ROCKY MOUNTAIN ELK FOUNDATION

September 12, 2023

Russell Bacon, Reviewing Officer
Attn: Objections
USDA Forest Service,
Medicine Bow-Routt National Forests and Thunder Basin National Grassland
2468 Jackson Street
Laramie, WY 82070-6535

The Rocky Mountain Elk Foundation would like to submit the following objections for the proposed Mad Rabbit Trails Project in the Medicine Bow-Routt National Forests, Hahns Peak/Bears Ears Ranger District.

Name and address of Objector
Karie Decker
submitting on behalf of the objector, the Rocky Mountain Elk Foundation (as an entity)
5705 Grant Creek Road
Missoula, MT 59808
406-523-0225
kdecker@rmef.org

Karie Decker

(Signature for Karie Decker, representing the Rocky Mountain Elk Foundation)

RMEF objection standing per 36 CFR Part 218 Subpart A and B:
RMEF qualifies as an entity, as defined in § 218.2, who has submitted timely, specific written comments regarding a proposed project or activity that is subject to these regulations during any designated opportunity for public comment. Opportunity for public comment on an Environmental Assessment (EA) includes during scoping or any other instance where the responsible official seeks written comments. RMEF submitted two separate comment letters during the periods when the responsible official was seeking written comments: February 9, 2018 (scoping) and November 22, 2022 (during the 30-day review of the draft EA); letters included in the Appendix.

Name of Project: Mad Rabbit Trails Project

Responsible Official: Michael J. Woodbridge, District Ranger Hahns Peak/Bears Ears Ranger District, Medicine Bow-Routt National Forests and Thunder Basin National Grassland

Location: Medicine Bow-Routt National Forests, Hahns Peak/Bears Ears Ranger District

Statement that Demonstrates Connection between Prior Specific Written Comments on the Proposed Project and Content of the Objection.
Statements are provided within each section below, referencing connection to prior comments.

Objection: Request for an Environmental Impact Statement (EIS)
[Objection relevance: In RMEF's comment letter dated November 22, 2022, we expressed concern about an EA being conducted rather than a full Environmental Impact Statement (EIS). We continue to justify this concern and request that an EIS be conducted.]

RMEF is discouraged by the decision to not conduct a full EIS. The scale and network of this project has impacts well beyond what is formally recognized in the Final EA. Based on details below, RMEF requests a decision of No Action and that a full EIS be prepared. The Proposed Action is likely to significantly affect the quality of the human environment, individually or cumulatively.

Comments related to a Finding of No Significant Impact (FONSI) criteria and justification for an EIS request:

- *Criteria 1: Impacts may be both beneficial and adverse. A significant effect may exist even if the Federal agency believes that on the balance the effects will be beneficial.*
    - The Terrestrial Biological Evaluation, Wildlife Specialist Report (Wildlife Report, pages 39-44) repeatedly recognizes the impact of increased recreation to elk behavior, breeding success, distribution and population-level responses. There is recognition of direct and indirect, long-term effects to elk due to increased trails and recreation activity. However, the EA states: 'Although elk are an important big game species, they are not a Region 2 sensitive species and so no determination will be provided' (EA page 58, 61). Many adjustments were made throughout project development to help conserve elk populations, yet the EA refuses to make a determination as to direct, indirect or cumulative impacts. With the Wildlife Report (pages 39-44) clearly pointing out the impacts of this project to elk, a non-determination is inappropriate. The USFS agreed to include elk in the assessment, despite not being a sensitive species. If an evaluation (in the Wildlife Report) is completed for the species, a determination must be made in the EA.
    - The Federal agency believes that on balance the effects of the Proposed Action will be beneficial; however, this alone does not warrant a FONSI.
- *Criteria 3: Unique characteristics of the geographic area such as proximity to historic or cultural resources, park lands, prime farmlands, wetlands, wild and scenic rivers, or ecological critical areas.*
    - The Proposed Action is still likely to significantly impact elk populations and their habitat, primarily in the Ferndale area. This area is identified by Colorado Parks and Wildlife (CPW) as High Priority Habitat and thus, an ecological critical

area. The current evaluation, EA and Proposed Action do not appropriately address this issue. While some adjustments were made to protect the High Priority Habitat, a full analysis and determination is needed to fully understand the effects. An EIS would help accomplish this.
    - Much of the proposed project would be implemented in Colorado Roadless Areas. With a significant increase in use anticipated, the Roadless Areas will likely exceed the designated Recreational Opportunity Spectrum as identified in the 1998 Routt National Forest Plan. An EA does not appropriately analyze or address this potential impact.
- *Criteria 6: The degree to which the action may establish a precedent for future actions with significant effects or represents a decision in principle about a future decision.*
    - Several elements in the Proposed Action qualify for further analysis due to their potential in setting a precedent for future trail development in Colorado. Not only does the Proposed Action include the first-ever 'gravity driven downhill mountain bike park,' constructed within a Colorado Roadless Area, but the Action is among the highest density of trail networks overlapping with mapped High Priority Habitat (elk production habitat). The trail network density exceeds what is allowed in the 1998 Routt National Forest Plan.

Best Available Science
[Objection relevance: In RMEF's comment letter dated November 22, 2022, we expressed concern about the use of outdated science to support the draft EA. RMEF's concern continues and is further detailed below.]

The Wildlife Report and EA fail to incorporate the best available science into the draft Decision as is required per 36 C.F.R. § 219.3 Role of science in planning. 'The responsible official shall use the best available scientific information to inform the planning process required by this subpart. In doing so, the responsible official shall determine what information is the most accurate, reliable, and relevant to the issues being considered. The responsible official shall document how the best available scientific information was used to inform the assessment, the plan decision, and the monitoring program as required in §§ 219.6(a)(3) and 219.14(a)(4). Such documentation must: identify what information was determined to be the best available scientific information, explain the basis for that determination, and explain how the information was applied to the issues considered.' These regulations also require Federal agencies to 'ensure the professional integrity, including scientific integrity, of the discussions and analyses.'

This objection refers particularly to use of an outdated model to assess habitat effectiveness for elk. The Wildlife Report and EA use the Elk Habitat Effectiveness Model that was developed in 1983 (Lyon 1983). While the 1998 Routt National Forest Plan references and uses this model, this EA should incorporate the best available science, particularly when more accurate, recent models are presented.

In addition, 'habitat effectiveness' is not defined in any of the current Draft Decision or EA documents. Thus, it is assumed that the EA relies on the definition provided in the 1998 Routt National Forest Plan (Glossary page 8): 'Percentage of available habitat that is usable by elk outside the hunting season' and references Lyon and Christensen (1992). By this definition, the current EA fails to properly analyze 'Habitat Effectiveness.' Furthermore, assuming again, that the 1998 Routt National Forest Plan definition was used, this Plan provides a formula for calculating Habitat Effectiveness in the Final EIS (page 130) as, '…the habitat effectiveness model developed by Lyon (1983) and modified for Region 2 ecosystems, was used to predict effects on Forest Habitat Effectiveness…'. The modifications of the Model for Region 2 are not disclosed in the 1998 Plan nor in the current EA. Nor are any of the methods presented on how the current EA Habitat Effectiveness or Hiding Cover was actually measured in the field (or when). RMEF requests increased transparency of the methodology and formula used to calculate Habitat Effectiveness/Hiding Cover as well as a supplemental analysis that incorporates more recent science that will assess the 'percentage of available habitat that is useable by elk outside the hunting season.'

The Wildlife Report recognizes that trails were not used to calculate Habitat Effectiveness and along with the EA, justifies this exemption, in part, through trail design: concentration of trails along Highway 40. A project adjustment to concentrate trails does not justify performing an outdated analysis. Furthermore, the Travelway Density assessment in the Wildlife Report *does* include trails in the density calculation. This inconsistency is not explained. RMEF asks that the USFS document how the best available scientific information was used to inform the assessment, particularly regarding 'Habitat Effectiveness,' and how this represents the best available scientific information used to inform the assessment, the plan decision and the monitoring program as required in §§ 219.6(a)(3) and 219.14(a)(4).

Current science also makes clear assertions on the effects of trail users (not just trails) on elk. In the publication that is frequently referenced in the EA (Wisdom et. al 2018), researchers highlight the importance of accounting for direct effects of recreation users. The study found that the mean minimum distance of elk from recreationists was 2-4 times farther than mean distances from trails alone. This manifested across four recreation types, indicating that the direct response of elk to recreationists was more predictable (and impactful) than the responses to trails alone. A separate study found that reproduction success fell nearly 40% when cow elk were disturbed by simulated recreationists during calving season (Phillips and Alldredge 2000). In the study, disturbance was defined as a cow elk taking flight. Eight disturbances led to a 40% reduction in calf survival, approximately 5% mortality rate per disturbance. The researchers speculated an elk calf changing location (due to disturbance) makes it more susceptible to predation, leading to the decline in the number of surviving calves. Thus, it is imperative that the EA take sufficient action to improve the assessment by using this updated science. In the Proposed Action, where an intense amount of recreational use is expected, an assessment of the trail alone is inappropriate.

RMEF requests that a more thorough analysis to incorporate new information and data concerning the impacts of the severe winter conditions of 2022-2023 and how the Proposed Action might add to these impacts. The Wildlife Report references outdated elk population data that is three years old (Wildlife Report page 39). The 2022-2023 winter had the most severe snow conditions seen in the past 70 years for the northwest corner of Colorado, ranging from Rangely to Steamboat Springs and the Wyoming state line. Multiple heavy snowstorms with strong winds generated hard-packed snow that severely buried food for elk, mule deer and pronghorn. In the Severe Winter Zone of northwest Colorado (including E-2 where the Proposed Action overlaps), severe winter conditions resulted in high elk calf and above-average cow mortality. Survival rates were the lowest CPW has ever documented and below what CPW previously thought possible in elk. Antlerless elk hunting opportunity in E2 was reduced by 89% to help the herd recover (CPW 2023 Colorado Big Game Regulation Brochure; included in the Appendix). The evaluation and EA must incorporate this data to fully assess the effects of the Proposed Action.

RMEF has also provided a list of updated/additional science for incorporation in the EA (available in the Appendix).

Closure and Rehabilitation of Unauthorized Non-system Trails
[Objection relevance: In RMEF's comment letter dated November 22, 2022, we provided comment regarding the timing and approach to closing and rehabilitating unauthorized trails. RMEF expands on this initial comment below.]

RMEF appreciates the USFS dedication (through this project) to rehabilitate and close 36 miles of unauthorized non-system trails. However, this activity appears to be used to justify the new trail development in the Proposed Action. Rehabilitation and closure of these trails is an action already authorized and should be conducted regardless of the Proposed Action. It is not appropriate to use an already authorized activity (rehabilitation and closure) as a balance measure to newly created trails and roads. Indeed, the current EA attempts to do so – using it as a reason for not completing a more thorough analysis of the impact to Elk Habitat Effectiveness. The EA also excludes rehabilitation and closure in the No Action Alternative, suggesting closure of unauthorized trails is not required by standard USFS practices unless assessed through NEPA. Furthermore, the EA attempts to offset increased recreational use on new trails with the 'reduction in recreational use' on closed unauthorized trails. Again, this is not an appropriate approach. No analysis was completed on current usage of the unauthorized non-system trails nor the impacts of such trails. There is now an expectation to assess the effects of non-system trails and roads (see recent U.S. District Court Ruling on the Helena-Lewis & Clark National Forest: Case 9:21-cv-00005-DLC, Document 42, Filed 08/03/23), which is particularly appropriate in this assessment, given that such roads are in the Proposed Action. In order to appropriately address the non-system trails, RMEF requests removal of any actions associated with rehabilitation and closure of non-system trails from the Purpose and Need (and the entire NEPA project). A new analysis should be conducted and NEPA decision based solely on the proposed new trails/roads alone and non-system trails addressed with existing authority.

