

Evaluating the risks and benefits of assisted migration in a stochastic metacommunity

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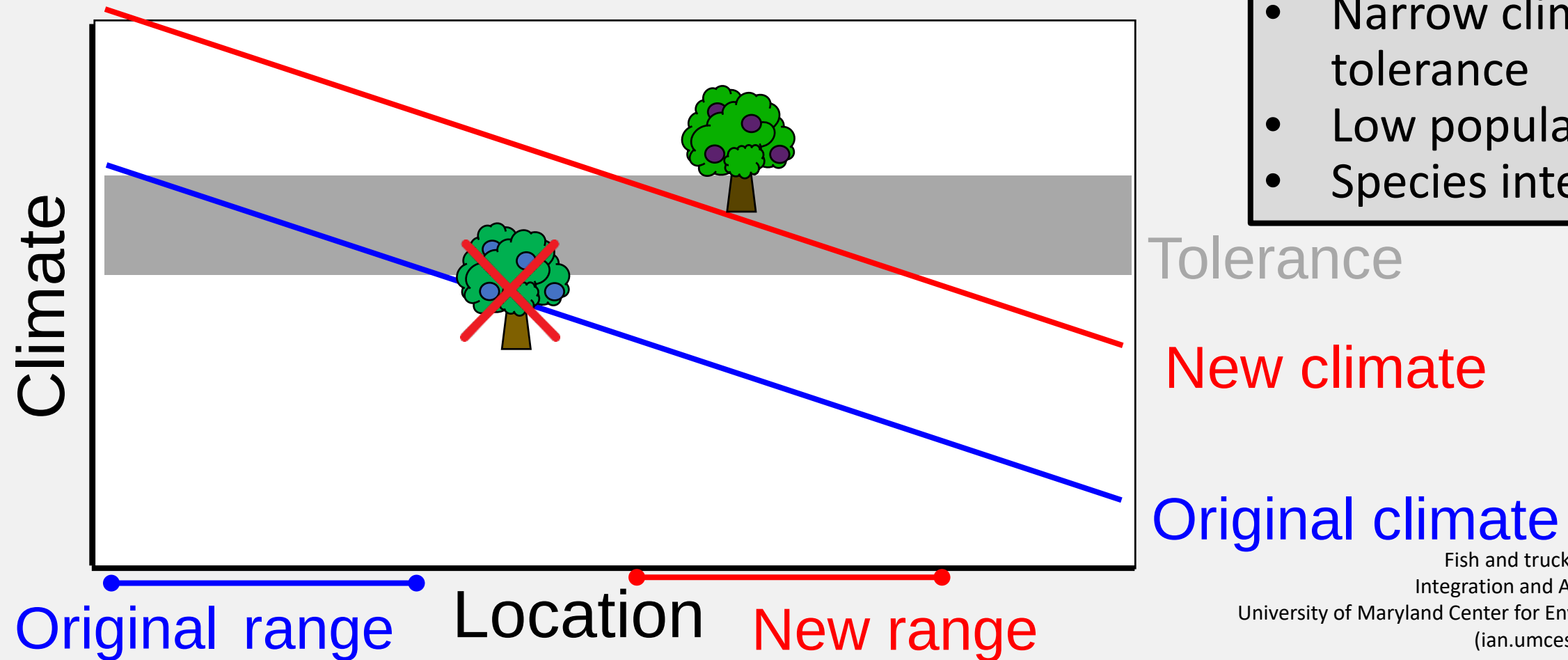
United States National Science Foundation
Grant DEB #1655475

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Some species can't keep up with climate change

Can assisted migration help these species?

- Short dispersal
- Narrow climate tolerance
- Low population size
- Species interactions

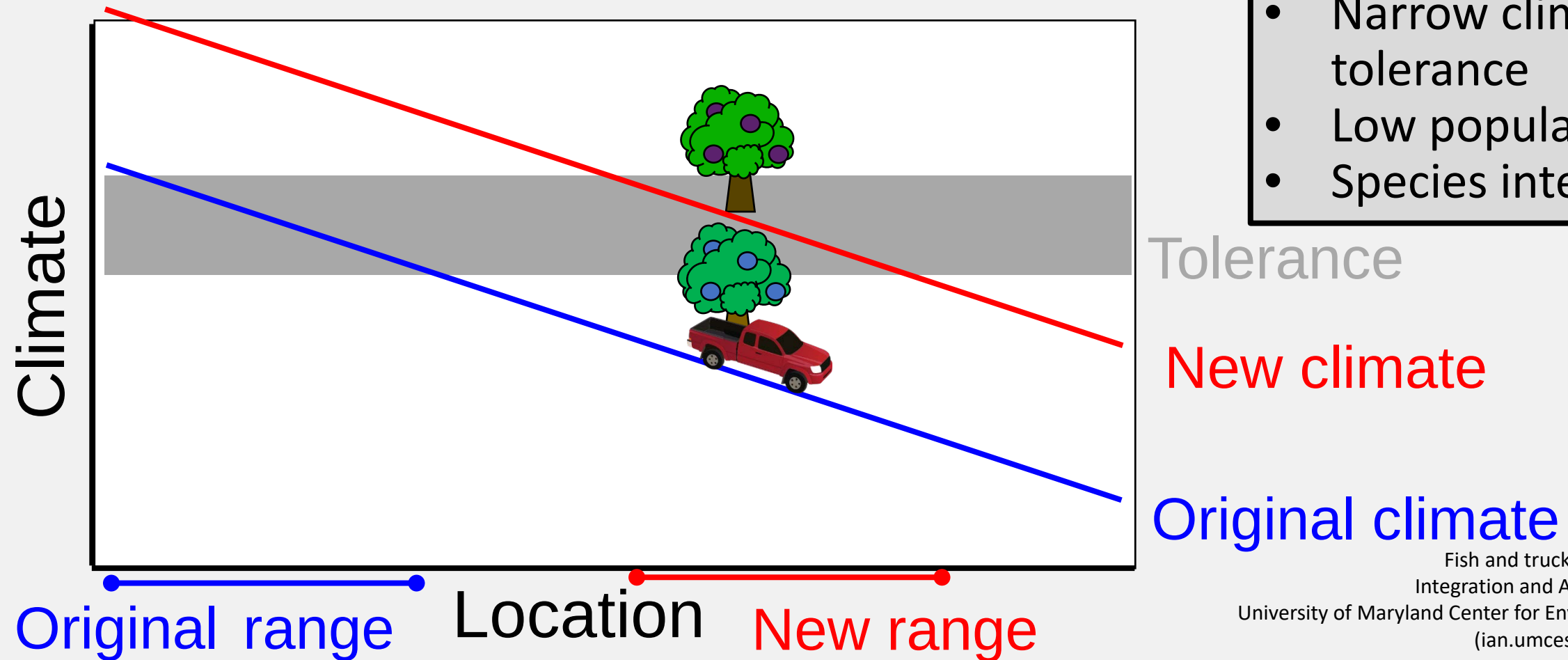


Fish and truck from: Tracey Saxby,
Integration and Application Network,
University of Maryland Center for Environmental Science
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Some species can't keep up with climate change

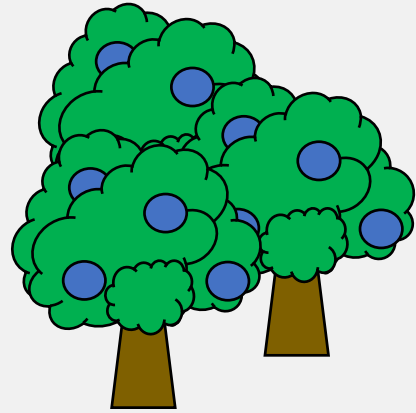
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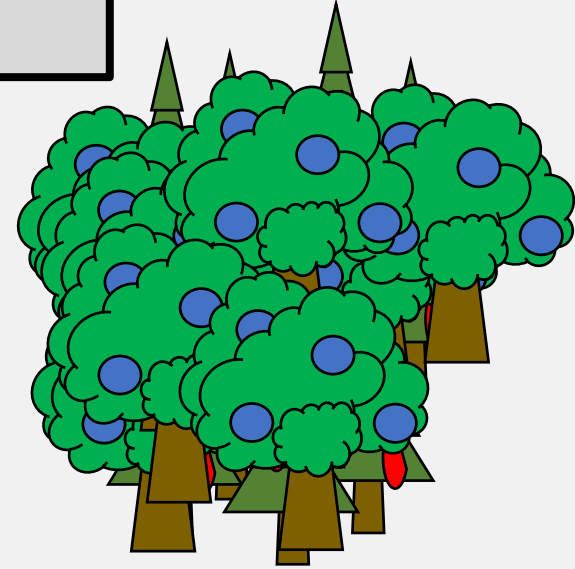
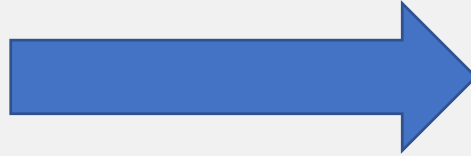


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Placing a species in a completely novel environment could cause an invasion



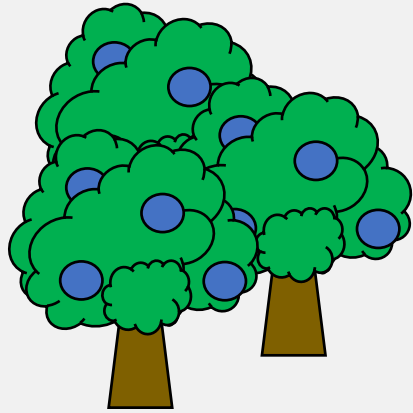
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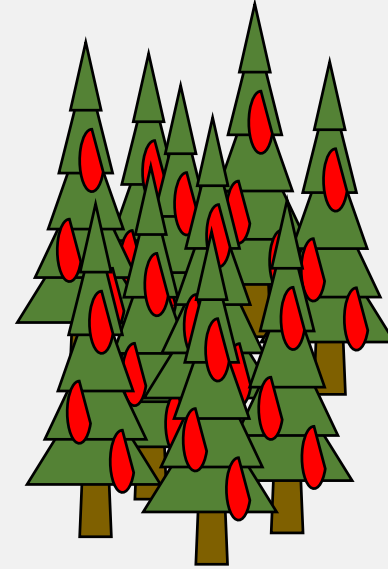
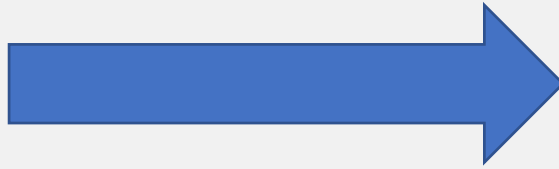
Recipient

