

Novel Ecosystems

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ZOO 4420
10 November 2015

What is a Novel Ecosystem?

- ❖ Characterized by combinations and abundances of species that differ from the historical baseline, as well as shifts in ecosystem functioning (Hobbs et al. 2006)



What is a Novel Ecosystem?

- ❖ Idea extends (loosely) back to Elton
 - ❖ Pervasiveness of biological invasions
- ❖ Concept still being distilled amongst conservation biologists
- ❖ “Trojan horse” for conservation?



Novel Ecosystems: 3 Main Causes

- ❖ Local extinction of native species
- ❖ Appearance of new dispersal barriers
- ❖ Major abiotic changes



Anthropogenic Influence

- ❖ Direct impacts:
 - ❖ Urban development
 - ❖ Energy resource extraction
 - ❖ Waste deposition
 - ❖ Agriculture
- ❖ Indirect impacts:
 - ❖ Accidental invasive species introduction
 - ❖ Climate change



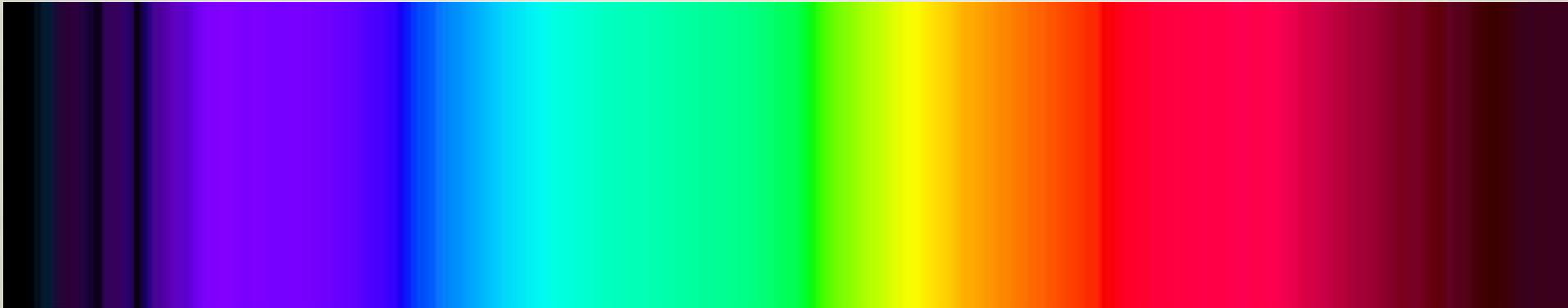
Before



After

Issues with the NE Concept

- ❖ When does a system “become” novel?



Issues with the NE Concept

- ❖ Hybrid ecosystems?



Issues with the NE Concept

- ❖ What happens as invasives become more and more integrated into interaction networks?
 - ❖ Ex: Clapper rail and *Spartina*



Issues with the NE Concept

- ❖ What happens as invasives become more and more integrated into interaction networks?
 - ❖ Ex: Deer mice and knapweed control



Issues with the NE Concept

- ❖ Aren't all ecosystems "novel"?
- ❖ What timescale do we use?



