Interacciones bioticas

Coexistencia y co-evolución

Ignasi (Nacho) Bartomeus y Virginia Dominguez

Presntaciones:

- Nacho Bartomeus
- Virginia Domínguez
- …

	Lunes	Martes	Miercoles
9:30-11:30	Comunidades, interacciones y regulación	Robustez y estabilidad.	Co-evolución
12:00-14:00	Redes de interacciones	Modern Coexistence Theory	Conclusiones y evaluación
15:30-16:30	Discusión: Thebault & Fontaine 2010	Dinamica de poblaciones	
17:00-18:00	Indices topograficos	Discusión: Domínguez-Garcia et al. 2024	

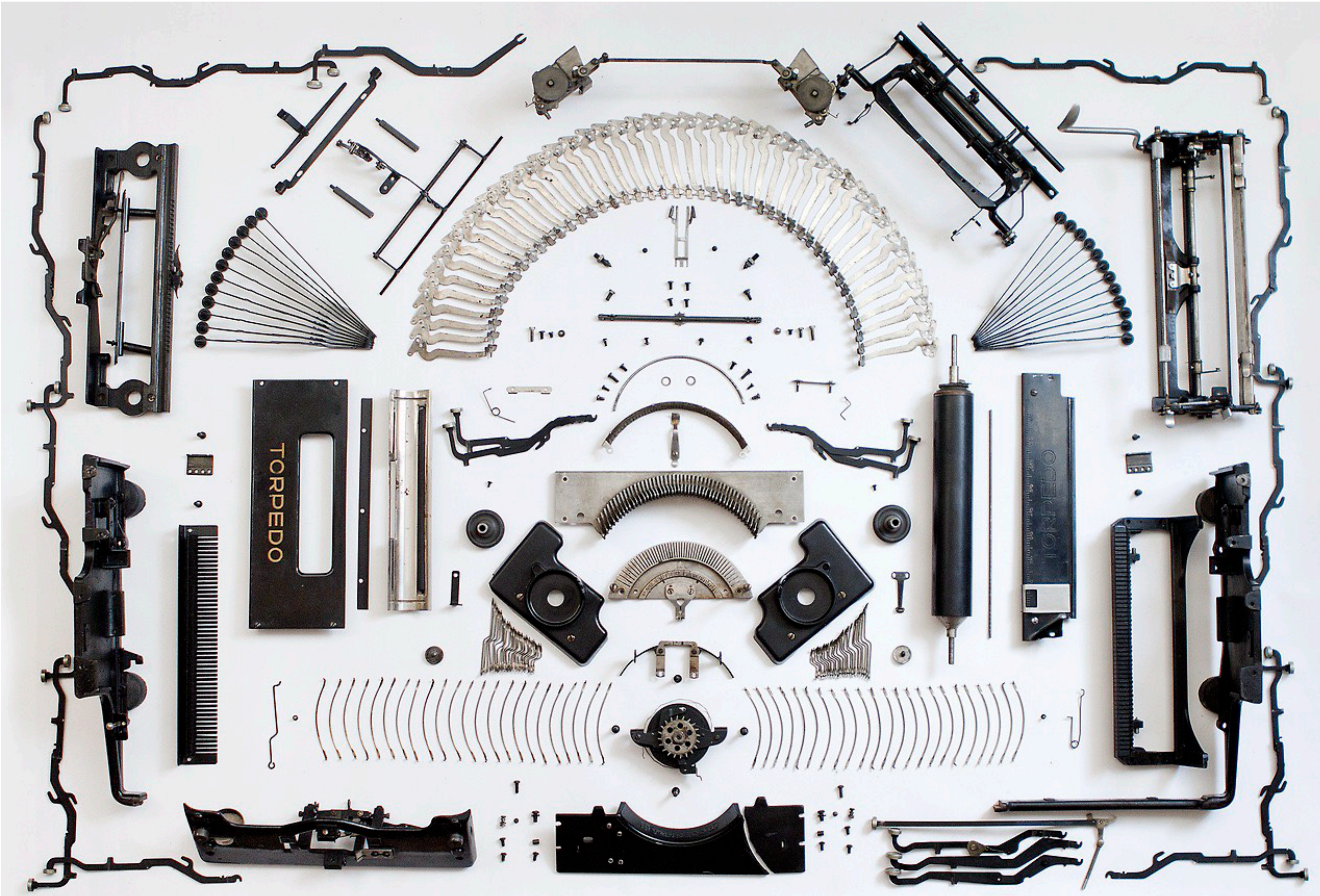
Comunidades, interacciones y regulación

Que es una comunidad?

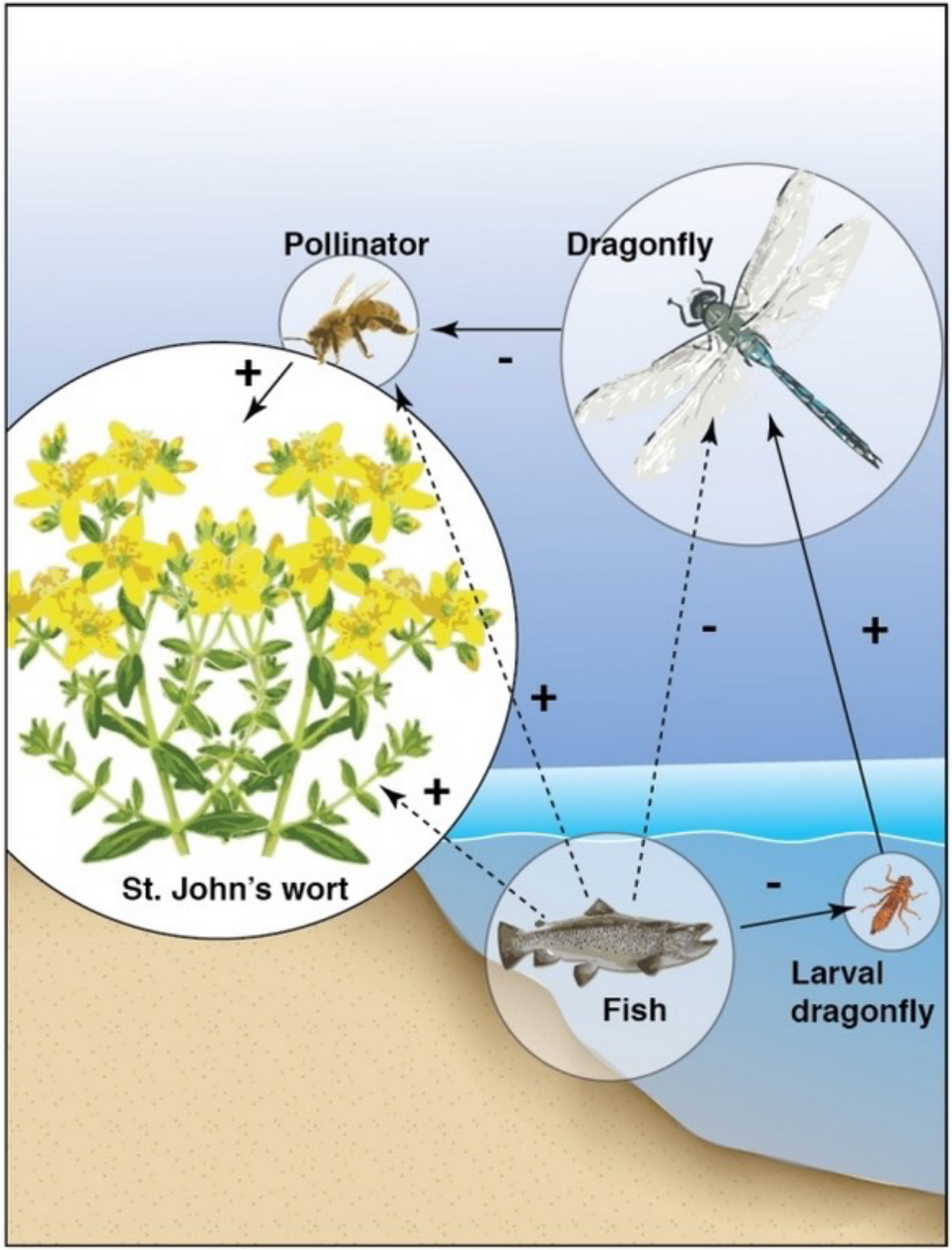

Que es una comunidad?


Conjunto de especies que persisten en un determinado lugar y tiempo.

VISIÓN DEL CAMPO



T. McLellan



Knight et al (2009)


Underwood
UNDERWOOD
UNDERWOOD STANDARD

LA ECOLOGÍA ES LA CIENCIA DE CÓMO LOS ORGANISMOS INTERACTÚAN ENTRE SÍ Y CON SU ENTORNO

Haeckel (1866)

HISTORIA DEL ESTUDIO DE INTERACCIONES

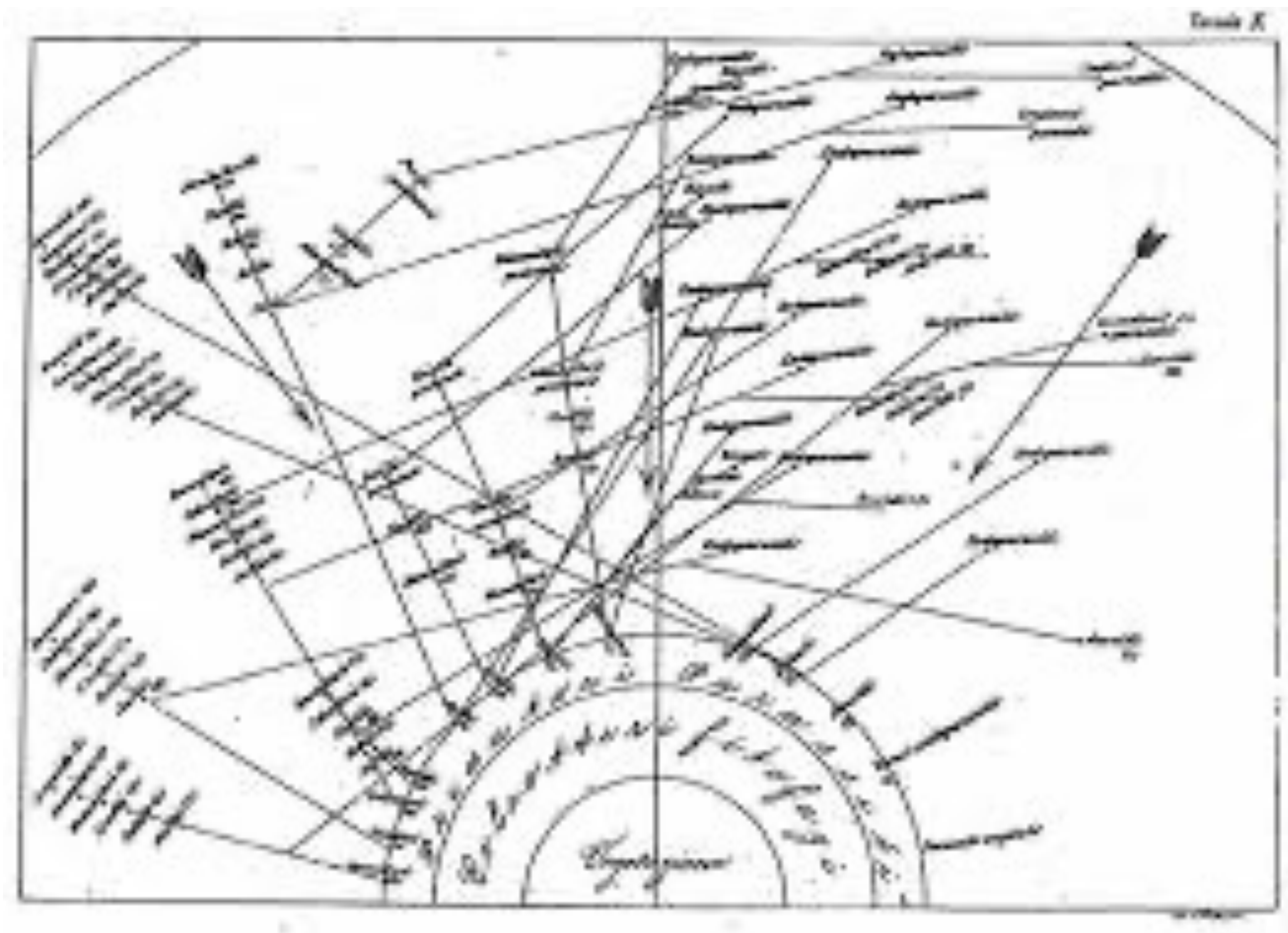
Altamira 15000 A.C.

HISTORIA DEL ESTUDIO DE INTERACCIONES

Aristoteles 344 A.C.

Al-Jahiz 800 D.C.

REDES DE INTERACCIONES



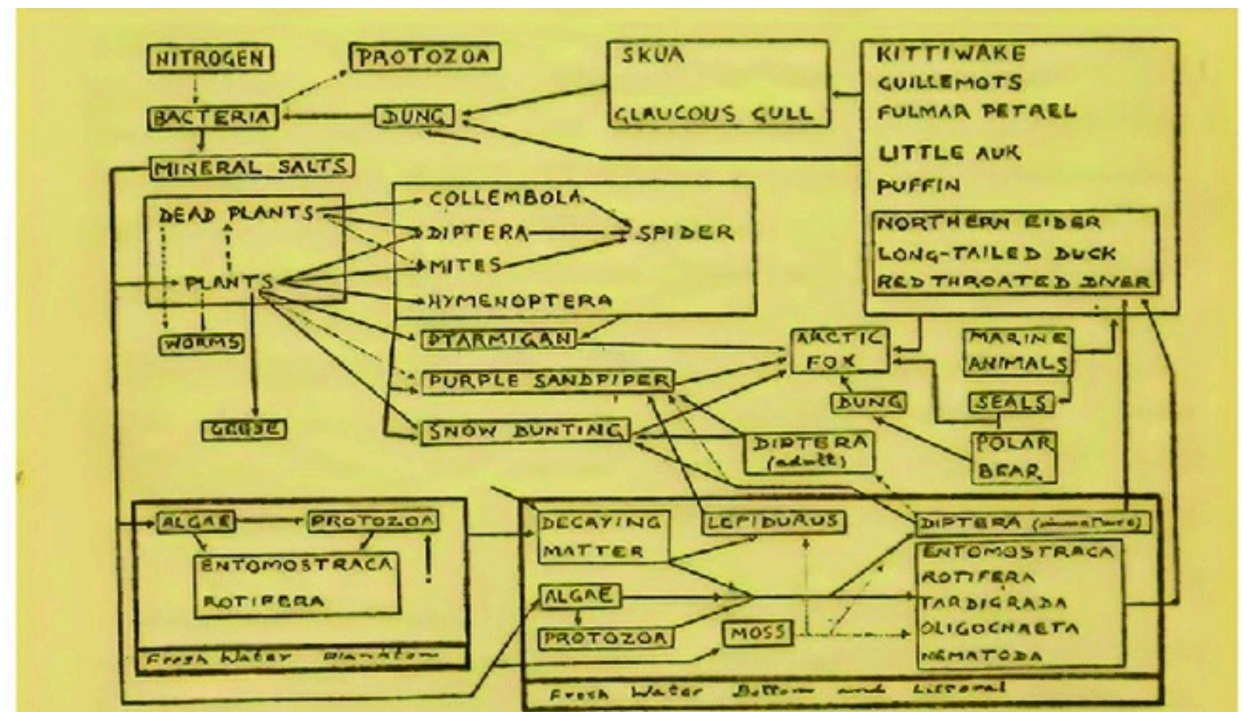


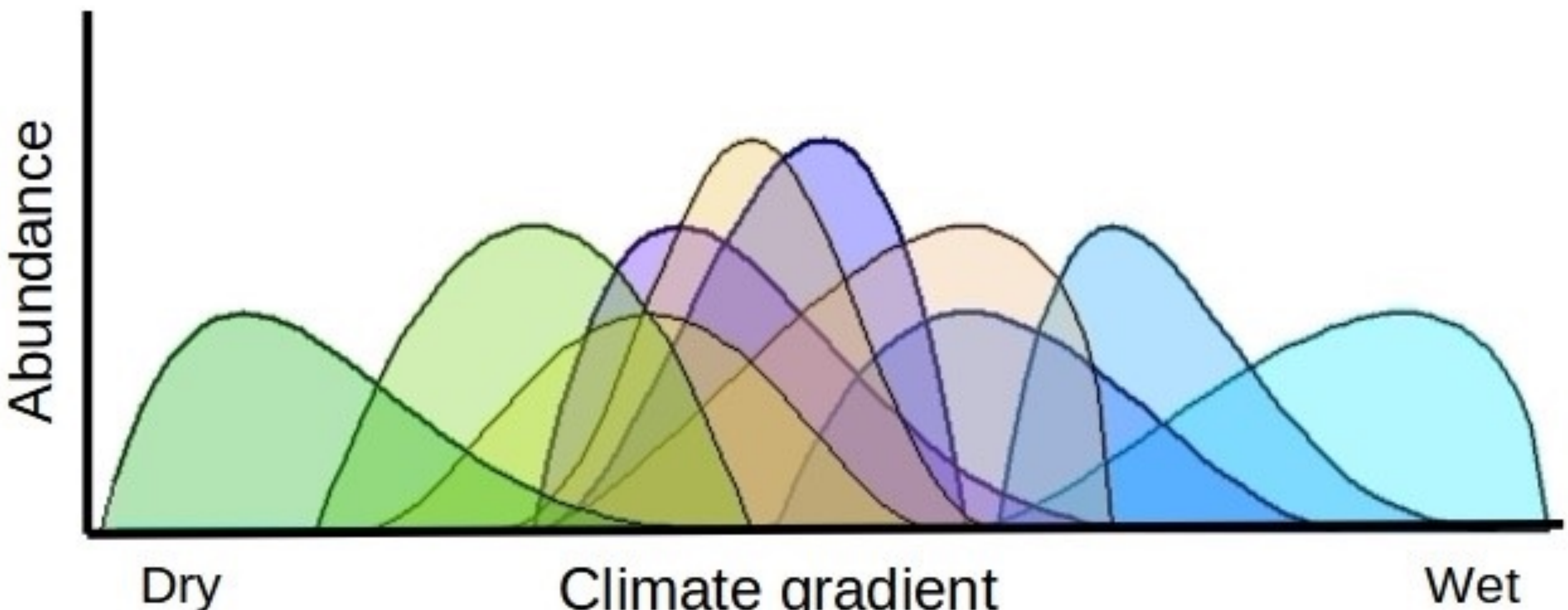
FIG. 4.—Food-cycle among the animals on Bear Island, a barren spot in the arctic zone, south of Spitsbergen. (The dotted lines represent probable food relations not yet proved.) The best way to read the diagram is to start at "marine animals" and follow the arrows. (From Summerhayes and Elton.[25])

