

Silviculture and its Effects on Amphibians

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WFS 533

Outline

- Silviculture basics
- Salamanders and Anuran importance
- Research
- Effects on Salamanders and Anurans
- Readings

Silviculture

- The art and science of controlling the establishment, growth, composition, health, and quality of FORESTS to meet diverse needs and values of the many landowners, societies and cultures over the parts the globe that are covered by dry land



Forest Regeneration

- The act of renewing tree cover by establishing young trees naturally or artificially
- Happens right after the previous stand or forest has been removed



Silvicultural Regeneration

- The harvest of the timber on the stand and re-establishment of the forest



5-Methods of Regeneration

- Single-tree selection method
- Group selection method
- Clear-cut method
- Seed-tree method
- Shelterwood method



Intermediate Stand Treatments

- Release Treatments
- Thinning
- Pruning



Amphibian Characteristics

- Relatively small home range
 - Sensitive to local changes in microclimate and microhabitat
- Remain close to the forest floor all the time
- Require a moist and cool environment for efficient respiration due to a permeable skin



Terrestrial Salamanders

- Are an important ecological component of deciduous forests
- Usually most abundant species
 - Total salamander biomass in a given area can exceed that of other small vertebrate species present
- Species distributions vary according to moisture and elevation gradients



Predator and Prey

- Very important in the food web
- Feed on prey that are too small for birds or mammals
- Are prey for snakes, birds, small mammals, and other salamanders
- Forage in the forest floor litter primarily at night, after rainfall or during high humidity



Anurans

- Important in the food web
- Species distributions vary according to moisture and elevation gradients
- Nocturnal activity and resting in a water-conserving position
- Are prey for snakes, birds and small mammals



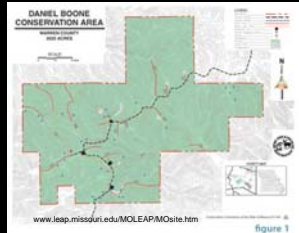
LEAP

- Land-use Effects on Amphibian Populations
- Study sites in Missouri, South Carolina and Maine



Missouri LEAP

- Daniel Boone Conservation Area (DBCA) in Warren County, Missouri
- 3500-acre Conservation Area
- Missouri Dept. of Conservation owns and manages
- Oak-hickory forest with ~35 ponds



Species of Concern

- Wood frogs (*Rana sylvatica*)
- Ringed salamanders (*Ambystoma annulatum*)



Target Species

- Wood Frog (*Rana sylvatica*)
- Spotted Salamander (*Ambystoma maculatum*)
- American Toad (*Bufo americanus*)



Experimental Forest Management Treatments

- Completed from May-December 2004
- 1. Control treatment
 - maintained in the original condition of the forest with only minor disturbance from skidders
- 2. Clear-cut with CWD retained treatment
 - all trees greater than 10 inches dbh were removed by loggers, the remaining trees were all cut by hand, tops and limbs were cut to <6 feet to facilitate contact with the ground

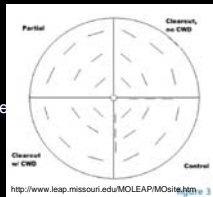


- 3. Clear-cut with CWD removal treatment
 - Same as other clear-cut plus quadrants will be burned in January 2007 to remove woody debris
- 4. Partial cut treatment
 - "thinned" quadrant to 50% stocking density by girdling unwanted species and defective trees, each array was inventoried so that the target stocking density was achieved accurately



Drift Fence and Pitfall Trap Schematics

- Figure 3
 - Each of the 4 treatments has 6 fences, set at 50m, 100m, and 150m, to monitor amphibian movement in the terrestrial habitat. A set of 3 fences have been added to the edges of the control treatment to monitor lateral movement into and out of the unaltered forest control quadrant
- Figure 4
 - A 50ft drift fence with pitfall traps. Each length of fence has 3 pairs of buckets per side for amphibian capture



