Squirrel Welfare	25 (13.8)	43 (23.8)	28 (15.5)	59 (32.6)	11 (6.1)	15 (8.3)
Bubonic Plague	17 (13.1)	34 (26.2)	15 (11.5)	44 (33.8)	12 (9.2)	8 (6.2)
Total	72 (12.3)	138 (23.5)	91 (15.5)	196 (33.4)	49 (8.4)	40 (6.8)

Averaging the results from all three sign situations, 51.4% of those persons

feeding the squirrels were under 20. The largest portion of this group was in the 6-11-year-old age bracket; this relatively narrow age bracket represented 23.5% of all squirrel feeders at the site. A surprising 72 individuals (12.3% of the total number of squirrel feeders) were estimated to be under 6 years of age. By far the largest adult group was in the 20-39-year-old range, comprising 33.4% of the total squirrel feeders. The two smallest percentages of squirrel feeders were in the 40-59 and the "over 60" age groups (8.4% and 6.8%, respectively). As expected, a seasonal trend among age groups was also apparent; after Labor Day the proportion of adults of all age classes dramatically increased.

The age distribution of squirrel feeders among the three sign situations was generally similar. Only in the 12-19-year-old class was a trend in the percentage of feeders apparent--a trend decreasing from 17.5% with no signs to 11.5% with bubonic-plague signs.

The results of the Rim Village study generally agree with Kellert's finding of a marked trend from more to less affection for both pets and wildlife with increasing age of adults. However, Kellert's finding of the very naturalistic and ecological orientation of the 19-29-year-old group seems to contrast with the results of the Rim Village study. My study tends to support Kellert's finding that the "over 65" age class is the age group least interested in animals (Kellert 1978a; Kellert and Berry 1980). Kellert and Westervelt's (1983) finding that "loveable" animals were nearly twice as preferred by 2nd and 5th graders as by 8th and 11th graders agrees well with the Rim Village study's finding that the largest portion of child squirrel feeders were in the 6-11-year-old group. Casual observation at the study site indicated that the golden-mantled ground squirrel is considered a loveable animal by a considerable portion of the squirrel feeders, especially women and children. A large number of individuals desired to

pet and hold a squirrel in their hands, and many succeeded in doing so.

### Party Composition

Another finding of this study, regardless of sign situation, is that 86.5% of the squirrel feeders at Rim Village participated in that activity as members of a group. Appendix 7 identifies the squirrel feeders at Rim Village into 1 of 13 different categories of parties, and in so doing, shows the combined effect of age and sex on feeding activity. By far the greatest number of feeding parties consisted of adults with children; combining the results from all three sign situations, 46.4% of the total feeding parties were so classified. The next largest number of feeding parties were young adult couples (age 20-39), representing 18.3% of the total feeding parties. Adult couples of all ages made up 24.2% of the feeding parties. Mixed adult parties made up 9.3% of the total feeding parties. Less than 4% of all feeding parties contained only adults of the same sex, and less than 2% of all parties contained only children of the same sex. Both the same-sex adult and children's parties were approximately two-thirds female. The reader should be cautioned, however, that the small size of the same-sex groups makes it difficult to draw any conclusions from the relative proportions of the sexes. Nine percent of all feeding parties consisted of children only.

A possible conclusion derived from the party composition observations is that most individuals participate in squirrel feeding along with others (whether the others feed squirrels or not), suggesting that for many persons, the activity might be perceived as primarily social. Casual observation at the study site supports this hypothesis. However, this conclusion can not be sustained, since the group nature of squirrel feeding may merely reflect the group nature of park visitation in general (of which no data are available).

## Interviews

Because of the small sample size (N=14), the results of the interviews provide only a preliminary indication of motivations and backgrounds of the Rim Village squirrel feeders. A variety of reasons for feeding the ground squirrels were given: "for the enjoyment of the children," "they're so friendly," "they're so cute," "it's a neat experience," "so the children could get close to the squirrels," and "to get a good picture of them." Three interview groups commented that for the children in their group, feeding the squirrels was probably the most important aspect of their visit to the park. Four other groups said feeding squirrels was a secondary purpose of their visit, and one adult group said it was the primary reason they had come to the park.

Almost two-thirds of the groups interviewed had planned to feed the squirrels prior to their arrival at the study site. All of these groups had been to the park before, but only half had fed squirrels on a previous visit. Almost all of the interviewed groups had visited other national parks, but only one-fourth remembered feeding animals in those parks. At least half of the groups had fed animals at zoos and several had fed them at wildlife parks.

