Climate Change and Invasive Plants in the Pacific Northwest

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Invasive plants are non-native to the local ecosystem and likely to cause economic or environmental harm

Meadow knapweed in a mixed conifer forest, eastern WA

Invasive plants of the Pacific Northwest include:

Knapweeds (e.g. *Centaurea stoebe (C. maculosa*))

Scotch broom (*Cytisus scoparius*)

English ivy (*Hedera helix*)

False brome (*Brachypodium sylvaticum*)

Cheatgrass (*Bromus tectorum*)





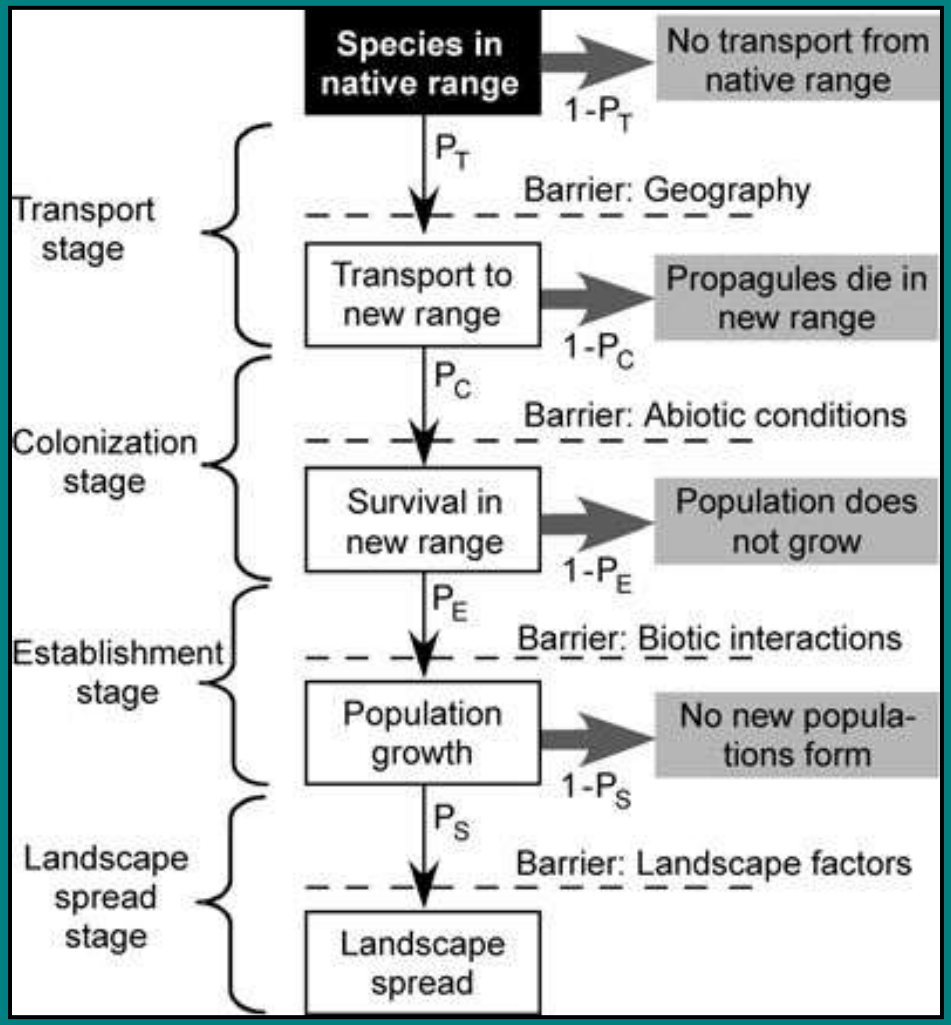
How will climate change and higher CO_2 affect invasive plants in the PNW?

- Growth & productivity
  - Physiological processes
  - Phenology
  - Biomass allocation
- Reproduction
- Establishment/survival
- Biotic interactions
- Disturbances
- Evolution
- Migration

How will climate change and higher CO_2 affect invasive plants in the PNW?

- Why talk about invasive plants specifically?
  - Invasive plants have characteristics that help them succeed outside their native habitat
    - Effective mechanisms for long-distance dispersal
    - Broad environmental tolerances
    - Highly plastic and adaptive.
    - Capable of rapid population expansion.
    - Managed differently than native species.

