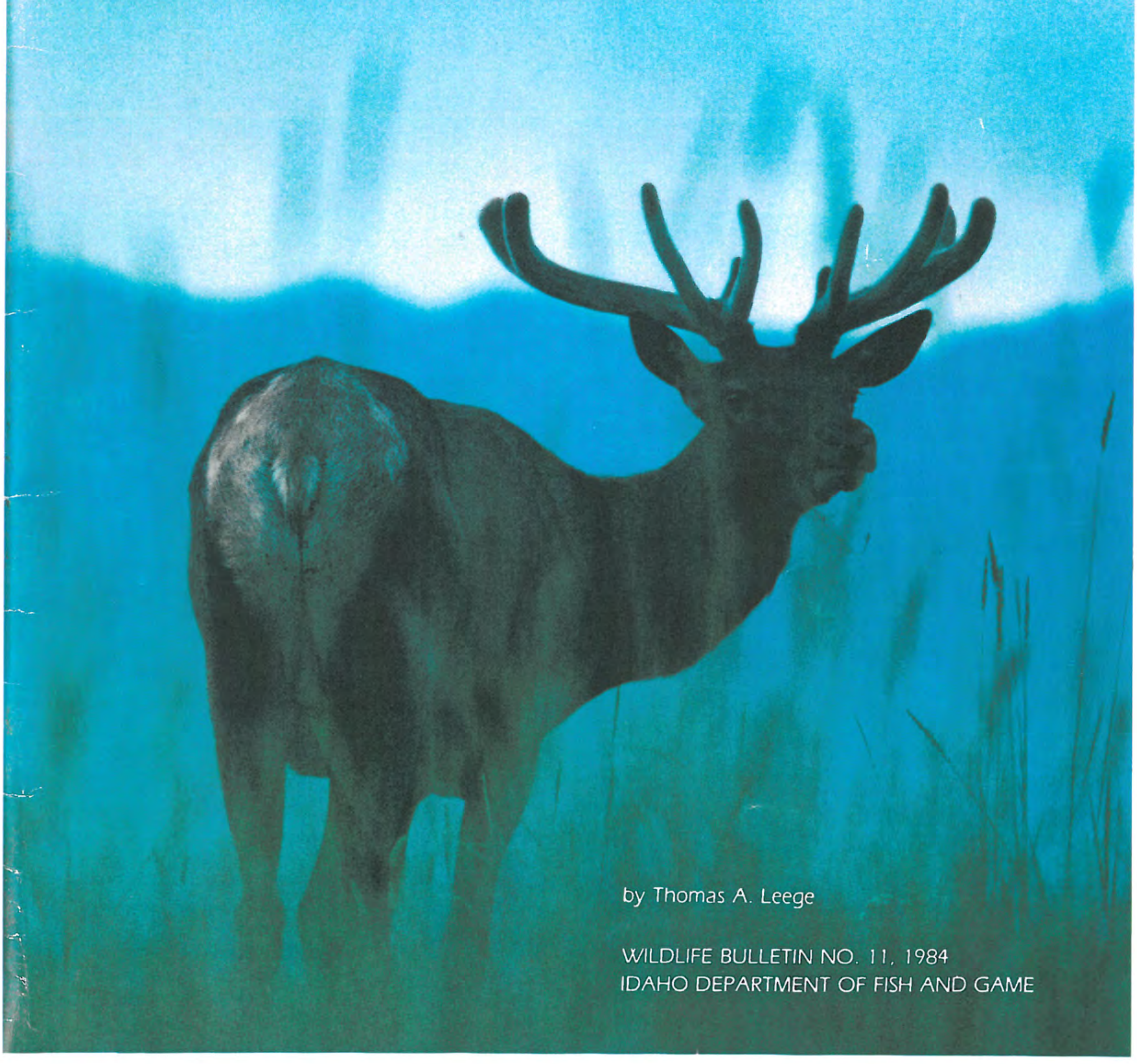
Guidelines for Evaluating and Managing Summer Elk Habitat in Northern Idaho



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Guidelines for

Evaluating and Managing Summer Elk Habitat

in Northern Idaho

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PlumCreek Timber Company, Inc.

A Cooperative Effort

Abstract

This document provides information on seasonal habitat preferences and food habits of elk during spring, summer and fall months in northern Idaho. Recommendations are made for coordinating logging, road building and livestock grazing with elk habitat preferences. An evaluation procedure is provided for estimating the effects of proposed land management activities on the quality of elk habitat. Computations take into consideration such things as quality, quantity and distribution of cover, forage, and security areas; and the density of open roads and livestock. Information for this document came from research literature and from numerous resource specialists in northern Idaho and adjacent areas.

Acknowledgments

This publication is the culmination of efforts initiated in 1977 by a self-appointed committee of Dean Carrier (U.S. Forest Service), Joe Lint (Bureau of Land Management), Larry Irwin (then at the University of Idaho), and Tom Leege (Idaho Department of Fish and Game). Even though only one committee member still resides in northern Idaho, all have made continuous contributions. Numerous other individuals have reviewed and commented on earlier drafts, and/or have attended meetings to discuss the same, and they are listed in Appendix D. Several who deserve special recognition for their extra efforts include: Lew Brown, Dan Davis, Dean Graham, Paul Harrington, Terry Hershey, Lorin Hicks, Ray Kiewit, Don Leckenby, L. Jack Lyon, Jack Nelson, Mike Schlegel and Dennis Talbert.

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The front cover photo of an adult bull Rocky Mountain elk on summer range was taken by Pete Bengeyfield. All other photos are by Tom Leege.

Preface

For the Blue Mountains of Oregon and Washington, Black, et al. (1976) developed a procedure for coordinating silvicultural activities with elk and deer habitat needs. This served as a stimulus for wildlife biologists representing the Idaho Department of Fish and Game, U.S. Forest Service, Bureau of Land Management and the University of Idaho to modify the "Blue Mountain" system for northern Idaho (USFS 1977). As new information on elk-livestock-logging relationships became available it was apparent that the system needed to be updated. A meeting was held for that purpose at Orofino, Idaho, on January 26-28, 1981. Representatives of all agencies present in 1976 as well as the Plum Creek Timber Company attended. From discussions at that meeting, a draft revision (Leege 1981) was prepared for review. A meeting was held on February 5, 1982, at Lewiston, Idaho, to discuss the draft and comments that it generated. In addition to previous representation, Potlatch Corporation also attended. In June 1982, a second draft (Leege 1982) was sent to all participants for comments. A final meeting occurred in Moscow, Idaho on December 21, 1982 to discuss the second draft with biologists from the Forest Service, Bureau of Land Management and Idaho Department of Fish and Game. Recommendations from that meeting were incorporated into a third draft (Leege 1983). This publication is similar to the third draft with only minor changes. Hopefully, it represents the latest research findings as well as a consensus of opinions from numerous resource specialists (see Appendix D). Revisions will occur as additional information becomes available.

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Introduction

The abundance of Rocky Mountain elk (*Cervus elephus nelsoni)* in northern Idaho resulted largely from vegetation changes brought on by extensive wildfires in 1910, 1919 and 1934 (Pengelly 1954, Leege 1968, Nyquist 1973). Because of an increase in forage, hunting restrictions, predator control and supplementing native herds with elk from Yellowstone Park, elk populations in the Clearwater and Spokane River drainages increased to high levels between 1935 and 1965. Increased access brought about by timber harvest activities, coupled with lenient hunting seasons and bag limits, increased hunter numbers, and natural plant succession on winter ranges are suggested as major factors causing the decline of elk populations since that time (Leege 1976, Schlegel 1976).

Elk are a product of their year-round environment, and it is difficult to say that any one season is more important than others for their well-being and survival. This document provides guidance for proper management of the spring-summer-fall (hereafter called "summer") habitat of elk, but in no way implies that this period of use is more important than the winter months. Hopefully, additional guidelines will soon be available for evaluating and managing winter habitat as well.

These guidelines are intended to provide forest resource managers in northern Idaho a means by which to assess and mitigate the effects of roads, logging activities, and livestock grazing on the summer habitat of Rocky Mountain elk. They can be used to (1) identify existing elk habitat quality, (2) evaluate the effects (improvement or degradation) a proposed activity would have on habitat quality, (3) specify which factor(s) are the primary agents affecting habitat quality, and (4) provide recommendations for minimizing negative effects on elk habitat. The evaluation section of this document is intended primarily for assessing impacts of individual projects such as logging sales or livestock grazing allotments. However, evaluations can also be made to monitor established management direction for a particular area. Local biologists should use their judgment and experience to supplement and temper these guidelines in specific management situations. Modifications of recommendations and computations should often occur (with justification) to more accurately reflect individual cases.

For proper use and understanding of these guidelines the following assumptions apply:

1. Displacement of elk from preferred habitats is often harmful to individual animals and general well-being of the herd.
2. There exists some natural and human caused imbalances between elk winter and summer ranges. Optimum populations for both habitats will seldom, if ever, be reached.
3. Elk populations with which we are dealing support an annual harvest. If regulations were such that elk were not hunted annually, potential elk use would be less affected by human activities than what is predicted by these guidelines.
4. The evaluation section is meant to estimate quality of elk habitat (potential elk use) rather than actual elk use. Actual use is also affected by factors other than habitat.

For quick reference, many of the terms used in this report are defined in the Glossary **(p. 36)**.

Rocky Mountain elk on summer range in northern Idaho.

Elk Habitat Preferences

Elk are tolerant of diverse environments as shown by their original widespread distribution over much of the North American continent and by their varied habitats today (Murie 1951, Thomas and Toweill 1982). However, elk do exhibit preferences for specific vegetation and terrain within areas they occupy. Protecting areas preferred by elk is considered to be an important aspect of preserving quality summer habitat.

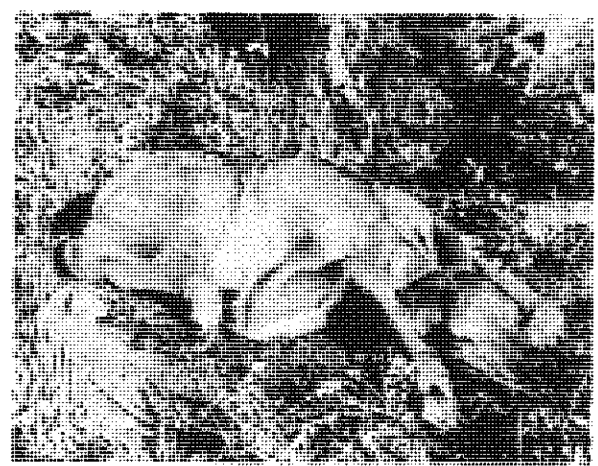
Elk often move from forage to cover areas and from one seasonal range to another along well established routes which often follow ridges and other areas of gentle terrain. Crossings from one drainage to another commonly occur in low saddles (Hershey and Leege 1982). Following are seasonal habitat preferences that elk have demonstrated. Detailed seasonal food habits appear in Appendix B.

