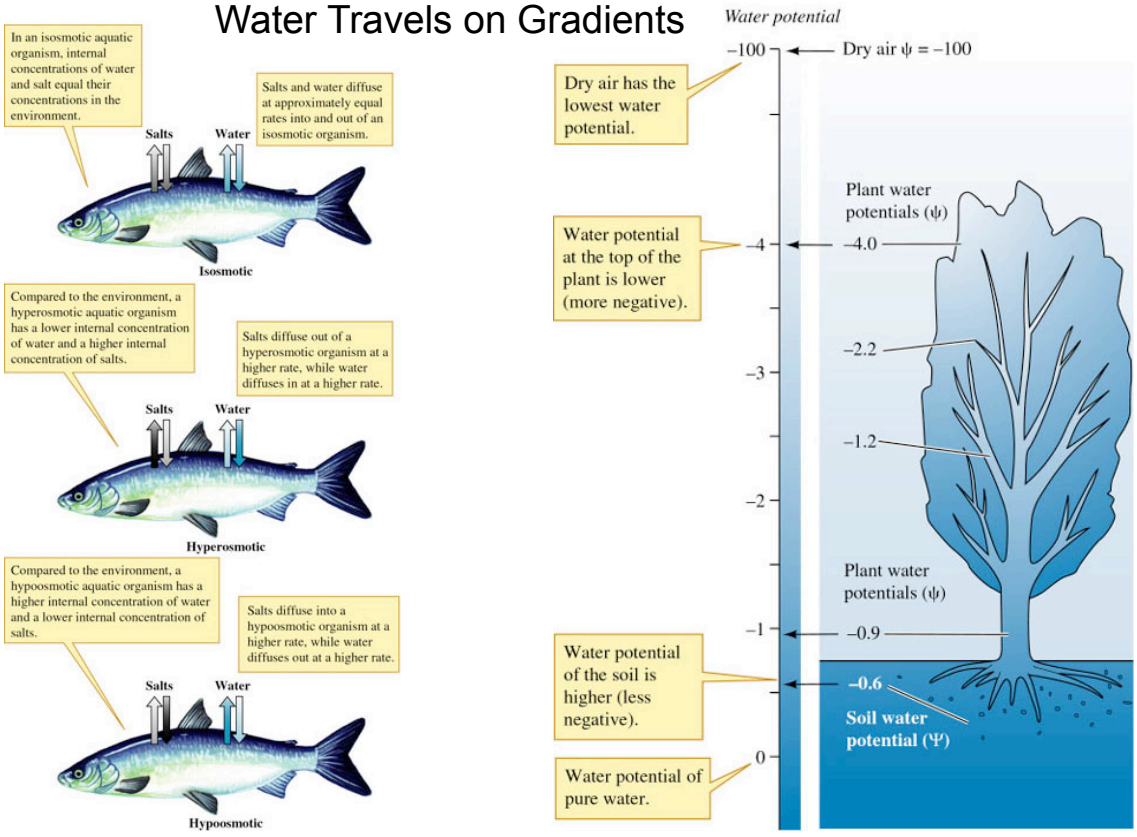
Water Travels on Gradients



Water movement from soil to plant

$\Psi_{plant} = \Psi_{solute} + \Psi_{matric} + \Psi_{pressure}$

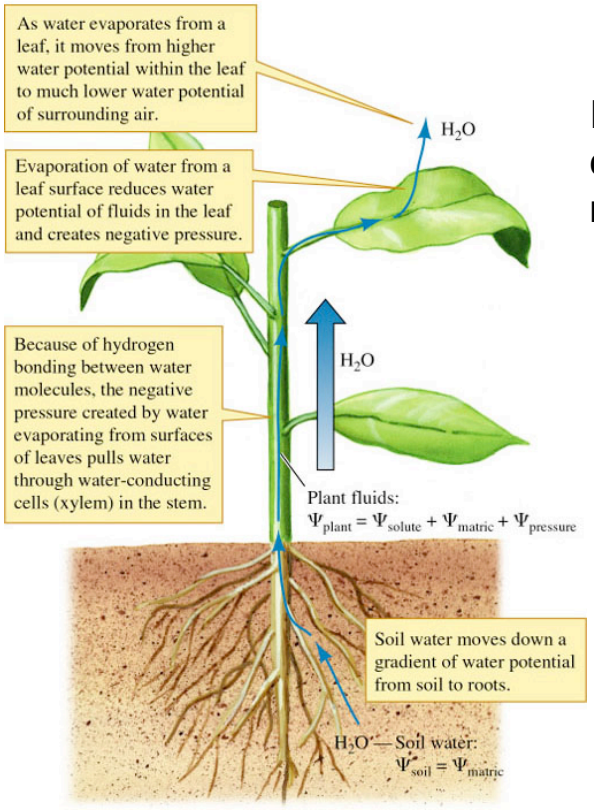
$\Psi_{soil} \approx \Psi_{matric}$

Water potentials are NEGATIVE and water flows from less negative to more negative potential.

