

Elk Habitat Management



INTRODUCTION

Pennsylvania's elk herd of 800-900 animals ranges over about 500,000 acres in Cameron, Clinton, Centre, Clearfield, Elk, and Potter Counties. The Game Commission's *Management Plan for Pennsylvania Elk 2006—2016* defines a 3,750 mi² elk management area across the state's northern tier. Each year about 60 harvest tags are issued via a lottery system for a six-day hunt that occurs in early November. Pennsylvania elk also provide a substantial tourist attraction with over 70,000 visitors hoping to catch a glimpse of wild wapiti each year.

The elk range occurs in one of the largest contiguous forest blocks in the Northeastern U.S. with nearly three quarters of the area in public ownership (DCNR State Forest and PGC State Game Lands). Similar to other eastern elk populations, strongholds are centered around reclaimed strip-mines that provide herbaceous foraging habitat in the middle of large forested expanses. Realizing this connection, habitat management efforts since the 1970s have focused on creating and maintaining herbaceous openings.

Today's managers are equipped with decades of research to guide their decision process AND many tools to improve habitat on the ground. Aldo Leopold's assertion of "the ax, the match, the plow, the cow and the gun" as essential wildlife management tools never rang truer than in the case of elk. In this centennial anniversary year of Pennsylvania's elk reintroduction, we look to build on past successes and partnerships while capitalizing on new opportunities to improve elk habitat.

HABITAT CHARACTERISTICS

Whether they bugle in Yellowstone, Arizona, or central Pennsylvania elk are closely associated with "early successional habitats." These young vegetation communities that include grasslands, meadows, young forest, and shrublands are the result of disturbance, either natural or human-induced. Whatever the cause, elk depend on periodic disturbances to perpetuate the food and cover they need for survival. Historic eastern elk populations likely used floodplains, abundant beaver meadows, young forest created by wind-throw, and clearings, barrens, and

savannahs maintained by natural and Indian-set wildfires. Although Pennsylvania's landscape has changed, elk still depend on disturbances and the early successional habitats they create.

Habitat in the elk range

The heart of Pennsylvania's elk range is in the Allegheny Plateau Ecoregion. Over 80% is forested with dry oak-heath, dry oak-mixed hardwood, northern hardwood, and red oak-mixed hardwood forest (in order from high to low dominance). Stands of hemlock and mixed hardwoods occur along steep hill sides that line deep drainages.

The entire area was clearcut by the early 1900s with subsequent wildfires burning intermittently until the early 1950s. Fire suppression policies reduced widespread wildfires over the past 60-70 years. History of the region and land management policies have resulted in predominantly even-aged, second growth forests.

Open areas (approximately 15-20% of land area) are represented by reclaimed surface mines and patchy agricultural lands. Smaller openings occur in riparian meadows, utility ROWs, residential lands, managed food plots and small shallow gas wells. Recent Marcellus Shale development has added larger well pads (3-10 acres) and associated pipelines and roads.

Over 70% of the elk range is in public ownership including State Forests managed by the Department of Conservation & Natural Resources (primarily Moshannon, Elk, and Sprout State Forests) and State Game Lands managed by the PA Game Commission (State Game Lands 14, 34, 94, 100, 311, and 321).



Pennsylvania's elk range is within one of the largest contiguous forest blocks in the eastern U.S.

Elk foods

How and when elk use habitats is largely determined by food availability. Elk eat grasses, woody browse, broadleaf forbs, ferns, acorns, berries, and bark. Food preferences change seasonally depending on what plants are available and their nutritional value. The best elk habitats meet nutritional demands that change through the seasons. These demands also differ between cows and bulls, with cows shouldering greater nutritional stresses brought on by calf-rearing (both gestation and lactation). Elk productivity and population growth are greatly influenced by food quality and availability.

Late winter-spring

By early March cows are in their sixth month of pregnancy, and the developing calf pulls significantly from its mother's reserves.

Cows must find quality food to achieve

healthy birth condition for their calf and themselves. Late winter is also a time of low food availability, prior to spring green-up in the elk range. Woody browse is especially important, with other foods such as wood fern helping fill the void (Figure 1). By late-April cool-season grasses and legumes are out of dormancy and providing excellent forage. Even after green-up, woody browse remains important, comprising up to 50% of elk diets in April through May.



