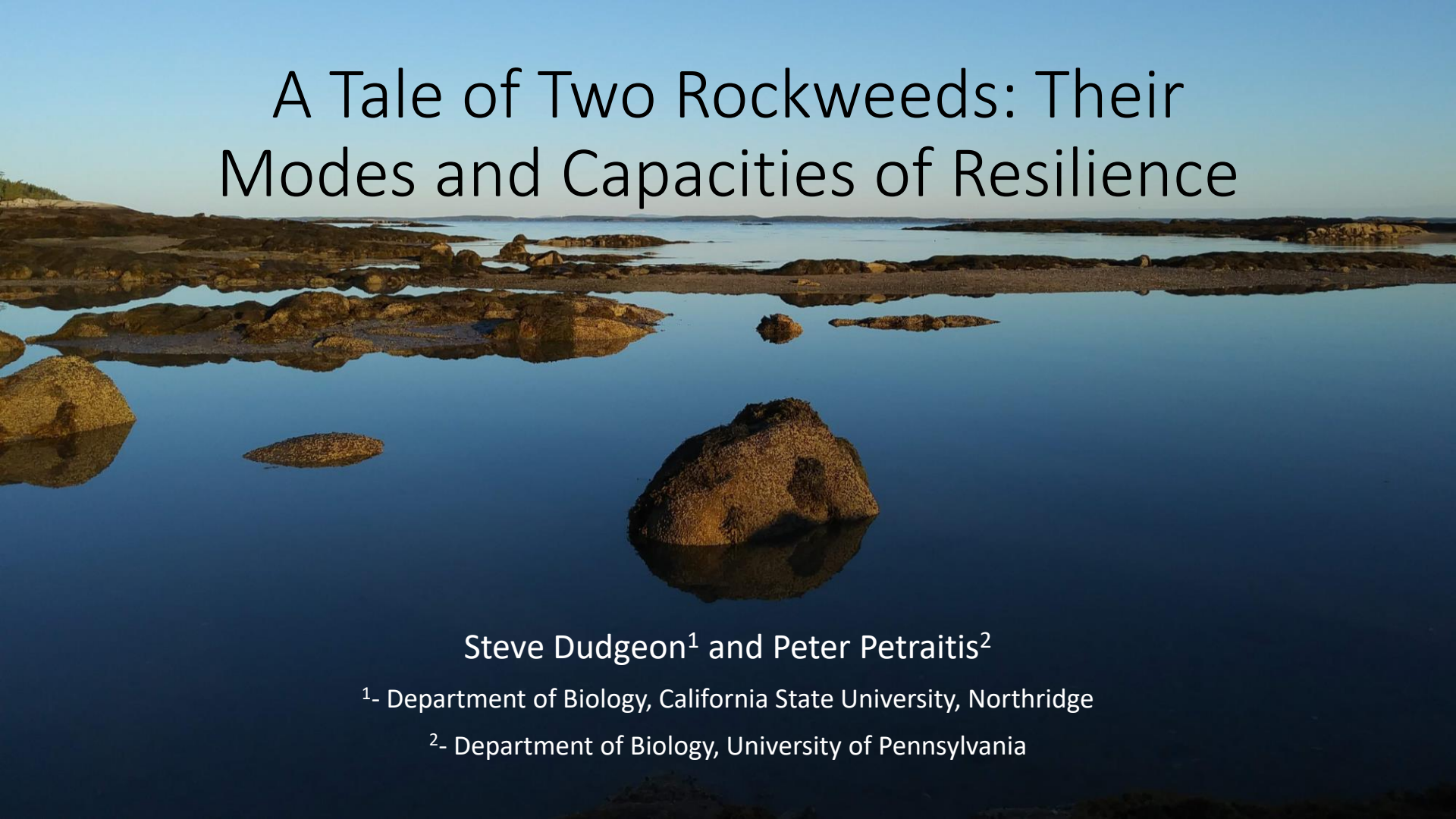
A Tale of Two Rockweeds: Their Modes and Capacities of Resilience



Steve Dudgeon[1] and Peter Petraitis[2]

[1]- Department of Biology, California State University, Northridge

[2]- Department of Biology, University of Pennsylvania

2015 2016 2017 2018 2019 2020 2021 2022 2023

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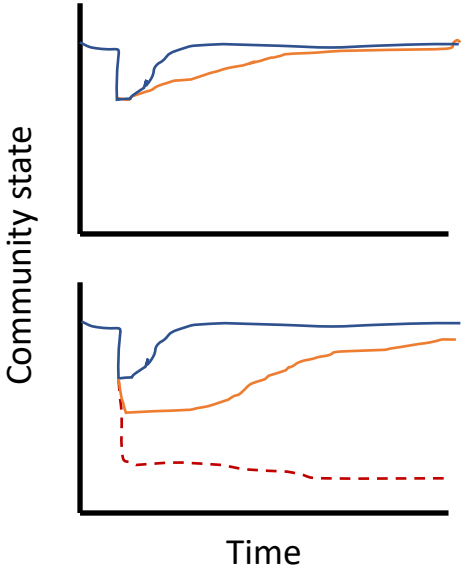
Hollings' (1973) original definition of resilience

