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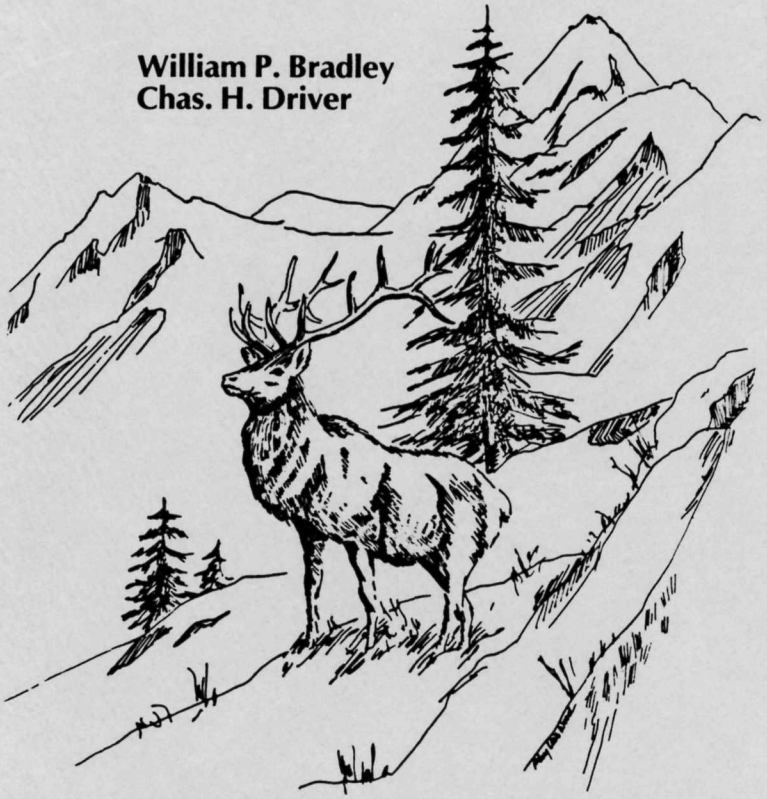

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INTRODUCTION

Elk management in the western states has often been subject to heated and emotional controversies, both among different public agencies responsible for elk management and between these agencies and the public at large. The National Park Service (NPS) is extremely susceptible to adverse criticism and negative public opinion resulting from elk management decisions, because they do not have at their disposal the accepted managerial tool of sport hunting to control and regulate problem populations. The NPS's direct reduction-by-shooting program in Yellowstone Park has become a classic example of a managerial solution resulting in inflammatory inter-agency conflict and public relations problems. (*See* Pengelly 1963 and Woolf 1971 for excellent discussions of the Yellowstone situation.)

The intent of this paper is to summarize the elk management problems at Mount Rainier National Park in the State of Washington and the actions taken to mitigate them. The seat of this controversy revolves around a large summering elk population's impact on the sub-alpine meadow system contained within the park. This pristine meadow complex, renowned for its outstanding floral displays, is second only to the mountain itself as a major park attraction. Mount Rainier National Park, located in the south-central Cascades (Figure 1), has within a 100-mile radius of its boundaries such large metropolitan centers as Portland, Tacoma and Seattle. The close proximity of the park to this large urban-oriented user group ensures careful scrutiny by the general public of all NPS management policies pertinent to Mount Rainier National Park.

While the NPS is tolerant to natural impacts on vegetation sustained by native herbivores, the present Mount Rainier elk herd stems from an introduced population which utilizes park habitats only on a seasonal basis. This fact necessitated the NPS to approach the management of the Mount Rainier elk herd from a cooperative inter-agency point of view. This paper provides a factual review of the Mount Rainier elk situation and an interesting perspective on the involved agencies' response to this management problem.

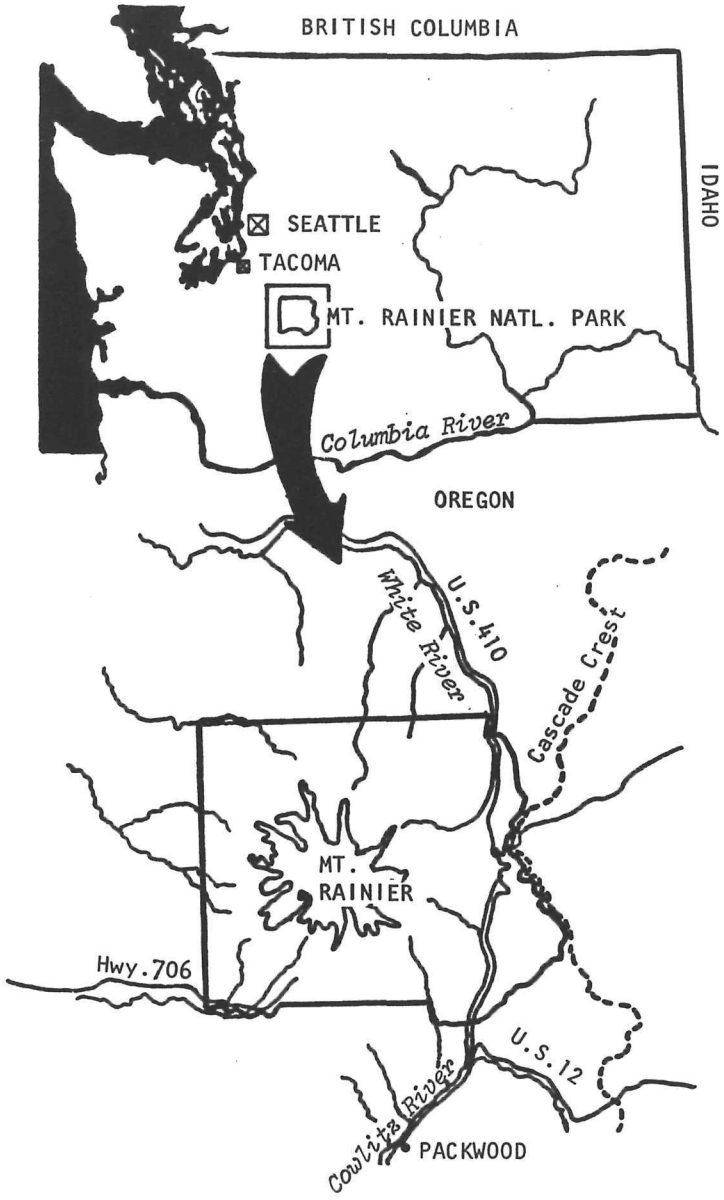

FIGURE 1. Location of Mount Rainier National Park in State of Washington.

WERE ELK NATIVE TO THE PARK?

The native elk of the western slopes of the Cascades and Western Washington was the Roosevelt elk (*Cervus canadensis roosevelti*). There is little evidence to demonstrate that this native elk ever existed within park boundaries in large numbers. Furthermore, we believe that the native Roosevelt elk never utilized the high sub-alpine zones of the Cascades as summer range and probably were not found in the upper headwaters of the White and Cowlitz River systems. The historical presence of Roosevelt elk has been firmly established along the western boundary of the park in the Puyallup, Mashell, and Nisqually River drainages; but even here it is very doubtful that they utilized habitats within the park above 3,000 feet in elevation. To examine this hypothesis, we offer the following lines of thought.

Archeological Evidence

If elk populations had existed within the boundaries of Mount Rainier National Park or the near vicinity, their remains would have been uncovered in archeological excavations of Indian encampments. Unfortunately, there is a paucity of information regarding ecological interrelationships of early inhabitants of the area with their environment (Smith 1964; Jermann and Mason 1976). Cascade Mountain and inland Washington environments have been neglected by archeologists in favor of the plethora of rich sites in the plateau and coastal regions of the state. The only archeological dig within the boundaries of the park was a high sub-alpine site at Frying Pan Rock-shelter in the northeast quadrant of the park (Rice 1965). This excavation indicated a temporary summer hunting camp that had been in occupation almost continuously for between 300 to 1,000 years. All bones identified were those of deer (*Odocoileus hemionus*) and no elk remains were found.

