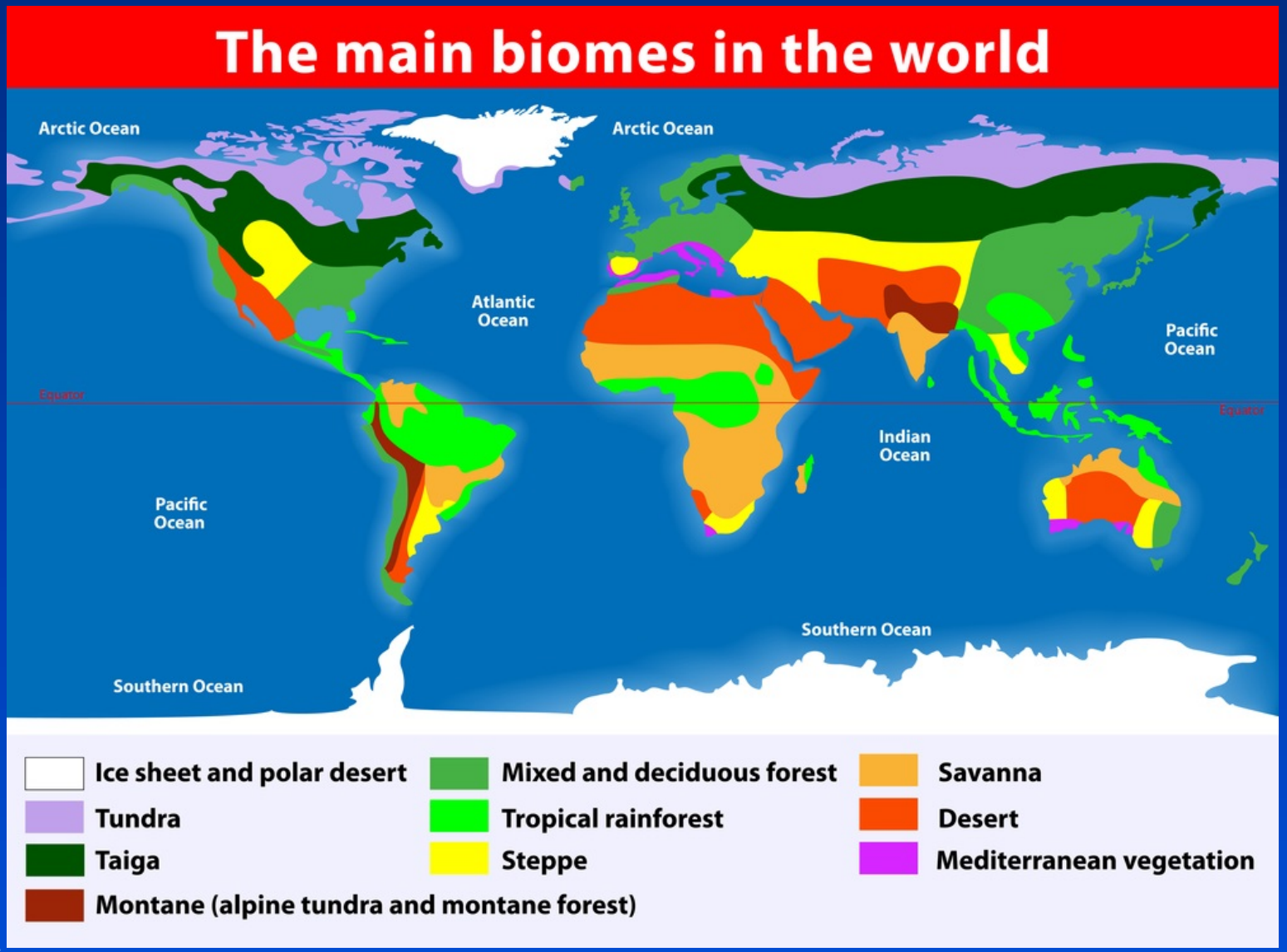
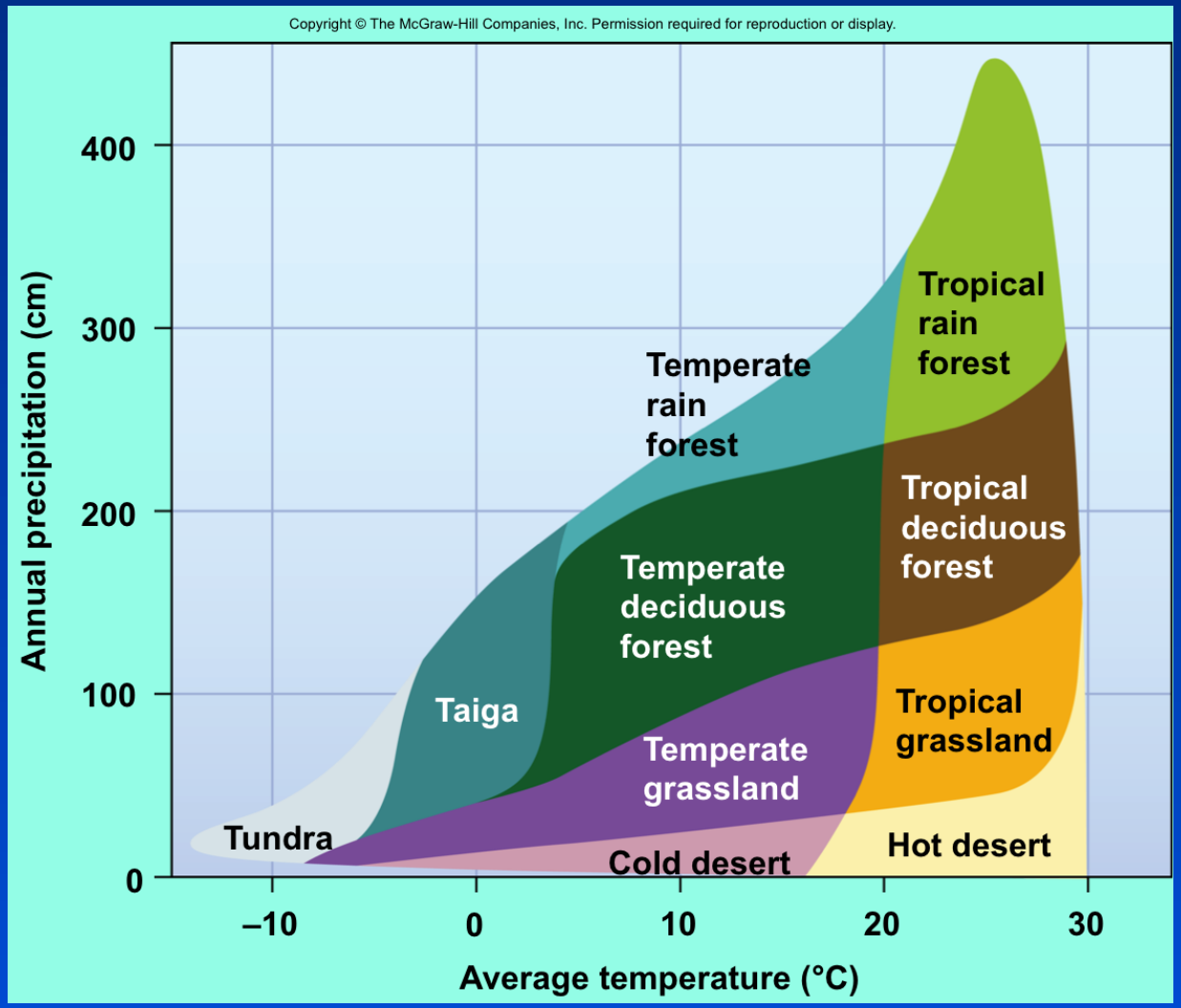
Climax communities



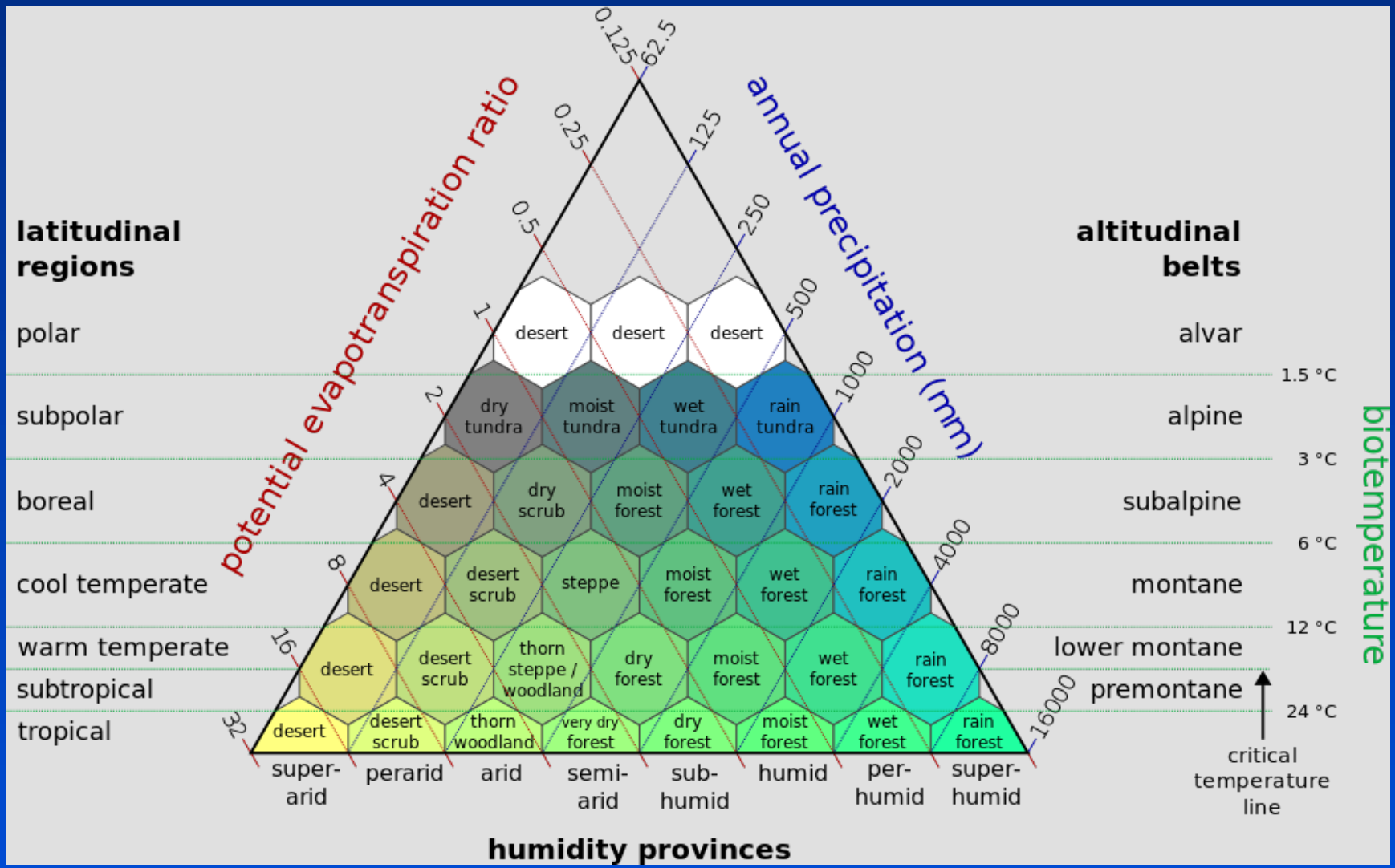
Climax communities

Main climatic determinants of biomes



Climax communities

Main ecological determinants of biomes



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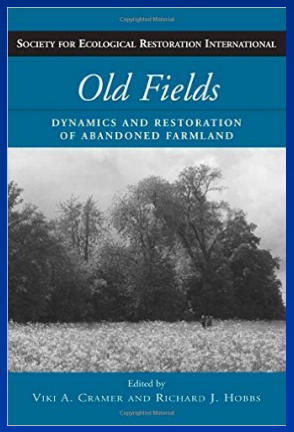
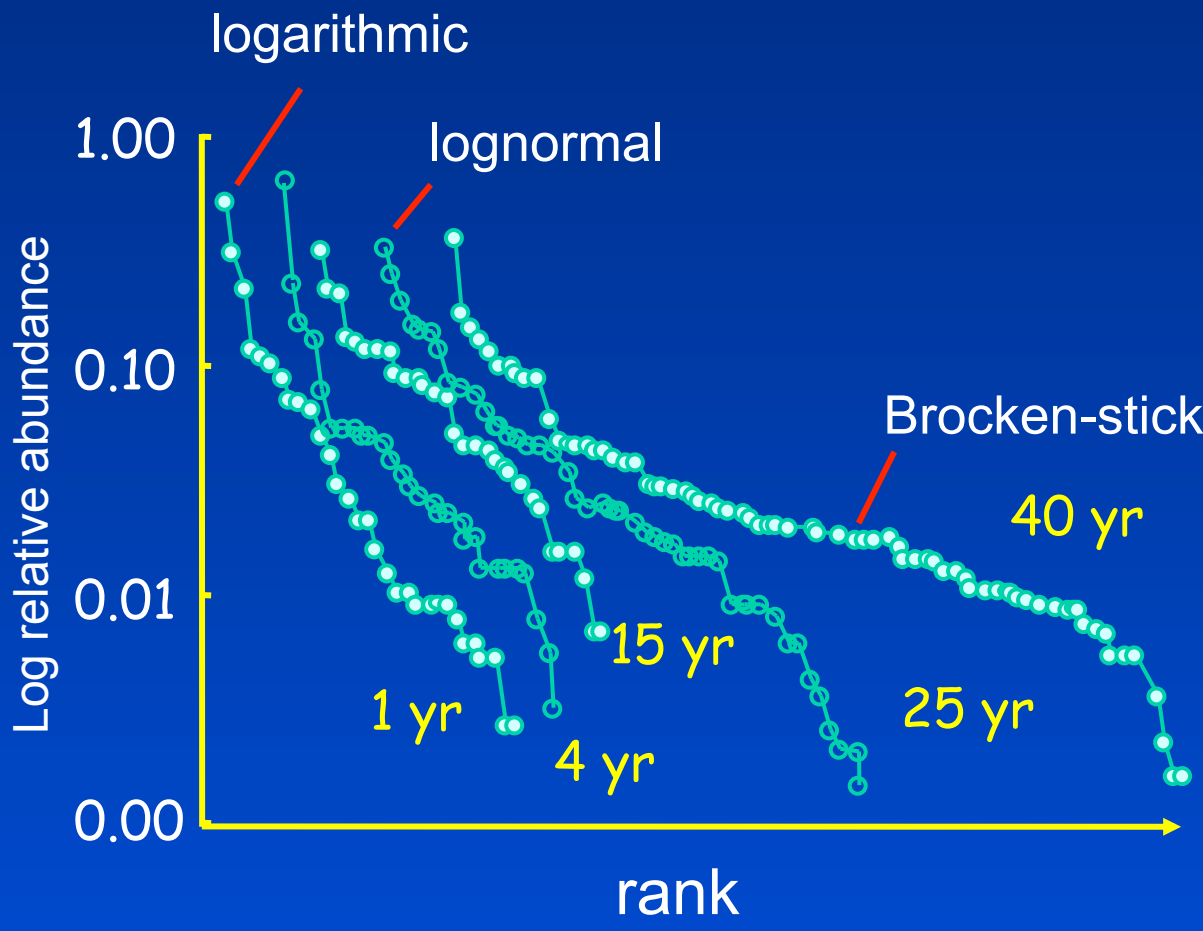
Community structure change during succession