Community ecology to evaluate the outcome of assisted migration

Translocated populations
often fail to establish



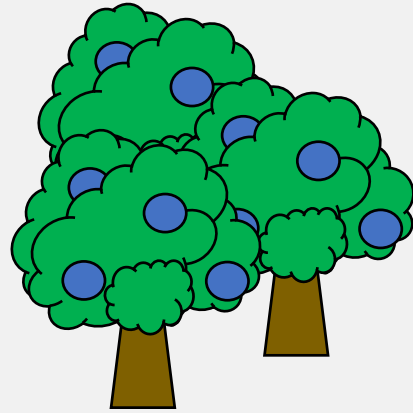
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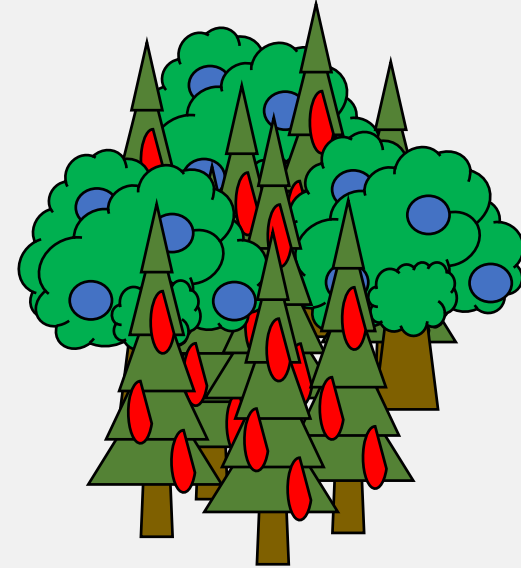
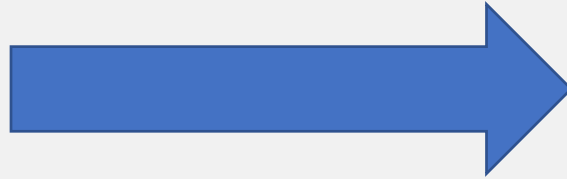
Recipient

**Community ecology to evaluate the outcome of
assisted migration**

Coexistence between relocated species and recipient ecosystem



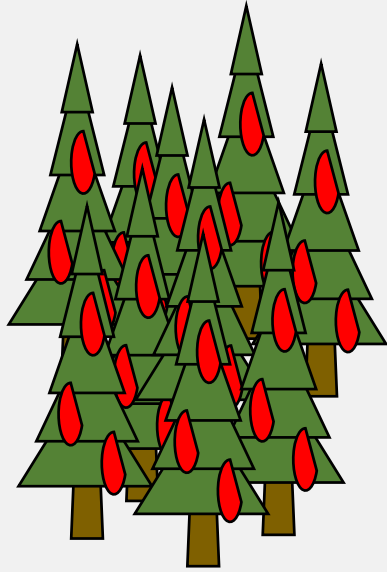
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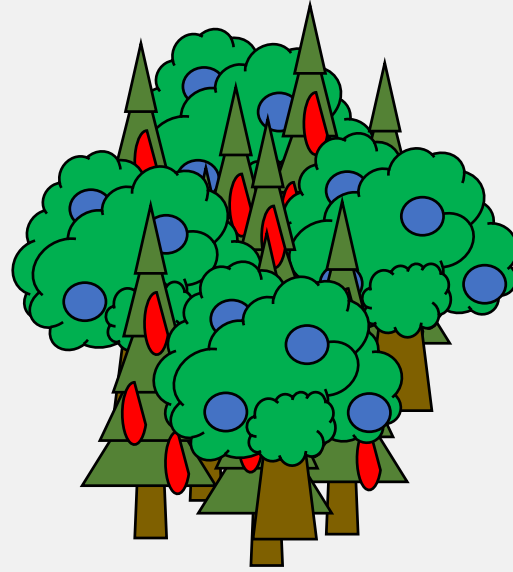
Recipient

Community ecology to evaluate the outcome of assisted migration

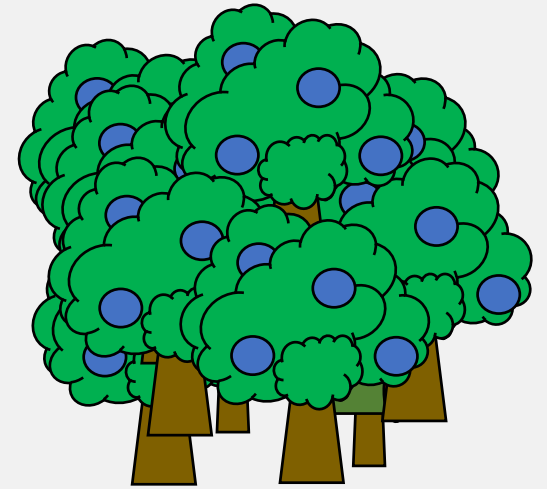
How do we get coexistence
with high uncertainty?



Relocated species
fails to establish



Coexistence



Relocated species
becomes invasive

**Community ecology to evaluate the outcome of
assisted migration**

How to approach assisted migration considering uncertainty and community interactions?

1. Which species?

- Short dispersal
- Narrow climate tolerance
- Low population size
- Species interactions

2. How much of the population do we move?

3. How many times?

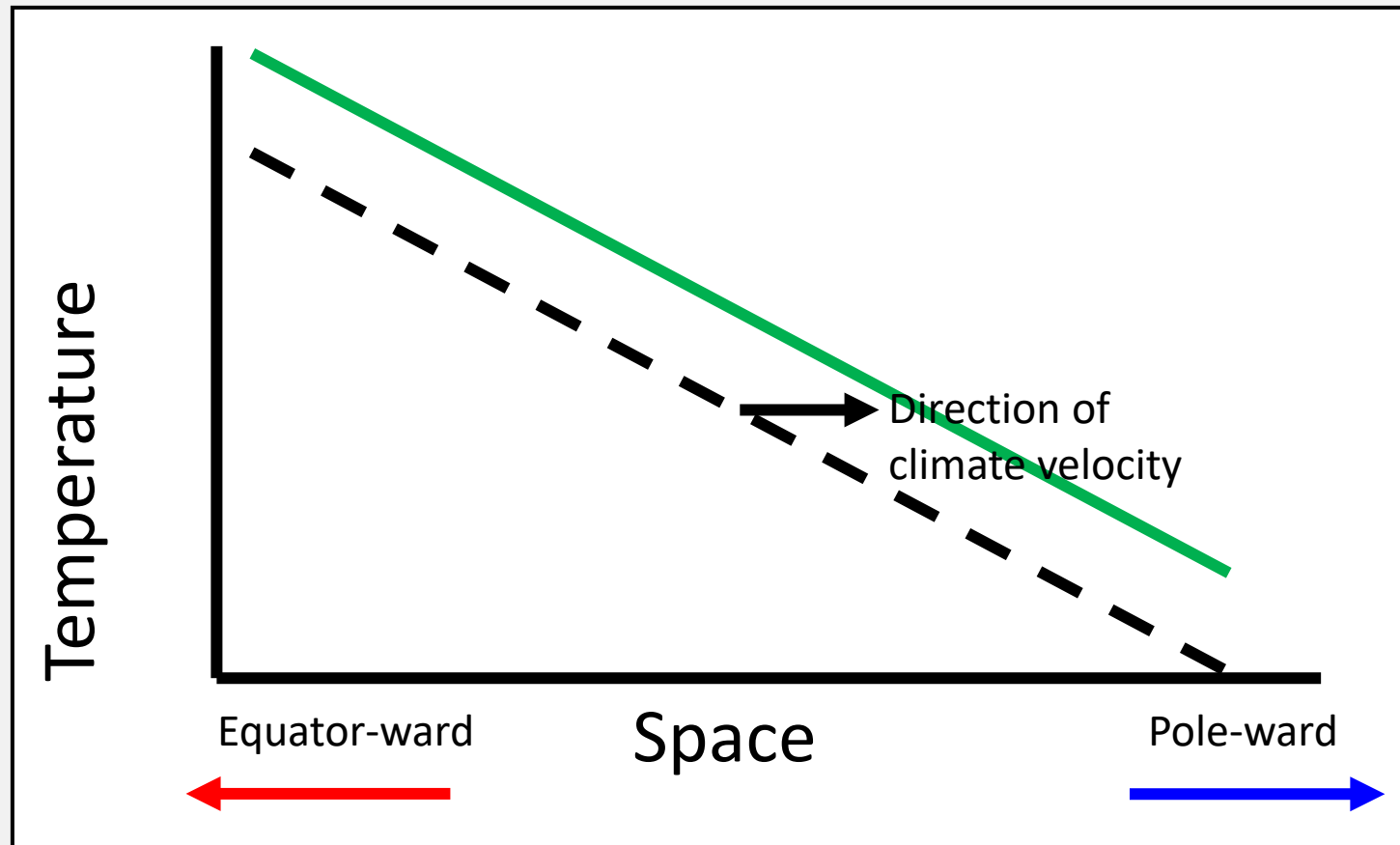
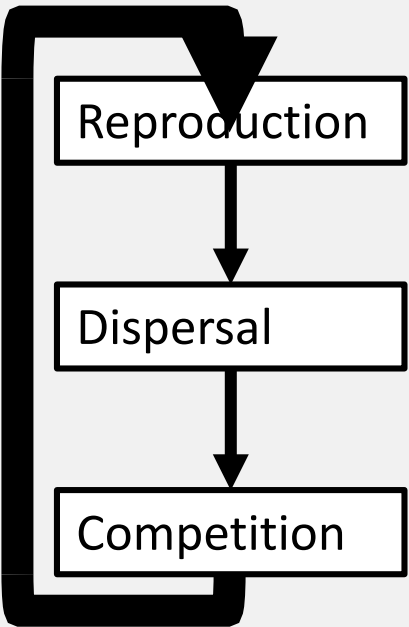
4. What makes a successful relocation?

