Foundations of Forest Wildlife Habitat Management
Habitat through Disturbance and Silviculture

Guest Lecturer: Dr. Brenda McComb, Oregon State University.

Series Description The Forest Ecology Working Group (FEWG) and NCTC are pleased to offer this 5-part focused lecture series to introduce fundamental principles of forest habitat management. Please contact Jeff_horan@fws.gov if you want more information about FEWG or this webinar series.

July 14 - Habitat Selection by Forest-Associated Species: Abiotic factors

July 28 - Saving all the Pieces: Forest structure and Composition

August 11 - Forest Disturbance and Stand Dynamics

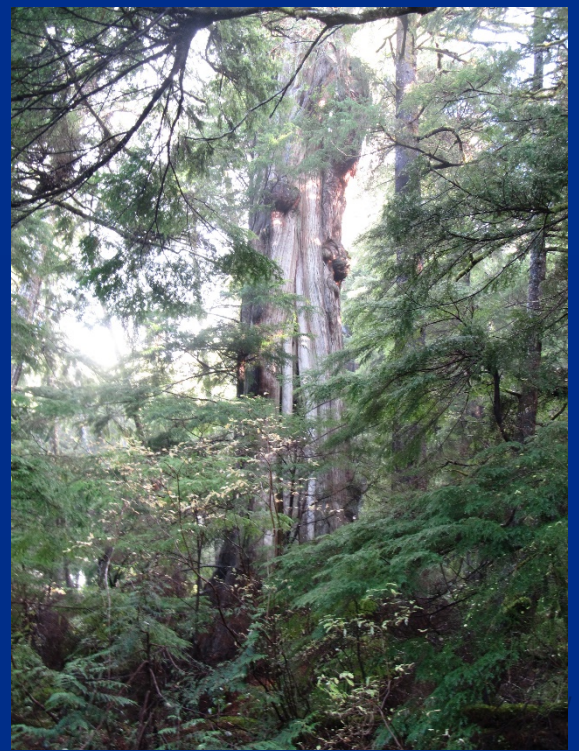
August 25 - Silviculture as a Forest Disturbance

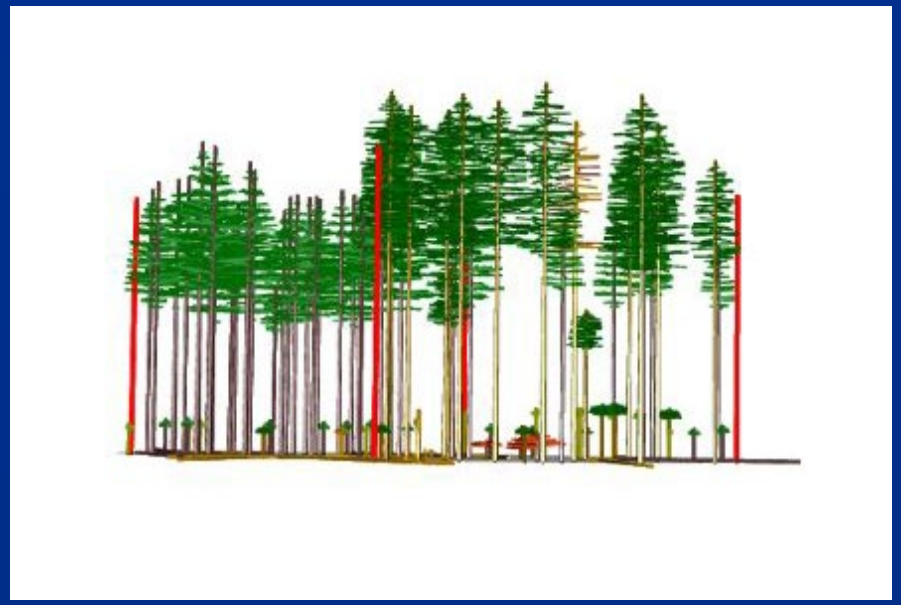
September 15 - Habitat Considerations: Dead wood and Riparian Areas

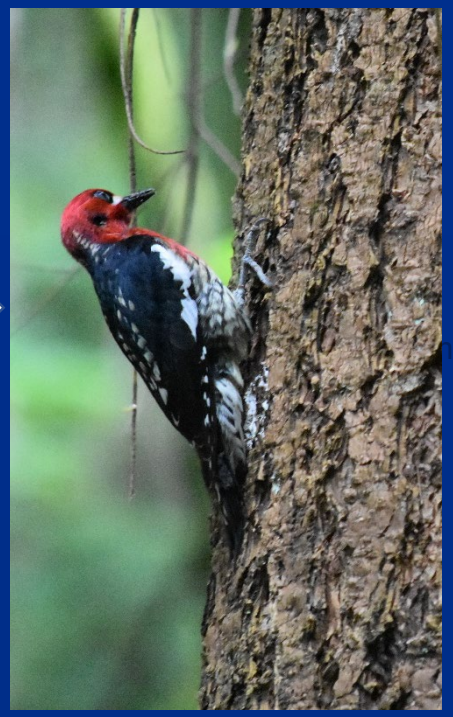
Foundations of Forest Wildlife Habitat Management:

Habitat Through Disturbance and Silviculture

Week 2: Saving all the Pieces: Forest structure and Composition (and Biotic Relationships)







Biotic relationships

- Competition – intraspecific
- Competition – interspecific
- Herbivory – e.g., Gypsy moth, white-tailed deer
- Disease – e.g., Chestnut blight
- Symbiosis – e.g., Mycorrhizae
- Allelopathy – chemical wars between plants
- Facilitation – e.g., nurse logs

Biotic relationships – Plant Biology

- **Seed/Seedling Biology** (Woody Plant Seed Manual)
  - Flowering – phenological patterns and effects of climate change
  - Pollinators – Insects? Wind? Bats? Birds?
  - Seed maturation – Red oaks (2 growing seasons) vs white oaks (one growing season)
  - Dispersal – wind, mammals, birds, water
  - Germination – Scarification? Stratification?
  - Growth – Emphasis on roots or shoots initially? Phototropic or geotropic?

Question: What is the stratification period for the dominant tree species in your area?

Intraspecific competition leads to suppression mortality and a stand will “self thin” and “self prune”

As trees grow, some trees have to die

How large are snags recruited by suppression mortality?

Interspecific Competition: Shade Tolerance

Red alder,
pin cherry,
loblolly pine

White pine,
Douglas-fir

hemlock,
redcedar,
sugar maple

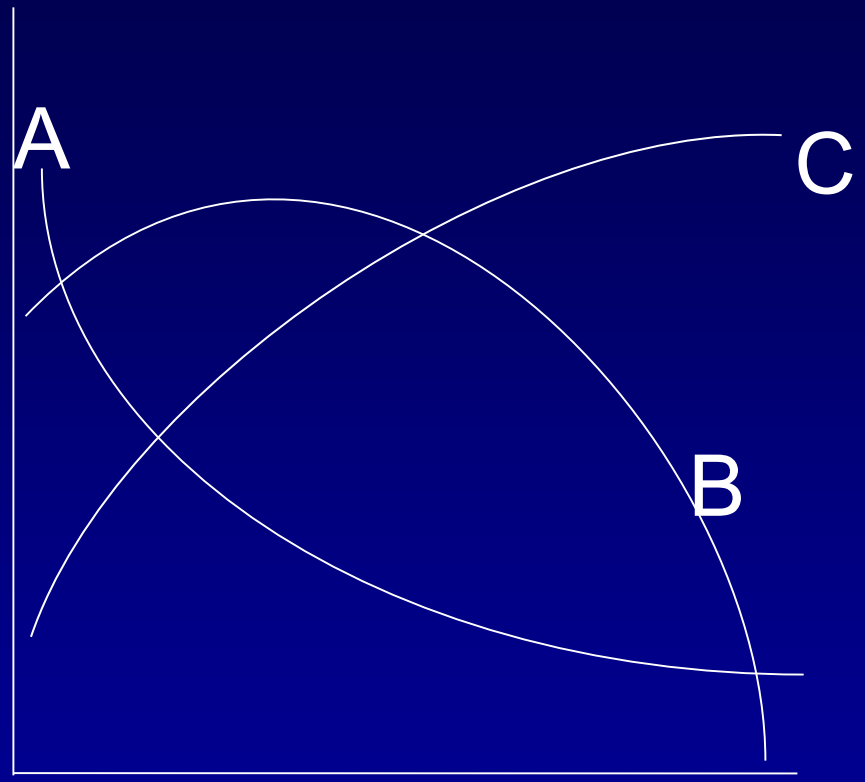
Intolerant

Tolerant

What would this look like for drought tolerance?

