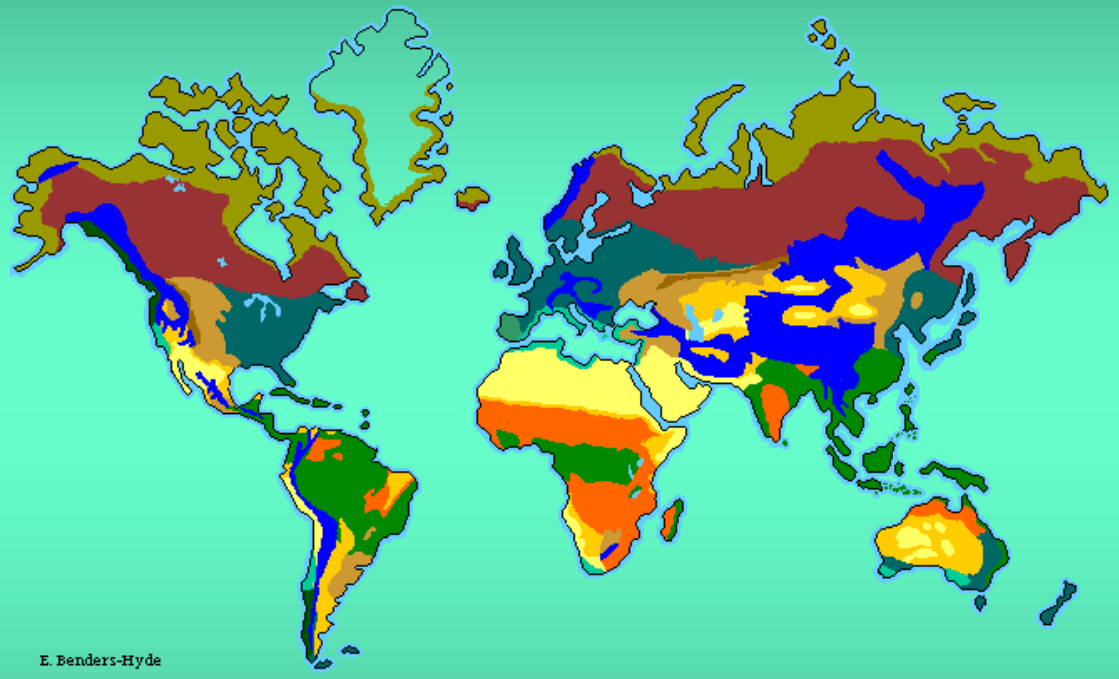
LIVING NATURAL RESOURCES



Questions we ask

- What resources are present?
- In what condition?
- How do we measure this and….
- How do we manage and what for?
    - Biodiversity and/conservation
    - Ecosystem function
    - Restoration
    - Harvest
    - Recreation

NRCM—Scale and Context

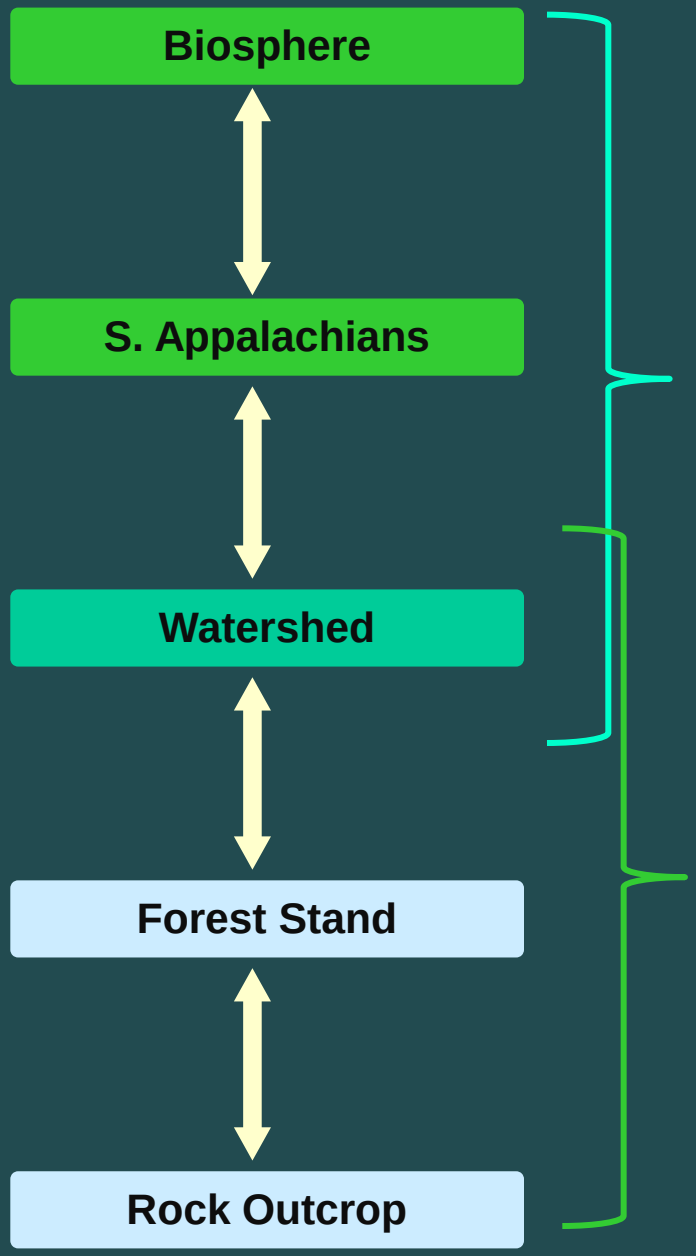
- Global (km^2)
- Regional (km^2)
- Landscape (ha or km^2)
- Local (m^2)
- Micro (cm^2)

- Climate
- Economics
- Politics
- History

- Land Use
- Management
- Policy

Ecology

SCALE



Management and policy decisions

Wildlife and Resource Ecology

Successful NRCM--MUST be able to integrate information across scales

What Resources are Present?

- Quantity and distribution of….
  - Forest types
  - Wildlife
  - Ecosystem components
  - Human land use
- Quality of resources for….
  - Wildlife habitat
  - Conservation
  - Recreation, Harvest etc.

Forests

How do we “measure” forests?

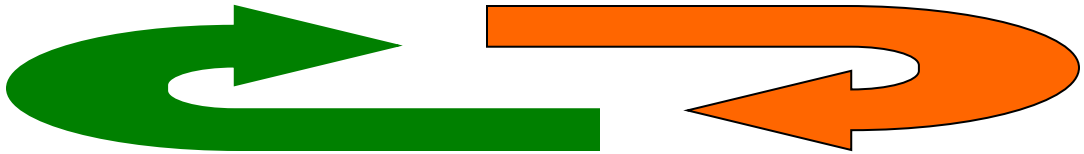
- Age of stand
- Density of trees
- Fragmentation
- Forest Type—dominant species in overstory
- Structure—layers
- Human land use (roads, houses, etc.)
- Ecologic processes---biodiversity, nutrient cycles, productivity

