WILDLIFE
IN MANAGED FORESTS

Deer and Elk

Wildlife in Managed Forests – Project Overview

This publication is one in a series from the Oregon Forest Resources Institute that aims to synthesize current research findings and make information available to foresters and wildlife managers, and to interested parties such as conservation organizations, regulators and policymakers. As part of the Wildlife in Managed Forests Outreach Project, information will be disseminated through publications such as this one, as well as workshops, tours and conferences.

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PacifiCorp

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The Starkey Project

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Cervid: Any of various hoofed mammals of the family Cervidae, which includes deer and elk.

1.0 Introduction

Deer and elk play important roles in the ecology and the culture of Oregon. Balancing healthy deer and elk populations with the need to manage forests for healthy and sustainable timber production is a challenge facing many Oregon land managers. Increasing pressures to convert land from forestry to other uses, combined with the social and political pressures that influence management tools and policies, reduces the available habitat for many wildlife species. Thus, the challenges of managing for sustainable deer and elk populations along with other desired forest outcomes will continue to increase. These pressures can be intensified by continued challenges to maintain and utilize current essential tools and policies. In general, keeping forestland as forests is the number one thing that land managers can do to promote wildlife habitat. This publication provides scientific background, identifies challenges, and offers answers and solutions for land managers.

2.0 Identification and natural history

ELK SPECIES IN OREGON

Roosevelt elk *(Cervus elaphus roosevelti)*

General: Roosevelt elk are the third largest land mammal in North America.

Ecoregions: Coast Range, Willamette Valley, Klamath Mountains and West Cascades.

Physical description: Bulls weigh between 700 and 1,100 pounds; cows weigh between 575 and 625 pounds.

Diet/habitat requirements: Preferred vegetation includes trailing blackberry, huckleberry, vine maple, big leaf maple, salmonberry, Douglas-fir, western hemlock, western redcedar, forbs and grasses. Found throughout western Oregon in riparian, mixed conifer, mixed conifer-hardwood and white oak forest types, and in subalpine parklands, grasslands and agricultural areas.

Preferred forest habitat age: All forest ages, but most heavily associated with young stands where food is most abundant.

Principal predators: Mountain lions, bears (especially on calves) and people.

Reproduction: Elk breed in the fall. Bulls gather cows and calves together in small groups called harems. To attract females, the males wallow in mud and coat themselves with urine. Males will also bugle and rub trees, shrubs and the ground with their antlers to attract cows and intimidate other bulls. Bulls will also aggressively guard their harems from other bulls. Cows produce one calf every year to every other year, depending on physical vigor. Twins are rare.

Rocky Mountain elk ***(Cervus elaphus nelsoni)***

General: Elk are among the noisiest ungulates, communicating danger quickly and identifying each other by sound (RMEF 2013).

Ecoregions: East Cascades, Blue Mountains, Klamath Mountains, Basin and Range, and Columbia Plateau.

Physical description: Cows weigh around 500 pounds while bulls weigh up to 700 pounds.

Diet/habitat: Preferred vegetation includes grasses and forbs in the summer, grasses in the spring and fall, and grasses, shrubs, tree bark and twigs during the winter, especially aspen (RMEF 2013).

Preferred forest habitat age: All forest ages, but most heavily associated with young stands where food is most abundant. Forested areas are used for forage in late summer, shelter and as hiding cover from predators.

Principal predators: Mountain lions, bears, wolves and people.

Reproduction: Elk breed in the fall. Bulls gather cows and calves together in small groups called harems. To attract females, the males wallow in mud and coat themselves with urine. Males will also bugle and rub trees, shrubs and the ground with their antlers to attract cows and intimidate other bulls. Bulls will also aggressively guard their harems from other bulls. Cows produce one calf every year to every other year, depending on physical vigor. Twins are rare.

DEER SPECIES IN OREGON

There are two species of deer in Oregon, each with two subspecies. The most common species is the mule deer, with Rocky Mountain mule deer found on the east side of the Cascades and Columbian black-tailed deer generally found west of the Cascades. The more common northwest white-tailed deer occur throughout most of northeastern Oregon including the Blue Mountains, Snake River and parts of the Columbia Basin. The Columbian white-tailed deer is found in several pockets in Oregon. The Columbian white-tailed deer is listed as an endangered distinct population segment in the lower Columbia River area under the federal Endangered Species Act, whereas the Roseburg population was delisted in 2003.

Salal, Oregon grape, bracken fern and sword fern (typically found in forests with a dense canopy) are not good forage species for deer and elk. Instead, deer and elk need nutritious grasses, forbs and shrubs common to open areas following fire, storm events or logging.

Deer eating a nutritious hazel.

Comparison of deer species in Oregon

	Rocky Mountain mule deer *Odocoileus hemionus hemionus*	**Columbian black-tailed deer** *Odocoileus hemionus columbianus*	**Columbian white-tailed deer** *Odocoileus virginianus leucurus*	**Northwest white-tailed deer** *Odocoileus virginianus ochrourus*
Physical description	Large mule-like ears, generally three quarters of the length of the head. They have a white rump patch and a small white tail with a black tip. Antlers typically branch twice.	Wide triangular tail with a black top and white underside. Antlers typically branch twice.	Similar to black-tailed deer, but has a longer tail that is brown rather than black on top, and white underside. Antlers usually branch off of a single main beam.	Slightly larger than Columbian white-tailed deer with longer tail that is brown on top and white underside. Antlers usually branch off of a single main beam.
Range	Widespread east of the Cascades.	Widespread west of the Cascades.	Two distinct areas in Oregon: near Roseburg and in the lower Columbia River in NW Oregon.	Most of Wallowa, Union, and Baker counties; parts of Umatilla and Grant counties.
Ecoregion	East Cascades, Columbia Plateau, Blue Mountains, Basin and Range.	Coast Range, Willamette Valley, Klamath Mountains, West Cascades.	Coast Range, Klamath Mountains, Willamette Valley.	Blue Mountains, Wallowa Mountains, Snake River, parts of the Columbia Basin.
Principal predators	Wolves, mountain lions, coyotes, bears and people.	Mountain lions, bobcats, bears, coyotes, dogs and people.	Coyotes, mountain lions, bears and people.	Wolves, coyotes, mountain lions, bears and people.
Habitat	Winter habitat is primarily in low-elevation areas with minimal snow that provide vegetation for forage. Summer habitats are commonly in agricultural areas and high-elevation mountains.	Young to old forest stands. Prefers young forest stands for feeding and fawning. Older stands are used for cover.	Prefers white oak woodlands. Historically, inhabited wet meadows, grasslands, and riparian and oak woodlands in the Willamette Valley.	Riparian valleys, mixed hardwood areas and agricultural lands.
Forage	Primarily forbs and the leaves and twigs of woody shrubs, especially shrubs of young ages following disturbance to vegetation such as fire, storms or logging.	Primarily forbs and the leaves and twigs of woody shrubs but consumes many plant species.	Feeds mostly on grasses and forbs; occasionally browses woody vegetation.	Feeds mostly on grasses and forbs; browses woody vegetation and agricultural crops.

