MITIGATING THE IMPACTS OF MINERAL EXPLORATION AND DEVELOPMENT ON WILDLIFE

Proceedings of the 1983 Annual Meeting of the

Montana Chapter of the Wildlife Society

February 9-11, 1983
Missoula, Montana

1983 Proceedings Montana Chapter T.W.S.

FOREWARD

The 1983 Annual Meeting of the Montana Chapter of the Wildlife Society was held February 9-11 at Missoula. Theme for the meeting was "Mitigating the Impacts of Mineral Exploration and Development on Wildlife."

A keynote address was delivered by the Honorable Ted Schwinden, Governor of Montana. The Chapter presented its Distinguished Service Award to Jim Posewitz of the Montana Fish, Wildlife and Parks Department. Mike Rath of the U.S. Forest Service received the Biologist of the Year Award.

These proceedings were compiled and edited by Program Chairman Jon Malcolm. However, the true credit is due those who presented papers at the meeting and submitted them for publication. In addition the publication task could not have been completed without the efforts of those who helped with typing and compilation. Typing was done by Kellianne Johnson, Raelyn Cox and Adrienne Dinwoodie. Maureen Himiob was proofreader. Illustrations on the front and back covers were done by Ernie Kraft.

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POPULATION ECOLOGY OF MULE DEER WITH EMPHASIS ON POTENTIAL IMPACTS OF GAS AND OIL DEVELOPMENT ALONG THE EAST SLOPE OF THE ROCKY MOUNTAINS, NORTH CENTRAL MONTANA

Helga Ihsel Pac[1]

During the last few years gas and oil exploration activity has substantly increased along the Rocky Mountain overthrust belt. A valuable and diverse wildlife resource also exists there. This has generated considerable concern regarding the possible short term and long term impacts of gas and oil exploration and development on wildlife. In particular, the east front of the Rocky Mountains is a wintering area for thousands of mule deer. In 1979, the Bureau of Land Management contracted the Montana Department of Fish, Wildlife, and Parks, and Montana State University to conduct a baseline study to determine the potential impacts of this activity on mule deer.

The study was made up of 2 phases under the direction of Dr. Lynn Irby. The first part was conducted by Wayne Kasworm from June 1979 through September 1980. I conducted the second part as a master's thesis project from June 1980 through September 1981. Dr. Richard Mackie both planned and assisted in various aspects of the study. Biologists Gary Olson, John McCarthy, and Dan Hook helped immensely.

The objectives of the study were: (1) establish baseline data on the mule deer population including: a) seasonal distribution, movements, and home ranges; b) population dynamics; c) habitat characteristics and use; (2) determine gas and oil impacts, and (3) develop management guidelines and recommendations.

The study area was located along the east slope of the Rocky Mountains, approximately 40 km west of Choteau, Montana. It was bordered to the north by Birch Creek and to the south by Sun River. Lower elevations on the study area which included deer winter ranges consisted of short grass prairies and shrublands interspersed with limber pine forests on buttes and ridges. The higher elevations were characterized by Douglas-fir, lodgepole pine, and sub-alpine forests.

The front is composed of parallel north and south extending ridges. The geology of this area makes it very conducive to petroleum deposition and accumulation, which led to the first exploration activity in the 1950's.

Very briefly, the methods we used included marking a sample of the 149 mule deer between 1978 and 1981 using a helicopter drive net and panel traps. Twenty-five of these animals were radio collared. Radio relocation flights were conducted two times per month, weather permitting. Population size was estimated by Lincoln indices of marked to unmarked deer observed during a full coverage helicopter survey in early and late winter. Sex and age classifications and habitat use were determined from ground observations conducted at least twice each month on each winter range from January through March. Habitat types similar to Pfister (1977) were mapped on winter, transitional ranges, and adjacent low deer use areas. Ground aerial observations were made near and around drill sites to assess short term impacts of gas and oil activity.

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I will summarize baseline data as follows: Deer were concentrated in the winter on 6 and possibly 7 distinct winter ranges. These extend from Birch Creek to the Sun River. Very few mule deer apparently winter on the west side of the divide, which means that probably 90% of the mule deer that summer in the Bob Marshall north of the Sun River may winter on these east front winter ranges. Marked animals showed strong fidelity to both winter and summer ranges. Because movements were traditional, a year long program population unit was defined for each of the four winter ranges that had sufficient numbers of marked animals to indicate seasonal distribution patterns. These are tentative and should be refined as more data become available. Population units were characterized by relatively low densities averaging 2-3 deer/km^2. Sizes of individual population units varied from 328 km^2 to 1056 km^2.

Three groups of deer were classified according to their patterns of summer movements: Group I: Deer that summer west of the divide, these were long distance movers that went as far as the Spotted Bear Ranger Station and made up 27% of the radioed deer. Group II: Deer that summered east of the divide, moving shorter distances to their winter ranges, and making up 59% of the radioed deer, and Group III: Resident deer that summered within or close to their winter ranges and made up 14% of the radioed deer. Average winter home range size of radioed female deer varied from 4.6 km^2 in 1979-1980 to 6.0 km^2 in 1980-1981. Summer home range size averaged 6.4 km^2 in 1979, 3.5 km^2 in 1980, and 1.4 km^2 in 1981.

In the spring and fall mule deer used transition ranges located in the foothills above the winter ranges. When the first severe weather occurred in the fall, deer summering west of the divide rapidly moved onto these transition ranges. The east of the divide deer were less sensitive to fall weather and moved down later in the fall than the west of the divide deer.

Helicopter surveys indicated that the mule deer population on the East Front was increasing during 1978-1981. The total population from the Sun River to Birch Creek was estimated to 6,000 in the late winter 1981. Sex and age composition data indicated no statistical difference between fawn/adult ratios on the five winter ranges sampled. These averaged 62 fawns/100 adults in 1980, and 50 fawn/100 adults in 1981 in the late winter. This data at least tentatively indicate a relatively productive population as compared to other mountain foothill ranges.

As we have seen, deer wintering along the Front are concentrated in discreet winter ranges. These are separated by areas receiving very little or no deer use in the winter. Analysis of habitat measurements indicated that winter ranges were significantly different from these low deer use areas with respect to several environmental parameters. The winter ranges had significantly higher percentages of moderate to steep slope categories and a wider availability of aspect classes, than low deer use areas.

These baseline data indicate that effective management of mule deer along the East Front must consider the entire population unit. Each unit is unique and reflects the environment it occupies. Within population units, seasonal ranges fulfill specific requirements. Winter range is necessary for deer productivity as well as for building body condition. Transition range provides security in the fall and also contributes to deer condition as they arrive on the winter range. The greatest opportunity for conflict between mule deer and gas and oil exploration occurs on winter ranges. The deer are concentrated, and much of the land is under private control.

Deer response to gas and oil drilling was very difficult to assess because: (1) The activity occurred in low deer density areas, (2) Development intensity was low, (3) Winter conditions were mild, and (4) The time period covered by the study was short. Home range activity centers shifted 1.8 to 4.1 km in the westerly direction from one year to the next, but movement was more likely due to differences in winter conditions than to the drilling activity. Four radioed deer at Ear Mountain, where no drilling activity took place also exhibited home range shifts of similar magnitude. However, as activity intensifies, particularly in core winter ranges, potenti for impacts will also increase, particularly if dense fields are developed leading to habitat loss, increased access, and probable increase in deer stre

Seismic activity was much more extensive than drilling. I had difficult in getting the seismic companies to divulge information as to exactly when and where the lines would be run. Five radioed deer that had summer home ranges where seismic lines were run did not change their home range in any noticeable long term pattern. The study area is partially in the Lewis and Clark National Forest. This forest sustained greater seismic activity than any other National Forest in western Montana during the time the study took place. Two hundred and eighty-eight km of seismic lines were completed in 1981. I was able to finally watch a few deer react to seismic blasting occurring about 3 km away. Some just looked up and others ran a short distance and then resumed feeding. However, Geist (1971) describes how a disturbance is potentially more detrimental if unpredictable and frequent, which would seem to apply to seismic activity.

Specific recommendations concerning gas and oil activities are as follows: Individual population units should be closely monitored on a systematic basis to detect changes in population size, productivity, morality, and distribution that may be associated with changes in land use. The following categories should be considered.

1. Seismic Activity: Because it is frequent and unpredictable, it can potentially disrupt fawn rearing, rut activity, and winter resting. Deer can evidently tolerate low to moderate frequency of seismic activity; however, if it is unlimited and loosely controlled as permitted under present laws, especially on private land, it could surpass the tolerance range of deer. Laws to regulate the frequency of seismic activity, and sharing information would reduce the stress on wildlife.

2. Timing and Access: Timing can minimize potential conflicts, by avoiding winter ranges from December 15 to May 15, migration routes from May 15 to June 15, and transition areas from October 15 to December 31. Road locations, permanence, and extent of traffic should be carefully planned prior to construction. Additional roads can increase harvest (legal and illegal), harrassment, and road kills.

3. Drilling and Production: Placement of drilling sites on core winter ranges can have detrimental effects. The potential for damage will vary depending on distribution of deer, condition of deer, condition of range, amount of new access, permanence, and intensity of disturbance.

4. Regulations: Restriction of firearms, motorbikes, and snowmobile use by personnel would minimize harrassment.

5. Consideration of Cumulative Impacts: When gas and oil development occurs in conjunction with other land uses, the impact on mule deer can be magnified

and consideration of the effect of cumulative demands should be made. No single, rigid regulation concerning mitigation can be expected to apply to the entire east front. Priorities for winter range protection should be determined relative to the potential value of each important population unit for development, livestock grazing, recreation, and wildlife habitat for deer or for other species. Regulation of impacts should be undertaken on a site by site basis.

6. Coordination: The most important of all is communication, cooperation, and coordination between resource managers, landowners, the public, and the petroleum industry to share the responsibility of planning, financial support, and scientific research. Otherwise, proper management with positive, desired results will never occur. The management of wildlife and their habitat is definitely related to the management of human impacts. The public must decide the balance between the shorter term economic gains from gas and oil development and the much longer term economic and aesthetic benefits of large, healthy, and productive mule deer populations.

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OFFSITE MITIGATION FOR ENERGY IMPACTS AND ISLAND BIOGEOGRAPHIC THEORY

Cliff Youmans

In recent years, the term "mitigation of impacts" has become commonplace in the vernacular of wildlife biologists and other resource managers. Countless symposia, "workshops", and blue ribbon committees have met to address some aspect of mitigation of impacts on wildlife occurring as a result of man's activities. The definition of the word "mitigate" is worthy of review. Mitigate is a verb, meaning to moderate (a quality or condition) in force or intensity; to alleviate. In other words, mitigation occurs after wildlife has already lost in competition with man's activities. For the most part, this competition is for the most fundamental requirement of wildlife; a place to exist and perpetuate.

Ever-increasing impacts on wildlife will occur as the nation turns from reliance on foreign energy sources to developing our domestic energy reserves. Concurrently, agricultural practices will continue to intensify as we seek to feed an exponentially increasing world population. As it is mathematically impossible to maximize for two variables in the same equation; so is it impossible to maximize for both development and preservation. As biologists we must attempt to solve the dilemma of managing for sustainable population levels of wildlife species on ever-decreasing amounts of suitable land. Thus the compromise of mitigation, like it or not, will assume an increasingly important role in our attempt to solve this dilemma.

Laurence R. Jahn, Vice-President of the Wildlife Management Insitute, in summarizing results of the Mitigation Symposium held July 16-20, 1979 at Colorado State University, Fort Collins, presented recommendations on the definition of the term mitigation:

"The term mitigation refers to a class of actions, which have the purpose of counteracting the effects of disruptions, on the natural environment and on renewable resources, associated with new physical structures and/or construction activities and/or new management objectives and practices. The connotations of mitigation should not be extended to encompass those more properly reserved for such terms as regulation, preservation, conservation, restoration, reclamation, enhancement (melioration), rehabilitation, compensation, substitution, palliation, etc. The usual tendency of a policy slogan to attract too may connotations should be contained."

Two conclusions from this definition of mitigation are implicit: (1) mitigation means reducing an impact in degree or severity anywhere form 1 to 100% (2) the adequacy of mitigation is a function of the degree to which the impact has been reduced.

Another conclusion is also implicit in the above definition, however it is far less obvious: some impacts, specifically cumulative impacts involving loss of wildlife habitat, transcend our ability to mitigate through traditional efforts.

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We are unable to adequately mitigate for cumulative impacts in part because such impacts are not attributable to a specific disruption or activity. The necessity of identifying a specific activity as the source of an impact is an inherent limitation in the mitigation process.

If we were to examine each impact on a wildlife population individually, we would likely find that most would be considered small or insignificant. However, when we view the sum total of each of these impacts, our perspective is sobering indeed! Unfortunately, this perspective is generally arrived at too late.

Before we can begin to mitigate cumulative impacts, we must first be able to recognize them. This may be accomplished by broadening our focus on impacts and their assessment. Since the passage of the National Environmental Policy Act (NEPA) in 1970, considerable time and effort has been committed to developing a reliable means of assessing the degree of severity of impacts and their probability of occurrence on an individual basis. Realiable assessment of impacts can occur with properly designed studies, and the law provides the impetus for industry to mitigate. Unfortunately, comparatively little emphasis has been placed on identifying cumulative impacts.

Recently, efforts to further reduce or categorize impacts have occurred. Labels such as "primary" and "secondary", referring to on-site and off-site impacts have been applied. While categorization may enhance our understanding of the diversity of impacts which arise from an activity, it also detracts from our recognition of cumulative impacts. When we categorize an impact, we reduce or isolate it from the whole; it is viewed piece-meal. Maintaining a broad perspective of the ultimate impact on wildlife becomes difficult if not impossible. I am reminded of the proverb: "he was unable to see the forest for all the trees."

Several phenomena occur when we examine potential impacts from a proposed activity individually, rather than cumulatively: (1) we tend to assign or negate responsibility for the impact depending on how it is categorized (i.e. as a primary or secondary impact) (2) we tend to moderate our evaluation of the degree of the potential impact (3) we tend to acquiesce or accept the impact more readily, or, in other words, the segregation of the impact has made it more "palatable."

In the future, we should resist the allure of focusing too finely on individual impacts. Instead we should seek perspectives which will allow us insight into the cumulative impact on a wildlife population. Having done so, we may initiate our quest for solutions.

As the nature of the impact is fundamentally that of cumulative loss of habitat for wildlife, it logically follows that fundamental mitigation must center on either creation of new habitat for wildlife (compensation and reclamation) or on setting aside habitat (preservation).

Reclamation can create and/or enhance wildlife habitat. However, reclamation alone cannot compensate for cumulative impacts. Preservation is also necessary.

Despite substantial advances in technology, reclamation takes time and successional patterns are not yet predictable. The length of time depends only partially on the technology used to reclaim. Climate and soils determine the rate of plant succession for the most part. Thus, reclamation in areas of low rainfall and with soils of low potential takes proportionately longer than in areas where these environmental factors are not limiting. Most reclamation associated with coal surface mines in eastern Montana is recent and lacking much of the diversity which it will ultimately attain through succession.

Wildlife use recent reclamation. In fact, where effective interspersion of reclamation and native habitat occurs, the resulting increased habitat diversity has benefitted wildlife. However, it should be noted that the present benefits reclamation offers to wildlife have an uncertain future. While the current conformation of much reclamation in Montana allows its forage and cover value to complement the values of surrounding native habitats, in time this effective interspersion will diminish. As ever-increasing acreages of native habitat are mined and reclaimed, the resulting large blocks of recent reclamation cannot reasonably be expected to sustain the diversity and abundance of fauna present on native habitat. Thus, the key to the value of recent reclamation to wildlife appears closely related to the availability of surrounding native habitat.

Wildlife are displaced or destroyed when their habitat is lost. We know that displacement can only occur if adjacent suitable habitat is not already occupied. As it is exceptionally rare for this to be the case, the concept of long term displacement is biologically naive. It is here that we have seemingly reached as impass. Yet the relationship between adjacent native habitat and reclamation is similar to that of which islands have to an adjacent mainland. This perspective allows application of island biogeographic theory (MacArthur and Wilson, 1967).

Essentially, island biogeographic theory attempts to arrive at empirical conclusions on the fundamental processes of dispersal, invasion, competition, adaptation and extinction on islands. The study of biogeography on islands offers unique opportunities to study the fundamental processes listed above for several reasons. MacArthur and Wilson (1967) state one reason islands are valuable to understanding complex processes: "...the island is the first unit that the mind can pick out and begin to comprehend."

Insularity includes not only "proper" islands, but "habitat islands" which are patches of habitat surrounded by other habitat (MacArthur and Wilson, 1967).

The interested reader should refer to MacArthur and Wilson (1967) for a proper and detailed explanation of island biogeographic theory. For our purposes here, three essential concepts apply: (1) there is a relationship between the number of species an island can support and its area and environmental diversity (2) islands are colonized at varying immigration rates depending upon such variables as distance from the mainland and distance from other islands (3) There is a limit to the number of species persisting on a given island with extinction of immigrants occurring with time as a result of new combinations of predators, prey and competitors.

What is the nature of the cumulative impact and how do we apply island biogeographic theory in our attempt to mitigate it?

Montana has approximately one third of the known recoverable coal reserves in the United States. Approximately 120 billion short tons of coal are potentially mineable by underground or surface mining in Montana, with approximately 40 billion tons of this total feasible for surface mining (United States Department of the Interior, Bureau of Land Management, 1979).

Currently, ten surface coal mines operate in Montana, with 28,902 acres under permit from the Montana Department of State Lands (MDSL) while an additional 19,082 acres are under application to MDSL for surface mining and associated disturbances (Ms. Theresa Blazicevich, MDSL, personal communication). This acreage applies only to coal surface mines; other development activities such as oil and gas, uranium, synfuels facilities and agriculture far exeed the current impact of coal surface mines in Montana.

Currently, native habitat for wildlife (if we include native grazed rangeland) exceeds the area in eastern Montana occupied or altered radically by man by an obvious margin. Thus, activities such as strip mines and towns and highways are analogous to islands adjacent to, and often surrounded by, native habitat. With the exception of reclamation, these islands are unsuitable for colonization by wildlife and they are increasing in area at an alarming rate. Given the potential for energy development in eastern Montana, it is not difficult to project a reversal of insularity, whereby native habitat becomes a series of small islands and man's activities and industry becomes the mainland.

As previously discussed, the value or suitability of recent reclamation to wildlife appears closely related to the presence of adjacent native habitat. Immigration of wildlife occurs onto reclamation areas at rates which follow island biogeographic theory. The distance of "mainland" native habitat from reclamation "islands" is the principal factor determining immigration rates while the area and diversity of reclamation will be the two principal factors determining species colonization and survial to equilibrium.

Of key importance is the presence of "mainland" type habitats, not only to reclamation but to other islands too small to permanently support a species. Yellowstone National Park is a excellent example of a "mainland" or large island, depending on your perspective. Yellowstone National Park serves as a seminal source of species to adjacent insular habitats. Its importance to these adjacent areas is beyond dispute. On a lesser scale, large islands of native habitat in eastern Montana could serve as permanent sources of immigration to reclamation and to unstable smaller islands of native habitat.

The size of the island necessary to provide for species endemic to eastern Montana and serve a seminal source to adjacent areas may be arrived at through empirical methods based on quantitative theorems of island biogeographic theory. These formula and calculations will be described in more detail in the subsequent paper by Dr. Harold Picton.

Clearly, here is a concept that can begin to address cumulative impacts. It is not a concept far from implementation. A precedent has already been set and off-site mitigation of cumulative impacts is now a reality.

Prior to discussing the actual agreement, the reader unfamiliar with Federal coal leasing rules, regulations and procedures should refer to Appendix A for a brief over-view.

The "Powder River Resource Area Management Framework Plan Amendments", dated June 6, 1980 prepared by the Miles City District Office of the Bureau of Land Management (BLM) excluded several areas from further consideration for coal leasing due to unsuitability criteria in the Hanging Woman Coal Field.

A protest was filed by the Kendrick Cattle Company, the legal surface owner, as a result of the Powder River Resource Area MFP Amendments document because it excluded certain areas on the Hanging Woman Coal Field due to unsuitability criteria. The unsuitability criterion applied was Criterion 15 (refer to Appendix A), due to the presence of several sage grouse strutting grounds within the potential lease area.

The Montana State Director of the BLM indicated that agreement with the BLM and the Department of Fish, Wildlife and Parks could lead to leasing of lands identified as unsuitable for leasing under Criterion 15. A pragmatic and working agreement was negotiated which would mitigate future impacts on sage grouse yet allow development of the coal field. On October 29, 1980, a formal mitigation agreement between the Kendrick Cattle Company of Sheridan, Wyoming and the Department of Fish, Wildlife and Parks was entered into.

Essentially, the agreement stipulated that approximately 11 sections of land be managed so that the sagebrush ecotype in the area would be maintained; subject only to natural succession processes and existing livestock grazing practices. The sections designated were of high value to sage grouse as determined through previous studies (Dr. Robert Eng, Biology Department, Montana State University, personal communication). This area had been proposed for sage brush control measures prior to the agreement.

In return, the Department agreed to recommend that exceptions be applied to the sage grouse unsuitability critierion in the Hanging Woman Coal Field such that certain areas listed as "not acceptable for further consideration for leasing" would be classified as "acceptable for further consideration for leasing."

The mitigation area provides habitat otherwise lost to species besides sage grouse. Antelope and mule deer are present on the site as well as golden eagles and other raptors. It constitutes a small yet significant victory in our pursuit of attempting to mitigate for cumulative impacts.

In closing I would like to quote Dr. M. Rupert Cutler, former Assistant Secretary for Agriculture for Conservation, Research, and Education, who made the following comments on mitigation at the Mitigation Symposium on July 17, 1979 at Colorado State University, Fort Collins:

> "Almost by definition, "mitigation" is:
>
> -An afterthought
> -An add-on to the planning process--often an unwelcome one, in the views of the construction agency.
> -Often, an attempt to compensate for a mistake. And,
> -At least in part, a failure.
>
> It doesn't have to be that way!"

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APPENDIX A

The Surface Mining Control and Reclamation Act of 1977 (SMCRA) requires the Secretary of the Interior to (1) establish a program to govern surface coal mining operations on Federal lands, (2) conduct a review to determine if certain classes of Federal lands should be designated unsuitable for leasing for surface coal mining operations, and (3) establish a process by which the public may petition to have Federal lands designated unsuitable for surface coal mining operations or to terminate such designations. When unsuitable lands are identified, the Secretary of the Interior is required to prohibit, or impose conditions or limitations for mining operations on those lands (SMCRA, Sec. 522 (b) and 523: 30 U.S.C. 1272, 1273).

Criteria of assessing lands unsuitable for all or certain stipulated methods of coal mining are published in Vol. 44 No. 14 of the Federal Register (July 19, 1979) under part 3461.1. There are 20 criteria published by which land may be designated unsuitable for mining. Among these 20 criteria, Nos. 9, 10, 11, 12, 13, 14, and 15 involve the protection of wildlife or wildlife habitat.

Of particular importance is Criterion No. 15 which reads as follows: "(1) Federal lands which the surface management agency and the state jointly agree are fish and wildlife habitat for resident species of high interest to the state and which are essential for maintaining these priority wildlife species shall be considered unsuitable. Examples of such lands which serve a critical function for the species include (i) Active dancing and strutting grounds for sage grouse, sharp-tailed grouse, and prairie chicken; (ii) Winter ranges most critical for deer, antelope, and elk; and (iii) Migration corridores for elk. A lease may be issued if, after consultation with the state, the surface management agency determines that all of certain stipulated methods of coal mining will not have a significant long-term impact on the species being protected. (2) Exemptions. This criterion does not apply to lands: to which the operator made substantial legal and financial commitments prior to January 4, 1977; on which surface coal mining operations were being conducted on August 3, 1977; or which include operations on which a permit has been issued.

The SMCRA of 1977 together with the Secretary of the Interior's decisions and Bureau of Land Management Rule Making of July 19, 1979, require that federally owned coal resources be subject to land use planning through a four step "screening process". These steps are:

1) Determine Known Recoverable Coal Resource Areas (KRCA's)
2) Identify key resource values on areas which may be impacted by mining and determine the applicability of the Secretary's "unsuitable criteria."
3) Identify additional resource values or concerns which may further restrict or eliminate portions of coal fields.
4) Surface owner consultation to determine views on mining of federal coal under their land.

APPLIED BIOGEOGRAPHY AND THE MITIGATION OF HABITAT NIBBLERS

Harold D. Picton[1]

Economic development with its many effects on wildlife habitat will always be with us. A major problem of wildlife habitat management is to compensate for habitat loss and to reduce the bits and pieces erosion of habitat areas. There have been no clear rules to guide action in these situations. But it is apparent that wildlife reserve areas must be large enough to maintain species for long periods of time and close enough to provide recolonization of reclaimed areas.

A major recent achievement in ecology has been the formulation of the theory of island biogeography by MacArthur and Wilson (1967) and its development by other workers. This applied theory uses areas as a predictor of the number of animal species that should be able to live in an area. My studies (Picton 1979) of Montana mammal distribution suggest that the historical distribution of mammals in Montana was about as expected for a continental unit. The Z or slope value (Fig. 1) was calculated to be .15, in the expected range for continental units. This slope value shows the relation of the number of mammals species to land area. It was originally calculated using big game animals but also seems to apply to all of our mammal species of over 5 kg in size.

These graphs (Fig. 1) illustrate that the land impacts associated with the settling of Montana resulted in the loss of 40 percent of the big game populations in these study areas. Second, they document that modern conservation practices have succeeded in restoring about half of the populations which were lost. Thus one-third of the populations in these areas are dependent on the maintenance of sound conservation practices. The graphs also indicate that as land use impacts increase and habitat islands are formed, populations will be lost. There is a minimum area necessary to maintain even one big game species. This area, as qualified for the drier prairie country of eastern Montana is probably about 60-100 miles square (167-280 km^2). Comparison of our developed and agricultural areas with wilderness areas and historical records suggests that carnivories and specialists will be the first species lost.

Other factors such as the number of Pfister-Mueggler vegetative habitat types (Picton 1979) can also be used to predict the number of species present in an area.

Although many efforts have been made to apply the island biogeographic theory to single species, little success has been achieved (Wilcox 1982).

Another exceptional achievement of modern science has been the non-equilibrium thermodynamic theory of Prigogine (1976; Nicoli and Prigogine 1977). When its concepts are combined with those of island biogeography it is possible to make specific estimates concerning the population densities, status and area requirements of a few big game species east of the Continental Divide (Picton, 1983).

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This work was supported by the Montana Agricultural Experiment Station.

POPULATION DENSITY

Climate studies indicate the heavy involvement of precipitation and climate in the regulation of big game carrying capacity. Nonequilibrium thermodynamic theory supports the importance of precipitation in habitat and diversity and can be used to predict the numbers of large and small mammal species in an area. This emphasis on the importance of long term precipitation has permitted its application in predicting the population size and density of some species (Picton 1983).

Mule deer are a major big game species in our eastern coal mining area. Recent studies by Swenson (1982); Kasworm (1981); Isle (1982); Hamlin (1981) and Pac (1981) have provided mule deer density information for a wide area east of the Divide. When this information is compared to the long term precipitation information of Farnes (1968) as integrated over the study areas a regression ($y = -.60 + 0.032$ (cm ppt); $r = .83$, $n = 24$, $P = .01$) is obtained which can be used to predict deer densities in specific areas. The prediction for the Kendrick area would be a density of about .54 deer/Km^2. Because of the nature of the data used in deriving the equation, this density assumes the multiple use of land typical of eastern Montana. Presumeably the deer density could be higher in an exclusive use area. The deer densities were obtained during a time of relatively low populations and these are conservative.

