PREDICTING THE IMPACTS OF A HIGH-VOLTAGE TRANSMISSION LINE ON BIG GAME HUNTING OPPORTUNITIES IN WESTERN MONTANA

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ABSTRACT: The State of Montana, in cooperation with the U.S. Forest Service and Bonneville Power Administration, is conducting a five-year study on the impacts of a 500-kV transmission line on elk habitat and hunter opportunity. In fall, 1983, baseline data on hunting patterns and quality were collected from over 600 hunters interviewed in three western Montana study areas. A cluster analysis revealed seven types of hunters, each of which should be affected differently by the transmission line impacts. Hypotheses developed will be tested during two subsequent hunter surveys in 1985 and 1986.

INTRODUCTION

In the spring of 1983, Bonneville Power Administration (BPA) began clearing the right-of-way for a 158-mile-long section of a 500-kilovolt transmission line across western Montana. The line, which begins at Garrison, will transfer power generated at Colstrip to a substation at Taft, near the Idaho border.

The final route for the transmission line was chosen from many alternatives, each having different effects on the Montana environment. The State and Federal agencies locating the line gave considerable weight to social concerns in the siting process, choosing a route that crossed very little private land. In western Montana, this meant avoiding the valleys, instead crossing National Forest lands that provide a wide spectrum of wildlife habitat and dispersed recreation settings.

Paper presented at the Recreation Choice Behavior Symposium, Missoula, MT, March 22-23, 1984.

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In its final report on the project, the Montana Department of Natural Resources and Conservation (DNRC) said that the chosen route would affect fewer people and fewer homes than the other routes, but would have greater potential to damage natural systems (DNRC 1983).

Of particular concern was the potential for adverse effects on hunting opportunity; the line would cross areas providing secure summer and fall habitat for elk and other big game species. Among these were three areas that had been evaluated under the Forest Service's Roadless Area Review and Evaluation process (RARE II). These areas were released and will likely be subject to multiple-use management. Habitat security in roadless areas is essential to allow elk to hide from hunters (Lonner and Cada 1982).

Not only is hunting big business in western Montana, it is an integral part of many Montana residents' lifestyles, and probably one of the reasons many people choose to live here.

The line could have three main types of effects on hunting opportunities in western Montana:

1. The many miles of new and upgraded roads needed to construct the line and maintain access to the towers would increase hunter access to these areas, potentially increasing elk vulnerability and kill rates.

2. The increased access could make the areas less remote, both physically and perceptually. Hunters desiring a remote setting would be less satisfied, while road hunters or others desiring improved access would benefit.

3. The transmission line itself, with its 175-foot-tall steel lattice towers and 150-foot-wide right-of-way clearing, could intrude on the naturalness of the

area, decreasing the quality of the experience for hunters who value esthetics.

The Montana Department of Fish, Wildlife, and Parks (DFWP) is especially concerned about the effects of increased access, which is already a problem in western Montana. A 1980 survey of hunters in western Montana found that "...Forest roads and the access they provide are, and will continue to be, a serious threat to the future of big game management in Region 2" (Thomas 1980, p. 1). Asked whether motorized travel should be reduced or increased in the hunting district, 24 percent of the hunters interviewed at check stations indicated that access should be greatly reduced, and 23 percent felt it should be moderately reduced. Thirty-seven percent favored maintaining present access levels, and only 12 percent wanted to see access moderately or greatly increased. It was concluded that hunters support existing road closure policies and favor further reductions in road access during hunting season.

Big game species such as elk are also valued by people who don't necessarily buy a hunting license. To many, wildlife symbolizes environmental quality and the human relationship with nature (Shaw 1978). This study does not address nongame values of wildlife, but readers should keep in mind that decreases in elk habitat may be viewed as negative by hunters and nonhunters alike.

THE ELK MONITORING STUDY

The Department of Natural Resources and Conservation, in cooperation with BPA, the Forest Service, Bureau of Land Management, and Montana Department of Fish, Wildlife, and Parks (DFWP) is monitoring transmission line impacts on elk habitat and hunting opportunity, and will explore the potential to reduce any significant impacts identified. The monitoring program has three main objectives:

1. Determine the changes in elk use of summer/fall security area habitat due to the construction of access roads and operation of the transmission line.

2. Determine the changes in hunting opportunity and quality caused by operation of the line and access roads.

3. Provide for integration of the elk monitoring study data into future logging plans for specific projects and the forest planning process.

The 5-year monitoring program has biological and social components. Current animal use of elk habitat, the extent and quality of elk habitat affected by construction, elk response to construction and operation disturbances, and elk population characteristics are being measured through foot surveys and radio telemetry (Elliott 1983).

For the social portion, hunters are being interviewed in the field at three times: once before construction; once in 1985 after the line is built and energized; and again in 1986 to see if any changes in hunting patterns remain over time. The baseline survey will also serve as a pilot study, to help develop hypotheses and research designs for the subsequent phases.

The preconstruction survey was designed to obtain baseline information on current hunter use of the study areas and predict how different types of hunters will be affected by the transmission line. This required a description of current users of the study areas. We needed to know not only who they were, where they were from, and how often they hunted in the study areas, but why they chose the study areas as recreation settings, and how these areas compared to their other hunting grounds. This information should help assess the hunters' responses to changes in the hunting setting (Manfredo and others 1983).

Our principal concern was how changes in the setting would alter the chance of hunters having desirable experiences (Clark and Stankey 1979).

If the setting attributes valued by hunters change, and settings similarly valued are unavailable (or farther away), then current hunters may have to use the altered area, perhaps decreasing hunting satisfaction, or find a substitute. Of course, new hunters could be attracted to the altered setting (Anderson 1981).

This paper presents the results from the baseline hunter survey, conducted by DNRC in fall 1983. The following sections describe the framework of the study, research hypotheses, results, and what the conclusions mean for the Phase II (post-construction) survey and detailed impact assessment.