Jake Dingel



Hal Korber

Across all seasons, over half of an elk's diet consists of woody browse and grasses; additionally, several other foods such as forbs, acorns and soft mast play a vital role.

Summer

Summer continues high nutritional demand with calves nursing and bulls growing antlers and putting on reserves for the rut. Elk eat a variety of foods in summer (Figure 1). This is a critical time of year as weaned calves begin foraging and bulls finish physical preparations for the rut. From May to mid-July, cool-season grasses and legumes that dominate strip mines and food plots are actively growing. But by late July, cool-season plants enter a period known to cattle grazers as "summer slump" when palatability and nutritional value decrease. Warm-season



Hal Korber

grasses and forbs (asters, goldenrod, pokeberry) are palatable and nutritious during summer slump, so there's often a shift from cool-season to warm-season forage in late summer. Crops also become a food component in summer and fall, creating potential for elk-human conflicts. Although woody browse is eaten less in summer than other seasons, it still comprises about a quarter of elk summer foods.

Fall-winter

With shorter days and cold weather, food availability and nutritional value change drastically. As winter approaches grasses and forbs lose nutritional quality as they transport protein underground to roots; however they do maintain carbohydrates important as an energy source. At this time, tree and shrub saplings have greater protein and digestible matter than even the most hardy herbaceous plants. The most preferred browse plants in Pennsylvania’s elk range include oaks, willow, dogwood, aspen, and autumn olive. A mix of grasses (for energy) and browse (for protein) allow elk to maintain good body condition through the winter.

The occurrence of autumn olive browse in elk diets may be a function of incidental consumption while foraging on the shrub’s berries. Autumn olive berries are highly palatable in late fall and contain lycopene, protein, sugar, minerals, vitamin C, and other valuable nutritional qualities.

Acorns are important in fall. They provide wildlife with a source of protein, vitamins, phosphorus, fat, carbohydrates, and calcium. Going into the long winter months, acorns are a super-food for elk, deer, bear, squirrels, small mammals, grouse, and turkey.

