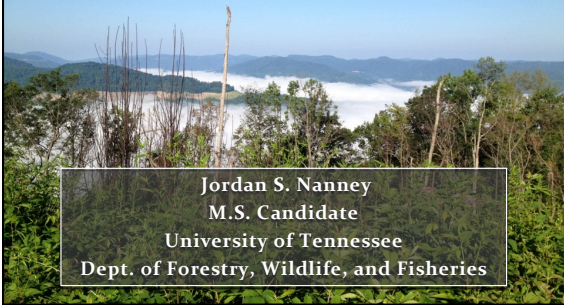


Influences of silvicultural treatments on forage availability for elk (*Cervus elaphus*) in the Cumberland Mountains



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Acknowledgements

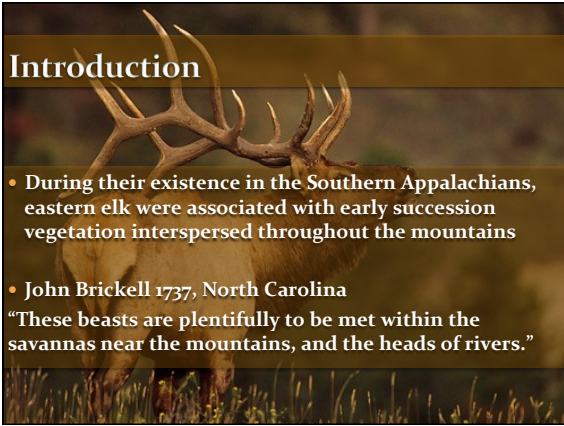
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Introduction

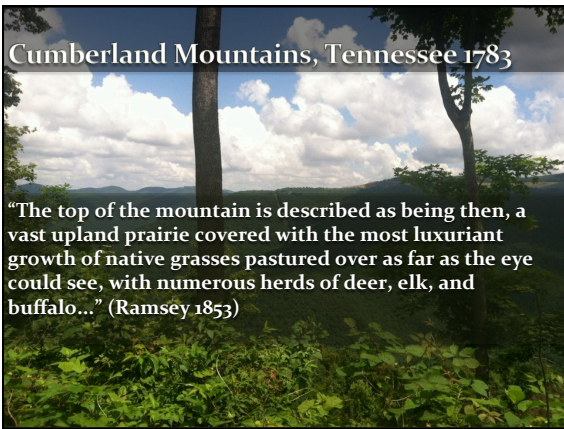
- The eastern elk (*Cervus elaphus canadensis*) once ranged throughout eastern North America (Bryant and Maser 1982)
- The last individual was reportedly killed in Pennsylvania by an American Indian in 1867 (O'Gara 2002)
- The last reported wild elk in Tennessee was killed in Obion County in 1865 (<http://www.tn.gov/twra/elkquestions.html>)





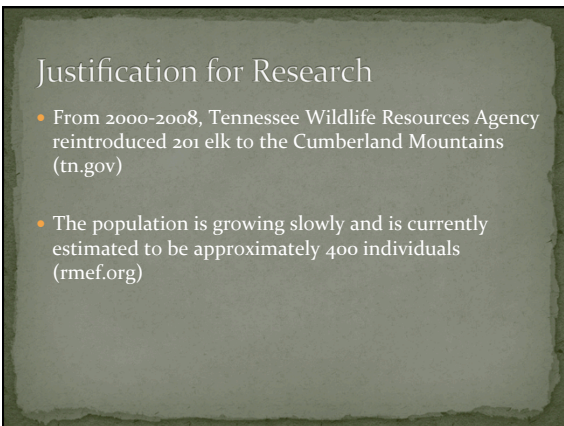
Introduction

- During their existence in the Southern Appalachians, eastern elk were associated with early succession vegetation interspersed throughout the mountains
- John Brickell 1737, North Carolina
“These beasts are plentifully to be met within the savannas near the mountains, and the heads of rivers.”