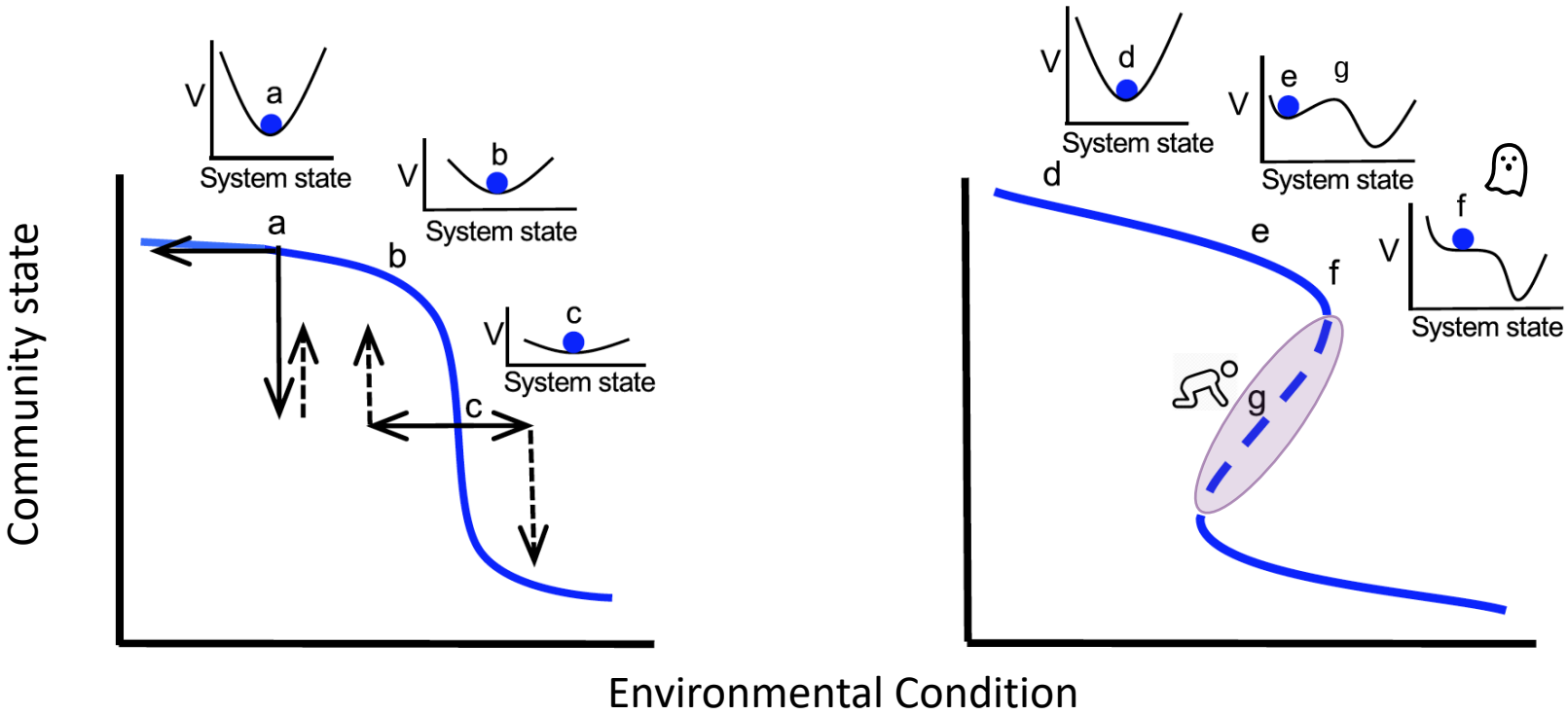
"Resilience determines the persistence of relationships within a system and is a measure of the ability of these systems to absorb changes of state variables, driving variables and parameters and still persist."

- "persistence of relationships"
  - emphasizes length of return time

- "ability to absorb . . . changes"
  - emphasizes magnitude of perturbation the system can withstand



State variables, driving variables, parameters



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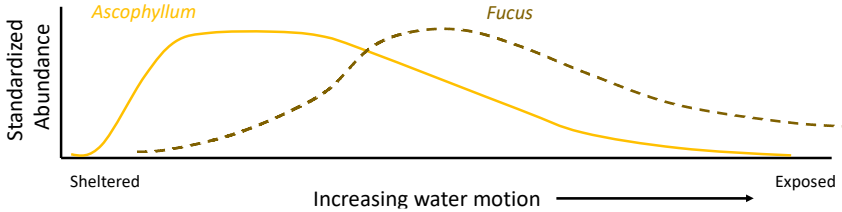
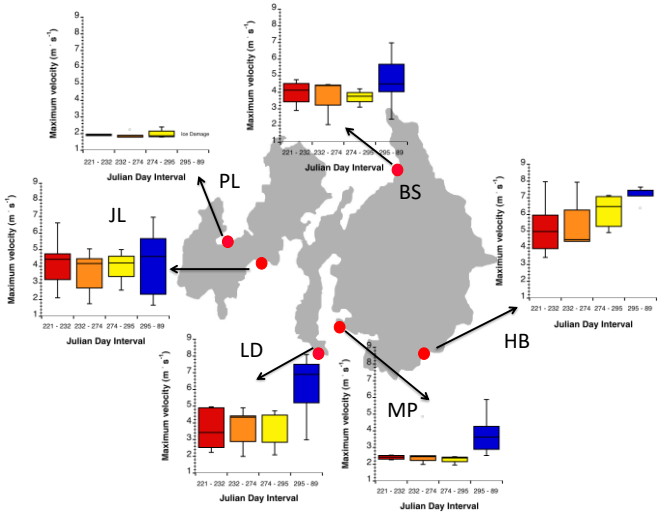
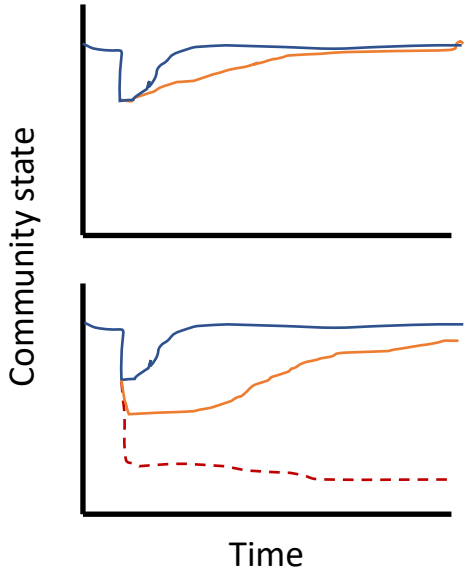
Hastings et al. 2018; Morozov et al. 2020