New Information, Changes, or Information not Found in the Final EA or Draft Decision
Socio-economic Impacts
RMEF is concerned with the lack of assessment on the socio-economic effects of the Proposed Action. NEPA requires that prior to funding, authorizing, or implementing an action, federal agencies consider the effects that their proposed action may have on the environment and the related social and economic effects. The evaluation and EA focus on benefits to narrow set of uses (primarily mountain biking and some hiking); however, fail to assess the cost that these increased uses have for other users. The recognition of 'likely to impact' elk in the Wildlife Report has effects on those who participate in elk viewing or elk hunting opportunities. The EA indicates that newly developed trails may benefit elk hunters by providing additional access routes. However, access to trails does not equate to access to elk. This loss of opportunity is recognized and as stated in the EA (page 59): 'Elk will stabilize their movements and avoid this disturbance over the long-term. Elk hunters may be pushed to hunt areas other than Rabbit

Ears Pass. Colorado Parks and Wildlife carefully sets herd objectives to maintain herds and may need to adjust licenses.' This statement suggests acknowledgement of impacts on elk and lost hunter opportunity and that hunters (and CPW elk management through hunting) will not be a priority consideration in the Proposed Action. The EA also fails to evaluate the socio-economics of maintaining new trail systems in the Proposed Action.

Travelway Density
CPW's High Priority Habitat guidance recommends that route (trail and road) density remain below the threshold of one linear mile per square mile within sensitive elk habitat to minimize disturbance. The Wildlife Report recognizes that the project will result in a high route density proposed (>1mi./mi^2) in elk production areas (a High Priority Habitat and thus an ecological critical area). This includes all or part of trail segments 14, 19, 20, 21, 22 and 30, where CPW data show high elk occurrence. RMEF requests the trail segments that fall within the elk production area also be put under a mandatory seasonal closure from May 15-June 30.

Design Criteria
With the final Design Criteria available for review, RMEF requests adjustments to the following criteria to maintain consistency across the Proposed Action.

- Criteria 39: 'Total miles of completed trail (primary routes and alternate lines) should not be 20 percent greater than the total miles of trail included in the project's decision unless extenuating circumstances require longer than anticipated trails. Supplemental information reports may be prepared by resource specialists to ensure compliance with all laws, regulations, and policies if the percentage may be exceeded.'
    - RMEF requests information on how the '20 percent' figure was determined and clarification as to what public engagement opportunities would be available if completed trail miles includes an additional 20 percent. This could equal up to an additional 10 miles of trail development, which currently, as proposed, has no specific location. Depending on where the additional trails occur, they may have sufficient impact to warrant a revised set of specialized reports, review by the public and an amended decision.
- Criteria 40: 'Resource specialists will be consulted before implementation of proposed alternate lines on trails.'
    - Given the amount of public engagement needed to arrive at the Proposed Action, RMEF requests that if alternate trail locations are anticipated, that the public be afforded opportunity to review and comment. Depending on where the alternate trail lines occur, they may have sufficient impact to warrant a formal set of revised specialist reports which would be open for public review.
- Criteria 44: 'There may be seasonal restrictions on proposed trails and/or segments of proposed trails to protect elk production (calving) habitat. There will be a mandatory closure from May 15 through June 30 on the route 14 area and in the Ferndale area on segments 23, 25, and 27 based on current information…'
    - RMEF requests this seasonal closure (May 15-June30) for all or part of trail segments 14, 19, 20, 21, 22 and 30, where CPW data show high elk occurrence.

- Criteria 45: '… Management actions would be phased in from least restrictive to more restrictive to preserve visitor freedom, to the extent feasible, in balance with resource needs and in coordination with partners…'
    - RMEF requests clarity on the timing of the phased action and what the Proposed Action considers least to more restrictive. There is little opportunity to provide feedback when these pieces are not defined. In addition, many of the management actions will occur on new trails (seasonal closure) where users don't already have a predetermined expectation), so should not impact visitor freedom and should be implemented as soon as trails are developed. Other closures (of unauthorized non-system trails) should occur immediately as the FS already has authorization to do so, particularly given the significant impact these trails are having on natural resources and the ROS of the Roadless Area.

RMEF Recommendations Summarized:

- Prepare a more thorough analysis through an EIS, as justified through three of the FONSI consideration criteria described above.
- Utilize information and assessments made in the Wildlife Report to make a determination in the EA on how the Proposed Action has direct, indirect and/or cumulative effects on elk. The EA currently indicates 'no determination will be made.'
- Incorporate the best available science into the analysis and decision.
    - Include trails in the Elk Habitat Effectiveness assessment or utilize more recent models to assess the effect of trails on elk.
    - Identify which definition of Habitat Effectiveness is being used in this current EA (assumed to be the Routt National Forest Plan definition). Provide more transparency on what modifications were made to accommodate Region 2 ecosystems in the model and overall transparency on how the field data was collected for the assessment.
    - Provide scientific evidence that the Proposed Action to concentrate trails (with a portion still within high priority habitat) will benefit elk.
    - Incorporate updated science to assess the effects of increased number of recreationists (and density of users) to elk, not just trail miles or development.
    - Respond to inconsistencies in what data was used in various assessments (i.e., trails were incorporated in the Travelway Density assessment but not Habitat Effectiveness).
    - Incorporate more recent data on elk population numbers (the EA references 2020 estimates) including an assessment on how new trails and increased use will exacerbate recent winter-related losses to the E2 elk herd.
- Remove portions of the Proposed Action associated with closure of 36 miles of unauthorized non-system trails. As an already-authorized activity, this should not be used to balance out the development of nearly 50 new miles of trails. The assessment should only consider actions not already authorized.
- Conduct a socio-economic assessment of the Proposed Action, accounting for loss of elk viewing and hunting opportunities and future trail maintenance.

- Implement additional seasonal closures (May 15-June 30) for all routes that are in high priority habitat (elk production area), currently without seasonal closures. This includes all or part of trail segments 14, 19, 20, 21, 22 and 30, where CPW data show high elk occurrence.
- Increase transparency in adjustments and public engagement opportunity if Design Criteria 39, 40, 44 and 45 are implemented.

RMEF appreciates the effort of the USFS to engage multiple stakeholders throughout this process and hopes for a new Proposed Action that will have much less of an impact to elk and other wildlife as well as hunting opportunity.

Sincerely,

Karie Decker

Karie Decker
Director of Wildlife and Habitat

Literature Cited
(includes a sampling of studies that should be incorporated into the EA)

Dertien, J.S., C.L. Larson and S.E. Reed. 2021. Recreation effects on wildlife: a review of potential quantitative thresholds. Nature Conservation 44: 51-68.

Lamont, B.G., K.L. Monteith, J.A. Merkle, T.W. Mong, S.E. Albeke, M.M. Hayes, and M.J. Kauffman. 2019. Multi-scale habitat selection of elk in response to beetle-killed forest. Journal of Wildlife Management 83: 679-693.

Lukacs, P.M., M.S. Mitchell, M. Hebblewhite, B.K. Johnson, H. Johnson, M. Kauffman, K.M. Proffitt, P. Zager, J. Brodie, K. Hersey, A.A. Holland, M. Hurley, S. McCorquodale, A. Middleton, M. Nordhagen, J.J Nowak, D.P. Walsh and P.J. White. 2018. Factors influencing elk recruitment across ecotypes in the Western United States. Journal of Wildlife Management 82: 698-710.

Lyon, L.J. 1983. Road Density Models Describing Habitat Effectiveness for Elk. Journal of Forestry 81: 592–613.

Lyon, L. J. and A.G. Christensen. 1992. A partial glossary of elk management terms. Gen. Tech. Rep. INT-288. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station. 6 p.

Marion S., A. Davies, U. Demsar, R.J. Irvine, P.A. Stephens and J. Long. 2020. A systematic review of methods for studying the impacts of outdoor recreation on terrestrial wildlife. Global Ecology and Conservation 22: e00917.

Miller, A.B, D. King, M. Rowland, J. Chapman, M. Tomosy, C. Liang, E.S. Abelson, R.L. Truex. 2020. Sustaining wildlife with recreation on public lands: a synthesis of research findings, management practices, and research needs. Gen. Tech. Rep. PNW-GTR-993. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 226 p.

Mumme, S., Middleton, A. D., Ciucci, P., De Groeve, J., Corradini, A., Aikens, E. O., Ossi, F., Atwood, P., Balkenhol, N., Cole, E. K., Debeffe, L., Dewey, S. R., Fischer, C., Gude, J., Heurich, M., Hurley, M. A., Jarnemo, A., Kauffman, M. J., Licoppe, A. … Cagnacci, F. 2023. Wherever I may roam—Human activity alters movements of red deer (Cervus elaphus) and elk (Cervus canadensis) across two continents. Global Change Biology 00: 1–14.

Naylor, L.M., M.J Wisdom and R.G. Anthony. 2009. Behavioral Responses of North American Elk to Recreational Activity. The Journal of Wildlife Management 73: 328-338.

Phillips, G. E., and A.W. Alldredge. 2000. Reproductive Success of Elk Following Disturbance by Humans during Calving Season. The Journal of Wildlife Management 64:521–530.

Quigley, T.M. and M.J. Wisdom. 2015. The Starkey Project: Long-term research for long-term management solutions. Pages 9-16 in Wisdom, M.J., technical editor, The Starkey Project: a synthesis of long-term studies of elk and mule deer. Reprinted from the 2004 Transactions of the North American Wildlife and Natural Resources Conference, Alliance Communications Group, Lawrence, Kansas, USA.

Rowland, M. M., M. J. Wisdom, B. K. Johnson, and M. A. Penninger. 2005. Effects of roads on elk: implications for management in forested ecosystems. Pages 42-52 in Wisdom, M. J., technical editor, The Starkey Project: a synthesis of long-term studies of elk and mule deer. Reprinted from the 2004 Transactions of the North American Wildlife and Natural Resources Conference, Alliance Communications Group, Lawrence, Kansas, USA.

USDA, Forest Service. 1998. Record of Decision Final Environmental Impact Statement and Revised Land and Resource Management Plan (Routt Forest Plan).

Wisdom, M. J., A. A. Ager, H. K. Preisler, N. J. Cimon, and B. K. Johnson. 2005. Effects of Off-Road Recreation on Mule Deer and Elk. Pages 67-80 in Wisdom, M. J., technical editor, The Starkey Project: a synthesis of long-term studies of elk and mule deer. Reprinted from the 2004 Transactions of the North American Wildlife and Natural Resources Conference, Alliance Communications Group, Lawrence, Kansas, USA.

Wisdom, M.J., H.K. Preisler, L. Naylor, R.G. Anthony, B.K. Johnson, M.M. Rowland. 2018. Elk responses to trail-based recreation on public forests. Forest Ecology and Management 411:223-233.

September 12, 2023

Russell Bacon, Reviewing Officer
Attn: Objections
USDA Forest Service,
Medicine Bow-Routt National Forests and Thunder Basin National Grassland
2468 Jackson Street
Laramie, WY 82070-6535

The Rocky Mountain Elk Foundation would like to submit the following Appendix to supplement the objections for the proposed Mad Rabbit Trails Project in the Medicine Bow-Routt National Forests, Hahns Peak/Bears Ears Ranger District. The documents include those referenced but do not fall under the reference allowance allowed in § 218.8(b).

February 9, 2018

Hahns Peak-Bears Ears Ranger District
Attn: Mad Rabbit Trails Project
925 Weiss Drive
Steamboat Springs, CO 80487
Email: comments-rm-medicine-bow-routt-hahns-peak-bears-ears@fs.fed.us

Dear Sirs:

The Rocky Mountain Elk Foundation (RMEF) appreciates the opportunity to provide comments on the "Mad Rabbit Trails Project." We are very concerned about the number of miles of trail that are proposed in both Proposal A and Proposal B. This area is very important to elk, mule deer, and many other wildlife species. We hope that you will take all public input and then complete an analysis that will measure the impact of these proposed trails on the area's wildlife. We also hope that you will consult with Colorado Parks & Wildlife's professionals to incorporate their data into a cumulative effects analysis.