Years after farmland abandonment





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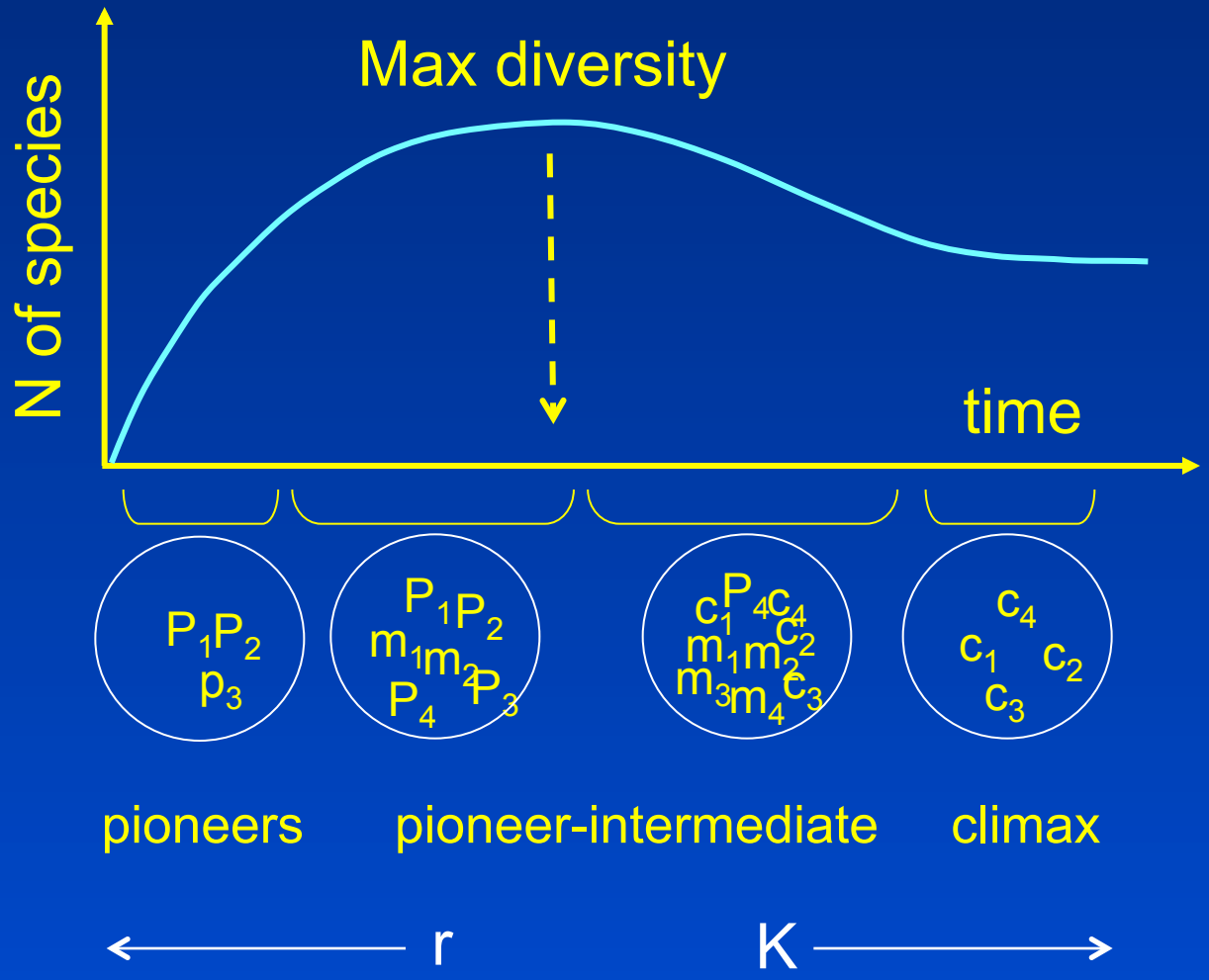
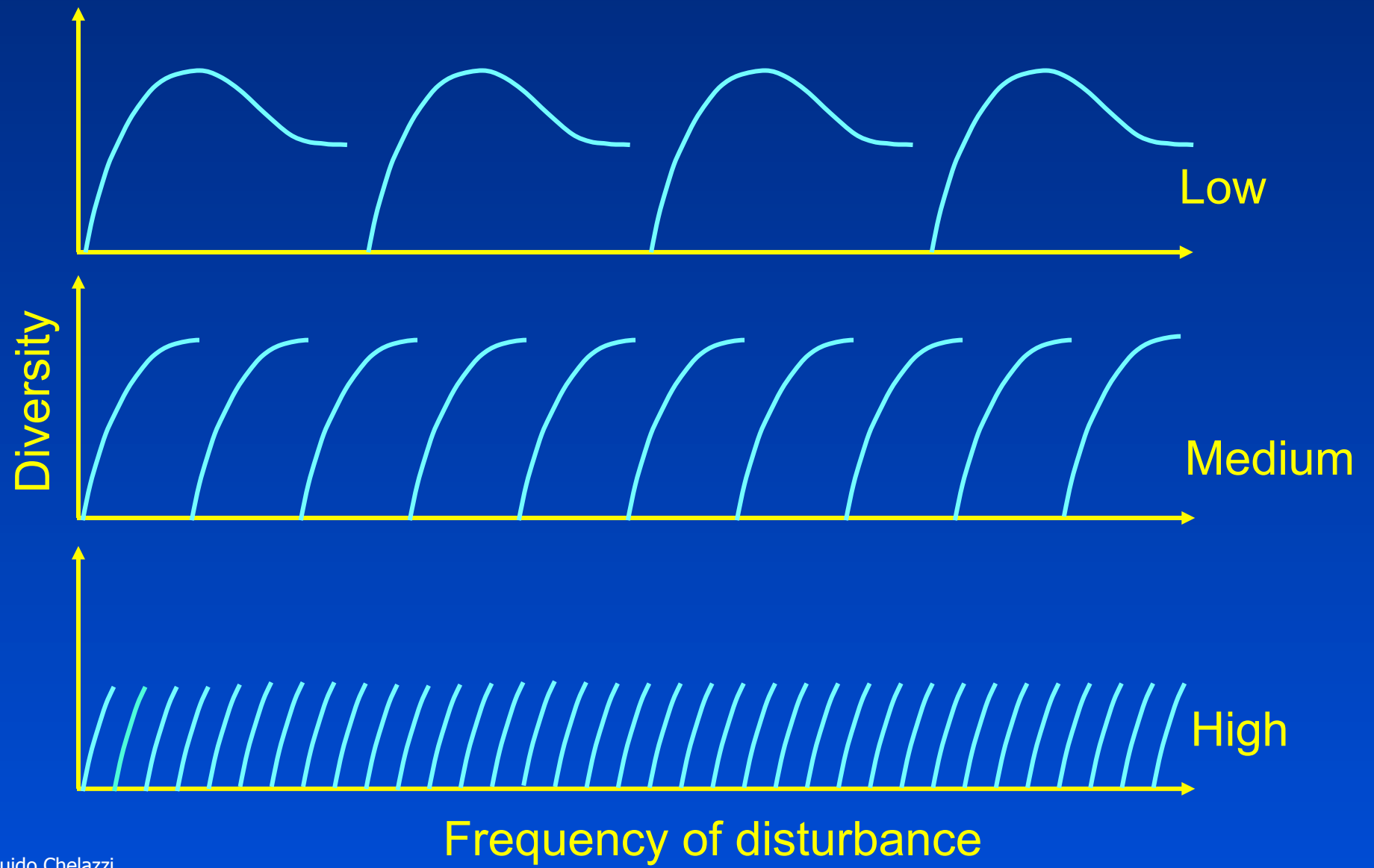
Biodiversity change during succession



Biodiversity change during succession



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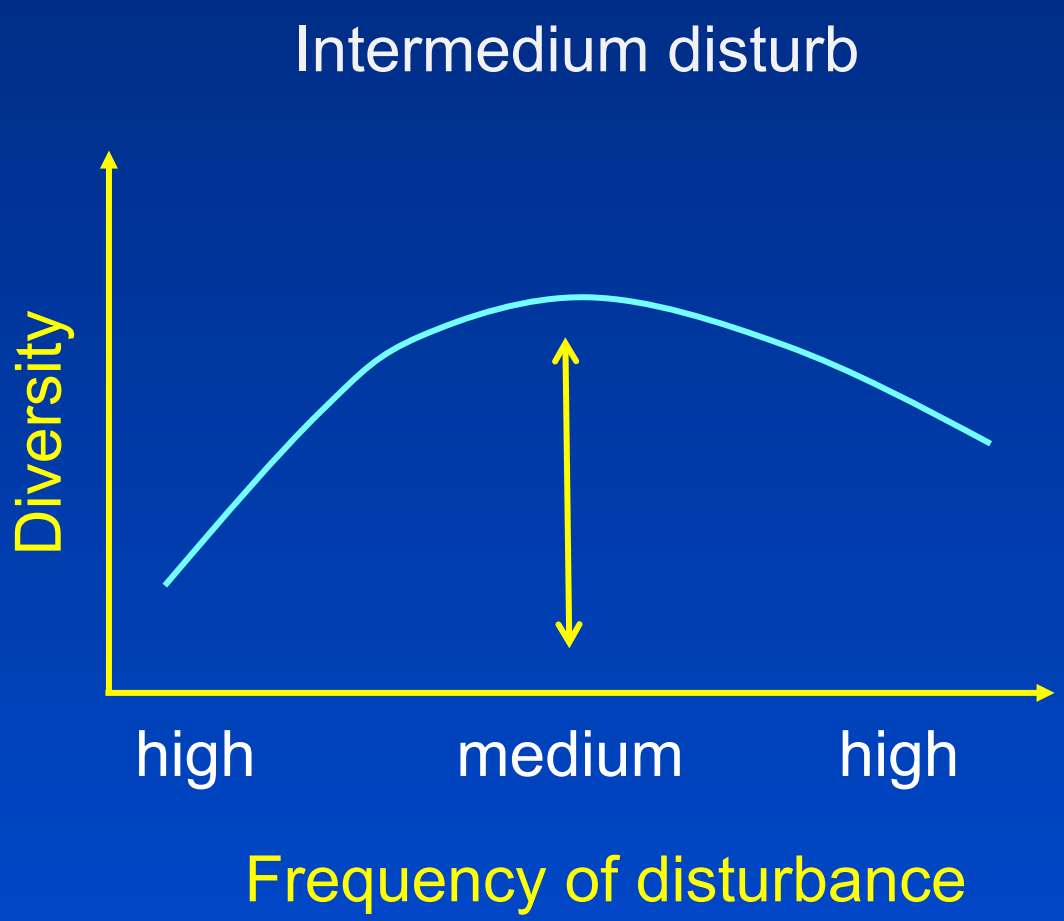
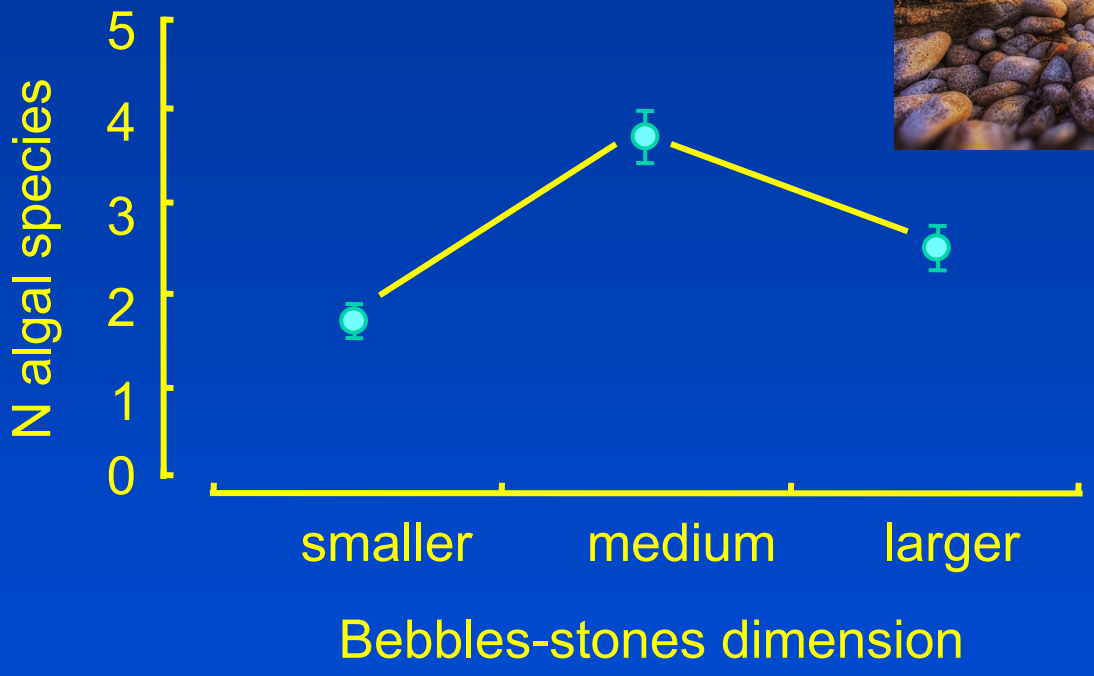
Biodiversity change during succession