Ascophyllum
Fucus
Standardized Abundance
Sheltered
Exposed
Increasing water motion

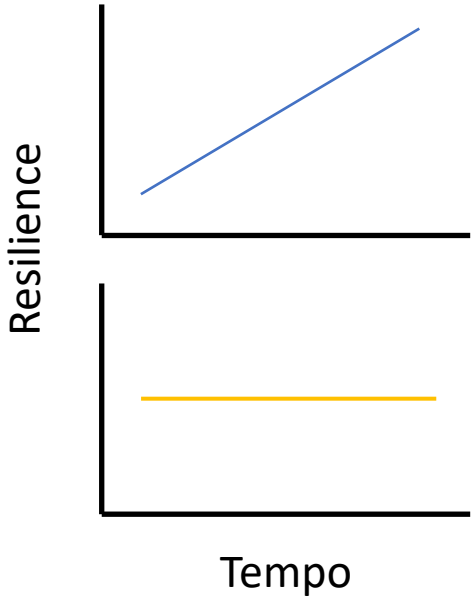

PL
BS
JL
LD
HB
MP
Maximum velocity (m s⁻¹)
Julian Day Interval
221 - 232 - 232 - 274 - 274 - 295 - 295 - 89
Ice Damage

Questions

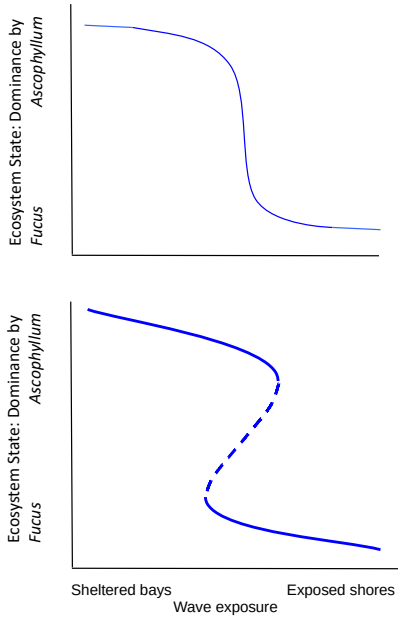
1. How resilient are dominant fucoid algae?

