Title

Wildlife Use of Open and Decommissioned Roads on the Clearwater National Forest, Idaho

Authors

Switalski, T. Adam
Broberg, Len
Holden, Anna

Publication Date

2007-05-20

Wildlife Use of Open and Decommissioned Roads on the Clearwater National Forest, Idaho

T. Adam Switalski (Phone: 406-543-9551, E-mail: adam@wildlandscpr.org), Wildlands CPR, P.O. Box 7516, Missoula, MT 59807
Len Broberg (Phone: 406-243-, E-mail: len.broberg@mso.umt.edu), Environmental Studies Program, Rankin Hall, The University of Montana, Missoula, MT 59812-4320
Anna Holden (E-mail: anna.holden@grizmail.umt.edu), Environmental Studies Program, Rankin Hall, The University of Montana, Missoula, MT 59812-4320

Abstract: The impacts of roads on wildlife are extensive and can be especially harmful on U.S. National Forest lands where ecosystems are relatively intact. Access allowed by wildland roads can increase poaching, over-hunting, and over-trapping. Roads also increase negative edge effects, cause fragmentation, and facilitate or hinder wildlife movement. Forest Service managers are removing some roads to mitigate these impacts on wildlife, but few studies have addressed the effectiveness of this strategy.

In this study, we tested if wildlife were using decommissioned roads more than adjacent open roads. The study was conducted on the Clearwater National Forest in the Bitterroot Mountains of north-central Idaho where they have removed and revegetated more than 500 mi of roads. From May to October 2006 we monitored wildlife use on open and decommissioned roads using remotely-triggered cameras and baited track plates. Wildlife monitoring was part of a larger citizen monitoring program where a trained volunteer coordinator lead trips into the field each week to collect data on decommissioned roads. Using t-tests, we compared the number of detections and rates of detection between open and decommissioned roads.

Remotely-triggered cameras detected mammals at a higher rate on decommissioned roads than open roads for all species. However, on track plates there were about the same number of detections on open and decommissioned roads. Overall, we could not statistically distinguish the rate of detection between open and closed roads for white-tailed deer, elk, moose, and coyotes. Black bear, however, had a significantly higher rate of detection on removed roads than open roads ($p<.01$). This finding is consistent with several studies that have found that bears avoid open roads.

While the sample size was small, this study is the first to demonstrate with statistical significance that road decommissioning is restoring habitat for bears. This summer we will increase our sampling efforts to help reduce variability and test if the level of security influences rates of detection. More research is needed to fully understand the effects of road removal on wildlife and their habitat.

Introduction

While providing many benefits to society, roads can negatively impact wildlife communities. Roads on U.S. National Forest lands can be especially harmful because of their location in relatively ecologically intact systems. Wildland roads allow access deep into forestlands increasing poaching, over-hunting, and over-trapping (Wisdom et al. 2000). Roads also increase negative edge effects, cause fragmentation, and facilitate or hinder wildlife movement (Trombulak and Frissell 2000).

Removal of some wildland roads is being used as a strategy to reduce the impacts of roads on wildlife; however, few studies have tested the effectiveness of road decommissioning (Switalski et al. 2004). Several studies have examined the effects of temporarily closing roads for elk (*Cervus canadensis*) security (e.g., Irwin and Peek 1979, Leptich and Zager 1991, Gratson et al. 2000). In a review, Rowland et al. (2005) reported that temporary road closures increase the amount of effective habitat, increase hunting opportunities, decrease damage to crops, improve diet quality, increase hunter satisfaction, and decrease vulnerability of elk during the hunting season. These studies just addressed short-term closures, with gates restricting access during the hunting season.

