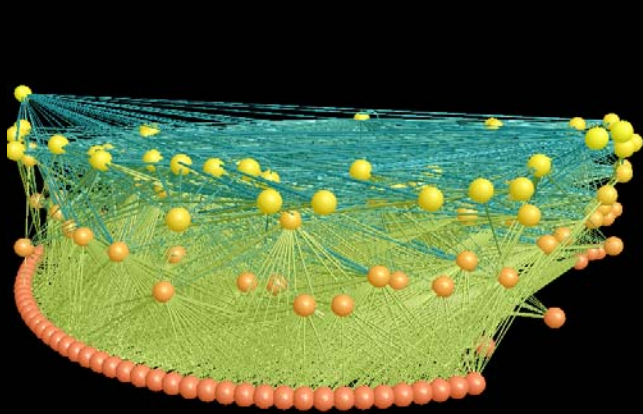
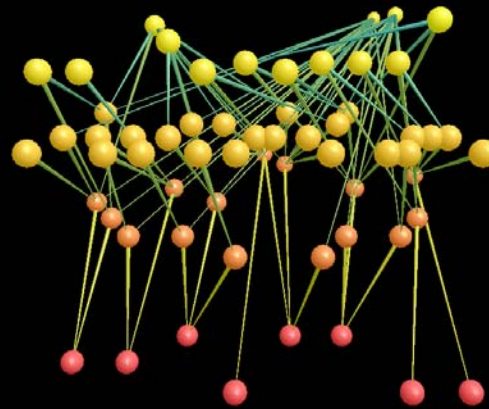


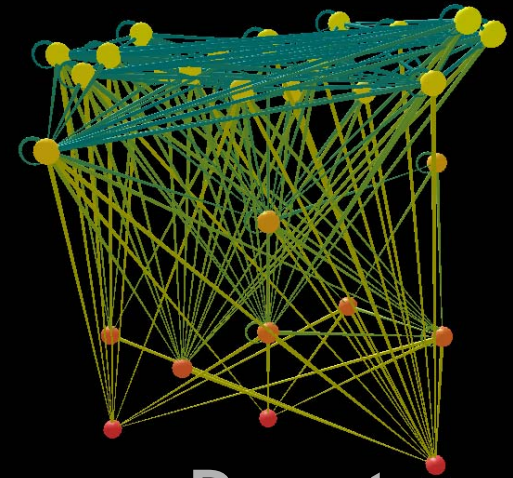
# Competitive Strategies in Changing Environments



**Lake**



**Grassland**



**Desert**

Lauren Buckley  
Santa Fe Institute  
August 2007

Dunne, SFI  
[foodwebs.org](http://foodwebs.org)

Finding a competitive strategy



Adapting strategies through time



Complex interaction networks



Competitive strategies in changing environments



# Finding a competitive strategy

## Paradox of the plankton



(Hutchinson 1961)

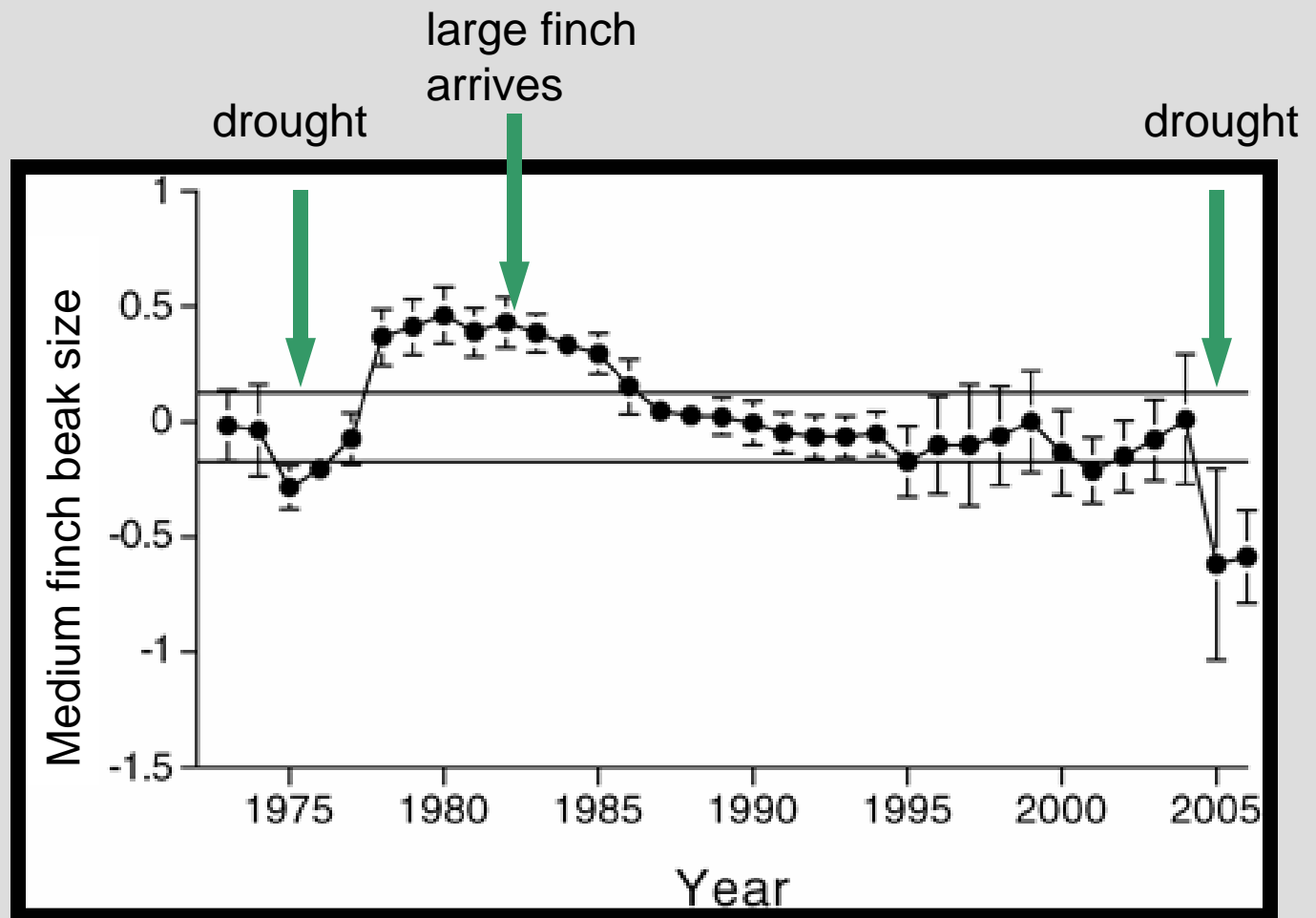
# Context matters



medium ground finch



large ground finch



Galapagos finches  
(Grant & Grant 2006)