The elk and hunter studies are taking place in three areas located along the transmission line route: the Harvey/Eightmile; Middle Fork Rock Creek; and Packer Creek areas. These were chosen because they contain elk security habitat, support large elk populations, and represent the various climatological and vegetational characteristics of lands along the route.

In addition, the Forest Service is planning timber sales near each of the areas, which could add to impacts created by the transmission line and access roads. Another criterion was ease of measuring hunter use; seven check stations were adequate to cover primary access points into the three study areas. Car counters were installed by DFWP at or near each check station to compare use levels during general hunting season with use before and after.

Use of the Harvey/Eightmile study area, about 13,000 acres in the John Long Mountains south of I-90 and between Rock Creek and Hall, was measured by check stations at Harvey Creek and Beavertail. The Middle Fork Rock Creek study area, about 6,000 acres north of I-90 between Twelve Mile road and DeBorgia, was monitored by three check stations. The Packer Creek study area, about 9,600 acres located north of I-90 between Haugen and Saltese, was monitored by two check stations.

LITERATURE REVIEW

It is helpful to begin by defining hunting as a recreational activity in which people participate in a recreational setting to attain certain types of experiences or satisfactions, and thereby achieve certain psychological outcomes or benefits (Driver and Brown 1975, 1978; Manfredo and others 1983). By understanding what types of experiences people are seeking through hunting, we can learn about their setting preferences--how likely a given recreational setting is to meet their needs (Clark and Stankey 1979).

Hunting, like other recreational activities, is done for many reasons. Utilitarians may hunt primarily for the meat, and their satisfaction can be measured by the size or quantity of animals killed. Others may hunt to bag a trophy animal, gaining a sense of achievement from displaying the trophy. Others perhaps hunt to be outdoors, walking through the woods and enjoying natural surroundings. Sharing the experience with others, or even just getting some exercise, are also possible motivations for hunting. To other hunters, seeing wildlife in its natural habitat or having a chance to test their tracking and shooting skills may provide the greatest enjoyment.

Hunters seek these and other types of experiences in different patterns and levels of intensity (Hautaluoma and Brown 1978; Brown and others 1977; Hautaluoma and others 1982). Nearly every study of hunting has concluded that there is far more to hunting than killing an animal; hunting is enjoyable for many reasons. In a review of 56 studies, Hendee and Bryan (1978) found that nearly all of the reasons people gave for hunting could be categorized under 16 general types of satisfaction people gain from outdoor recreation. This suggests that hunters share many goals with participants in other activites, such as backpacking. Ashor and McCool (1983), for example, found that hunters and nonhunters visited the Bob Marshall Wilderness for many of the same reasons.

Schole and others (1973) identified 12 sources of satisfaction among Colorado hunters, including being outdoors, socializing, and escaping from the daily routine. Potter and others (1973) reached a similar conclusion: "Hunting satisfaction is complex and consists of many elements or aspects of the hunting experience" (p. 220). Their study of Washington State hunters listed 11 dimensions of hunting satisfaction, that overlapped Schole and others' categories.

In a national poll, Kellert (1978) found that killing an animal, hunting for sport, and enjoying nature were the broad reasons given for hunting. He believed that although people hunt for all of these (and other) reasons, one reason should be the most important, and the others subordinate.

Once researchers identified the various dimensions of satisfaction, the next obvious step was to see if hunters could be grouped into categories based on their patterns of satisfactions derived from hunting. This would let resource managers gain a better understanding of their "clients," thus improving their ability to create and maintain satisfying recreational experiences.

This has been accomplished in several studies using cluster analysis to group hunters based on types of satisfaction they value. Such analyses first require identifying the dimensions of satisfaction for a given group of hunters. After the hunters are scored on each dimension, their scores across all dimensions are compared. Hunters having similar patterns of responses are grouped together, forming a hunter "type" having common reasons for hunting, attitudes toward possible management actions, and demographic characteristics. This method has also been used to type the attitudes of resource managers toward recreation activities (Allen 1979).

Hautaluoma and Brown (1978) used data collected in Washington State to identify 10 types of hunters, each having a different pattern of satisfactions across five dimensions: nature; harvest; equipment; out-group contact; and skill. The types

also differed on many other variables, including age when they began hunting, commitment to the sport, age, education, and income. Some types of satisfaction--enjoying nature and applying hunting skills--were important to nearly every hunter type. Other variables--desire for harvest and solitude--effectively distinguished one type from another.

Brown and others (1977) used the same method to define types of deer hunters in Colorado. They identified nine dimensions of hunting satisfaction, four of which were chosen for cluster analysis: easy hunt; harvest; out-group contact; and nature. Based on how much each of the four dimensions added to or detracted from their hunting experiences, eight hunter types emerged. The types also differed on attitudes toward three of ten possible management actions, including two dealing with increased access to hunting areas.

Elk hunting in Colorado has been similarly studied. Hautaluoma and others (1982) found that six sources of hunting satisfaction (outgroup contact, harvest, easy hunt, frustration release, in-group contact, and a broad dimension containing skill, equipment, excitement, and nature) were stable across four license groups (resident rifle hunters, nonresident rifle hunters, muzzle-loaders, and archers).

Depending on the license group, from five to seven types of hunters were found. Among resident rifle hunters, for instance, one type was low on all dimensions—potential dropouts of the activity who did not seem enthusiastic about any aspect of hunting. A second group was characterized by a high need for skill display, equipment use, excitement, and contact with nature, and by low needs for an easy hunt or releasing frustration. A third group was high on all dimensions, enthusiastic hunters who enjoy many aspects of hunting. The fourth type was also high on most dimensions, but had a low need for releasing frustration. The fifth group did not derive satisfaction from out-group or in-group social contact, and the sixth was not sufficiently unique to score one way or the other across the six dimensions. The authors used this information, plus the demographic correlates of the hunter types, to develop a brief case history for each group, outlining the similarities and differences among the various types.

