

Succession dynamics from fire to finish



Jill Johnstone
University of Saskatchewan



Succession models

- Relay succession
 - Species replace each other over time
 - Driven by environmental niche
 - Alternate dominants establish at different times
- Direct regeneration
 - Everyone comes in at the same time
 - Some are weeded out
 - Sequence of dominance driven by life history

Succession in AK boreal forests



Long-term observations

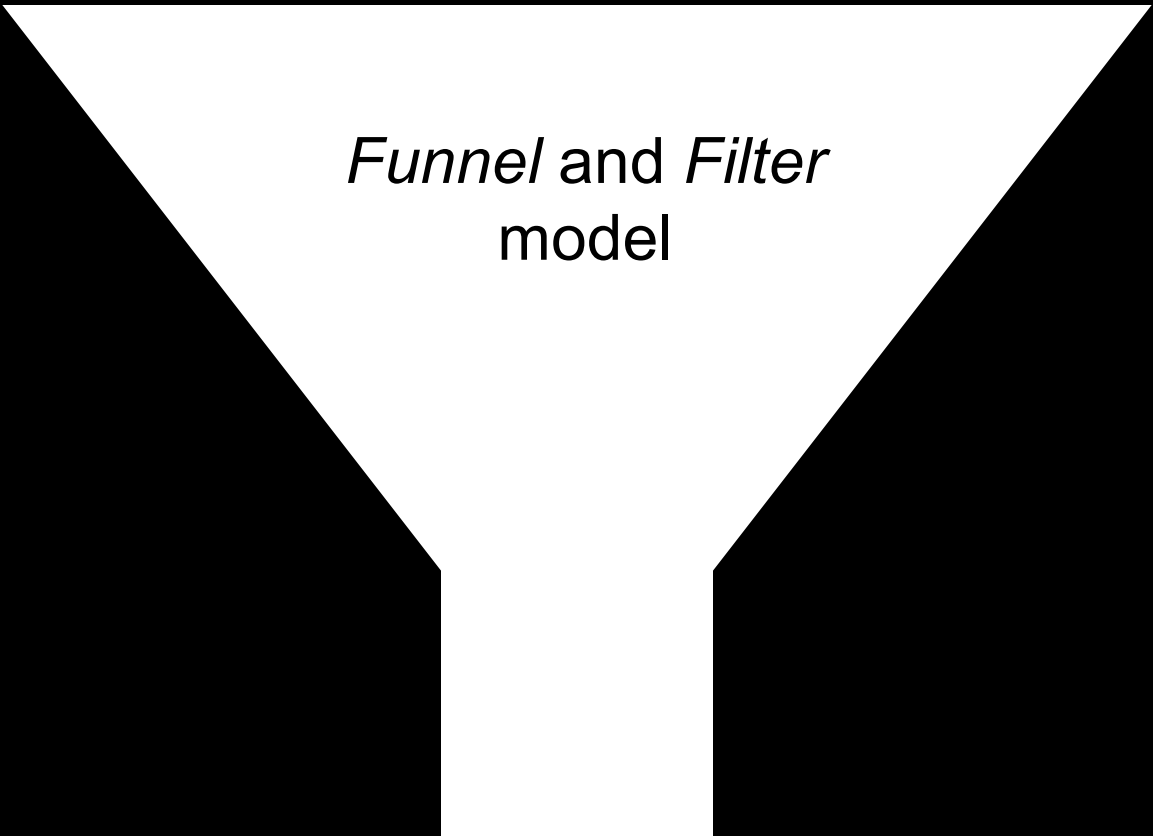
- Tree recruitment within first 10 years
- Patterns of dominance established during recruitment

- Stand reconstruction

- Canopy trees recruit during a short pulse
- Dominant pattern with frequent, stand-replacing fire

