In the anthropogenic biome ("anthromes") framework, ecosystem processes are considered to be mainly functions of:

1. Temperature and precipitation
2. Biodiversity and biomass
3. Net primary productivity (NPP) and carbon storage
4. Population density and land use

Today

- **Turn in section exercise if you have not already.**
- **Finish lecture and discussion on anthromes**
- **Succession and disturbance**

- ***Friday: Results from your mid-quarter feedback on the course***

Section recap: Ecosystem services

- **The benefits humans derive from ecosystems.**
  - ❖ **Provisioning of water, food, raw materials, medicines, etc.**
  - ❖ **Processes like carbon sequestration, purification of air and water**
  - ❖ **Non-material benefits like spiritual value, recreational experiences, cognitive development**

- **What do you think are some of the advantages and problems associated with the economic valuation of ecosystem services?**

Anthropogenic Biomes Globally

People: 80% live in urban and village anthromes

Land: 23% Wildlands, 77% Anthropogenic Biomes

NPP: 11% Wildlands, 89% Anthropogenic Biomes

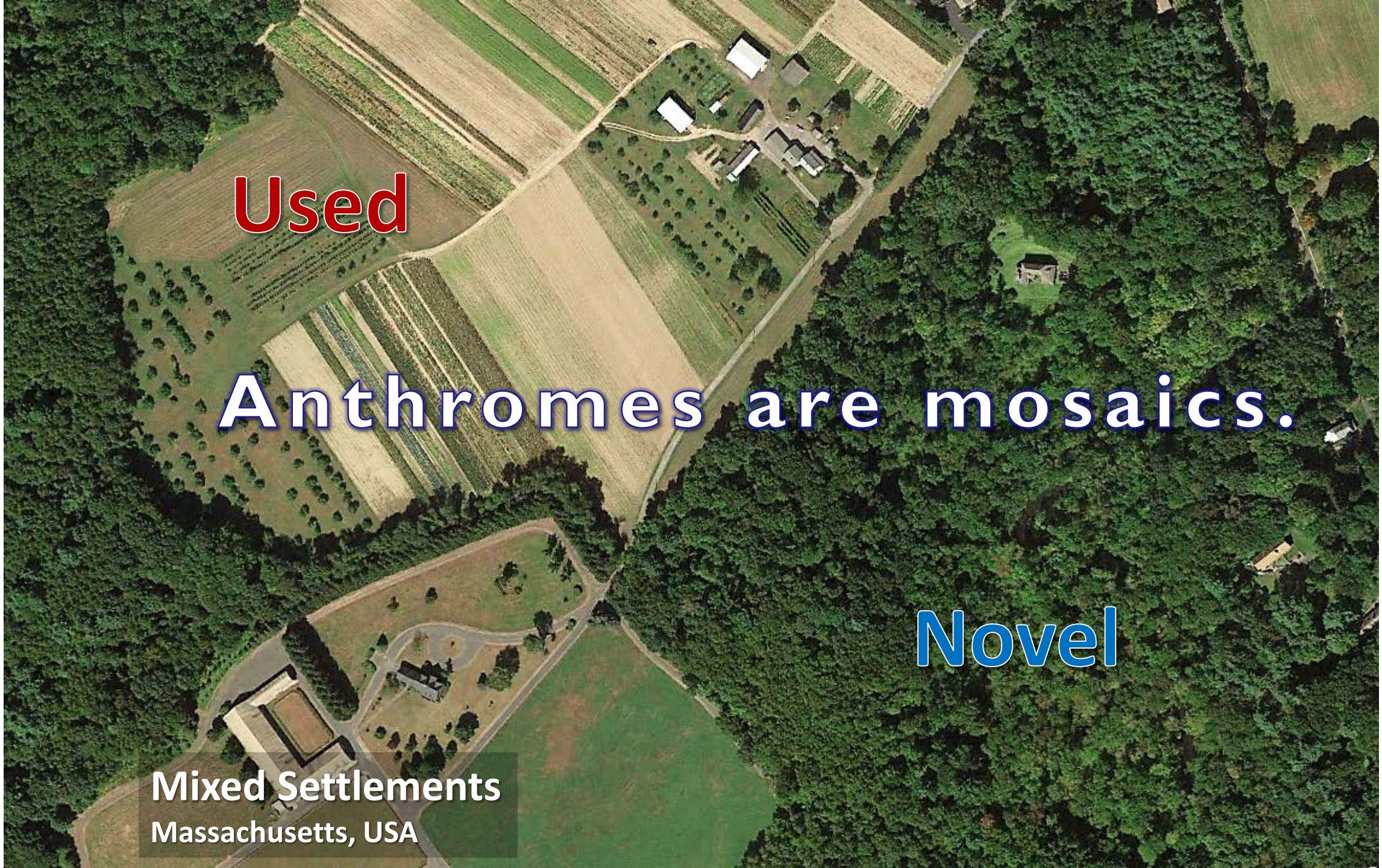
NPP of "wild" forests is LESS than NPP of densely populated anthromes!