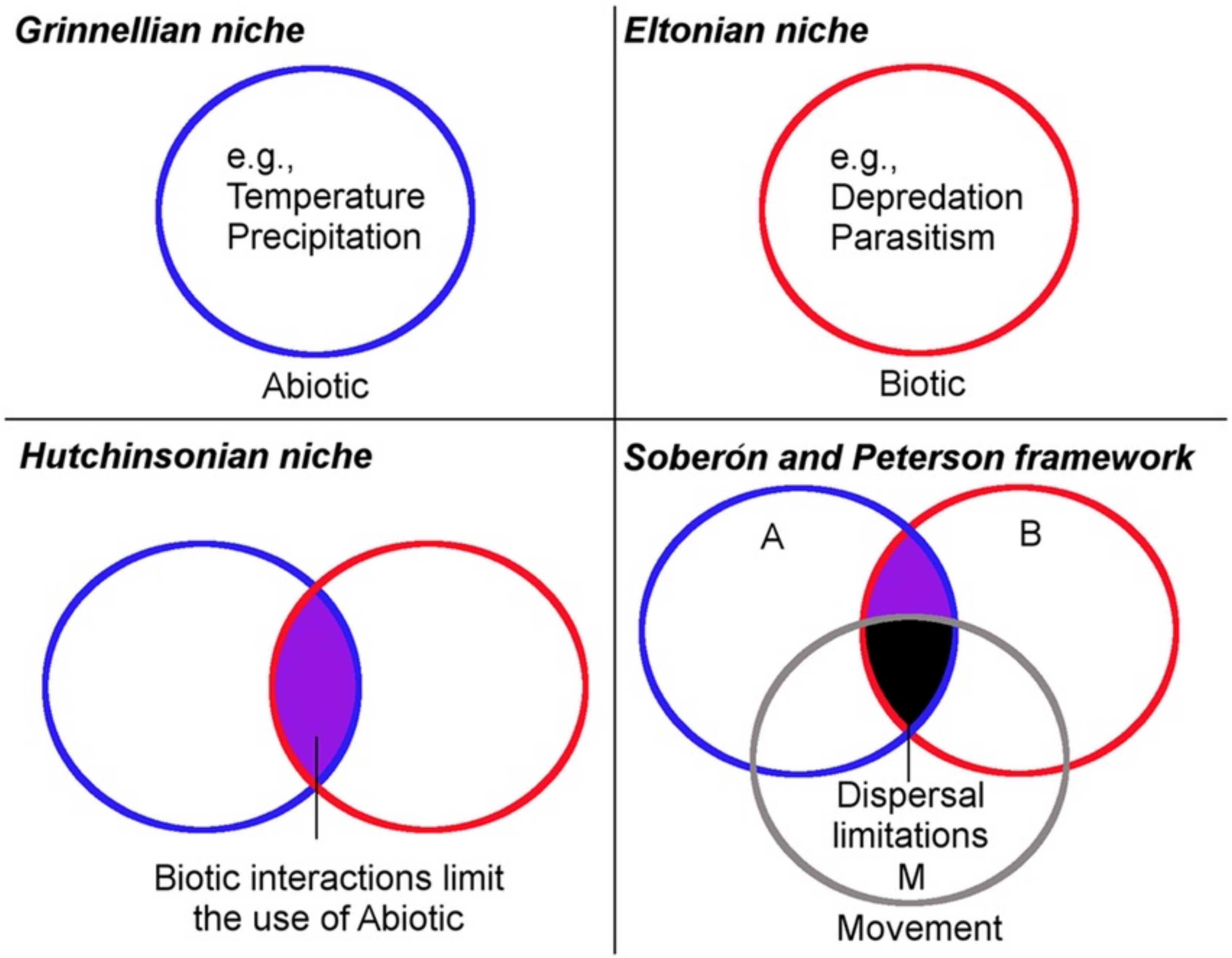
L. Camerano 1880

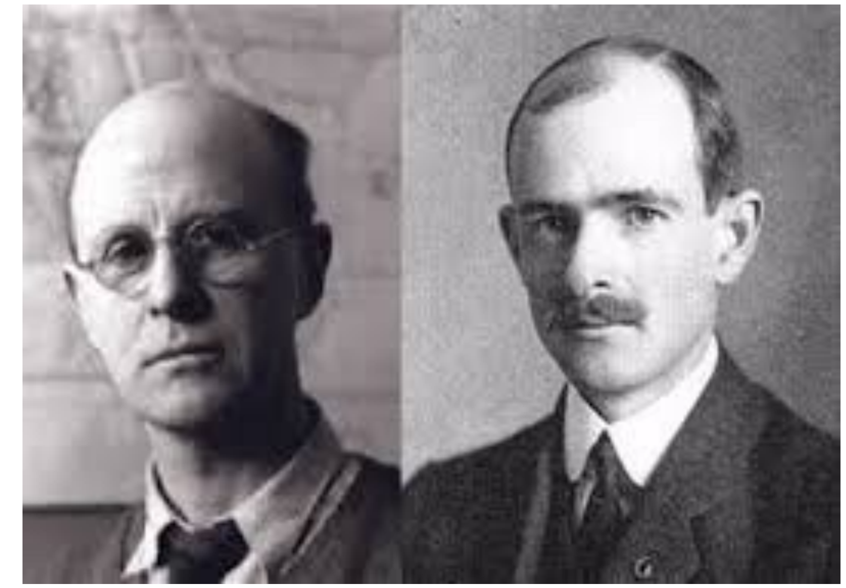
Summerhayes and Elton 1923

Frederic and Edith Clements

A. Classical



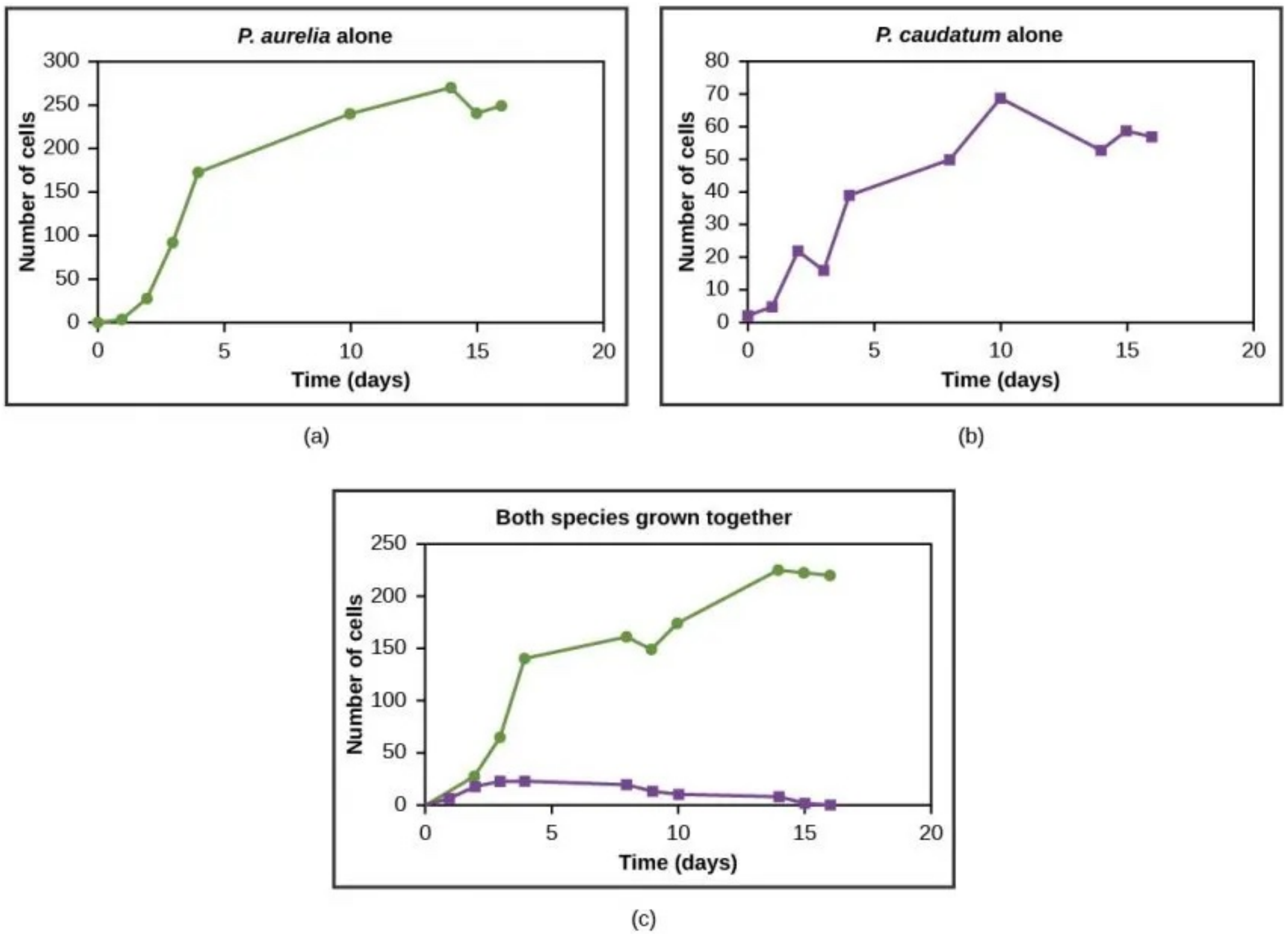




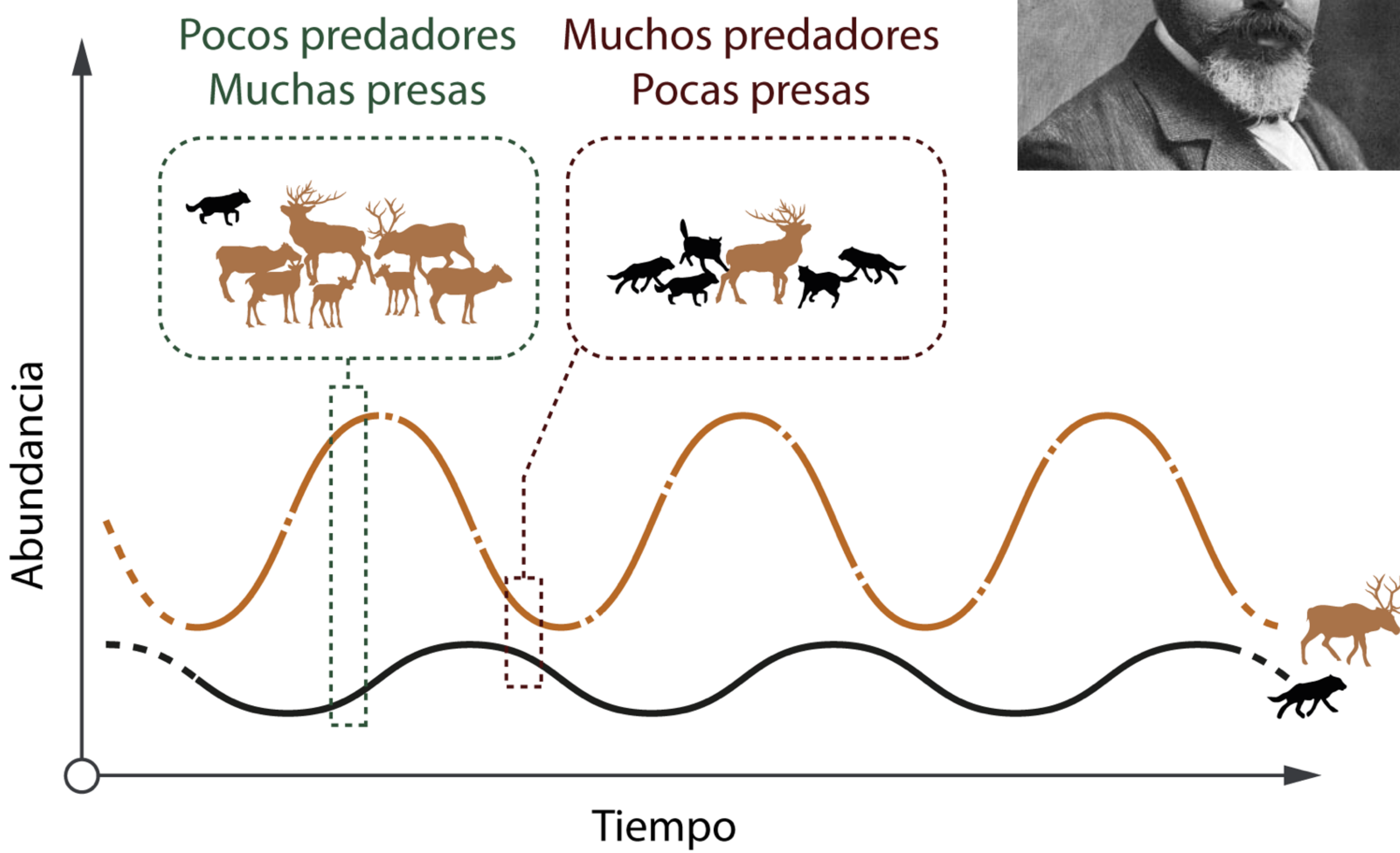
Elton - Grinell

~1920

PRINCIPIO DE EXCLUSION COMPETITIVA

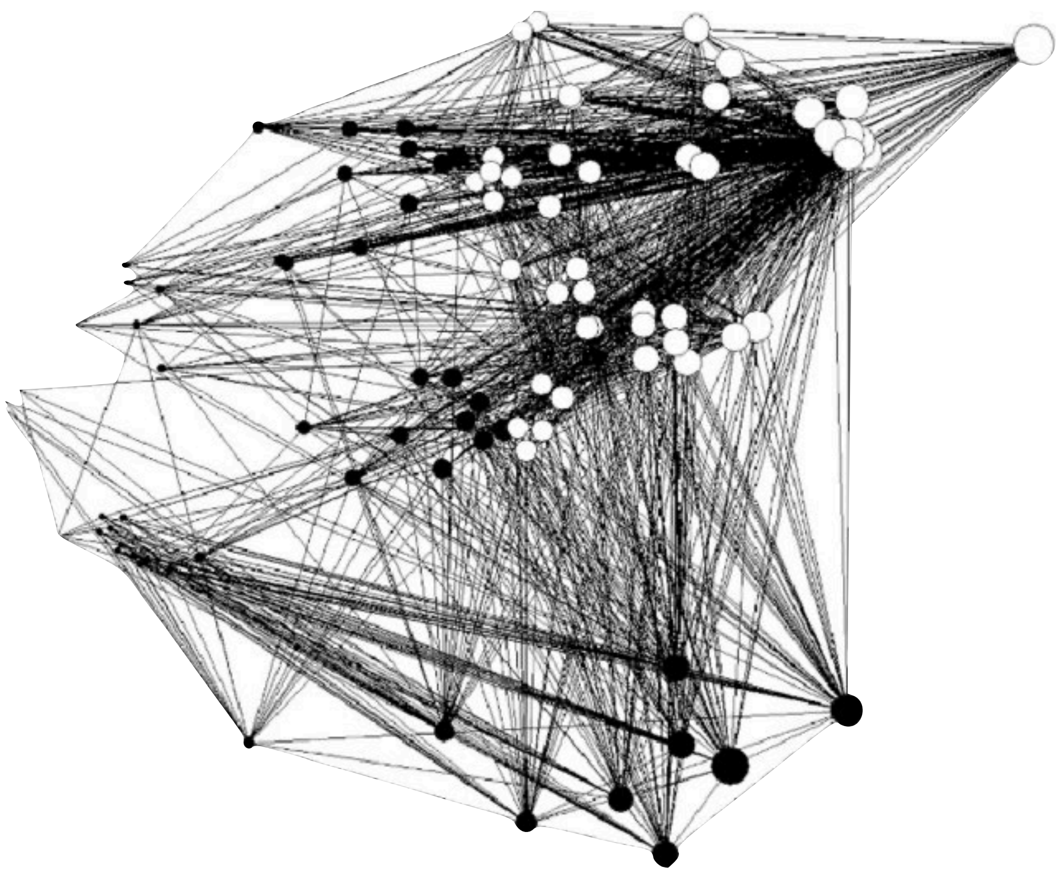


Gause 1934



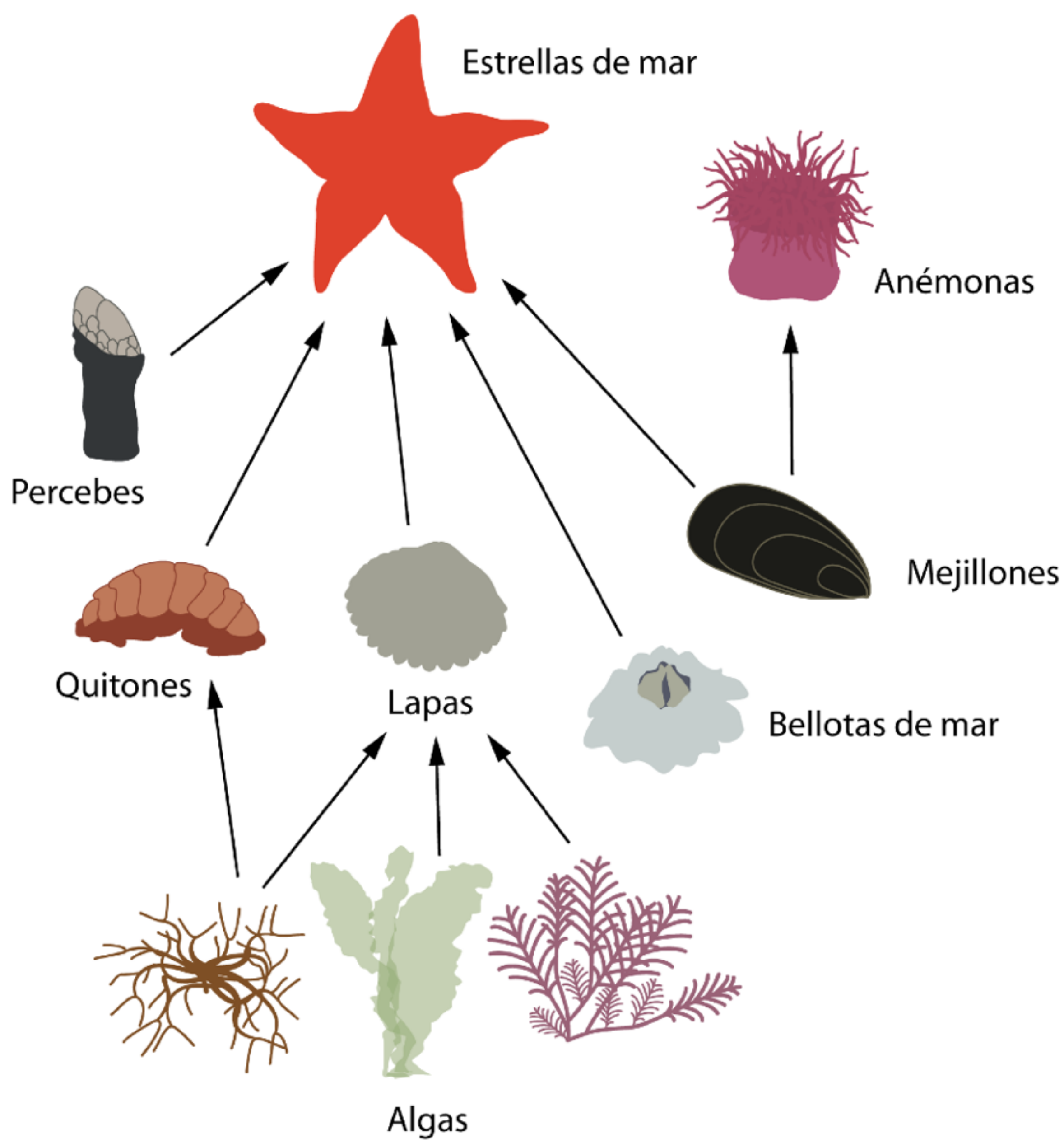
Lotka 1920, Volterra 1928

REDES DE INTERACCIONES



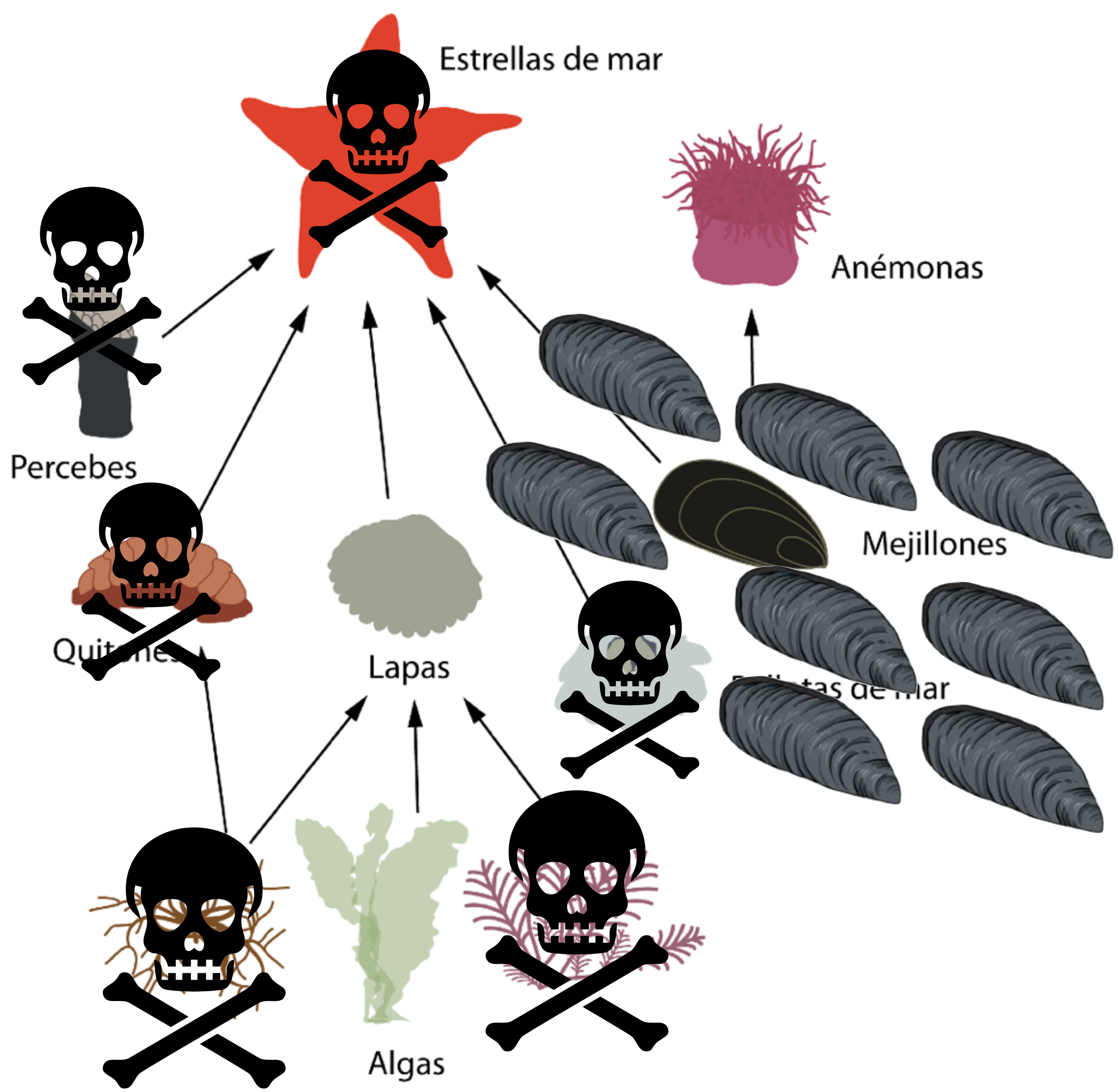
Lindeman 1942

REDES DE INTERACCIONES



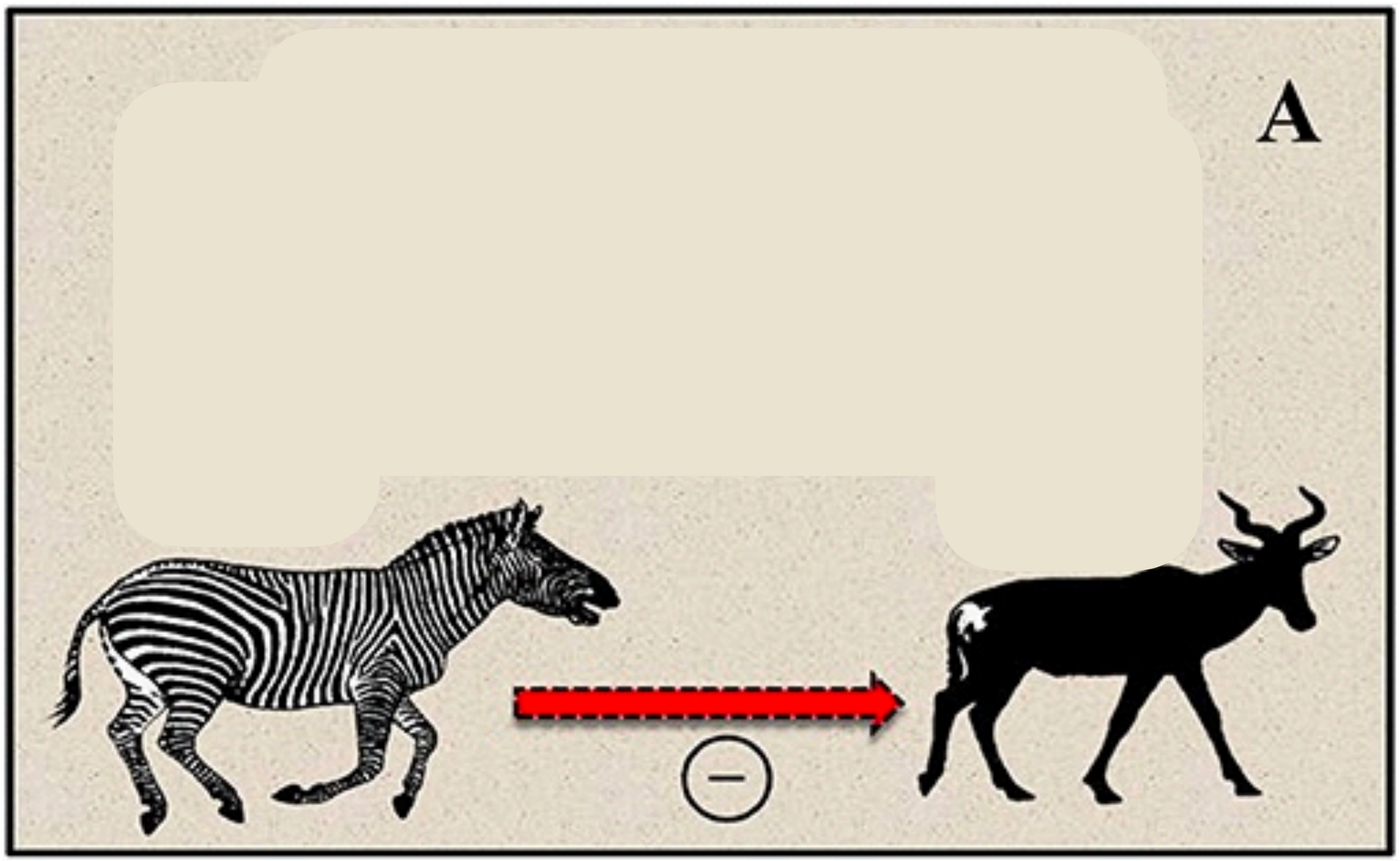
Paine 1969

REDES DE INTERACCIONES



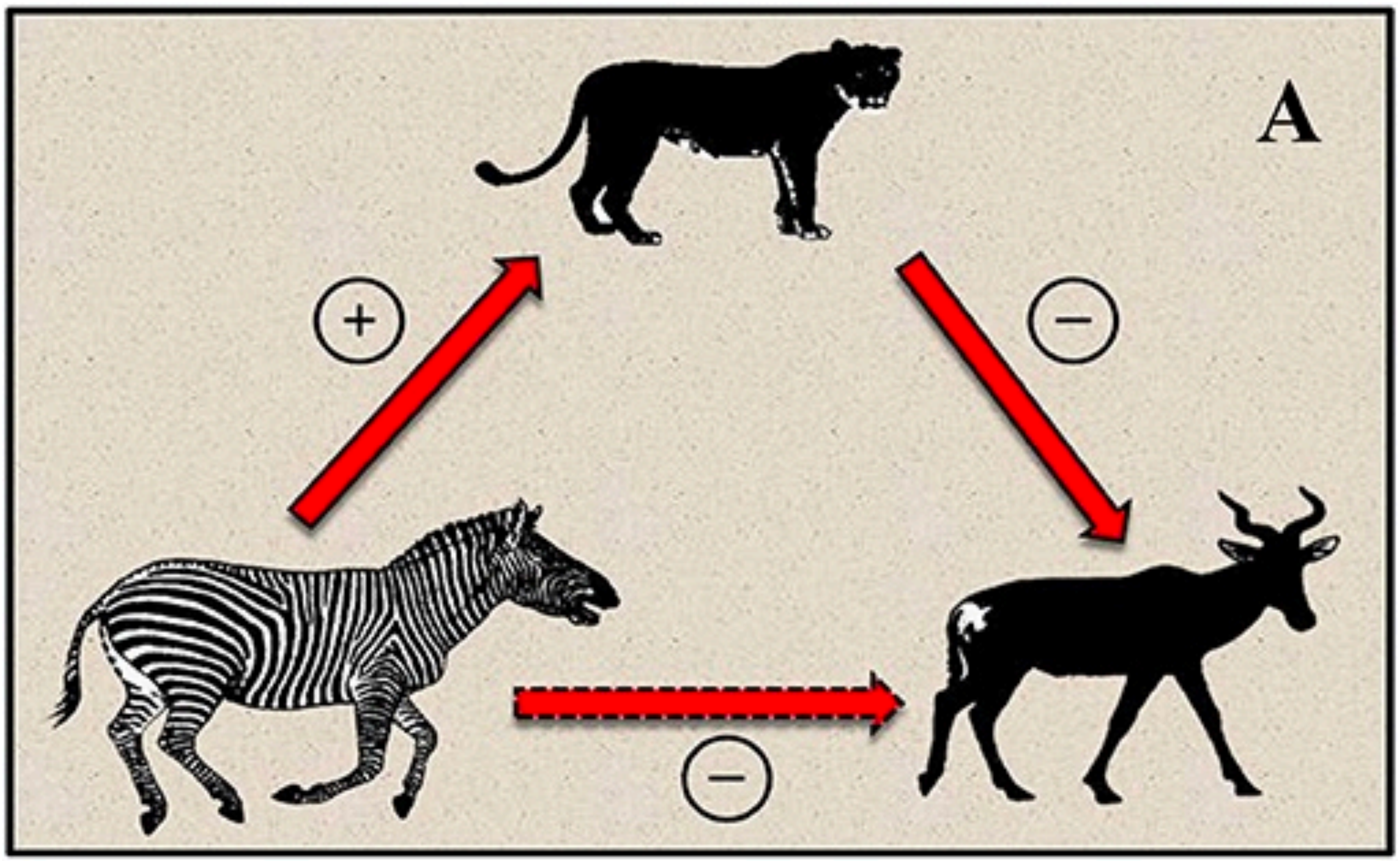
Paine 1969

APPARENT COMPETITION



Holt 1977

APPARENT COMPETITION



Holt 1977

INTERACCIONES

Tipo de interacción	Signo
Depredación, Parasitismo, Herbívora	+/-
Competición	-/-
Mutualismo	+/+
Comensalismo	+/0

Que es una comunidad?

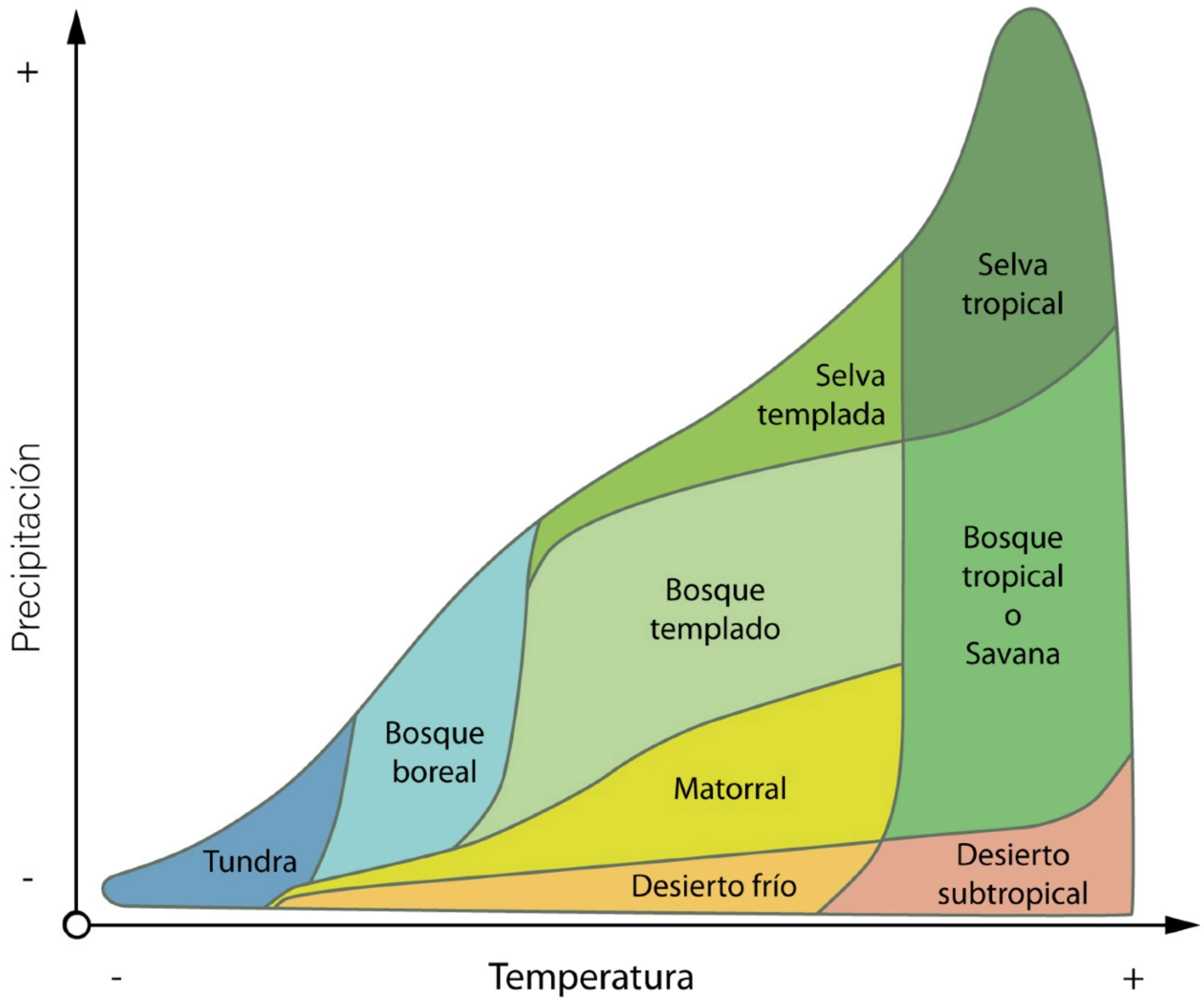
Conjunto de especies que *persisten* en un determinado lugar y tiempo.

Cuando persisten las especies?

Cuando persisten las especies?