Experimental Terrestrial Pens

- 64 pens will be used to assess metamorph survival under each of the 4 forestry treatments. Four 3x3m pens will be built in each quadrant.
- In the spring 32 pens will be stocked with wood frogs and 32 with American toad metamorphs
- Pens will be stocked with *spotted salamnder* metamorphs the following spring.
- Pen construction began in November 2004 and is scheduled to be finished by mid-March 2005



Publications

- Rothermel, B.B., and R.D. Semlitsch. 2006. Consequences of forest fragmentation for juvenile survival in the salamanders *Ambystoma maculatum* and *A. opacum*. *Canadian J. Zoology* 84: 797-807
- Rittenhouse, T.A.G., M. Doyle, R. Mank, B.B. Rothermel, and R.D.Semlitsch. 2004. Substrate cues influence habitat selection by spotted salamanders. *Journal of Wildlife Management* 68:1151-1158
- Rothermel, B.B., and R.D. Semlitsch. 2002. An experimental investigation of landscape resistance of forest versus old-field habitats to emigrating juvenile amphibians. *Conservation Biology* 16:1324-1332
- <http://www.leap.missouri.edu/MOLEAP/MOpublications.htm>

Research - Paper

- Following research comes from:
- Effects of seven silvicultural treatments on terrestrial salamanders
- Douglas N. Harpole and Carola A. Haas

Research - Clearcutting

- Removed all merchantable trees and stems down to 5 cm during a single harvest. Some mast, snag, and cull trees are left for wildlife
- Clearcutting increases the surface temperature and leads to drying of the litter layer limiting salamander surface activity
- Studies have shown that populations decline by 75-80% after clearcut timber harvesting $p=0.001$

Research - Herbicide

- Intended to remove non-desirable understory woody vegetation to reduce competition to promote the growth of desirable species for timber products
- No effect on salamanders or anuran populations
- $p= 0.862$



Research - Group selection

- Removal of a group of trees in the same manner as clearcutting, generally on harvested on a 20 year cutting cycle
- Significant decline in salamander and anuran population
- $p= 0.005$



Research - Single harvest

- Overstory is removed which creates a gap in the canopy simulating the death of an old-growth tree

- Significant decline in salamander and anuran population

- $p = 0.001$



Research - Shelterwoods

- Remove trees in a series of three harvests:
 - 1) Preparatory cut
 - 2) Establishment cut
 - 3) Removal cut

- Alters understory environmental conditions
 - sunlight, temperature, and moisture

- Significant decline in salamander and anuran population
- $p = 0.007$

Research – Un-harvested

- No silvicultural treatment applied to the forest

- No effect on salamanders or anurans

- $p = 0.788$



Analyzing the Research

- When overstory is removed or altered there is a decline
 - Temperature increase
 - Moisture decrease
- When understory is removed but overstory remains intact no change is seen
 - microhabitat and microclimate conditions are not altered

Correlations to Environment

- Amphibians are positively correlated with
 - Quantity of coarse woody debris
 - Quality of coarse woody debris
 - Litter depth and moisture
 - Understory vegetation density
 - Overstory canopy closure



Salamanders vs. Anurans

- Salamanders are more sensitive to clearcutting and associated edge effects than anurans



Future Research

- Despite their importance in many forest systems, salamanders and anurans are often been ignored in forest management studies
- More research in all the methods of silviculture and its effects on populations
- Need more Long-term data on salamander populations
- Need more studies with both pre- and post-harvest data from the same location

Readings

- **Required**
 - Harpole, D. N. and C. A. Haas. 1999. Effects of seven silvicultural treatments on terrestrial salamanders. *Forest Ecology and Management* 114: 349-356.
 - Phillip G. Demaynadier, Malcolm L. Hunter (1998) Effects of Silvicultural Edges on the Distribution and Abundance of Amphibians in Maine *Conservation Biology* 12 (2) , 340-352
- **Recommended**
 - Shannon M. Knapp, Carola A. Haas, Douglas N. Harpole, Roy L. Kirkpatrick (2003) Initial Effects of Clearcutting and Alternative Silvicultural Practices on Terrestrial Salamander Abundance *Conservation Biology* 17 (3) , 752-762