POPULATION SIZE

Now that a deer density estimate has been derived the next question is how big a population do we need? Small populations are likely to become extinct in a short time while large populations require large areas. What do we really need to insure continuation of the species in the area? A good handy dandy estimate of population extinction time can be derived from MacArthur and Wilson (1967) using reproductive and mortality information. Of course these have to be adjusted for the specific site being studied. A rough estimate of the long term population turnover rate can be made from the amount of vegetative and geomorphic security cover in the area (Picton and Mackie, 1980). Since long term reproductive rates are generally inversely related to mortality (MCullough, 1979) an estimate of the propagule (reproductive unit) lifetime can be derived. This, in turn, can be used to estimate the average lifetime that can be expected from a population of given size. These values probably convert to about a 66 mi^2 (185 Km^2) area for a situation similar to the Kendrick site. This assumes normal grazing and hay field agricultural use within this 8 x 8 mile (14 x 14 Km) block.

COLONIZATION AND DISTANCE

It is highly desirable to locate reserve areas close enough so that disturbed areas can be recolonized as they are reclaimed. Migration theory (Baker 1978) and observations of radio equipped animals suggest that ideally the mitigation reserve areas should be located within an annual home range diameter of the reclaimed lands. The inverse square rule can be expected to apply to colonization. This is, an area two home range diameters from the reserve can be expected to have a colonization probability of 25 percent that of an area within one home range diameter of the reserve. The topographical focusing of movement routes, as along drainages, will modify this enhancing the colonization of some areas decreasing it elsewhere. Because of EHD and similar diseases it may be desirable to maintain separations of several

home range distances between mitigation reserve areas. This also assumes that the reserve areas will be managed so as to produce a surplus of animals for colonization.

DISCUSSION

A basic conclusion from ecological theory is that habitat nibbling, destroying a bit here, a piece there, does add up to produce a predictable extinction of species. This can be offset by retaining blocks of sufficient size and by setting specific management goals. Radio telemetry and marking stuides, to gather movement and population dynamics data, should be done as a part of impact studies. These studies will pay for themselves in the design of mitigation areas and in their efficient management. There is really no reason to lose all of our wildlife resources to economic development when the tools of ecological science need only to be applied to preserve viable populations into the indefinite future. To effectively use this approach information concerning climate, population density, reproduction, mortality and some concerning movements is required. The framework does exist to assemble this information for its use in solving long term problems. Site specific effects must be considered, but the consideration of site specific effects alone is not adequate to protect a population over the long term.

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MOUNTAIN GOATS AND DEVELOPMENT - HOW WILL WE MANAGE?

Gayle Joslin[1]

Misunderstandings about mountain goats (Oreamnos americanus) stem from the fact that goats are unusual animals that inhabit terrain generally unfamiliar to people. There are several widely held beliefs, although erroneous, about mountain goats that indicate they are tough, durable creatures able to accommodate almost anything: they easily adapt to human developments, they are not bothered by noise or the activities of people, they move about relatively little but yet they will go to new country if disturbance gets too intense, they stick to cliffy areas and make little use of timber. We now realize that these assumptions are wrong and that we actually know very little about mountain goats and their habitat.

In charting the history of mountain goats in Montana, we acknowledge that mountain goats have been somewhat neglected because we believe that they were insulated from man and his actions by virtue of seemingly impenetrable terrain. This has changed. We need only look at Forest Service plans for the sobering realization that mineral and timber resources are being targeted for removal in mountain goat country. Serious herd declines have occurred where developments have encroached into mountain goat terrain. It appears as though a continual loss in goat populations is imminent as more and more activity takes place.

Today I would like to discuss why mountain goats, as compared to other ungulates, appear to be particularly vulnerable to activities of man and what we are doing on the East Front goat population to better understand goat ecology and its response to human influence. The final line is whether or not mountain goats can continue to occur in areas significantly affected by man and what measures will be necessary to ensure the survival of goats in a given area. My experience is that when we have collected sound biological data, land management has been more accommodating to wildlife. Good information does change land management policies.

To better understand the relationship of man and mountain goats, we have to start with a basic understanding of the species. The evidence we have at hand indicates that the survival strategy of mountain goats makes them rigidly unadaptable. For a simple comparison, consider deer (Odocoileus spp.) and elk (Cervus canadensis) with their typical behavioral and physical traits in comparison to mountain goats:

> Mountain goats are not geared for speed or flight, they are careful, sure-footed creatures.
>
> Mountain goats are not high-strung, nevous, flighty types; they are calm, deliberate and methodical.
>
> Although mountain goats have highly developed senses of hearing, smell and sight, they depend primarily upon sight, to a lesser degree upon smell and to a limited extent upon hearing.

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Mountain goats are not the characteristic brown or tan color of most wild ungulates, they are a milky - even translucent white.

Mountain goat sexes are not morphologically distinct, rather they are virtually the same in appearance to the untrained eye.

Mountain goats did not develop in habitats where the vegetation structure is often changing, rather they evolved in a stable, predictable environment.

I probably need not go to such lengths to exemplify differences between mountain goats and other ungulates, but I do not think that biologists can stress enough to the layman and land managers that peoples' preconceived notions about wildlife are sometimes invalid for mountain goats, that in fact, goats are extremely delicate, vulnerable, unusual animals that live by a slightly different set of rules--rules which have been shaped by a unique evolution.

Mountain goats evolved to exploit a harsh, precipitous niche through pressure from predators and interspecific competition. The method or strategy whereby mountain goats survive in the niche they do involves an intimate knowledge of their terrain and strict adherence to systematic and predictable use of that terrain. This survival strategy is based on a combination of simplistic behavior and efficient use of little pieces of habitat. Although goat habitat may encompass hundreds of square kilometers, the areas actually used are disjointed segments that have been discovered through a trial and error process. The traits previously described for mountain goats comprise the framework of this survival strategy, and probably the most important trait to keep in mind is that goats are staunch creatures of habit.

A goat seems to be dull-witted when compared to a deer, but his apparent nonchalant attitude is a crucial feature of the adaptive strategy of mountain goats. A goat can ill afford to dash off in a panic when a mistep might lead to oblivion. So they stand and watch, long beyond the time a deer would stand and watch. This nonchalant appearance is usually misinterpreted as adaptability. What is actually occurring physiologically is the question.

Although only limited information specific to mountain goats has been collected, there is no reason to believe that increased hormone levels (Thompson 1957, Denenberg and Rosenberg 1967), raised heart rates (MacArthur et al. 1979) and respiration, as well as increased metabolic levels (Webster and Blaxter 1966, and Blaxter 1962 in Geist 1978) are not occurring as they do in other animals when unfamiliar situations occur. These physiological conditions are typical of stress. The consequences of chronic stress are insidious and difficult to document. They may show up as reduced feeding time (Kiley 1974), yet when under stress there is an increased nutritional need even for basal metabolic rates (Geist 1978), plus the additional needs of the active inhibition period. In addition, there may be increased fetal abortion and resorption (Geist 1971), reduced reproduction (Reid and Miles 1962 in Geist 1978), avoidance of certain areas, resulting in loss of access to resources and ultimately reduced population (Batcheler 1978 in Geist 1978).

So for mountain goats who are extremely methodical in the use of their range and reluctant to move or change their habits, exposure to peoples' activities are likely to be manifest internally where the field biologist cannot document the effects of that exposure except through long-term monitoring of population dynamics.

The unique survival strategy of mountain goats has also controlled their abilities to pioneer new country and has, thus, limited their distribution. Habitats of the world are filled by animals utilizing dispersal and life-style methods involving either generalization or specialization. The mountain goat of course is a specialist, who in order to exploit a very demanding, limited, stable environment has had to develop rigid behavioral traits.

Unlike elk and bighorn sheep (Ovis canadensis) that have been reduced to a fraction of their former native range, mountain goats were never broadly distributed. Although fossil records indicate that goats occurred as far south as northern Mexico (Cowan and McCrory 1970), they did not occur east of the Continental Divide because mountainous country became discontinuous east of the Divide. Since acceptable, secure habitat did not connect these ranges, massive mountainous islands remained unoccupied by goats. Away from suitable terrain, goats are not capable of competing with other species nor are they able to readily survive. Precipitous terrain is their primary defense mechanism. The psychological need for this type of habitat probably accounts for their poor survival in captivity (Richardson 1971).

It was the mountain goat's survival strategy tying it to specific habitats that prevented it from pioneering new mountain ranges. Mountain goats do not readily disperse since they are tied to a relatively stable climax environment and, therefore, are not geared to taking advantage of early successional habitats as are most other ungulates.

The same survival strategy that limited continental distribution applies at the local level. Although suitable goat habitat may be available within a few kilometers of an established goat herd, goats are very slow to use it--simply because it is not part of their traditional area. For example, if goats are prevented from using a portion of their range over one or more generations, they may lose the knowledge of the existence of that range.

In the Cabinet Mountains where goats are native, there are several examples where logging and mining created access into goat range and subsequently the goats disappeared. The drainages that once supported goats have been used very little over the past 30 years even though goats occur in adjacent drainages only a few kilometers away (Joslin 1980).

Even if their pioneering abilities were not so limited, it would still be disturbing that mountain goat declines seem to occur whenever people initiate projects in goat habitat. Such declines have been reported in the Swan Range (Chadwick 1973) and Cabinet Mountains (Joslin 1980) of Montana as well as in Idaho (Kuck 1977), British Columbia (Phelps et al. 1975), Alberta (Kerr 1965 and McFetridge 1977) and Alaska (Merriam 1965, Ballard 1977, Alaska Dept. Fish & Game 1975 and 1976, Schoen and Kirschoff 1981). We may now begin to see the ramifications of introducing human influences into goat range on the East Front.

Energy exploration and development are newcomers to Montana goat range. Recently a frenzy of activity from the energy industry materialized along Montana's Disturbed Belt, which runs roughly north and south through the western one-third of the state. Much of the activity has occurred along the East Slope of the Lewis Range, which runs from Highway 200 at Rogers Pass, north along Glacier National Park to the Canadian border. The area is locally known as the East Front. The East Front, rising abruptly from the plains, is a series of long reefs that line up in parallel ranks back to the Continental Divide. This country is extreme in both relief and climate. The area where we are working varies in elevation 1,524 meters (5,000 feet) from the major river bottoms to the top of Rocky Mountain (2,863 meters). On the East Front as a whole, temperature extremes range from an all-time low at Rogers Pass of -58°C (-72°F) to over 38°C (100°F) at Gibson Dam. Average annual rainfall is 50 cm (20 in) on the plains east of the Front and vary from that to over 203 cm (80 in) in the alpine where 60 to 80 percent falls as snow. Average growing seasons range from 70 to 50 frost-free days.

But the overriding climatic feature of the East Front is the wind, where speeds in excess of 130 km per hour (80 mph) are common.

There are two prerequisites to analyzing human impacts upon a wildlife population. First, the status and trend of the population must be determined: is it high or low, is it increasing or decreasing? Second, how is the population distributed: how does it use the habitat, what are the seasonal use areas, how do the animals move from one area to another, how often do they move, how much area do they cover? So the urgent question is WHY are there inevitable herd losses when man moves into goat range? In order to address today's problems, we cannot rely on management practices of the past. Through the work on the East Front we hope to document the mechanism of herd loss. Our findings, although preliminary, suggest the hypothesis that the mountain goat's survival strategy is actually its downfall when faced with something out of the ordinary. Their strategy for survival, although very effective in undisturbed natural circumstances, appears to make them vulnerable to human disruption.

The East Front mountain goat population is a portion of the much larger Northern Continental Divide population which encompasses thousands of square kilometers, ranging from the Swan Valley to the East Front and from Highway 200 to the Canadian border. The 1,295 square km (500 square mile) area which we have been working in is defined by the Sun River on the south, the North Fork Sun and Continental Divide on the west, the Badger-Two Medicine on the north and the prairies bordering the reefs on the east.

This area provides an excellent opportunity to understand mountain goat ecology and the influences of man. The East Front breaks down into three units of roughly the same size (415 sq km), each of which has experienced different levels of human influence over the years, and each of which has a more or less autonomous goat population. Our survey data and radio relocation information bear this out. There is a northern, middle and southern unit. The northern Birch-Badger unit supports a remote goat herd that has had little exposure to man other than our surveys and the occasional hearty hunter. The center Teton-Dupuyer unit supports and apparently healthy goat herd that is just starting to be exposed to a number of seismic operations and exploratory drilling activities. The southern Deep Creek-Sun River portion supports only vestiges of a once thriving goat herd. The low numbers here seem to be related to accessibility and an enthusiastic mountain goat transplanting program during the 1940's, 50's and 60's that used goats from this area as source stock for new transplant sites (Watt et al. 1971). There is an excellent opportunity to learn about mountain goat behavior and population dynamics on the East Front since within a single area three situations are occurring simultaneously.

Work on the East Front mountain goat herd was initiated by Mike Thompson in 1978 as a thesis project supported by the Montana Department of Fish, Wildlife and Parks (MDFWP). By 1981, with energy activity intensifying, both the study area and scope of study were expanded to address this issue. The MDFWP and the Lewis and Clark National Forest entered into a joint project agreement, and it was at this time that I came on the project.

We are in the initial stages of building a base of information on the population dynamics and habitat use of the East Front goat population for future comparisons. For each unit, we are in the process of collecting information on actual population levels and trends, as well as indicators of population condition that include kid to adult, subadult to adult, and male to female ratios. However, fluctuation in ratios from year to year are of little interpretive value unless they are considered in conjunction with reliable yearly population counts. Eventually yearling and two-year-old recruitment and mortality rates will emerge. In addition, habitat use information is being collected regarding overall distribution and seasonal use areas.

Most emphasis to date has been placed on the center Teton-Dupuyer unit, where a maximum of 79 animals was observed in July 1982. Based on a Lincoln Index, the population in this unit appears to be about 130. Six helicopter surveys have been conducted for this unit over the last four years, but classifications were general during the first three surveys, thus allowing comparison of kid to nonkid ratios only. Kid to adult ratios the last two years have been approximately 26 per 100 adults, while subadult to adult ratios have been approximately 28 subadults to 100 adults. Status, trends and dynamics and information on the northern Birch-Badger unit are limited, but during two years about 70 goats were consistently observed during each survey. This unit accumulates the greatest snow depths, which undoubtedly influences kid and/or subadult survival, perhaps to a larger degree than in the other teo units. Kid to adult ratios here vary from 35 on the winter count to a summer count of 47 kids per 100 adults. The subadult to adult ratios vary drastically from 16 to 58 per 100. The southern unit is a case study of a depleted mountain goat herd. Past records report 115 mountain goats were observed in the Deep Creek and South Fork Teton vicinity (Goers and Brandborg 1948), and on a single occasion in 1941, 31 goats were seen at the Deep Creek lick site (Cooney 1942). Although the major decline in this herd occurred 20 to 30 years ago, the southern unit has been very slow to come back. Thirty-five goats were observed in this unit during the 1982 survey.

Population distribution and habitat use are being determined through monitoring of radio-marked animals, recent surveys and historic records. We have some historic distribution information for all three units. Our telemetry work has concentrated on the center unit where we have marked 36 goats over the last four years. This has been the basis for delineating summer and winter range, travel routes, breeding, kidding and nursery areas and mineral licks.

Mountain goat seasonal use of the northern unit is not clear. The center Teton-Dupuyer unit is showing distinct areas of use, and certain critical areas are surfacing. For example, it appears that most of the goats on the unit utilize the Blackleaf lick site between May and August. This was possibly also the case for the Deep Creek lick in the south unit, which is why transplanting goats from this one spot could have affected the entire herd. Because there are so few goats in the southern unit, mapping seasonal habitat has been difficult. We do know of areas all along the southern half of this unit that used to support goats at least during the fall but now do not.

Information on habitat use is being obtained primarily through biotelemetry. Forty-five animals were captured in the center unit, involving 36 different individuals. The maximum number of radioed collars functioning at any one time has been 21. Movement and behavior of radio-marked goats on the East Front are providing some new insights as well as corroborating the litature concerning the frequency and magnitude of movements by both males and females, fidelity to seasonal use areas and passage of home range knowledge from generation to generation. Although the center unit covers roughly 415 sq km, many (if not most) of the goats in this unit funnel into the Blackleaf lick site in late spring and throughout the summer. If this area were to be disturbed, particularly at this time of year, this unit's goat herd could be seriously affected.

We are plainly only at the beginning of understanding mountain goat population dynamics and habitat use in the three units of the East Front. We have begun monitoring individual goats in the center unit, and the effort has yet to be expanded to the north and south.

Before we can address energy impacts, we must understand how the East Front mountain goat population functions. As far as actual responses of mountain goats to seismic testing, we found that when a line was set up in the Blackleaf Canyon four radio-marked goats in that drainage moved into adjacent drainages even before the blasting occurred. Similiarly on Walling Reef, according to the sheep researcher who was observing them (T. Andryk, pers. comm.), four adult goats as well as a band of sheep all left the area of a seismic test within 24 hours after the blasting. Immediate responses to actual blasting range from no apparent change in activity to leaping out of their beds and running in confusion. Although these responses are interesting, more importantly we have to understand how reproductive performance, habitat use and population stability are affected by energy activity.

In summary, 94 percent of mountain goat habitat occurs on Forest Service land. In game of land allocation, wildlife and its habitat are the only resources that must compete with several other resources. In order to effectively compete with the energy industry that commits millions of dollars, uses the finest technology and equipment and, in general, takes its business very seriously, wildlife agencies will have to work with the same level of intensity. Our experience is that we can influence land use decisions if our data is sound. As the resource competition game intensifies, we must show cause and effect on wildlife populations--only then will land allocations in favor of wildlife withstand the test of time.

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EFFECTS OF SEISMIC EXPLORATION ON SUMMERING ELK IN THE TWO MEDICINE-BADGER CREEK AREA, NORTHCENTRAL MONTANA

Gary Olson[1]

Abstract

Four radio collared cow elk were monitored throughout the spring, summer, and fall, 1981, to assess the effects of geophysical exploration on their distribution in the Badger Creek-South Fork Two Medicine River area of north-central Montana. For comparison, movements of two radio collared elk summering in the Middle Fork Flathead drainage (where no seismic activity took place) were also monitored.

Seismic methods employed were mainly surface blasting with one line by porta-drill. Helicopters were used to transport men and equipment. A total of seven seismic lines were surveyed through the study area during August, September, and October by Seisdata Services, Inc., SEFEL Company, and Mountain Geophysical Corporation.

As helicopter and blasting activity proceeded eastward, elk generally began moving back into the drainages occupied before exploration began. No locations were noted in direct line of sight of seismic work, rather the elk preferred to remain at least one ridge or drainage from the disturbance, mostly in heavy timber cover.

Based on average distances moved between flights for radio collared elk along the Middle Fork Flathead River in the Great Bear Wilderness, the Two Medicine group moved at least 50% more between observations.

Another collared elk which summered in Glacier National Park moved over a steep pass into an adjacent drainage approximately the same time as seismic work began in the South Fork Two Medicine valley. Her average movements between locations for the summer-fall period were much the same as the Middle Fork Flathead elk.

Levels of activity in winter similiar to that of this summer may cause severe physiological stress on the South Fork Two Medicine herd. Forced movements to marginal winter range may disrupt reproductive processes and nutritional balances. The net effect could be calf losses and death of weaker segments of the herd structure.

Recommendations for future seismic activity in this area are:

1. Eliminate activity on occupied winter range from November 1-May 15.
2. Prevent disturbances in known calving and spring migration zones from May 1 - July 1.
3. Designate specific travel routes, no more than ½ mile wide, for aircraft and work crews to minimize "cut across" traffic between lines. Helocopters in flight should maintain a 500 foot elevation above valley bottoms, sideslopes, and passes. Bighorn sheep and mountain goat concentration areas should be avoided altogether.
4. Maintain a distance of one main drainage or three tributary drainages between concurrent seismic lines. Lines running

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perpendicular to the direction of drainages could be handled in a manner which would allow at least 5 miles between concurrent lines.

Introduction

Early in the spring of 1981 three elk (Cervus elaphus) were collared with radio transmitters on winter range along the South Fork Two Medicine River. The radio telemetry study was initiated in order to assess the effects of geophysical exploration on summering elk in the Badger Creek-Two Medicine drainages. A portion of the funding was provided by the Rocky Mountain Ranger District, Lewis and Clark National Forest, with the remainder by Montana Department of Fish, Wildlife, and Parks. In addition, movements of two radio collared elk were monitored on summer range along the Middle Fork Flathead River (Great Bear Wilderness) where no seismic activity occurred.

The scope of the study was limited to actual movements of elk from the time they were collared through the general hunting season of 1981. Up to this time there had been no intensive studies of the Badger-Two Medicine elk herd. Tracking of elk occurred from fixed wing aircraft and on the ground with portable receiving equipment. Locations were plotted on 7.5 minute topographic maps. Seismic data such as line locations and dates of activity was provided by Lewis Young, Wildlife Biologist, Rocky Mountain Ranger District.

Hydrocarbon extraction and development along the Rocky Mountain Front are quite likely, as evidenced by the intense interest oil and gas companies have shown in the leasing of minerals and seismic exploration. Wildcat discoveries of natural gas in the Blackleaf area, (30 miles southeast of the Badger-Two Medicine study area) in late 1980 intensified seismic exploration and leasing interest on National Forest lands along the Front in 1981, when approximately 190 miles of lines were surveyed. Three companies operated in the Badger-Two Medicine area during August, September, and October for a total of 48 miles of seismic lines.

Description of Study Area

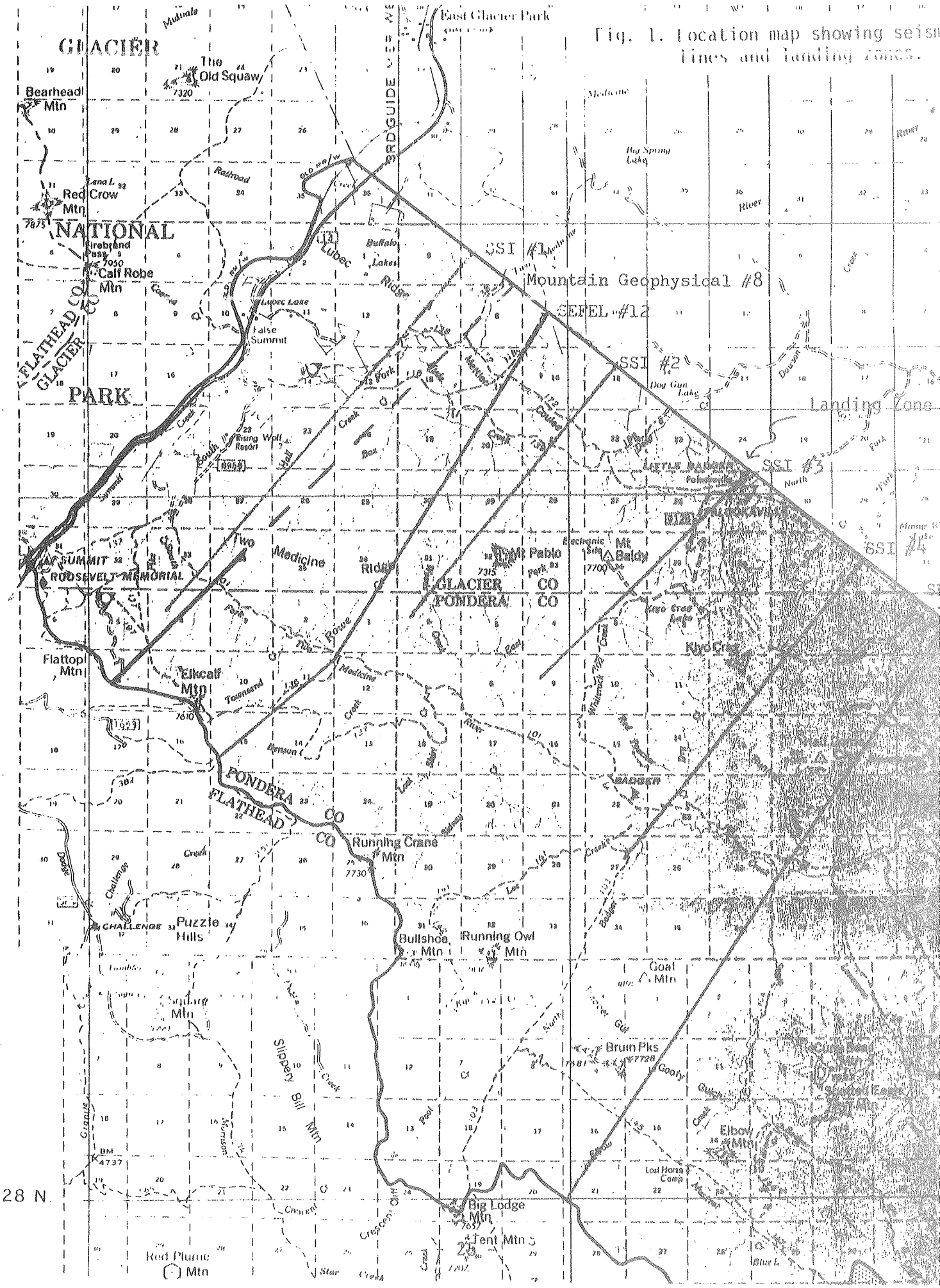
The Badger Creek-Two Medicine River Study area (Fig. 1) is bounded by Highway 2 and Glacier National Park on the northwest, by the Blackfoot Indian Reservation on the east and north, by Birch Creek on the southern end, and by the Continental Divide on the west. The area contains some 123,000 acres of National Forest with 2,800 acres private (Schallenberger 1974).

Elevations in this mountainous terrain vary from 8,385 foot Morningstar Mountain to 4,653 feet on lower Badger Creek, near the National Forest boundary. Weather records for the area reveal a mean annual precipitation of around 40 inches, approximately 60% of which falls as snow during November through April. The mean monthly temperature is 36°F, with extremes of -40°F in the winter to 90-100°F in late summer. Strong westerly winds often contribute to the "chinook" effect that is common along the Rocky Mountain Front.

Birch Creek, Badger Creek, and the South Fork Two Medicine River all drain in an easterly direction toward the Blackfoot Indian Reservation. These river valleys are generally U-shaped with a flood plain and sideslopes that are heavily timbered and dotted with moist open meadows.

Wintering elk concentrate in the lower Two Medicine and Badger Creek area, area, as well as open south and west facing slopes along tributary streams. Lubec Ridge and Two Medicine Ridge are also heavily used, especially during the mild winters. Summering areas include Two Medicine Ridge and beyond to high valleys beneath the Continental Divide, however, a portion of the winter herd

Fig. 1. Location map showing seism
lines and landing zones.



apparently moves across U.S. Highway 2 into Glacier National Park for the summer and fall months.

Fires in 1889 and 1910 burned a majority of the study area. Today widespread aspen and lodgepole pine stands verify the fire record and indicate an early successional vegetative phase.

The Two Medicine-Badger unit contains 174 miles of trails as well as 34 miles of former primitive seismograph roads; there are 26 miles of roads including about 8 miles of U.S. Highway 2 (Schallenberger 1974). The main line Burlington Northern track lies adjacent to Highway 2.

Seismograph roads were constructed in the area during 1955-57 with extensive seismic activity in the 1960's. These roads provided convenient routes of travel with the advent of the snowmobile. Many feel that the roads combined with fourwheel drives and snowmobiles increased illegal hunting, especially during the winter and spring. Two of the main roads were closed in October, 1972, but snowmobile activity persists. Year round hunting, especially on snowmobiles, greatly impacts wintering elk and moose. Several outfitters and hunters utilize the Badger-Two Medicine area for elk and bear hunting. The present five week season allows one week of either sex elk hunting, with the remainder antlered bulls. Approximately 50 animals per year are harvested in Hunting District 415, of which Badger Creek and South Fork Two Medicine are the primary elk habitat. Hunter success varies annually with weather conditions, averaging 11%. Periodic winter flights are conducted by Department of Fish, Wildlife, and Parks personnel to get population numbers as well as annual production.

