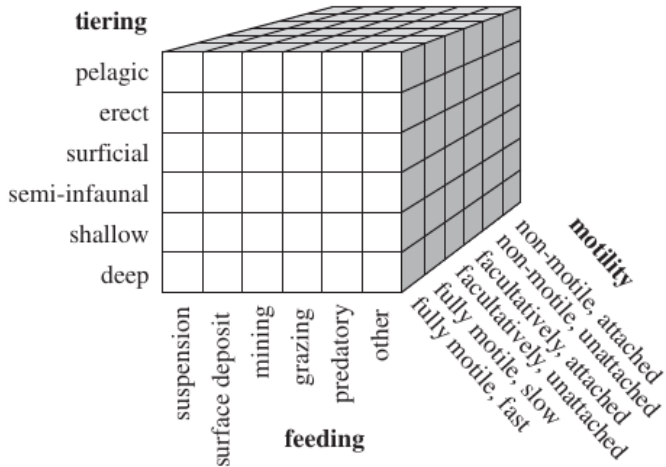


General Models of Ecological Diversification

Talk at **Earth** by Ankit

Introduction



Ecospace

How the Ecology of Past Utilized?

There has been many hypothesis to explain the utilization of ecospace of past.

- These hypothesis can be generalized into four models of ecological diversification.

Four Models of Ecological Diversification

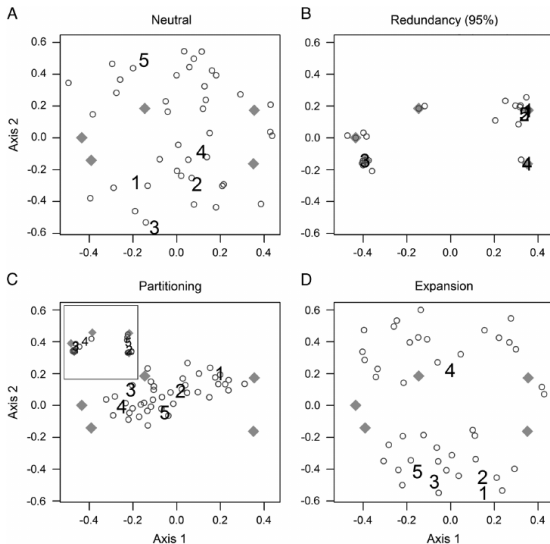


Figure 1: Four ecological Models

Potential Mechanism: Expansion

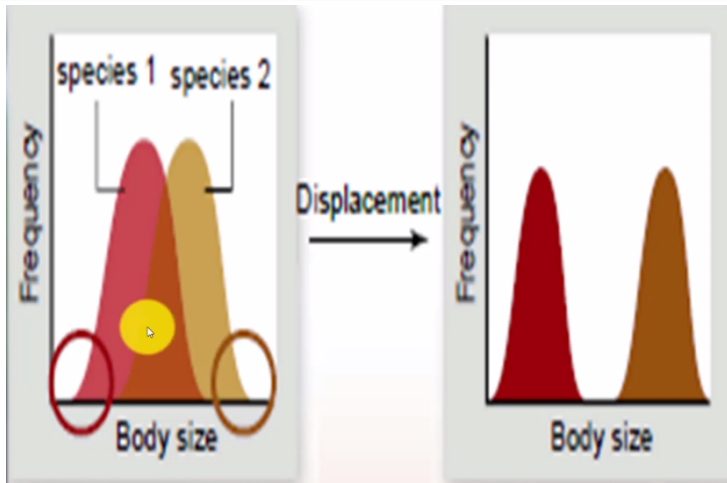


Figure 2: Character Displacement

Hey !! we don't want to fight, let's be strong at our own places.