SPRING PREFERENCES (APRIL-JUNE)

Throughout this period, elk prefer open areas where grasses and forbs develop earlier and provide nutritious forage (Irwin and Peek 1983). Use is confined to winter ranges during early spring but progresses upward in elevation as the season advances (Dalke et al. 1965a). Although south exposures are used more frequently during April, all exposures are important during June. Thermal relief is not a major concern for elk because air temperatures are moderate during this period.

As elk change their diet to green succulent material in spring, they develop an appetite for salt and utilize mineral licks when available. In northern Idaho most of these licks are sites of past or present salting activity (either for game or livestock) or where naturally salty water and/or soil is present. Dalke et al. (1965b) analyzed the water from natural salt licks in north-central Idaho and found that sodium seemed to be the element attracting elk. They found that elk made peak use of these licks during the second and third weeks of June. Murie (1951) stated ". . .that wild game species need salt is open to serious question. . .since animals are adapted to natural food sources." However, Botkin et al., (1973) suggested that the availability of sodium on Isle Royale in Lake Superior controls the moose population. So the question of how critically elk need supplemental salt remains unanswered; however, salt licks are heavily used when available.

Calving normally occurs between May 15 and June 15 with a peak in activity about June 1 (Moroz 1976, Schlegel 1976). Calving frequently occurs on secluded slopes of 15 percent or less on microsites within areas which may have up to 40 percent slopes (Davis 1970, Roberts 1974). Typical calving habitat commonly contains open foraging areas adjacent to dense woody vegetation that can serve as hiding cover. Most cows appear to have traditional areas they return to each year at calving time. Sometimes elk calve on or adjacent to winter ranges whereas other times they migrate to summer range before calving—depending on the rate of snowmelt and plant development (Hershey and Leege 1982).



Calving usually occurs between May 15 and June 15 and on areas traditionally used for that purpose.

SUMMER PREFERENCES
(JULY-SEPTEMBER)

The climate in northern Idaho is typically hot and dry during this period. Elk shift their diet away from grasses and sedges toward the forbs that are found along streams and shady places where they still remain succulent. In Montana, Smith (1978) and Daneke (1980) suggested that succulence replaces availability as a dominant factor in forage selection during warm weather. Irwin and Peek (1983) found elk feeding in north- and east-facing clearcuts where forbs and shrubs were most succulent. Elk also feed in timbered areas during this period where forage is more succulent and nutritious than in openings (Holecheck et al., 1981). In the Selway drainage, Young and Robinette (1939) found that "elk sought out dense thickets or patches of timber for shade during the day" from mid-July until September 1. In the South Fork of the Clearwater River drainage, Hershey and Leege (1982) reported that old-growth grand fir associated with poorly drained, cool, moist land types were important habitat components during late summer. Elk also selected for relatively level areas with less than 20 percent slope. Similar habitat preferences for a conifer overstory and gentle topography have also been reported for western Montana for the hot summer months (Scott 1978, Lehmkuhl 1981). Edgerton and McConnell (1976) and Pedersen et al. (1980) indicated that old growth conifer stands were highly preferred by elk during hot periods on summer range in northeastern Oregon. Lyon (1979b) indicated a similar concern by his statement that ". . .finally, the behavior response to hot dry summer weather in two different years can be taken as further evidence of the importance of cool moist habitat types to the overall integrity of elk summer ranges. Maintenance of body temperatures at some relatively constant level may be comparable to feeding as a daily preoccupation for elk." In addition to thermal relief and nutritious forage, forested areas also provide some protection from biting insects (Collins and Urness 1982).

An important component of late summer habitat is wallows used primarily by bull elk during the rutting season. These are shallow pools located in moist areas, often near the headwaters of small streams. Murie (1951) indicated they function to soothe the rutting bull by cooling the body and by serving as an outlet for pent up energy. Struhsaker (1967) speculated that ". . .the function of wallowing facilitates the location of bulls by one another."

Elk wallows are heavily used by bulls during the rutting season.

FALL PREFERENCES
(OCTOBER-DECEMBER)

In north-central Idaho elk used dense forests through the month of October and then gradually made greater use of openings for the remainder of the fall (Hershey and Leege 1982). However, further north in Idaho, Irwin and Peek (1983) reported that elk preferred dense pole timber for the entire fall period. In Montana, Lieb (1981) found that elk shifted to remote sites characterized by large expanses of escape cover during the fall hunting season. The use of heavy cover during October has been documented by others and may be associated with the need for security during hunting season and the breeding period (Altman 1952, Irwin and Peek 1979a). A shift to openings during late fall may be in response to the green-up that sometimes occurs following fall precipitation.

Recommendations for Coordinating Land Management Activities with Elk Habitat Preferences

The major activity affecting summer elk habitat in northern Idaho is timber harvesting and road construction associated with it. Annually, about 27,000 acres of trees are harvested and 185 miles of new roads constructed on just northern Idaho's National Forests that total 6,564,259 acres. With proper planning, timber harvest can often be conducted with minimal detrimental impacts on elk habitat—sometimes even positive effects result. However, access associated with timber harvest often has negative impacts that are impossible to completely mitigate. This section provides recommendations with background rationale for making timber and elk habitat management as compatible as possible. Recommendations made without supporting documentation or at variance with documentation are the concensus of resource specialists in northern Idaho.

TIMBER HARVEST

Logging has the potential for altering the amount and distribution of cover and forage areas and changing elk movements, distribution, and habitat utilization. In addition to vegetation changes caused by timber removal it is necessary to consider the effects of logging slash, and the timing, pattern and duration of logging activity.

Silviculture Methods - Natural forest stands commonly have micro openings in the canopy that allow sunlight needed for growth of elk forage. In these situations, creation of additional openings through logging may not provide forage benefits needed by elk (Marcum 1976, 1979; Hershey and Leege 1982). However, beneficial forage can result when logging in elk home ranges that have a dense canopy and a limited understory of shrubs, grasses and forbs.

Sometimes elk make heavy use of clearcuts on summer ranges (Irwin 1978, Nelson et al. 1981, Hershey and Leege 1982). Irwin (1976) and Irwin and Peek (1979b) reported that clearcut sites produced the most palatable elk forage and partial cuts the least in the cedar/hemlock zone. Edgerton and McConnell (1976) found that partial cut stands provided neither optimal forage nor cover during the summer period in northeastern Oregon. Partial cuts also have the disadvantage of requiring more timber harvest entries and thus cause more disturbance to elk in the area.

Lyon (1976) reported heavier elk use in 10-40 acre openings as compared to larger ones. Irwin and Peek (1983) indicated that 35-50 acre clearcuts were used most. Reynolds (1962, 1966) found in Arizona that forage sites created by harvesting timber had decreased elk use at distances beyond 600 ft. from the edge of cover. Hershey and Leege (1982) reported that aerially observed elk in northern Idaho were usually within 300 ft. of cover when using clearcuts during daylight hours.

Slash Disposal - The accumulation and treatment of logging debris or slash is inherent with any timber harvest action. This by-product of timber harvest has the potential to affect elk behavior and movement in both the cut area and adjoining uncut area. Lyon (1976) stated that elk use in and adjacent to cutting units diminished when slash and other down material exceeded 1.5 ft. in depth. The method of slash disposal has a great effect on elk forage production after treatment. On many habitat types in northern Idaho broadcast fall burning favors the establishment of forage plants preferred by elk (Cholewa 1977, Wittinger et al. 1977).

Timing, Scheduling, and Duration of Timber Harvest - The activities associated with road construction and logging can disrupt elk migrations and displace elk for a distance of 0.5 to 4 miles away from the activity area (Leege 1976, Lyon 1975, 1979b; Long et al. 1981; Hershey and Leege 1982). Displaced animals often remain within undisturbed portions of their traditional home ranges (Lieb

1981, Hershey and Leege 1982). Distance of movement is reduced if elk can put a topographical barrier between themselves and the disturbance (Lyon 1979b). Lyon further stated that topography appeared to be more effective than undisturbed forest vegetation for reducing the effect of disturbance.

The duration of disturbance in a logged area appears to affect the time it takes for elk to reoccupy the area after disturbance ceases. In several logging sales where activity was no longer than one operating season, elk returned soon after removal of people and machinery (Lyon 1979b, Hershey and Leege 1982). However, in a logging sale which had five consecutive years of disturbance, it took four additional years after complete road closures to get the same amount of elk use as what existed prior to logging (Lyon 1979b). Results from these studies should not be interpreted to mean that all elk leave an area when disturbed as some individuals often remain in close proximity to logging operations.

Recommendations:

1. Any silvicultural method that changes the vegetation so that it no longer meets the definition of cover (see Glossary) should be confined to an area with a maximum width of 1,000 ft. and should be bordered on all sides by cover of not less than 800 ft. width.
2. Clearcutting is usually preferred over other types of timber harvest techniques because it provides better forage and reduces the amount of future harvest activity in the area.
3. Maintain slash depth at less than 1.5 ft. in order to minimize impact on elk movements, distribution and habitat use.
4. In appropriate habitat types, broadcast burn logging slash in the fall to get maximum elk forage production.
5. Plan timber sales so maximum duration of disturbance in any one area is two years in succession. This can be accomplished with smaller sales, or scheduling larger sales by compartment in a certain sequence through contract stipulations. This would eliminate random logging over the entire sale area.
6. Refrain from logging areas when elk would normally be using them, if feasible. For example, do not log important summer habitat during that season, especially if a viable option is to log during the winter.
7. If summer logging is planned on elk summer range, provide adjacent security areas at least as large as the area being disturbed for the animals to move to during periods of timber harvest and/or road building activity. Try to provide a ridge line between the disturbed area and security area. It is preferable to have several adjacent security areas available.

ROADS

Roads constructed through elk habitat and left open for public use with motorized vehicles have a significant influence on animals using that area. Such adverse effects include displacing elk from preferred habitats because of increased disturbance, and the over-harvest of elk in localized areas adjacent to roads.