According to research on anthropogenic biomes, the biosphere we have is:

40% Used Lands

37% Novel Ecosystems

23% "Wild"


Used
Anthromes are mosaics.
Novel
Mixed Settlements
Massachusetts, USA

The old biosphere story…

"Natural ecosystems with humans disturbing them".

A new story…

"Human systems, with natural ecosystems embedded within them".

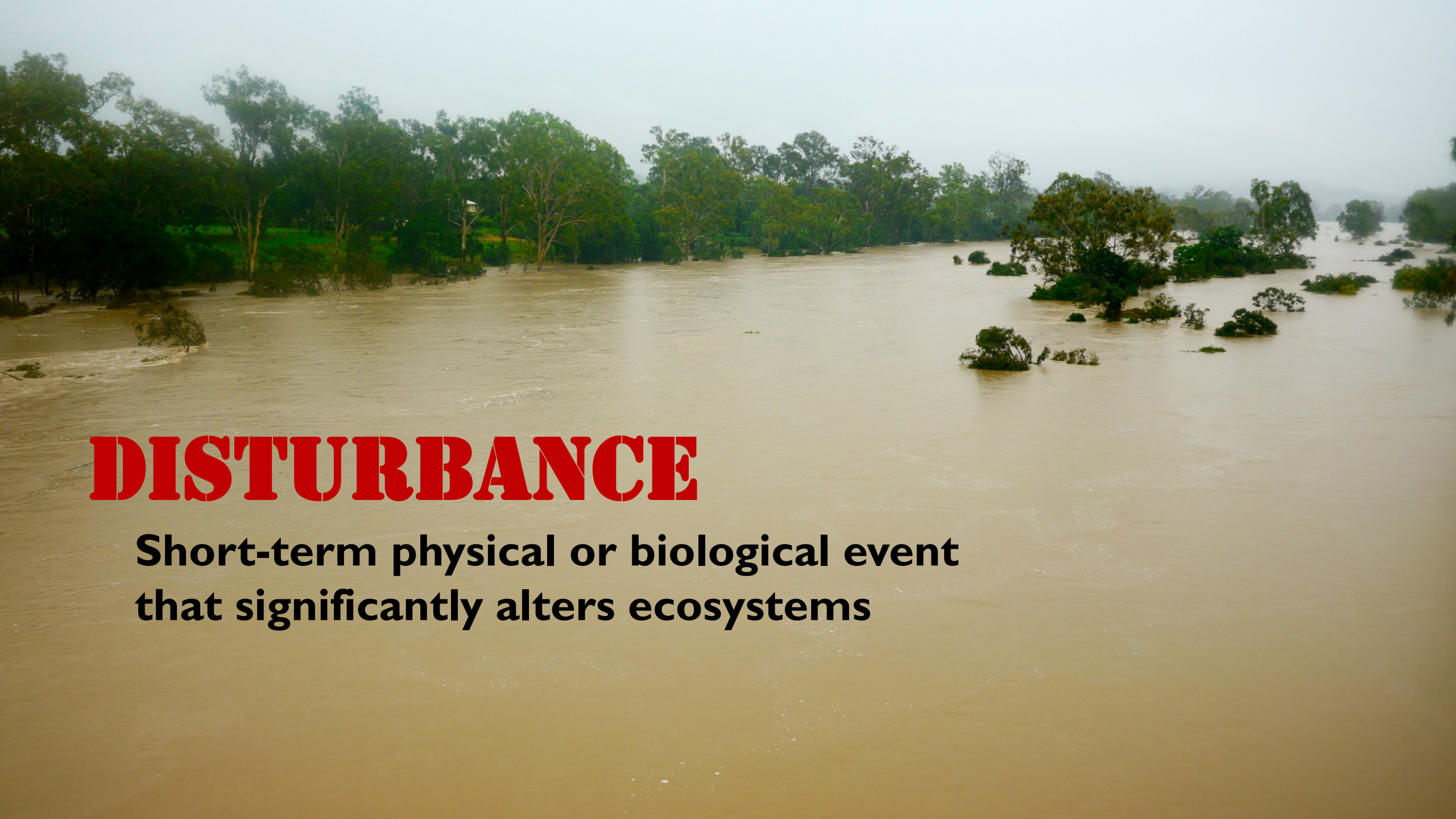
How might anthromes change the way people think about nature? Do you buy the idea that biomes are no longer an adequate classification scheme?