Road decommissioning has been recommended to improve habitat security for grizzly bears (*Ursus arctos horribilis*; Frederick 1991, USFWS 1993, Powell et al. 1996, and Mace et al. 1999), black bears (*Ursus americanus*; Boone and Hunter 1996), and rare forest carnivores (Bull et al. 2001). Reduced access for wood cutting resulting from road decommissioning has also been predicted to benefit cavity nesting birds (Bull and Wales 2001). Anecdotal evidence suggested that Western toads (Bufo boreas) were breeding on decommissioned roads in western Montana where slash created structural diversity and microhabitats (Bradley 1997).

While several studies have hypothesized that road decommissioning would improve wildlife habitat and decrease sources of mortality, there has been no formal study conducted to support or refute these ideas. In this study, we tested if wildlife were using decommissioned roads more than adjacent open roads.

Study Area

The study was conducted on the Clearwater National Forest (CNF) in the Bitterroot Mountains of north-central Idaho. The CNF has removed and revegetated more than 500 mi of roads on the forest. Our sites were located within the Lochsa River watershed. Most sites were remote, but accessible by a paved highway (Hwy. 12) throughout the field season. Lolo and Kooskia were the closest towns and ranged from 17 mi to 57 mi from our sites.

Elevation of the study sites ranged from 3,360 ft to 4,850 ft and slopes generally exceeded 30 percent. The climate is characterized by heavy snowfall from November to March with the nearby Powell Ranger Station (3,630 ft) receiving an average annual total snowfall of 169.4 in. Rain is common in the spring and fall with slight drying in the summer. Powell Ranger Station receives an average annual total precipitation of 38.97 in with more precipitation at higher elevations. The average annual maximum temperature is 56.1 °F and the average annual minimum temperature is 29.4 °F (data from Western Regional Climate Center http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?idpowe).

The tree canopy is dominated by Douglas-fir (*Pseudotsuga menziesii*), western larch (*Larix occidentalis*), and Englemann spruce (*Picea engelmannii*). In riparian, corridors old growth western red cedar (*Thuja plicata*) and grand fir (*Abies grandis*) are the dominant tree species. Important understory shrubs include Sitka alder (*Alnus sinuata*), Rocky Mountain maple (*Acer glabrum*), mountain ash (*Sorbus scopulina*), western thimbleberry (*Rubus parviflorus*), and blue huckleberry (*Vaccinium globulare*).

Decommissioned roads were seeded with non-persistent non-native see mixes, and some level of native plant and shrub community has returned. On many of the sites, trees have also begun to recolonize the decommissioned roads. Additionally, some non-native invasive plants are present on decommissioned roads including spotted knapweed (*Cntaurea maculosa*), St. Johnswort (*hypericum perforatum*), sulfur cinquefoil (*Ptentilla recta*), and oxeye daisy (*Crysanthemum leucanthemum*).

A complete suite of native wildlife species still thrive in the area, except grizzly bears. Most roads receive little human use, except during the hunting season. Archery season for white-tailed deer (*Odocoileus virginianus*) and elk began on August 10 and lasted the remainder of the study. Moose (*Alces alces*) were hunted with rifles from August 30 until the end of the study. Black bear hunting with dogs took place for most of the study and was allowed April 1 until June 30 and then again from August 30 until the end of the study. Coyotes (*Canis latrans*) were managed as predatory wildlife and could be shot on sight. Trapping was generally not allowed during our study.

Methods

From May to October 2006 we monitored wildlife use on open and decommissioned roads using remotely-triggered cameras and baited track plates. Wildlife monitoring was part of a larger citizen monitoring program where a trained volunteer coordinator lead trips into the field each week to collect data on decommissioned roads.

Using GIS, we calculated the "local road density" of each site for an average female black bear home range (12 km^2; Reynolds and Beecham 1980) around each study site (table 1). We also recorded the amount of human use on open and decommissioned roads, aspect, and the amount of cover on decommissioned roads (table 2).