Habitat Use and Roads - A subject well researched in recent years is the effect of open roads on elk use adjacent to them. Focusing on just the research done in northern Idaho and adjacent states, it is evident that open roads substantially reduce elk use in adjacent habitat (Hershey and Leege 1976, Marcum 1976, Perry and Overly 1976, Pedersen 1979, Lyon and Jensen 1980, and Lyon 1979a, 1982). Roads themselves are not at fault since closed roads are often preferred by elk as travelways (Marcum 1976). Amount of vehicle traffic is a factor determining how much elk use will occur adjacent to roads. Heavily used forest roads have a much greater effect on elk use of adjacent habitat than do primitive roads (Marcum 1976, Perry and Overly 1976, Long et al. 1981). There is some indication that elk respond less to constant non-stopping vehicular traffic than to slow vehicles which periodically stop and have human activity associated with them (Burbridge and Neff 1976, Ward 1976). In addition to disturbance caused by traffic, roads remove about 5 acres of productive habitat per mile if the surface is such that vegetation is prohibited from growing (Langdon, personal communication).

Elk Harvest and Roads - Despite the fact that elk densities adjacent to open roads are reduced, the harvest rate on elk remaining is much higher because of high hunter densities (Hershey and Leege 1976, Daneke 1980). Daneke reported that almost twice as many elk were killed within a quarter mile of open roads as any subsequent quarter mile interval. However, elk densities and hunter success were lowest in the quarter mile adjacent to open roads. Thiessen (1976) indicated that a substantial reduction of elk between 1960 and 1974 in Unit 39 in southern Idaho was probably caused by over-harvest of female elk made possible by a combination of increased forest access and long, either sex hunting seasons. Leege (1976) and Schlegel (1976) suggested that the decline of elk in north-central Idaho was partially due to increased access to elk summer range by numerous logging roads which made elk more vulnerable to hunters. Road closures have proven beneficial for allowing elk to remain on normal ranges longer during the hunting seasons before being displaced by hunters (Basile and Lonner 1979, Irwin and Peek 1979a). The need for cover on elk ranges is particularly important during the hunting season to provide security. However, even large areas of dense cover do not provide adequate security if the area is laced with an open road network (Allen 1977). The amount of cover and degree of open roads are two major factors determining elk vulnerability to harvest within an area. These two factors working together or separately often make necessary more restrictive regulations and reduced hunting opportunity in order to protect the elk resource from over-harvest (Schlegel 1981, Lonner and Cada 1982).

Steep cutbanks and fills along roads should be modified where they bisect major elk trails.

Recommendations:

8. When major elk trails are bisected by roads, crossings should be provided across cut and fill slopes so they do not exceed natural gradients. This is especially necessary when cut slopes are over 8 ft. high and/or have a greater than ¾ to 1 slope.
9. Vegetation removal along road sides should not extend any further from road edge than necessary for logging activities.
10. Slash depths adjacent to roads in cleared rights-of-way should not exceed 1½ ft. in depth. In areas where this level of slash disposal is impractical, openings 16 ft. wide thru the slash at 200 ft. intervals are recommended, especially on ridges and trail crossings.
11. Maintain a minimum 300 ft. buffer strip (see Glossary) between open forest roads and openings which serve as feeding areas.
12. Roads that are to remain open should avoid saddles, meadows, riparian areas, and ridge tops as these are usually major elk use areas.
13. Design roads so they can be easily and effectively closed (either permanently or temporarily) at a low cost.
14. Install gates at onset of road building activity when the objective is to prevent human use patterns from becoming established. These gates should be closed and locked during any period of logging inactivity exceeding 24 hours.
15. Inform the public by all types of news media, including signs on gates, about the reasons for and dates of road closures.
16. Replace gates with permanent barriers after logging activity where maximum elk security and habitat use is desired.
17. Revegetate the driving surface as well as cut and fill slopes on permanently closed roads.
18. Maintain buffer strips (that will qualify as hiding cover if possible) along roads left open during the normal elk use period. These buffers should be at least two sight distances wide when separating the road from an opening.

LIVESTOCK GRAZING

In some areas livestock are permitted to graze on summer elk habitats in northern Idaho. Numerous studies indicate that livestock sometimes compete with elk for forage and that a social interaction occurs (Nelson 1982). Nelson and Burnell (1976) found that elk moved to new areas when cattle were placed on the range. Lieb (1981) reported that both cattle and horses displaced elk when introduced onto their ranges. However, sometimes elk returned after a few days and continued to use the area despite the presence of livestock. In northcentral Idaho, Dalke et al. (1965a) found a "definite dispersion" of elk when cattle were moved onto the Coolwater Ridge Study Area in late June. Elk moved away from open areas preferred by cattle and into tall dense shrubs. In Oregon, Skovlin et al. (1968) indicated that elk use declined with onset of cattle grazing. In Wyoming, Long, et al. (1981) reported that once cattle entered an area, elk use declined. In Montana, Lonner (1977) and Mackie (1970) noted that the movement of cattle into areas being used by elk caused displacement of elk into areas where cattle had not been. Several of the studies indicated that as density of cattle or livestock increased, the effect on the elk also increased.

Lieb (1981) reported that forage competition between livestock and elk appeared to occur in moist riparian areas in late summer. This could be an important conflict because riparian habitat is highly preferred by elk during summer months (Pedersen et al. 1980).

Recommendations:

19. Direct livestock use away from preferred elk habitat since social conflicts between livestock and elk appear to alter normal elk distribution patterns.

20. Examine potential forage conflicts on ranges commonly used by elk and livestock to determine if big game carrying capacity is being reduced.

PROTECTING SPECIAL HABITAT COMPONENTS

There are portions of summer habitat that receive concentrated elk use. These include salt licks, wallows, established travel routes and calving areas. It is important to protect these areas in order to preserve the value of the entire habitat.

Recommendations:

21. Consult a wildlife biologist about the occurrence and/or importance of special habitat components on a case by case basis.

22. Maintain the value of licks and wallows by buffering from disturbance for at least two site distances.

23. Do not permit activities such as timber harvest, livestock grazing, or road building on established calving and rearing areas during the period May 1 through July 15.

24. Protect known major elk travel routes with buffer strips on either side for at least two sight distances.

Elk often move to new areas when cattle are placed on their range.

Evaluating Effects of Land Management Activities on Elk Habitat Quality

In this section various factors affecting elk habitat quality are evaluated and assigned a numerical rating. Background information is given about the rationale for values assigned. The end product of this exercise is a prediction of the change in summer elk habitat quality (expressed as percent of potential) which would result from a proposed project.

When all habitat factors are in optimum abundance and distribution, habitat will be rated at 100 percent of potential elk use. The percentage value for potential elk use refers only to habitat quality and not to actual elk use. For example, a potential elk use value of 43 percent indicates that an area can support 43 percent as many elk as it could if all habitat factors were optimal. Percentages can be converted to elk numbers by assuming that specific potential elk densities can occur on certain areas. For example, a biologist may have data which indicate that maximum potential elk density is 1 elk per 40 acres. If the evaluation procedure calculates the habitat to be at 43 percent of potential elk use, then the area has the capability to support 0.43 elk per 40 acres.

AREA TO BE EVALUATED

Several options are available when selecting the area for evaluating the impact of human activities on potential elk use. It appears logical to have the area approximately equal the average size of an elk home range. Studies in northern Idaho indicate that summer home ranges of individual elk vary in size from 600 to 9,000 acres, with 3,800 acres being about average (Irwin 1978, Nelson et al. 1981, Hershey and Leege 1982). It is recommended that 3,800 acres be used as the minimum size for evaluation areas.

If there are no logical boundaries for the evaluation area such as drainage, timber compartment/subcompartment, or cattle allotment, then it is appropriate to circumscribe a 3,800-acre circle around the approximate center of the proposed activity (Figure 1). The radius of such a circle is 1.37 miles. The 3,800 acres is not a sacred value and can be increased if there are logical boundaries for the evaluation area. However, for project level evaluations, care should be taken not to make the evaluation area too large (greater than 5,000 acres) or the effects of a proposed activity may be significantly diluted. However, when project boundaries are greater than 5,000 acres, actual project boundaries may be used as the evaluation area. After an evaluation area is chosen, portions of the area that are winter range should be omitted from all calculations since these guidelines only apply to other seasonal ranges. However, include winter range if field surveys indicate that summer use has also occurred.

ROAD EFFECTS

The most important factor usually regulating actual use of habitat by elk is disturbance caused by people. Most disturbances originate from roads, both from construction and subsequent use. Degree of disturbance is related to amount of traffic, season of traffic, type of traffic, and amount of buffer available to separate the disturbance from elk.

Lyon (1982, 1983) used several different road density models to estimate elk use in northern Idaho and found that a curve developed with data from Burdette Creek-Deer Creek in Montana proved most effective (Figure 2). This curve represents a main road with some vegetation adjacent to it and is used as the standard road to which other types are compared (Table 2). To clarify Table 2, the value of .50 next to open secondary road through hiding cover indicates that 1 mile of that type of road would be the equivalent of .50 mile of standard road. When doing the computations, all road types need to be converted to standard roads so that Figure 2 can be used. To arrive at equivalent values for other types of roads, information was used from Perry and Overly (1976) and Lyon (1979a); collective judgement was used for situations where no data were available.

Different types of road closures have varying degrees of effect on lessening impacts on elk (Table 2). For making computations, we assumed that gates were 70 percent effective in reducing motorized disturbance if they allowed for a minimal level of administrative activity and some trespass. If major activity, such as road construction or logging, occurs behind the gate, then the gate has 0 percent effect in reducing disturbance. If roads are gated to all motorized use during hunting season, assume they reduce disturbance for 1 month of a 6 month summer use period, and are 1/6 of 70 percent or 12 percent effective. A two month closure would be 24 percent effective. If roads are closed completely with barriers such as tank traps, immovable boulders, or bridge removals, disturbance is reduced by 90 percent. Even after complete road closures, elk may not resume their normal use of an area for several years—the exact time influenced by the number of years the habitat was disturbed. In fact, elk use may never return to the level that existed prior to road construction since even closed roads provide improved access for hikers, trail bikes, and livestock.

Road closures during hunting season may have significant value for improving hunting success, hunting opportunity, and the quality of the hunting experience. Those values are in addition to the habitat improvement values reflected by the computations.

LIVESTOCK EFFECTS

Painter (1980) summarized eleven studies which showed the relationship between cattle density and elk use. The curve showing that relationship (Figure 3) was derived from an equation presented by Painter. All eleven studies were not done in comparable ways. However, in all cases cattle density was known and percent elk use, before and after cattle entry, was obtained. It has also been demonstrated that elk distribution is influenced by domestic sheep (Nelson 1982) and horses (Schlegel, unpublished data), but cause and effect curves have not yet been developed. However, rather than ignore this impact for lack of data, assume for computation purposes that horses and sheep numbers can be converted to cattle equivalents and the effect estimated from Figure 3. Use the standard conversion procedure which is based on forage consumption; one cattle equivalent equals: 1 cow with calf, 0.8 horse, or 5 sheep.