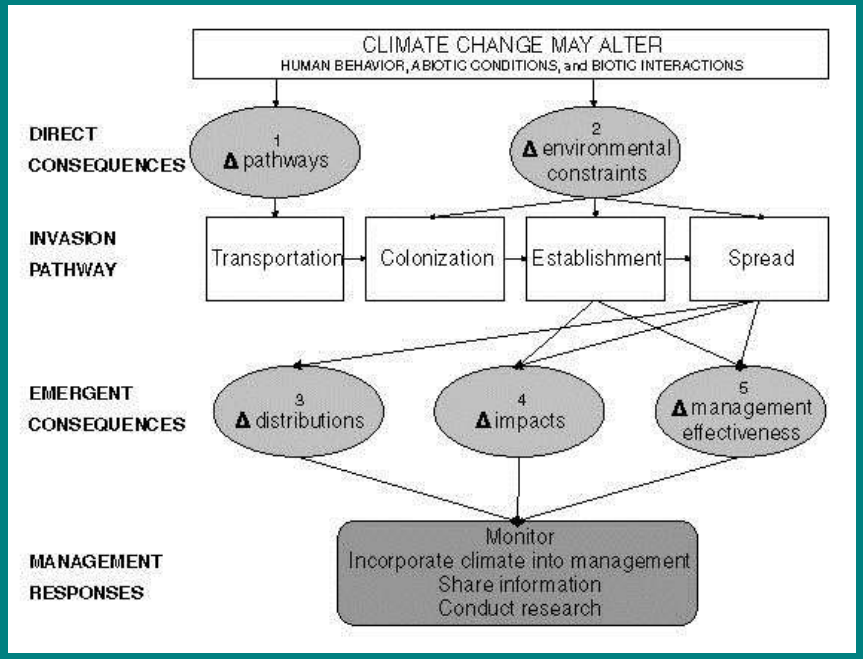
A conceptual model of the species invasion process shows four stages



- Transport
- Colonization
- Establishment
- Landscape spread

- *Hellmann and others (2008), Conservation Biology*

The model suggests five consequences of climate change for invasive species…

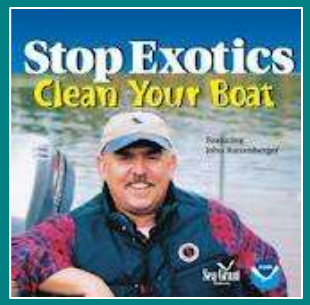


- Altered mechanisms of transport & introduction
- Altered climatic constraints on invasives
- Altered distribution of existing invasive species
- Altered impact of existing invasive species
- Altered effectiveness of management

From *Hellmann and others (2008) Conservation Biology*

Climate change may alter the transport of invasive species by altering…

- Patterns of human transport
  - Shipping patterns and modes
  - Tourism & recreation
  - Nursery species use
  - Assisted migration
- Hurricanes & severe storms
- Survival during transport



Climate change may alter climatic constraints on invasive plants…

- Habitats become more/less suitable for invasive plants
  - Alter establishment success
- Native plant communities become more/less resistant to invasion (competition)
  - Alter establishment success
- Established non-native species become invasive
  - Reproduction increases
  - More competitive
  - Higher rate of spread

Science News

Climate Change May Wake Up 'Sleeper' Weeds

ScienceDaily (Apr. 16, 2009) — Weeds cost Australia more than A$4 billion a year either in control or lost production and cause serious damage to the environment.

Climate change may alter the geographic distribution of current invasive plants

- Spread into new areas
  - Improved environment in new area
  - Increased reproduction and dispersal
  - Increased landscape permeability
  - Reduced biotic resistance due to stress or disturbance in new area
- Extirpation of existing populations
- Potential regulators on migration
  - Biological dependency (need another species to move with it)
  - Population adaptation rates