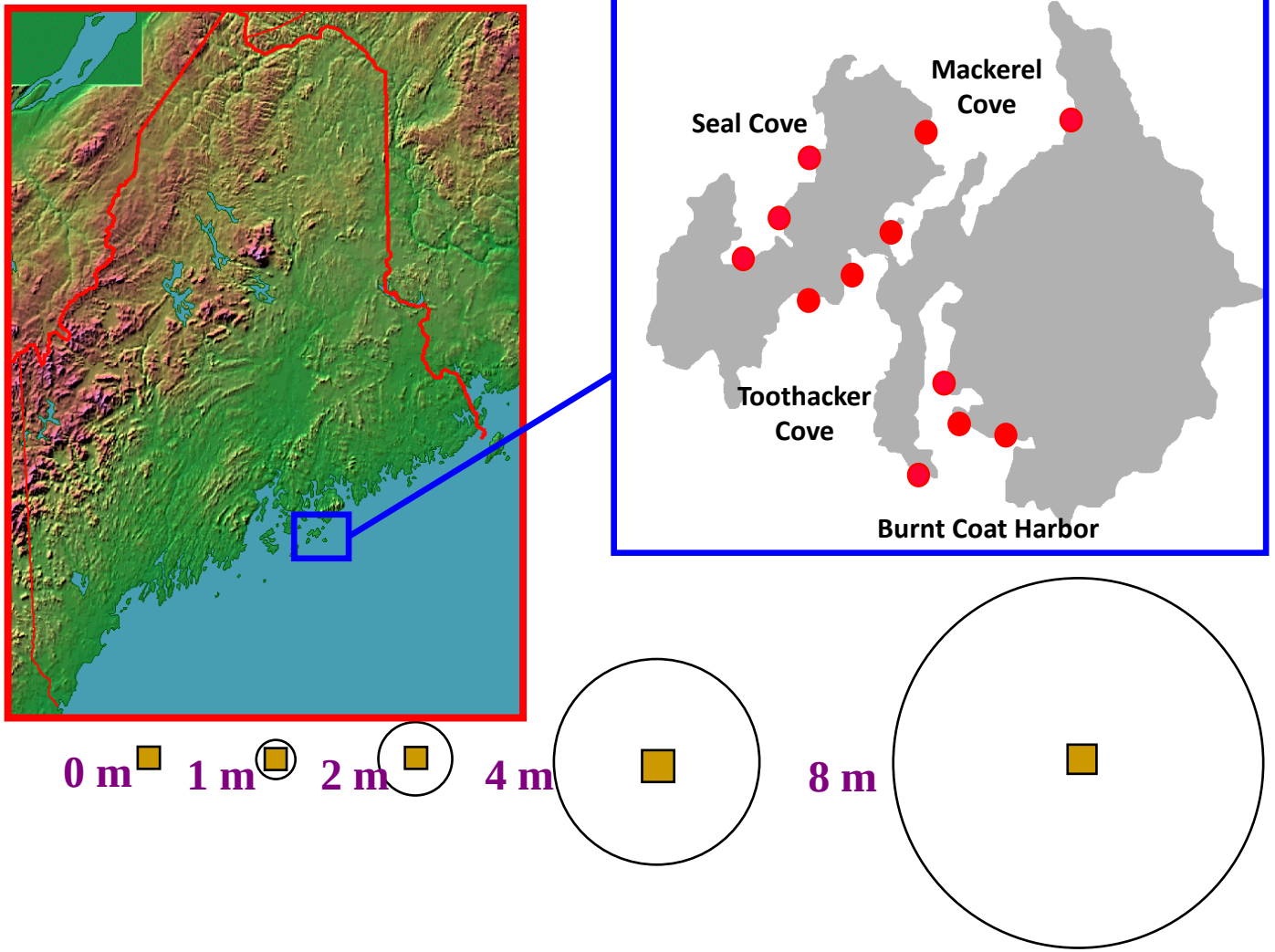


2. Does the tempo of ecological dynamics influence resilience?

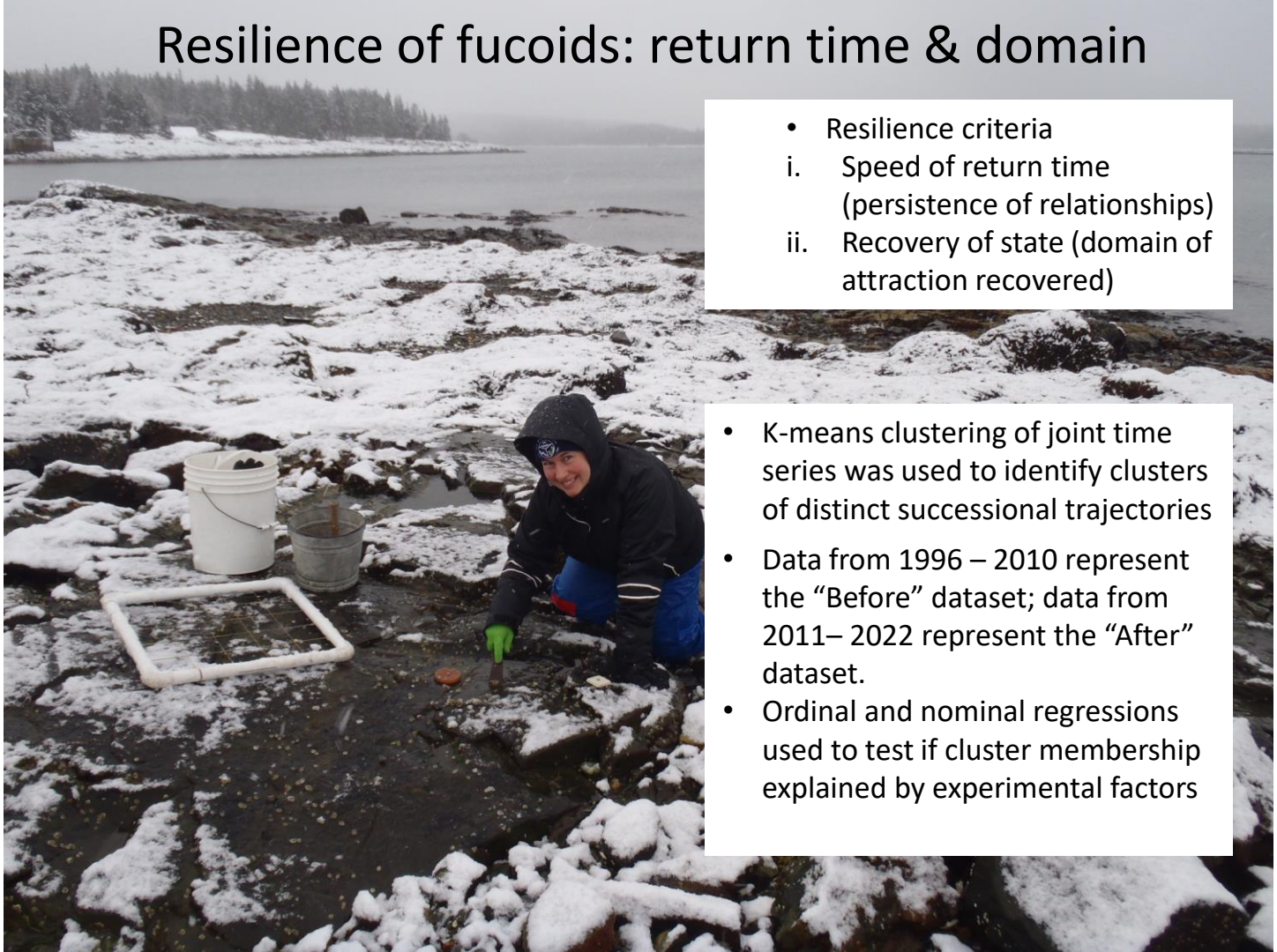


3. How do resilience, long transient stages and tempo inform alternative models?




Mackerel Cove
Seal Cove
Toothacker Cove
Burnt Coat Harbor
0 m
1 m
2 m
4 m
8 m

Resilience of fucoids: return time & domain



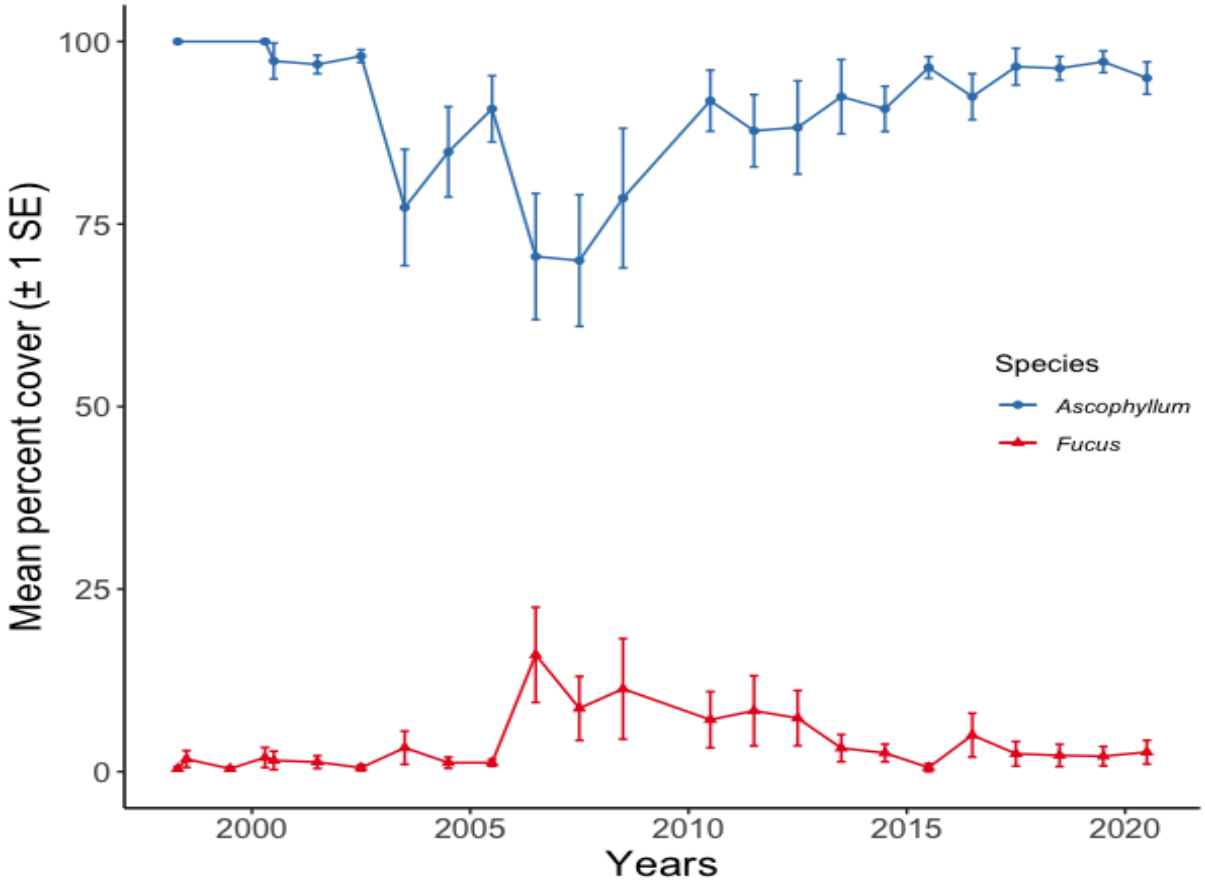
- Resilience criteria

i. Speed of return time (persistence of relationships)