Model structure

1-D linear, discrete space temperature gradient

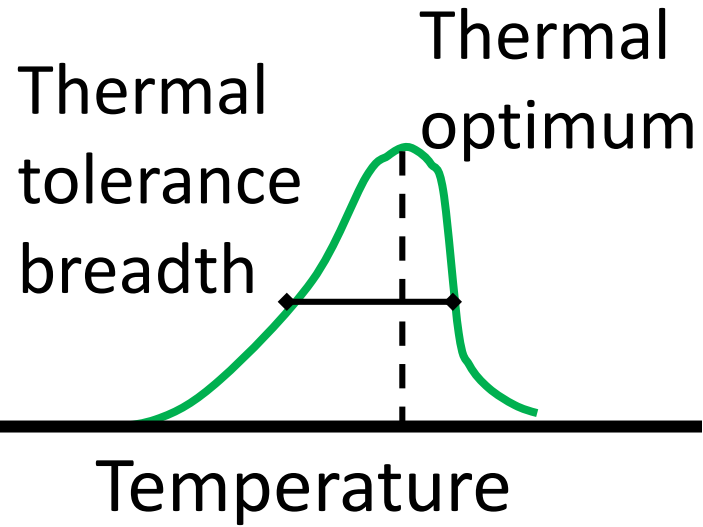
Temperature increases stochastically

Temperature
change



Reproduction

Mean reproduction



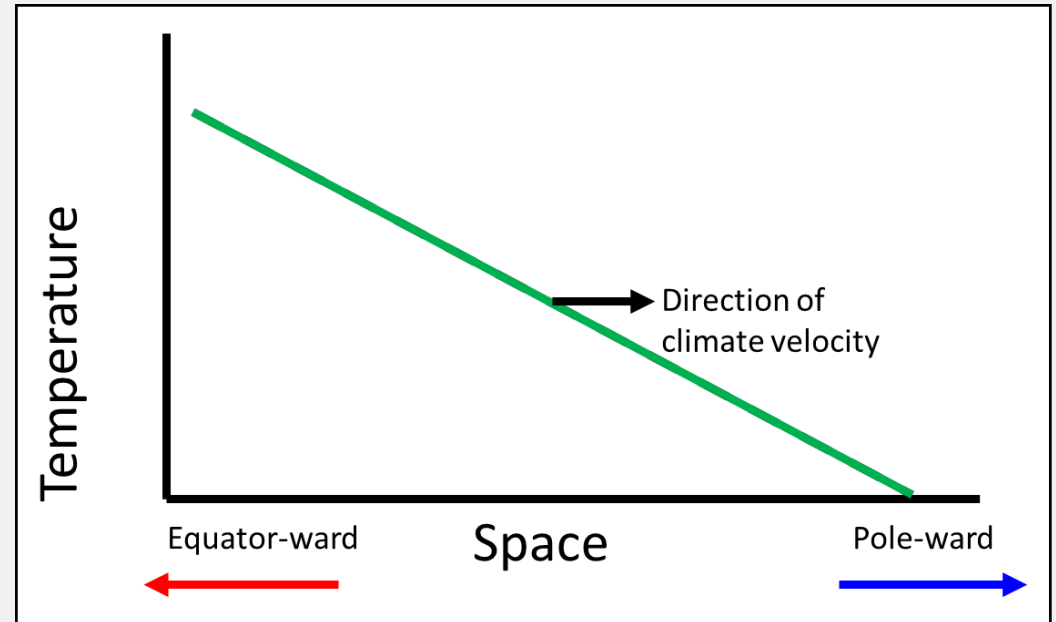
Temperature change

Reproduction

Dispersal

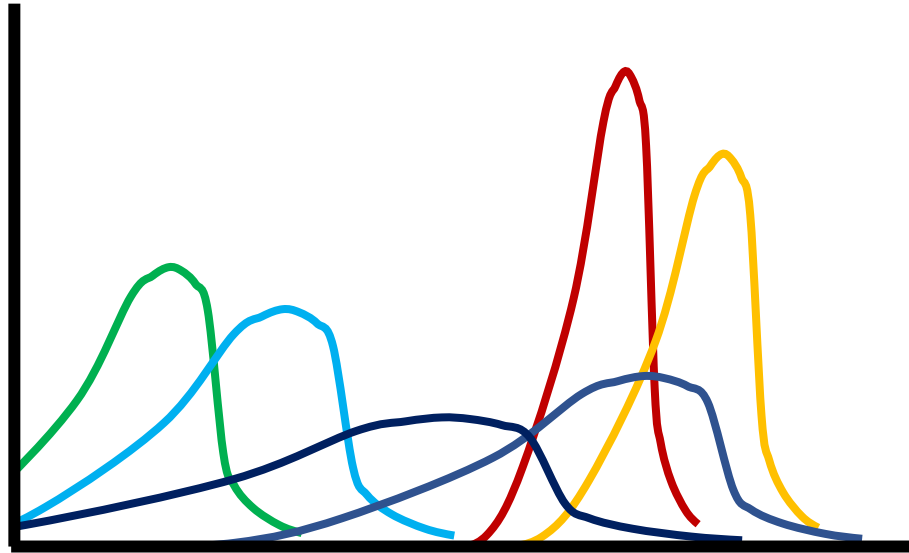
Competition

Model structure



Reproduction

Mean reproduction



Temperature

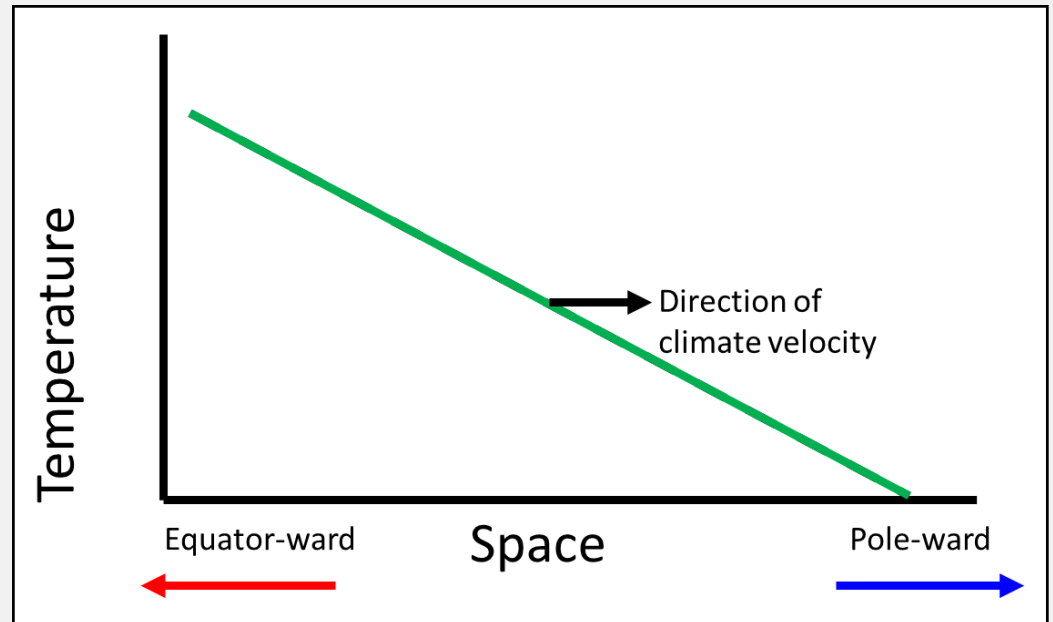
Temperature change

Reproduction

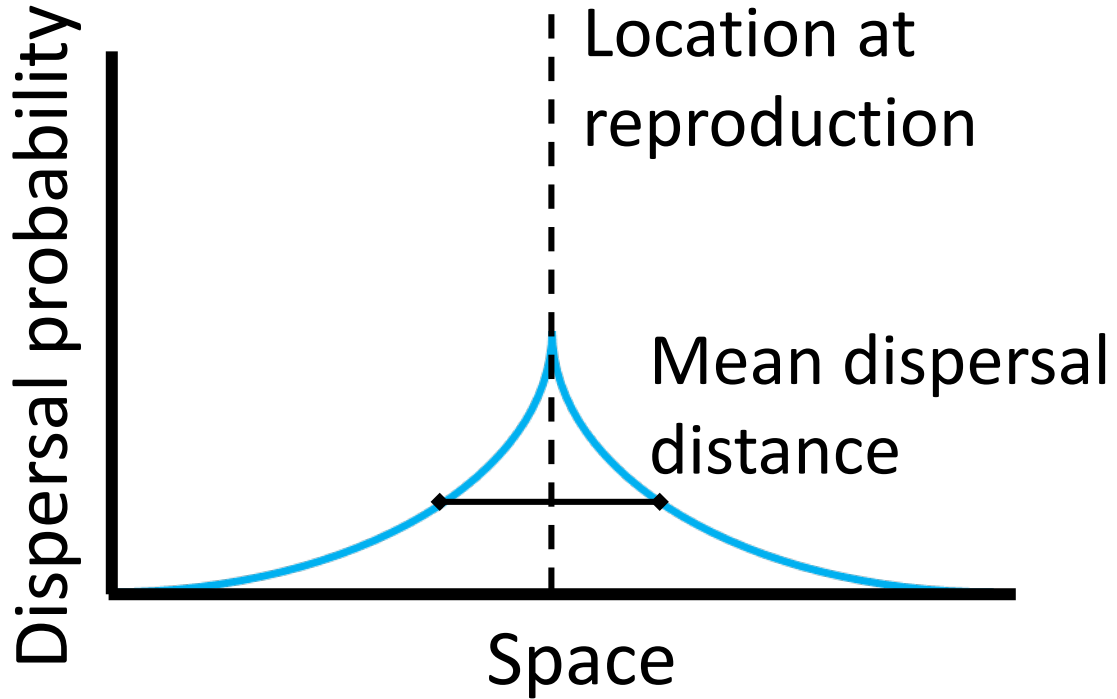
Dispersal

Competition

Model structure



Dispersal



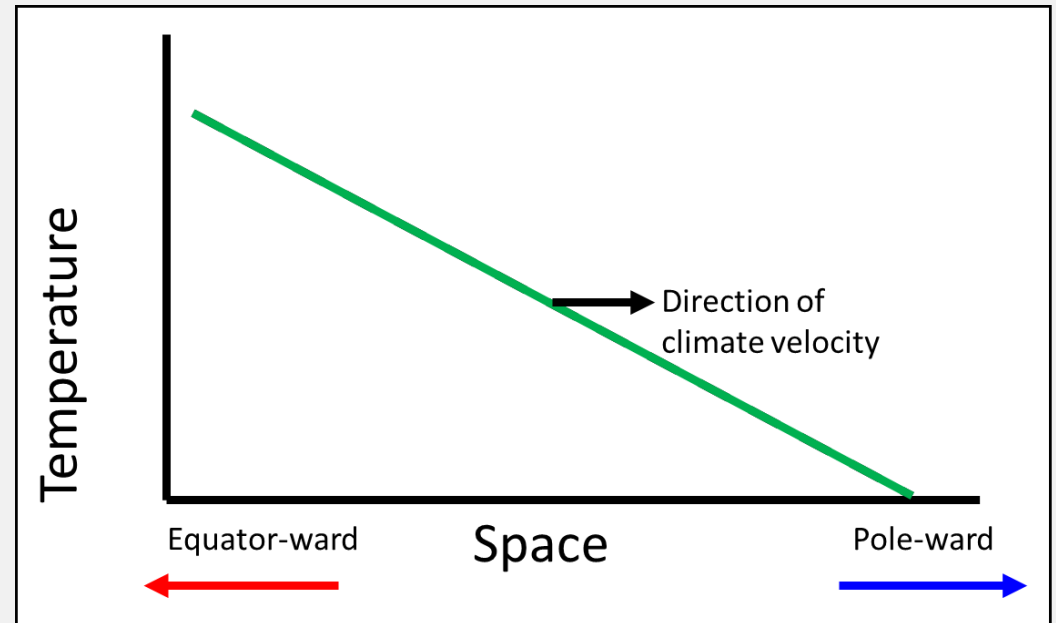
Temperature change

Reproduction

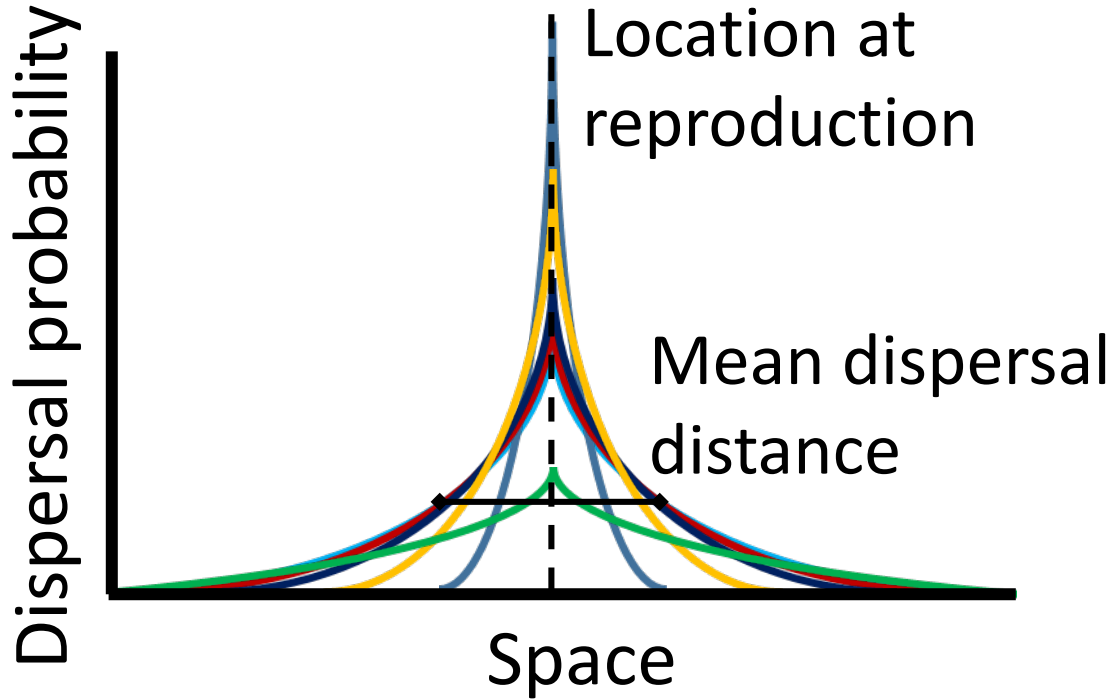
Dispersal