Biodiversity change during succession

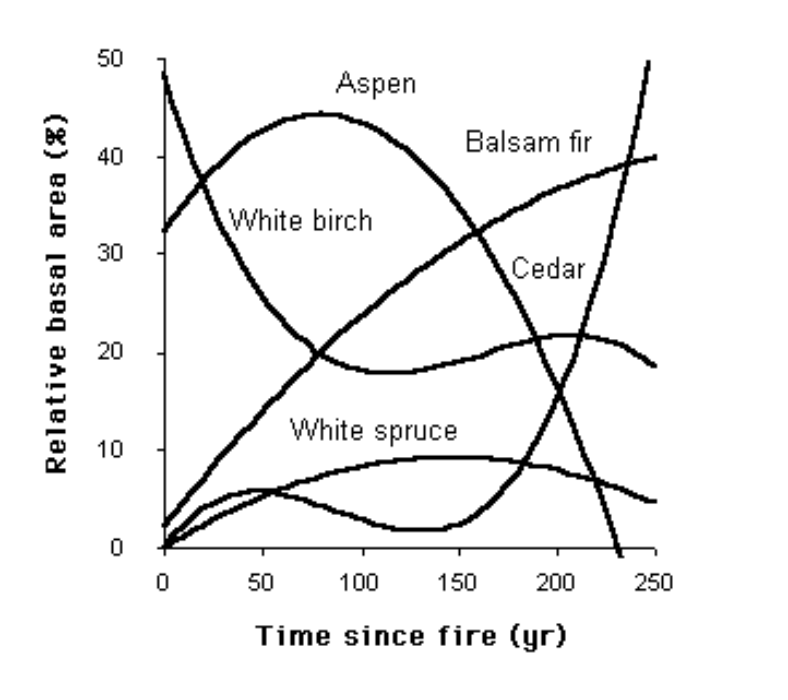
Intermedium disturb (Sousa experiment)