Ψ_{matric} represents water's tendency to adhere to surfaces.

$\Psi_{pressure}$ is the reduction in water potential due to negative pressure created by water evaporating from leaves.

As long as $\Psi_{plant} < \Psi_{soil}$, water flows from the soil to the plant.

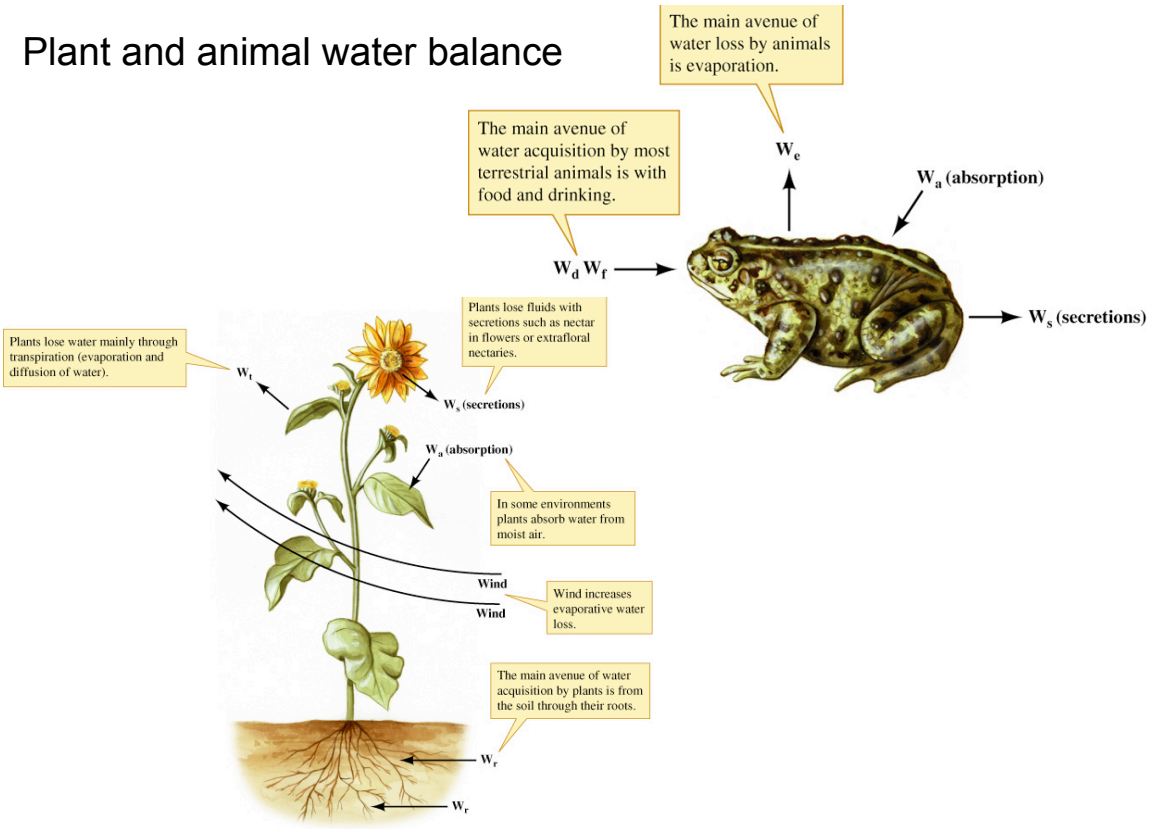


In plants, water flows in a continuous stream from root to leaf

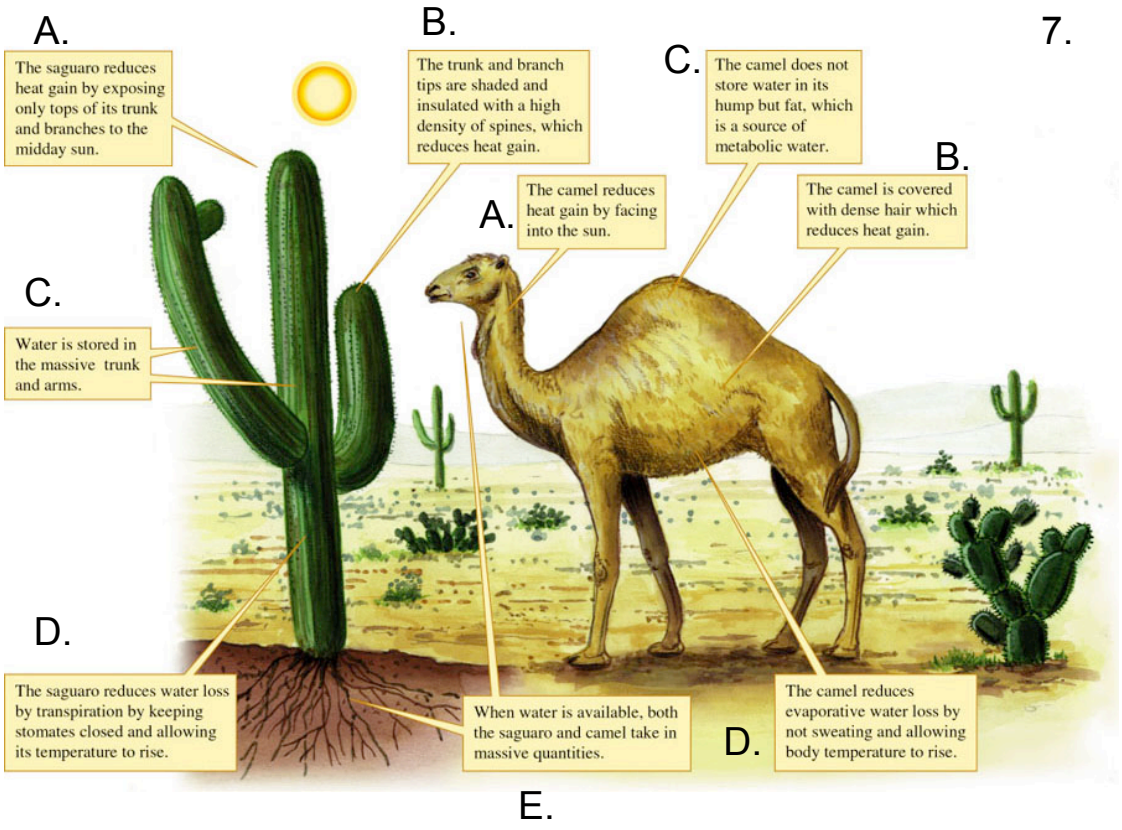
Plant	Animal