This research has a clear application for resource managers. If hunting is done for many reasons, then a multiple-satisfaction approach to game management is necessary (Hendee 1974). The traditional approaches of using game killed or hunter days expended as measures of recreational quality ignore many of the other, sometimes more important, aspects of hunting. Like other recreational activities, hunting is done for different reasons, and identifying these reasons—and for whom they are important--can help resource managers:

> Rather than managing as if all users are alike, it is possible to conceive of the kinds of users according to the patterns of satisfaction they seek, the relative proportions of the kinds of users in the population, and the characteristics that distinguish the kinds of users from one another (Hautaluoma and others 1982, p. 79).

METHODS

DNRC assumed that some hunters--those who value aspects of the setting that could be altered by the transmission line--will be particularly vulnerable to the types of impacts expected to occur. The key variables likely to predict vulnerability to impacts were isolated from the literature based on the anticipated effects of the line on hunting areas, and on the hunting satisfactions that seem most dependent on the settings that will be affected. Hunters were also asked to indicate on a map where they had hunted. The following variables were measured:

1. The role of nature, harvest, access, remoteness, convenience, and past experience in recreation setting choice;

2. Hunting style and success;

3. Hunters' evaluations of the study areas compared to other places they hunt; and

4. Age, residence, previous big game hunting experience.

DNRC asked hunters whether enjoying nature was extremely, very, moderately, slightly, or not at all important in their decision to hunt where they did. (This same response format was used in subsequent questions.) The larger the proportion of hunters for whom enjoying nature is important, the greater the chance the line would disrupt their behavior.

Two questions were used to tap the access-remoteness dimension: the importance of hunting in an area with few roads; and of hunting in an area with few other hunters. In phrasing the questions this way, DNRC assumed that the study areas were perceived as having few roads and other hunters; the study areas provide secure habitat because roads are sparse. Hunters saying these two reasons were not important in their setting

choice could, however, actually be saying that they do not consider the study areas to have these attributes.

The issue was split out because the impacts could be independent. For example, it might not be the roads themselves that people object to, but the likelihood that more hunters will use the area. Similarly, other hunters might not mind seeing more people, but object to being around vehicles, or simply being near a road. Each of these access items was scaled similarly to the question on enjoying nature.

Another question was designed to measure the perceived adequacy of the existing road system; hunters indicated whether, for hunting purposes, they believed the study areas contained too few, too many, or about the right number of access roads.

Because road hunters could have different views on appropriate levels of access than those hunting primarily away from roads, DNRC categorized hunters as road hunters or non-road hunters based on their responses to a question asking where they hunted.

Two Likert-scaled items similar to those described above asked hunters the importance of obtaining a trophy animal, and the importance of putting meat in the freezer. Although both involve killing an animal, hunters rating one of these as more important could be affected differently by the line. Trophy hunters would presumably be more concerned over effects on branch-antlered bulls, and meat hunters concerned about effects on all elk. Although these two aspects of harvest have often been lumped together in past studies, it was desirable to separate them to better define impact vulnerability.

Hunters were also asked how important hunting nearby was in recreation setting choice. If the most important reason someone hunts a given area is simply that it is close, then he or she may continue to hunt there, even if the setting is altered. However, if hunters value hunting nearby in combination with other experiences, such as being in an area having few roads, then any impacts on the study area gain significance.

We also asked hunters how many years they had hunted in the specific area they indicated on the map. Hunters using the area for the first year were formed into one group for analysis. The remaining hunters were formed into two groups, those who had hunted there less than or more than the median number of years hunted (not including first-time visitors).

Hunters who return to the same settings year after year can develop a knowledge of and affinity for these areas. Viewing the area as their "home range," they may respond with "territorial defense" to alterations of their hunting spots (Thomas and others 1973). They should therefore be more opposed to changes in the physical, biological, social, or managerial character of the resource than someone having little experience in the area (unless, of course, they find such changes beneficial). They should also be more apt to view the area as one of their favorite places to hunt, and to favor the number of existing roads in the area. Hunters return to an area, presumably, because they find aspects of it attractive. More experienced hunters should also be more specialized (Bryan 1979) and, therefore, more dependent on a specific area or type of area in which to hunt.

How the study area fits into the range of places people hunt in western Montana should be crucial in predicting both the magnitude and significance of impacts from the transmission line. If a person's favorite hunting spot is disrupted, the impact would be perceived as greater than if the affected area is just one of many places a person hunts. Hunters were asked whether the specific area was their favorite place to hunt in western Montana, one of their favorite places, one of many places they hunt, or whether they prefer to hunt elsewhere.

The survey was conducted during the 1983 big game hunting season, October 25 to November 27. The seven check stations, staffed for 91 person-days with six interviewers hired by DNRC, consisted of a State vehicle and two signs (one 500 feet up the road and one at the vehicle) similar to those regularly used by DFWP at its enforcement check stations. (In Montana, hunters are required by law to stop at check stations, even if they have not harvested any game.)

All hunters who stopped were asked to answer a few questions about their hunting trip. After identifying themselves, the interviewers administered the first half of the questionnaire, recording each hunter's responses on separate forms. If they were hunting in or adjacent one of the study areas, hunters were asked to complete the second half of the questionnaire themselves, and given a clipboard and pencil.

Hunters who had already completed a questionnaire on an earlier visit were not asked to complete another unless they were hunting in a different area or had killed an elk or deer. Repeat hunters (and

nonhunters) were noted to help interpret car counter data. (This report will not deal with that information.)

The first 2 days of the survey were treated as a pilot study, after which DNRC and the interviewers reviewed the questionnaire and check station methods, refining them as needed. Because no changes were made in questionnaire content, the data from these 2 days were combined with that from the rest of the study.