The authors of research on anthropogenic biomes (Erle Ellis et al.) tell ecologists to "go home." What do you think they mean by this?

Should scientists and conservations focus their attention more on peopled landscapes or wild landscapes?

What do anthromes and ecosystem services have in common?

HOW ECOSYSTEMS CHANGE: DISTURBANCE & SUCCESSION



DISTURBANCE

Short-term physical or biological event that significantly alters ecosystems

SUCCESSION

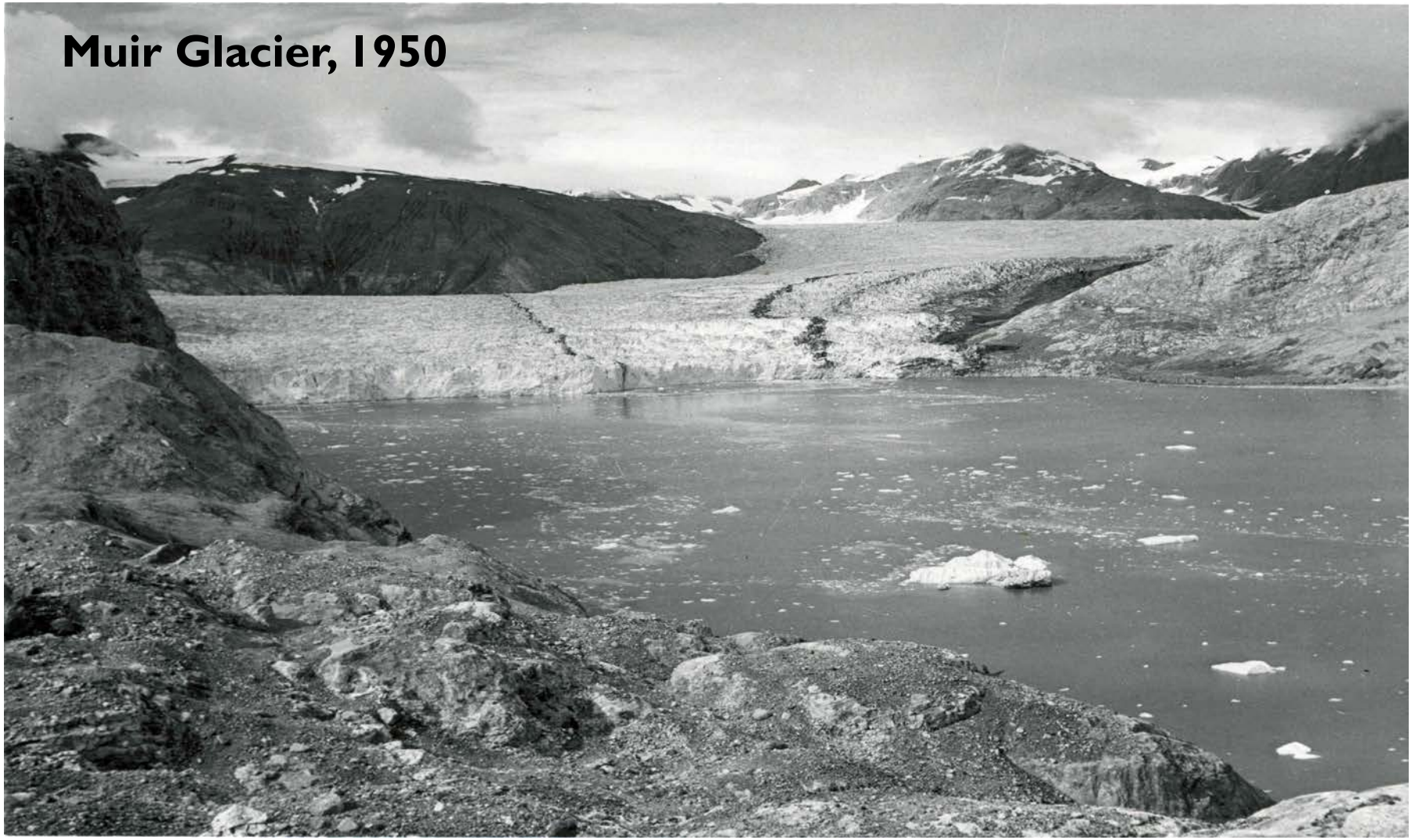
A series of changes in species composition over time, following a disturbance event.

PRIMARY SUCCESSION

A previously lifeless surface is colonized by life.