$W_{ip} = W_r + W_a - W_t - W_s$	$W_{ia} = W_d + W_f + W_a - W_e - W_s$
W_{ip} = Internal water	W_{ia} = Internal water
W_r = Root uptake	W_d = Drinking
W_a = Absorbed (air)	W_f = Food (as source)
W_t = Transpiration	W_a = Absorbed (air)
W_s = Secretions	W_e = Evaporation
	W_s = Secretion / Excretion

Water budgets in plants and animals.

Plant and animal water balance



7.



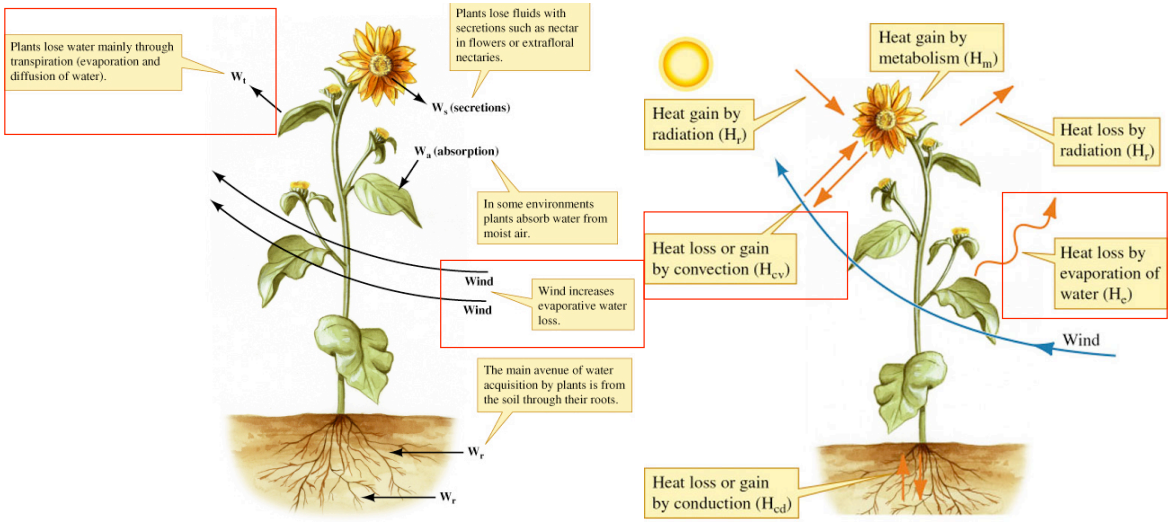
Ecological transactions with *multiple currencies*