3.0 Deer and elk population trends in Oregon

Oregon Department of Fish and Wildlife (ODFW) monitors populations of ungulates in Oregon. Results from this monitoring effort provide ODFW with the information necessary to predict population trends and manage hunter harvest throughout the state.

BLACK-TAILED DEER

ODFW developed a black-tailed deer management plan in 2008. The goal of this plan is to manage black-tailed deer populations in Oregon consistent with both the available habitat on all lands of the state and the Oregon Conservation Strategy; to be compatible with primary land uses; and to provide optimal recreational benefits to the public (ODFW 2008). Typically, ODFW manages deer based on population trends, buck ratios and damage reports. In 1979, ODFW estimated the statewide black-tailed deer population at 452,000. Population estimates during the next 10 years, based on computer modeling that relied primarily on population parameters collected during field surveys, varied between 400,000 and 500,000. However, in 2004, ODFW estimated the black-tailed deer population for Oregon at 320,000.

The plan shows black-tailed deer are difficult to survey because of their secretive life history and the dense cover they inhabit (ODFW 2008). As a result, ODFW is finding it increasingly difficult to define the current population of black-tailed deer, but it is generally believed that the overall state population is declining. Locally, some herds are increasing, but only in areas with adequate resource availability. Risks for black-tailed deer include starvation, parasites and

In 2004, ODFW estimated the black-tailed deer population for Oregon at 320,000.

disease (including Deer Hair Loss Syndrome, or DHLS), predation, collision with vehicles and illegal harvest.

For more information on black-tailed deer populations, visit: www.dfw.state.or.us/wildlife/docs/Oregon_Black-Tailed_Deer_Management_Plan.pdf

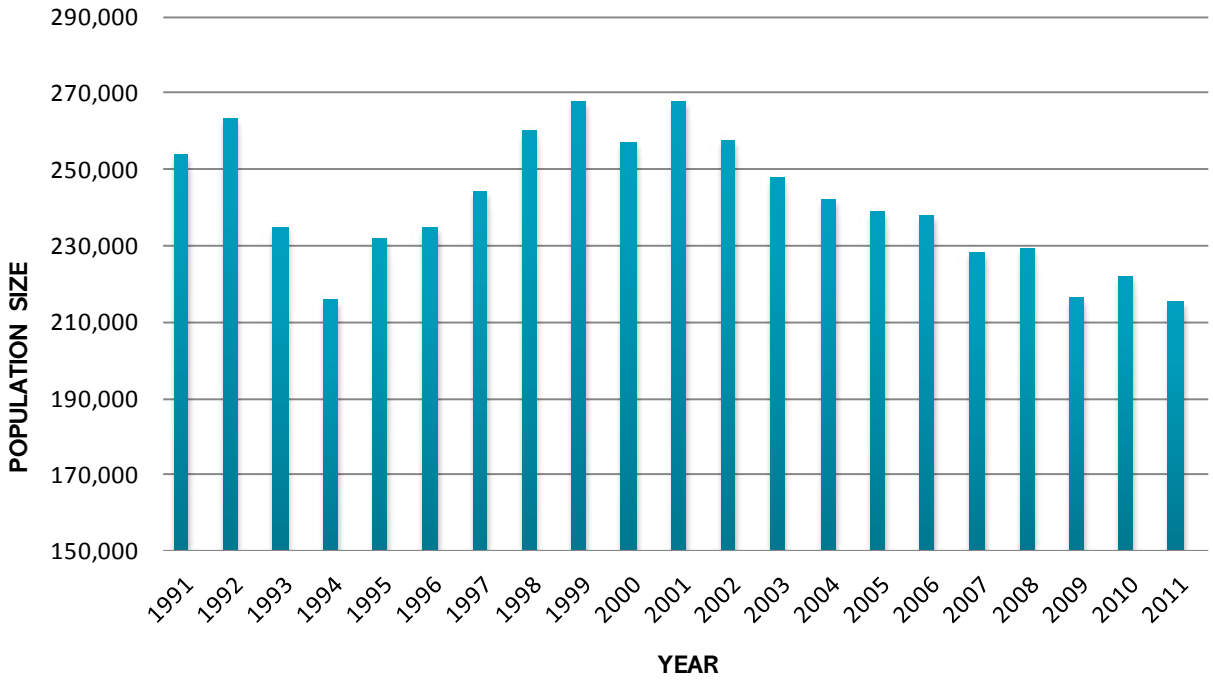
Mule deer populations were estimated at about 212,000 in 2011.

MULE DEER

Fluctuations in mule deer populations can be attributed to the condition of their habitat. Lack of available forage and difficult weather conditions (i.e., harsh winters) can result in poor deer condition, which results in lower survival rates. Other influences include competition with livestock for forage, predation, collisions with vehicles and illegal harvest. The following graph shows Oregon mule deer population trends from 1991 to 2011 (Don Whittaker, pers. comm., 2013).

For more information, see: www.dfw.state.or.us/resources/hunting/big_game/mule_deer/MDI.asp

Recent trends in Oregon's mule deer populations



COLUMBIAN WHITE-TAILED DEER

Early records indicate that Columbian white-tailed deer were once quite numerous over their historic range, from the western slopes of the Cascade Mountains to the ocean, and from Puget Sound in Washington southward to the Umpqua River Basin in southern Oregon, especially in association with major river valleys (USFWS 1983). When the Columbian white-tailed deer was first listed as an endangered species in 1968, the number of deer remaining was estimated at less than 1,000 individuals. Columbian white-tailed deer became endangered throughout their range due to habitat modification by human activities including commercial and residential development. Overhunting and poaching also contributed to the decline.

The population of Columbian white-tailed deer near Roseburg was delisted (removed from the endangered species list) in 2003.

Columbian white-tailed deer are now found in two distinct population segments in Oregon. The population located in Clatsop, Columbia and Multnomah counties remains listed as endangered by the U.S. Fish and Wildlife Service. However, the population of Columbian white-tailed deer found near Roseburg in Douglas County was delisted in 2003 due to recovery. Under the protection afforded by the Endangered Species Act, the Douglas County population has increased to more than 5,000 animals.

