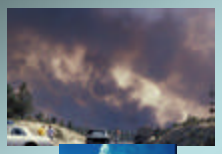
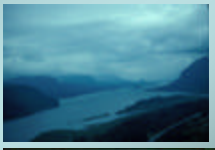
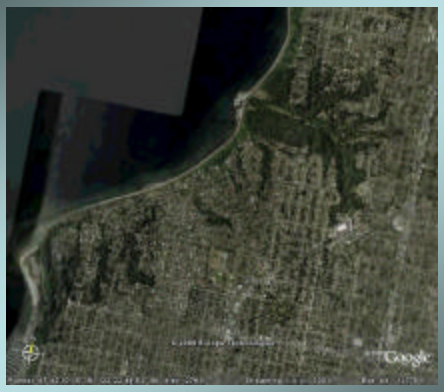
Disturbance Ecology



Succession

- Communities change through time
- Succession is the replacement of one community by another over time

Primary succession

Secondary succession

Traditional views of succession

- It proceeds in a predictable manner from disturbance through changes to reach a climax.
- It is primarily autogenic (driven by changes caused by the plants and other organisms in the community).
- Failure of a community to reach the climax state is the result of temporary obstacles.

Species Longevity

• Fireweed	6 months
• Scot's broom	7 years
• Red alder	80 years
• Big leaf maple	150 years
• Black cottonwood	150 years
• Douglas-fir	700 years
• Western hemlock	1000 years
• Western red cedar	1000-1500 years
• Giant sequoia	2500 years

Disturbance effects are affected by: Spatial Factors

- Size
- Shape
- Connectivity
- Closeness to unaffected areas

For species to recolonize the site


Disturbance effects are affected by: Temporal

- Frequency - number of events per unit of time
- Duration
- Time of year

Disturbance effects are affected by Magnitude:

- Intensity - Physical force of the event

Response of Organisms to Disturbance

- r and K selection – as succession moves from primary to secondary, different organisms colonize the site. Those that come in during primary succession are said to have "r selection" and those later, move towards "K" selection

r and K selection

	r	K
Climate	Variable, unpredictable	Consistent, predictable

r and K selection

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Mortality	Density-dependant (competition between species)	Density-independent (fire, flood, frost)

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Body types – life history	Rapid growth, early reproduction, small	Slow growth, delayed reproduction, large

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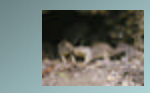
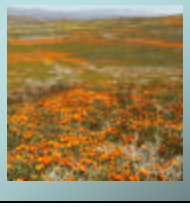
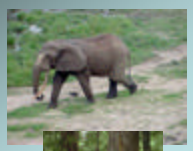
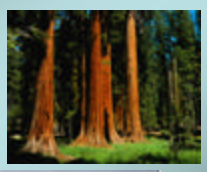
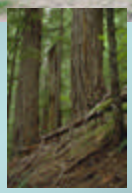
Overall	Productivity	Efficiency

r selected species




K selected species


r/K Continuum




r selection → K selection

r/K Continuum
Locate a mosquito, a Douglas-fir, a crow and a coyote on the line

r selection → K selection

Student response

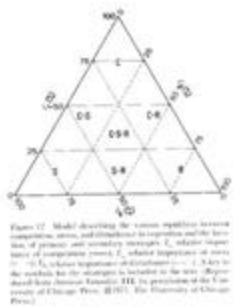
Population Models

$$r_1N_1\left(\frac{K_1-N_1-aN_2}{K_1}\right) = \frac{dN_1}{dt} = 0 = \frac{dN_2}{dt} = r_2N_2\left(\frac{K_2-N_2-\beta N_2}{K_2}\right)$$

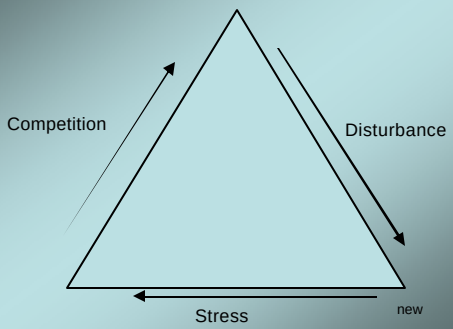
Population Models

$$N_{t+1} = N_t + B - D + I - E$$

N_{t+1} = the size of the population at a future time
N_t = the size of the population at the original time it was measured
B = Number of births in the population
D = the number of deaths in the population
I = the number of individuals who immigrant in
E = the number of individuals who emigrate out



"Grime Strategies"



Definitions

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- Disturbance – relatively discrete event in space or time that alters populations, communities, or ecosystems
- Stress – The external constraints which limit the rate of growth and biomass (roots, leaves, etc) of all or part of vegetation

"Grime Strategies"

Disturbance \ Stress	Low	High
Low	Competitor	Stress-tolerator
High	Ruderal	Dead!