Use the Silvics Manual to determine what the shade tolerance is for a species dominant in your area

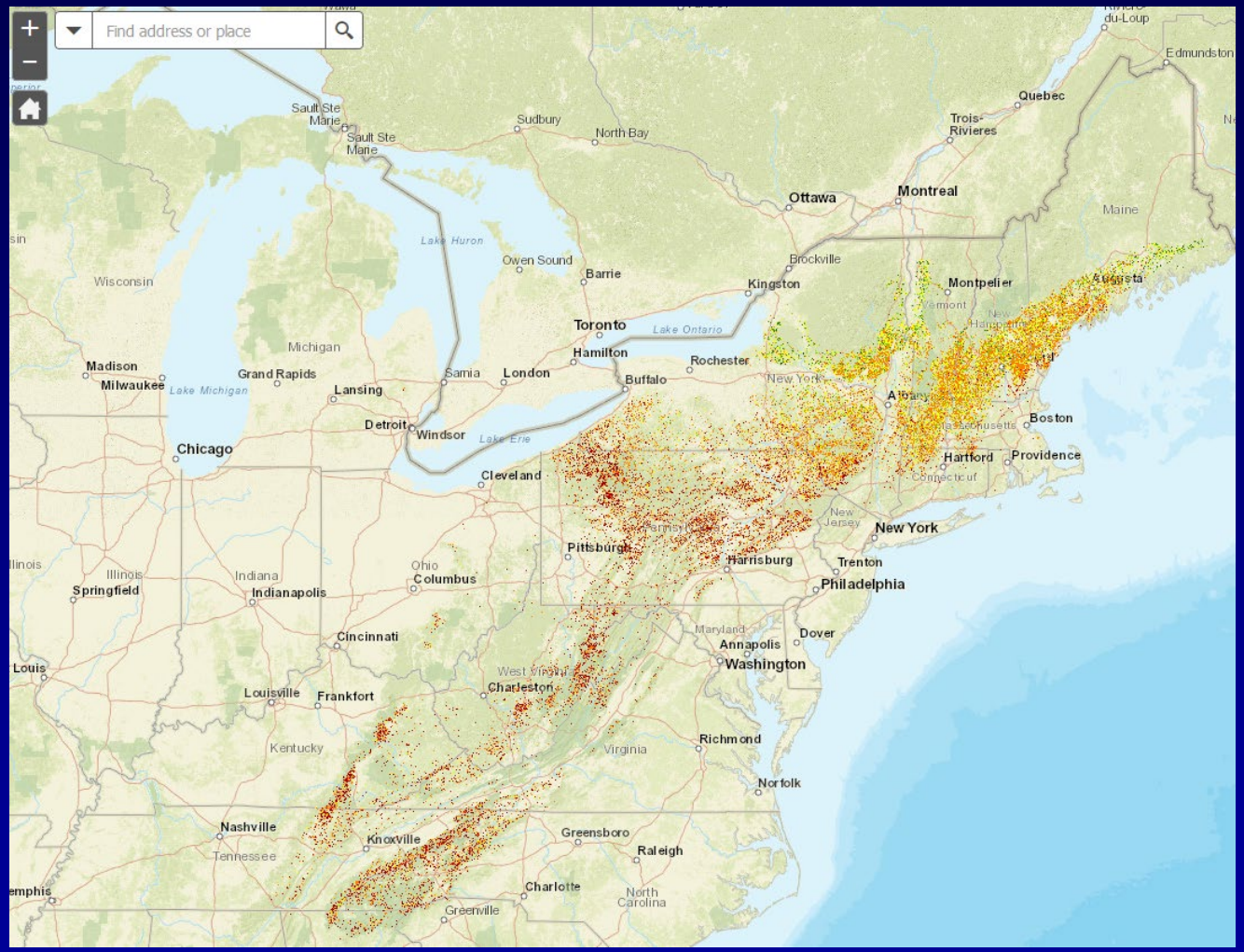
Browsing



https://www.flickr.com/photos/nicholas_t/9463176528

Curve A = taxa or communities that are adversely affected by browsing
Curve C = taxa or communities that benefit
Curve B = intermediate ungulate densities

Insects as stressors on trees and forests



- Defoliators
- Bark beetles
- Wood borers
- Bud insects
- Sap insects

https://www.na.fs.fed.us/spfo/pubs/pest_al/hemlock/hwa05.htm

Predicting insect and disease risk

Insect and disease risk across the US

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United States Department of Agriculture

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- Data and Application Development
- National Insect & Disease Risk Maps
- Individual Tree Parameter Maps
- Forest Damage Agent Range Maps
- Soil Drainage & Productivity Indexes
- SPB Hazard Rating Maps

Mapping & Reporting

National Insect & Disease Risk and Hazard Mapping

FHAAST has completed the 2013 - 2027 National Insect and Disease Risk Map (2012 NIDRM); a nationwide strategic assessment and database of the potential hazard for tree mortality due to major forest insects and diseases. The goal of NIDRM is to summarize landscape-level patterns of potential insect and disease activity, consistent with the philosophy that science-based, transparent methods should be used to allocate pest-management resources across geographic regions and individual pest distributions. In other words: prioritize investment for areas where both hazard is significant and effective treatment can be efficiently implemented.

NIDRM data can be used to:

- Identify the potential impacts of pests and pathogens to forest ecosystems throughout the US for the 2013 - 2027 timeframe.
- Generate forest pest and pathogen risk maps at a scale useful for resource planning and management purposes in many of our National Forests, National Parks, and other local units.
- Develop an effective strategic planning tool that can inform assessments of natural ecosystems and ensure resources for forest pest prevention, suppression, and restoration reaches the highest priority areas.
- Detect areas where hazardous fuels treatments coincide with lands at risk for forest pest activity, much of which is density driven. Efficiencies will be gained by prioritizing coincident areas.

For a quick overview of the 2013 – 2027 assessment and to learn more information on the differences between the 2006 and 2012 NIDRMs download the executive summary (2 MB PDF).