For more information, see:
www.fws.gov/oregonfwo/Species/Data/ColumbianWhiteTailedDeer

NORTHWEST WHITE-TAILED DEER

The northwest white-tailed deer overlaps with mule deer (mule deer and northwest white-tailed deer do not interbreed) in much of Wallowa, Union and Baker counties of northeastern Oregon. They generally occur in the lower-elevation riparian and agricultural areas. Northwest white-tailed deer are not managed to the intensity of mule deer, but are included in the bag limit for buck deer in eastern Oregon, and there are a few whitetail-specific hunts.

For more information, see: www.dfw.state.or.us/

ELK

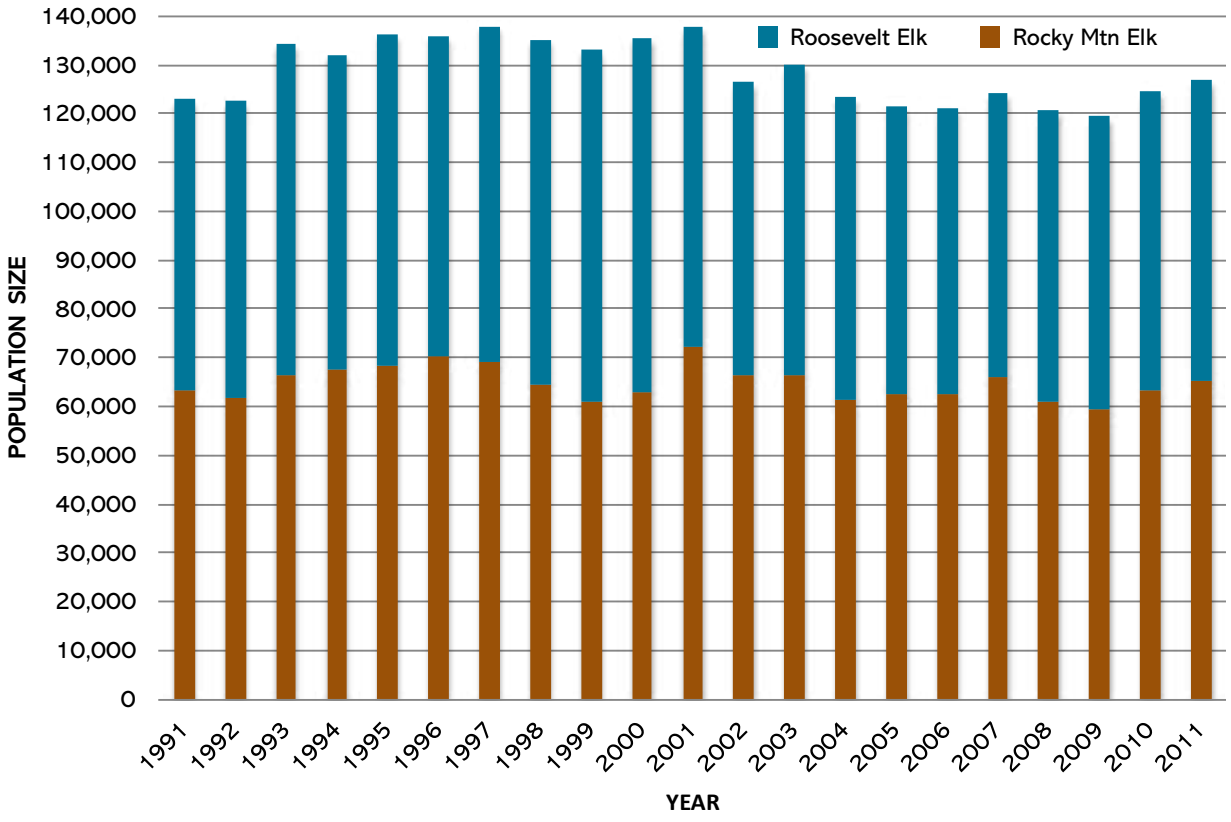
Historical records indicate that both Roosevelt and Rocky Mountain elk were numerous and widely distributed in Oregon before the arrival of non-native settlers (ODFW 2003). There are records of elk being plentiful in the Enterprise area and the Wallowa Mountains, as well as sightings and remains reported from the Burns area and the John Day River (ODFW 2003). Numerous other historical reports indicate elk were plentiful throughout most of western Oregon (ODFW 2003). Hunting through the latter half of the nineteenth century, as well as human

encroachment, took a heavy toll on elk populations. Market hunters killed thousands of elk for meat, hides and antlers. Reports of elk scarcity became common in the late 1880s. The Oregon Legislature provided protection for elk in 1899 by making it illegal to sell meat from wild animals and by closing legal elk hunting from 1909 to 1932 (ODFW 2003). There have been and continue to be numerous restoration efforts for elk in Oregon. The Rocky Mountain Elk Foundation (RMEF) works cooperatively with many Oregon landowners to provide better habitat for elk. In fact, as of December 1, 2012, the RMEF has funded a total of 724 projects in Oregon, affecting 60,000 acres. These efforts, along with management by ODFW, have led to fairly constant elk population numbers in Oregon. The following graph shows recent population trends for both Roosevelt and Rocky Mountain elk in Oregon (Don Whittaker, pers. comm., 2013).

For more information, see: www.dfw.state.or.us/wildlife/management_plans/docs/ElkPlanfinal.pdf

Elk populations in Oregon (Roosevelt and Rocky Mountain combined) are estimated at approximately 128,000 (2011).

Recent trends in Oregon's elk populations



4.0 Managing forests inhabited by deer and elk

It can be challenging to manage forests for both timber production and healthy deer and elk populations. Researchers in Oregon and across the Pacific Northwest have been studying various aspects of deer and elk biology in relation to contemporary timber management practices. Some of the more common questions surrounding deer and elk populations and forest management are addressed in the following sections.

QUESTION 1: HOW DO DEER AND ELK INTERACT WITH INTENSIVELY MANAGED DOUGLAS-FIR PLANTATIONS?

The black-tailed deer, Roosevelt elk and Rocky Mountain elk, hereafter deer and elk, inhabit the Pacific Northwest region where Douglas-fir is the primary commercial species. Deer and elk are wide-ranging, can be locally abundant and consume a diverse variety of palatable plant species and growth-forms, including grasses, forbs, shrubs and trees. In addition, they utilize a broad range of forest types and successional stages, from young stands regenerating after natural or anthropogenic disturbances to old-growth stands. Given their large body size, flexibility in habitat use and diet, behavioral adaptations and population numbers, these species can have a profound influence on plant community composition and structure at local and landscape scales.

Even in the absence of forage resources, deer and elk frequently utilize commercial tree plantations and browse planted seedlings and saplings.