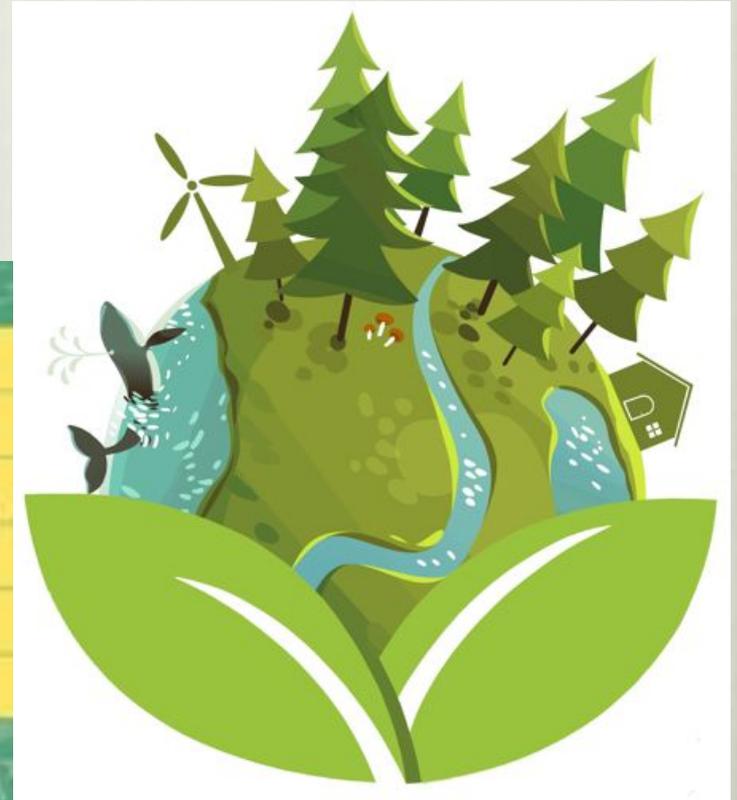
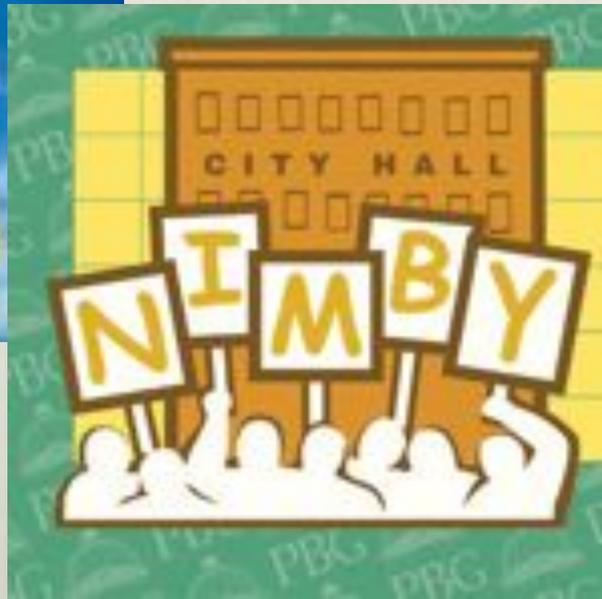
Issues with the NE Concept

- ❖ What message does it send?



Issues with the NE Concept

- ❖ What is the “giving up” point?
 - ❖ Economic/sociopolitical versus ecological



Need a Better Understanding of “Tipping Points”