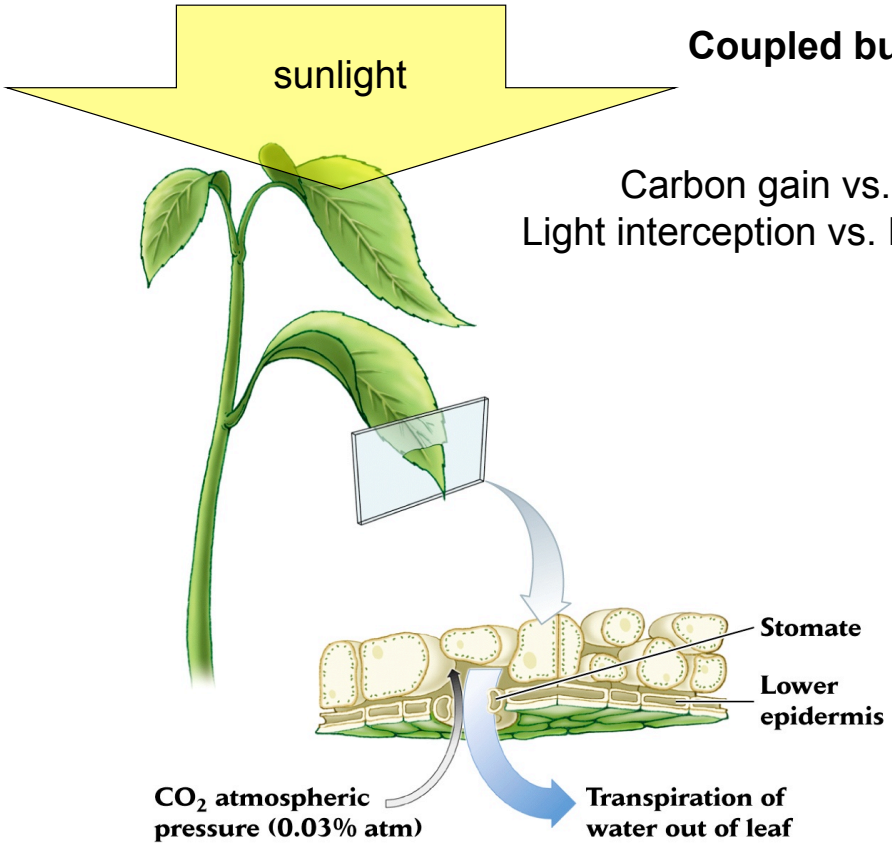
<u>Water budget:</u>
Water balance

<u>Heat budget:</u>
Energy balance

$W_{ip} = W_r + W_a - W_t - W_s$

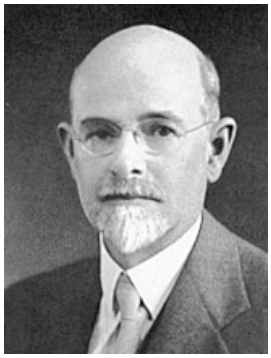
$H_S = H_m \pm H_{cd} \pm H_{cv} \pm H_r - H_e$





Coupled budgets and trade-offs:

Carbon gain vs. Water loss
Light interception vs. Heat stress



Joseph Grinnell

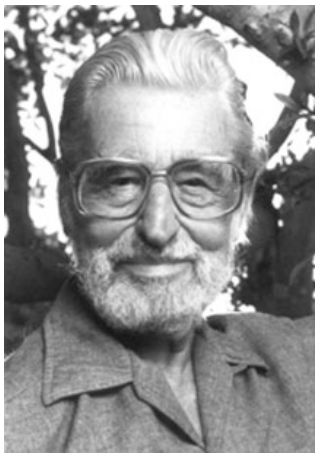
Niche pioneers

Charles Elton

(w/ Aldo Leopold)

And NUH is the letter I use to spell Nutches,
Who live in small caves, known as Niches, for hutches.
These Nutches have troubles, the biggest of which is
The fact there are many more Nutches than Niches.
Each Nutch in a Nich knows that some other Nutch
Would like to move into his Nich very much.
So each Nutch in a Nich has to watch that small Nich
Or Nutches who haven't got Niches will snitch.