Forest and wildlife managers in the Pacific Northwest have long been interested in relationships between commercial forestry practices and deer and elk populations. For example, information on interactions between contemporary stand regeneration practices and deer and elk population dynamics, habitat preferences and diet can be used to calculate landscape carrying capacity and set harvest quotas. Generally, Douglas-fir plantations are planted with high densities of seedling nursery stock (~400-450 trees per acre) and herbicide treatments are applied during the first two years after planting to reduce competition between conifer seedlings and grasses, forbs and shrubs. Even in the absence of forage, deer and elk frequently utilize commercial tree plantations and browse planted seedlings and saplings. Intense and prolonged browsing by deer and elk may impact economic viability of commercial tree plantations by suppressing growth and reducing wood quality.

One attempt to examine herbicide effects on the quality of ungulate forage is a retrospective study in the Mt. St. Helens area of Washington. Researchers from the University of Alberta and the National Council for Air and Stream Improvement (NCASI) sampled inside and outside of ungulate exclosures to evaluate potential impacts of herbivory on plant community composition in both herbicide-treated and untreated regenerating harvest units. In regenerating units (1-13 years old), 65 percent of the plant biomass outside the exclosures was composed of plant species that were unpalatable forage to elk. Average shrub height was reduced but total shrub biomass was not in sample plots outside the exclosures. Overall, herbicide applications reduced both total and palatable biomass in 1- and 2-year-old units and, while biomass of unpalatable species remained suppressed after 10 years, biomass of palatable species was no different from that found in untreated stands. Also in this study, forage biomass in treated regenerating stands was compared to that in mature (>60 years old) forest stands: results indicated that young treated stands contained, on average, twice as much biomass as mature stands, and in some cases biomass of palatable species was six times higher. These results suggest that current commercial forestry practices are compatible with maintenance of ungulate forage species.

A recent study shows average shrub height was reduced but total shrub biomass was not in sample plots outside the exclosures.

The study described above illustrates why understanding the relationships between herbivory and herbicides is critical for managers. Manipulating the available forage for deer and elk with herbicides and other methods could help land managers reach specific goals such as providing forage for deer and elk while still meeting long-term economic objectives. Some biologists have seen that by providing quality forage for deer and elk, browsing-induced damage to seedlings was reduced and that herbicide use and forage availability are not mutually exclusive.

QUESTION 2: HOW IMPORTANT IS THERMAL COVER TO DEER AND ELK POPULATIONS?

Big game biologists long believed that forest cover provided critical thermal protection from the elements for deer and elk during the winter and summer months. However, studies suggest that, although cover is important for deer and elk, it's important for reasons different than once believed.

In studies conducted from 1991 to 1995 at the Starkey Experimental Forest and Range in northeastern Oregon, researchers found no measurable benefits of thermal cover in either winter or summer. Instead, biologists found that elk held in dense cover stands during the winter lost more weight than elk held in clearcuts. Also, biologists found that during the summer there was no difference in growth of yearling elk among the different thermal cover treatments.

Forage meadow with available hiding cover adjacent.

Similar studies were conducted for mule deer and white-tailed deer in Maine and Colorado. These studies also found that thermal cover has little influence over animal energy balance and performance. However, biologists do recommend cover for both deer and elk as it provides security and protection from predators (Wisdom and Cook 2000).

Management implications for cover:

- Thermal cover may be important under certain conditions, but its value depends on other habitat attributes such as the availability of forage.
- Food enables animals to grow and animals must grow and survive before cover becomes important.

"For land managers who are interested in increasing healthy elk populations, their focus would be better spent on providing forage opportunities rather than cover."

— JOHN COOK, RESEARCH WILDLIFE BIOLOGIST, NCASI

CASE STUDY:

PacifiCorp's management of deer and elk populations

Here is an example of a landowner's strategy for managing healthy deer and elk populations and healthy forests. PacifiCorp owns 13,135 acres in southwestern Washington that have been managed as wildlife habitat since 1983 to offset habitat impacts and loss associated with the Lewis River hydroelectric projects. PacifiCorp's forestry management program benefits a variety of wildlife species, with particular emphasis on improving habitat for deer, elk, black-capped chickadee, pileated woodpecker, savannah sparrow, northern flying squirrel and northern spotted owl.

Timber harvests are 30 acres in size, on a 60-year rotation and are planned across the ownership to provide a mosaic of cover and forage for big game. Security cover for deer and elk and in-stand diversity are retained in harvested areas by:

- limiting the boundaries to within 600 feet of hiding cover
- retaining patches of residual vegetation
- retaining buffer strips to screen natural openings (such as meadows)
- providing travel corridors between natural openings to nearby cover

Specifically for deer and elk, each clearcut timber harvest is:

- mechanically treated to prepare the site for tree seedling planting and grass seeding
- planted with tree species and spacing according to site conditions; the most commonly planted species include western redcedar, Douglas-fir and western hemlock
- planted with an average spacing of 300 trees per acre
- seeded with a forage mix that is palatable and nutritious to deer and elk
- treated with a pre-emergent herbicide (applied at an 18-inch radius around each seedling)

PacifiCorp employs several silvicultural practices to sustain elk forage by promoting continued understory development, while also reducing competition between the trees.

- The first pre-commercial thinning (before age 15) is conducted at an early age of the plantation, when the average trees in the plantation are 10 to 13 feet tall; the spacing objective is approximately 14 by 14 feet or 220 trees per acre.
- Trees are pre-commercially thinned again when they reach a height of 20–24 feet to a spacing of approximately 15 by 15 feet or 194 trees per acre, and the lower branches of the trees are pruned to 6 feet from the ground. Pruning of these long lower branches allows more sunlight to understory shrubs, providing browse, hiding cover and a richer understory herbaceous layer.

PacifiCorp says the most important lesson is to be adaptable; it is much easier to succeed when managing with the landscape instead of against it. An area that was traditionally managed as a pasture or formerly a natural meadow will require considerably less management as a permanent elk forage area than an area that has been traditionally forested.

QUESTION 3: HOW IMPORTANT ARE WINTER AND SUMMER FORAGE FOR ELK?

Studies through the years have explored the importance and timing of forage availability for elk. Research biologists John Cook, Rachel Cook, Mike Wisdom and others have led the effort to understand relationships between summer and winter forage and elk in forest ecosystems.

Ungulate herbivory has profound effects on vegetation development and productivity in forest ecosystems. Likewise the availability of forage for elk has profound effects on their survivability. The requirements of elk vary depending on the season of the year. According to work conducted by John Cook (2002), elk require the most energy and food from midsummer through fall. During the winter their nutritional requirements drop and don't pick up again until the summer. There are differences between males and females. Whether or not the female is pregnant is also a factor, but in general all elk require the most energy – and therefore the most forage – during the summer. Winter forage is obviously important too, but available, high-quality summer forage is critical to the survivability of elk through winter months. Nutritional needs will also increase in summer following a particularly harsh winter.