Table 1: Study site characteristics

Study Site	Distance to paved road (mi)	Distance from closest town (mi)	Local road density (mi/mi^2)*
Shotgun	6.5	44 (Lolo, MT)	8
Doe	6	57 (Lolo, MT)	2.8
Pete King	6	17 (Kooskia, ID)	7.3

* Calculated using an average female black bear home range (12km^2; Reynolds and Beecham 1980) buffer; ground truthing will be necessary because not all decommissioned roads have been removed from the Forest Service inventory

Table 2: Study site characteristics for open and decommissioned roads

Study Site	*Open road sites*		*Decommissioned road sites*			
	Amount of use	Aspect	Year of decomm	Degree of Cover	Amount of use	Aspect
Shotgun	low	NE	~1990	high	none	NE
Doe	low	creek bottom	2000	low	low	creek bottom
Pete King	high	SE	2003	low	low	ridgetop

Sampling Design

Our study design consisted of three paired monitoring sites on open and decommissioned roads. One set of a remotely-triggered camera and a track plate were placed on an open road near the beginning of the decommissioned road. A second camera and track plate was set 0.3 mi back on the decommissioned road. A third camera was placed 1 mi back on the decommissioned road to test if increased security (i.e., increased distance from an open road) influenced wildlife use. In order to minimize the amount of variability, sites were located at similar elevation and between 6 and 7 mi from a paved road (table 1).

Sampling Methods

StealthCam© remotely-triggered film and digital cameras were used to record large mammal use. Remotely-triggered cameras have been used successfully for many years to detect wildlife and have been commercially available since the early 1990s (e.g., Kucera and Barret 1993). They contain a passive infrared sensor which triggers the camera using heat and motion. Cameras were mounted on trees adjacent to open and decommissioned roads. On decommissioned roads, cameras were next to existing wildlife trails on the former location of the road prism. Camera stations automatically photograph animals that interrupt the infrared "trip" beam. At night, a visible flash allowed animals to be identified. Cameras were programmed to take three consecutive photos with a 60-second delay between triggers. The camera tagged each photo with the date on each photo. Cameras were checked once a week to ensure they were functioning properly.

Track plates were used to record small and medium size mammals. We employed similar tracking methods as developed by Fowler and Golightly (1994). Track plates consisted of a 24 in x 36 in piece of sheet metal covered by an aluminum roof. In the center of the track plate, a 12 in x 18 in piece of white contact paper was placed sticky side up and affixed with double-sided tape. The remainder of the track plate was covered with a tracking medium consisting of Sight Black©. The track plate was baited with a small can of cat food. Each week, the contact paper with tracks was removed and kept as a permanent record.

Statistical Analysis

For analysis, the total number of detections on open and decommissioned roads from remotely-triggered cameras and track plates were summarized. For remotely-triggered cameras, each trigger was counted as an individual unless it was apparent that the same animal was repeatedly triggering the camera. We had different levels of sampling effort because of camera malfunctions, stolen cameras, and to account for an additional camera on decommissioned roads. In order to accommodate for this disparity of effort, we calculated the rate of detection for each species on open and decommissioned roads dividing the number of individuals of a species by the number of days of sampling (fig. 1). We conducted t-tests to identify if there was a significant difference in the means of the rates of detection between open and decommissioned roads (Zar 1999).

For track plates, there was generally the same amount of sampling effort on each site, so we used raw data for analysis. Multiple tracks of the same species during one sampling period were counted just once. For track plate data, we conducted t-tests to identify if there was a significant difference in the means of the amount of detections between open and decommissioned roads (Zar 1999).

Results

We recorded 11 mammalian species, 1 avian species, and people on open and decommissioned roads. We had a total of 505 camera days which recorded 154 wildlife detections and people (vehicles on open roads; hunters and Agency personnel on decommissioned roads; fig.1). Track plates were checked a total of 38 times resulting in 135 individual detections (fig. 2).

The amount of use on open roads appeared to correspond with distance from the closest town. The closest site to a town (Pete King) had the most use. The amount of use on decommissioned roads appeared to be related to the degree of cover and/or year decommissioned. Shotgun Creek which did not have any human use had been decommissioned for almost 20 years and had dense spruce and alder covering much of the old roadbed.