-On Beyond Zebra (1955)



Niche: Questions

Are niches properties of species or habitats?

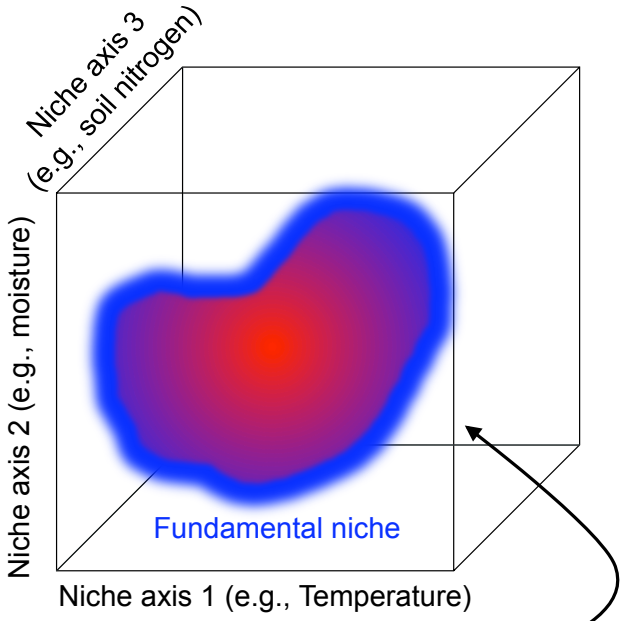
Do they describe roles (professions) or conditions (addresses)?

How do you measure them or quantify them?

Are there “empty niches?”

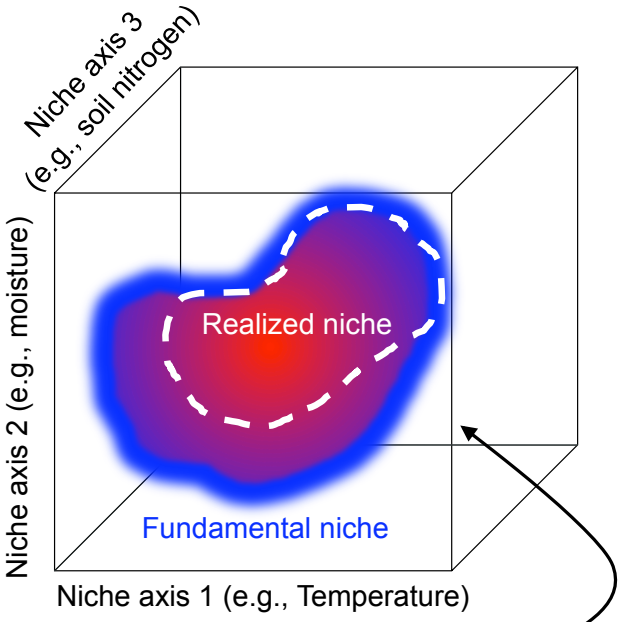
Can two species share the same niche?

G. Evelyn Hutchinson



Niche as “N-dimensional hypervolume”
the set of all conditions under which a species can exist