# Adapting strategies through time

## Competition - colonization tradeoff



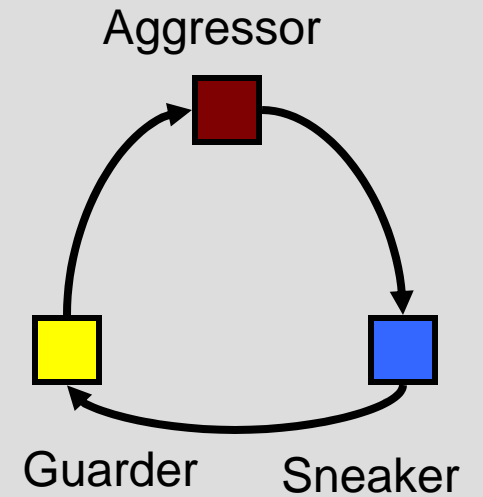
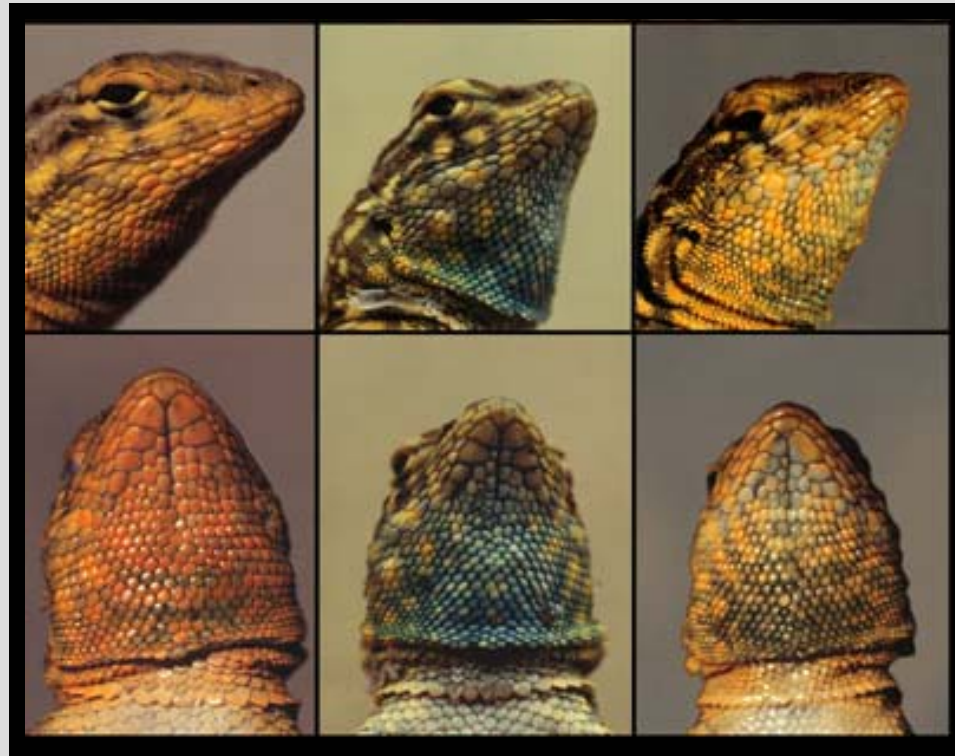
colonize



compete

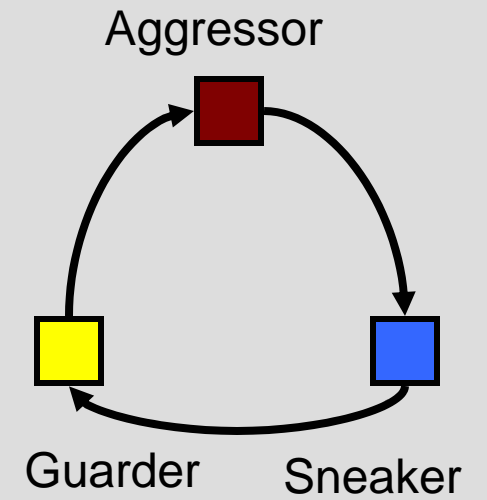
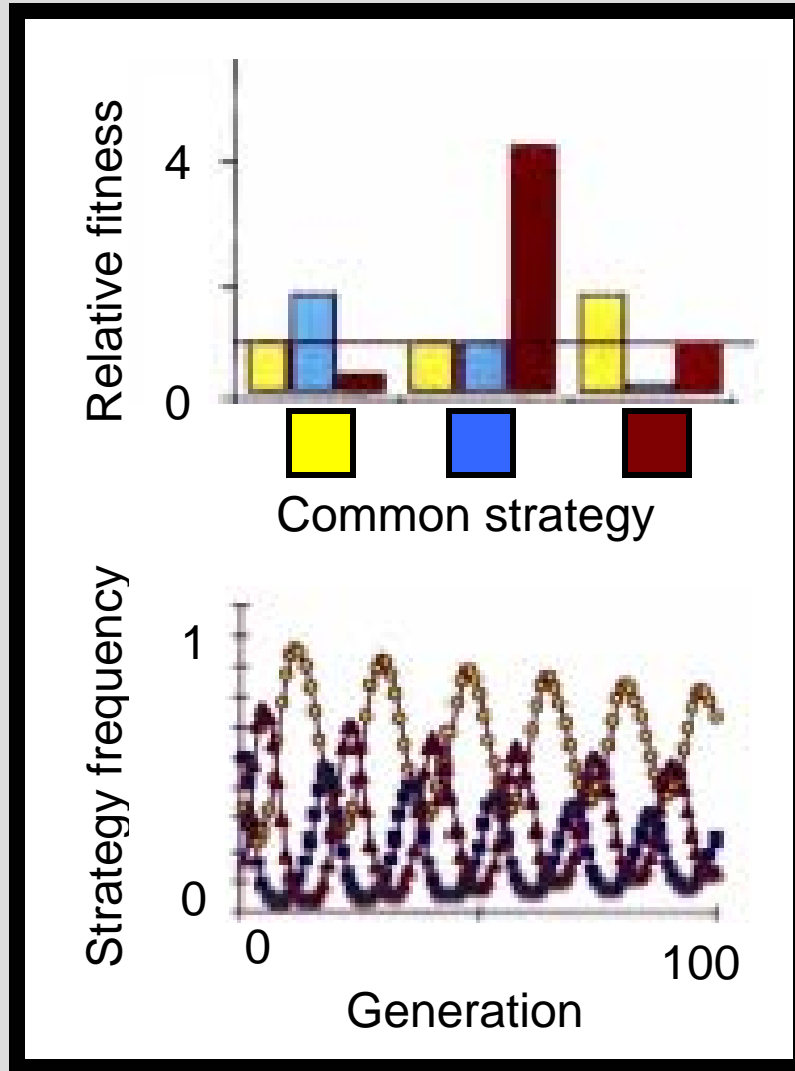
# Complex interaction networks

