



Forests have complex physiognomy: "stand structure"

Complex overall structure → habitat diversity (plants & animals)

Red-tailed hawks Scaups Swallows Fly catchers	Overstory canopy
Pileated woodpeckers Sapsuckers Pygmy owls	Understory canopy
Brown creepers Nuthatches	Shrub layer
Toughsues Towhees Winter wrens	Ground vegetation

Stand structure develops through time

External succession
Grass-forb
Shrub-seedling

Pole-sapling

Young forest

Mature forest

Old growth

Succession begins

Canopy closure

Self thinning

Structural complexity develops



Stand structure develops through time

Increasing structural complexity & species diversity

Structural complexity

Biological diversity


Time

Four key structural elements that create complex overall stand structure

1. Large, old live trees


Four key structural elements that create complex overall stand structure

2. Standing Dead Woody Material ("snags")




Four key structural elements that create complex overall stand structure

3. Dead woody material lying down



Nurse Logs




Nurse logs as hot spots of successful recruitment

Why?

Nurse logs help to define spatial patterns within forests

Four key structural elements that create complex overall stand structure

4. Dead woody material in water




Understanding species' distribution and abundance in wetland communities has a lot to do with [topography & water](#).



Understanding species' distribution and abundance in forest communities has more to do with [light](#).







Competition for light is fierce – among the trees

This competition drives the dynamics of our local forest overstory

- Major competitors are large evergreen trees
- Western hemlock, Western red cedar, Douglas-fir




Douglas-fir (*Pseudotsuga mensezeii*)




Deeply furrowed bark

Pointy buds



3-pointed cone bracts



Among the 3 largest PNW trees

- Up to 300 ft tall
- 8 – 15 ft diameter

Rapid growth: 170 ft in 72 years
Life span – 800 – 1000 years
Comes in early after disturbance; shade intolerant




Western hemlock
Tsuga heterophylla




Western red cedar
Thuja plicata

Western red cedar (*Thuja plicata*)



Foliage of flattened scales




Stringy bark

Among the 3 largest PNW trees


- Up to 200 ft tall
- 8 – 10 ft diameter

Life span – 800 – 1000 years
Common later in forest development; shade tolerant
Wet sites (>30 in rain / yr or along streams)
Important ethnobotanical species


Western hemlock (*Tsuga heterophylla*)



Platy bark



Drooping leader



Small, delicate cones



Flattened needles of varying lengths

"Moderate" size

- Up to 200 ft tall
- 4 – 5 ft diameter

Life span up to 500 yrs
Common later in forest development; shade tolerant
Often on stumps & downed logs




Western hemlock growing out of old stumps

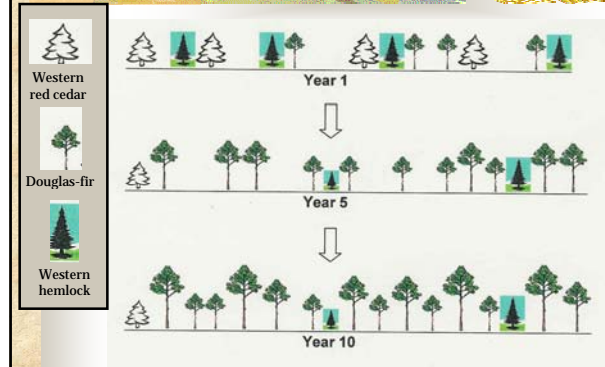


In general the distribution of secondary substrates is important in these forest communities, as it was in wetlands

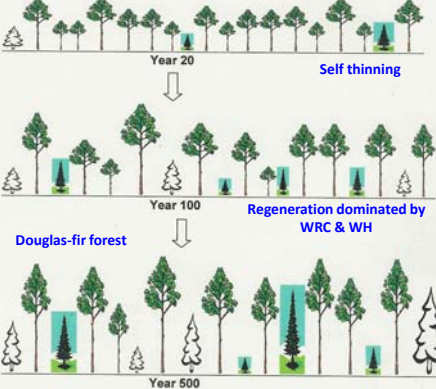


PNW forest canopy development hinges upon disturbance, shade tolerance, and life span

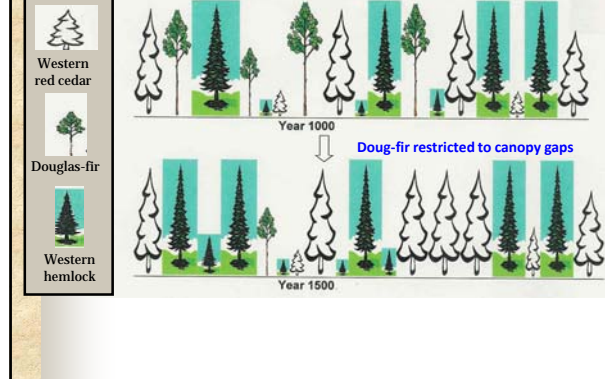
	Douglas-fir	Western Hemlock	Western Red Cedar
Life Span (years)	800 - 1000	500	800 - 1200
Seedling shade tolerance	Poor	Good	Good
Seedling survival & growth in forest clearings	Good	Poor	Poor
Symbol			