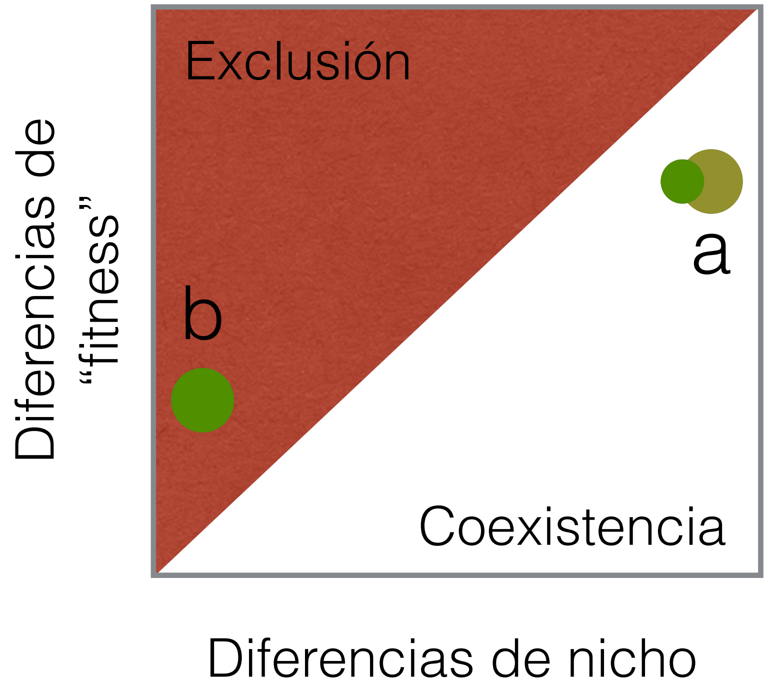
Growth rate > 0

Regulación



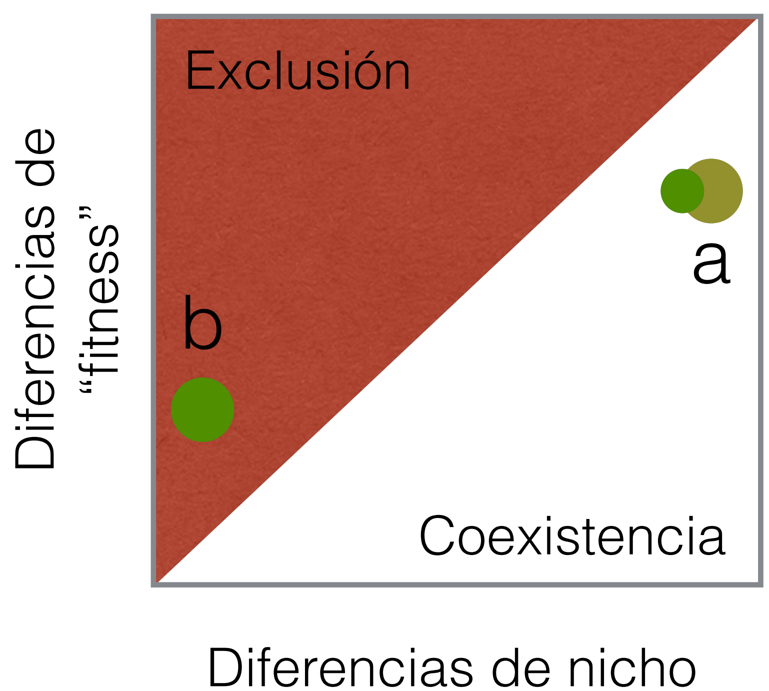
+
-
Precipitación
-
Temperatura
+
Selva
tropical
Selva
templada
Bosque
templado
Bosque
tropical
o
Savana
Bosque
boreal
Matorral
Tundra
Desierto frío
Desierto
subtropical

REDES DE INTERACCIONES

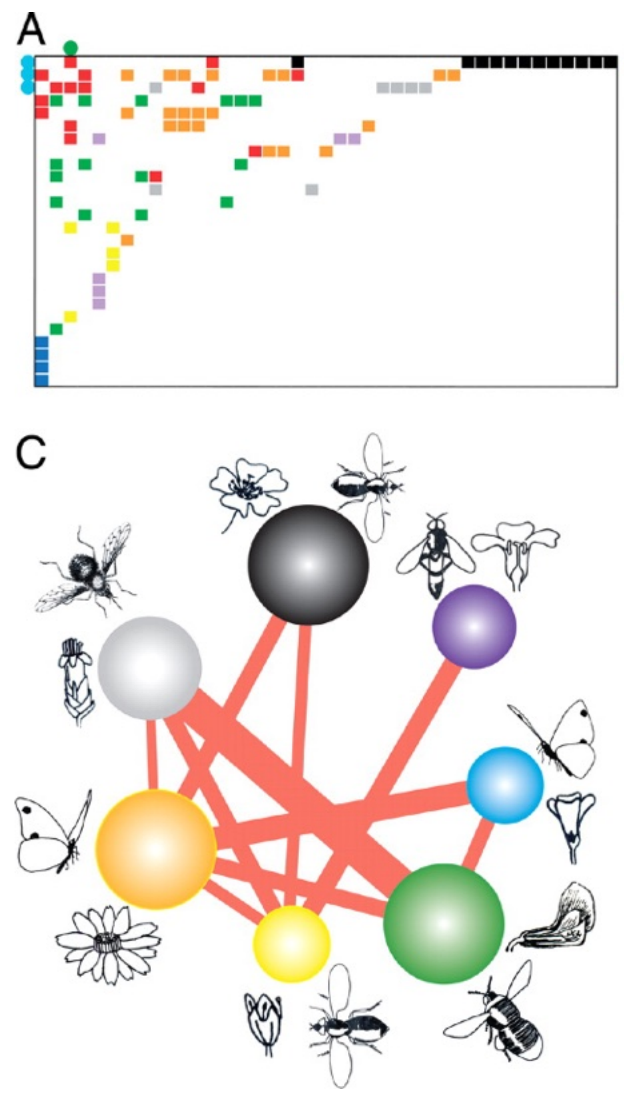


Tilman 1982
Chesson 2000

REDES DE INTERACCIONES

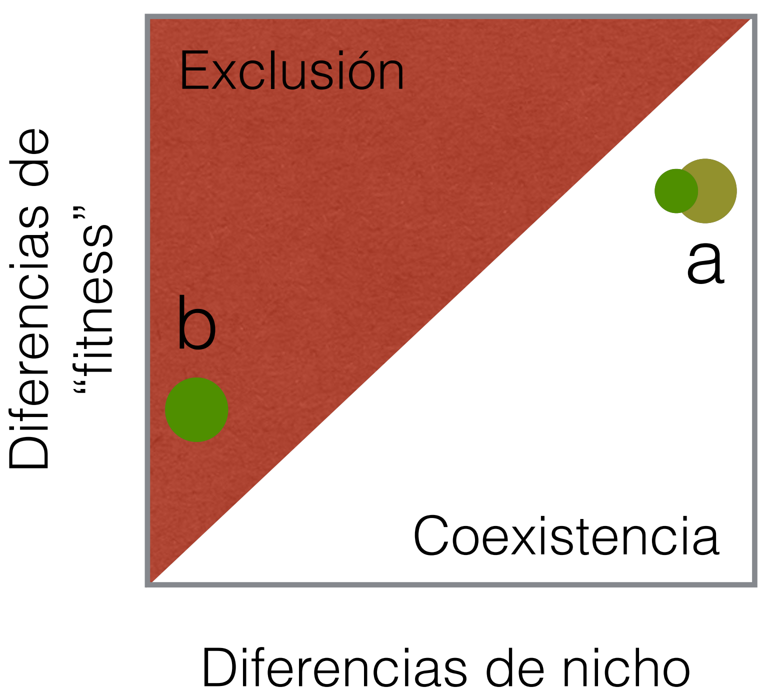


Tilman 1982
Chesson 2000

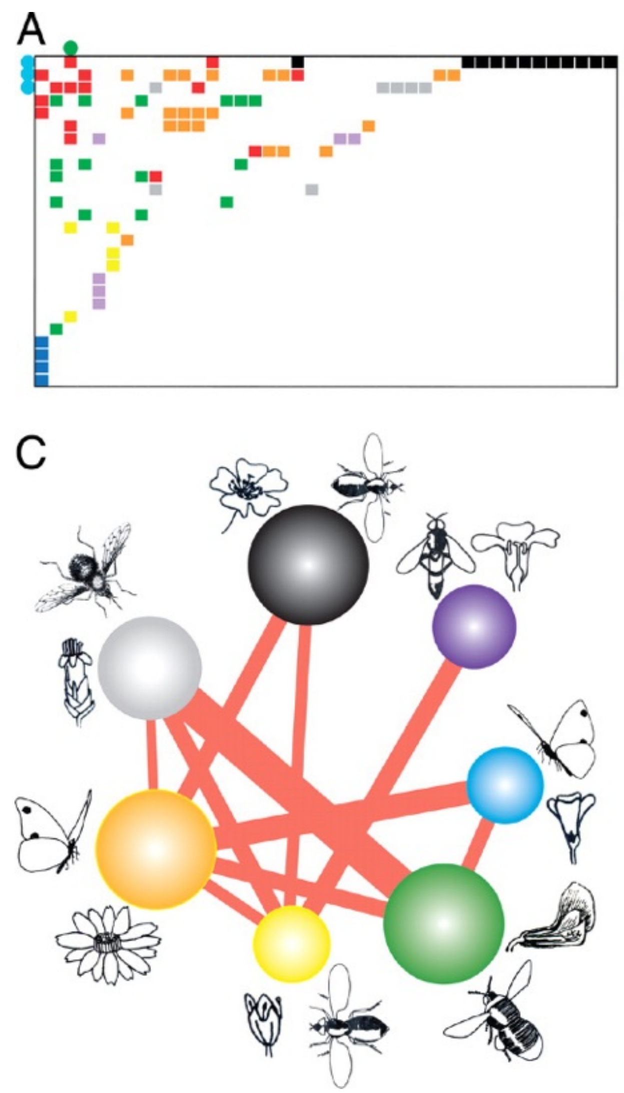


Jordano 1987

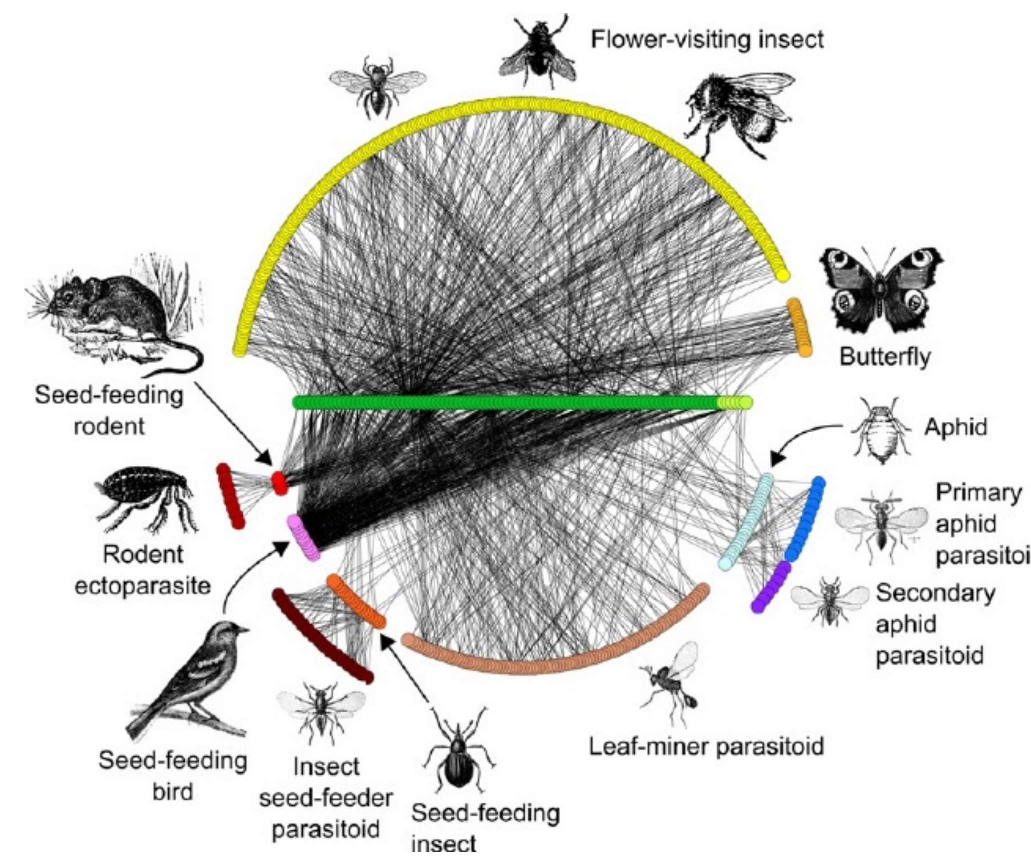
REDES DE INTERACCIONES



Tilman 1982
Chesson 2000

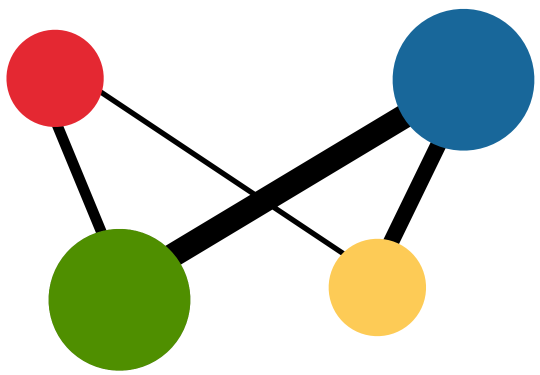


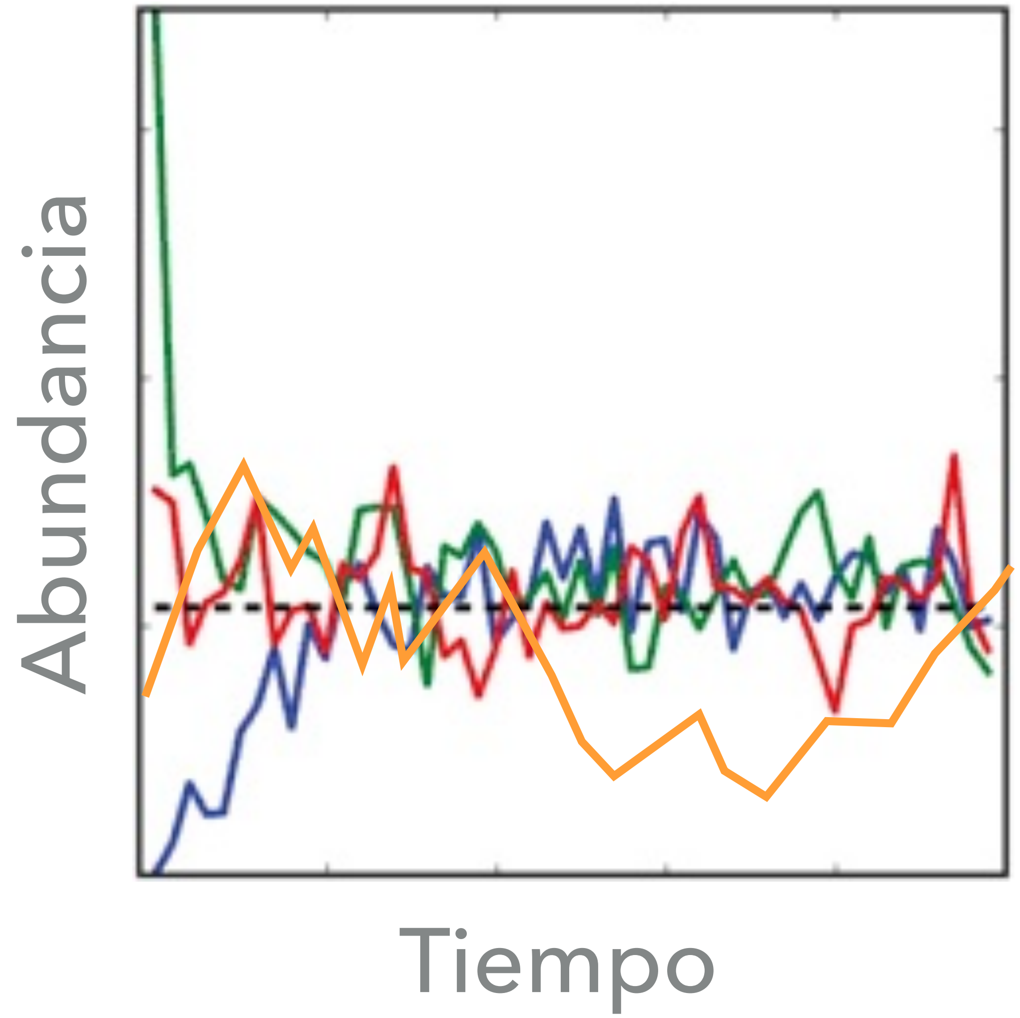
Jordano 1987



Pocock et al. 2012

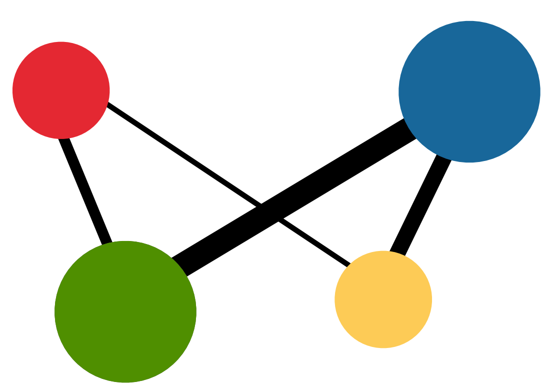
DEFINEN LA ESTABILIDAD Y COEXISTENCIA DEL SISTEMA

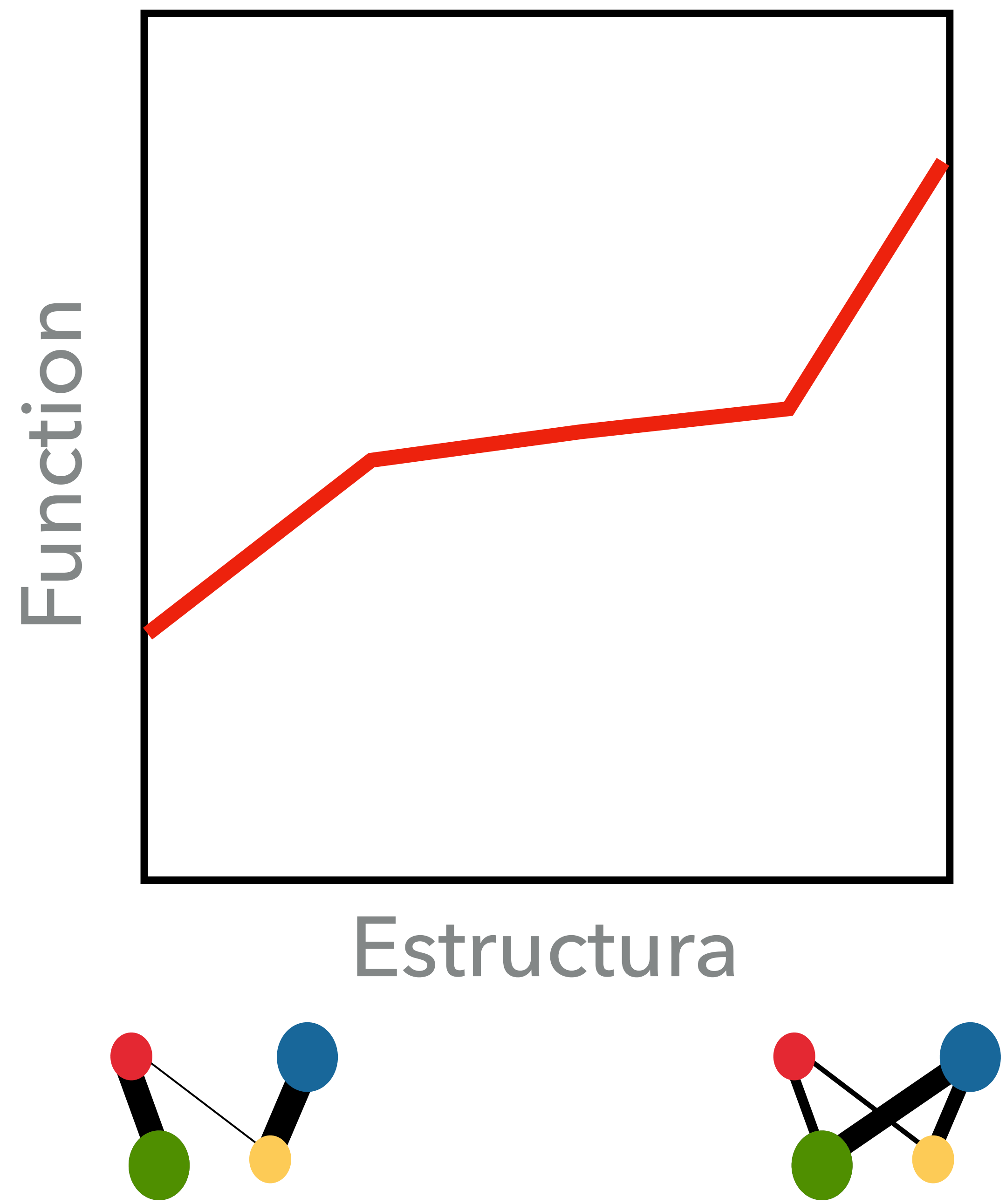




May 1972

DEFINEN LA FUNCIONALIDAD DEL SISTEMA



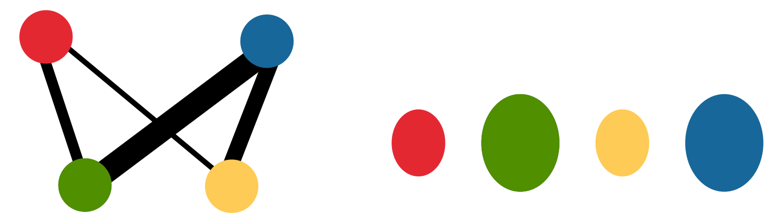


> LO QUE A MENUDO PASA DESAPERCIBIDO, ES UN TIPO DE EXTINCIÓN MUCHO MÁS INSIDIOSA: LA EXTINCIÓN DE LAS INTERACCIONES ECOLÓGICAS.

D. Janzen

Inputs

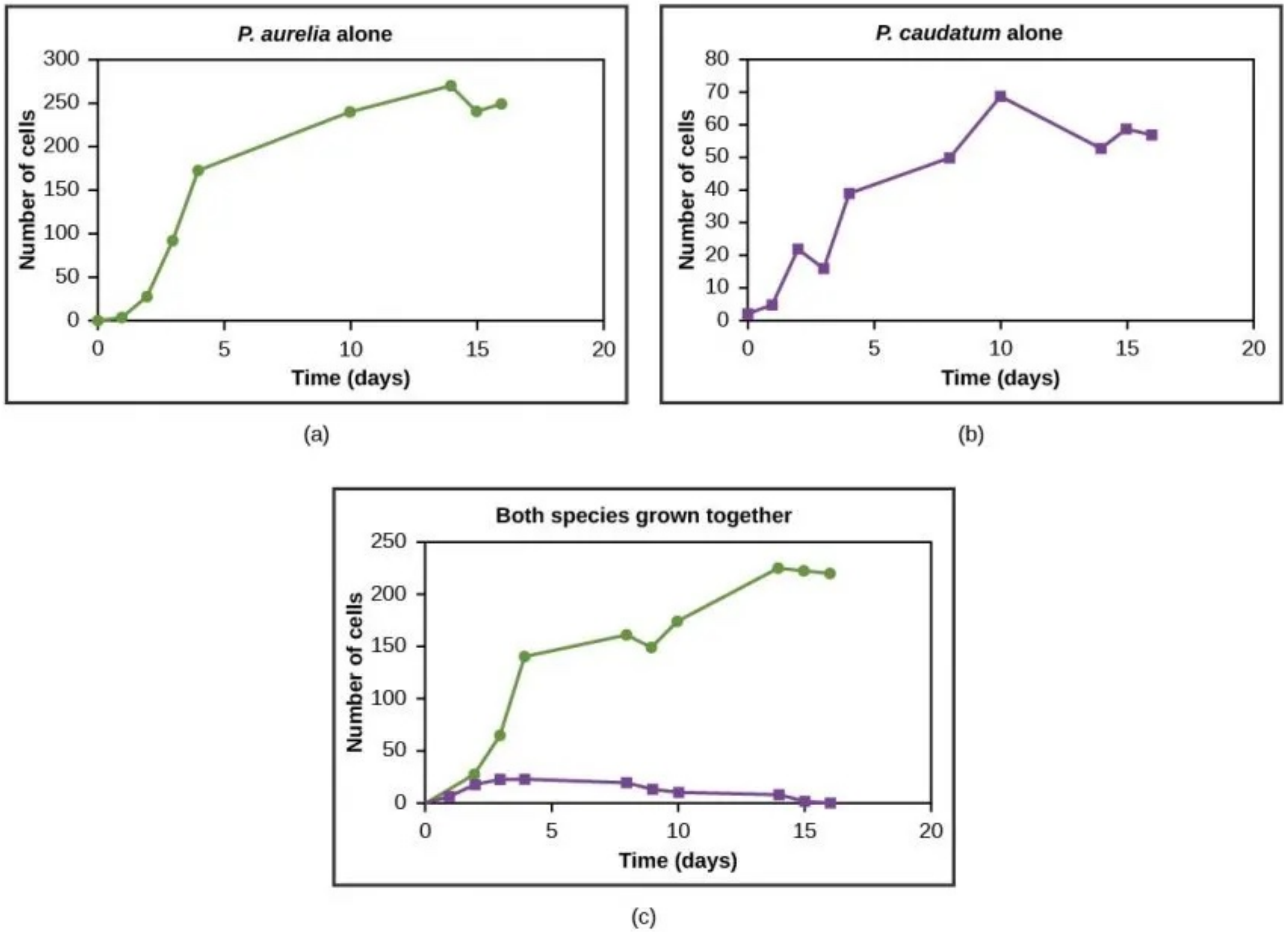
Outputs



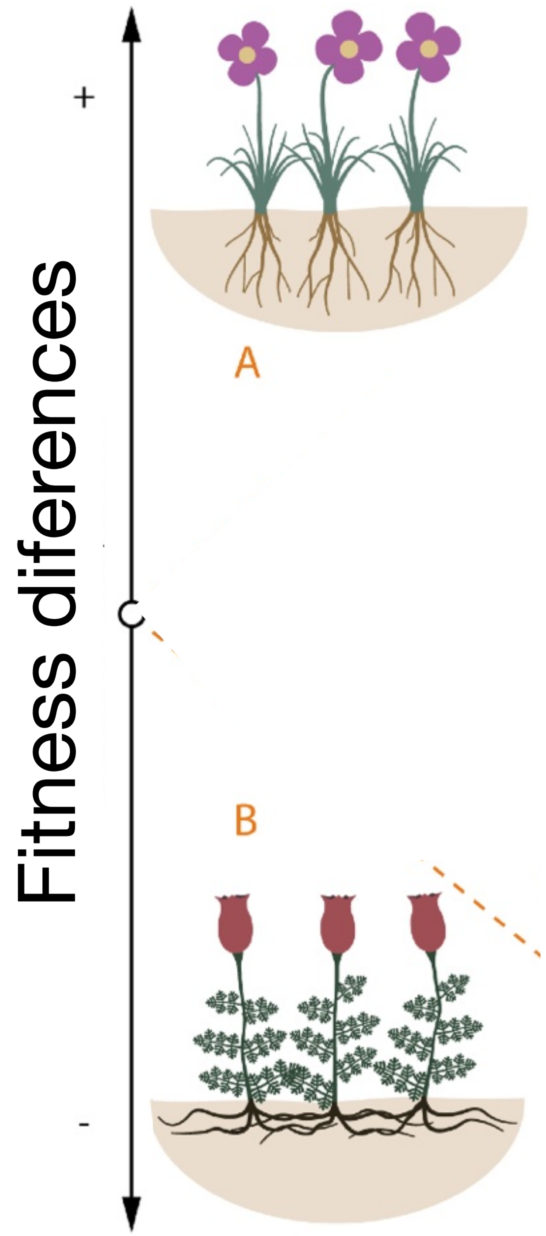
	Growth rates	Interaction Network	Abundance	Aim
Topology				Description of patterns
Coexistence			(Persistence)	Describe mechanisms
Dynamics				Predict estability
Structural stability			(Persistence)	Predict estable conditions