ii. Recovery of state (domain of attraction recovered)

- K-means clustering of joint time series was used to identify clusters of distinct successional trajectories
- Data from 1996 – 2010 represent the “Before” dataset; data from 2011– 2022 represent the “After” dataset.
- Ordinal and nominal regressions used to test if cluster membership explained by experimental factors

12 Control Plots



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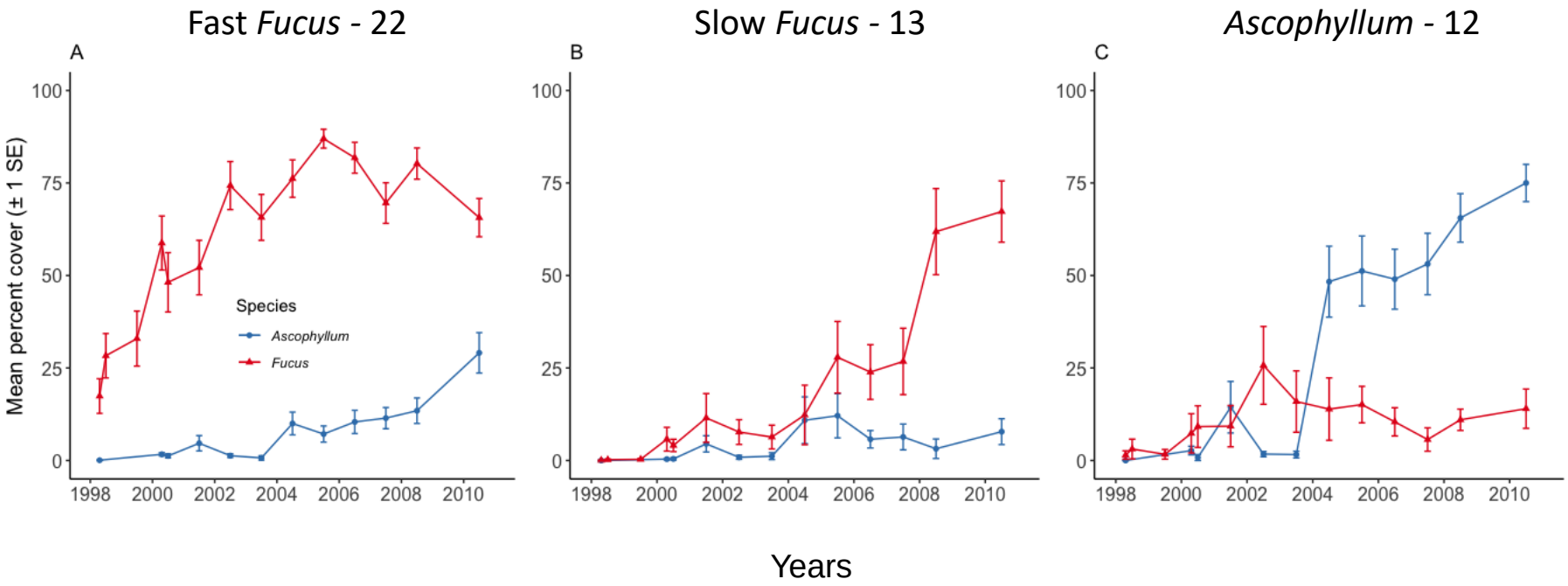
“Before” Dataset (1997-2010)