Respondents were almost equally divided as to whether they were from a city, town, or rural area. Several currently owned farm animals. All but one or two groups had pets. Three groups indicated they had three or more types of pets, and two groups volunteered the information that they had previously had pet squirrels in their home. A few groups said they were not aware they were not supposed to feed the squirrels, even when signs were posted. Most visitors could offer no suggestions which would keep people from feeding the squirrels. Those suggestions which were made are: "make the signs with red letters," state "absolutely no feeding on the signs," "mention a fine" on the signs, "make the signs bigger," "poison the squirrels," and "provide good foods for visitors to

feed the squirrels."

The data resulting from the interviews suggest that Rim Village squirrel feeders are pet owners, that they are repeat visitors to the park who planned to feed the squirrels prior to their arrival, and that they have a wide variety of motivations for feeding the squirrels. Further research will be necessary to confirm or invalidate these and other indications suggested by the interviews.

#### Summary and Conclusion

Direct systematic observation of the interaction between park visitors and the golden-mantled ground squirrel at Rim Village in Crater Lake National Park showed that, with no signs or uniformed rangers acting as a deterrent, approximately 12% of park visitors entering the study site fed the squirrels. The greatest portion of this feeding occurred between 12 noon and 4 pm. With the exception of people who were eating, all observations pertained to squirrel feeders only. Participation in squirrel feeding was almost equally divided between men and women. Slightly over half of all those participating were under the age of 20, and by far the largest portion of adults were in the 20-39-year-old range. Over 86% of people feeding the squirrels were part of a group, and almost half of all feeding parties consisted of adults with children. More than five times as many squirrel feeders as non-squirrel feeders ate food themselves when they were in the study site. Approximately two-thirds of the squirrel feeders participated in the activity for under ten minutes. A variety of food items were offered to the squirrels, with peanuts, bread, crackers, popcorn, ice cream cones, and sunflower seeds leading the list.

From the standpoint of park managers, probably the most significant and easily utilizable information of the entire study deals with the varying effectiveness of different signs in deterring park visitors from feeding the ground squirrels. A sign noting the danger to humans of contracting bubonic

plague was found to be twice as effective as one which pointed out that feeding was harmful to the welfare of the squirrel. The latter sign, in turn, proved to be twice as effective as having no signs at all. The differing effectiveness of the two signs probably indicates that people are more likely to alter their behavior when they become aware of a threat to their own health as opposed to the health of another animal. The study also found that the presence of either sign resulted in a diminished length of time which visitors fed the squirrels. Such data clearly indicate to Crater Lake National Park managers that signs can significantly limit the tendency of some park visitors to feed ground squirrels. The data also suggest that signs may be an effective means of deterring visitors from feeding other types of wildlife in other natural areas.

## References

- Allen, D. L. 1973. Report of the committee on North American wildlife policy. Wildlife Society Bulletin 1:73-91.
- Aney, W. W., and Cowan, C. D. 1975. Survey shows wildlife important recreational resource. Oregon Wildlife 30:8-9.
- Brown, P. J. and Hunt, J. D. 1969. The influence of information signs on visitor distribution and use. Journal of Leisure Research 1:79-83.
- Clark, E. L. 1932. In memoriam. Crater Lake Nature Notes 5:10.
- Clark, R. N. 1977. Alternative strategies for studying river recreationists, pp. 91-100. In Proceedings, River Recreation Management and Research Symposium. U. S. Forest Service General Technical Report NC-28, North Central Forest Experiment Station, St. Paul, MN
- Crater Lake National Park. 1983. Record of river and climatological observations. August, September. Crater Lake National Park files.
- Day, J. S. 1931. Bobby learns to trust nobody. Crater Lake Nature Notes 4.
- Eskey, C. R. 1938. Fleas as vectors of plague. American Journal of Public Health 28:1305-10.
- Evans, D. L. 1932. The receding rim of Crater Lake. Crater Lake Nature Notes 5:7.
- Faulkenberry, G. D. and Cowan, C. D. 1974. Survey of Oregon Wildlife Preferences and Activities. Corvallis: Oregon State University, Survey Research Center.
- Forbes, M. 1983. Plague tied to K. F. death. Herald and News (Klamath Falls), June 14.
- Gordon, K. 1943. The Natural History and Behavior of the Western Chipmunk and the Mantled Ground Squirrel. Corvallis: Oregon State University Press.
- Hendee, J. C. 1969. Appreciative versus consumptive uses of wildlife refuges: studies of who gets what and trends in use. Transactions of the 34th North American Wildlife and Natural Resources Conference 34:252-64.
- Huestis, R. R. 1951. The golden-mantled ground squirrel. Crater Lake Nature Notes Special Number.
- Jarvis, J. 1983a. Integrated pest management plan for the golden-mantled ground squirrel at Rim Village, Crater Lake National Park. June 1. Crater Lake National Park files.
- Jarvis, J. 1983b. Memorandum to all employees. July 27. Crater Lake National Park files.