Cumberland Mountains, Tennessee 1783

“The top of the mountain is described as being then, a vast upland prairie covered with the most luxuriant growth of native grasses pastured over as far as the eye could see, with numerous herds of deer, elk, and buffalo...” (Ramsey 1853)



Justification for Research

- From 2000-2008, Tennessee Wildlife Resources Agency reintroduced 201 elk to the Cumberland Mountains (tn.gov)
- The population is growing slowly and is currently estimated to be approximately 400 individuals (rmef.org)

Justification for Research

- Closed-canopy forests dominate the landscape and often lack food and cover resources for many wildlife species that require a well-developed forest understory (de Calesta 1994, Johnson et al. 1995, Edwards et al. 2004, Jackson et al. 2007)
- Food plots are seasonally available, costly, and labor intensive
- Evaluations of forage production and habitat management for elk in the eastern U.S. are needed as populations expand
- Nutritive value and available forage has a large influence on reproductive success for elk (Cook 2002)

Justification for research

- The Tennessee elk restoration zone is dominated by closed canopy mature mixed-hardwood forest (87%)
- 12% is made up of reclaimed surface mines, food plots, or pasture TWRA, 2000

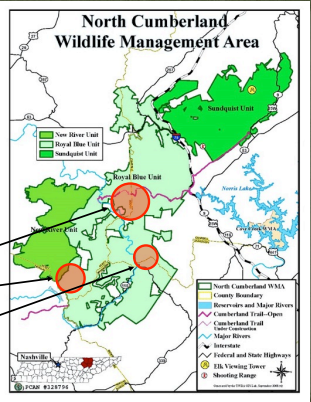


Objectives

- 1.) Determine the effects of six silvicultural treatments on:
 - forage production in two nutritional stress periods
 - production of selected elk forages
- 2.) Assess and compare the forage production of mature forest stands, reclaimed surface mines, and food plots to that within the silvicultural treatments
- 3.) Use results to help guide TWRA in future elk habitat management decisions

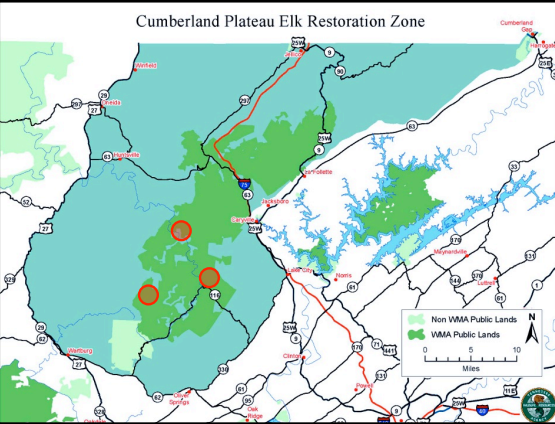
Study Area

- Campbell, Scott, Anderson, and Morgan Counties
- 3 Sites: Royal Blue
-Anderson Mtn.
-Burge Mtn.
-Red Oak



The map shows the North Cumberland Wildlife Management Area with various management units: New Silver Unit, Royal Blue Unit, and Pendragon Unit. Three study sites are marked with red circles: Anderson Mtn., Burge Mtn., and Red Oak. The map also shows county boundaries, major rivers, and highways.

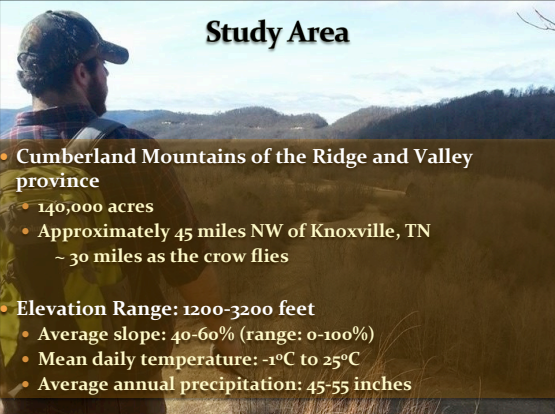
Cumberland Plateau Elk Restoration Zone



The map displays the Cumberland Plateau Elk Restoration Zone, highlighting VMA Public Lands in green and Non VMA Public Lands in light green. Major roads and geographical features are also shown.