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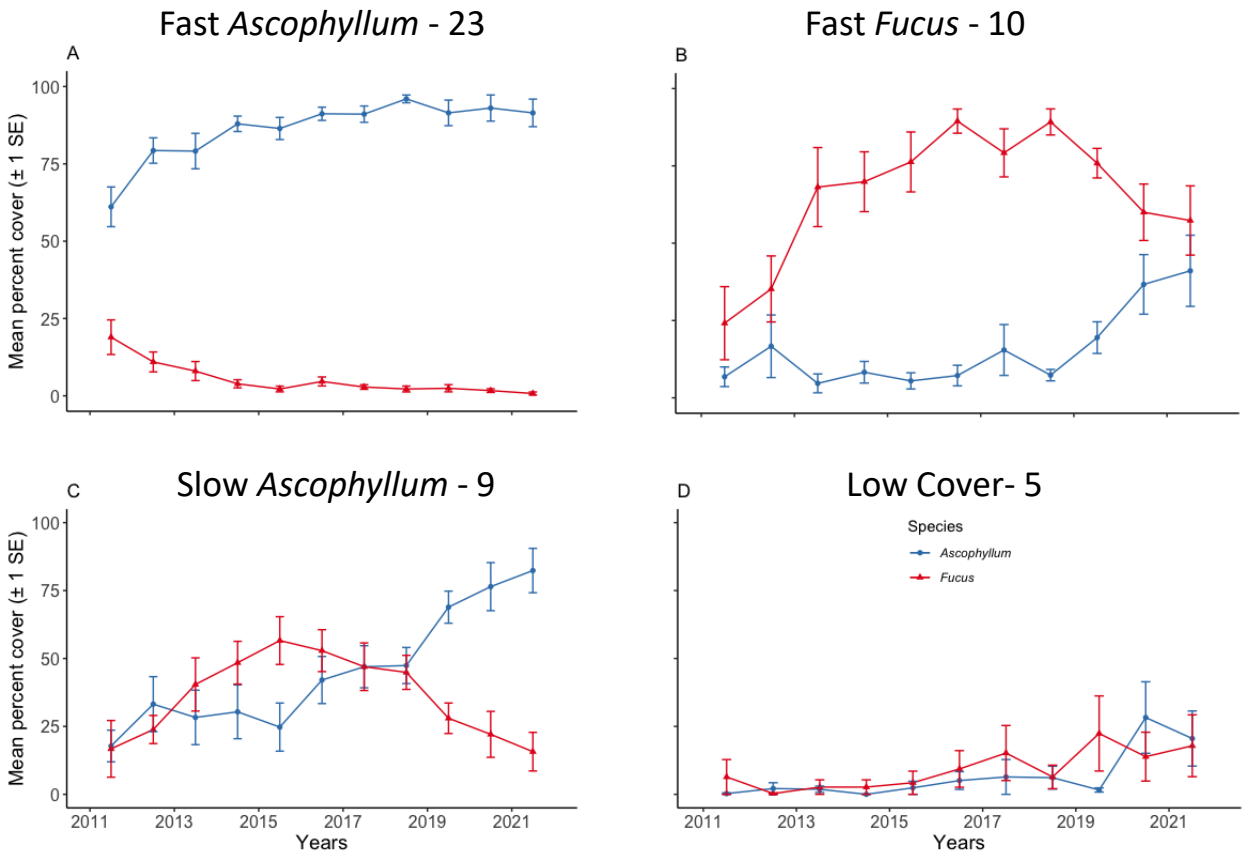
“After” Dataset (2011-2020)