Competition

Model structure



Dispersal



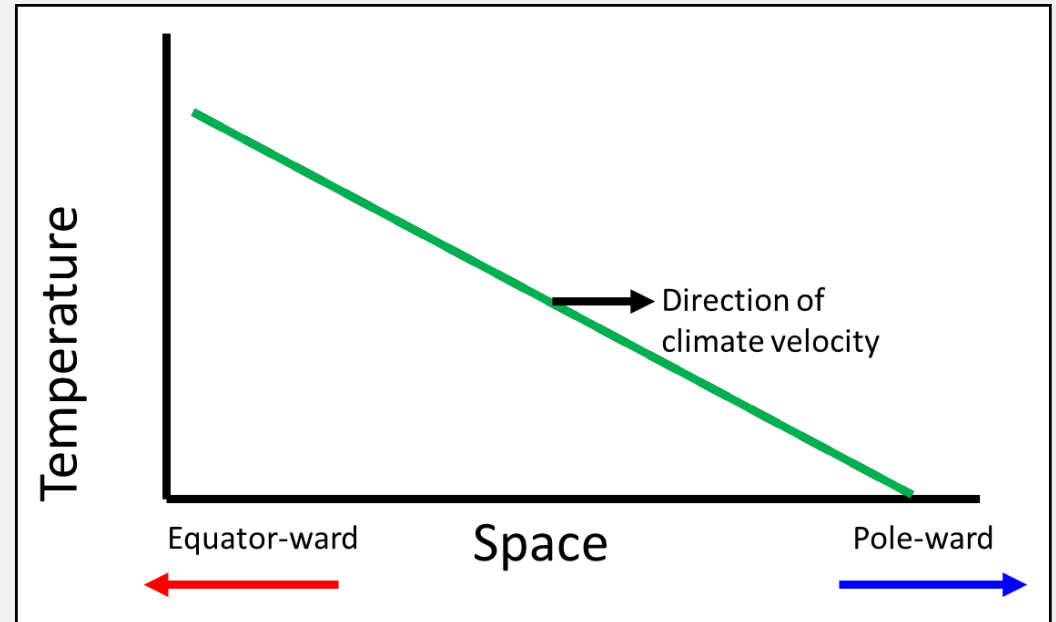
Temperature change

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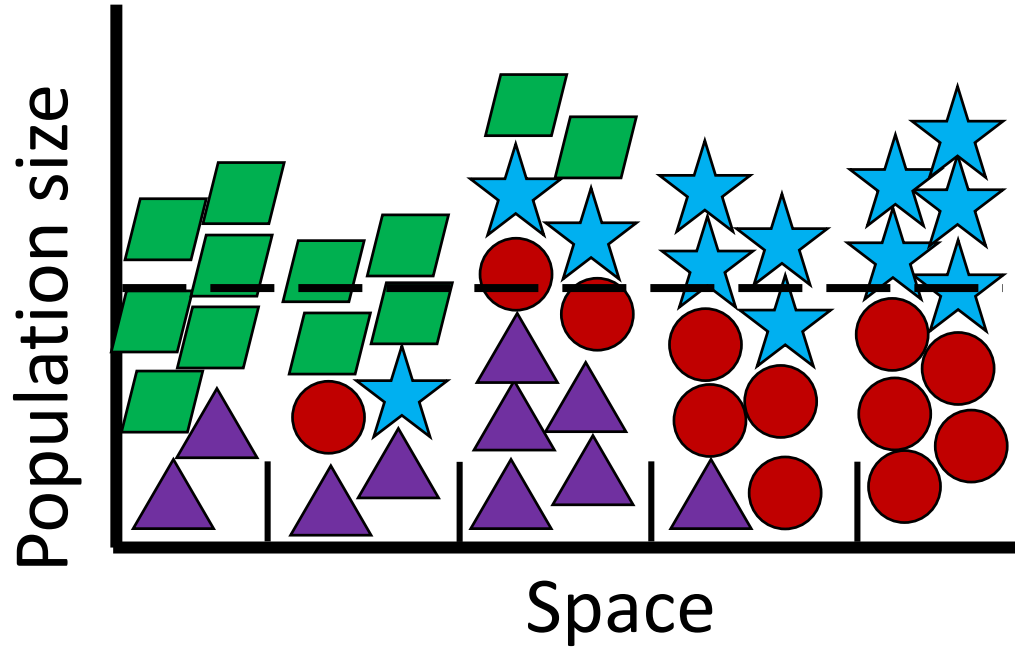
Dispersal

Competition

Model structure



Competition



Lottery competition
- All individuals of all species same chance of surviving competition

Temperature change

Reproduction

Dispersal

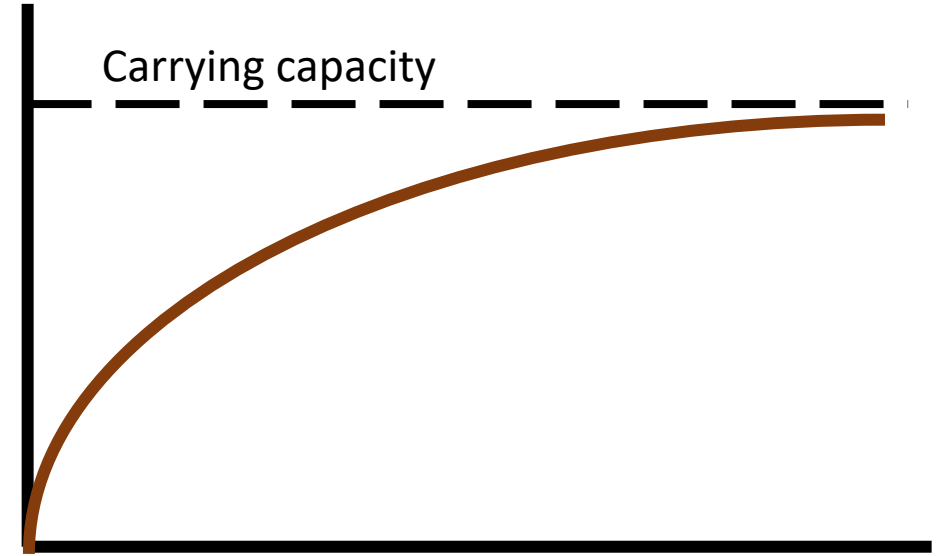
Competition

Model structure

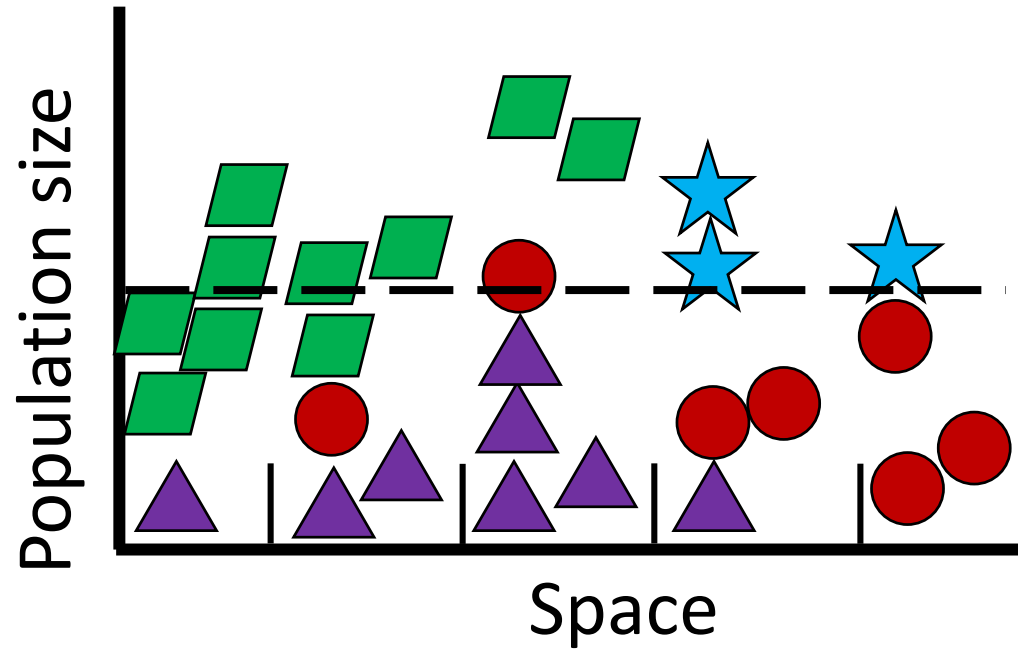
Community size after competition

Carrying capacity

Community size before competition



Competition



Lottery competition
- All individuals of all species same chance of surviving competition