Homesteads were established within the National Forest about 1910; several of these are still inhabited year round. In 1909, 8,000 sheep were authorized on the South Fork Two Medicine Creek. Cattle were also allowed on the Forest at this time. At present about 600 head of cattle and 1000 sheep are allowed to graze on this portion of the Forest.

Literature Review

Even a very superficial review of work done on elk, roads, and human disturbance indicates that line of sight barriers are important as elk move away from the source of the disturbance. Avoidance of roads by elk has been documented by several researchers, Roberts 1974, Black et al. 1975, Gruel and Roby 1975, Ward 1975, Hershey and Leege 1975, Marcum 1975, Basile and Lonner 1979, Lyon 1979, Rost and Baily 1979, and Montana Cooperative Elk-Logging Study 1981.

Perry and Overly (1977) found that roads in the Blue Mountains of Washington significantly reduced both elk and deer distribution in meadow habit. South and west slopes were used to a greater extent and therefore roads in these areas were particularly detrimental. Lonner (1981) states that when man alters the environment in which elk live, individual elk or groups of elk usually remain on their established home range but will use it differently. The larger the home range area altered and the faster the rate of alteration the more tenuous the elk use of that area becomes. Morganti (1979) studying big game in western Alberta found that learned avoidance of human activities by hunted elk could prevent them from optimizing their distribution and habitat selection. Disturbance, therefore, may disrupt herd use of critical winter range and force animals into marginal habitats (Telfer 1978).

The effects of hydrocarbon exploration and development on elk are not well documented in earlier literature, however, limited research in areas of such activities is currently available. Intense exploration and subsequent development produced many hastily planned roads which in conjunction with a vast network

of seismic lines resulted in almost unlimited access to critical elk winter range concentration along the Pembina River in Alberta (Smith et al. 1980). The net result was thought to be a reduction in total elk numbers and a decrea in productivity resulting from displacement of animals from primary range.

Reductions of elk in response to increased access has been documented in several other areas. Johnson and Lockman (1980) found that elk moved their calves at earlier ages in areas where drilling was occurring and avoided meado which were visible from rig access roads.

Knight (1980) indicated that seismic activity significantly effected the movements but not the distribution of elk in northern Michigan. He further stated that significant increases in elk daily movements may disturb rut and calving activities. In marginal quality habitat sudden movements could possib place the elk in critical situations.

A study in Alberta by Stubbs, et al. (1979) revealed the impacts of seism activity of big game winter range. Indications are that helicopters have a ve distressing effect on big game and therefore this activity should be kept at a minimum. These researchers recommend:

1. No activity between December 1 and May 1 on ungulate winter ranges.
2. To protect lambing and calving grounds no activity until after July 1.
3. Specific travel lanes should be designated.

Kasworm (1981) felt that timing restrictions for oil and gas activities along the Rocky Mountain Front on mule deer winter ranges should be implemented from December 15 - May 15, migration corridors from May 15 - June 15, and transitional ranges from October 15 - December 31.

Hoskins (1981) during an elk-seismic study in Wyoming noted that elk at a distance of over 2 miles from the disturbance distributed themselves more at random, while elk within 2 miles of the disturbance used the terrain as a shelt from the activity. Other research in Alberta has indicated that the impact of seismic activity is probably cumulative and where one program might be easily tolerated, numerous projects create considerable impact from line clearing, explosions, machinery, campsites, and concentrated human activity (Telfer 1978). Shared collection of seismic data may be one solution. Kasworm (1981) felt tha weather, livestock grazing, housing developments, and recreation in combination with oil and gas development could produce significant changes in mule deer populations.

Stubbs, et al. (1979) summarized the problem, "our approach has been that wildlife and its management is no more important than other renewable and non-renewable resource management - but certainly no less".

Methods

Radio collaring of elk was accomplished by use of a state-owned Bell (4763B- helicopter and tranquilizer gun. Animals were immobilized using approximately 22-24 milligrams of succinylcholine chloride dihydrate. Reaction times varied from 2.5-15 minutes. Elk remained immobilized for 45-120 minutes. Tag numbers and neckband descriptions are summarized in Table 1. Movements of two cow elk not subject to seismic disturbance (in the Great Bear Wilderness) approximately 12 miles south of the study area were compared and treated as controls.

An AVM model LA-12 receiver was used as well as AVM transmitters. Receiving antennas were mounted beneath a Piper Supercub aircraft and rotated in the directic of the signal. Locations were plotted on 7.5 minute quadrangle maps. On the groun locations were made using a Telonics RA-2AK two element directional "H" antenna. Three elk were monitored from April through December, 1981, while a fourth elk moved into the area from the Dupuyer-Blackleaf drainages (30 miles southeast) during the summer of 1980 and remained in the Badger area during 1981.

TABLE 1

Trapping and tagging information of Two Medicine elk.

Elk =	Date Collared	Location	Collar Description	Ear Tag ='s
3-8	3/13/82	Lubec Ridge, S. Fk. Two Medicine River		L.E. A6257 R.E. A6256
4-1	4/13/81	Box Creek, S. Fk. Two Medicine River		L.E. A6254 R.E. A6255
4-6	3/26/80	Blackleaf Creek		L.E. A6260 R.E. A6261
4-7	4/13/81	Mettler Coulee, S. Fk Two Medicine River		L.E. A6258 R.E. A6259

A total of 64 locations of six elk (4 in study area plus 2 in adjacent wilderness) was accumulated from May through November, 1981, with the majority during August and September while seismic blasting occurred. Line locations and working dates were supplied by the U.S.F.S. from seismic company records. Distances between radioed elk and seismic activity were calculated using the closest perpendicular distance to a line, or, if daily activity along that line was identified, then the distance from the activity to the elk (in Miles)

Results

Elk 4-1 (an adult cow) was collared in the Box Creek drainage on April 18 1981. Fourteen relocations have since been plotted on topographic and National Forest maps (see Fig. 3). Seventy percent of the observations of this cow were made during August and September, which coincided with seismic activities on the South Fork Two Medicine River and Badger Creek.

On May 19, cow 4-1 was observed on the west end of Two Medicine Ridge and by June 25 had moved eastward on the ridge to the West Fork of Woods Creek (actual sighting). A July 9 flight found her approximately five miles south of the June location (actual sighting). Seismic activity began in the area on August 1 with SSI line #1 (Seisdata Services, Incorporated). Elk 4-1 was located on the west end of Two Medicine Ridge in heavy timber on August 4, on the opposite side of the ridge and about 1 mile from the nearest source of surface activity (no visual). On August 9, she was found in a basin on the north side of Two Medicine Ridge, again in heavy timber (no visual). This location was approximately 2 miles from seismic activity and out of sight. Activity on SSI lines #2 and 3 was begun on August 14. Elk 4-1 was located August 14, in a heavily timbered area 1.5 miles from the nearest possible ground activity on SSI #1 and two miles from the end of SSI #2 where no activity had yet taken place. SSI lines #1, 2, and 3 were completed by August 19. Elk 4-1 was located in heavy lodgepole timber on August 18, four miles from the nearest activity on SSI #1 and two miles from SSI #2. On August 19, SEFEL line #12 was started and on August 24 elk 4-1 had moved to a heavily timbered area between Rowe Creek and Woods Creek. Activity on SSI #2 had ceased by this time and SEFEL #12 was operative. The cow was within 0.5 miles of SEFEL #12 but the actual ground activity along that line is unknown. On September 1, the elk was tracked to another timbered area 1.5 miles from SEFEL #12 and two drainages south. On September 4, elk 4-1 was sighted at the head of Lost Shirt Creek, near the Continental Divide, two miles and two drainages distant from SEFEL #12. On September 4, SSI #4 was expected to be done shooting in the Badger Cabin vicinity. A September 7, location revealed her less than 0.25 miles from SEFEL #12 which had been finished for approximately 10 days. On September 15, SEFEL #12 was trashed and on September 18, elk 4-1 was four miles south of the helicopter activity and two drainages apart. "Trashing" is a helicopter assisted cleanup procedure after blasting and recording are finished. Trash would include stakes, flagging, or other debris left from the operation.

Mountain Geophysical began line #8 on October 8 and had to abandon their operations early in November because of weather. Elk 4-1 was located on October 21 on the opposite side of Two Medicine Ridge, approximately 3.5 miles from the line. She was found two miles from the inactive line on November 10.

Elk 4-7, an adult cow, was collared in Mettler Coulee on April 18, 1981, (see Fig. 6). Her next location was in upper Hyde Creek on May 19, near the summit of Mount Pablo on June 25 (visual) and on upper Hyde Creek again on July 9. Most of the locations occurred during August and September in order to gauge the impacts of seismic activity on her summer movements.

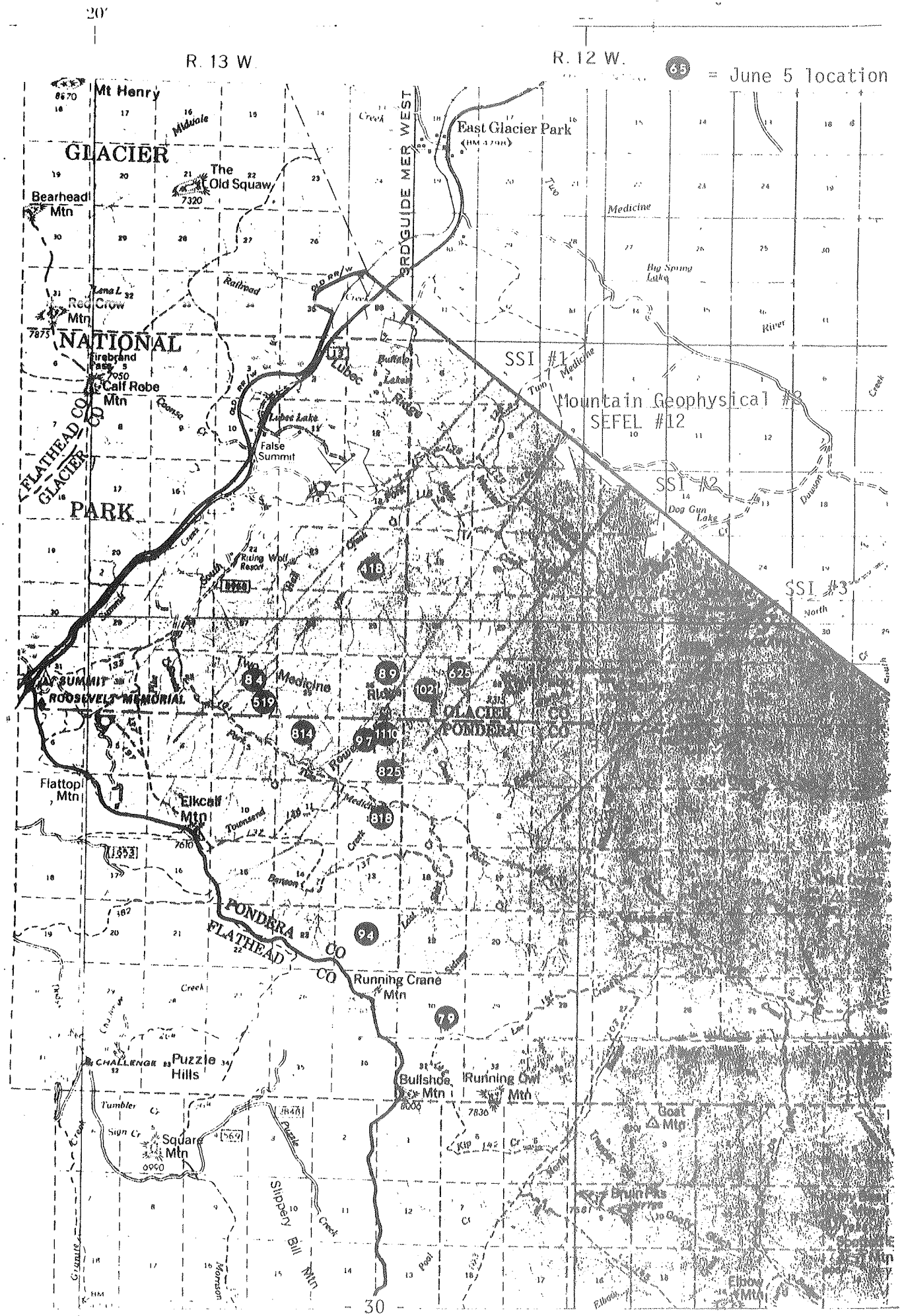
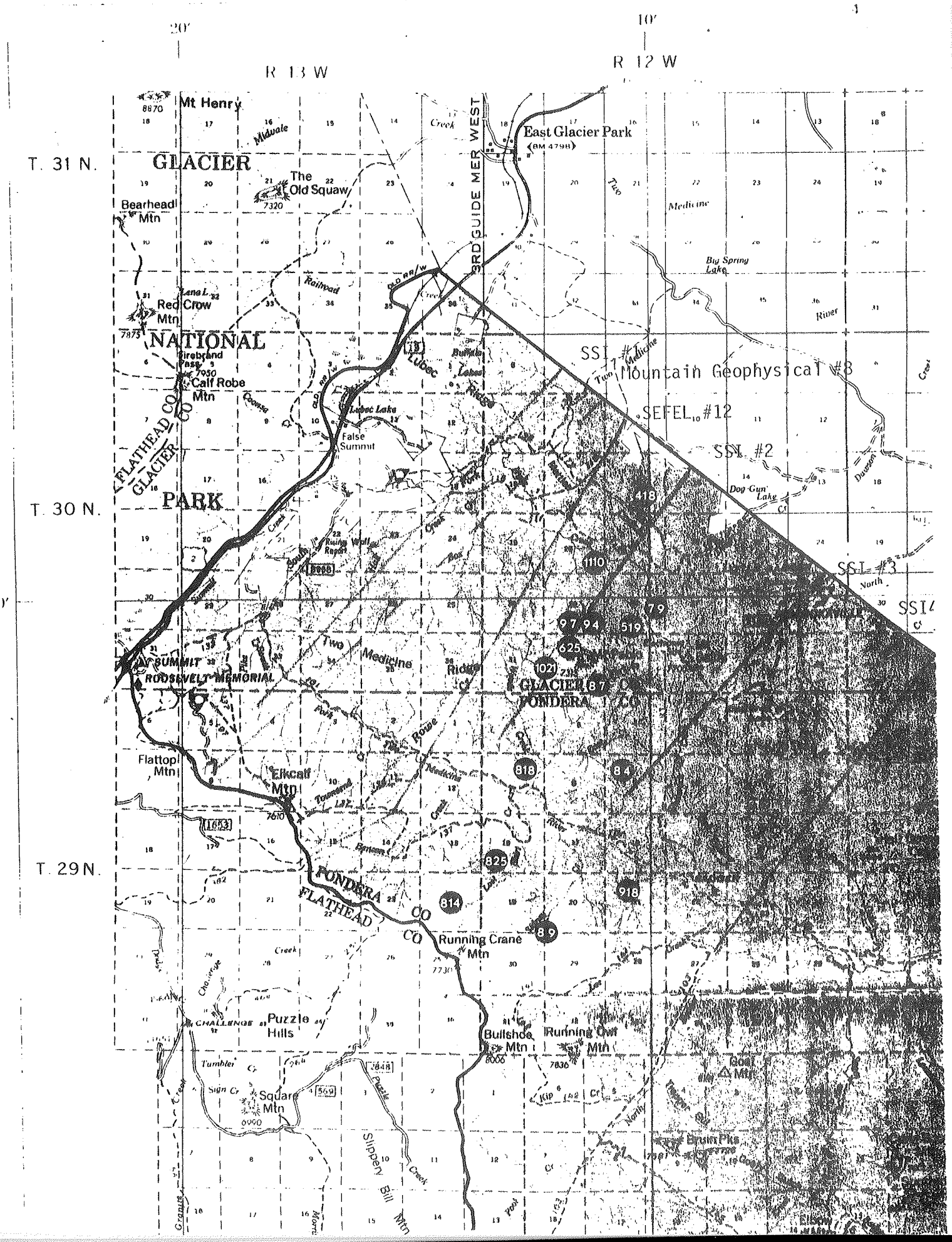

R. 13 W.
R. 12 W.
= June 5 location
T. 31 N.
T. 30 N.
T. 29 N.
GLACIER
NATIONAL
PARK
Mt Henry
Midvale
The Old Squaw
Bearhead Mtn
Red Crow Mtn
Firebrand Pass
Calf Robe Mtn
FLATHEAD CO
GLACIER CO
Lubec
Lubec Lake
False Summit
3RD GUIDE MER WEST
East Glacier Park
Medicine
Big Spring Lake
SSI #1
Mountain Geophysical #2
SEFEL #12
SSI #2
Dog Gun Lake
SSI #3
Riding Wolf Resort
SUMMIT
ROOSEVELT MEMORIAL
Two Medicine
GLACIER CO
PONDERA CO
Flattop Mtn
Elkcalf Mtn
Townsend
PONDERA CO
FLATHEAD CO
Running Crane Mtn
CHALLENGE
Puzzle Hills
Bullshoe Mtn
Running Owl Mtn
Goat Mtn
Square Mtn
Tumbler
Sign Cr
Slippery Bill Mtn
Morrison
Elbow Mtn
418
89
625
84
519
1021
814
97
110
825
818
94
79

Fig. 2 Elk 4-1 under effects of drug. Glacier National Park in background.

Fig. 4 Upper South Fork Two Medicine River

Fig. 6. Movements of elk 4-7 in relation to seismic activity.



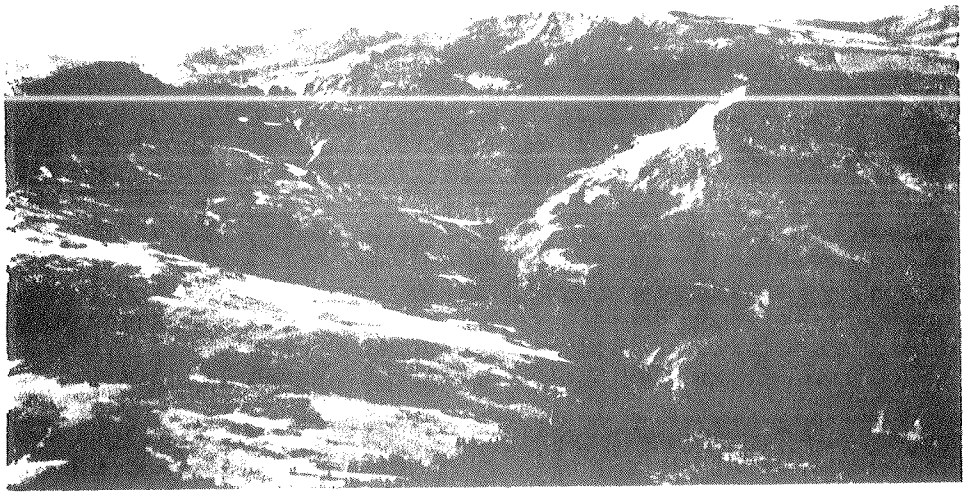


Fig. 5 Hyde Creek drainage and Two Medicine Ridge

Fig. 7 Continental Divide at head of Lee and Sydney Creeks

Seismic work began on August 1 and on August 4, elk 4-7 had moved out of the Hyde Creek drainage on the opposite side of the ridge from helicopter and blasting activity. Distance to the nearest activity on the seismic line was 5 miles. She was located in the same drainage on August 7, but had moved 6.5 miles away by August 9, as the activity progressed eastward toward her general area.

On August 14, elk 4-7 was sighted near the Continental Divide, 3.5 miles from the closest activity. On this same day SSI lines #2 and #3 were begun in the Whiterock Creek-Mount Pablo area. SSI #1 was finished on August 17 and SEFEL #12 began under Elk Calf Mountain. Elk 4-7 was located in heavy timber near the mouth of Woods Creek on August 18. SSI lines #2 and #3 were finished on the 17th and 19th of August, respectively, near the Reservation boundary.

The elk was observed in upper Lost Shirt Creek on August 25, two drainages south of the activity on SEFEL #12, which by this time had progressed on down Two Medicine Ridge toward her last location. She was approximately 2.5 miles from the nearest seismic work at this time.

On September 4, SSI #4 was expected to finish its shot hole operation and elk 4-7 was located back at the head of Hyde Creek. By this time the blasting activity from SSI lines #1, #2, #3 and SEFEL #12 had subsided.

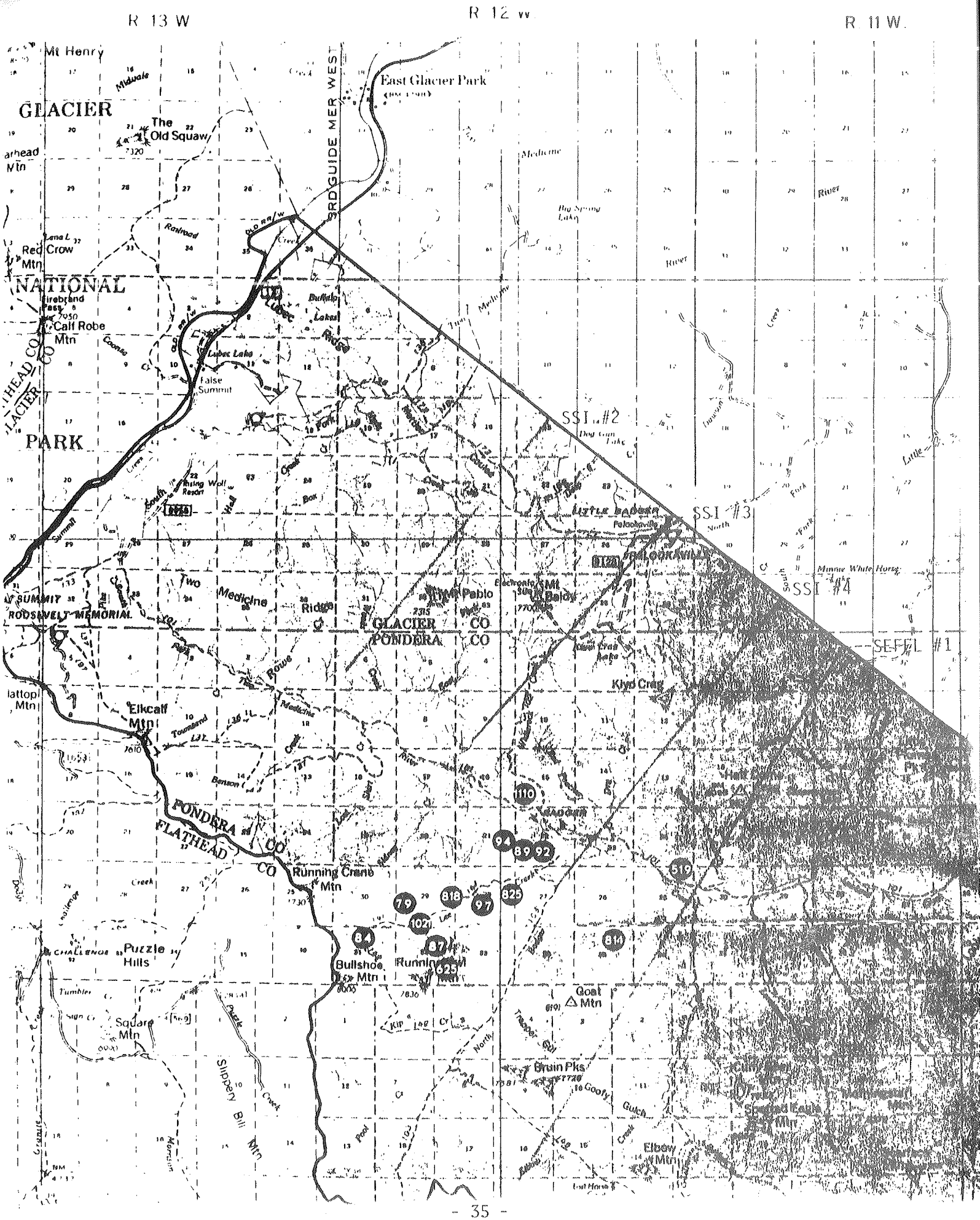
Elk 4-7 was located in the Hyde Creek drainage again on September 7. SEFEL #12, according to USFS records, was trashed on September 15 and on a September 18 flight she was tracked into the Sydney Creek area, four miles south of the previous two locations.

By October 21, elk 4-7 had moved back up on Two Medicine Ridge at the head of Woods Creek, and on November 10 had situated back on Hyde Creek. Mountain Geophysical line #8 was active during portions of October, but shut down for the winter sometime early in November.

Elk 4-6 was collared March 26, 1980 in Ping's Coulee, approximately two miles north of the Blackleaf Wildlife Management Area (35 miles southeast of study area). April and May, 1980 locations were in the South Fork Dupuyer Creek and Scoffin Butte area. She was not located again until November 12, 1980 in the Badger Creek drainage. Subsequent locations were all in Lee Creek and Badger Creek (Fig. 8).

Seismic activity in the Lee Creek-Badger Cabin vicinity began by about August 10 with SSI lines #3 and #4. Dates and locations of the porta-drill activity on SSI #4 are sketchy, but apparently the line was drilled in segments and not necessarily in sequence from west to east. SSI #3 skirted the northern edge of elk 4-6's known range, while SSI #4 ran up to the east end of her range on Lee Creek.

On August 14 she was tracked to an area on the northeast edge of Goat Mountain, a movement that falls in line with the seismic work that began on SSI lines #3 and #4. By August 18 she was back on Lee Creek, but on September 1 she had moved out of Lee Creek into a heavily timbered area just 0.5 miles from Badger Cabin. SEFEL #1, using surface charges, began surveys August 24 and was located northwest of Goat Mountain. This line was also worked from west to east, so it is assumed that by the first week in September the blasting would have progressed eastward out of the Badger drainage. Elk 4-6 remained in the area south of Badger Cabin until at least September 4, since she was relocated on Lee Creek September 7. On September 18 the 4-6 signal came from a general area between the North Fork Badger Creek and Goat Mountain; a precise location was not obtained. Four days before the opening of the general hunting season she was again back in Lee Creek. A November 10 flight indicated that she had moved into heavy timber between Red Poacher and Whiterock Creeks.


R 13 W
R 12 W
R 11 W
Mt Henry
GLACIER
The Old Squaw
East Glacier Park
3RD GUIDE MER WEST
Red Crow Mtn
NATIONAL
Firebrand Pass
Calf Robe Mtn
Lubec Lake
False Summit
PARK
SSI #2
SSI #3
SSI #4
SEFEL #1
Two Medicine Ridge
Pablo
Elkcalf Mtn
GLACIER CO
PONDERA CO
FLATHEAD CO
Running Crane Mtn
Puzzle Hills
Bullshoe Mtn
Square Mtn
Goat Mtn
Grain Pks
Elbow Mtn
Slippery Bill Mtn

Elk 3-8 was radio collared on Lubec Ridge March 13, 1981, (see Fig. 9). On May 19 she was north of U.S. Highway 2, just east of Lubec Lake, in Glacier National Park. On June 25 elk 3-8 was on upper Railroad Creek, further into the Park. The next flight was on July 9 and she had moved up Railroad Creek to Leena Creek. An August 4 trip into the area revealed that she had moved over Firebrand Pass into the head of Ole Creek. It is about this time that the helicopter and blasting activity began on SSI #1, approximately 2 miles southeast of the Park boundary.

The 25th of August elk 3-8 had moved to an east facing slope on the Old Squaw and spent most of September back on Railroad Creek. She was found on Ole Creek on October 21 and had moved even further down Ole Creek to a basin under Mount Despair by November 10.

Elk 1-2 and 3-7 are adult cows that summer along the Middle Fork Flathead River, in the Great Bear Wilderness, approximately 12 miles south of the study area. Both elk were collared in March, 1979, in roughly the same area as elk 4-6, adjacent to the Blackleaf Wildlife Management Area. Monitoring of these animals movements since 1979 has been less intensive in the study area. The total number of relocations are listed in Table 2. While no seismic activity has occurred in the Great Bear Wilderness, human activity in the form of hunting is much the same in both areas. The results of the comparison revealed that the movements of elk most likely to be displaced (4-1 and 4-7) actually moved between 30% and 50% more between locations than those in more isolated locations.