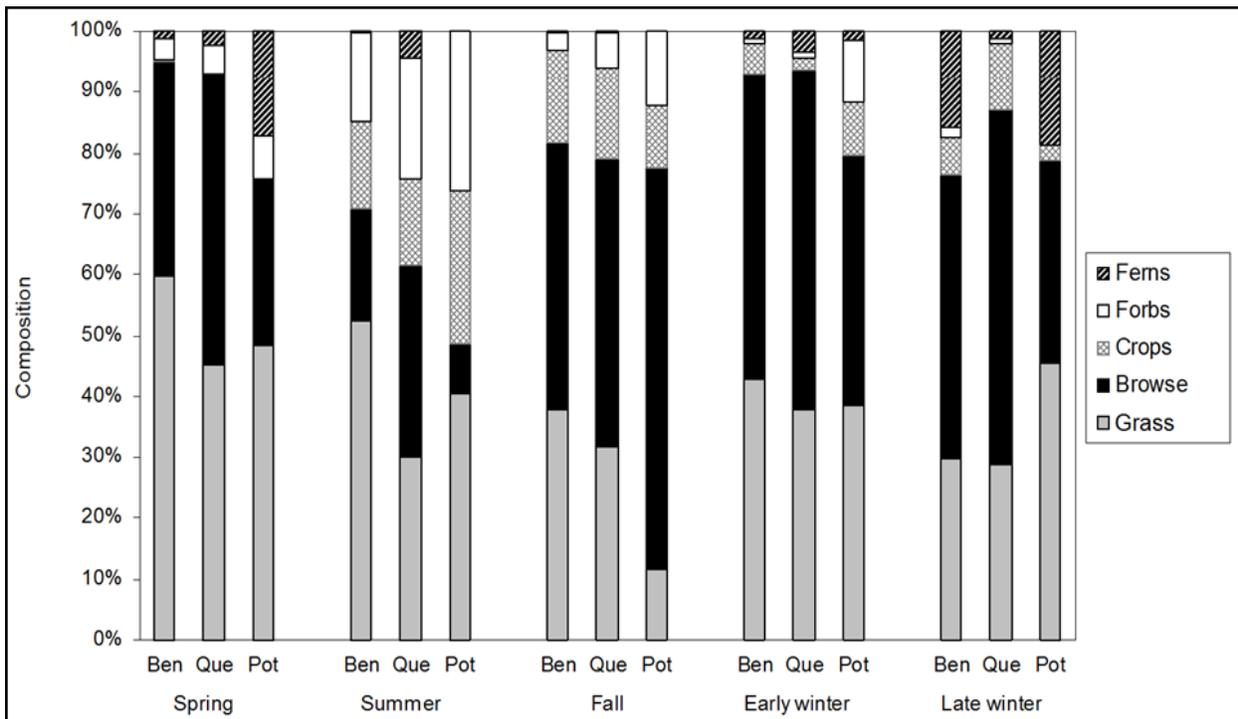


Figure 1. Composition of ferns, forbs, crops, browse, and grass in elk diets in Benezette (Ben), Quehanna (Que), and Pottersdale (Pot), Pennsylvania during each of five seasons: spring (April 1 – May 31), summer (June 1 – August 31), fall (September 1 – October 31), early winter (November 1 – January 31), and late winter (February 1 – March 31) L. Heffernan 2009.

Elk Habitat use

Radio telemetry conducted since the early 1980s by Game Commission biologists and university partners offers insight into elk habitat use. In general, elk habitat suitability is driven by food and cover. Elk are an “edge species”; using habitats where multiple components are found side by side. Whether you call them edges, ecotones, or transition zones, elk need early successional habitat mixed with herbaceous openings, conifers, and forests in varying age classes. Studies in Pennsylvania have shown that elk are seldom more than 300 yards from edges.



Elk prefer staying close to protective cover of shrublands and young forest. Even when foraging in openings they are seldom farther than 300 yards from cover.

Early successional habitats offer security cover *and* food. Plant communities include regenerating timber harvests, blowdowns, mined lands planted with shrubs and trees, riparian shrublands, burned areas, woodlands, and scrub oak-pitch pine barrens.

Conifers occur in two main habitat types in the elk range, riparian hemlock stands and reclaimed strip mine pine plantations. Studies are inconclusive regarding whether elk and other large ungulates require conifers for “thermal cover” to maintain body condition through the winter. Nonetheless, conifers are important because they offer security, reduced snow depth, and distance from human disturbance (in the case of remote riparian hemlock stands).

The elk range is over 80% deciduous forest, and the majority of elk telemetry locations are recorded in this habitat. Elk use deciduous forest extensively and it defines the background canvas on which habitat managers work. It’s essential to fully utilize current forest management methods to improve elk habitat. Among the most important considerations are sustaining oak-habitats for acorn production and interspersing young stands over time across a sea of 80-100 year-old second growth forest.

Herbaceous openings are important to elk in forested north central Pennsylvania. In fact, their home ranges often include reclaimed strip mines, managed food plots, and residential areas (i.e., lawns, landscaping). Openings provide forage spring through fall. The most heavily used openings are those near thick shrublands or young forest cover.



HABITAT MANAGEMENT STRATEGIES

Herbaceous Openings

Herbaceous forage is an important component of elk habitat management. Much emphasis has been placed on managed openings or “food plots” mostly on reclaimed strip mines and scattered forest openings. Because Pennsylvania’s elk range isn’t known for quality agricultural soils, forage production is a challenge. This is particularly true of strip-mined soils that are typically thin, acidic, and highly compacted. Nonetheless, wildlife managers can use some of the same vegetation management techniques as cattle grazers, whose bottom line depends on forage. The main goal is to *efficiently* provide quality forage throughout the year.

Strategy 1. Annual and managed perennial openings

Currently, most elk range openings are dominated by cool-season perennials (orchardgrass, timothy, bluegrass, fescue, clovers, trefoil) or annuals such as wheat, turnips, and rape. To be productive, such openings require multiple treatments which may include mowing, liming, fertilizing, spraying, disking, planting, or all of the above in a given year. Even with large scale soil amendments (i.e., biosolids) managed food plots are labor and cost-intensive.

Is the cost worth it? The answer can be yes, as long as these openings are limited in scope and meeting specific objectives (attracting elk to a public viewing area). For perspective, a managed 10-acre clover plot produces enough forage to sustain 20 elk for about 30 days. Similar or even higher yields can be realized using less costly methods.

Strategy 2. Diversify plantings

While cool-season plants provide excellent forage from green-up to mid-summer and again in early fall, their ability to support grazing declines sharply from July to September (known as summer slump).