Modern Coexistence Theory

Local coexistence is rare in experimental conditions…



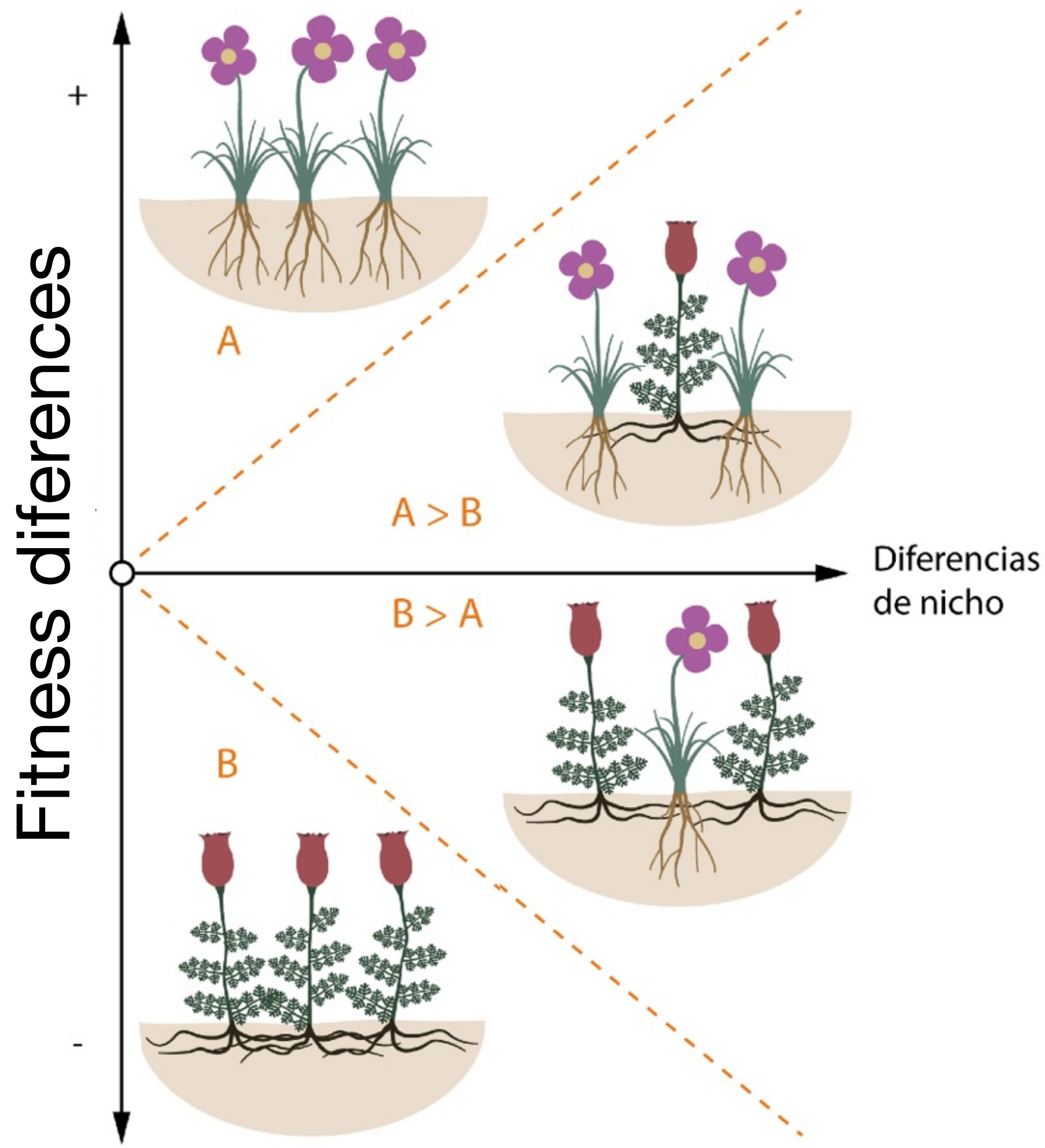
Gause 1934



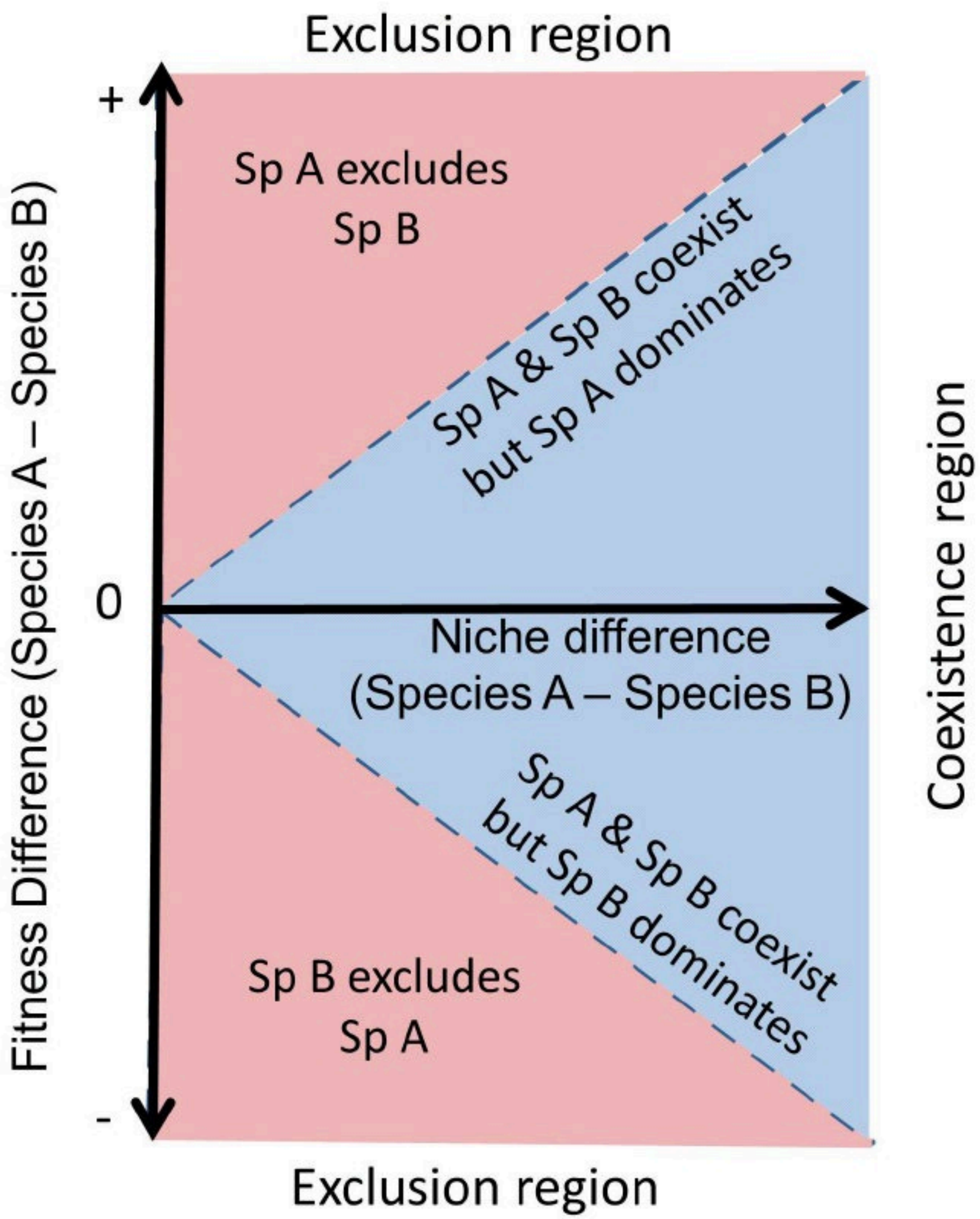
A >> B

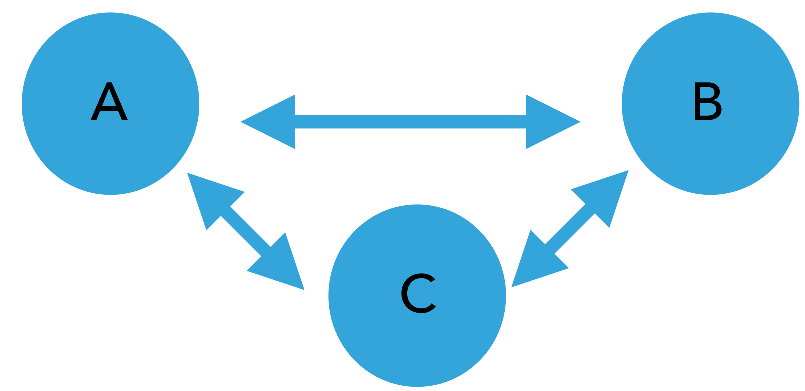
B >> A

Fitness = “optimal” Growth rate



Niche = resource use





All you need to know is "fitness" , and "competition matrix"

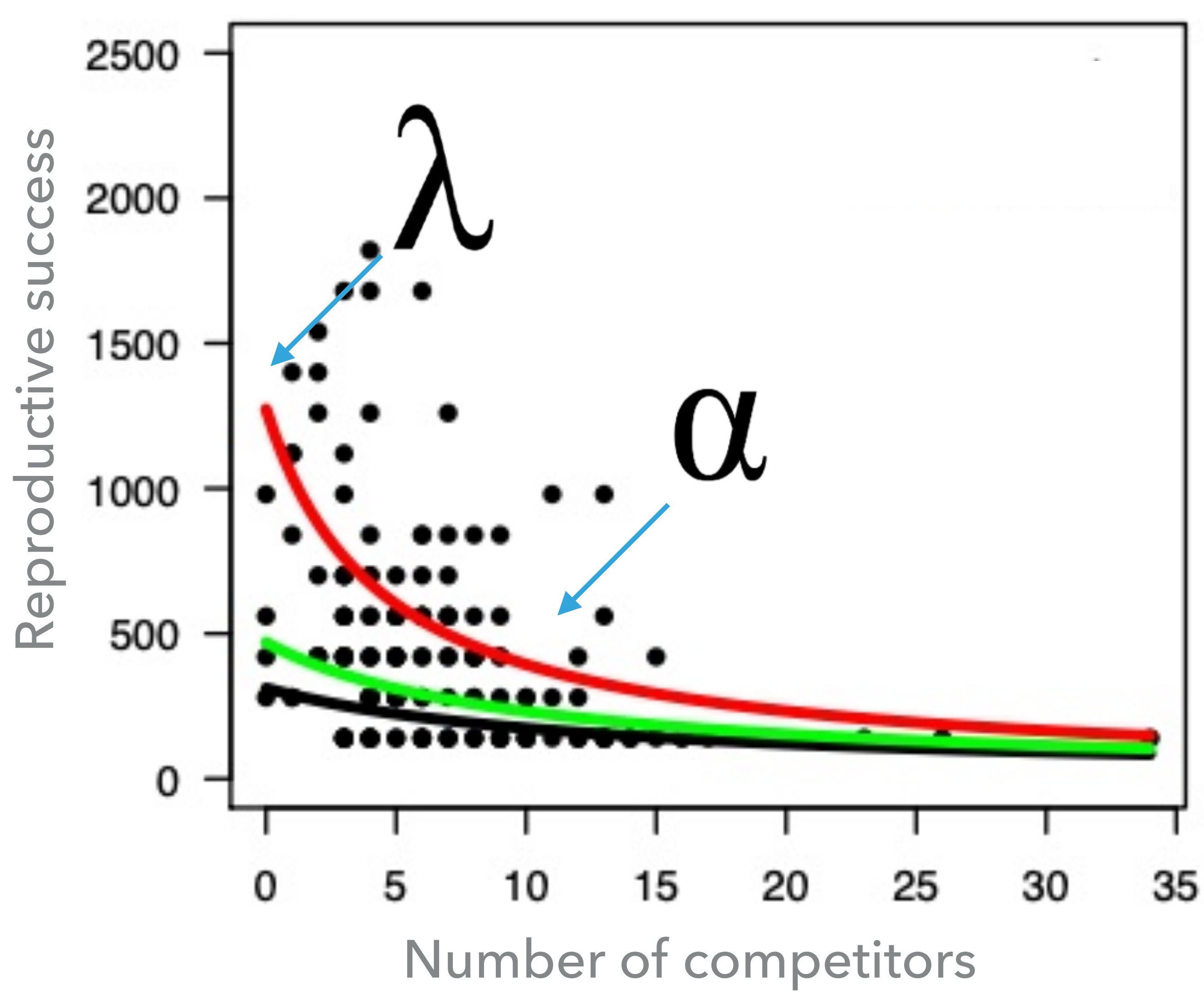
Chesson 2000

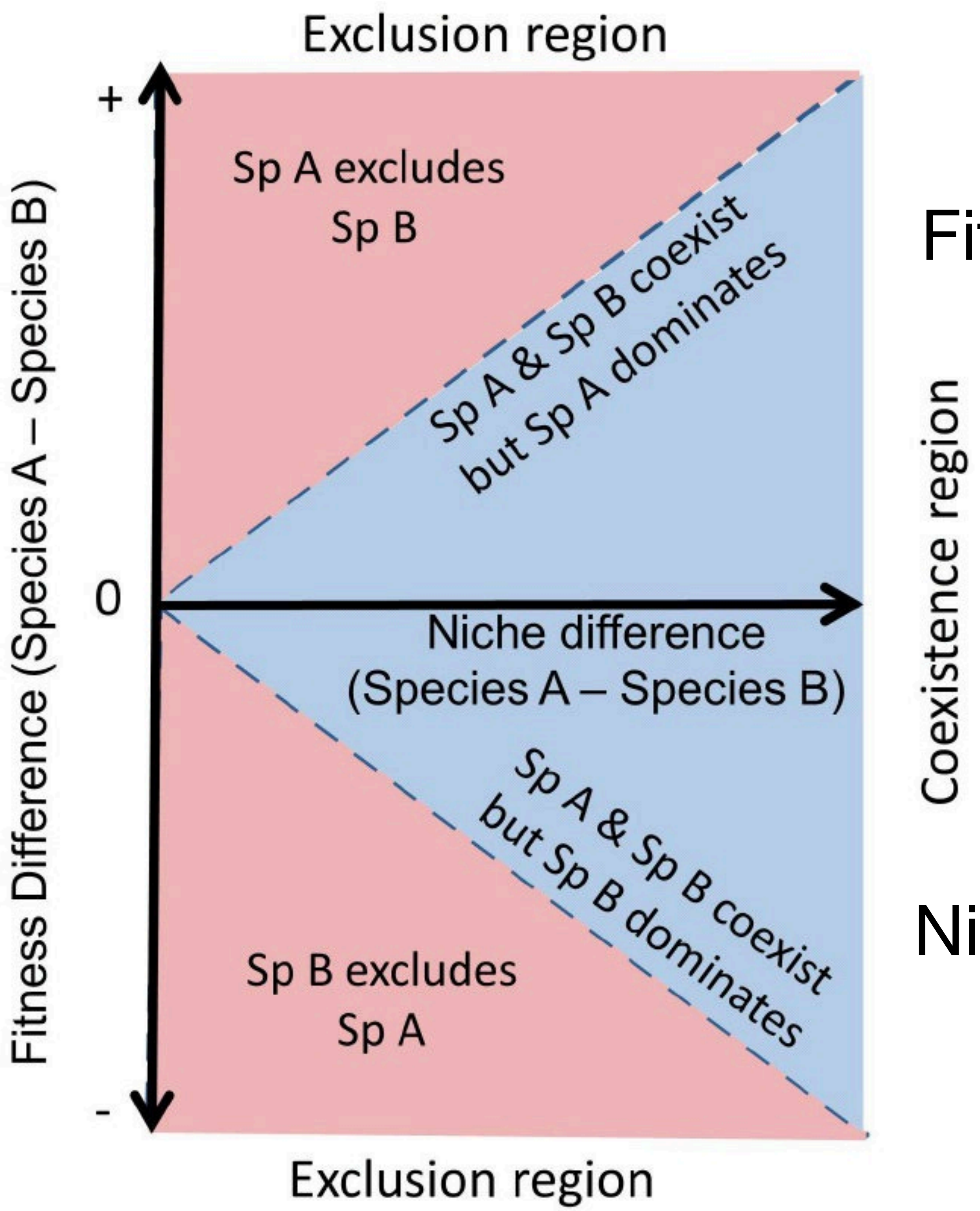
Growth rate

$$Fi = \frac{\lambda_i}{1 + \sum(\alpha_{ij})Nj}$$

Reproductive success

Competition

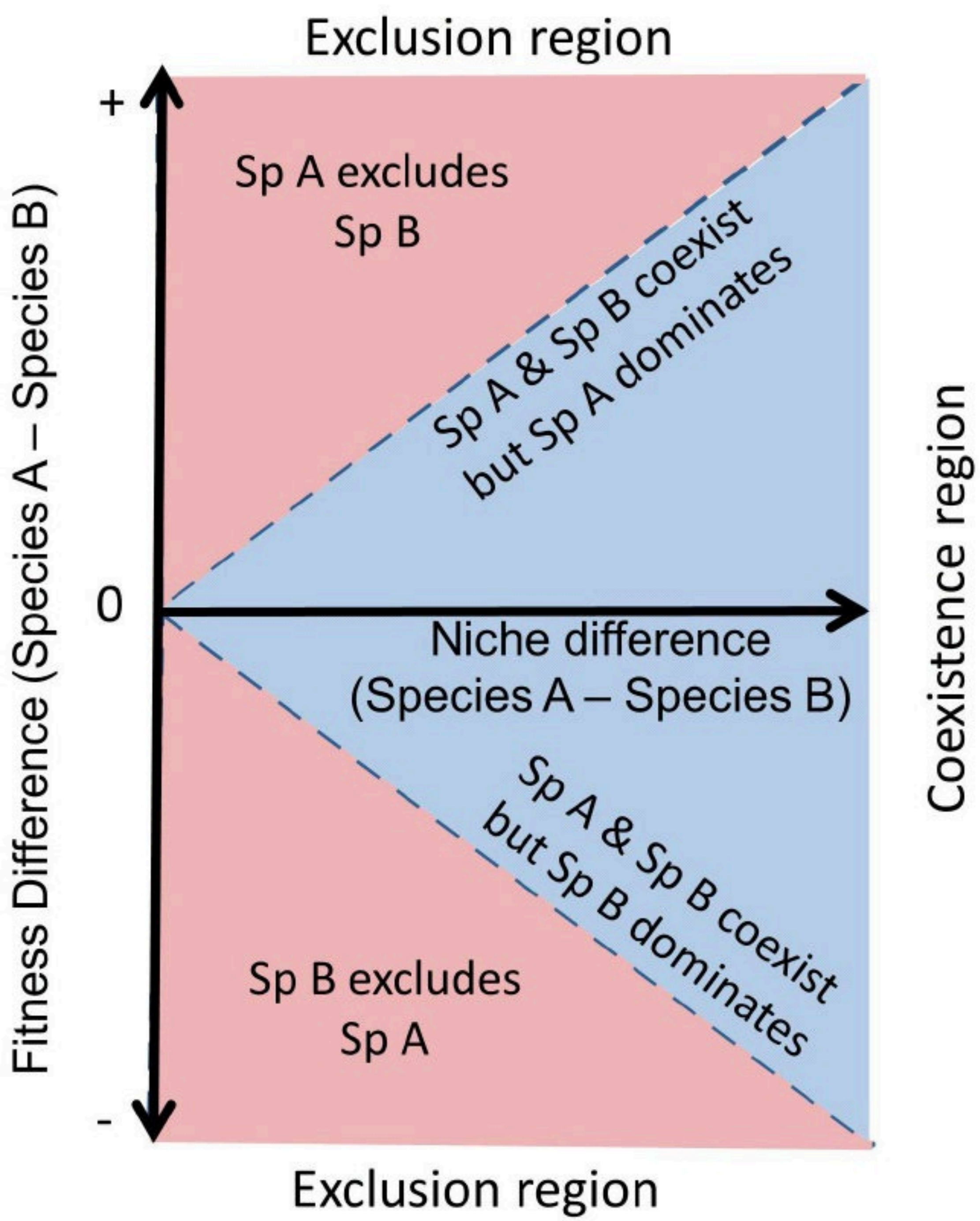


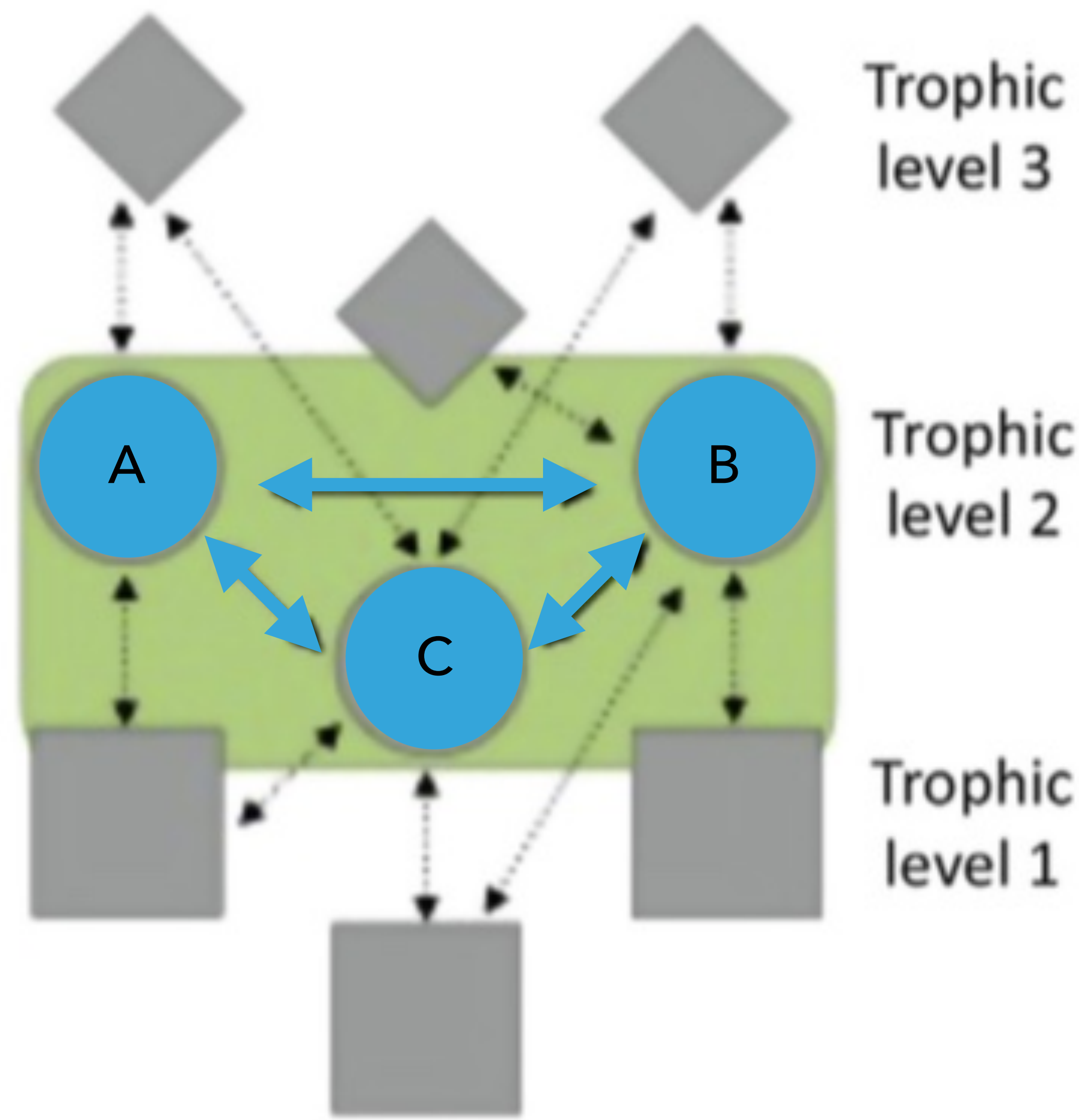


Fitness differences = $$1 - \frac{\lambda_A}{\lambda_B}$$

Niche differences = $$\sqrt{\frac{\alpha_{AB}\alpha_{AB}}{\alpha_{AA}\alpha_{BB}}}$$

Chesson 2000





Chesson 2000

Godoy et al. 2018

Rohr et al 2014

Growth rate

Environment

Mutualistic effect

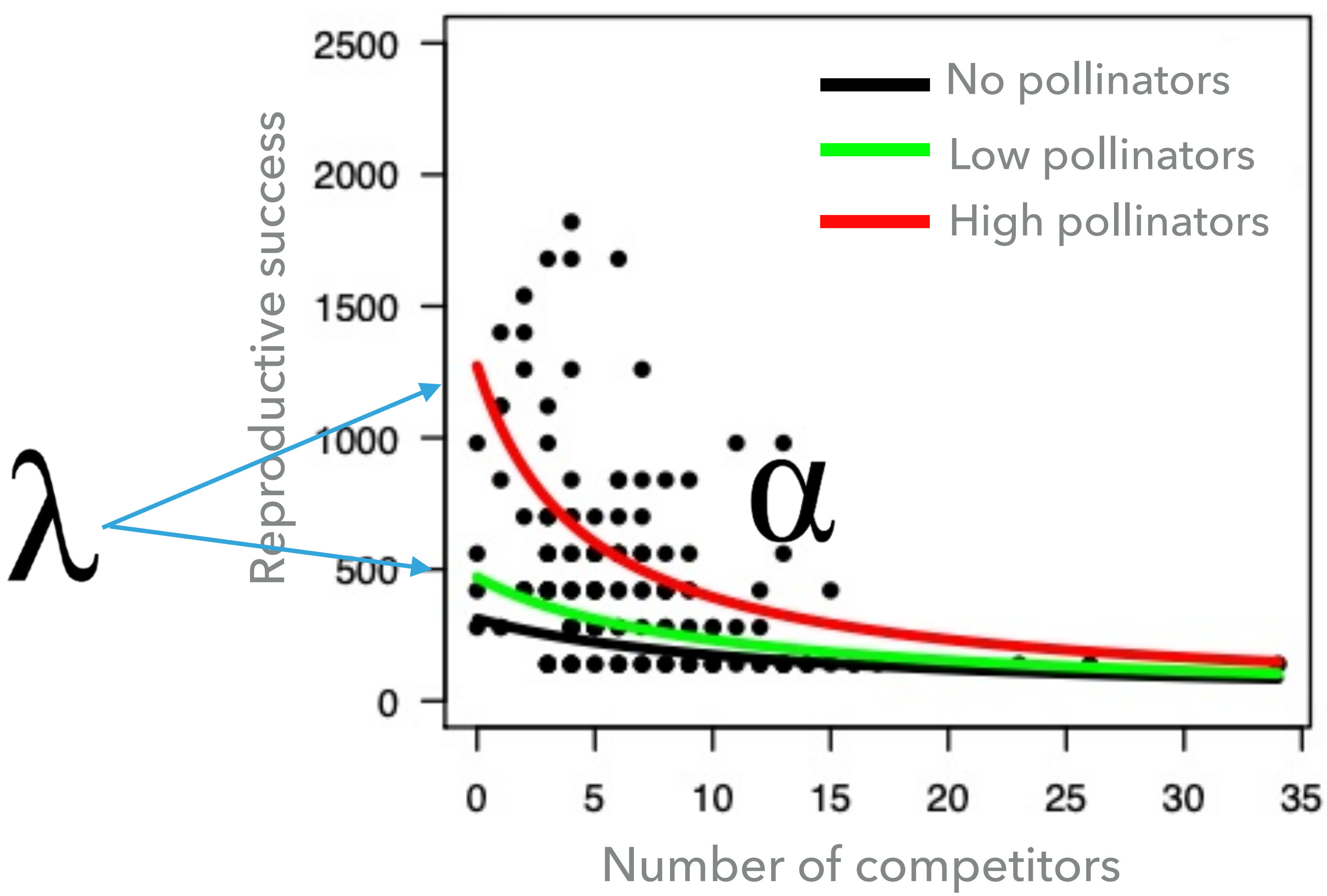
$$F_i = \frac{\lambda_i(1 + \theta_{i,s} S_t + \gamma_{i,fv} A_t)}{1 + \sum(\alpha_{ij} + \psi_{ij,s} S_t + \omega_{ij,fv} A_t) g_j N_{j,t}}$$