Movements of elk 4-6 are not as easily related to seismic work as those of 4-1 and 4-7, probably because the Lee Creek drainage is more isolated that others and because seismic lines were not surveyed through her summer use area as they were in the case of the other two elk. Nonetheless, trends of movements do correlate with the timing of seismic activity and do support evidence gained in the study of 4-1 and 4-7.

Although no seismic work occurred within Glacier National Park SSI #1 was close enough to the boundary to have an effect on elk 3-8, and a movement out of the area did in fact occur sometime in late July or early August. It is possible that the sight or sound of helicopters or blasting may have pushed her over Firebrand Pass.

Figure 10 shows movements of elk 4-1 and 4-7 before, during, and after seismic activity. Why 4-1 made a long trip from Two Medicine Ridge to the Continental Divide early in July is unknown. No seismic work had yet taken place. Possibilities include illegal harrassment by aircraft, movement of cattle into the area the last week in June, and a one day motor-cross race that was held July 12. Preparations for the race took place in June and numberous "runs" over the course with bikes were needed to mark trails, etc. This reasoning is purely speculative, especially, since data from the previous summer was not obtained on any of the four elk.

After August 1, elk movements began to follow a pattern of avoidance to helicopters and explosives until late September when activity subsided. It is interesting that on September 15, SEFEL #12 was trashed. On September 18 both elk had moved 2-4 miles from their previous locations on the vacated line; by October 23 they were back in the area of the abandoned line. Summering elk in the Two Medicine drainage apparently have a great affinity for certain habitat types and locations, as is indicated by their willingness to relocate in such areas after seismic work was finished. The data suggests that a few days of activity is tolerated but when that time limit is exceeded elk begin a series of movements to avoid the disturbance.

to seismic activity.

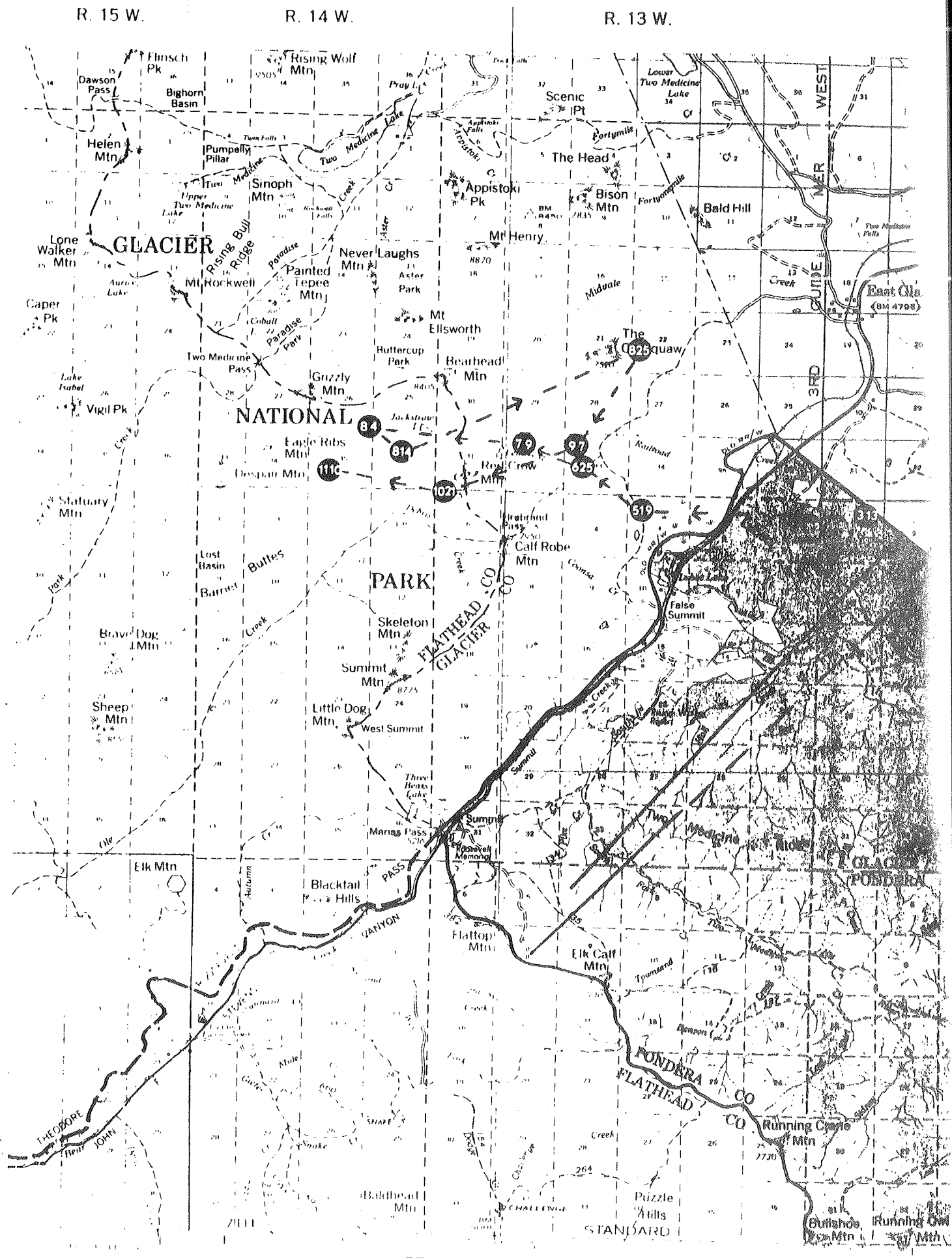


TABLE 2

Comparison of elk movements on two different summer ranges in relation to seismic activity

Elk #	Ave. Movement Between Relocations	Number of Relocations	Frequency of Relocation	Summer Range Area
1-2	1.72 miles	19	0.6/ mo.	Middle Fork Flathead River Great Bear Wilderness (No Seismic Activity)
3-7	1.98 miles	14	0.4/ mo.	" "
3-8	1.88 miles	8	2.0/ mo.	Glacier National Park
4-1	3.05 miles	13	3.0/ mo.	South Fork Two Medicine River
4-6	1.71 miles	14	3.2/ mo.	North Fork Badger Creek
4-7	2.56 miles	12	3.0/ mo.	South Fork Two Medicine River

Discussion

Analysis of movements of four radio collared elk in the Badger-Two Medic drainages from May through November, 1981, indicates a tendency to avoid visu disturbances rather than auditory signals, at least initially. Seismic blast could be heard in all drainages of the study area during August, however, elk movements appeared to be more related to visual barriers between them and hum activity. The average distance moved between relocations is presented in Tab 2. Elk 4-7 showed similiar tendencies to 4-1 in relation to movements in area where seismic blasting occurred. Distances moved by both elk increased as the disturbance approached areas that they frequented.

Wintering big game species, especially elk, in the Two Medicine-Badger drainages are severly limited, both by time and space. Year round illegal hun ing may cause excessive energy expenditure due to induced avoidance behavior. Foraging areas that are relatively inaccessable by humans are few. Fortunatel forage quality is good and wintering elk make use of these windswept rough fescue openings. It is interesting to note that while summering elk are in areas adjacent to grazing allotments not one relocations was made where the two inter mingled. Winter habitat is generally occupied after cattle are removed from th forest.

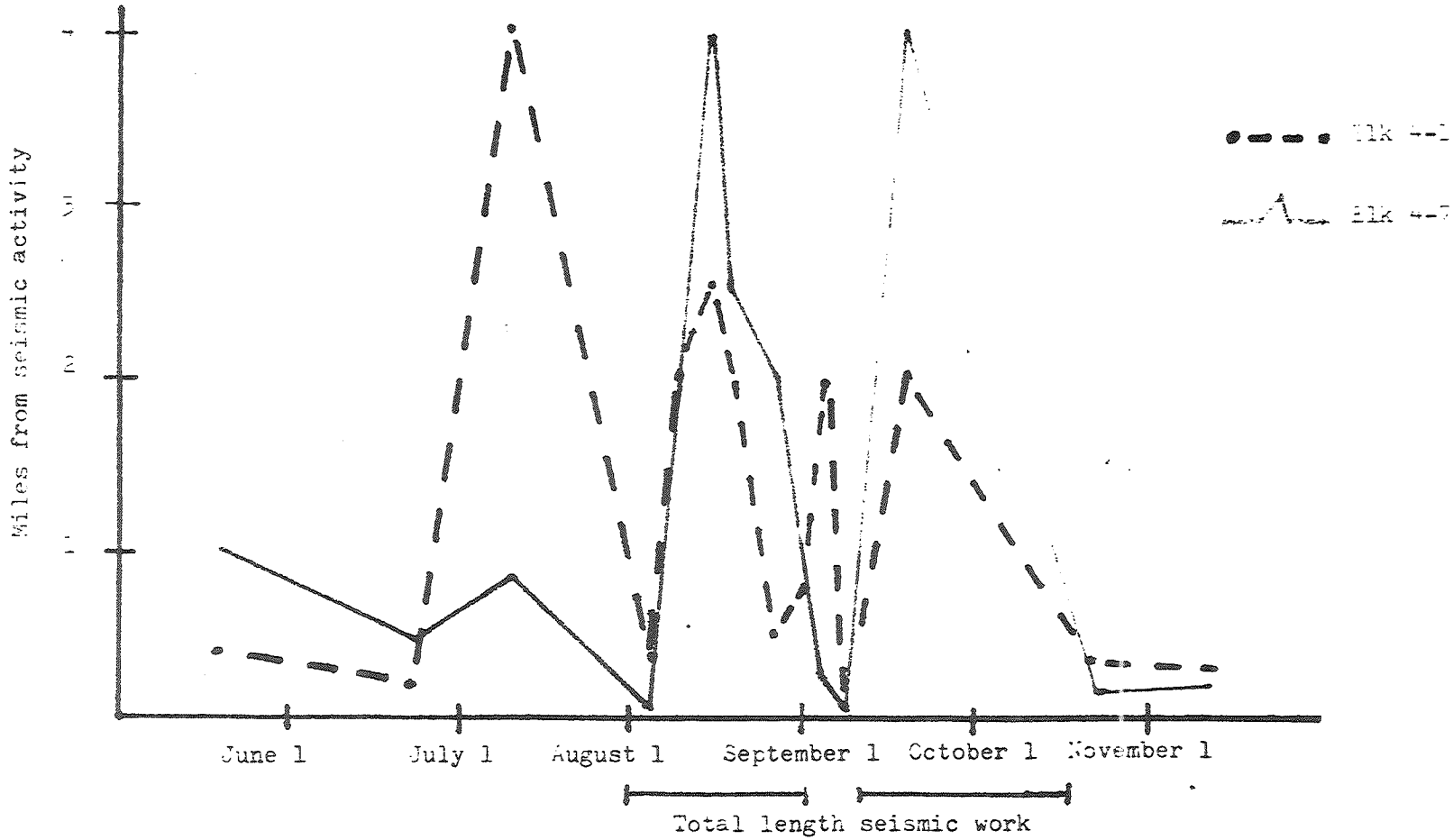
The quality of forage for wintering elk is directly related to successful reproduction. Thorne, et al. (1976) found that in Wyoming elk, a calf that was born weighing approximately 16 kg or more at birth would have a 90% chance of s vival to one month of age. Chances for survival fell below 50% when calf weigh were less than 11.4 kg. Energy expenditures during winter months are critical to elk and any additional disturbances result in an energy deficit, both to the cow and her fetus. In severe cases herd productivity suffers with total popula tion levels falling within a few years. Considering the amount of human activi ty in this area, it is apparent that some degree of regulation may be necessary to insure a viable, healthy elk herd.

Winter activity should be kept at a minimum. Illegal hunting is a problem which will likely persist, and, even though the entire wintering herd is not affected at the same time, movements to avoid these activities may be very cost (energy-wise) to the whole population. It is recommended that no seismic exploration be allowed on winter foraging areas or adjacent thermal cover from November 1 - May 1. These dates provide flexibility for elk to deal with hunters, winter conditions, and early calving periods. Disturbance on known calving grounds and spring migration zones should be prevented from May 1 - June 30. This will insure that calving elk and those migrating with calves will be able to establish on summer ranges before seismic activity begins.

Specific travel routes should be designated for aircraft and work crews to minimize "cut across" traffic between lines. Helicopters in flight should maintain a 500 foot elevation above valley bottoms, sideslopes and passes. In areas of goat and sheep concentrations timberline areas and above should be avoided as much as possible with no hovering or low altitude passes in selected alpine zones (Joslin, 1981). It is suggested that these travel routes be no more than 0.5 miles wide.

A distance of at least one main river drainage or three tributary drainages should be maintained between concurrent seismic lines. The South Fork Two Medicine River would be defined as a main drainage, with Sydney Creek, for example, serving as a tributary stream. Lines running transversely to the direction of streams or drainages could be handled in a manner which would allow at least

Fig. 10. Movements of two cow elk in relation to seismic blasting and associated activities.



5 miles between concurrent lines, making sure that adequate visual barries were available.

Aldo Leopold (1933) put it very neatly, "control is the combination of science and use". Therefore, in order to fully understand the complexities of our resources we need to integrate management theory with resource use. Hopefully, impact studies such as this one will contribute something towards that end.

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HABITAT USE AND POPULATION CHARACTERISTICS OF BLACK BEARS IN THE EAST BOULDER IN RELATION TO PROPOSED MINING ACTIVITIES

Al Rosgaard[1]

Introduction and Study Area:

This study originated in response to a proposal by Stillwater PGM to dig a low level exploratory adit in the East Boulder drainage which would become a production platinum mine. This area is in the Beartooth Mountains of South central Montana about 25 miles south of Big Timber in Sweetgrass County.

Other associated mining operations were also proposed, and included a mill and concentrator near the mine entrance, a tailings pond in the Dry Fork (eastern tributary of East Boulder), and construction of haul roads and maintenance buildings. The tailings pond would be constructed by damming the mouth of the Dry Fork and flooding the bottom.

This study was designed to determine the potential impacts of these proposed mining activities on big game species (mule deer, elk, and black bear) using the Dry Fork-East Boulder area. The objectives of this study were to determine the following for these species:

1. Seasonal and yearlong distribution.
2. Normal travel and migration patterns.
3. Population characteristics, including sex and age structure and density.

For this presentation I will discuss the black bear portion of this study.

Methods:

Black bears were captured and marked during June 1981 in the Dry Fork and East Boulder drainages and during May and June 1982 in Meyers, Lodgepole, Castle, Dry Fork and East Boulder drainages. Bears were trapped in Adlrich footsnares set at the entrance of log cubbies baited with a mixture of Rompun (Xylazines hydrochloride) and Keto Set (Ketamine hydrochloride) in a ratio of 100 mg Rompun to 200 mg Keto Set per 100 pounds of estimated body weight. Yearling cubs were held down with a log and hand injected with a syringe.

In 1981 captured bears were marked with numbered plastic roto-type ear tags in each ear. In 1982, in addition to the ear tags, a colored streamer was attached to each ear. The streamers were 1x6 inch strips of Armortite material, color coded for each individual bear. Adult bears were fitted with radio transmitter collars made of conveyor belting padded with foam rubber and wrapped with colored tape.

Data collected for each bear included sex, coat color and condition, weight, and several body measurements (total length, chestgirth, neck and head circumference, and foot and pad width and lengths). Bears were weighed using a 300 pound spring scale. Bears were placed in a canvas tarp hooked to the scale and were lifted using a block and tackle.

A rudimentary premolar was extracted from each bear using dental pliers. Teeth were sent to Gary Matson (Box 308, Milltown, Montana 59851) for age determination by sectioning and staining of cementum layers as described by Stoneberg and Jonkel (1966).

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During May and June 1982, a 161 km^2 (62 mi^2) area adjacent to and including the proposed mining area was surveyed intensively in an attempt to observe and classify as many bears as possible. Surveys were conducted during early morning or late afternoon hours using a Bell helicopter.

Results:

Trapping Results:

During June 1981, 3 adult male black bears were captured in the Dry Fork East Boulder area and fitted with radio transmitter collars. In May and June 1982, 16 individual bears were trapped, 10 in the Dry Fork-East Boulder, and 6 in adjacent drainages to the east (Meyers, Castle, and Lodgepole). Table 1 summarizes the results of both years' trapping.

In 1982, 2 males slipped off their radio collars shortly after they were trapped, 1 radio-collared male was shot by a hunter, and another was killed by a U.S. Fish and Wildlife Service predatory animal control agent. Two of the 3 bears caught in 1981 were recaptured in 1982. The radio collar was removed from one due to an irritation on his neck. The other bear not recaptured in 1982 either shed his collar at the den site or died during the 1981-1982 winter.

Movements, Distribution and Habitat Use:

Black bears using the Dry Fork and adjacent drainages during the spring utilize a very extensive yearlong area. Using locations of all the radio-collared bears, this area was computed to be 1,050 km^2 (405 mi^2) as shown in Figure 1. Yearlong homerange sizes for adult males ranged from 92-216 km^2 (59 mi^2), (Table 2). The two adult females had considerably smaller yearlong ranges of 6.5 km^2 (2.5 mi^2) and 35.2 km^2 (14 mi^2). Seasonal distribution, movements, and habitat use was as follows:

Spring (den emergence to July 15) - Figure 1 shows the collective spring range, based on locations for all radio-collared bears. Locations were concentrated in the Dry Fork, East Boulder, and Elk Creek areas. Bears concentrate in these areas in spring because of early green-up and lush forage production. Bears and bear sign were frequently observed in aspen and mixed aspen-conifer stands. These habitats as well as meadows and open grassy hillsides were important feeding areas. Key areas within this spring range include the following: 1) the south-facing bench above Dry Fork, 2) the Dry Fork bottom, 3) the East Boulder Bottom below Dry Fork mouth, and 4) the band of mixed aspen-conifer in Elk Creek. Sows with cubs and also solitary bears were observed in these areas, which indicate their importance for breeding and young rearing.

Weather conditions and plant phenology affect bear distribution and movements within spring range. The mean elevation used by radio-collared bears in spring 1981 was 2,289 m (7508 ft.) compared to 1,958m (6424 ft.) for radio-collared bears in spring 1982. Cooler temperature and occasional snow in May and June 1982 delayed green-up, causing bears to remain at lower elevations throughout the spring.

Individual spring home ranges were only a small portion of the yearlong home ranges (Table 2). The mean spring home range sizes for adult males was 19.8 km^2 (7.6 mi^2) compared to 1.9 km^2 (0.7 mi^2) for the two females.

Table 1. Results of spring bear trapping 1981 and 1982, on the East Boulder study area (cont.)

Bear No.	Date	Sex	Age	Weight (lbs.)	Color	Ear Tags[1] Right	Ear Tags[1] Left	Trap Site	Remarks
10-82	6/05/82	F	2	65	Black	247/Red	143/White	Dry Fork	
11-82	6/06/82	F	8	110	Lt. Brown/ Blonde	142/Red	227/Red	Upper Dry Fork	Radio B1 CH4 (yellow collar); recaptured 6/13/82
12-82	6/09/82	M	1	30	Blonde	246/Dk. Blue	248/Orange	Upper Dry Fork	Yearling cub of sow 11-82
13-82	6/09/82	M	2	165	Black	249/Yellow	250/White	Dry Fork	Radioed but slipped collar
14-82	6/14/82	M	1	30	Lt. Brown	237/Dk. Blue	236/White	Lower Dry Fork	Yearling cub belonging to sow 11-82
15-82[3]	6/15/82	M	3	140	Blonde	202/Green	201/Yellow	Upper Dry Fork	Radio B2 CH3 (red collar)
16-82	6/16/82	M	5	190	Dk. Brown	129/Green	128/Orange	Upper Dry Fork	Bear 2-81; added ear streamers; radio still working

[1] Bears trapped in 1981 received ear tags but no streamers; bears caught in 1982 received both ear tags and colored streamers.

[2] Radio signal indicated either bear died in den or slipped the collar in den, spring 1982.

[3] Bear 15-82 was shot and killed by U.S. Fish & Wildlife Service predator control agent, August 22, 1982.

Table 2 Results of spring bear trapping 1981 and 1982, on the East Boulder study area

Bear No.	Date	Sex	Age	Weight (lb.)	Color	Ear Tags[1] Right	Ear Tags[1] Left	Trap Site	Remarks
01-81[2]	6/14/81	M	5	230	Black	127	126	East Boulder	Radio B4 CH12
02-81	6/15/81	M	4	205	Brown	129	128	Dry Fork	Radio B4 CH8 - recaptured once in 1982
03-81	6/17/81	M	10	210	Brown	132	131	Dry Fork	Radio B4 CH11 - recaptured 3 times in 1982; collar removed
01-82	5/09/82	M	3	180	Black	Orange	Orange	Lodgepole Cr.	Radioed but killed by hunter in June 1982
02-82	5/13/82	M	10	225	Brown	132/Yellow	131/Yellow	Lodgepole Cr.	Bear 3-81; radio collar removed
03-82	5/15/82	F	3	93	Red Brown	149/Lt. Blue	148/Lt. Blue	Castle Creek	
04-82	5/16/82	M	2	140	Brown	228/White	229/White	Meyers Creek	Radioed but slipped collar
05-82	5/19/82	M	3	95	Black	150/Green	147/Green	Lodgepole Cr.	
06-82	5/23/82	M	9	207	Black	232/Lt. Blue	233/Yellow	Castle Creek	Radio B3 CH3 (orange/blue collar)
07-82	6/02/82	M	1	40	Black	146/White	145/Lt. Blue	Lower Dry Fork	Recaptured 6/5/82 and 6/16/82
08-82	6/04/82	F	10	100	Black	230/Yellow	231/Red	E. Boulder - Dry Fork	Radio B4 CH9 (green/black collar)
09-82	6/05/82	M	14	310	Black	245/Dk. Blue	244/Red	Lower Dry Fork	Radio B1 CH11 (blue/yellow collar)

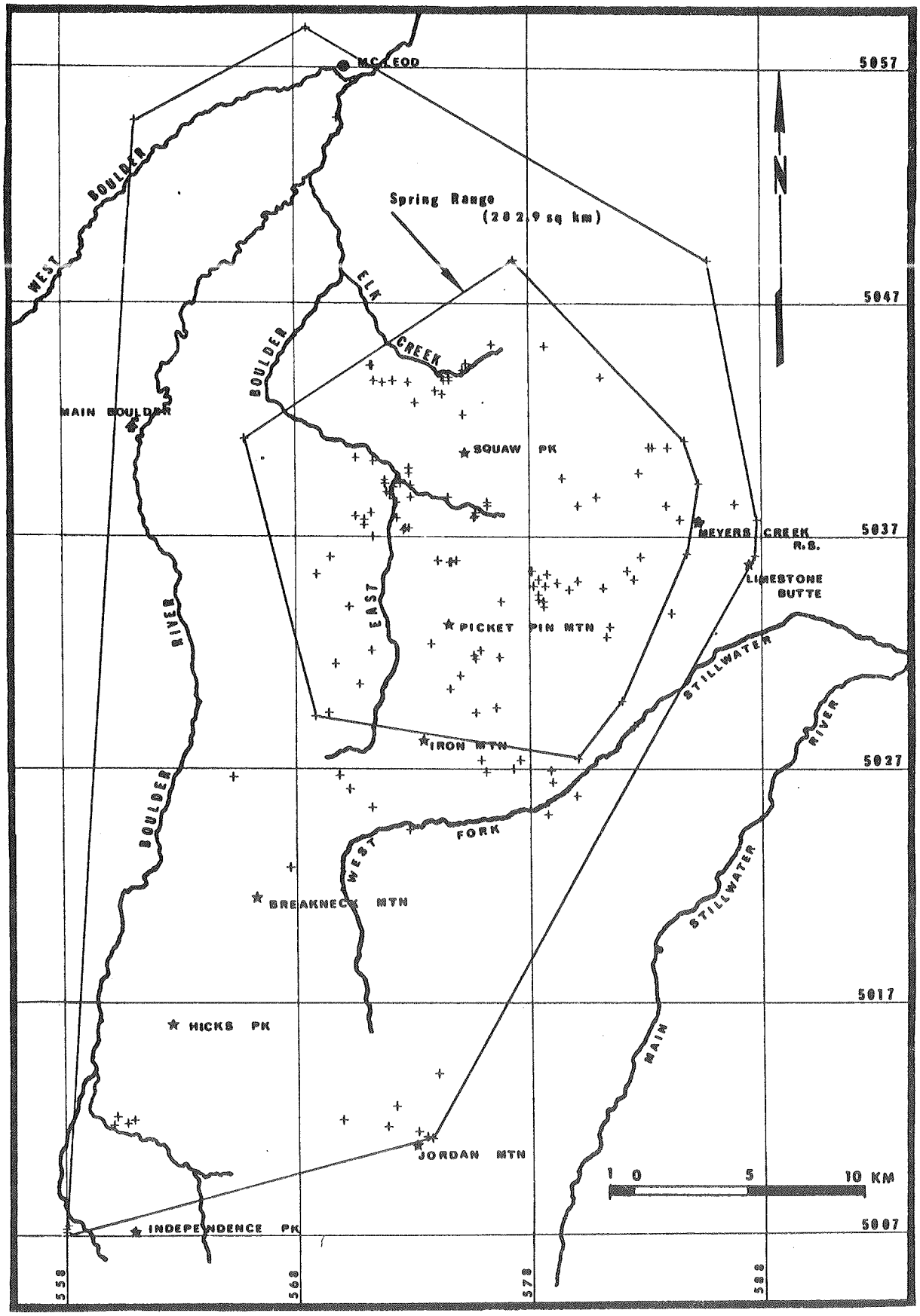

Fig. 4. Total yearlong area used and spring use area (April-July 15) of radio-collared black bears captured on the East Boulder Study Area.

Table 3 Home range size and mean elevation of radio-collared black bears captured on the East Boulder Study Area

Animal ID	Sex	Yearlong Home Range Size km^2	(mi^2)	Mean Elevation (m)	Spring Home Range Size km^2	(mi^2)	Mean Elevation (m)	Summer-Fall Home Range Size km^2	(mi^2)	Mean Elevation (m)
3-81[a]	♂	165	(64)	2,280	32	(12)	2,291	58	(23)	2,485
3-81[b]					4	(1.6)	1,890			
2-81[a]	♂	126	(49)	2,292	3.4	(1.3)	1,961	68	(26)	2,480
2-81[b]					62	(24)	2,015	1	(0.4)	2,336
1-81[a]	♂	210	(81)	2,697	9	(3.5)	2,615	151	(58)	2,725
1-82[c]	♂				29	(11)	1,925			
15-82	♂	103	(40)	1,856	6	(2.4)	1,935	84	(32)	1,792
6-82[d]	♂	92	(36)	2,060	4.5	(1.7)	1,875			
9-82	♂	216	(83)	2,131	29	(11)	2,107	64	(25)	2,152
11-82	♀	35	(14)	2,230	4.4	(1.7)	2,164	35	(13)	2,271
8-82	♀	6.5	(2.5)	2,081	1.9	(0.7)	1,957	4.2	(1.6)	2,150

[a]Data for 1981.

[b]Data for 1982.

[c]Bear killed late May 1982; only spring data available.

[d]Radio failed August 1982; insufficient data for summer-fall home range size.

Summer-Fall (July - Denning)- During 1982 black bears remained at lower elevations throughout most of the summer in response to forage availability brought on by the late wet spring even after green-up had occurred in the high country. The mean elevation of radio-collared males was 2,093 m (6,865 ft) in 1982 compared to 2,563 m (8,407 ft) in 1981. In 1981 males moved to white bark pine stands at high elevations by late summer-early fall, possibly in response to forage dessication at lower elevations.