The primary methods to overcome summer slump are inclusion of warm-season grass paddocks (paddocks are simply patches within the larger field complex) and elimination of fescue. Warm-season grasses including bluestems, indiagrass, gamagrass, and switchgrass have relatively high nutritional value during the heat of summer. Additionally, forbs such as asters, goldenrod, desmodium, and perennial sunflowers are palatable and nutritious in mid-summer.

Fescue should be eliminated because it outcompetes more valuable forages. Additionally, fescue toxicity can negatively impact grazing animals. Fescue cover can be reduced by using a grass-selective herbicide (such as Poast®) during the 3-4 weeks prior to first frost in fall. If an area is dominated by fescue, a glyphosate herbicide can be applied at a rate of 2 quarts/acre during the same time period. Often, many beneficial plants from the seed bank appear following fescue removal with no planting necessary.

The most productive forage areas will include diverse plants and a mixture of cool-season and warm-season patches. Additional guidelines for herbaceous opening management for wildlife are included in [Native Warm-Season Grasses, University of Tennessee Extension PB1752](#).

Strategy 2. Utilize prescribed fire

Application of fire can improve forage production by over 75%. Fire removes dead plant material, freeing essential nutrients for plant re-growth. Following a burn, actively growing plants are more nutritious and palatable than older, unburned plants. Grazing animals like elk preferentially use burned areas, allowing adjacent unburned patches to rest. The practice of “patch burning” allows managers to influence grazing intensity within a field complex without the need for fences. Fields (or strip mines) can be divided into units that are burned on a 2—3-year rotation.



Prescribed burning improves forage quality and palatability for several years post-fire.

Burning also discourages woody tree and shrub invasions that threaten herbaceous openings. Detailed information on patch burning is available in [Patch Burning: Integrating Fire and Grazing](#), Publication E-998, Oklahoma Cooperative Extension Service.

Strategy 3. Stockpile forage

Some fields or sections of fields may be managed as “stockpiles”, extending forage availability past the growing season. While most farmers bale hay for winter feeding, grasses and legumes can be left standing, where they remain available as long as snow accumulation is not too deep. Stockpile areas should be left unburned or unmowed during the last 70-80 days of the growing season (i.e., no treatments occurring after July 1). Cool-season grasses and clovers are better candidates for stockpiling compared to warm-season plants.

