

Silviculture: Stand Dynamics and Ecology



Michael R. Photography

Silviculture

The art and science of
growing trees OR managing
forests for sustained values

Science = Ecology; math; hydrology

Art = Creativity

Sweet Chestnut in Whales

150 - 1500 AD

Ashton & Kelty 2018

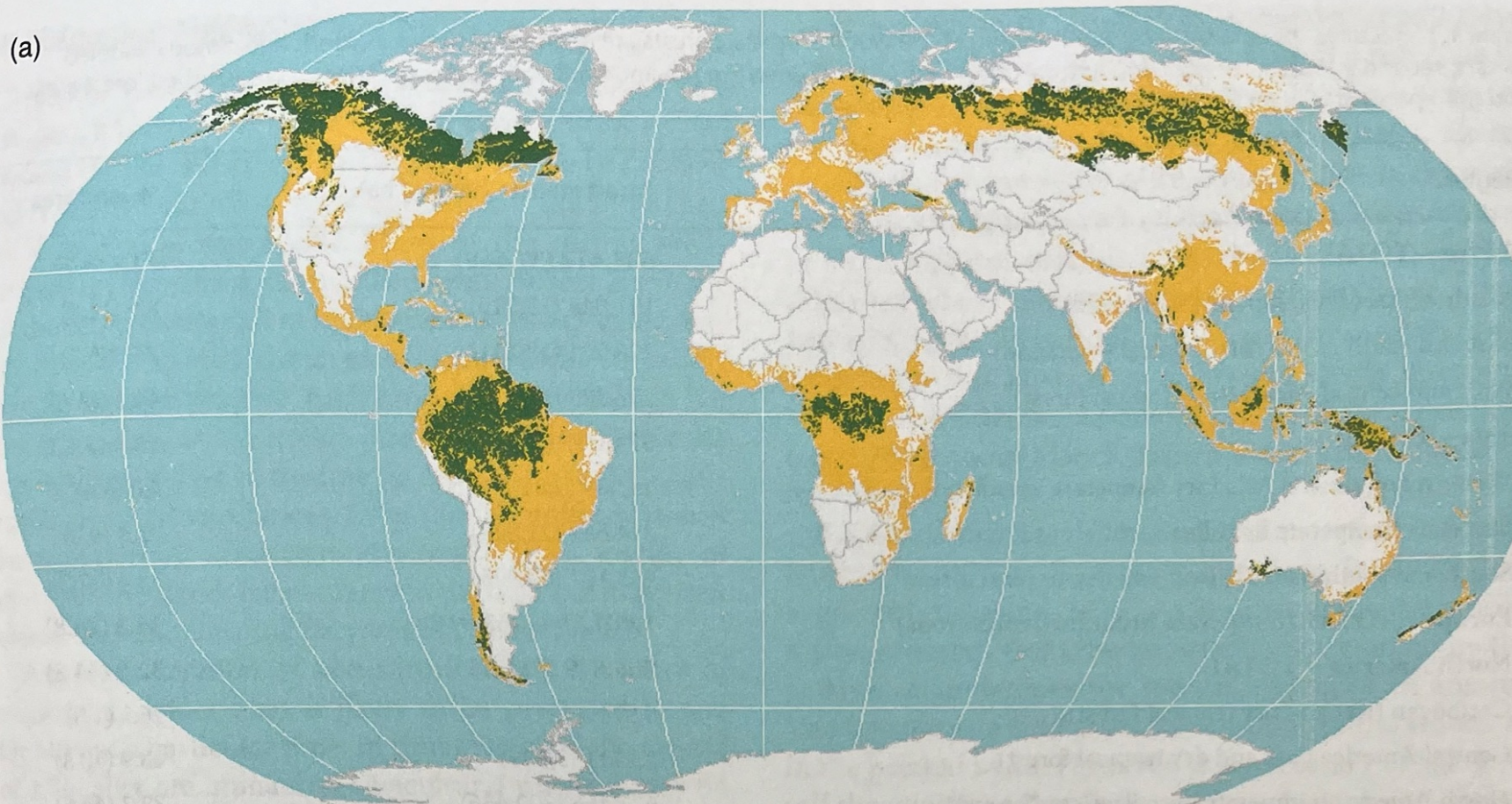


(b)

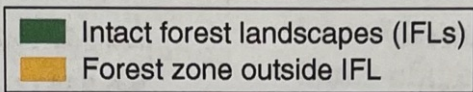
Ashton & Kelty 2018



(a)