Adult males moved to summer ranges distinct from their spring ranges. For several bears this was a considerable distance. Male #1-81 moved to Lake Plateau near Barrier Lake, 30 km (19 mi) south of the Dry Fork. Male #9-82 moved southwest from the East Boulder-Elk Creek area up to Sheep Creek near the head of the Main Boulder River, a distance of about 41 km (26 mi). Another male #15-82 moved north from Elk Creek down the East Boulder to the north side of the West Boulder (17 km, 11 mi).

The 2 adult females stayed in the vicinity of the Dry Fork-East Boulder throughout the summer and fall and denned in this area as well.

Denning - The dens of most bears were found on north facing slopes in areas of large outcropping of rock within dense lodgepole pine timber at elevations ranging from 2,133 m (7000 ft) to 2,591 m (8500 ft). Only the 2 females of the radio collared bears remained and denned in the Dry Fork-East Boulder drainage.

Population Characteristics

Aerial and ground observations of black bears on the study area during spring and early summer resulted in 57 observation of which 35 were determined to be different individual bears. Criteria used to distinguish different individuals were body size, coat color, visible makings, presence of cubs or yearlings, and location. These 35 individuals added to our 16 marked bears and 7 bears killed by hunters in spring 1982 (Table 3) gave a minimum spring population estimate of 58 black bears for the study area. This area was approximately 161 km^2 (62 mi^2) and thus a density of 1 black bear/2.8 km^2 (1.1 mi^2) was calculated. This is similar to spring densities for 2 areas in Idaho where Beecham (1977) found 1 black bear/2.1 and 2.3 km^2 (0.8 and 0.9 mi^2), respectively. Jonkel and Cowen (1971) found densities ranging from 1 black bear/ 2.1 - 4.4 km^2 (0.8 - 1.7 mi^2) in northwestern Montana.

Of the 35 unmarked bear observed in the study area, 16% were cubs and 10% were yearlings. This figure compares similarly to the findings of Jonkel and Cowen (1971) in northwestern Montana where cubs and yearlings made up 29% of that population. Table 4 shows the black bear age distribution developed from tooth sectioning of 18 hunter-killed and 13 trapped bears older than 1 year. The hunter killed bears included bears shot in the survey area as well as adjacent drainages from 1980-1982. Fifty percent of the bears trapped in our study area were 4 years old or less. The older adult segment of this black bear population is evenly represented throughout the age classes for each sex up through age 10. One radio-collared male was 14 years old and a female found dead was 22 years old.

For the 5 sows with cubs that were observed, the mean litter size was 1.8. Jonkel and Cowen (1971) stated that litter size of 1.5-1.8 are representative of black bears in habitats of Montana.

Potential Impacts

The greatest potential for direct impact on black bears would occur in spring. this is a critical time when bears are trying to regain weight lost during the denning period. At this time they spend extended periods

Table 4. Black bears killed on the East Boulder Study Area

Date	Sex	Age	Color	(Size)	Location
5/16/82	♂	2	Black	(Small)	Elk Creek
5/21/82	♀	5	Brown	(Medium)	Elk Creek
5/22/82	♂		Black	(Small)	Meyers Creek
5/23/82	♀	4	Black	(Medium)	Dry Fork
5/28/82[a]	♂	3	Black	(Medium)	Elk Creek
5/28/82	♀		Blonde	(Small)	Elk Creek
6/5/82[b]	♀	22	Black	(Medium)	Elk Creek
Early June 1982	♀		Blonde	(Medium)	Elk Creek
Other black bears killed on the Study Area and Adjacent drainages, 1980-82					
Early June 1980	♂	9			Elk Creek
Early June 180	♂	7			Elk Creek
Early June 1980	♂	4			Elk Creek
August 1980	♂	8			Susie Creek
Late April 1981	♂	10			Elk Creek
May 1981	♂	5			East Boulder
May 1981	♂	3			Bridger Creek
Early June 1981	♂	5			Elk Creek
Mid-June 1981	♀	10			Froze-to-Death Creek-Main Boulder
6/15/81	♀	6			Upper Deer Creek
5/21/82	♀	7			Lower Deer Creek
Early June 1982	♀	7			Main Boulder
6/10/82	♂	2			Derby Gulch-Deer Creeks
Mid-June 1982	♂	5			Main Boulder-Fourmile Creek

[a]Radio-collared bear #4112

[b]Died of natural causes.

Table 5. Age distribution of trapped and hunter-killed black bears from the study area and surrounding drainages

Sex	Age										
	2	3	4	5	6	7	8	9	10	14	22
♂	3	5	1	5	0	1	1	2	3	1	0
♀	1	0	1	1	1	2	1	0	1	0	1
Total	4	5	2	6	1	3	2	2	4	1	1

feeding on open slopes and meadows where they are most visible and thus more vulnerable to hunters. The breeding season begins at this time as well.

Results of spring trapping and monitoring of radio-collared bears indicate that bears, especially males, from a large surrounding area are attracted to the East Boulder-Dry Fork area in spring by the availability of abundant succulent forage and in search of suitable mates. Radio-collared males left the Dry Fork area following the breeding season, but both radio-collared adult females remained in the Dry Fork-East Boulder throughout summer, fall, and winter, suggesting the area is important for breeding and cub rearing.

The tailings pond in the Dry Fork would represent a direct spring habitat loss for all bears and yearlong habitat loss for females that are resident to the area. The loss of the key spring habitat is the critical paint.

Improved public access, increased numbers of people, and a growing awareness of the location of spring bear use areas could result in increasing heavy hunting pressure and harvest in the Dry Fork-East Boulder area. Continual heavy harvests from these spring concentration areas would affect the bear population over a much larger area. More restrictive bear hunting seasons could likely be required to avoid overharvesting the population.

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IMPACTS OF COAL DEVELOPMENT ON WILDLIFE IN SOUTHEASTERN MONTANA - A COMPANY PERSPECTIVE

Bill F. Schwarzkoph[1]

During the past decade many wildlifers have been concerned about impacts to wildlife from coal development in Montana. The coal industry today works in a big way. The massive equipment and subsequent monstrous spoil piles gives a wildlifer a forboding impression, of what this will do to wildlife habitat. Can this habitat be reclaimed and the impact lessened? Will the impact from coal development have a long term effect? Are all impacts from mining negative concerning wildlife, or with proper reclamation can some wildlife species actually benefit from the change? This paper should provide some insight on these questions from a coal company perspective. A perspective from a member of the wildlife society, with a degree in wildlife management. Today, a decade out of graduate school, I work for a coal company in a position responsible for reclaiming these "impacted" coal areas.

A LEARNING PROCESS

My first job, fresh out of college, was with an environmental consulting firm, conducting wildlife and range surveys to assess impacts of coal mining on wildlife populations near Colstrip. It was a shock, as a rookie wildlife biologist, to work around the "Moon-like" appearance of coal mine spoil piles. Coal mining definitely had an impact on me, and my feelings towards the coal industry. I was very skeptical of the standard mining company photos of "successful" reclamation and of the promises that the coal companies were going to make it better than before.

As I continued working on the wildlife surveys, I began to notice the reintroduction of wildlife. Small mammal numbers were higher in reclaimed areas, due to super abundant food and cover. More and more raptors of varying species were observed hunting over reclaimed areas. Nests of western meadowlarks, mourning doves, and even sharp-tailed grouse began to appear in reclamation, especially during drought years when reclamation had more cover than the surrounding native range. The adaptability of wildlife was apparent as beaver and waterfowl were observed using newly constructed sediment ponds. Owls actually nested and reared young in active highwalls. Ground-nesting raptors also began nesting in reclamation. Projects to re-establish sharp-tailed grouse dancing grounds on reclamation were very encouraging.

I soon began to realize that possibly the impacts from mining were not so severe or long-term. I began to see potential for wildlife enhancement during reclamation procedures. About that time, I attended the Prairie Grouse Technical Council's biennial meeting at Wisconsin Rapids, Wisconsin. I recall a fellow from Kansas discussing how the coal companies in Montana were impacting wildlife by turning everything upside down. He then proceeded to give his presentation on how center-pivot irrigation and subsequent farming practices were impacting the lesser prairie chicken in Kansas. Talk about impacts to wildlife; they were virtually wiping out the prairie chicken habitat in Kansas. I began to see how some impacts were more "acceptable" to the general public, especially when related to agriculture and that most people had the wrong impression about the coal industry in Montana. After that, I decided I wanted to work for a coal company to show what could be done with reclamation when proper planning for wildlife habitat was considered.

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I had determined that the impacts were only short-term and with proper reclamation plans, many positive things could be done to enhance reclamation to benefit wildlife as well as livestock.

Many things are done to enhance reclamation for wildlife. Small outcrops and snags are replaced for small mammal and raptor use. Kestrel nest boxes are built and placed throughout the reclamation to increase nesting habitat. Nesting habitat is created in old highwalls for cliff-nesting raptors. Sediment ponds are enhanced to be retained as permanent features. Waterfowl utilize these ponds readily during migration periods and as brood rearing areas. Largemouth bass can be stocked in sediment ponds to offer future recreational opportunities for local people. Shoreline conditions can be improved and shrubs are planted to create shrubby draws for wildlife cover. Establishment of small cropland fields that add habitat diversity and edge effect enhance the area for wildlife.

COMMITTMENTS

There was a definite need for strong new laws governing surface mining. The coal industry had a terrible track record in the eastern United States as well as in Montana. However, some current laws, regulations and guidelines actually hamper and halt innovative reclamation practices that could benefit wildlife. The coal industry is now mired in government regulations. The pendulum has swung too far. Costs of operating a mine in Montana are sky-rocketing and costs of reclamation are doing the same, and a large part of it is due to a lack of public awareness and the relentless push for more government regulations.

The coal industry in Montana has accepted the basic laws and regulations and its' corporate responsibility to reclaim the land. To that end, Western Energy Company has employed nine professionals as a reclamation staff, consisting of wildlife biologists, hydrologists, soil scientists, vegetation and air quality specialists. The reclamation staff has the responsibility to gather the pre-mining inventory data of each discipline, and monitor annually, before, during and after mining and reclamation. Environmental Consultants are also used when necessary.

Western Energy Company hydrologists are presently monitoring over 450 observation wells drilled in various aquifers in pre- and post-mine areas to assess water levels and water quality. They also monitor 150 surface water sites for water quality and quantity. After mining, stock wells are re-established in reclamation to once again provide water for livestock.

Soil scientists map and sample all pre-mine areas. The soils data is used to compute how much topsoil will be salvaged and replaced. Most of the soils are hauled directly to the regraded surface in two lifts, with stockpiling of soils only occurring during the initial boxcut stage.

Vegetation specialists use pre-mine vegetation survey data to prepare seed mixes of native grasses, forbs and shrubs. Post-mine plant communities are designed and planted with these seed mixes. Additional shrubs and trees are planted in specific areas to supplement shrub and tree plant communities. Management practices such as irrigation, burning, and livestock grazing are used to manipulate plant communities towards successful bond release criteria.

Western Energy's Rosebud Mine at Colstrip has an air quality permit specific to the area and a subsequent mine-wide dust control plan. An air quality specialist monitors eleven high-volume air samplers throughout the area and collects all pertinent meterological data at a mine meterological site.

The wildlife biologist assesses and monitors all pre- and post-mine areas for wildlife occurence, distribution, habitat use, and population trends. This information is used to formulate habitat and enhance areas specifically for wildlife.

Western Energy Company also contracts annually with both State Universities for reclamation research projects. Montana State University is presently conducting a grazing study, while the University of Montana is conducting a study on the re-establishment of ponderosa pine.

FRUSTRATIONS

After all these commitments, securing a mining permit or even keeping a permit is frustrating and extremely expensive. The "suspected" impact to a hydrologic regime alone can cost a coal company thousands of dollars. Due to this suspect, coal companies must maintain a very intensive monitoring program. It currently takes three full-time Western Energy Company staff persons plus the use of a consulting firm to keep up with all the "suspected" hydrology issues.

Statewide, the public is concerned about mining impacts on nearby drainage systems, even though sediment ponds large enough to contain 100-year 24 hour precipitation events have been built. Armells creek, an intermittent stream above Colstrip, is a good example. It is frustrating when, for example, persons tour the mine and voice concerns about possible damage from mine water seeping into the creek while "Blue Ribbon" trout streams such as the lower West Gallatin is virtually drained every year in the name of agriculture. Along that same line, although the coal industry must maintain sediment ponds, (to contain all runoff), each year, tons of sediment flow directly from agricultural fields into some of our best trout streams with nary a peep from the "concerned" public.

Since all water must drain from the reclaimed surface, no ponding is allowed, even if wildlife would benefit. On one hand, if a small ponding situation occurs, (adding diversity), it becomes "an issue" that must be resolved. Most regulatory solutions are to fill the "low areas" to rid the area of ponding thus eliminate any chance for diversity. Although it was difficult and time-consuming, Western Energy Company finally received "permission" to leave two ponded areas where volunteer cottonwoods and willows were already growing, adding diversity to the reclamation.

What about reclaiming former cropland areas back to cropland? The Montana Department of Agriculture recommends it. The state regulations now allow it under certain criteria, such as a 10-year history of cropping prior to mining, slopes no greater than 5%, and SCS capability class rates of at least III and IV. Small tracts of cropland can benefit wildlife. The criteria for cropland alternate reclamation can be met at several sites at Western Energy Company's Rosebud Mine, yet initial reactions from the regulators have not been met with much encouragement and a decision to allow such a plan may not be granted.

What should be done with areas reclaimed in the early 1970's with "approved" mixes that are dominated by introduced species such as crested wheatgrass. Some areas are now ready for bond release, but in 1978 the laws were changed requiring reclamation to be dominated by "native" species. These areas have been successfully grazed and are similar to local improved pastures. Should they be disked under and replanted with an approved "native" mix or, should we leave them as is, to be used as a "special use (spring-fall grazing) pasture."

We prefer the latter but, again, have not been met with much reasurance of it's approval to date.

Will the coal industry be able to meet the strict re-vegetation requirements now in effect? Although we are planting native shrubs such as big sagebrush, it is unreasonable to assume we can or should obtain the densities of pre-mine conditions. On the other side of the coin, our agricultural neighbors eradicate shrubs, while the coal industry is required to establish densities similar to pre-mine conditions.

State and federal regulations, readily establish buffer zones around such items as falcon nesting sites or sharp-tailed grouse dancing grounds. One BLM document even advises against exploratory activities, within ½ mile of a prairie falcon nest. The public has forgotten how adaptable some wildlife species can be. At Colstrip, mining and reclamation occured immediately adjacent to a sandstone outcrop. Later we became aware of a prairie falcon eyrie in the sandstone outcrop. Falcons have been successfully rearing broods from that site for the past 5 years. We don't know if they nested there prior to mining. They probably did, but the important thing is that they are nesting there now! If a ½ mile buffer zone would have been enforced, millions of tons of coal would have been left needlessly at a time when equipment and such was available to extract it efficiently.

Another example of inflexibility in our rigid regulations is the requirement to reduce all highwall to a 5:1 slope. Why not have enough flexibility in the regulations to allow for the retention of some highwall upon initial permit submittal to blend the reclamation to the existing terrain. It may be more aesthetically pleasing and actually benefit wildlife by creating cliff nesting habitat that was lost through mining or create it where none existed before. Recently, through an alternate reclamation plan, Western Energy Company received approval to leave 900' of highwall to be retained as cliff habitat.

SUMMARY

We need to take a better look at our current existing surface mine and reclamation regulations and guidelines and put them in proper perspective. Somehow we must legislate more flexibility and common sense use back into the management of our basic reclamation rules and regulations. The state of Montana can benefit from the wise use of its coal resource. Western Energy Company's mine alone, pays the state of Montana $30,000 in severance taxes every time a unit train leaves Colstrip and two to three unit trains leave each day. On a per acre basis the state receives $120,000 from each acre mined and the land is still returned to a productive agricultural use. Let's not make this a state that our children (Montana's most valuable natural resource) will have to leave, because there are no jobs available in the future. The coal industry offers many fine professional jobs, even in the natural resources field. With the wise use of our coal resource, and a common sense application of our regulations, we can continue to enjoy our wildlife after mining on reclaimed lands.

APPLICATION OF THE WILDLIFE UNSUITABILITY CRITERIA IN COAL MINING

Ray Hoem[1]

The Surface Mining Control and Reclamation Act was passed by the Federal lawmakers in August of 1977. Part of that Act was to provide for the protection of "environmental degradation" by surface mining companies.

One of the subjects protected under this umbrella of "environmental degradation" is wildlife. (I use wildlife herein to include both fish and wildlife.)

Shortly after passage of the above Act, a group of us were called together to formulate "criteria" for the protection of environmental issues. I was fortunate to be part of the group and to be assigned to work on the wildlife "criteria." These "criteria" became known as unsuitability criteria because, if applied to an area which was underlain by coal, it rendered the area unsuitable for surface coal mining.

At any rate these criteria were drafted together in December of 1977, six years ago. They were then sent to Washington, D.C. for changes and approval. As you can imagine, they were scrutinized severely by industry and political types, but were finally drafted into regulations in 1979.

For those of you who are not familiar with the coal unsuitability criteria, let's look at them (Appendix A). Criterion 1 basically eliminates National Parks, wildlife refuges, wilderness areas, wild and scenic rivers, recreation areas and national forests. There are others included within this criterion but these are the main ones to remember. Criterion 2 deals with rights-of-ways, easements, surface leases, public purpose lands or agricultural areas. Criterion 3 deals with rights-of-ways for roads, cemeteries and buildings. Criterion 4 deals specifically with wilderness study areas. Criterion 5 deals with scenic areas. Criterion 6 talks about lands being used for scientific studies. Criterion 7 addresses archeological areas. Criterion 8 deals with natural areas and landmarks. Criterion 16 deals with riverine, coastal and special floodplain areas. Criterion 19 exempts municipal watersheds. Criterion 18 deals with natural resource waters; Criterion 19 exempts alluvial flood plains. Criterion 20 deals with state-developed criteria or changes made by the Secretary.

All these criteria are important to keep in mind and become reasonably familiar with them for at least two reasons. They basically harbor fish and wildlife habitat and probably just as important, they may also apply where specific fish and wildlife criteria apply. This last point is extremely important from the standpoint that the more criteria which apply to a piece of land, the better chance there is it can be declared unsuitable.

Let's now look at the criteria which deal specifically with fish and wildlife:

Criterion 9 deals with critical habitat for a threatened and endangered (T&E) species. The key point here is critical habitat.

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Critical habitat being defined in the Federal Register requires that the U.S. Fish and Wildlife Service (FWS) participate in the determination of such. Hence, those of you who may be field checking such potential habitats should do so with FWS personnel. If a determination of "critical habitat" is reached, formal Section 7 consultation must be undertaken. Therefore, it is imperative that you become familiar with the Endangered Species Act. The Section 7 consultation with the FWS follows some very specific rules which, if you haven't already, you probably will run into sometime during your career.

Criterion 10 also applies to T&E species; however, these are species of state interest. Several states have listed plants and animals which they consider threatened or endangered. Montana does not have a specific list of threatened or endangered species but if you happen to work in other states, it would behoove you to check and see if they do and this criterion can apply.

Criterion 11 deals both with bald and golden eagles and nesting sites. Bald eagles themselves will more likely be treated under criterion 9. However, golden eagles and nesting sites would most probably fall under this criterion.

The Bald Eagle Act, on which this criterion is based, provides no one shall take, possess, sell, purchase, barter, etc., any bald eagle, part, nest or egg. This Act was amended to include the golden eagle. Also note that the word "take" is defined as pursue, shoot, shoot at, wound, kill, capture, trap, collect, willfully molest or disturb. So, under this Act, the eagles virtually cannot be, in any way bothered.

More recently, the Fish and Wildlife Improvement Act, was passed. It provided for taking of golden eagle nests which interfere with resource development or recovery operations. To date there have not been regulations developed which allow for this Act to be carried out. Nevertheless, keep checking with your nearest FWS office to determine when this Act will become useable.

Until that time, and even after that, depending on a biological opinion, eagles, nests are off-limits to mining. Biologically, one may be called upon to determine a buffer zone around which mining would take place. In Montana, we have generally taken the position of ½ mile line of sight from the nest, but that is up to each individual case. The point here is--don't become unreasonable. Examine the coal data, overburden, lay of the land, and the eagle's actual potential hunting area from the nest site.

Criterion 12 deals with eagle roosts and concentration areas for wintering and migrating. As many of you may know, eagles have certain areas to which they return during migration and wintering that normally would be considered eagle habitat because the birds are not usually seen during the "field season." If such an area is discovered and cannot be protected by altering the mining sequence, it should be determined to be unsuitable for surface mining.

Criterion 13, this criterion deals with falcon cliff nesting areas and prey areas. Again as with bald eagles, peregrine falcons will probably be treated under criterion 9. Also, your biological expertise will be needed to determine prey areas and a suitable buffer area. Be sure to take FWS and Game and Fish agency people to assist in determining buffer areas. Kestrels were excluded because of their being so numerous and practically ubiquitous.

Criterion 14 deals with migratory bird habitat. Most coal areas have lists of birds, developed by the FWS, for which biologists should be determining priority habitat. This criterion presents probably the most difficulty to the Bureau biologists. It's easy enough to delineate waterfowl habitat and some of the other migratory birds, but how many of you are intimately

familiar with habitat necessary to provide for the Dicksissel, for instance?

My recommendation is that you notify FWS personnel to assist you in delineating habitat for all migratory birds, or at least those with relatively undefined habitats.

Criterion 15 deals with resident species of Fish and Wildlife. Each state should have submitted to the Bureau a list of species of interest to the state. A joint determination of essential habitat must be made under this criteria so land management agencies must work closely with your respective state wildlife management agency.

Not all habitat is essential; but the point here is that we must and should work together as biologists to determine what areas are to be designated unsuitable for coal mining.

Admittedly, this has been a brief introduction to the unsuitability criteria. Let me proceed then to try and cover when they enter the land-use system and who actually determines areas to be suitable.

Land management people generally go through elaborate gyrations in planning uses of their lands. One of these exercises pertaining to the possibility of leasing lands for mining of coal is application of these wildlife unsuitability criteria. Lands that meet the criteria to be designated as unsuitable for mining are, during the process of planning, removed from those available for potential leasing.

In Montana, a team of biologists from Montana Department of Fish, Wildlife and Parks, FWS and the Bureau of Land Management (BLM) have gotten together and agreed upon those lands to be designated unsuitable from the fish and wildlife perspective. This team has then made their recommendations to the District Manager in the BLM.

Up to this time, it is a recommendation. However, the District Manager, Forester or Chief Land Manager applies the criteria and ultimately makes the decision as to which pieces of land are actually unsuitable.

All criteria have an exemption which basically states that if a lessee has made substantial legal and financial commitment prior to 4 January 1977, then he will be exempt from application of the unsuitability criteria. Almost all criteria have an exception clause which states something to the effect that if it can be shown that certain types of mining practices will not jeopardize fish and wildlife populations then mining will be allowed. In this case stipulations to the lease can be worked up to allow mining if certain methods are applied.

This has been brief - admittedly, but let me leave you with three thoughts before I open this up to questions:

FIRST: In application of wildlife criteria, try to tie a piece of habitat to several criteria. For instance, an eagle nest could be tied to criteria 4,6,8,10,15,16,17,18, or 19. Try not to limit the wildlife habitat to those criteria dealing specifically with wildlife, although that is perfectly satisfactory if it's the only way it can be done.

SECONDLY: Remember that these criteria are meant to protect essential wildlife habitat. Not all wildlife habitat is essential for survival of wildlife. Look at a broad scope of wildlife in your area. Will the loss of one grouse lek mean the demise of the population? Are the leks grouped, providing for several areas from which a grouse population can breed?

These unsuitability criteria are under severe scrutiny at the Washington level, in Congress - and while zealous application of these criteria may result in saving small areas of wildlife habitat, the end result may be loss of the criteria and loss of any protection for fish and wildlife habitat. I'm not preaching "forget the wildlife habitat" in your consideration of these criteria, but pick your important habitat areas, learn all you can about surface mining of coal and the deposit, then pick the areas that are important and negotiate with those areas of less importance.

THIRDLY: Remember - a recommendation for areas being unsuitable is just that - a recommendation. If a manager decides to apply an exception or exemption, be prepared to offer an alternative; i.e., a preferred method of mining or a preferred season of mining. We're not going to win every battle but let's be prepared to offer a means to lessen the impact if we don't win!!! Now - Any Questions?

APPENDIX A

(i)(1) Criterion Number 9. Federally designated critical habitat for threatened or endangered plant and animal species, and habitat for Federal threatened or endangered species which is determined by the Fish and Wildlife and the surface management agency to be of essential value and where the presence of threatened or endangered species has been scientifically documented, shall be considered unsuitable.

(2) Exception. A least may be issued and mining operation approved if, after consultation with the Fish and Wildlife Service, the Service determines that the proposed activity is not likely to jeopardize the continued existence of the listed species and/or its critical habitat.

(i)(1) Criterion Number 10. Federal lands containing habitat determined to be critical or essential for plant or animal species listed by a state pursuant to state law as endangered or threatened shall be considered unsuitable.

(2) Exception. A lease may be issued and mining operations approved if, after consultation with the state, the surface management agency determines that the species will not be adversely affected by all or certain stipulated methods of coal mining.

(3) Exemptions. This criterion does not apply to lands: to which the operator made substantial legal and financial commitments prior to January 4, 1977: on which surface coal mining operations were being conducted on August 3, 1977: or which include operations on which a permit has been issued.

(k)(1) Criterion Number 11. A bald or golden eagle nest or site on Federal lands that is determined to be active and an appropriate buffer zone of land around the nest site shall be considered unsuitable. Consideration of availability of habitat for prey species and of terrain shall be included in the determination of buffer zones. Buffer zones shall be determined in consultation with the Fish and Wildlife Service.

(2) Exceptions. A lease may be issued if:

(i) It can be conditioned in such a way, either in manner or period of operation, that eagles will not be disturbed during breeding season; or

(ii) The surface management agency, with the concurrence of the Fish and Wildlife Service, determines that the golden eagle nest(s) will be moved.

(iii) Buffer zones may be decreased if the surface management agency determines that the active eagle nests will not be adversely affected.

(1)(1) Criterion Number 12. Bald and golden eagle roost and concentration areas on Federal lands used during migration and wintering shall be considered unsuitable.

(2) Exception. A lease may be issued if the surface management agency determines that all or certain stipulated methods of coal mining can be conducted in such a way, and during such periods of time, to ensure that eagles shall not be adversely disturbed.

(m) (1) Criterion Number 13. Federal lands containing a falcon (excluding kestrel) cliff nesting site with an active nest and a buffer zone of Federal land around the nest site shall be considered unsuitable. Consideration of availability of habitat for prey species and of terrain shall be included in determination of buffer zones. Buffer zones shall be determined in consultation with the Fish and Wildlife Service.

(2) Exception. A lease may be issued where the surface management agency, after consultation with the Fish and Wildlife Service, determines that all of certain stipulated methods of coal mining will not adversely affect the falcon habitat during the periods when such habitat is used by the falcons.

(n) (1) Criterion Number 14. Federal lands which are high priority habitat for migratory bird species of high Federal interest on a regional or national basis, as determined jointly by the surface management agency and the Fish and Wildlife Service, shall be considered unsuitable.

(2) Exception. A lease may be issued where the surface management agency, after consultation with the Fish and Wildlife Service, determines that all or certain stipulated methods of coal mining will not adversely affect the migratory bird habitat during the periods when such habitat is used by the species.

(o) (1) Criterion Number 15. Federal lands which the surface management agency and the state jointly agree are fish and wildlife habitat for resident species of high interest to the state and which are essential for maintaining these priority wildlife species shall be considered unsuitable. Examples of such lands which serve a critical function for the species involved include:

(i) Active dancing and strutting grounds for sage grouse, sharp-tailed grouse, and prairie chicken;

(ii) Winter ranges most critical for deer, antelope, and elk; and

(iii) Migration corridors for elk.