Canopy closure



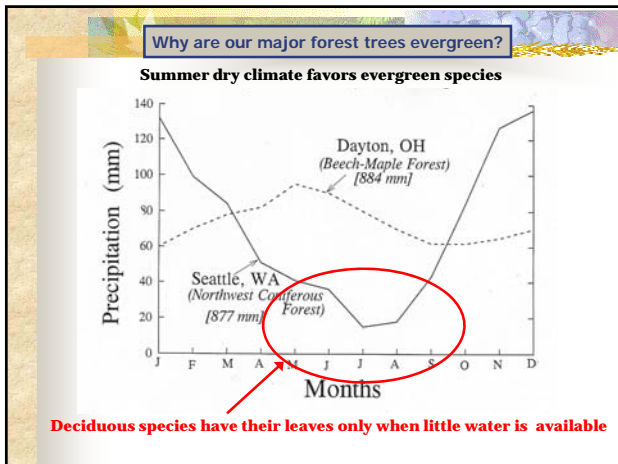
Douglas-fir mortality leads to WH/WRC forest



Fire & other disturbances create gaps that maintain Douglas-fir

Western red cedar
Douglas-fir
Western hemlock

- Western hemlock & western red cedar are climax canopy species because ?
- Douglas-fir is maintained in forest stands because?



Forest understory is dominated by also by **evergreen** species specifically adapted to low light levels

Why are our forest understory plants mostly evergreen?

Some understory species are restricted to gaps – gap dynamics play a critical role in determining the locations of such species

Our forest support a rich diversity of animal life


1. Complex stand structure
2. Diversity and abundance of structural elements
3. Dynamic nature (disturbance mosaic)

Animal Species in PNW Forests


~ 210 native vertebrates

Animals strongly tied to mature forest conditions – overall structure & habitat elements


- 56 vertebrate species use cavities of large trees
- 42 vertebrate species use woody debris



Northern spotted owl




Douglas squirrel (*Tamiasciurus douglasii*)



Marbled Murrelet

High number of endemic amphibians





Photos from Mathews (1988)

Data: NAS (2000); Bunnell & Chan-McLeod (1997); Johnson & O'Neil (2001)

Analysis of a Forested Plant Community in BES 316

Monday, April 27

- Species abundance / cover
- Structural complexity by growth form
- Species' age class structures ← This is new

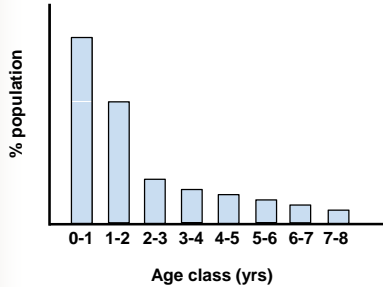
Age class structures

What is a population age class structure ?

The relative distribution of individuals in a population among age categories (“age classes”)

Age class structures

What is a population age class structure ?

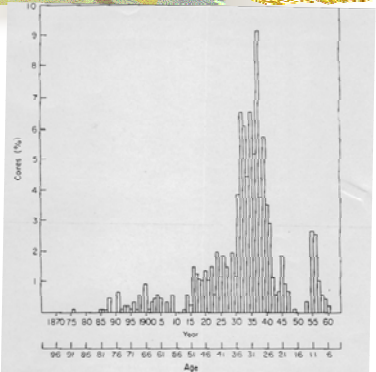


Age class (yrs)	% population
0-1	~10
1-2	~8
2-3	~4
3-4	~3
4-5	~3
5-6	~2
6-7	~1.5
7-8	~1

Age class structures

Age class structure information can be useful


- Is the population healthy (currently reproducing)?
- When & under what conditions does reproduction occur?