EFFECTS OF OTHER FACTORS

In this section, there is opportunity to evaluate the size and interspersion of hiding cover, thermal cover, forage and security areas within the evaluation area. When these factors are found to be at less than optimal levels, additional reductions in potential elk use can be assessed in relation to general descriptions in Table 3.

COVER

Cover:forage ratios have been widely used as an index of elk habitat quality since they were proposed by Black et al. (1976) for the Blue Mountains. In earlier drafts of the northern Idaho elk-logging guidelines they were an important factor in estimating potential elk use. As these guidelines were used in the field, biologists became uncomfortable with what they perceived as unrealistic predictions about potential elk use because of cover:forage changes. These doubts were recently confirmed by Lyon (in press) when he tested guideline predictions of elk use in Montana and northern Idaho. He found that the cover:forage function failed to improve predictions made by the road model alone. Lyon concluded that habitat relationships for the summer period are far more complex than can be defined by a cover:forage ratio, especially since those habitat needs change drastically during that period. Because of Lyon's findings, the cover:forage ratio per se is not included in these guidelines as a factor influencing potential elk use. However, we recognize cover and forage as important habitat components and use them in other ways to help predict elk use (Table 3).

Cover can be further divided into hiding cover and thermal cover. Hiding cover is defined as vegetation capable of hiding 90 percent of a standing elk from view of a human at 200 ft. or less during that period when elk normally use the area. Thermal cover is a stand of conifers at least 40 ft. tall with an average canopy closure exceeding 70 percent. Both definitions are from Thomas (1979). The amount of both types of cover is often not determined from field surveys because of the time and expense required. O'Neil (1981) evaluated various methods for determining cover using aerial photos, maps and ground surveys and recommended that photo interpretation (P.I.) maps be used for cover determination. P.I. maps are based on differences in visual appearance of vegetation on aerial photographs and the classification system is standard for national forest lands in northern Idaho. The various vegetative types designated by P.I. numbers are listed in Appendix C, and descriptions can be used on other landownerships to designate P.I. type. A plastic guide for estimating degree of stocking for P.I. determinations is available from the U.S. Forest Service (see Appendix C) as are training handbooks (Moessner 1960).

P.I. maps only break vegetation into categories and field sampling is necessary to determine what percent of each category constitutes cover by definition. Lyon (in press) surveyed small study areas in all three of the northern Idaho national forests in the summer of 1981 and estimated percentage of hiding and thermal cover by P.I. type. Data in Table 1 are averages for the three forests and should be used as a guide only until site specific information is available for each area in question.

FORAGE

Elk forage is present in openings and under forest canopies, and quantity is usually not a limiting factor on summer range. However, there are situations where home ranges have limited diversity and/or dense overstory canopies which seriously limit understory vegetation. In these cases, carrying capacity may be increased through vegetation manipulation. When home ranges have openings that are greater than 1,000 ft. wide, elk will refrain from using some areas in the center too far from cover. Openings refer to meadows and other areas of vegetation that do not provide hiding or thermal cover. Areas more than 500 ft. from cover only receive about 25 percent of normal use unless there are no open roads in or adjacent to the opening.

SECURITY AREAS

These are areas elk retreat to for safety when disturbance on their usual range is intensified—such as would occur with road construction, or hunting. The value of a security area depends upon the distance from an open road and the amount of cover thereon. In order to qualify as a security area, there must be at least 250 contiguous acres that are more than ½ mile from open roads. Always consider roads adjacent to the evaluation area as well as those within when determining size of security areas.

It may appear that deductions for security area deficiencies are double counting as we have already assessed the detrimental effects of roads on potential elk use. However, the effects of intensified disturbance were not considered in the road effects calculations.

EXAMPLE OF TIMBER SALE COMPUTATIONS

Information Needed - The proposed sale area boundary and selected evaluation area should be outlined on an aerial photo or map, preferably one that has contours and a scale larger than 2 in. per mile. The vegetation and roads should reflect the existing condition and all developments that will be in place before the sale being evaluated occurs. This refers primarily to timber sales that have already been sold but not yet cut, or roads not yet constructed.

For the proposed sale, information is needed on location of cutting units and roads, and season and type of road closures planned. Much of the information can be gathered from current aerial photos and records; however, a biologist should look over the proposal on the ground to identify special habitat components, location of security areas, distribution of hiding and thermal cover areas, and to examine the forage base to decide whether additional foraging areas created by logging will be beneficial.

Actual computations - For our example, please refer to the schematic sale layout (Figure 1). Here is a proposed regeneration harvest cut of 297 acres which are surrounded by areas clearcut logged several years prior. The approximate center of the proposed cutting units was located and a circle encompassing 3,800 acres drawn about the center. All of the roads shown in solid lines are existing secondary open roads (see Table 2 for definitions of road types and closures), while dashed lines represent proposed roads for the new sale. All proposed roads may or may not be closed off with physical barriers after the sale so the computations will examine both possibilities.

To facilitate making the calculations, blank computation forms are provided in Appendix A. These forms can be photocopied and used for future calculations. The order of the calculations on each form is indicated by letters which follow in alphabetical sequence. The evaluation area and alternatives being evaluated (pre-sale, post-sale with roads closed, post-sale with roads open, etc.) should be indicated in the appropriate places on Forms 1 and 2. The calculations are first made for existing pre-sale conditions (including sales already approved but not cut) and then the same computations are made for post-sale conditions. Space is available on Form 2 to evaluate the pre-sale and three post-sale alternatives; however, Form 1 must be completed for each alternative. All calculations made for the following example are recorded on the computation sheets on pages 15-18.

1. **Total size of evaluation area** (pp. 15-17)

   There are no acres of non-use within the evaluation area so 3,800 is entered for (A). This is converted to square miles by dividing by 640 to equal 5.94 (B).

2. **Potential elk use as affected by roads**

   PRE-SALE (p. 15): Miles of road for each road type, road status and vegetation type (as defined in the footnotes for Table 2) are then determined and entered in one of two columns (C), depending upon whether adjacent vegetation is hiding cover or open. These mileage values are then multiplied by the figure in Column (D) which is the coefficient for changing all types of roads to a standard road mileage (E). Both (E) columns are then added to get (F) values which are added to arrive at 3.18 for (G). This total standard road mileage is converted to miles of standard road per square mile by dividing by (B) to get .54 for (H). This value used with Figure 2 estimates 74 percent of potential elk use as related to roads (I).

   POST-SALE, ROADS OPEN (p. 16): The proposed sale adds 1.8 miles of secondary road thru cover, 1.3 miles of primitive road through open areas, and 1.2 miles of primitive road through cover. These values are added to pre-sale road mileages and entered in column (C). The remainder of the calculations are made with the result being 68 percent of potential elk use (I) instead of the pre-sale value of 74 percent, a reduction of 6 percent caused by leaving new roads open.

   POST-SALE, ROADS CLOSED WITH BARRIERS (p. 17): For this alternative, new proposed road mileages would be put on the lines in column (C) but across from the "closed with barrier" status instead of "open" status. After computations are made for this example, the evaluation area is usable at 73 percent (I) compared to 74 percent pre-sale and 68 percent when none of the new roads are closed.

3. **Potential elk use as related to livestock density**

   PRE-SALE (p. 18): The best information available indicates that 70 head of cows with calves occupy about 3.5 square miles within the evaluation area for 75 percent of the period that elk would normally use that area. These values are entered for (K), (J), and (N). Cattle equivalents per square mile (L) is computed by dividing (K) by (J). Then use (L) with Figure 3 to get (M) which is an estimate of potential elk use for the period when elk and cattle both use the area. For the period that cattle do not use the area, 25 percent in this case, cattle would have no effect so potential elk use would be 100 percent.

The weighted average (P) then is derived by multiplying potential elk use for each period by its percentage of the total period—and then adding these together for a final value. The formula for (P) shows a divisor of 100 which is necessary to move the decimal to the right place. (P) is then converted using the given formula to 81 percent (Q) for the entire evaluation area.

POST-SALE (p. 18): Both post-sale alternatives keep the same stocking level for cattle so the pre-sale computations would remain the same post-sale.

4. Potential elk use as related to other factors (refer to Table 3)

PRE-SALE (p. 18): In our example, P.I. maps in conjunction with Table 1 indicate that about 55 percent of the evaluation area qualifies as hiding cover and 17 percent as thermal cover. Cover is well distributed among the quadrants so no deductions for inadequate cover are made.

Field surveys indicate that forage is adequate and properly distributed in all quadrants. However, openings created by past logging are very large and cause about 500 acres, or 13 percent of the evaluation area to be more than 500 ft. from cover. Since these openings all have open roads through them, areas more than 500 ft. from cover are only considered 25 percent usable. Therefore, 375 acres, or 10 percent of the evaluation area is considered unusable and 10 percent is deducted from potential elk use.

At least 20 percent of the evaluation area qualifies as security area and has more than 60 percent cover, so no points are deducted in this category.

Rarely will habitat factors fit into one of the categories exactly as listed in Table 3. However, the percent reduction values listed can be used as a guide to assist in assigning an appropriate value.

These "other factors" add up to 10 percent that is reduced from potential elk use (R), leaving 90 percent of potential use (S).

POST-SALE, ROADS LEFT OPEN (p.18): In this proposed alternative, not enough timber would be cut to cause hiding or thermal cover inadequacies. The new openings would not be too large for elk use and no additional points would be deducted for having areas too far from cover. The security area is adversely impacted by additional roads. The amount of security area is now reduced to about 10 percent of the evaluation area so 10 percent potential elk use is subtracted (according to Table 3).

POST-SALE, ROADS CLOSED WITH BARRIERS (p. 18): The difference between this alternative and the previous one is that the security area would be affected by road closures. Since even roads closed with barriers provide access that was nonexistent prior to road construction, the same quantity of security cannot be attained by merely closing roads. Barriered roads still provide very good access for people hiking as well as those using motor bikes and other cross country vehicles. Although somewhat arbitary, a reduction of 5 percent for security areas is given because of diminished cover and additional access.