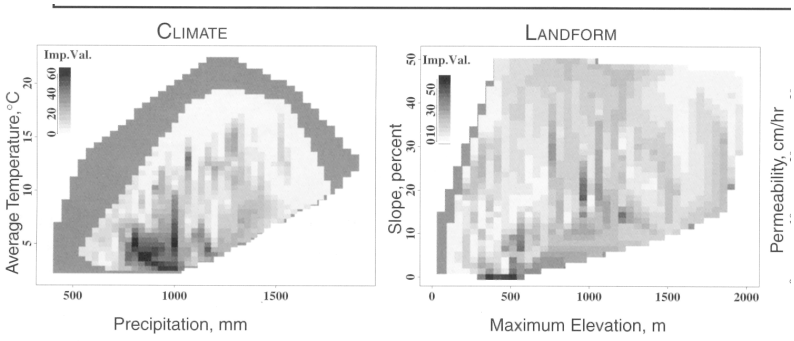
G. Evelyn Hutchinson

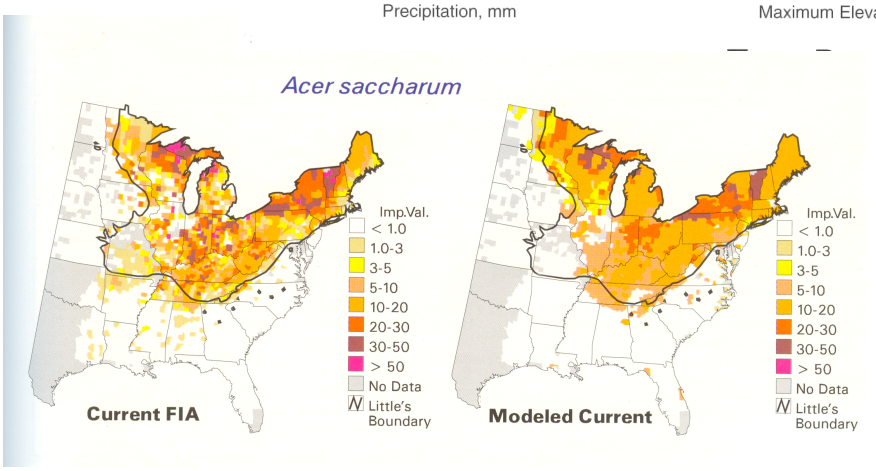


Niche as “N-dimensional hypervolume”
the set of all conditions under which
a species can exist

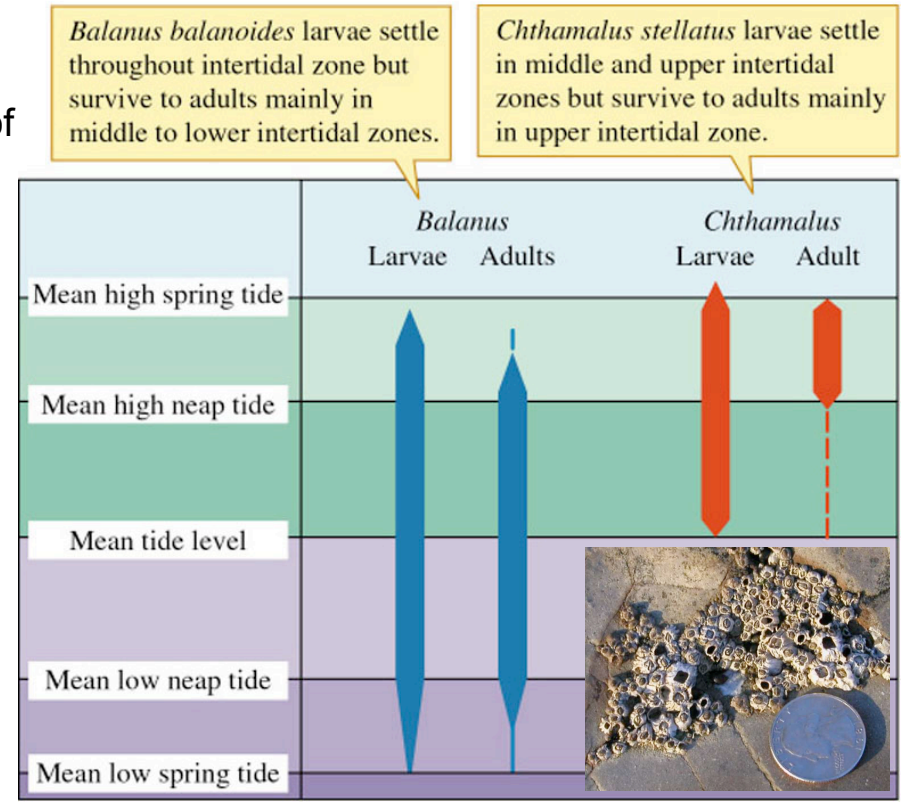
Iverson and Prasad 1998, Distributions of 80 sp. of trees

Fundamental or realized niche?