Explore forests vulnerable to attack from major insects and diseases by viewing the Interactive Story Map of the National Insect and Disease Risk Map

FOREST HEALTH PROTECTION
2013-2027 National Insect and Disease Composite Risk* Map by Subwatersheds (6th Level HUCs)**

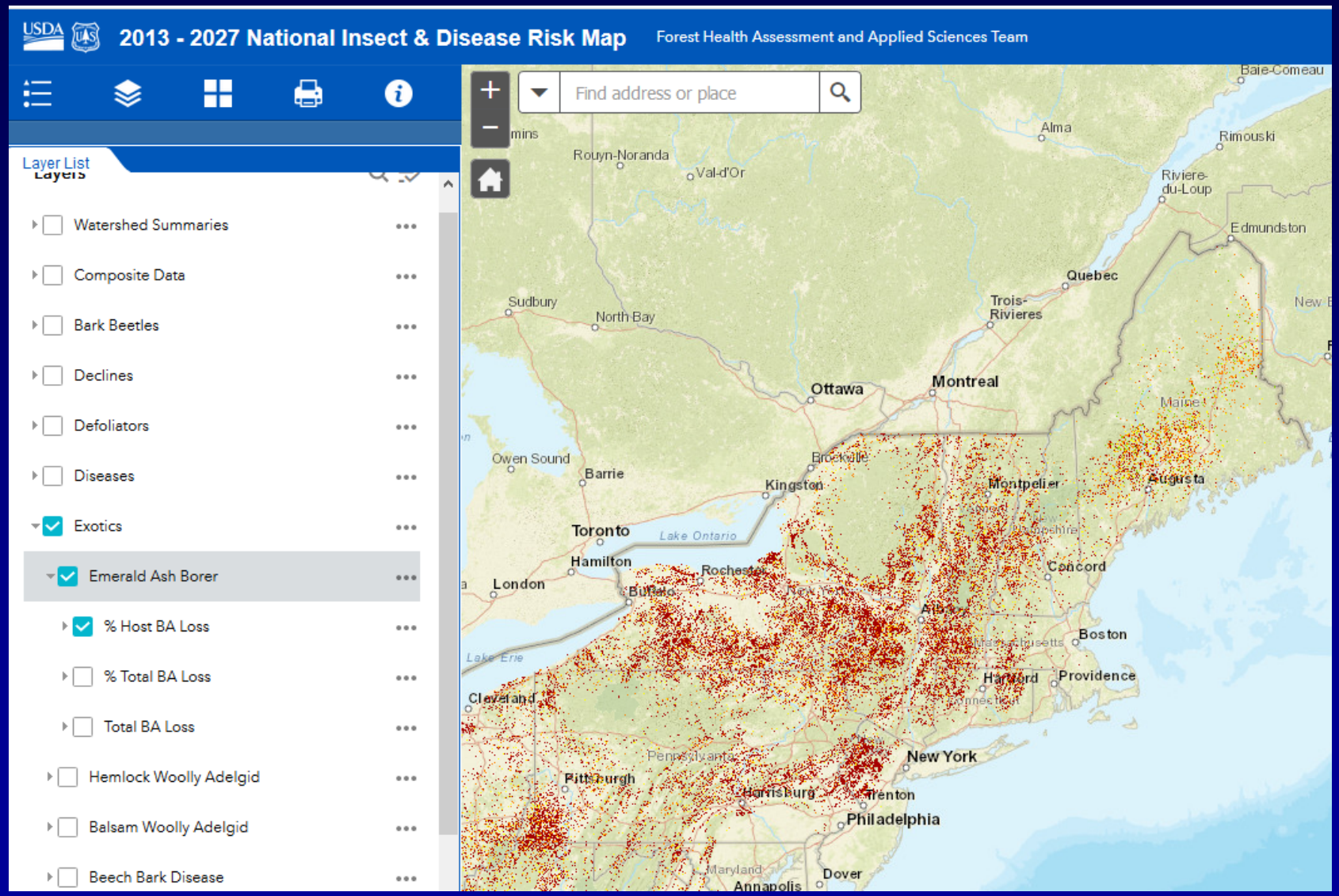
NIDRM Composite Risk Map by Subwatersheds

Related Links
- National Forest Health Conditions & Highlights Interactive Maps
- National Insect & Disease Risk Map Viewer
- Individual Tree Species Parameter Maps
- Individual Tree Species Parameter Maps Viewer
- National Forest Damage Agent Range Maps
- SPB County Hazard Rating Maps
- Thousand Cankers Disease Survey Maps
- Forest Health Assessment & Applied Sciences Team Publications

Want to know if your forest is at risk of damage by an insect or disease?

Predicting insect risk – an example

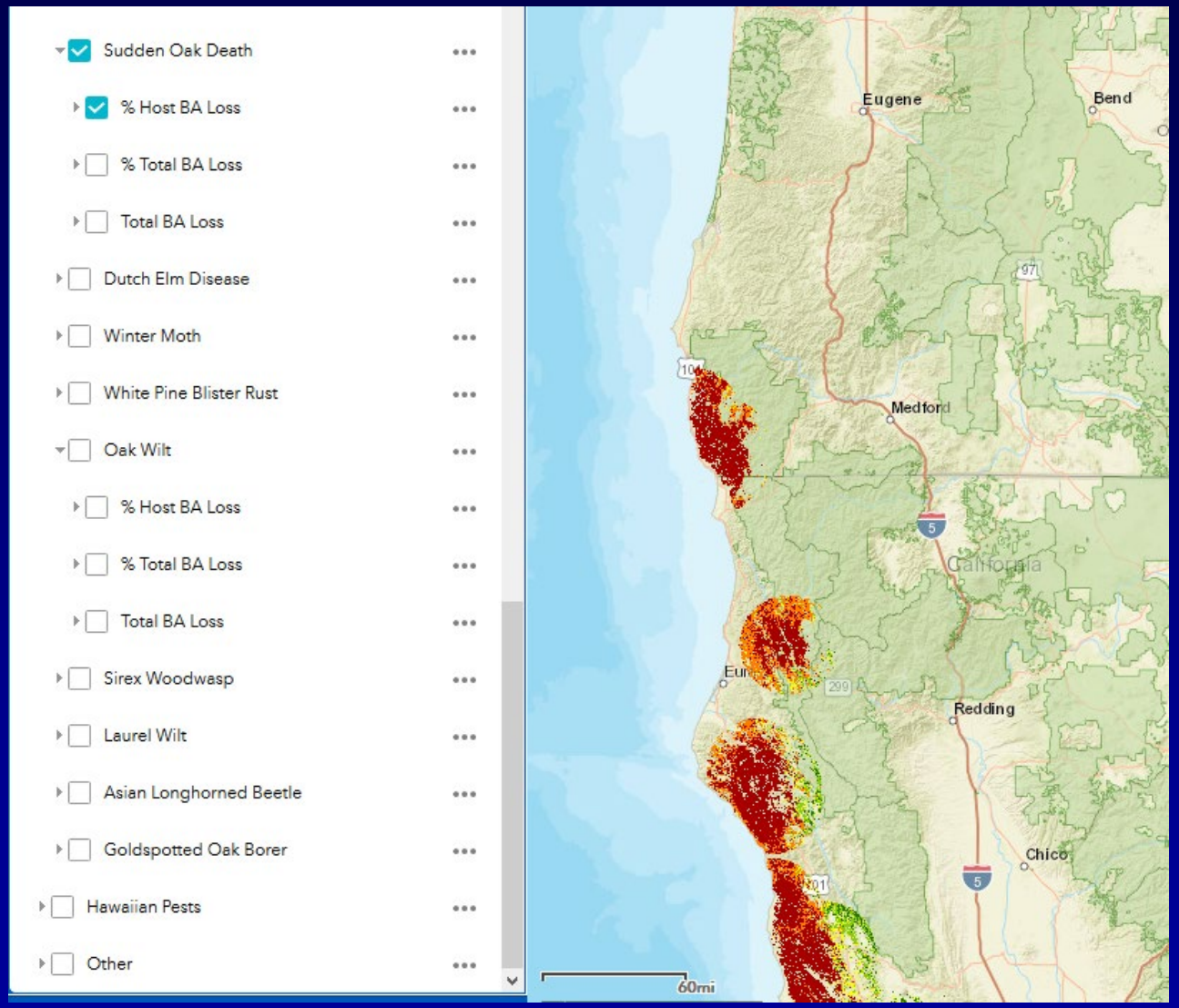
Emerald Ash Borer distribution and activity



Tree diseases as stressors on trees and forests

Chestnut Blight

https://www.forestfoundation.org/woodland-restoring-woodland-icon



Sudden Oak Death

Mycorrhizal relationships

https://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/soils/health/biology/?cid=nrcs142p2_053864

"In exchange for carbon from the plant, mycorrhizal fungi help solubolize phosphorus and bring soil nutrients (phosphorus, nitrogen, micronutrients, and perhaps water) to the plant."