5. Existing and long-term potential elk use (p. 18)

In this section, all impacts on potential elk use are summarized and the remaining potential elk use computed for all alternatives. In the example, all pre-sale factors reduced potential elk use to 54 percent (T). Under the "Roads-open" alternative potential elk use was reduced to 44 percent, primarily because of increased roading and decreased security area. The "Road-closed-with-barriers" alternative showed only a 4 percent decrease from pre-sale since road impacts were minimized.

It is important to recognize that for the years during the sale and for about three years after roads are closed, potential elk use will not be at the high levels predicted by (T) for the "Roads closed" alternative. Based on assumptions that road construction, timber harvest and post-sale management activities will take about seven years, and elk return response to take an additional three years, it will be about ten years after initial development before potential elk use returns to the level indicated by (T). To show a more accurate picture of long-term effects, it is necessary to make estimates about future management of roads.

It is recommended that number of years for long-term evaluation (U) be equal to years of development plus years of commitment to road closures. This should normally not exceed 20 years since it is difficult to predict management further into the future with any accuracy.

In this example, assume that it is planned to keep the evaluation area closed to motorized vehicles for 13 years after barriers are installed on the "Roads closed" alternative. It is estimated that all roads will be open for motorized traffic during 7 years of development (I = 68). For the first 3 years after barriers are installed, assume that effect on potential elk use would equal the average of roads open and roads closed: (68 + 73) ÷ 2 = 70.5. To estimate long-term potential elk use as related to roads, calculations would be as follows: (7 x 68) + (3 x 70.5) + (10 x 73) = 1,417.5. This answer is divided by 20 (number of years for which a road plan is made) to arrive at a weighted average of 71. This value substituted for 73 (I) in the equation for (T) would equal 49 percent long-term potential elk use (U) for the "Roads closed" alternative.

For the "Roads open" alternative, there is a commitment to leave the roads open for the 20 year period, and therefore (U) is equal to (T). If it was assumed that roads would be closed for only 5 years under the "Roads closed" alternative, then the evaluation period would be 12 years. The calculation would be: (7 x 68) + (3 x 70.5) + (2 x 73) = 833.5. This divided by 12 equals 69 percent for road effects (I). Similar changes would be made for "other factor" calculations because of road effects on security areas.

Another option for the "Roads closed" alternative would be to gate the new roads when constructed and restrict all except administrative and logging traffic. During the 7 year development period, assume that logging and road building activities have the effect of "Roads open" for the first 4 years; for the remaining 3 years there is only minimal administrative use on the roads. For the next 5 years, access is controlled by earthen barriers. Therefore, in the computations, the first 4 years would be treated as "Roads open," the next 3 as an average of "Roads open" and "Roads closed with gates" and the last 5 as "Roads closed with barriers." Calculations would be (4 x 68) + (3 x 70) + (5 x 73) = 847. When this is divided by 12 years the answer (I) is 71 percent of potential.

There are numerous other options for road closures and the reader will need to use his/her own discretion in applying these computations if the particular situation is not covered herein.

A meaningful way to evaluate an alternative is to examine the percent change (V) in potential elk use from pre-sale condition. In our example, the "Roads open" alternative reduced potential elk use from 54 to 44 percent. This is a 10 percent change from maximum potential of 100 percent. However, it represents a 19 percent (V) change from the existing situation.

FORM 1

Calculated by: ______________________ AREA: ELK CR

Date: ______________________ ALTERNATIVE: PRE - SALE

ESTIMATING QUALITY OF ELK SUMMER HABITAT IN NORTHERN IDAHO

1. Total size of evaluation area in usable acres* 3800 **(A); and square miles (A ÷ 640)** 5.94 **(B)**

2. Potential elk use as affected by roads.**

		Hiding Cover			Open		
		Miles (C)	**Coeff. (D)**	**Std. Miles (C x D) (E)**	**Miles (C)**	**Coeff. (D)**	**Std. Miles (C x D) (E)**
Road Type	**Road Status**						
Main	Open		.80			1.20	
	Closed—hunting season		.71			1.06	
	Closed (w/gates)		.24			.36	
	Closed (w/barrier)		.08			.12	
	Closed completely		.00			.00	
Secondary	Open	2.75	.50	1.38	2.0	.90	1.80
	Closed—hunting season		.44			.80	
	Closed (w/gates)		.15			.27	
	Closed (w/barrier)		.05			.09	
	Closed completely		.00			.00	
Primitive	Open		.03			.07	
	Closed—hunting season		.03			.06	
	Closed (w/gates)		.01			.02	
	Closed (w/barrier)		.01			.01	
	Closed completely		.00			.00	
	Subtotal Std. Miles			1.38 (F)			1.80 (F)
	Total Std. Miles (**F** + **F**)			3.18 (G)			

Miles of standard road per square mile (**G** ÷ **B**) .54 **(H)**

Percent of potential elk use after road effects [use (**H**) and **Fig. 2**] 74 % **(I)**

*All acres usable *except* talus, water surface, and other areas elk would not use because of *natural* features—may also include winter range.

**Refer to Table 2 for coefficient information and definitions of road and vegetation types.

FORM 1

Calculated by: ______________________ AREA: ELK CR

Date: ______________________ ALTERNATIVE: POST-SALE ROADS OPEN

ESTIMATING QUALITY OF ELK SUMMER HABITAT IN NORTHERN IDAHO

1. Total size of evaluation area in usable acres* 3800 **(A); and square miles (A ÷ 640)** 5.94 **(B)**

2. Potential elk use as affected by roads.**

		Hiding Cover			Open		
Road Type	**Road Status**	**Miles (C)**	**Coeff. (D)**	**Std. Miles (C x D) (E)**	**Miles (C)**	**Coeff. (D)**	**Std. Miles (C x D) (E)**
Main	Open		.80			1.20	
	Closed—hunting season		.71			1.06	
	Closed (w/gates)		.24			.36	
	Closed (w/barrier)		.08			.12	
	Closed completely		.00			.00	
Secondary	Open	4.55	.50	2.28	2.0	.90	1.80
	Closed—hunting season		.44			.80	
	Closed (w/gates)		.15			.27	
	Closed (w/barrier)		.05			.09	
	Closed completely		.00			.00	
Primitive	Open	1.2	.03	.04	1.3	.07	.09
	Closed—hunting season		.03			.06	
	Closed (w/gates)		.01			.02	
	Closed (w/barrier)		.01			.01	
	Closed completely		.00			.00	
	Subtotal Std. Miles			2.32 (F)			1.89 (F)
	Total Std. Miles (F + F)			4.21 (G)			

Miles of standard road per square mile (G ÷ B) .71 (H)

Percent of potential elk use after road effects [use (H) and Fig. 2] 68 % (I)

*All acres usable *except* talus, water surface, and other areas elk would not use because of *natural* features—may also include winter range.
**Refer to Table 2 for coefficient information and definitions of road and vegetation types.

Calculated by: ______________________ AREA: ELK CR

Date: ______________________ ALTERNATIVE: POST-SALE ROADS CLOSED - BARRIERS

ESTIMATING QUALITY OF ELK SUMMER HABITAT IN NORTHERN IDAHO

1. Total size of evaluation area in usable acres* 3800 (A); and square miles (A ÷ 640) 5.94 (B)

2. Potential elk use as affected by roads.**

		Vegetation Adjacent to Roads					
		Hiding Cover			Open		
		Miles (C)	Coeff. (D)	Std. Miles (C x D) (E)	Miles (C)	Coeff. (D)	Std. Miles (C x D) (E)
Road Type	**Road Status**						
Main	Open		.80			1.20	
	Closed—hunting season		.71			1.06	
	Closed (w/gates)		.24			.36	
	Closed (w/barrier)		.08			.12	
	Closed completely		.00			.00	
Secondary	Open	2.75	.50	1.38	2.0	.90	1.8
	Closed—hunting season		.44			.80	
	Closed (w/gates)		.15			.27	
	Closed (w/barrier)	1.80	.05	.09		.09	
	Closed completely		.00			.00	
Primitive	Open		.03			.07	
	Closed—hunting season		.03			.06	
	Closed (w/gates)		.01			.02	
	Closed (w/barrier)	1.2	.01	.01	1.3	.01	.01
	Closed completely		.00			.00	
	Subtotal Std. Miles			1.48 (F)			1.81 (F)
	Total Std. Miles (**F** + **F**)			3.29 (G)			

Miles of standard road per square mile (**G** ÷ **B**) .55 (**H**)

Percent of potential elk use after road effects [use (**H**) and **Fig. 2**] 73 % (**I**)

*All acres usable *except* talus, water surface, and other areas elk would not use because of *natural* features—may also include winter range.

**Refer to Table 2 for coefficient information and definitions of road and vegetation types.

Calculated by: ______________________

AREA: ELK CR

Date: ______________________

ESTIMATING QUALITY OF ELK SUMMER HABITAT IN NORTHERN IDAHO
(continued)

3. Potential elk use as related to livestock density.

		Pre-Sale	Post-Sale Alternatives: Rds open	Post-Sale Alternatives: Rds clsd-Barriers	
Square miles within evaluation area used by livestock	(J)	3.5			
Total cattle equivalents using area	(K)	70			
Cattle equivalents per sq. mi. (**K** ÷ **J**)	(L)	20			
Percent of potential elk use [use (**L**) and **Fig. 3**]	(M)	57 %	%	%	%
Percent of elk use period used by livestock	(N)	75 %	%	%	%
Weighted percent of potential elk use on livestock portion $\frac{(M \times N) + 100\,(100 - N)}{100}$	(P)	68 %	%	%	%
Percent of potential elk use on entire evaluation area $\frac{(P \times J) + 100\,(B - J)}{B}$	(Q)	81 %	81 %	81 %	%

4. Potential elk use as related to other factors. (Refer to Table 3)

		Pre-Sale	Rds open	Rds clsd-Barriers	
Size and distribution of hiding and thermal cover		-0 %	-0 %	-0 %	- %
Size and distribution of forage areas		-10 %	-10 %	-10 %	- %
Adequacy of security areas		-0 %	-10 %	-5 %	- %
Total decrease from these factors	(R)	-10 %	-20 %	-15 %	- %
Potential elk use remaining (100 - **R**)	(S)	90 %	80 %	85 %	%

5. EXISTING AND LONG-TERM POTENTIAL ELK USE

		Pre-Sale	Post-Sale Alternatives: Rds open	Post-Sale Alternatives: Rds clsd-Barriers	
Potential elk use of home range		100%	100%	100%	100%
Potential use as related to roads	(I)	74 %	68 %	73 %	%
Potential use as related to livestock	(Q)	81 %	81 %	81 %	%
Potential use as related to other factors	(S)	90 %	80 %	85 %	%
REMAINING POTENTIAL ELK USE (100%) $\times \frac{(I)}{100} \times \frac{(Q)}{100} \times \frac{(S)}{100} =$	(T)	54 %	44 %	50 %	%
LONG TERM POTENTIAL ELK USE (see instructions p. 13)	(U)		44 %	49 %	%
PERCENT CHANGE FROM PRE-SALE CONDITION 100 (Pre-Sale **T-U**) ÷ Pre-Sale **T**	(V)		19 %	9 %	%

Table 1. Percent cover for photo interpretation (P.I.) types of northern Idaho (Lyon, in press).[1,2]

P.I. Type	Hiding Cover	Thermal Cover	Total Cover
11	51	31	82
12	65	20	85
13	46	0	46
14	64	15	79
15	39	25	64
16	53	5	58
17	52	13	65
18	45	5	50
19	50	0	50
20	25	0	25
21	30	0	30
22	30	0	30
23	50	0	50
24	30	0	30
25	30	0	30
26	15	0	15
27	50	0	50
28	30	0	30
29	15	0	15
30	20	0	20
31	35	0	35
32	21	0	21
33	4	0	4
91	15	0	15
92	0	0	0
93	10	0	10

[1]See Appendix C for descriptions of each P.I. type.
[2]In older P.I. classification systems, P.I. 91 and P.I. 93 were listed as P.I. 40 and P.I. 60, respectively.