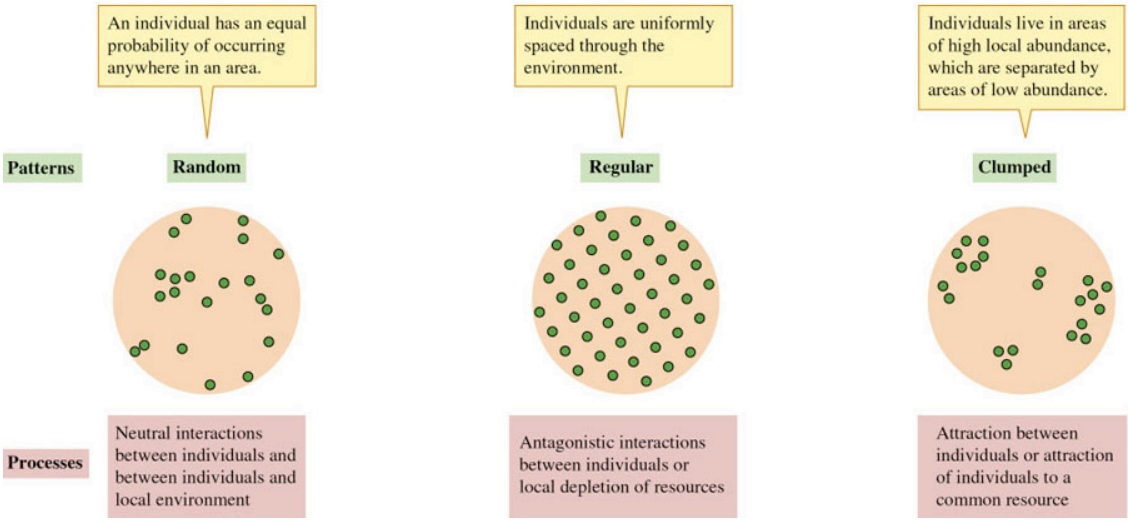


What limits the distribution of barnacles?



Is there a trade-off?

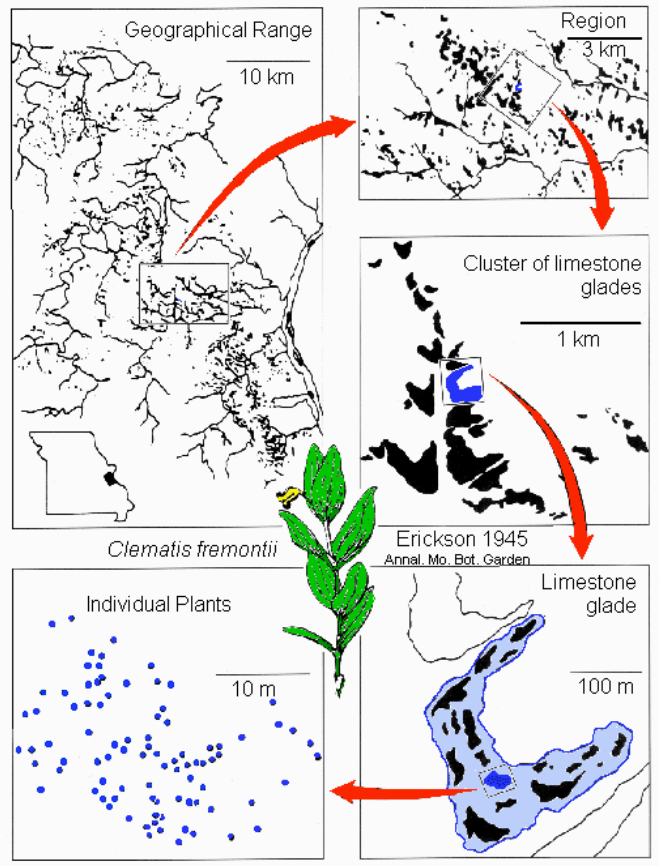
Spatial patterns within populations



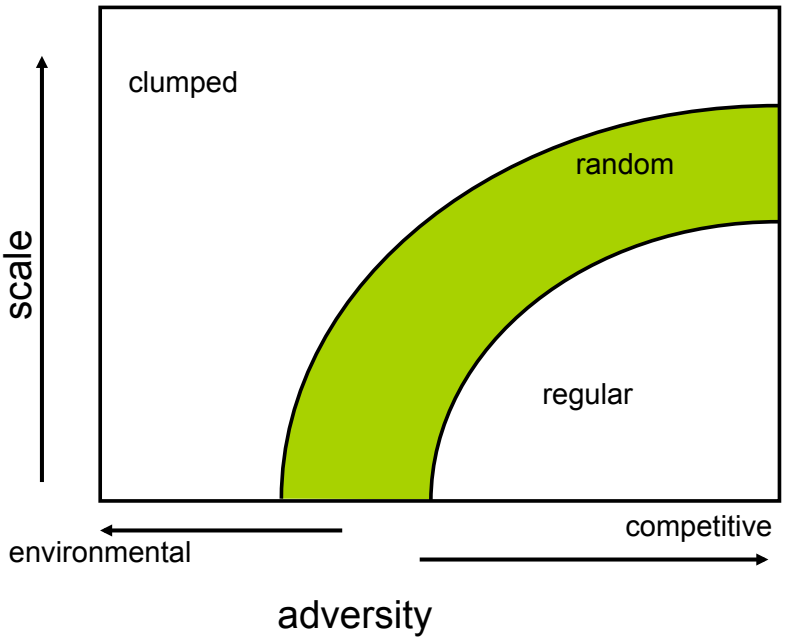
What is the role of scale?