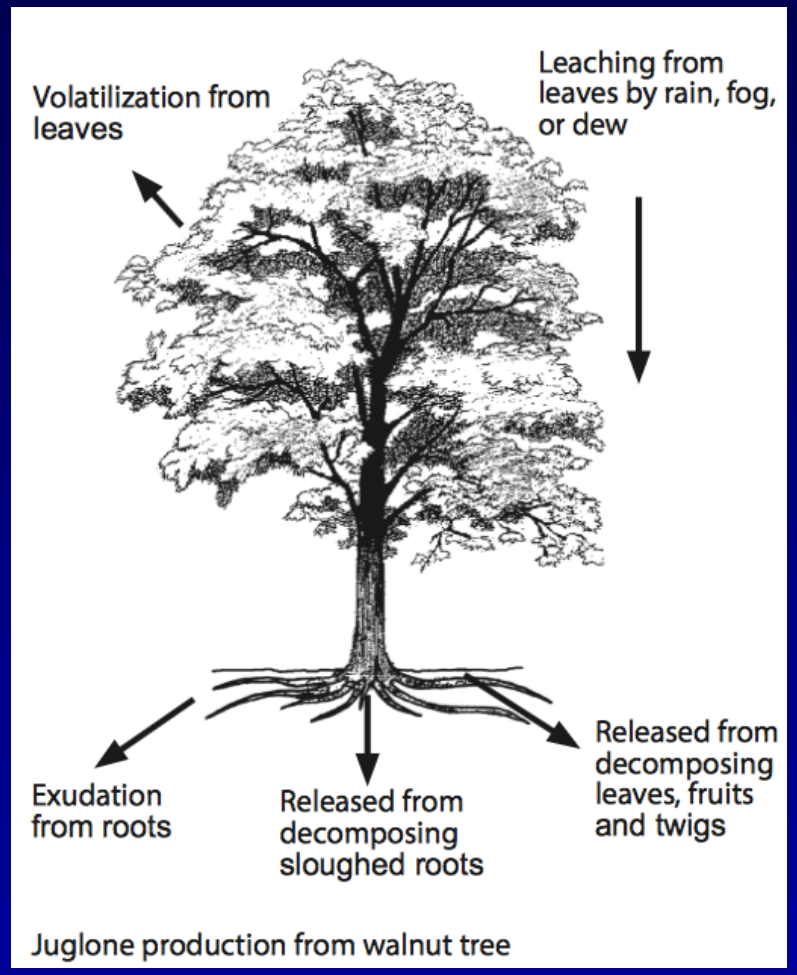
http://www.chrismaser.com/truffle.htm

Short video on Mycorrhizal symbiosis

How trees talk to one another Min:10-12

Allelopathy

http://phytoimages.siu.edu/imgs/pso/r/Juglandaceae_Juglans_nigra_4178.html



http://growingva.com/news/2015/04/walnut-tree-allelopathic-effects-and-tolerant-plants/

Facilitation

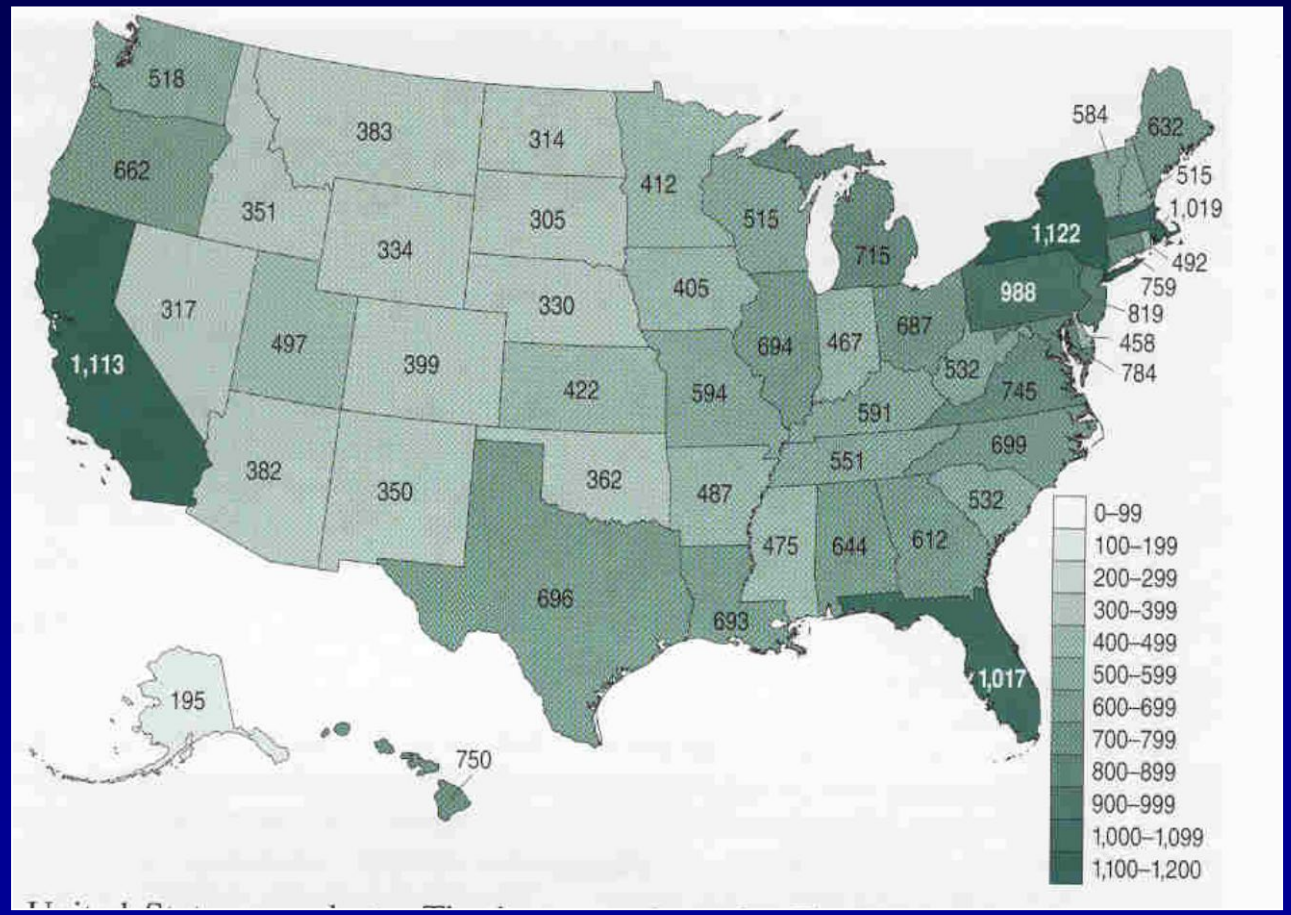
Decaying logs provide a seedbed for tree seeds.

