Herding Rats: Fifteen Years of Appalachian Northern Flying Squirrels

USGS science for a changing world

1872 VirginiaTech Invent the Future

Appalachian Northern Flying Squirrels

- Pleistocene relict
- *G.s.coloratus* inhabits high elevation forest islands in southern Appalachians; *G.s.fuscus* inhabits more connected landscape in central Appalachians
- Prefers red spruce or mixed red spruce-northern hardwood forests
- Cavity nester
- Mycophagus
- Parasite-mediated competition with *G. volans*

Pre-exploitation forest structure similar to Pacific Northwest?

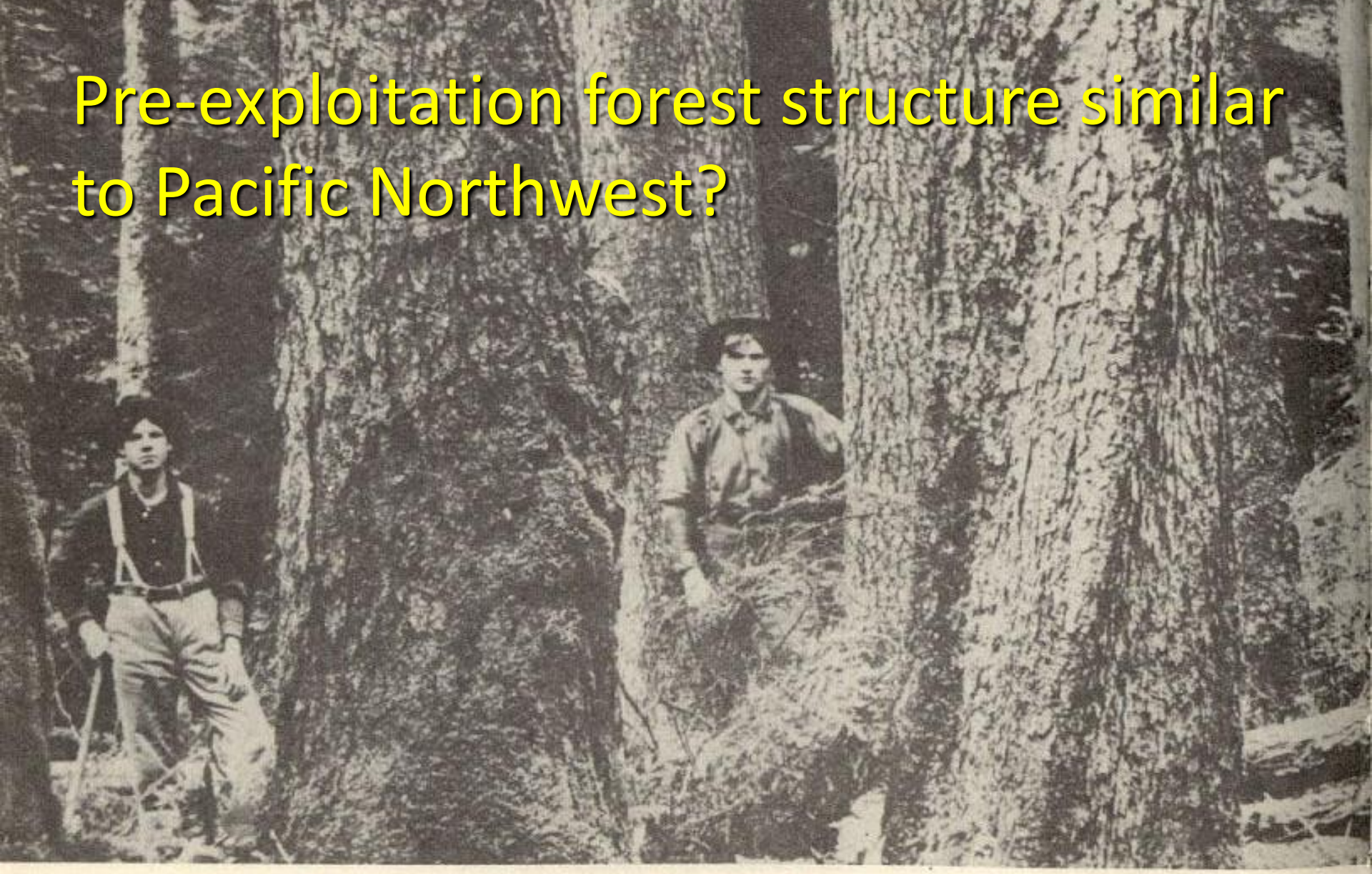
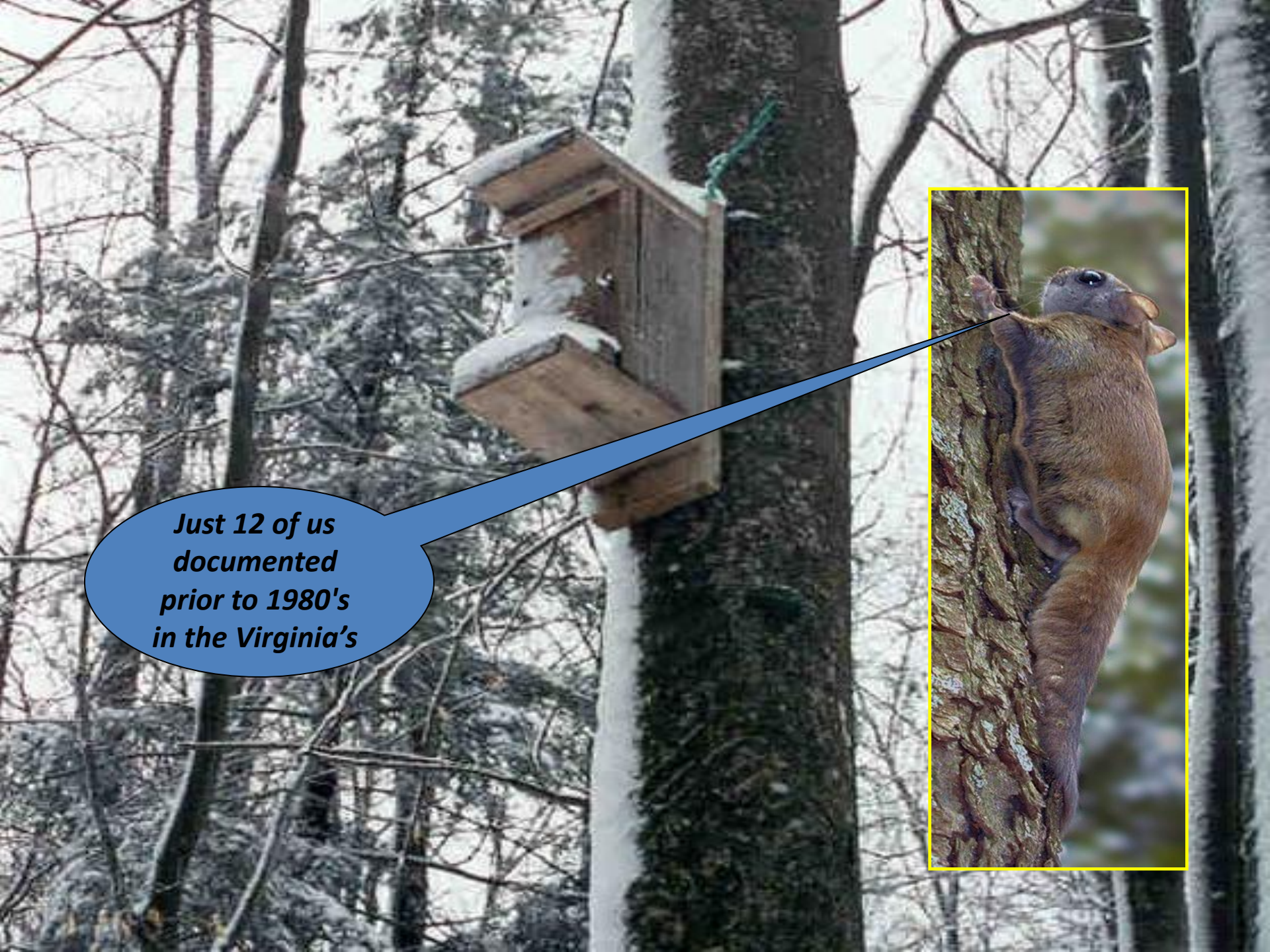
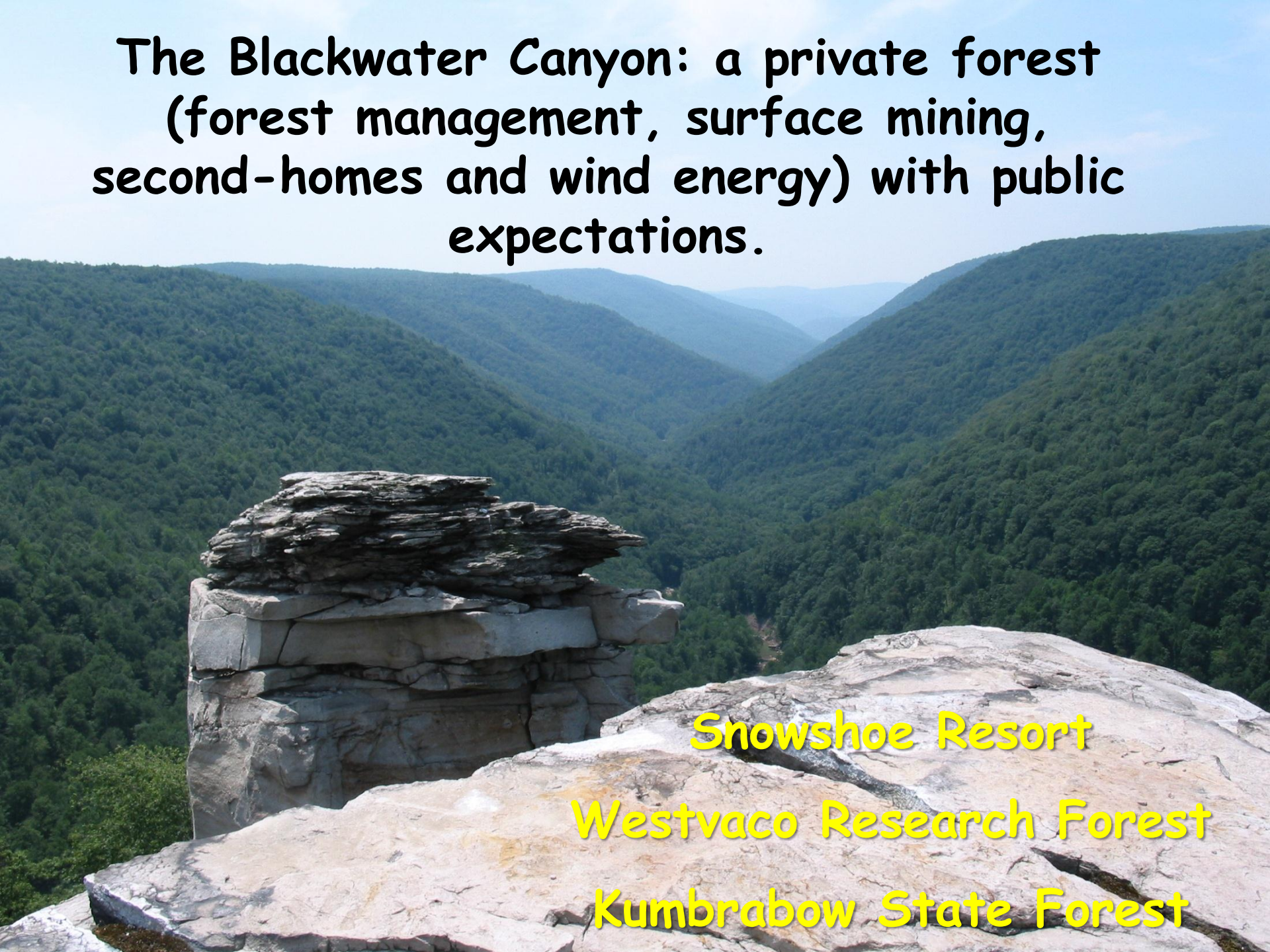


Fig. 2—Red spruce trees dwarf the lumberjacks who are soon to cut them. Cheat Mountain, Pocahontas County on lands of the West Virginia Pulp and Paper Co., 1910. *Courtesy Mrs. Emory P. Shaffer.*


Just 12 of us
documented
prior to 1980's
in the Virginia's

The Blackwater Canyon: a private forest (forest management, surface mining, second-homes and wind energy) with public expectations.