Temperature change

Reproduction

Dispersal

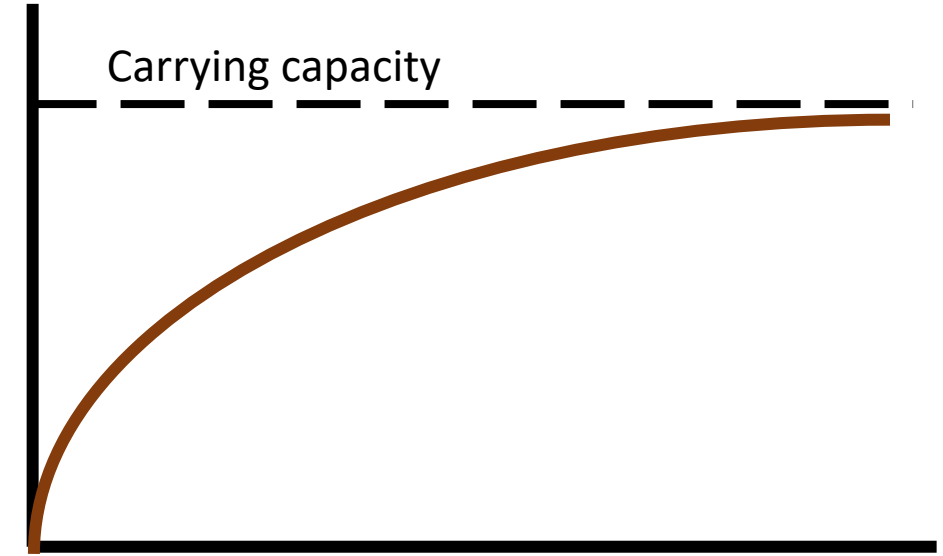
Competition

Model structure

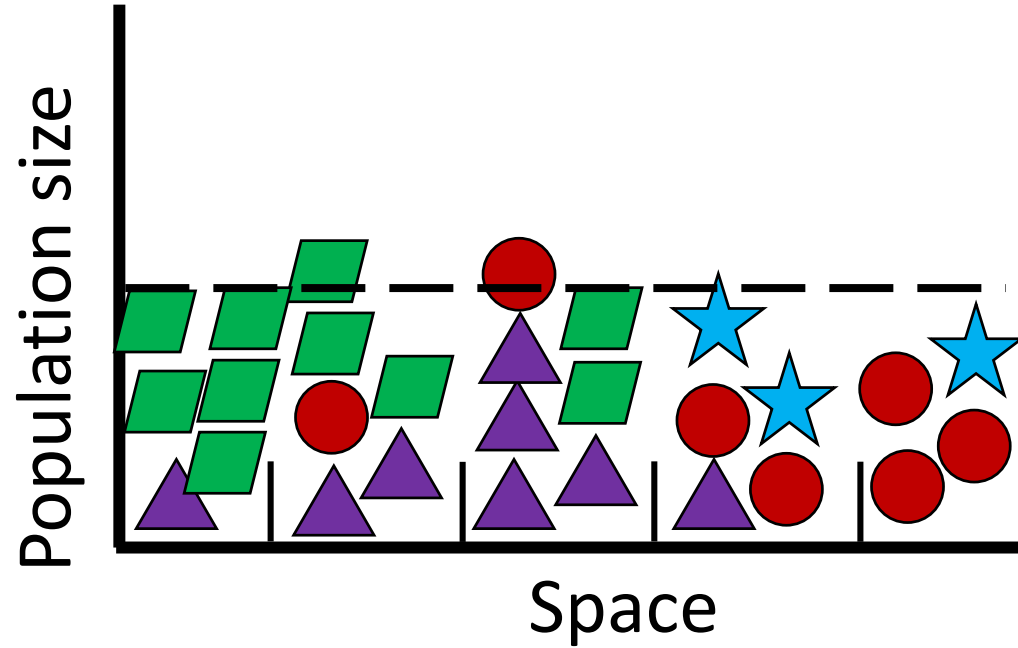
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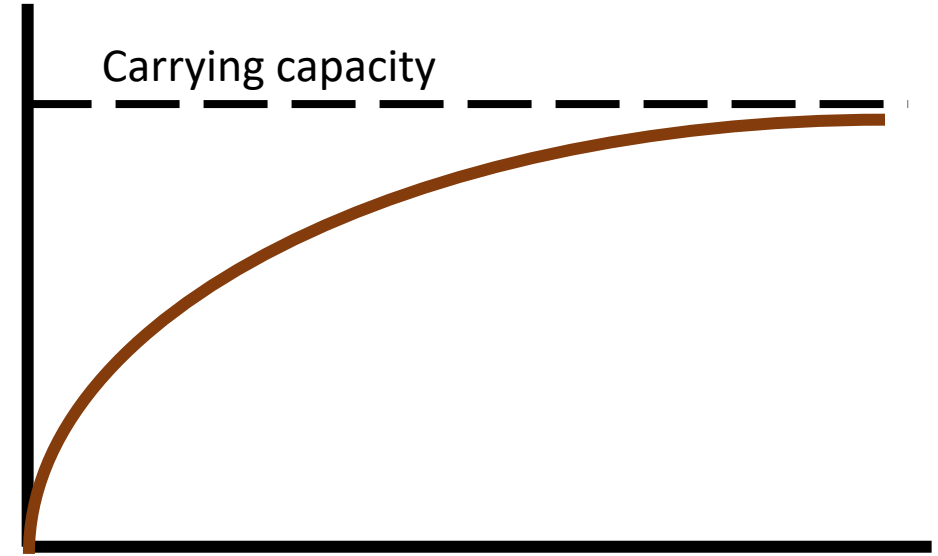
Competition

Model structure

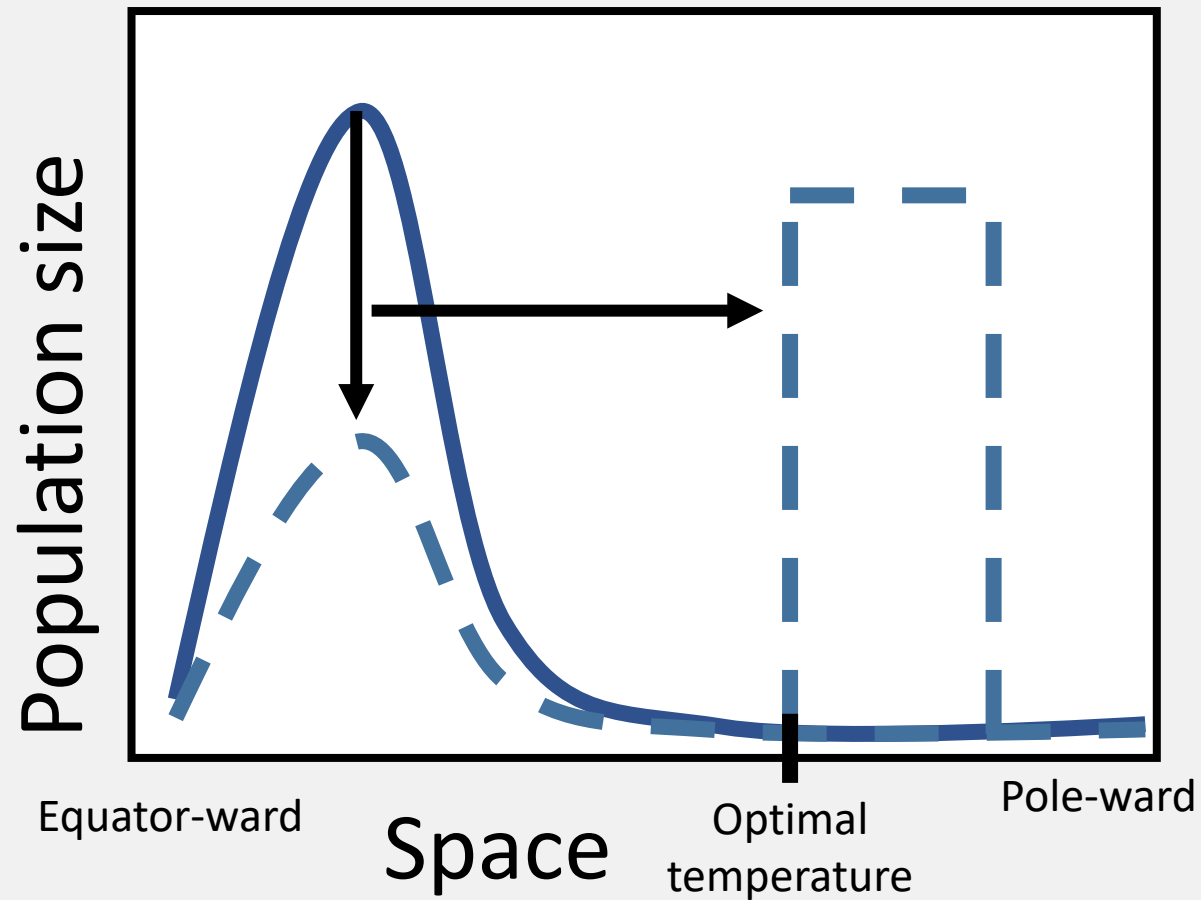
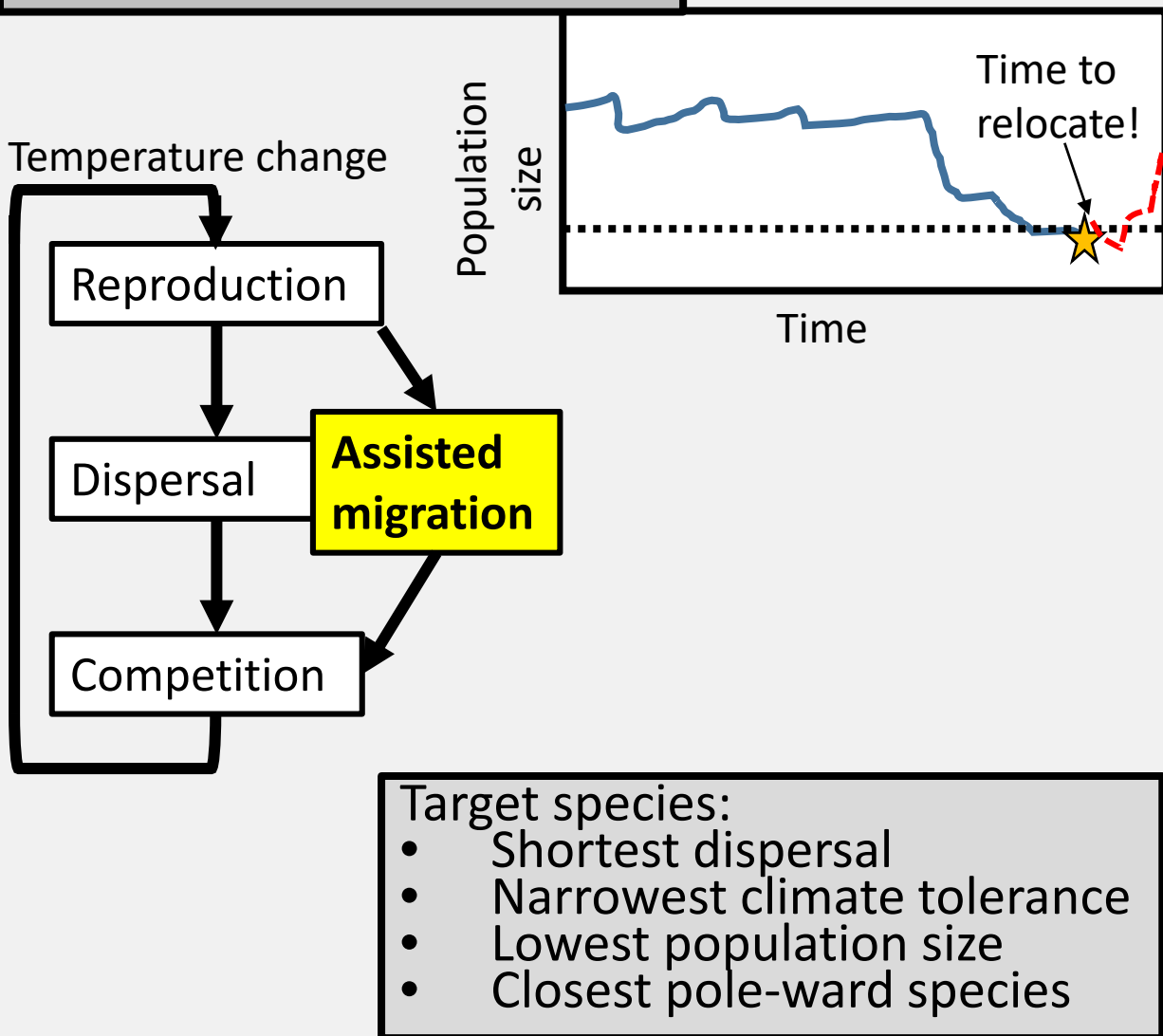
Community size after competition