A lease may be issued if, after consultation with the state, the surface management agency determines that all or certain stipulated methods of coal mining will not have a significant long-term impact on the species being protected.

(2) Exemptions. This criterion does not apply to lands: to which the operator made substantial legal and financial commitments prior to January 4, 1977; on which surface coal mining operations were being conducted on August 3, 1977; or which include operations on which a permit has been issued.

MONTANA'S CONCERNS OVER THE PROPOSED CABIN CREEK COAL MINE

Ron Cooper[1]

Located in the extreme southeast corner of British Columbia extending for a distance of approximately 160 km north from the border with Montana to the Continental Divide, is an area known as the Crownsnest Coal Field. Coal mining has occurred in this area since 1898. (Dick 1979) Until 1968, mining was accomplished primarily through underground mining methods, remaining static at approximately one million tons of coal annually.

Beginning in 1966, a major coal exploration program was undertaken. Today five open pit coal mines are being mined within the region. B.C. Resource's Harmer Ridge mine is the largest open pit coal mine in North America. Southeastern British Columbia has become a major coal mining area in Canada shipping both thermal and metallurgical grade coal to worldwide markets. This area was responsible for $573 million in coal revenues for British Columbia in 1982 (Coal Association of Canada 1983). Presently, this mining is confined to the Elk River drainage, a tributary of the Kootenay River which enters Lake Koocanusa a short distance north of British Columbia's border with Montana.

At the same time that the Elk drainage was experiencing this major coal expansion, interest began to spill over into the next drainage south, into the headwaters of the North Fork Flathead River. (See Figure 1) Five areas within the British Columbian portion of the drainage have been identified as potential coal mine sites. (Personal communication, B.C. Ministry of Energy, Mines & Petroleum Resources, 1980). One of these areas, the proposed Cabin Creek Coal mine continues to move towards approval. Governmental decision on the company's Stage II, or detailed environmental assessment is expected sometime this winter. (Personal communication, B.C. Coal Guidelines Steering Committee).

The prospect of an open-pit coal mine in the North Fork Flathead River drainage has caused deep concern from people throughout Montana and the entire United States, as well as from British Columbia and Alberta. Unlike coal mining in the Elk River Valley where major east-west rail and highway lines exist as well as long established towns, the North Fork has a few hunting and fishing cabins with the major land use activity being timber harvesting. Resource managers have expressed concerns regarding the opening of a headwaters area to mining with its attendant loss of security for fish and wildlife resources and downstream air and water quality impacts. Montana's concerns have been further heightened in that the mine would be located within six miles of the Montana/British Columbia border straddling two tributaries to the North Fork Flathead River.

The North Fork Flathead River drainage is an area recognized as unique in Montana. From the mid-point of the river east lies Glacier National Park, a designated World Biosphere and a component of an international Peace Park. The North Fork Flathead River is a designated component of the National Wild, Scenic and Recreational River system. Its existing high water quality has been recognized by the state through management designation for the state's highest water quality, A-1, and as a Class I fishery.

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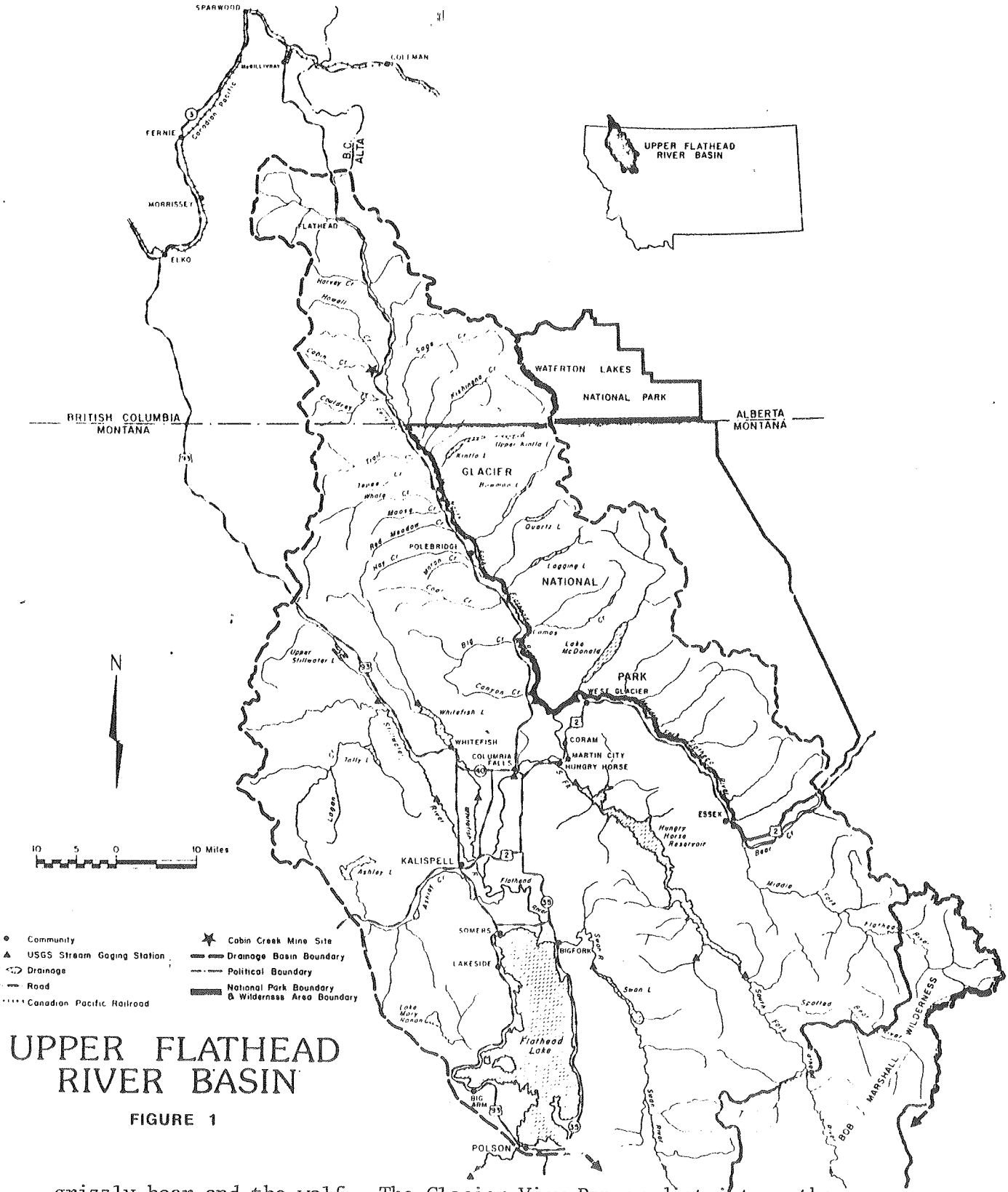
Flathead Lake, an extremely high quality resource of local, state and national significance, is located a short distance downstream. Federal land management has recognized the uniqueness of the basin's resources particularly the



UPPER FLATHEAD RIVER BASIN

FIGURE 1

grizzly bear and the wolf. The Glacier View Ranger district on the Flathead National Forest, is proposing through the forest management

plan to manage the northern end of the district primarily for grizzly bears. Until the 1930's, woodland caribou, another species of special concern, were known to reside within the drainage. Occassional sightings have been made recently. The thought of major mine development upstream from an area recognized for its uniqueness has caused serious concerns from the public, elected officals and resource managers in Montana.

In reponse to this perceived threat, a number of governmental actions have been undertaken. Discussion begun under the previous administration between Montana and British Columbia are continuing under the auspices of Govenor Schwinden. Recognizing the difficulty of making a strong case regarding our concerns without good solid baseline data, then Congressman Baucus was instrumental in convincing the U.S. Congress to direct the U.S. Environmental Protection Agency to undertake a five year regional environmental impact study. That study is now nearing completion.

Still, we are talking about resource development in another country. Let us stop for a minute and ask the question, what right do we have to tell another country how it utilizes its resources and undertakes economic activities? It is extremely important to recognize that we in fact do not have a legal right to tell a sovereign nation how to develop its resource, yet the North Fork Valley is extremely important to us.

Since 1909, we have had a mechanism to at least add a factual basis to these concerns. The Boundary Waters Treaty has provided principles of how to govern use of all international waters between the United States and Canada (International Joint Commission 1980). Since this mine would affect an international river, we do have a right to question the way this mine is developed. Although the Boundary Waters Treaty speaks to water, both countries have relied upon it to resolve air issues. As we move to other resource concerns such as wildlife, we are on much less sound legal footings.

Before the Cabin Creek Coal mine proposal concerns are discussed, let's look for a moment at the Boundary Waters Treaty in a little detail. Article IV of the treaty states that "waters flowing across the boundary shall not be polluted on either side to the injury of health or property on the other". This article has given Montanans great hope concerning the control of pollution from the Cabin Creek Coal Mine. To understand what this protection provides, we need to go beyond an American interpretation of this clause and look at it in a Canadian light. In Canada, courts intervene into governmental affairs only on the basis of administrative decisions rather than matters of policy. It can be argued that treaties lack legal standing (Honklin 1977). Without this legal standing, we are forced to rely upon the good will of British Columbia.

Since it is good will which makes the Boundary Waters Treaty operative, it is in this area that Montana has expended its greatest effort, although not relying directly upon the International Joint Commission. Perhaps if all else fails, the treaty and the International Joint Commission could provide a neutral forum in which to identify the factual basis for our concerns.

In 1976, the United States and Canada held consultations regarding Montana's environment. The major result of these consultations was that British Columbia agreed to provide environmental impact studies and to seek input from Montana concerning the effectiveness of provincial licensing in protecting Montana's environment. How this input would be made was unclear.

Subsequent to these consultations, the Flathead River Basin Environmental Impact Study was undertaken. The Steering Committee for the study recognized

very early in the study that by making their data available to British Columbian agencies, it could be used directly in the formulation of mining plans. By not making this data readily available, there was great risk that committments which could adversely effect Montana would have already been made. It was felt that by approaching British Columbia in an open cooperative spirit good will could be furthered. Information exchanges were undertaken in 1979 and have been held yearly since that time. Through these meetings, Montana and U.S. officials have established direct lines of communication with their counterparts in Canada and gained a better understanding of how the British Columbian review system operates. Further, these information exchanges have played a critical role in demonstrating our resolve to deal with the issue.

The working relationships established through these exchanges set the stage for Montana's input into the Sage Creek Coal Company Stage II application. British Columbia not only provided copies of the application as previously agreed, but they decided to treat Montana's comments as they would an agency in British Columbia incorporating our concerns into Ministry of Environment's review.

Before looking specifically at Montana's concerns, let us take a moment and look at the mine proposal. The type of mining being proposed is quite different than any presently being undertaken in Montana. Montana's experience has been with plains strip mining in low precipitation areas. Although mining methods will be similar to hard rock mining, there is a major difference. The nature of the coal resource is such that the highwalls will be developed in unconsolidated or at most poorly consolidated materials in a high precipitation area. The proposed Cabin Creek Coal Mine will produce 2.2 million tons of medium volatile clean thermal coal over a 21 year mine life. With 152 million tons of coal in situ, the company plans to leave the pits open in order to facilitate additional mine development in the future. The two open pits proposed will each be approximately one mile across by a thousand feet deep. The pits will parallel Howell Creek and bisect Cabin Creek. Mine site development will include a processing plant, coal dryer, tailings ponds, refuse dump, emergency stockpiles and ancillary facilities. Coal will be processed at the mine site and transported by truck over an upgraded paved road to a load-out facility at Morrissey 66 kilometers away where it will be loaded on unit trains for shipment to the coast. An 87 kilometer 230 KV transmission line will supply power for the project (Sage Creek Coal Limited 1982).

Two major changes in the coal mine proposal have been made since the Stage I application. Although Montana can not claim impetus for these changes, we did influence their decision since our data was utilized by British Columbia Ministry of the Environment in pushing for these changes.

The British Columbia government has established a policy against developing new towns in remote areas where existing towns are located within a reasonable distance. The Sage Creek Coal Company has proposed that Fernie serve as the major municipality for the mine, thus eliminating the need for a new town in the North Fork Flathead basin. The second major change in the mine plan is the deletion of plans to divert Howell Creek due to its importance as a bull trout spawning stream. Both changes are encouraging to Montana.

In order to effectively review the Stage II application, an interdisciplinary team comprised of technical specialists from state agencies, federal agencies and researchers associated with the Flathead River Basin Environmental Impact Study was assembled. On May 13, 1982, Governor Schwinden forwarded 115 pages of technical comments to Premier Bennet. The technical evaluation included an assessment of air quality; the water resources

and aquatic ecology; hydrology and geomorphology; fisheries, terrestrial resources and reclamation.

The design of the proposed mine's water management plan, mine lay-out and reclamation plans were identified as being critical to insuring that the North Fork Flathead River not be degraded. It was felt that the Sage Creek coal conservatively assessed storm events a major basis for design criteria, but failed to adequately assess the large volumes of groundwater which would need to be handled throughout the year. It is feared that the B.C. discharge standard of 50 mg/1 TSS coupled with a year-round decant from sediment ponds could seriously degrade the quality of the North Fork Flathead River. It was further feared that these discharges could release significant amounts of phosphorous, nitrogen and trace metals from the disturbed overburden and coal deposits.

As well as downstream impacts, concern for bull trout spawning and rearing immediately adjacent to the mine site, has been raised. Within 3 km of the mine site, Howell Creek is responsible for approximately ten percent of the spawning within the entire Flathead River drainage (Shepard et al. 1982). Although a positive step was taken in agreeing not to relocate this section of stream, it is felt that the close proximity of waste dumps and protective rock berms coupled with a potential for pit dewatering to dewater Howell Creek could negate the steps which had been proposed to protect this resource.

Further heightening our concern for the water resource was the proposal to reclaim waste dumps at an angle of repose of 26 degrees or approximately 56%. We expressed serious reservations that dumps at this angle of repose could be expected to sustain an erosion resistant cover. Even with a 90% reclamation success rate, we estimate that 11,000 tons of sediment per year would be produced after a 26 year period of time. Failure of a single waste dump could seriously negate water management efforts.

Air quality, although not addressed in the Stage II application, was modelled by the Montana Air Quality Bureau. Class I standards in Glacier National Park for particulates, sulphur dioxides and perhaps visibility would all be violated without additional control measures.

Wildlife concerns were confined primarily to protected species such as the grizzly bear and the wolf. Research on grizzly bears conducted under the auspices of the B.C. Ministry of the Environment and the Border Grizzly Project indicates that this area of the North Fork may have the highest density of grizzly bears in North America (McLellan, personal communication 1982). Other species such as elk, moose, mule deer, white-tailed deer and mountain goats have been identified as species which could be affected by the mine, although it was felt that these impacts would be primarily felt in British Columbia. The application in identifying these species does not address mitigation, but simply indicates that any impacts could be addressed in Stage III, the permit stage for the application.

During September of last year, the B.C. Ministry of Energy, Mines and Petroleum Resources responded to Montana's initial review. British Columbia indicated that they were in general agreement on many of the points of concern raised by Montana and assured us once again that the Stage II application would only be approved if the Environment and Land Use Committee of the Province's Cabinet is satisfied that sufficient care has been taken to minimize adverse environmental impacts (letter from R.D. Smith, 1982). Although we had originally interpreted the Stage II application as the point

where environmental impacts would be addressed, it now appears that many of Montana's specific concerns will need to be addressed through individual permits.

Although not optimal as far as Montana is concerned, at least British Columbia has agreed that we should be part of the permit review process. Unfortunately, these permits will not be provided as a cohert package similar to the Stage II application. It will place the burden squarely on us to insure that our concerns are made known. If we begin to feel that direct good will between Montana and British Columbia is not sufficient to alleviate our concerns, we can always turn to the Boundary Waters Treaty. As I have stated previously, this mechanism would still rely largely upon good will. On the one hand, the treaty would provide for a formalized procedure through the International Joint Commission. Unfortunately, it would bring the Dominion and the U.S. Federal government into the controversy directly and could risk polarization from British Columbia, the government ultimately responsible for the decision.

In closing, let's look at where the decision stands. It is our understanding that final comments from the various provincial agencies have been forwarded to the Coal Guidelines Steering Committee. This committee is expected to have their recommendation before the Cabinet level Environment and Land Use Committee by the end of March. Information received to date indicates that the B.C. government is leaning towards an approval conditioned so that Montana's concerns will be addressed. Close scrutiny of this decision will determine whether or not our concerns have been addressed.

Whatever action is taken, it has become apparent to Montana that this small area of the basin can have profound affects upon us. It will only be through close continuing coordination and cooperation that we will not pay the environmental costs for their economic development.

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A CUMULATIVE EFFECTS ANALYSIS PROCESS FOR GRIZZLY HABITAT CABINET MOUNTAINS, MONTANA

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Michael Madel[1]

Abstract: Historic declines in grizzly bear populations and current pressure on remaining population centers are primarily associated with man-caused activities. Multiple use land management agencies are legally bound to respond to laws which may provide conflicting guidance in a specific geographical area. A technique for analyzing the cumulative effects of all known man-caused activities on grizzly bear habitat in the Cabinet Mountains of Montana provided a better perspective for making resource management decisions and complying with existing laws. The quantity, location, and seasonal importance of 13 habitat components based on food and denning requirements was plotted on project maps and data sheets for eight bear units totaling about 2085 km^2. Systematic analysis of habitat component maps with clear plastic activity proposal overlays provided a basis for quantifying available space, food, and denning habitat for grizzly bears at any time. Analysis of all eight bear units provided a better perspective on the condition of grizzly bear habitat in the Cabinet Mountains and spotlighted core habitat areas and problem areas. The technique should be applicable to other species with known habitat needs.

Introduction

The decline in numbers of grizzly bears (*Ursus arctos horribilis*) in the United States is closely associated with the settlement and development of the West in the last 100 years. The trend continues but now the remaining strongholds of grizzly habitat are associated with established Wilderness areas, National Parks, and National Forests. The Grizzly Bear Recovery Plan (USDI, 1982) identifies three primary population centers, or "ecosystems," where there remain viable populations of grizzly bears in the continental United States. One is the Cabinet-Yaak Ecosystem (CYE) located primarily on the Kootenai National Forest (KNF) in Northwestern Montana.

The settlement of Northwestern Montana was spurred by mining and logging, both of which are now major factors in the local economy. Recent exploration for minerals inside the Cabinet Wilderness, growth in forest related recreation, rural subdivision, and potential microhydro developments heighten the concern for the welfare of grizzly bears and their habitat in the CYE. As a mutliple use land management agency, the KNF is obliged to address the legal requirements of the Endangered Species Act of 1973, the Mining Law of 1872, and the Wilderness Act of 1964 on sites supporting resources addressed by all three laws. This has intensified the need for a procedure which accommodates a variety of activities and provides a format for displaying and measuring the effect of those activities on grizzly bear habitat. The objective of this effort was to develop a systematic analysis process which identified and quantified grizzly bear habitat and the related effects of man-caused activities. In addition we felt it was important to provide a basis for developing an overall perspective regarding the viability of grizzly habitat on a large scale.

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We wish to acknowledge the assistance of KNF personnel, especially M. Craig, A. Bratkovich, R. Kuennen, and M. Mantas. The helpful criticism of C. Servheen, C. Jonkel, W. Brewster, and D. Harms contributed materially to the successful completion of the process.

Study Area

The cumulative effects analysis area (analysis area) encompasses about 208,502 ha of the KNF, or roughly 45% of the CYE (Map 1). It contains the 38,202 ha Cabinet Wilderness, the 19,385 ha proposed Scotchman Peaks Wilderness, and 6,465 ha proposed Cabinet Wilderness Additions. These areas are characterized by steep granitic peaks up to elevations of 2651 m. The Cabinet Mountains extend north and south for about 52 km between the Clark Fork River and the Kootenai River. The range is a maximum of 16 km wide with portions of the Cabinet Wilderness being only 3.2 km wide. The proposed Scotchman Peaks Wilderness lies about 8 km west and separated from the Cabinet Wilderness by the Bull River valley. The valley bottom averages about 701 m in elevation and is predominantly private land occupied by small, family ranches. The entire area is influenced by Pacific maritime weather patterns and receives up to 279 cm of precipitation annually at higher elevations. Valley bottoms and adjacent slopes are heavily forested with stands of mixed conifers which extend to elevations of about 1830 m. Most of the nonwilderness public lands support commercial stands of timber which are managed under the sustained yield concept. Portions of the analysis area are owned by Burlington Northern Industries, St. Regis Corporation, and the State of Montana and are managed to produce timber products.

Mining and prospecting in the Cabinet Mountains were initiated in the late 1800's. Several large mines were operated until known deposits of gold, silver, copper, or lead were exhausted. Between about 1920 and 1960 there were intermittent periods of activity, but nothing which equalled the earliest activities. Beginning in the 1960's more sophisticated exploration and recovery techniques permitted the location and mining of silver and copper trapped in strata bound deposits. American Smelting and Refining Company (ASARCO) is currently operating one of the largest silver mines in North America within the analysis area. Exploration for strata bound deposits is being conducted by ASARCO, US Borax, Burlington Northern Industries, and numerous private parties.

State of Knowledge and Methods

Since 1977, with the initial identification of "essential" habitat (an internal USFS method), the KNF has gone through a series of refined efforts to identify and quantify habitat important to grizzly bears (Moore and Gilbert 1977, Erickson 1978, Madel 1982).

During the field season of 1980, the KNF funded an effort to trap and radio collar some grizzly bears in the Cabinet Mountains (Thier 1981). The effort was unsuccessful and represents the main attempt at gathering grizzly behavioral information in the CYE. No behavioral or habitat use information based on radio collared grizzly bears from the CYE exists. Validated sightings and field evidence provide an insight into important areas and suggest similar habitat use patterns described in grizzly literature (Mealey 1975, Mealey, Jonkel, and DeMarchi 1977, Border Grizzly Project 1977 and 1978).

Delineation of the analysis area boundary was based on several factors. We wanted to define an area extensive enough to provide a broad perspective yet not so excessive that our limited field and office capability would be exhausted. The Cabinet Mountains, and generally all recognized grizzly

habitat on the KNF south of the Kootenai River, is being subjected to a combination of timber sales, minerals exploration, michrohydro proposals, recreation, and subdivision of private lands at a more rapid pace than elsewhere on the KNF. A significant portion of the CYE is located in the area and contains what is felt to be some of the best grizzly habitat on the KNF. These facts prompted us to select the Cabinet Mountains as our project area. The analysis area boundary was based closely on the outer periphery of identified grizzly bear habitat with some exceptions to accommodate topography or ownership. Major drainages and administrative boundaries defined portions of the area. Intermingled sections of private land were contained in the analysis area. In all, 24 major subdrainages containing 71 watersheds were contained in the 208,5 ha analysis area.

Monitoring studies have shown that bear movements during the active season are strongly influenced by plant phenology and the availability of preferred foods (Pearson 1975, Amstrup and Beecham 1976). Denning habitat is an essential element of grizzly habitat and its recognition in the field has important management implications (Jonkel 1979). Therefore, the identification and mapping of preferred foods and denning habitat can provide an accurate profile of grizzly bear habitat.

We defined habitat components as vegetation of a structure and composition that is recognizable and predictably contains food items which grizzly bears are known to eat or characteristics selected as denning sites. The vegetation may be influenced by topo-edaphic features, fire history, or land management practices. The process of identifying components and the mechanics of mapping is thoroughly described by Madel(1982) and denning habitat characteristics have been described by Vroom et al. (1977), Werner et al. (1978), and Servheen (1981

Basically, 13 different components (Table 1) were identified, mapped, and quantified. Approximately 35% of the analysis area was directly mapped on the field and ground truthed over two field seasons. The remainder was mapped on the basis of infrared aerial photo interpretation as experience allowed us to extrapolate ground truthing to other areas.

The components were drawn and coded on 15 "project maps" with a base scale of 1:24,000. Individual components were carefully measured using an electronic planimeter with a tested accuracy of $\pm 2\%$. Components were measured to the nearest 0.4 ha and data were entered on compilation sheets (figure 1).

Habitat components were further identified as to season of importance defined as:

(a) Spring - Den emergence to June
(b) Summer - July 1 to August 15
(c) Fall - August 16 to denning
(d) Denning - Den up to emergence (about mid-November to mid-April)

Due to plant phenology and specific food items present some components are important for more than one season and were so identified. For example, low gradient stream bottoms have spring and fall significance. In addition, it was recognized that within season some components were more valuable than others. On the basis of food abundance, diversity, and cover values components were ranked 1 (low), 2 (medium), 3 (high) (figure 1). This ranking process provided the capability of weighing the various components in terms of their contribution to the seasonal habitat. An average weighting for the season was determined by dividing the weighted acres (figure 1). This weighted average was identified as a "quality index," a reflection of the overall quality of the seasonal components.

Depending on the season, a maximum of six individual components contributed to the seasonal habitat. The number of individual components in any one season was considered a reflection of the diversity of seasonal components available. Thus, the "component index" is the total number of individual habitat components available within a given season (figure 1).

The quantity of seasonal "habitat units" was developed as a method of comparing between areas of grizzly habitat on a common basis. Seasonal habitat units are not in themselves habitat components but are arbitrary units providing a basis for habitat comparison and measuring changes. They were calculated by multiplying the total net acres of seasonal habitat components times the quality index times the component index. The resulting number is an expression of available seasonal habitat in units that can be compared with other drainages within the analysis area (figure 2).

Cover is an important habitat requirement, especially in movement corridors and feeding areas, but the cover needs of grizzlies varies so much by sex, age, and season that cover habitat cannot be managed on a quantitative basis (Jonkel, pers. comm.). The habitat components themselves often provide cover (e.g., shrugfields, timber-vaccinum) and the degree of isolation strongly influences the dependency of bears on cover (Jonkel, pers. comm.). In general, brushy vegetation and coniferous cover are dominant characteristics of grizzly habitat on the KNF and were not felt to be limiting and, therefore, were not identified specifically as components in the analysis process.

Space and isolation are essential elements of grizzly habitat (Jonkel 1979, USDI 1982) and, while not specifically mapped as habitat components, are important parameters in the analysis process. Recognition of spatial needs was the primary criteria used to further subdivide the analysis area and isolation was addressed in the analysis process through identification of access and activities.

It was recognized early in the process that subdivisions within the analysis area would be needed to facilitate the cumulative effects analysis of grizzly habitat. For example, activities occurring on Seven Point Mountain in the extreme southern portion of the Cabinet Mountains, and their effect on grizzly bears, could not be directly linked in terms of displacement or compensation to Sawtooth Mountain in the western portion of the Cabinet Mountains. The areas are geographically separated by many miles yet, truly, intrinsically linked to the welfare of grizzly bears in the CYE. In addition, working with one large area presented clerical and mapping problems in the quantification steps. A means of dividing the analysis area into smaller parts was devised and was based on the mean home range size of adult ($\geq$5 years) female grizzly bears as determined in other studies. Table 2 displays data provided by C. Servheen, Fish and Wildlife Service, which was the basis for delineating eight "bear units." Based on the data provided 251 km^2 was felt to represent a viable home range which spatially met the needs of a resident female grizzly bear.

Adult females are extremely important segment of a grizzly population (Martinka 1974, Sidorowicz and Gilbert 1981) and often their home ranges will overlap or include the home ranges of younger bears and males (USDI 1982). Thus, by protecting their needs it is assumed that the welfare of other grizzlies will be accommodated to a large extent as well.

The delineation of eight bear units within the analysis area was accomplished using major topographical features as identifiable boundaries (Map 1). We based the delineation on field knowledge of the area and the following criteria:

1. A bear must supply all seasonal needs with respect to food and denning habitat.

2. East-west movement which allowed elevational change to correspond with seasonal food supplies must be maintained. Servheen (1981) identified this important factor in the Mission Mountains, Montana, which are lineal and extend north and south, similar to the Cabinet Mountains.