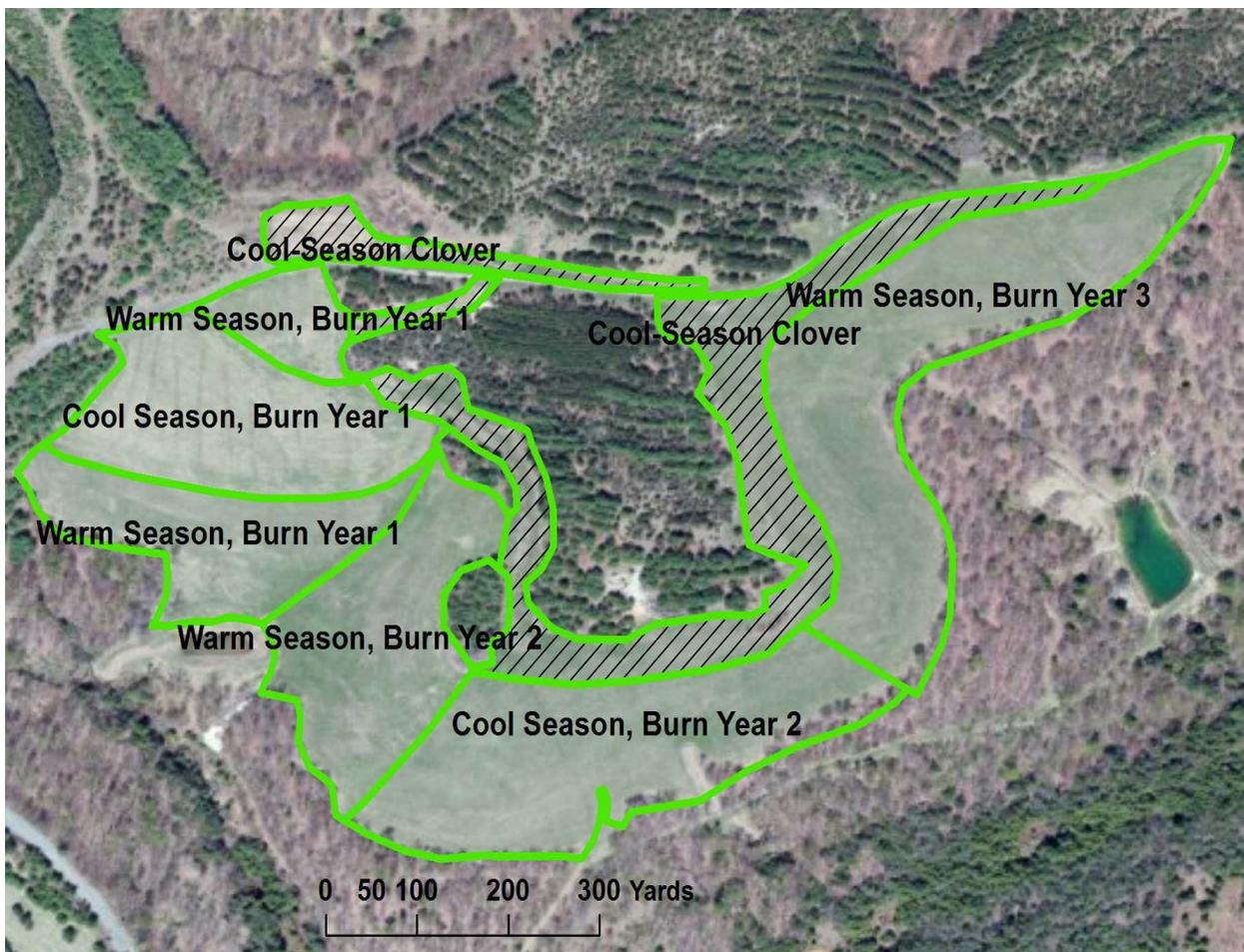


Rotational burning and stockpiling can be used together to manage grazing areas. Elk preferentially graze burned patches for 1-2 years post-fire while adjacent, untreated fields are left standing for late season forage. The untreated patches are burned in subsequent years, providing high quality forage over time. Fire breaks 8-20 feet wide can be annually planted or established in perennial clovers maintained by mowing.

Strategy 4. Tie it all together

Multiple strategies can be applied within large reclaimed strip mines. The example below intersperses warm and cool-season plantings with a patch burning management schedule. The clover mix surrounding the central conifer patch provides a permanent firebreak that can be maintained by summer mowing. The lines surrounding the mine complex and dividing field patches can also be maintained as 8-16 foot clover firebreaks that facilitate safe burning and additional forage. Some firebreaks could also be disked strips that stimulate the seedbank (with the opportunity for disking depending on soil depth, compaction, and surface rock). Strip mines like the one below are used heavily by elk because of the excellent mixing of forage, browse, and cover in close proximity.

The exact pattern of field design depends on many factors and creativity is encouraged. Managers can also apply this concept at larger spatial scales. For example, if there are multiple small openings (i.e., <10 acres) it doesn't make sense to split them into tiny sections; rather they can be treated as individual patches within the larger landscape. The point is to intersperse herbaceous cover types to benefit elk and other wildlife sustainably over time.



Herbaceous Openings (well pads, pipelines, electric ROWs)

Although not as large in scope as reclaimed strip mines, smaller herbaceous openings including managed food plots, gas well pads, pipelines, and electric rights of way are important sources of forage and browse.

Strategy 1. Diversify plantings

Similar to strip mines, the majority of food plots, well pads and pipelines are planted in cool-season grasses and legumes. Because most food plots and well pads are relatively small, it's difficult to split them into sections with alternating cool-season and warm-season plantings.



warm-season forage



cool-season forage



Forage and cover



Forage, browse, and cover

Craig Harper

Instead of interspersing forage types within openings, managers can vary them across the landscape. The intensity of management can also be adjusted with some openings planted annually while others are in a minimal maintenance schedule that includes biennial mowing, burning, or herbicide spot treatments to address encroaching trees and shrubs.

Non-native perennial grasses should be avoided in planting mixes because of their tendency to outcompete all other plants in the mix. If grasses such as orchardgrass, bluegrass, timothy or fescue are included, they will overtake the plot by year 3 post-planting.



Craig Harper

Larger food plots or well pads (>2 acres) can be enhanced with field borders. This approach diversifies forage, supplies cover and softens hard edges where openings adjoin older forest. These soft edges are a benefit to many wildlife species!