Carrying capacity

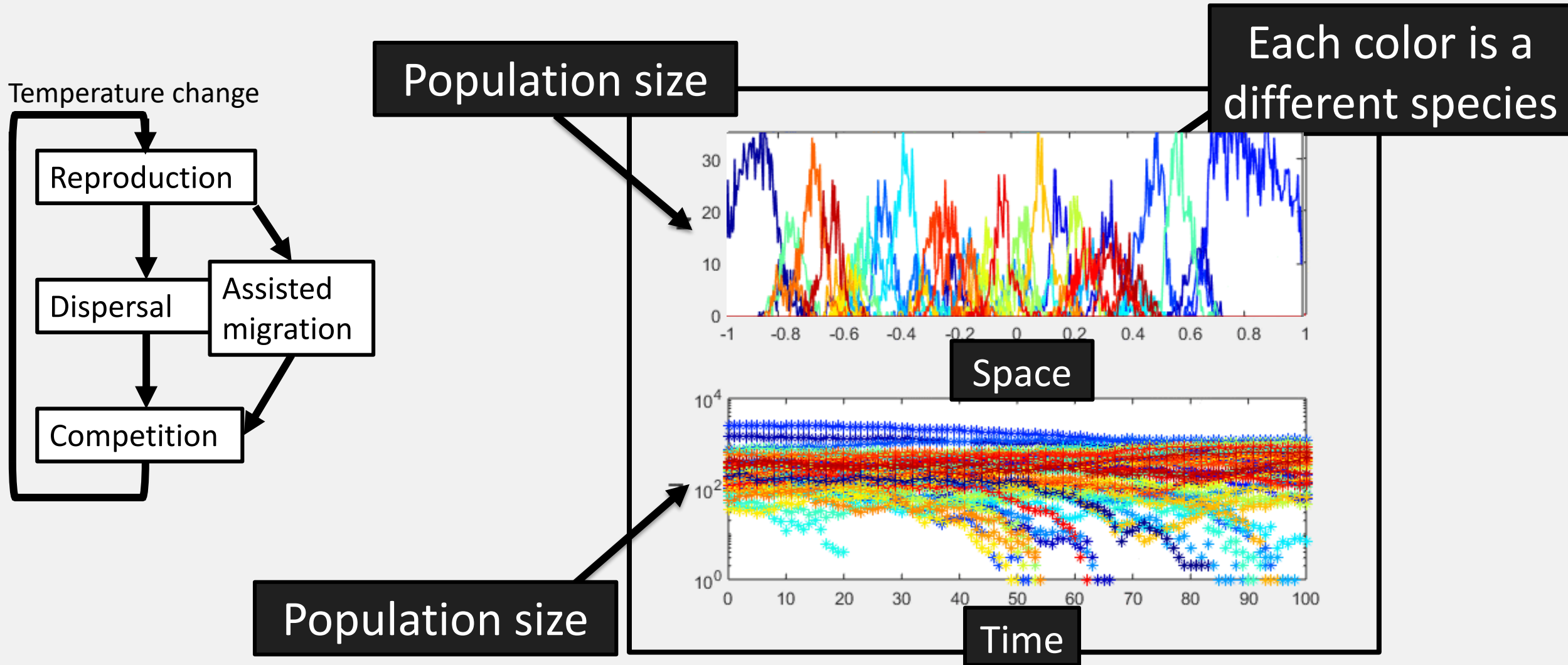
Community size before competition



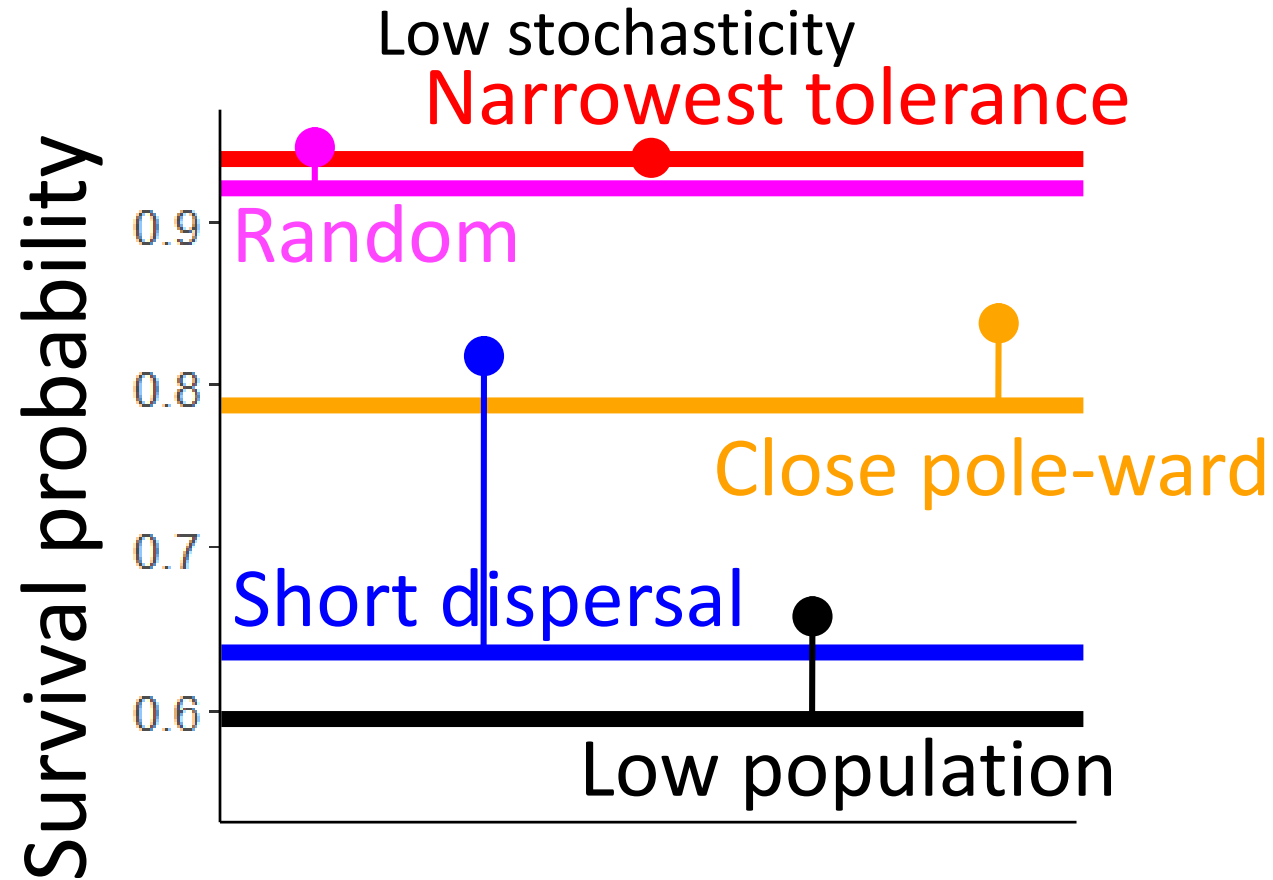
Model structure



Over time, metacommunity cycles through these processes as climate changes



1. Which species do we move??

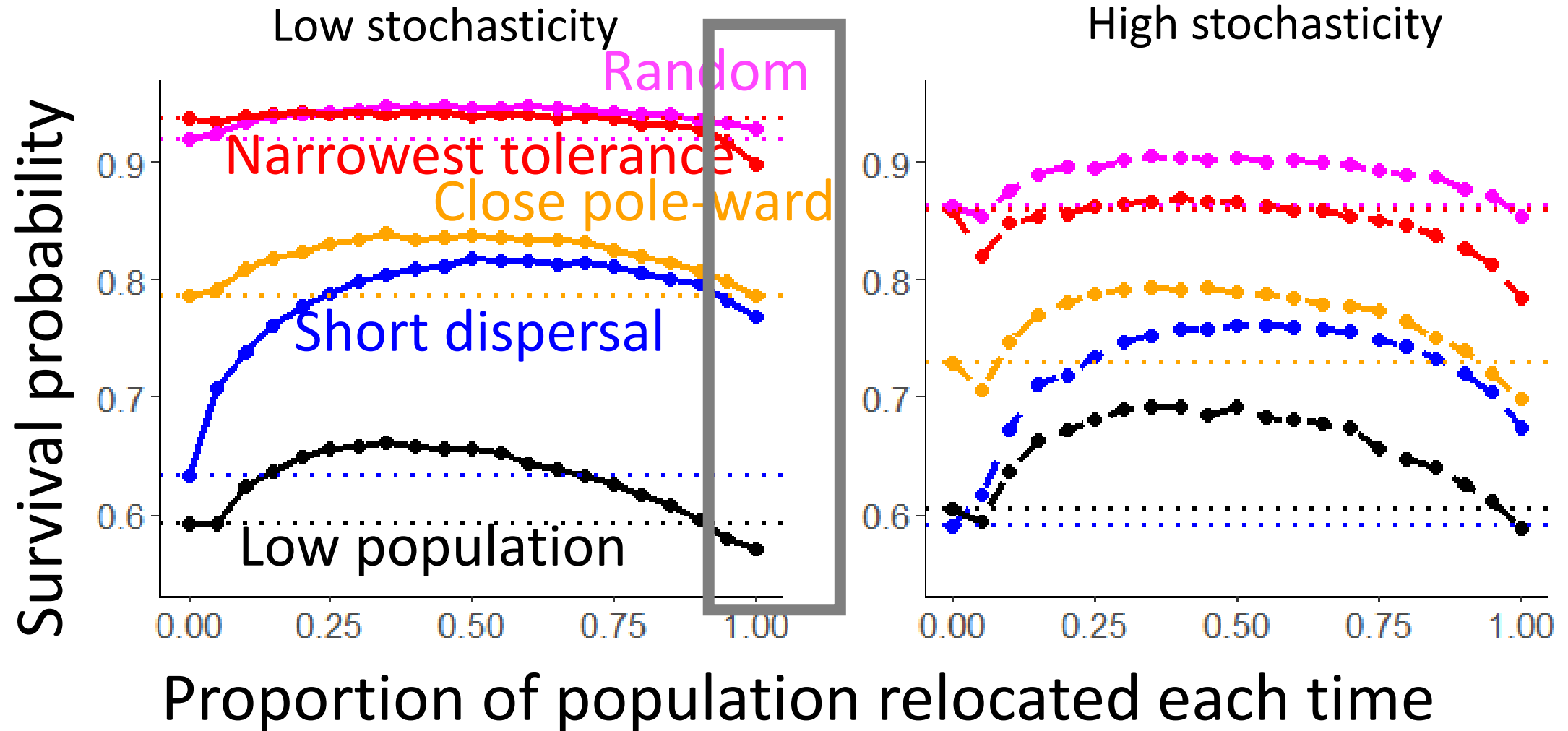


Short dispersers
have higher survival
with AM

Narrow thermal
tolerance usually
does not

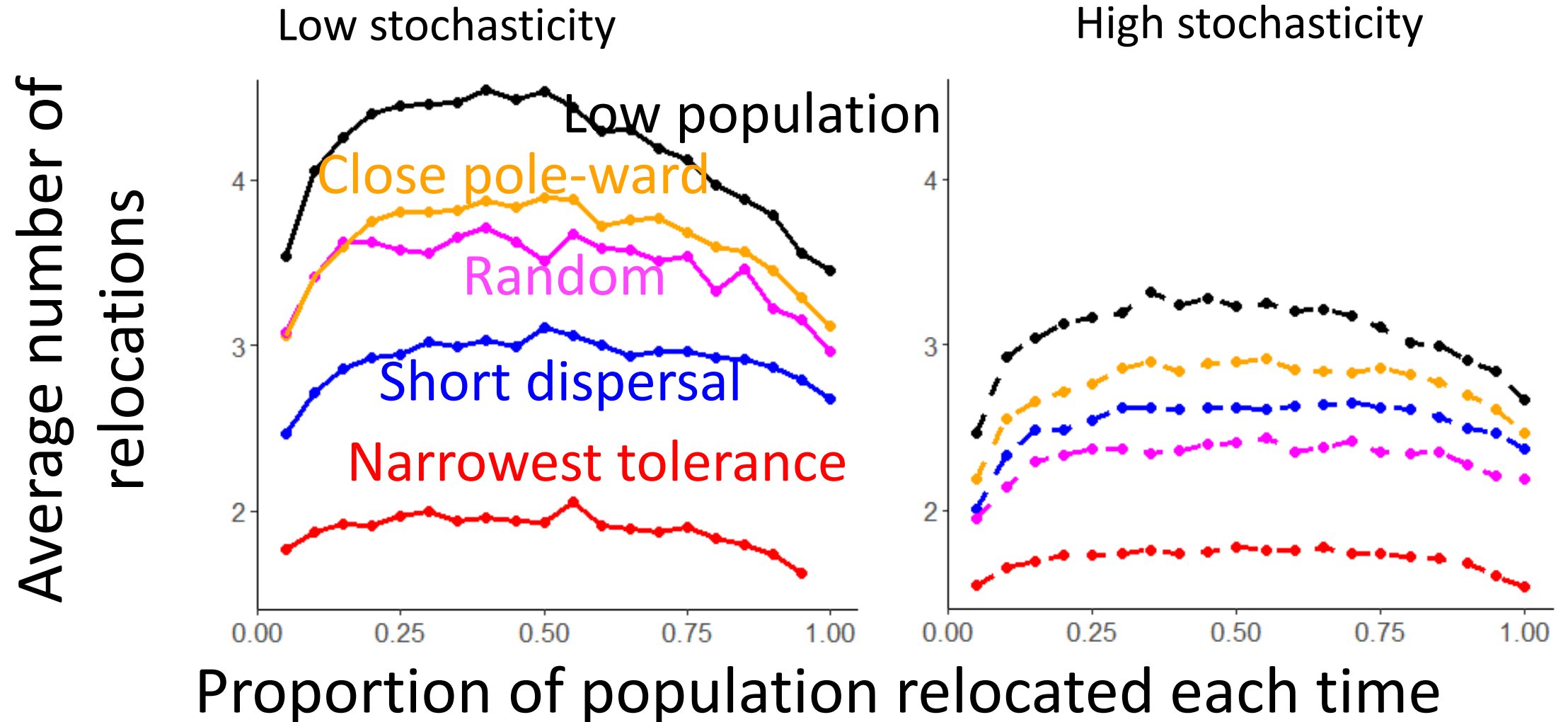
2. How much of the population do we move?

Intermediate fraction has highest survival
100% usually has lower survival

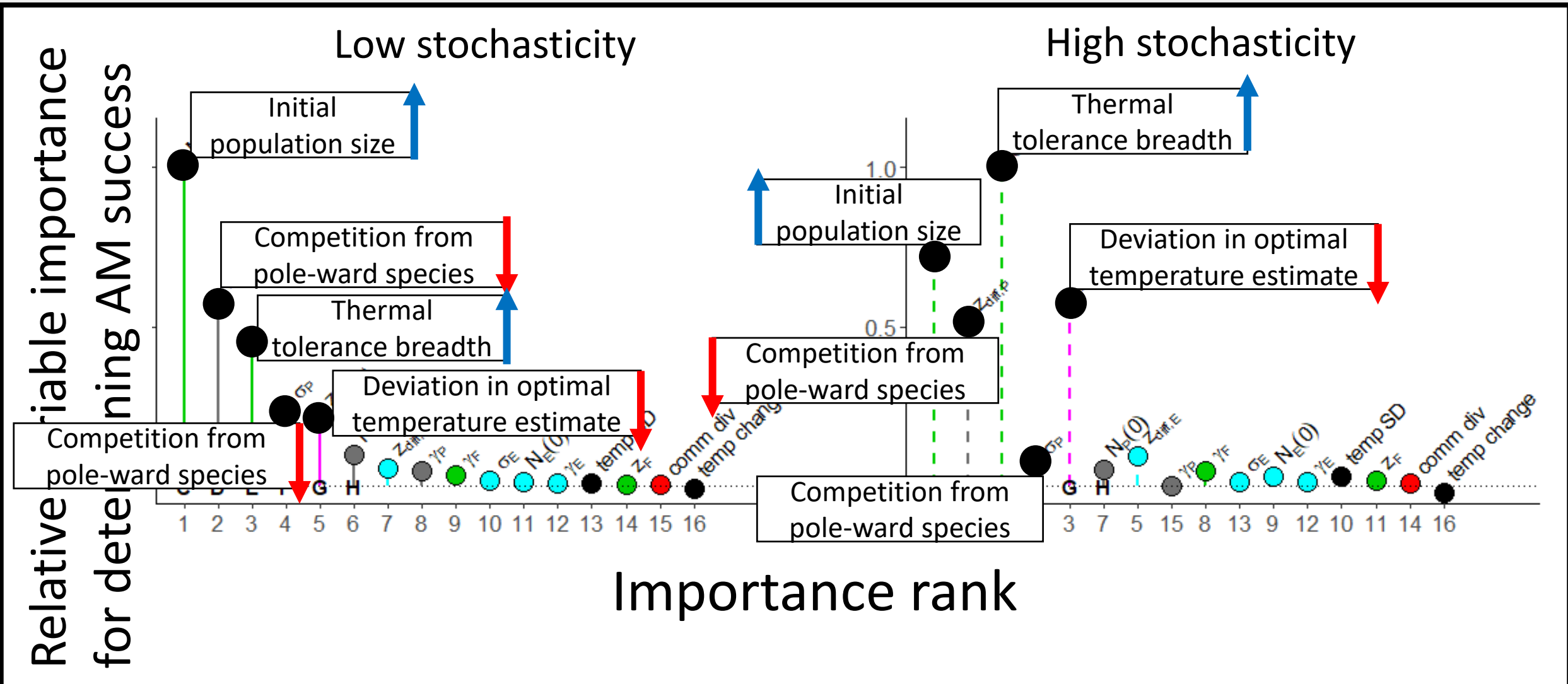


3. How many times?

Low populations were moved most times