Ethnographic Record

Smith (1964) and Jermann and Mason (1976) provide excellent reviews of the native Indian utilization of environments in and around Mount Rainier National Park. All of these tribes utilized elk as a food source. However, references to elk and elk hunting are limited to the foothill areas of the Cascades. Indian expeditions into the Mount Rainier area were largely for the purpose of berry picking or the hunting of mountain goats and deer. The feeling that elk were hunted by early Indian tribes in Mount Rainier National Park seems to emanate from the unsubstantiated writings of Schmoe (1924, 1925, 1926) and Winthrop (1913). Schmoe recorded his statements in the *Mt. Rainier Nature News*, a non-technical public information document produced by the park staff. Winthrop's writings concerned the ancient Indian legend of Hamitchou, which he first heard from an elderly Indian in 1852. This legend concerns the mystical experiences of an Indian elk hunter on the flanks of the mountain then referred to as Tahoma. We feel that none of these

sources can be substantiated or accurate and regret that they have been incorporated in the literature as factual. It is interesting that Smith's (1964) informants also noted that the native elk of the lowland areas were different from the present introduced variety.

Early Historical Evidence

Early written historical records of the Mount Rainier area also support our contention that the Roosevelt elk did not historically inhabit the park. In 1841, Lt. Robert Johnson, a member of the Wilkes expedition, traversed the White River Valley on the northern boundary of the park and crossed Naches Pass into eastern Washington (Meany 1916). Throughout the entire trip, Johnson only saw one deer at the junction of the Carbon and White Rivers (which he shot) and his comments on the near impassability of the dense vegetation in the White River Valley reflect the area's heavy stand of timber. Johnson's feelings on the denseness of the forest vegetation in the White River Valley were echoed by Winthrop (1913) when he traversed the same route in 1853. Winthrop was only able to shoot one grouse for food during his trip and his horse almost starved for lack of palatable forage.

The Upper Cowlitz River Valley was first visited by white men in 1854, when James Longmire and William Packwood were guided into the area by an Indian (Tompkins 1933). No mention of elk was made on this trip, or of elk in the general area south of Mount Rainier in the later published narratives of James Longmire, although he did state he was daily supplied with wild deer meat from an Indian hunter (Palmer 1932). In 1859, a hunting trip to the eastern flanks of Mount Rainier was undertaken by two unknown white men and their Indian guides (McWhorter 1917). Deer and mountain goat were plentiful but elk were not observed. P.J. Flint took a party of Yakima hunters over the Cowlitz Pass, down the Summit Creek drainage to the Ohanapecosh River, and then up the Cowlitz Divide ridge in 1881 (McIntyre 1952). This party saw no game throughout the entire trip. In 1886, a party of Yakima Indians and one white man hunted the eastern slopes of Mount Rainier (Brown 1920). They found no game and were forced to hunt the south side of the mountain, in the vicinity of Indian Henry's Hunting Ground, for mountain goats.

Further evidence of the lack of elk in the immediate area can be seen through the settlement patterns of the Upper Cowlitz River Basin. This region was settled by transplanted Appalachian mountaineers and, between 1882 and 1925, was referred to as Little Kentucky (Clevenger 1938). The Appalachians were excellent hunters, and the freedom to hunt and support themselves with wild meat was one of the main reasons for their settling in this area. The main game animals were deer, bear and cougar; elk were not mentioned.

Large group outings by the Mazama Club in 1897 (McIntyre 1952) and the Sierra Club in 1905 (Sampson 1908; Randall 1908) also failed to provide evidence of any elk in the Mount Rainier high country or surrounding

environments. Both of these parties reported deer and mountain goats as the only large game animals observed.

Ecological Evidence

Perhaps the most convincing argument lies in the habitat requirements of elk. If one envisions the historical vegetation from the crest of the Cascades to the foothill area of the Puget Sound trough, the picture presented is an endless blanket of conifer vegetation, much like the present conifer habitats in the lower elevations of Mount Rainier that have not recently been disturbed by fire. The relatively homogenous conifer overstory lacked the diversity of habitats necessary to continually support a large ungulate such as the elk. These forest conditions in west slope Cascade habitats have remained relatively intact for nearly 2,500 years (Heusser 1960) and this contention is supported by paleoecological pollen analysis (Hansen 1947). While some slopes have been occasionally and temporarily disturbed by forest fires, the only areas capable of continually maintaining the habitat diversity necessary for moderate to dense elk populations would have been the riparian corridors and their associated flood plains. We feel confident that limited amounts of such habitats did exist around the periphery of Mount Rainier and that there were probably small pockets of Roosevelt elk present in these habitats.

These populations may have temporarily expanded in burned areas, but the natural fire rotation exceeding 450 years (Hemstrom 1979) suggests that enhanced elk habitat occurred only during a small proportion of the forest successional cycle. As an example, there was only one small clearing, a five-acre sedge meadow, in the entire Upper Cowlitz River Valley when the first settlers arrived (Clevenger 1938). We feel that the structure of habitats surrounding Mount Rainier were not conducive to the establishment of moderate populations of Roosevelt elk and, due to its generally higher altitude, we doubt that any such populations existed on a permanent basis in the park.

ORIGINS OF PRESENT ELK POPULATIONS

With the beginning of the conservation movement at the turn of the century, a great amount of emphasis was placed on re-stocking former big game ranges. Within the State of Washington, local county game commissions began to import elk from the Yellowstone/Grand Teton area to re-colonize areas from which the native elk had been extirpated. Between 1912 and 1933, 509 elk were transplanted from those two Rocky Mountain parks into the State of Washington.

The most significant plants affecting the future history of the Mount Rainier elk herd were the 1912 plant on Grass Mountain in the White River drainage, the 1914 and 1915 plants on Bethel Ridge to the east of the park

boundary and the 1932 and 1933 plants between the west park boundary and Eatonville. These transplants ultimately formed the nucleus of the elk populations presently inhabiting Mount Rainier National Park.

These transplanted herds of Yellowstone elk gradually dispersed into park environments until, by the early 1930s, elk were observed on permanent winter ranges in the Upper Cowlitz Valley outside the park boundary. The general pattern of observations recorded during this period suggests a two-pronged invastion of park habitats by the introduction of elk herds. One path suggests the movement of elk west, over the Cascade crest and into the park. The newly established elk herds continued a slow growth until the early 1950s. At this time, changing patterns of land use created the winter range necessary to sustain large populations. This land use was, of course, the clear-cut logging practices utilized by the US Forest Service around the periphery of the park boundary. Small clear-cut blocks of land in early seral vegetative conditions created by logging provided the elk with the necessary base to sustain the harsh winters. Sighting records in the park and estimates of total park elk populations increased dramatically from this point on.

HISTORY OF PARK SERVICE INVOLVEMENT IN MOUNT RAINIER ELK MANAGEMENT

Early Concerns

With the establishment of the park in 1899, much concern was voiced in early park records for the extirpation of local wildlife by unregulated sport hunting. The general feeling in regard to elk at this time was that they probably represented part of the original park fauna, but had been eliminated some time ago with the encroachment of civilization into the area.

With the introduction of the Yellowstone elk populations around the periphery of the park, further concern surfaced over this species invading park habitats and replacing the supposedly native Roosevelt elk. It is interesting to note that in 1934 members of the park staff met with the recently appointed State Commissioner of Game and Fish, Mr. Roy James, to discuss this problem. The state agreed that these introduced elk should be eliminated and replaced with the native species, and expressed a strong willingness to assist in every possible way to accomplish this end.

Later in this same year, the National Park Service made a decision about the fate of the introduced elk in Mount Rainier. They felt it would be impossible to totally eliminate the Rocky Mountain elk from Mount Rainier and that their best hope for maintaining a stable gene pool of Roosevelt elk was to concentrate on the Olympic Peninsula. The NPS felt that the Puget Sound trough provided a fairly effective barrier against further mixing of any Yellowstone and Roosevelt elk and that no further attempts to

re-introduce Roosevelt elk into Mount Rainier should be attempted (Thompson 1934).