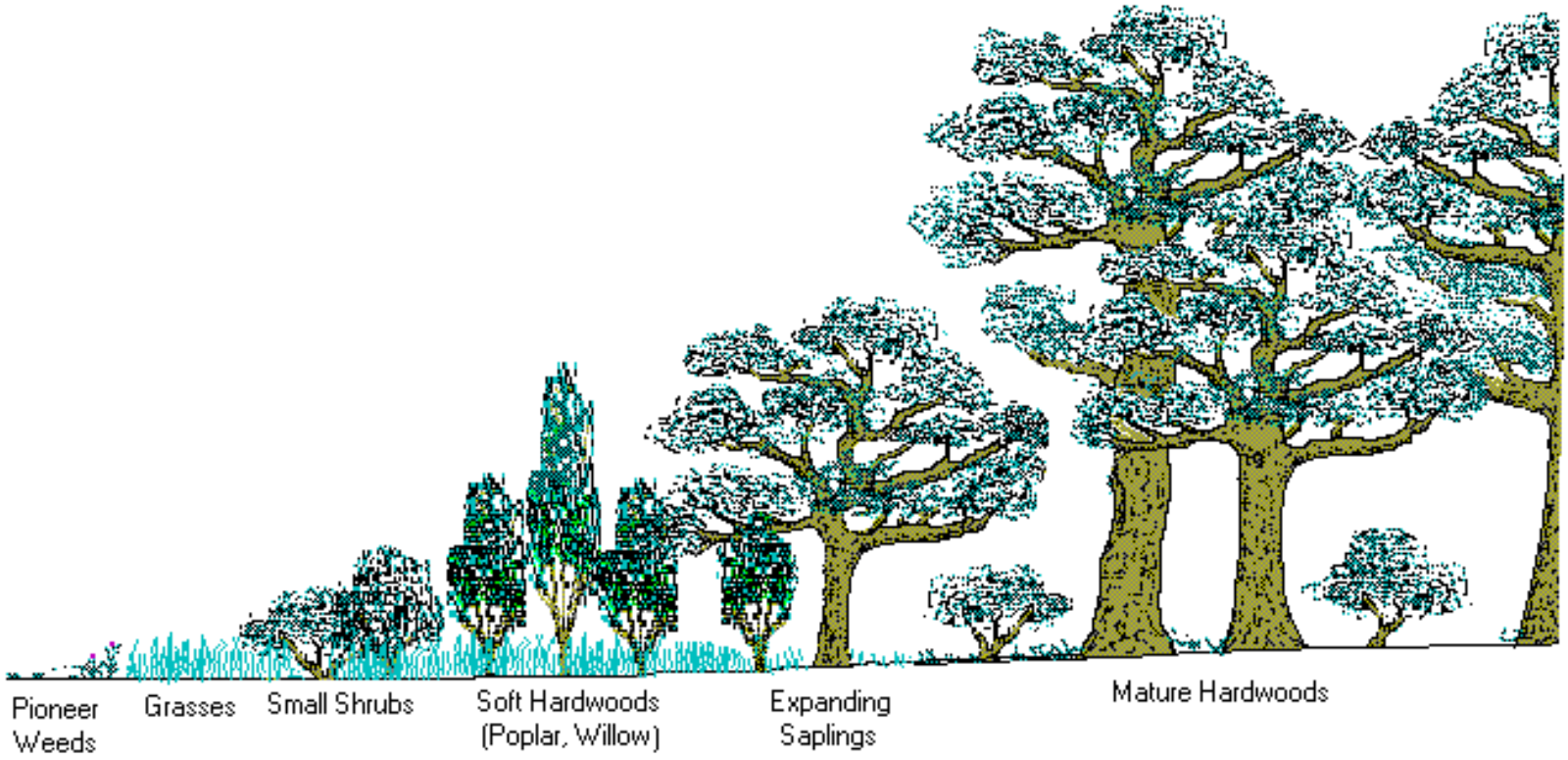
Forest Ecology

Disturbances can reverse or alter patterns

Fire, Storms, Floods, logging, development, disease, invasive species

Natural disturbances tend to cause aesthetic damage others cause permanent changes

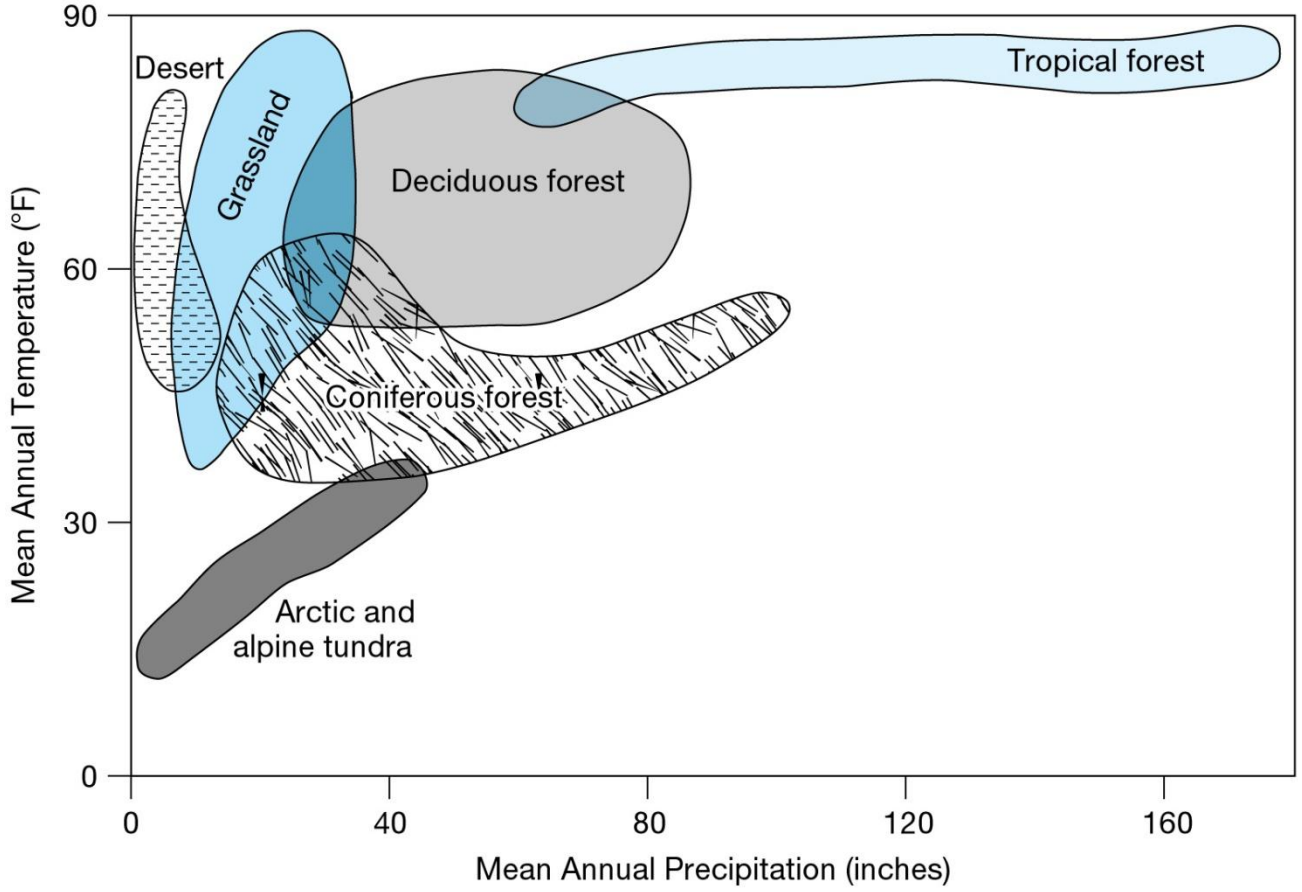




Forest Ecology

Forests: What we see is a snapshot in time

A response" to a suite of short to long term and local to global processes.