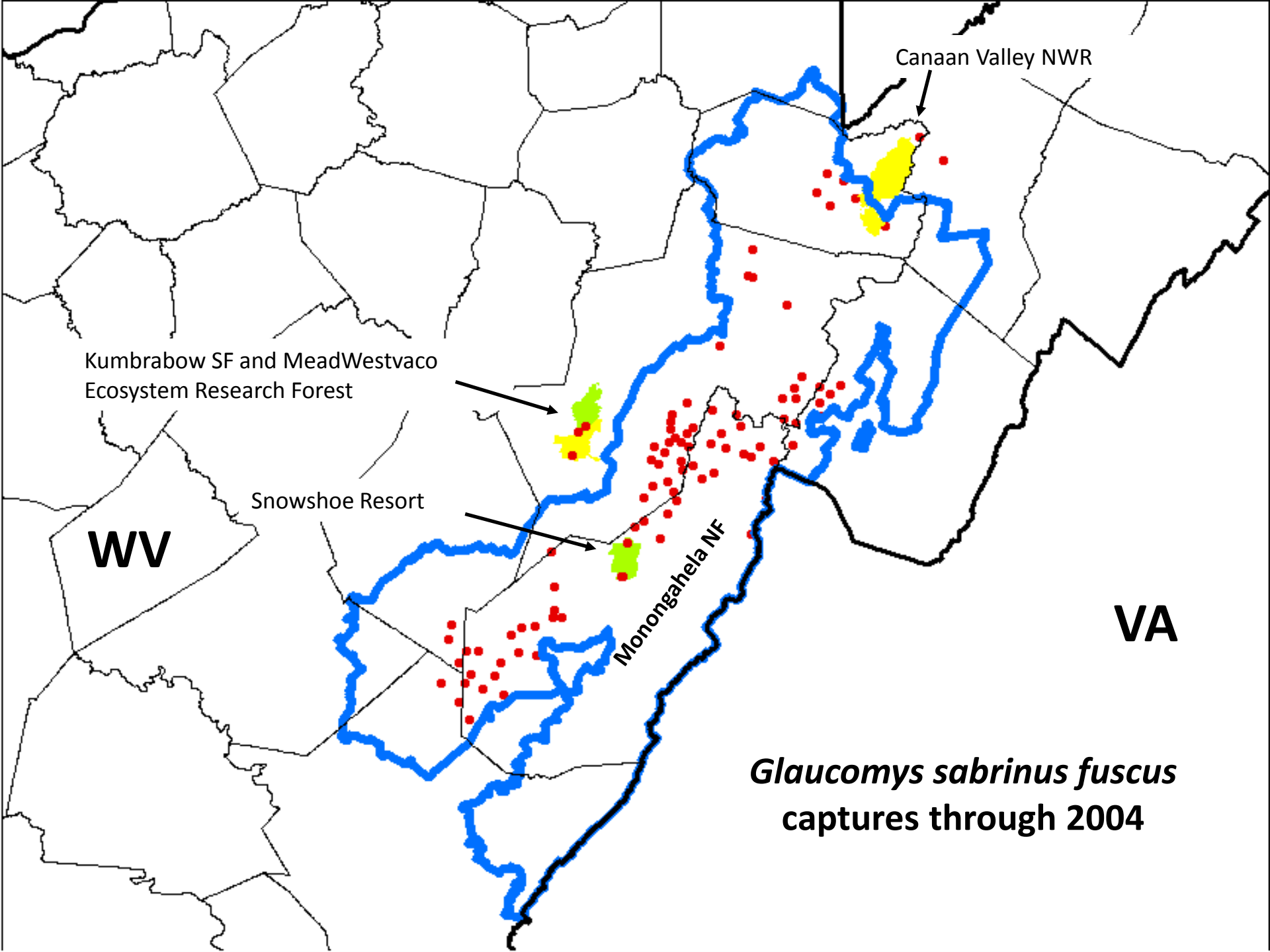
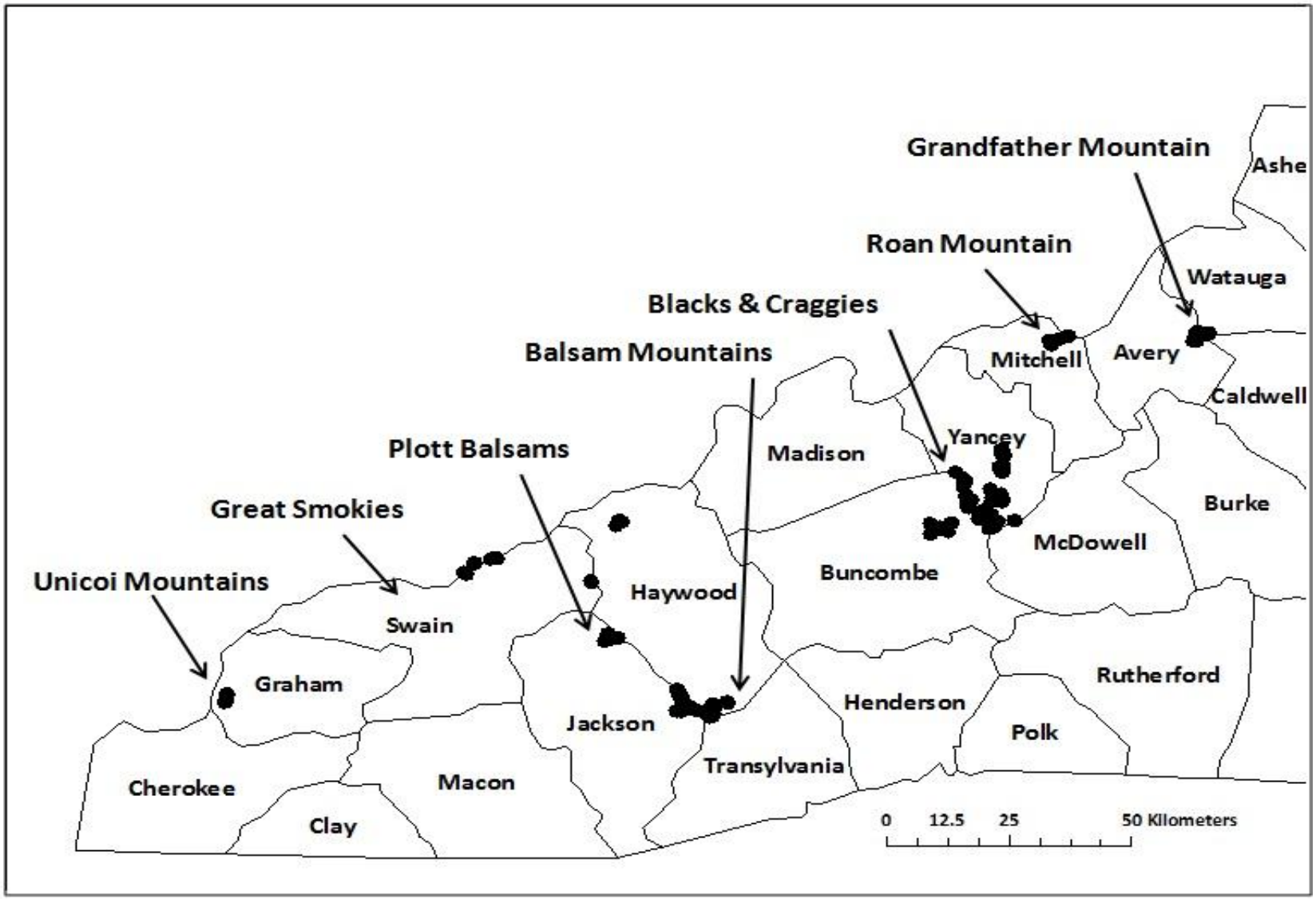
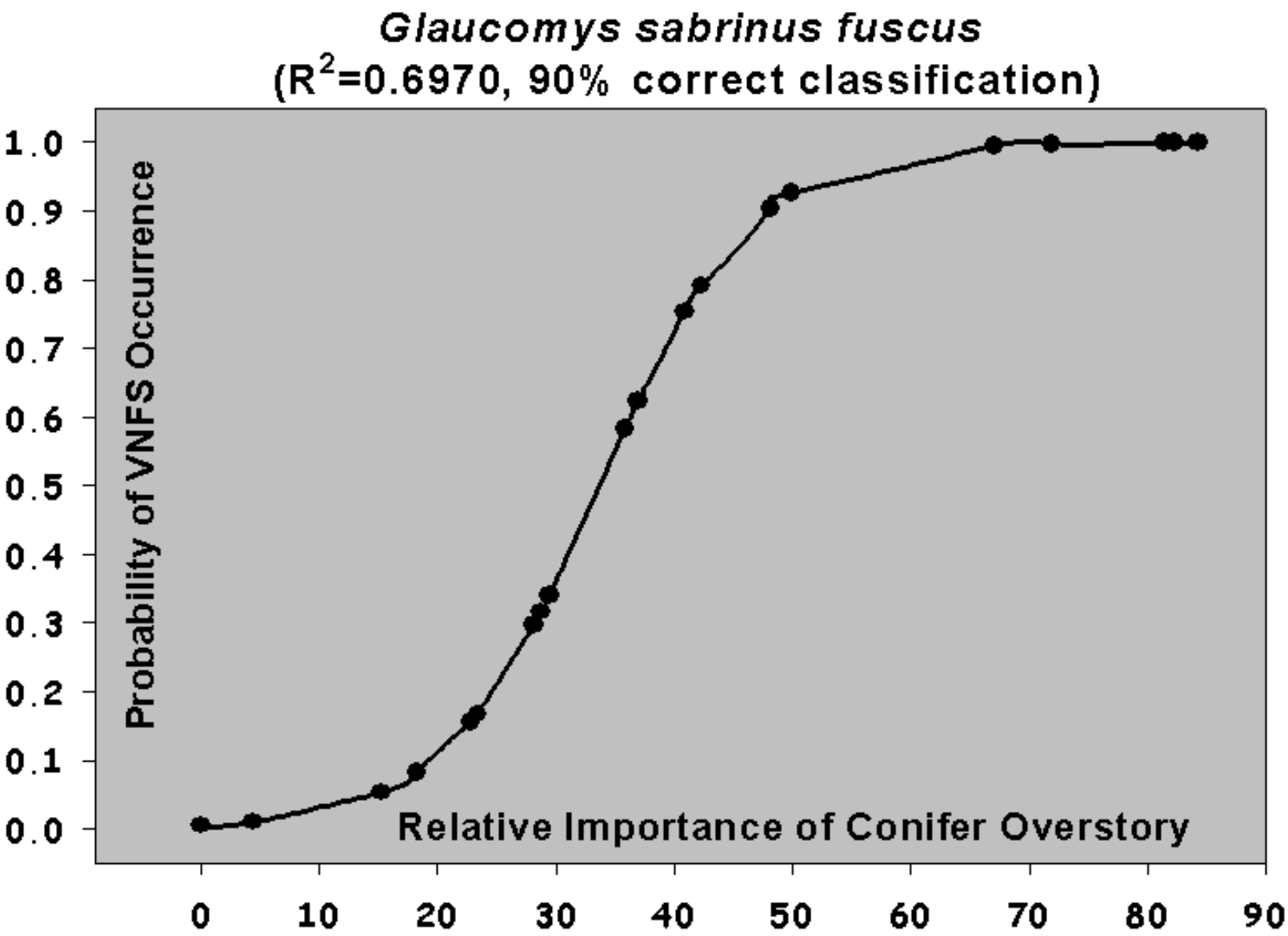