For some species on some site, partial shade can shelter seedlings (e.g., Oregon oak and Douglas-fir)

Effects of Humans: Invasive Species

Latitudinal homogenization of ecosystems through dominance by invasives

Example of non-indigenous plant species introduced into each state circa 1998



https://www.nwrc.usgs.gov/sandt/Nonindig.pdf

Biotic relationships

- What about GMO's?
- Webinar – Forest Ecology at the U.S. Fish and Wildlife Service

The Potential for Biotechnology
to Address Forest Health

Perspectives from the
U.S. Fish and Wildlife Service's
Forest Ecology Working Group

For the National Academies of Sciences,
Engineering, and Medicine

Chuck Hunter
U.S. Fish and Wildlife Service
Atlanta, GA

March 5, 2018

Mount Graham
Red Squirrel

A study in extinction
prevention

Marit Alanen, Fish and Wildlife Biologist, USFWS
Arizona Ecological Services Office, Tucson, AZ

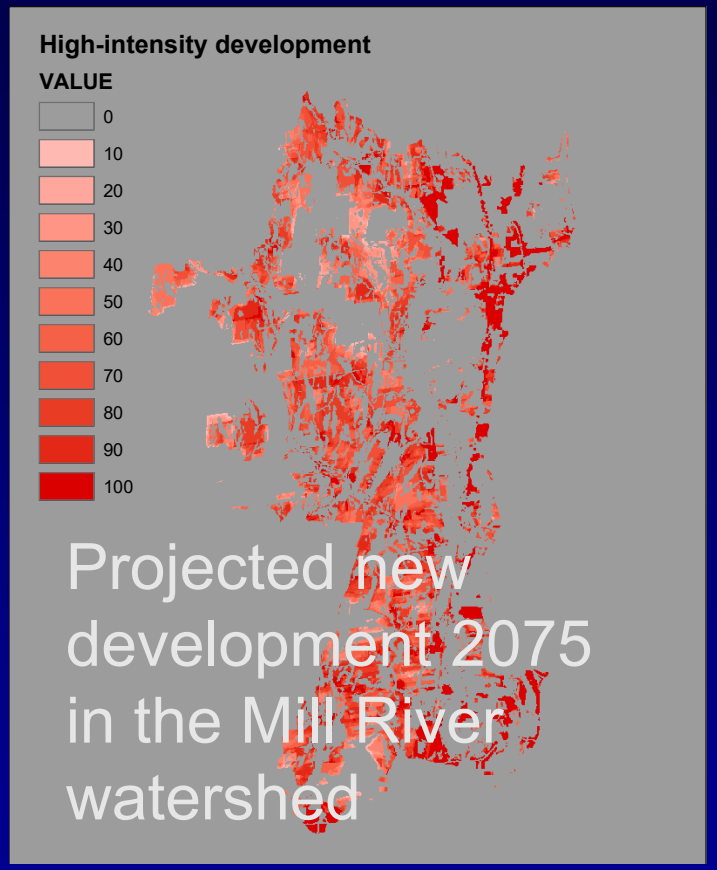
Stressors

Managing forests for future options in the face of uncertainty through synergistic effects of novel stressors (Synergistic Effects of Pervasive Stressors on Ecosystems and Biodiversity):

- Climate change
- Invasive species
- Land use
- Pollutants

https://pxhere.com/en/photo/1189751

https://commons.wikimedia.org/wiki/File:Pestering_pests,_Entomology_sprays_down_threats_150323-F-XD389-010.jpg



Consider how expansion of new housing projects exacerbates invasive species proliferation and distribution of pollutants.

Questions?

Habitat structure and composition

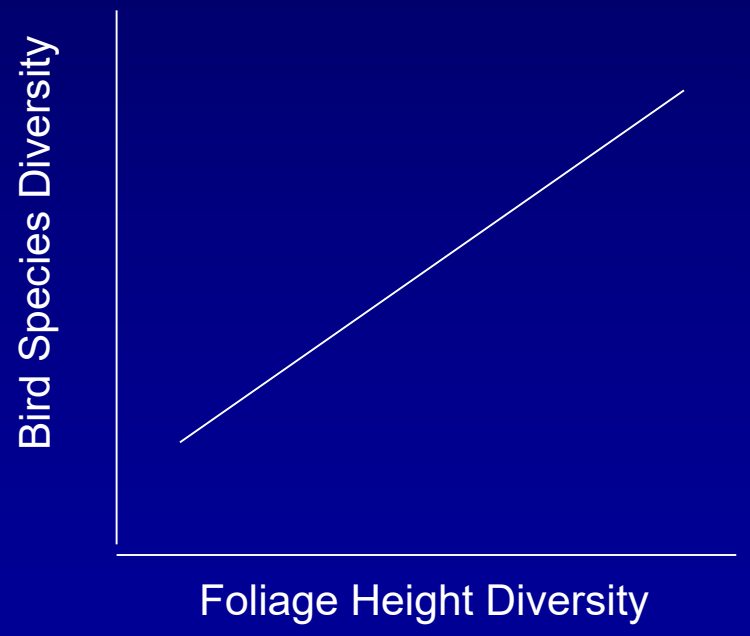
Identifying and managing habitat elements important to many species in forests