For the next 28 years, little was done in the form of policy or decision making regarding the introduced elk populations in Mount Rainier National Park, even though these populations kept increasing. By the late 1950s, it was not uncommon to see large groups of elk in the Shriner Peak vicinity and in the Nickle Creek drainage. During this period, elk observations in the north side of the park also started to increase. It is important to note that at this time there still had been no quantifiable studies made to ascertain the effects of elk utilizing the park.

The park's attitude toward its elk population was abruptly changed during the summer of 1962. John Larson, a biologist for the US Forest Service, conducted an aerial elk census along the Cascade Crest encompassing the park's eastern boundary. He counted a total of 466 elk, with over 300 of them observed in the general vicinity of the Shriner Peak complex. No one had previously imagined that this many elk were utilizing the high sub-alpine environments of the park, and it generated attention toward the impact of this large introduced ungulate on the sub-alpine meadows.

Beginning of Current Management Activities

In response to the data generated by the Larson flight, Park Superintendent John Rutter officially declared the elk situation in Mount Rainier to be a problem worthy of NPS concern. He designed an in-house task force to review the elk situation and produce a report and recommendations. Several reports surfaced during the next eight years, but all of them underscored the lack of any quantifiable information on which to base a management decision. The general feeling of park personnel was that elk inhabited Mount Rainier only during the summer months and migrated to lower winter ranges outside the park boundaries during the winter. This fact limited the amount of direct control the Park Service had over the situation and brought other land management agencies into the picture.

To address both the seasonal movements of the elk herd and the need for increased communication with other land management agencies, the Park Service formed the Mount Rainier Deer and Elk Management Coordinating Committee in 1968. This committee was composed of individuals from the US Forest Service (including personnel from three different National Forests), the Washington State Game Department, the National Park Service, and designated representatives from the Washington State Sportsmen's Council and from Weyerhaeuser Company. After several years of observations and cooperative discussions by all parties, it was agreed that more detailed information was needed on the use of elk within the National Park boundary. Because the other cooperating agencies did not agree completely with the Park Service's contention that elk were adversely affecting the native vegetation, nor with the idea that the elk were seasonal migrators in and out of the park boundaries, it was necessary to research the following questions:

1. What was the total population of elk in the park and what were the characteristics of this herd;

2. Was the population a resident herd, staying within the park boundaries or did it, indeed, migrate outside the park during the winter;

3. What were the characteristics of elk use and their impact on sub-alpine environments; and,

4. What areas of the park were most intensively utilized.

As a result of these actions by the Mount Rainier Deer and Elk Management Coordinating Committee, the NPS moved to initiate the development of a research program to look into these areas of needed information. In 1969, NPS research biologist Max Holden initiated an elk marking program for the purpose of delineating patterns of elk movement and migration. Holden was transferred, however, and the in-house research efforts were extremely limited by available personnel.

National Park Service officials also felt that the data should be generated by an outside agency and therefore eliminate any possibility of internal bias in the results. In response to this need, an elk research program, supported by the NPS, was established at the College of Forest Resources at the University of Washington. Field activities were initiated in March, 1973 and continued actively through the summer of 1977.

THE ELK RESEARCH PROGRAM IN MOUNT RAINIER NATIONAL PARK

The elk research program initiated by the Park Service spawned a new era in understanding of elk ecology and movement in Mount Rainier National Park and the surrounding area. Space limitations and the intent of this paper do not permit thorough examination of all the results of this research; only the highlights as they are pertinent to our understanding of the Mount Rainier elk situation will be given here. The actual data on which the following statements are based, however, can be found in annual reports by Driver and Danielson (1974), Bradley et al. (1975), Bradley and Driver (1976), and Bradley (1978a, 1978b, and 1978c). These individual reports are presently being condensed into one volume detailing the Mount Rainier elk investigations.

Abundance and Distribution

To provide accurate data on the present distribution and number of elk currently utilizing sub-alpine environments in Mount Rainier a unique aerial survey technique was developed. The aerial survey involved flying over the sub-alpine meadow complexes in the two hours immediately prior to sunset on

repeated aerial flights throughout the summer. The technique was field tested in the summer of 1973 and then used repeatedly during the summers of 1974 through 1976 without deviation.

The results of this survey, shown in Figure 2, indicate that the entire eastern half of the park is occupied by summering elk populations. The arrows in this figure point to recent observations of elk in the relatively unoccupied western portion of the park. Most of these observations are found in the low elevation riparian corridors along the major stream sources.

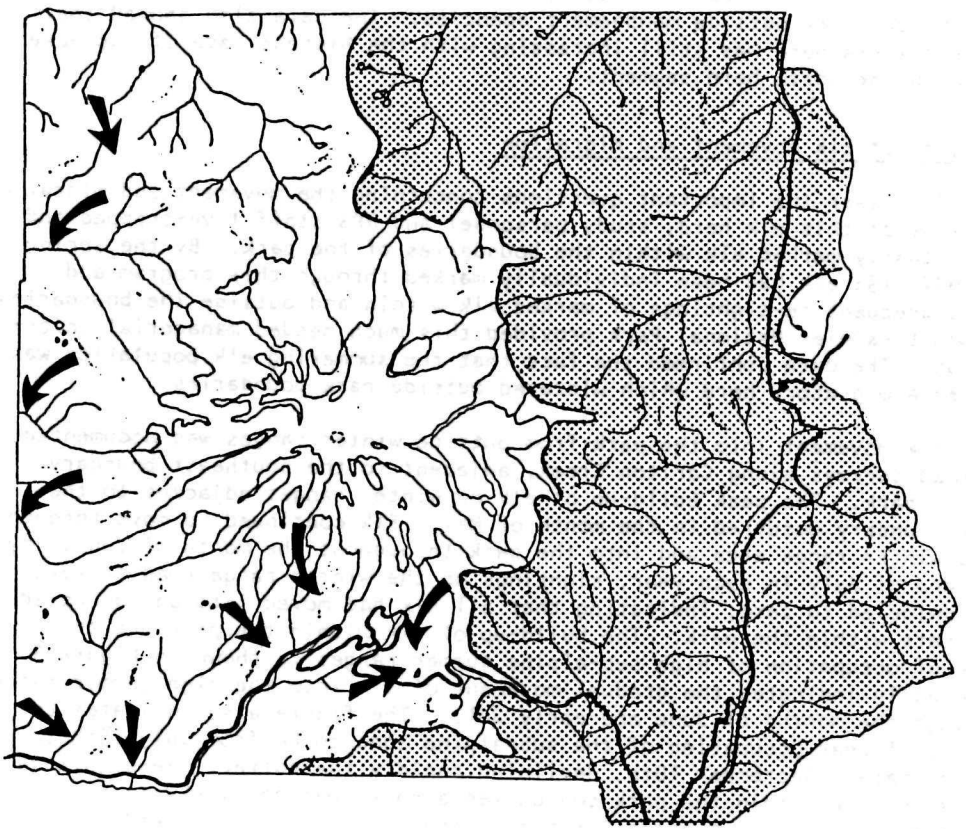

FIGURE 2. Present distribution of summer elk populations in Mount Rainier National Park (stippled area). Arrows indicate recent observations of elk in the eastern region of the park.

These observations were not surprising as elk were known to inhabit the river drainages on the west of the park boundary prior to the start of the present study. However, observations were also made in sub-alpine habitats on Mazama Ridge and Indian Henry's Hunting Ground during the course of the study. These observations may indicate a westward expansion of the present Mount Rainier elk population.

The number of elk utilizing sub-alpine habitats in Mount Rainier were estimated by the same aerial census technique. These data showed between 1300 and 1700 elk utilizing park habitats throughout the course of the study during summer months. The abundance of elk within park habitats was much higher than was previously thought by either the National Park Service or other outside management agencies. The data also showed that the total elk herd was still increasing with the highest rate of increase found in the north herd segment.