We look forward to the draft environmental analysis on proposed action and possibly other alternatives available for formal 30-day public comment sometime during summer 2018.

Sincerely,

Blake L Henning

Blake L. Henning
Chief Conservation Officer

November 22, 2022

Michael Woodbridge
Hahns Peak / Bears Ears Ranger District
925 Weiss Drive
Steamboat Springs, CO 80487
Submitted electronically via USFS Comment Portal https://cara.fs2c.usda.gov/Public//CommentInput?Project=50917

The Rocky Mountain Elk Foundation (RMEF) appreciates the opportunity to comment on the Mad Rabbit Trails Project Environmental Analysis (EA).

The mission of RMEF mission is to ensure the future of elk, other wildlife, their habitat and our hunting heritage. We represent more than 225,000 members nationwide and over 14,500 members in Colorado. Since its inception in 1984, RMEF has permanently conserved or enhanced more than 8.5 million acres of North America's most vital habitat for elk and other wildlife, including over 500,000 acres in Colorado. As such, RMEF has a vested interest in ensuring the sustained productivity of elk and other wildlife in Colorado.

The Mad Rabbit Trails Project is situated in the habitat of the E-2 Bear's Ear elk herd, the second largest elk herd in Colorado. While the larger herd in this area is reaching the upper population objective, the Steamboat sub-herd shows a decrease in both number of elk and calf:cow ratios.

Extensive research has demonstrated the impact that recreation can have on wildlife, elk, in particular. Elk are sensitive to all forms of recreation, including biking and hiking (the primary uses identified in the project EA). Not only does elk distribution shift in response to continued disturbance, but in critical areas such as winter range or calving areas, disturbance can begin to impact herd population numbers and recruitment. In addition, elk avoidance of recreation trails and recreationists represents a form of 'habitat compression' (functionally, habitat loss), considering the potentially large areas not used or used less in the presence of humans and that otherwise might be selected by a species in the absence of humans. Habitat compression can ultimately lead to large-scale population shifts in elk distribution, away from critical habitats on public land.

RMEF expressed concern during the scoping period about the potential for this project to impact elk and other wildlife. RMEF appreciates inclusion of elk (and other big game) throughout the EA. However, RMEF has continued concerns about how the impacts to elk were analyzed along with portions of the proposed action.

RMEF does not support the full proposed action, nor any of the alternatives. Rather, RMEF supports a portion of the proposed action – to rehabilitate and close 36 miles of unauthorized non-system trails. This is an immediate need prior to the addition of new trails. Use of other trail systems will shift with the closure of unauthorized trails and RMEF requests the USFS first assess how use is shifted, then follow through with a full Environmental Impact Statement (EIS) to fully account for significant impacts.

Overall, RMEF expresses concern about this project assessment through an EA rather than a full EIS. Justification for not completing an EIS appears to be based on the EA's reliance on the 1998 land and resource management plan (Plan). The relevant pieces identified in the Plan are based on very outdated research. Specifically, the Elk Habitat Effectiveness Model (1983) that was used draws inappropriate assumptions and utilizes open roads as the only metric – it does not include any impact caused by recreational trails. Both roads and trails (cumulatively) should be considered in an updated model.

Furthermore, the current analysis does not take into account direct effects of recreational trails (other than construction). Again, habitat effectiveness is measured by the presence of a road (assumed trail) only. It does not account for the direct effect of users on the trails. In the publication that is regularly referenced in the EA (Wisdom et al. 2018), researchers highlight the importance of accounting for direct effects of recreational trails. The study found that the mean minimum distances of elk from recreationists were 2-4 times farther than mean distances from trails alone. These differences manifested across the four recreation types, indicating that the direct response of elk to recreationists was more predictable (and impactful) than the indirect responses to trails alone. Thus, it is imperative that the USFS take sufficient action to better understand the timing and density of users on these trails and to then analyze the potential impacts of recreationists on elk rather than just the presence of a trail (where use is highly variable across trails). In this project, where an intense amount of usage is expected, an assessment of the trail alone is inappropriate. As studies have shown, wildlife also respond to the activity on the trail and must be included in the cumulative effects analysis. Wisdom et al. (2018) also found that elk shifted farther from trails during mountain biking activities, compared to other types of recreation, thus codifying the need to assess this component more thoroughly.

Despite elk not being classified as a sensitive species for Region 2, RMEF asks the USFS to complete an analysis of cumulative effects on elk. This species was specifically called out in the EA due to partner concerns. If the EA identifies elk as a species of concern, then all auspices of the analyses, including a cumulative effects analysis should occur. This EA represents a unique situation where multiple other EAs in the surrounding area have identified an expected increase in recreation. Each of these projects were analyzed independently, and simply referencing each of those separate analyses does not give justice to a cumulative effects assessment.

The Mad Rabbit Trails Project site-specific EA does not sufficiently address the impacts of new trail development on wildlife, and RMEF requests that the USFS complete a full EIS and fully incorporate recent research into the analysis.

Sincerely,

Karie Decker
Director of Wildlife & Habitat

East have little competition from private entrepreneurs in the provision of trail building and maintenance services. In other regions of the country where entrepreneurs have traditionally provided these services for a fee, managers should be prepared for possible resistance to significant cooperation with nonprofit groups.

Political Considerations

One of the more important advantages noted by our agency respondents was the education of the participants in management problems and their solutions. In addition, agency staff felt it was often valuable to have informed conservationists looking over their shoulders in a non-adversary relationship. Agency staff did not note any difficulties with the dual role of nonprofit organizations as management partner and interest group. It might be thought that a non-adversary relationship would be difficult to cultivate with politically active nonprofit groups. Such partnerships do exist, however, and have the additional benefit of lessening polarization. The educational function of agency-nonprofit partnerships is to make each member aware of the other's perspectives and problems.

An additional benefit is the political support provided to the agency. Taking nonprofit groups into partnership builds a constituency which may generate letters to Congress, help defend budgets, and justify decisions. Of course, nonprofit groups can become large enough and strong enough to be accused of dominating agency decisions, just as commodity interests such as timber companies or concessionnaires have been accused in the past. Some of the partnerships we examined had encountered this problem but were able to cope with it. One effective way to counter accusations, we found, is for agencies to have a clear and straightforward rationale for every decision.

On Balance

Our results lead us to believe the potential advantages of nonprofit-agency partnerships in resource-based recreation management outweigh the disadvantages. While the partnerships we studied are somewhat unique because of the strength of the nonprofit partners, there is every reason to believe that other nonprofit groups are or can become similarly capable. Properly handled, nonprofit-agency partnerships can help to provide quality recreation opportunities to growing numbers of visitors in times of government retrenchment. ■

Literature Cited

APPALACHIAN TRAIL PROJECT OFFICE. 1981. Comprehensive plan for the protection, management, development and use of the Appalachian National Scenic Trail, USDI Natl. Park Serv., Appalachian Trail Proj. Off., Harpers Ferry, W. Va. 43 p.

BURNHAM, C. 1979. Open door: backcountry partnerships. Appalachia 45(7):7.

JACOBI, C. D. 1982. Case Studies of the Role of Nonprofit Volunteer Organizations in Forest Recreation and Park Management. Master's thesis, Va. Polytechnic Inst. and State Univ. 131 p.

RIDDELL, R. 1976. Project flow: a volunteer perspective. Appalachia 42(4):8–10.

USDA FOREST SERVICE. 1982. Friday Newsletter no. 25, June 18.

USDI HERITAGE CONSERVATION AND RECREATION SERVICE. 1978. Report of the Task Force to Consider the Role of Nonprofit Organizations in Providing Outdoor Recreation Opportunities. (Prepared for the 1978 Nationwide Outdoor Recreation Plan.) Copies available from the Appalachian Mountain Club, 5 Joy St., Boston, Mass. 02108. Typescript. 19 p.

Road Density Models Describing Habitat Effectiveness for Elk

L. Jack Lyon

ABSTRACT—Models depicting elk response to changes in the density of forest roads usually require extrapolation beyond the data. Results are likely to reflect the calculation technique rather than elk behavior. One technique described here does produce a model that coincides with actual elk behavior. This model can be used to predict habitat effectiveness for elk at road densities up to six miles per square mile.

Declines in use of habitat adjacent to forest roads have been documented in studies of the North American elk (*Cervus elaphus*) on most of its range (Hershey and Leege 1976, Lyon 1979a, Marcum 1976, Perry and Overly 1976, 1977, Rost and Bailey 1974, 1979, Thomas et al. 1979, Ward 1976). Evidence is consistent and overwhelming that vehicular traffic on forest roads evokes an avoidance response by elk. Even though habitat near roads is not denied to elk, it is not fully used.

Many attempts have been made to restructure available data and provide models for evaluating elk habitat effectiveness as related to miles of road per square mile (density) rather than distance from a road. Only two models have been published (Thomas et al. 1979, and Lyon 1979a), but others have been proposed for local applications. That these models are not identical has been no surprise to wildlife biologists. Every elk herd is unique in some respect, and behavioral differences in adapting to available habitat would be expected.

A more important problem is whether the differences among road density models are artifacts of calculation technique rather than a demonstration of real differences in elk behavior. Most research on elk response to roads has shown, through pellet-group distributions or radio monitoring, less than normal use of areas adjacent to forest roads open to travel. However, no research has been reported in which elk use was compared under different road densities in adjacent areas. As a result, the development of density models has been based on the manipulation of data to conform to one or more assumptions about elk behavior in the area between roads.

In this article, I present three independent sets of data describing elk response to roads and show that calculation methods probably produce greater differences among road density models than do behavioral differences among elk populations. In addition, some new data suggest a way to fit existing information to actual elk behavior.

Data Sources

Few published sets of data include samples of elk use to distances greater than 0.75 mile from a road, and data are often stratified to separate differences related to road quality and cover. I have selected three data sets that appear to describe similar situations and deal only with the effects of unpaved gravel roads in forest habitats.

In the state of Washington, Perry and Overly (1977) established pellet-group control plots two miles from any road and set up sample plots at specified distances from roads. Their data are stratified for road quality. I have used only the data for secondary roads. Pellet-count data from our western Montana studies represent the weighted average of relative pellet-group densities for eight years of study. Stratifications for cover quality (Lyon 1979a) were combined for the evaluation presented here. The Idaho data are unpublished radio location averages for 1979 and 1980 provided by Michael D. Scott and James Peek, University of Idaho. They used the utilization-availability index of Marcum and Loftsgaarden (1980).

Original data, and my calculations for the three data sets, are presented in *table 1*. I forced the origin through zero and assumed that habitat-effectiveness potential is reached at one mile from a road. The resulting elk-use percentages at various distances from roads are graphed in *figure 1*.

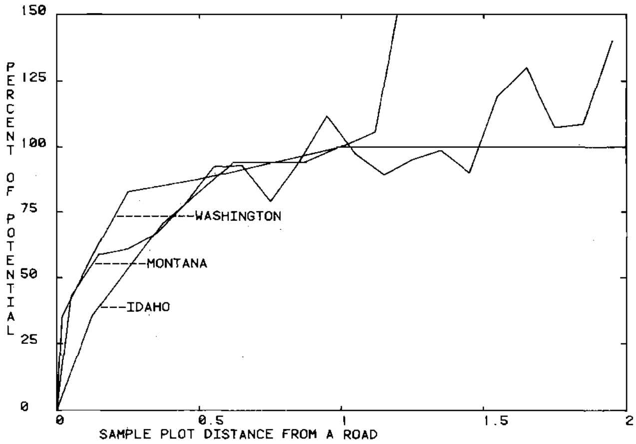


Figure 1. Percentage of elk use recorded at various distances from open forest roads; Washington, Montana, and Idaho sample data.