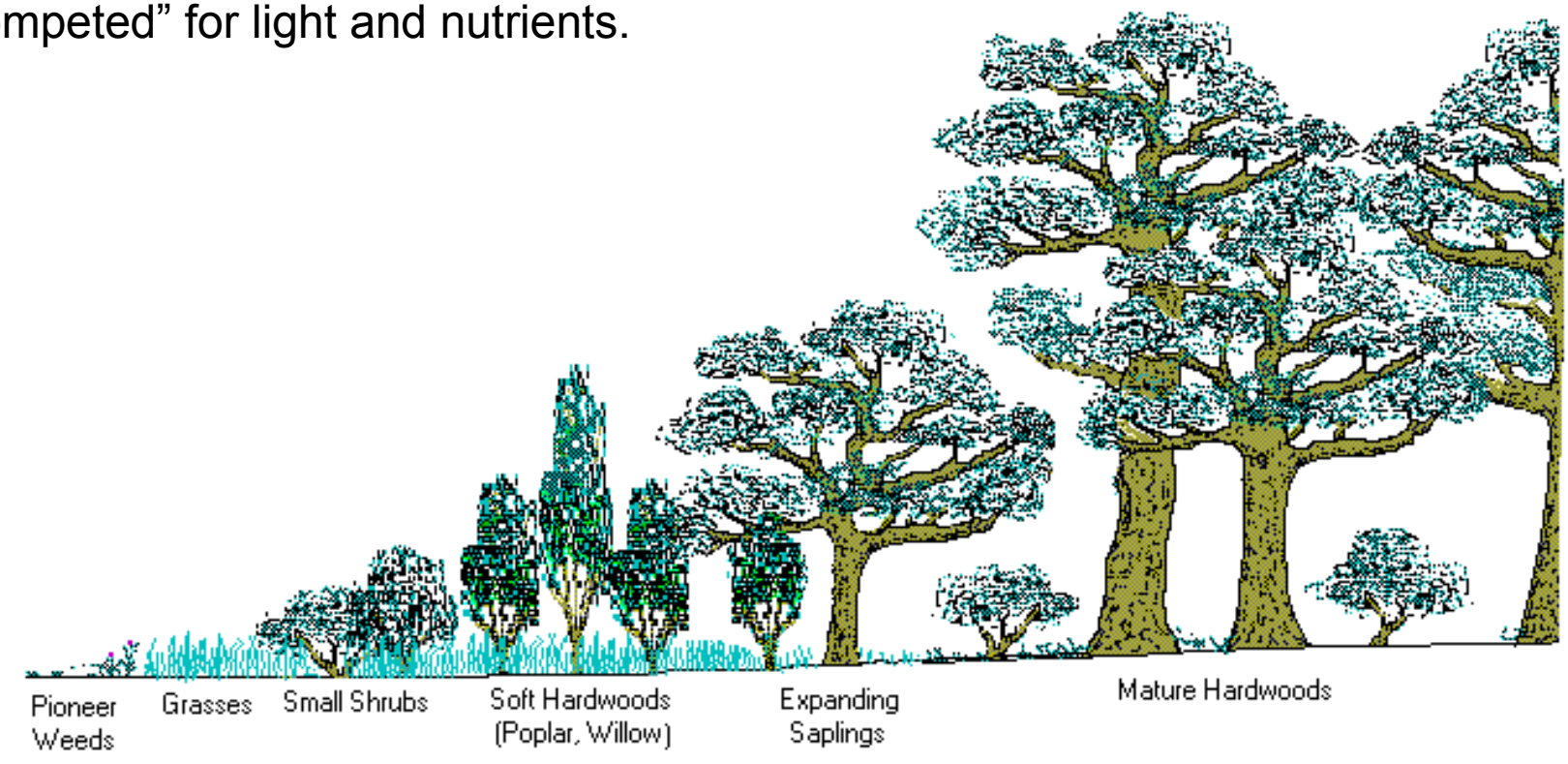


Local Forest Ecology—A fight for light.

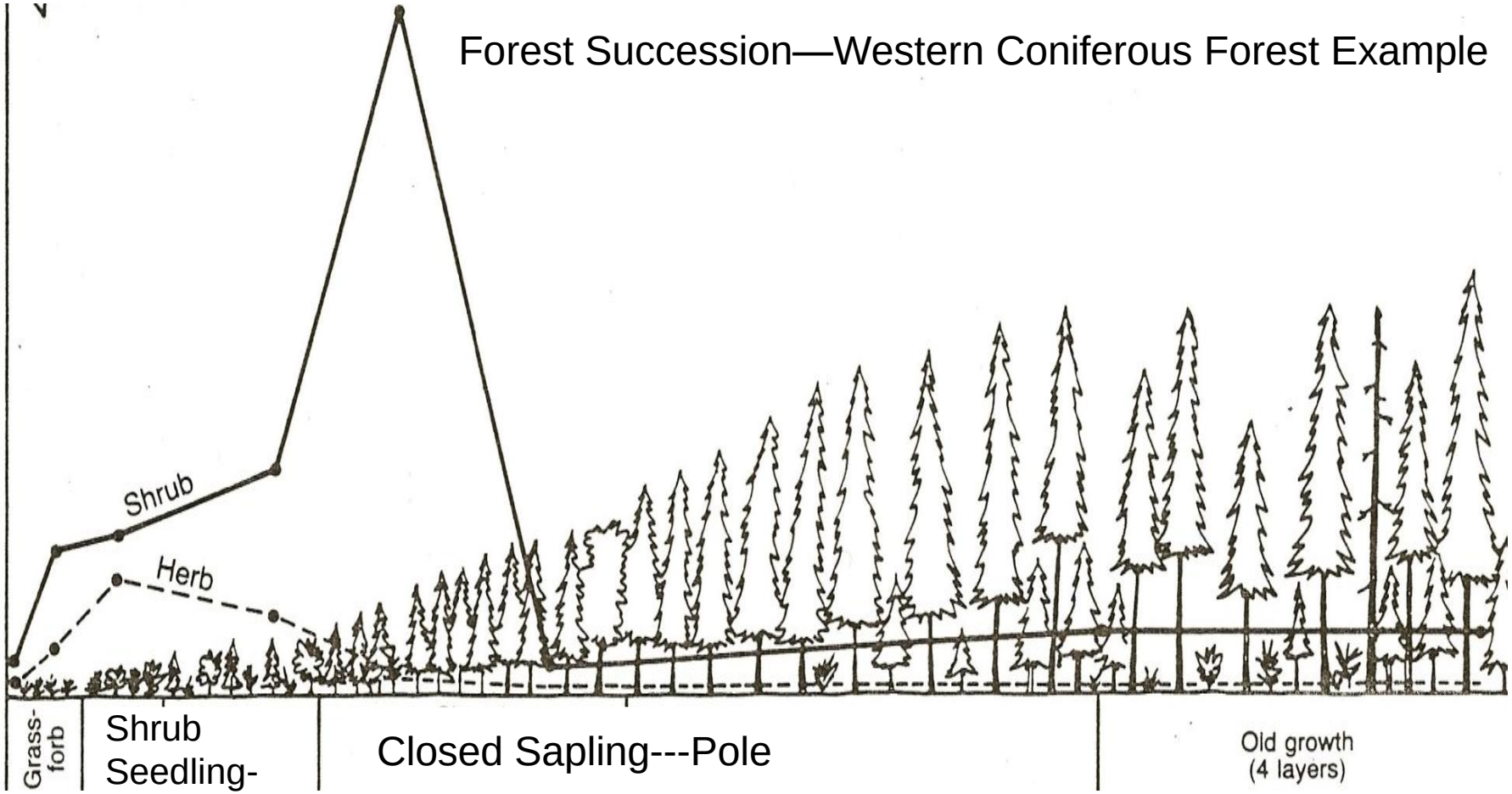
Succession—progression toward mature forest

Slower growing species eventually “shade out” pioneer species

Changes over time as some get “out competed” for light and nutrients.



Forest Succession—Western Coniferous Forest Example



SNAPSHOT—many processes at work

GEOPHYSICAL FACTORS

Geologic history

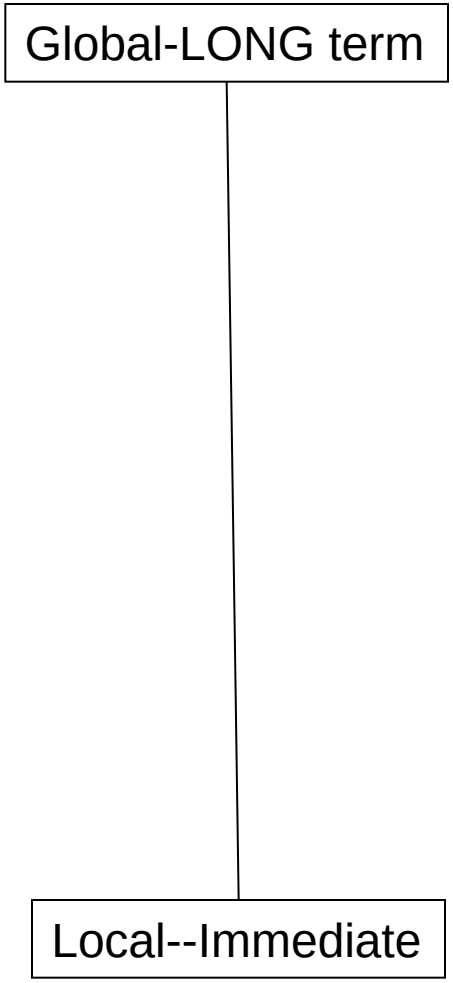
Climate (temp, precip)

Storm/disaster

Fire

LIGHT (Solar Radiation)