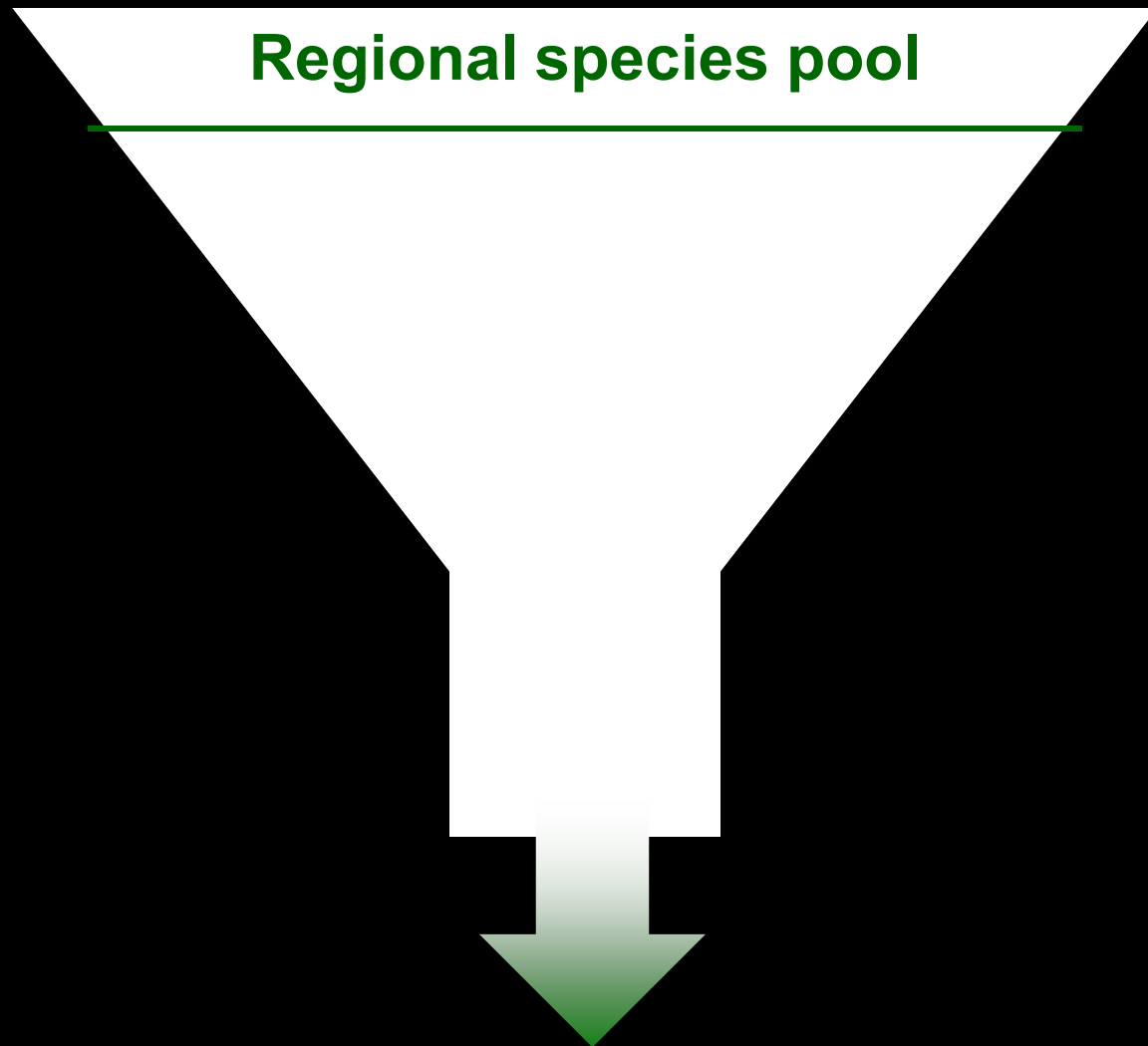


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Funnel and Filter
model

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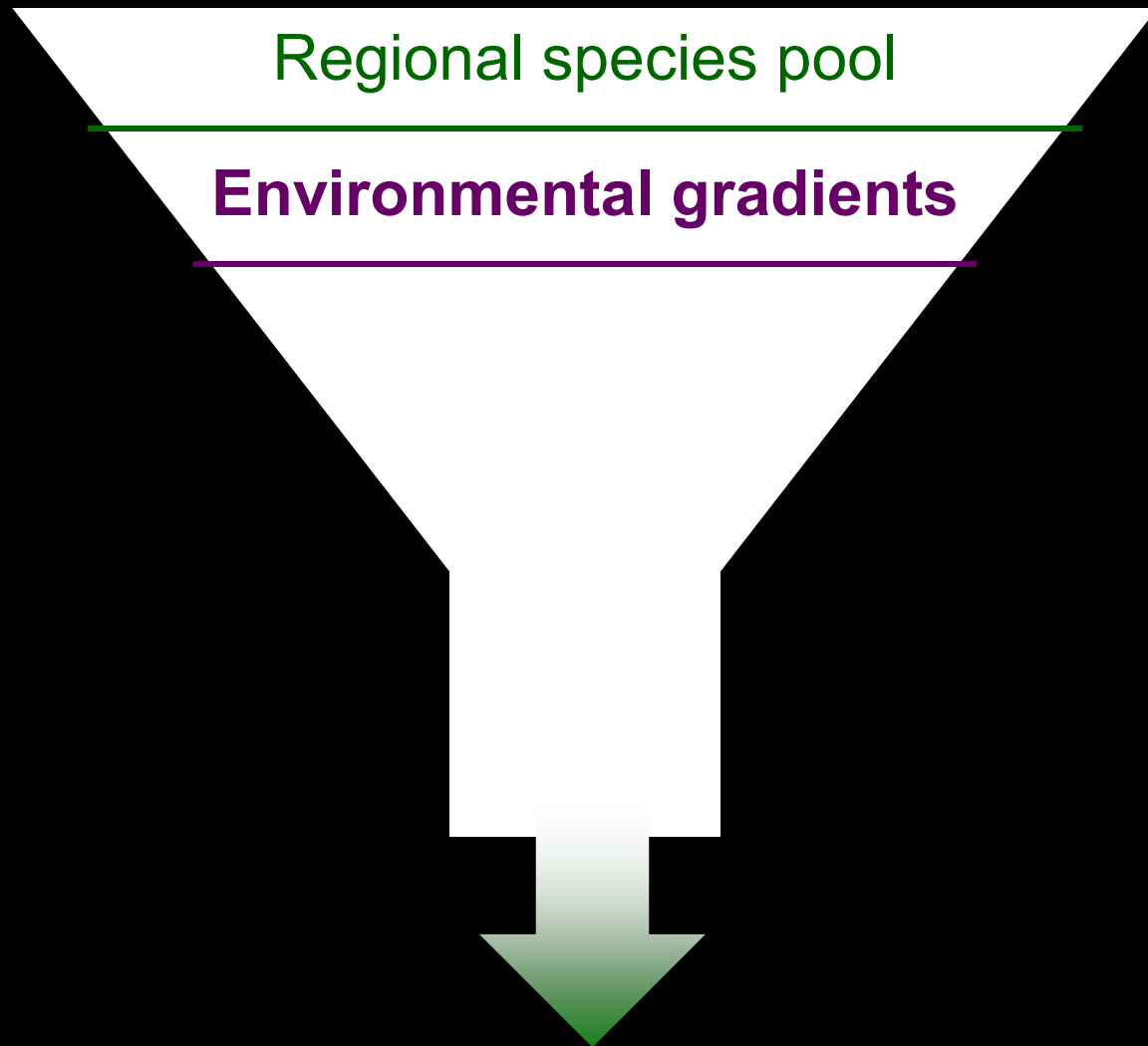