Ashton & Kelty 2018



Early

Secondary forest succession

Late

Mayan Milpa Farming



Annual CROPS

Corn

Squash

Chilies

Beans

30 m

15 m

5 m

(1) Ka'anal'k'aax (2) Sak'aab (3) Sak'aab-kool (4) Kambal-hubche (5) Kanalhubeche (6) Kelenche (1) Ka'anal'k'aax

>100 years

1-2 years

2-5 years

5-10 years

10-30 years

30-100 years

>100 years

Synthesis / Analysis
- Policies



Assessing and
maintaining values

Silviculture; laws; Ethics



Skills and tools for
gathering information

- GIS

- Remote Sensing

- Dendrology

- Measurements

Understanding facts / values

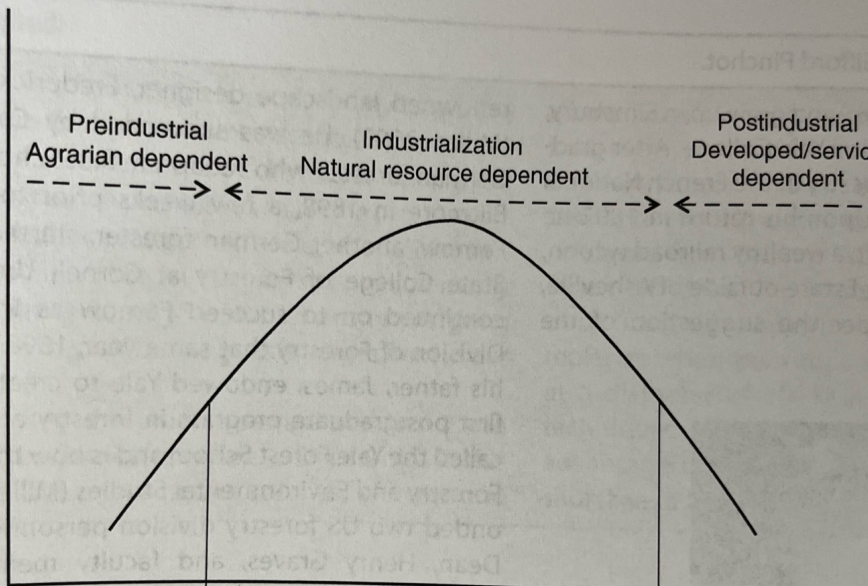
- Ecology

- Wildlife

- Economics

- Watershed Science

Degree of forest degradation ↑



Preindustrial
Agrarian dependent

Industrialization
Natural resource dependent

Postindustrial
Developed/service dependent

Silvicultural application

Indigenous silviculture

Restoration/reforestation silviculture

Sustainable silviculture

Stage of economic development

Subsistence

Exploitation and resource development

Conservation →

WWTI

~~Silviculture~~

Forests

provides

Products

- Construction Lumber
- Luxury Lumber
- Fiber/composite materials
- Biomass/fuel vines
- Fruits/Lianas/Plants

Services

- Wildlife habitat
- Water
- Recreation
- Carbon Sequestration
- Urban Climate
- Forest health

The Six Principles of Silviculture

1. Imitating nature through silviculture

- Forests are the product of evolution...

- Forests predate civilization

2. Conservation of site productivity

productivity = growth (biomass)

Site = A given area (all of biotic
and abiotic)

— Soil; climate; trees
↳ self reproducing

3. Control of stand structure and process

→ "Architecture of Stands"

- infinite number of possible stand conditions

4. Control of species composition

→ Choosing species that are biologically, economically and socially fit for a site.

5. Control of Stand density

→ Too few = lack of regeneration
or undesired other species

→ Too many = competition for
growing space
or prone to
disease / wildfire / insect

6. Control over rotation length

Rotation length = time between
harvests

→ Too short = not enough wood

→ Too long = loss of growth/rot/
mortality

Silvicultural System

→ Set of treatments for
a given unique biophysical
and social condition

Not a recipe in
a cook book!!