Aggressor      Guarder      Sneaker



Side-blotched Lizard

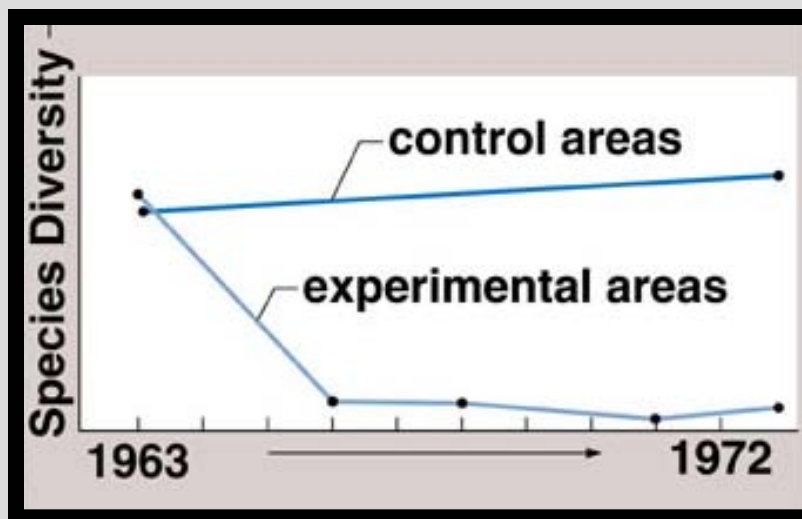
(Sinervo and Lively 1996)



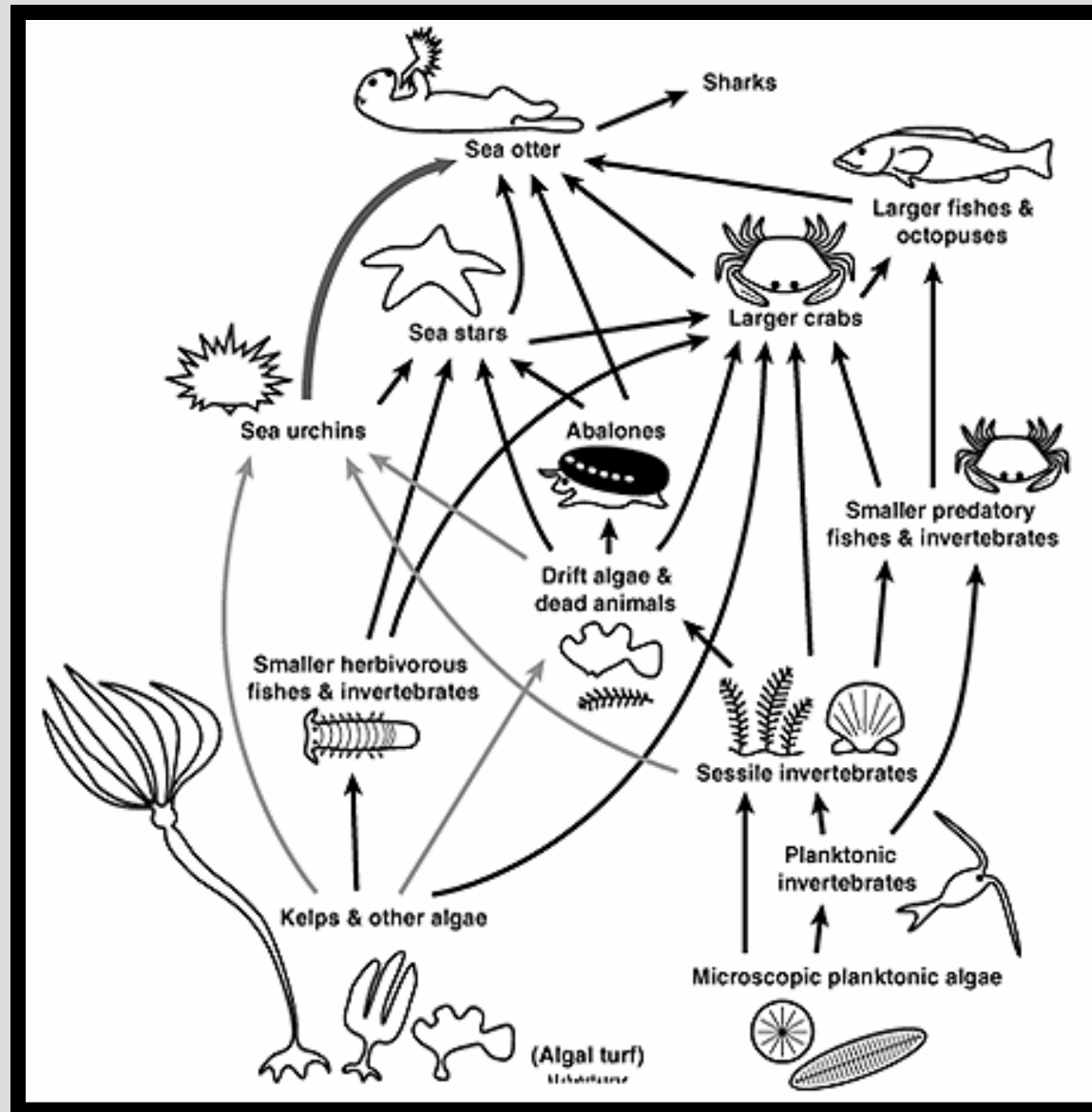
Side-blotched Lizard

(Sinervo and Lively 1996)