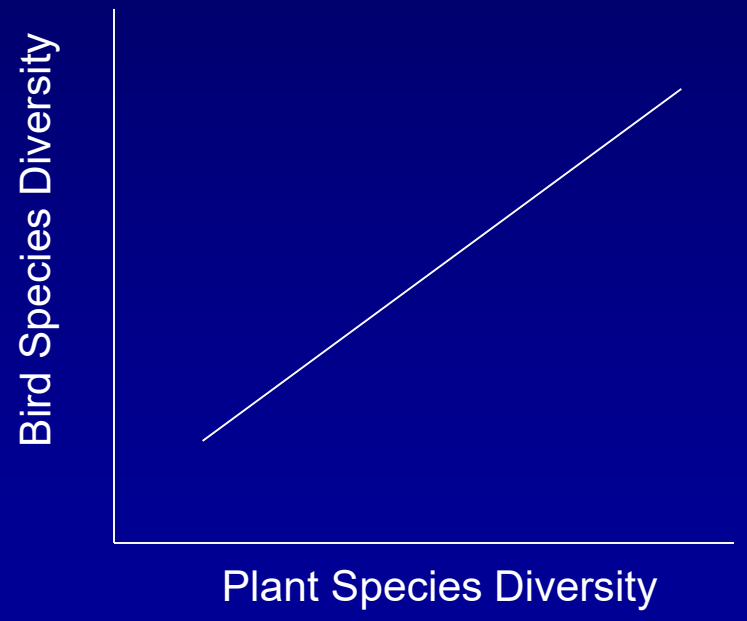
Forests have 3 dimensions

Species are often associated with layers in the forest

Vertical Complexity

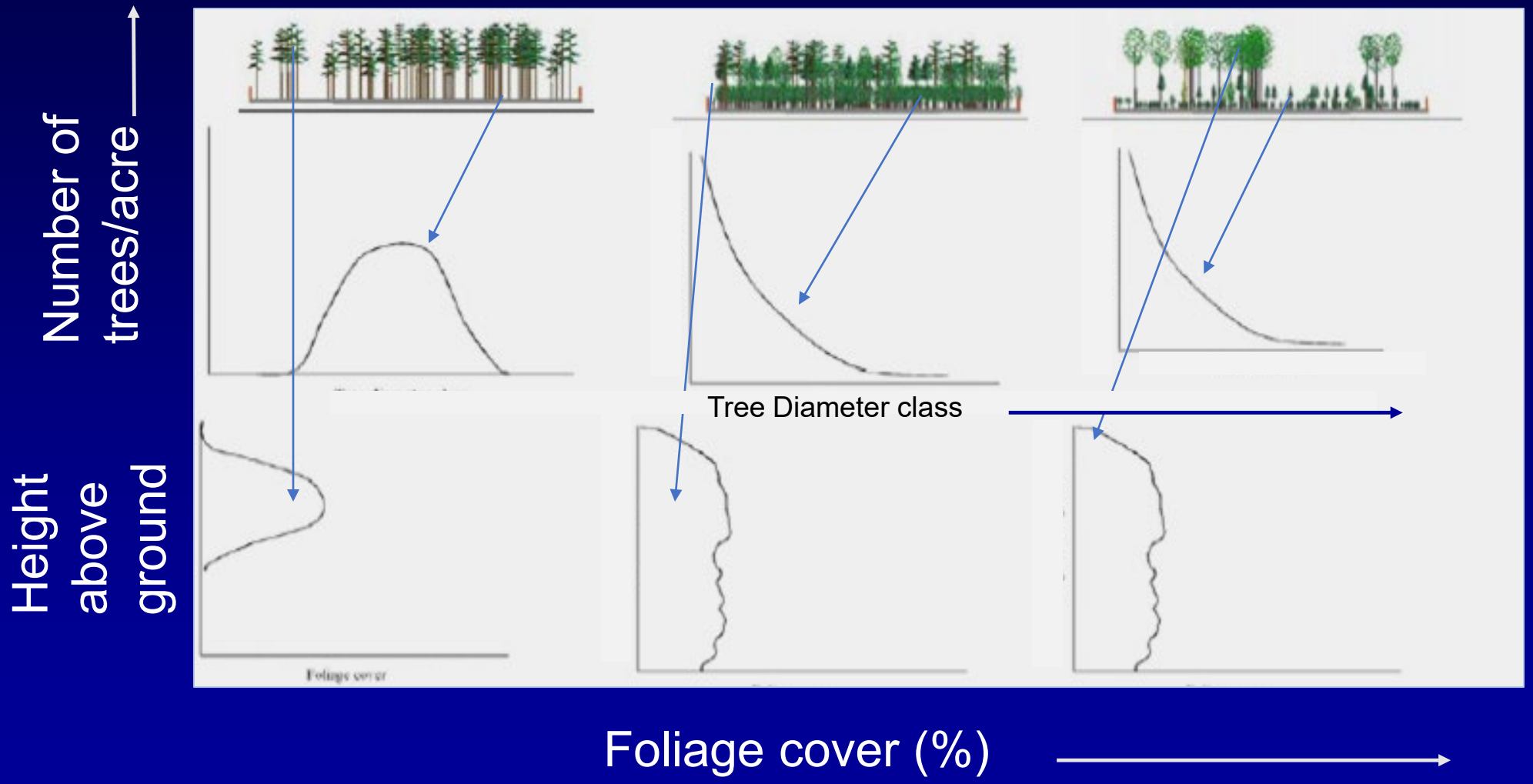
The number of foliage layers is related to the number of niches for birds in some forest types





MacArthur and MacArthur 1962

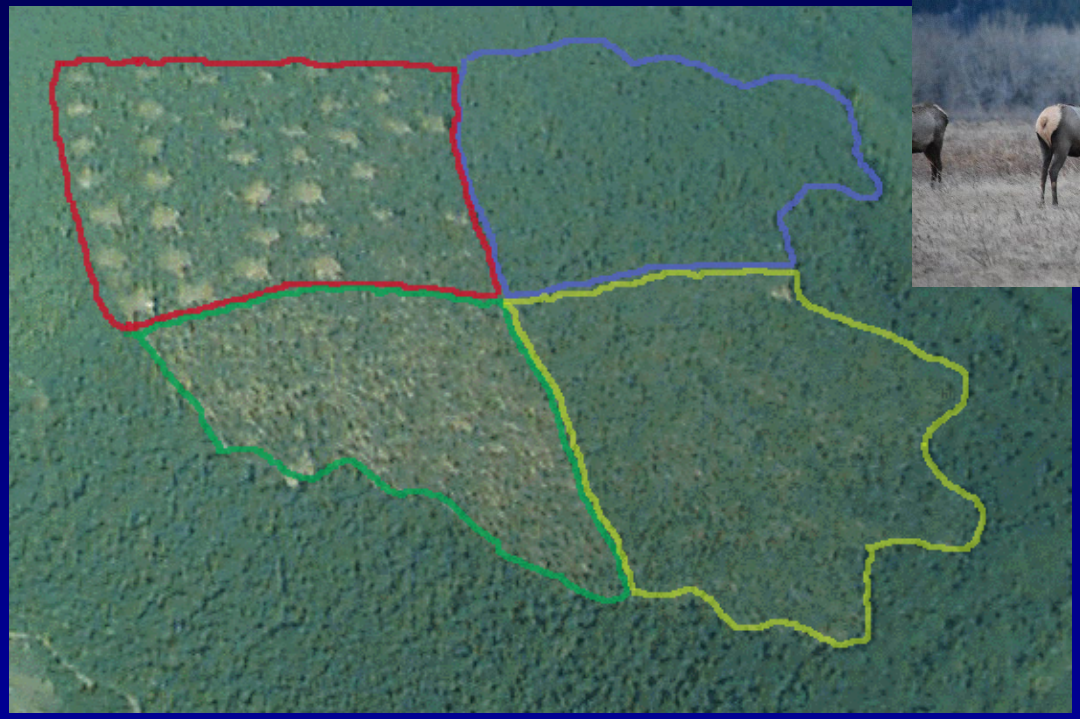
Vertical Structure



Horizontal Patchiness

Which stand has the greatest patchiness?

- Ungulate food/cover
- Grazing and detrital based energy
- Food and cover resource diversity



https://ecoshare.info/projects/central-cascade-adaptive-management-partnership/forest-studies/young-stand-thinning-and-diversity-study/photo-tour-of-treatments/

Hard fruits

- In the US seed production is greatest in open grown trees.
- Generally plants in full sunlight with large crowns more regularly produce large mast crops
- Provide a variety of hard mast producing species
- Compare maturation of white oak acorns vs red oak acorns.

http://forestry.ohiodnr.gov/whiteoak

Soft fruits

- Production is highest where the fruit-producing plants are receiving full sunlight.

https://www.fws.gov/refuge/willapa/wildlife_and_habitat/red_huckleberry.html

https://www.fws.gov/refuge/julia_butler_hansen/wildlife_and_habitat/habitats/plants/salmonberry.html

Browse

- Browse are new-growth twigs and leaves eaten by mammals
- Browse quality varies among plant species (phenols, cellulose)
- Animals often lose weight or starve on browse diets

https://commons.wikimedia.org/wiki/File:Photograph_of_Extreme_Browse_Line_-_NARA_-_2128196.jpg

Dead and damaged trees

- **Primary cavity nesters** are those species that can excavate a cavity in dead wood or trees with heart rot decay

- **Secondary cavity users** use cavities that either were created by primary cavity nesters or in natural cavities

Bark-dwelling Insects

- Rough-barked species host more insects

http://forestry.ohiodnr.gov/silvermaple

http://forestry.ohiodnr.gov/americanbeech

- Bark dwelling insects are an important winter food supply for some bird species

Natural Cavity Production

- Some species are more cavity prone than others

https://www.dnr.illinois.gov/OI/PublishingImages/SnagOrDeadTree6.jpg

- Pines/Douglas-fir are not cavity prone

Snags

- Snags are particularly important in conifer forests
- Hardwood forests, especially with large trees, often have large dead limbs that provide many of the same benefits as snags
- Large snags are used by more species than small snags

https://www.fws.gov/midwest/insider3/November15Story16.htm

Logs

- Large logs provide more cover and nesting opportunities for more species than small logs

- Hollow logs can only occur if a hollow tree falls to the ground

https://www.dnr.illinois.gov/OI/PublishingImages/SnagOrDeadTree3.jpg

Other Habitat Elements

- Perch Sites
- Leaf litter on the forest floor
- Cover by rocks or talus
- Proximity to Water
- Burrows
- Tree size
- Lichens
- Others????

Questions?

Stand exams: describing stand structure and composition

- Defining a stand
- Random or systematic sample?
- Number of samples?