RESULTS AND DISCUSSION

During hunting season, about 6,000 hunters passed by the seven check stations. Questionnaire data were obtained from 664 hunters. Respondents hunting elk in or within 1 mile of the study areas were also asked to complete the back side of the questionnaires, so some questions had a sample size of 525. Seven hunters went past the check stations without stopping, and seven more stopped but refused to complete the questionnaire, citing a variety of reasons (some of them quite colorful). The final response rate was thus high--98 percent.

The check stations efficiently sampled study area users; 89 percent hunted inside or within 1 mile of the study areas. Only one check station, Cabin City, sampled a high rate of people hunting elsewhere (40 percent). Most were hunting for the day (83 percent), while 9 percent were on a 2-day trip. Eighty-six percent lived in Montana, and 36 percent of the sample lived in Missoula. Their average age was 36, and they had been hunting big game in Montana for over a decade (mean = 13 years, median = 10). The specific locations where they hunted were coded on a grid system for each study area.

Two-thirds of the hunters (67 percent) said that enjoying nature was an extremely or very important reason they were hunting in the specific area indicated on the map, while 10 percent said that nature was of slight or no importance. Hunters rated this dimension of hunting as the most important in setting choice of any reason listed, a finding consistent with past research. Hunters in the study areas were hunting close to the line's future path; 54 percent hunted to within one-half mile of the route, and 18 percent more were within one mile. Furthermore, 70 percent of the hunters would have to cross under the line to reach their hunting areas. This close proximity indicates that any esthetic impacts would be very noticeable, although some hunters may not mind the change.

Because 74 percent of those sampled hunted primarily away from roads, one would expect them to value remote hunting areas containing limited road access and not overpopulated by other hunters. This was the case, as over half (54 percent) of the hunters said that being in an area where there were few other hunters was extremely or very important in their setting choice (table 1). Only one-fifth said this was not much of a factor in their decisions. The

Table 1.—Hunters' ratings of the importance of reasons for hunting in the area (total sample, n = 528)

Reasons	Ratings				
	Extremely important	Very important	Moderately important	Slightly important	Not at all important
A. To enjoy nature	33	34	23	7	3
B. To put some meat in the freezer	30	23	31	12	4
C. To hunt in a remote area where road access is limited	20	20	31	13	16
D. To get a trophy animal	8	9	28	21	34
E. Because I (or others I know) have hunted here before	12	21	29	22	26
F. Because I live near here	15	17	21	15	32
G. To hunt in an area where there are few other hunters	28	26	25	10	10

other Likert-scaled question on remoteness found that 40 percent rated being in an area having limited road access as an extremely or very important reason in their setting choice (table 1). Twenty-nine percent said this was unimportant in their decision.

These findings can be interpreted two ways. The preference for limited road access and few other hunters could indicate desire for solitude. It could also, however, indicate a concern over hunting success; increased roads and hunters could be viewed as more competition for game.

The hunters did not favor increased road access; 62 percent thought that the existing number of roads was about right, 27 percent thought there were too many, and only 11 percent felt the number of roads was too few. It is not surprising that the majority favored the status quo, for if they didn't like the area, they probably wouldn't hunt there, assuming better-liked settings are available. If the number of roads is altered, however, most hunters would prefer to see it lessened, not increased. Many comments volunteered by hunters dealt with access roads, showing the concern over this issue.

The hunters interviewed killed 20 elk, 38 deer, and one bear. About 900 hunter-days were expended to kill the elk, with 45 hunter-days required for each elk. This corresponds roughly to historical figures (DFWP 1978).

The primary aspects of hunting success--putting meat in the freezer and getting a trophy animal--were valued very differently by the hunters. As has been found in previous research, the prospect of bagging an animal for meat was a primary component of hunting. However, it was slightly less important than enjoying nature ($t = 3.62$, $p < 0.01$). Hunting for meat (along with hunting in an area where there are few other hunters) was the second most important reason given for setting choice; 53 percent said this was extremely or very important to them (table 1). Only 16 percent said its importance was low.

Obtaining a trophy animal was the least valued reason of all listed, extremely or very important to only 17 percent. An equal proportion said it was only of minor importance, and 34 percent said obtaining a trophy was not a factor in their setting choice at all. Other aspects of hunting played a greater role in choosing the area in which to hunt.

Some hunters said they chose a hunting location in part because they lived nearby; 32 percent rated this as extremely or very important, compared to 47 percent who said it was of little or no importance. Overall, this was the second-lowest factor in setting choice.

The other question, designed in part to tap a convenience/preference dimension, asked about the role of having hunted in an area before. Thirty-six percent said this was an extremely or very important reason they chose to hunt where they did, while a nearly equal number, 39 percent, said it was of little or no importance. No differences among check stations were evident ($F = 0.77$, $p = 0.60$).

One-third of the hunters (33 percent) were hunting in the area for the first year, while 13 percent were returning for the second year, and 10 percent for the third. The overall average number of years hunting was 6. Two-thirds of the hunters were returning to their hunting areas, presumably because they found some aspect(s) of them attractive. For these returning hunters, the potential for impacts is high, particularly if the changes in the setting conflicted with peoples' desired experiences.

Sixteen percent said they were hunting in their favorite spot in western Montana, and 25 percent said it was one of their favorite places. Another 45 percent said it was just one of many places they hunt, and 14 percent said they prefer to hunt elsewhere.

For all hunters, evaluation was clearly linked to previous experience in the area. Among first-year visitors, only 3 percent were in their favorite area, 14 percent were in one of their favorites, and 29 percent said they prefer to hunt elsewhere. Among those having visited the area 6 or more years, however, 30 percent said it was their favorite, 32 percent said it was one of their favorites, and only 4 percent said they would prefer to hunt elsewhere. The longer people hunt in an area, the more likely they are to become attached to it and its many attributes.