Canaan Valley NWR
Kumbrabow SF and MeadWestvaco
Ecosystem Research Forest
Snowshoe Resort
WV
Monongahela NF
VA
Glaucomys sabrinus fuscus
captures through 2004

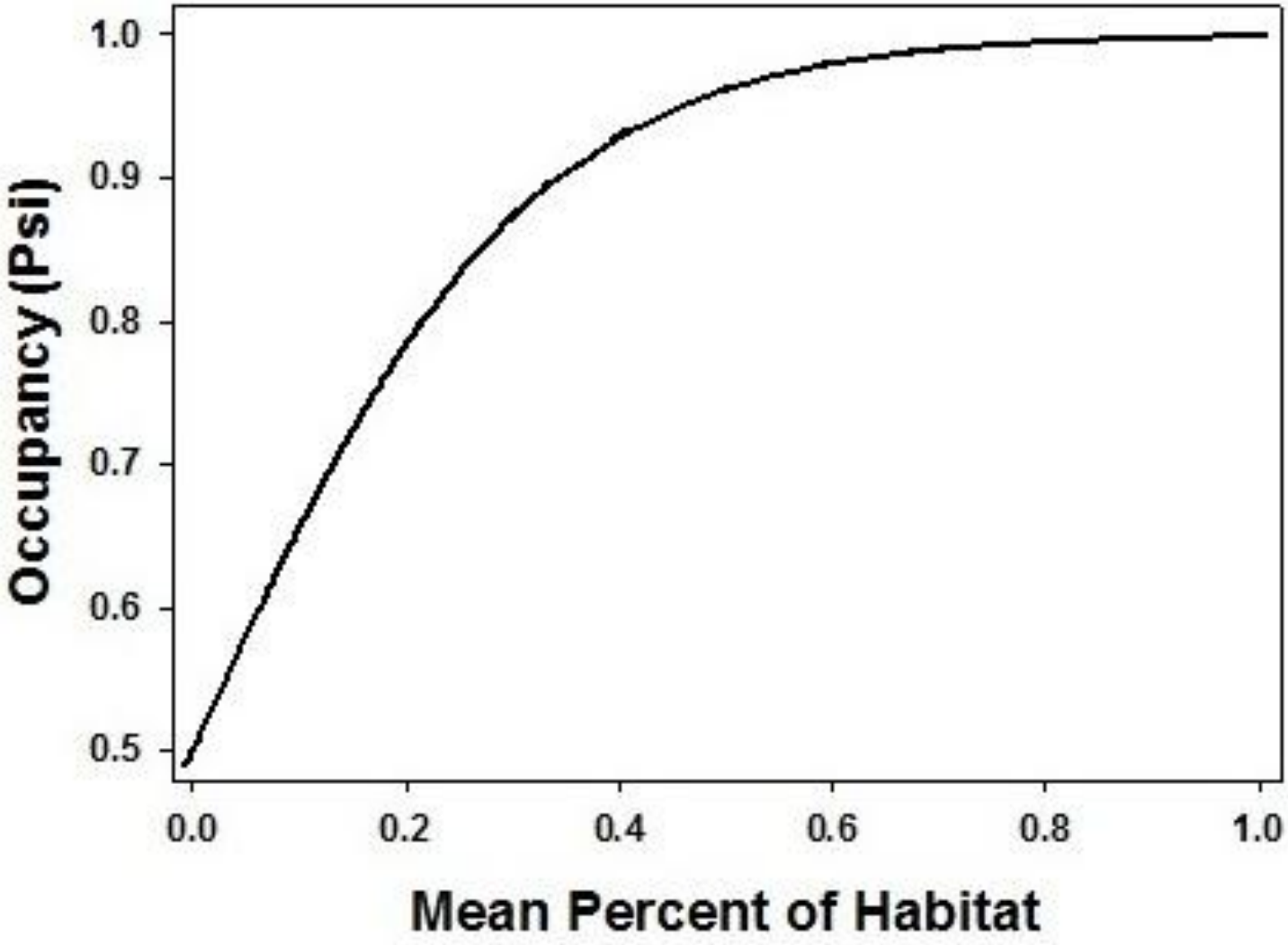
Figure 1. Location of Carolina northern flying squirrel nest box-lines, 1996-2011.

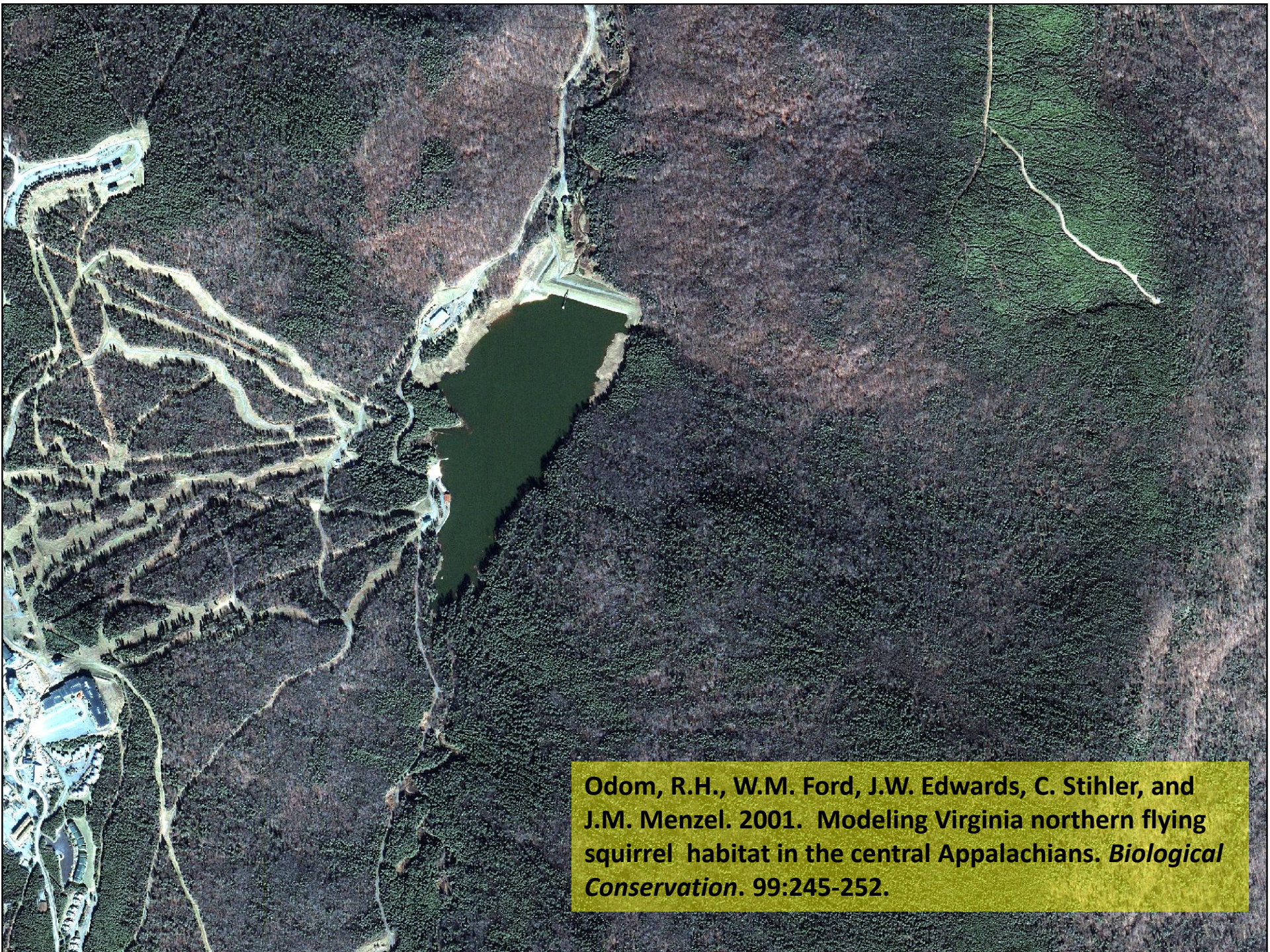




Ford, W.M., S.L. Stephenson, J.M. Menzel, D.R. Black and J.W. Edwards. 2004. Habitat characteristics of the endangered Virginia northern flying squirrel (*Glaucomys sabrinus fuscus*) in the Central Appalachian Mountains. *American Midland Naturalist 152:430-438.*

Mixed Northern Hardwood - Red Spruce





Odom, R.H., W.M. Ford, J.W. Edwards, C. Stihler, and J.M. Menzel. 2001. Modeling Virginia northern flying squirrel habitat in the central Appalachians. *Biological Conservation*. 99:245-252.