Silviculture operates at

a stand scale

landscape



forest



Stand

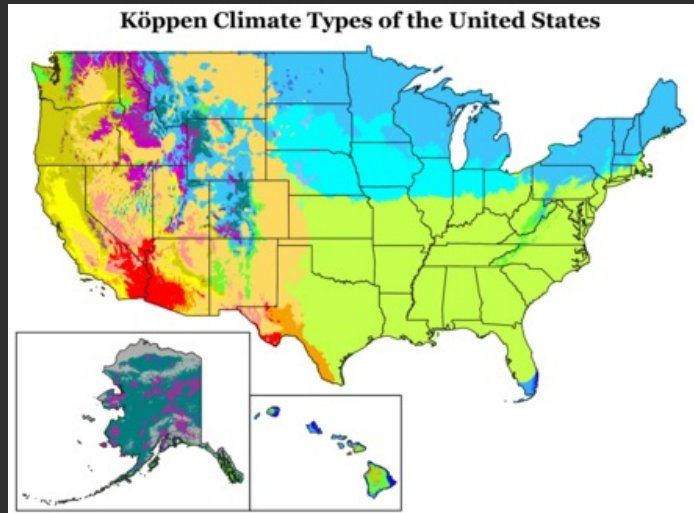


Grove (a group trees)



How do we
define stands?

Climate zones

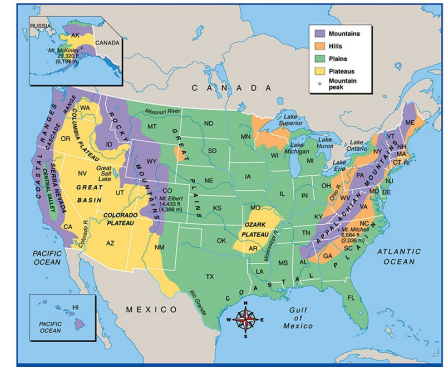


Köppen Climate Type

■ Af (Rainforest)	■ Csc (Cold-summer mediterranean)	■ Dwa (Hot-summer humid continental)
■ Am (Monsoon)	■ Cwa (Humid subtropical)	■ Dwb (Warm-summer humid continental)
■ Aw (Savanna)	■ Cwb (Subtropical highland)	■ Dwc (Dry-winter subarctic)
■ BWh (Hot desert)	■ Cfa (Humid subtropical)	■ Dfa (Hot-summer humid continental)
■ BSh (Cold desert)	■ Cfb (Oceanic)	■ Dfb (Warm-summer humid continental)
■ BSk (Hot semi-arid)	■ Cfc (Subpolar oceanic)	■ Dfc (Subarctic)
■ BSL (Cold semi-arid)	■ Dsa (Hot-summer mediterranean continental)	■ ET (Tundra)
■ Csa (Hot-summer mediterranean)	■ Dsb (Warm-summer mediterranean continental)	■ EF (Ice-cap)
■ Csb (Warm-summer med)		