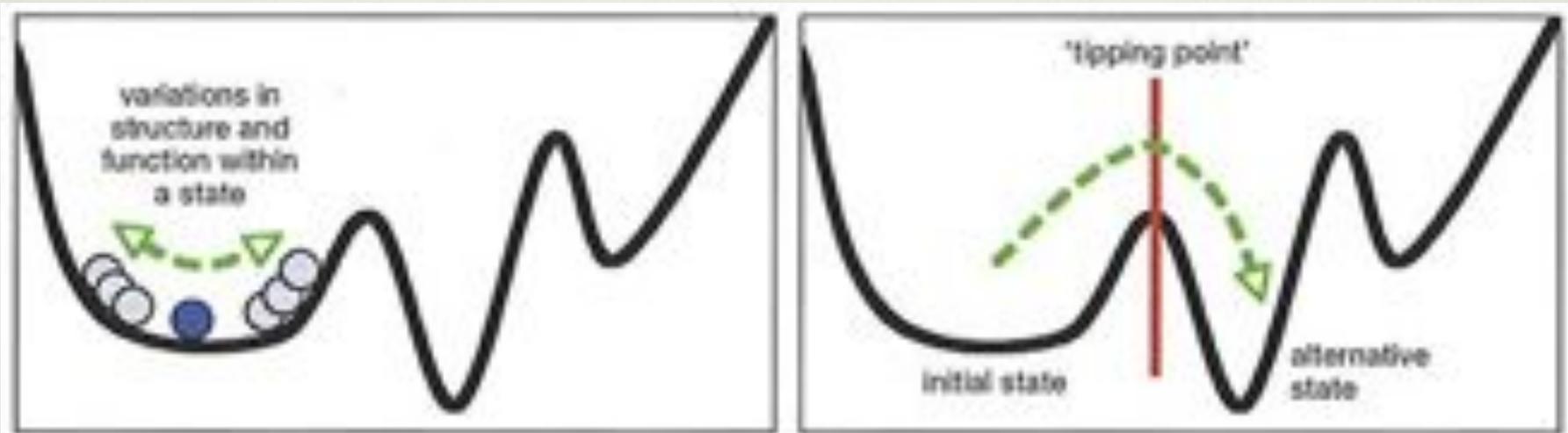


Figure 2: Diagram illustrating ecosystem tipping points. The balls represent the range of possible conditions that normally exist in any given year. If the system is disturbed beyond its resilience capacity, it “tips” to a new state, for ex. shrubland to desert.



<https://hainanproject.wordpress.com/2010/05/12/gbo-3-biodiversity-losses-increasing-and-ecosystem-services-may-reach-tipping-points/>

<https://encrypted-tbn2.gstatic.com/images?q=tbn:ANd9GcTzzF5kCXuqH3kR3UJ1GqOET5kvsGWbgH5Xkf19f5RVNkVWYq1rFA>

Issues with the NE Concept

- ❖ Can native species become “invasive”?

Issues with the NE Concept

- ❖ Can native species become “invasive”?
- ❖ Black vulture



Issues with the NE Concept

- ❖ Can native species become “invasive”?
- ❖ Western juniper



Issues with the NE Concept

- ❖ What goals are driving conservation of ecosystems?
 - ❖ Historic assemblages vs ecosystem services
 - ❖ “Trojan horse” of conservation



Biotic Homogenization

❖ One impact of the development of novel ecosystems on biodiversity

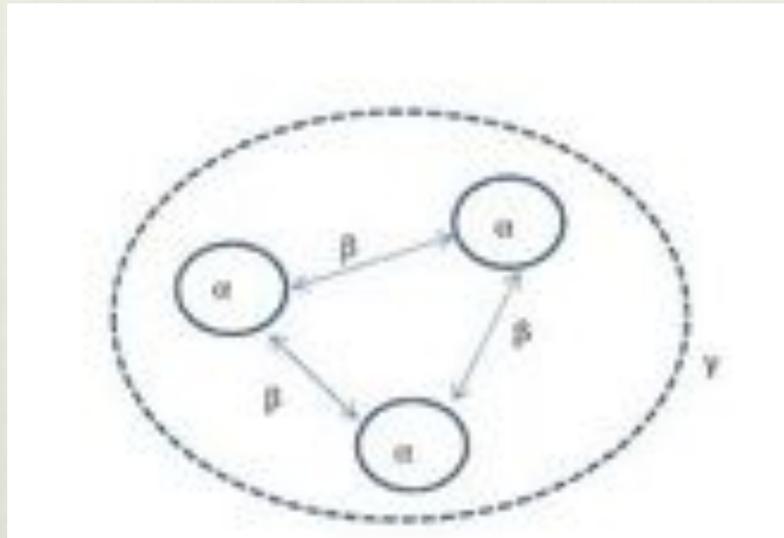
❖ Urban areas cater to one species: humans.

❖ = Similar conditions around the globe

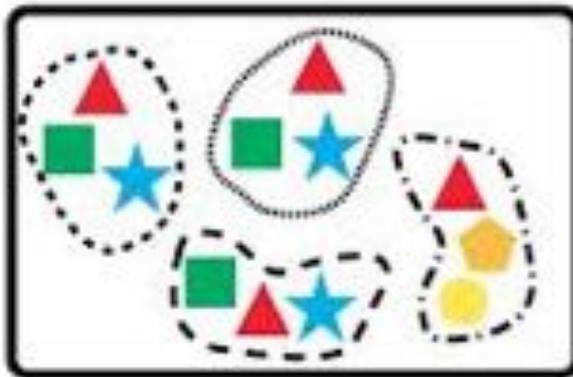
❖ Species assemblages become more similar over time and space