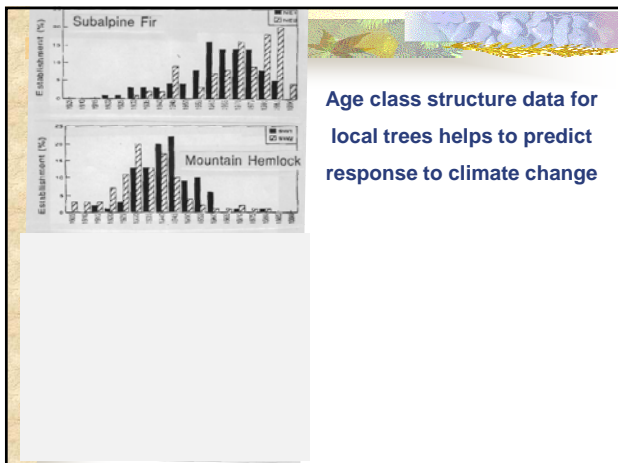
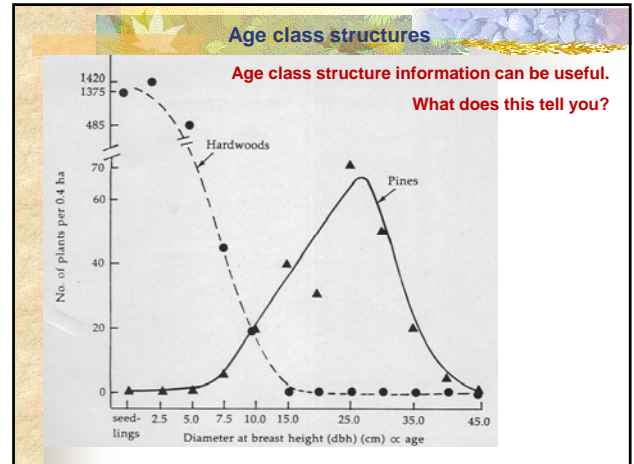
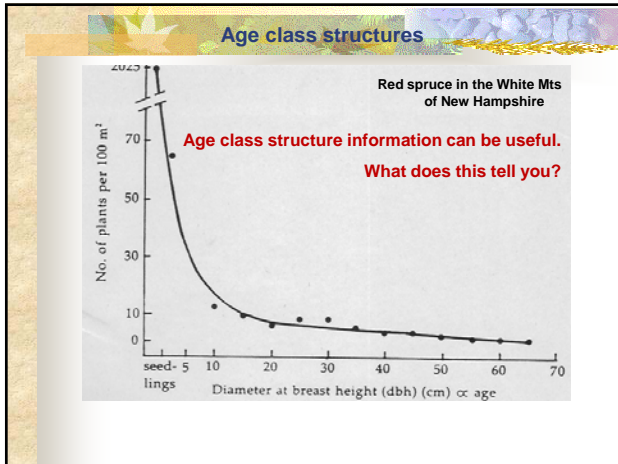
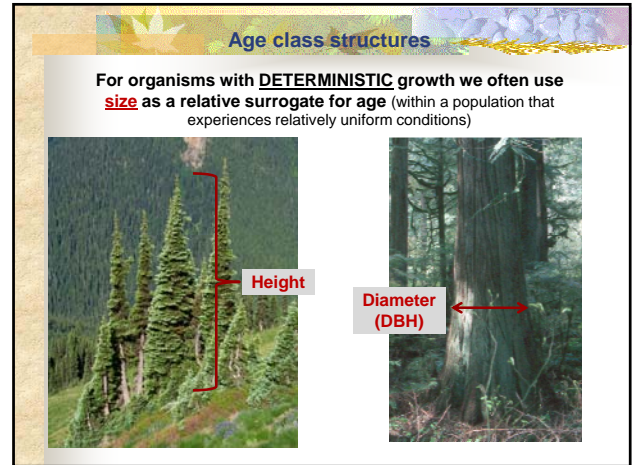
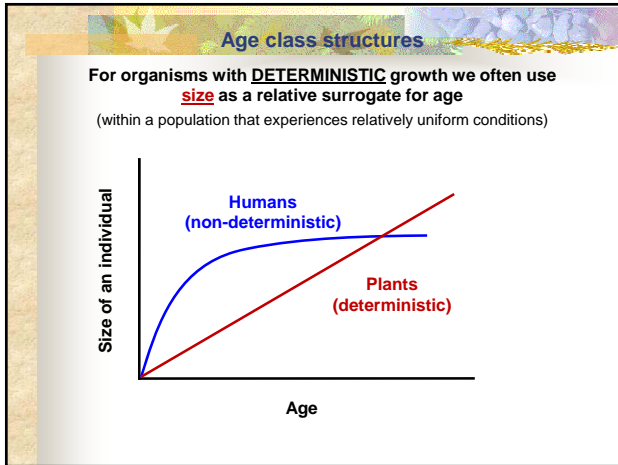


2011. The age class distribution of *Prunus serotina* in a Wisconsin oak wood – based on 854 live stems. (From Auchter and Cottam, 1971)

Age class structures

But it is not always easy to get AGE data





- You will measure the DBH of your trees in your forest stand Monday to create age-class structures
- Measurements at 1.5 m above the ground surface
 - Measure AROUND the tree – the circumference
 - Either calculate the diameter or use a DBH tape
 - Take care if using a DBH tape (they are marked off in units for diameter even while measuring circumference)
-