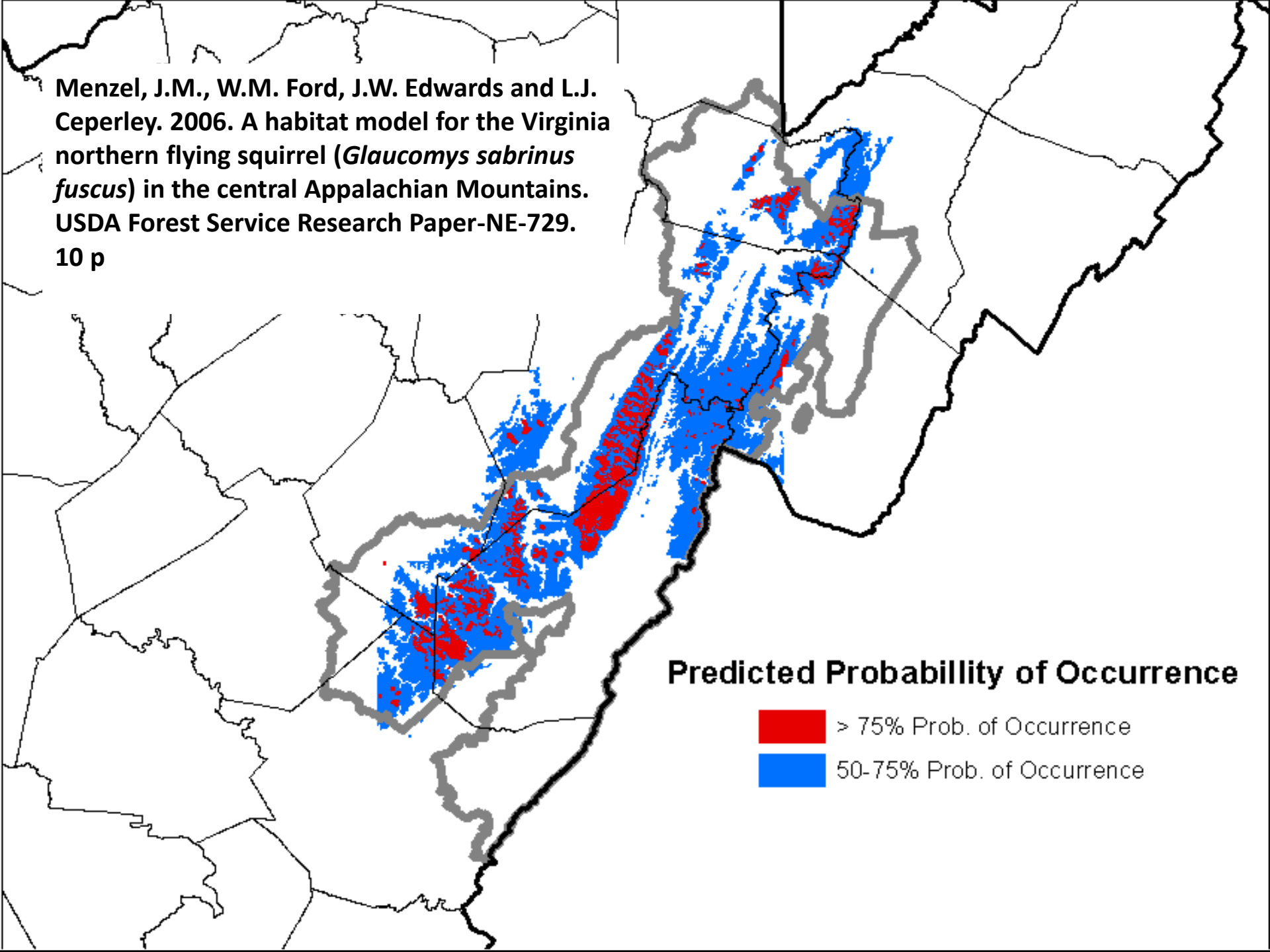
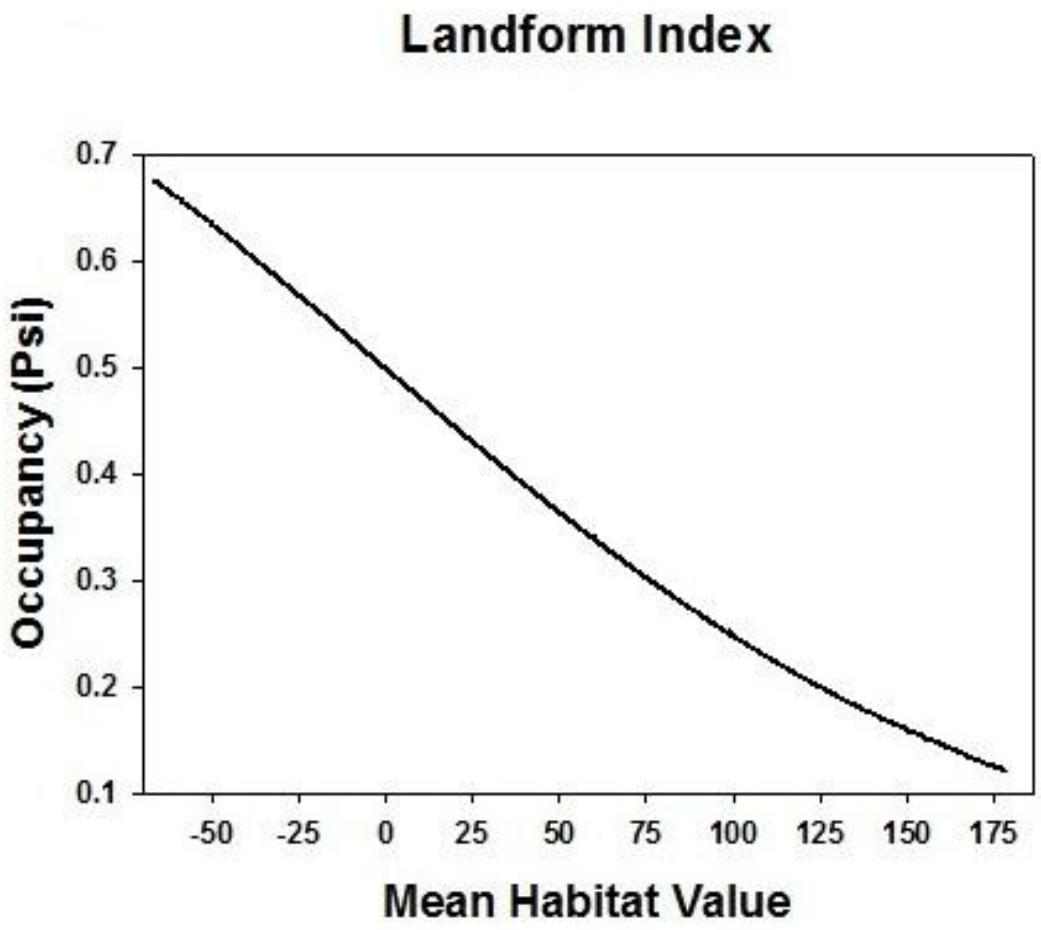

Menzel, J.M., W.M. Ford, J.W. Edwards and L.J. Ceperley. 2006. A habitat model for the Virginia northern flying squirrel (*Glaucomys sabrinus fuscus*) in the central Appalachian Mountains. USDA Forest Service Research Paper-NE-729. 10 p
Predicted Probabillity of Occurrence
> 75% Prob. of Occurrence
50-75% Prob. of Occurrence

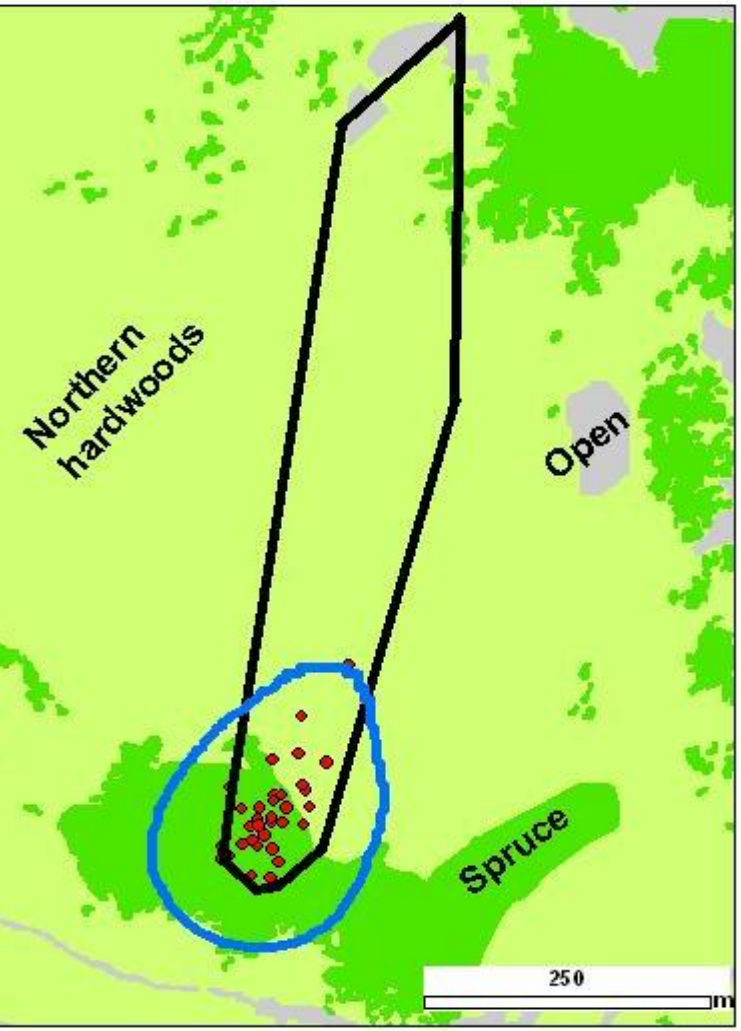
Figure 3. Relationship of predicted occupancy of Carolina northern flying squirrels in North Carolina (80 lines), 1996-2011 with landform index of surrounding habitat.



Den Tree Results

- 41 cavity and 18 drey nests
- Yellow birch and Fraser's magnolia chosen more than expected; Norway spruce, red spruce, American beech, black birch, red maple, sugar maple and black cherry used in proportion or less than expected.
- Trees on north facing slopes
- Larger and taller than surrounding trees
- Close to hiking and skidder trails
- Switched nest trees frequently
- High plasticity in nest tree selection
  - –wide variety of characteristics
- No difference between male and female

Menzel, J.M., W.M.Ford, J.W. Edwards and M.A. Menzel. 2004. Nest tree use by the endangered Virginia northern flying squirrel in the central Appalachian Mountains. *American Midland Naturalist* 151:355-368.



Home Range and Habitat Use

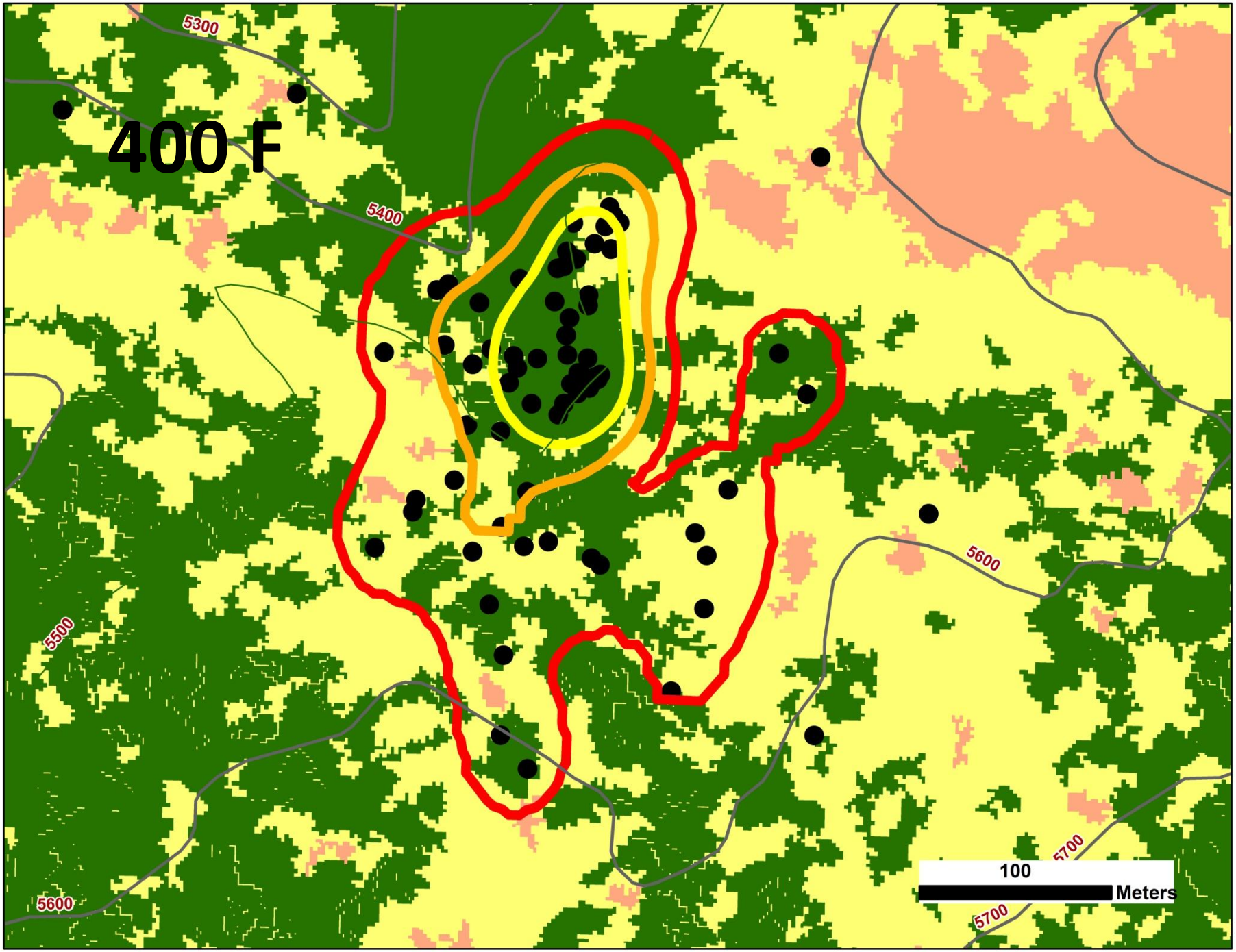
* **Male - 54.2 ha (summer), 25.8 ha (winter)**
* **Female - 15.3 ha (summer), 3.8 ha (winter)**