3. Habitat must be contiguous and not divided into smaller parcels by physical or other barriers.

4. The size must closely match the identified mean home range size (251 km^2) of our sample population.

5. The entire bear unit must be within the cumulative effects analysis area.

Proposed and ongoing legally permitted man-caused activities preclude managing all the acres in a bear unit as undisturbed grizzly habitat. Therefore, it was necessary to define a lower threshold of viability, in terms of space and habitat components, below which the ability of the bear unit to meet the needs of grizzly bears was jeopardized.

Studies have shown that grizzly bears' home ranges overlap with those of other bears and that grizzly bears which have been displaced from segments of their home ranges can adapt if remaining portions provide the necessary habitat components (Mace and Jonkel undated, USDI 1982). Permanent displacement from portions of their home range would raise serious questions about the long term welfare of grizzly bears but, seasonal or somewhat longer periods of displacement appear to be within the bear's ability to accommodate (Jonkel 1979, Mace and Jonkel undated, Jonkel et al. 1979). Reaction to disturbance varies between individual bears (Mace and Jonkel undated) and while a certain degree of accommodation may be desirable, a population of grizzlies which avoids contact with humans and exhibits the characteristics of wild bears is highly desirable. Therefore, areas occupied by man and related activities would not be used by bears that avoided man and related activities. Simultaneously, a sufficient area must be available to bears to meet behavioral needs and supply necessary habitat components. Thus, identification of a suitable smaller area, within a bear unit, that meets the spatial and other needs of an adult female grizzly bear would define the lower threshold of a viable home range.

Because the sample size was small (n=13) and originated in three different ecosystems no attempt was made to statistically analyze the data to identify a lower threshold. Rather, the lower threshold of 181 km^2 was based on the following rationale:

1. Six adult females from the NF Flathead River drainage, the closest geographical location to the CYE, had an average home range size of 184 km^2 (Table 2).

2. The Grizzly Bear Recovery Plan (USDI 1982) reports an average home range size of 186 km^2 for adult females in the Northern Continental Divide Ecosystem, the closest adjacent ecosystem for which data is available.

3. In the judgment of the authors and their cohorts 181 km^2 seems biologically sound and realistic in view of available information.

In addition to the lower threshold of 181 km^2, other factors were identified which must be present to insure viability:

1. Habitat components for all seasons of use must be present in the 181 km^2 area and in a ratio similar to that for the entire bear unit.

2. The 181 km^2 area must be contiguous within the bear unit with no major barriers preventing a bear's movement in or through the entire 181 km^2.

Upon completion of component mapping, delineation of bear units and compilation of habitat units, analysis of cumulative effects was initiated.

The cumulative effects document produced in 1981 by the Glacier View District of the Flathead National Forest was used as a model in identifying what activities would be analyzed.

An intensive effort was made to gather information on all activities, known or suspected, that would occur in the analysis area during CY 1982. Minerals claims holders, Ranger Districts on the KNF, large corporate landowners, and adjacent National Forests were contacted. Information on timber sales, prospecting, exploration for minerals, recreation, road construction, cattle grazing, and other pertinent activities was compiled.

A worksheet was devised (figure 3) which allowed for the systematic analysis of activities within each bear unit.

The analysis was based on the location, scope, size, length, and specifics of a particular activity and how that activity affected the use of habitat by grizzly bears. We attempted to reduce the activity to a common denominator such as: 1) access, 2) length and duration of activity, 3) mechanized or not, and 4) season.

The assumed response of grizzly bears to these common factors was based on data reported in grizzly literature (BGP Annual Report No. 2 (1977) and Report No. 3 (1978); Zager, 1980; Mace and Jonkel, undated; Jonkel, 1979; Jonkel, et al., 1979).

1. Access - This factor was generally the most important consideration in the analysis. Identification of impacts was based on whether access existed and was maintained in the form of trails and roads. Specific analysis was conducted in a manner similar to roads analysis identified in Elk Habitat Timber Management Relations, Central Zone--Northern Region (USDA 1980). Generally, an influence zone of 0.4 km was identified that paralleled existing roads open to motorized traffic. This influence zone was adjusted to respond to topography in many cases. For example, the influence of a road in a drainage may extend to adjacent ridgelines in narrow canyons. Primitive 4-WD roads that were lightly travelled were given a narrower zone of influence, approximately half that of better roads. However, this zone was also modified to fit topography. If roads were closed to motorized traffic year round no deduction was made for access. Overall, road access and associated use was the most significant deduction in the analysis.

If any other activity fell within the road influence zone it was identified under the appropriate heading but no further deduction was made. Often, the road influence zone deduction accounted for most activities.

2. Timber - Sales were identified on the basis of active, sold but not active, or proposed. If a sale was active a deduction in available habitat was possible. Often timber activity was completely within the road influence zone but when this did not occur the influence of the sale was extended to a logical topographical feature (ridge or draw) or a zone of about 0.4 km, whichever was the most appropriate for the unit in question.

Some sales are sold but not active. In such cases a best determination was made as to the level of activity planned for the analysis period. Often, the road influence zone had already resulted in a deduction and whether the sale was active or not was a moot point.

3. Recreation - Initial analysis considered whether recreation was road related or not and whether dispersed or developed. Road related recreation consisted to a large extent of firewood gathering, hunting, berrypicking, picnicking driving for pleasure. Non road-related recreation consisted mostly of hiking and camping. No deduction was made for hiker use of trails as this was considered such an ephemeral affect on a site that it could not be accounted for. However, known high use camping areas were deducted on the basis that grizzly bears would be precluded from using the site. This was the case adjacent to several Wilderness high mountain lakes. The vast majority of recreation on the KNF is road related and fell within the road influence zone. No deductions were made for winter recreation.

4. Minerals - Analysis consisted of identifying the scope and intensity of activities. "Pick and shovel" activities generally consisted of one or two people spending several days per year at a site working with hand tools to conduct prospecting, assessment, or validation work. Pick and shovel use was considered similar to nonroaded dispersed recreation and did not cause a deduction from available habitat.

The use of mechanized equipment and occupancy of the site were considered sufficient to displace bears and deductions were made. Mechanized equipment ranged from small backpack drills to helicopters and the level of impact, in terms of habitat deducted, ranged from low to high, respectively. Some work was conducted in adits (underground) and the reduction for such activities was small usually including the immediate site and a narrow zone around it. A helicopter corridor which received daily or consistent use represented the other end of the mechanized spectrum. The influence zone of a helicopter's main flight corridor was considered to extend at least 0.8 km beyond the corridor or to a topographic feature which broke the line of sight or sound. Regular use of helicopters was a feature of two ongoing exploration operations.

There was such a variety in the types of activities, equipment uses, and site specific conditions that no fixed deductions could be used for minerals related activities. Each activity greater than a "pick and shovel" action and lying outside a road influence zone was individually analyzed. Activities on patented claims (private lands) were also identified and considered.

Generally, mechanized mineral activities which involve several people were treated in a manner similar to active timber sale work. If the activity occurred at higher elevations where tree cover was not available to reduce noise and provide a visual screen, the area of influence was extended up to 0.8 km or to significant topographical features.

5. Special Features - This category included mention of features or conditions which may affect the analysis positively or negatively. Such recognition as the proportion contained within wilderness or proposed wilderness was identifi The existence of occupied lookouts, proximity to state or Forest boundaries, and the inclusion of significant private inholdings were identified. Such features as landfills and the types of activities on adjacent private lands were also mentioned where that information was known and deductions were made where appropriate.

6. A "remarks" and "other" column were included to mention special considerations, items of significance, or as a space for describing unique situations. Examples include mention of such sites as grizzly bear relocation area, the activities of guides and outfitters, instances where biological evaluations have resulted in formal consultation, and areas where management emphasizes compensation or displacement for grizzly bears due to existing activities.

Each activity was analyzed for each of the 71 watersheds. This was accomplished by overlaying the project maps with clear plastic upon which the influence zones of the various activities were drawn, watershed by watershed. Acres within the influence zones were measured with an electronic planimeter and identified as deductions on the analysis form (figure 3). This technique provided a visual diplay of remaining undisturbed space, clearly outlining the shape and extent. Also, because underlying habitat components were colored coded, the specific seasons of disturbance could be determined at a glance. Remaining available free space and undisturbed habitat components were then measured. The results of this step were compared to the criteria defined earlier to determine if adequate space and components were available for grizzly bears after the identified reductions were made. In this manner each bear unit was analyzed to determine available space and components. The process was further refined, as necessary, to a specific season or watershed.

Discussion

While the analysis is not in itself a decisionmaking tool, it provides land managers with information which aids in decisionmaking. The ability to subdivide a larger area into smaller units and to develop data that is sensitive to temporal and spatial considerations provides important perspective.

The relatively fixed bear unit boundaries provide a recognizable unit within which activities can be coordinated, planned, and scheduled to maintain the maximum amount of undisturbed grizzly habitat. The actual shape and size of the undisturbed habitat will change over time as activities occur but, in a somewhat predictable fashion.

Coordination between adjacent bear units can easily occur and, if each individual bear unit is maintained in a healthy condition then the entire cumulative effects area, the total of all bear units, should be maintained in a healthy condition.

The mapping and quantification of habitat components provides an important perspective as to the comparability of various watersheds. This can be of great significance in the selection of displacement areas or with respect to seasons of importance for various foods. Once the data base is generated and the existing situation is analyzed it becomes easier to monitor the influence of new proposals or to identify areas of special management concern. For example, after the existing situation is analyzed it becomes graphically clear as to how much and where additional activities can occur or where direct management can improve bear habitat.

The habitat units, at present, provide a method of assessing the quantity of grizzly habitat within the cumulative effects area and for measuring the changes brought by various activities. They are not in themselves a means of identifying how many grizzly bears an area can support but add perspective to spatial information and other habitat factors. The collection of habitat use data from radio collared grizzly bears would significantly strengthen the analysis process.

Implementation of the cumulative effects process on the KNF has shortened response time for mineral exploration proposals, facilitated formal consultations with the Fish and Wildlife Service, aided in scheduling land management activities and strengthened commitment to coordination recommendations.

We feel this process could be applied to other species for which habitat needs have been identified.

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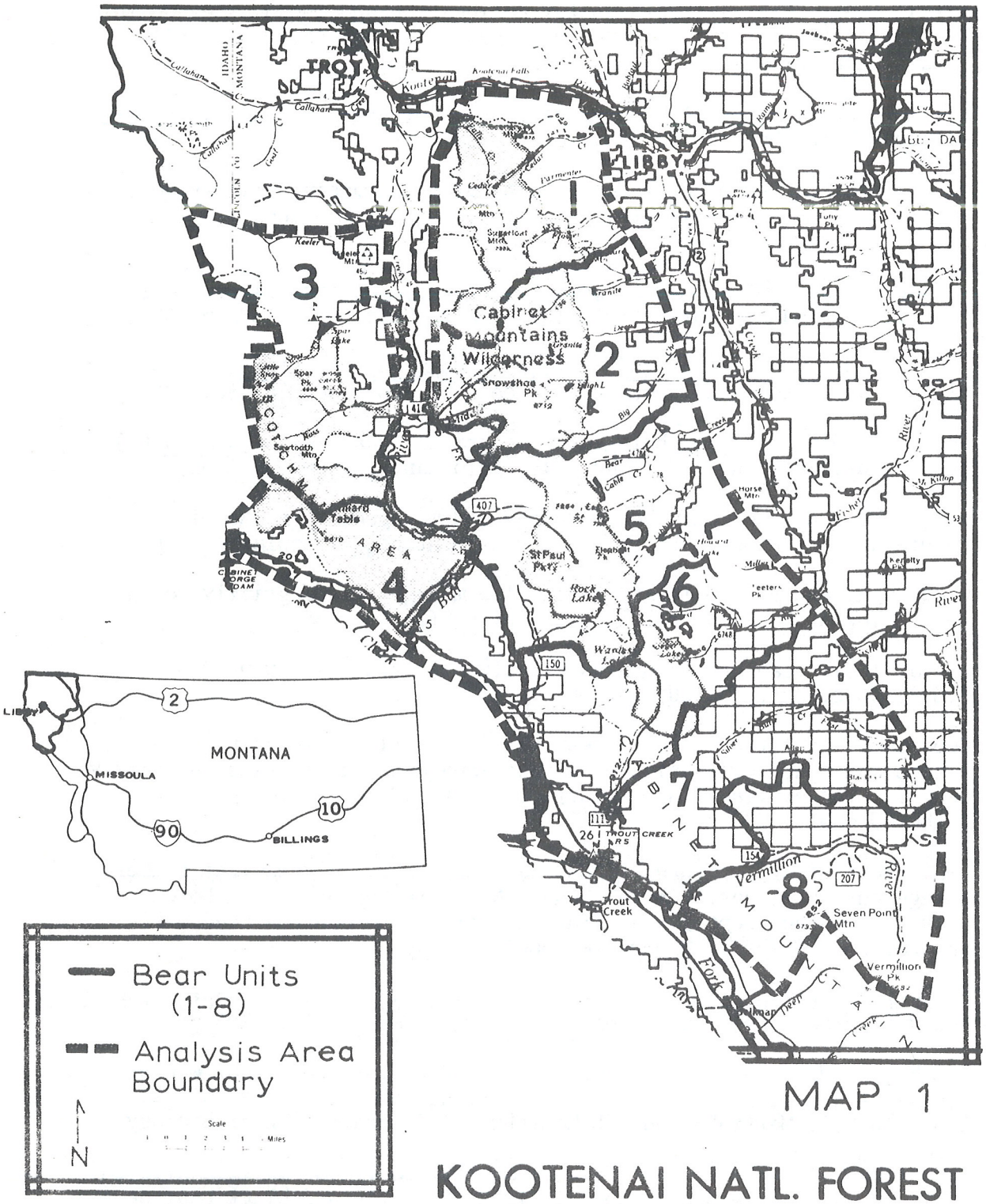

MAP 1

KOOTENAI NATL. FOREST

CUMULATIVE EFFECTS ANALYSIS AREA

Table 1

Grizzly Bear Habitat Components*

I Closed Timber

II Open Timber

III Timbered Shrubfield

IV Shrubfield

- A. Mixed Shrubfield
  - 1. Mixed Shrubfield/Snowchute
  - 2. Mixed Shrubfield/Cutting Unit
  - 3. Mixed Shrubfield/Burn
- B. Alder Shrubfield
- C. Huckleberry Shrubfield

V Low/High Gradient (Riparian) Streambottom

VI Marsh

VII Wet Meadow

VIII Dry Meadow

IX Drainage Meadow (Forbfield)

X Snowchute

XI Sidehill Park

- A. Graminoid Sidehill Park
- B. Beargrass Sidehill Park

XII Slabrock

XIII Talus-Scree-Rock

*Madel, 1982

FIGURE 1
COMPILATION SHEET

Subdrainage Mill-West Fisher-Standard

Ref. Maps 5,6

Total Acres 9075

Bear Unit 6

SPRING

Components	Acres	Quality Rating	Weighted Acres
L/H Gradient Stream Bottom	88	3	264
Marsh	11.3	1	11.3
Graminoid Sidehill Park	379.6	2	759.2
Mixed Shrubfield/Snowchute	970.7	3	2910
Snowchute	3.1	3	9.3
Total	1452.7	Total	3953.8

Quality Index = Weighted / Net = 2.721

Component Index = 5

Spring Habitat Units 19764

SUMMER

Components	Acres	Quality Rating	Weighted Acres
Wet Meadow	49	2	98
Drainage Meadow	6.6	3	19.8
Snowchute	3.1	3	9.3
Graminoid Sidehill Park	379.6	1	379.6
Mixed Shrubfield/Snowchute	970.7	2	1941.4
Alder Shrubfield	—	3	—
Total	1409	Total	2448.1

Quality Index = Weighted / Net = 1.907

Component Index = 5

Summer Habitat Units 12237

FALL

Components	Acres	Quality Rating	Weighted Acres
Vacc Shrubfield	81.7	3	245.1
Timber/Vacc Shrubfield	383.2	2	766.4
Mixed Shrubfield/Snowchute	970.7	2	1941.4
Mixed Shrubfield/Cutting Unit	—	2	—
Mixed Shrubfield/Burn	—	3	—
L/H Gradient Stream Bottom	88	1	88
Total	1523.6	Total	3040.9

Quality Index = Weighted / Net = 1.995

Component Index = 4

Fall Habitat Units 12158

DENNING

Components	Acres	Quality Rating	Weighted Acres
Xete Sidehill Park	293	3	879
Timber/Vacc Shrubfield	383.2	1	383.2
Vacc Shrubfield	81.7	1	81.7
Total	757.9	Total	1343.9

Quality Index = Weighted / Net = 1.773

Component Index = 3

Denning Habitat Units 4031

FIGURE 2
SUMMARY SHEET

Subdrainage	Watershed	Net Acres	Acres of Components	Percent Components	Total Habitat Units	Units Per Acre	Seasonal Component Ratios Sp	Su	F	Den
Miller-West Fisher		36260	6074.4	16.7	95515	2.63	10.0	9.2	10.0	4.6
	Bu-6 31. Mill-West Fisher Standard	9075	2266.2	24.9	48190	5.31	16.0	15.5	16.7	8.4
	Bu-6 32. Miller	7610	926.7	12.1	5655	.74	10.9	10.3	1.9	0
	Bu-6 33. W. Fisher Teeters Pk.	9260	1318.7	14.2	14339	1.55	7.3	4.3	9.9	1.6
	Bu-6 34. Bramlet-Lake	5265	1202.3	22.8	22089	4.20	10.4	11.0	16.4	10.9
	Bu-6 35. Trail	5050	360.5	7.1	5242	1.04	2.5	2.9	3.9	3.8
Spring-Lyon Vermilion		27385	2621.2	9.6	33795	1.23	2.1	1.7	8.1	3.1
	Bu-7 36. Canyon-20 Odd	9545	733.2	7.7	6272	.66	1.5	1.2	6.3	1.1
	Bu-8 37. Lyons Gulch-Sims	10785	715.2	6.6	11075	1.02	2.1	1.9	5.2	1.8
	Bu-8 38. Spring-Blacktail	7055	1172.8	16.6	16448	2.33	2.7	2.2	15.0	7.6
Swamp-Galena		19555	5218.9	26.7	71988	3.68	8.6	6.9	17.9	8.4
	Bu-7 39. Galena	5515	1249.2	22.7	16111	2.92	8.1	6.9	14.8	4.1
	Bu-6 40. Swamp	14040	3969.7	28.2	55877	3.98	8.8	6.9	19.2	10.1
Belgian-Waterhill		11080	2091.1	18.9	8277	.75	10.9	10.9	14.5	.3
	Bu-7 41. Twenty Peak-Belgian	4380	1454.1	33.2	4361	.99	16.9	16.9	16.2	0
	Bu-8 42. Grimes Gulch-Belgian	6700	637	9.5	3916	.58	6.9	6.9	2.3	.6

Table 2

Home Range Size for Adult ($\geq$ 5 yr.) Female Grizzly Bears*

Origin	km^2
N.F. Flathead (Canada)	65
N.F. Flathead (Canada)	391
N.F. Flathead (Canada)	313
N.F. Flathead (Canada)	75
N.F. Flathead (Canada)	154
N.F. Flathead (Montana)	104
Rocky Mtns. East Front (Montana)	369
Rocky Mtns. East Front (Montana)	446
Rocky Mtns. East Front (Montana)	305
Rocky Mtns. East Front (Montana)	202
Mission Mountains (Montana)	458
Mission Mountains (Montana)	112
Yellowstone	273
$\bar{X}$	251

*Data provided by C. Servheen, Fish and Wildlife Service.

FIGURE 3
CUMULATIVE EFFECTS EXISTING SITUATION

BEAR UNIT _____ PROJECT MAPS _____ YEAR _____ GROSS TOTAL AVAILABLE _____ NET TOTAL AVAILABLE _____

WATERSHED NAME	SIZE (ACRES)	ACCESSIBILITY/DEDUCTION (Road Influence)	TIMBER ACTIVITIES/DEDUCTION	RECREATION/DEDUCTION	MINERALS/DEDUCTION

OTHER/DEDUCTION	SPECIAL FEATURES	REMARKS	NET AREA AVAILABLE WITHIN WATERSHED AND COMMENTS

BALD EAGLE MANAGEMENT IN MONTANA - AN INTERAGENCY APPROACH

Lorin Hicks[1]

When the Lewis and Clark Expedition entered Montana near the confluence of the Yellowstone and Missouri Rivers during the nesting season of 1805, bald eagles became plentiful enough to command attention. As the expedition moved up the Missouri to the Milk River that spring, Lewis noted in his journal that "the Bald Eagle are more abundant than I ever observed them in any part of the country" (April 28, 1805). Today there are no known bald eagles nests on the Missouri River from Great Falls to the North Dakota border. Clearly, the historical decline in abundance and changes in distribution for bald eagles in that area and other areas in Montana is a valid cause for concern.

In 1978, the bald eagle was officially listed as an endangered species in Montana and 42 other states. Under authority of the Endangered Species Act of 1973, five regional recovery teams were appointed to develop and implement bald eagle recovery plans. Montana was originally placed in the Northern States Recovery region but was moved to the Pacific States region in 1982 to facilitate coordination with other western states of similar biological and ecological characteristics.

In January 1982, the Montana Bald Eagle Working Group (MBEWG) was provided interagency committee status through authorities of the Area Manger, U.S. Fish and Wildlife Service and the Director of the Montana Department of Fish and Wildlife and Parks. As one of only four such working groups in the nation, the MBEWG serves as coordinating point for management, research, information exchange, and bridges the gap between recovery team planning efforts and specific management and recovery efforts in Montana.

The concept of the working group is supplemental and additive to the recovery plan objectives on the ground with the various management agencies in Montana. A copy of the group charter is available from Working Group Chairman, Dennis Flath, or other group members.

Membership is based on management responsibility, personal interest, technical expertise, and degree of involvement in the recovery of bald eagles. The core working group is composed of representatives from state and federal agencies, conservation groups, and private industry. Much of the actual work is done by appointed subcommittees with periodic full meetings to inform the group of progress on specific tasks and develop additional projects. Working group meetings are designed to include outside speakers and open public sessions to infuse as much information and public involvement as possible.

At present, priority topics for the working group involve statewide nesting and productivity surveys, preparation of standardized data forms and computer storage facilities, compilation of historical nest site data, preparation of a manual on eagle survey and management techniques, and a slide-tape presentation on bald eagles in Montana for public education.

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When requested, the MBEWG can also assist public and private landowners in solving specific land management problems related to eagles. However, it should be stressed that recommendations offered by the working group are strictly advisory in nature and carry no regulatory implications.

The state has been divided into seven zones to facilitate national recovery planning. Recovery zones were established using major hydrologic boundaries with four of the seven extending into adjacent states. Recovery goals and actions will be applied on a zone-by-zone basis.

In order to set realistic recovery goals for future populations, a thorough knowledge of present as well as historical abundance must be obtained. To achieve that objective, the MBEWG last year initiated and interagency statewide bald eagle nest inventory and productivity survey. All known nesting territories were intensively monitored during the year to determine occupancy, nesting success, and fledgling production. The results of this survey clarified the current status of bald eagles in Montana.

In 1982, 34 territories were occupied by adult pairs in March. Six of these failed to establish an active nest, and six active nests failed to produce young. Three additional nests were discovered midway through the survey. Twenty-five (25) nests fledged 44 young for a total nest success rate of 65%. Net production was 1.15 young fledged per occupied territory with a mean brood size of 1.76 young per successful nest. This compares favorably with eagle production in adjacent states.

State	Young per Occupied Teritory	Young per Successful Territory
Montana	1.15	1.76
Idaho	1.12	1.80
Oregon	1.02	1.54
Wyoming	0.84	1.65
Washington	0.82	1.42

*Source: Draft Pacific States Bald Eagle Recovery Plan (USFWS, 1982)

It is important to note the distribution of currently occupied nesting territory as well as proposed population goals for Montana in order to understand where recovery efforts will be directed. The following table lists the current distribution of known pairs by zone for Montana.

Montana Zones No.	Names	No Current Pairs
7	Upper Columbia	24
18	Greater Yellowstone	4
38	Headwaters	1
39	Upper Missouri	3
40	Bighorn	2
41	Powder	3
47	Missouri Basin	0
		37

As seen from this table, an overwhelming majority of current nesting activity occurs in the forested areas of the Upper Columbia zone in northwestern Montana. Tentative recovery goals are designed to provide for a moderated, achievable increase in nesting territories where nesting currently

occurs, as well as establish territories in the Missouri Basin where Lewis and Clark recorded high levels of eagle activity 178 years ago but where no nests exist at present.

Historical presence of breeding bald eagles does not necessarily mean that the area has the same potential for breeding eagles today. At a recent conference, Peter Nye of New York's Department of Environmental Coordination stated that historical bald eagle data cannot be relied on because the original habitat may largely be gone while new habitat has been and is being created.

The MBEWG has attempted to assess habitat capabilities for breeding bald eagles within Montana. Realizing that lack of data precludes an accurate assessment of potential, we estimated potential in two ways. Using a conservative approach, we estimated that Montana could host 61 pairs of breeding bald eagles. Then, using a more liberal approach, we think it conceivable that approximately 139 breeding pairs could be established. It should be understood that the latter number is a best guess effort.

In addition to providing nesting habitat, Montana also provides habitat for migrant and wintering bald eagles. The MBEWG recently compiled existing information to identify primary migration routes and key wintering areas in the state for recovery planning. Additional work is planned to define and identify major winter eagle roost sites in the state.

The working group has recently developed standardized forms and recording procedures for bald eagle observations and nest site descriptions in the state. These forms were carefully prepared to provide quick translation into a centralized computer storage and retrieval facility.

The objective of developing these forms is to provide an easy and effective method to obtain statewide cumulative data on eagles to identify "high use areas", migration corridors, potential new nesting territories, roosting, perching, and feeding site locations. The forms have now been printed and will be distributed during the 1983 field season. We hope that many of you here today will assist us in obtaining this much needed information.

The forms will be handled in the following manner. Raptor observation cards will be made available to all field offices. This form is intended for use by field personnel as well as recording observations made by the general public. Compilers will be designated in each organization to collect and screen the completed forms for storage in the computerized data base. Additional forms have been developed for more specialized activities such as raptor nest surveys, nest site descriptions, and cumulative nest and territory histories. The forms and reporting procedures will be evaluated after three years of use. Periodic computer outputs of the data will be distributed to all compilers who participate. This method assures that only the most valuable data will be collected in a systematic and timely manner for immediate use by managers and researchers alike.

The Montana Bald Eagle Working Group has concentrated a diversity of interagency expertise, energy, and responsibility into a common effort for on-the-ground progress in bald eagle management and recovery in Montana. The interagency concept insures that diverse interests are represented and involved in the function of the working group.

The success of the Montana Bald Eagle Working Group, to serve as a clearing house for information on management, research, and recovery of bald eagles in the state, depends on the assistance obtained from "rank and file" field contacts in obtaining data on bald eagles in Montana. We believe our interagency approach is a good one and ask you to join us in our endeavors.

SUMMER RANGE ECOLOGY OF WHITE-TAILED DEER IN THE SWAN VALLEY

Rosemary H. Leach[1]

Introduction

The white-tailed deer (Odocoileus virginianus) is an important game animal in northwestern Montana, where it is closely associated with coniferous forest habitat. Recent studies there (Weckwerth 1958, Hildebrand 1971, Mundinger 1979) indicate reduced deer harvests and increased hunting pressure concurrent with increased timber harvests. Those investigations focused on winter ecology of deer.

However, if we view the relevant habitat as the total environment that deer occupy yearlong, then spring-summer-fall ranges may be equally as important or more important than winter ranges in their influence on population dynamics (Mackie et al. 1979).

Literature review showed few deer studies on summer ranges and none focused on deer and habitat relationships in coniferous forests of the mountainous northwest. During summer 1980, I began to study deer summer range ecology in the Swan Valley, Montana. Objectives were to: 1) identify and describe summer habitat; and 2) determine ecological relationships between deer and habitat components.