Data sources: Climate nor
Outline map from US Cen
Data periods: 1991-2020 (

Land forms
E: edge top
Slope



Associated Veg

↳ sensitive

to microvariation
in climate and

soil

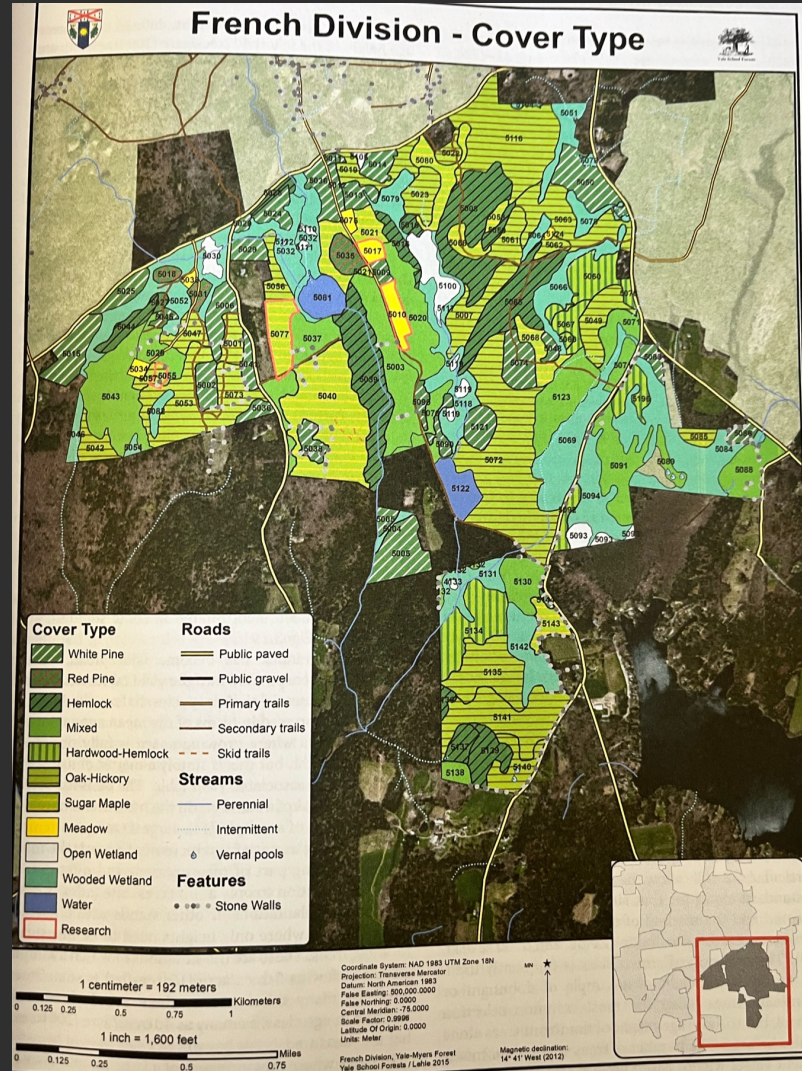


Pacific 9 bark

- Aspen
Stand

Yale-Myers Research Forest - NE CT

Stand delineations
by forest type



Ashton & Kelty 2018

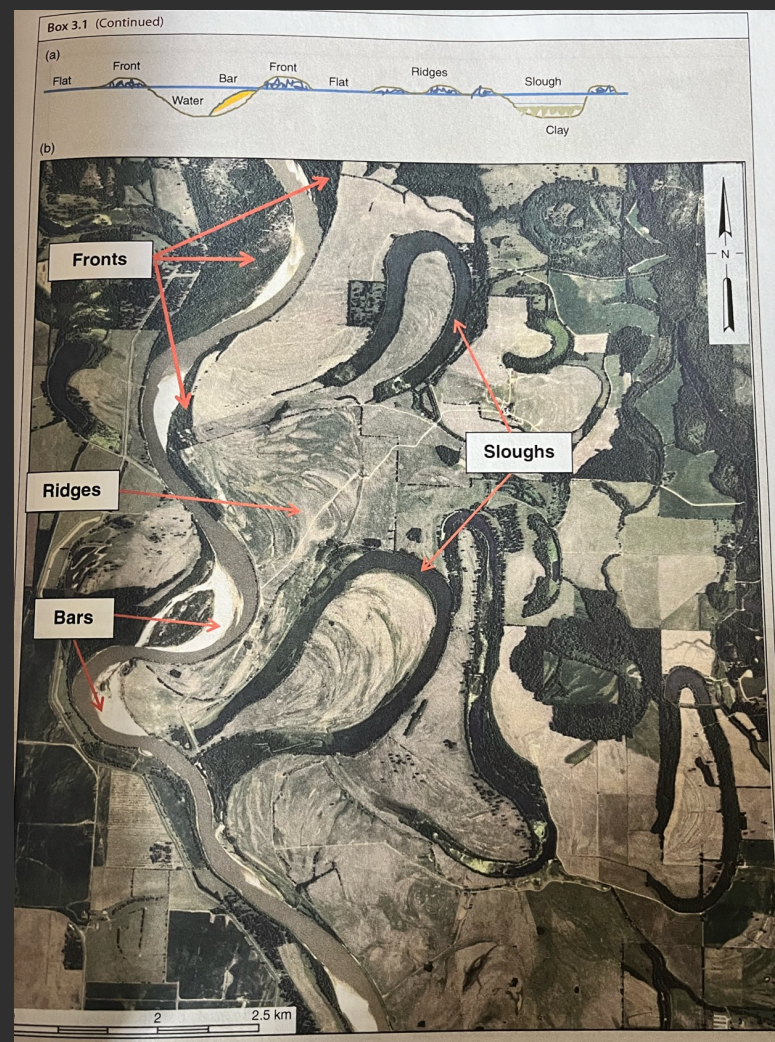
What is a Stand then?

→ A contiguous community of trees, sufficiently uniform in composition, structure, spatial pattern, age, size, etc to distinguish it from other locations.

continuous vs. discrete stands.

Red River - Mississippi River Bottom Lands Arkansas

Landform based
stand delineation



Pinus monticola - Western white pine ~ 160 ya



Pinus ponderosa ~ open south facing stand with fire

Photograph by John Marshall
for the U.S. Forest Service



Tropical Rain Forest with 250 species....