Table 2. Equivalent mileage of standard road (modeled in Figure 2) for 1 mile of various types of roads, road closures, and vegetation adjacent to roads.[1]

Road type[2]	Road status[3]	Vegetation types adjacent to roads Hiding cover[4]	Open
Main	Open	.80	1.20
	Closed-hunting season	.71	1.06
	Closed-entire elk use period (w/gates)	.24	.36
	Closed-entire elk use period (w/barrier)	.08	.12
	Closed completely	.00	.00
Secondary	Open	.50	.90
	Closed-hunting season	.44	.80
	Closed-entire elk use period (w/gates)	.15	.27
	Closed-entire elk use period (w/barrier)	.05	.09
	Closed completely	.00	.00
Primitive	Open	.03	.07
	Closed-hunting season	.03	.06
	Closed-entire elk use period w/gates)	.01	.02
	Closed-entire elk use period (w/barrier)	.01	.01
	Closed completely	.00	.00

[1]These values derived from data reported by Perry and Overly (1976), Thomas et al. (1979) and Lyon (1979a, 1982), and by extrapolation to situations for which no data were available.

[2]*Main* road is improved, has constant maintenance and has more than five motorized vehicles average daily traffic (adt) during most months of the elk use period; *secondary* road is somewhat improved, has irregular maintenance and from 1-5 adt; *primitive* road is unimproved, seldom or never maintained, and less than 1 adt.

[3]*Open* road status means open to motorized use during the period elk normally use the area. *Closed hunting season* means closed for about a 1 month period when area is open for elk or deer hunting. *Closed with gates* means closed to motorized vehicles for entire period of elk use. *Closed with barriers* means to close roads with effective means for stopping all 4-wheeled traffic. *Closed completely* means that roads have revegetated with brush or for one reason or another all types of motorized travel are prevented. Gated closure will allow for a minimal amount of administrative activity. This, along with the trespass through or around gates, is the reason why gates are not as effective as barriers.

[4]Vegetation must be dense enough to qualify as hiding cover within 300 ft. on both sides of road or it is classified as open.

Table 3. Other factors affecting elk use.

	% Reduction
Size and Distribution of Hiding and Thermal Cover:	
1. At least 40% of evaluation area qualifies as hiding cover. At least 15% of evaluation area qualifies as thermal cover. At least 25% of each quadrant qualifies as cover.	0
2. At least 30% of evaluation area qualifies as hiding cover. At least 10% of evaluation area qualifies as thermal cover. At least 20% of each quadrant qualifies as cover.	10
3. At least 20% of evaluation area qualifies as hiding cover. At least 5% of evaluation area qualifies as thermal cover. At least 15% of each quadrant qualifies as cover.	20
Size and Distribution of Forage Areas:	
1. All openings less than 1,000 ft. wide. At least 800 ft. of cover between all openings. Forage appears adequate and present in all quadrants.	0
2. About 7% of usable acres in evaluation area more than 500 ft. from cover; or, less than adequate amounts of cover between 50% or more of openings; or, forage adequate but present in only two quadrants.	5
3. About 13% of usable acres in evaluation area more than 500 ft. from cover; or, less than adequate amounts of cover between 100% of openings; or, forage not adequate.	10
Adequacy of Security Areas:	
1. At least 20% of evaluation area qualifies as security area. At least 60% of security area qualifies as cover.	0
2. At least 20% of evaluation area qualifies as security area. Less than 60% of security area qualifies as cover.	5
3. 10% of evaluation area qualifies as security area. At least 60% of security area qualifies as cover.	10
4. 10% of evaluation area qualifies as security area. Less than 60% of security area qualifies as cover.	15
5. No security area in evaluation area.	20

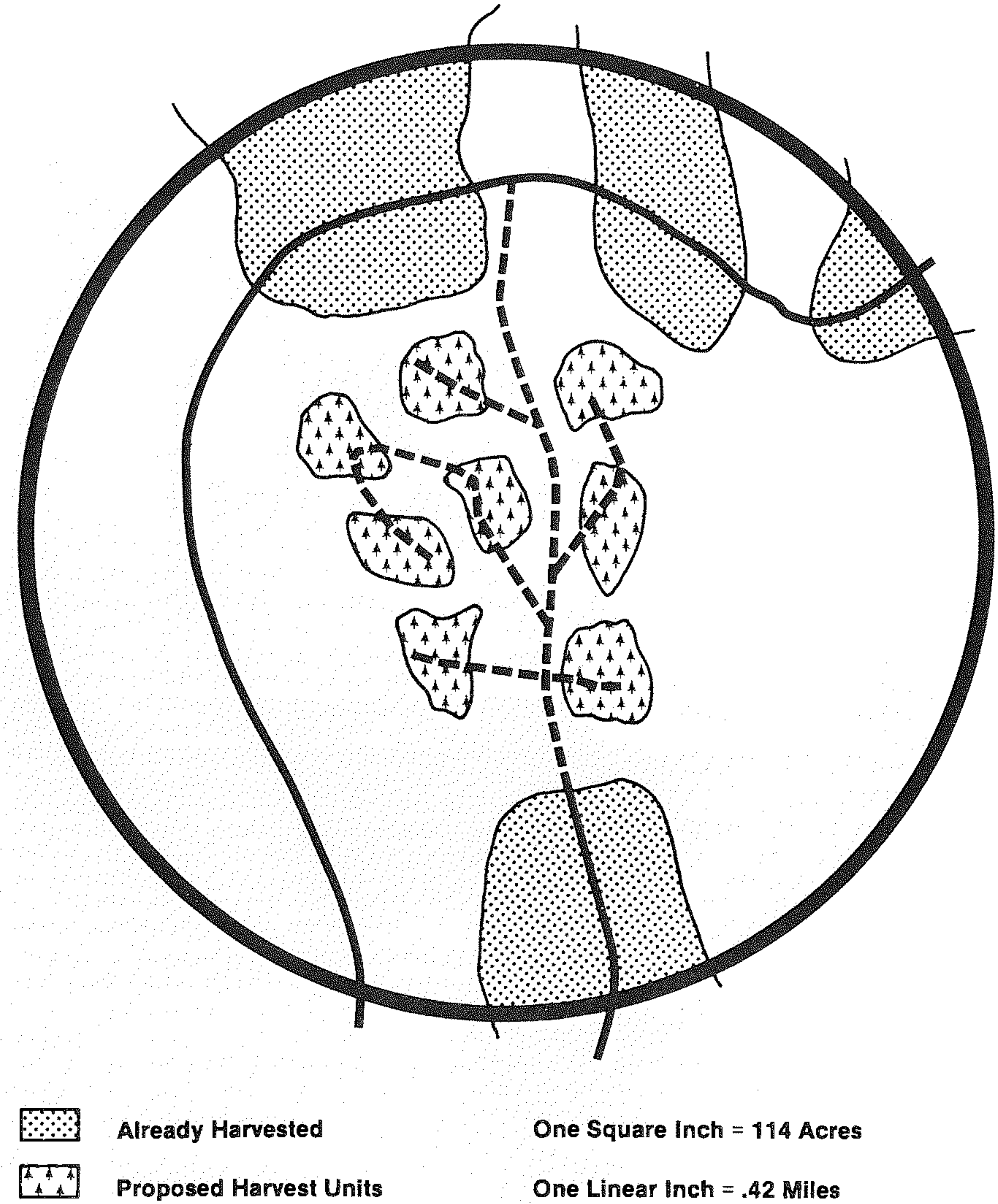


Figure 1. Schematic drawing of a 3800-acre evaluation area for elk habitat computations.