Less movement in high stochasticity



5. What sets a successful relocation apart from a failed relocation?



Conclusions

AM reduces extinction
most of the time

But not all of the time

High stochasticity – precision
Low stochasticity - competition

Intermediate fraction
offers a safety net

- **Short dispersal**
- ~~Narrow climate tolerance~~
- **Low population size**
- **Competitive pole-ward species**

No invasions?

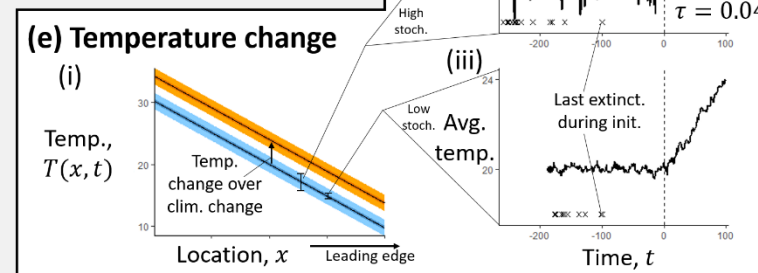
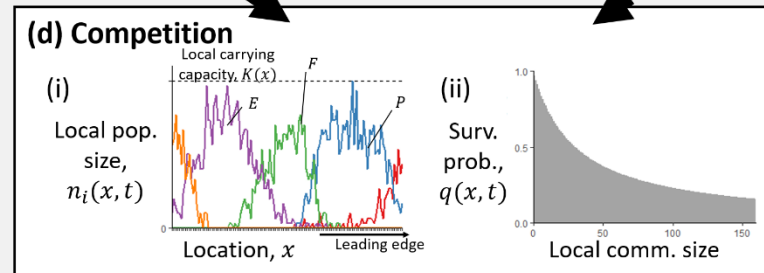
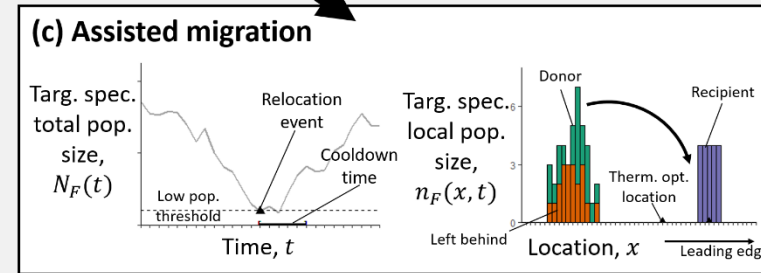
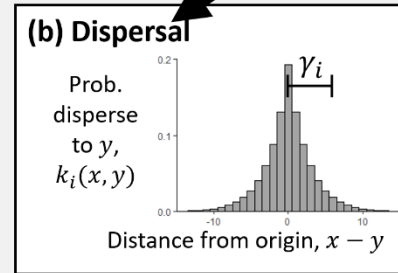
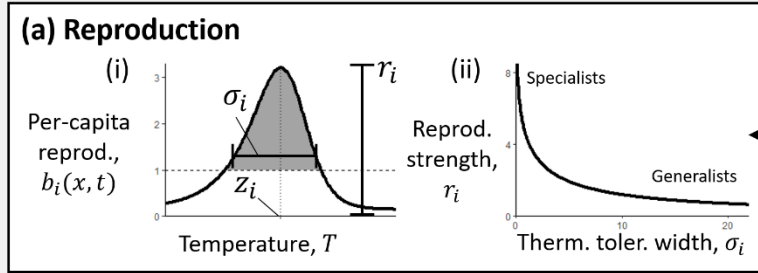
Thank you!