Study Area

- Cumberland Mountains of the Ridge and Valley province
 - 140,000 acres
 - Approximately 45 miles NW of Knoxville, TN
~ 30 miles as the crow flies
- Elevation Range: 1200-3200 feet
 - Average slope: 40-60% (range: 0-100%)
 - Mean daily temperature: -1°C to 25°C
 - Average annual precipitation: 45-55 inches



A photograph showing a person in a cap and jacket looking out over a vast mountain landscape under a clear sky.

Site description

- Mixed-hardwood forest
 - Oaks (*Quercus* spp.), maples (*Acer* spp.), yellow-poplar (*Liriodendron tulipifera*), w/ American beech (*Fagus grandifolia*) and pines (*Pinus* spp.) interspersed
- Reclaimed surface mines
 - Sericea lespedeza (*Lespedeza cuneata*) and tall fescue (*Schedonorus arundinaceus*)
- Food plots
 - Cool season plots of ryegrass, wheat, and clovers

Treatment Design

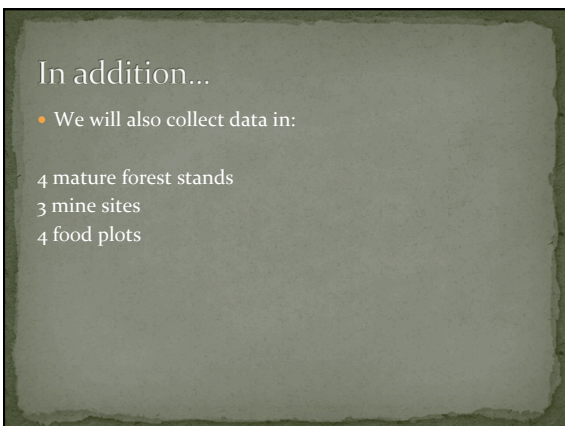
- Six treatments applied in patch clearcuts at each of three sites: Anderson, Burge, and Red Oak
- Units average 10 acres

Control (Clearcut only)	Clearcut w/ Late burn	Clearcut w/ Herbicide & Early burn
Clearcut w/ Early burn	Clearcut w/ Herbicide & Late burn	Clearcut w/ Herbicide only









Sampling Methods

- Data will be collected on the following:
 - Plant species composition
 - Browse selectivity
 - Soft mast abundance
 - Vegetative structure
 - Forage availability

Species Composition Transect

- 40 meter point transect
- Center points are randomly selected
- Transects are run along the slope
- Living plant species will be documented at 2m intervals




Browse Selectivity

- Collected with plant species composition transect
 - Browse intensity will be recorded for each individual plant detected at each transect point
- Selectivity will be evaluated using Chesson's index (Chesson 1978, 1983)



Soft mast abundance

- Each soft mast producing species within 0.5 meters of the transect will be examined for fruit
- All fruits within 0.5 meters of the transect line will be counted and separated by species



Vegetative Structure

Vegetative structure will be measured using a vegetation profile board (Nudds board, Nudds 1978)

-Density scores are given to each section

0 = 0%	> 2 m
1 = 1-20%	2.0 m
2 = 21-40%	1.5 m
3 = 41-60%	1.0 m
4 = 61-80%	1.0 m
5 = 81-100%	0.5 m

Forage Availability

- Two random numbers between 1 and 40 will be assigned to each transect
- 1m² PVC forage collection frames will be placed along the transect where the meter correlates with the random number




Forage Availability

- Available forage is characterized as recent growth (≥ 1 year) from woody plants and palatable portions of herbaceous plants
- All available forage within the forage collection frames will be collected and separated by genus




Forage Availability



Forage collections will be placed in a walk in dryer and dried at 50°C for 72 hours