Patterns of Elk Movement and Migration

To answer the important questions concerning the movement and migration patterns of this elk herd, study personnel and NPS staff live-trapped and individually marked elk within the boundaries of the park. By the spring of 1977, 193 elk had been individually marked through this program and the subsequent re-sightings of marked elk within and outside the boundaries of Mount Rainier National Park provided this much needed managerial information. The data confirmed the fact that the summering elk population was indeed a migratory herd which wintered outside park boundaries.

Elk movement into the park from outside winter ranges was documented by road surveys along Carlton Creek, adjacent to the southeast boundary of the park. The peak build-up of elk on winter ranges adjacent to the park boundary occurred in the month of May. Elk continued to move through this winter range area and into the park throughout the month of June. By the end of July in each year, sightings on the winter range road surveys had dwindled to zero, indicating that all elk had moved into and occupied habitats within the park. The build-up of elk within the park and the rate of occupation of high sub-alpine summer ranges is shown in Figure 3; it clearly indicates the gradual movement of elk into the high summer ranges through the months of June and early July. The figure also indicates the period of peak occupation of the sub-alpine zone to be from July 15th to approximately September 10th, declining rapidly thereafter. Re-sightings of marked elk within the park boundaries also showed conclusively that there are two distinct herds inhabiting the park. The north herd winters in the White River drainage while the south herd winters in the upper Cowlitz River drainage. Although the range of these two distinct herds comes together in the park in the vicinity of Cayuse Pass, there is little interchange between them. Similarly, there was shown to be little interchange between Mount Rainier elk herds and elk herds summering on the crest of the Cascades, adjacent to the eastern boundary of the park.

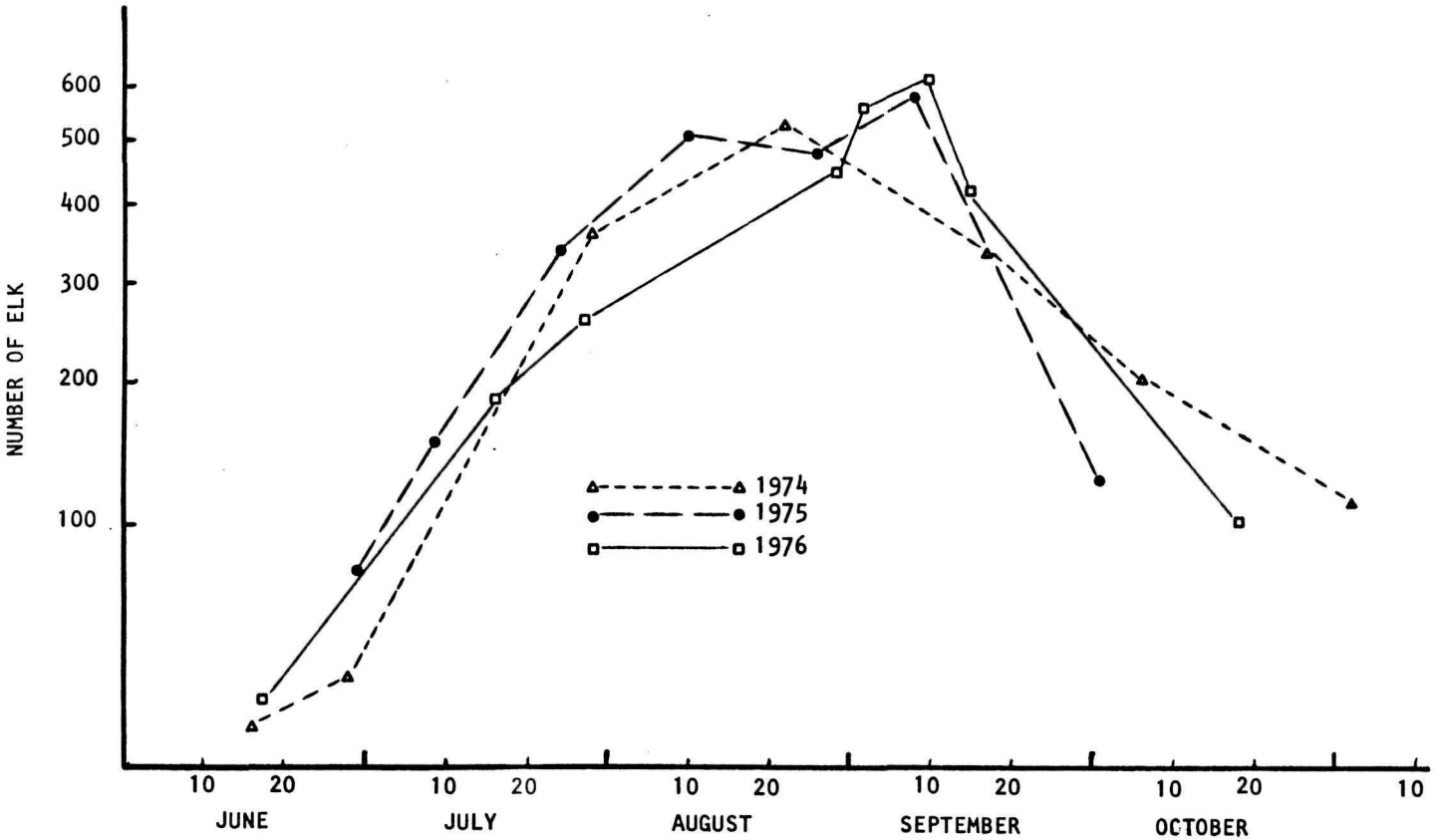

FIGURE 3. Number of elk observed on subalpine ranges during individual aerial surveys, 1974-76. The graph illustrates the temporal pattern of elk migration and occupation of summer range units within the park.

Re-sightings of elk marked in the park on winter ranges outside the boundaries are shown in Figure 4 for the south herd area. Additional documentation substantiating the migratory nature of the elk herd is shown in Figure 5. This figure was obtained by plotting the known death sites from all sources of mortality obtained for individually marked elk during the course of the study. Of the forty individually marked elk trapped within the park boundaries whose death sites were known, 90 percent of them died outside the park. Migrational distances from winter range outside park boundaries to summer range inside park boundaries averaged from eight to twelve miles, although distances of up to 25 miles were recorded.

Impacts on Vegetation

The research effort documented the obvious physical impacts of elk, such as wallowing, trailing and denudation of vegetated areas. Small vegetation exclosures were erected around intensive use areas to measure the rate of recovery and the response of vegetation in the absence of grazing pressure from elk. Although these techniques measured an obvious and certainly substantial impact, the real question we sought to answer was the more subtle effects of elk grazing and trampling on the floristic dynamics of the meadows themselves. Measuring this elusive relationship proved difficult, for virtually all of the sub-alpine meadow areas on the eastern side of the park had already been impacted by the presence of the elk. It was decided that similar sub-alpine areas on the west side of the park could not be used, as the influence of different weather patterns on the vegetative structure would not yield comparable results.

It was decided to approach this question with a uniquely designed simulation study. Two small areas unaffected by the presence of elk were located. Random plots were laid out and elk foraging was simulated by clipping with grass shears, while elk trampling was simulated by physically trampling the vegetation with an artificially constructed elk hoof. Nine different combinations of clipping and trampling, ranging from control plots with neither impact to plots receiving both heavy clipping and heavy trampling, were built into the experiment. Other treatments evaluated different areas of use, different intensities of use (one treatment vs. two treatments per year), different soil substrates and different vegetative communities. Impacts on specified soil parameters were also evaluated. Vegetative cover was chosen as the main unit of measurement and this was broken down by forage class and by individual species.