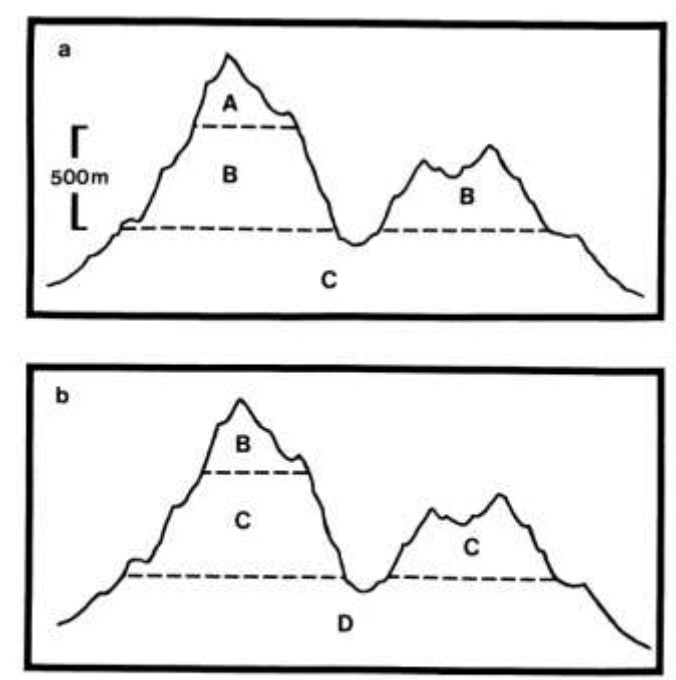
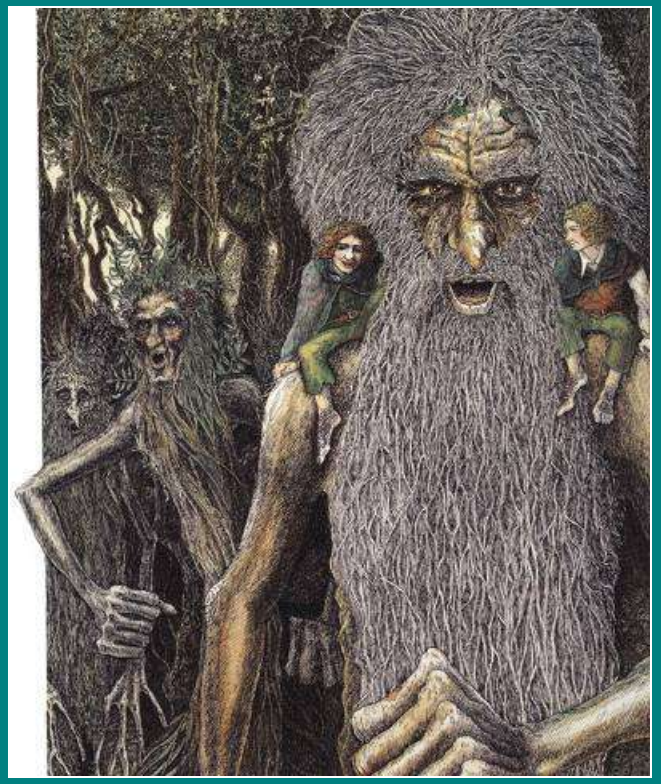


Figure 3. a. Present altitudinal distribution of three species, A, B, and C. b. Species distribution after a 500-m shift in altitude in response to a 3° C rise in temperature (based on Hopkin's bioclimatic law; MacArthur 1972). Species A becomes locally extinct. Species B shifts upward, and the total area it occupies decreases. Species C becomes fragmented and restricted to a smaller area, while species D successfully colonizes the lowest altitude habitats.