Development of Road Density Models

When a single road is being considered, investigators have little difficulty calculating losses in habitat effectiveness. For example, the Washington data show elk use to be 35.2 percent of potential in plots 100 feet from the road. The average use of the 200-foot strip nearest the road (100 feet on each side) is 17.6 percent of potential. In effect, the 24.2 acres adjacent to one mile of road receive only as much elk use as 4.3 acres of undisturbed habitat. Similarly, the 135.8 acres lying between 100 and 660 feet of the road are 46.7-percent effective and are therefore equivalent to 63.4 acres of undisturbed habitat.

Continuation of these calculations to one mile suggests that habitat effectiveness is reduced by 226 acres per mile of road. Similar calculations on the Montana and Idaho data predict effectiveness losses of 300 and 360 acres per mile of road. Within the zone influenced

Table 1. Representative data points[1] and calculations for road density models, data sets from Washington, Montana, and Idaho.

	Washington				
ORIGINAL DATA[2]					
Plot distance from road (feet)	100	660	1,320	2,460	10,560
Pellet groups per plot	.37	.61	.87	.92	1.05
CALCULATIONS—potential = 1.05 at 1 mile					
Distance from road (miles)	.019	.125	.250	.500	1.000
Percent of potential	35.2	58.1	82.9	87.6	100.0
Cumulative effectiveness	17.6	42.3	56.4	70.8	82.3
Road density (miles per section)	26.4	4.0	2.0	1.0	0.5
	Montana				
ORIGINAL DATA[3]					
Increment from road (miles)	.1	.3	.5	.7	1.0
Relative elk use	43.0	61.0	78.2	93.0	111.7
CALCULATIONS—potential = mean for elk use over 0.7 mile					
Distance from road (miles)	.05	.25	.45	.65	.95
Cumulative effectiveness	21.5	48.6	57.3	67.1	69.2
Road density (miles per section)	10.0	2.0	1.1	.8	.5
	Idaho				
ORIGINAL DATA[4]					
Distance from road (feet)	656	1,968	3,281	4,593	5,905
Elk use index	.3	.6	.8	.8	.9
CALCULATIONS—potential = elk use index of 0.85					
Distance from road (miles)	.12	.37	.62	.87	1.12
Percent of potential	35.3	70.6	94.1	94.1	105.9
Cumulative effectiveness	17.6	41.2	57.6	67.8	71.8
Road density (miles per section)	4.0	1.3	.8	.6	.5

[1]*Additional points were available and are plotted in* figure 1.
[2]*Source: Perry and Overly 1977.*
[3]*Modified from Lyon 1979a, b.*
[4]*Source: Scott and Peek, unpubl.*

by a single road, the habitat effectiveness ranges from 72 to 82 percent

Modeling of the simultaneous effects of several roads has been considered in two ways. In one approach, it is assumed that losses of habitat effectiveness are cumulative. This assumption produces linear models, as illustrated by the dashed lines in *figure 2*. Extrapolation to road densities of only two to three miles per square mile will usually produce negative estimates of habitat effectiveness. I previously recognized this difficulty (Lyon 1979a), but suggested that "habitat effectiveness in occupied elk range probably cannot be reduced below 10 to 15 percent by roads alone."

In the second approach, it is assumed that any influence of roads on elk terminates at the midpoint between roads. Calculations with the Washington data estimate that habitat is 17.6-percent effective in the 100 feet nearest the road and 46.7-percent effective in the next 560 feet. From the road to a distance of 660 feet, elk habitat effectiveness averages 42.3 percent. Assuming 660 feet as the midpoint between roads, and no overlap in the influence on elk, this estimate of habitat effectiveness is considered representative for a calculated road density of four miles per square mile. Similar calculations for all available data points (*table 1*) produced the nonlinear, no-overlap models presented as solid lines in *figure 2*.

Most biologists have been reluctant to accept the proposal that an elk midway between two roads is as secure as an elk an equivalent distance from a single road. It is evident that extrapolation of the no-overlap models to road densities above two to three miles per square mile seriously underestimates the influence of multiple roads. Thomas et al. (1979), in developing the Perry-Overly road model presented in Agriculture Handbook 553, adjusted for this perceived underestimate by assuming that the calculated habitat loss for a road density of four miles per square mile would actually occur at three miles per square mile.

Evaluation of the models presented in *figure 2* demonstrates that the calculation method can lead to substantial differences in predictions. The Idaho data, from radio locations monitored during the fall, suggest a somewhat greater sensitivity to roads than the two data sets based on pellet groups, but even this difference is less than the differences related to calculation methods. At the same time, it should be noted that the differences in predictions only become inconsistent after 25 to 50 percent of habitat effectiveness has been lost. In the average situation, and independent of the calculation method, habitat effectiveness can be expected to decline

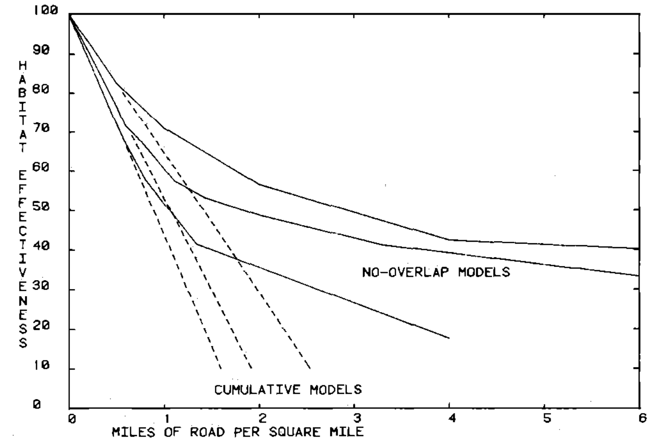


Figure 2. Comparisons between road density models using the no-overlap and cumulative assumptions.

by at least 25 percent with a density of one mile of road per square mile and by at least 50 percent with two miles of road per square mile.

The inherent problem in developing a model appropriate to high road densities is that little of the available data were collected where elk are using areas with road densities greater than two miles per square mile. I have reexamined my (1979a) data to determine elk response to roads on individual square-mile sections. Within the approximately 80-square-mile study area, only 14 sections had road densities as great as two miles at any time during the eight-year study. Over this period only 20 observations in five sections were made where road densities were greater than four miles.

Despite these small samples, elk use in areas with high road densities demonstrates a consistent pattern of response (*table 2*). For the 20 observations of road density between two and three miles per square mile, elk use averaged 47.5 percent of potential. As road densities increased to five to six miles per square mile, elk use declined to less than 25 percent of potential These averages are somewhat misleading, however, because most of the samples with road densities greater than three miles per square mile involved newly constructed roads in a timber sale area. In the year following construction, elk use was 56.9 percent of potential By the third year, logging was nearly completed and elk use had declined to 25.0 percent. And, despite a closure to all but essential management traffic, elk use declined to 20.4 percent of potential in the fifth year after road construction.

The importance of this continuing decline is obvious Although the averages in *table 2* suggest elk use might

Table 2. Habitat effectiveness (percent) for elk where road densities are greater than two miles per section, western Montana.

Age of road (years)	Miles of road per section				Average
	2–3	3–4	4–5	5–6	
Average	47.5 (20)[a]	44.2 (6)	30.3 (9)	22.4 (11)	
1	71.3 (2)	52.0 (2)	53.6 (2)		56.9
2		71.8 (1)	27.7 (1)	29.0 (4)	33.6
3	33.6 (2)		24.2 (2)	23.2 (3)	25.0
4	34.7 (2)	33.5 (1)	23.0 (2)	9.0 (2)	21.1
5	21.2 (2)	15.9 (1)	20.6 (2)	21.4 (2)	20.4
over 5	51.9 (12)	67.0 (1)			53.2 (13)
Average > 3	45.0 (18)	37.3 (3)	22.6 (6)	18.8 (7)	

[a]*Numbers in parentheses are sample sizes.*

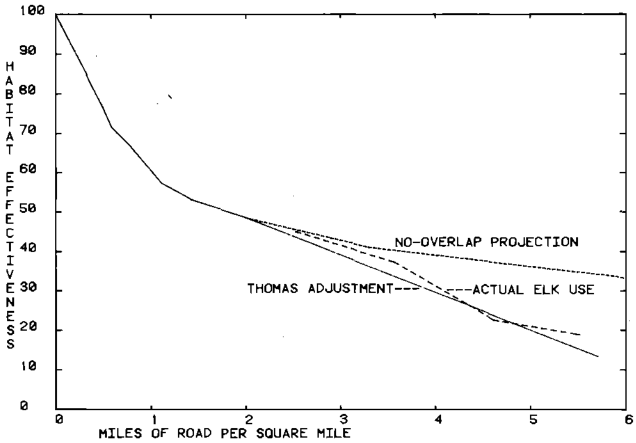


Figure 3. Composite road density model showing actual elk use at densities greater than two miles per section.

remain as high as 20 percent of potential with five and a half miles of road per square mile, it must be recognized that the full impact of a road does not occur until at least the third year after construction. Thus I have assumed that the best estimate of habitat potential for elk as influenced by traveled roads is represented by the average elk use in habitat with roads more than two years old. In the seven areas with an average road density of five and a half miles per square mile, elk use was 18.8 percent of potential.

Figure 3 shows a composite model of the Montana data using the no-overlap assumption for road densities under two miles per square mile and the *table 2* projections for higher road densities. In addition, I have used the Thomas et al. (1979) adjustment to produce a projection of the no-overlap calculations. The agreement between this road density model and the adjustment is coincidental, but the similarity does suggest that this approach may be valid in the absence of data taken in areas with high road densities.

Management Application

Once a graphic display such as the solid line in *figure 3* is developed, it can be directly applied to management of elk habitat. An evaluation area should be at least 3,000 acres; mileage of open roads can be determined from maps or aerial photographs. Roads that dead-end in less than half a mile need not be counted unless they receive unusually heavy traffic. The calculated road density—miles per section—is entered on the horizontal axis to predict habitat effectiveness on the vertical axis.

Avoidance of roads is presumed to be a behavioral response conditioned by vehicular traffic. Other factors, including better hiding cover and lower road standards, can be expected partially to mitigate the negative response by elk. However, the best method for attaining full use of habitat appears to be effective road closures. ■

Literature Cited

HERSHEY, T. J., and T. A. LEEGE. 1976. Influences of logging on elk summer range in north-central Idaho. P. 73–80 *in* Proc. Elk-Logging-Roads Symp., Univ. Idaho, Moscow.

LYON, L. J. 1979a. Habitat effectiveness for elk as influenced by roads and cover. J. For. 77:658– 660.

LYON, L. J. 1979b. Influences of logging and weather on elk distribution in western Montana. USDA For. Serv. Res. Pap. INT-236, 11 p.

(Continued on page 613)

Optimum Stand Prescriptions For Ponderosa Pine

David W. Hann, J. Douglas Brodie, and Kurt H. Riitters

ABSTRACT—Two examples for a northern Arizona ponderosa pine stand illustrate the usefulness of dynamic programming in making silvicultural decisions. The first example analyzes the optimal planting density for bare land, while the second examines the optimal precommercial thinning intensity for a 43-year-old stand. Both examples assume that the manager's primary objective is maximization of the soil expectation value. A number of near-optimal solutions are also provided by the program, and may be preferable when the manager takes account of noneconomic considerations. The optimal solution then provides a standard for cost comparison of these noneconomic considerations.