Forage quality in late spring and summer is key to successful reproduction.

Inadequate maternal nutrition in winter and spring, especially in late spring when the greatest fetal weight gain occurs, results in low-birthweight calves, which are less likely to survive (Thorne, Dean, and Hepworth 1976). Summer nutrition affects the growth and development of calves (Cook et al. 1996, 2011), both through effects on maternal lactation and on weight gain of calves after they are weaned, and it plays a large role in their subsequent size, vigor and survival chances. Forage quality in late spring and summer is key to successful reproduction.

Landowners whose management goals include healthy deer and elk populations may want to consider which forage species they leave for deer and elk and what time of year they are available. Elk prefer and will select certain highly nutritious and palatable plant species when they can get them. These species, mostly in the forage classes of grasses, sedges, annual forbs and deciduous shrubs, provide a more concentrated source of energy than the less-preferred ferns, evergreen shrubs and conifers (Cook 2005).

Where do I go to find cervid-friendly seed mixes?

The Rocky Mountain Elk Foundation has lots of information and experience on seed mixes. There are also local seed companies that sell seed mixes specifically for deer and elk. They are sometimes called "Buck Fever." Common species found in these seed mixes include buckwheat, timothy, oats, chicory, annual ryegrass, red clover, white clover, perennial ryegrass and crimson clover. Landowners looking for seed mixes should be aware of the source and be sure to buy mixes that are free from noxious weeds. Also consider your own site conditions and select a mix that is suitable.

Observing the forage preferences of cow-calf pairs in enclosure pens on industrial timberlands in a variety of habitats, Cook (2005) and others found the following:

Selected by elk	Avoided by elk	Neither selected nor avoided by elk
bigleaf maple	conifers*	most grasses
hazelnut	evergreen shrubs (e.g., salal, Oregon grape and rhododendron)	alder
cascara	sword and deer fern	elderberry
Queen's cup beadlily		salmonberry
northern bedstraw		many forbs
false Solomon's seal		lady fern
oxalis		

**Elk are known to damage conifer seedlings.*

In moist west-side forest ecosystems, vegetation preferred by elk tends to colonize a harvest site following clearcutting or thinning of trees, encouraged by the increase in sunlight that reaches the forest floor. Cook (2005) found that clearcutting, site preparation, planting and herbicide application produced a large flush of early-successional vegetation with good representation of species preferred by elk and deer during summer and fall. The average digestibility of forage was highest in the early years, although even during some of the early years of this study, forage in some geographies was inadequate to provide high-quality nutrition. Given the importance of summer forage, land managers may also want to consider using seed mixes in disturbed areas. Many seed mixes are available, and choosing a deer- and elk-friendly mix could go a long way toward providing much-needed forage. Also, as the conifers on a site begin to close canopy, the deciduous component of the vegetation starts to dwindle, and over the next 20 to 30 years the site becomes dominated by less-nutritious evergreen shrubs and forbs. Land managers may want to consider ways to increase forage for deer and elk within closed canopy stands – especially in summer months.

QUESTION 4: HOW HAS THE CHANGE IN MANAGEMENT ON FEDERAL FORESTLANDS IMPACTED DEER AND ELK DISTRIBUTION?

Limited timber harvest on USFS lands since the implementation of the NW Forest Plan and social, political and legal mandates associated with late successional species have resulted in less early seral habitat on large contiguous tracts of USFS lands. Deer and elk rely on these young forest habitats for foraging opportunities. The most recent elk population survey flights by ODFW were completed in most of Oregon by late February 2012. Although national forest lands account for approximately half the land base, only 69 of the 532 (13 percent) counted elk were observed on national forest lands. The rest (87 percent) were seen on

privately owned timber lands (ODFW 2012). This is not to say that elk are not on national forest lands, but aerial surveys may not detect them because elk would be difficult to see in mature forested stands. The lower levels of early seral forests on federal lands may be impacting deer and elk distribution, but studies need to be conducted to determine if the actual use is less. Some biologists think that there is a distribution problem in both deer and elk herds, and that deer and elk are found too often on private lands and not often enough on federal and state lands (Don Whittaker, pers. comm., 2012). Mary Rowland, a research wildlife biologist with the USFS, says that lack of early seral habitat does affect deer and elk distribution, but cautions that we must look at the entire picture. Human disturbance, roads and predators, as well as early seral habitat, combine to affect the distribution of deer and elk.

Some biologists believe that one way to encourage deer and elk to utilize more federal lands is to create additional early seral habitat on federal lands. The Rocky Mountain Elk Foundation strongly supports federal forest management that develops, restores or enhances early seral-type vegetation.

Cook and others, in a study conducted in the Pacific Northwest, found that elk influence ecology across broad expanses of public and private lands. Where the objective is to provide landscapes with mosaics of early and advanced seral stages for elk, the effort will have to be ongoing in perpetuity and thus will be most effective if integrated in long-term management plans where habitat needs of elk are tied to forest manipulations (Cook et al. 2013). Manipulations may include reducing wildlife potential, producing biofuels, altering forest density, restoring forest health and commercial forestry. The models described in the subsequent pages are tools for landowners that may help land managers address elk distribution across the landscape.

Cultural importance of deer and elk

by Bill Richardson, Rocky Mountain Elk Foundation

Big-game hunting is an important heritage that provides an opportunity for multi-generations to share a tradition and connect to the land.

For many, hunting season is the best time of year. For those who hunt with family and friends, hunting season is about so much more than harvesting meat. The sounds of camp at night, the challenge of the elements, the presence of other keystone predators besides ourselves, and the quest for the most organic meat on the planet combine to form lasting traditions.

A century ago, these traditions were in danger of vanishing. Most states issued moratoriums on big game hunting due to scarcity of animals from uncontrolled hunting that included market hunting. Animal populations did rebound, with the help of reintroductions of elk and deer in areas where they had been extirpated. For many families, this time of scarcity resulted in a deeper appreciation of our hunting heritage. It also contributed to the development of the North American Wildlife Conservation Model, with hunters' self-imposing limitations, including bans on market hunting and commercialization of wildlife. This is the greatest wildlife success story in existence, and behind it all is that deeper quest for freedom to hunt and harvest game.