Strategy 2. Wire zone-border zone management

Electric utility rights of way are prominent features that intersect hundreds of miles in the elk range. Most notable are the 100—200 foot, 230 and 500 kV transmission lines that transport electricity from generation stations to substations across the state.

Wire zone-border zone management, the concept of low-growing vegetation under wires (i.e., herbaceous plants, low shrubs) with taller vegetation along ROW margins (taller shrubs low-growing trees) is central to ROW vegetation management strategies (Figure 2). Wire zone-border zone management has been researched and refined for over 50 years on a State Game Lands 33 demonstration site in Centre County, as well as other sites across the state. Wire zone-border zone provides an opportunity to intersperse habitats (i.e., herbaceous, shrubland, and forest) along the ROW corridor while allowing the utility company to meet their wire clearance needs.



Detailed wire-zone border zone techniques are provided in the Game Commission's Habitat Manual chapter, [Electric Utility Right of Way Management](#).

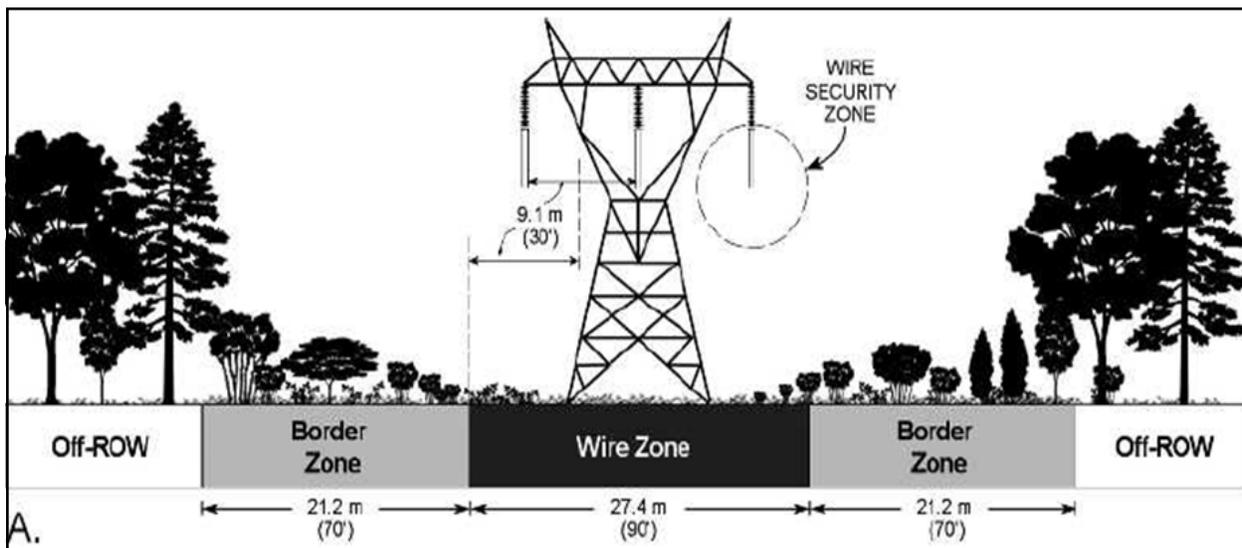


Figure 2. Division of a powerline ROW cross-section into three zones: the border zone (BZ), the wire zone (WZ), and another BZ. (A) ROW cross-section based on Bramble et al. (1985, 1986) figure dimensions scaled for a 340 kV powerline and a horizontal conductor configuration. The WZ for both figures was determined using the distance between conductors (30 ft. in this case). Woody vegetation was not restricted to the BZ here, because low-growing shrubs can be compatible even in the WZ, depending on access requirements, site topography, and position relative to mid-span between tower structures.

Forest Management

Elk depend on periodic disturbances to promote the food and cover they need. In fact, the majority of elk habitat research papers cite the animals' affinity for timber harvests and burned areas. To foster high quality elk habitat in forested areas, an active management program is essential.



Active forest management that spaces young forests across the landscape should be a primary focus of elk habitat management.

Strategy 1. Intersperse forest age classes

The concept of developing a “shifting mosaic” describes ideal forest management for elk. In a shifting mosaic, habitat patches — or “stands” — are in various successional stages across the landscape. Forage and browse are available in 1-5 year-old stands, browse and protective cover are offered in the 6-20 year age class, and hard mast is provided in stands older than 40 years. As stands succeed to the next age classes over time, new timber harvests are prepared in other stands to fill the young forest need. With the exception of aspen, repeated, short rotation cutting in the same stand is not recommended. Each successional stage is important and forest sustainability is paramount!