Potential Mechanism: Expansion

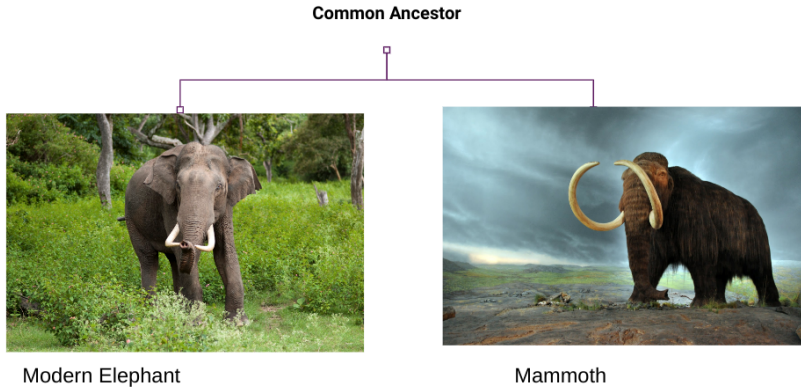


Figure 3: Divergence

Potential Mechanism: Expansion

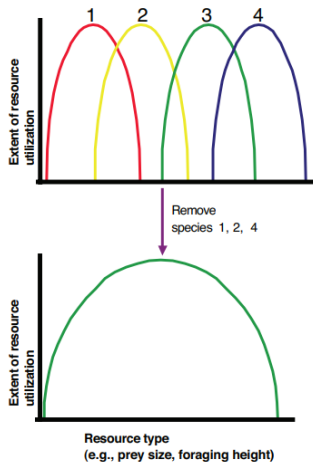


Figure 4: Ecological Release

Potential Mechanism: Expansion

Few more

Key innovation, habitat colonization, increased nutrient availability etc.

Potential Mechanism: Redundancy

- **Niche Conservatism** The tendency of species to retain ancestral ecological characteristic.

Potential Mechanism: Redundancy

- **Niche Conservatism** The tendency of species to retain ancestral ecological characteristic.
- **Competition- Colonization trade-offs** that allow poorer competitors to resist extinction by virtue of higher dispersal rates- can maintain redundancy by restricting opportunities for local competitive interactions.

Potential Mechanism: Redundancy

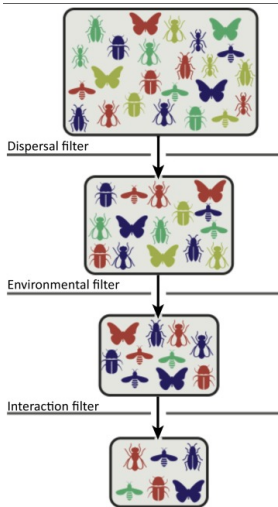


Figure 5: Habitat filtering control on community membership, can restrict community membership to species sharing particular functional traits

Potential Mechanism: Redundancy

Disruption in competitive interactions lead to increase in degree of redundancy. Sometimes Keystone species (and predation help in disrupting the competition.

Keystone species hold together the complex web of relationships in an ecosystem.

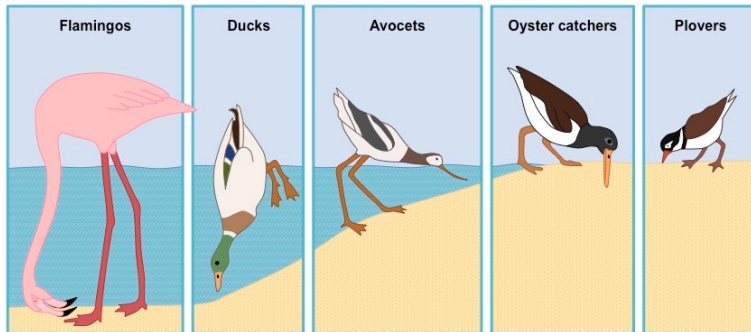
e.g., The foxes prey on other species and help to keep their populations down.

Potential Mechanism: Partitioning

In a generalized sense, partitioning is a form of resource specialization.

Niche Differentiation

Resource Partitioning: Species alter their use of the niche to avoid competition, by dividing resources among them



Potential Mechanism: Partitioning

Ecological fitting

An organism continues to exploit the same resources, but in a new host or environment.

Potential Causal Mechanism: Neutral

Not a cause driven model, its a passive model which is random.

Statstical Metrics used

- Functional Richness (FRic)- Volume of the functional space occupied by the community.