(compare with 1- 4 ha in Cascade and Coast Ranges in Pacific Northwest)

* **Spruce > northern hwds. > mixed mesophytic**
* **Males will cross roads and ski slopes**

Menzel, M.A., W.M. Ford, J.W. Edwards, and T.M. Terry. 2006. Homerange and habitat use of the endangered Virginia northern flying squirrel *Glaucomys sabrinus fuscus* in the Central Appalachian Mountains. *Oryx* 40(2):204-210 .

Ford, W.M., K.N. Mertz, J. M. Menzel and K.K. Sturm. 2007. Winter home range and habitat use of the Virginia northern flying squirrel. *USDA Forest Service Research Paper NRS-4*. 12p.


400 F
5300
5400
5500
5600
5700
100
Meters

Occupancy:

$\psi(\text{high}) = 0.95 \pm 0.17$

$\psi(\text{medium}) = 0.80 \pm 0.29$

$\psi(\text{low}) = 0.50 \pm 0.00$

$\psi(\text{high}) = 0.50 \pm 0.05$

$\psi(\text{medium}) = 0.50 \pm 0.03$

Detection:

$\rho = 0.65 \pm 0.1$

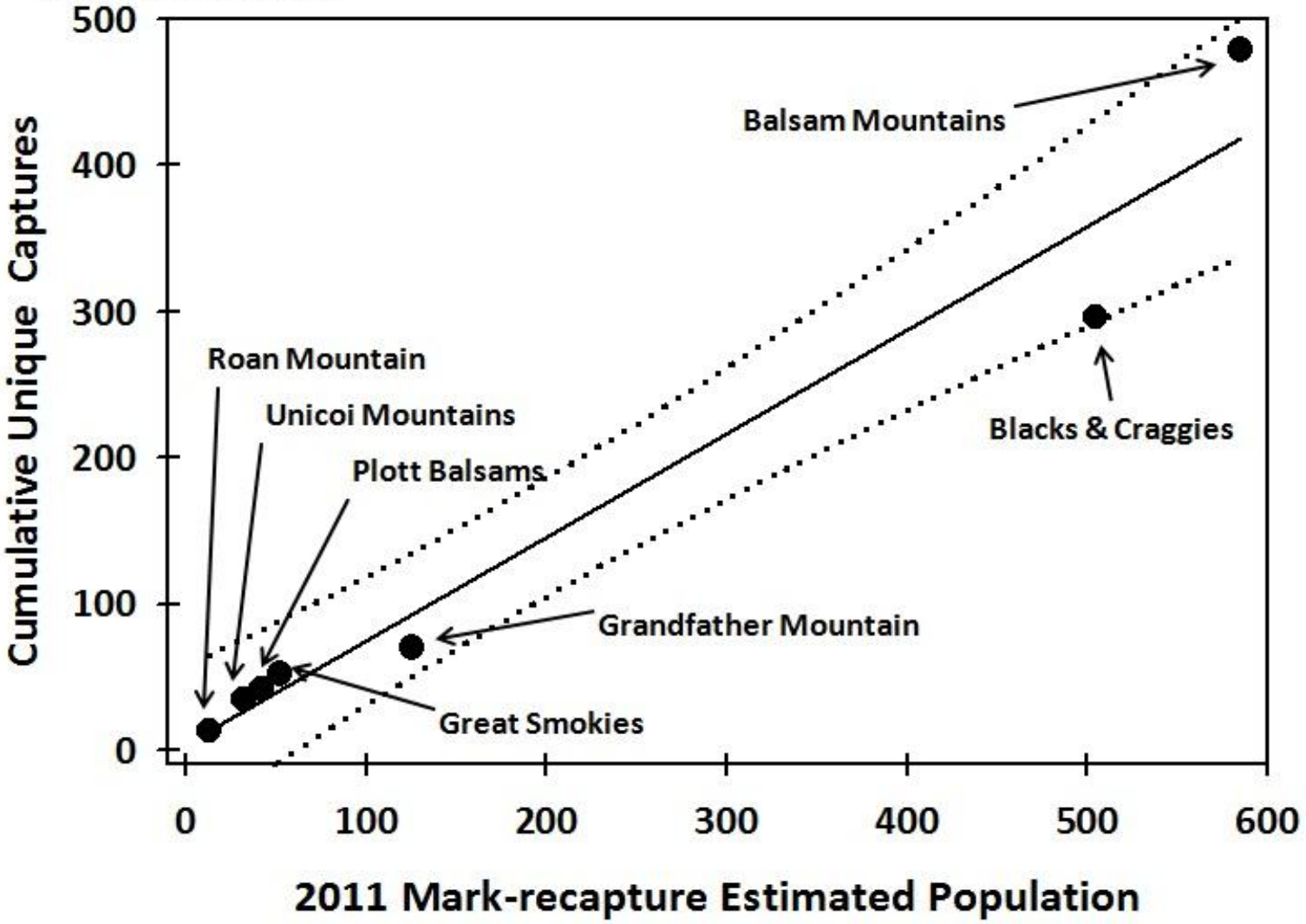
$\rho\ (\text{high}) = 0.76 \pm 0.05$

$\rho\ (\text{medium}) = 0.64 \pm 0.05$

Ford, W.M., K.R. Moseley, C.W. Stihler and J.W. Edwards. 2010. Area occupancy and detection probabilities of the Virginia northern flying squirrel (*Glaucomys sabrinus fuscus*) using nest-box surveys. Pages 37-47 in J.S. Rentch and T.M. Schuler (eds). Proceedings from the Conference on the Ecology and Management of High Elevation Forests in the Central and Southern Appalachian Mountains. USDA Forest Service General Technical Report NRS-P-64.

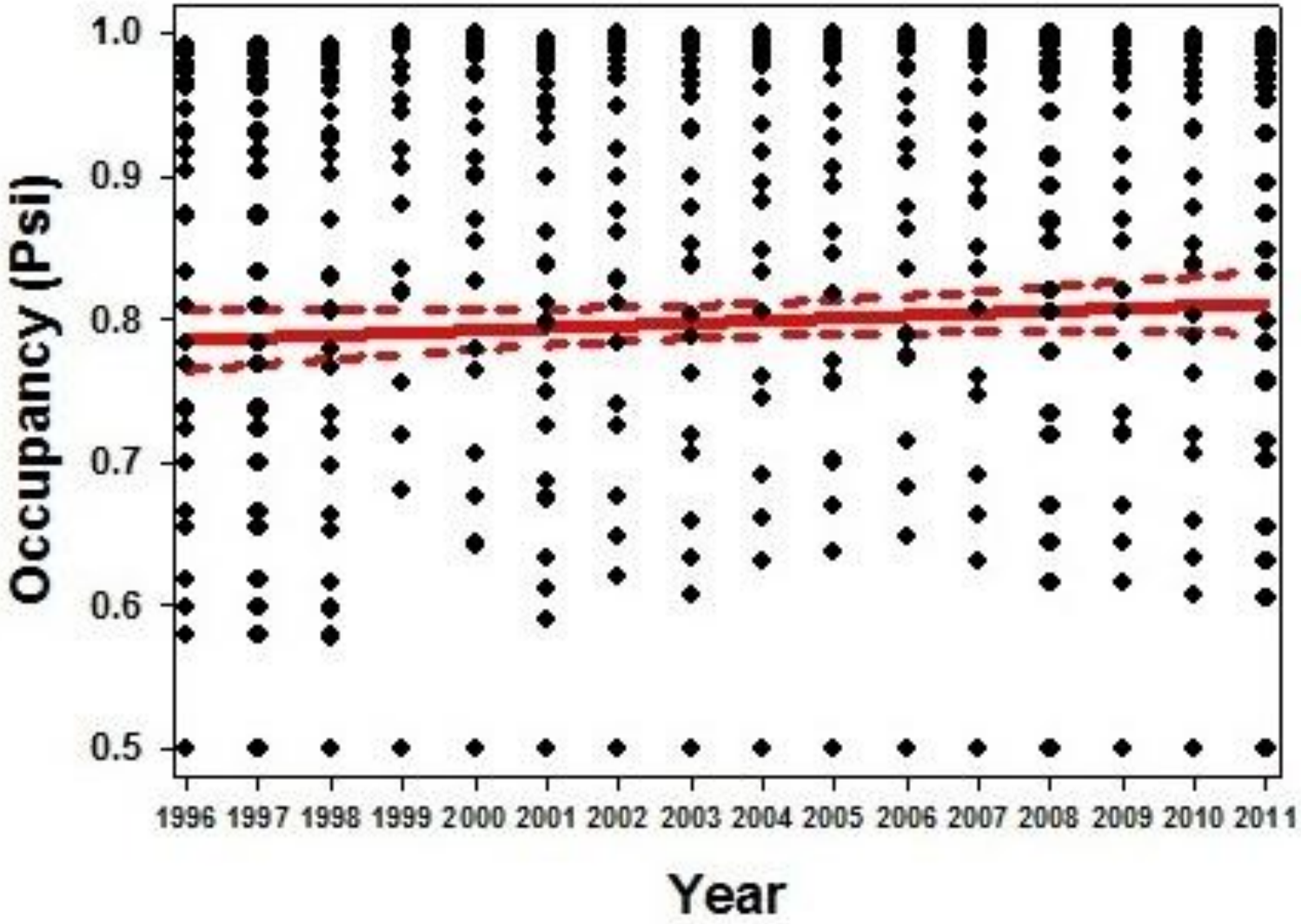
Kelly, C.A., and W.M. Ford. 2010. Occupancy rate and detection probability of the Carolina northern Flying squirrel in North Carolina. Abstracts of the 20th Colloquium on Conservation of Mammals in the Southeastern United States. 20:13.

