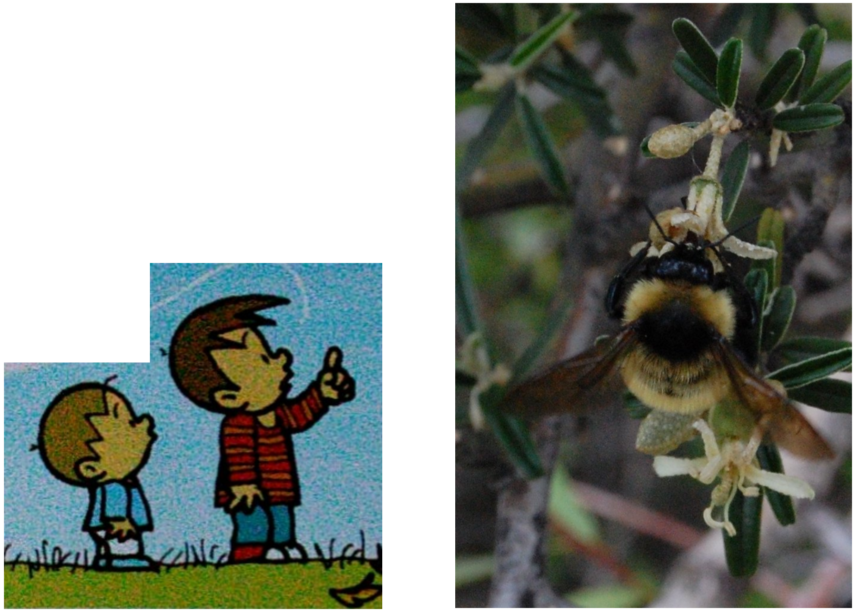
Todo lo que usted siempre quiso saber sobre

las interacciones planta-polinizador

y nunca se animó a preguntar



Diego P. Vázquez
Instituto Argentino de Investigaciones de las Zonas Áridas,
CONICET & Universidad Nacional de Cuyo
http://interactio.org

Esquema de la charla

0. Introducción: Interacciones planta-polinizador para dummies
1. ¿Especialización recíproca?
2. ¿Beneficio mutuo?
3. ¿Complejidad predecible?
4. ¿Establilidad espacio-temporal?
5. ¿Coevolución?

Qué es la polinización...