Elk habitat selection and modeling

Excerpts from USFS-PNW Research Station summaries by Rachel White

Land managers will be the first to admit that managing the landscape with elk is challenging. Elk have multimillion-dollar effects on recreation and land management. The Elk Modeling Team, made up of multiple collaborators from the U.S. Forest Service, BLM, ODFW, WDFW, NCASI, local tribes, OSU and others, has developed new habitat-selection models in conjunction with new elk nutrition models. These new models incorporate updated research and provide a foundation for setting future management direction and habitat restoration guidelines for elk in landscapes across the Pacific Northwest. Models have been developed for both east-side (Blue Mountains) and west-side landscapes.

The elk models focus on summer, a critical time for elk productivity, because summer conditions affect year-round animal performance. For example, the amount and quality of available summer forage directly affect elk pregnancy rates. Management of summer forage areas for elk is thus critical to the management of healthy elk herds, and providing foraging opportunities in summer helps elk survive winter.

This big-picture approach is designed to help landowners work to integrate management objectives and habitat treatments for elk across ownerships. The models were tested across several land ownerships including tribal, Forest Service and BLM lands in order to test real-life management scenarios.

Biologists working on the model found:

- The needs of elk are compatible with active silvicultural management. Elk generally benefit from management practices that reduce overstory cover. Use of the forage base resulting from silvicultural actions is based on the availability of nearby cover and on human disturbance levels.
- In general, forests with less-dense canopies and located at higher elevations have more high-quality forage species for elk. Elk need high-quality summer forage to increase their body fat in order to survive the winter.
- Biologists found that most elk forage in the Coast Range and in many areas of the Cascades is relatively poor nutritionally. Even in clearcuts, where one expects to see more deciduous growth, forage is often below maintenance levels for lactating elk.
- Biologists found that in western Oregon and Washington, elk select gentle slopes close to forest edges that contain both hiding cover and forage, and that are away from open roads.

What do the models do and how can they be applied?

- The habitat model has two main components:
  - nutrition that is ranked across landscapes according to its nutritional value to elk
  - a habitat-selection model incorporating nutrition with other variables (e.g., slope, distance to open roads, distance to cover) that ranks areas according to predicted level of use by elk
- Both the Blue Mountain and west-side models characterize elk use patterns across landscapes. They can help set goals for changing elk use in certain areas and help assess how to get more out of management prescriptions.
- A manager can run scenarios with the models to predict elk use across all land ownerships.

"One of our biggest problems is not elk numbers, but their distribution. With the help of these models, elk distribution can be managed effectively among ownerships."

— MIKE WISDOM, PACIFIC NORTHWEST RESEARCH STATION, FORESTRY AND RANGE SCIENCE LAB

- Minimum size of an area for appropriate application of the habitat-selection model is approximately 25,000 acres; the nutrition models can be run at much smaller scales, such as an individual forest stand.
- The model cannot be used to predict winter habitat conditions or winter use of habitat by elk.
- The models are not applicable to southwest Oregon – at least not yet. Managers need to be sure they are using the appropriate model for their area (i.e., west-side or east-side [Blue Mountain model]).
- The nutrition models can be used to help identify which forage species are avoided and selected by elk. However, the models focus on groups of species and not individual plant species. Still, a manager could look at manipulating habitat to attract or deter elk from a particular area.

If you have elk on your land, these models can help predict where the elk will be during the summer and what the available nutritional resources are like. Managers can then apply their professional judgment to manipulate these areas to increase or decrease elk use consistent with overall management objectives.

For more information or to obtain the models and the user guide, visit the project website: www.fs.fed.us/pnw/research/elk

QUESTION 5: HOW MUCH DAMAGE DO DEER AND ELK CAUSE?

Determining the cost to landowners resulting from deer and elk herbivory is difficult. However, there are some data that shed light on the damage caused by deer and elk. Mike Dykzeul, the director of forest protection for the Oregon Forest Industries Council (OFIC) collects annual voluntary data from their members on deer and elk damage, mostly from western Oregon. Each year, landowners are sent the annual "OFIC Annual Animal Damage Survey for Deer and Elk" complaint forms. The form asks the landowner to provide information such as legal location, whether the damage is from deer or elk, number of units (acres) with damage, and whether the damage is severe or moderate. Severe means reforestation and further protection efforts are required, while moderate means stocking levels are well below management objectives, but meet Forest Practice Act Rules. Moderately damaged units may or may not receive additional reforestation efforts. The following table summarizes the data from 2012 by county for 29 respondents.

Summary of OFIC damage complaints for deer and elk by county in 2012*

	Deer			Elk		
County	**Moderate**	**Severe**	**Acres**	**Moderate**	**Severe**	**Acres**
Benton	12	20	985	8	3	321
Clackamas	11	4	710	31	5	1,211
Clatsop	0	0	0	117	18	8,120
Columbia	0	0	0	19	10	920
Coos	35	0	2,080	248	0	6,035
Curry	10	3	820	61	4	4,350
Douglas	67	15	4,490	43	2	3,029
Jackson	1	1	121	6	2	201
Josephine	9	3	500	0	0	0
Lane	106	16	7,227	17	22	1,919
Lincoln	1	0	46	84	149	15,626
Linn	10	16	1,295	12	20	1,869
Marion	10	4	707	0	0	0
Multnomah	6	0	205	18	0	364
Polk	6	11	1,064	7	2	733
Tillamook	0	0	0	54	21	4,084
Washington	7	0	250	8	0	300
Yamhill	0	0	0	0	0	0
Total	**291**	**93**	**20,500**	**733**	**258**	**49,082**

**Survey conducted in 2012 – actual damage occurred in 2011.*

The table at left shows the number of landowner complaints about deer and elk damage and the resulting 69,582 acres involved in these complaints. It is important to note that though we can clearly see the number of acres affected by deer and elk by these complaints, we cannot estimate what, if any, additional damage to trees would occur if not for the preventive efforts of land managers. We also do not know the potential lost revenue of future harvest dollars resulting from damage by deer and elk. Many biologists think that more studies are needed to quantify the economic loss from deer and elk damage at the time of browse and potential loss at rotation age. However, these numbers do shed some light on the conflict between managing both healthy deer and elk herds and healthy forests.

This vexar tube may not be sufficient to prevent browse damage, which may cause long-term deformity.

Managing for browse damage by deer and elk is second nature to Jimmy Taylor, a research biologist with the National Wildlife Research Center (NWRC). Jimmy notes that conifer forests in the Pacific Northwest are susceptible to deer and elk browse primarily during stand initiation following harvest or natural disturbance (e.g., fire). During the first five years of tree growth, deer and elk forage on the terminal and lateral shoots of young seedlings. In some cases, seedlings are completely uprooted, usually indicative of elk. Elk also trample and break seedlings by running through and bedding in young plantations. Browsing and other sources of seedling mortality are expected by land managers; however, severe and repeated browse can lead to significant economic loss and noncompliance with reforestation standards.