Strategy 2. Focus on sustainable forestry practices

Before a stand can be harvested, young trees representing the future must be present. Developing this regeneration often requires time and investments. Stands to be regenerated in the future receive intermediate treatments such as low shade removal, shelterwood, prescribed fire, competing vegetation removal, or others to initiate regeneration. It can take up to 10 years of site preparation before a stand is harvested, and that time must be incorporated into rotations and planning. Without good planning, bottlenecks will occur when no young stands exist and new harvests have not been implemented.



Controlled burning is integral to oak habitat sustainability.

Oak forests are invaluable to wildlife, elk included. Pennsylvania's oak forests have been fostered by recurring fires for thousands of years. The most current knowledge of oak habitat management cites fire as an essential tool for sustainability. The judicious use of controlled burning will be necessary to maintain the nearly 800,000 acres of oak forest in the expanded elk range.

At high population levels, herbivores like elk and deer can over-browse young forest stands. Over-

browsing to a level that prohibits forest sustainability is a sign of overabundance. This could be too many mouths to feed, not enough habitat, or both! Habitat managers can lessen potential impacts of over-browsing by planning relatively large harvest units (>100 acres). Small patches (<25 acres) are almost certain to be over browsed by elk and deer. Additionally, stands that are well managed with abundant regeneration (i.e., burned oak stands) are more resilient to browse than areas just scraping by with minimal seedling and sapling counts. In some cases, targeted herd reductions may be necessary in problem areas. Deterrent fencing should be avoided.

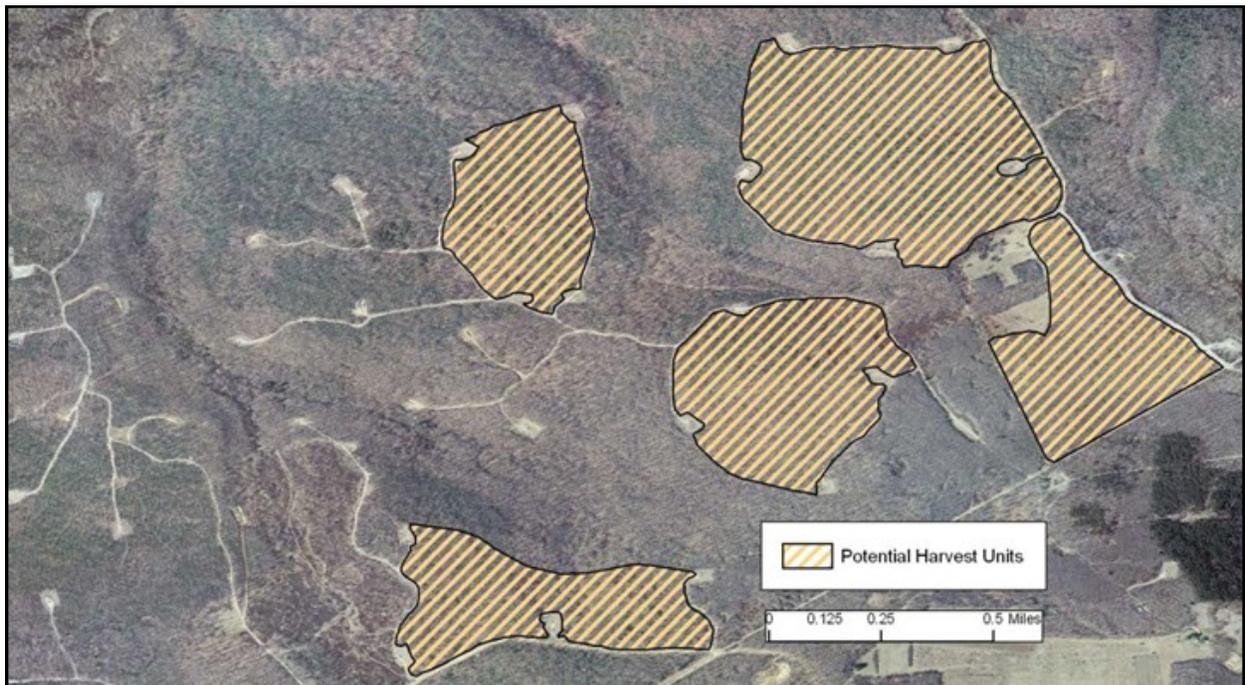
The document, [Golden-winged Warbler Habitat Best Management Practices](#) provides an excellent forest management approach that's ideal for elk whereby 10% of a management compartment is harvested every 15 years. The percentage is a general guideline and decisions should ultimately be based on landscape context, current habitat condition, access, and other logistics.