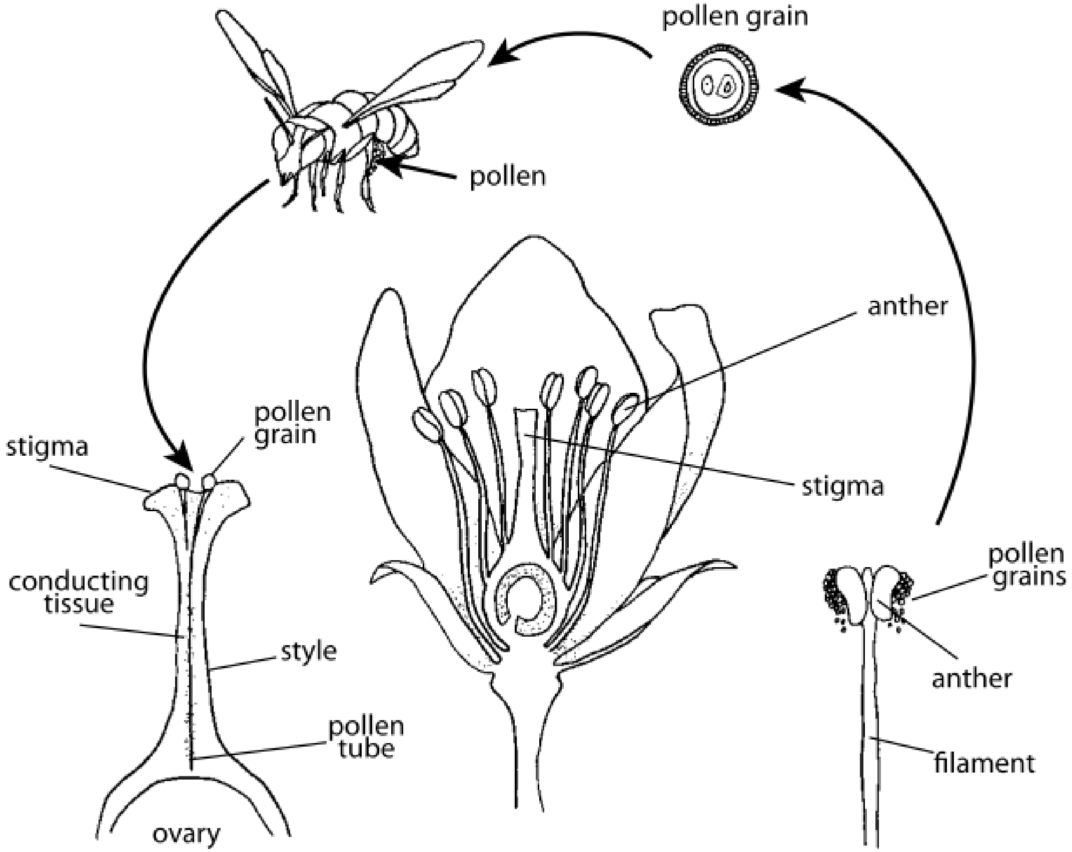


Figure 1.1 The central processes of pollination in a typical angiosperm flower, with the route taken by pollen from anther to stigma (followed by pollen tube growth into the style) in an animal-pollinated species. (Modified from Barth 1985.)