Soil nutrients



Biological and Human Factors

Competition

Disease

Herbivory

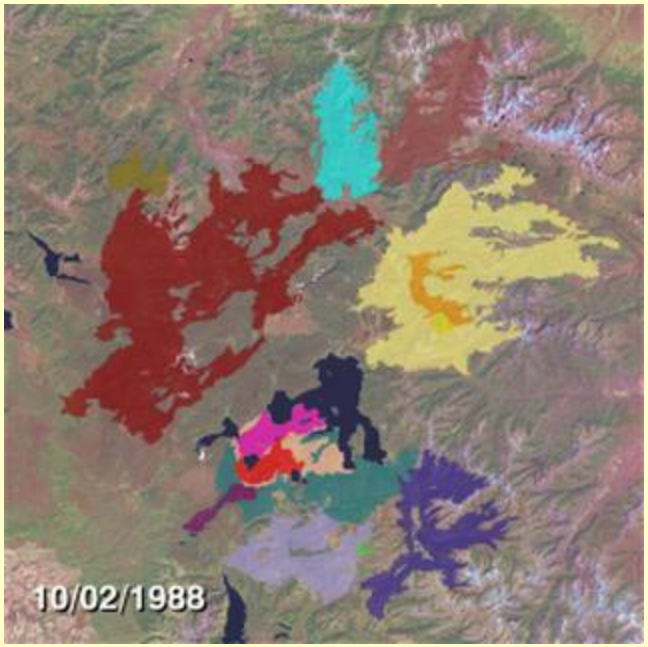
Harvest

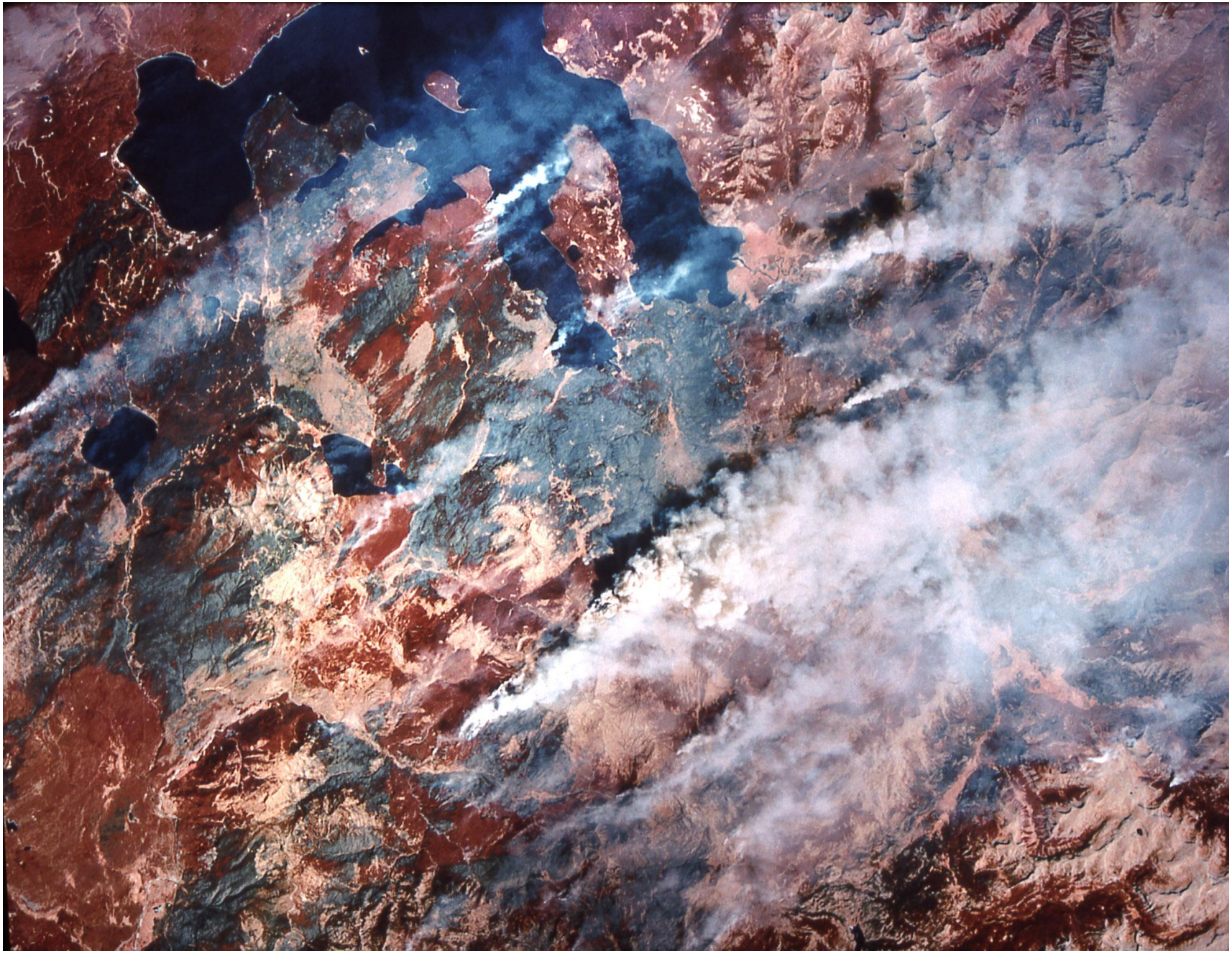
Development

Invasive Species

Ecology impacts how we can use a forest and should inform how we manage it.

Yellowstone Fires of 1988





Values/Demands placed on a forest
Ecologic health
Recreation
Aesthetics
Preservation
Timber
Intrinsic
How do we manage for all these values? Can we?

Sustainable Forestry

HARVEST

Clear Cut—takes all board feet

Selective (thinning)—takes a % board feet

Best Management Practices

How many ha of each type?

Estimate the maximum sustainable harvest per year in board feet/year from the site shown.

Use a combination of at least 2 approaches.

Challenge: Add a small 10 ha (any shape) park for recreation/wildlife to your design for each.

Streams must be buffered by at least 100m (1 side of a box)

No new roads.

Work individually or in pairs but I need a sheet from everyone.

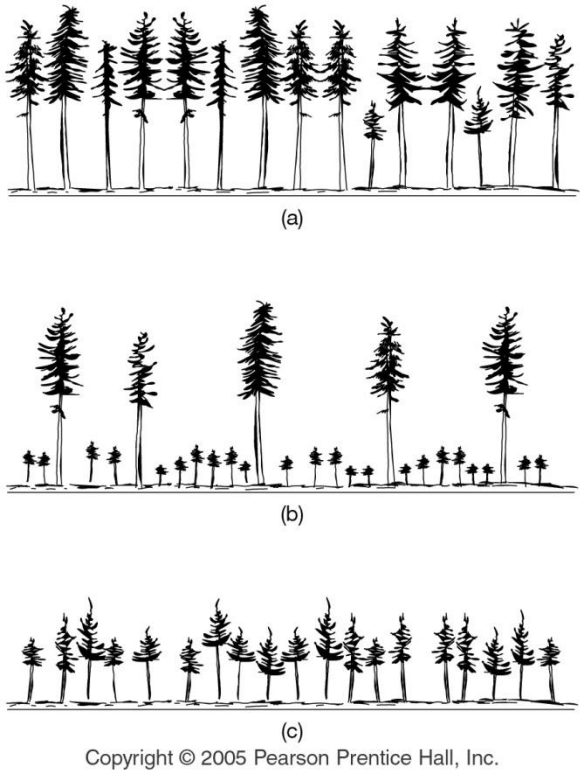
Harvesting Trees—How often?

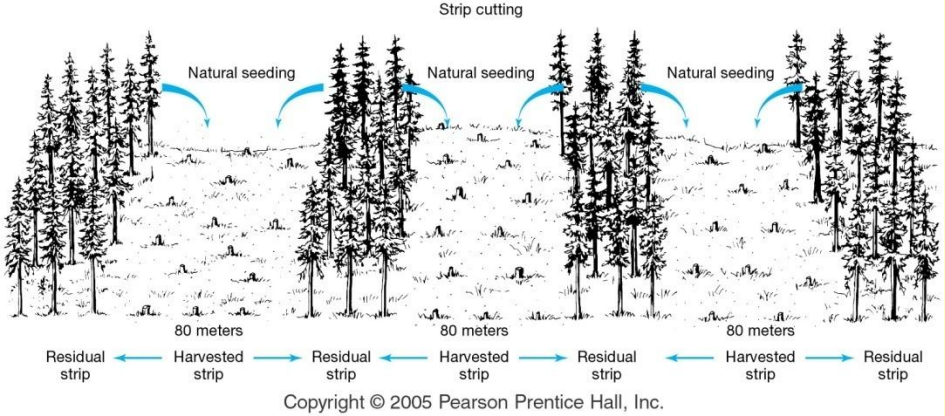
“Stand replacement time”

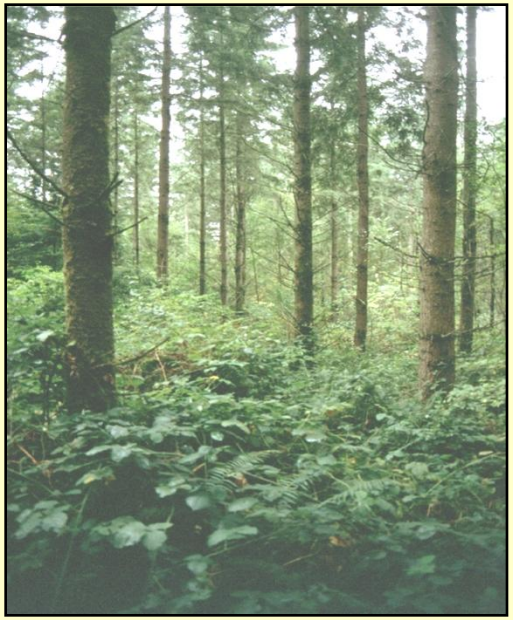
“Harvest interval”

In general if your stand takes 40 years to replace then your yearly harvest needs to max out at 1/40th of your land area.