Management of an even-aged stand requires decisions about planting density, timing and intensity of thinning (both precommercial and commercial) and of fertilization, and rotation length. Because these decisions are interrelated and complex, considerable research has been devoted to developing methods to assist the forest manager in making them. One such management method which has received substantial recent attention is dynamic programming (Hann and Brodie 1980, Martin and Ek 1981, and Riitters et al. 1982).

In this article, the use of dynamic programming in determining optimum and near optimum decisions will be demonstrated with two examples for a ponderosa pine stand (with Arizona fescue understory) on site index 88 land in northern Arizona. The first concerns the optimum planting density on bare land. The second addresses the intensity of precommercial thinning in an overstocked stand. In both examples, the analysis also determines the optimum thinning scheme and rotation length.

Dynamic Programming

Optimization of stand growth under a wide array of silvicultural treatments can be readily accomplished with dynamic programming. Analysis of silvicultural treatment is complex because of the high degree of interdependency between stand treatments over time. For example, an array of planting density alternatives would create an array of stands for first commercial thinning. Each of these stands can be thinned to a number of densities, each of which creates a slightly different stand for consideration at second thinning. The types of stands and possible sequences of treatments multiply with each successive set of possible decisions. Additional treatment options, such as precommercial thinning, types of thinning (high, low, mechanical), and fertilization, further increase the number of potential treatment schedules. There are literally millions of pos-

DEERE & Co 1979 Forestry equipment purchasing guide Moline, Ill 80 p
FISKE, M., and R. B. FRIDLEY. 1975. Some aspects of selecting log skidding tractors. Trans. Am. Soc. Agric. Eng. 18(3):497–502.
FREITAG, D. R., 1965a. Wheels on soft soils, an analysis of existing data. U S. Army Eng. Waterways Exp. Stn. Tech. Rep. 3-670.
FREITAG, D. R. 1965b. A dimensional analysis of the performance of pneumatic tires on soft soils. U.S. Army Eng. Waterways Exp. Stn. Tech. Rep. 3-688.
HASSAN, A. E. 1976. Trafficability study of a cable skidder. Trans. Am. Soc. Agric. Eng. 20(1):26–29.
HERRICK, D. E. 1955. Tractive effort required to skid hardwood logs. For. Prod. J. 5(4):250–255.
KOCH, P. 1972. Utilization of the Southern Pines. Vol. I. USDA Agric. Handb. 420, 734 p.
PERKINS, R. H. 1982. Estimating sawlog center of gravity by empirical formula. For. Prod. J. 32(3):50–53.
PERUMPRAL, J. V., J. D. BALDWIN, T. A. WALBRIDGE, and W. B. STUART. 1977. Skidding forces of tree-length logs predicted by a mathematical model. Trans. Am. Soc. Agric. Eng. 20(6):1008–1012.
RUSH, E. S., and J. H. ROBINSON. 1971. Effects of surface conditions on drawbar pull of a wheeled vehicle. 19th Supplement to Trafficability of Soils, U.S. Army Eng. Waterways Exp. Stn. Tech. Memo. 3-240.
WISMER, R. D., and H. J. LUTH. 1973. Off-road traction prediction for wheeled vehicles. Trans. Am. Soc. Agric. Eng. 17(1):8–10, 14.

Harvest Schedules *(from page 603)*

period were actually available when opening restrictions were observed. No alternative allocations were generated.

Applicability

The system of mapping, stand selection, and simulation programs is potentially useful when restrictions on the size of cutting units complicate implementation of harvest schedules. The "artificial intelligence" provides a means of evaluating both alternative schedules and the effects of current selections on the spatial feasibility of schedules for future periods. The example run on the Chattahoochee indicated that harvest schedules based on aggregated data may not be truly feasible. The procedures presented here could be used to perform an analysis to evaluate actual acreage constraints prior to running a harvest scheduling model.

Computer programs described here were written in FORTRAN for implementation on an IBM 370 computer operating under IBM Time Sharing Option at the University of Georgia. All programs were written as a demonstration of the method (Hokans 1980) and were not intended to be a fully operational system for public dissemination. The existing software depends on a grid-type data base. Although many organizations are now using the superior polygon-type method of data storage, these programs could operate on a polygon-to-grid file created from basic polygon data. When all operations must done on polygon data, the approach (Hokans 1980) could still be used, but new spatial comparison programs would have to be written. Program listings and documentation may be obtained from the author. ■

Literature Cited

CHAPPELLE, D. E., M. MANG, and R. C. MILEY. 1976. Evaluation of timber RAM as a forest management planning model. J. For. 74:288–293.
DAVIS, K. P. 1966. Forest Management. McGraw-Hill, New York. 519 p.
HOKANS, R. H. 1980. Spatial Feasibility Determination of Management Allocations Based on Aggregated Response Groups. Ph.D. Diss., Univ. Ga., Athens. 78 p. University Microfilms order no. 81-07917, Ann Arbor, Mich.
JOHNSON, K. N., and H. L. SHEURMAN. 1977. Techniques for prescribing optimal timber harvest and investment under different objectives—discussion and synthesis. For. Sci. Monogr. 18, 31 p.
MORRISON, D. F. 1967. Multivariate Statistical Methods. McGraw-Hill, New York. 415 p.
NILSSON, N. J. 1971. Problem Solving Methods in Artificial Intelligence. McGraw-Hill, New York. 387 p.

Catfaces on Lodgepole Pine
(from page 601)

BERRYMAN, A. A. 1982. Mountain pine beetle outbreaks in Rocky Mountain lodgepole pine forests. J. For. 80:410–413, 419.
COLE, W. E., and G. D. AMMAN. 1980. Mountain pine beetle dynamics in lodgepole pine forests. Part I: Course of an infestation. USDA For. Serv. Gen. Tech. Rep. INT-89, 56 p.
FURNISS, R. L., and V. M. CAROLIN. 1977. Western Forest Insects. USDA Misc. Publ. 1339, 654 p.
HEPTING, G. H. 1971. Diseases of forest and shade trees of the United States. USDA Handb. 386, 658 p.
MARTIN, R. E., and J. D. DELL. 1978. Planning for prescribed burning in the Inland Northwest. USDA For. Serv. Gen. Tech. Rep. PNW-76, 67 p.
MITCHELL, R. G., R. H. WARING, and G. B. PITMAN. 1983. Thinning lodgepole pine increases tree vigor and resistance to mountain pine beetle. For. Sci. 29:204–211.
REID, R. W., S. WHITNEY, and J. A. WATSON. 1966. Reactions of lodgepole pine to attack by *Dendroctonus ponderosae* Hopkins and blue stain fungi. Can. J. Bot. 45:1115–1126.
REID, R. W., and H. GATES. 1970. Effect of temperature and resin on hatch of eggs of the mountain pine beetle *(Dendroctonus ponderosae)*. Can. Entomol. 102:617–622.
ROBINSON, R. C. 1962. Blue stain fungi in lodgepole pine (*Pinus contorta* var. *latifolia* Engelm.) infested by the mountain pine beetle (*Dendroctonus monticolae* Hopk.). Can. J. Bot. 40:609–614.
SAFRANYIK, L., D. M. SHRIMPTON, and H. S. WHITNEY. 1975. An interpretation of the interaction between lodgepole pine, the mountain pine beetle and its associated blue stain fungi in western Canada. P. 406–426 *in* Management of Lodgepole Pine Ecosystems. Symp. Proc. Vol. I, Wash. State Univ., Coop. Ext. Serv., Pullman.

THE AUTHORS—R. G. Mitchell is a research entomologist, Silviculture Laboratory, Pacific Northwest Forest and Range Experiment Station, USDA Forest Service, Bend, Oregon 97701. R. E. Martin is a professor of wildland forest management, Department of Forestry and Resource Management, University of California, Berkeley. John Stuart is a Ph.D. candidate, College of Forest Resources, University of Washington, Seattle. Support for part of the study was provided by National Science Foundation grant DEB8209813.

Road Density Models Describing Habitat Effectiveness for Elk *(from page 595)*

MARCUM, C. L. 1976. Habitat selection and use during summer and fall months by a western Montana elk herd. P. 91–96 *in* Proc. Elk-Logging-Roads Symp., Univ. Idaho, Moscow.
MARCUM, C. L., and D. O. LOFTSGAARDEN. 1980. A nonmapping technique for studying habitat preferences. J. Wildl. Manage. 44:963–968.
PERRY, C., and R. OVERLY. 1976. Impact of roads on big game distribution in portions of the Blue Mountains of Washington. P. 62–68 *in* Proc. Elk-Logging-Roads Symp., Univ. Idaho, Moscow.
PERRY, C., and R. OVERLY. 1977. Impact of roads on big game distribution in portions of the Blue Mountains of Washington, 1972–1973. Appl. Res. Bull. 11, 38 p. Wash. State Game Dep.
ROST, G. R., and J. A. BAILEY. 1974. Responses of Deer and Elk to Roads on the Roosevelt National Forest. Northwest Section, Wildl. Soc., Edmonton, Alta., Canada. 19 p., mimeo.
ROST, G. R., and J. A. BAILEY. 1979. Distribution of mule deer and elk in relation to roads. J. Wildl. Manage. 43:634–641.
SCOTT, M. D., and J. PEEK. 1980. Radio Location Averages of North American Elk. Univ. Idaho, Moscow. Unpubl. data.
THOMAS, J. W., H. BLACK, JR., R. J. SCHERZINGER, and R. J. PETERSON. 1979. Deer and elk. P. 104–127 *in* Wildlife Habitats in Managed Forests of the Blue Mountains of Oregon and Washington. USDA For. Serv. Agric. Handb. 553.
WARD, A. L. 1976. Elk behavior in relation to timber harvest operations and traffic on the Medicine Bow Range in south-central Wyoming. P. 32–43 *in* Proc. Elk-Logging-Roads Symp., Univ. Idaho, Moscow.

THE AUTHOR—L. Jack Lyon is wildlife research biologist and project leader, USDA Forest Service, Intermountain Forest and Range Experiment Station, Forestry Sciences Laboratory, Missoula, Montana 59806.