The response of total vegetative cover to the simulations on all plots is shown in Figure 6 for two years of treatment. Heavy trampling alone resulted in a 44 percent loss of vegetative cover by the second year of treatment. The combined effects of heavy trampling and heavy foraging resulted in a 60 percent loss of vegetative cover through the second year of treatment. The analysis was further broken down into forage classes of woody browse, grass and grasslike plants, and forbs. These results were

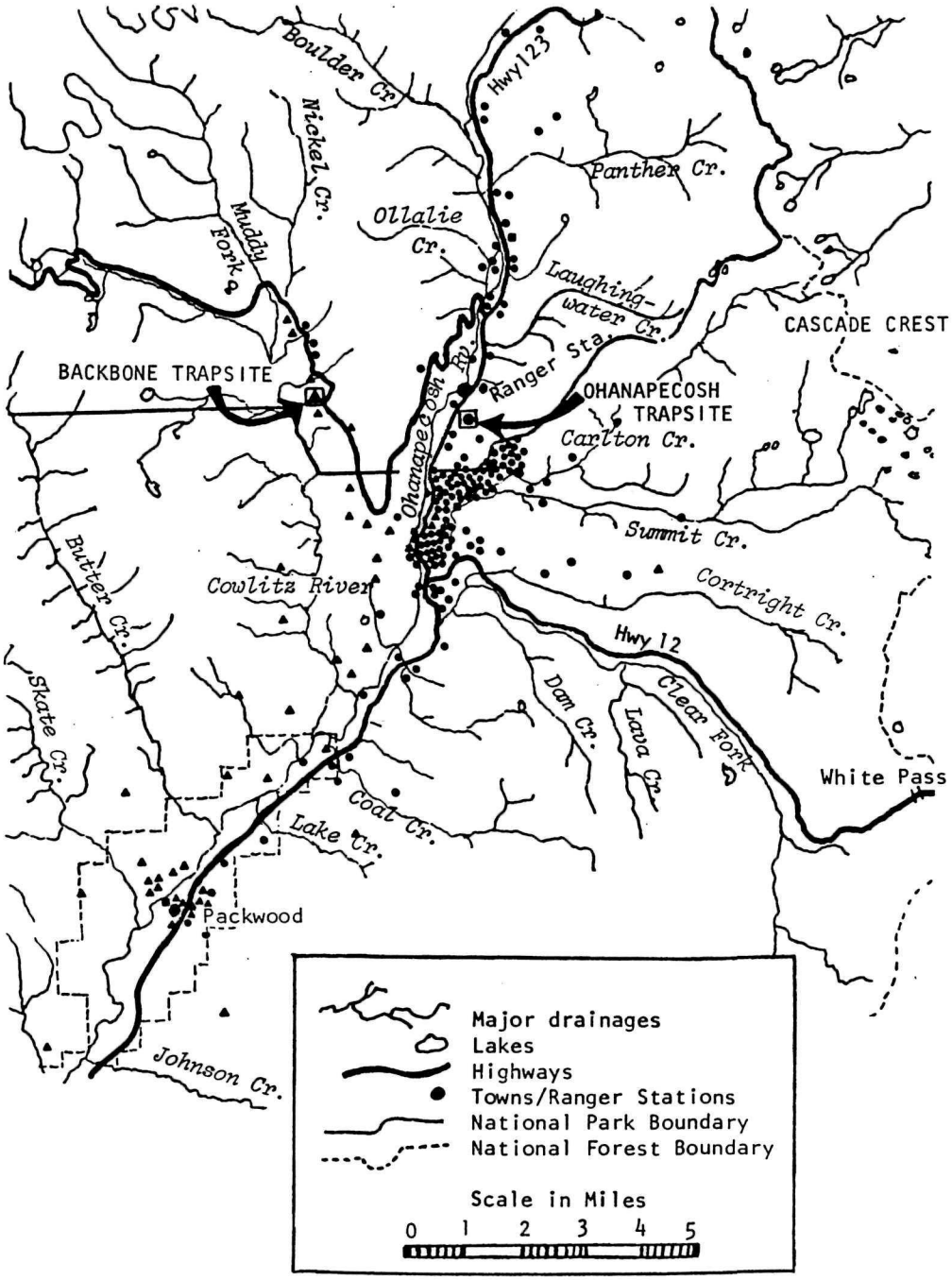

FIGURE 4. Winter and early spring re-locations of individually marked elk caught in the Backbone and Ohanapecosh traps within the boundaries of Mount Rainier National Park. Concentration areas reflect degree of observation time and may not indicate true densities.

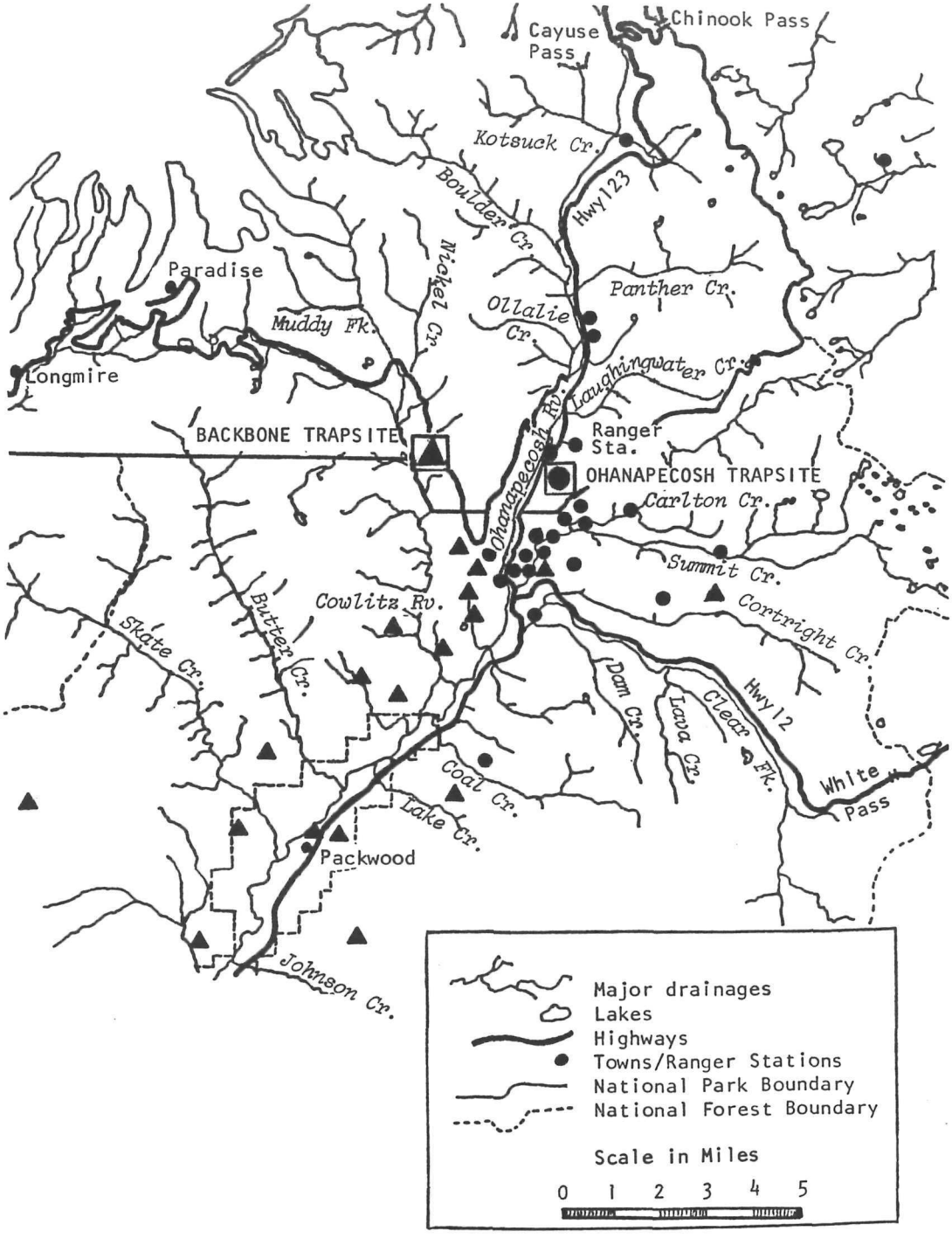

FIGURE 5. Known death sites of forty individually marked elk recovered from the South Rainier herd area during the course of study.