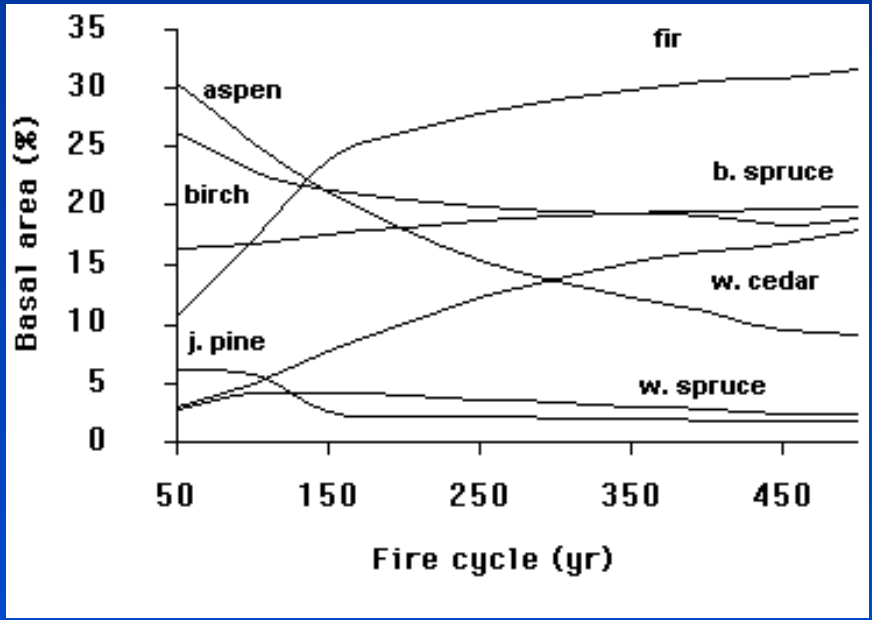
Bebble-stony beach



Biodiversity change during succession

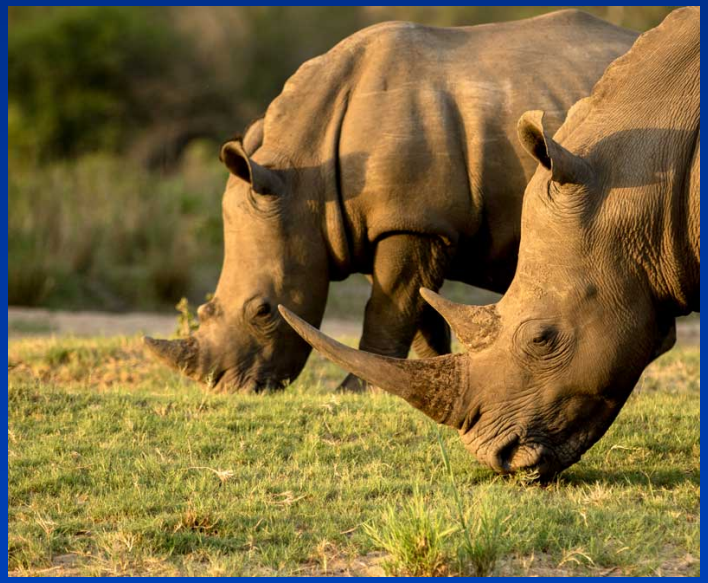
Frequency of wildfires

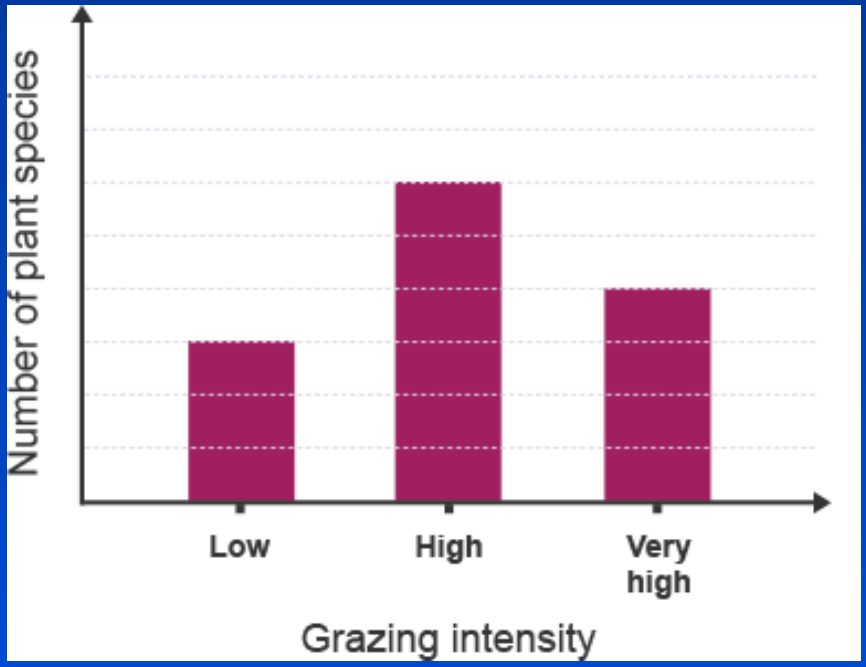




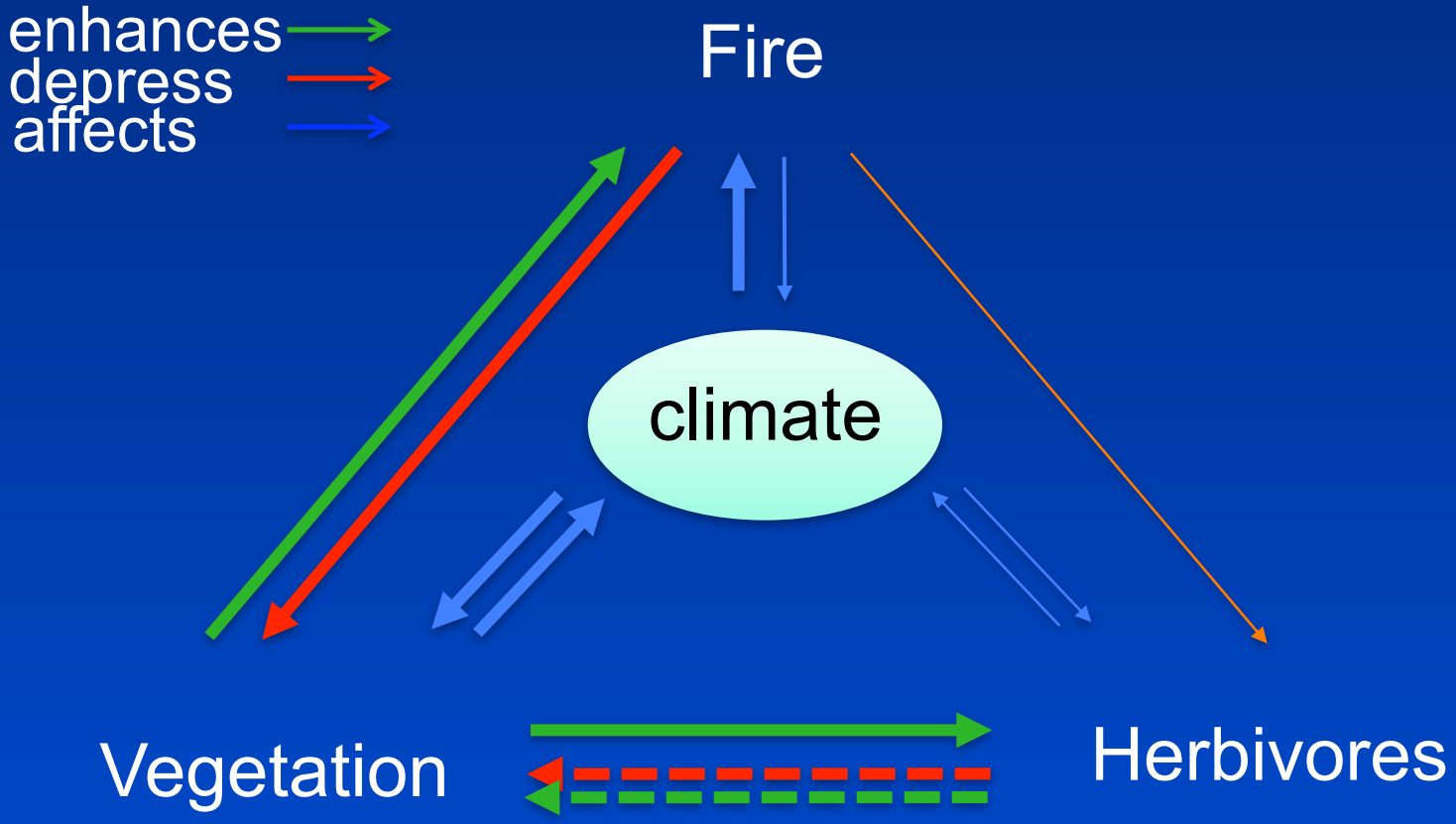
Biodiversity change during succession

Intensity of grazing

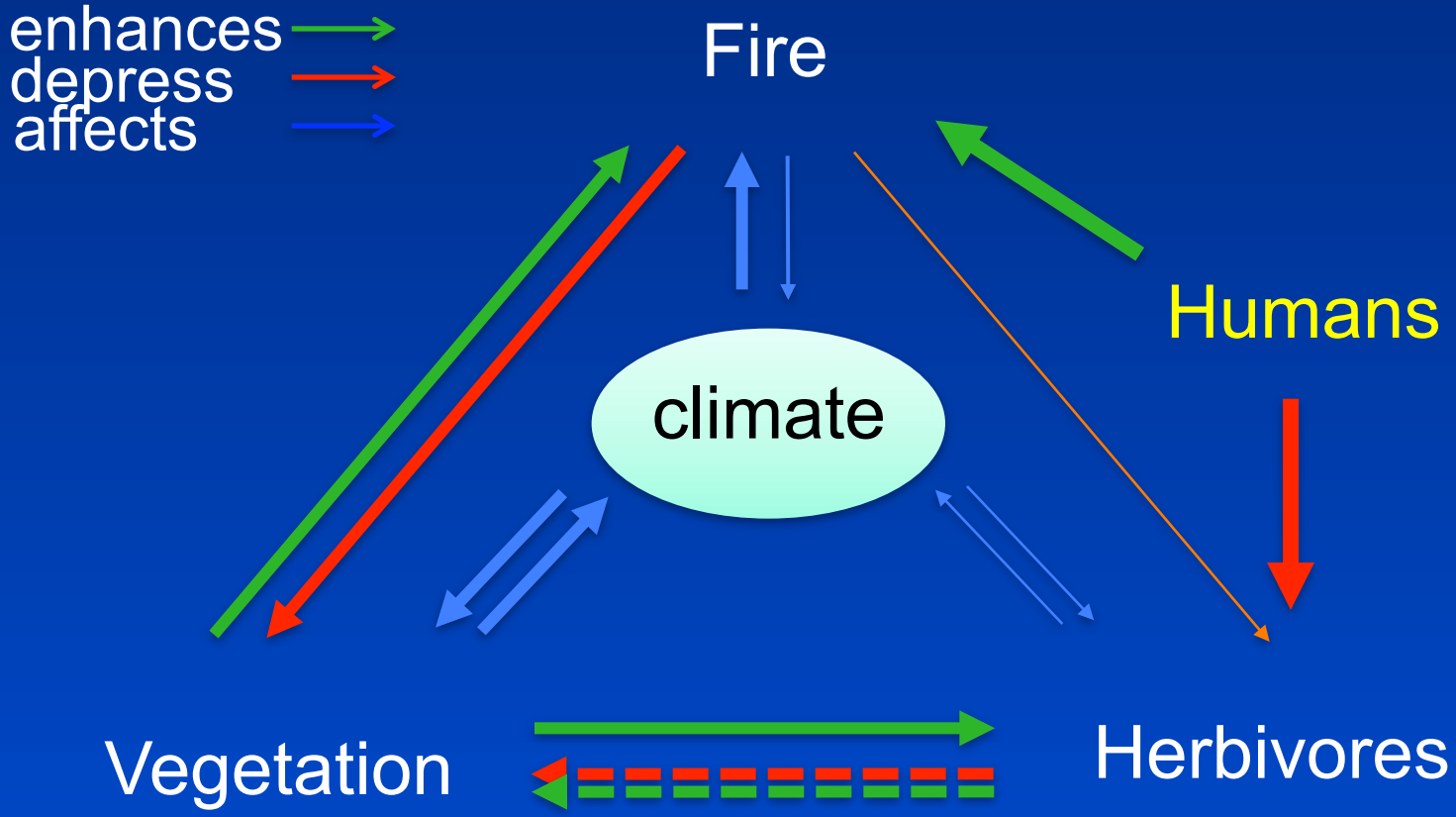




Climate-Fire-Grazing interactions



Climate-Fire-Grazing interactions
Human impact



Community as a functional system

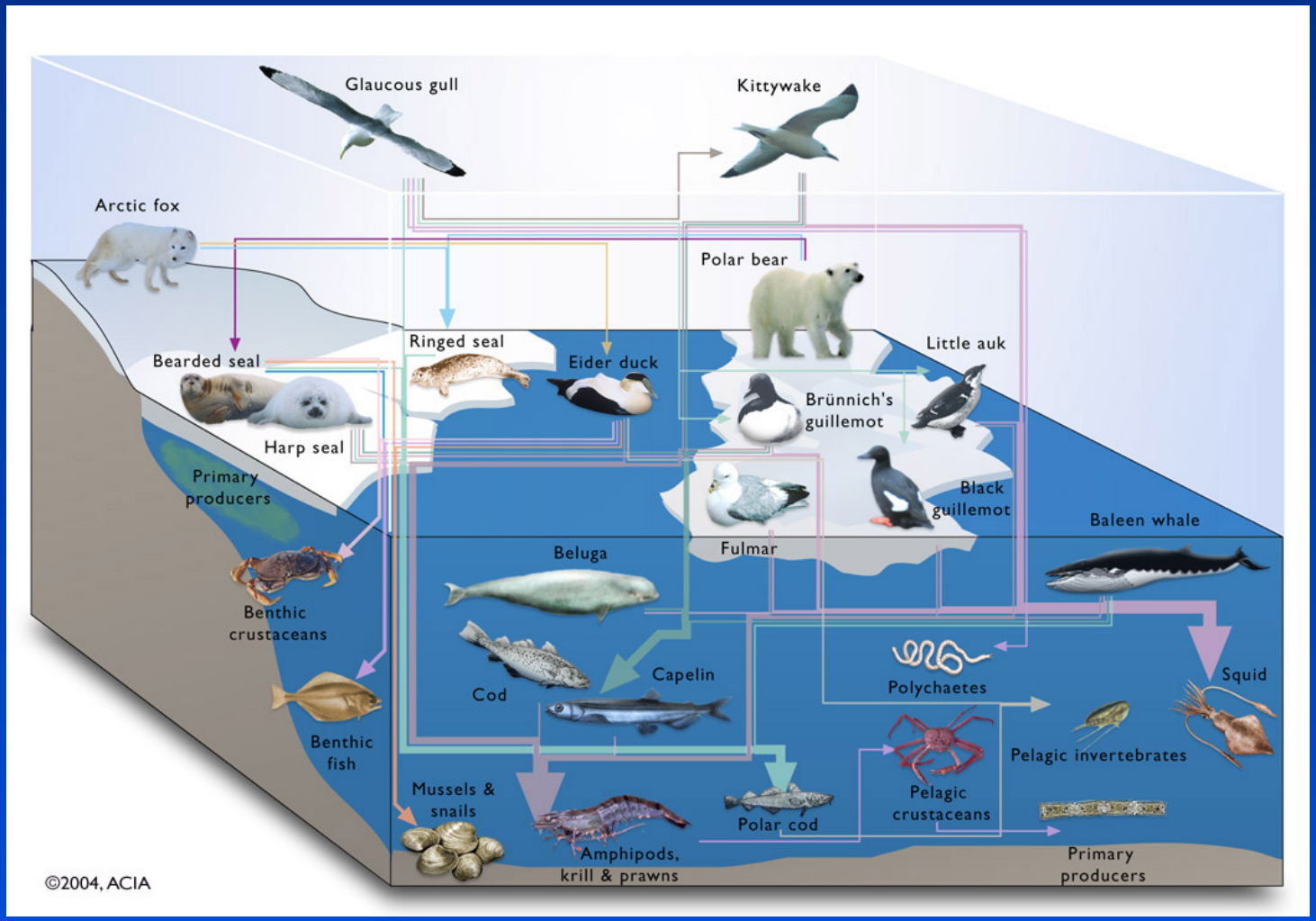
However formed, communities must have an internal, functional consistency to persist within an ecosystem, or to develop coherently

Each species must find its own functional, ecological space to be a stable member of a given community

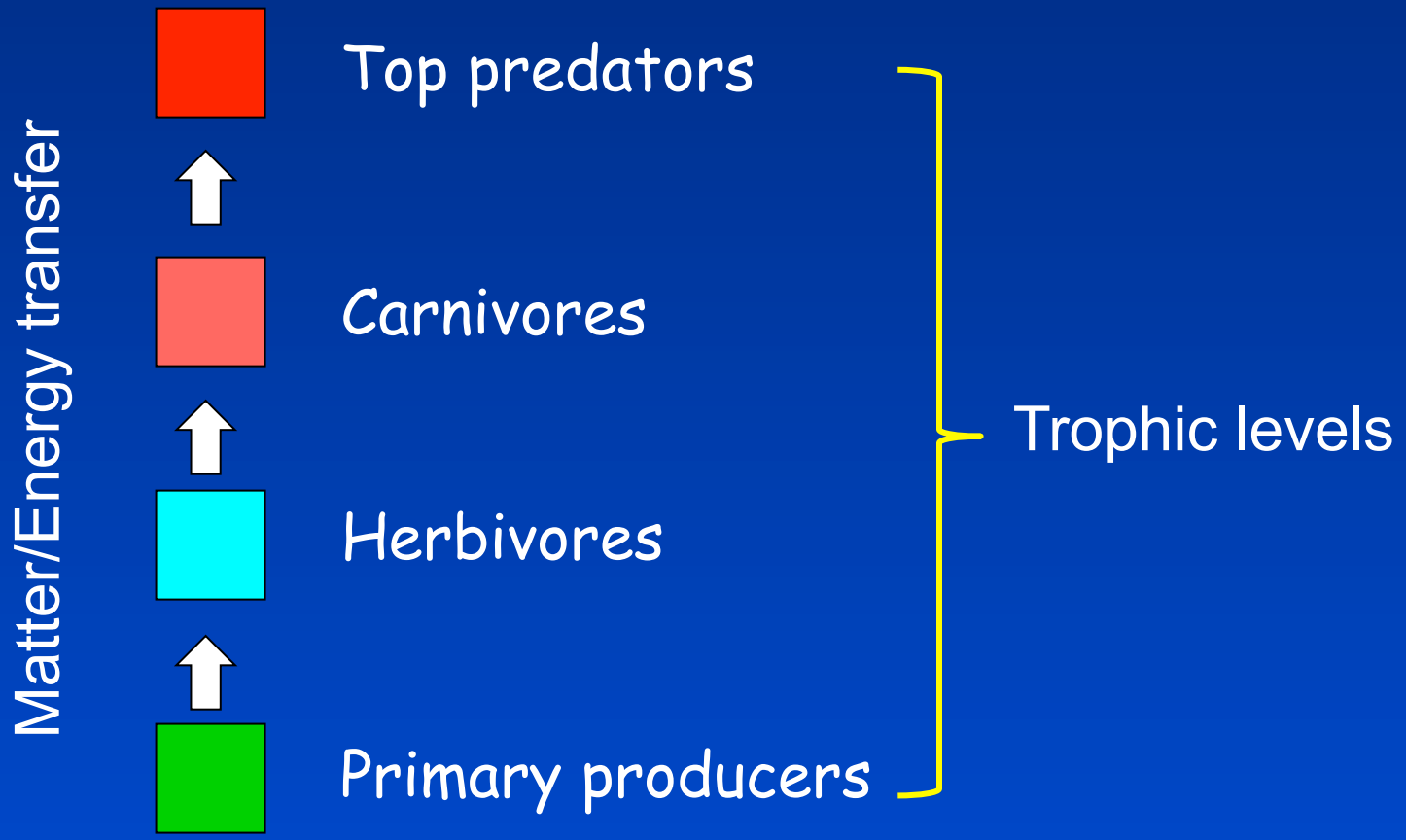
Species are "packaged" within communities according to their ecological prophyle (e.g. trophic prophyle, sustainable interactions with other species in terms of predation, competition, mutualism etc.)

Trophic web

A description of the trophic relationship within the community



Vertical stratification of the community (Food chain)



Assessment of the “vertical position” of each species along the trophic chain

A) Ethological assessment: direct observations of the foraging behaviour of the single species

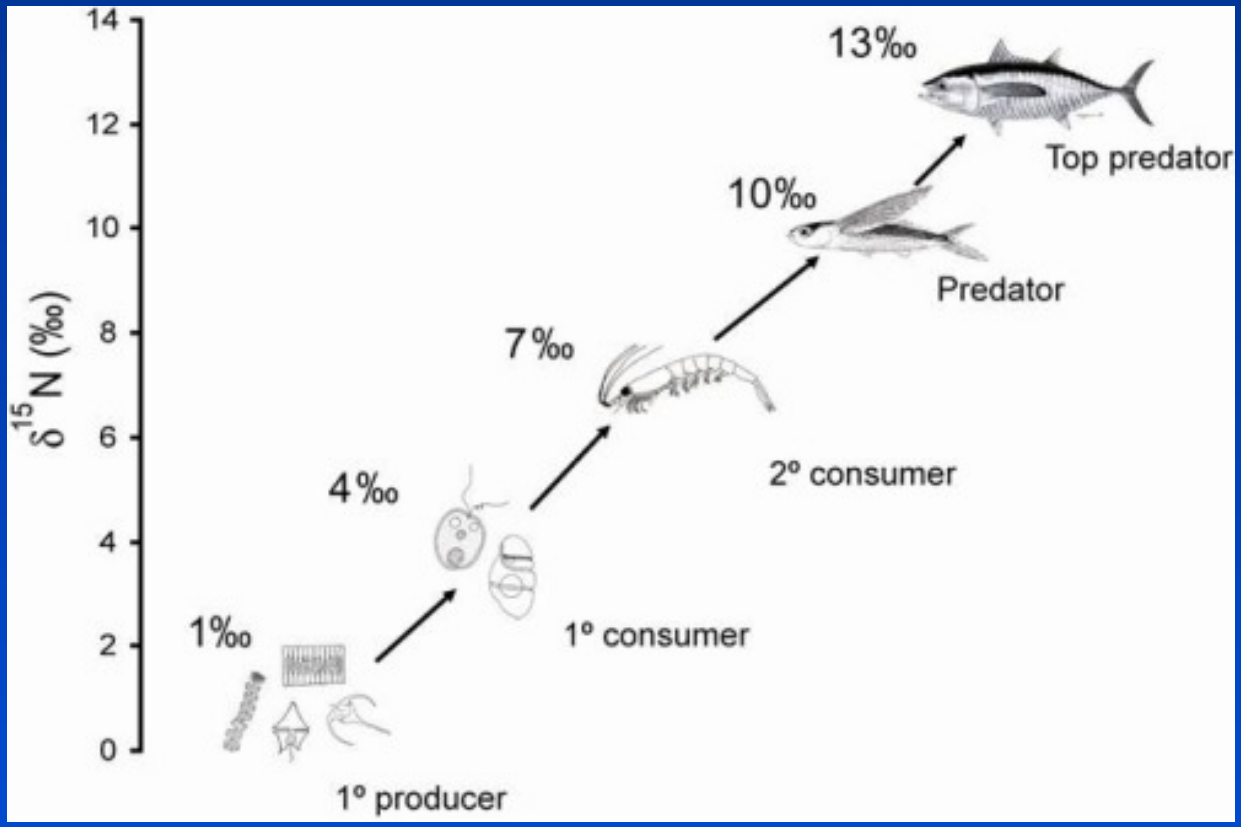
B) Dietary assessment: analysis of gut content, faeces content, discarded items etc.