Overall, remotely-triggered cameras detected mammals at a higher rate on decommissioned roads than open roads for all species (fig. 1). Deer were the most frequently detected species on open and decommissioned roads (10% and 22%, respectively). Coyotes were only detected on decommissioned roads. The one avian species detected, turkey, was only found on open roads.

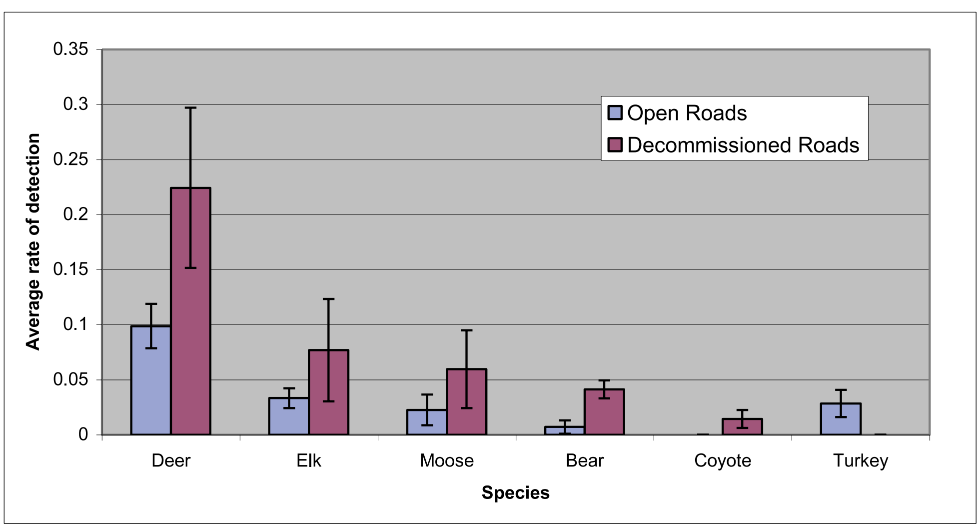

Figure 1. Average rate of detection (number of species/number of camera days) by remotely-triggered cameras on three open and decommissioned roads in the Powell Ranger District of the Clearwater National Forest (May 2006 through October 2006). Error bars are ± one standard error.

On track plates, there were about the same number of detections on open and decommissioned roads (66 and 69, respectively; fig. 2). However, bear tracks were found more on decommissioned roads than open roads. Mice (*Peromyscus* spp.) and voles (*Microtus* spp.) were detected the most and were found on almost every track plate. We could not distinguish these species by their tracks, so they were grouped together. Other species detected on track plates included jumping mouse (*Zapus princips*) , chipmunk (*Tamias* spp.), red squirrel (*Tamiasciurus hudsonicus*), short-tailed weasel (*Mustela erminea*), and American marten (*Martes americana*).

Statistical analysis of camera data found that black bear were detected at a significantly higher rate on decommissioned roads than on open roads (p<.01; fig. 1). There were high levels of variability between sites for most other species and thus there wasn't a statistical difference in detection between open and decommissioned roads.