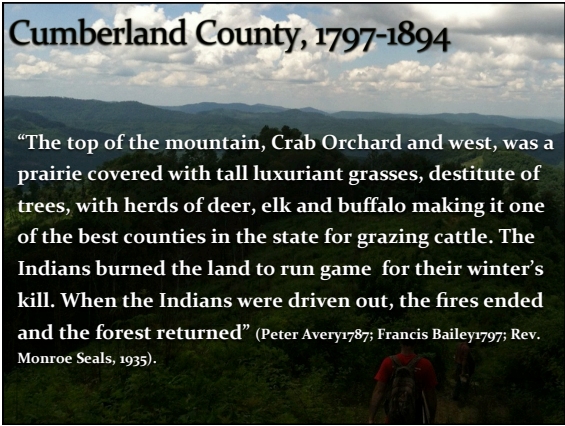
After drying, forage samples are weighed and processed for nutrient analysis



Nutrient analysis will be conducted at the Clemson University Forage Testing Lab

Data Analysis

- Randomized Complete Block Design
 - Blocked by site
 - Mixed model ANOVA using SAS 9.1 (Cary, NC)
 - Selection index to calculate species selection



Cumberland County, 1797-1894

“The top of the mountain, Crab Orchard and west, was a prairie covered with tall luxuriant grasses, destitute of trees, with herds of deer, elk and buffalo making it one of the best counties in the state for grazing cattle. The Indians burned the land to run game for their winter’s kill. When the Indians were driven out, the fires ended and the forest returned” (Peter Avery 1787; Francis Bailey 1797; Rev. Monroe Seals, 1935).



Literature Cited

- Bryant, L.D., and C. Maser. 1982. Classification and distribution. Pages 1-59 in J. W. Thomas and D.E. Towell, eds. Elk of North America: ecology and management. Stackpole Books, Harrisburg, Pa
- O’Gara, B.W. 2002. Taxonomy. Pages 3-65 in J.W. Thomas and D.E. Towell, eds. North American Elk: Ecology and Management. Smithsonian Institution Press, Washington and London
- Brickell, J. 1737. The natural history of North Carolina. James Carson, Dublin, Ireland. 417 pp.
- Chesson, J. 1978. Measuring preference in selective predation. Ecology 59: 211-215.
- Chesson, J. 1984. The Estimation and Analysis of Preference and Its Relationship to Foraging Models. Ecology 64:1297-1304.
- Ramsey, J. G. M. 1853. The annals of Tennessee to the end of the eighteenth century. Reprint edition 1971 by Arno Press, Inc., New York. 744 pp.
- Cook, J.G. 2002. Nutrition and Food. Pages 259-349 in J.W. Thomas and D.E. Towell, eds. North American Elk: Ecology and Management. Smithsonian Institution Press, Washington and London.
- de Calesta, D. S. 1994. Effects of white-tailed deer on songbirds within managed forests in Pennsylvania. Journal of Wildlife Management 58:711-718.
- Edwards, S. L., S. Demarais, B. Watkins, and B. K. Strickland. 2004. White-tailed deer forage production in managed and unmanaged pine stands and summer food plots in Mississippi. Wildlife Society Bulletin 32:739-745.
- Jackson, S. W., R. G. Basinger, D. S. Gordon, C. A. Harper, D. S. Buckley, and D. A. Buehler. 2007. Influence of silvicultural treatments on eastern wild turkey habitat characteristics in eastern Tennessee. Proceedings of the National Wild Turkey Symposium 9:109-108.
- Johnson, A. S., P. E. Hale, W. M. Ford, J. M. Wentworth, J. R. French, O. P. Anderson, and G. B. Pullen. 1995. White-tailed deer foraging in relation to successional stage, overstory type and management of Southern Appalachian forests. American Midland Naturalist 133:18-35.
- Nudds, T. D. 1978. Convergence of group size strategies by mammalian social carnivores. American Naturalist 112:977-960
- <http://www.tn.gov/twra/elkquestions.html>



Photo Credits

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