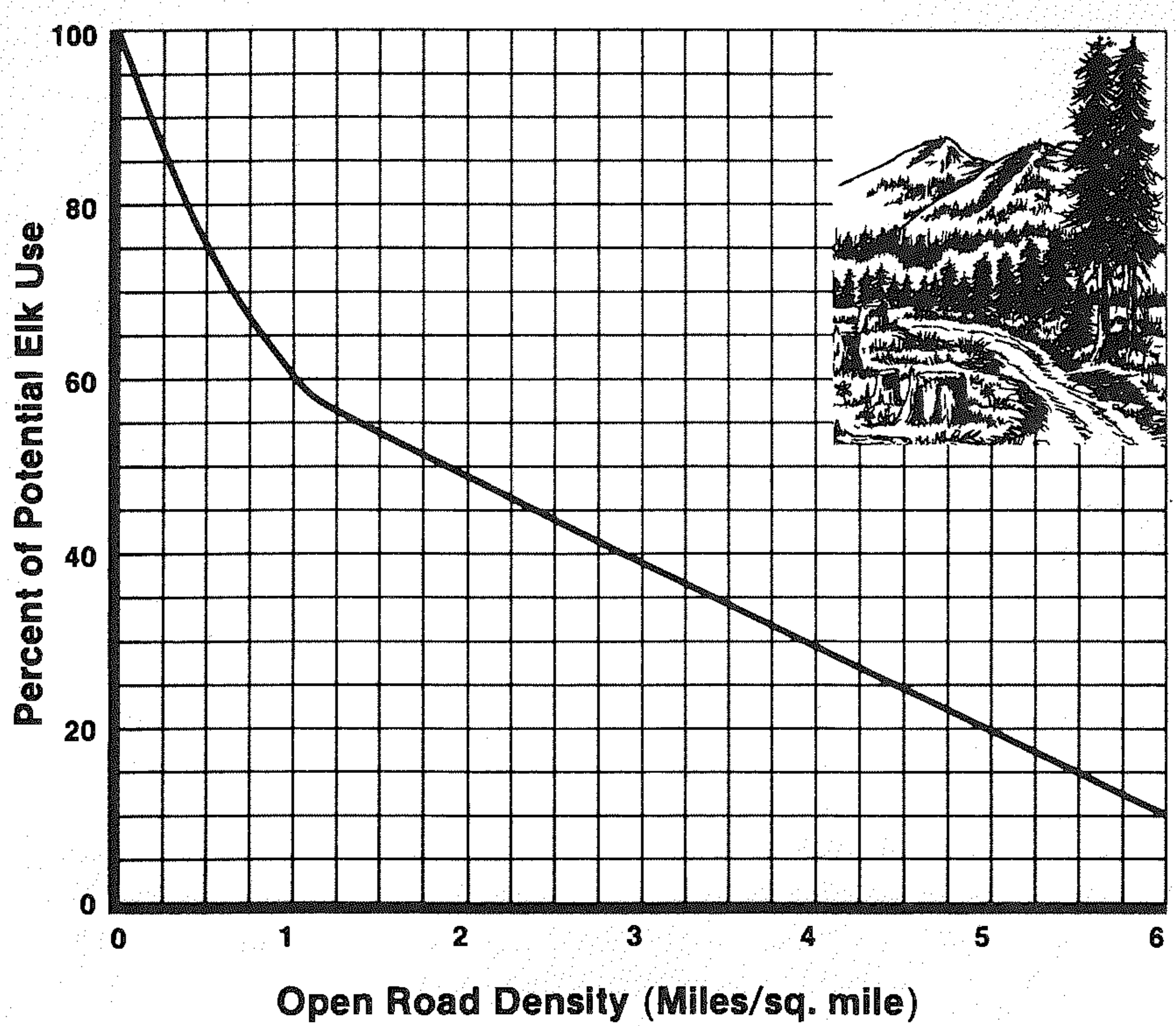


Figure 2. Relationship between miles of open main road per square mile and potential elk use (from Lyon, 1983). This curve is used as a standard against which other road types are compared (Table 2).

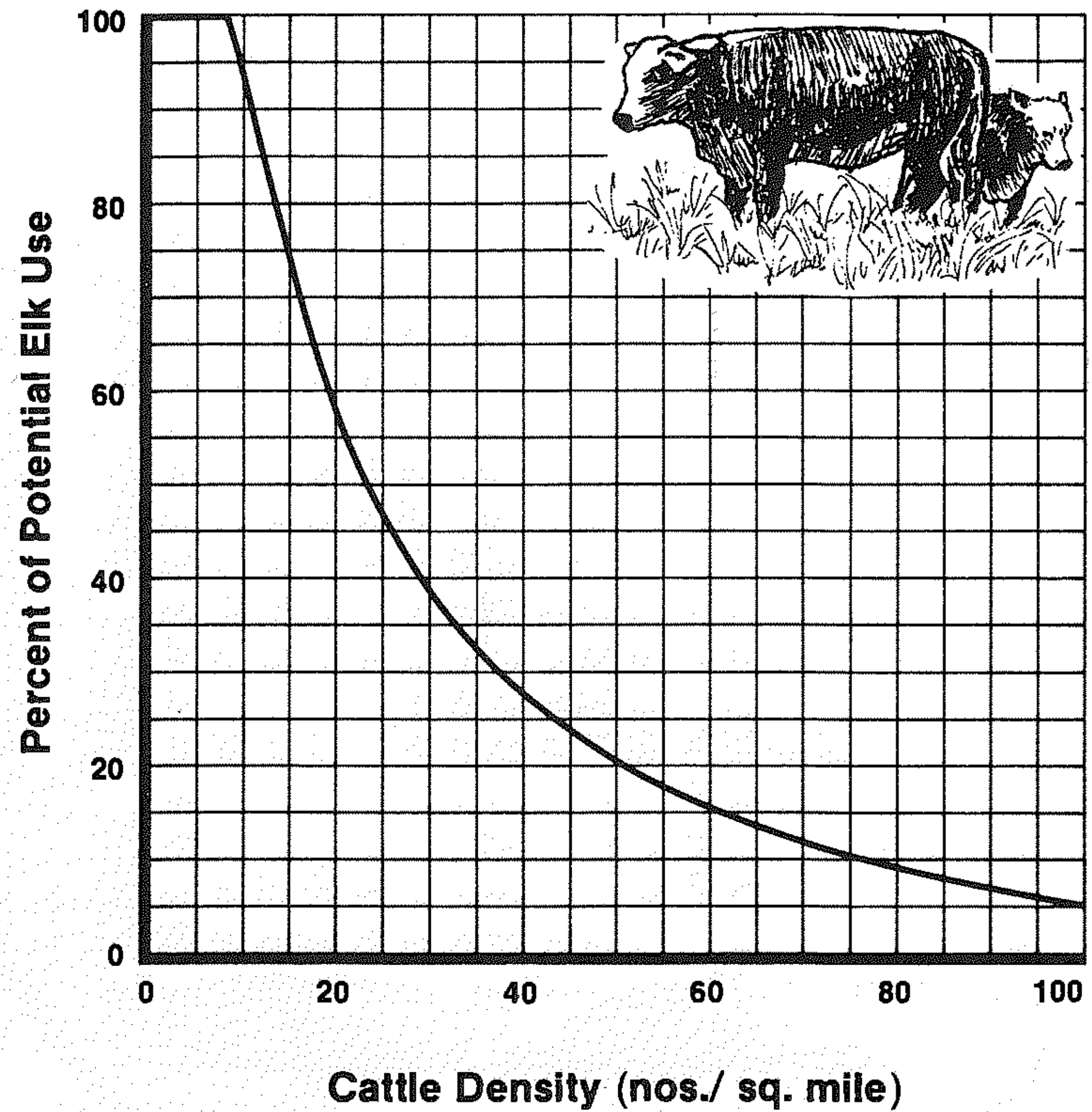


Figure 3. Relationship between cattle equivalents per square mile and potential elk use (from Painter, 1980).

APPENDIX A

BLANK COMPUTATION SHEETS

FORMS 1 and 2

FORM 1

Calculated by: ____________________ AREA: ____________________

Date: ____________________ ALTERNATIVE: ____________________

ESTIMATING QUALITY OF ELK SUMMER HABITAT IN NORTHERN IDAHO

1. Total size of evaluation area in usable acres* ________ **(A)**; and square miles **(A ÷ 640)** ________ **(B)**

2. Potential elk use as affected by roads.**

		Hiding Cover			Open		
		Miles (C)	**Coeff. (D)**	**Std. Miles (C x D) (E)**	**Miles (C)**	**Coeff. (D)**	**Std. Miles (C x D) (E)**
Road Type	**Road Status**						
Main	Open	____	.80	____	____	1.20	____
	Closed—hunting season	____	.71	____	____	1.06	____
	Closed (w/gates)	____	.24	____	____	.36	____
	Closed (w/barrier)	____	.08	____	____	.12	____
	Closed completely	____	.00	____	____	.00	____
Secondary	Open	____	.50	____	____	.90	____
	Closed—hunting season	____	.44	____	____	.80	____
	Closed (w/gates)	____	.15	____	____	.27	____
	Closed (w/barrier)	____	.05	____	____	.09	____
	Closed completely	____	.00	____	____	.00	____
Primitive	Open	____	.03	____	____	.07	____
	Closed—hunting season	____	.03	____	____	.06	____
	Closed (w/gates)	____	.01	____	____	.02	____
	Closed (w/barrier)	____	.01	____	____	.01	____
	Closed completely	____	.00	____	____	.00	____
	Subtotal Std. Miles			____ (F)			____ (F)
	Total Std. Miles (**F** + **F**)			____ (G)			

Vegetation Adjacent to Roads (column group heading)

Miles of standard road per square mile (**G** ÷ **B**) ________ **(H)**

Percent of potential elk use after road effects [use **(H)** and **Fig. 2**] ________ % **(I)**

*All acres usable *except* talus, water surface, and other areas elk would not use because of *natural* features—may also include winter range.

**Refer to Table 2 for coefficient information and definitions of road and vegetation types.

FORM 2

Calculated by: ____________________

AREA: ____________________

Date: ____________________

ESTIMATING QUALITY OF ELK SUMMER HABITAT IN NORTHERN IDAHO
(continued)

3. Potential elk use as related to livestock density.

		Pre-Sale	Post-Sale Alternatives ____	____	____
Square miles within evaluation area used by livestock	(J)	____	____	____	____
Total cattle equivalents using area	(K)	____	____	____	____
Cattle equivalents per sq. mi. (**K** ÷ **J**)	(L)	____	____	____	____
Percent of potential elk use [use (**L**) and **Fig. 3**]	(M)	____%	____%	____%	____%
Percent of elk use period used by livestock	(N)	____%	____%	____%	____%
Weighted percent of potential elk use on livestock portion $\frac{(M \times N) + 100\,(100 - N)}{100}$	(P)	____%	____%	____%	____%
Percent of potential elk use on entire evaluation area $\frac{(P \times J) + 100\,(B - J)}{B}$	(Q)	____%	____%	____%	____%

4. Potential elk use as related to other factors. (Refer to Table 3)

Size and distribution of hiding and thermal cover		-____%	-____%	-____%	-____%
Size and distribution of forage areas		-____%	-____%	-____%	-____%
Adequacy of security areas		-____%	-____%	-____%	-____%
Total decrease from these factors	(R)	-____%	-____%	-____%	-____%
Potential elk use remaining (100 - **R**)	(S)	____%	____%	____%	____%

5. EXISTING AND LONG-TERM POTENTIAL ELK USE

		Pre-Sale	Post-Sale Alternatives ____	____	____
Potential elk use of home range		100%	100%	100%	100%
Potential use as related to roads	(I)	____%	____%	____%	____%
Potential use as related to livestock	(Q)	____%	____%	____%	____%
Potential use as related to other factors	(S)	____%	____%	____%	____%
REMAINING POTENTIAL ELK USE $(100\%) \times \frac{(I)}{100} \times \frac{(Q)}{100} \times \frac{(S)}{100} =$	(T)	____%	____%	____%	____%
LONG TERM POTENTIAL ELK USE (see instructions p. 13)	(U)		____%	____%	____%
PERCENT CHANGE FROM PRE-SALE CONDITION 100 (Pre-Sale **T**-**U**) ÷ Pre-Sale **T**	(V)		____%	____%	____%

APPENDIX B

FOOD HABITS (PERCENT OF DIET) OF ROCKY MOUNTAIN ELK DURING SPRING, SUMMER, AND FALL MONTHS IN NORTHERN IDAHO[1]

	Spring	Summer	Fall
Grasses and sedges	37	17	17
Forbs	20	35	30
Shrubs	43	48	53

Important species in spring: bluebunch wheatgrass, clover, elk sedge, goldthread, Idaho fescue, mountain brome, myrtle boxwood, oniongrass, orchardgrass, Oregon grape, redstem ceanothus, shiny leaf ceanothus, strawberry, violet, willow.