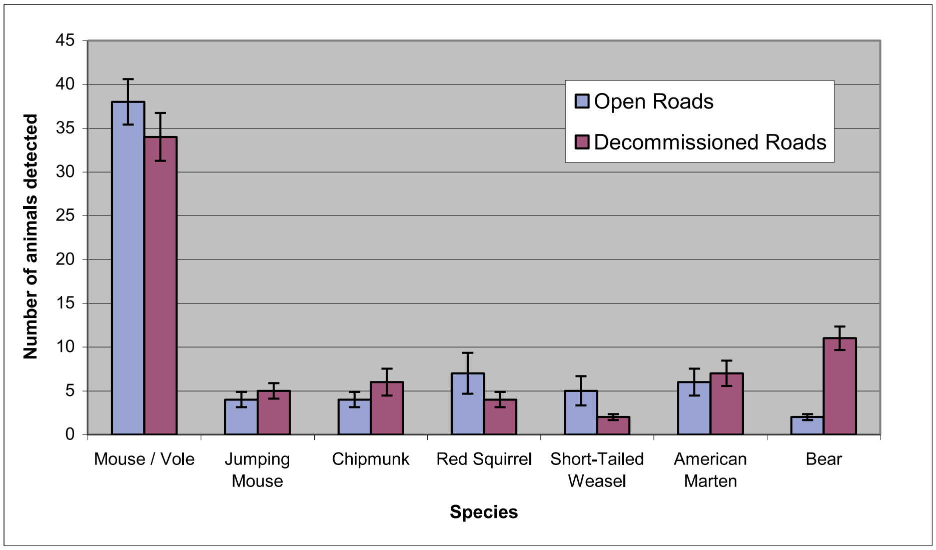

Figure 2. Number of species detected by track plates on three open and decommissioned roads in the Powell Ranger District of the Clearwater National Forest (May 2006 through October 2006). Error bars are ± one standard error.

Discussion

Overall, we could not statistically distinguish the rate of detection between open and closed roads for white-tailed deer, elk, moose, and coyotes. Black bear, however, had a significantly higher rate of detection on removed roads than open roads (p<.01). This is consistent with the scientific literature that suggests that bears avoid roads. Numerous studies have found avoidance of open roads by grizzly bears (e.g., McLellan and Shakleton 1988, Mace et al. 1996, 1999) and black bears (e.g., Brody and Pelton 1989, Kasworm and Manley 1990, Powell et al. 1996). On open roads, these animals are susceptible to poaching and increased hunting pressure. The result of bears avoidance of roads leads to decreased habitat in areas with high road density.

Bear hunters with dogs were documented on open roads during the study and it is likely that bears would avoid these areas to reduce mortality risk, especially during the hunting season. Only on two of our open road sites did we once detect bears. And we never detected bears on roads during the spring or fall hunting season. While Powell et al. (1996) suggested road decommissioning as a critical management scheme to protect hunted populations of black bears; this is the first study to show that this may be the case.

There were high levels of variability due to our small sample size. The Doe Creek site only recorded elk on an open road and had more deer on an open road. Doe Creek was decommissioned in 2000 and has not had much time for vegetation to become established. The low number of detections of ungulates on Doe Creek decommissioned road site could be due to their preference for hiding cover. This site had a low degree of cover and several long lines of sight. Distance to cover was found to be a significant factor determining use of crossing structures by wildlife in Banff National Park, Canada (Clevenger and Waltho 2005).

The management implications of these findings could be very important both in the Clearwater National Forest and beyond. For example, six of eight species of bears around the world are experiencing significant declines in their populations (Servheen 1989). While black bear populations are generally stable, isolated populations in the southern U.S. have been in decline. Additionally, black bears could be a surrogate for the more endangered grizzly bear that are expected to naturally reoccupy the Selway-Bitterroot ecosystem. Considering that black bears tend to be less wary of humans than grizzly bears, they likely would respond similarly to road decommissioning efforts. The Flathead National Forest (MT) has decommissioned more than 300 miles of roads for grizzly bear security, yet little is know if this program is effective. Our study may provide supporting evidence that decommissioned roads provide more security for bears and use them more than open roads.

Our track plates did not find any statistical difference between open and decommissioned roads. This could be due to the lack of structural complexity on recently decommissioned roads. Recently decommissioned roads resemble clearcuts or open roads, and it may take many years for small mammal habitat to return. Many small mammals will avoid and in some occasions not cross open roads (Wisdom et al. 2000). Recently, Semlisch et al. (2007) examined road effects on a woodland salamander (Plethodon metcalfi) in the southern Appalachian Mountains. In addition to finding lower salamander abundance adjacent to forest roads, they also found lower abundance on old (80 years), abandoned overgrown logging roads. Thus, the effects of road building may persist for generations.