# Keystone species

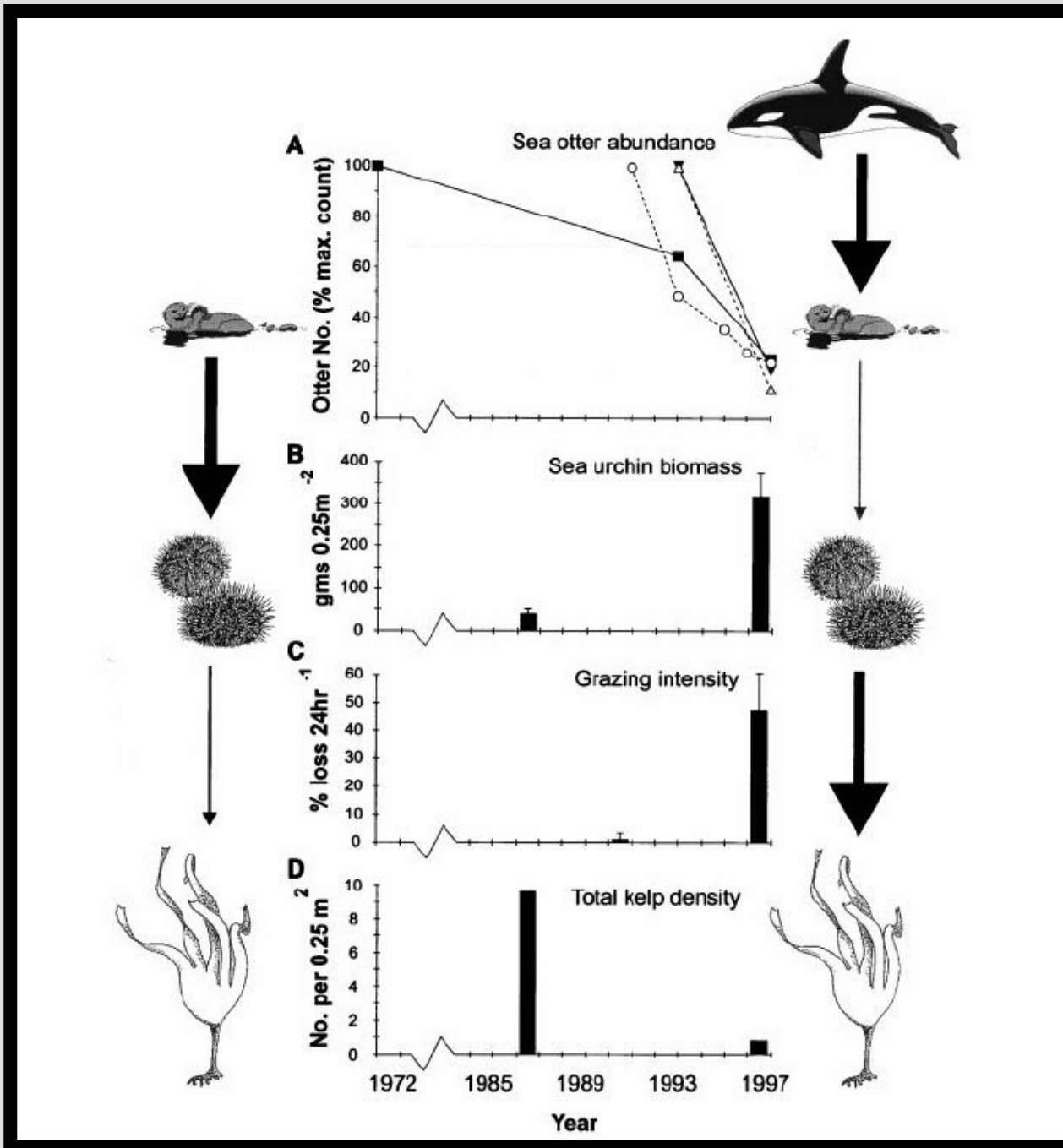


Piaster starfish  
(Paine 1966)