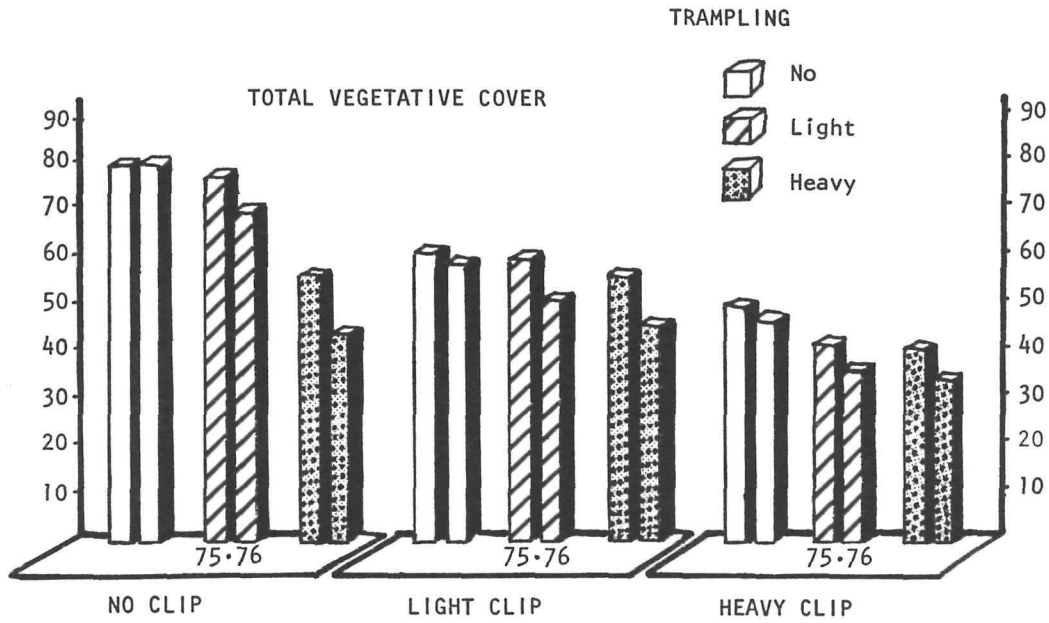

FIGURE 6. Response of total vegetative cover to varying degrees of simulated elk foraging and trampling over a two-year time span. (For each pair of bars on the graph, the bar on the left represents percentage for 1975 and the bar on the right represents percentage for 1976.)

even more enlightening. In all the different treatments measured, the forb component of the meadow systems sustained the greatest damage due to the simulated presence of elk. In those plots treated twice per year, the forb component of the meadow system decreased almost 77 percent by the end of the second year of treatment. The woody browse plants, mostly *Vaccinium* spp., were most affected by trampling and least affected by foraging. Grasses and grasslike plants showed a large decline in percent vegetative cover the first year of treatment but held their own or increased slightly during the second year of treatment. As vegetative cover decreased, accumulated surface organic litter also decreased, exposing more bare mineral soil. After the second year of treatment the plots were allowed to rest for one year and then were re-measured. This recovery phase never attained the vegetative cover found on the sites previously and was characterized by a rapid invasion of the disturbed sites by species not previously found in the vegetative association. These species were characteristic of drier, more arid sites found in other areas of the park.

Concurrently with the simulation experiment, we conducted studies on the food habits of elk within the park. These studies corroborated our observations in the simulation experiment in that those forb species most consumed by elk were the same species that were disappearing on the simulation sites, while the invading species were of a less palatable nature.

Although the results of any simulation experiment can never be presumed to exactly mimic the situation as found in nature, the treated plots closely resembled those meadows found in high use concentration areas. We feel that the presence of elk in Mount Rainier sub-alpine environments is definitely changing the floristic composition of the sub-alpine meadow system.

The Effects of Sport Hunting

Because of the potential of sport hunting around the periphery of the park to regulate the Mount Rainier elk herds and the differing opinions on whether the "park" elk constituted any segment of the huntable population, studies were carried out to determine the impact of sport hunting on the Mount Rainier elk herd. Check stations were set up in strategic areas outside the park boundary. This effort was concentrated in the south herd area.

Monitoring the sport hunting season further documented the migratory nature of the Mount Rainier elk herd and also pointed out the effects of weather on these movements and their influence on the success or failure of the general elk hunting season. In both 1974 and 1976, early winter storms did not occur until mid-November. In both these years, few elk were harvested in the area from Packwood north to the park boundary. In 1975, however, early winter storms came in the middle of October. By the beginning of elk season in the first week of November, elk had already started their migration out of the park to the lower winter ranges. This resulted in a

harvest five times greater than that occurring in the two years of good weather. In addition, hunters observed and harvested many elk that had been individually marked within the boundaries of Mount Rainier National Park. Succeeding storms during the 1975 hunting season also allowed documentation on the effect of inclement weather in triggering additional waves of elk migrating out of the park boundary with each passing weather front. This fact was reflected both in the observations of elk and in the harvest of elk. These data showed fairly conclusively that, in the south Rainier herd area, the success of the sport hunting season is dependent largely on the inclusion of the Mount Rainier herd in the harvest and that this herd's presence or absence is determined largely by the severity of early winter weather patterns.

THE MANAGEMENT PROGRAM

A major objective of the Mount Rainier elk study was to develop potential management alternatives based on scientific research and appraisal of the elk situation in Mount Rainier National Park. The purpose of this emphasis was to integrate research findings into the decision making process of the park management staff and provide administrators with the knowledge of the management options available to them. It was one thing to assess the impact of a large introduced ungulate on a natural system and quite another to decide on an appropriate management strategy.

The Role of the Mount Rainier Deer and Elk Management Coordinating Committee

This committee, as previously noted, was originally formed in 1968 as a forum in response to damage complaints by the NPS. An inter-agency agreement was drawn up and signed, followed by much discussion of the "elk problem." It was this inter-agency committee that had outlined the need for research input before a management decision could be made. Attendance and interest in the committee functions increased as the research data was reviewed. Additional working group meetings of field biologists were formed from the parent committee in 1974. This group planned the collection of field data during the fall hunting seasons and coordinated these efforts. By 1977, the committee meeting was attended by US Forest Service personnel from three different national forests, Game Department personnel from two districts and the Olympia main office, NPS personnel from Mount Rainier National Park and the Regional Office, University of Washington biologists and representatives from public sportsmen's organizations--a total of over 60 people.

The main purpose of these meetings was to publicly review the results of the NPS research effort conducted by the University of Washington. As the results were shared, criticisms and new ideas were aired, and deficiencies were pointed out. The committee proved to be an extremely effective vehicle for presenting information, exchanging ideas and promoting management interests.

The Management Alternatives

In 1976, University of Washington personnel submitted a detailed report of five management alternatives available to the NPS to control the Mount Rainier elk population. These five alternatives were:

1. No action on the part of the National Park Service.
2. Exclusion of elk from the park by fencing.
3. Physical manipulation of elk in areas of concentration.
4. Direct reduction by shooting of elk herds within the park.
5. Control of number of elk through sport hunting.

The first four alternatives were considered either too expensive or impractical. The fifth alternative, sport hunting (which is not allowed within national parks), had tremendous potential to regulate and control an elk herd within reasonable limits. Research had already indicated that at some point in virtually every winter the majority of the Mount Rainier elk herd must migrate outside the park boundaries to find suitable winter range. This fact made portions of the herd available to hunters outside the park, the size of the portion being dependent on the severity and earliness of the winter.

The major advantage of this management alternative was that it allowed potential control of the population through an established social tradition, thus eliminating an adverse public reaction. Sport hunting exerts a control function that is independent of the quality of the winter range in that, if the quality and availability of the winter range unexpectedly increases due to logging or wild fire, the only adjustment necessary is to increase the harvest to maintain an established base population. This was of critical value due to the lack of land management control exercised by the Park Service for the winter range.