Conclusion and Next Steps

While the sample size was small, this study is the first to demonstrate with statistical significance that road decommissioning is restoring habitat for bears. While more research is needed to fully understand the effects of road removal on bears, this is a first step. This summer, we will be increasing our sample size to include two more study sites. We also hope to increase our sampling effort by monitoring sites more than once a week. Checking on our cameras and track plates twice a week would increase the amount of data collected and reduce the amount of data lost due to camera malfunctions. By increasing our sample size, we hope to reduce variability and gain greater insight into the impacts of increased levels of security on wildlife use of decommissioned roads.

Acknowledgements: We thank Rachel Kalenberg, Sam Rogers, Coleman Whitney, Denver Henderson, and Gini Porter for their help summarizing our data and conducting data analysis.

Biographical Sketches: Adam Switalski has been Wildlands CPR's Science Coordinator since 2002. Adam received his M.S. in wildlife ecology from Utah State University. He is a faculty affiliate at the University of Montana and sits on the Board of the Montana Chapter of the Society for Conservation Biology. Recently, Adam organized an Organized Oral Session on road removal research for the 2007 ESA/SER conference in San Jose, CA. He currently is coordinating road removal research projects in Idaho and Montana.

Len Broberg is Professor and Director of the Environmental Studies Program at the University of Montana. He received his J.D. at Wayne State University and a Ph.D. in Biology from the University of Oregon. Len teaches courses in conservation biology and environmental law and policy. He has also published work on transboundary conservation, land use planning, restoration, and wildlife ecology.

Anna Holden is an Environmental Studies graduate student at the University of Montana. Previously she has worked with the University of Montana's Wilderness Institute as a field instructor. Anna was also a recipient of the Doris Duke Conservation Fellowship.

References

Boone, R.B., and M.L. Hunter. 1996. Using diffused models to simulate the effects of land use on grizzly bear dispersal in the Rocky Mountains. *Landscape Ecology* 11(1): 51-64.

Bradley, K. 1997. An evaluation of two techniques for the utilization of logging residues: organic mulch for abandoned road revegetation and accelerated decomposition in small chipped piles. M.S. thesis. Missoula, MT: University of Montana. 58p.

Brody, A.J., and M.R. Pelton. 1989. Effects of roads on black bear movements in western North Carolina. *Wildlife Society Bulletin* 17: 5-10.

Bull, E. L., B. C. Wales. 2001. Effects of disturbance on birds of conservation concern in eastern Oregon and Washington. *Northwest Science* 75 Special Issue 166-173.

Bull, E. L., K. B. Aubry, B. C. Wales. 2001. Effects of disturbance on forest carnivores of conservation concern in eastern Oregon and Washington. *Northwest Science* 75 Special Issue 180-184.

Clevenger, A.P., and N. Waltho. 2005. Performance indices to identify attributes of highway crossing structures facilitating movement of large mammals. *Biological Conservation* 121: 453-464.

Fowler, C.H. and R.T. Golightly, Jr. 1994. Fisher and marten survey techniques on the Tahoe National Forest. Report for U.S. Forest Service. Contract No. PSW-90-0034CA. 64 pp.

Frederick, G.P. 1991. Effects of forest roads on grizzly bears, elk, and gray wolves: a literature review. USDA Forest Service – Kootenai National Forest, Libby MT. Publication number R1-91-73. 53p.

Gratson, Michael W., and Craig L. Whitman. 2000. Road closures and density and success of elk hunters in Idaho. *Wildlife Society Bulletin* 28(2): 302-310.