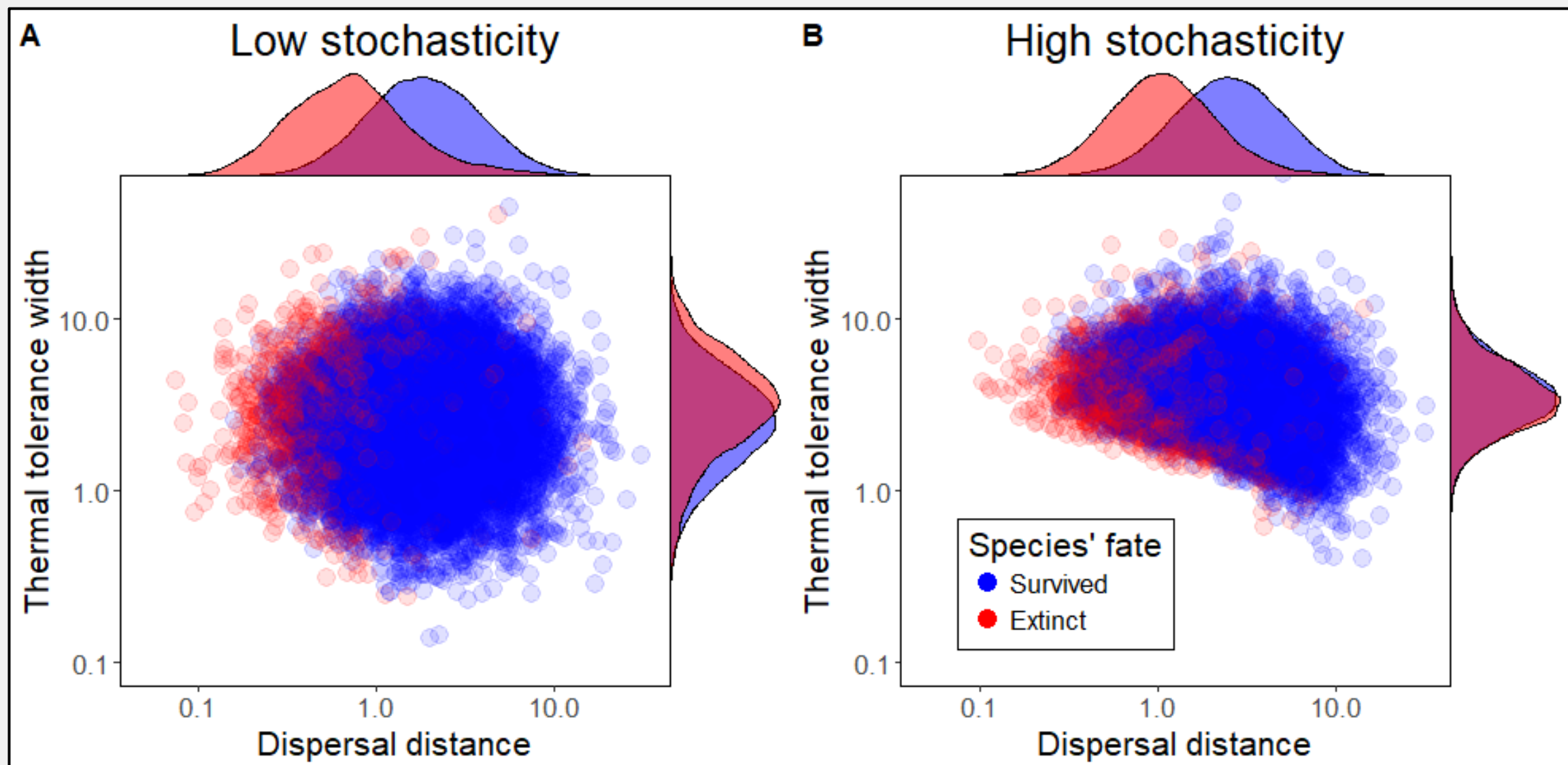
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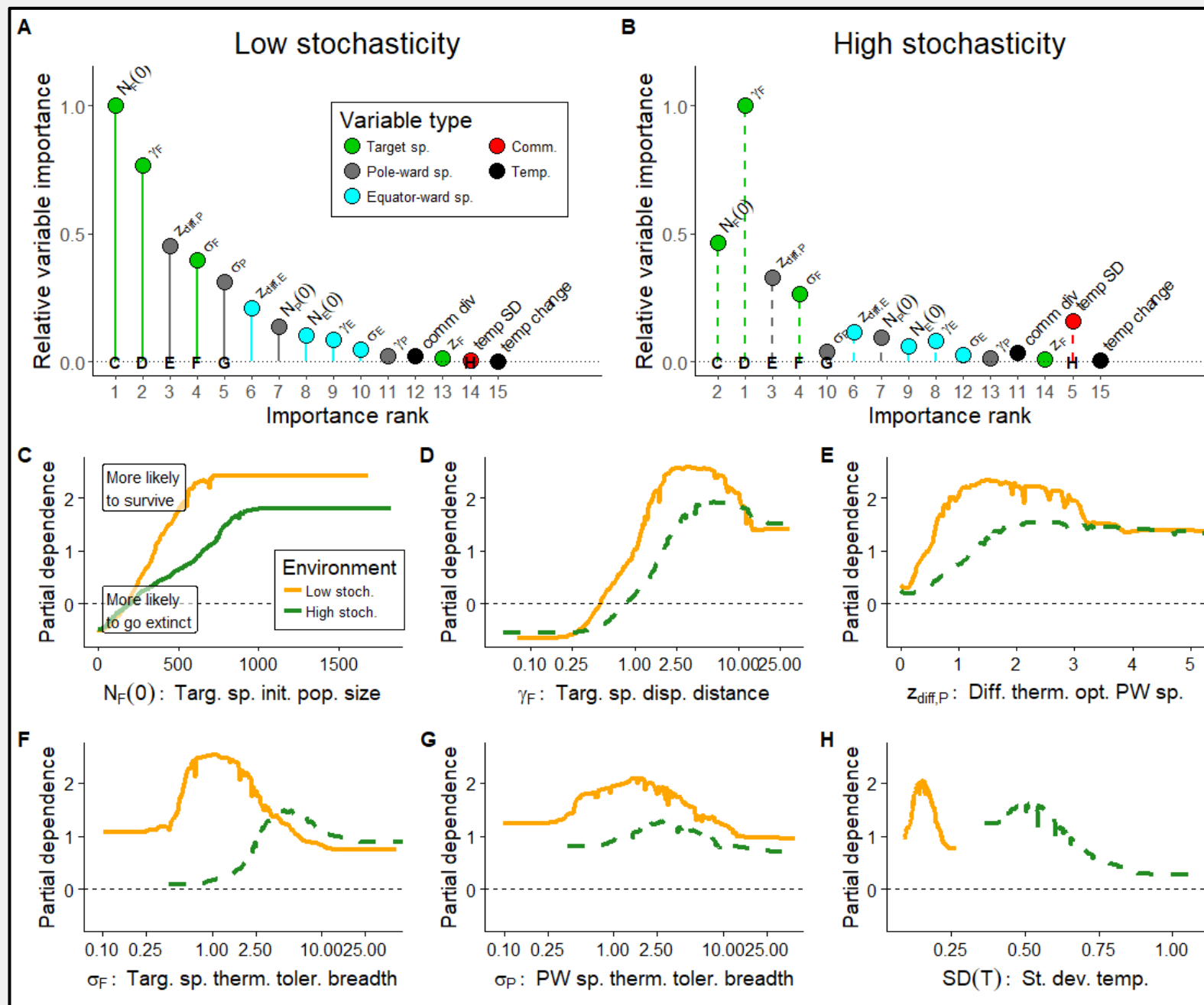
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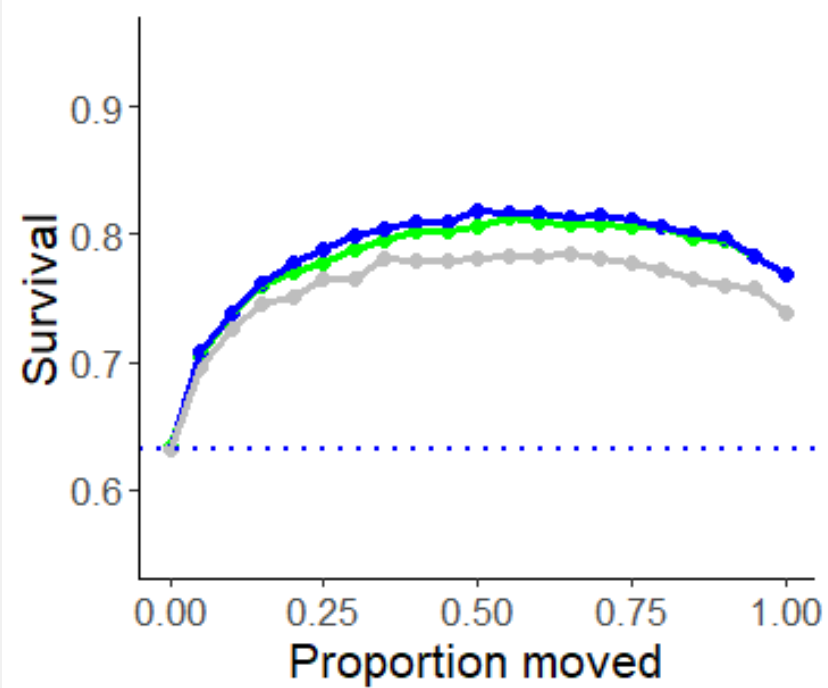
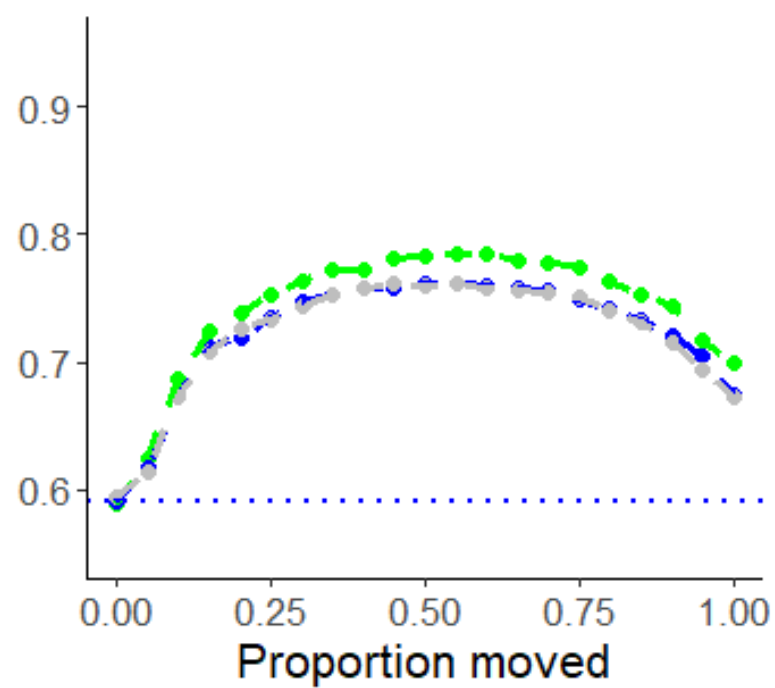
The Baskett Lab (and other theoretical ecologists at UC Davis)



(e) Temperature change





C**D**

Thermal optimum estimate
(shortest disperser target)

Perfect knowledge

Initial distribution

Climate limits (no comp.)