United States Department of Agriculture

Forest Service

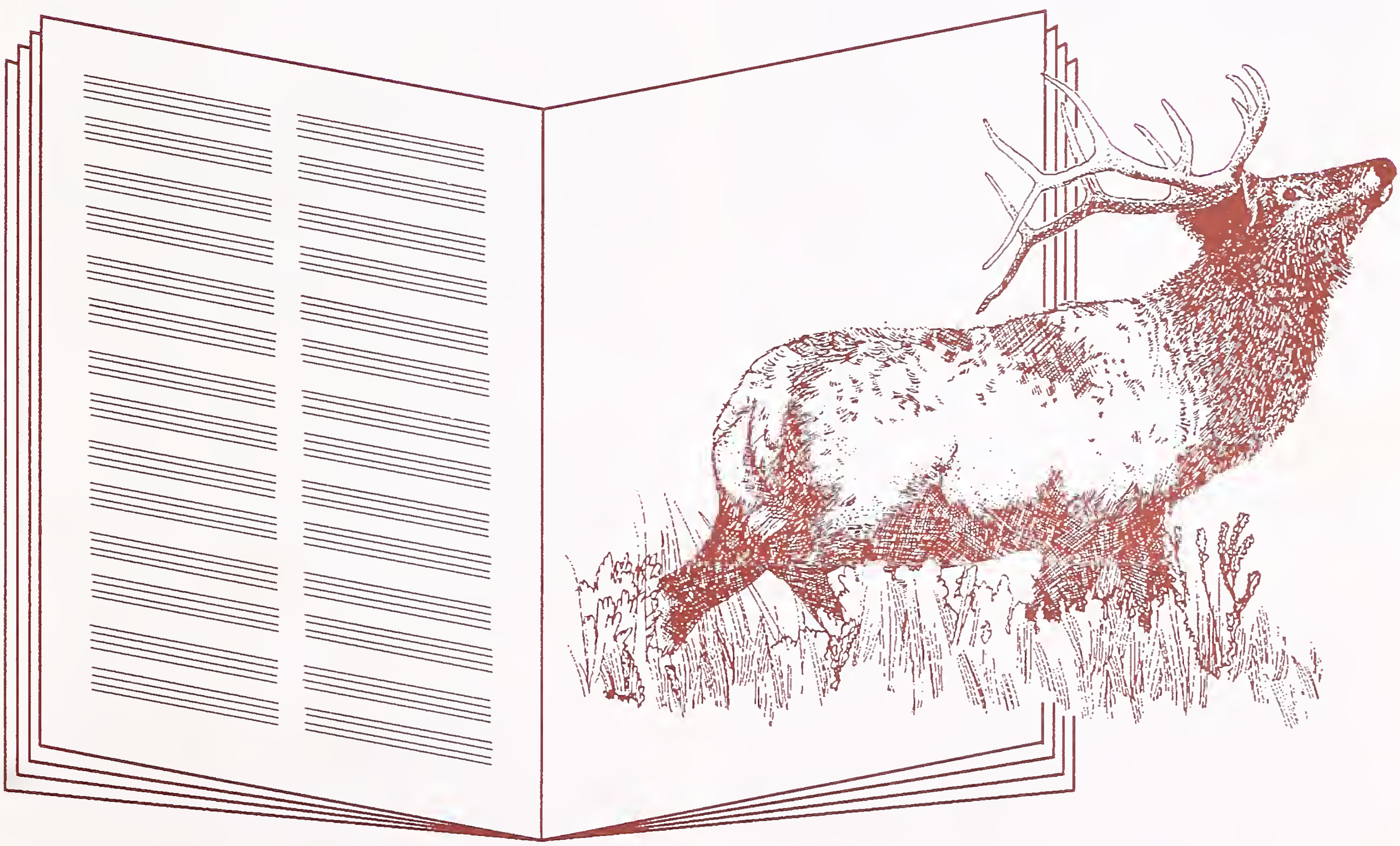
Intermountain Research Station

General Technical Report INT-288

June 1992

A Partial Glossary of Elk Management Terms

L. Jack Lyon
Alan G. Christensen



THE AUTHORS

L. JACK LYON is Wildlife Research Biologist and Project Leader for the Northern Rockies Forest Wildlife Habitat research work unit located at the Intermountain Research Station's Forestry Sciences Laboratory, Missoula, MT.

ALAN G. CHRISTENSEN is Northern Region Wildlife Program Leader and National Elk Initiative Coordinator located in the Wildlife Branch, Northern Region, Forest Service, U.S. Department of Agriculture, Missoula, MT.

RESEARCH SUMMARY

Elk habitat management guidelines have been incorporated into forest plans throughout North American elk range. These guidelines were developed from research on the influences of timber sales and roads during the summer months. Use of these guidelines has too often resulted in inappropriate extrapolation of available information to applications on winter range, hunting seasons, and other conditions outside the scope of the original research.

As a result of extrapolation, some commonly used terms have taken on several meanings, unusual analysis procedures have been developed, and some completely new terminology has been created. There have been applications that are confusing to managers and the public alike. It is essential that the terminology of elk habitat management be clarified.

This paper presents the results of an "Elk Management Terminology Workshop" held at the University of Montana's Lubrecht Experimental Forest on April 3 and 4, 1990. Biologists representing State and Federal governments, universities, and private management concerns participated in a facilitated workshop to identify the most commonly misused terms in elk management guidelines and develop consensus definitions.

ACKNOWLEDGMENTS

We are deeply indebted to the many biologists who helped to organize and complete this project. This paper was originally presented at the Western States and Provinces Elk Workshop in Eureka, CA, May 15-17, 1990. It appears in the proceedings of that workshop, but is being revised and reprinted to obtain wider circulation in the Rocky Mountain West.

Intermountain Research Station
324 25th Street
Ogden, UT 84401

A Partial Glossary of Elk Management Terms

L. Jack Lyon
Alan G. Christensen

INTRODUCTION

Over the past decade we have witnessed the development and proliferation of elk habitat management guidelines throughout North American elk range. These guidelines were primarily developed from research on the influences of timber sales and roads on elk behavior and summer/fall habitat use. However, the development of forest plans and environmental evaluations have too often resulted in inappropriate extrapolation of available information to applications on winter range, hunting seasons, and other conditions outside the scope of the original research.

In the course of this extrapolation, some commonly used terms have taken on several meanings, unusual analysis procedures have appeared, and some completely new terminology has been created. Some applications have been confusing to managers and the public alike. The future of elk management depends on clear communication among agency personnel and the public. We believe it is essential that the terminology of elk habitat management be clarified and standardized.

This paper presents the results of an "Elk Management Terminology Workshop" held at the University of Montana's Lubrecht Experimental Forest on April 3 and 4, 1990. Biologists representing State and Federal governments, universities, and private management concerns participated in a facilitated workshop to identify the most commonly misused terms in elk management guidelines and develop consensus definitions.

Neither the workshop nor this paper could be comprehensive. Most common terminology in elk management is easily understood and used correctly. The recommended definitions for some terms that have often been misinterpreted or used in ways that suggest two or more meanings are presented here. Workshop participants identified some terms that have been so misused as to become virtually meaningless. We recognize that everyone will not agree with our assessments. We expect misuse will continue. Maybe the best we can hope for is to take a step toward making it possible for professionals to communicate with each other.

SELECTION OF TERMS

The Elk Management Terminology Workshop emerged from discussions among eight to 10 concerned biologists in Montana and northern Idaho. An initial list of terms to be discussed was generated by this group. This list was circulated to State and Federal biologists and managers actively involved in elk management and the application of elk management guidelines. Participants were asked to indicate the most troublesome terms on the list and write in additional terms if needed. Based on the responses, about 30 respondents were invited to a formal workshop on the terminology of elk management.

We selected 44 commonly used elk management terms for further study. Each term was sent to at least one prospective workshop participant. Some were sent to as many as three participants. Each participant was asked to determine the history and origin of the assigned terms, to note when they were first used in the literature, and to recommend an acceptable definition. Returns from this second mailing were particularly edifying when some participants supplied their own definitions without recourse to the literature.

At the beginning of the workshop, all recommended definitions were distributed to participants. We determined that about a third of the terms are the source of most of the confusion and misuse. Another third have perfectly acceptable definitions and are rarely misused. Troublesome terms were often interconnected so that misuse of one resulted in confusion and misuse of several others. Finally, we discovered that troublesome terms often had a good definition for either structure or function, but not both. If one definition is missing, for instance, function, the term is likely to be misused or misinterpreted, or both.

Participants were split into three workshop groups. All three groups discussed the highly controversial terms. Less difficult terms were handled by only one group. At the conclusion of the workshop, participants recommended development of a new term:

Accessibility index: This term will become an essential component of future management for elk security during the hunting season. It is needed to summarize the degree of human access facilitated by such components as roads, trails and their management, terrain and vegetation, season length, and legal restrictions. No specific definition is proposed at this time, but we recommend that research in this area recognize the need for broad applicability.

WORD LIST

- BEDDING AREA
- BULL AGE DIVERSITY
- CALVING AREAS
- CARRYING CAPACITY
- COVER FORAGE RATIOS
- CRITICAL HABITAT
- CUMULATIVE EFFECTS
- ELK EFFECTIVE COVER
- ELK EVALUATION/ ANALYSIS AREAS
- ELK HABITAT POTENTIAL
- ELK MANAGEMENT UNIT
- ELK USE POTENTIAL
- ELK VULNERABILITY
- ESCAPE COVER
- ESCAPEMENT
- FORAGE AREA
- FORESTED FORAGE
- GAME MANAGEMENT UNIT
- HABITAT ANALYSIS UNIT
- HABITAT CAPABILITY
- HABITAT EFFECTIVENESS
- HABITAT USE POTENTIAL
- HERD HOME RANGE
- HIDING COVER
- HUNTER OPPORTUNITY
- KEY COMPONENTS
- MIGRATION CORRIDOR
- NURSERY AREAS
- OBJECTIVES
- OPEN ROAD EQUIVALENTS
- OPEN VEGETATION
- OPTIMAL COVER
- POPULATION/HABITAT UNIT
- POTENTIAL ELK USE
- ROAD INFLUENCE
- SECURITY
- SECURITY AREA
- SECURITY COVER
- SECURITY HABITAT
- SIGHT DISTANCE
- THERMAL COVER
- TRANSITIONAL RANGE
- TRANSITORY RANGE
- WINTER RANGE

GLOSSARY

Terms evaluated in the workshop discussions are presented here in alphabetical order, and interrelated terms are cross referenced. Those terms rarely misused are not discussed. Words in all capital letters are defined elsewhere in the glossary.

Bedding area: A specific site selected by big game animals to lie down and rest. See OBJECTIVES.

Bull age diversity: An attribute of population age structure providing a relative measure of the distribution of bull elk among age classes in a population. See OBJECTIVES.

Calving areas: Any areas between WINTER RANGE and summer range where cows give birth to calves.

Discussion: This may be a specific area where a majority of calving for a herd takes place. It may also be scattered locations throughout the HERD HOME RANGE. See OBJECTIVES.

Carrying capacity: Maximum rate of animal stocking without damaging vegetation or related resources.

Discussion: This is a well-established biological concept, but it is too imprecise for any useful application in elk management terminology.

Recommendation: Avoid using this term in relation to elk.

Cover forage ratios: The percentage of a HABITAT ANALYSIS UNIT in cover condition, and the percentage in forage condition, expressed as a ratio totaling 100.

Discussion: COVER:FORAGE has had general application and can be useful in discussing the diversity of summer elk habitat. Application of the term is usually related to habitat models and habitat analysis, but COVER:FORAGE is not an evaluation of overall habitat quality. It should be recognized that COVER:FORAGE contains no inherent provision of SECURITY.

Recommendation: Use of the term should be limited to applicable situations described in the literature.

Critical habitat: A term preempted by the Endangered Species Act of 1973 and considered inappropriate in elk management since then.

Recommendation: Do not use this term when KEY COMPONENT is intended.

Cumulative effects: The additive impacts when a number of unrelated, or related but discrete, management activities take place in a given area.

Discussion: Multiple impacts on wildlife populations of simultaneous but not necessarily coordinated human activities have been recognized as extremely difficult to measure and express. Commonly included are past, present, and reasonably foreseeable future activities. We will need technologies for considering multiple effects as the implications of hunting season SECURITY become more apparent.

Elk effective cover: As used in several forest plans, this term appears to be equivalent to HABITAT EFFECTIVENESS, but it includes implications of both habitat productivity and SECURITY.

Discussion: Because of the way it is used, the term appears to provide habitat information that does not, in fact, exist.

Recommendation: This term should only be used on those forests where it appears in the forest plan. Every effort should be made to clarify the usage so as not to include SECURITY or productivity.

ELK EVALUATION/ANALYSIS AREAS: See HABITAT ANALYSIS UNIT.

ELK HABITAT POTENTIAL: Cannot be defined, although it has been used as a synonym for CARRYING CAPACITY, for HABITAT CAPABILITY, and for ELK USE POTENTIAL.

Discussion: This appears to be a term that tries to find some middle ground between elk use and CARRYING CAPACITY. As a result, the term also confuses accepted definitions of HABITAT EFFECTIVENESS. See ELK USE POTENTIAL for further discussion.

Recommendation: Do not use this term.

ELK MANAGEMENT UNIT: An administrative unit established by the Montana Department of Fish, Wildlife and Parks. See HABITAT ANALYSIS UNIT.

Discussion: Other States probably use other terms.

Recommendation: This term should not be used in reference to habitat analysis.

ELK USE POTENTIAL: A scaled representation of maximum possible use by elk.