Regional species pool

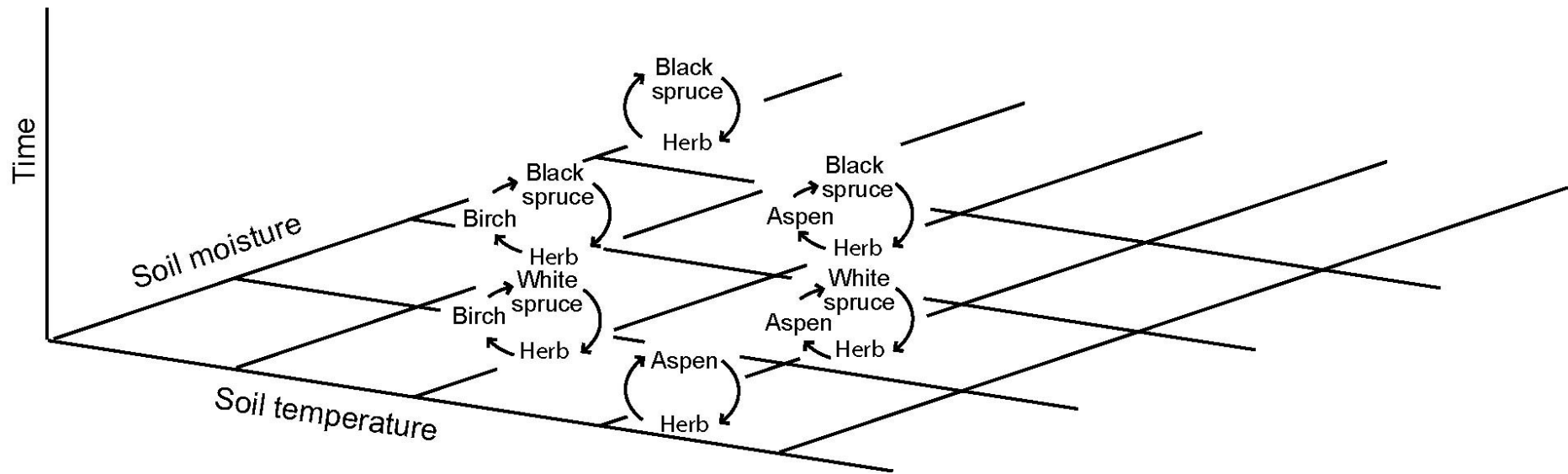


Biogeography constraints
Dispersal

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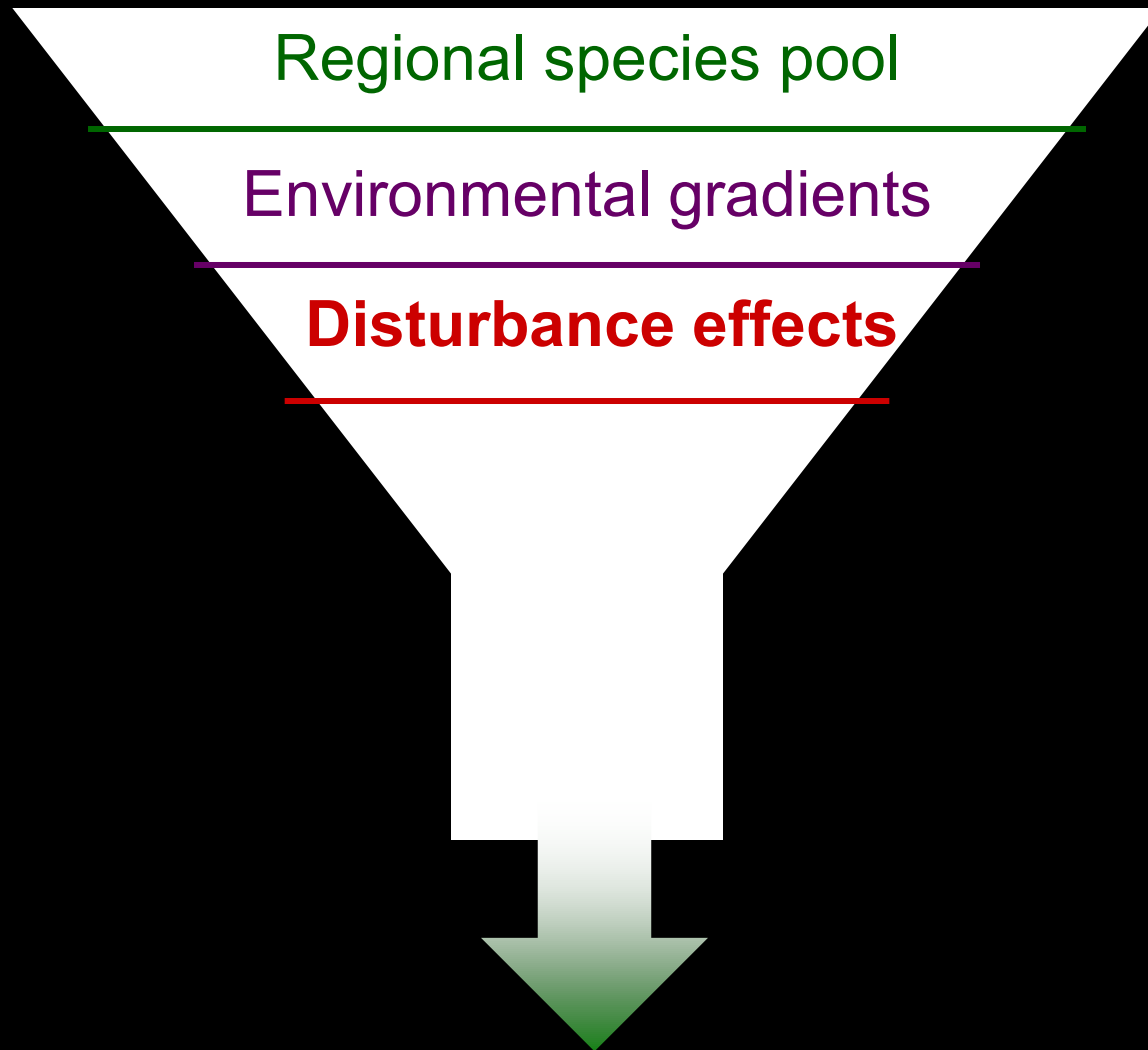


Environmental gradients



Species-specific tolerance
(environmental niche)

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Disturbance effects

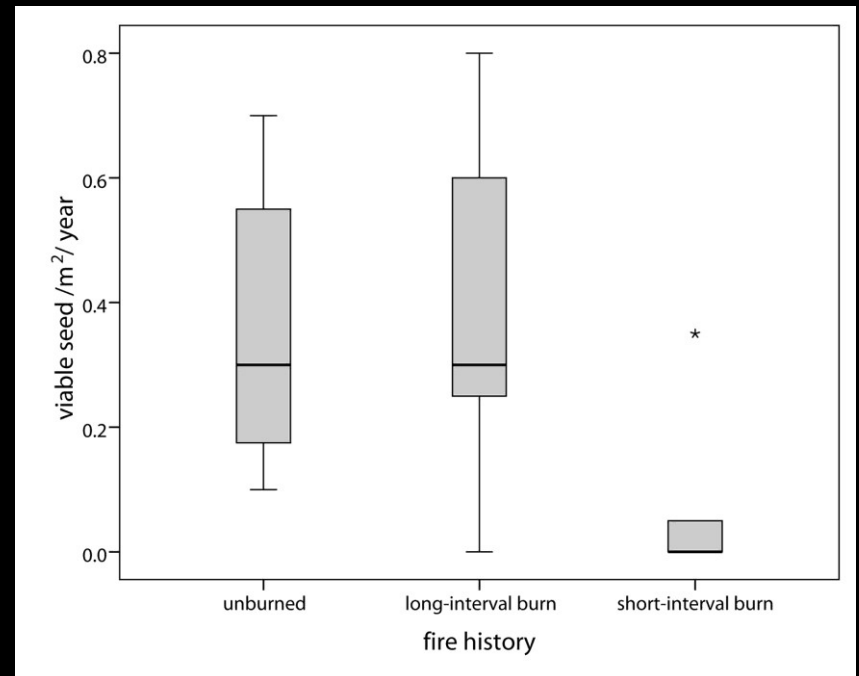
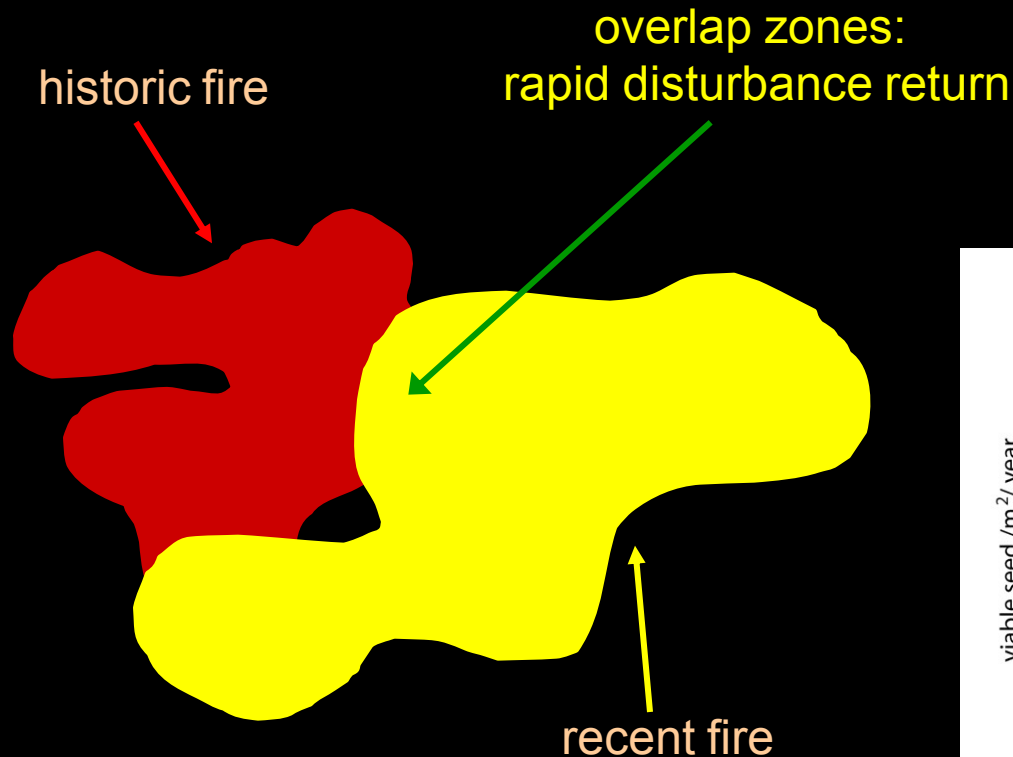