- Kellert, S. R. 1978a. Americans and animals: perceptions and policy implications, pp. 55-84. In Policy Implications of a National Study of American Attitudes and Behavioral Relations to Animals, S. R. Kellert. Washington, D. C.: U. S. Government Printing Office.
- Kellert, S. R. 1978b. Attitudes towards animals and characteristics of various animal activity groups other than hunters, pp. 86-124. In Policy Implications of a National Study of American Attitudes and Behavioral Relations to Animals, S. R. Kellert. Washington, D. C.: U. S. Government Printing Office.
- Kellert, S. R. 1980. Activities of the American Public Relating to Animals. Phase II. Washington, D. C.: U. S. Government Printing Office.
- Kellert, S. R. and Berry, J. K. 1980. Knowledge, Affection, and Basic Attitudes Toward Animals in American Society. Phase III. Washington, D. C.: U. S. Government Printing Office.
- Kellert, S. R. and Westervelt, M. O. 1983. Children's Attitudes, Knowledge, and Behaviors Toward Animals. Phase V. Washington, D. C.: U. S. Government Printing Office.
- LaHart, D. E. 1978. The influence of knowledge on young people's perceptions about wildlife. Final project report to the National Wildlife Federation. Tallahassee: Florida State University, College of Education.
- Lime, D. W. 1976. Wildlife is for non-hunters, too. Journal of Forestry 74: 600-04.
- Manski, D. A. 1982. Management of gray squirrels and people in a downtown national park. Park Science 2:8-9.
- Manski, D. A., VanDruff, L. W., and Flyger, V. 1981. Activities of gray squirrels and people in a downtown Washington, D. C. park: management implications. Transactions of the 46th North American Wildlife and Natural Resources Conference 46:439-54.
- Oregon State Health Division. Plague in Oregon: how to avoid it. Pamphlet.
- Oregon State Health Division. 1978. Plague surveillance in Oregon. Oregon Health Bulletin 56:3.
- Ormrod, R. K. and Trahan, R. G. 1982. Can signs help visitors control their own behavior? Trends 19:25-27.
- Pomerantz, G. A. 1977. Young People's Attitudes Toward Wildlife. Wildlife Division Report No. 2781. Lansing, MI: Department of Natural Resources.
- Ream, C. H. 1979. Human-wildlife conflicts in backcountry: possible solutions, pp. 153-63. In Recreational Impact on Wildlands, Conference Proceedings. U. S. Forest Service, Pacific Northwest Region (Report No. R-6-001-1979), Seattle, WA.

- Ream, C. H. 1980. Impact of Backcountry Recreationists on Wildlife: An Annotated Bibliography. U. S. Forest Service General Technical Report INT-84, Intermountain Forest and Range Experiment Station, Ogden, UT.
- Robinson, D. J. and Cowan, I. McT. 1954. An introduced population of the gray squirrel (Sciurius carolinensis Gmelin) in British Columbia. Canadian Journal of Zoology 32:261-82.
- Shelby, B. and Wolf, D. W. 1981. Social Impacts of Design Alternatives, Crater Lake National Park. Corvallis: Oregon State University/National Park Service Cooperative Park Studies Unit.
- Wright, G. M., Dixon, J. S., and Thomson, B. H. 1933. Fauna of the National Parks of the United States. Fauna Series No. 1. Washington, D. C.: U. S. Government Printing Office.

APPENDIX 1

Definitions of nine basic attitudes of Americans toward wildlife  
and the natural world proposed by Stephen R. Kellert.