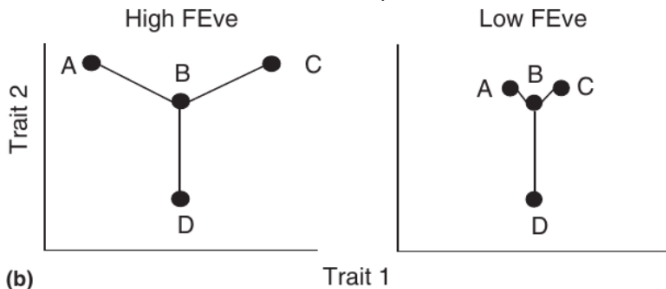
Calculated by Quick hull algorithm

Statistical Metrics used

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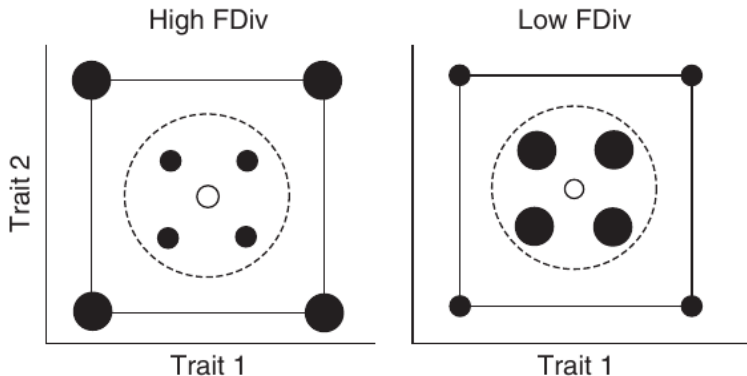
Calculated by Quick hull algorithm

- Functional Evenness (FEve)- the evenness of the abundance distribution in a functional trait space.



Statistical Metrics used

- Functional Divergence (FDiv)- FDiv measures the degree to which the abundance of a community is distributed toward the extremities of occupied functional trait space.



Statistical Metrics used

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- Functional Dispersion (FDis)

Distinguish the models

Redundancy models

- Life-habit richness (H) values far lower than species richness(S)

Partitioning

Discrete clumps in Redundancy whereas Partitioning model shows are more continuously distributed life habits.

Distingusih the models

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Partitioning

- Declining trends in all statistics (except for certain such as $FRic$ and M , that will increase slowly).
- Linear gradients are present in ecospace occupation.

Discrete clumps in Redundancy whereas Partitioning model shows are more continuously distributed life habits.

Expansion vs Neutral

- The rate of increase will be slightly greater for the expansion model.

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- ***Need large ecospace frameworks with many characters***

Dynamics and Mechanism of Models

Model	Rule	Potential causal mechanisms	Dynamics			
			Richness (H)	Disparity / dispersion ($FDis$, V , $FRic$, M)	Internal structure ($FDiv$, D)	Spacing ($FEve$)
Expansion	Successive species occupy life habits divergent from those already inhabited.	Divergence, character displacement, adaptive radiation, ecological opportunity, ecological release, key innovation, habitat colonization, increased nutrient availability, (in part: ecosystem engineering, escalation, Red Queen, seafood through time)	$\approx S$	\uparrow (fastest)	$\downarrow FDiv$	Constant
Neutral	Successive species accumulate without regard to existing life habits.	Stochasticity, random colonization from species pool	$\approx S$	\uparrow (fast)	$\downarrow Fdiv$ D constant	Constant
Partitioning	Successive species occupy life habits intermediate to those already inhabited.	Niche partitioning, specialization, coevolution, ecological fitting	$rel: \leq S \text{ str.} < S$	\uparrow (slow) $FRic$, M , \downarrow (slow) $FDis$, V	\downarrow	\downarrow
Redundancy	Successive species occupy life habits already inhabited.	Keystone species, intermediate disturbance, competition—colonization trade-off, emergent neutrality, habitat filtering, niche conservatism, adaptive peaks, systems stability	Constant and low	$\downarrow FDis / V$, low $FRic$, constant M	$\uparrow FDiv$, $\downarrow D$	\downarrow