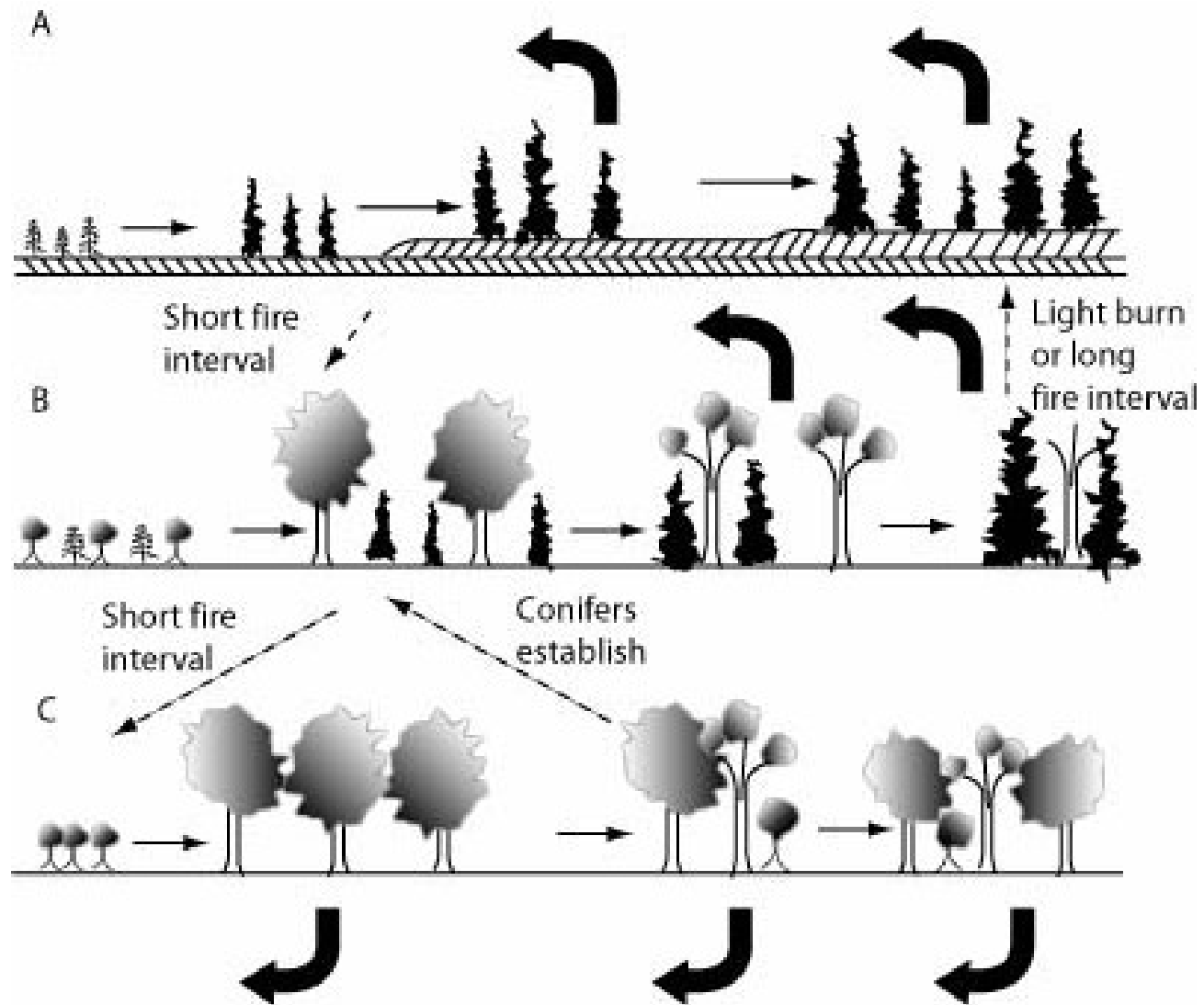
Disturbance severity, frequency, size

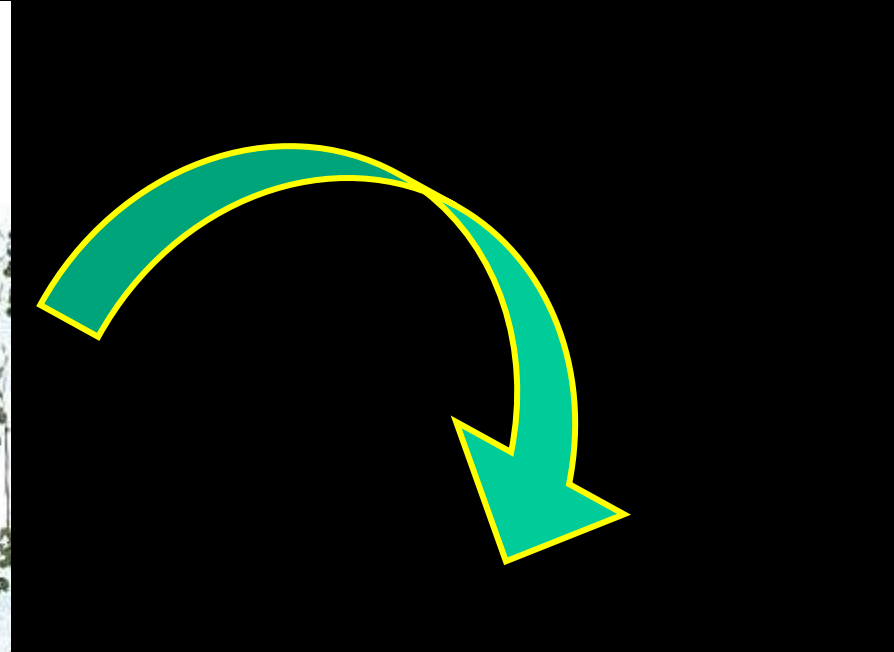
Deep burning fires can alter successional trajectories



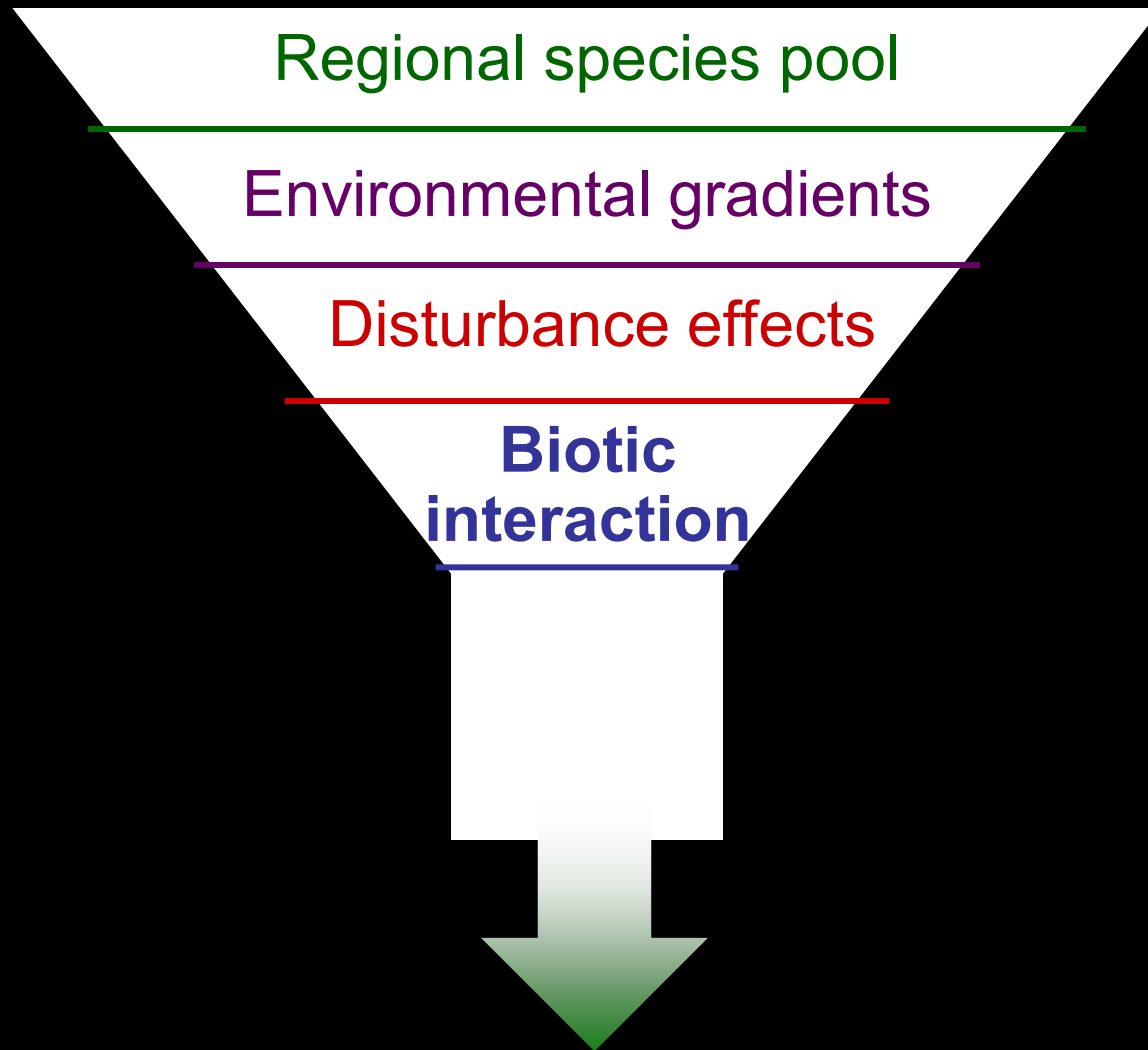
Repeat fires disrupt regeneration pathways