Figure 2. Linear relationship between cumulative captures of Carolina northern flying squirrels and site-specific POPAN population estimation, 2011.

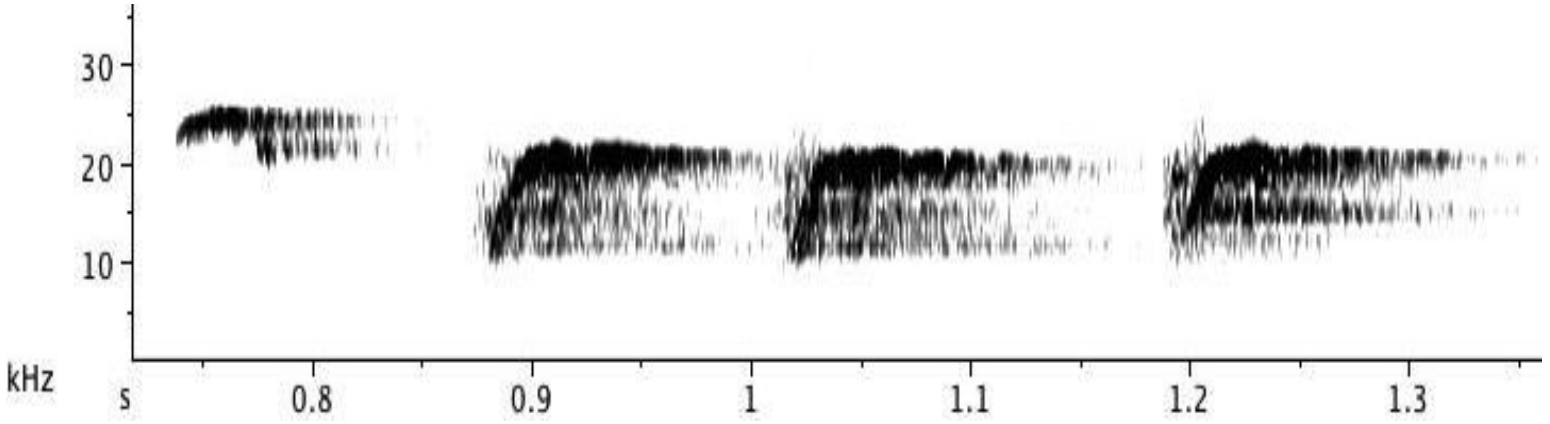


Statewide Occupancy

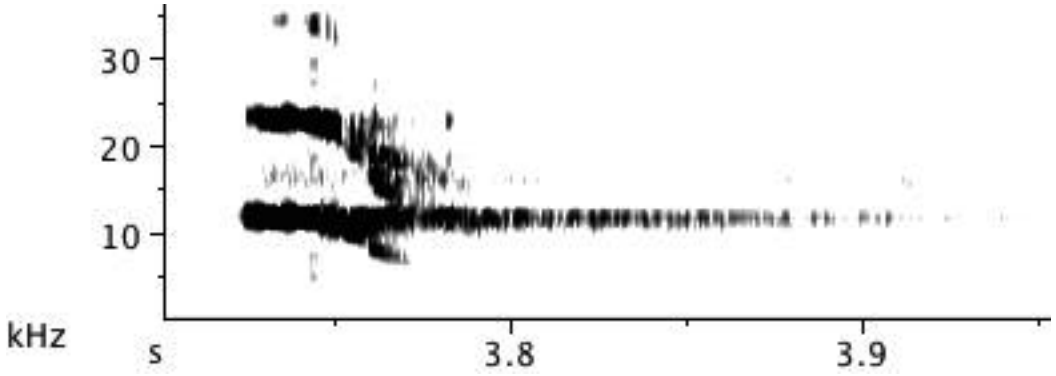
(mixed northern hardwood-red spruce covariate)



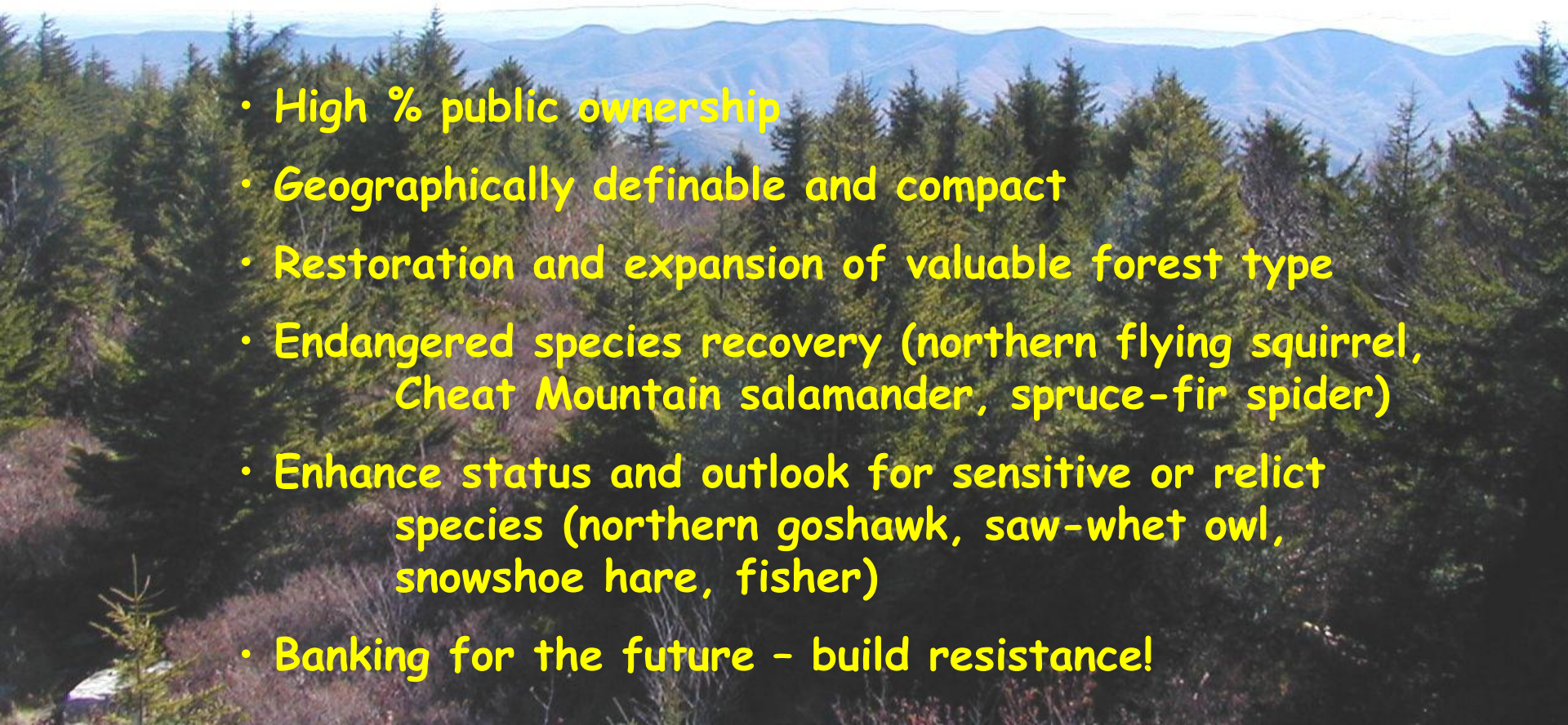
Northern flying squirrel upsweep



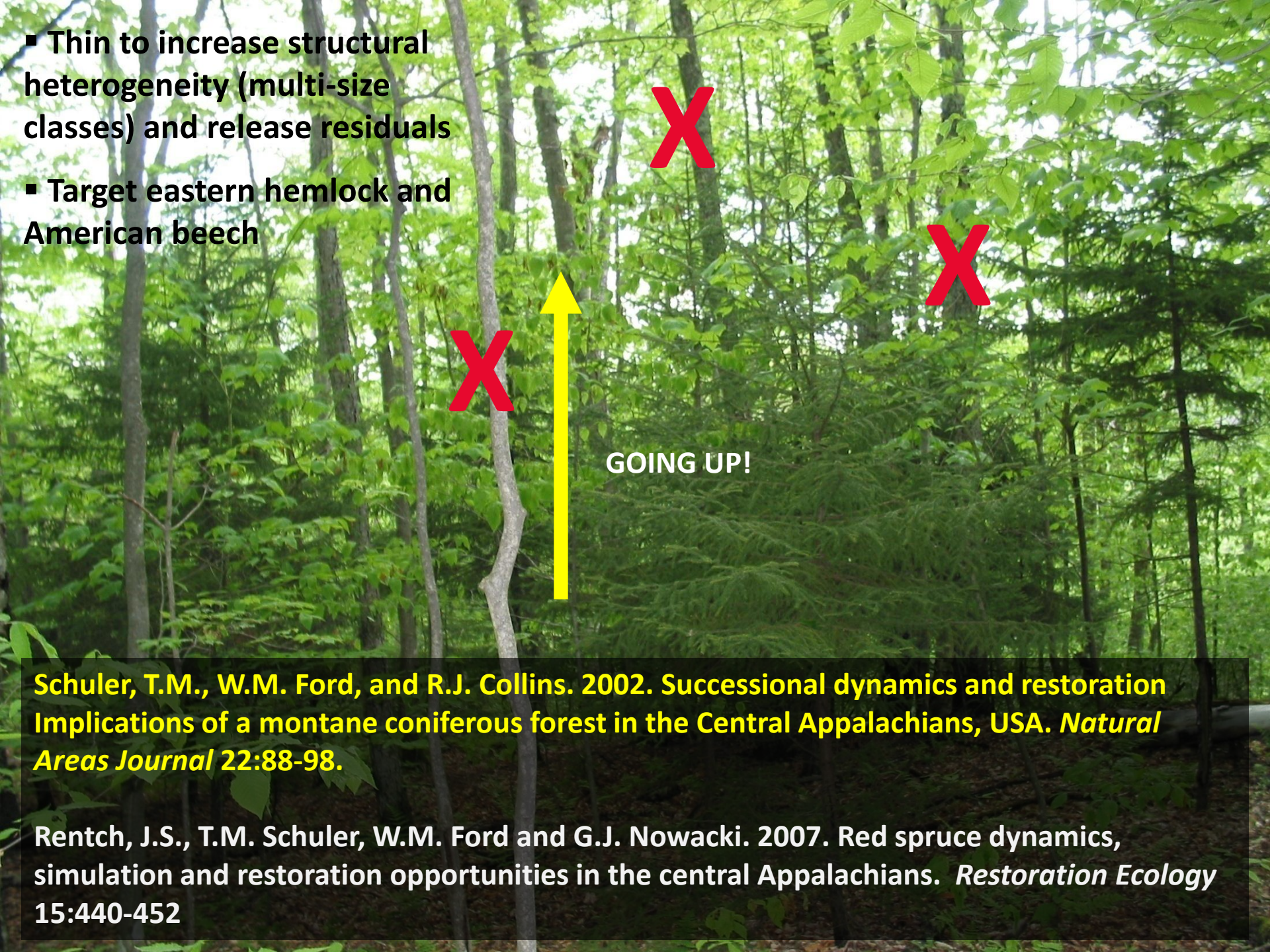
Southern flying squirrel down-sweep



Would going from degraded and potential habitat to occupied and restored (semi-functioning) montane conifer habitat be a suitable management objective in West Virginia and Virginia - and perhaps now North Carolina and Tennessee?