Evaluation also tended to be linked to success. Among hunters who killed an elk or deer, 60 percent said they were in their favorite or one of their favorite areas, compared to 40 percent of the unsuccessful hunters. Nearly 90 percent of the hunters who said they were in their favorite area, however, didn't kill anything, suggesting that an area can be viewed very favorably even if no game is harvested.

Predictably, Montana residents differed from nonresidents, who were older (average age 42 vs. 35 for residents) and had less big game hunting experience in Montana. All of the out-of-State hunters were after elk,

and they killed one-third of the elk despite comprising only 12 percent of the sample. They were also more likely to see elk; 15 percent of the residents saw one or more, compared to 26 percent of the nonresidents.

The out-of-State hunters were thus more successful. Although many were not as familiar with the area, 44 percent were returning for at least the second time, and some may have been hunting with guides. Fewer of them were road hunters, 26 percent vs. 31 percent of the Montanans. They were also trying to harvest game for different reasons. Hunting for meat was less important that it was for residents ($t = 4.6$, $p < 0.01$), and obtaining a trophy was more important ($t = 3.9$, $p < 0.01$).

Even though out-of-State hunters were only a small proportion of the sample (<4 percent), they came to Montana in part to shoot a trophy animal, and seemed dedicated to this pursuit. They were also highly concerned with enjoying nature in the study areas.

Cluster Analysis

A primary goal of the survey was to determine the distributive effects of the line: who would view the impacts as positive; who would view them as negative; and who would be indifferent. We have hypothesized that the reasons hunters chose for hunting in the study areas will predict how they will react to the line-induced changes in the setting. To reach this goal, it would be valuable to group hunters together based on their reasons for hunting where they did; we could then predict how each group would respond to the physical, biological, social, and esthetic changes in the study areas. The cluster analysis technique used in previous studies of hunting seemed well suited for the task.

Hunters' responses to the questionnaire items on reasons for choosing hunting locations were selected to perform a cluster analysis. Clustering the hunters on these questions identified subgroups of hunters (hunter types) who had similar patterns of response. The cluster analysis was performed for the sample as a whole, rather than separately for each study area or check station.

The BMDPKM program (Dixon 1983) was chosen to perform the cluster analysis. Known as a k-means procedure, this hierarchical clustering method first assumes that all respondents form one cluster and at each step divides the cluster into two, based on how close each case is to the cluster center (measured by the Euclidean distance). Once the specified number of clusters is reached, the program iteratively reallocates cases into the cluster whose center is closest. Hunters within the final clusters should be similar, and differ from hunters in other clusters (Hartigan 1975).

Because there was no predetermined basis for picking the final number of clusters, the program was run six times to obtain final cluster sizes of 4, 5, 6, 7, 8, and 9. Examination of the results showed that seven clusters best described the hunters, based on comparison of the cluster means for each of the seven variables, cluster sizes, interpretability of the findings, and the desire for a concise explanation. A cluster size of seven (which required 12 iterations to reallocate the cases into clusters) provided important information not present in smaller cluster sizes. Increasing cluster size, however, added little to the analysis while making interpretation more complex.

Cluster One.—This group, composed of 64 hunters (12 percent of the total sample), was characterized by the hunters' low ratings of importance on nearly all of the variables; as shown in figure 1, they rated five of the seven possible reasons as having little importance.

They did indicate that enjoying nature and hunting for meat were moderately to very important. These two reasons were rated as this important by all hunter types; everyone wanted to enjoy nature while hunting and also to put some meat in the freezer. As seen in figure 1, these two variables did not distinguish very well among the seven hunter types. Worthy of note, however, for this and the other hunter types, was whether nature or meat was rated as more important. Hunters in Cluster One rated hunting for meat as slightly more important than enjoying nature—one of only two types to do so.

Twelve percent of this group was from out-of-State, a proportion near the middle compared to other clusters. A full 65 percent were under the median age for all hunters; this group had one of the two highest proportions of younger hunters out of the seven clusters. Eighty-six percent were on day trips, a figure near the middle compared to other groups.

A relatively high proportion—35 percent—were primarily road hunters; it is therefore not surprising that they tended more than any other group to rate their hunting areas as having too few roads (although the majority still felt that the number of roads was about right). This group had the lowest rate of seeing elk and killing an elk or deer of all groups.