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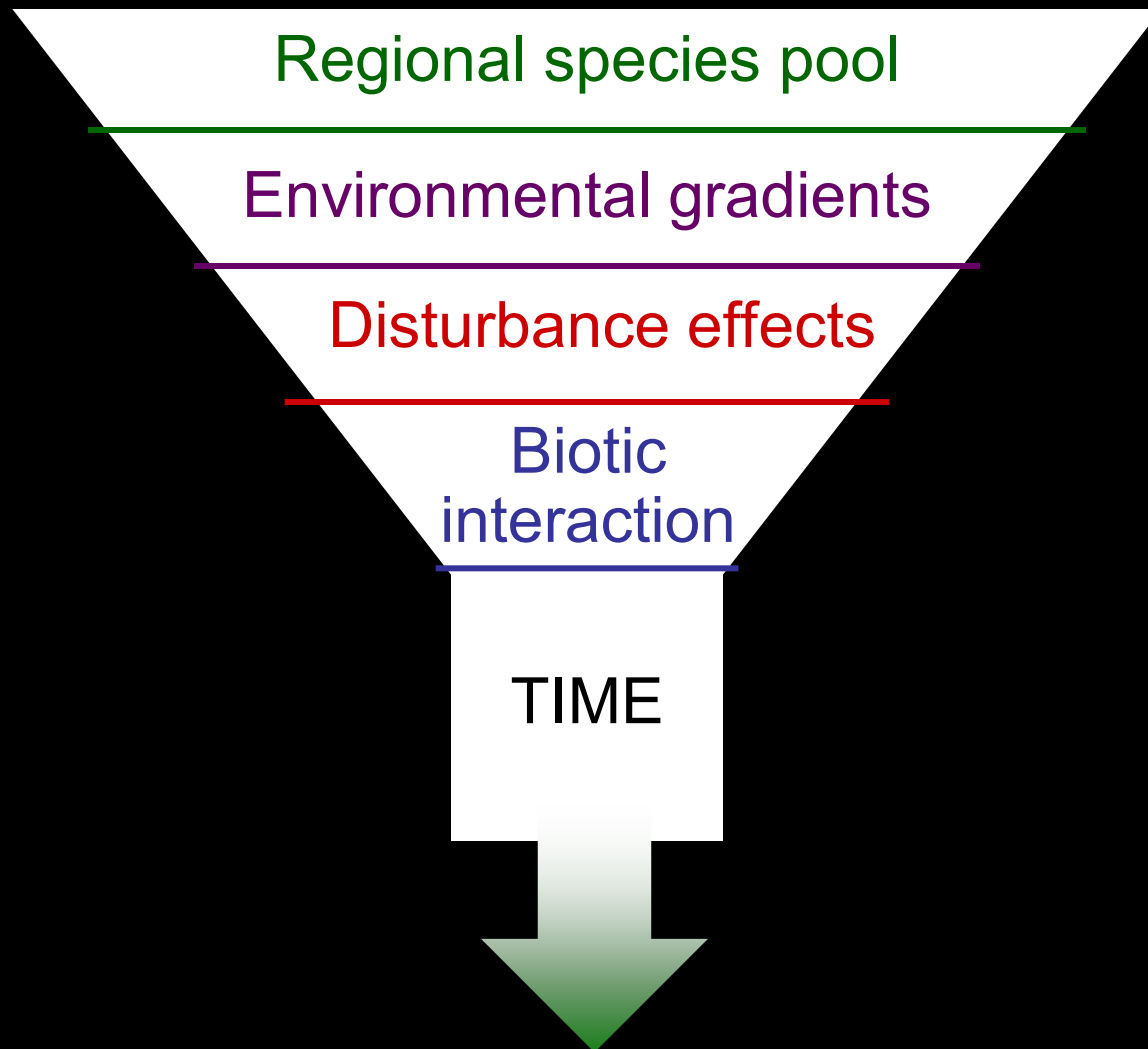


Biotic Interactions - *What about herbivory?*





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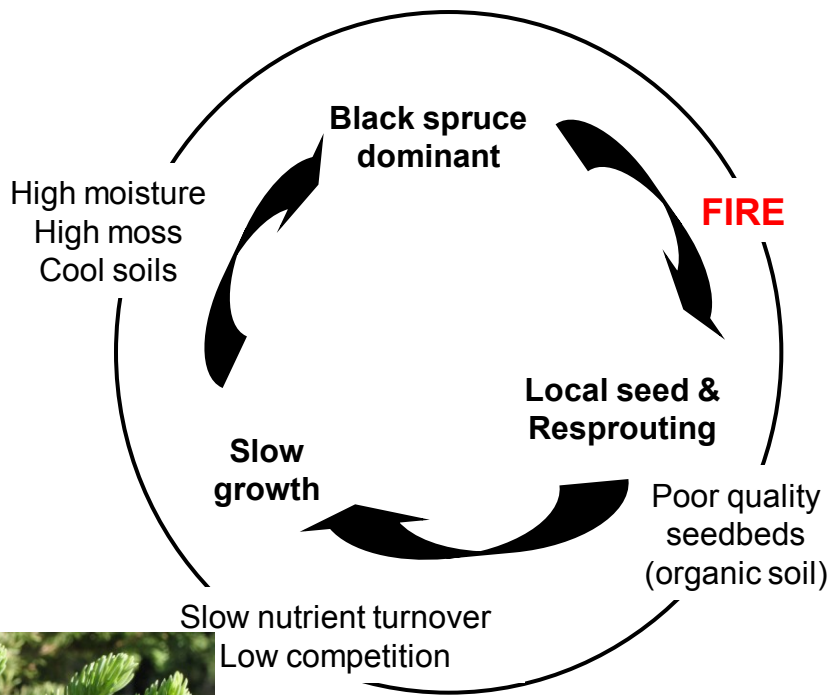
Predictability from species traits