Several commercial repellents are sold to deter deer browse. They generally act on one or more modes of action including neophobia, irritation, conditioned aversion and flavor modification. Research conducted at the National Wildlife Research Center (NWRC) has shown that habituation to odor limits the effectiveness of repellents that are not applied directly to food sources, while topically applied irritants and animal-based products produce significant avoidance. Additional NWRC studies have demonstrated that alternative protein sources such as hydrolyzed casein and feather meal are effective in repelling deer; however, these products are not available to

This seedling has been browsed. Preventing damage from deer and elk can be costly and maintenance-intensive with results not realized for decades.

consumers. While repellents may provide temporary relief in some situations, they are not a long-term solution to deer browse. The durability and effectiveness of repellents can be affected by environmental factors such as air temperature, rain, snow and wind.

Physical barriers range from protection of individual trees with devices such as tubing to exclusion of large areas with fencing. Fencing is an option for excluding deer and elk but is usually avoided because it is cost-prohibitive. Research has shown that not just any fence will exclude deer and elk. Fences must be sturdy enough to withstand break-through by running ungulates and tall enough to prevent jumping (minimum 8 feet). In a research study conducted on commercial forests with historic browse damage, NWRC scientists found that survival of Douglas-fir seedlings inside and outside fences was similar after two years; however, seedling heights were reduced significantly outside fences due to browsing by deer and elk. Furthermore, measures of relative abundance showed that deer and elk were present in young stands year-round, even during hunting seasons. Additionally, NWRC scientists found that survival and heights of seedlings planted with scented bud caps were no different than untreated seedlings.

What are the hidden costs associated with protecting trees from deer and elk?

We talked with a few landowners about their costs of dealing with deer and elk. Many landowners use vexar tubes to prevent damage to young seedlings. One landowner with property in the Coast Range of Lane County suggests that, though tubes are effective, they involve high maintenance and cost. He says his seedling survival rate with the tubes is 85-90 percent, but it's hard to calculate the cost of the effort this landowner expends tubing and adjusting tube heights. Another landowner with property in the Coast Range spent approximately $250 per acre toward initial protection from deer and elk. That might not seem like a lot, but it doesn't count the time it takes to install or maintain the tubes, and it is a cost borne early in the life of a stand where production results will not be realized for decades. Preventing damage from deer and elk is expensive in both time and resources.

QUESTION 6: HOW DO DEER AND ELK RESPOND TO FUELS REDUCTION PROJECTS ON FEDERAL LAND?

There are many ways to actively manage forested habitats in Oregon. Mechanical thinning and prescribed fire are common practices on east-side federal lands of Oregon. Knowledge about the effects of these management tools on wildlife is still somewhat limited. In an experiment conducted at the Starkey Experimental Forest and Range in northeastern Oregon, Ryan Long, a doctoral student at Idaho State University, evaluated the effects of an experimental fuels reduction program on elk and mule deer.

The objectives of the study:

1. Evaluate patterns of stand use by female elk and mule deer following fuels reduction.
2. Evaluate how use of untreated stands by female elk and mule deer differed from use of treated stands.
3. Determine whether male and female elk responded differently to the fuels reduction program.
4. Evaluate the effects of fuels reduction on quantity and quality of forage for elk.

In this study, 26 stands of true fir and Douglas-fir that suffered high rates of mortality from an outbreak of spruce budworm were selectively thinned and burned, while 27 similar stands were left untreated as the experimental control group. Biologists used GPS location data for elk and mule deer over a period of seven years to compare use of treated and untreated stands through time and to evaluate effects of topography, roads, weather and competition. Biologists also estimated quality and abundance of 16 important forage species for elk in the treatment and control stands during the spring and summer for two years.

The results from this study:

- Female mule deer did not change their use of treated stands following the fuels reduction management. Female mule deer used and avoided all stand types in proportion to their availability during spring and summer months.
- During spring, female elk selected treated stands and avoided untreated stands. But during summer, female elk selected untreated stands and largely avoided treated stands.
- Female and male elk use stands differently. Biologists found that during spring, females selected older burns, but males avoided all treated stands. Additionally, untreated stands were avoided by females but selected by males during spring. During summer, however, untreated stands were selected and treated stands were avoided or used in

proportion to their availability regardless of sex.

- Biologists found that both quality (in terms of nutritional value) and quantity of forage for elk were lower in summer than spring across all stand types. In particular, the reduction in canopy cover associated with fuels reduction increased the growth of quality forage in spring, but led to a more rapid aging of important forage species in summer. Responses of individual forage species to fuels reduction varied, but the total abundance of forage was higher in treated than untreated stands during spring months. The opposite was true for summer months.

Harvester being used for a fuels reduction thinning project. Long's study (2008, 2009) showed a reduction in canopy cover associated with fuels reduction increases the growth of quality forage in spring, but led to a more rapid aging of important forage species in summer.

Researchers found that fuels reduction techniques influence how forests are used by mule deer and elk. Although elk may increase use of forest stands following fuels reduction, that response will likely vary seasonally and be influenced by many factors. Consequently, a mixture of treated and untreated forest habitat may provide better long-term foraging opportunities for elk rather than thinning or burning large portions of the landscape. For example, fuels reduction treatments at Starkey appeared to increase foraging opportunities for female elk in the spring, yet were of little benefit to mature male elk. Thus, if management objectives include increasing the number of large males, manipulating habitat in a way that benefits only females would be counterproductive. This study also showed that where elk and mule deer occur together on the landscape, manipulating forest habitat with prescribed fire may be of greater short-term benefit to elk than to mule deer. Finally, this work underscores the importance of considering potential interactions between seasonal changes in plant growth and substantial reduction of canopy cover when planning fuels reduction activities.

Collectively, these results highlight the need for forest managers and biologists to work together to consider potential trade-offs. Understanding how the management actions you take on your forestland, over the landscape and over time, may impact the wildlife that live there is an important step toward managing for both forestry and wildlife.

The Starkey Project

The Starkey Project, located in northeastern Oregon, began in 1987 and continues today. It's a unique program that has combined long-term research with multidisciplinary, multi-partner involvement. Research projects at Starkey are designed to answer specific management questions, many involving forestry and ungulate management. Even basic research projects are designed to identify mechanisms relevant to management. This research approach has resulted in a wide array of information critical to the management of elk, mule deer and forests.

Above, right: Wildlife biologist Ryan Long with a 1-day-old elk calf at the Starkey Experimental Forest and Range. The calf was captured and fit with a radio collar as part of a 3-year study to evaluate the fitness consequences of habitat selection by elk.

Above, inset: After being fitted with a collar, this elk calf quickly returned to its mother unharmed.