PRIMARY SUCCESSION

Example: Glacier Bay, Alaska



PRIMARY SUCCESSION

Example: Glacier Bay, Alaska

PRIMARY SUCCESSION

Example: Volcanic eruptions

Pioneer species & their characteristics

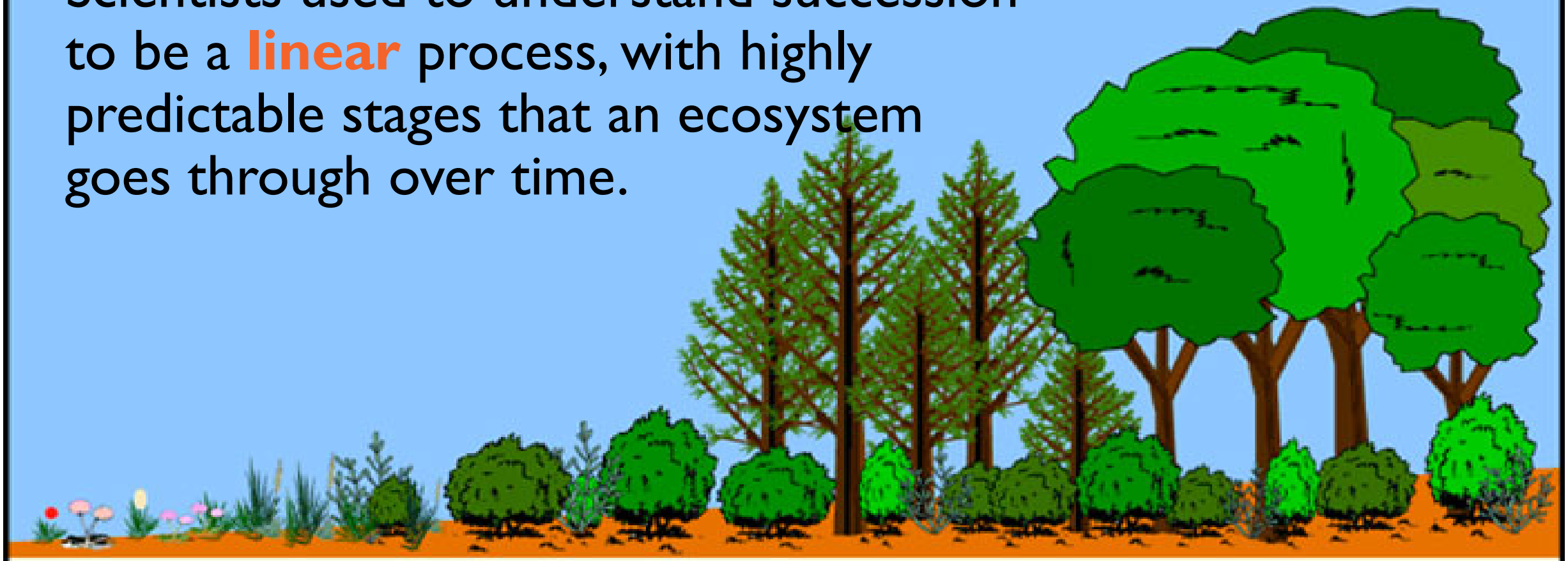
SECONDARY SUCCESSION

Ecosystem changes after a disturbance that leaves soils intact; surface of earth has not been stripped bare.

Example: Clear-cutting


Example: Downed trees
Microclimate

Scientists used to understand succession to be a **linear** process, with highly predictable stages that an ecosystem goes through over time.