---

Attitude	Definition
<u>NATURALISTIC:</u>	PRIMARY INTEREST AND AFFECTION FOR WILDLIFE AND THE OUTDOORS.
<u>ECOLOGISTIC:</u>	PRIMARY CONCERN FOR THE ENVIRONMENT AS A SYSTEM, FOR INTER-RELATIONSHIPS BETWEEN WILDLIFE SPECIES AND NATURAL HABITATS.
<u>HUMANISTIC:</u>	PRIMARY INTEREST AND STRONG AFFECTION FOR INDIVIDUAL ANIMALS, PRINCIPALLY PETS.
<u>MORALISTIC:</u>	PRIMARY CONCERN FOR THE RIGHT AND WRONG TREATMENT OF ANIMALS, WITH STRONG OPPOSITION TO EXPLOITATION OR CRUELTY TOWARDS ANIMALS.
<u>SCIENTISTIC:</u>	PRIMARY INTEREST IN THE PHYSICAL ATTRIBUTES AND BIOLOGICAL FUNCTIONING OF ANIMALS.
<u>AESTHETIC:*</u>	PRIMARY INTEREST IN THE ARTISTIC AND SYMBOLIC CHARACTERISTICS OF ANIMALS.
<u>UTILITARIAN:</u>	PRIMARY CONCERN FOR THE PRACTICAL AND MATERIAL VALUE OF ANIMALS OR THE ANIMAL'S HABITAT.
<u>DOMINIONISTIC:</u>	PRIMARY INTEREST IN THE MASTERY AND CONTROL OF ANIMALS TYPICALLY IN SPORTING SITUATIONS.
<u>NEGATIVISTIC:</u>	PRIMARY ORIENTATION AN ACTIVE AVOIDANCE OF ANIMALS DUE TO INDIFFERENCE, DISLIKE OR FEAR

---

\* The aesthetic attitude was eliminated from most of Kellert's results because he found no adequate scale to measure the attitude.

Source: Kellert 1980.

APPENDIX 2

Postulated attitude occurrence, behavioral expressions, and values and benefits of ten basic attitudes of Americans toward wildlife proposed by Stephen R. Kellert.

<u>Attitude</u>	Estimated % of American Population Strongly Oriented Towards the Attitude*	<u>Common Behavioral Expressions</u>	<u>Most Related Values/Benefits</u>
Naturalistic	10%	outdoor wildlife related recreation -- backcountry use, nature birding and nature hunting	recreational
Ecologicistic	7%	conservation support, activism and membership, ecological study	ecological
Humanistic	35%	pets, wildlife tourism, casual zoo visitation	companionship, affective
Moralistic	20%	animal welfare support/membership, kindness to animals	ethical, existence
Scientistic	1%	scientific study/hobbies, collecting	scientific
Aesthetic **	15%	nature appreciation, art, wildlife tourism	aesthetic
Utilitarian	20%	consumption of furs, raising meat, bounties, meat hunting	consumptive, utilitarian
Dominionistic	3%	animal spectator sports, trophy hunting, animal training	sporting
Negativistic ***	2%	cruelty, overt fear behavior	little or negative
Neutralistic ***	35%	avoidance of animal behavior	little or negative

\*Totals more than 100% as persons can be strongly oriented toward more than one attitude.

\*\* The aesthetic attitude was eliminated from most of Kellert's results because he found no adequate scale to measure the attitude.

\*\*\* The negativistic and neutralistic attitudes were combined under the single attitude: negativistic.

Source: Kellert and Berry 1980.

APPENDIX 3

Specific days, hours of observation, and weather conditions for each of the three sign situations at the Crater Lake National Park study site. Weather observations are for Crater Lake National Park Headquarters, three miles and 500 feet in elevation below Rim Village.

---

No Signs

Day (Date)	Hours of Observation	Sky and Wind Conditions	Maximum Temperature ( °F)
Tues (8-9)	1:00 pm - 4:00 pm	clear, calm	73
Sun (8-14)	10:30 am - 1:30 pm	clear, calm	74
Tues (8-16)	12 noon - 3:00 pm	clear, calm	72
Fri (9-16)	12 noon - 6:00 pm	clear, calm	72
Sat (9-17)	12 noon - 6:00 pm	clear, calm	67
Mean Max. Temp.			71.6