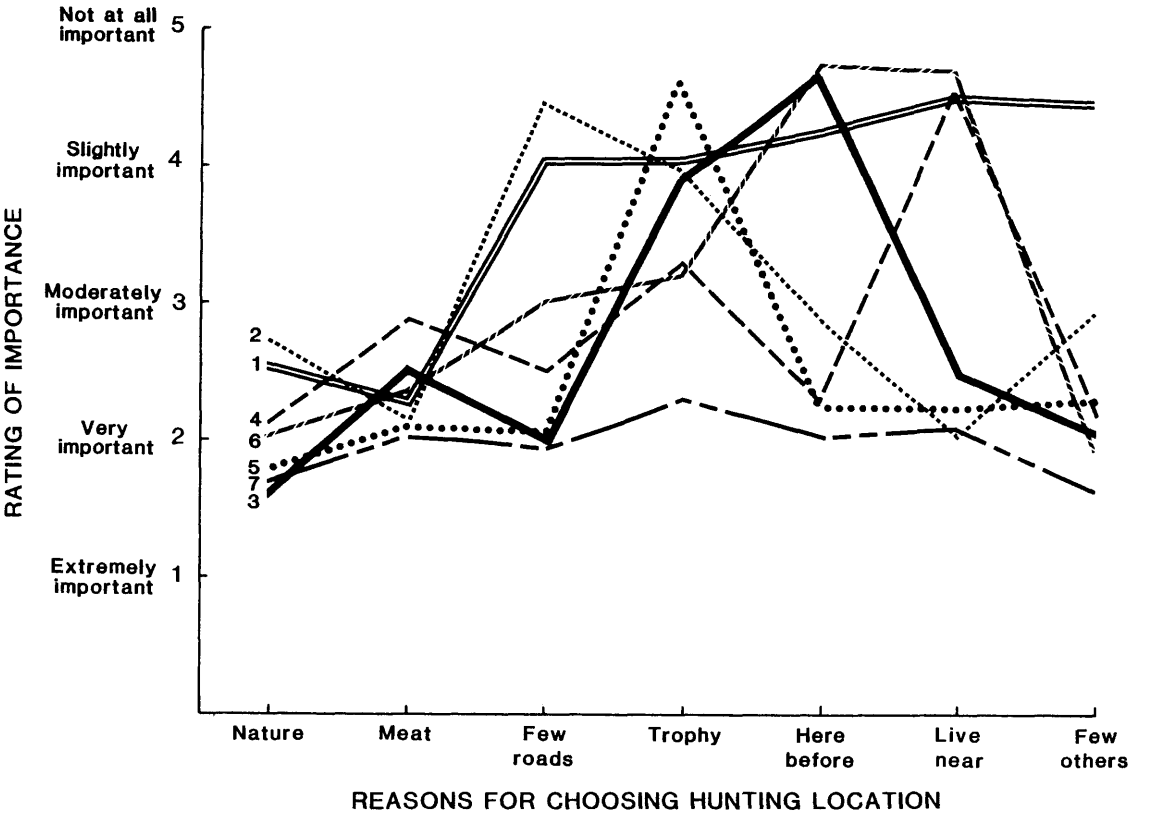

Figure 1.--Graph of cluster means.

Along with one other cluster, this group had a very high proportion of hunters visiting the area for the first time--52 percent, with only 22 percent having visited the area for 6 or more years. This group therefore did not rate the area in which they were hunting as one of their favorite places; only 6 percent said this was the case, the lowest proportion of any cluster. Similarly, 31 percent of this group said they would prefer to hunt elsewhere, again the highest percentage of the seven hunter types.

This group is particularly concerned with many characteristics of the study areas, and though most are from Montana, they didn't choose the area because it was close to home.

These hunters would either favor or not greatly object to the increased road access and would likely not be as concerned as other hunters with the esthetic changes in the setting caused by the transmission line. This group would not likely be displaced by the line, and they may even prefer the new setting to the old.

Attitudes toward possible management actions or restriction were not measured in Phase I, so we cannot be sure how this group (or the other hunter types) would react. For all hunters, this is another possible source or impact that would probably be viewed by some as positive and by others as negative.

Cluster Two.--This group of 80 hunters (15 percent of the total) was the only other cluster to rate hunting for meat as more important than enjoying nature in choosing a hunting location. Hunting in an area with few roads was of little or no importance to them, but they did rate as moderately important being in an area with few other hunters. Obtaining a trophy was of little importance, but hunting close to home was very important in their hunting area decision. Having hunted in the area before was moderately important, near the middle of the seven clusters.

This group, interviewed mainly at Beavertail, Cabin City, and Haugen, contained only 5 percent out-of-State hunters. They tended to be older hunters, with 56 percent over the median age for all hunters, and contained more day hunters than any other type.

This group had the highest proportion of road hunters (43 percent), but also the highest proportion who said the number of

roads was about right. As many felt there should be more roads as fewer. They saw an average number of elk (89 percent saw none) but killed fewer elk or deer than did any other hunter type.

They had considerable experience hunting in the area; only 22 percent were hunting where interviewed for the first time, and 39 percent had been hunting there 6 or more years. Forty percent said they were hunting in their favorite spot or one of their favorite spots, and only 14 percent said they would prefer to hunt elsewhere.

These hunters are also not likely to be affected by the line, although the effects could be more adverse than for the first type. Although many are road hunters, they do not want to see more roads. Because they are more concerned with the number of hunters than with the number of roads, successful closure of new roads would probably effectively mitigate any adverse impacts, as long as large numbers of new hunters did not use the new access. Enjoying nature, although of moderate importance, was rated by this group as less important than by any other cluster, suggesting that any esthetic impacts would be moderate.

This group of hunters, 15 percent of the total interviewed, would likely not be displaced by the line; they would keep using the study areas as long as the game was still there; a decrease in the opportunity to shoot a trophy animal would not bother them greatly. However, those hunters who did not like the changes could have a more difficult time finding other attractive hunting locations; they have returned to these areas for many years, and a sizable minority are hunting in one of their favorite places. Even so, this group may not be strongly affected by the transmission line.

Cluster Three.—This was the smallest group (49), comprising only 9 percent of the hunters interviewed. They were characterized by their lack of concern for hunting for a trophy or in areas where they have hunted before, and the importance they placed on the other variables. Unlike the previous two hunter types, this group rated enjoying nature as much more important than hunting for meat, and rated nature, few roads, and few hunters as very important. Hunting near home was also valued by this group.

This group contained a low proportion of nonresidents (6 percent). They were older than other hunters, with 65 percent above the median age, and hunted mostly on day trips. A relatively high number (37 percent) hunted along and near roads, but this group, more than any other, preferred to see far fewer roads in their hunting areas. This was the only cluster in which more hunters rated the number of roads as too many than rated the number as about right. They saw an average number of elk but were more successful (12 percent) than other hunters at killing an elk or deer.

These hunters were older and had more experience than other respondents in hunting in their areas; a full 47 percent had been returning for 6 or more years. They were average in the ratings of the area; 34 percent said it was their favorite or one of their favorite places to hunt, and 16 percent said they prefer other locations.

Because this group placed high importance on being in an area with few roads and few other hunters, the increased access accompanying the line will likely be viewed negatively. The very strong emphasis on nature, especially when viewed relative to the lower emphasis on meat, suggests that esthetic aspects of hunting may also be negatively affected by the line. A majority of the hunters may have a great deal of trouble finding other places to hunt if indeed they respond negatively to the changes in the setting, but some of these hunters value the study area locations highly, in part because of the close proximity to their homes. However, they are not particularly attached to an area simply because they have been there before (although they have extensive experience hunting in the area).