Spatial pattern is scale dependent

Metapopulations - Populations of populations

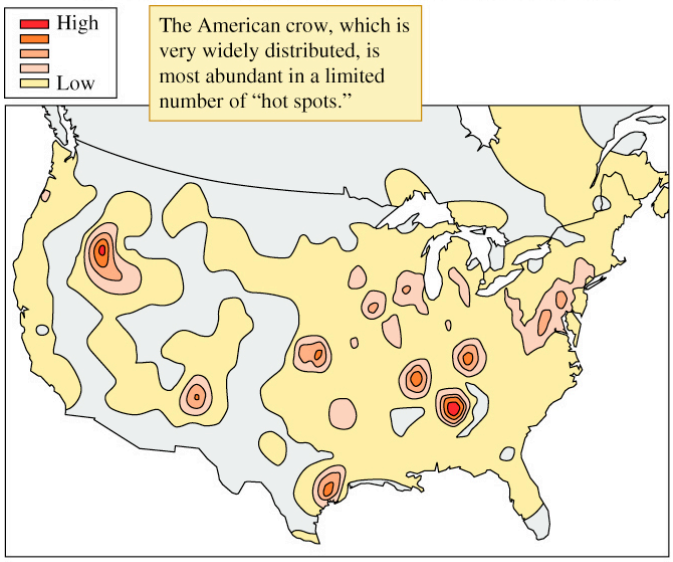


Weiher and Keddy 1999 – Conceptual Model

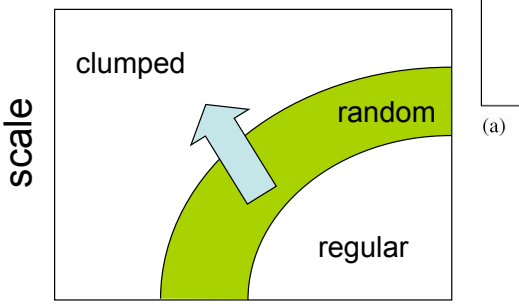


Abundance
Varies in Space

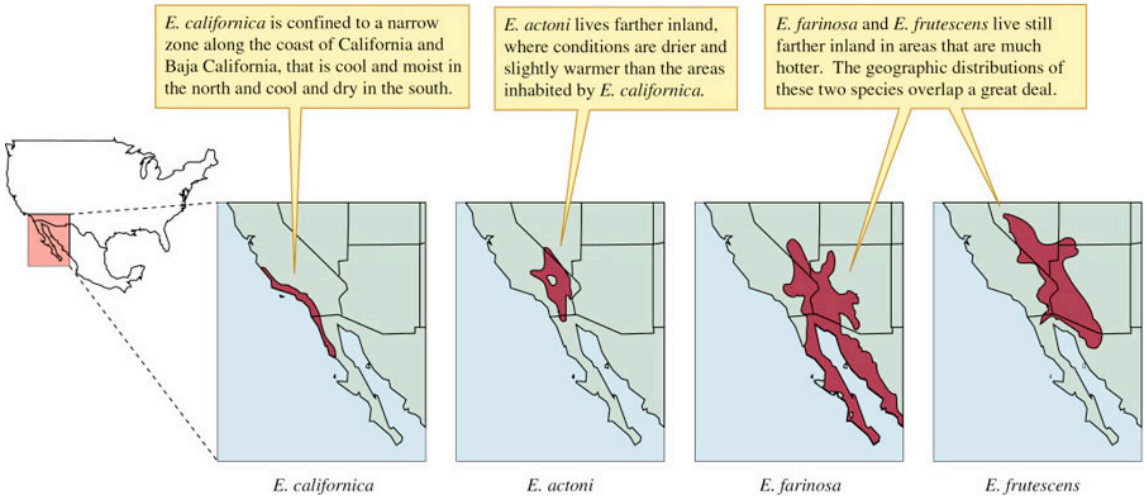
Clumped at
Broad Scales



(a)



Tolerance and distribution in Encelia species



They are all closely related, how are they different?