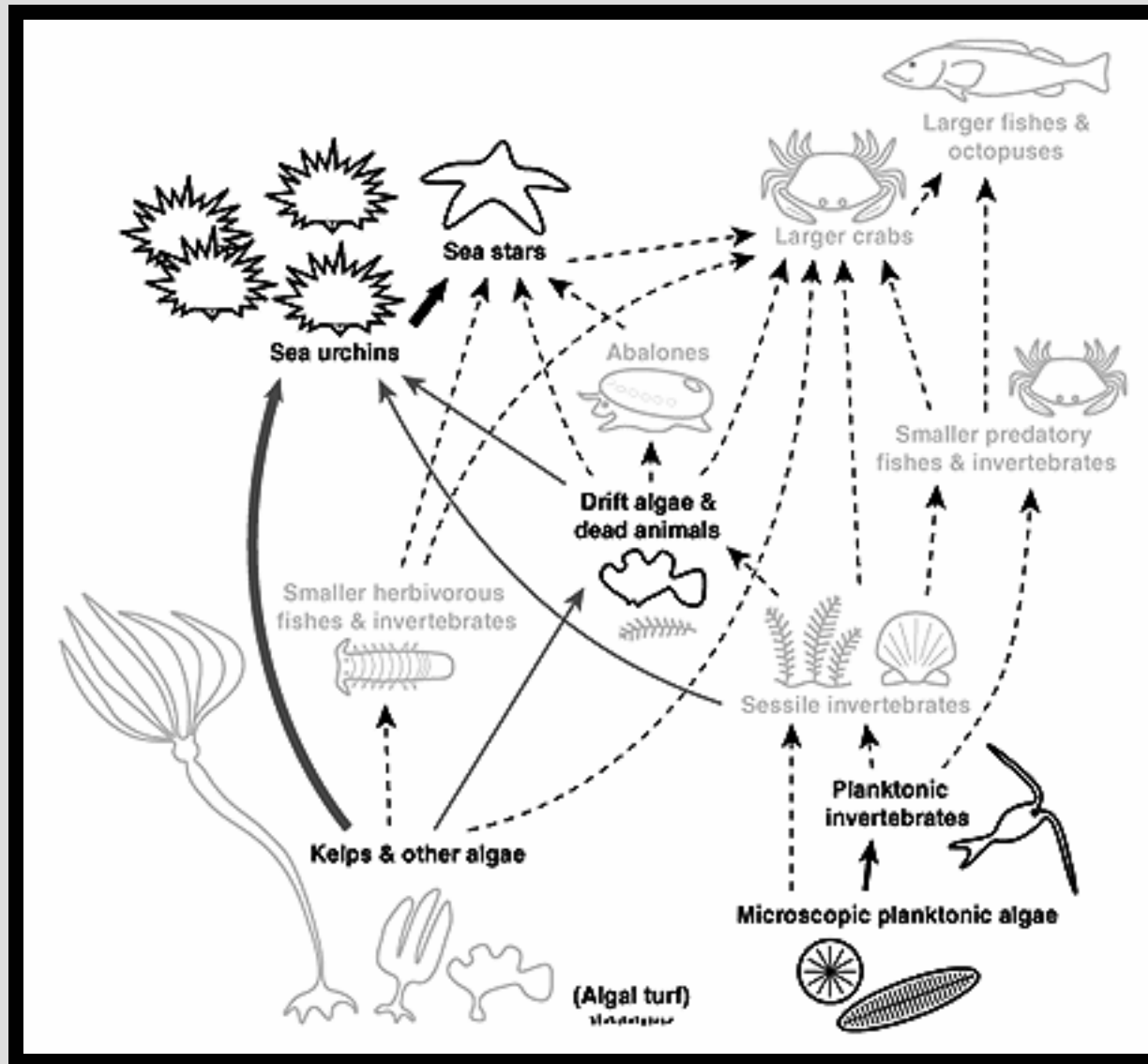


With otters

amnh.org



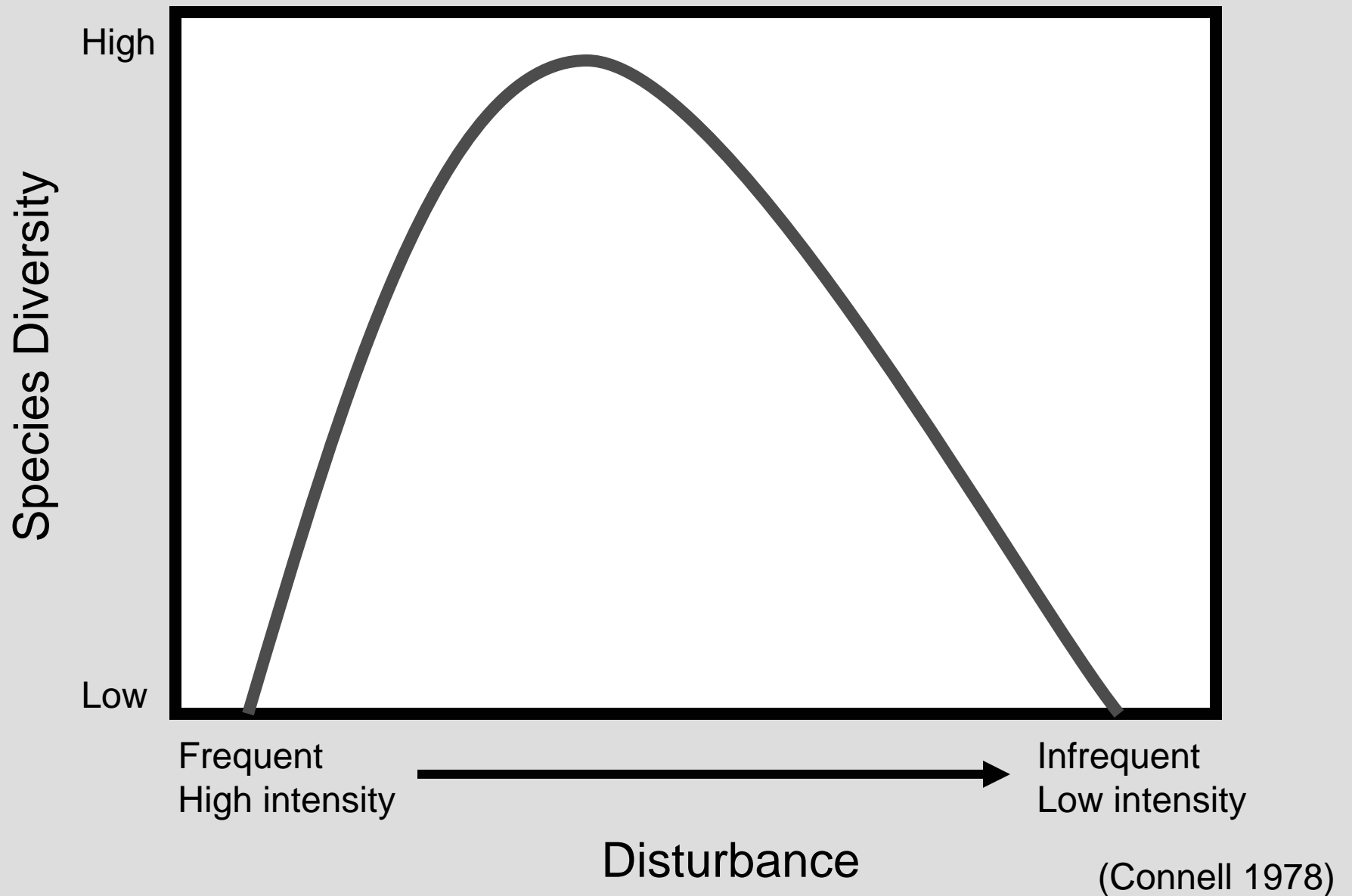
Killer whales  
(Estes *et al.* 1998)

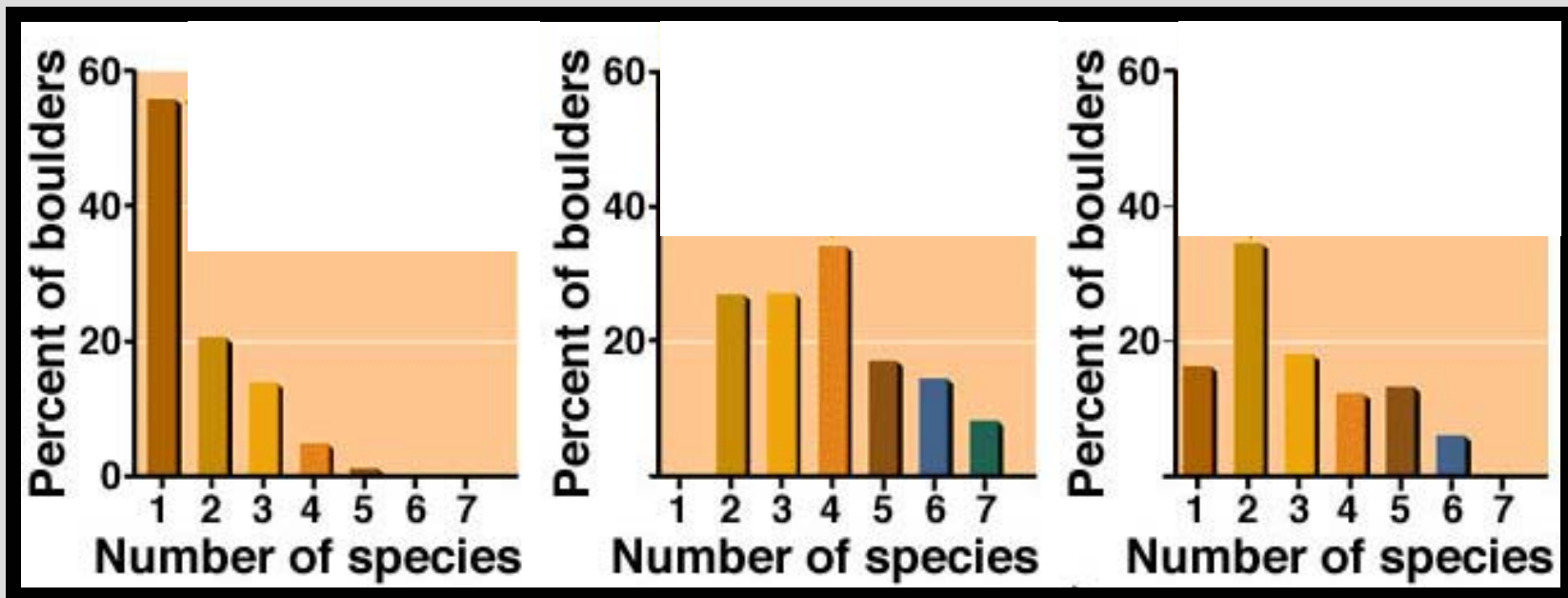


Without otters

amnh.org

# Intermediate disturbance principle





High

Low

Disturbance

Algae on boulders

(Sousa 1979)