Stand exams: describing stand structure and composition

- Fixed area or point (Prism) sampling – usually 0.1 acre or 10 factor prism

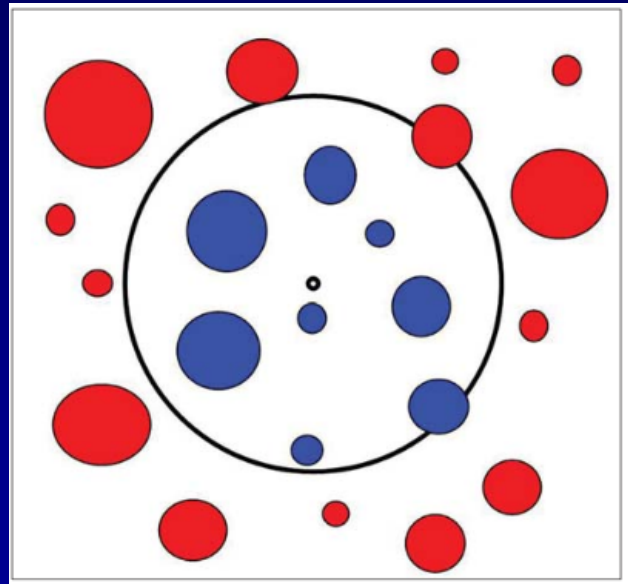


Figure 4-2: A schematic of a fixed area plot. "In" (sample) trees are identified in blue, and "out" trees are shown in red. Trees that fall along the plot boundary are determined as "in" or "out" based on whether the center of the tree falls within the plot.

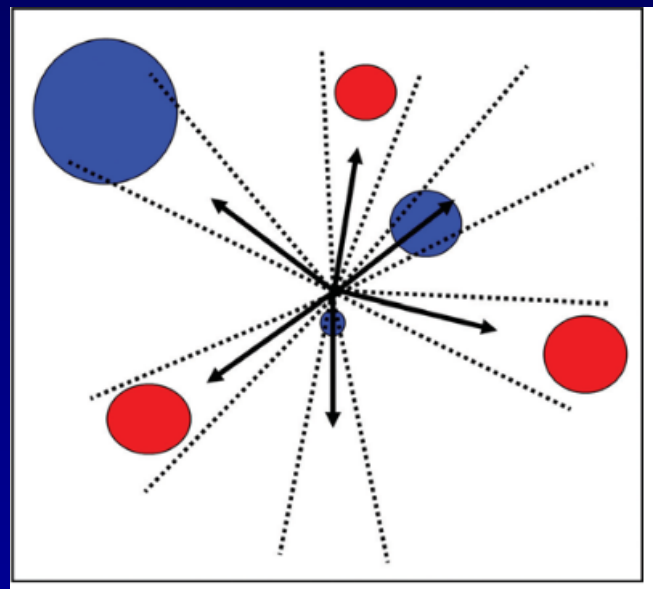


Figure 5-1: A schematic of a variable plot, where an angle gauge is applied in several different directions (indicated by the arrows). Trees intersected by the angle (indicated by the dotted lines) are considered "in" trees (shown in blue).

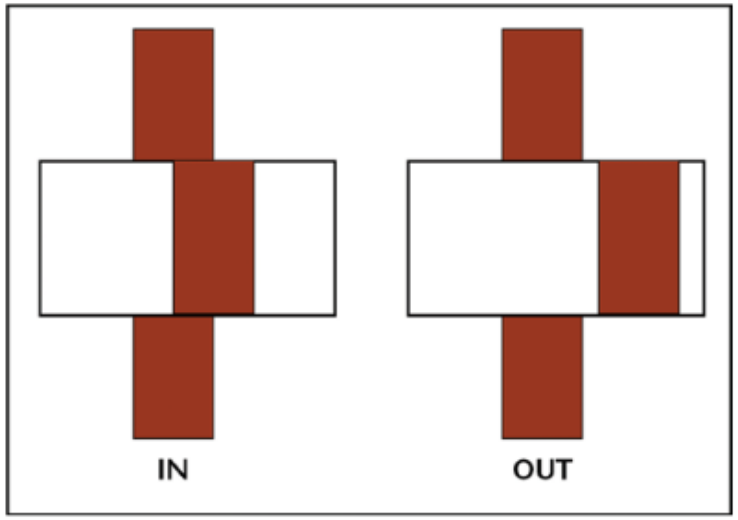


Figure 5-2: Looking at the stem of the tree (at breast height) through a prism will shift the image of the tree. If the shifted image overlaps (example on the left), the tree is "in." If the shifted image is completely separated (example on the right), the tree is "out."

https://catalog.extension.oregonstate.edu/pnw630
Zobrist et al. (2012)

Stand exams: describing stand structure and composition

- Measure dbh of each ‘in’ tree (Required)
- Record species (Required)
- Record height of 1-2 dominant trees in each plot
- Record age to calculate site index
- Record habitat elements important to your species (snags, logs, cavities, browse, etc.)

https://catalog.extension.oregonstate.edu/pnw630
Zobrist et al. 2012)

Stand data, NCTC Campus, Shepherdstown, WV

Stand_ID	Variant	Inv_Year	Groups	Location	Age	Basal_Area_Factor	Inv_Plot_Size	Brk_DBH	Num_Plots	Sam_Wt	Site_Species	Site_Index
Example	NE	2020	All_Stands	909	80	10	100	4		20	WP	80

Tree_ID	Tree_Count	History	Species	DBH	Ht
1	1	6	WA	23	
2	1	1	SY	21.8	
3	1	1	SY	12.5	
4	1	1	SY	26	
5	1	1	SY	22.7	
6	1	1	SY	23.5	
7	1	1	SY	18	
8	1	1	SY	18.5	
9	1	1	PH	9.5	
10	1	1	OH	4.5	
11	1	1	BC	17.8	
12	1	6	WA	23.1	
13	1	1	SY	22.7	
14	1	1	MH	15.1	
15	1	1	HK	13.8	
16	1	6	WA	27.6	
1	1	1	RO	31.1	
2	1	1	CK	17	
3	1	1	MH	18.5	107
4	1	1	RO	20.5	
5	1	1	OH	5	
6	1	1	RO	32.3	
7	1	1	HK	14.3	
8	1	1	CK	13.5	
9	1	6	BW	14.3	

Tree data

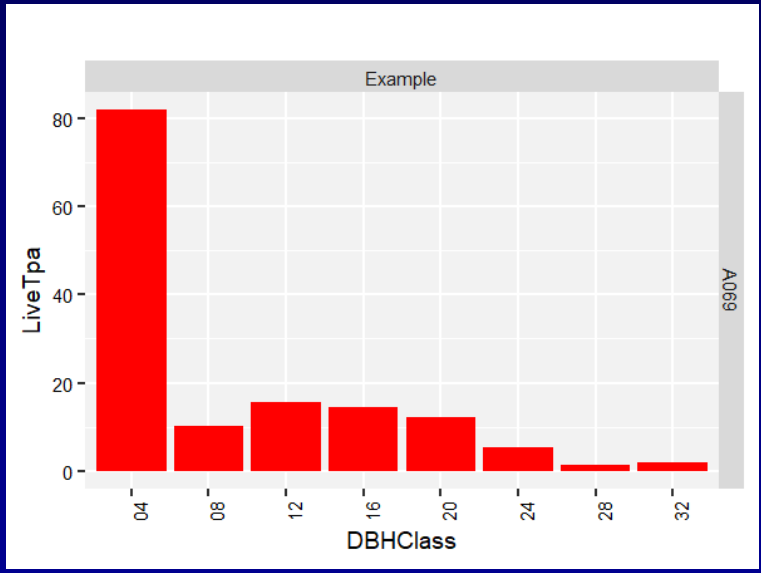
Stand structure and composition, NCTC Campus