Important species in summer: beardtongue, boykinia, elderberry, false hellbore, fireweed, fool's huckleberry, goldthread, huckleberry, miner's lettuce, mountain ash, mountain brome, myrtle boxwood, oniongrass, Pacific yew, redstem ceanothus, serviceberry, shiny leaf ceanothus, tall bluebell, wakerobin.

Important species in fall: beardtongue, elderberry, fireweed, goldthread, huckleberry, mountain ash, myrtle boxwood, Pacific yew, redstem ceanothus, shiny leaf ceanothus, willow.

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[1]Percentages are averages of data from Young and Robinette (1939), Hash (1973), Irwin (1978), Herman (1978), and Leege (unpublished data). Important species were also taken from these references.

Redstem ceanothus is a preferred elk forage plant during all seasons.

APPENDIX C

DESCRIPTIONS OF PHOTO INTERPRETATION (P.I.) TYPES USED WHEN CLASSIFYING VEGETATION FROM AERIAL PHOTOS[1]

I. Stand height greater than 40 feet

A. Coarse texture - usually indicates mature or overmature sawtimber

11 - Well stocked
12 - Medium stocked
13 - Poorly stocked

B. Fine texture - small sawtimber or pole stands. These are not easily separated as to maturity, and may be either mature or immature, depending on site, etc.

14 - Well stocked or overstocked
15 - Medium stocked
16 - Poorly stocked

C. Two-storied - At least 15-20 feet height difference between overstory and understory.

Unmanageable Two-Story Stands

Overstory well or medium stocked - classify as under A or B above.

Manageable or Potentially Manageable Two-Story Stands

Overstory generally poorly stocked but no more than medium stocked.

17 - Understory well and medium stocked
18 - Understory poorly stocked. Understory with at least 100 trees per acre.

D. Cutover - areas with obvious evidence of man's recent cutting activities, such as cutting unit boundaries, characteristic roading systems, etc.

Cutover - Coarse Texture

19 - Well or medium stocked
20 - Poorly stocked

Cutover - Fine Texture

21 - Well or medium stocked
22 - Poorly stocked

Cutover - Two-Storied

23 - Residual overstory with a well or medium stocked understory.
24 - Residual overstory with poorly stocked understory.

II. Stand Height Less than 40 feet

A. Coarse texture

25 - Well and medium stocked
26 - Poorly stocked

B. Fine texture

27 - Well stocked immature stands less than pole size, usually, but may also be stagnated.
28 - Medium stocked
29 - Poorly stocked
30 - Apparently nonstocked (refers to conifer trees)-due to natural conditions such as fire, but not due to logging.

C. Cutover

31 - Well and medium stocked residual after cutting
32 - Poorly stocked residual
33 - Apparently nonstocked after cutting

III. Other

91 - Noncommercial forest
92 - Water
93 - Nonforest

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[1]A plastic guide (timber survey aid no. 5) for estimating degree of stocking for P.I. determinations is available from: Regional Forester, U.S. Forest Service, P.O. Box 3623, Portland, OR 97208. Training handbooks (Moessner 1960) can also be obtained.

APPENDIX D

ALPHABETICAL LISTING OF THOSE WHO ATTENDED GUIDELINE REVISION MEETINGS AND/OR CONTRIBUTED WRITTEN COMMENTS

Name	Affiliation
Robert Abbott	Nez Perce National Forest
Don Biddison	NezPerce National Forest
Larry Blasing	Inland Forest Resource Council
Bob Boston	Clearwater National Forest
Kevin Boling	Potlatch Corporation
Jon Bledsoe	Clearwater National Forest
Tom Blunn	Clearwater National Forest
Walt Browne	Idaho Department of Fish and Game
Lew Brown	Bureau of Land Management
Dean Carrier	U.S. Forest Service
Dave Colclough	Clearwater National Forest
M. Cook	NezPerce National Forest
Dr. Paul Dalke	U.S. Fish and Wildlife Service -retired
Dan Davis	Clearwater National Forest
George Davis	Idaho Panhandle National Forests
Mike Dunbar	Idaho Department of Fish and Game
Duane Fisher	NezPerce National Forest
Mary Lou Franzese	Potlatch Corporation
Dean Graham	NezPerce National Forest
Valerie Guardia-Harper	NezPerce National Forest
Paul Harrington	Idaho Panhandle National Forests
Terry Hershey	Clearwater National Forest
Lorin Hicks	Plum Creek Timber Company
William Hicks	NezPerce National Forest
Rich Inman	NezPerce National Forest
Dr. Larry Irwin	University of Wyoming
Don Jenni	Clearwater National Forest
Danielle Jerry	Idaho Panhandle National Forests
Craig Johnson	Bureau of Land Management
Ray Kiewit	Idaho Panhandle National Forests
Ralph Kizer	Idaho Panhandle National Forests
Donavin Leckenby	Oregon Department of Fish and Wildlife
Tom Leege	Idaho Department of Fish and Game
Ed Lider	Idaho Panhandle National Forests
Joe Lint	Bureau of Land Management
Terry Lonner	Montana Department of Fish and Game
Dr. L. Jack Lyon	Int. Forest and Range Exp. Sta.
Dr. Les Marcum	University of Montana
James McAdoo	Potlatch Corporation
Sam McNeill	Idaho Department of Fish and Game
Paul Moros	NezPerceNational Forest
Bill Mulligan	Potlatch Corporation
John Mumma	U.S. Forest Service
Wally Murphy	Clearwater National Forest
Dr. Jack Nelson	Washington State University
Dr. Lou Nelson	University of Idaho
Lloyd Oldenburg	Idaho Department of Fish and Game

Name	Affiliation
Mark Orme	Targhee National Forest
Tim Patton	Idaho Panhandle National Forests
Jim Penzkover	Idaho Panhandle National Forests
Dr. Richard Pedersen	U.S. Forest Service
Dr. Harold Picton	Montana State University
Dick Presby	Clearwater National Forest
Bob Riggs	Plum Creek Timber Company
John Righter	NezPerce National Forest
Hadley Roberts	Salmon National Forest
Mike Scott	University of Idaho
Mike Schlegel	Idaho Department of Fish and Game
Ed Schneegas	U.S. Forest Service
Dave Spores	NezPerce National Forest
Fred Stackpole	Clearwater National Forest
Jerry Stern	Idaho Panhandle National Forests
Bob Summerfield	Idaho Panhandle National Forests
Dennis Talbert	Clearwater National Forest
Jerry Thiessen	Idaho Department of Fish and Game
Dick Thompson	Clearwater National Forest
Harold Wadley	Idaho Panhandle National Forests
Tom Wittinger	NezPerce National Forest

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Glossary*

Buffer strip—a corridor of dense vegetation that reduces the impact of a treatment or disturbance on an adjacent area.

Cattle equivalent—a standardized unit which is equal to 1 cow w/calf, 5 sheep, or .8 horse.

Clearcut—an area from which all trees have been removed by cutting.

Compartment/Sub-compartment—U.S. Forest Service terms referring to units of National Forest land that have been identified and categorized for timber management purposes.

Cover—vegetation used by elk for protection from hunters and other predators. In this report it is considered to be hiding cover or thermal cover.

Evaluation area—a parcel of land chosen as the unit for evaluating the quality of elk habitat.

Forage, Forage area—elk food, places where elk obtain food.

Habitat—the sum total of environmental conditions.

Hiding cover—vegetation capable of hiding 90% of a standing adult elk from the view of a human at a distance equal to or less than 200 ft. during all seasons of the year that elk normally use the area. Also see definition for cover.

Home range—the area an elk traverses in the scope of normal activities during a particular season of the year.

Open vegetation—refers to all vegetation other than that qualifying as hiding cover.

Openings—refer to meadows, clearcuts, and other areas of vegetation that do not provide hiding or thermal cover.

Partial cuts—any timber harvest that leaves live trees standing for some management purpose.

P.I. type—Abbreviation for photo interpretation type and refers to a specific, relatively homogenous, type of vegetation identified on aerial photographs. See Appendix C for description of all P.I. types.

Potential elk use—refers to elk habitat quality. 100% potential elk use means that a site has the optimum amount and interspersion of all habitat factors including security, to permit elk use at the maximum potential for that site.

Quadrant—a ¼ portion of an evaluation area usually defined by north-south and east-west lines through the mid-point.

Regeneration harvest—any removal of trees intended to assist regeneration already present or to make regeneration possible. Clearcut, shelterwood, and seedtree are common regeneration harvest techniques.

Riparian area—an area identified by the presence of vegetation that requires free or unbound water or conditions more moist than normally found in the area.

Road Types—*Main* road is improved, has constant maintenance and has more than 5 motorized vehicles average daily traffic (adt) during most months of the elk use period; *Secondary* road is somewhat improved, has irregular maintenance and from 1-5 adt; *Primitive* road is unimproved, seldom or never maintained, and less than 1 adt. Adt should be calculated for the period elk normally use the area.

Security area—an area elk retreat to for safety when disturbance in their usual range is intensified—such as by logging activities or during the hunting season. To qualify as a security area, there must be at least 250 contiguous acres that are more than ½ mile from open roads.

Sight distance—the distance at which 90% of a standing adult elk is hidden from human view.

Silviculture—generally, the science and art of cultivating forest crops.

Slash—the residue left on the ground after trees are harvested, or accumulated there as a result of storm, fire or silvicultural treatment.

Succession—the changes in vegetation and in animal life that take place as the plant community evolves from bare ground to climax.

Thermal cover—Vegetation used by elk to help maintain comfortable body temperatures with minimal energy expenditure. For this report, it is defined as a stand of coniferous trees 40 ft. or more tall with average crown cover exceeding 70 percent.

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*All or portions of many of these definitions are from Thomas (1979).