# Competitive strategies in changing environments

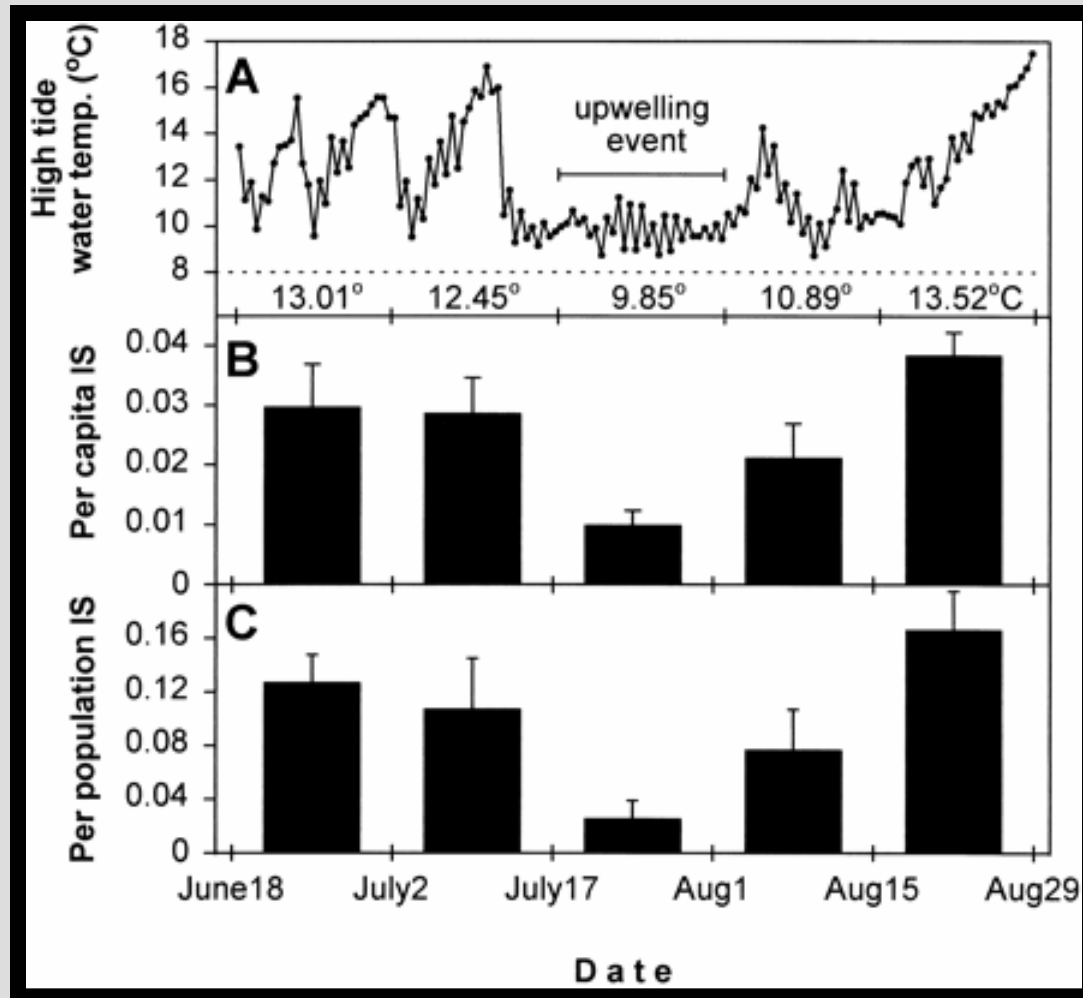
Diverse strategies provide

resistance

resilience



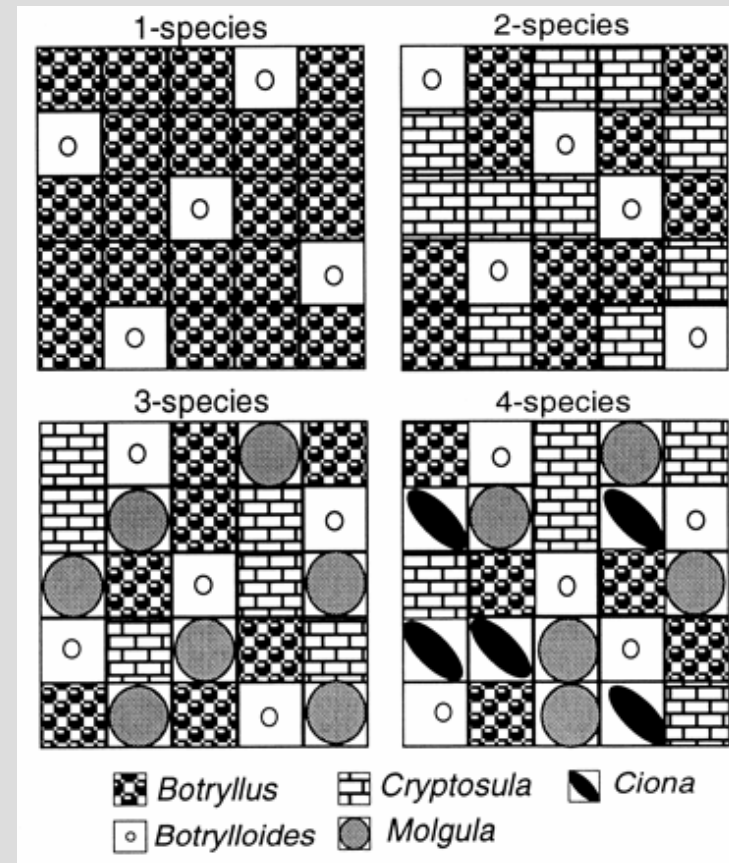
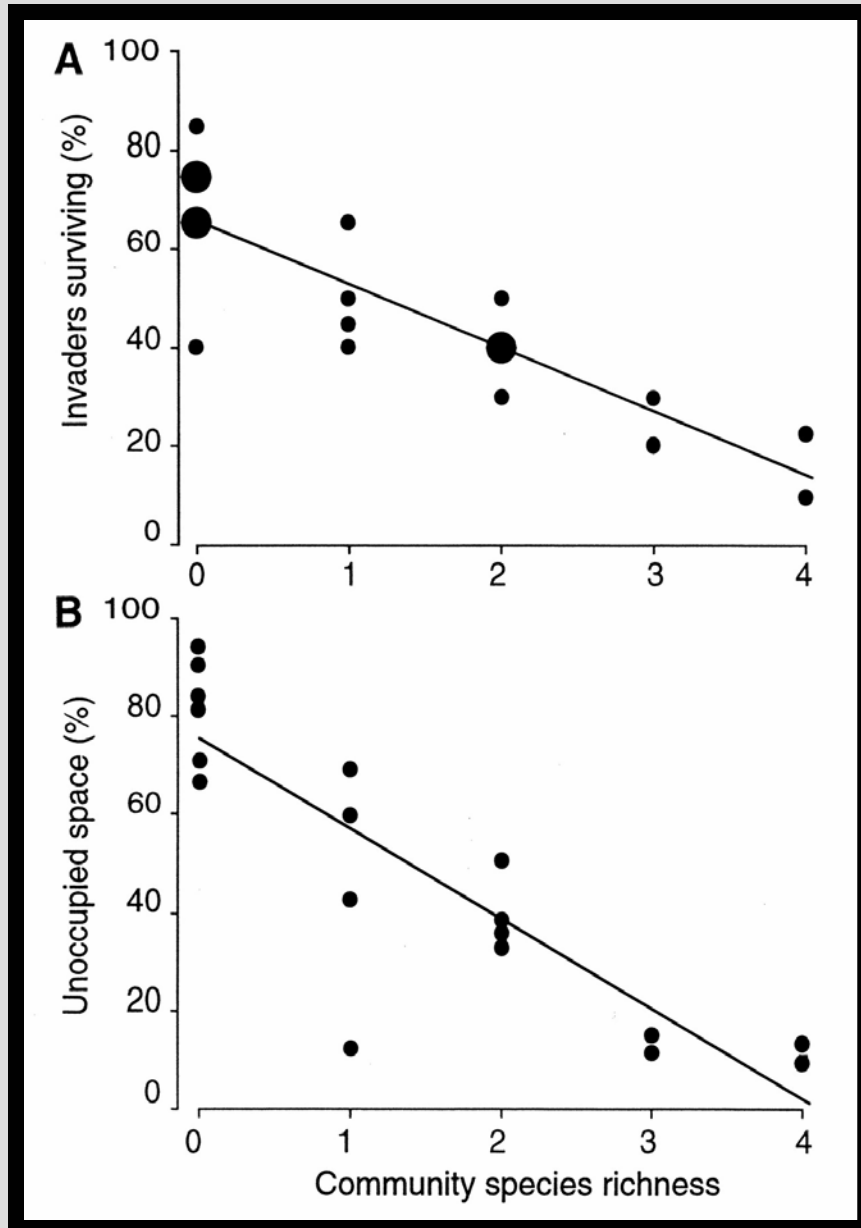
Interaction strength