The major disadvantage to this alternative was that the decision making body controlling sport hunting lies outside NPS administration--in the Washington State Department of Game. However, this agency, through its participation in the inter-agency elk management committee, had already demonstrated that it was cognizant of the elk situation within the park and was willing to work out a management solution to alleviate the problem.

The Sport Hunting Proposal and its Results

Prior to 1976, the Washington State Game Department hunting unit boundaries were too large to manage for a specific reduction in the Mount Rainier elk herd. In order for hunting to be an effective management tool around the periphery of the park, changes were in order. Small management units would have to be created that would primarily affect only the desired target population. A special or late season hunt would have to be instigated, which would compensate for the erratic weather patterns and ensure the presence of elk in the management units at the desired time. The force of mortality would have to be concentrated on the reproductive segment of

the herd, i.e., females, until the desired level of population reduction would be achieved.

The sport hunting management alternative was proposed before the elk management committee during their 1976 winter meeting. Changes in the management units were proposed (Figure 7). These small units were selected to affect only specific target populations and were based on the movement and migration studies of marked elk. Adjacent elk herds, such as the Goat Rocks herd in the south unit and the Clearwater River herd in the north unit, would not be affected. This proposal was well received and action was initiated at an earlier date than anticipated. The Washington State Game Department structured a special late season antlerless-only elk hunt in the recommended area in the south herd unit, known as the Backbone Unit, and the first hunt was held on an experimental basis in December, 1976.

The results of the first four years of this special late-season hunt may be seen in Table 1. The first hunt was conducted during the driest winter on record and the typical weather-influenced migration of park elk did not occur until well after the special season closed. This resulted in only five female elk being harvested during this hunt. These results were disappointing at first; however, they proved to be a fortuitous circumstance. Local public disapproval was running at a high level prior to the 1976 hunt. The low percentage harvest did much to alleviate the public's fears that the special hunt would "wipe the elk out," or decimate resident elk herds outside the park.

TABLE 1. Results of late season anterless-only Backbone Unit elk hunt in the Mount Rainier south herd area, 1976-79.

Year	Number of Permits	Number of Elk Harvested	Success Rate
1976	75	5	7%
1977	75	68	90%
1978	75	71	95%
1979	75	33	44%

An excellent harvest has been obtained in the three years subsequent to that first hunt. The Backbone Unit hunt has turned out to be one of the most successful and popular late season control hunts ever structured by the Washington Department of Game. Marked elk have appeared among the harvested elk in each year, and their presence contributes to the general public's feeling that they were, indeed, harvesting park elk. The special late season hunt has also effectively checked the rate of increase in the south Rainier herd (Hanley et al. 1979).

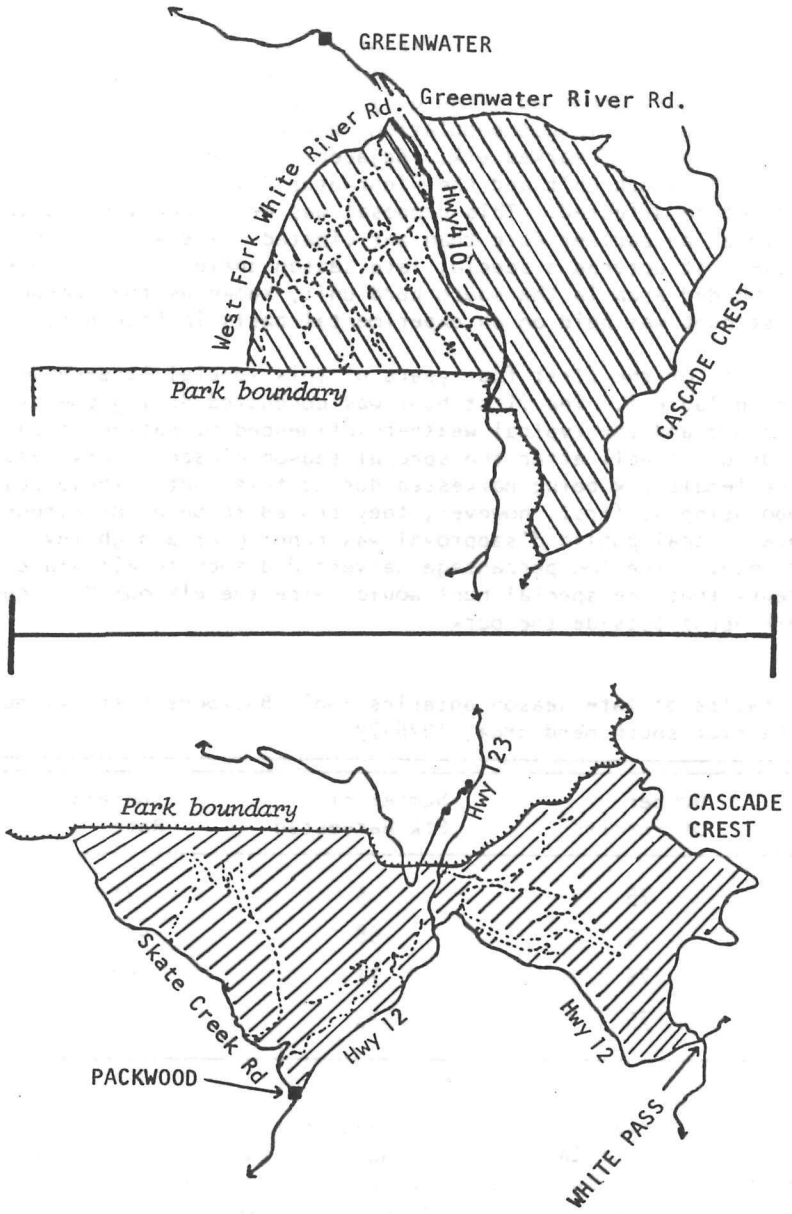

FIGURE 7. Proposed boundary changes in State Game Department hunting units in the upper White River drainage (*above*) and the upper Cowlitz River drainage (*below*). These changes would allow late season controlled hunting specifically targeting Mount Rainier elk.

Increased Activity by Other Agencies

The shared results of the NPS research on the Mount Rainier elk herds also stimulated other agencies to participate in active data gathering. In particular, the patterns of herd movement in the less intensively studied north herd conflicted with previous theories of movement in this drainage. The single NPS elk trap on the White River was not sufficient to obtain an overall picture of movement within the entire north herd area. This fact prompted the US Forest Service and the Washington State Game Department, in cooperation with the Park Service, to intensify the elk marking program in this drainage. Three new elk traps were constructed outside park boundaries and an active elk tagging program was initiated. The US Forest Service also initiated its own aerial census program to monitor elk marked in the new trapping program.

The Washington State Game Department has conducted a 100 percent sample of all special season elk hunters since the inception of the hunt. The Department's efforts have provided the needed information with which to evaluate the new management activity.

DISCUSSION

The chain of events outlined in the preceding summary indicates that the conflict over elk management in Mount Rainier National Park can be approached through a logical and orderly chain of events. There were and are conflicts and disagreements between agencies involving the interpretation of research results, over the severity of the problem, and its method of handling. Part of the controversy lies in the differing management objectives of the agencies involved. Some officials from the Washington State Game Department and the US Forest Service believe that what the National Park Service calls impact represents elk "use" and not "abuse." These agencies have differing responsibilities but both are actively involved in the management of habitat to promote the enhancement of big game populations.

In one sense, they are quite correct. The sub-alpine environments of Mount Rainier National Park could actually support a denser elk population than now exists based on standing biomass of available vegetation. Early environmental concerns that elk impact within Mount Rainier National Park would result in the sub-alpine system literally washing down the sides of the mountain and into Puget Sound are incorrect. However, the management objectives of the Park Service as mandated by Congress are quite different from these other two agencies. The NPS is responsible for conserving and preserving the integrity of an ecologically unique sub-alpine meadow system as defined by the synecological studies of plant ecologists. The complexity and composition of these meadows have been previously documented and studied by both Hamann (1972) and Henderson (1974). The NPS is not in the business of managing meadow systems as elk summer range, but rather in preserving this unique ecological entity as part of the natural heritage of millions of Americans.