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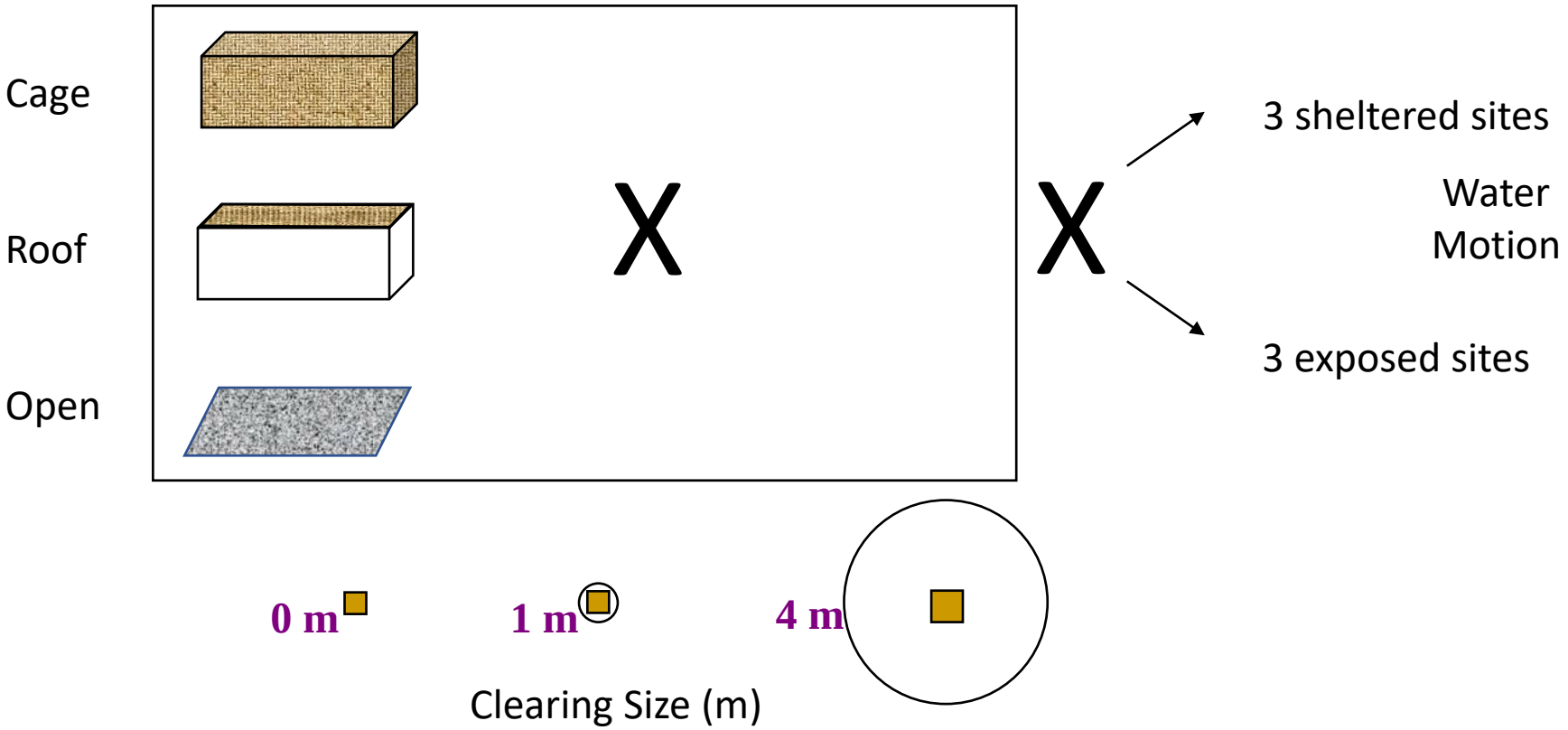
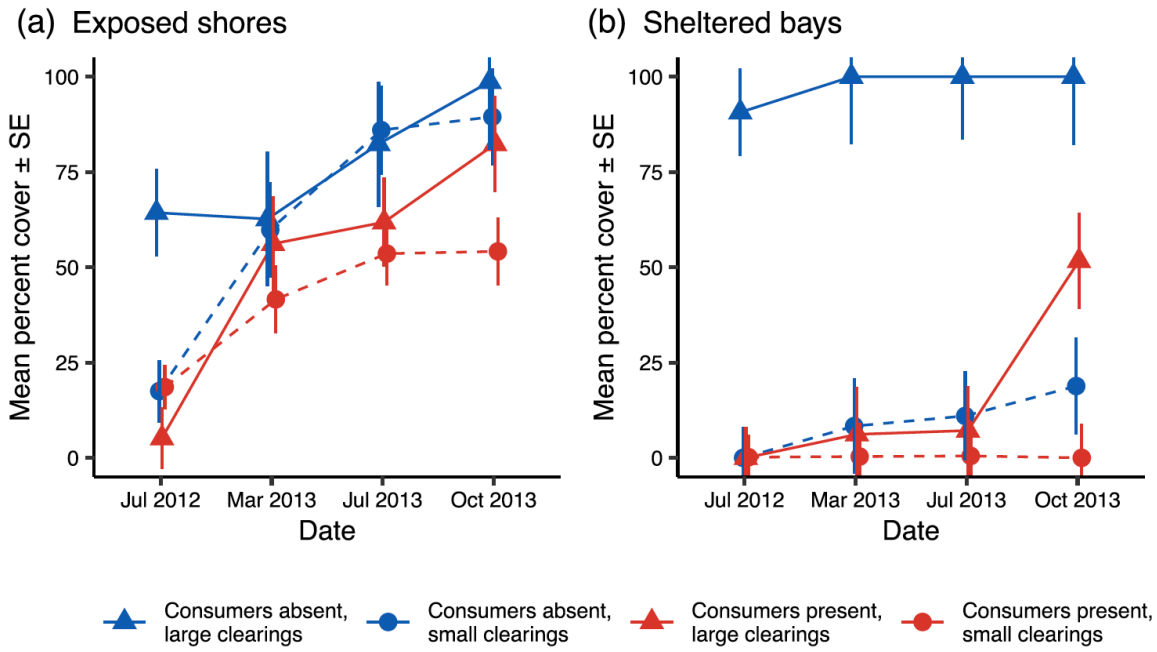
Water motion, disturbance & grazing and the tempo of succession