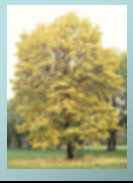
Competitors:

- Storage organs >> fast mobilization
- Height – get most of the light
- Lateral spread – get light, possible water and nutrition
- Photosynthesize over a long period
- Respond to stress with growth (to find new resources
- Respond to disturbance with growth (repair)
- "out-biomasses its neighbors"

Competitors

Oak

Beech



Maple

Stress-tolerators:

- Reduction in growth form
- Grow slowly
- Use resources slowly
- Accumulate nutrients
- Evergreen
- Conserve resources (rather than capture new)
- Not palatable to herbivores

Pines

Douglas-fir

Disturbance Adapted Ruderals:

- Annual or short-lived perennials
- High rates of biomass production
- Fast seed ripening
- Respond to stress with seed production
- Many seeds per plant

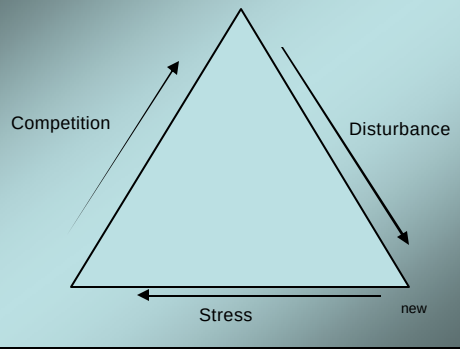
Ruderals

cheatgrass

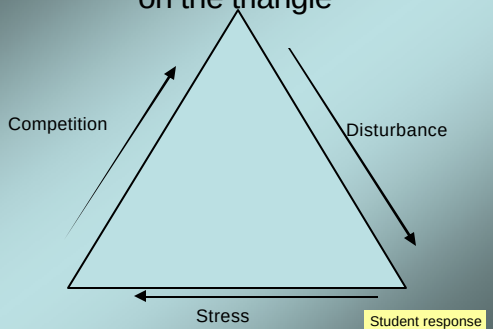
fireweed

tumbleweeds

"Grime Strategies"



Locate a dandelion and a Sequoia on the triangle



Student response

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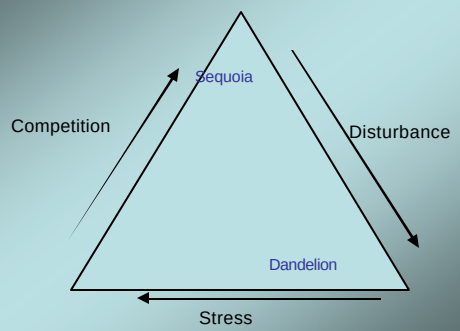

Intermediate Disturbance Hypothesis

- High disturbance – only ruderals
- Low disturbance – mostly competitors
- Intermediate disturbance – some disturbance takes out some competitors but not all, brings in some ruderals and even stress tolerators

So… Highest species diversity

Response of the community may be one of:

- Succession
- Resilience – the ability of the community to return to a former state after disturbance and the capacity to continue functioning
- Resistance – the ability of the community to withstand disturbance

Urban Landscape Ecology

- Patches and matrix

- Post-disturbance species dynamics, remnant patches
  - Elevated species extinction rate for rare spp. and those with large home range requirement
  - Some species will immigrate to the remnant and establish
  - Continuing extinctions will occur
  - Eventual community will contain fewer of original spp. and more of immigrants

Bottom Line

- Urban areas have high disturbance
- Species with a strategy of productivity rather than efficiency are better adapted
- Some disturbance may lead to urban areas actually having higher diversity
- Urban areas are composed of early successional communities as well as those able to resist or continue functioning after disturbance

Maintaining Nature