Irwin, L.L., and J.M. Peek. 1979. Relationship between road closure and elk behavior in northern Idaho. In North American elk: ecology, behavior, and management. Editors MS Boyce, and LD Hayden-Wing, 199-205. Laramie, Wyoming, USA: Univerity of Wyoming.

Kasworm, W.F., and T.L. Manley. 1990. Road and trail influences on grizzly bears and black bears in northwest Montana. In Bears – their Biology and Management: Proceedings of the 8th International Conference on Bear Research and Management, February 1989, Victoria, B.C. Edited by L.M. Darling and W.R. Archibald. Bear Biology Association, University of Tennessee, Knoxville. Pp. 79-84.

Kucera, T.E., and R.H. Barrett. 1993. The Trailmaster camera system for detecting wildlife. *Wildlife Society Bulletin* 21: 505-508.

Leptich, D.J., and P. Zager. 1991. Road access management effects on elk mortality and population dynamics. In Proceedings of the elk vulnerability symposium, compilers A.G. Christensen, L.J. Lyon, and T.N. Lonner, 126-31 Bozeman, Montana: Montana State University.

McLellan, B.N., and D.M. Shackleton. 1988. Grizzly bears and rsource-extraction industries: effects of roads on behavior, habitat use, and demography. *Journal of Applied Ecology* 25: 451-460.

Mace, R.D., J.S. Waller, T.L. Manley, L.J. Lyon, and H. Zuuring. 1996. Relationships among grizzly bears, roads and habitat in the Swan Mountains, Montana. *Journal of Applied Ecology* 33: 1395-1404.

Mace, R.D., J.S. Waller, T.L. Manley, K. Ake, and W.T. Wittinger. 1999. Landscape evaluation of grizzly bear habitat in western Montana. *Conservation Biology* 13(2): 367-377.

Powell, J.W., J.W. Zimmerman, D.E. Seaman, and J.F. Gilliam. 1996. Demographic analysis of a hunted black bear population with access to a refuge. *Conservation Biology* 10(1): 224-234.

Reynolds, D.G., and J.J. Beecham. 1980. Home range activities and reproduction of balck bears in west-central Idaho. In: Martinka, C.J., McArthur, K.L. (eds.) Bears-their biologu and management. Bear Biology Association Conference Series 3. U.S. Government Printing Office, Washington, D.C. pp.181-190.

Rowland, M.M., M. 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 2004 Transactions of the North American Wildlife and Natural Resources Conference, Alliance Communications Group, Lawrence, KS.

Semlitsch, R.D., T.J. Ryan, K. Hamed, M. Chatfield, B. Brehman, N. Pekarek, M. Spath,and A. Watland. 2007. Salamander abundance alon road edges and within abandoned logging roads in Appalachian forests. *Conservation Biology* 21: 159-167.

Servheen, C. 1989. The status and conservation of the bears of the world. International Conference on Bear Research and Management. Monograph Series 2: 1-32.

Switalski, T.A., J.A. Bissonette, T.H. DeLuca, C.H. Luce, and M.A. Madej. 2004. Benefits and impacts of road removal. *Frontiers in Ecology and the Environment* 2(1): 21–28.

Trombulak, S.C., and C.A. Frissell. 2000. Review of ecological effects of roads on terrestrial and aquatic communities. *Conservation Biology* 14: 18-30.

US Fish and Wildlife Service (USFWS). 1993. Grizzly bear recovery plan. Missoula, MT. 181p.

Wisdom, M.J., R.S. Holthausen, B.C. Wales, C.D. Hargis, V.A. Saab, D.C. Lee, W.J. Hann, T.D. Rich, M.M. Rowland, W.J. Murphy, and M.R. Eames. 2000. Source habitats for terrestrial vertebrates of focus in the interior Columbia basin: broad-scale trends and management implications. Volume 1 – Overview. Gen. Tech. Rep. PNW-GTR-485. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station.

Zar, J.H. Biostatistical Analysis. 1999. Prentice Hall, Inc. Upper Saddle River, New Jersey