Harvesting Trees—How to harvest?







Harvesting Trees

Clear Cut—takes all board feet

Selective (thinning)—takes a % board feet

Shelterwood—takes % 60%

Strip—takes all w/in a strip

How many ha of each type?

Estimate the maximum sustainable harvest per year in board feet/year from the site shown.

Use a combination of at least 2 approaches.

Challenge: Add a small 10 ha (any shape) park for recreation/wildlife to your design for each.

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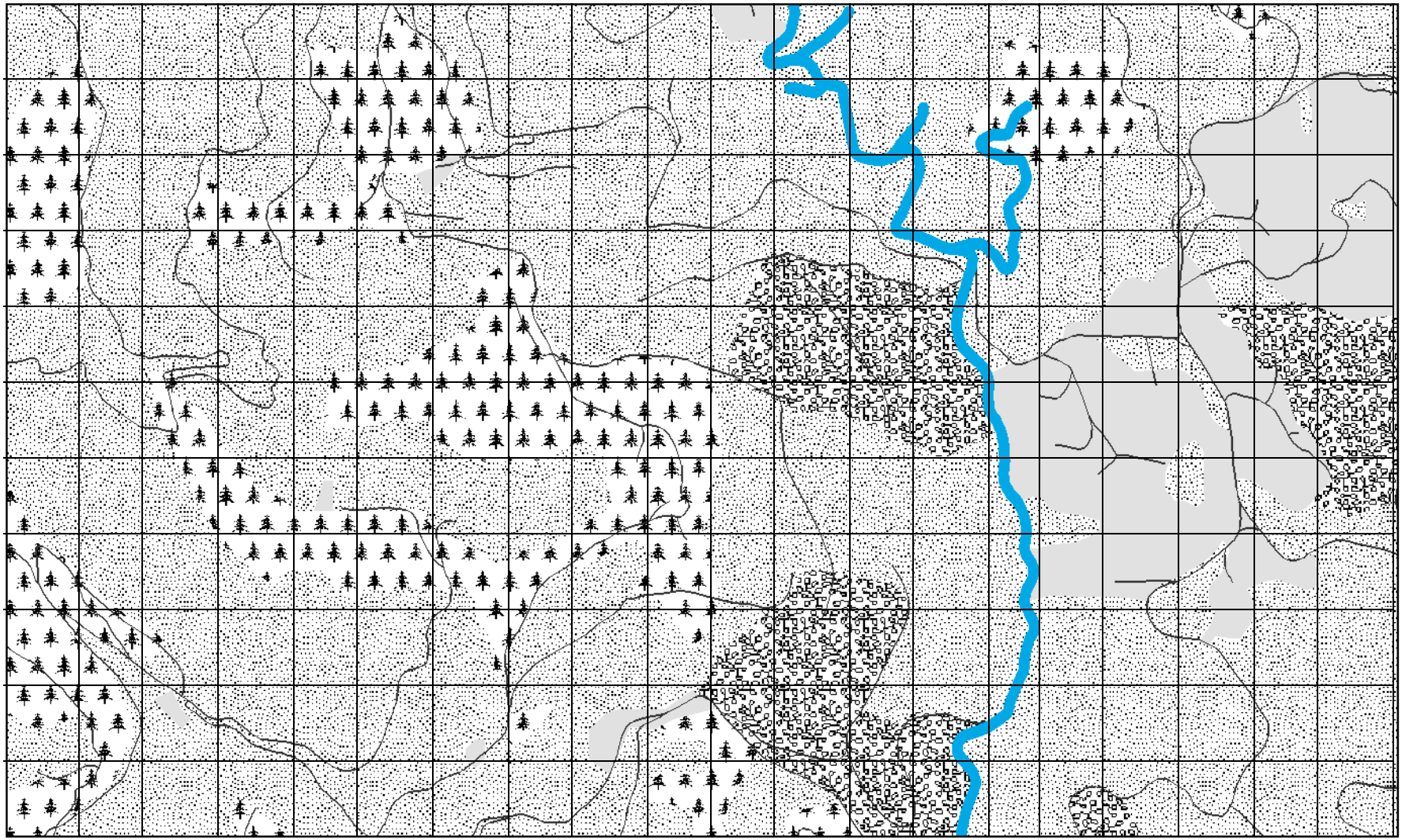
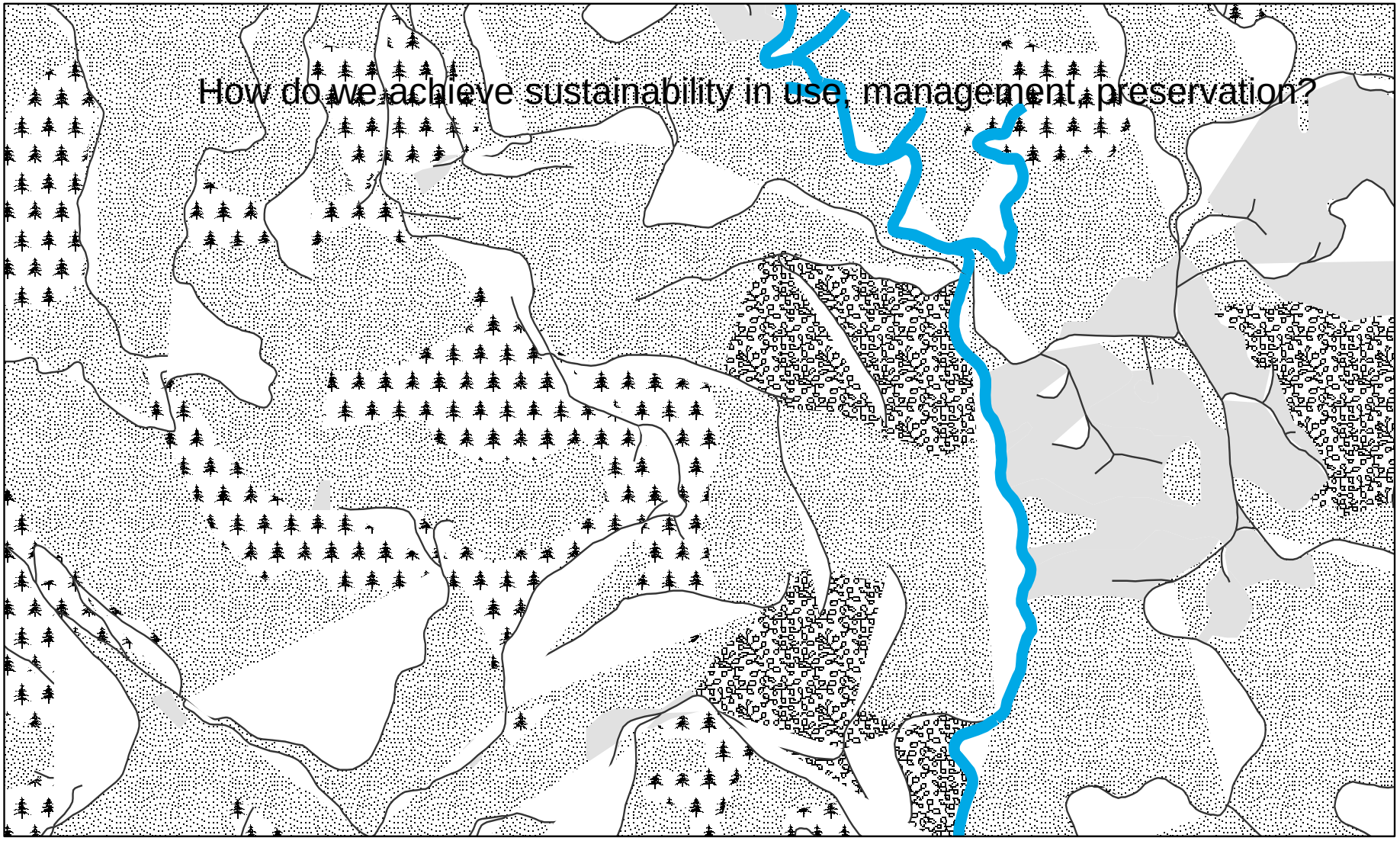