This is one of the few groups for whom esthetic impacts would likely outweigh game-related impacts. They could likely be displaced from the study areas, and if other settings were not available nearby, the impacts would gain significance. Of the first three clusters identified, this relatively small group (9 percent of the total sample) is the most vulnerable to the line's effects.

Cluster Four.—This group, the largest of the seven (100), comprised 19 percent of the total sample. They attached relatively high levels of importance to all variables except hunting close to home, which was viewed as having little or no role in their hunting area decisions. Enjoying nature was more important than hunting for meat; in fact, this group attached less importance than any other to hunting for meat. They were seeking areas having few roads and other hunters, and said that their previous hunting experience in the area was important to them. Obtaining a trophy was moderately important.

This cluster had the lowest proportion of Beavertail hunters of any subgroup (only

17 percent), with larger ratios of hunters from Haugen and Saltese. Nearly one quarter, 24 percent, were from out-of-State. the largest percentage of any cluster. About half were above and half were below the median age for the whole sample, and more of this group than any other hunted for more than 1 day--not surprising given the higher number of nonresidents in the group. Few were road hunters (20 percent), and only 5 percent thought that their hunting areas should have more roads. They saw more elk than any other type of hunter but were not quite as successful as most in killing a deer or elk.

One-third were hunting in the area for the first time, and about the same number had hunted there for 6 or more years. Forty-six percent were hunting in their favorite or one of their favorite areas, and only seven percent said they would rather hunt somewhere else. Like the other groups, most said the area where they were hunting that day was one of many places they hunt in western Montana.

These hunters are nonresidents and residents who value the esthetics of hunting more than obtaining a trophy or meat, although all aspects of their hunting choice were important. The exception was hunting near home; these hunters may be willing to travel farther to find hunting areas meeting their expectations. This may be disturbed by the line's effects on esthetics and access, but are apt to be slightly less concerned over any impacts on hunting success. It seems likely that if acceptable substitute settings were available, they would be willing to travel there, somewhat reducing the significance of the impacts.

Cluster Five.--This group of 79 hunters composed 15 percent of the hunters interviewed. Their main characteristic was a very high level of concern for all variables except obtaining a trophy. They attached as much importance as any hunter type to enjoying nature, getting meat, hunting where they've been before and near home, and to being in an area with few other hunters. No other group, however, placed less importance on obtaining a trophy.

Like most other groups, this contained a high proportion of hunters interviewed at Beavertail. Very few--only 3 percent--were from out-of-State, and their ages were mixed. Eighty-seven percent hunted for the day only; the rest stayed out for 2 or more days. A relatively low proportion (20 percent) were hunting primarily along roads, but about as many felt there should be more roads as felt there should be fewer. They saw and killed an average number of elk and deer, despite their extensive experience hunting in the area. Only 16 percent (the lowest of all types) were first-time visitors, and 44 percent had hunted there for more than 6 years. More hunters in this group than any other said they were hunting in their favorite place in western Montana, and only 3 percent (the lowest of all groups) said they prefer to hunt elsewhere.

To these hunters, everything was important except obtaining a trophy. The importance they attached to nature, few roads, and few other hunters highlights their vulnerability to the new access roads and the line's esthetic impacts. They could also be concerned about decreased opportunity to obtain meat, though they probably would not object if their chances of obtaining a trophy decreased. For them, like the previous two groups, the potential for adverse impacts is high. However, the significance of those impacts is greater for this group, because they also place a high value on hunting near home and say that the affected area is one of their favorites. Impacts of the line may force this group to travel farther and hunt elsewhere, or stay in the same areas with a decrease in perceived hunting quality.

Cluster Six.--This group of 83 (16 percent of the total) placed relatively high levels of importance on enjoying nature, getting meat, and being in an area with few other hunters. Of very low importance were hunting near home or in a previously hunted area. The presence of few roads or chances of obtaining a trophy were moderately important.

Thirty-five percent of the group were interviewed at Beavertail, with Haugen and Saltese also represented. The second highest proportion were from out-of-State (20 percent), part of the reason for their low value on hunting near home. They were younger than any other group except Cluster One; 64 percent were below the median age for all hunters. More than any other group, they stayed out for over a day.

Only 23 percent were primarily road hunters, and the majority rated the number of roads as about right. Equal portions of the group felt there should be more or fewer roads. Twenty-one percent saw one or more elk, and 12 percent killed an elk or deer. Unlike the previous four groups, however, they were relatively inexperienced in the area; only 17 percent (the lowest of any group) had hunted there for 6 or more years. Like the members of Cluster One. most said the area was one of their many hunting grounds, and over twice as many said they prefer other places as said it was their favorite.

In terms of likely response to the line's effects predicted in Phase I, this

group is harder to pin down than the others. They have not hunted where they were interviewed for long, are not particularly attached to those areas, and didn't choose them to hunt near home. Seeing few other hunters was more important than being away from roads in their decisions, suggesting that road closures may be effective mitigation for those who either want fewer roads or feel that the current number is about right. This group may not be greatly affected by the line, compared to Clusters Three, Four, and Five. Yet, if they are, they could probably find somewhere else to hunt without great difficulty. They could be more concerned than groups One, Two, and Three if the supply of trophy animals were to decrease, but remain about as concerned as other groups over enjoying nature and hunting for meat.

This type of hunter may not be as vulnerable to the impacts as some of the other groups, but their behavioral responses are more difficult to predict.

Cluster Seven.—This group of 73 (14 percent of the total) has a profile that is immediately distinguishable from all other types. They rated every one of the possible reasons as very important, and their ratings across the board were as high or higher than those of any other group.