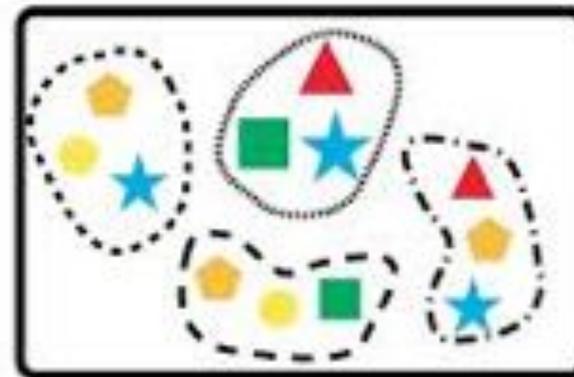
Alpha vs Beta Diversity



low spatial turnover



high spatial turnover



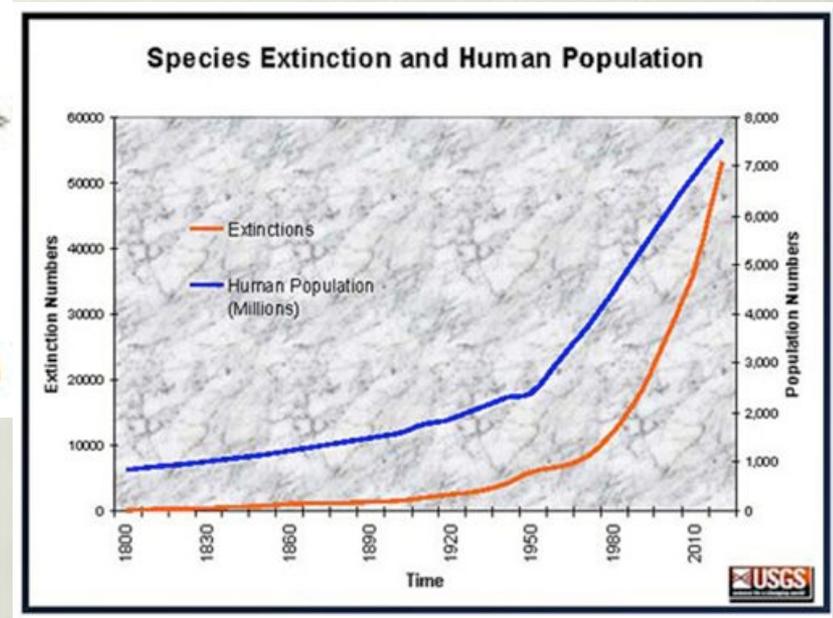
Drivers of BH

- ❖ Establishment of non-native species



Drivers of BH

- ❖ Extirpation/extinction of native species



Drivers of BH

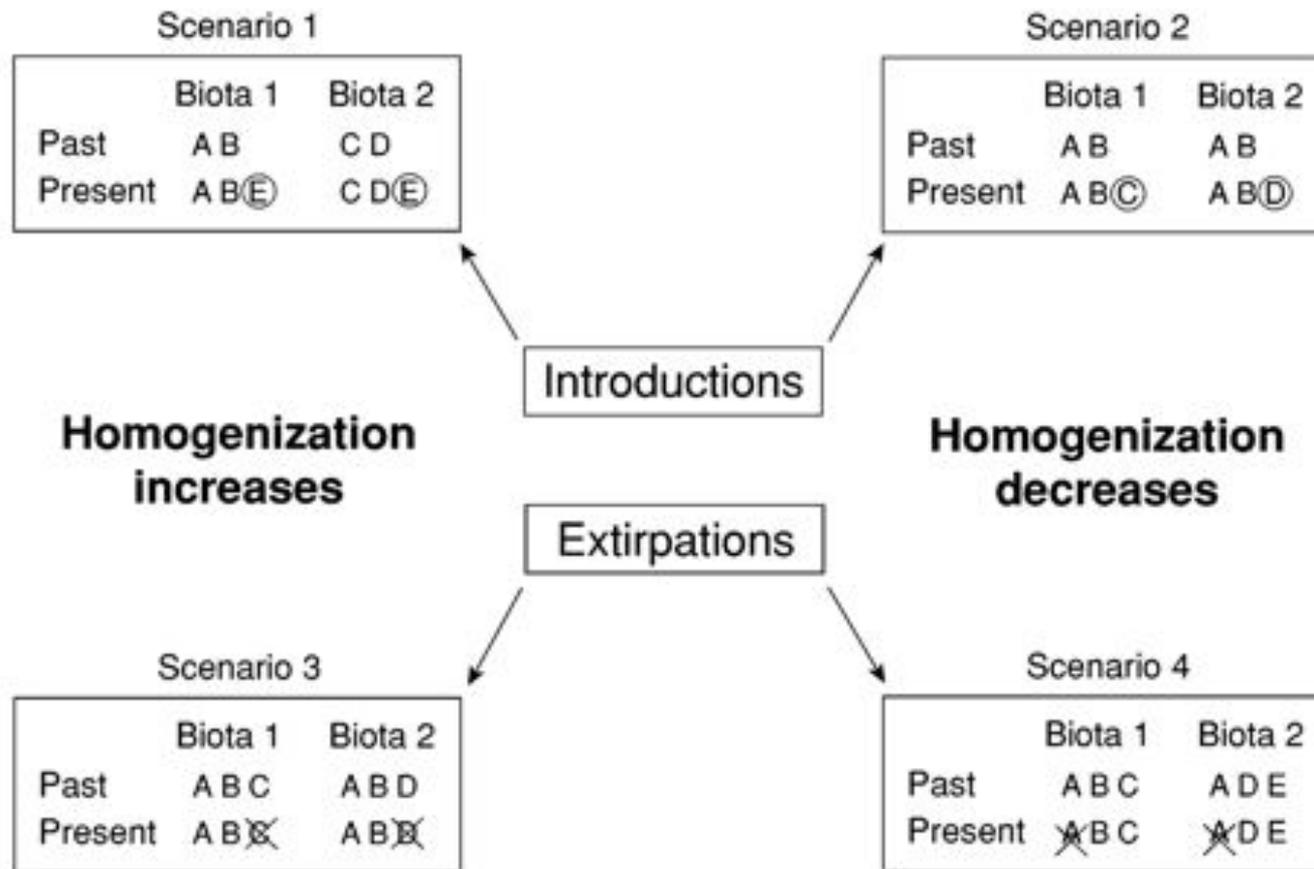
❖ Habitat alteration



Biotic Homogenization

- ❖ Key point: increased local diversity can mean decreased global diversity

Biotic Homogenization



Questions?



Research Example: Introduced cactus (*Opuntia*) in central Kenya

- ❖ *Opuntia stricta*
- ❖ Prickly pear – Native to southwestern U.S. and Central America



Problem: Invasive Cactus is Taking Over Laikipia's Rangelands

- ❖ Introduced as an ornamental in mid-20th century
- ❖ Thanks, colonialism



Opuntia: Optimized for Invasion

- ❖ Produces by both budding and seeds
- ❖ Makes tasty fruits that many animals will eat
- ❖ Produces fruits year-round in certain climates
- ❖ Seeds viable after up to 20 years of dormancy



Opuntia: Optimized for Invasion



Opuntia problem: Questions

- ❖ Does digestion by native mammals enhance germination of *Opuntia*?
- ❖ Is species richness of native mammals different in invaded areas than non-invaded areas?
 - ❖ How does introduction of a biocontrol insect affect this?
- ❖ What environmental and management variables contribute to *Opuntia* success?



Biotic Homogenization: Global Urbanization and Bird Diversity

- ❖ Use citizen science data to test hypotheses about BH in relation to available green space and economic development indicators.
- ❖ Calculate BH between urban and control areas, compare across globe, build a model using environmental and socioeconomic predictor variables.



More Questions?