Legend

- Clearcut
- Old 100,000 BF/ha
- Mature 75,000 Bf/ha
- Pole 50,000 BF/ha
- Sapling Out of commission for at least 30 years

Boxes = 1ha



Legend

- Clearcut
- Old 100,000 BF/ha
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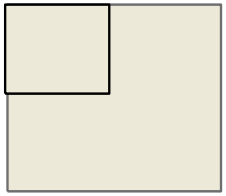
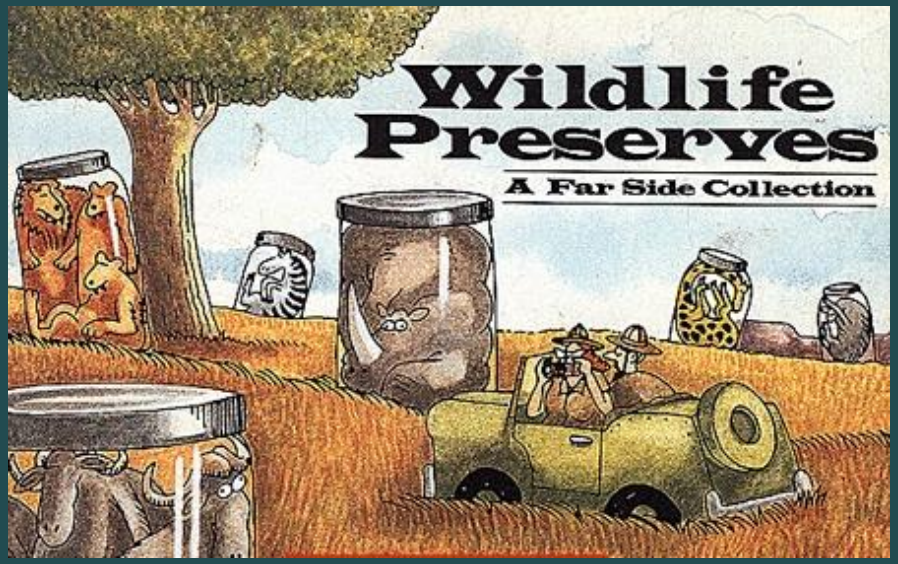
- Sapling



Boxes show 1 ha and 1/4 ha

Forest and Wildlife Habitat Management and Conservation



Ecology

What resources do they require?

How good are these resources?

How will animals use resources?

What other factors are at work?

Management

What do we conserve?

What can we manage?

Other factors?

What should we do?

What will happen to the population?

How do we relate forests measurements to the basic needs of wildlife?

Security/safety/shelter

Food

Habitat

Reproduction

Food/Nutrition—source of energy ultimately from the sun and essential nutrients— used for chemical energy and cellular activity

Security—provided by habitat, physical appearance, behavior or even social interactions.

Reproduction—only possible when other conditions are met.

Survival—to breeding age

Recruitment—young reaching next year

- Habitat—must provide physical conditions resources and space for shelter, feeding, reproduction.

- Loss of habitat—leading cause of biodiversity declines

- We use those resources too.

Wildlife and Forest Management

Much of the focus of managing resources involves assessing and/or manipulating populations

Habitat management---to provide conditions for species to maintain, increase or in the case of nuisance, decrease.

Direct manipulation—planting, harvest, hunting, fishing, enhancement

MUST understand the ecology of species in order to best try to manage habitats and populations---knowing why and how about their ecology is essential.

How do we decide “how good” resources are for wildlife?

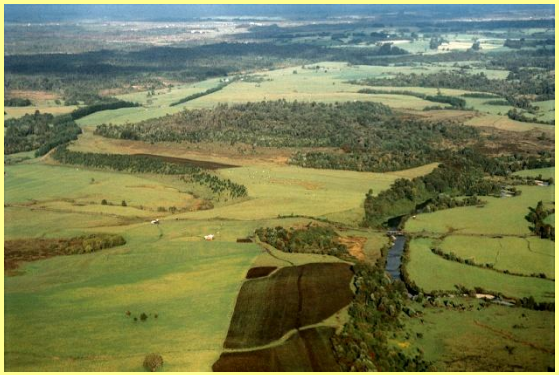
WHAT TO MEASURE?

PREDATORS
VERY controversial
***wide public acceptance**
***declines began before predator controls stopped**
***MUCH more empirical work needed**

REPRODUCTION: Low numbers of mature bulls
- **widely accepted**
- **empirical data doesn't generally support its role**

▪FOOD SUPPLY
▪Generally has been discounted by commonly used habitat evaluations

▪Poor condition—nutritional needs not being met in some areas



▪CRITICAL HABITAT RESOURCES

Cover, Roads, Landscape Pattern: often used as surrogates for factors more difficult to measure

Challenges

How to measure forage selection and diet quality in wild animals?

How do we measure detailed habitat selection at multiple scales?

How do we relate this to population dynamics in order to manage habitat?

Habitat Suitability Index & Habitat Effectiveness Index (HSI & HEI)

SCORES:

1. Amount, size, and spacing of **Forage** & **Cover**
2. Density of, or distance to, open **Roads**
3. Scored on a 0 – 1. 0 scale (unsuitable-optimum)

Overall habitat value is computed as the geometric mean of all inputs

$$[\text{Forage Area} \times \text{Forage 'quality'} \times \text{Cover Quantity} \times \text{Roads}]^{0.25}$$

0-<0.2 = Non-Viable
0.2-0.4 = Marginally Viable
0.4-0.6 = Viable
>0.6 = Highly Viable
1.0 = Optimal

Habitat Suitability Index (HSI)

Determine critical habitat elements and 0-1.0 (or other)scoring system representing quality for wildlife.

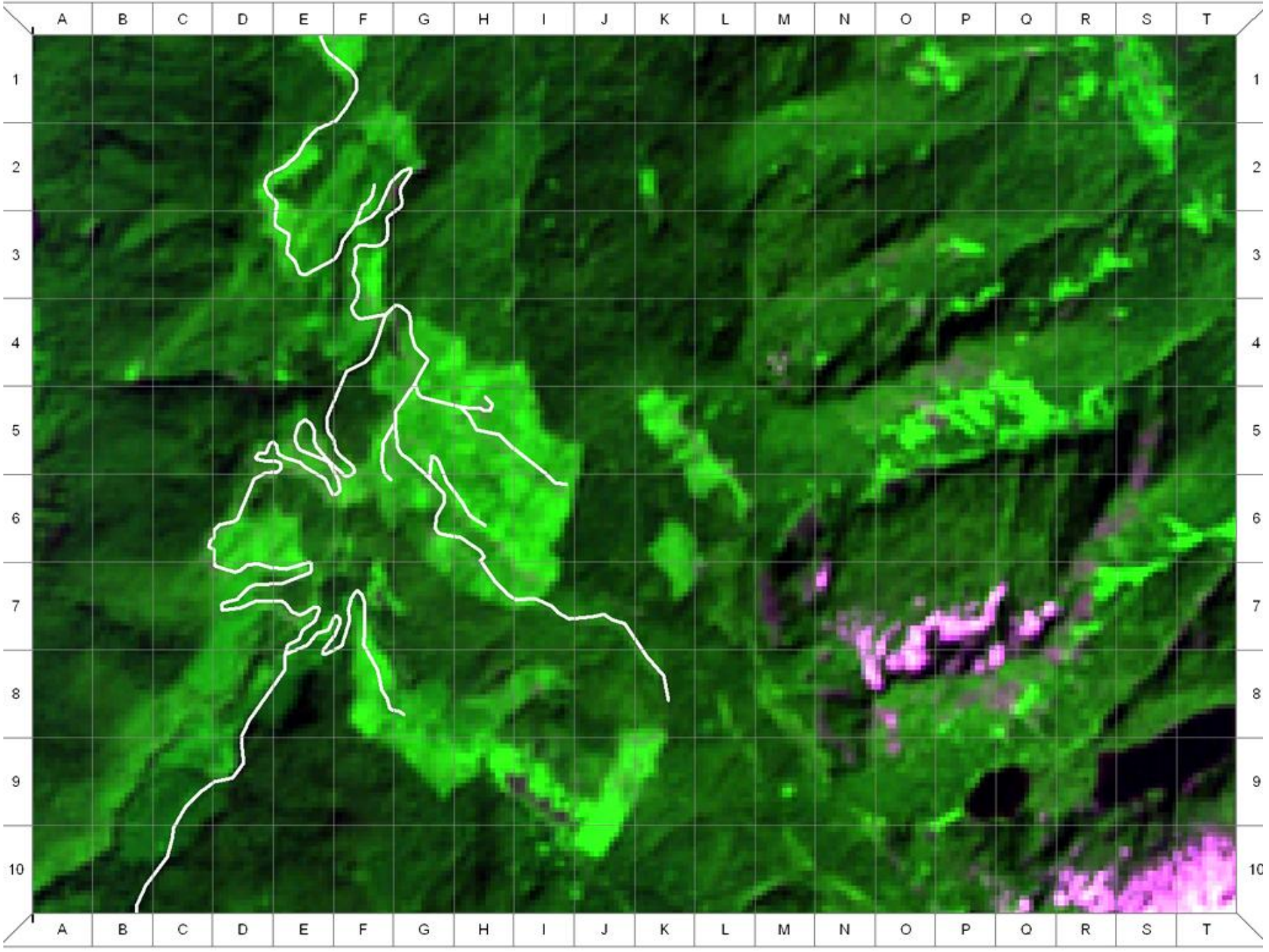
Provides a 0-1.0 index of “habitat viability”