Temp ↓  
Sea-star predation ↓

Sea-stars & mussels  
(Sanford *et al.* 1999)

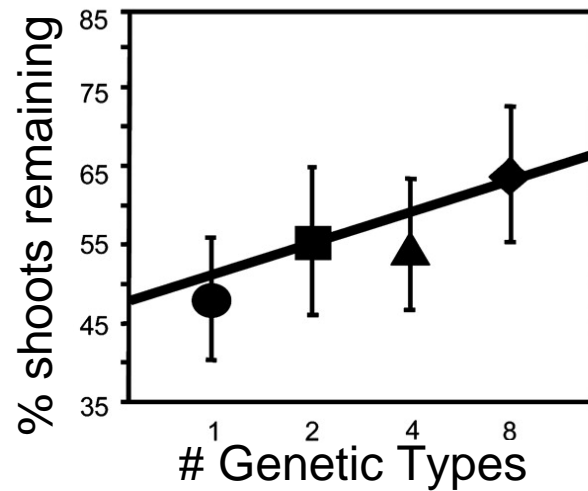
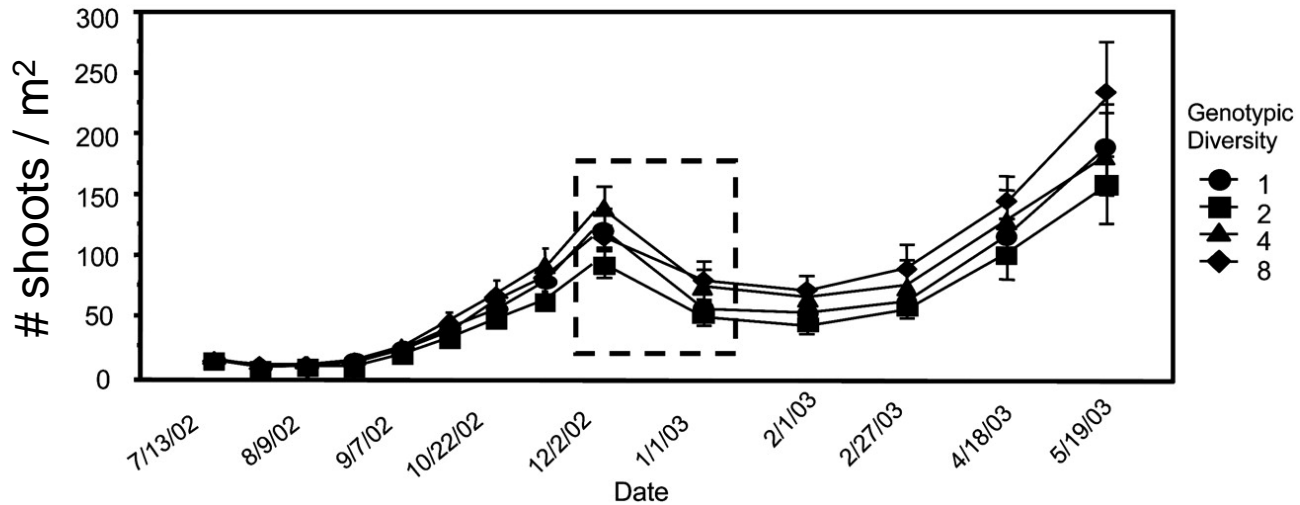
# Resistance



Marine invertebrates

(Stachowicz *et al.* 1999)