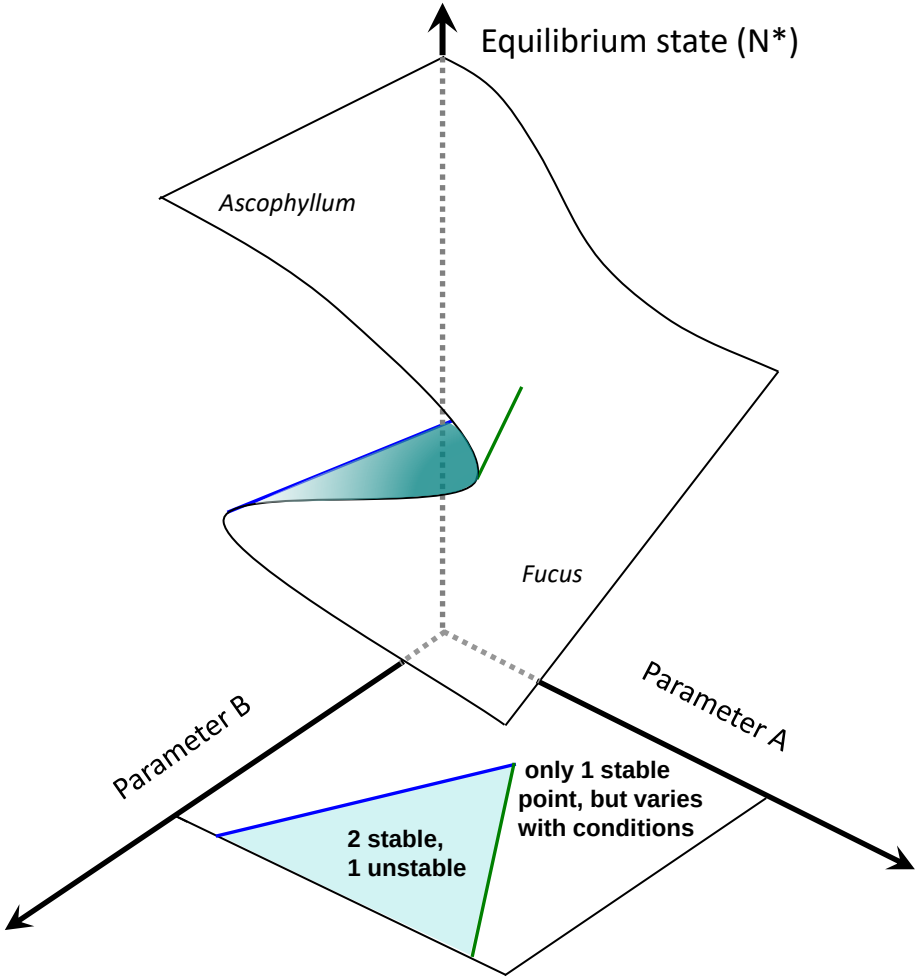


Water motion, disturbance & grazing set tempo of succession

Fucus colonization of clearings in *Ascophyllum* stands

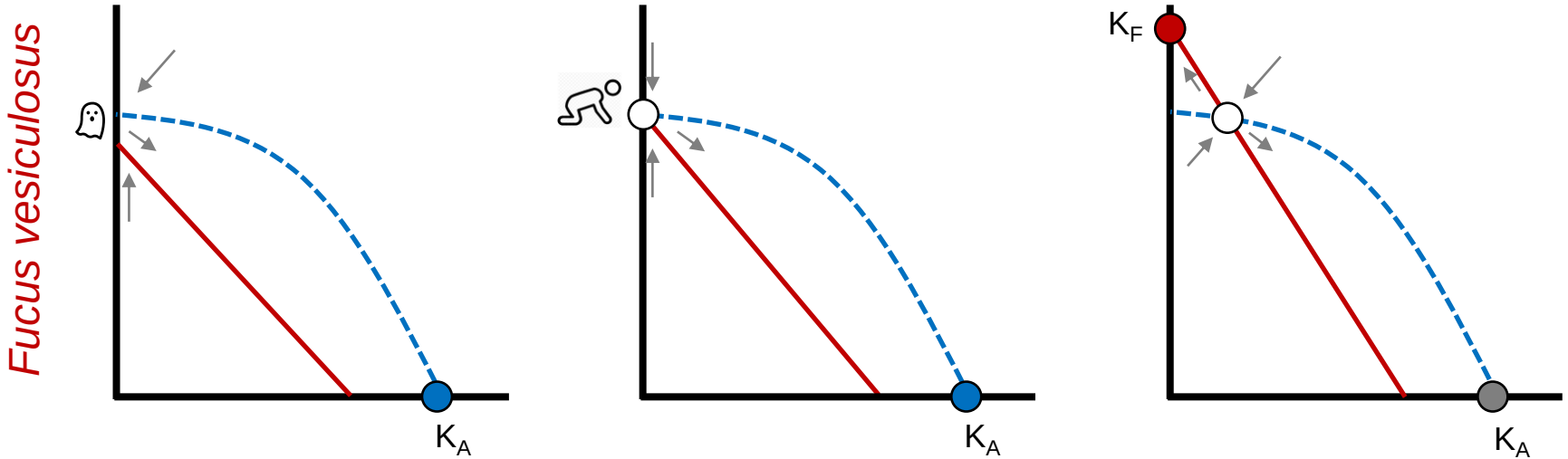


Dudgeon and Petraitis 2022



Petraitis and Dudgeon 2015

Increasing water motion



Ascophyllum nodosum

Acknowledgements

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Take Home Messages

- Hydrodynamics set the tempo of ecological dynamics on rocky shores
- *Fucus* is resilient to large (8 m diameter) perturbations if it can dominate space within 1-2 generations (3 years)
- *Ascophyllum* is resilient within ~2 generations (15-18 yrs.) to small (≤2 m diameter) perturbations
- Perturbations ≥4 m diameter require ~25 years (2.5-3 generations) for *Ascophyllum* to recover
- Low resilience to ≥8 m diameter perturbations enable switches of community state

Population and Community Ecology Lab

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Swans Isl, ME