Reproductive success

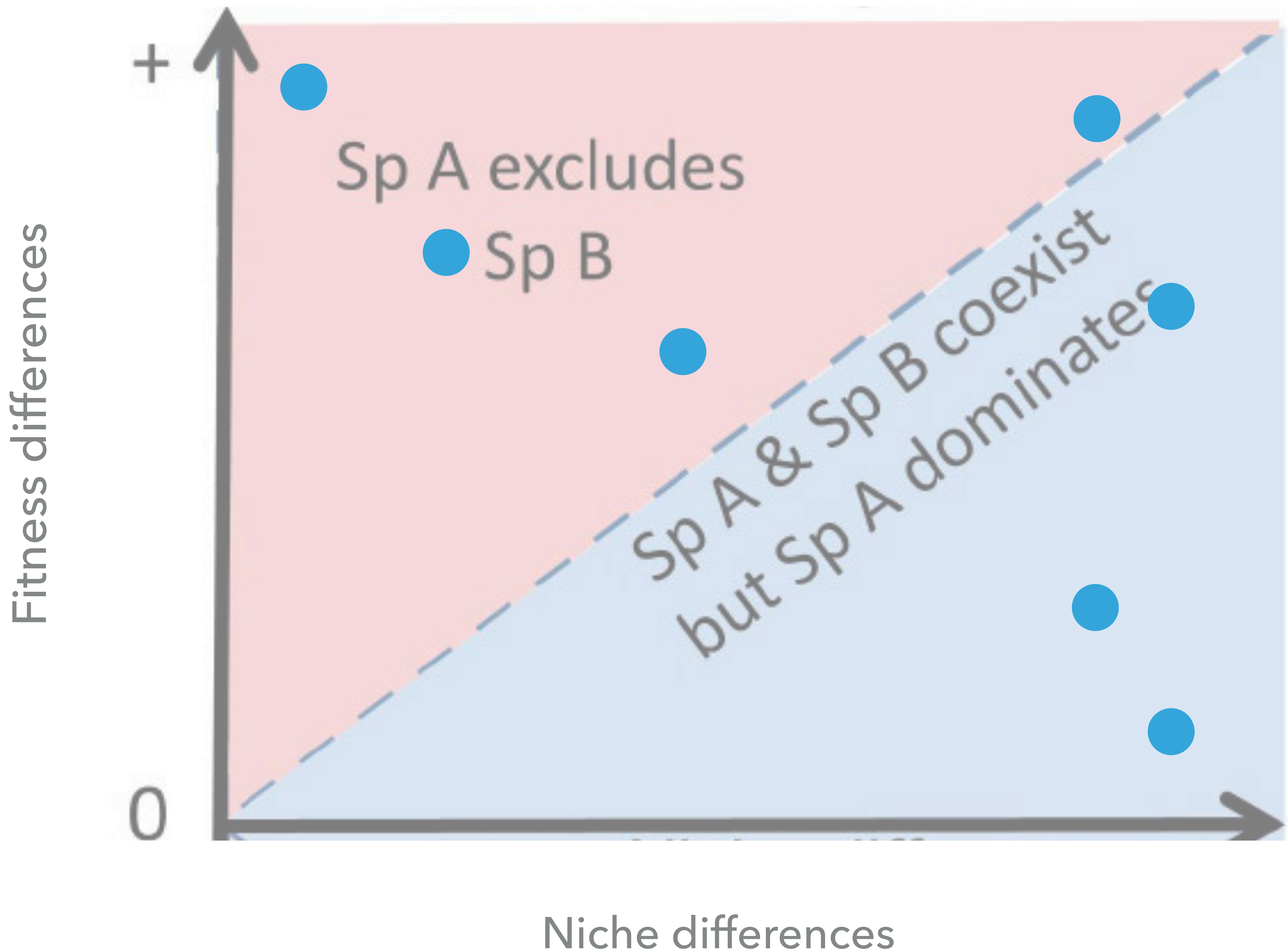
Competition

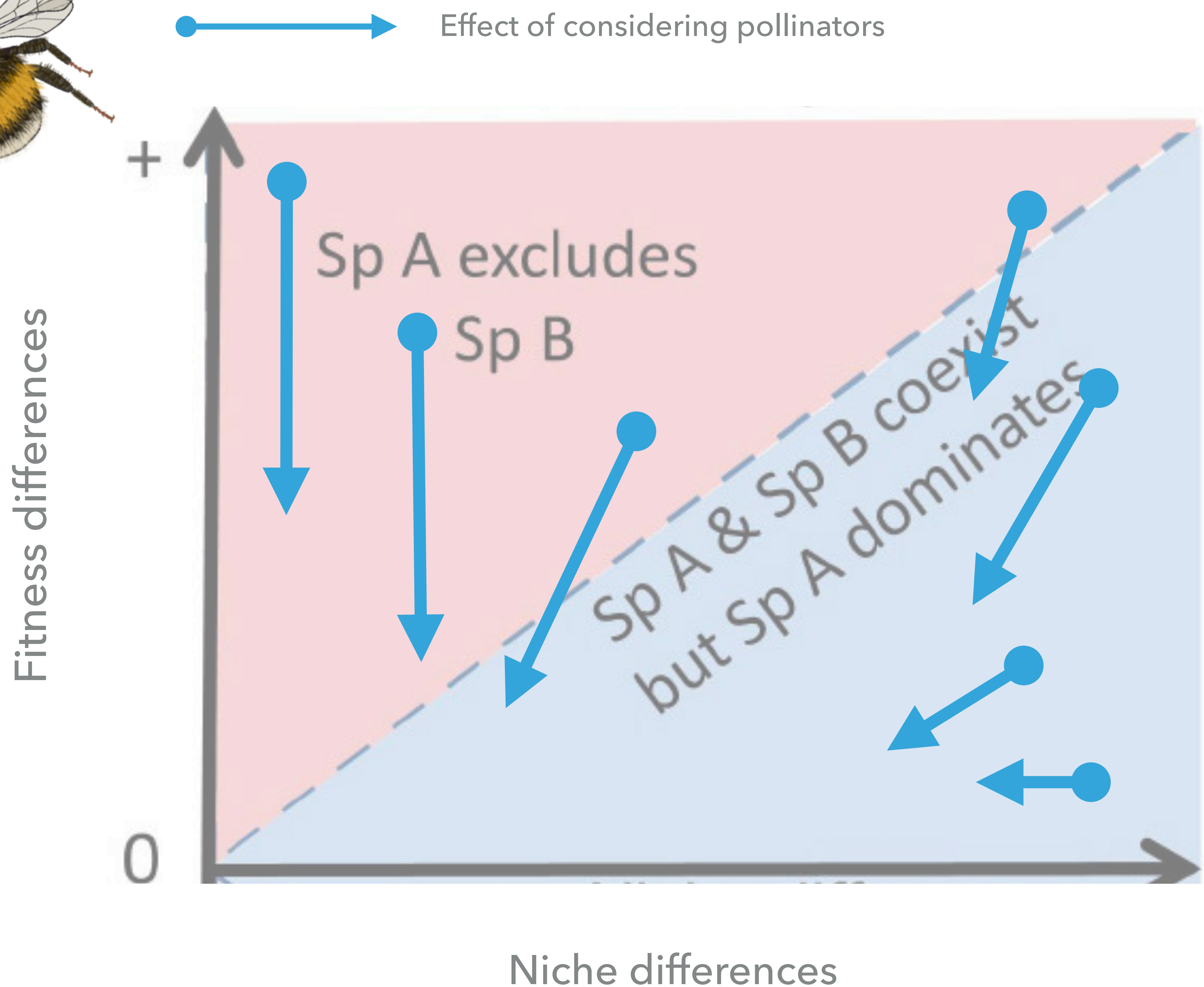
Environment

Mutualistic effect



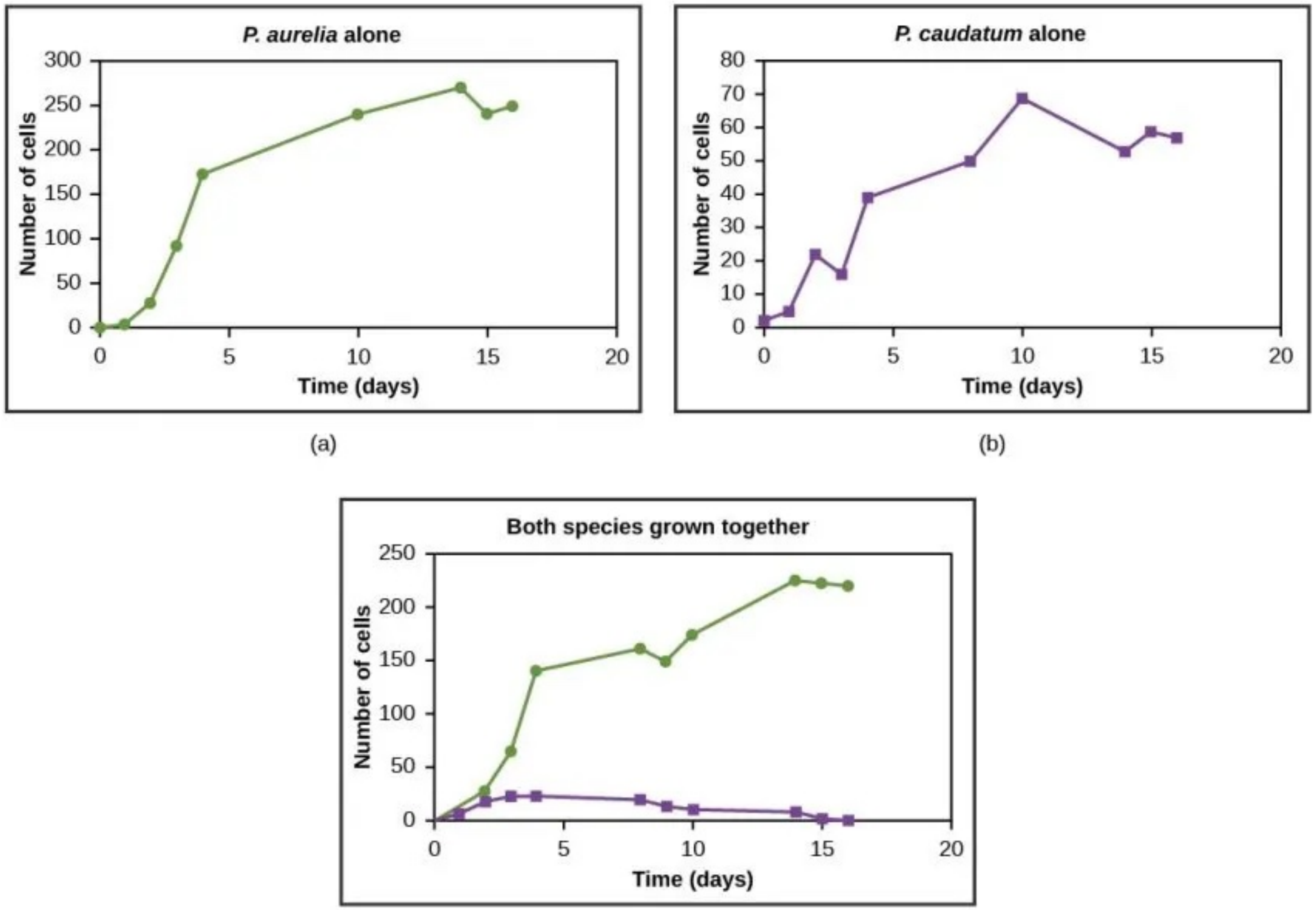
Lanuza et al 2018


+
0
Sp A excludes
Sp B
Sp A & Sp B coexist
but Sp A dominates
Fitness differences
Niche differences


Effect of considering pollinators
+
0
Sp A excludes Sp B
Sp A & Sp B coexist but Sp A dominates
Fitness differences
Niche differences

Modern Coexistence Theory

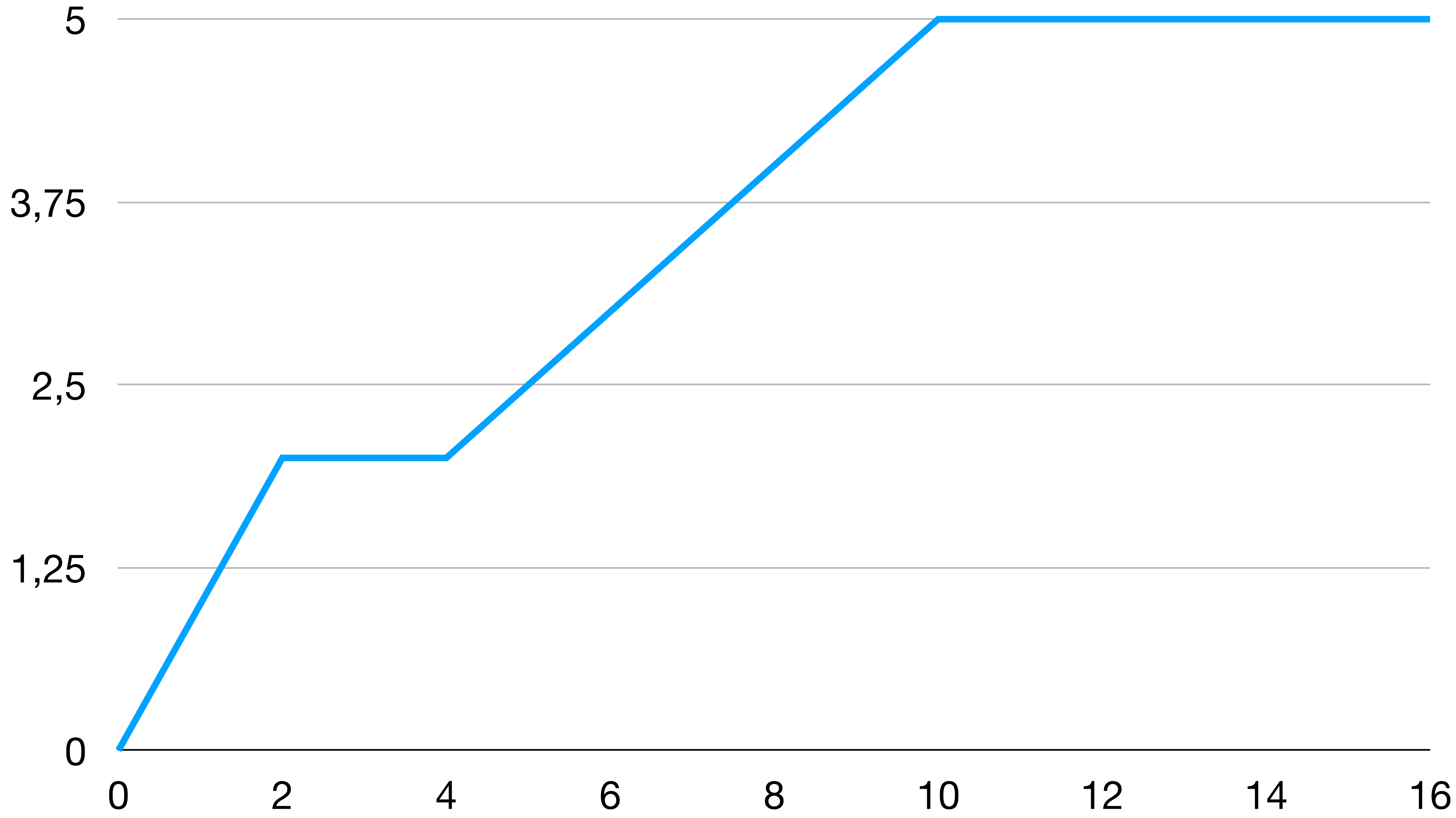
Local coexistence is rare in experimental conditions…

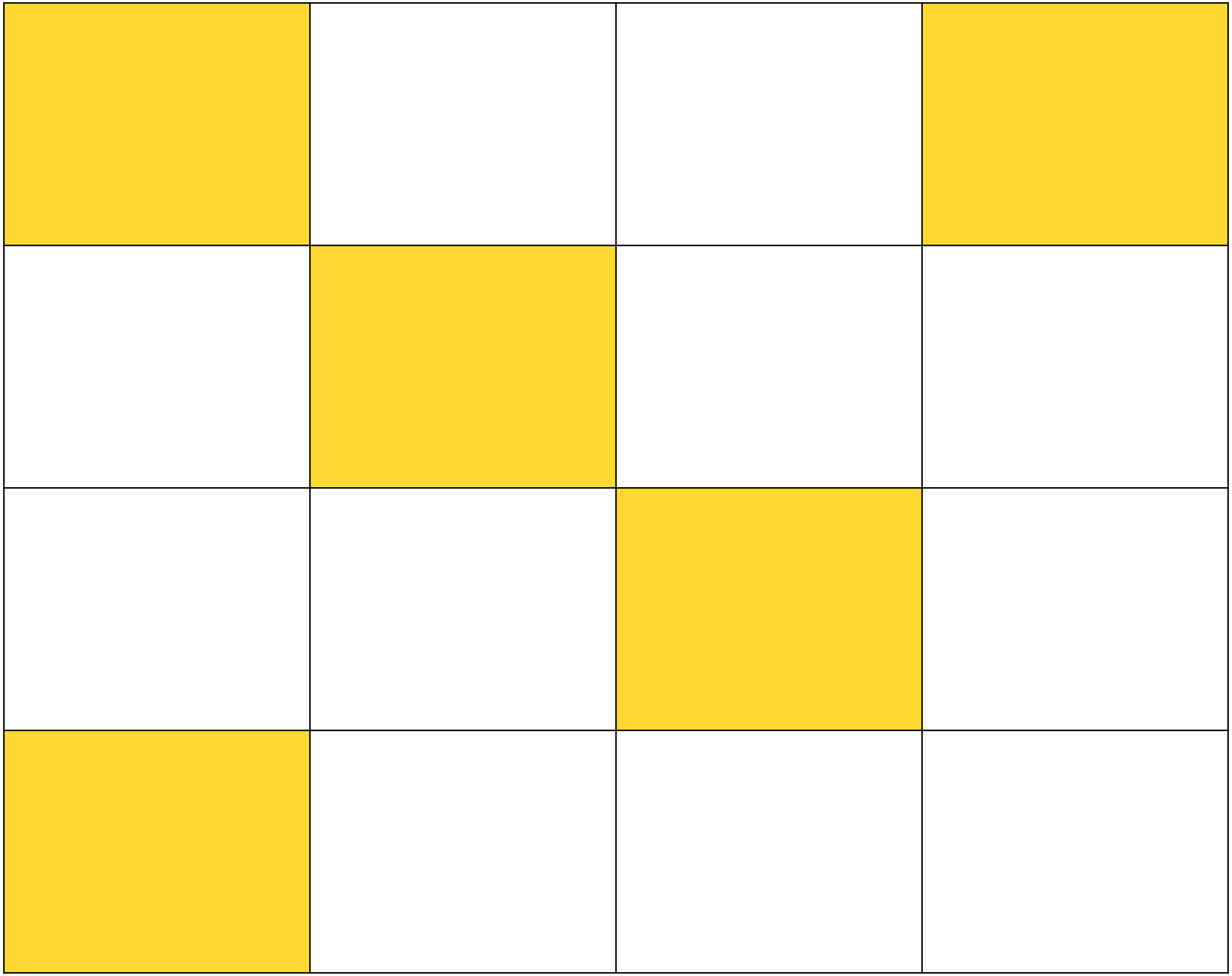


(a) (b) (c)

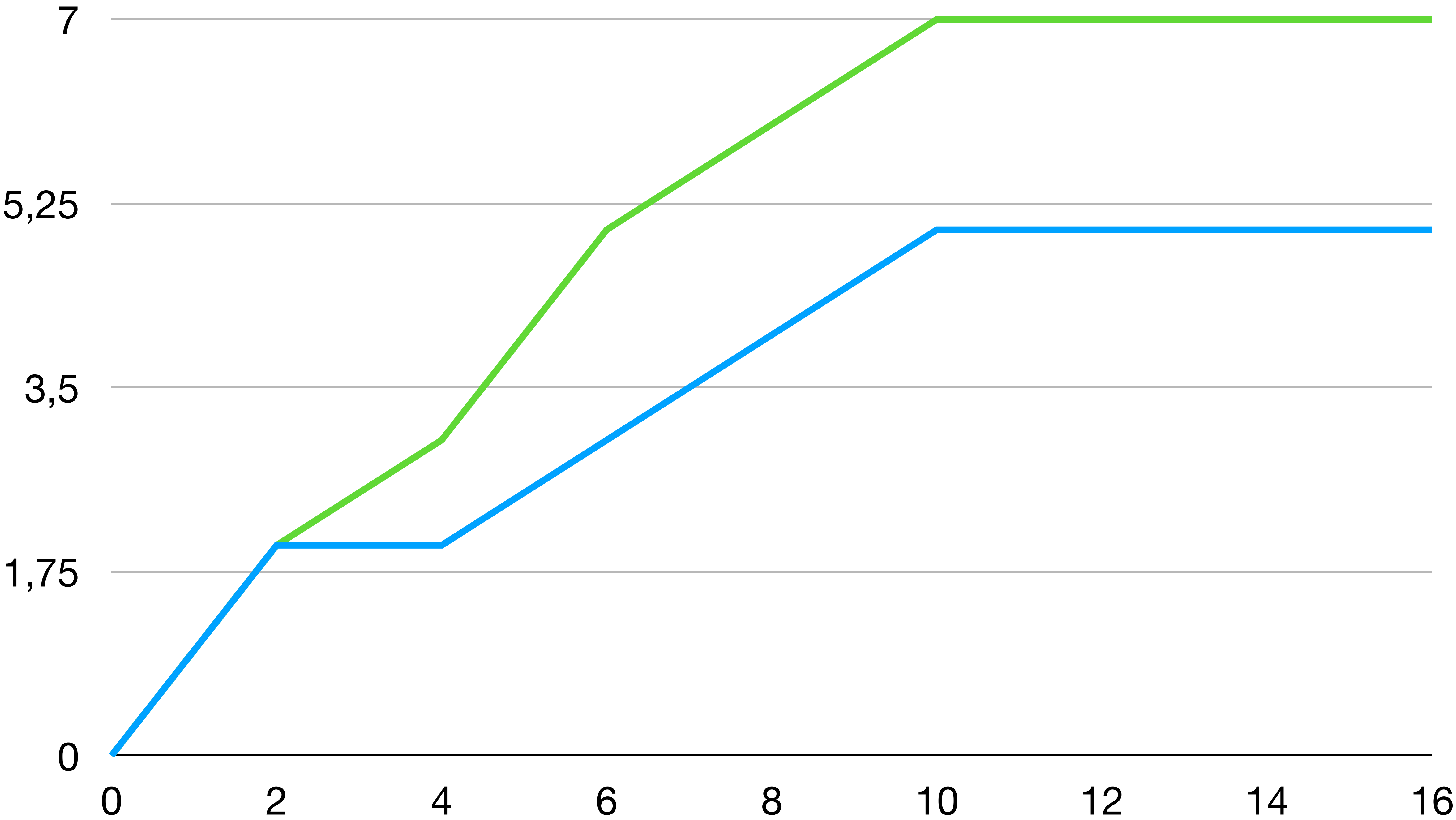
Gause 1934

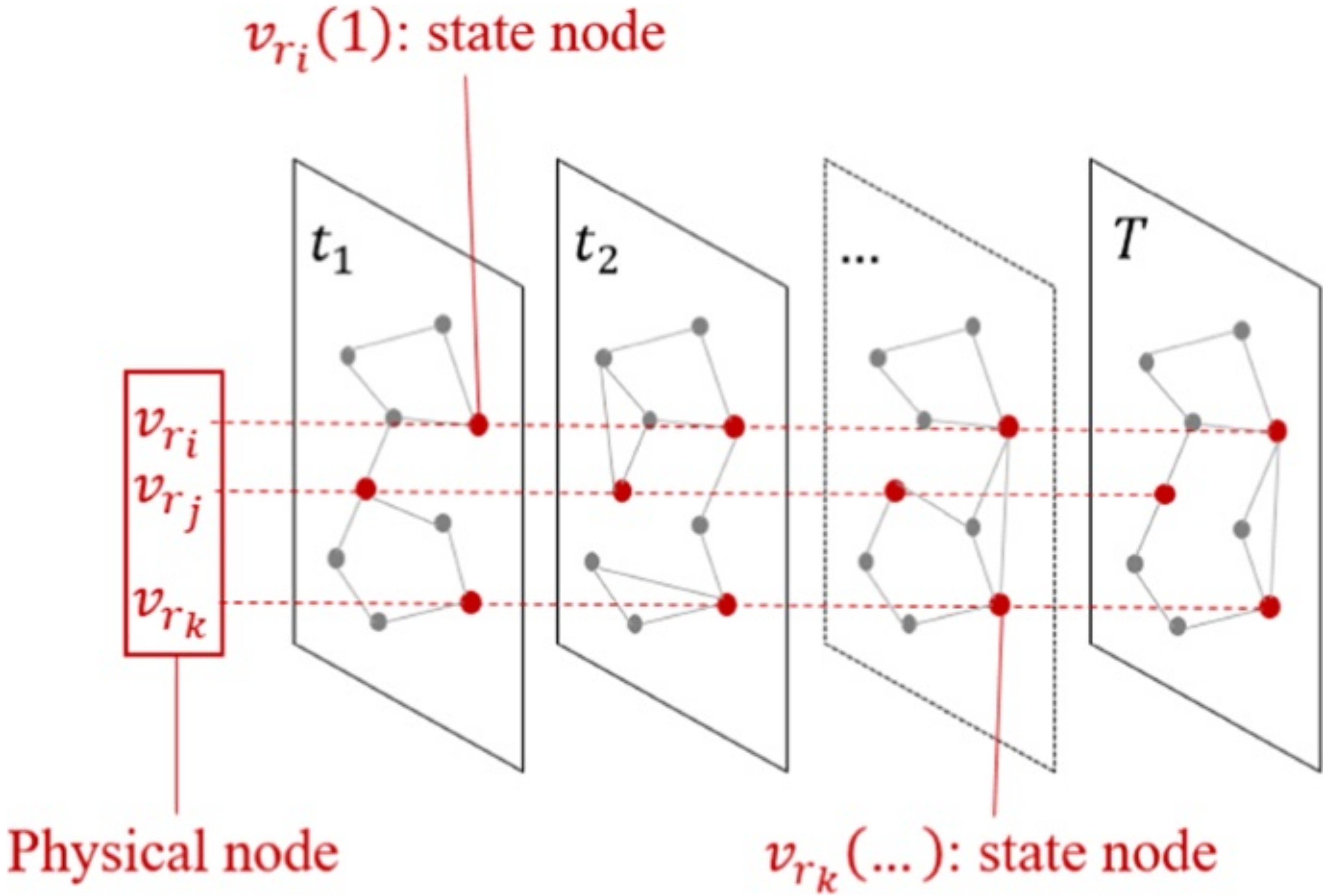
	Ambiente Salino
Amarillo	2
Rojo	3
Azul	4
Verde	4
Naranja	5
Blanco	6
Marrón	7


5
3,75
2,5
1,25
0
0
2
4
6
8
10
12
14
16



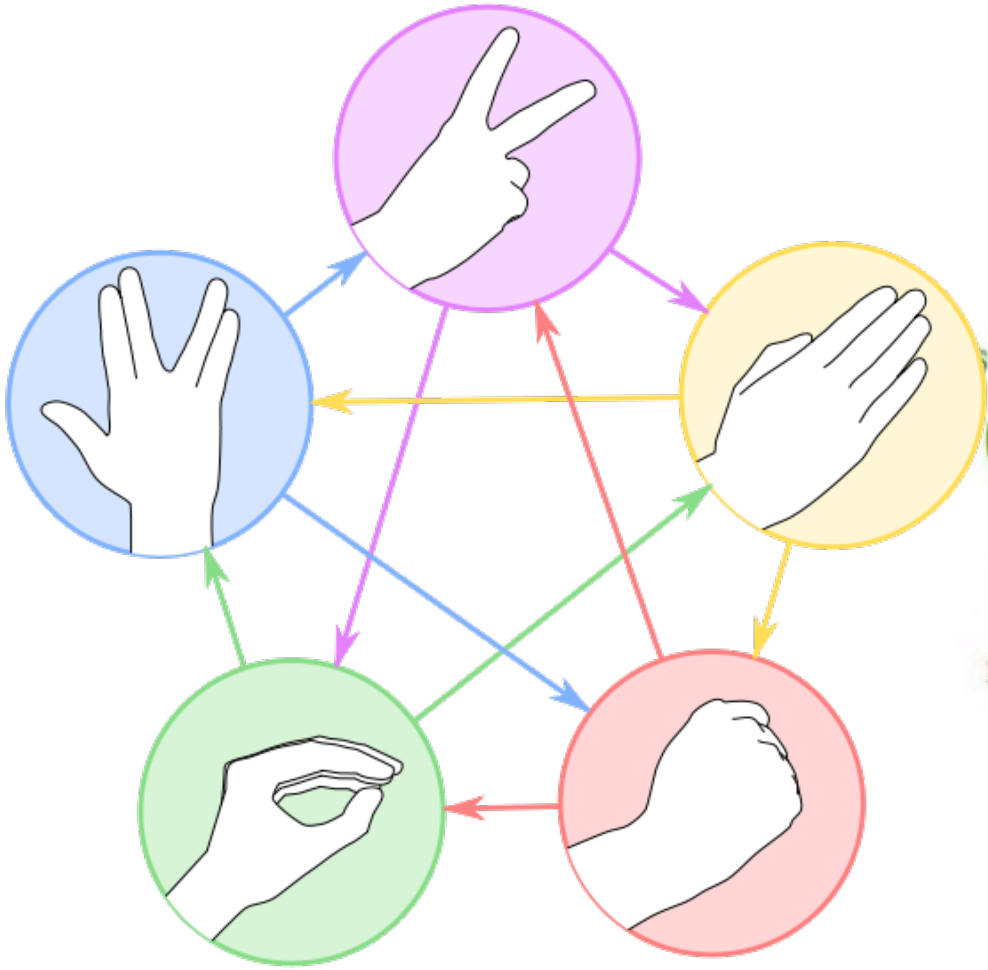
	Ambiente Salino	Ambiente hipersalino
Amarillo	2	5
Rojo	3	5
Azul	4	4
Verde	4	3
Naranja	5	3
Blanco	6	2
Marrón	7	2

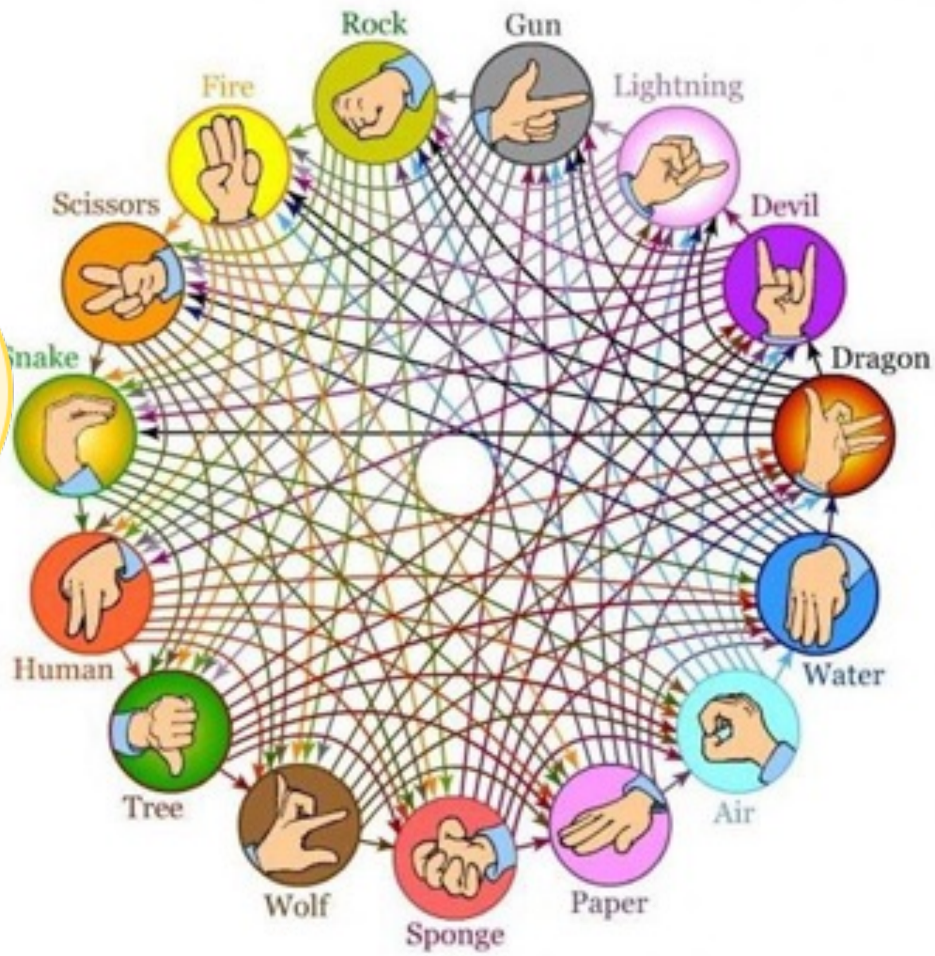

7
5,25
3,5
1,75
0
0
2
4
6
8
10
12
14
16



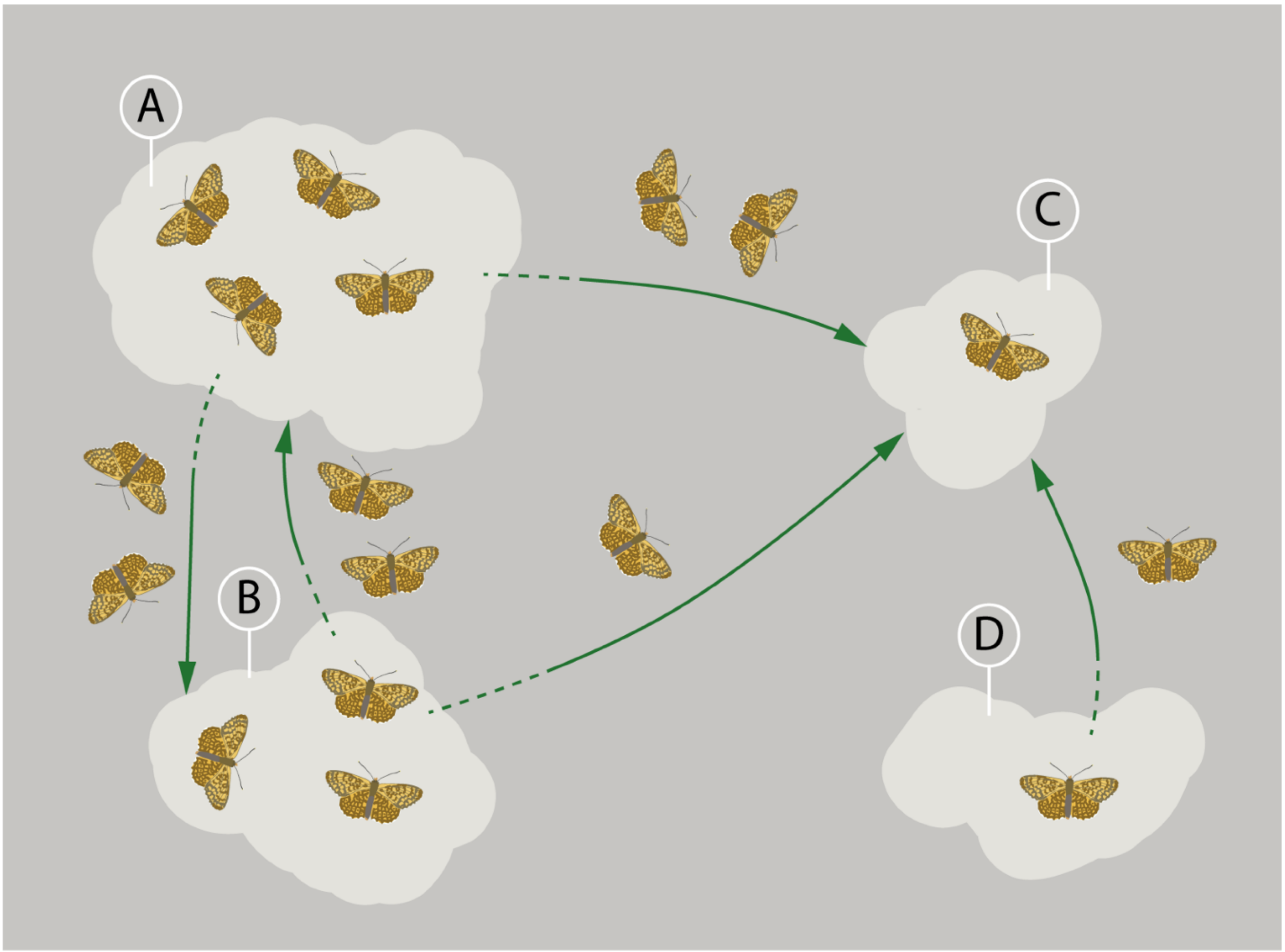
Las interacciones cambian en el espacio y en el tiempo