0 = Non-viable

0.5 = Marginal

1.0 = Highly

Intended as an efficient indicator


A B C D E F G H I J K L M N O P Q R S T
1 2 3 4 5 6 7 8 9 10

Habitat: Security/shelter, Food, Nutrients, Territory/Space

HABITAT SUITABILITY INDEX WORKSHEET

Names:

	Forest (No Roads)	Forest /roads	Forest-Clearing (No Roads)	Clearing (With roads)	Water & Forest	Forest & Bare Soil	Mostly Bare Soil	Final HSI—add all columns
Multiplier for Species A								
Multiplier for Species B								
Number of Cells								
Number of Cells times the multiplier and divided by 100 **Species A**								
Number of Cells times the multiplier and divided by 100 **Species B**								

Final HSI

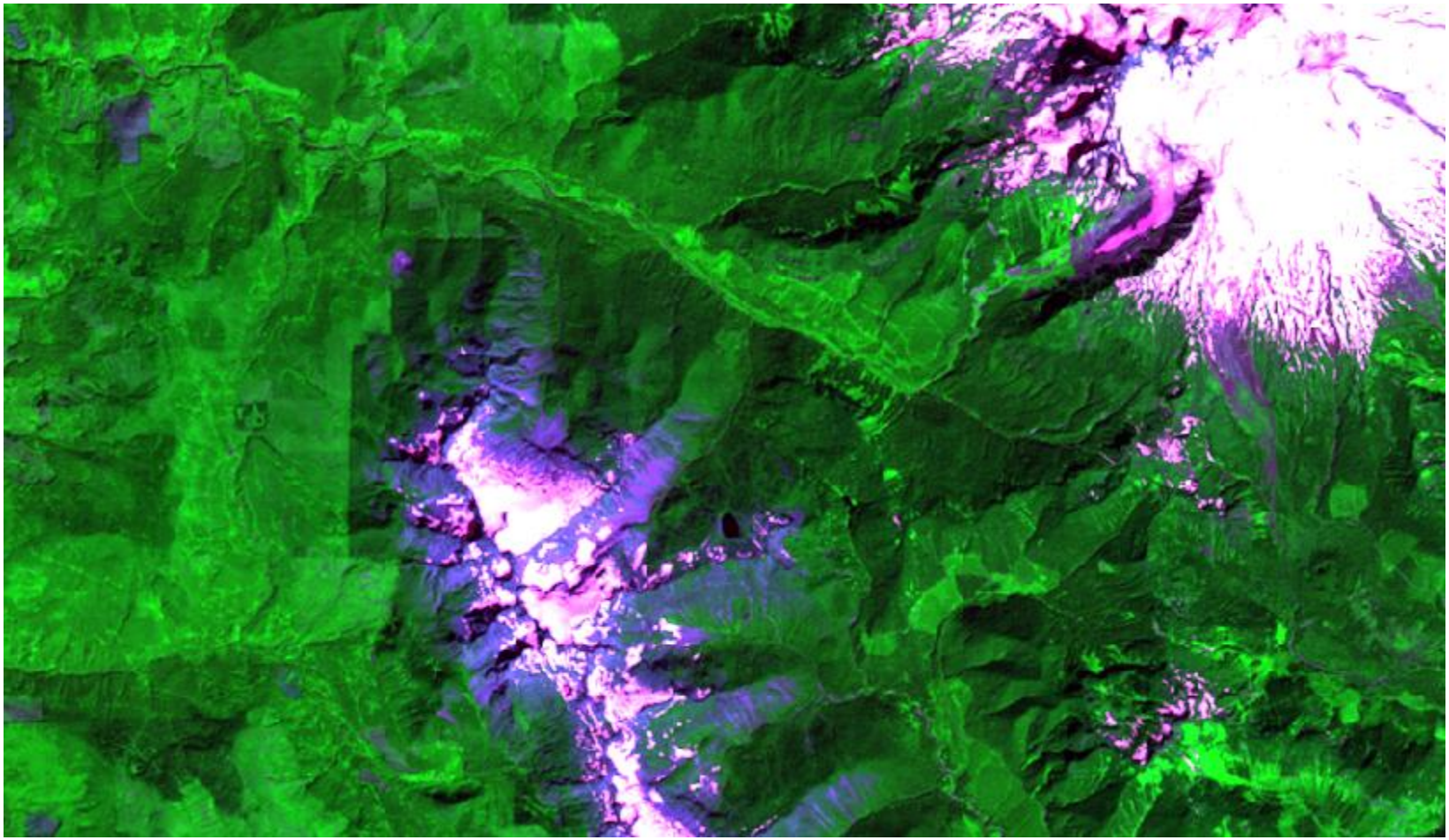
Species A_____

Species B_____

Which species is better suited to this habitat?

What can you tell me about the ecologic needs of Species A vs. B?

Even “contiguous” tracts of forest are actually a mosaic of various stages/conditions due to interacting environmental factors



Strategies

Species differ in their methods of finding food, avoiding becoming food, finding mates etc.

Costs vs. benefits must continually be “weighed” in making decisions about habitat use, movements etc.

The better understanding managers have of these strategies and the ecological needs of wildlife the better they can “manage” habitat to create conditions needed to best provide.

Some “Strategies”

Feeding: Carnivore, omnivore, herbivore, parasite, scavenger, decomposer, producer.

Activity: Diurnal, nocturnal, arboreal, fossorial, migration, hibernation

Reproduction: Monogamous, polygyny, polyandry

Wildlife Management—providing habitat or manipulating populations

The availability of adequate ***habitat***

-Food and Space

-Reproduction

-Safety

-Dispersal/Migration routes

-Territory defense

The loss of most biodiversity on Earth can be linked to habitat loss or degradation

What do we conserve, restore or manage?

Wildlife

Presence/Absence of key species

Population Size (increase, decrease, stay the same)

Population demographics (age structure, birth rates, recruitm

Movements, behavior, dispersal

Species “health” or condition

Harvest, recreation

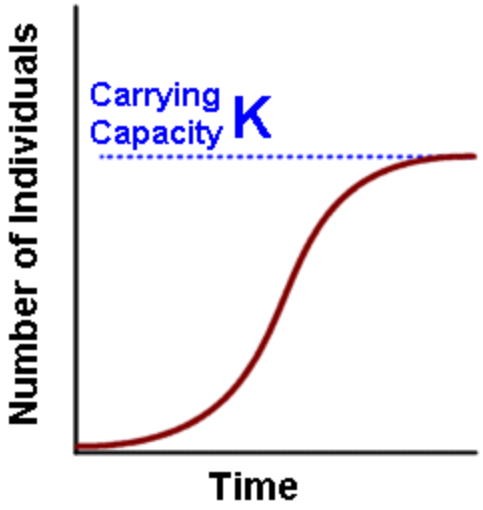
Politics

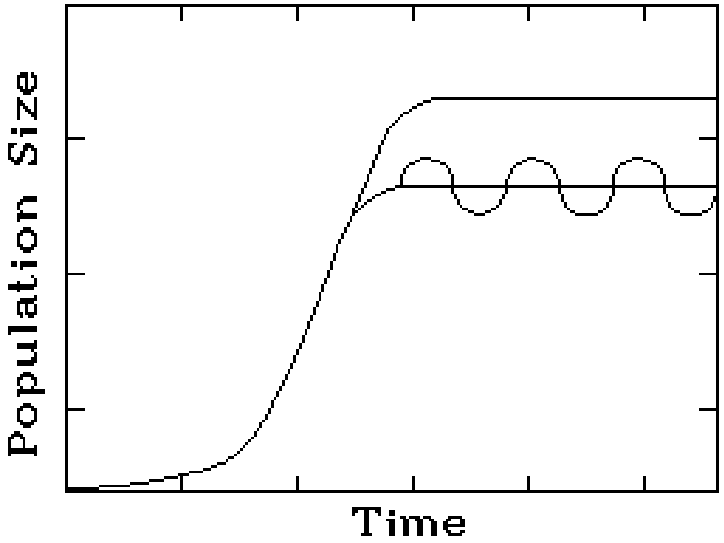
Carrying Capacity

General—Maximum numbers of any given species an area can support

Ecologic—maximum numbers w/o detriment to ecosystem or processes

Social—maximum number tolerated by society





Multiple Use Approach

Wood products (global average use = 25 cubic feet/year / person or about a 100 ft. 16 in diameter tree.