Annual Plants

Perennial Plants and Grasses

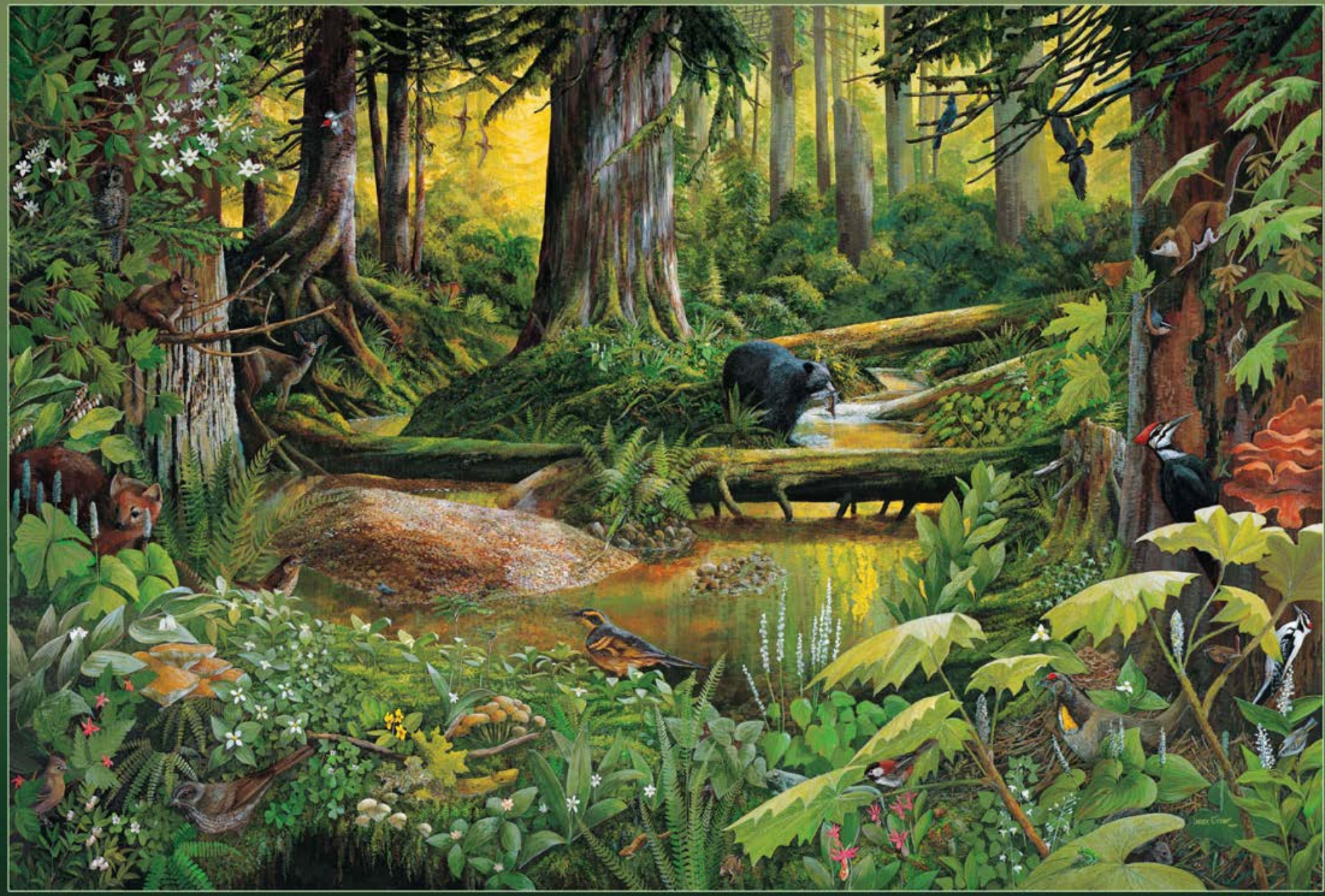
Shrubs

Softwood Trees - Pines

Hardwood Trees

Time →

Pioneer species



LARRY EIFERT

OLD-GROWTH FORESTS OF THE PACIFIC NORTHWEST

CLIMAX COMMUNITY

A stable plant community* that is the end result of succession. Will not change without disturbance.

*What exact form this ideal community takes will depend on location and climate