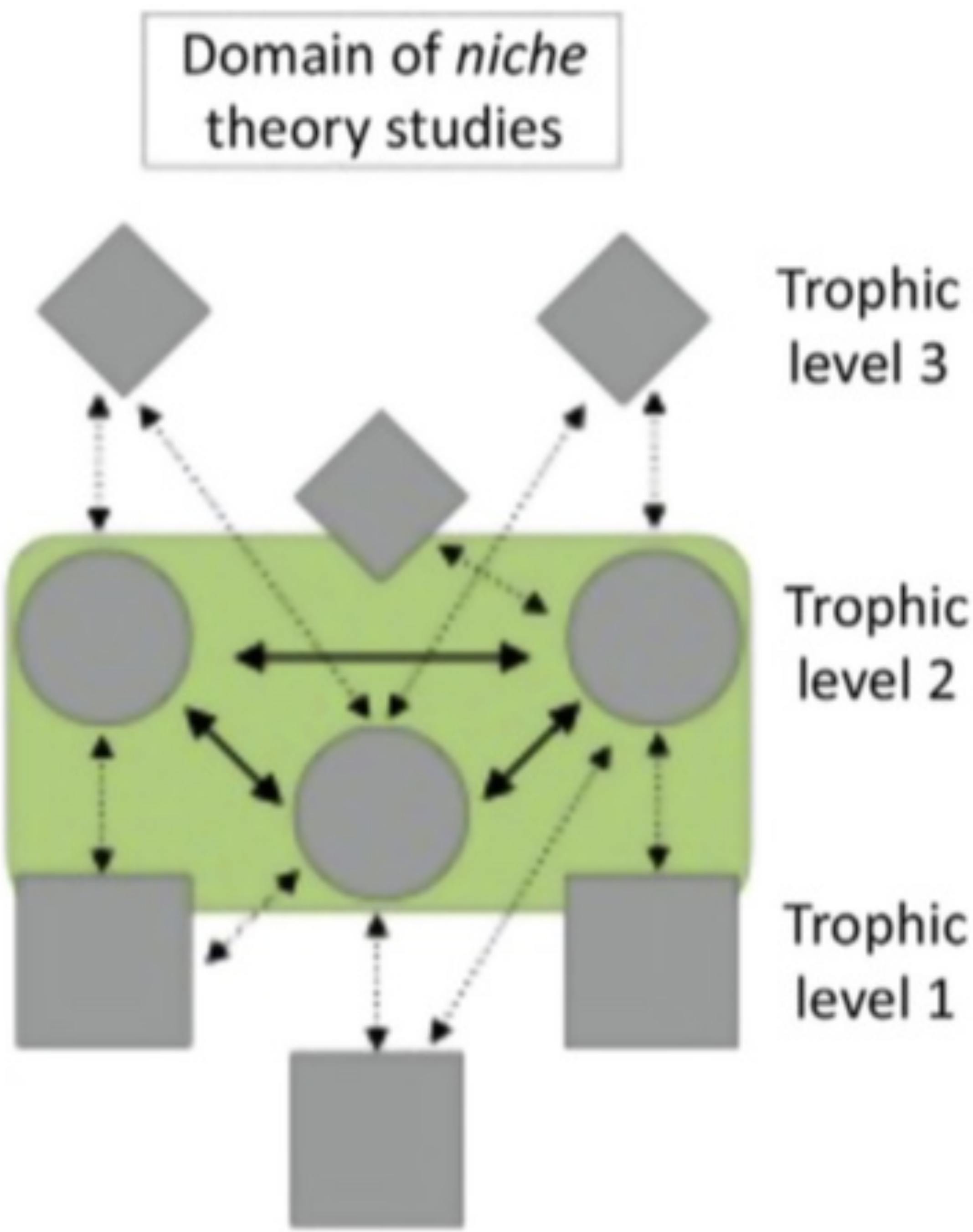
	Ambiente Salino	Ambiente hipersalino
Amarillo	2	2
Rojo	3	5
Azul	4	4
Verde	4	3
Naranja	5	3
Blanco	6	2
Marrón	7	2



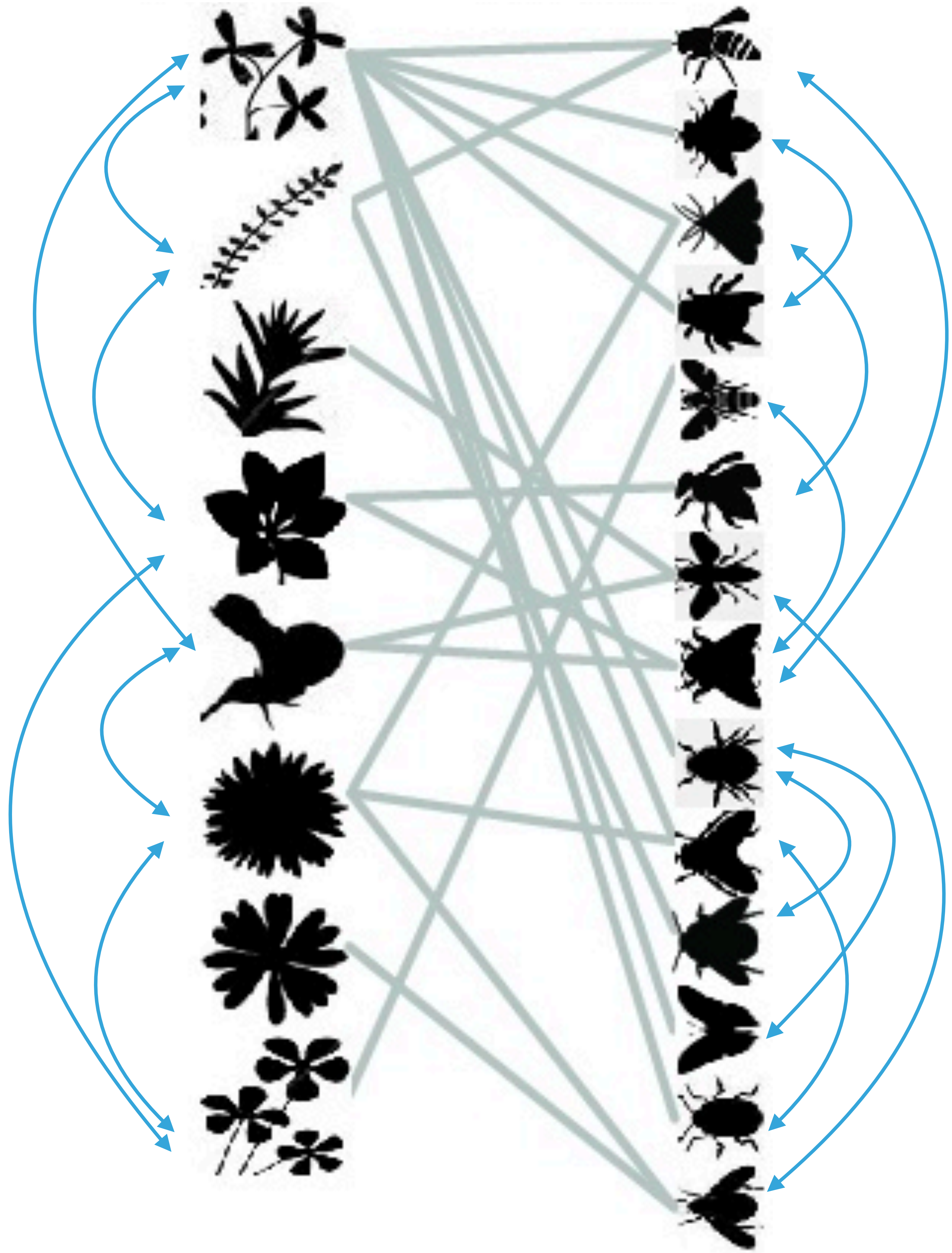

Rock
Gun
Lightning
Devil
Dragon
Water
Air
Paper
Sponge
Wolf
Tree
Human
nake
Scissors
Fire

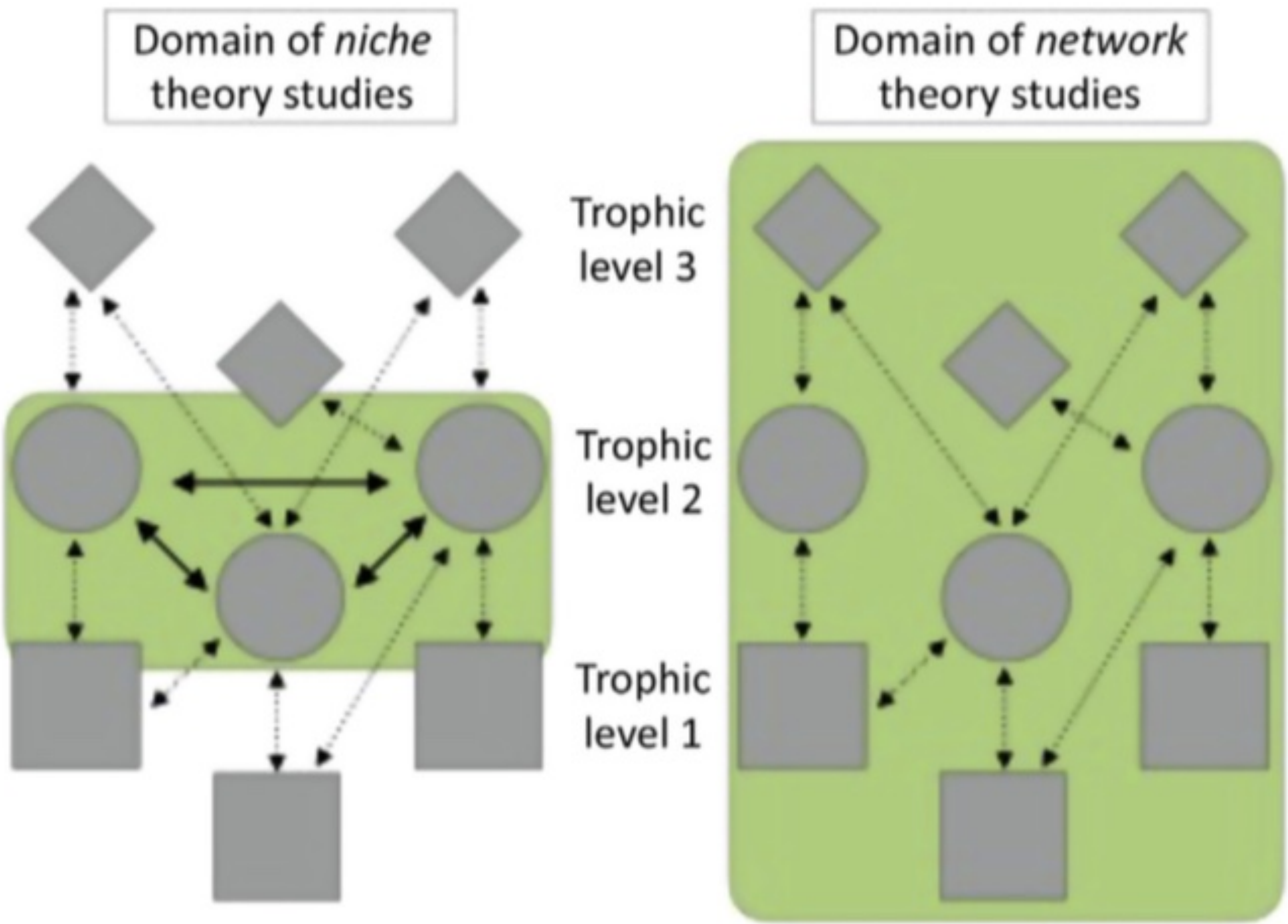
Transient species





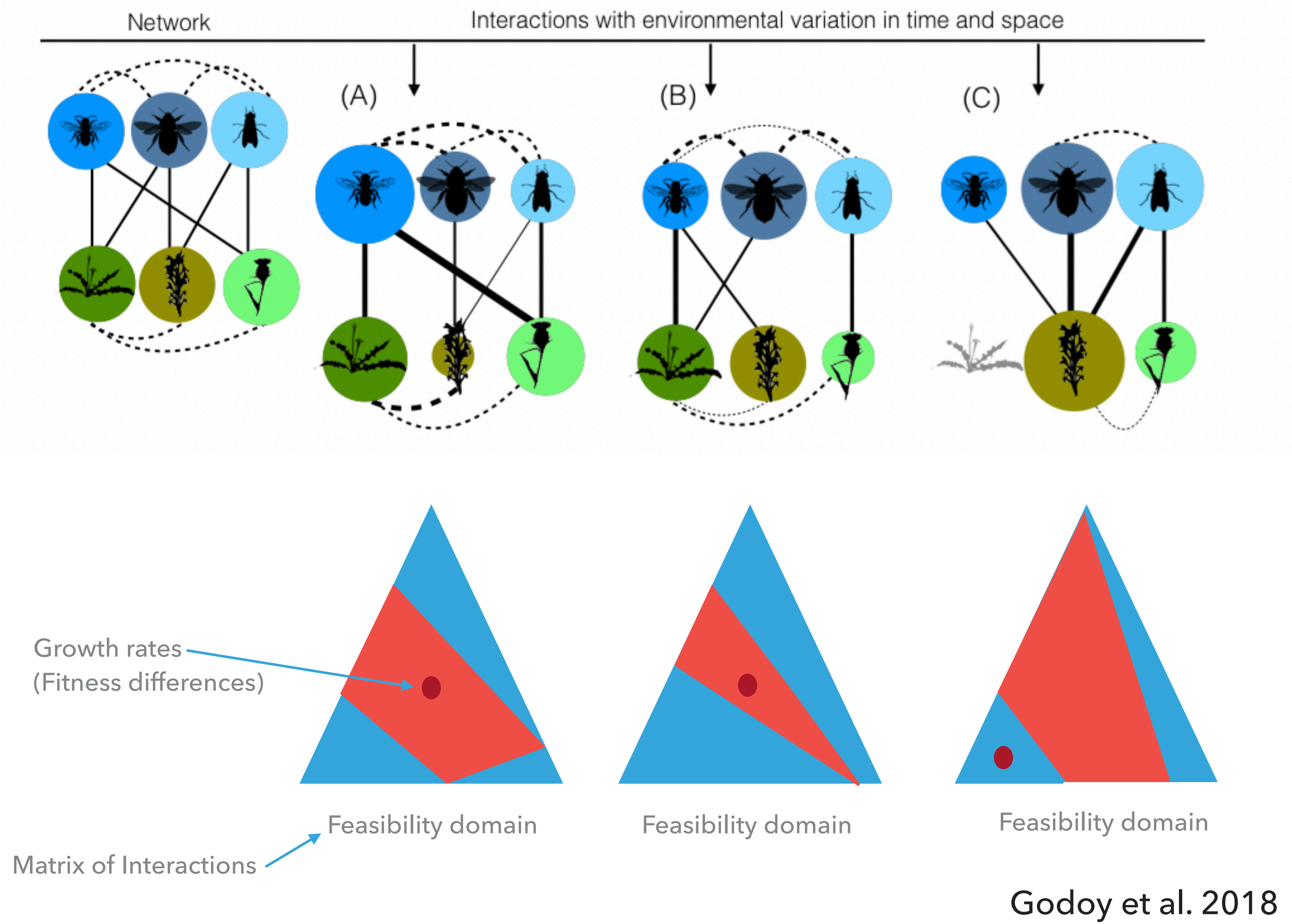
Godoy et al. 2018
Rohr et al 2014





Godoy et al. 2018

Rohr et al 2014



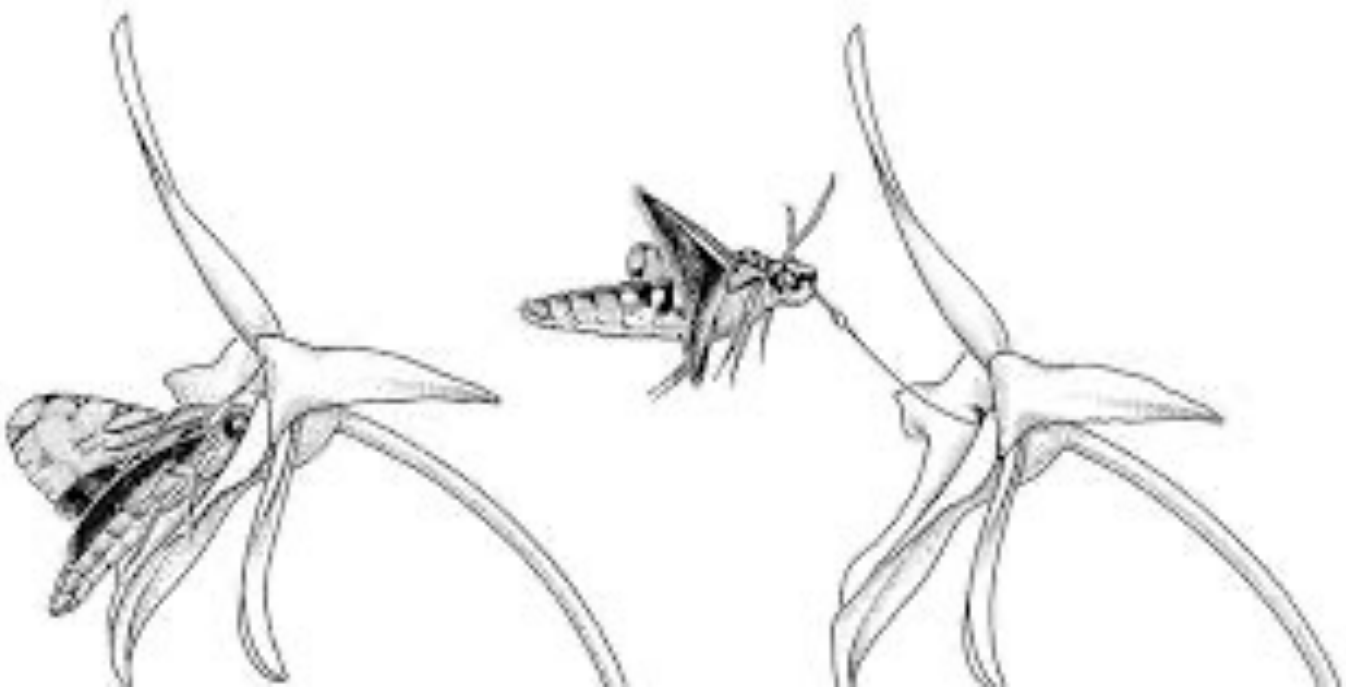
Network
Interactions with environmental variation in time and space
(A)
(B)
(C)
Growth rates
(Fitness differences)
Feasibility domain
Feasibility domain
Feasibility domain
Matrix of Interactions
Godoy et al. 2018

Coevolución

Plantas-Polinizadores

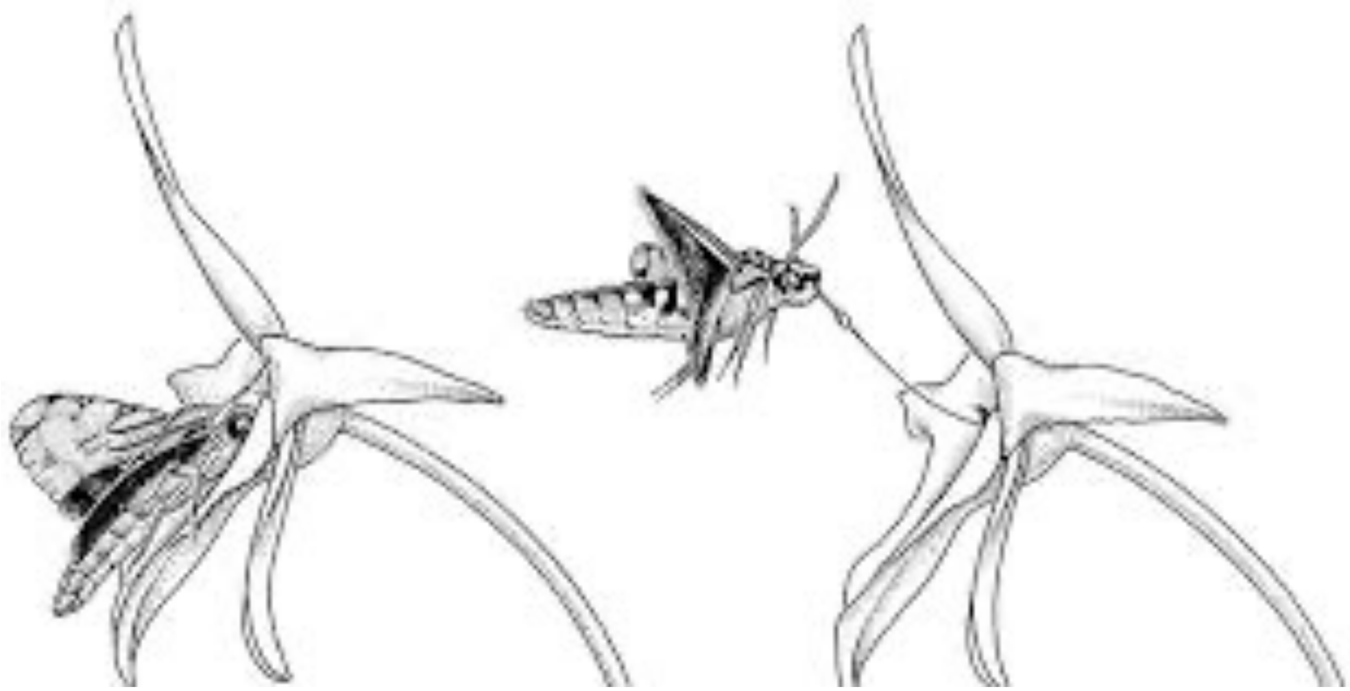
Dobbs (1750)