---

Squirrel-Welfare Signs

Day (Date)	Hours of Observation	Sky and Wind Conditions	Maximum Temperature ( °F)
Sun (8-21)	11:30 am - 5:30 pm	clear, calm	62
Sun (8-28)	10:30 am - 4:30 pm	clear, calm	63
Tues (8-30)	11:00 am - 5:00 pm	overcast, calm	48
Fri (9-9)	11:00 am - 5:00 pm	clear, calm	45
Mon (9-12)	11:00 am - 5:00 pm	clear, calm	68
Mean Max. Temp.			57.2

---

Bubonic-Plague Signs

Day (Date)	Hours of Observation	Sky and Wind Conditions	Maximum Temperature ( °F)
Sat (9-3)	10:00 am - 4:00 pm	clear, calm	58
Sun (9-4)	10:00 am - 4:00 pm	clear, calm	66
Tues (9-6)	11:00 am - 5:00 pm	clear, calm	69
Thurs (9-8)	10:00 am - 4:00 pm	partly cloudy	61
Sun (9-11)	11:30 am - 5:30 pm	clear, calm	60
Mean Max. Temp.			62.8

---

APPENDIX 4

Total visitors, visitors eating, and squirrel feeders eating at the study site in Crater Lake National Park. Five days of sampling under each sign situation are included.

Signs	Visitors in Study Area		
	Number of Visitors	Visitors Eating	Percent Visitors Eating
None	2,356	195	8.3
Squirrel Welfare	3,069	214	7.0
Bubonic Plague	3,889	250	6.4
Total	9,314	659	7.1

APPENDIX 5

Food items offered to the squirrels at the Crater Lake National Park study site.

Food Item	No. of Individuals Offering Item	Percent of Individuals Offering Item
Peanuts	120	20.5
Bread	92	15.8
Crackers	78	13.4
Popcorn	54	9.2
Ice Cream Cones	40	6.8
Sunflower Seeds	37	6.3
Potato Chips	28	4.8
Candy	27	4.6
Corn Chips	19	3.3
Cheerios	18	3.1
Cheetos	17	2.9
Pretzels	11	1.9
Cake	9	1.5
Gorp	9	1.5
Cookies	6	1.0
French Fries	4	0.7
Breadsticks	3	0.5
Apple	3	0.5
Other	9	1.5
Total	584	100.0

APPENDIX 6

Feeding parties taking pictures of the squirrels under the three sign situations at the Crater Lake National Park study site.

---

Signs	Feeding Parties Taking Pictures	
	Number*	Percent of Total Feeders
None	44	36.4
Squirrel Welfare	42	45.2
Bubonic Plague	32	46.4
Total	118	41.7

---

N=283

\* Twenty-seven squirrel feeders were not observed as to whether or not they were taking pictures.

APPENDIX 7

Participation in squirrel feeding by groups and individuals under each of three different sign situations at the Crater Lake National Park study site.\*

Categories of Parties	Signs			Total No. (%)
	None No. (%)	Squirrel Welfare NO. (%)	Bubonic Plague No. (%)	
Single Male Adult	4 (3.0)	1 (1.1)	2 (3.1)	7 (2.4)
Male Adult Group	0 (0.0)	2 (2.2)	1 (1.6)	3 (1.0)
Single Female Adult	6 (4.5)	6 (6.6)	3 (4.7)	15 (5.2)
Female Adult Group	1 (0.7)	3 (3.3)	3 (4.7)	7 (2.4)
Adult Couple, Aged 20-39	31 (23.1)	14 (15.4)	8 (12.5)	53 (18.3)
Adult Couple, Aged 40+	6 (4.5)	6 (6.6)	5 (7.8)	17 (5.9)
Mixed Sex Adult Group (More Than 2 Persons)	18 (13.4)	3 (3.3)	6 (9.4)	27 (9.3)
Adult(s) with Child or Children	54 (40.3)	48 (52.7)	32 (50.0)	134 (46.4)
Single Male Child	4 (3.0)	3 (3.3)	3 (4.7)	10 (3.5)
Male Children's Group	1 (0.7)	0 (0.0)	0 (0.0)	1 (0.3)
Single Female Child	3 (2.2)	4 (4.4)	0 (0.0)	7 (2.4)
Female Children's Group	2 (1.5)	1 (1.1)	0 (0.0)	3 (1.0)
Mixed Sex Children Only	4 (3.0)	0 (0.0)	1 (1.6)	5 (1.7)

N=289

\* Persons under 20 years of age were classified as children. Each group (more than one person) was characterized by all members of a party, not just those members who were feeding squirrels.