Study Area

The study area includes the southern half of the Swan Valley and the northern quarter of the Clearwater Valley. It extents from Dog Creek south to Lake Inez, and spreads east and west to the mountain foothills. The Swan Highway and the Swan and Clearwater Rivers run the length of the study area.

Two factors contribute to unique vegetative characteristics found there. First, the area is the eastern edge of low elevation, wet coniferous forests influenced by moist Pacific air masses (Antos and Habeck 1981). Second, the entire area was glaciated, contributing to broken topography, variable soil moisture regimes, and numerous inclusions of microhabitats.

Methods and Materials

Deer were captured in Clover traps (Clover 1956) on the Upper Swan winter range, north of the summer range. Suitable deer, healthy does between 1½ and 5½ years of age, were radio-collared. However, 5 fawns were collared in 1980-81 because of poor trapping success of adults that winter.

I monitored 18 different individuals and some adults were followed for 2 summers. I treated each summer's home range data individually, so in most of my analyses I had a sample size of 21 adults and 5 yearlings. Home ranges were delineated by connecting the outermost relocations to form a convex polygon (Mohr 1947).

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I mapped each home range according to 4 broad habitat categories: unlogged upland, logged upland, unlogged riparian, and logged riparian. This was my measure of habitat availability. Deer relocations or use in the 4 habitat categories were compared to habitat category availability to determine habitat selection. Using methods of Neu and others (1974) I calculated 90% simultaneous confidence intervals to determine if deer used each habitat category more or less than expected, based on proportionate availability.

Actually, habitat selection can be considered as a hierarchy, where primary selection involves the geographical range of the species, secondary selection involves the location of home ranges within the geographical range, and tertiary selection involves the use of specific habitats within the home range (Johnson 1980). I've just described tertiary selection analysis, the only level considered in many studies.

To determine secondary selection, I compared home ranges with unsampled portions of the study area. To do this, I selected and visited 15 so-called "random areas". These simulated the size, shape, and elevation of an "average" deer summer home range. Again, I constructed confidence intervals to determine if deer summer home ranges contained each habitat parameter in amounts more or less than expected from availability on random areas.

Results and Discussion

Deer established summer home ranges from 6 to 40 km south of the winter range where they were marked. This dispersion throughout the study area indicated that a variety of places provided suitable deer habitat.

Gaps between the identified home ranges included home ranges of unmarked deer and probably some areas of unsuitable habitat.

Home ranges of radioed adults did not overlap, and this distribution may have reflected social behavior to avoid other does, consistent with other studies (Dasmann and Taber 1956, Ozoga et al. 1982).

Swan-Clearwater deer returned annually to their summer ranges, consistent with other studies (Progulske and Basket 1958, Hoskinson and Mech 1976, Janke 1977). Core areas of use were the same between years. An advantage of annual fidelity by matriarchal does is the retention of successful fawning grounds for family groups. This would enhance the reproductive success of matriarchs during times of high population densities and stress (Ozoga et al. 1982).

The average home range size for adults was 71 ha, and 91 ha for yearlings (not significantly different, Mann-Whitney $P=0.25$). Average sizes in the Swan-Clearwater were generally smaller than those reported in other studies (Leach 1982), reflecting diverse habitat that is capable of meeting the needs of deer in small areas.

Tertiary habitat selection by adults and yearlings was similar, and use differed significantly from availability in all 4 habitat categories ($P \leq 0.10$). For both age groups, deer used riparian habitats more than expected, and upland habitats less than expected. Other studies have reported similar preferences for riparian areas, perhaps because of preferred and abundant food and cover found there (Townsend and Smith 1933, Severinghaus and Cheatum 1956, Progulske and Duerre 1964, Allen 1968, Martinka 1968, Mundinger 1979).

Of the 2 riparian habitats, deer apparently preferred unlogged riparian because only 2 deer used logged riparian more than expected. The summer ranges of those deer contained almost no unlogged riparian habitat, but they were apparently suitable because the logged riparian was widespread, and contained abundant deciduous cover and remnant conifers.

Secondary habitat selection differed between age groups. Adult home ranges contained significantly more of the 2 riparian habitats and unlogged upland than was present on random areas. Yearling ranges, in contrast to adults, resembled random areas except they had significantly more logged riparian than random areas.

For adults, the preponderance of the 2 riparian habitats was consistent with tertiary selection for them. Secondary selection for unlogged upland, however, contrasted with tertiary selection against it. Thus, unlogged upland was an important component of home ranges, although it was utilized less than expected at the tertiary level. Adults may have located home ranges in areas of unlogged upland for security and diversity.

Adult ranges contained significantly less logged upland than was available on random areas, consistent with tertiary selection against this habitat. Adult ranges had an average of 2 cutting units of about 12 ha each, per 100-ha home range.

Although adults and yearlings used their home ranges similarly at the tertiary level, they established their home ranges in different habitats. If we use adult selection as a standard in the Swan-Clearwater, we can rank the habitats in the order of preference: unlogged riparian, logged riparian, unlogged upland, and logged upland. Thus, secondary selection of logged riparian by yearlings may mean that this was the most preferred habitat available to them. Apparently, yearlings were forced to occupy the marginal or logged habitats. A Denmark study showed similar displacement of yearling roe deer (Capreolus capreolus) to suboptimal habitats (Klein and Strandgaard 1972). Yearlings compensated for unavailable preferred habitats by selecting logged reparian habitat that contained abundant deciduous cover and remnant conifers.

Summary, Conclusions, and Management Recommendations

Deer movements, fidelity, home range juxtaposition, and home range size reflect strategies of habitat utilization. In the Swan-Clearwater, an "average" adult summer home range was approximately 71 ha and contained more than expected riparian habitat, unlogged uplands and diversity. Habitat components were in close proximity, allowing a deer to maintain a small home range size while selecting habitats to meet its needs.

Most yearlings and 2 adults demonstrated a degree of adaptability by selecting home ranges in marginal habitats. Their home ranges were extensively logged, but contained much riparian habitat, deciduous cover, and remnant patches of mature coniferous forest. Otherwise, they were physiographically similar to preferred areas.

Logged uplands on random areas usually equalled or exceeded the amounts found on deer home ranges. The few deer whose summer home ranges contained more logged upland than expected from random areas, always used it less than expected. Thus deer apparently tolerated rather than required logged uplands.

Within home ranges, adults and yearlings selected similar habitats; both preferred riparian areas.

To provide optimal white-tailed deer summer habitat within the multiple use concept, the following guidelines should apply in the Swan-Clearwater:

1. Protect riparian areas from logging activities.
2. Maintain mesic sites contiguous with larger areas of forested upland.
3. Preferred Management: uneven-age management to maintain forest mosaics.

4. Alternative management: even-age management within these constraints:
   a. Plan the maximum cutting unit size as 12 ha.
   b. Plan only 2 cutting units per 100 ha, or per section.
   c. Limit post logging scarification to the minimum necessary to provide for tree reproduction. This should enhance shrub production to provide deer forage and cover.
   d. Make additional entries only after second growth in logged units is sufficiently developed to provide hiding cover (Thomas et al. 1979).

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MODELING GAS AND OIL IMPACTS ON WILDLIFE IN THE FOREST RESOURCE PLAN

John Edwards[1]

Abstract: Forest planning uses a linear program called FORPLAN for analysis and allocation. The Custer National Forest included assessment of gas and oil impacts in the model. An index rating for ecosystems was established using habitat requirements of key wildlife species. Population estimates were made using long term averages. Gas and oil impacts were assessed on roads and associated activities. The system provides an indication of trend for the model to include in allocations.

The Forest Service is currently going through a convolution called Forest Planning. The goal is to determine the management of the Forests and the outputs to be produced for the next 150 years. The Custer National Forest is also going though this effort. For the past two years I was assigned to the Core Team as the Planning Team Biologist. During that time we developed a method for evaluating the habitats for wildlife and a method for evaluating the impacts of gas and oil to wildlife.

Most Forests, including the Custer, are using a linear program called FORPLAN for analysis and allocation. The model works on base units called analysis areas (AA's). The Custer is using ecosystems as the AA's. The model is hierarchal with AA's grouped into physiographic areas (PA's). These PA's are collections of ecosystems that show similar responses, or which have special management designations. For example, the Absaroka-Beartooth Wilderness Area is one PA; the badlands in North Dakota are in another PA. The PA's are then grouped into the Forest level.

For analysis, the base unit was the ecosystem. Each ecosystem was evaluated against criteria developed for key wildlife species. A sample of the criteria is included as Appendix A. The rating was used as a coefficient to multiply against acres in an ecogroup to establish effective acres, which was the output for wildlife in the FORPLAN (Table 1).

A wide variety of management activities were developed for each AA. Each activity or prescription was assessed for its effect on the habitat for key species. The coefficient was changed to reflect expected changes in the environment. A change in the coefficient resulted in a change in effective acres.

The Custer Forest is the most widespread in the Forest Service. From the high alpine habitats in southcentral Montana to the eastern hardwood draws in eastern North Dakota, the Forest is 600 miles across. The scattered parcels of Forest-administered lands within these bounds contain a multitude of habitats. Included in this area is the Williston Basin with proven oil and gas reserves. Each ecosystem was assessed according to the established criteria for current conditions.

A wide variety of wildlife occurs on the Custer, however, because of the long distances between Districts (and habitats), some species are not found on most of the Forest lands. Elk, for example, have a limited distribution. With the exception of occasional observations elsewhere, one

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TABLE 1 - ECOSYSTEM RATING

Ecosystem	Acres	Coef	Effective Acres	Deer Coef	P.C.[1]
Woody Draws	100	.6	60	.0313	1.8
Breaks	200	.9	180	.0234	4.2
Slopes	200	.7	140	.0156	2.2
Grasslands	500	.7	350	.0078	2.7
	1,000		730		10.9

1/ provided capacity

TABLE 2 - ECOSYSTEM RATING - MOST ROADS WERE LOCATED IN GRASSLANDS

Ecosystem	Original Acres	-	Acres Lost	=	Coef	New Effective Acres	Deer Coef	P.C.[1]	Percent Change
Woody Draws	100	-	10	= 90	.6	54	.0313	1.7	
Breaks	200	-	20	= 180	.9	162	.0234	3.8	
Slopes	200	-	30	= 170	.7	119	.0156	1.9	
Grasslands	500	-	100	= 400	.7	280	.0078	2.2	
	1000		160			615		9.6	-12

1/ provided capacity
2/ comparison of this alternative with current Table 1.

TABLE 3 - ECOSYSTEM RATING WITH ROADS - MOST LOCATED IN BOTTOMS AND BREAKS ECOSYSTEMS

Ecosystem	Original Acres	-	Acres Lost	=	Coef	New Effective Acres	Deer Coef	P.C.[1]	Change[2]
Woody Draws	100	-	80	= 20	.6	12	.0313	.4	
Breaks	200	-	80	= 160	.9	144	.0234	3.4	
Slopes	200	-	0	= 200	.7	140	.0156	2.2	
Grasslands	500	-	0	= 500	.7	350	.0078	2.7	
	1000		160			615		8.7	-20%

District (D-2) contains all the major elk herds on the Forest. Despite this localization, these are animals of high concern to the public.

In contrast, both whitetail and mule deer are widespread and are the most sought-after big game animals on the Forest. At least some whitetail are found on every District, while mule deer occur on all but the eastern-most areas. Both deer and elk coefficients will be developed for FORPLAN.

Deer, especially whitetail, are associated strongly with the bottom-lands and woody draws. Their inclusion allowed the Forest to evaluate impacts on this habitat, but a substantial amount of Forest Service acreage is in a grassland habitat. This habitat is utilized by a variety of species. Impacts to this grassland community of wildlife species needed to be evaluated also. Because of the amount of information available, the visibility of the dancing grounds, the tie to the prairie vegetation, and widespread interest in this species, sharptail grouse was selected as an indicator species representing grassland habitats.

The scheduled output for all three wildlife slots is effective acres. This output is the best indicator of changes in the wildlife habitats; it measures what the Forest Service is responsible for--habitats. Since the public is principally concerned with number of wildlife, the effective acres was converted to a population figure which represented the provided capacity (PC) for key species. For sharptail grouse, provided capacities were too inaccurate and only effective acres was used. Appendix B contains the methods and definitions used to develop the PC.

The Williston Basin occurs over much of the Forest-administered lands in western North Dakota. Exploration and development activities have increased substantially in the late 1970's and early 1980's. In 1980, 150 wells were drilled on Forest-administered lands. While activity has subsided somewhat in 1983, the level is still high above that of the mid-1970's. Because of this activity and because the geologists indicate that most areas of the Forest have some potential for gas and oil, it was decided to include these activities within the FORPLAN model.

To include gas and oil activity, a whole range of minerals prescriptions were developed ranging from no activity to heavy emphasis on development. Each prescription required an assessment of impacts to wildlife. This proved to be quite a problem.

A survey of the literature, including two computer surveys was disappointing. Quantified assessment was lacking. Most reports were an evaluation after minerals activity had occurred. Almost none had baseline data to compare. The more recent publications have baseline data but few wells. A survey of biologists showed a wide divergence of opinion. Estimates ranged from 100 percent--"all the deer moved out of the draw"--to 3 percent (acres actually disturbed). A few general areas of agreement were identified: a) the amount of activity is key to the amount of impact, and b) the increased access can be a major problem.

Experience on the Custer implied that roads, and pads along with the activity on these areas, was the single largest impact of development activity on wildlife. Assessment of the impact of raods on deer was only marginally more available than gas and oil impacts. Most studies have concerned themselves with elk and few with deer. Reports were often conflicting in the amount of displacement associated with roads. It was evident that some baseline assumptions were necessary before an analysis could be made.

The area where most mineral development was taking place was a grassland, badland complex. In most areas topographic relief provided the only screening available. The drainage ways were characteristically narrow bands of hardwood vegetation. Most of the areas were accessible to 4-wheel drive vehicles,

however, only a few roads existed and most activity was limited to the fall hunting seasons. The remainder of the year saw little traffic.

When gas and oil activity increased, the amount of roads increased. The new roads were constructed to a higher standard and the volume of traffic increased dramatically. On arterial roads traffic counts of vehicles per day have been recorded. This amount of activity is a major change from 10 years ago.

In addition, some acres are taken out of production for each well pad constructed. On the average, 3 acres of land are required for each pad. The number of pads per section is regulated by the states involved. For planning purposes the geologist estimated the mineral potential for all areas in the Forest. From this, various scenarios of development were created. Average numbers of roads and pads per section were estimated for each scenario.

Impacts of roads was defined as the zone around and immediately adjacent to roads or pads wherein wildlife can reasonably be expected to change patterns of use in response to the various sounds and activities occurring on these areas. It represents a functional loss of habitat.

It is obvious that the degree to which the affected habitats are less utilized depends on the species considered and for each species the degree to which habitat is less utilized decreases as the source distance increases.

Although most resident wildlife utilizing habitats in areas immediately adjacent to gas and oil development will be affected to some degree, the species most affected at the greatest distances will be the sensitive, wide-ranging big game species. It is unknown at precisely what distances and to what degree big game animals such as mule deer are affected, but it is known that deer change their use of the habitat in response to new road construction.

Various studies have shown that deer adjust to roads. After use on a road becomes established and predictable, deer adapt to that pattern. However, when new roads and pads are constructed impacts occur. Impacts have been estimated at 100 yards (A. Lorin Ward personal communication) and at 300+ yards (Terry Lonner, personal communication) in a forest environment.

The acreages affected are influenced by site-specific topography. The effects on each species are dependent upon the behavioral characteristics of the affected species, the size of the local population, and in turn, the quality and quantity of affected habitats. The general area of development and location of well pads and roads determine the types and amount of affected habitats and to what degree each species is affected. As the distance from the source of disturbance increases, topography becomes the dominant consideration.

The above factors indicate impacts to big game can be mitigated by road and well placement. However, the model allows for all variations in ecosystem use. Variations in topography could not be included since they complicate the model beyond use. Impacts from activities was arbitrarily set at 100 yards. For simplicity it is assumed that the area enclosed within the 100 years is effectively lost. This is a compromise with topography effects and gradient effects. The model ignores the overlapping effects that occur at junctions.

To operate the model a current run for an area was made. A layout of roads and their placement in ecosystems was also made. Road acres were calculated using a 20' width on road and 600' (100 yards either side of the road) times the length.

$$\frac{(20 + 600\ (5280'/\text{mile})}{43560\ \text{acres/mile}} = 75.2\ \text{acres}$$

For 1 mile of road 75.2 acres of habitat are lost.

These acres are then subtracted from the acres in the ecogroup and the model rerun. The total change in effective acres is an index of the impacts. By locating roads in the ecosystem which has the least impacts, total impacts to wildlife can be minimized (Table 2 versus Table 3). However, some impacts can not be avoided and these are conservatively estimated here.

Interpretation

The wildlife output of the FORPLAN model was effective acres. Interpretation of the effects of gas and oil required a knowledge of the assumptions implied. All results were believed to be conservative and are best used as indicators of trend rather than a quantification of impacts. However, inclusion in the linear model provided FORPLAN with a consideration in the allocation of prescriptions which would not occur if handled outside the model.

APPENDIX A

SHARPTAIL GROUSE
(*Pedioecetis phasianellus*)

The sharptail grouse was selected because it is one of the most important upland game birds and because it represents a variety of upland bird and mammal species which use grass and woodland habitats for food, reproduction, and winter cover.

General Habitats

Sharptail dancing grounds are usually situated on a knoll or flat area with an open view of the surroundings (Pepper 1972, page 14). Sharptails initiate courtship and display activities in late March with the peak of activity occurring in late April (Pepper 1972, page 15; Hillman 1973, Page 14).

Hens select residual cover for nesting with greatest success in natural grass shrub (Pepper abstract 1972). Vegetation 12 inches in height and of adequate density is preferred (Christenson 1971, Jones 1968). The amount of standing cover, excluding shrubs, is important in limiting sharptail breeding populations (Browne 1968, page 8). In North Dakota a minimum of 10 inches of residual cover may be necessary (Christenson 1971).

The number of males on dancing grounds is reported to be proportional to the acreage of ungrazed or lightly grazed natural grass-shrubs within a mile of the dancing ground (Pepper abstract 1972).

Shrub coulees of 30-60 percent crown cover (Grange 1948, Amman 1957) and 6-12 feet high are used for brooding and roosting (Sisson 1976, Nielsen 1978). Sharptails' use of woody vegetation increases during dry summers and inclement weather (Brown 1966, page 2; Pepper 1972, page 31). Grouse may avoid close association with cattle during summer and fall (Nielsen 1981).

Heavy grazing has a detrimental effect on sharptail populations (Marshall and Jensen 1937; Hart et al. 1950, page 58; Brown 1966, page 2; Pepper abstract 1972; Hillman 1973, page 25; Sisson 1976). Intensive grazing systems may also be detrimental to grouse (Nielsen 1981). A deferred rotation system with two pastures on a last out, first in schedule may be beneficial (Sisson 1975, page 1).

Sharptail Effective Habitat Criteria

June 1981

Rating	Description
10	Nesting Effective residual cover (grasses) 10-12" high for nesting preferably on north slopes. Brood rearing Good shrub cover in draws--crown coverage approximately 30-60 percent and 6-12' high. Principal species are deciduous: chokecherry, wild rose, buffaloberry, service berry. Shrubs with all terminal leaders alive. Forbs and grasses abundant and in good condition.
7	Nesting Residual grass cover 8-10" high. Brood rearing Shrub crown coverage 45-60 percent in draws and 6-8' high. Shrubs with 75 percent of terminal leaders alive. Less forbs available and in good condition.
3	Nesting Residual nesting cover 6-8" tall. Brood rearing Shrub crown cover 20-30 percent. Shrubs are 4-6' tall. Two or three deciduous species present. Deciduous plants with 25-50 percent of terminal leaders alive. Understory sparsely vegetated.
1	Nesting Residual nesting cover less than 6" high. Brood rearing Shrubs scattered in draws (less than 10 percent crown cover, less than 2 feet tall). Shrubs decadent with less than 25 percent of leaders alive.

APPENDIX B

POPULATION COEFFICIENTS

INTRODUCTION

The development of effective acres represents a measure of the quantity and quality of habitats. Without suitable habitat no species could exist, however, the public and many people in-Service have trouble valuing an effective acre. In order to communicate effectively it is important to use terms that the listener is familiar with. For wildlife, this means talking in terms of animal numbers.

Biologists are extremely reluctant to use animal numbers for a variety of well-founded reasons.

1. Census

Numerous studies have indicated that it is virtually impossible to obtain a complete count of a given species even in a restricted area. Even for a large animal such as buffalo, which is highly visible, obtaining a total count is improbable. Some animals may be in tree cover and not visible, and some may be counted twice. For less visible species such as deer the problem is more difficult. Studies have been done in which deer were marked with either bright collars and/or radio collars. Attempts to relocate these animals show a low observability. Even when radio tracking located the animal in a small area, observers missed seeing the animal more often than they saw it.

2. Population Dynamics

For most species the young are born in the spring. In a very short period of time the numbers of a single species can increase 20-40 percent. A count taken just prior to birthing, even if 100 percent accurate, would differ largely from an equally accurate count taken one month later after the young are born. A similar problem occurs for hunted species around the hunting season. Studies have indicated that populations of ungulates are most stable towards the end of winter. Even then a total count is impossible and the numbers obtained are most accurate as a trend. Over a long period of time, these counts can show a trend in the population.

3. Complexity

Using numbers of animals as a reflection of capacity is a simplification of a complex, dynamic process. The number of animals present at any instant in time is a reflection of a number of factors; weather (severe or mild winters), habitat (cover, forage), genetics, and for hunted species, regulations, seasons, buck or either sex seasons, length of seasons. Each of these vary in importance year to year and are interdependent. To pick out habitat as the sole factor is to oversimplify a complex process.

Despite these difficulties, some means of expressing numbers is necessary to adequately value the habitat for the land manager who is responsible for decisions that affect wildlife.

METHODS

Certain definitions and assumptions can be made which help to minimize the problems of numbers of animals.

Provided Capacity (PC)-- this term, expressed in numbers of animals, is not a population count. It is defined to mean the number of animals that the habitat can support in an average year. At any instant, the actual population of animals existing in the designated area may vary greatly from the provided capacity.

1. The Fish and Game Departments provided long-term population censuses for the areas in numbers of deer/section. The professionals in the field were surveyed to ascertain if the present population was at, above, or below the carrying capacity.

Assumption: The carrying capacity (CC) reflects the current condition--that is to say that the impacts of traditional uses, timber and range are included in the carrying capacity. The CC would change if these other activities would change. The CC does not reflect the maximum potential of wildlife.

The PC was initially set based upon herd counts and professional judgement. More recent activities such as gas and oil development have had an impact on wildlife. In areas where a field has undergone rapid development the PC was adjusted to reflect this activity.

2. Since the Forest Plan uses ecogroups as a base the PC needed to be assigned to ecogroups. Pellet group counts in ecogroups were used as a starting point.

Assumption--the amount of pellet groups (or time spent in an area) is reflective of the value of that area to the animal.

The PC is broken out into ecogroups based on pellet group counts. Where pellet group counts are unavailable and where extrapolation from similar habitats is not realistic, observations of animal use of ecogroups was utilized after adjusting for observational bias (most observers go home at night, the time when deer make the highest use of grasslands).

3. The Ecogroup P.C. was divided by the effective acres to provide a Population Coeffecient per effective acre of ecogroup. This process was involved and over 50 attempts were made to check the effective acre coefficient with the population coefficient.

4. Once an effective acre coefficient, a population coefficient and a PC were initially set, the effective acre coefficient was increased to 1.0 to show the maximum population possible. This provided a check on the upper end of the population coefficient. Note: In some areas the effective acre coefficient was raised to 1.1 or 1.2. The increase above 1.0 was a result of some assumptions concerning a wildlife maximum prescription namely that money was not a constraint and the single purpose was to increase deer numbers. As a result of this assumptions a program of fertilization, seeding and burning was developed to increase the quantity and quality of these habitats. Whenever this prescription was used (only in the benchmark runs) the costs were high.

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THE INFLUENCE OF ROADS ON WILDLIFE

Glenn Erickson[1]

A skit was presented concerning the influence that roads and their use have on wildlife populations.

The presentation began with a typical forest scene and a large six-point "trophy" bull elk. For several years, the bull had utilized the area from summer through fall. Although it was not a perfect home, it did meet the bull's needs for food, water, and cover. In addition, it was a simple task to avoid people and remain secure during hunting season.

In later scenes, an attempt was made to dramatize the influence that new roads, timber removal and human activity had on the elk's home.

To enhance the habitat, the forest canopy was opened by selectively logging the area. The primary purpose was to improve the forage/cover ratio and make the area a better home for the elk.

With the subsequent removal of timber, the elk was left with few trees to hide behind. Vehicle use of the road increased, and the elk was continually disturbed. Although the elk moved to other drainages nearby during the activity, he returned because of the traditional use established in prior seasons.

When the hunting season arrived, the major influence on wildlife was apparent. With little security, the elk was an easy target for the hunters.

Although the skit was presented in an atmosphere of frivolity, it is hoped that the audience gained an understanding of the influence that roads and timber harvest have on wildlife populations. The major impact most often overlooked is the decrease in security for the animal during the hunting season.

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OIL AND GAS ACTIVITIES AND WILDLIFE IN MONTANA'S NATIONAL FORESTS

Ronald Escano[1]

I. What is the status of oil and gas activities?

A. Leasing

Most of Montana's National Forest lands are under lease application. Since 1980 approximately forty percent of the non-wilderness lands have been leased or recommended for lease. This includes about one million acres of Occupied Threatened or Endangered Species Habitat. All of the Special Management Areas (Wilderness, proposed Wilderness, and Wilderness Study Areas) in Montana were being analyzed for oil and gas leasing when Congress stopped "wilderness" leasing activities. The first stage of oil and gas activities, "leasing" is basically complete for Montana National Forests.

B. Exploration

Seismic exploration is occurring over most of western Montana. Approximately 2,000 miles of seismic line were run in 1982. The seismic activity level is relatively small compared to some other parts of the overthrust belt. The Bridger-Teton National Forest in Wyoming alone had 2,000 miles of seismic line in 1982. The seismic program is still in its infancy on National Forest lands in Montana, but we should expect significant activity increases in the future.

Drilling has occurred on only two Montana National Forest locations: (1) Hogback Ridge, Helena National Forest, and (2) Blackleaf Canyon, Lewis and Clark National Forest. We should expect significant increases in requests to drill.

C. Development

Forest Service lands have not been involved with oil and gas field development in Montana. Several areas have been identified as "likely" for field development: (1) Tendoy Mountains, Beaverhead National Forest, and (2) Blackleaf Canyon, Lewis and Clark National Forest.

II. Wildlife Coordination in the Leasing Process

A. Leasing

The Forest programatic oil and gas environmental assessments have set the framework for a ten-year lease period on non-Wilderness lands. The lease evaluation process sections of these assessments identify the surface resource coordination direction, and stipulation procedures. Four basic types of lease stipulations have been used to protect wildlife values: (1) No Surface Occupancy (NSO); e.g., grizzly spring range, (2) Seasonal Occupancy Restrictions (SOR); e.g., elk winter range, (3) Activity Coordination; e.g., elk wallows. The ability to incorporate special lease stipulations is limited by the availability of existing mapped data.

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B. Subsequent oil and gas activities

Because of the general lack of project specific resource data, the low probability (10% in a given lease tract) that drilling will occur, and the short response times required in the drilling permit procedures, our ability to coordinate surface resource values with oil and gas development rests with area development planning. In those areas where oil and gas field development is likely, a site specific analysis over a large enough area to address cumulative effects, large home ranges, etc., is key for an effective bridge between the lease stipulation process and project coordination. The area planning concept is part of the general process where the potential conflicts, coordination needs, areas unsuitable for occupancy are identified as early in the oil and gas process as possible.