POLINIZACIÓN

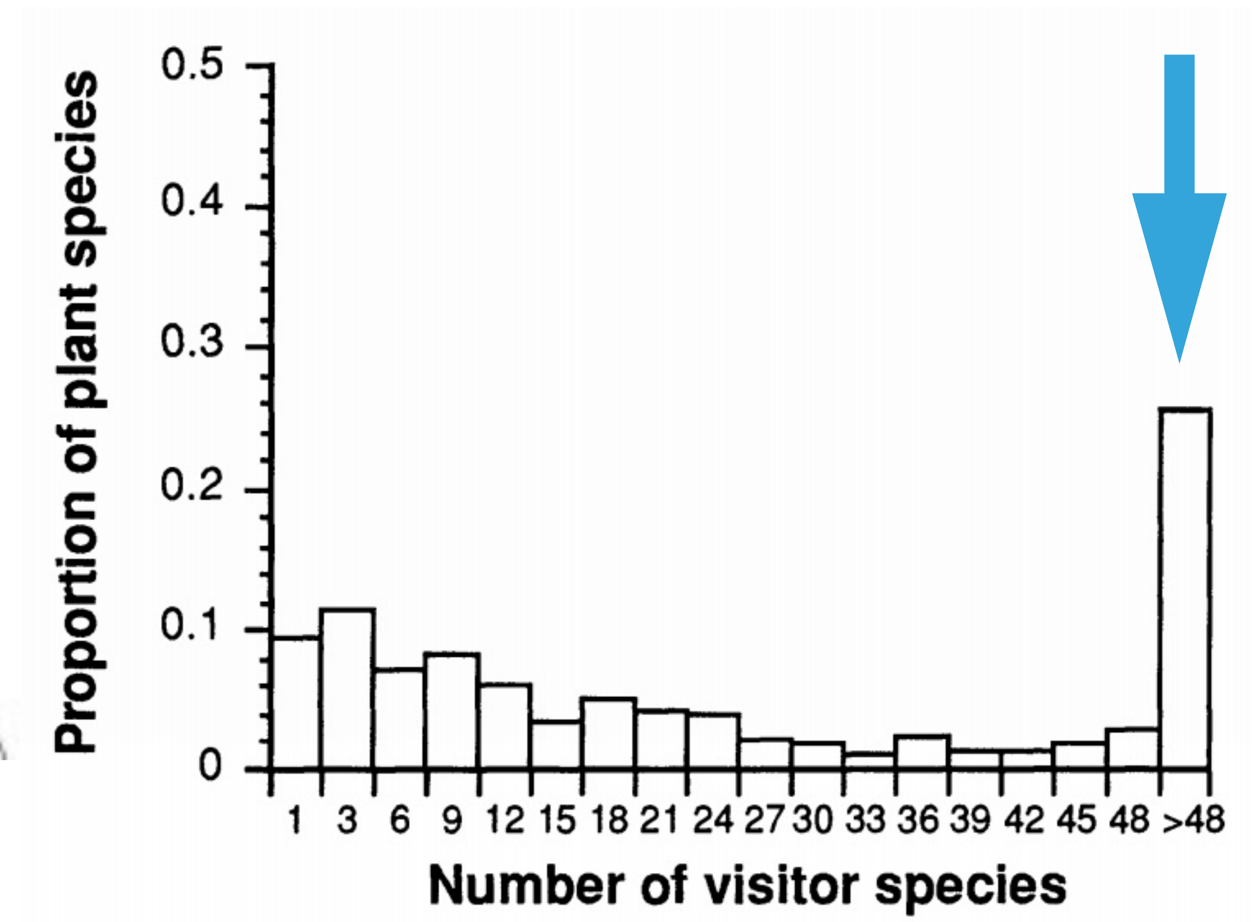


Darwin 1862

POLINIZACIÓN

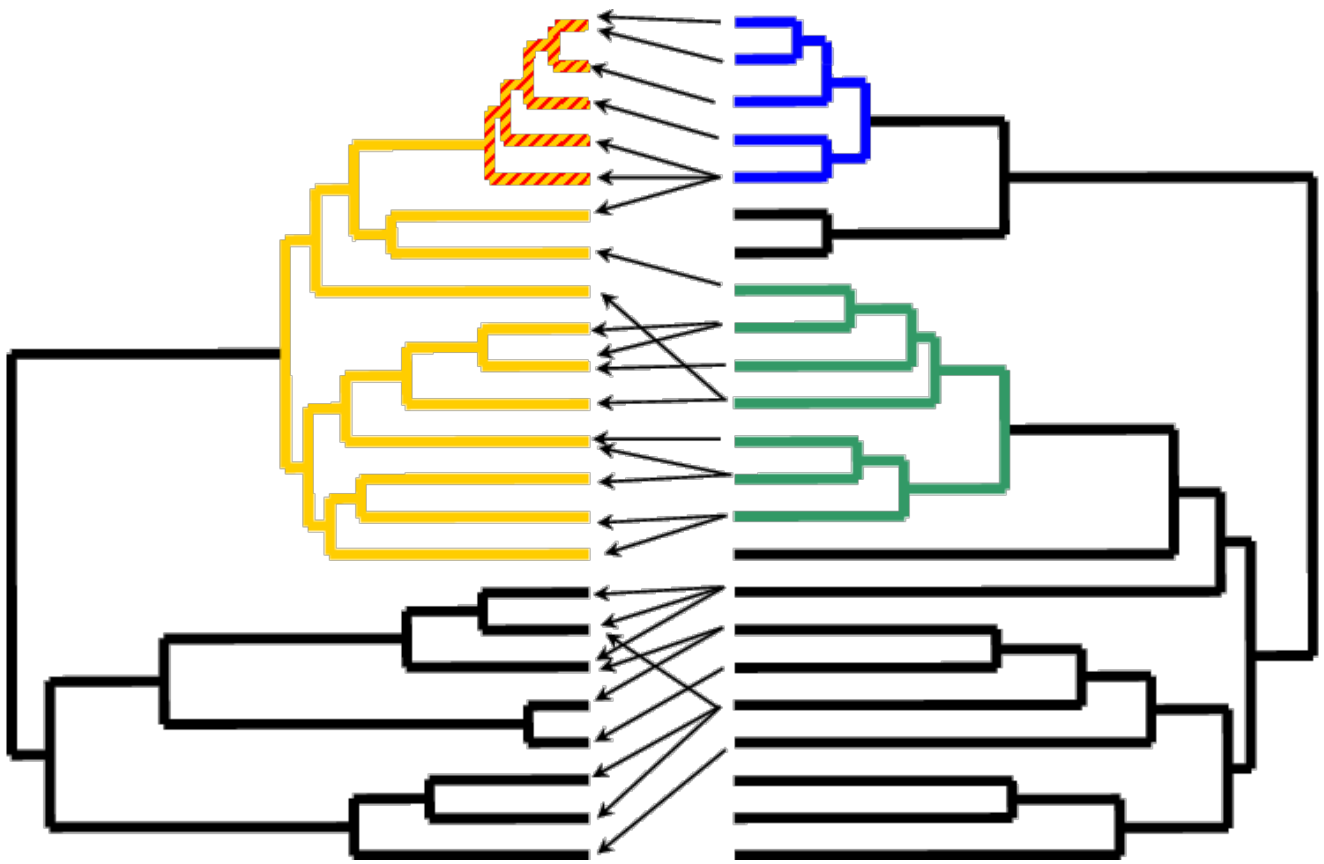


Darwin 1862



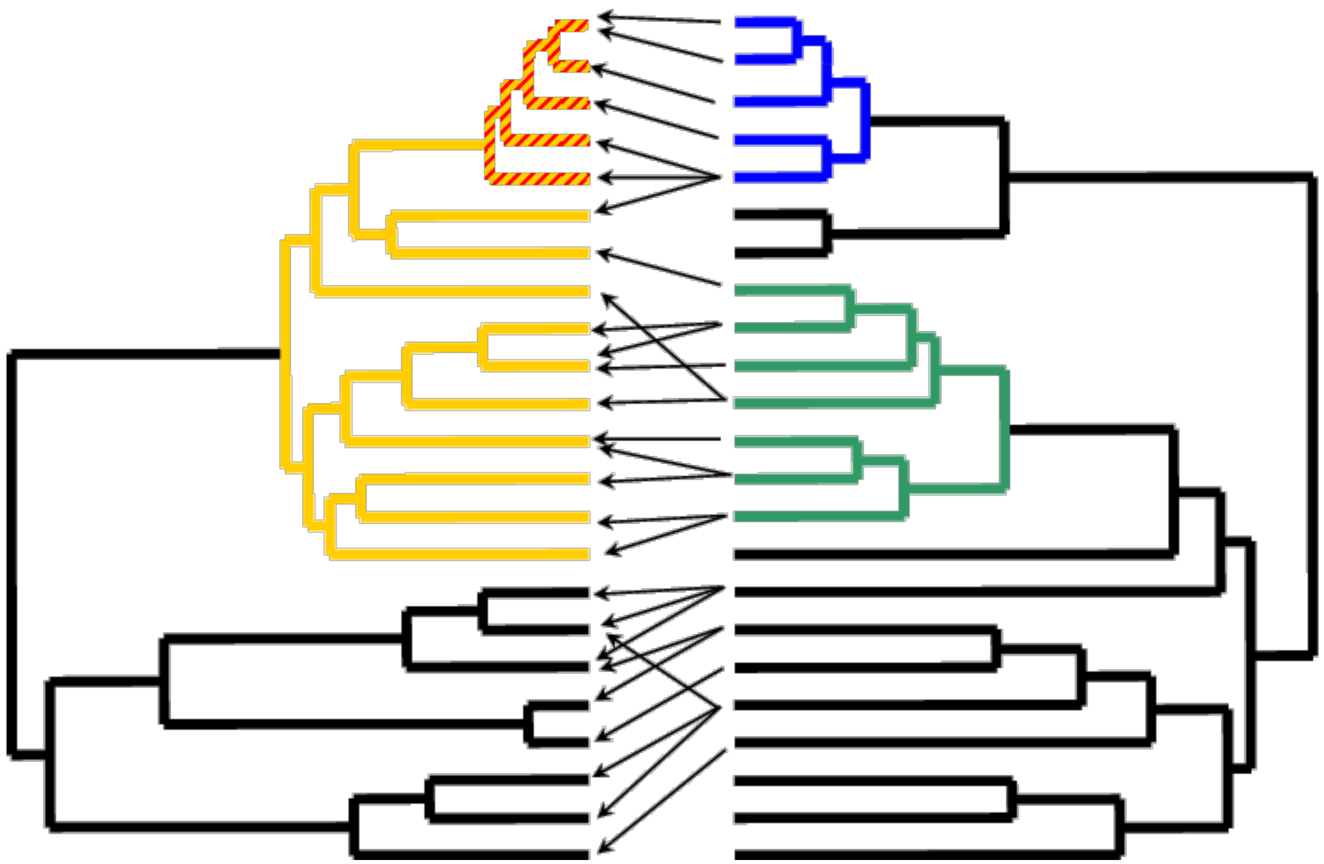
Waser et al. 1996

POLINIZACIÓN

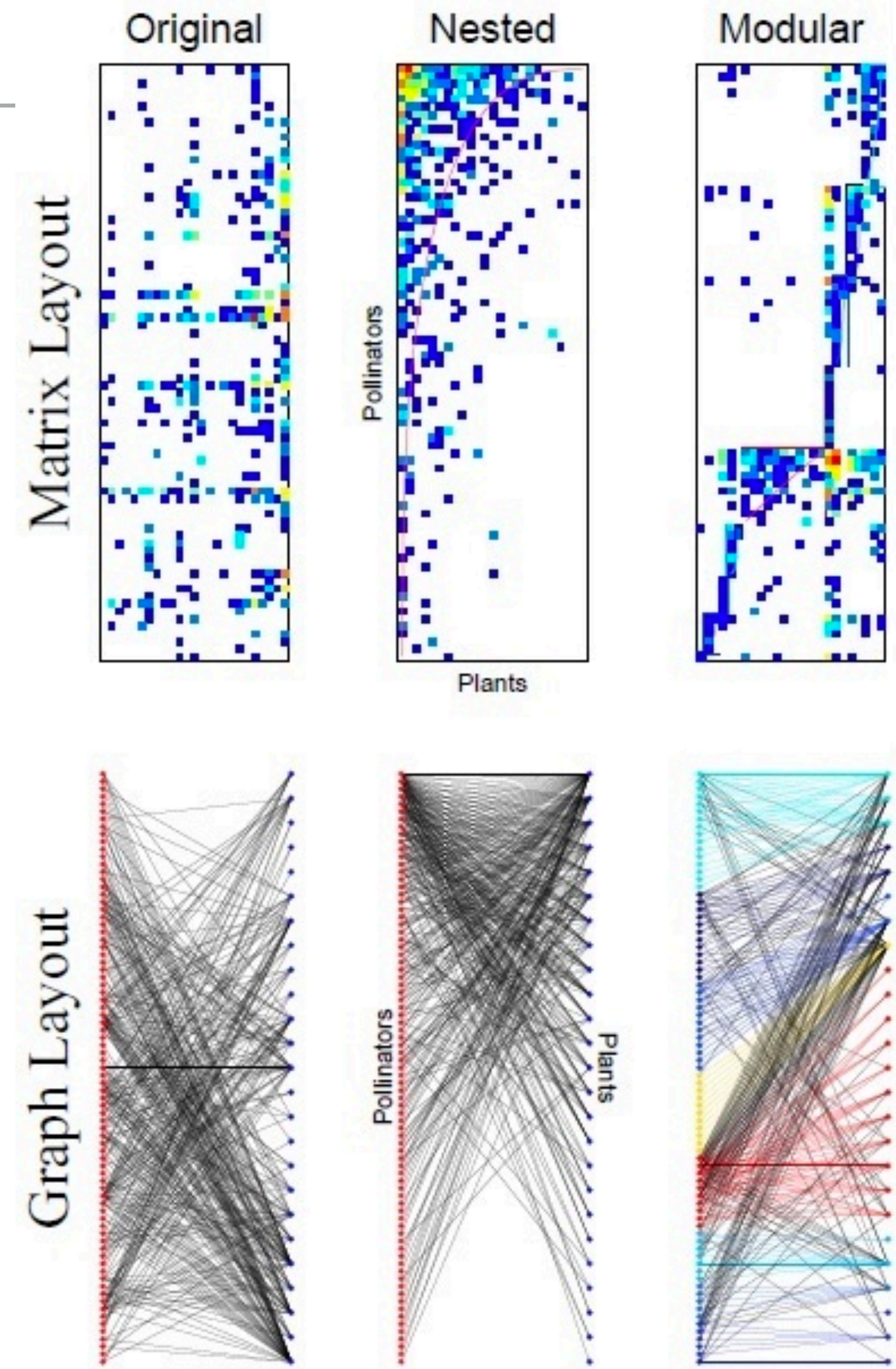


Janzen 1980
Thomson 2005

POLINIZACIÓN



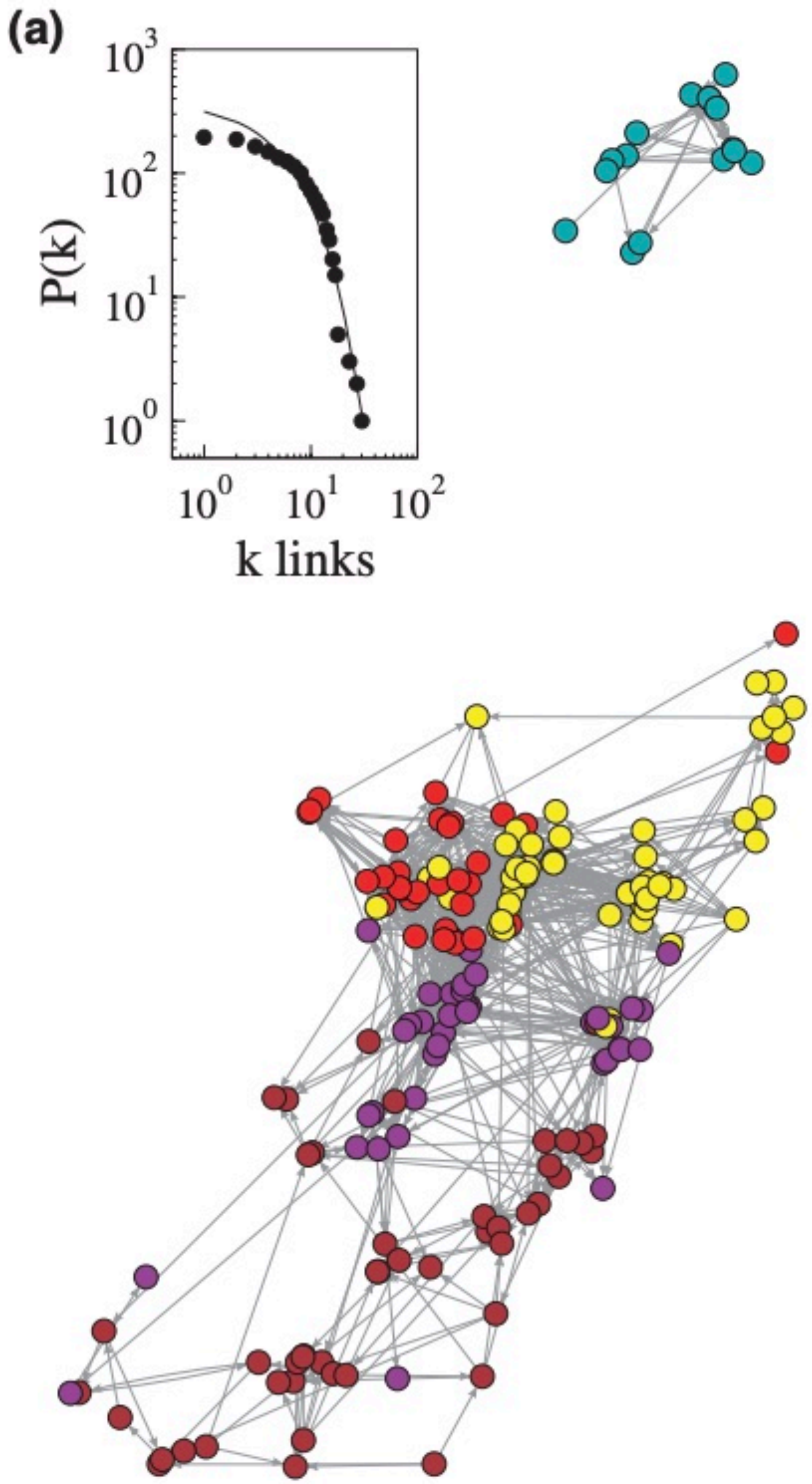
Janzen 1980
Thomson 2005

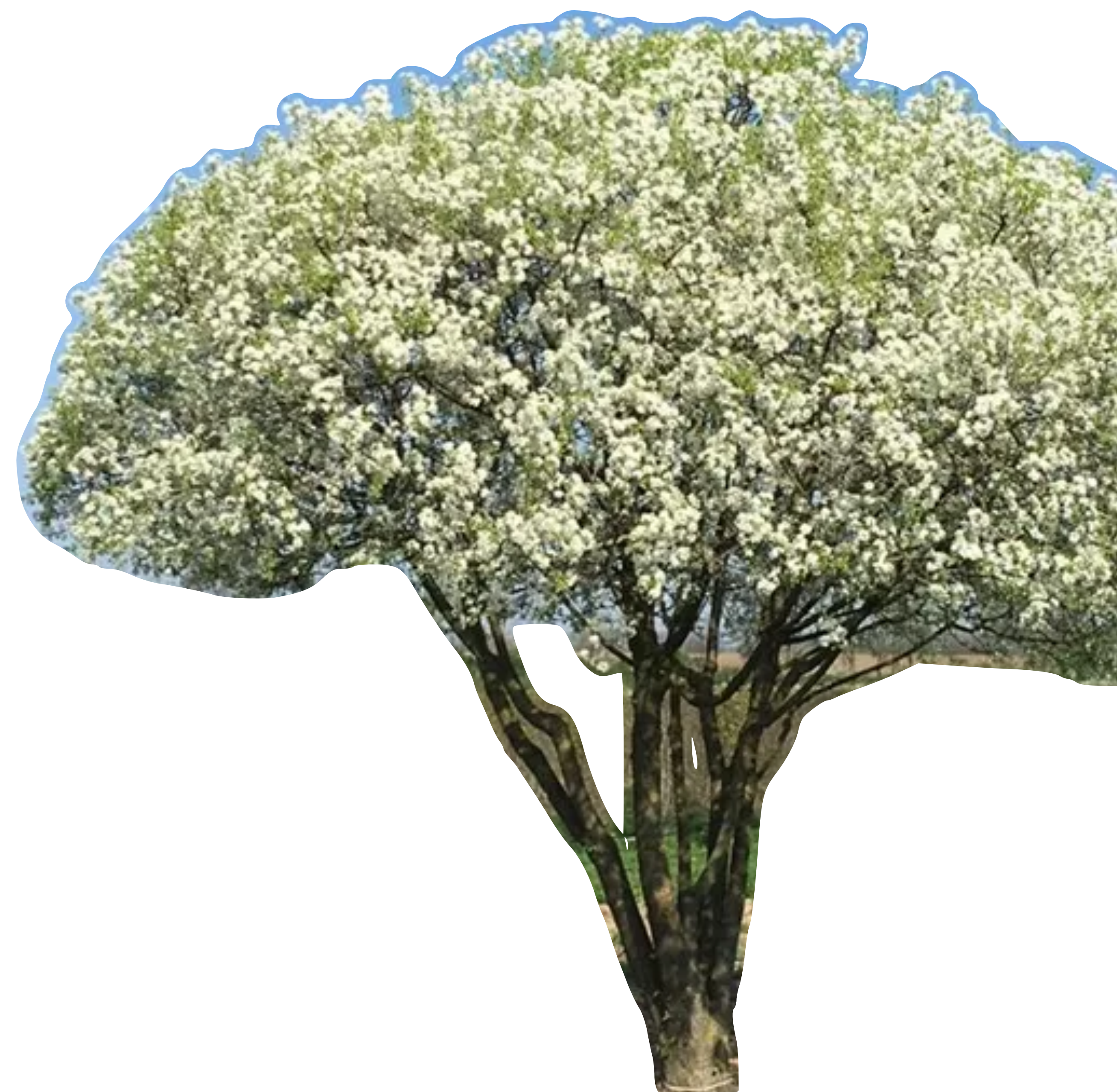


Bascompte et al. 2003

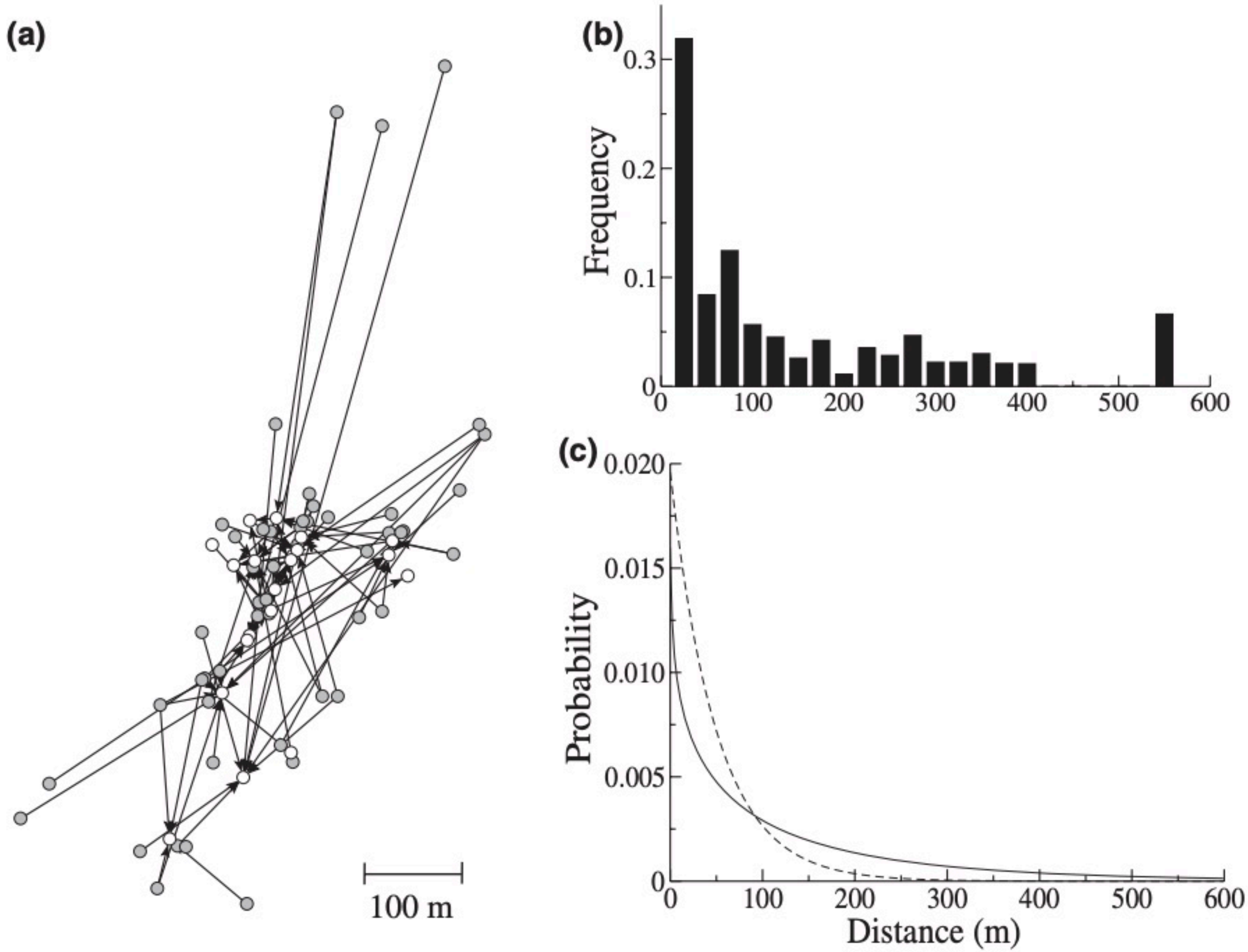
Pair-wise coevolution

Fortuna et al. 2008

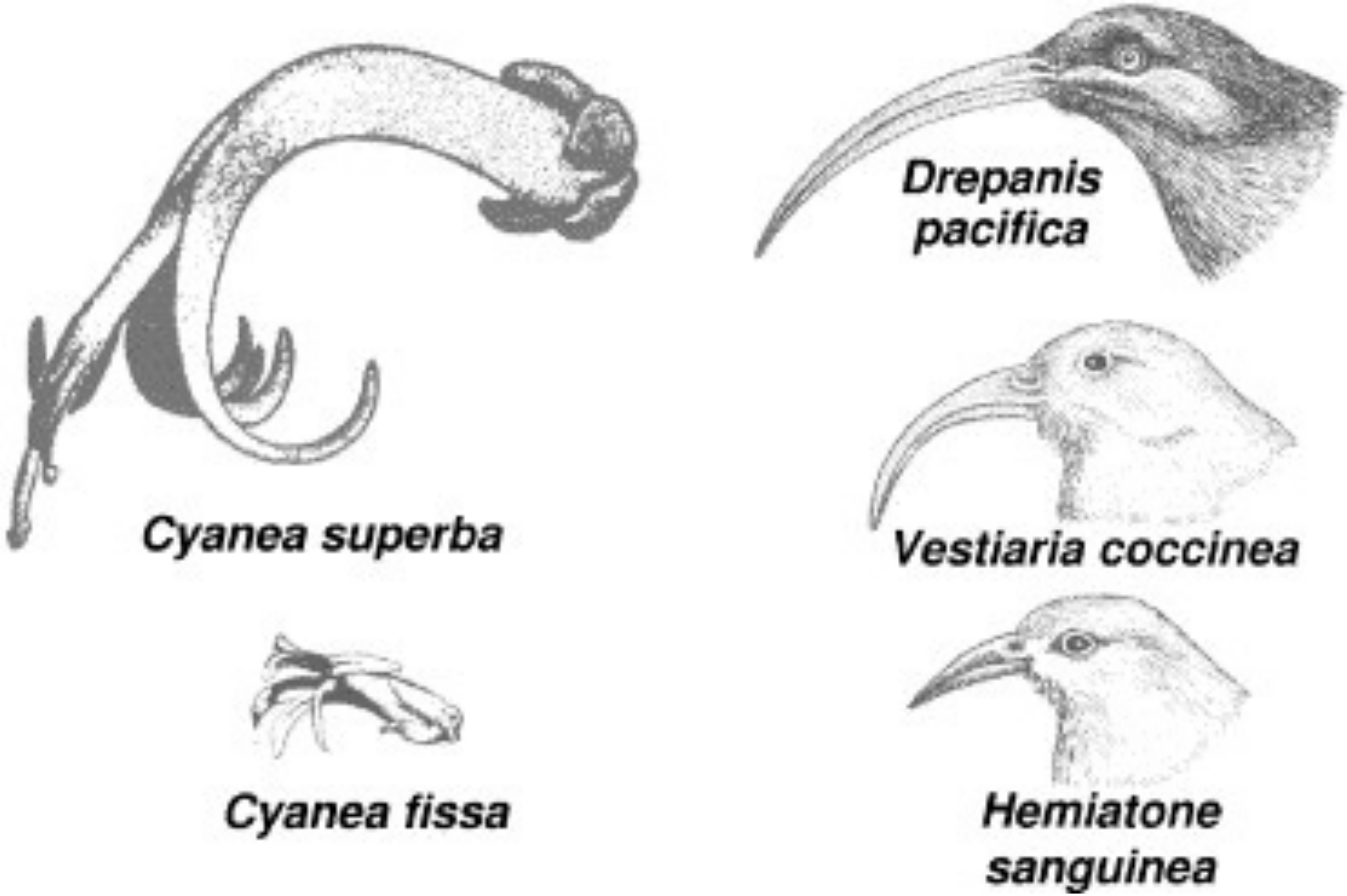




Fortuna et al. 2008



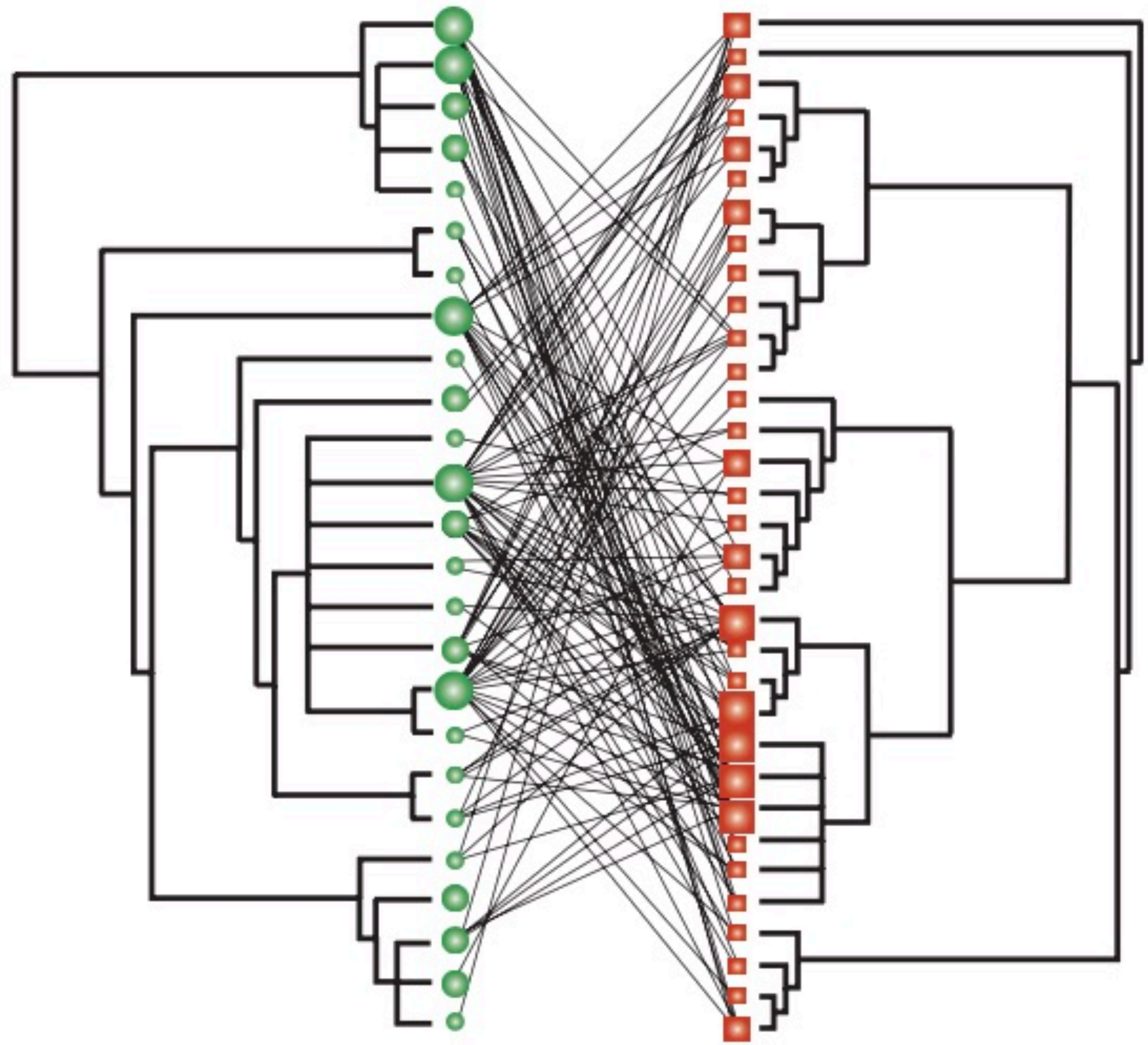
https://excalidraw.com/
#room=9162aea1b89229f72a7d,gFk_F6L8JnzOAG4gJ-PC9w