Discussion: ELK USE POTENTIAL is the standard against which HABITAT EFFECTIVENESS is normally calculated. It is not, however, an acceptable expression of HABITAT CAPABILITY or CARRYING CAPACITY. Other terms cross-referenced to ELK USE POTENTIAL include ELK HABITAT POTENTIAL, POTENTIAL ELK USE, HABITAT USE POTENTIAL, and HABITAT CAPABILITY. All of these terms strive to identify the ability of a habitat to support elk. However, they are almost always used in a context that compares current with predicted elk use in relation to changes in vegetation. The terms based on "use" appear in the literature related to habitat models. They are probably valid synonyms.

Recommendation: These terms should be used only as justified by the existing literature. They should not be considered random synonyms, and under no circumstances should they be considered equivalent to either CARRYING CAPACITY or HABITAT EFFECTIVENESS.

ELK VULNERABILITY: A measure of elk susceptibility to being killed during the hunting season. This is the antonym of SECURITY during the hunting season.

Discussion: This is primarily a functional concept that is the sum of many factors such as SECURITY, HUNTER OPPORTUNITY, hunter behavior, and elk behavior. It has often been defined in ways related to ESCAPEMENT of branch-antlered bulls.

Recommendation: This term represents a complex area in which a great deal of research remains to be done.

ESCAPE COVER: Vegetation dense enough to aid animals in escaping from potential enemies.

Discussion: Although this is one of the oldest terms in game management, workshop participants considered it too imprecise for use in elk management. It appears as a synonym for SECURITY, SECURITY AREA, SECURITY COVER, and HIDING COVER, but fails to convey any satisfactory meaning.

Recommendation: Do not use this term.

ESCAPEMENT: The number, or proportion, of elk surviving the hunting season. Frequently the emphasis is on specific age and sex classes of elk.

Discussion: In common usage there is confusion with ESCAPE COVER and with the act of escaping. Fisheries literature is clear and useful, indicating that this term can be used to describe the number of animals surviving.

FORAGE AREA: In habitat evaluation models, the percentage of a HABITAT ANALYSIS UNIT not considered HIDING COVER or THERMAL COVER.

Discussion: The workshop agreed that this term will be used correctly in most instances. However, some elk habitat models define FORAGE AREA as openings, which confuses the status of forage found within timber stands. See FORESTED FORAGE.

FORESTED FORAGE: Sometimes used in habitat evaluation models to describe FORAGE AREA within forest stands that are neither HIDING COVER nor THERMAL COVER.

Discussion: Although intended to be a solution, FORESTED FORAGE has become an additional problem. One workshop group noted that because valuable forage is often found in defined cover areas, the term might be interpreted to include all of COVER:FORAGE.

Recommendation: If used at all, this term should be carefully and specifically defined by the user.

GAME MANAGEMENT UNIT: An administrative unit established by the Idaho Fish and Game Department. See HABITAT ANALYSIS UNIT.

Discussion: Other States probably use other terms.

Recommendation: This term should not be used in reference to habitat analysis.

HABITAT ANALYSIS UNIT: An area of land selected as the unit for evaluating the quality of elk habitat.

Discussion: This term and ELK EVALUATION/ANALYSIS AREAS had identical definitions and seem to be used interchangeably. The areas are commonly defined by geographic or administrative boundaries.

Recommendation: The workshop achieved no consensus for selecting one term over the other. These two terms, plus HERD HOME RANGE, POPULATION/HABITAT UNIT, ELK MANAGEMENT UNIT, AND GAME MANAGEMENT UNIT, all attempt to define a specific area within which an analysis procedure can be performed. The first two are defined by animals (by radio locations), the remainder by people. The latter all seem to be arbitrary in the sense that they are drawn to contain a general area of elk habitat rather than a specific area defined by animals. Management units are most often used in management of hunting seasons. All terms should be used as defined. They are not interchangeable.

HABITAT CAPABILITY: The capacity of a given area to meet the needs of elk, either seasonally or year-round.

Discussion: Interestingly, this term is widely used and well-defined in the fisheries literature. The workshop participants considered it nearly equivalent to CARRYING CAPACITY and inapplicable to elk management. See ELK USE POTENTIAL for further discussion.

Recommendation: Should not be used unless used correctly.

HABITAT EFFECTIVENESS: Percentage of available habitat that is usable by elk outside the hunting season.

Discussion: HABITAT EFFECTIVENESS appears to have originated in the road density models as a means of expressing habitat loss associated with open forest roads. It has since been used to express habitat quality, hunting season SECURITY, HABITAT CAPABILITY, CARRYING CAPACITY, and several other conditions not justified by the available data.

Recommendation: We cannot just throw out all existing uses of the term, but biologists and managers should recognize that it has been widely abused. It is usually correct when applied to area. It is usually incorrect when substituted for SECURITY, capability, or productive capacity of habitats. Strive to limit applications to situations meeting the definition.

HABITAT USE POTENTIAL: See ELK USE POTENTIAL.

HERD HOME RANGE: The area a social group of ungulates traverses during normal activities.

Discussion: Although this is a viable concept, we rarely have enough information to use it. It usually includes the total range for a year. See HABIT ANALYSIS UNIT.

HIDING COVER:

Structural definition: Vegetation capable of hiding 90 percent of a standing adult elk from the view of a human at a distance equal to or less than 200 feet. As a site-specific vegetative component of SECURITY, the quality of HIDING COVER varies inversely with SIGHT DISTANCE.

Functional definition: HIDING COVER allows elk to use areas for bedding, foraging, thermal relief, wallowing, and other functions year-round. HIDING COVER may contribute to SECURITY at any time, but it does not necessarily provide SECURITY during the hunting season.

Discussion: Without question, the terms causing the greatest problems and the most confusion involved multiple interpretations and cross-referencing of HIDING COVER and SECURITY. The terms in this subject area often had several different meanings. The implications, particularly with regard to the hunting season, were extremely varied.

Recommendation: Workshop participants were unanimous in concluding that HIDING COVER is a requisite of elk habitat and a component of SECURITY. HIDING COVER alone does not provide SECURITY during the hunting season.

HUNTER OPPORTUNITY: An array of options that allows hunters to choose situations that are personally rewarding.

Discussion: Components of HUNTER OPPORTUNITY are influenced by human activities, hunting regulations, access, time and space, and land management activities. The key to this concept is the ability to select an option that is personally rewarding from several options. An important management decision in providing HUNTER OPPORTUNITY involves the scale of application: statewide, regionwide, forestwide.

KEY COMPONENTS: Areas or landscape features particularly important for maintaining the overall integrity of elk habitat.

Discussion: An acceptable term, other than the potential confusion with CRITICAL HABITAT.

MIGRATION CORRIDOR: Situations, usually linked to topography and vegetation, that provide a completely or partially suitable habitat that animals move through during migrations.

Discussion: This term is easy to misapply because it generally relates to specific locations and can be broadly or narrowly applied. The term usually describes a management problem rather than a definable component of habitat.

Recommendation: Be cautious in application. See TRANSITIONAL RANGE.

Nursery areas: Areas used by a temporary elk social unit consisting of cows and young calves.

Discussion: It is not certain that the term has a specific meaning beyond normal early summer range for large elk cow/calf groups in relatively open habitat. See OBJECTIVES.

Objectives: The workshop participants identified six terms that are generally used correctly by biologists and managers although they have a high potential for misuse. SIGHT DISTANCE, BULL AGE DIVERSITY, NURSERY AREAS, CALVING AREAS, BEDDING AREA, and WINTER RANGE are seemingly unrelated, but they share a potential for misapplication in situations involving objectives other than protection of elk habitat.

Recommendation: Use these terms correctly in situations where they really are applicable.

Open road equivalents: A measure of access that addresses all types of roads and trails used by motorized vehicles, equating these to a common standard. Frequently used in the computation of HABITAT EFFECTIVENESS.

Discussion: Commonly, miles of secondary and primitive road are converted to equivalent primary road miles. Data are available to support such conversions. Various attempts have been made to extrapolate the concept to closed roads, to trails, and to roads and trails during the hunting season. There are no data to support such conversions.

Recommendation: Confine equivalent mileage conversions to evaluation of open roads and recognize that use by any motorized vehicle creates an open road.

Open vegetation: In habitat evaluation models, clearcuts, meadows, and other openings.

Discussion: The term may be useful in verbal discussions but probably defies written definition.

Recommendation: Clarity in descriptions is probably better served by actually saying "clearcuts" and "meadows." Do not use this term.

Optimal cover: A forest stand with four layers, an overstory that will intercept snow, and small openings that provide forage.

Discussion: Other than the clear similarity to old-growth, this was considered a vague term, difficult to measure and define.

Recommendation: Do not use this term.

Population/habitat unit: A discrete association of individual elk bonded together by traditional use of a habitat.

Discussion: By definition, this appears to be identical to HERD HOME RANGE. In use, the unit is usually smaller, indicating some seasonal use by a group of elk. We rarely have enough information to use this concept, but it can be extremely useful when data are available. See HABITAT ANALYSIS UNIT.

Recommendation: Use when data are available.

Potential elk use: See ELK USE POTENTIAL.

Road influence: The effect a road has on elk distribution, behavior, and vulnerability to hunters.

Discussion: This is sometimes interpreted as a zone of influence and is often associated with calculations involving HABITAT EFFECTIVENESS.

Recommendation: Use only as justified by existing literature and within the context of existing habitat models.

Security: The protection inherent in any situation that allows elk to remain in a defined area despite an increase in stress or disturbance associated with the hunting season or other human activities.

Discussion: SECURITY is a state of being or a condition. The workshop group agreed that SECURITY is a functional concept most important when viewed in relation to the hunting season. The components of SECURITY may include, but are not limited to, vegetation, topography, areal extent, road density, distance from roads, size of vegetation blocks, hunter density, season timing, and land ownership.

Recommendation: Very little problem can be encountered in the use of this term if it recognized that HIDING COVER is site specific, while SECURITY is area specific.

Security area: Any area that will hold elk during periods of stress because of geography, topography, vegetation, or a combination of those features.

Discussion: SECURITY AREA is the structural constituent of SECURITY. The workshop group considered this term more meaningful than SECURITY HABITAT. The consensus opinion was that SECURITY HABITAT, even if used as a synonym, can only add confusion and should be avoided.

Security cover: The vegetative cover component of SECURITY.

Discussion: The literature review for this term demonstrates a tendency to equate SECURITY AREA and SECURITY COVER. Although the definition is fairly clear, the consensus of the workshop was that SECURITY AREA is entirely adequate.

Recommendation: Do not use this term.

Security habitat: See discussion for SECURITY AREA.

Recommendation: Do not use this term.

Sight distance: The distance at which 90 percent or more of an adult elk is hidden from human view.

Discussion: A measure of the effectiveness of HIDING COVER, but not a measure of SECURITY. See OBJECTIVES.

Thermal cover:

Structural definition: For elk a stand of coniferous trees 40 feet tall or taller with average crown closure of 70 percent or more. In some cases, topography or vegetation less than specified may meet animal needs for thermal regulation.

Functional definition: Situations, usually related to vegetation structure, used by animals to ameliorate effects of weather.

Discussion: THERMAL COVER, as much as any other term discussed at the workshop, seems to have developed cadres of adherents and of detractors. One reviewer suggested the substitution of "overstory cover" as a replacement. Discussion also noted that thermal relief can be supplied by topography, other animals, and different combinations of vegetation, water, and air movement.

Recommendation: Acceptable concept but should not be used loosely.

Transitional range: Areas where elk concentrate during spring and/or fall. TRANSITIONAL RANGES are generally adjacent to WINTER RANGE and may provide important SECURITY during the fall.

Discussion: TRANSITIONAL RANGE may be important for SECURITY. "Transitional" should not be confused with "transitory." Nearly all MIGRATION CORRIDORS are better described as TRANSITIONAL RANGE.