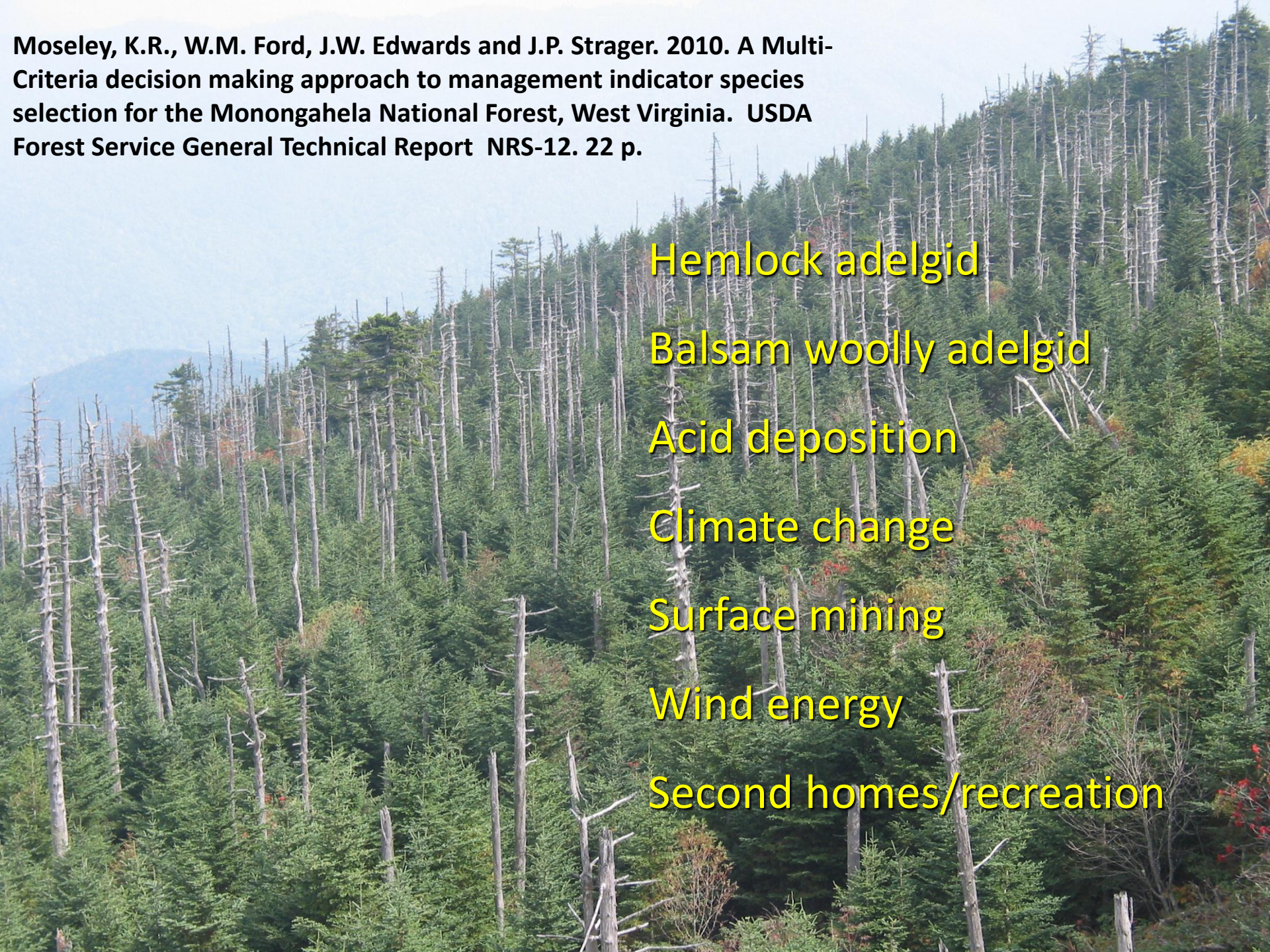


- High % public ownership
- Geographically definable and compact
- Restoration and expansion of valuable forest type
- Endangered species recovery (northern flying squirrel, Cheat Mountain salamander, spruce-fir spider)
- Enhance status and outlook for sensitive or relict species (northern goshawk, saw-whet owl, snowshoe hare, fisher)
- Banking for the future – build resistance!

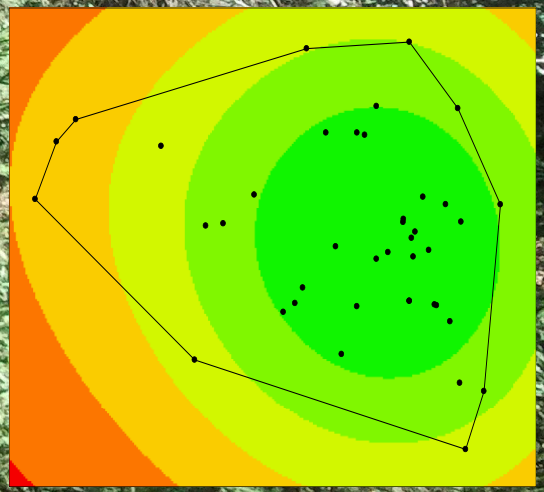


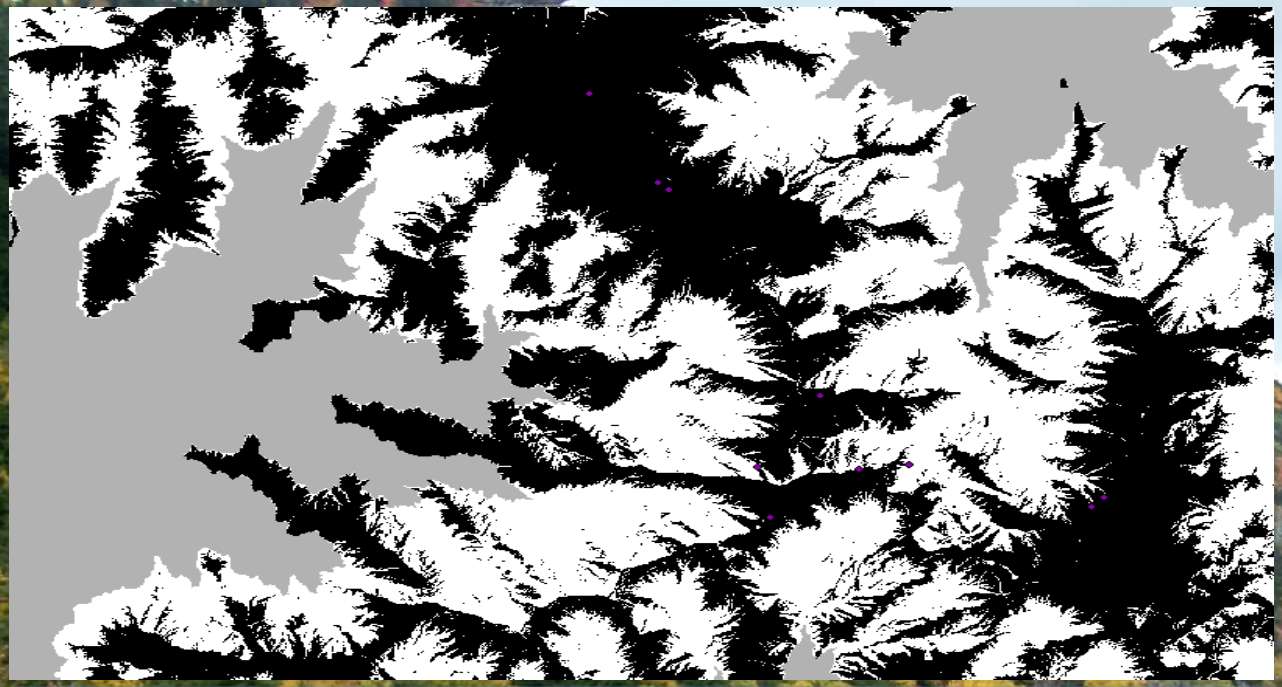
Schuler, T.M., W.M. Ford, and R.J. Collins. 2002. Successional dynamics and restoration Implications of a montane coniferous forest in the Central Appalachians, USA. *Natural Areas Journal* 22:88-98.

Rentch, J.S., T.M. Schuler, W.M. Ford and G.J. Nowacki. 2007. Red spruce dynamics, simulation and restoration opportunities in the central Appalachians. *Restoration Ecology* 15:440-452


Moseley, K.R., W.M. Ford, J.W. Edwards and J.P. Strager. 2010. A Multi-Criteria decision making approach to management indicator species selection for the Monongahela National Forest, West Virginia. USDA Forest Service General Technical Report NRS-12. 22 p.
Hemlock adelgid
Balsam woolly adelgid
Acid deposition
Climate change
Surface mining
Wind energy
Second homes/recreation