C) Isotopic assessment: sorting of different stable isotopes of N and C

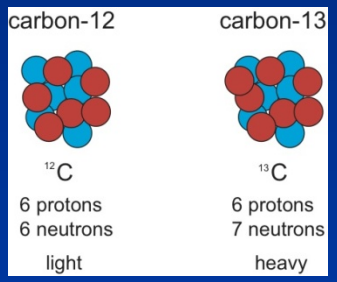
Dietary assessment of the position along the trophic chain

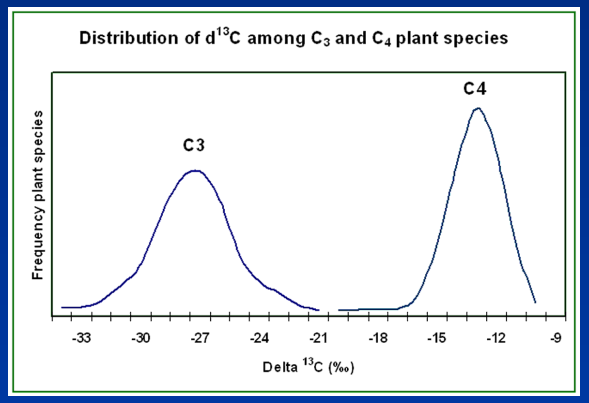
Predatory birds' pellet analysis

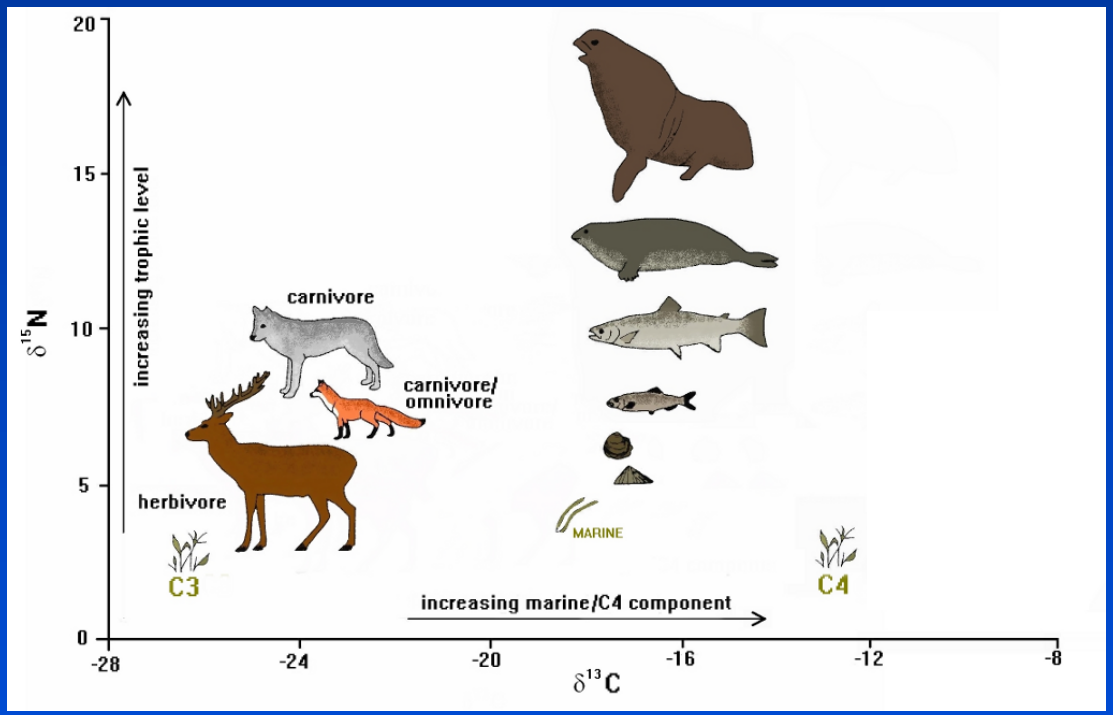
Trophic position (N isotopes)



Trophic position (C isotopes)







Biomass/Energy transfer at each step of the food chain

P / A = Net coefficient of production

P = Allocated into "production" (Growth + Reproduction)

M = Spent for Metabolism

biosyntesis
concentration
mobility

Se = Secreted

U = Utilized

Es = Escreted

A = Assimilated

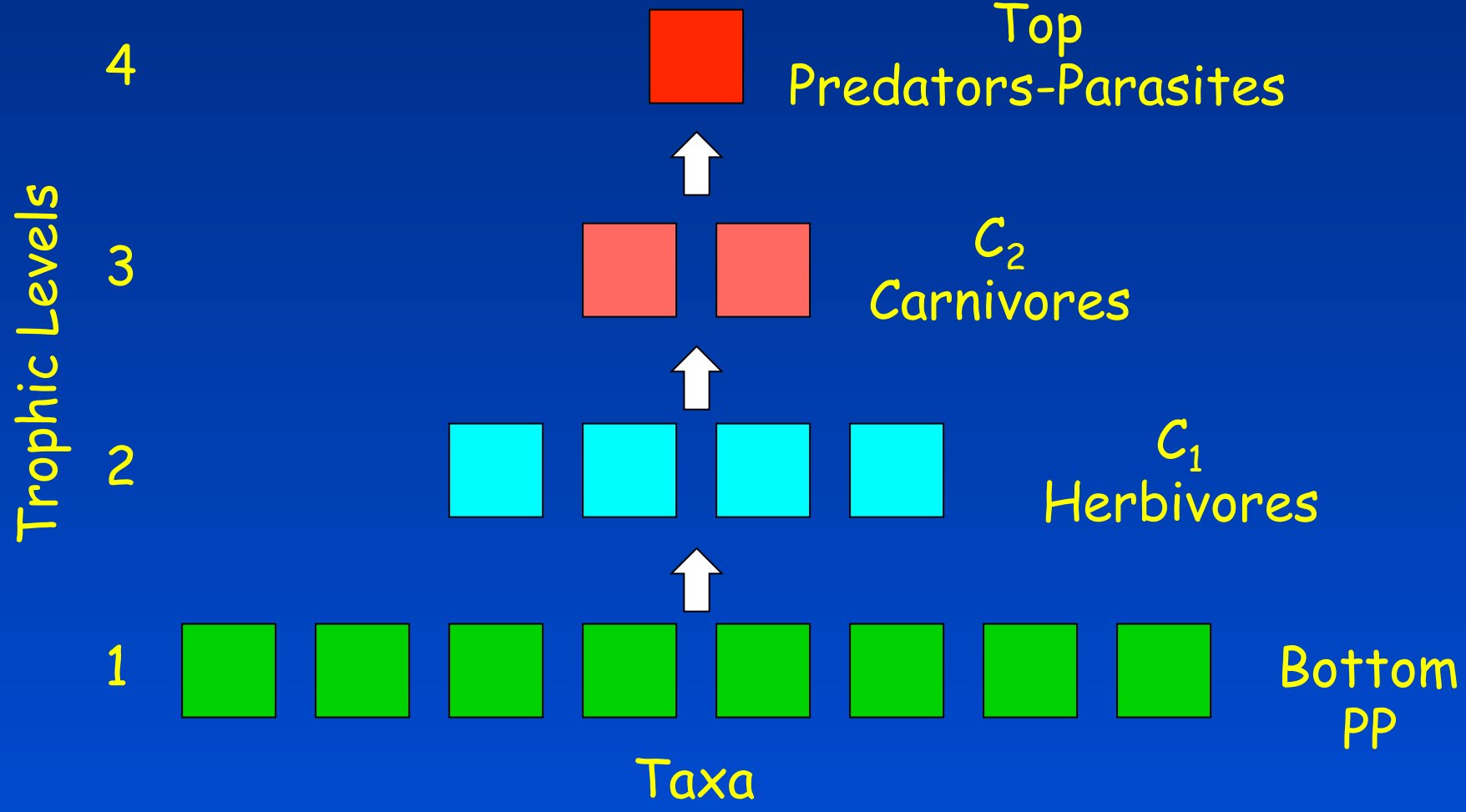
S = Discarded

C = Consumed

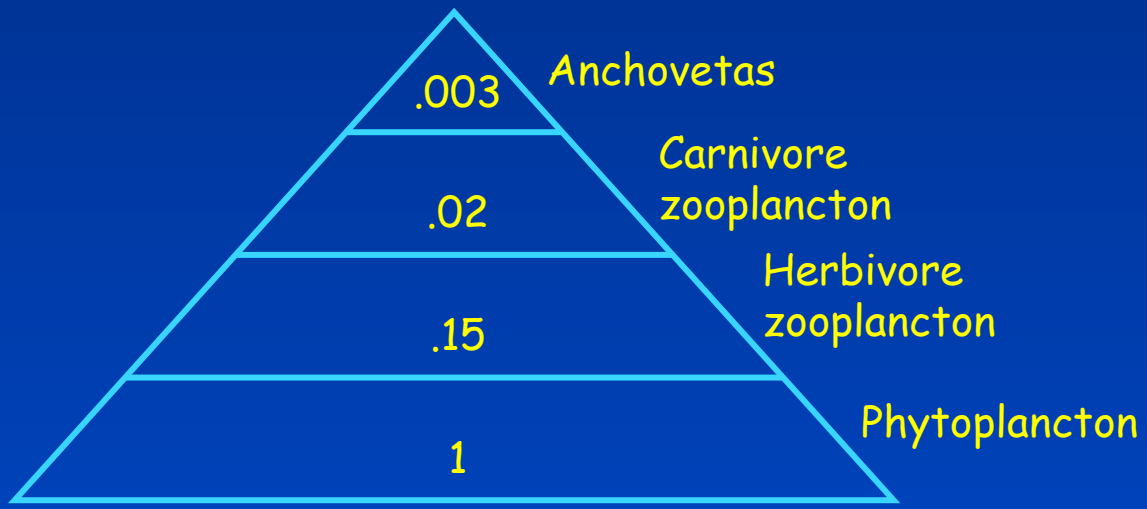
Not intercepted

E = Energy available (per unit space and time)

Reduction of the total biomass/energy with increasing level of the food web

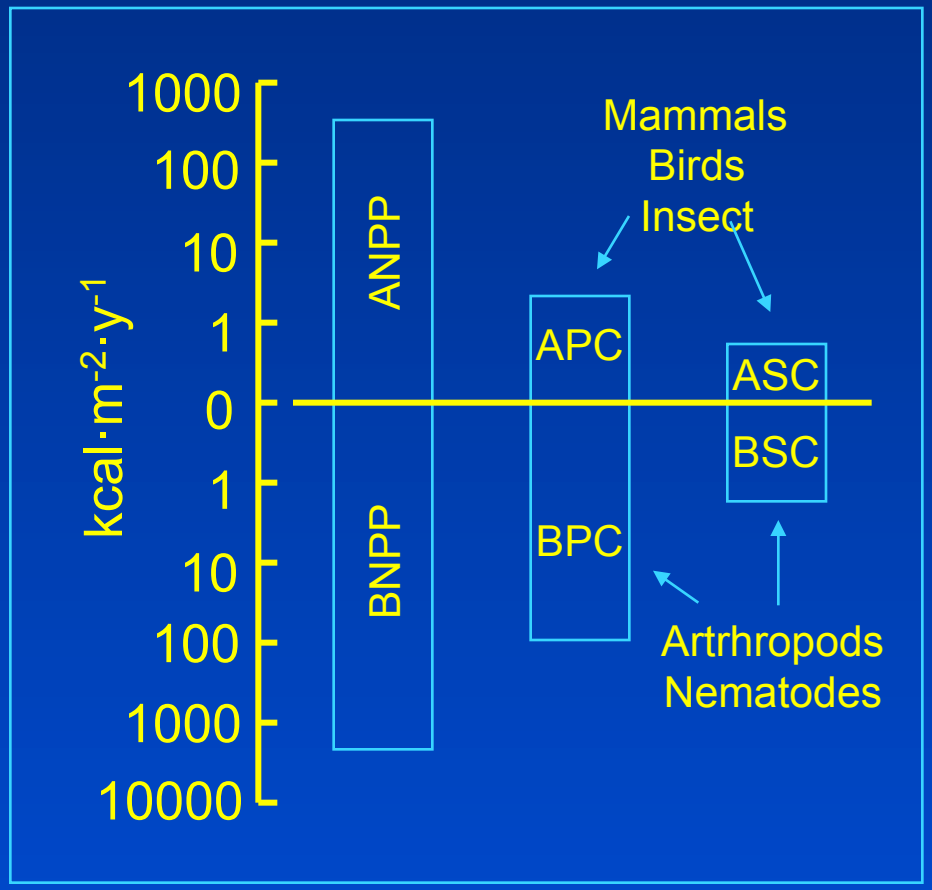


Oceanic trophic chain
(off Peru coast)



Relative biomass per habitat unit

Above- and below-ground energy allocation in mixed (savannah like) ecosystem



Consumption matrix

- Direct observation in field or in the laboratory
- Indirect assessment (gut content, faeces etc.)

Consumption matrix

Trophic Cascade

Consumed \ Consumer	Sp1	Sp2	Sp3	Sp4	Sp5
Sp1	0	1	1	1	1
Sp2	0	0	1	1	1
Sp3	0	0	0	1	1
Sp4	0	0	0	0	1
Sp5	0	0	0	0	0

Cannibalism + Circularity

Consumed \ Consumer	Sp1	Sp2	Sp3	Sp4	Sp5
Sp1	1	1	1	1	1
Sp2	0	0	1	1	1
Sp3	1	0	0	1	1
Sp4	0	0	0	1	1
Sp5	0	0	0	0	1