A controlled burn in a juniper-sagebrush ecosystem in central Oregon


Yellowstone National Park
forest regeneration after
1988 wildfires

Newer way of thinking:

Succession and the adaptive cycle of complex systems

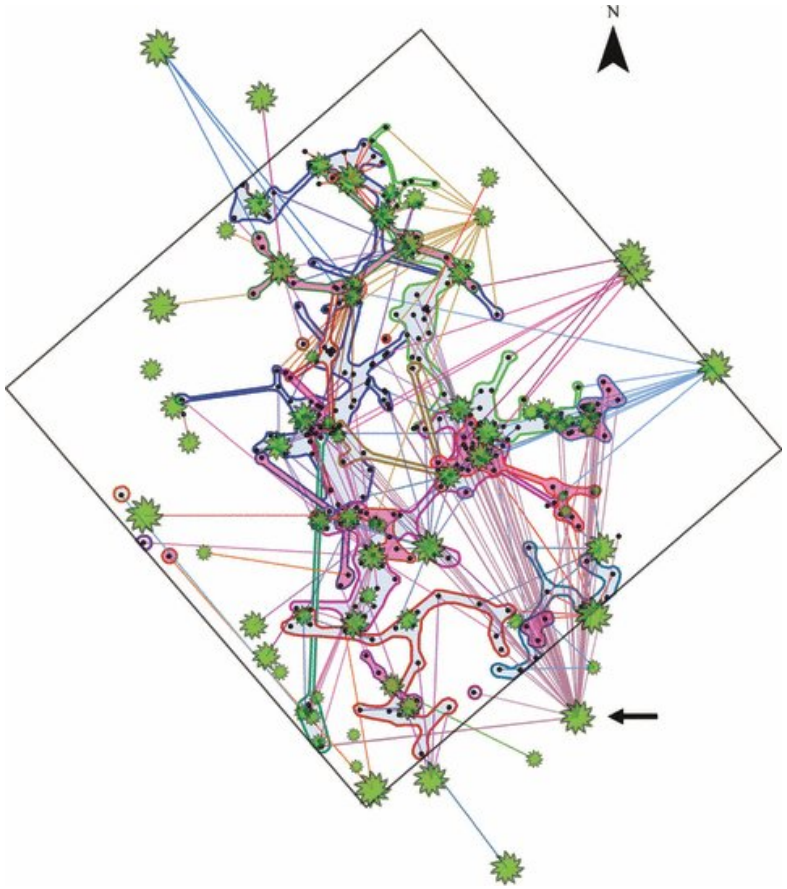
- **Communities do not gravitate toward a single equilibrium state**
- **"Non-equilibrium ecology" (1990s to today)**