- Traits shape succession outcome
- Can help make succession more predictable:
 - Life history traits (RGR, shade tolerance, life span, etc)
 - Species functional traits (litter quality, evapotranspiration, palatability)
- Deterministic aspects = happy modelers

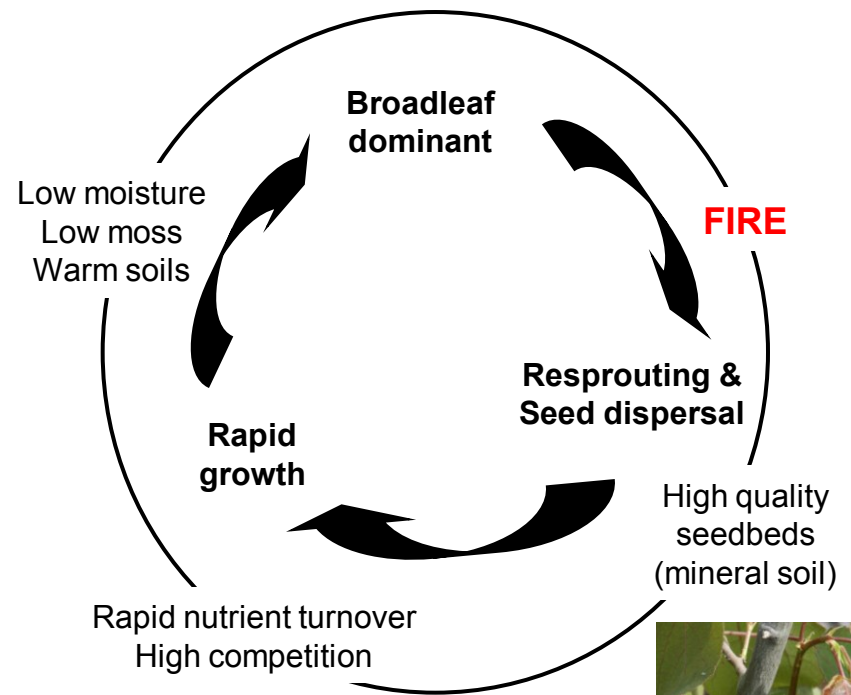


Alternate successional cycles

A. Black spruce domain

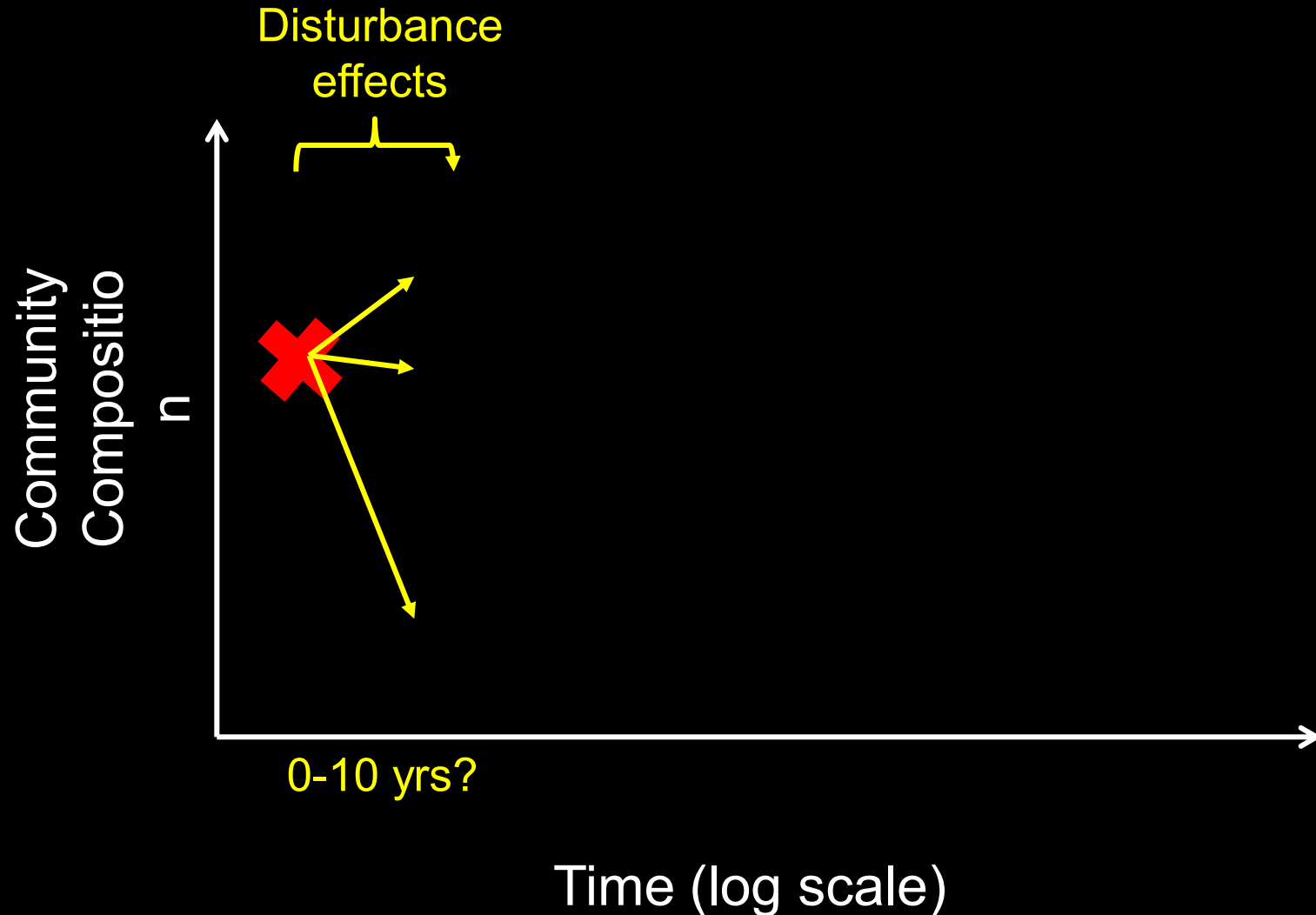


B. Broadleaf forest domain

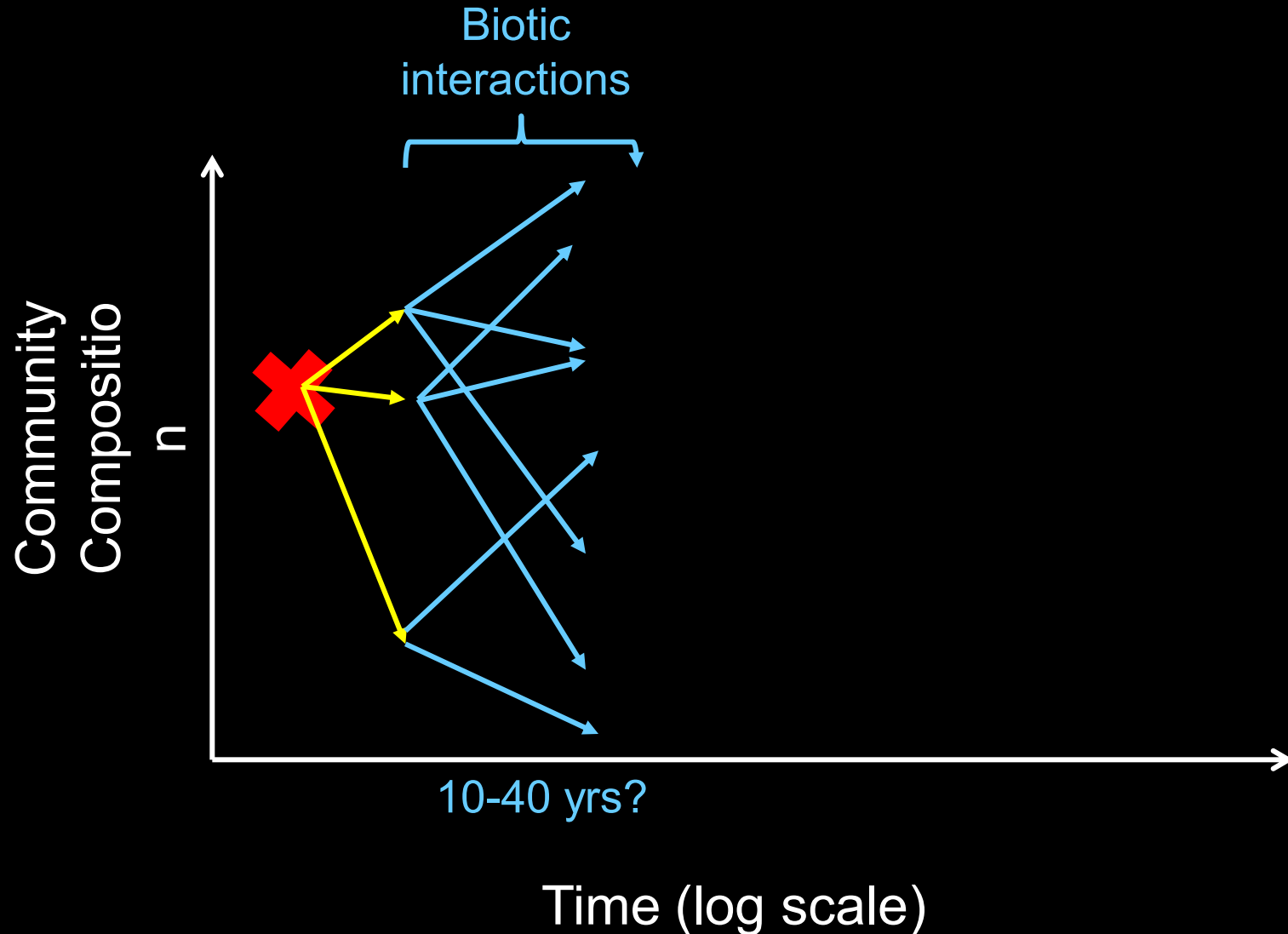


Johnstone et al. 2010, *Can. J. Forest Research*

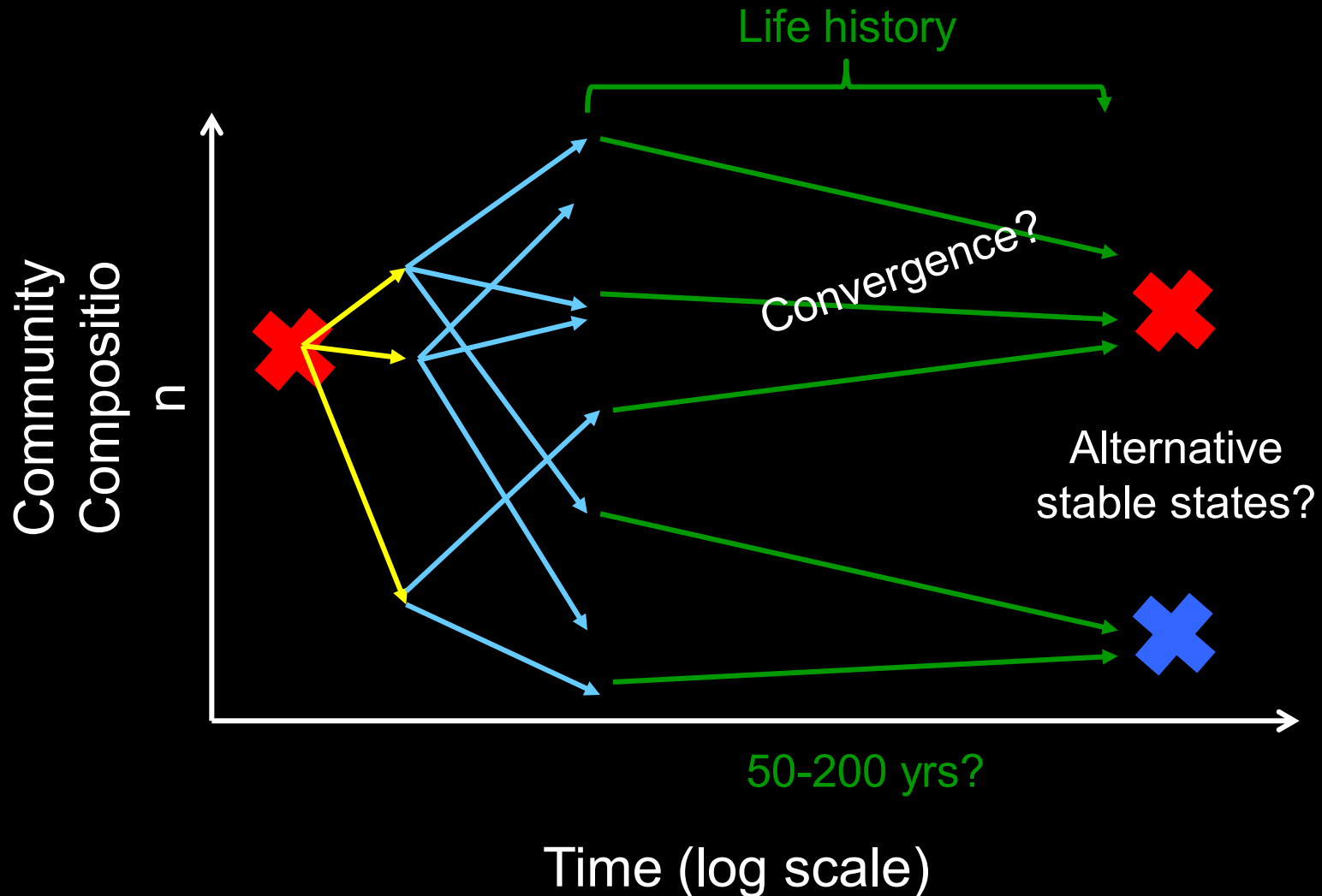
Successional pathways