A low number, 7 percent, were nonresidents, but otherwise these hunters shared many characteristics of the nonresident hunters (except their concern for hunting near home). They were of average age, and 22 percent hunted for more than one day on their trip. This group had the lowest proportion of road hunters (only 12 percent), and the lowest number who said there were too few roads (3 percent); 40 percent wanted to see fewer roads in their hunting areas. A relatively large proportion saw elk, and a greater number killed an elk or deer (13 percent) than did any other hunter type.

Given this profile, one would expect them to be experienced in their hunting areas, and they were; 41 percent were returning for at least the sixth year, and only 19 percent were first-time visitors. A full 63 percent said they were hunting in their favorite or one of their favorite areas—far more than any other group.

This seems the group of hunters most at risk from the transmission line. They value hunting in an area perceived to contain few roads and want to see even fewer. They place great emphasis on success, both for meat and trophy, and said that enjoying nature was also very important. They are skilled hunters who are used to the study areas and consider them one of their favorite places to hunt. They also value hunting near home.

These hunters would probably object to the line on many grounds, and their long-established hunting patterns could be disrupted. They may have a difficult time finding acceptable substitute areas to hunt if they are displaced.

CONCLUSIONS

The results of the baseline study show that about 59 percent of the hunters interviewed have characteristics that may sensitize them to the transmission line's effects. Some hunters will view the changes as an improvement, and some will not care much one way or the other. The cluster analysis enabled DNRC to identify groups of hunters that will be affected differently by the line and to hypothesize how each will react to the setting changes. We cannot yet say what will precisely happen, but the next phase of the study will assess the accuracy of our empirically derived predictions and measure the type and level of impacts to hunting opportunity in the study areas.

The findings to date suggest that, for many, the impact magnitude will be high. Of the hunter types identified, Clusters One and Two (27 percent of the total) are not as likely to be adversely affected, and the net effect may be positive. This, of course, depends in part on what happens to the elk populations, which will be studied by the biological portion of the monitoring effort.

Clusters Three, Four, and Five (43 percent of those sampled), will likely be adversely affected. The net impact will depend on whether they have acceptable substitutes, but hunters in these groups chose the study areas in part for their perceived limited road access.

For hunters in Cluster Seven (16 percent of the total), both the magnitude and the significance of the impacts are likely to be high, and these users are the most prone to be displaced by the line. We may therefore anticipate finding fewer of these types of hunters in the sample during the next phase; this hypothesis will be tested after the line is built. If they continue to hunt in the study areas, it will likely be out of convenience and with decreased satisfaction. Again, this depends on the impacts to elk; if the hunting were to improve, for example, some of the negative impacts could be offset.

The effects on Cluster Six (16 percent) were difficult to predict. Hunters within

this cluster may respond differently, depending on how they interpret the impacts.

The magnitude of the impacts on the study areas, however, is only part of the picture; we must also examine the significance of these impacts--or how the study areas are viewed in relation to other hunting grounds. Hunters who do not like the changes in the study areas may not object if they have many other places to hunt that also meet their criteria (or meet them better than the study areas). The study area impacts must be placed in a greater context to interpret their significance. The next phase will accomplish this by asking hunters specific questions about how the attributes of the study area are perceived--before the line, after the line, and in relation to specific attributes of other places they hunt in western Montana.

Most of the nonresident hunters fell into the groups that would likely be adversely affected. Possible economic impacts to local communities could result unless these hunters find other hunting locations near the study areas. Assuming they continue to hunt big game in Montana, however, other communities could benefit. A complete economic impact study is beyond the scope of our research, and we can only speculate.

So far, we have talked about impacts to the esthetic, physical, biological, and social characteristics of the study areas. Another important aspect of recreational settings is the managerial situation (Clark and Stankey 1979).

If elk were adversely affected by the increased hunting pressure and loss of secure habitat, managers may have to impose stricter regulations. The questionnaire did not contain items on perceptions of hunting regulations, but the large number of comments received on the issue points to its notoriety as a topic among hunters. It is clear that different types of hunters would react differently to new management actions. Previous cluster analytic studies of hunters have found that response to management actions can be predicted from hunter types (Hautaluoma and others 1982).

Reactions to management actions will be assessed during Phase II, when hunters have something specific to respond to (such as access roads). Hunters will be asked how they would prefer to see the new roads managed and will be asked other management-related questions. DNRC also plans to assess the effectiveness of visual mitigation and to assess the actual esthetic impacts. Planned use of the study areas will also be measured, and it may be possible to study bow hunters, who were not studied during Phase I.

Access roads were an important consideration to five of the seven clusters identified, or 73 percent of the hunters. It may be that hunters of all types will react negatively to access roads if they are gated. Hunters who prefer limited numbers of roads may not approve, but neither would those who want new access roads without locked gates. In any case, it will be important to learn their reactions and see what proportion of hunters favors what management strategy.

For Phase II studies, a potential problem exists if current users are displaced, some hunters would not be there to interview if they decided not to hunt there at all. It would be valuable to talk with this group, because they would be the most adversely affected by the line (their behavior would have been changed).

This problem will be dealt with in two ways: one based in a change in methodology; and one by the type of analysis that has been and will be conducted. The change in method will be to administer the entire questionnaire to every hunter interviewed--regardless of whether they hunted in or near the study areas. This will provide a control group that has not hunted near the line. In addition, some hunters who do not like the changes in the settings may continue to hunt in the areas (out of convenience, for instance) and will still be there to interview. The baseline study found people who preferred to hunt elsewhere, and the next phase will too.

Second, the baseline data collected in 1983 will be compared to that collected during Phase II. Any substantial changes in hunter populations or types should be able to be detected. For example, another cluster analysis will explore similarities to and differences from the types of hunters now using the study areas.

Subtle changes may not be discernible or attributable to the line and its impacts. But this is compatible with the research goals, for it is likely that minor impacts would create less demand for additional mitigation. Substantial changes, however, would call for a closer look at the magnitude and significance of the impacts (Phase III) and at the need for further mitigation.

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