Nº 12740

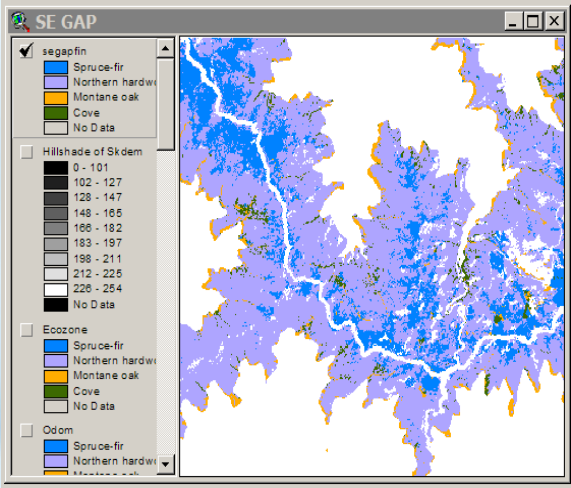


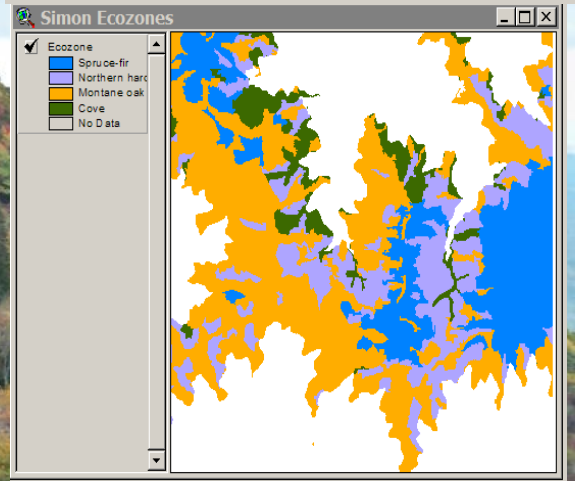


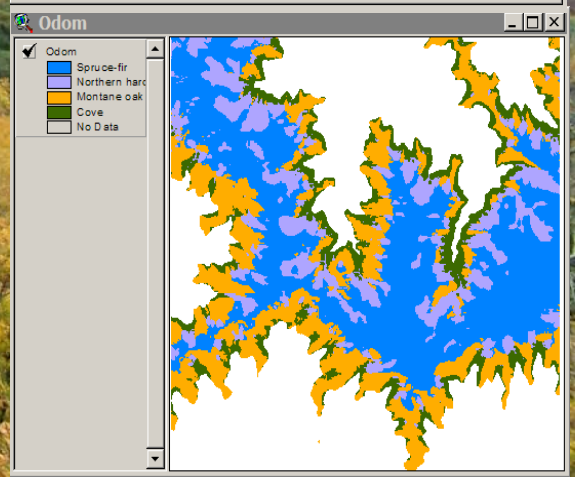
< 0.70 probability of Northern Hardwood

> 0.70 probability of Northern Hardwood

89.47% correct classification

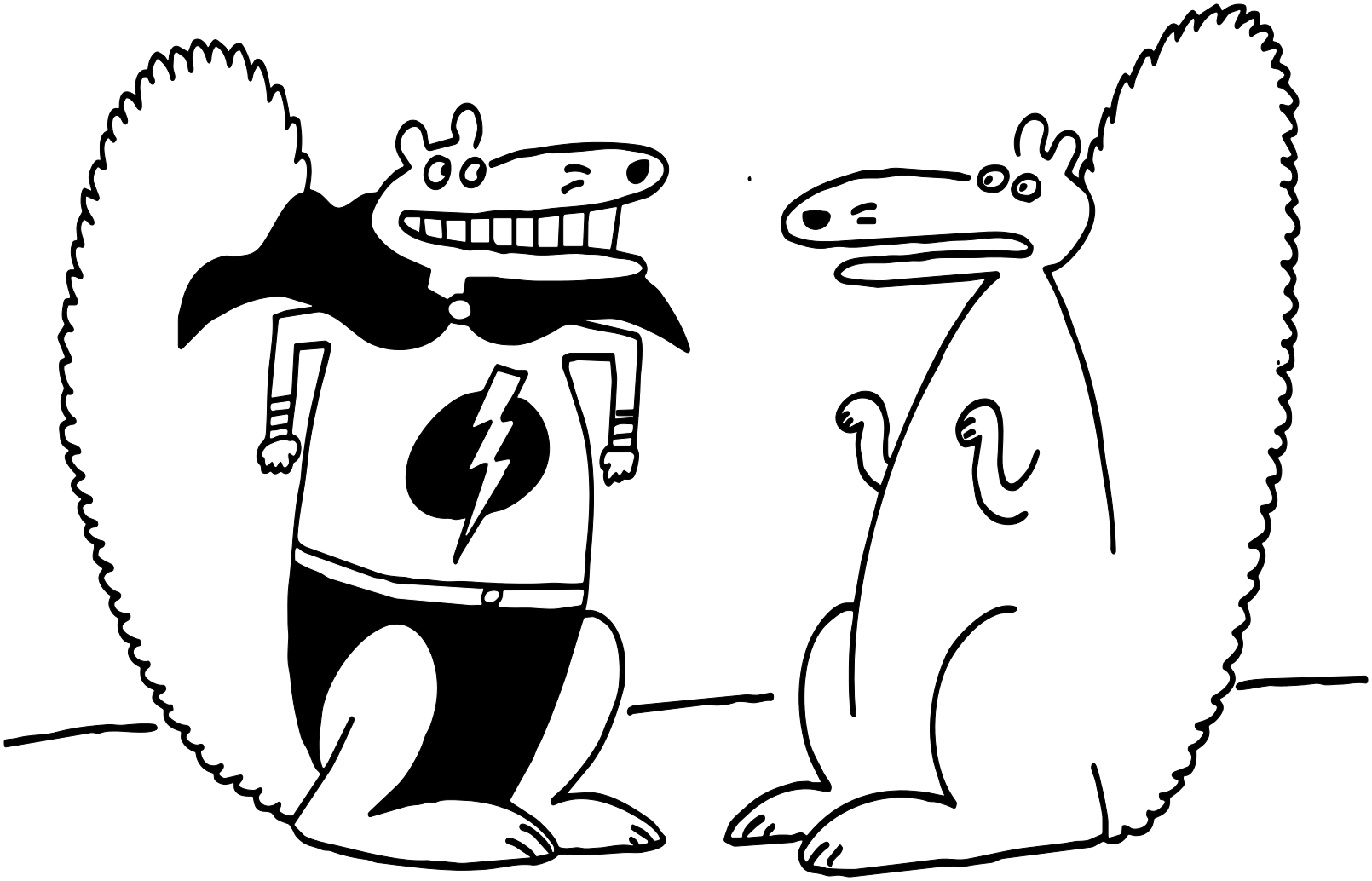






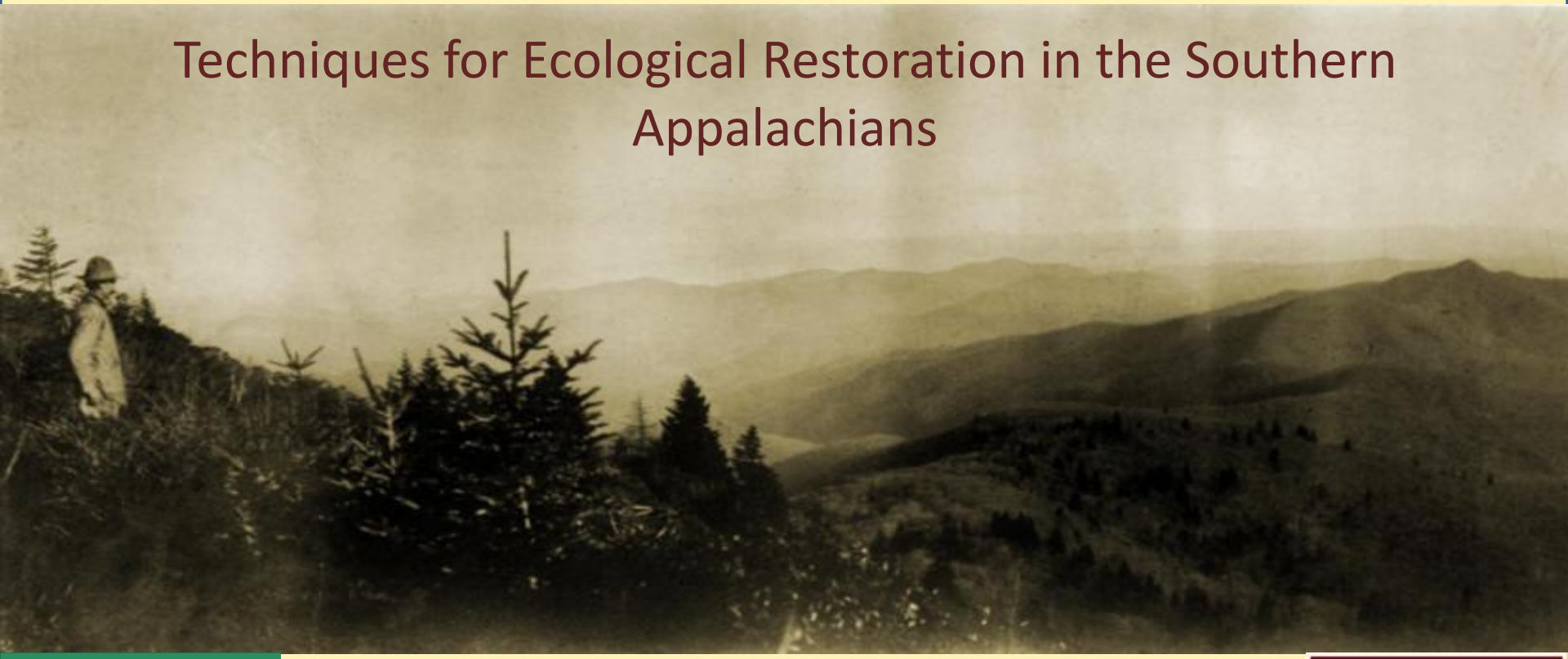
Red oak or northern hardwood?

"You're a hell of a squirrel, but you're still just a squirrel."



Getting It Right

Techniques for Ecological Restoration in the Southern Appalachians



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USGS Virginia Cooperative Fish and Wildlife Research Unit

Steps in Restoration

- Time of reference
- Clearly state reference conditions used for restoration
  - Critical first step in the restoration process
  - Helps garner more public support
  - Without clearly stated and proper application of reference conditions, it is not restoration!!!

Steps in Restoration

- Time of reference
- Clearly state reference conditions used for restoration
- Define restoration treatments
  - Take into account site-to-site variability
  - Blanket prescriptions are inappropriate for promoting structurally diverse systems
- Carry out preliminary, small scale on-the-ground experiments prior to application on the landscape level
- Monitor restoration treatments
- Evaluate effectiveness of restoration treatments using Evidence-based Conservation
- Use adaptive management to perfect restoration treatments

Goals for Restoration in Southern Appalachians

- Ecological Fidelity
  - Main goal of restoration
  - Determined by time of reference
  - 3 principles
    - Structural/compositional replication
    - Functional success
    - Durability
- Increase ecological health and integrity
- Methods of restoration should be effective and efficient

Photo Credit: C.F. Korstian, USFS

Reference Conditions

- Old-growth stands
  - Gaudineer Knob Scenic Area
  - War Spur
  - Great Smoky Mountains
- Historic accounts of spruce in Central and Southern Appalachians
  - Written accounts (USDA 1902, Murphy 1917, Davis 1930, Korstian 1937, Minckler 1940 & 1945, McCullough 1948, Hoffman 1950, Oosting and Billings 1951, Clarkson 1964, Adam and Stephenson 1989, Lewis 1998, etc.)
  - Photographs during logging era in 1880-1920s
- Early land surveys
- Soils and ectomycorrhizal fungi
- Dendrochronology studies
  - Determine second-growth hardwood forests (Schuler et al. 2002)

Getting it right

- Using clearly defined reference conditions, test several different methods to restore spruce on-the-ground using scientific methodology
  - Need to experiment on small scale to determine the best methods to efficiently restore spruce while considering the following:
    - Available resources
    - Easy of application on the ground
    - Translation to large scale application
  - Benefits
    - Small scale equals little to no impact on wildlife (e.g., Carolina and Virginia northern flying squirrel, Cheat Mountain salamander, avifauna, etc.)
    - Gain support from public by producing research-based methods for restoration prior to applying them on a larger scale

Applying Landscape Scale Restoration

- After determining which restoration methods are the most effective on a small scale, apply them over a large contiguous area adjacent to an established spruce stand to study effects of restoration on a landscape scale using a before-after control-impact approach
  - Effects on wildlife populations and habitat dynamics
  - Nutrient cycling
  - Carbon sequestration
  - Ectomycorrhizal fungi associations
  - Herbaceous understory diversity
  - Insect communities
- Long term monitoring
- Evidence-based conservation to adjust restoration methods

Evidence-based Conservation

Evidence-based conservation uses systematic reviews to evaluate the effectiveness of specific restoration treatments and present the likely outcomes of using such treatments.

- Formulate the management question with the relevant stakeholders
- Conduct a systematic review by performing an exhaustive, repeatable search of the literature; assessing the quality of the data; and objectively synthesizing and presenting the results
- Communicate the results in accessible forms to the relevant stakeholders, presenting management alternative and recommendations as well as directions for future research
- Reconvene the stakeholders to select a course of action based on the systematic review, and then monitor and evaluate the outcomes

Centre for Evidence-Based Conservation 2003

Questions?

Photo Credit: C.F. Korstian, USFS