Successional pathways



Successional pathways

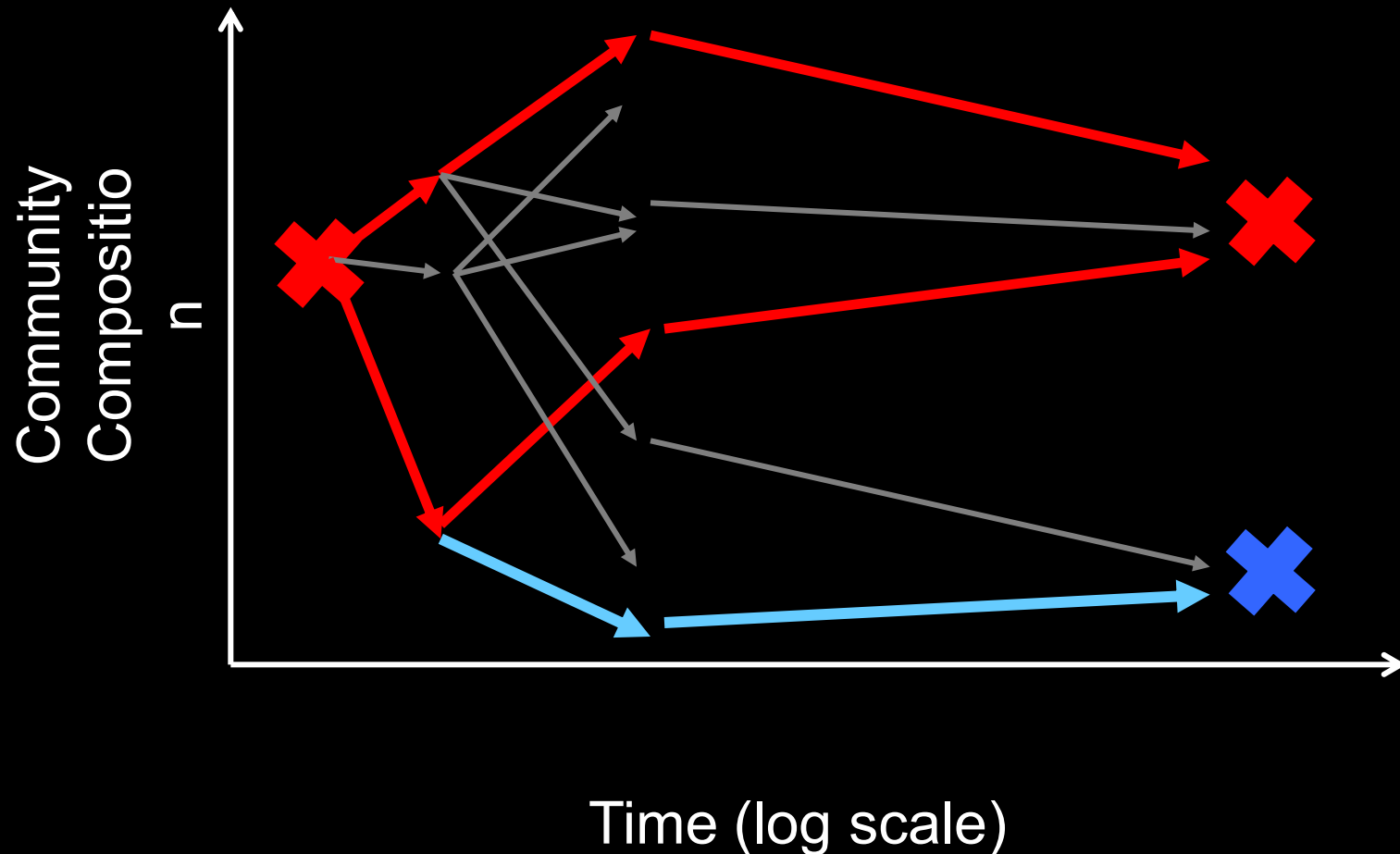


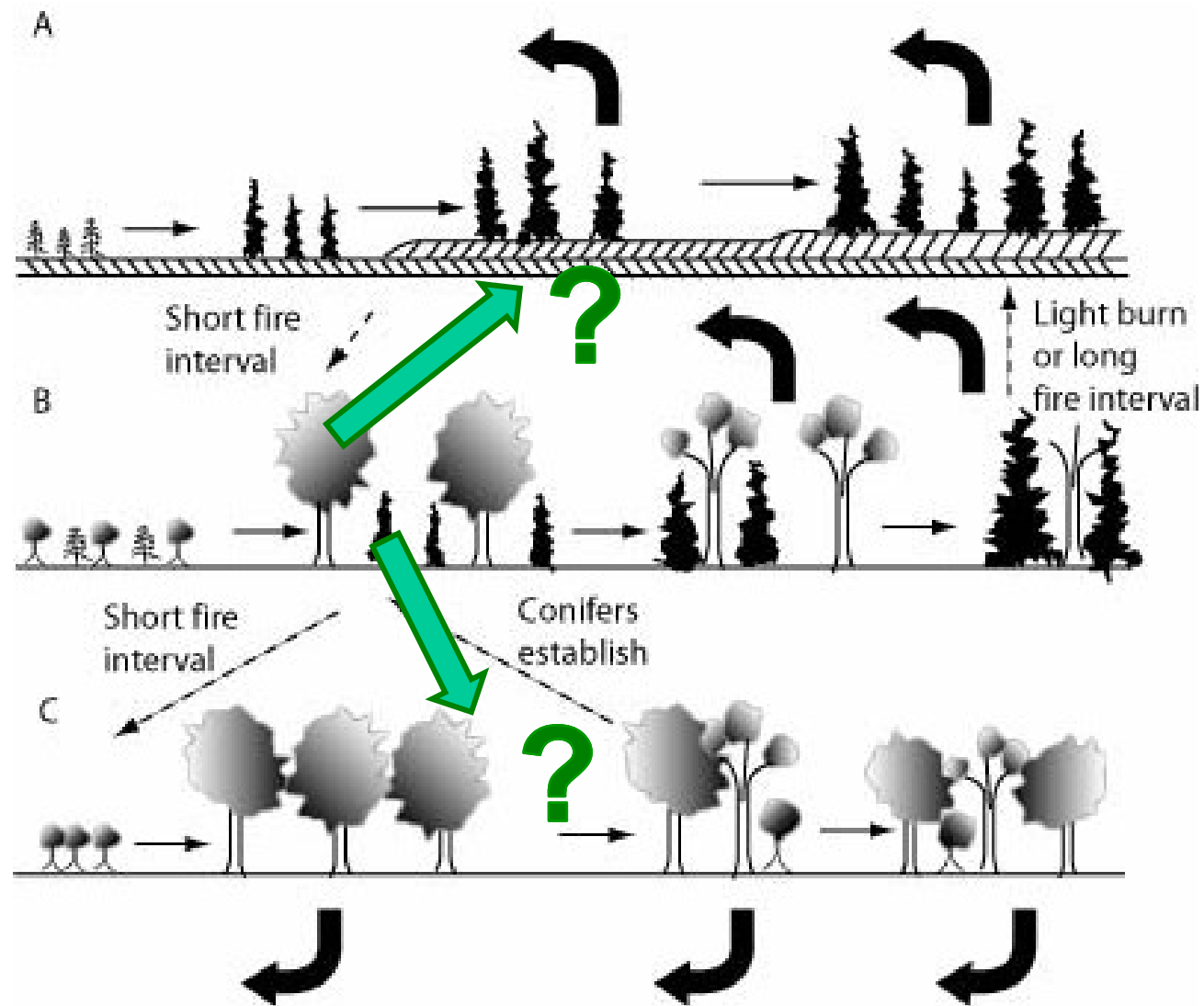
Successional convergence

- Difficult to assess with repeated disturbance (fire cycle <200 yrs)
 - Evidence from other conifer trajectories: convergence over 1-2 centuries
 - Boreal mixedwoods:
 - Convergence to conifers driven by insects
 - Outbreaks facilitate reduction of deciduous canopy
- Is it important to know if they are rarely reached?

Successional pathways

Stochastic pathways to
semi-deterministic endpoints?





Conclusions

- Succession as a probabilistic process
 - Both stochastic & deterministic components
 - Complex path dependence
- Still, patterns exist:
 - Sorting of cover types across environmental gradients
 - General sequence of succession dominance
- But:
 - Predicting future change challenges our assumptions

Alternate successional trajectories

- A useful fiction?
- What if each trajectory is unique?
 - Does uniqueness depend on the question?
 - Key factors of particular importance?
- Predicting successional pathways
 - Where flexible and where “fixed”?
 - Identify thresholds & bifurcation points?
 - Positive and negative feedbacks?