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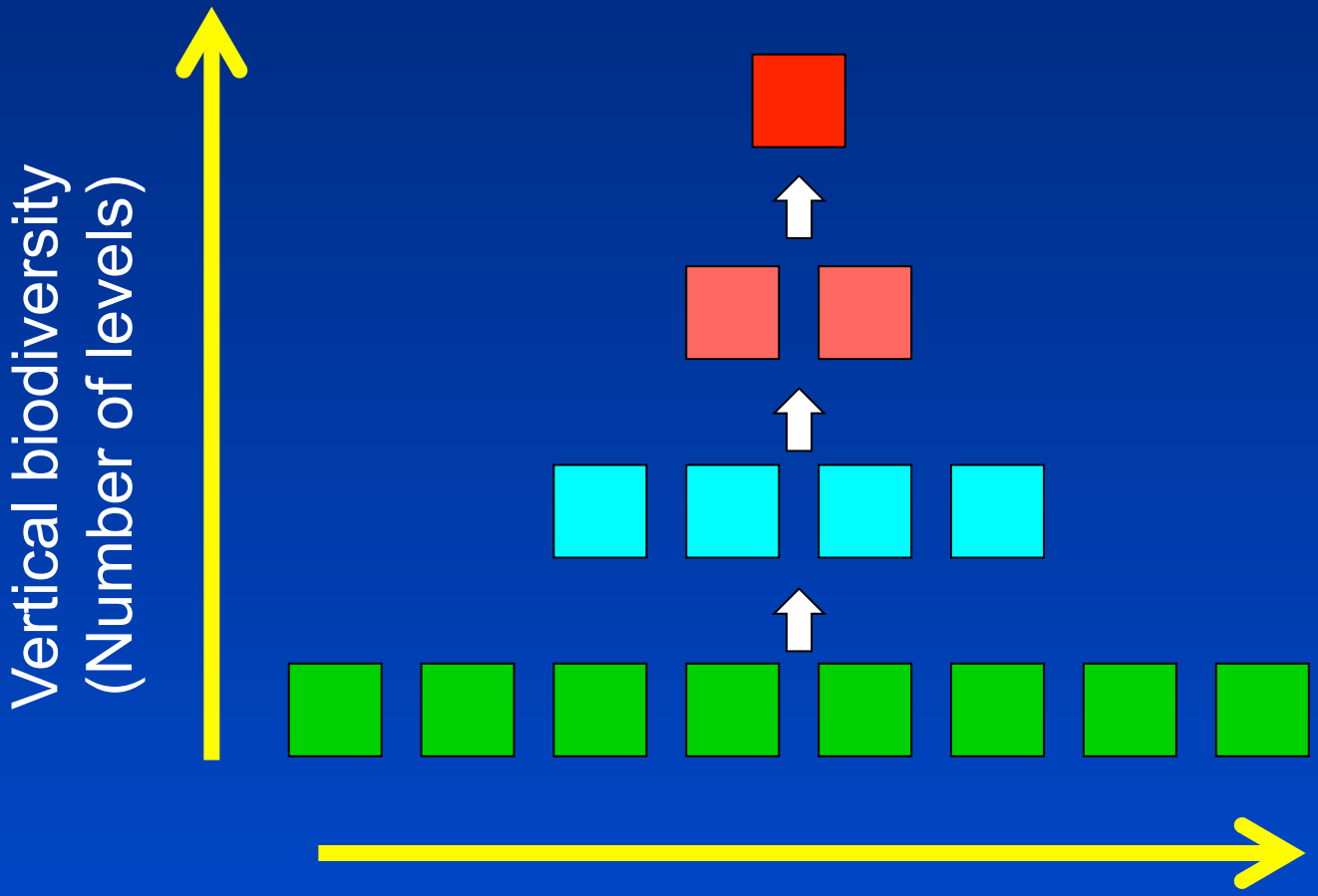
Biodiversity within trophic webs



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Biodiversity within trophic webs

- Horizontal diversity

is controlled by demographic interactions between species of the same trophic level (competition, mutualism)

- Vertical diversity

is controlled by prey-predators interactions (energy flow, structural and behavioural characteristics of both)

Energetic control of vertical biodiversity

Energy available at the basal level

$$E_n = E_1 \cdot \eta^{n-1}$$

Energy available at n_{th} level

Energy conversion coefficient

Minimun energy to sustain a level

$$n = 1 + \frac{Log(E_{min}) - Log(E_1)}{Log(\eta)}$$

Number of permitted levels

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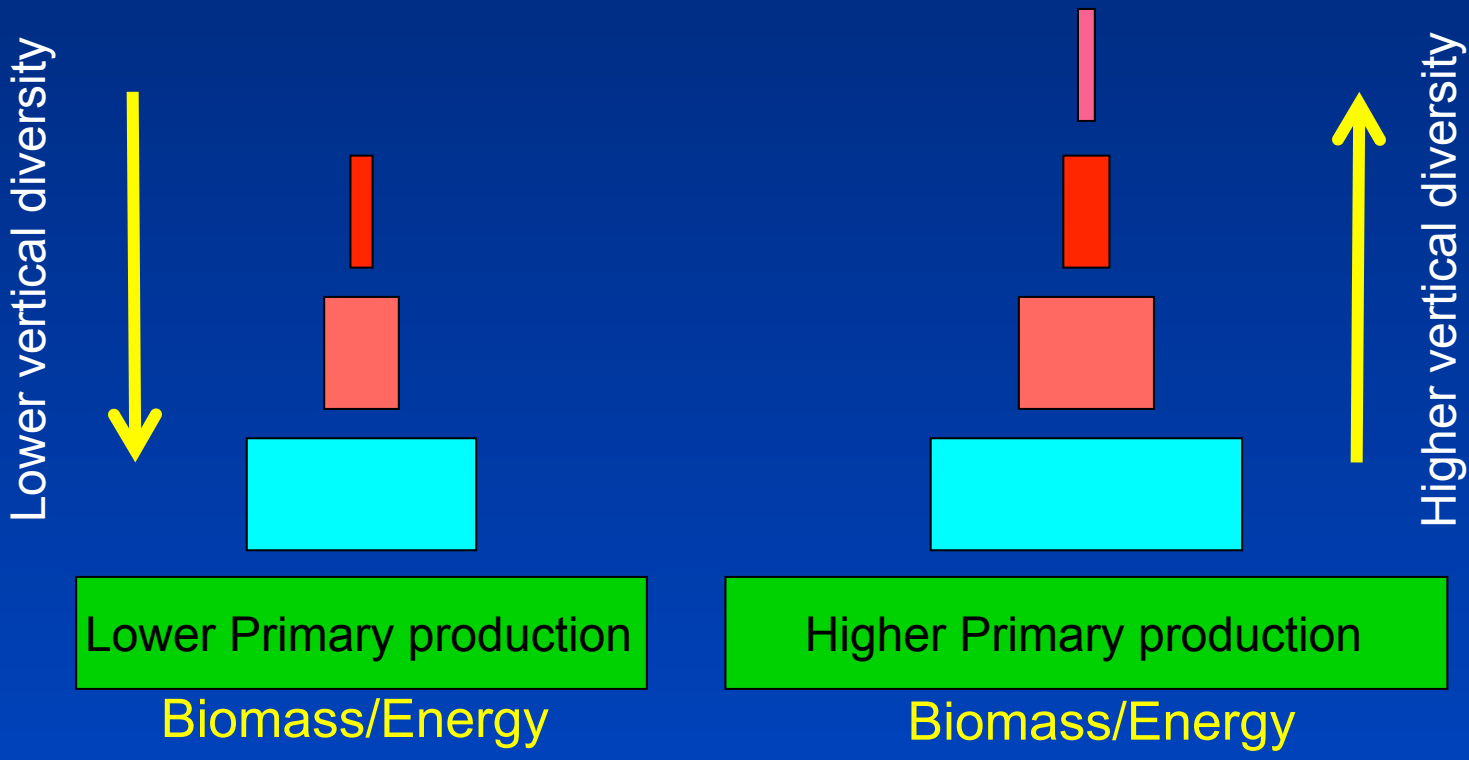
Primary production control of vertical biodiversity



This is not a general effect because:

- ✓ Increased mass production can impair the functionality of organisms at higher levels of the trophic chain (e.g. hypoxia)
- ✓ Vertical packaging depends also on morpho-functional & behavioural hierarchy

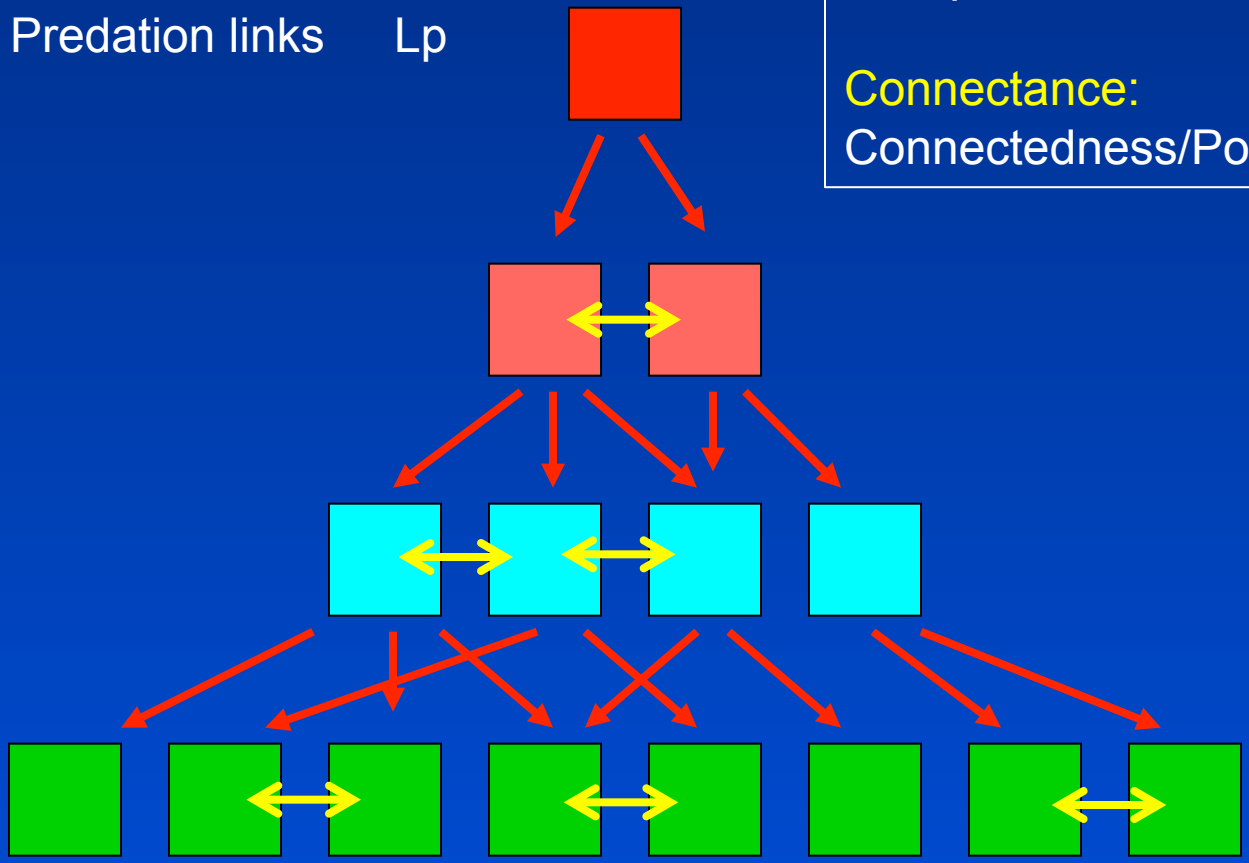
Community connectedness (connectance)