The differing opinions and conflicts between these land use agencies, then, are not necessarily biological ones, but rather are basic differences in management objectives. This takes the controversy out of the realm of mere biology and places it in the bio-political arena. Ability to resolve these differences in management objectives, therefore, revolves around the willingness of the separate agencies to sit down and share concern for each other's problems and perspectives. One of the more unique aspects of the Mount Rainier elk story is that this is being accomplished by these various agencies. All participants have demonstrated a willingness to look beyond their agency's philosophical perspective and appreciate the constraints faced by the other agencies.

The Park Service's reaction to this situation is particularly noteworthy. In past resource conflicts of this nature, the NPS has received considerable public criticism for actions taken without input from other resource agencies. In some cases, the NPS's reaction has been to withdraw within itself and carry on all further efforts in-house. The response to the present situation was exemplary and merits review. The NPS first called

attention to this situation as a problem. It gathered all potentially involved agencies into a public forum to discuss the situation and receive input. Realizing nothing would be accomplished without research data, the NPS commissioned an independent and unbiased body of investigators to appraise the elk situation. It allowed these investigators to operate outside park boundaries during the general hunting season. It took the results of this research and formulated management alternatives, and again turned and presented these before the public inter-agency committee. The NPS took no actions solely on its own, but pressed hard for resolution of its problem based on the research data.

The NPS has also made a long-range commitment to elk research and monitoring within the park. Recently, a permanent vegetative monitoring system was designed and installed (Hanley et al. 1979) to monitor the effects of elk within the sub-alpine system. The Park Service continues to monitor elk population levels every summer with the aerial census program.

There are still many problems associated with the presence of elk in Mount Rainier. The north herd is continually increasing and it is hoped that a management solution involving sport hunting can be derived for this herd. The NPS has also been forced to accept the permanence of elk within these ecosystems as there are too many points of re-introduction around the park boundary to feel that elk could ever be permanently eliminated. Although all these matters are still of paramount managerial concern, the Mount Rainier elk situation has become a classic combination of problem definition, research activities, and inter-agency coordination.

The NPS needed a determination of a tenable level of impact beyond which it felt it could no longer perform its own management perogatives. It then needed the sympathetic cooperation of outside management agencies to achieve any hope of rectifying the situation. These things were and are being achieved in the Mount Rainier elk herd. Such responsible actions by the NPS and by all agencies connected with this inter-agency approach at elk management should serve as a model for similar confrontations in the future.

LITERATURE CITED

Bradley, W.P. 1978a. Management considerations for the Mount Rainier elk herd. Univ. of Wash., College of For. Res., unpubl. ms. 20 pp.

_____. 1978b. Population distribution and abundance in the Mount Rainier elk herd. Univ. of Wash., College of For. Res., unpubl. ms. 23 pp.

_____. 1978c. Patterns of elk movement and migration in the Mount Rainier elk herd. Univ. of Wash., College of For. Res., unpubl. ms. 28 pp.

Bradley, W.P., J.E. Danielson, L.P. Landrie, and G.C. Burrell. 1975. Studies on the effects of elk on ecosystems of Mount Rainier National Park. Univ. of Wash., College of For. Res., 2nd Ann. Prog. Rpt. 85 pp.

Bradley, W.P. and C.H. Driver. 1976. Studies on the effects of elk on ecosystems of Mount Rainier National Park. Univ. of Wash., College of For. Res., 3rd Ann. Prog. Rpt. 80 pp.

Brown, A.L. 1920. Ascent of Mount Rainier by the Ingraham Glacier. The Mountaineer, 13(1):49-50.

Clevenger, W.R. 1938. The Appalachian mountaineers in the upper Cowlitz region. Pac. N.W. Quart., 29(2):115-134.

Driver, C.H. and J. Danielson. 1974. Studies on the effects of elk on ecosystems of Mount Rainier National Park. Univ. of Wash., College of For. Res., 1st Ann. Prog. Rpt. 85 pp.

Hamann, M.J. 1972. Vegetation of alpine and subalpine meadows of Mount Rainier National Park, Washington. M.S. thesis, Wash. St. Univ., Pullman. 120 pp.

Hanley, T.A., C.H. Driver, R.D. Taber, and M. Wallace. 1979. Design and implementation of a monitoring system for elk populations and their impact on subalpine meadows in Mount Rainier National Park. Univ. of Wash., College of For. Res., Final Rpt. to U.S.N.P.S., Pac. N.W. Reg. Off., Seattle, Wa. 108 pp.

Hansen, H.P. 1947. Postglacial forest succession, climate, and chronology in the Pacific Northwest. Trans. of the Amer. Phil. Soc., 37(1):1-130.

Hemstrom, M. 1979. A recent disturbance history of forest ecosystems at Mount Rainier National Park. Ph.D. dissertation. Oregon St. Univ., Corvallis. 67 pp.

Henderson, J.A. 1974. Composition, distribution, and succession of sub-alpine meadows in Mount Rainier National Park. Ph.D. thesis, Oregon St. Univ., Corvallis. 152 pp.

Heusser, C.J. 1960. Late-Pleistocene Environments of North Pacific America. Amer. Geograph. Soc. Publ., No. 35. 308 pp.

Jermann, J.V. and R.D. Mason. 1976. A cultural resource overview of the Gifford Pinchot National Forest, south-central Washington. Univ. of Wash., Off. of Publ. Arch., Inst. for Environ. Affairs, Recon. Rpt. No. 7. 217 pp.

McIntyre, R.N. 1952. A brief administrative history of Mt. Rainier National Park. M.F. thesis. University of Washington, Seattle. 259 pp.

McWhorter, L.V. 1917. Chief Sluskin's true narrative. Wash. Hist. Quart., 8:96-101.

Meany, E.S. 1916. Mount Rainier: A Record of Explorations. Macmillan Co., New York. 325 pp.

Palmer, L. 1932. Narrative of James Longmire. Wash. Hist. Quart., 23:47-60.

Pengelly, W.L. 1963. Thunder on the Yellowstone. Wildl. and Nat. Parks Naturalist, 14(2):18-25.

Randall, M. 1908. The sky line of the Tatoosh Range: Mt. Rainier National Park. Sierra Club Bull., 6:15-21.

Rice, D.G. 1965. Archaeological test excavations at Frying Pan Rockshelter, Mt. Rainier National Park. Wash. St. Univ., Lab of Anthro. Rpt. of Investigations. No. 33.

Sampson, A. 1908. Wild animals of the Mt. Rainier National Park. Sierra Club Bull., 6:32-38.

Schmoe, F.W. 1924. Mt. Rainier National Park Notes. Mt. Rain. Nat. News., 2(1):1-4.

_____. 1925. Our Greatest Mountain: A Handbook for Mt. Rainier National Park. Putman, N.Y.

_____. 1926. Two distinct types of people. Mt. Rain. Nat. News., 3(15):2-3.

Smith, A.H. 1964. Ethnographic guide to the archaeology of Mt. Rainier National Park. Unpubl. Final Rpt., Contract No. 14-10-0434-1422, submitted to U.S.N.P.S. by Wash. St. Univ. 275 pp.

Thompson, B.H. 1934. Memo to Park Supt. Tomlinson from Chief of the Wildl. Div., U.S.N.P.S. on file at Mt. Rainier Nat'l. Park, Wa.

Tompkins, W.A. 1933. The big bottom (Lewis County), 1883-1933. Wash. Hist. Quart., 24:250-257.

Winthrop, T. 1913. The Canoe and Saddle (J.H. Williams, ed.). Franklin Ward Co., Portland, Or.

Woolf, A. 1971. The Yellowstone elk controversy. Pp. 230-248, *in* Natural Resources and Public Relations (D.L. Gilbert, ed.). The Wildl. Soc., Wash., D.C. 320 pp.

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