Cyanea superba
Cyanea fissa
Drepanis pacifica
Vestiaria coccinea
Hemiatone sanguinea

Atracting pollinators vs detering hervibors


Diffuse coevolution

Rezende et al. 2007



Rezende et al. 2007

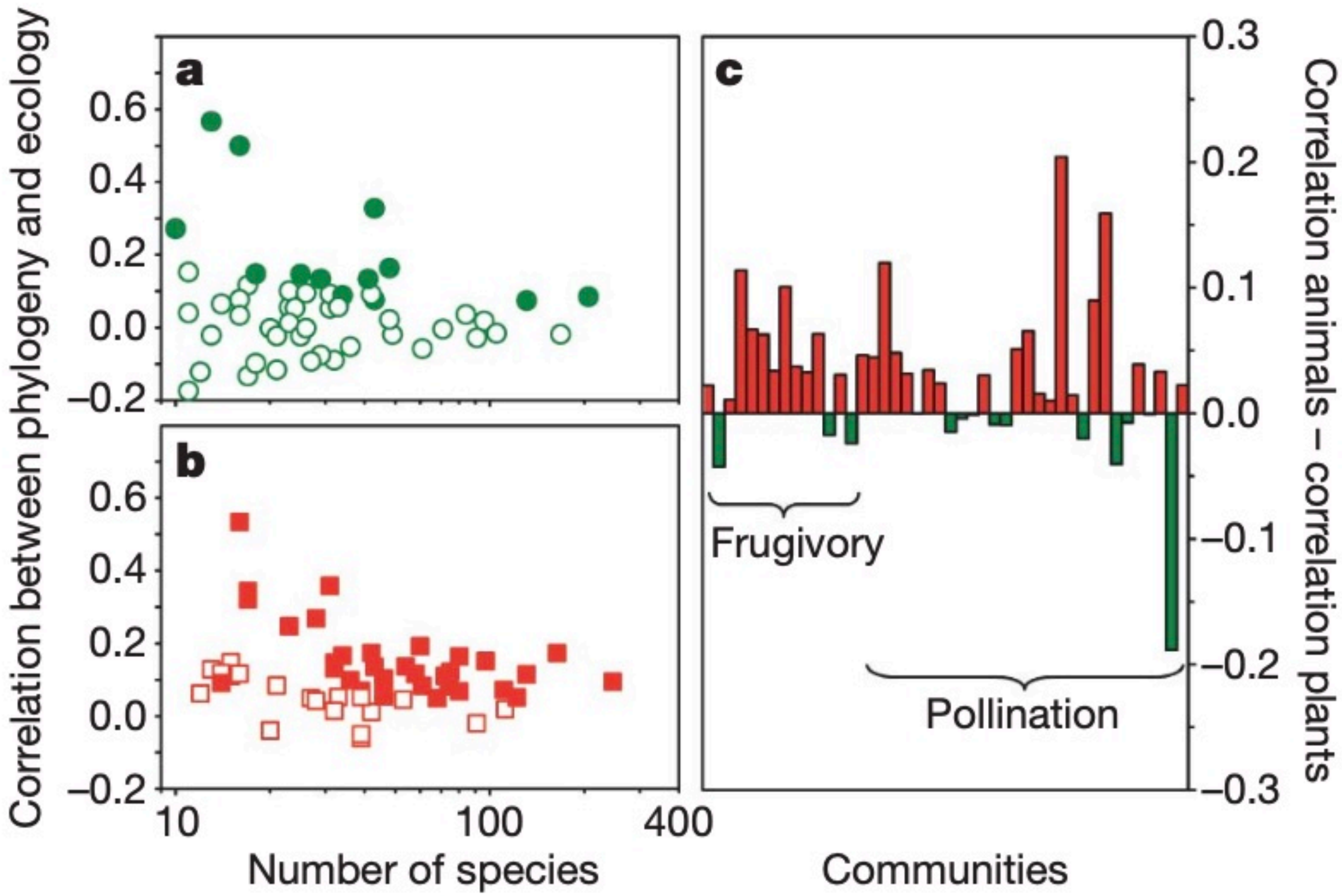
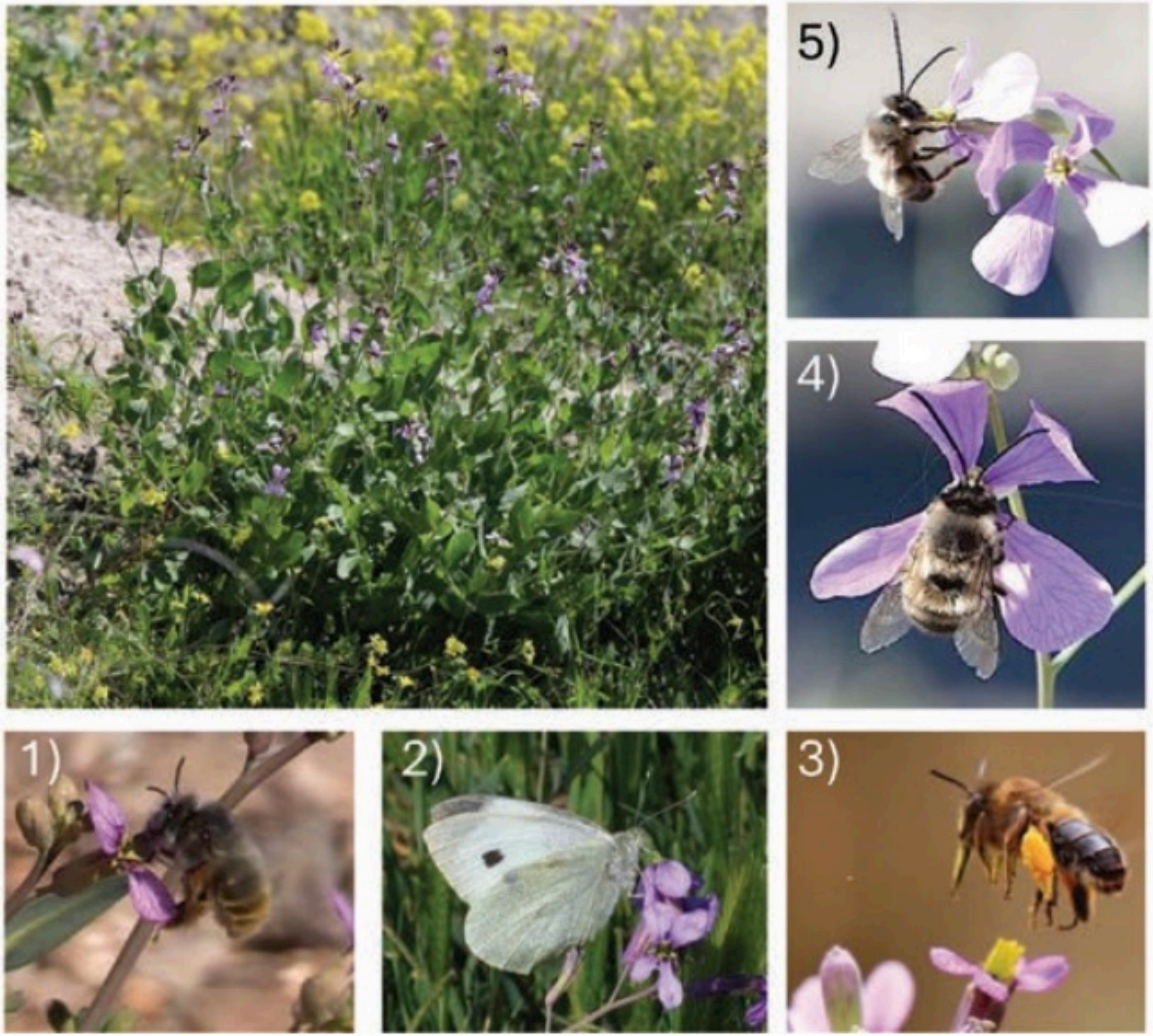


Figure 3 | Correlation between ecological similarity and phylogenetic relatedness. Results of regular Mantel tests correlating phylogenetic and ecological distance matrices plotted against phylogeny size, obtained for plants (**a**) and animals (**b**). Each data point corresponds to a phylogeny, and a solid symbol indicates a statistically significant correlation. **c,** Comparison between Mantel *Z* estimates obtained separately for plants and animals composing each network. Communities where interaction patterns are more associated with animal phylogenies are depicted in red; those more associated with plants in green. The phylogenetic structure of animals correlates significantly better with interaction matrices than that of plants.

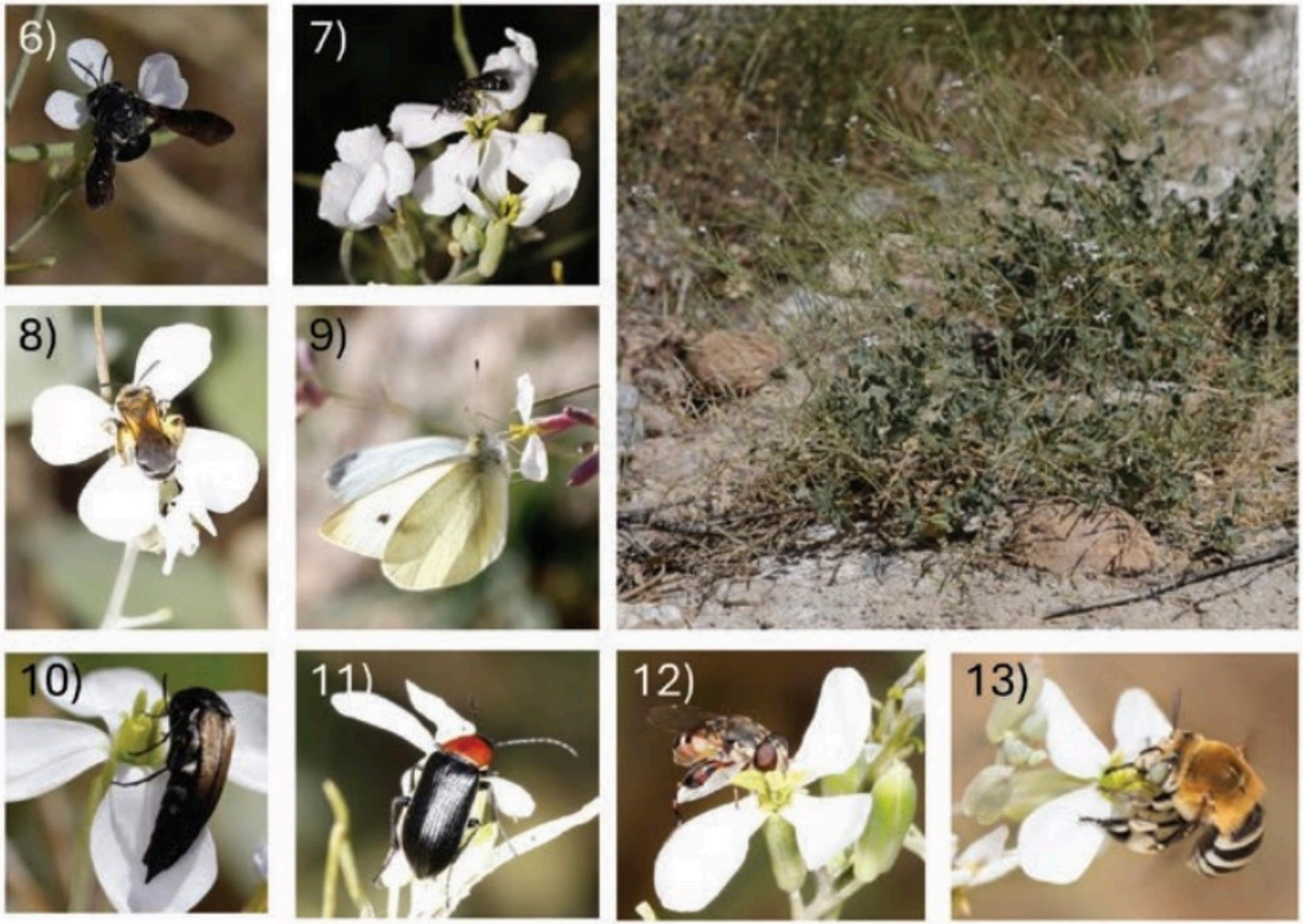
Floral visitors during spring

Gómez et al. 2024

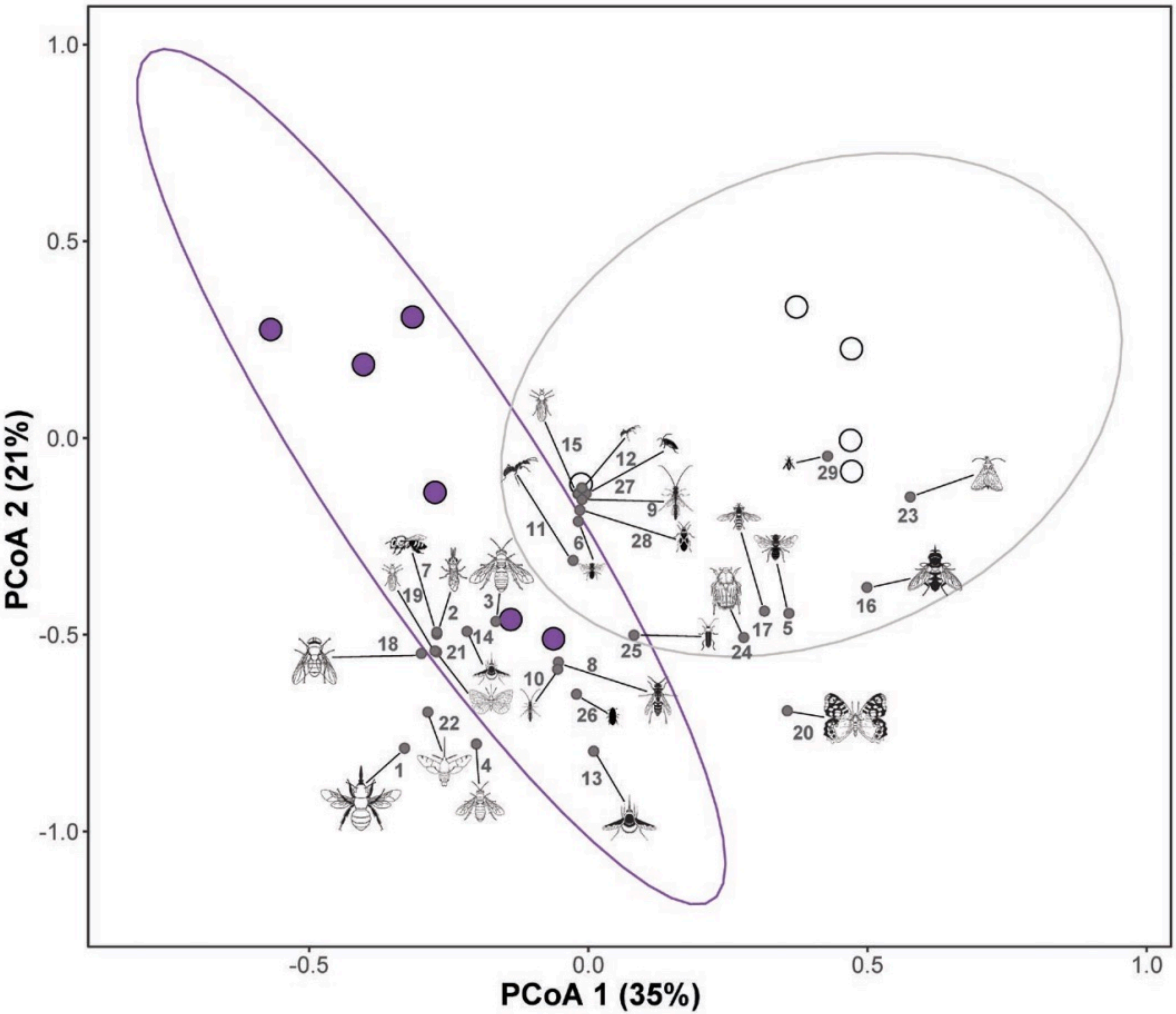


Floral visitors during summer

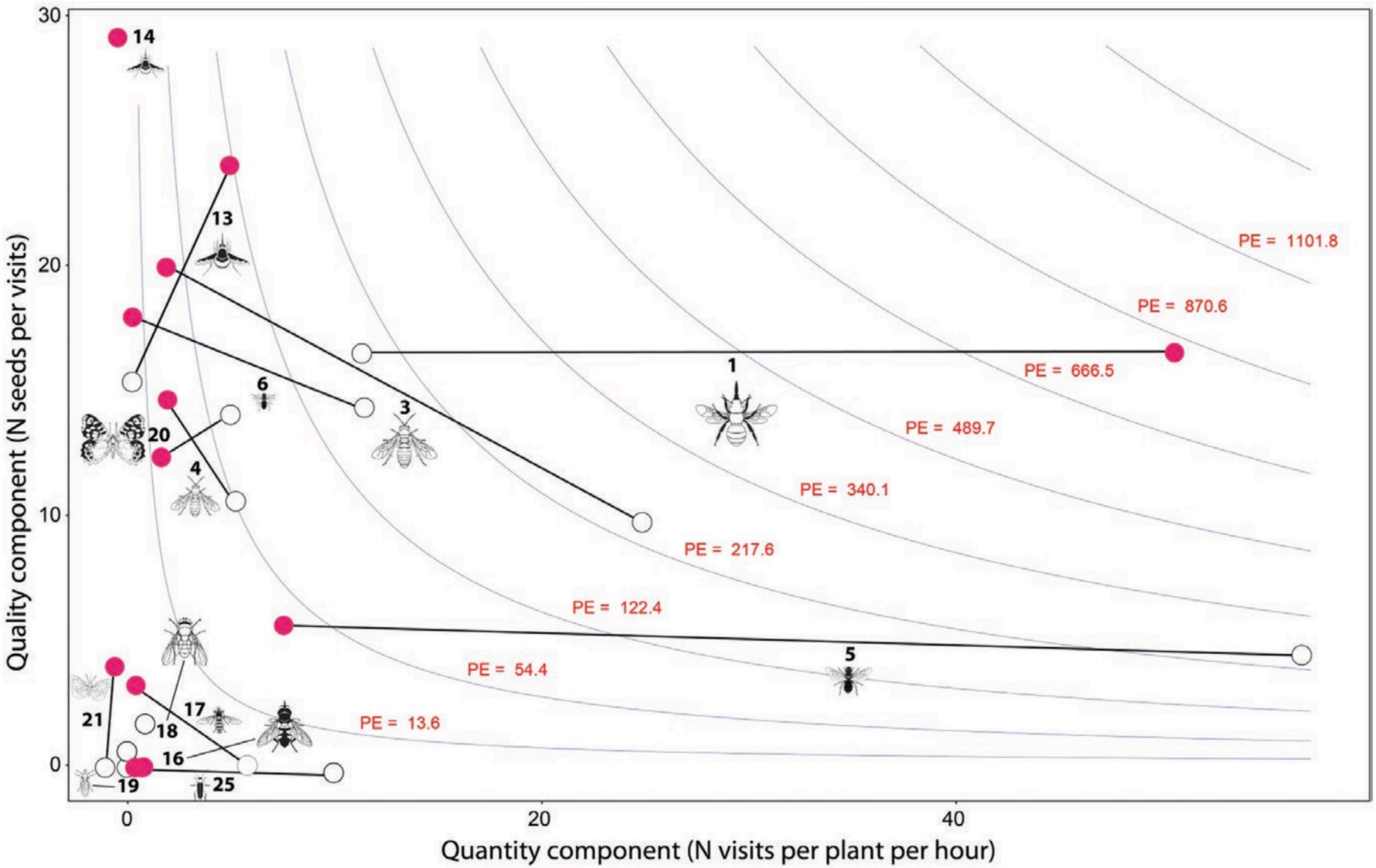
Gómez et al. 2024



Gómez et al. 2024



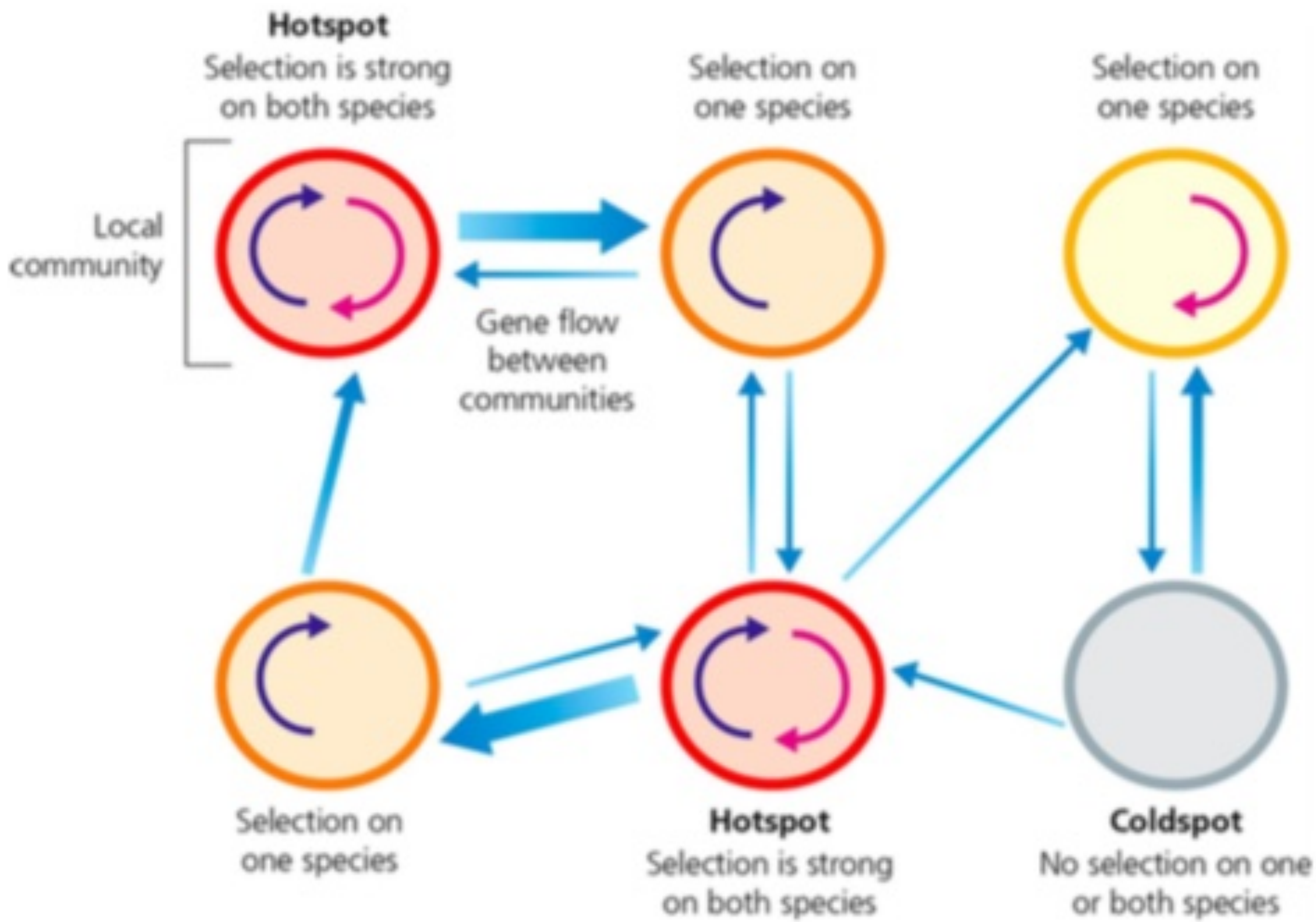
Gómez et al. 2024

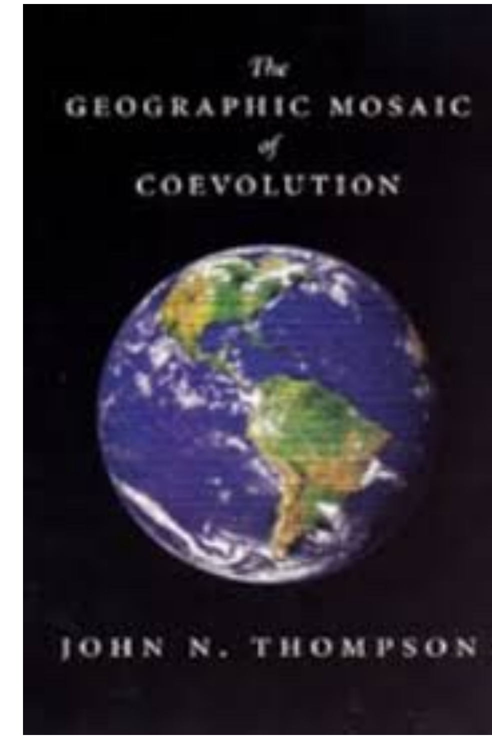


Geographic mosaic of coevolution

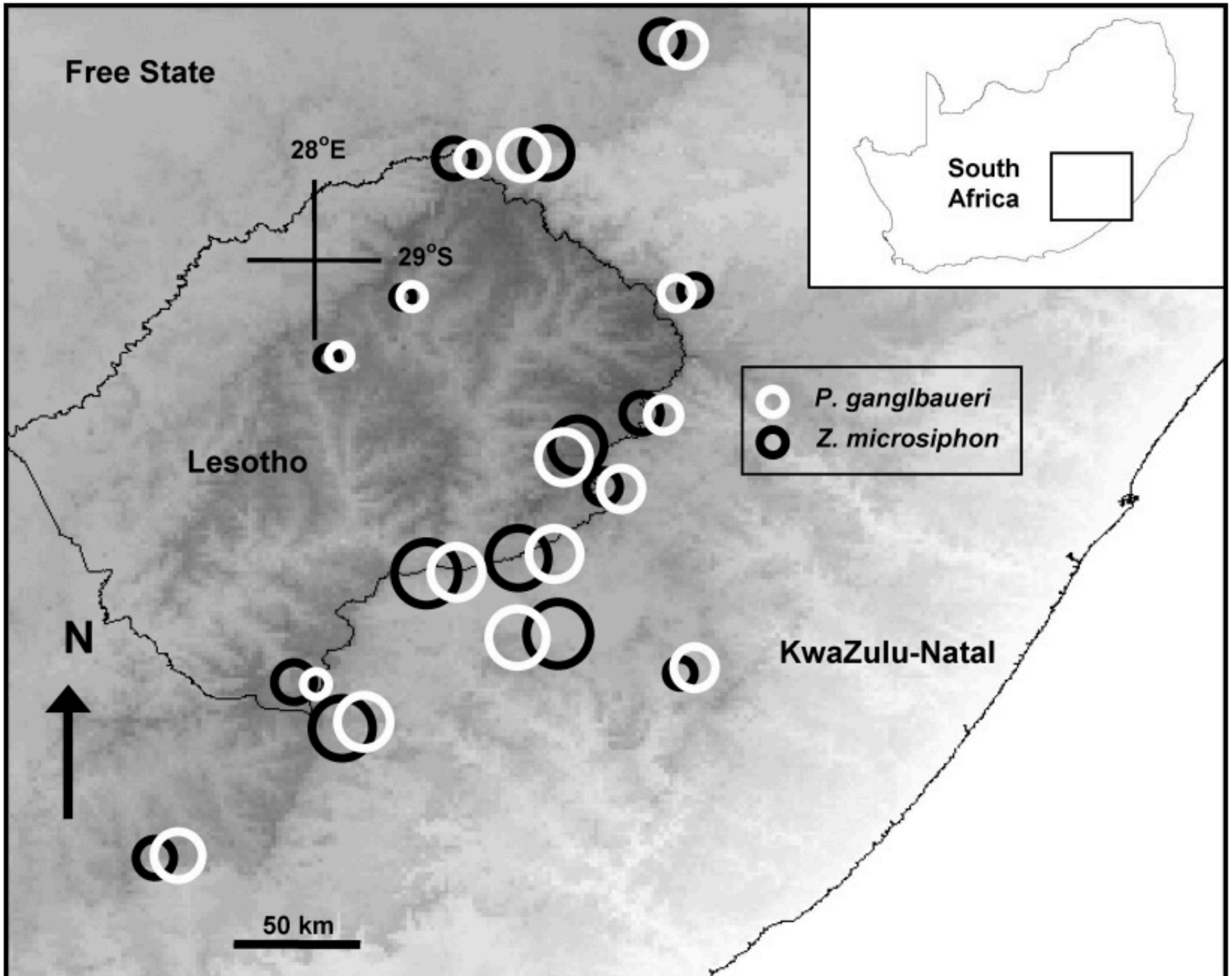
pattern of coevolution does not have to be the same everywhere

geographic mosaic theory of coevolution: geographic structure of populations is central to coevolution





Anderson et al 2008



Anderson et al 2008