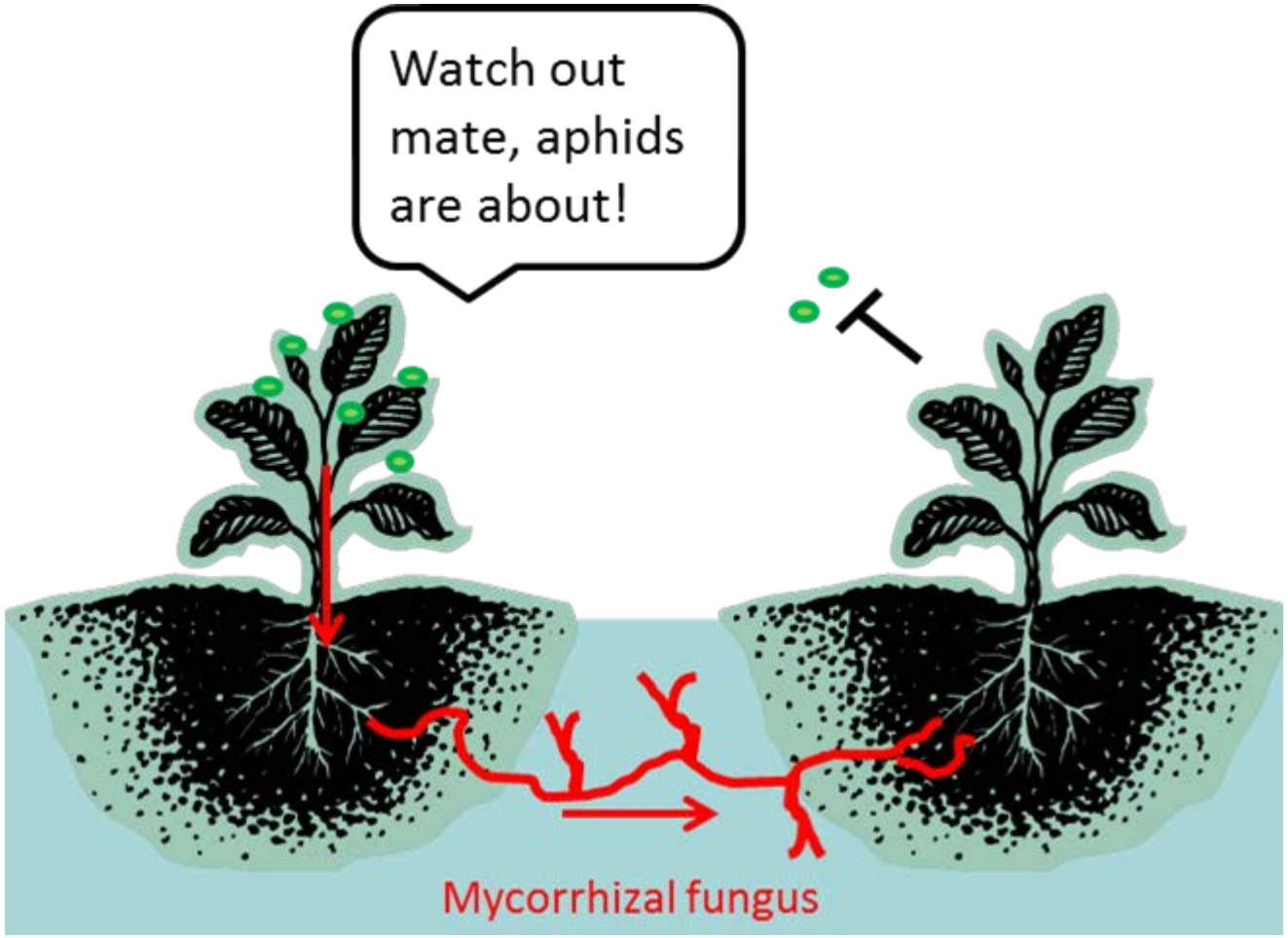
Disturbance as an inevitable part of the system