Aspen communities are important habitat areas for mule deer on the east side, especially during the spring, summer and fall.

5.0 Summary

Deer and elk play important roles in the ecology and the culture of Oregon. Managing for healthy forests and healthy deer and elk populations continues to be challenging. With increasing human population and demand for human habitat on the rise, there will be more pressure to convert forested areas to other uses. In general, keeping forestland in a forested condition is the number one thing that land managers can do to promote wildlife habitat.

More specifically, deer and elk require the right kinds of nutrition at the right times of year. Land managers whose goals include healthy deer and elk herds may consider what actions they can take to provide forage opportunities for ungulates on their lands. Conversely, managers may look at ungulate distribution across the state and take appropriate actions to discourage deer and elk from their lands. Damage to trees resulting from deer and elk is one of the biggest challenges facing landowners today. There are many ways of dealing with deer and elk damage, and more studies are needed to determine the actual cost to landowners resulting from deer and elk browse. Understanding the needs of deer and elk is an important step toward achieving individual management objectives. Forests can be managed to help provide excellent habitat for deer and elk through timber harvest and other management activities.

Vegetation preferred by elk tends to appear following clearcutting or thinning of trees, encouraged by the increase in sunlight that reaches the forest floor.

Early seral vegetation provides forage and habitat for deer and elk as well as many of the other wildlife species associated with young forest habitats in Oregon. Land managers whose objectives include providing habitat and forage for deer and elk may want to consider the following silvicultural treatments:

- Where thinning is prescribed, thin timber stands to or below 50 percent crown closure to allow sufficient sunlight to reach the ground surface for early seral vegetation to become established.
- Retain any natural meadows and openings and remove encroaching conifers from these open areas. Note that power-line easements make great openings and often provide habitat for deer and elk.
- In thinned stands, create gaps of 1 to 5 acres on sites with east, south or west solar aspect and slopes less than 30 percent and away from open roads.
- In created gaps, plant a few native shrubs that provide fruit, nuts, berries or browse for wildlife.
- Seed all disturbed soil including skid trails, yarding corridors, landings and decommissioned roads with a seed mix of native grass and forb species that will provide high forage value for deer, elk and other species.

These management prescriptions may not make sense for all landowners or all landscapes, but they will work in some areas to help provide habitat for deer and elk.

"The most important lesson is to be adaptable."

KENDEL EMMERSON,
WILDLIFE BIOLOGIST, PACIFICORP

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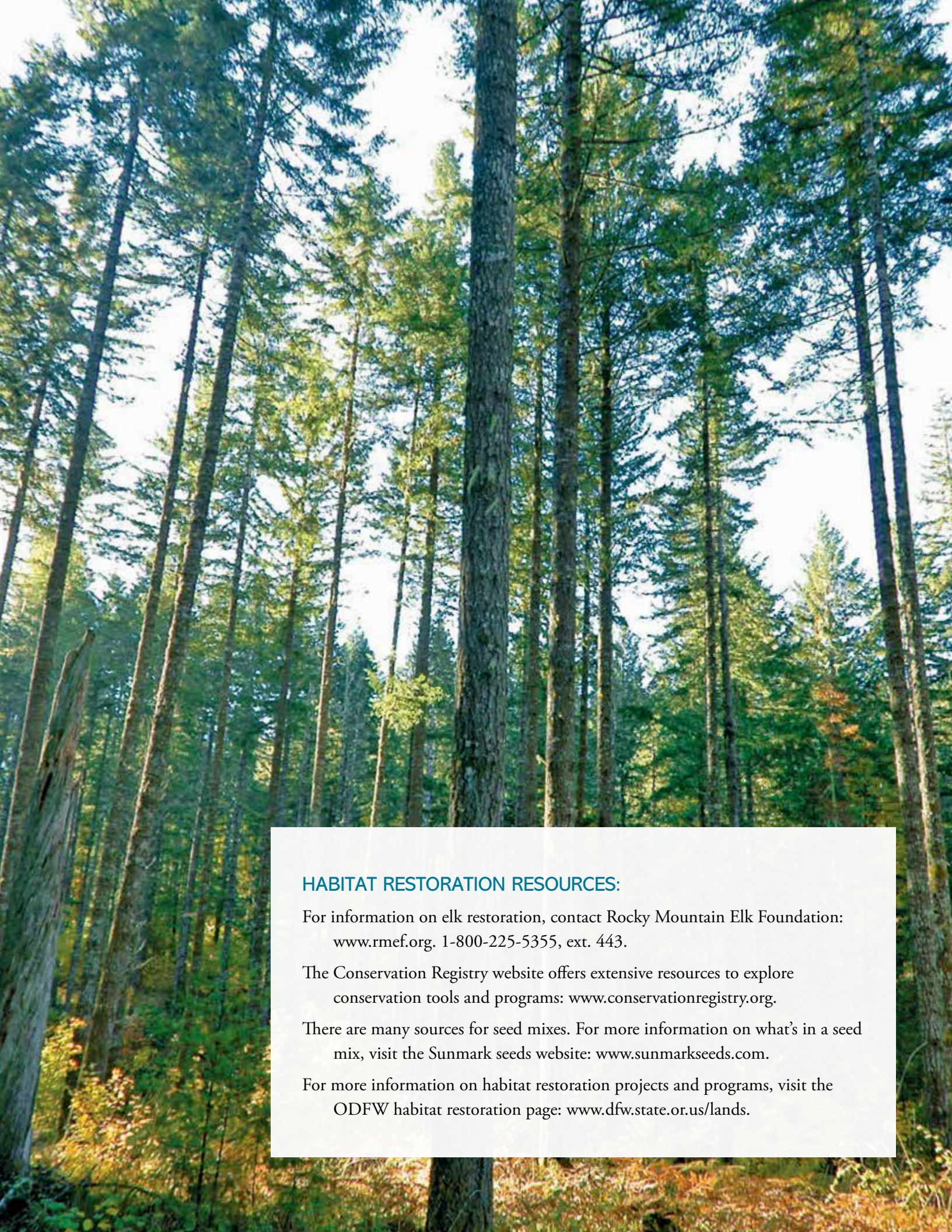

HABITAT RESTORATION RESOURCES:

For information on elk restoration, contact Rocky Mountain Elk Foundation: www.rmef.org. 1-800-225-5355, ext. 443.

The Conservation Registry website offers extensive resources to explore conservation tools and programs: www.conservationregistry.org.

There are many sources for seed mixes. For more information on what's in a seed mix, visit the Sunmark seeds website: www.sunmarkseeds.com.

For more information on habitat restoration projects and programs, visit the ODFW habitat restoration page: www.dfw.state.or.us/lands.

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