Regenerating timber harvests are needed for concealment cover and browse.

Strategy3. Maintain conifers in riparian corridors

Conifer habitats, especially hemlock-pine stands along stream corridors, are important for elk across seasons. Hemlock woolly adelgid is a major threat that is reducing hemlock cover in the elk range. Because no control methods have been identified, managers should consider native spruce plantings in riparian corridors where hemlock is threatened or in decline. Pine plantations on reclaimed strip mines are also used heavily by elk and may become even more vital as hemlock is lost.



Timber harvests adjacent to openings (well pads here) provide cover, forage and browse in close proximity.

Woodlands and Barrens

Woodlands, savannahs, and barrens are relatively open habitats with scattered overstory trees and an understory of grasses, forbs, and shrubs. They have characteristics of both late successional habitats (large trees with well developed crowns) and early successional habitats (herbaceous plants and shrubs). Their open condition is promoted by regular disturbance, especially fire. Generally speaking, more frequent fire (i.e., burning every 3-5 years) results in a greater herbaceous component while longer intervals favor shrubs.

Elk affinity for burned areas is well documented, due in large part to increased forage. Studies consistently show 200– 400% boosts in forage production that last for several years following burning. This increased food availability can more than triple elk carrying capacity, revealing the value of prescribed burning as an elk habitat management tool!

Strategy 1. Identify woodland and barrens restoration areas

Prior to the mid-1900s, open woodlands were prevalent throughout much of the state, including the elk range. Following extensive logging and fire suppression, these habitats disappeared over the last 60 years. Nonetheless, remnant woodlands are still evident.

Many habitats typed as Dry Oak Heath (AH) can be managed toward woodland conditions through repeated controlled burning, as occurred in the photo below. Managers should prioritize delineation of woodland sites. Sometimes, large areas of decadent scrub oak and/or pitch pine make identification easy. Often, the signs are more subtle such as scattered pitch pine among hardwoods or small remnant scrub oak patches. Even when obvious patches are discovered, the search for more subtle signs should be expanded to surrounding areas.



An oak woodland maintained by fire. This high value habitat for elk and other wildlife provides excellent forage, browse, mast, and cover.

Strategy 2. Develop woodland and barrens restoration plans

Once identified and mapped, woodland restoration can be incorporated into management plans. Important factors to consider in final burn plan development include available fire breaks, fuel loading, potential need for mechanical treatment, and burn unit size. The Game Commission's Habitat Manual chapter, "[Barrens Habitat Management](#)" covers relevant strategies in detail.



Prior to oak-pine woodland restoration on a State Game Land. After 60 years of fire suppression, the understory and midstory are choked by black gum, maples, and mountain laurel. Low habitat value.



The beginning of restoration; dense fuels were mowed to allow safe return of fire to the area. The existing SGL road was incorporated as a permanent firebreak.



Several growing seasons after fire re-introduction. Scruboak, blueberry and many herbaceous plants are abundant beneath the open canopy. Habitats like this provide unparalleled browse, mast, and cover. Such habitats can be maintained with a 3 to 15-year controlled burn rotation.

Summary

The potential of Pennsylvania's elk range to support and expand a healthy elk herd will depend on active habitat management. With over 70% of Pennsylvania's elk range is in public ownership, there's a unique opportunity for large scale efforts. Aldo Leopold, the renowned conservationist and founder of wildlife management asserted that the five essential tools of wildlife conservation are, "the ax, the match, the plow, the cow and the gun." These words never rang truer than in the case of elk management.

- **the ax**—sustainable forest management to intersperse young forest across the landscape over time.
- **the match**—judicious use of prescribed fire to encourage diverse herbaceous plants, oak woodlands, maintain shrublands, and promote desirable tree regeneration.
- **the plow**—soil cultivation to establish and stimulate herbaceous plants.
- **the cow**—application of grazing management concepts to sustain highly productive forage.
- **the gun**—adaptive harvest management to keep a growing elk population in balance with local habitat conditions.



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SUPPORTING INFORMATION

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