"The only constant is change." - Heraclitus

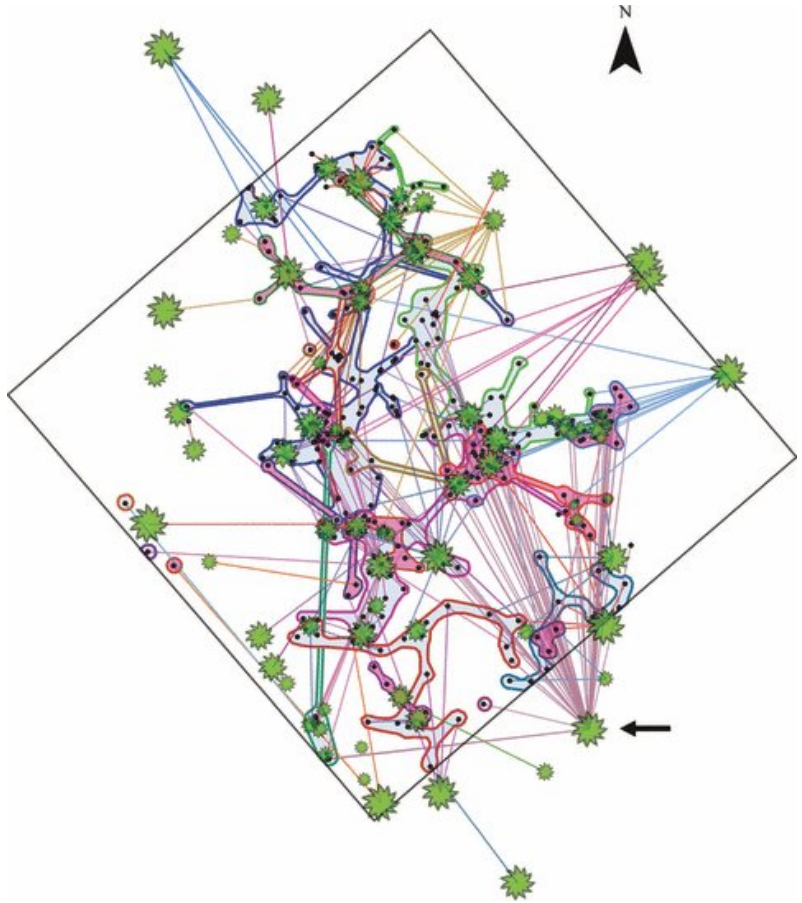
Still, an ecosystem can be thrown off it's trajectory:

How do trees "communicate" and "interact" with one another? And how might these ideas impact how we think about succession?





Implications



- **Should competition be de-emphasized in understanding succession?**
- **Mixed age stands might be more resilient in the face of disturbance and climate change. (Why?)**
- **Need for conservation of mycorrhizal fungi!**