Recommendation: Use this term rather than MIGRATION CORRIDOR in most cases.

Transitory range: Rangeland created to increase forage production for livestock.

Discussion: This term is sometimes substituted for TRANSITIONAL RANGE. It is not the same thing.

Recommendation: Term should be avoided in any discussion of elk management because it applies directly to livestock.

Winter range: The area, usually at lower elevations, used by elk during the winter months. See OBJECTIVES.

☆U.S. GOVERNMENT PRINTING OFFICE: 1992-673-041/61000

Lyon, L. Jack; Christensen, Alan G. 1992. A partial glossary of elk management terms. Gen. Tech. Rep. INT-288. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station. 6 p.

This glossary helps define terms that have been misused during forest planning. Terms that were developed from research on the influences of timber sales and roads during the summer months have been used inappropriately when referring to winter range, hunting seasons, and other conditions. The glossary is based on the results of an "Elk Management Terminology Workshop" held at the University of Montana's Lubrecht Experimental Forest on April 3-4, 1990.

KEYWORDS: terminology, forest planning, elk security, elk vulnerability

Printed on recycled paper

INTERMOUNTAIN RESEARCH STATION

The Intermountain Research Station provides scientific knowledge and technology to improve management, protection, and use of the forests and rangelands of the Intermountain West. Research is designed to meet the needs of National Forest managers, Federal and State agencies, industry, academic institutions, public and private organizations, and individuals. Results of research are made available through publications, symposia, workshops, training sessions, and personal contacts.

The Intermountain Research Station territory includes Montana, Idaho, Utah, Nevada, and western Wyoming. Eighty-five percent of the lands in the Station area, about 231 million acres, are classified as forest or rangeland. They include grasslands, deserts, shrublands, alpine areas, and forests. They provide fiber for forest industries, minerals and fossil fuels for energy and industrial development, water for domestic and industrial consumption, forage for livestock and wildlife, and recreation opportunities for millions of visitors.

Several Station units conduct research in additional western States, or have missions that are national or international in scope.

Station laboratories are located in:

Boise, Idaho

Bozeman, Montana (in cooperation with Montana State University)

Logan, Utah (in cooperation with Utah State University)

Missoula, Montana (in cooperation with the University of Montana)

Moscow, Idaho (in cooperation with the University of Idaho)

Ogden, Utah

Provo, Utah (in cooperation with Brigham Young University)

Reno, Nevada (in cooperation with the University of Nevada)

COLORADO PARKS & WILDLIFE

2023 Colorado Big Game

DEER — ELK — PRONGHORN — MOOSE — BEAR

APPLICATION DEADLINES — Primary draw: April 4 *(8 p.m. MT)* ▪ **Secondary draw: June 30** *(8 p.m. MT)*

cpw.state.co.us

Updated Big Game Regulations Summary

EFFECTIVE FOR 2023 BIG GAME SEASON

The Severe Winter Zone - License Reduction

The most notable changes in the 2023 big game license quotas are related to the severity and duration of the historic winter in the northwest corner of the state from Rangely to Steamboat Springs and to the Wyoming state line. In this severe winter zone, the winter at lower elevations, where mule deer, elk, and pronghorn winter, was the worst in at least 70 years because of deep, long-lasting, low-elevation snowpack.

CPW recommended unprecedented license reductions within this severe winter zone to account for high mortality rates experienced by mule deer, elk, and pronghorn. These substantial reductions should allow herds to recover as quickly as possible:

- **MULE DEER:** In the severe winter zone, male and either-sex deer licenses are reduced by 5,000 (-48%) in D-2 (GMUs 3, 4, 5, 14, 214, 301, 441), D-6 (GMU 10), and D-7 (GMUs 11, 12, 13, 22, 23, 24, 131, 211, 231) combined. Female licenses are reduced by 2,900 (-94%) and to the minimum of 10 licenses per hunt code in D-2 (GMUs 3, 4, 5, 14, 214, 301, 441) and D-7 (GMUs 11, 12, 13, 22, 23, 24, 131, 211, 231) combined.

- **ELK:** In the severe winter zone, antlerless elk license recommendations are reduced in E-2 (GMUs 3, 4, 5, 14, 214, 301, 441) by 5,600 (-89%) with all public cow hunts reduced to the minimum of 10 licenses per hunt code. In E-6 (GMUs 11, 12, 13, 23, 24, 25, 26, 33, 34, 131, 211, 231) antlerless licenses are reduced 8,700 (-63%) and for E-21 (GMU 10) the reduction is 400 (-60%) antlerless licenses.

- **PRONGHORN:** In the severe winter zone, pronghorn male and female license quotas are reduced to the minimum of 10 per hunt code. Male licenses are reduced by 1,100 (-74%) and female licenses are reduced by 700 (-83%) combined for all DAUs. Affected DAUs include PH-9 (GMUs 3, 4, 5, 13, 14, 131, 214, 301, 441), PH-10 (GMU 11), PH-11 (GMUs 1, 2, 201), and PH-34 (GMUs 12, 23, 211).

Elk Over-The-Counter Season Dates

The duration of the second and third rifle seasons for over-the-counter bull elk licenses have been reduced to five days if used in GMUs 3, 4, 5, 11, 12, 13, 14, 23, 24, 131, 211, 214, 231, 301, and 441. The second rifle season is reduced from Oct. 28–Nov. 5, 2023 to Oct. 28–Nov. 1, 2023, and the third rifle season is reduced from Nov. 11–Nov. 17, 2023 to Nov. 11–Nov. 15, 2023. If such licenses are used outside the severe winter GMUs, the full season dates apply. (*See page 40*)

Late Season Youth Pronghorn Hunts

New regulations specifically require youth hunters to have unfilled ***limited*** doe or either-sex pronghorn licenses to participate in late season youth pronghorn hunts. These changes were made to align regulation with the approved Big Game Season structure for 2020-2024. Previous regulation did not require the unfilled license to be a limited license. (*See page 19*)

Complete Colorado Parks and Wildlife statutes and regulations are available online: **cpw.info/regulations**

OVER-THE-COUNTER LICENSES: ANTLERED ELK — RIFLE — SECOND & THIRD SEASONS

NEW Due to the severe 2022–2023 winter, the second and third rifle seasons for over-the-counter bull elk licenses have been reduced to five days in northwest GMUs. The adjusted season dates and the affected "Severe Winter GMUs" are listed in **RED** below. (*These limitations only apply to the 2023 season.*)

► **SECOND SEASON DATES:** Oct. 28–Nov. 5
NEW **Oct. 28–Nov. 1**

SEX: Bull

LIST: A

LICENSE AGENTS ONLY: E-M-000-U2-R

NEW **VALID UNITS:** **3, 4, 5**, 6, **11, 12, 13, 14**, 15, 16, 17, 18, 21, 22, **23, 24**, 25, 26, 27, 28, 30, 31, 32, 33, 34, 35, 36, 37, 38, 41, 42, 43, 44, 45, 47, 52, 53, 54, 55, 59, 60, 62, 63, 64, 65, 68, 70, 71, 72, 73, 74, 75, 77, 78, 80, 81, 82 *on public lands only*, 85, 86, **131**, 133, 134, 140, 141, 142, 161, 171, 181, **211, 214, 231, 301**, 361, 371, 411, 421, **441**, 444, 471, 511, 521, 551, 581, 591, 681, 691, 711, 741, 751, 771, 851 *except on Bosque del Oso SWA*, 861

► **THIRD SEASON DATES:** Nov. 11–17
NEW **Nov. 11–Nov. 15**

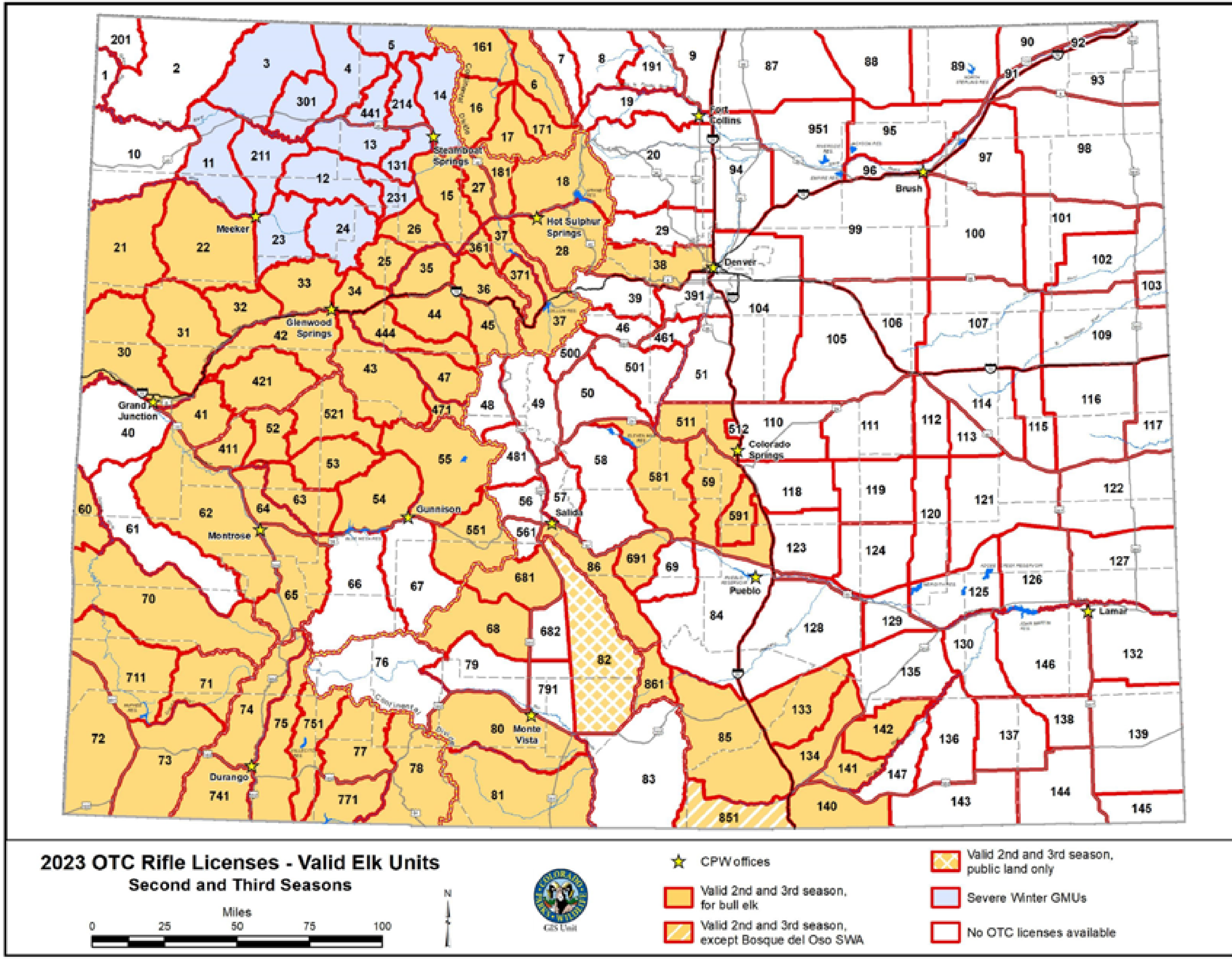
SEX: Bull

LIST: A

LICENSE AGENTS ONLY: E-M-000-U3-R

VALID UNITS: same as second season (*see above*)

Licenses are unlimited in number and available over the counter, **on sale starting at 9 a.m. on AUG 1**. These **ARE NOT** available through the draw.



GAME MANAGEMENT UNIT MAP: Map boundaries are approximate. The map is an aid to apply for the correct unit, **NOT** to be used in the field as an indicator of unit boundaries. See the unit descriptions on pages 69–72 for specific unit boundaries.