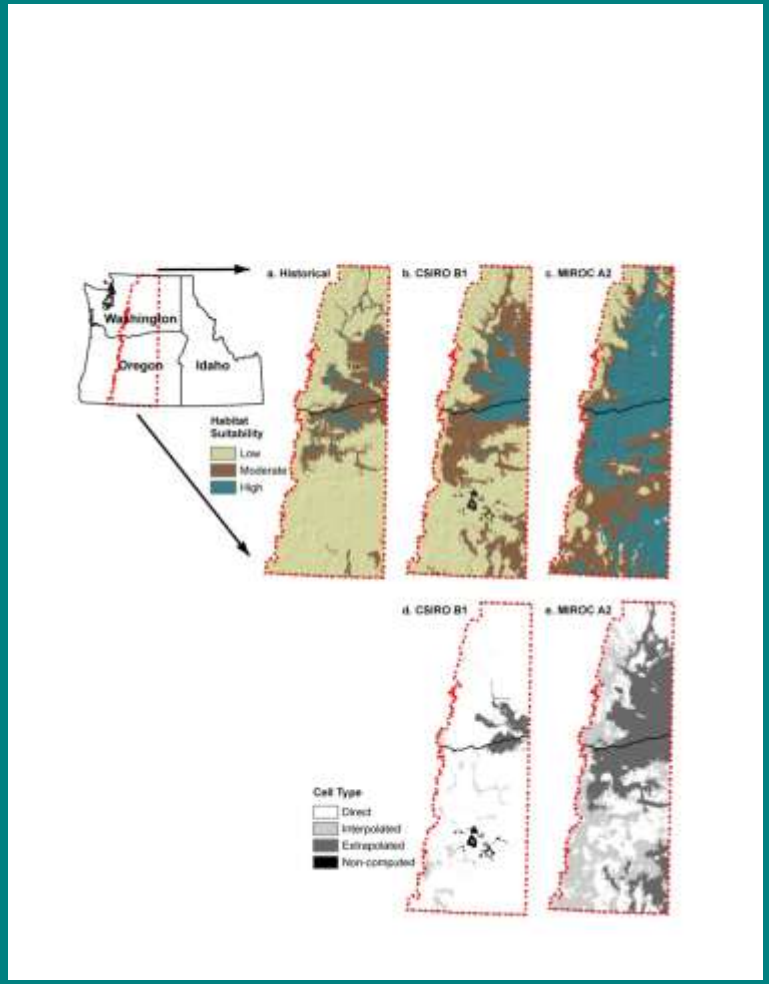
Climate change may alter the geographic distribution of current invasive plants

- Higher temperatures promotes migration toward poles and higher elevations
  - Some evidence this is occurring
  - Little evidence for invasive plants
- Precipitation and soil moisture changes also important
  - Limit plant responses to higher temperatures
  - Plant species may track soil mosture availability, even downhill
  - Higher water availability or water pulses may promote establishment and persistence of invasive plants



Bioclimatic envelope models project potential changes in species distributions

- Tamarisk (*Tamarix* spp.)
  - Invasive shrubs and small trees
  - Currently limited to warm, dry environments of interior PNW
  - Expected to expand its range in the PNW even without climate change
- Models suggest climate change may accelerate expansion and create new habitat
- Model projections are based on statistical relationship and should be viewed as possible outcomes

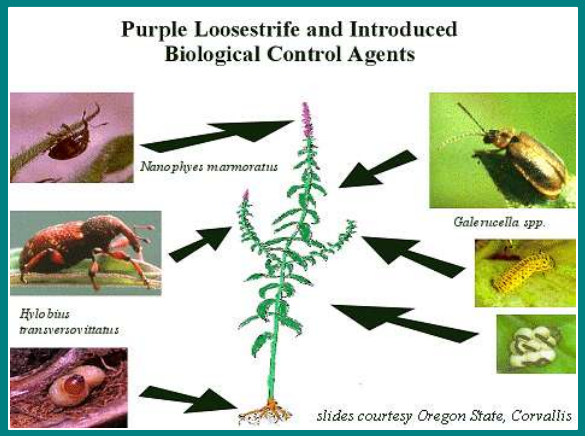


Climate change may alter the impact of existing invasive plant species

- Local abundance
- Competition – resource capture and utilization
  - Soil water
- Interactions with disturbance processes
  - Fire
- Impacts on ecosystem services
  - Water, habitat quality

Climate change may alter effectiveness of current management strategies

- Mechanical control
- Chemical control
- Biological control
  - More/less adapted to new climate
- Policy control



Lots of questions remain, and the answers likely vary among species…

- Altered mechanisms of transport & introduction
  - Do we know which species are being transported but not becoming established under current climate?
- Altered climatic constraints on invasives
  - Do we understand the climatic constraints on current invasive species (establishment, growth, reproduction, competition)?
- Altered distribution of existing invasive species
  - Are current invasive plants more constrained by climate, biotic resistance, landscape permeability, or migration rates?
- Altered impact of existing invasive species
  - What controls invasive species abundance within its range?
- Altered effectiveness of management
  - How well will current treatments work in new climate?

Questions?