Competition links Lc

Predation links Lp

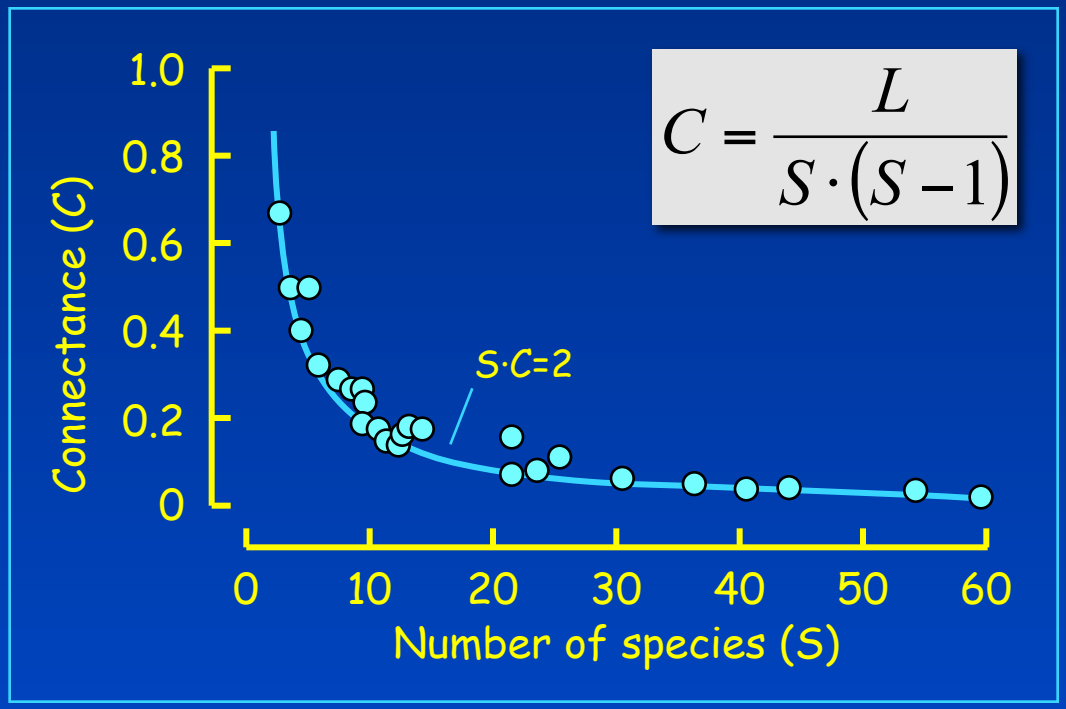
Connectedness:
Lc+Lp

Connectance:
Connectedness/Possible links

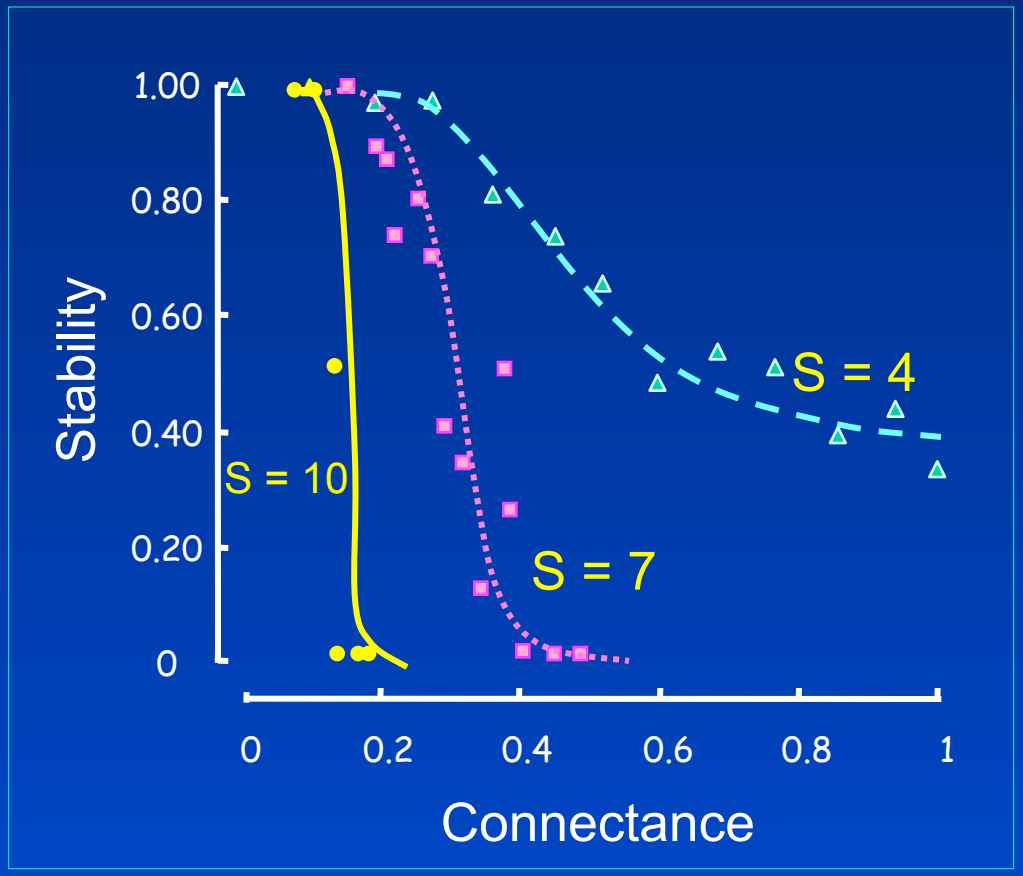


Taxa

Connectance in real (benthonic) communities

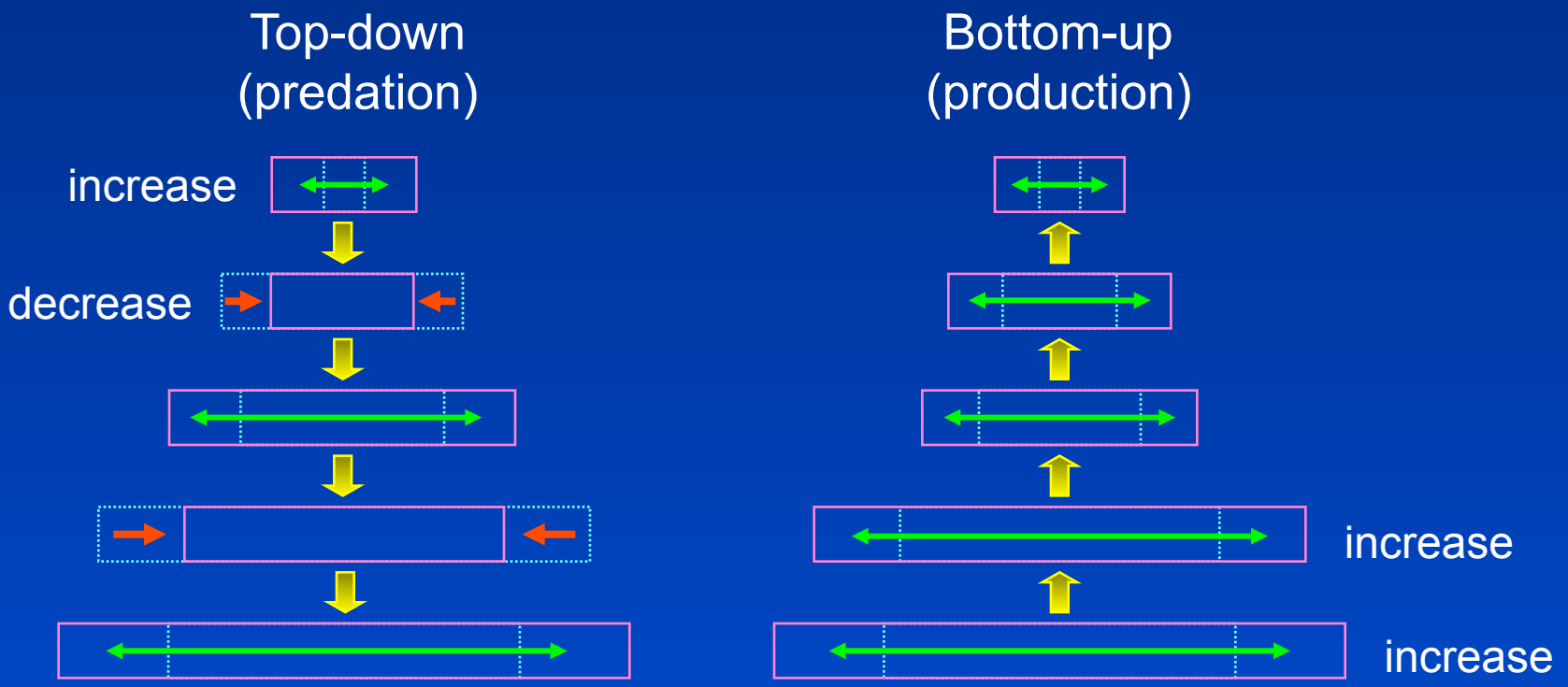


Stability vs connectance in simulated communities



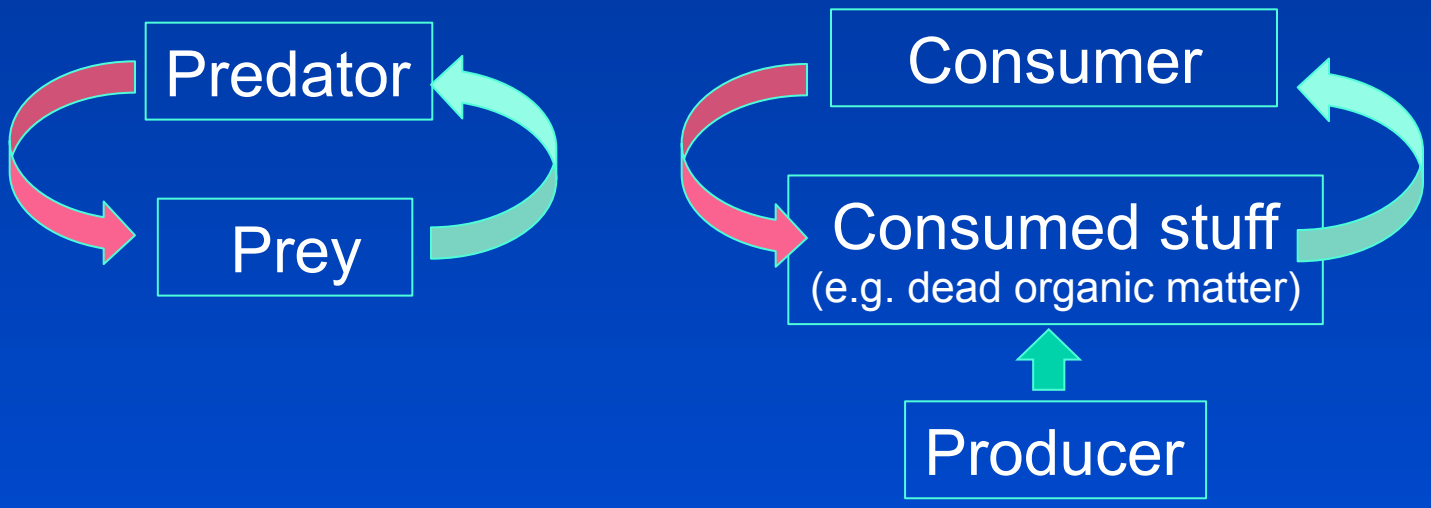
S = number of species

Propagation of demographic disturbance

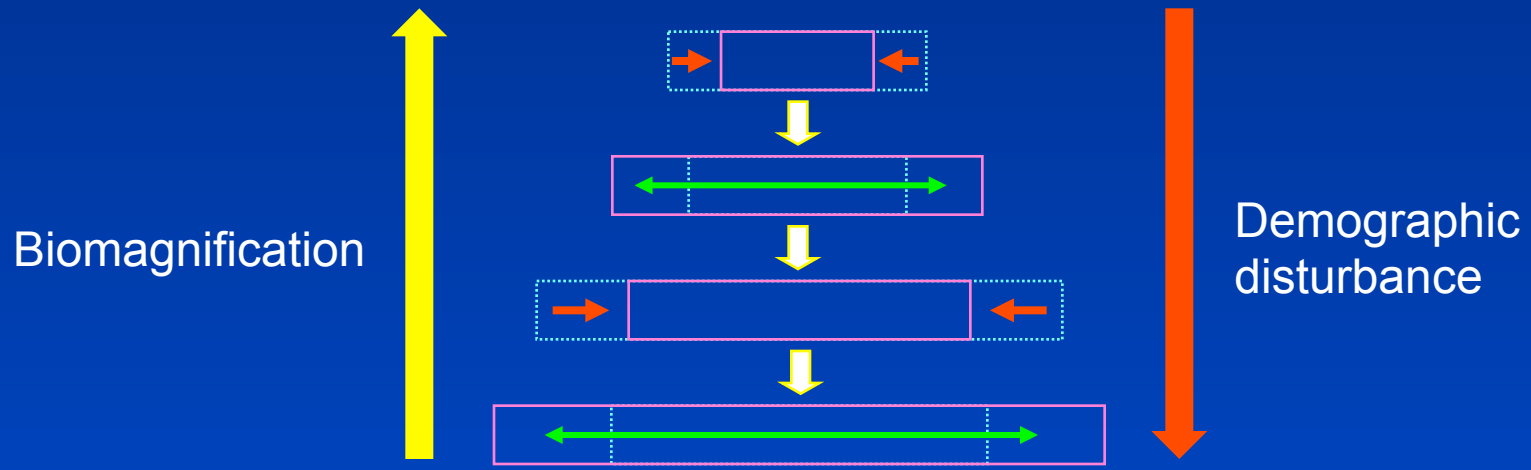


Propagation of demographic disturbance

- Top-down progagation prevails in communities where classic predator-prey relationships are dominant
- Bottom-up prevails where donor-controlled relationships are common (e.g. in scavenger dominated communities)

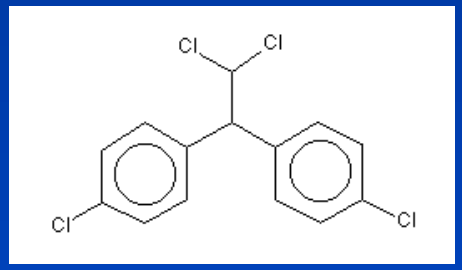


Bottom-up biomagnification of POP
Top-down propagation of demographic disturbance



Biomagnification of persistent pollutants
and community disruption

DDD treatment of Clear Lake (California)
to eliminate the non biting dipteran
Chaoborus astiptocus



Diclorodifenildicloroetano

Flint & van der Bosch, 1981
in Begon et alii, 1990

0.02 ppm

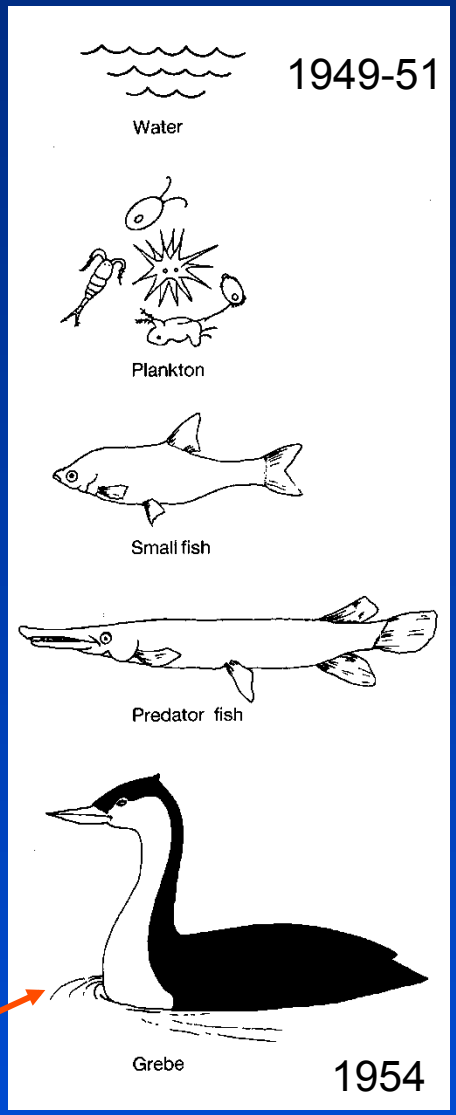
5 ppm

10 ppm

1500 ppm

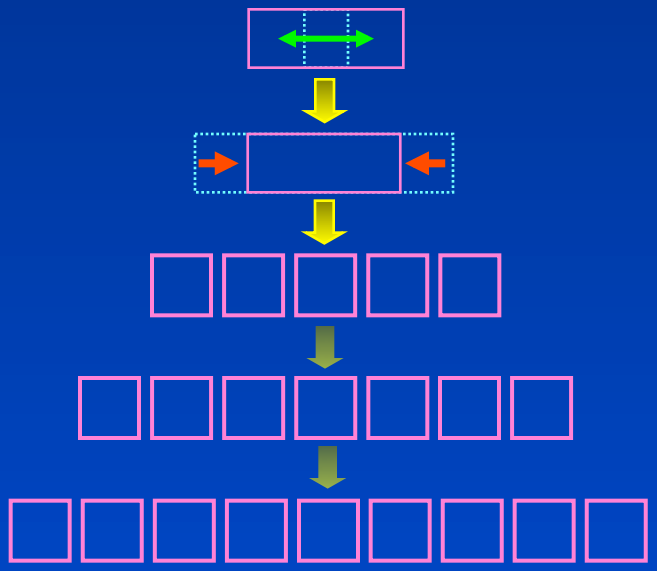
1600 ppm

Grebe disappearence



Propagation of demographic disturbance

Top-down



Taxonomic horizontal diversity
is a buffer for top-down demographic disturbance propagation

Reducing horizontal diversity
reduces the community resilience
to demographic fluctuations

Non-trophic relationships within communities

Members of a community (different species) may establish relationships different from predation and competition:

Mutualism/Commensalism – Reciprocal or directional trophic exchange between species

Facilitation – Non-trophic reciprocal or directional benefits (e.g. modification of abiotic components of the environment which "facilitate" the presence of another species)

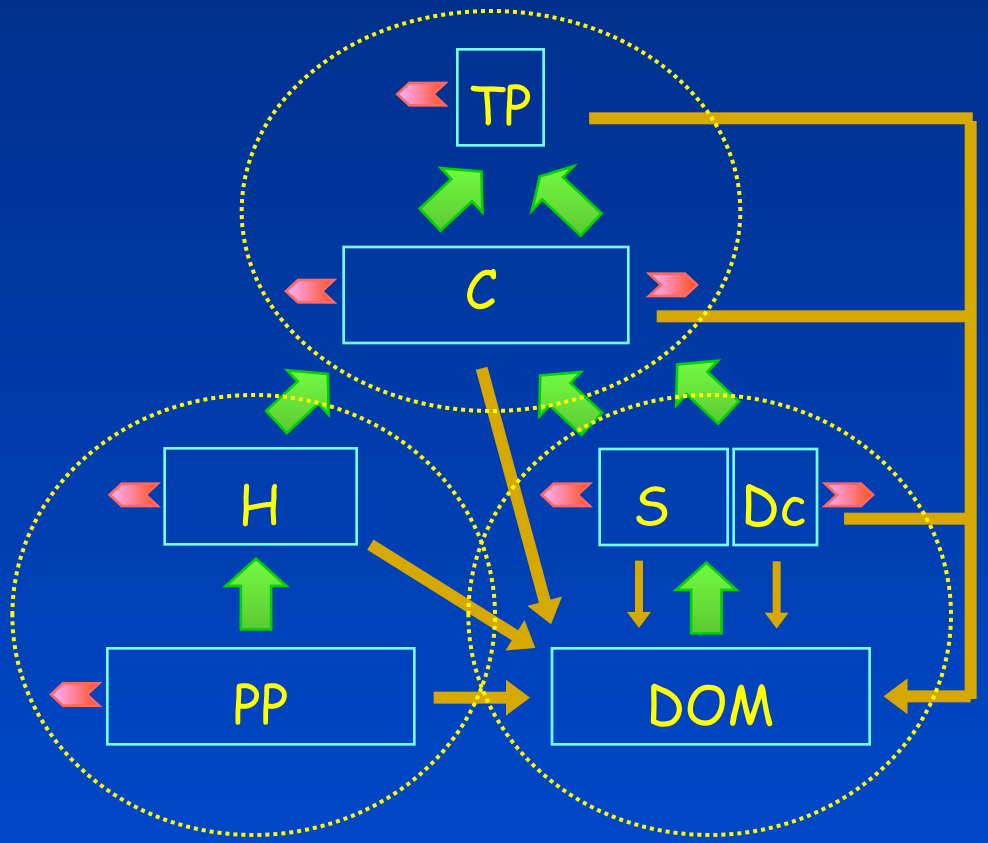
Ecological engineering - When one species modifies the abiotic/biotic structure of an ecosystem in such a way that this reshape the environment and makes it suitable for survival-reproduction of other species

Niche construction – When protracted and profound niche construction leads to selection of new traits (genetic-phenotipic) in the constructor species and in other species which became "entrapped" into the constructed niche (one extreme case is domestication)

Schemes of energy/matter circulation in communities

PP primary production
DOM dead organic matter
H herbivores
S scavengers
Dc decomposers
C carnivores
TP top predators

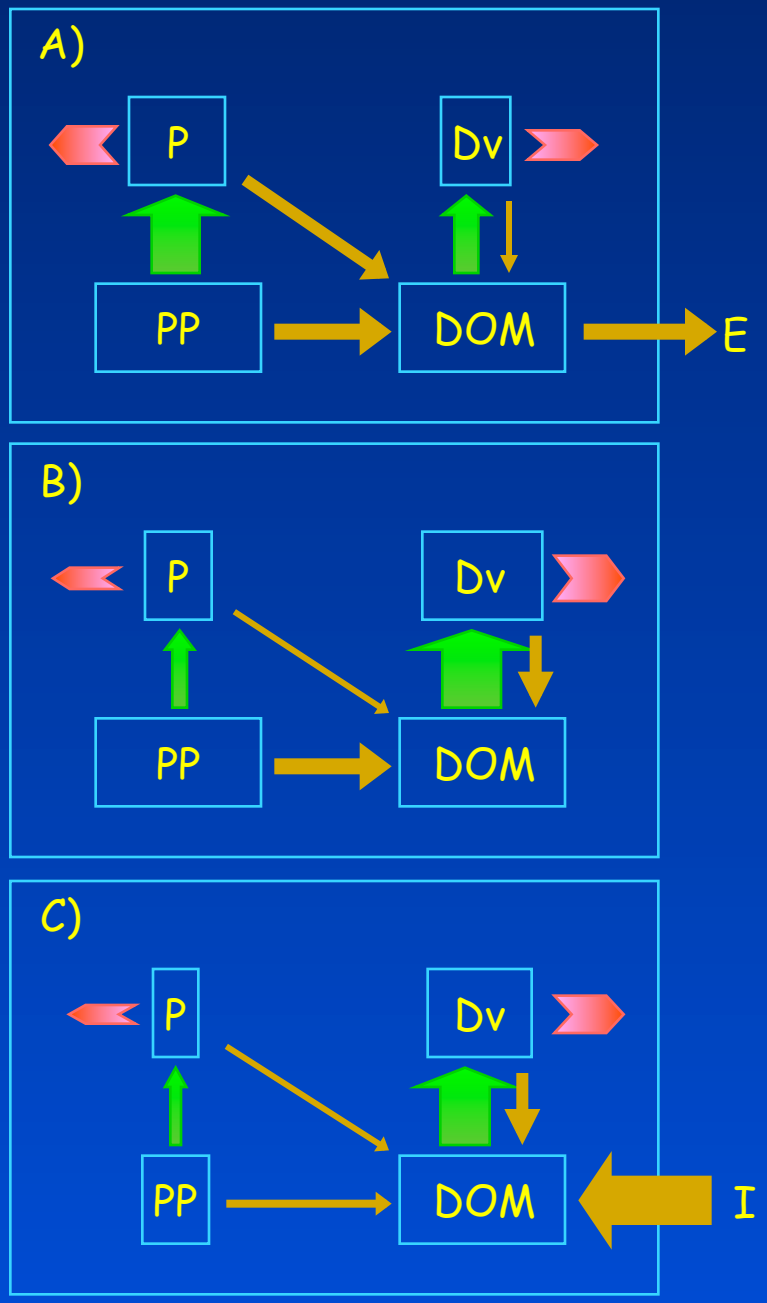
Energy transfer
Matter transfer
Heat loss



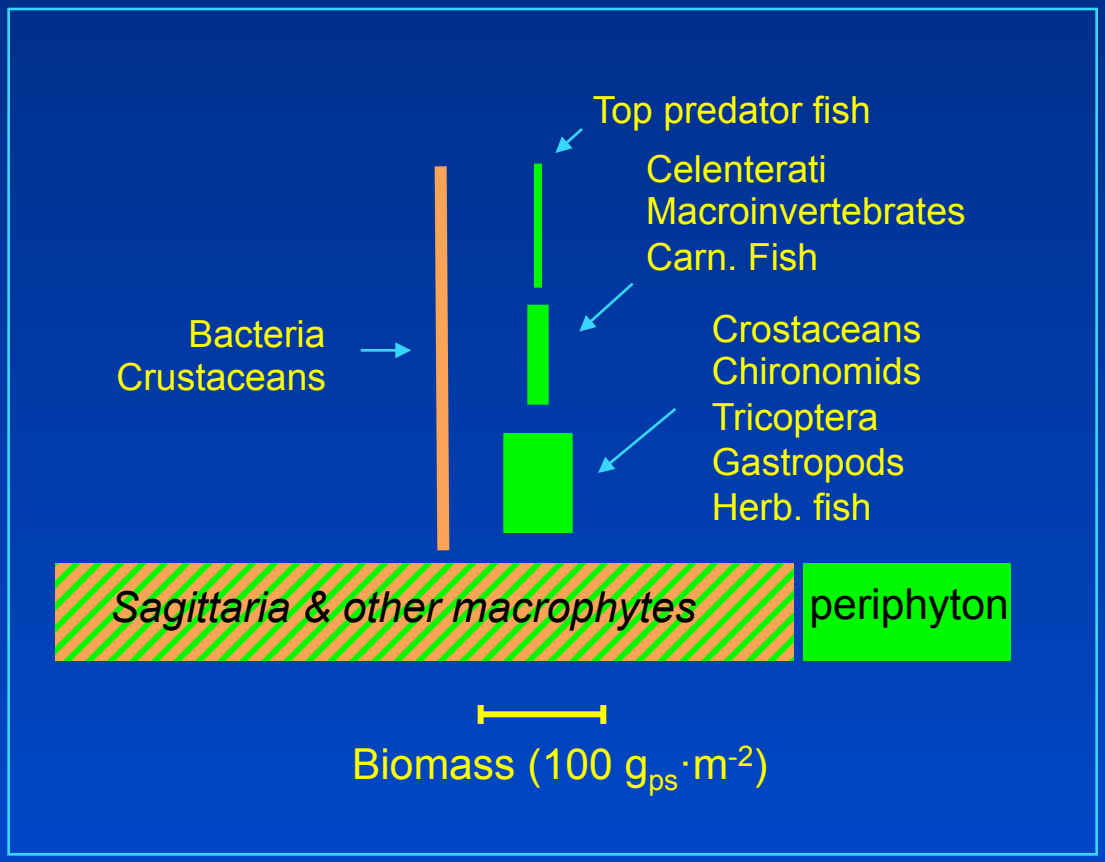
Schemes of energy/matter circulation in communities

PP primary production
DOM dead organic matter
P predators
Dv detritivores

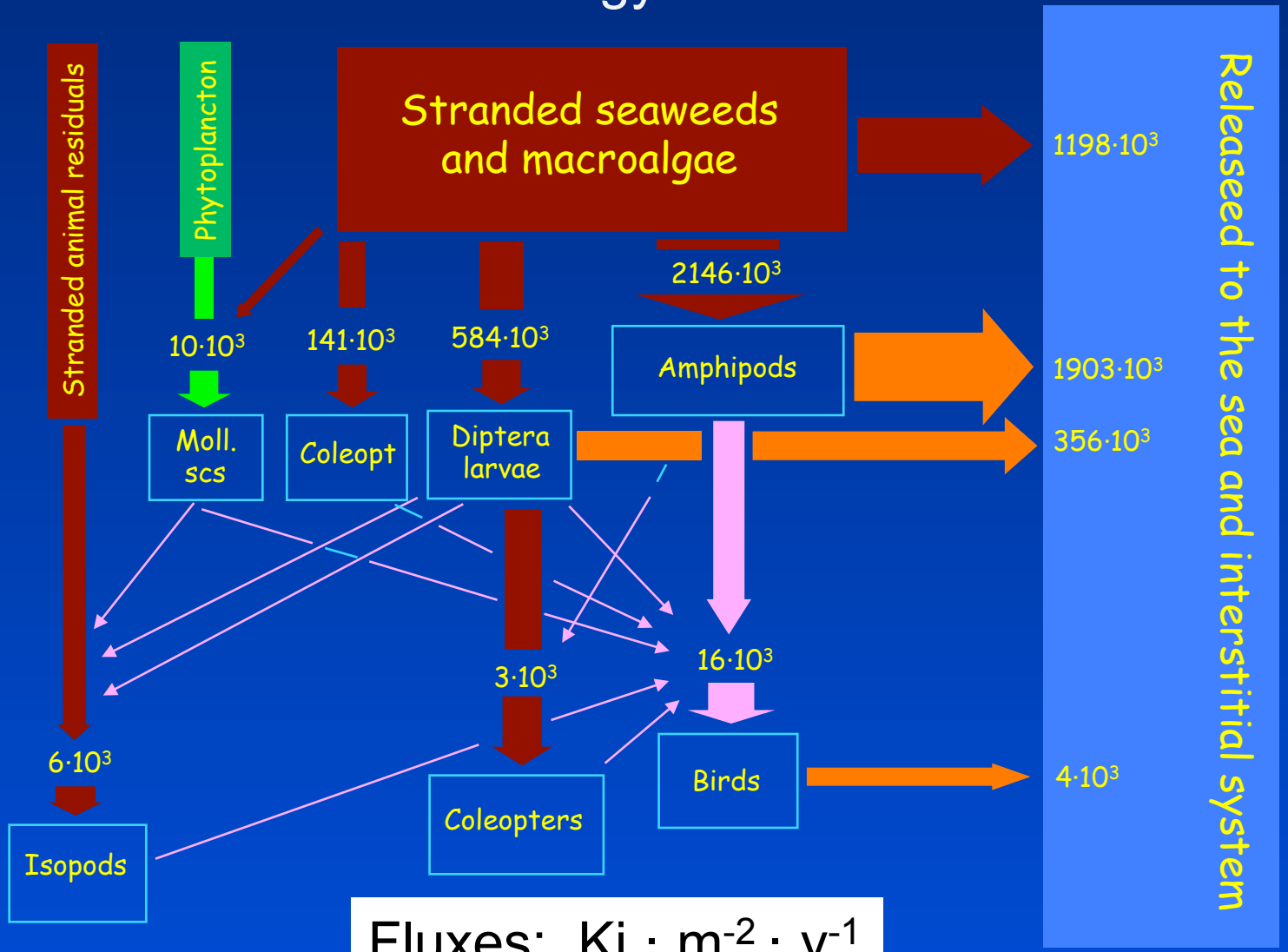
Energy transfer
Matter transfer
Heat loss



Stream community (USA)
Standing biomass



Sandy beach community
Energy flows



Fluxes: $Kj \cdot m^{-2} \cdot y^{-1}$

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Source-sink coupled ecosystems

Rivers

Rocky shores

Seagrass beds

Sea currents

Sandy beach

Stranded
organic materials

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