# Resilience



# Resistance

Seagrass

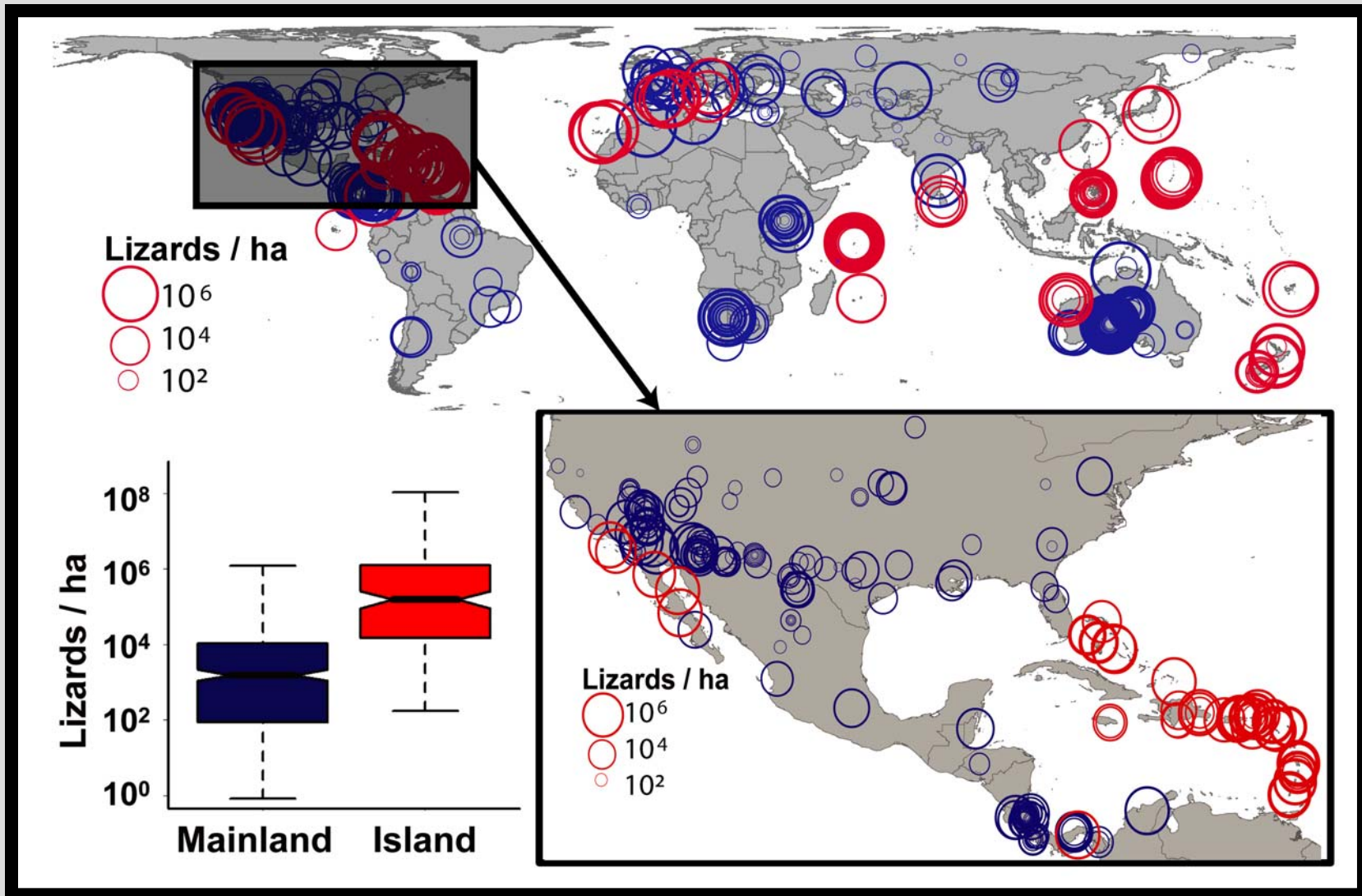
(Hughes & Stachowicz 2004)

# System sensitivity to change varies



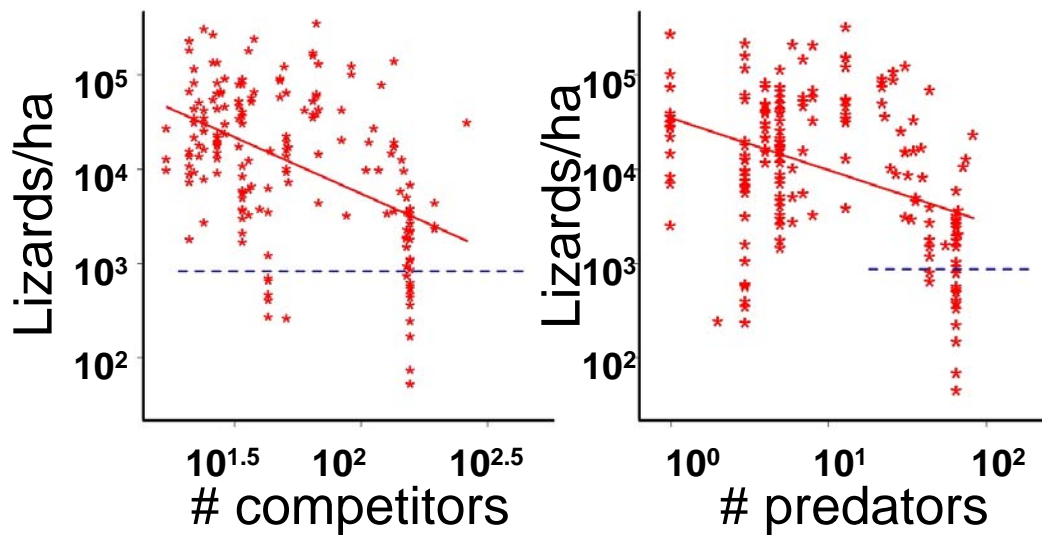
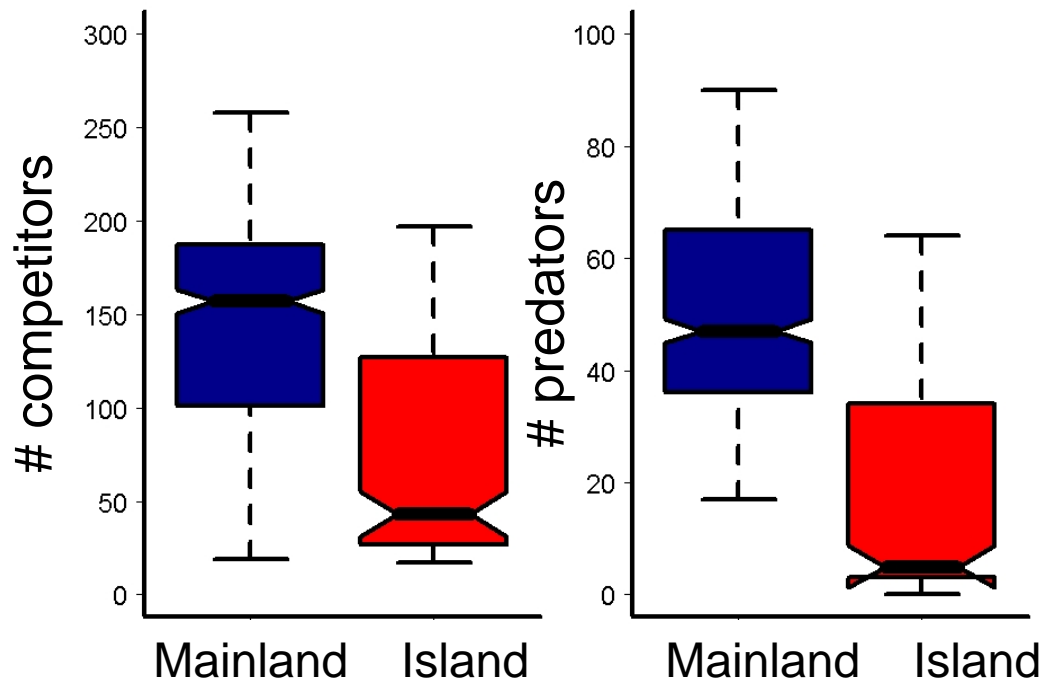
Density compensation

(MacArthur *et al.* 1972)



Lizards

(Buckley & Jetz 2007)



# Lessons from ecological systems

Optimal competitive strategy is context dependent



Changes percolate through networks



Disturbance maintains diversity



Diversity promotes resilience and resistance