Erosion Control and flood control

Rangelands

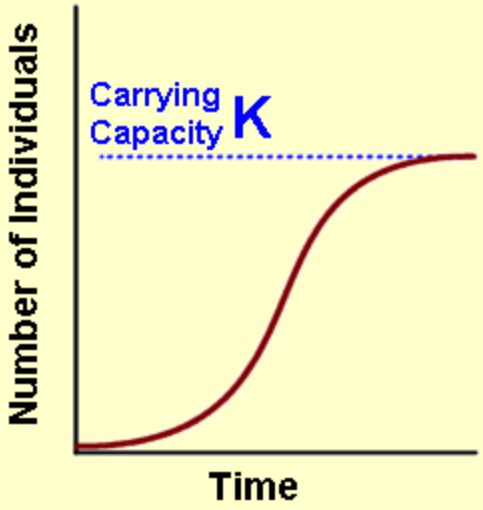
Wildlife habitat

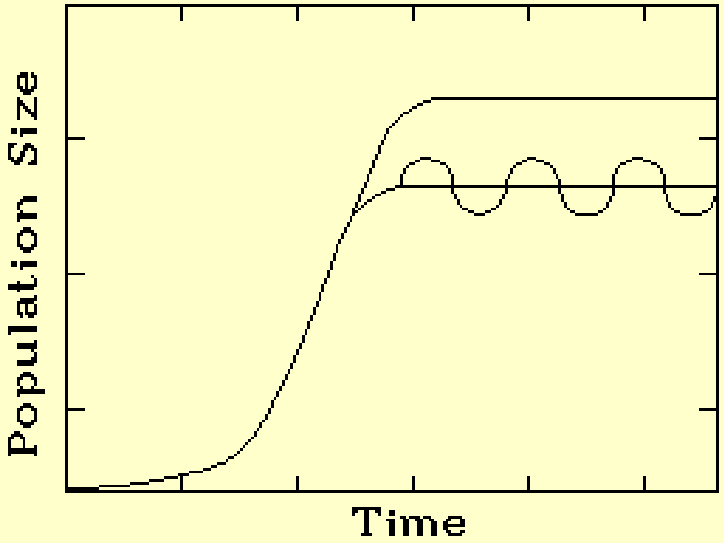
Carrying Capacity

General—Maximum numbers of any given species an area can support

Ecologic—maximum numbers w/o detriment to ecosystem or processes

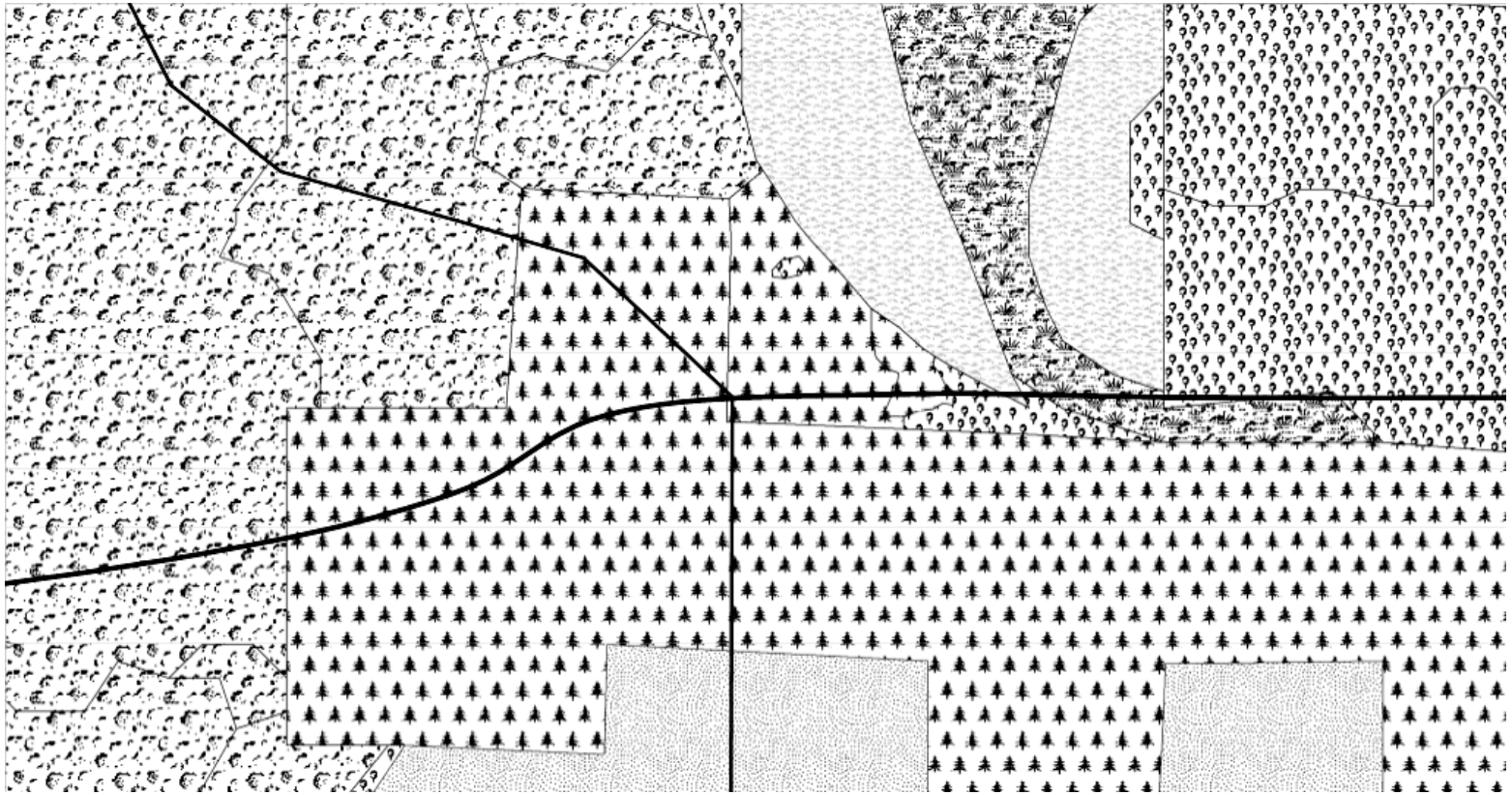
Social—maximum number tolerated by society





Management Problem: *Cervus fictitious*

Winter Habitat Carrying Capacity and Range Management



GRASSLAND
CONIFER
WOODLAND
SCRUB
CROPLAND
Wetland

100m

1 ha

Landcover	Area	Road Effects	Forage/ha	Total	Total Deer
Grassland	31	30	196	5880	
Conifer	155	140	10	1400	
Woodland	200.9	190.9	40	7636	
Scrub	70.4	65	30	1950	
Cropland	29	26	75	1950	
Wetland	19	16	200	3200	
	505.3			22016	**101.9259259**

Kg/ha forage

GRASSLAND	196
CONIFER	10
WOODLAND	40
SCRUB	30
CROPLAND	75
Wetland	200

- 1.2 kg/day intake for deer
- Winter Season
- 50% reduction in use w/in 100m of roads
- Winter home range @ 1 km^2
- Habitat needs: Forage, cover, water w/in homerange

What is the winter carrying capacity?
What is the maximum supportable density?
What management steps could be used to increase carrying capacity?