Stand Summary

Year	Age	Tpa	BA	SDI	CCF	TopHt	QMD	MCuFt	SBdFt
2020	80	143.1	105.0	162.0	171.0	78.0	11.6	3009.4	15319.1

Stock table

Year	Species	DBHClass	LiveTpa	MrtTPA	LiveBA	MrtBA	LiveSCuFt	MrtSCuFt	LiveMCuF	MrtMCuFt	LiveSBdFt	MrtSBdFt
2020	BC	All	2.9	0.0	5.0	0.0	125.0	0.0	140.6	0.0	795.7	0.0
2020	BW	All	0.0	4.5	0.0	5.0	0.0	113.9	0.0	151.5	0.0	641.1
2020	CK	All	8.2	0.0	10.0	0.0	198.0	0.0	246.9	0.0	1180.0	0.0
2020	HK	All	9.3	0.0	10.0	0.0	216.6	0.0	289.1	0.0	1174.2	0.0
2020	MH	All	6.7	0.0	10.0	0.0	279.2	0.0	332.8	0.0	1557.9	0.0
2020	OH	All	81.9	0.0	10.0	0.0	0.0	0.0	40.3	0.0	0.0	0.0
2020	PH	All	10.2	0.0	5.0	0.0	0.0	0.0	114.8	0.0	0.0	0.0
2020	RO	All	4.0	0.0	15.0	0.0	474.7	0.0	493.3	0.0	3103.2	0.0
2020	SY	All	19.9	0.0	40.0	0.0	1210.4	0.0	1351.5	0.0	7508.1	0.0
2020	WA	All	0.0	4.7	0.0	15.0	0.0	453.0	0.0	475.5	0.0	2937.8



Snag summary

Year	Hard_snags_class1	Hard_snags_class2	Hard_snags_class3	Hard_snags_class4	Hard_snags_class5	Hard_snags_class6
2020	9.14	9.14	4.65	1.20	0.00	0.00

Crown Cover

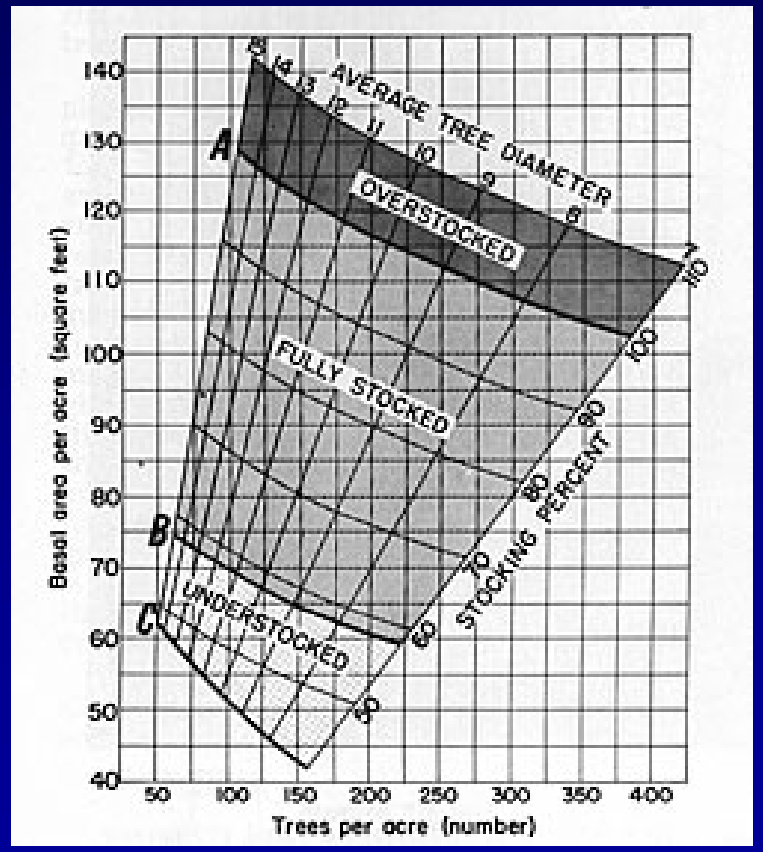
Year	Stratum_1_Crown_Cover	Stratum_2_Crown_Cover	Stratum_3_Crown_Cover	Total_Cover
2020	62	16	0	68

And much more…

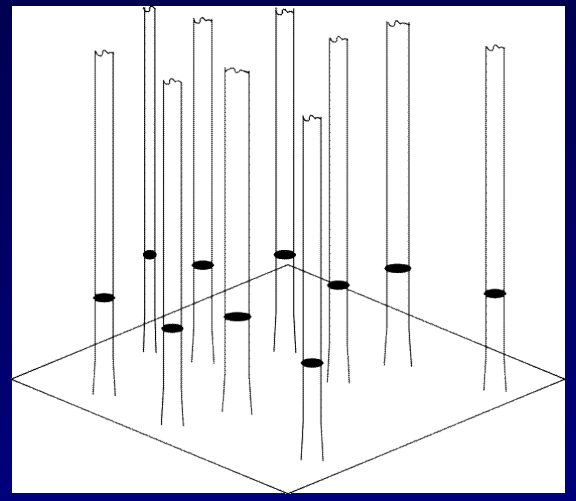
Basal area and stocking

- Basal area is the cross-sectional area of the tree boles per acre measured at 4.5 feet above ground
- There are a limited number of trees of a given size that an acre can support (stocking)
- Reducing stocking will change the structure and function of the stand

Tpa	BA	SDI	CCF	TopHt	QMD
143.1	105.0	162.0	171.0	78.0	11.6



https://www.nrs.fs.fed.us/sustaining_forests/conserve_enhance/timber/stand_density/



http://oak.snr.missouri.edu/nr3110/topics/basalarea.php

Example

- What species groups are you trying to manage? What are their habitat needs? Be specific.

Pileated woodpecker

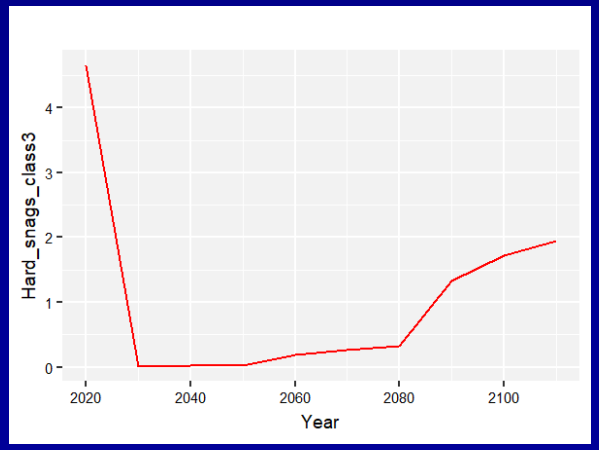
- Canopy cover > 75%
- > 30 trees/acre that are > 20” dbh
- > 1 snag /acre that is > 20” dbh

- Based on an inventory or site visit, which elements are present and which are absent?

Current conditions

- Canopy cover = 68%
- Trees > 20” dbh/acre = 14
- Snags > 20” dbh/acre= 4

- How will the abundance or availability of these habitat elements likely change as the forest grows, or is disturbed?



Principles

- What species groups are you trying to manage? What are their habitat needs? Be specific.
- Based on an inventory or site visit, which elements are present and which are absent?
- How will the abundance or availability of these habitat elements likely change as the forest grows or is cut?

Questions?

For questions, comments and ongoing discussions to the group for all 5 Forest Wildlife Habitat Management webinars:

forestwildlifehabitatseminars@doimspp.onmicrosoft.com

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