Willmer (2011) Pollination and Floral Ecology. Princeton Univ. Press

...y por qué vale la pena estudiarla

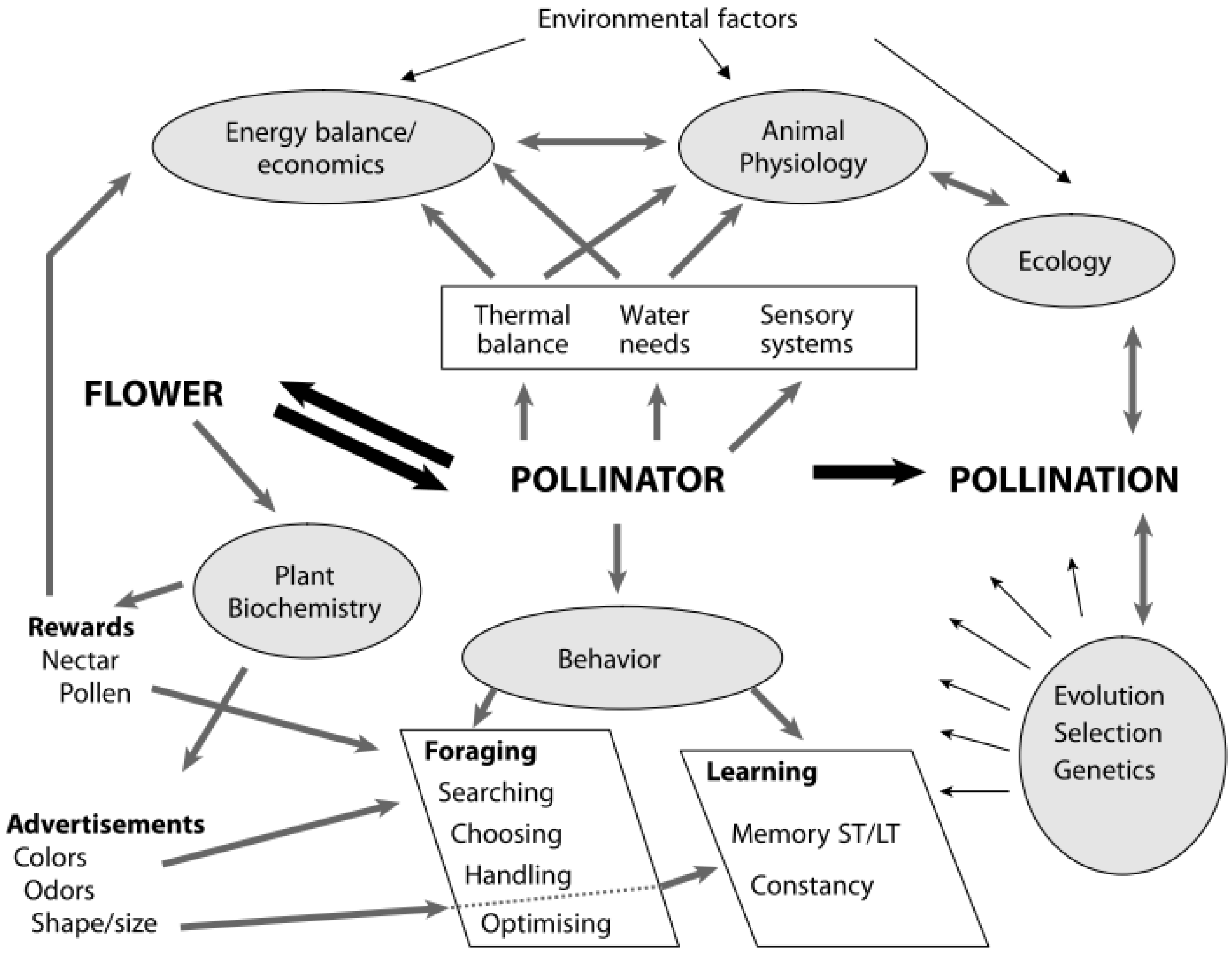


Figure 1.2 Key interactions of major biological topics and themes promoting interest in the study of pollination.

Willmer (2011) Pollination and Floral Ecology. Princeton Univ. Press

Las angiospermas no fueron las únicas...

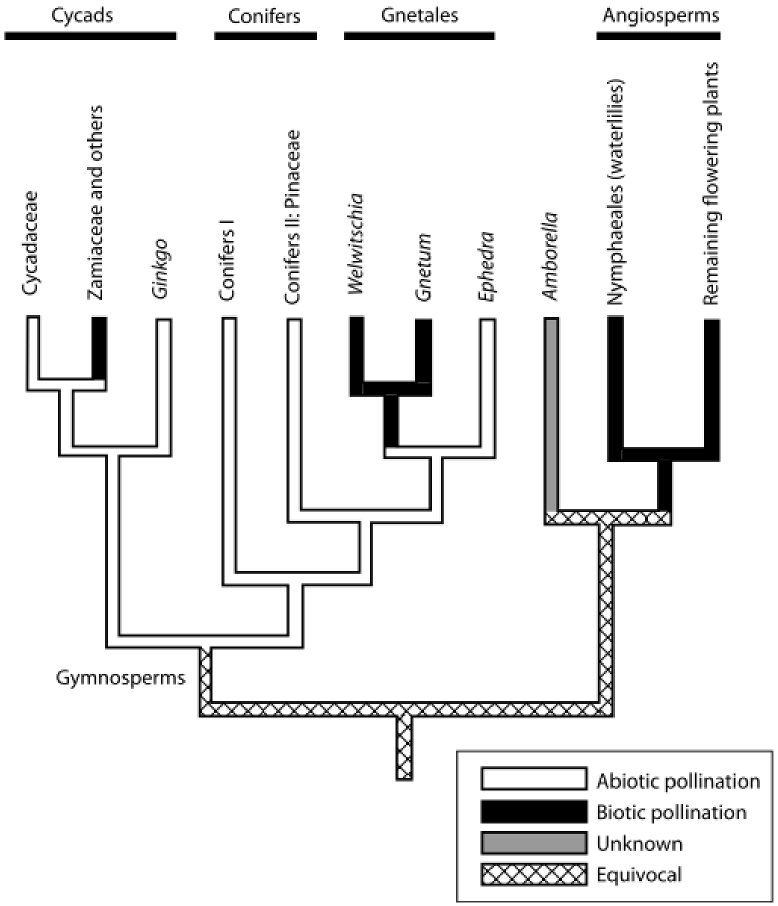


Figure 4.1 A modern phylogeny of seed plants, indicating the occurrence of abiotic and biotic pollination modes; on this view, biotic pollination has arisen at least three times. (Redrawn from Pellmyr 2002, based on earlier sources.)

Willmer (2011) Pollination and Floral Ecology. Princeton Univ. Press

...pero les fue muy bien

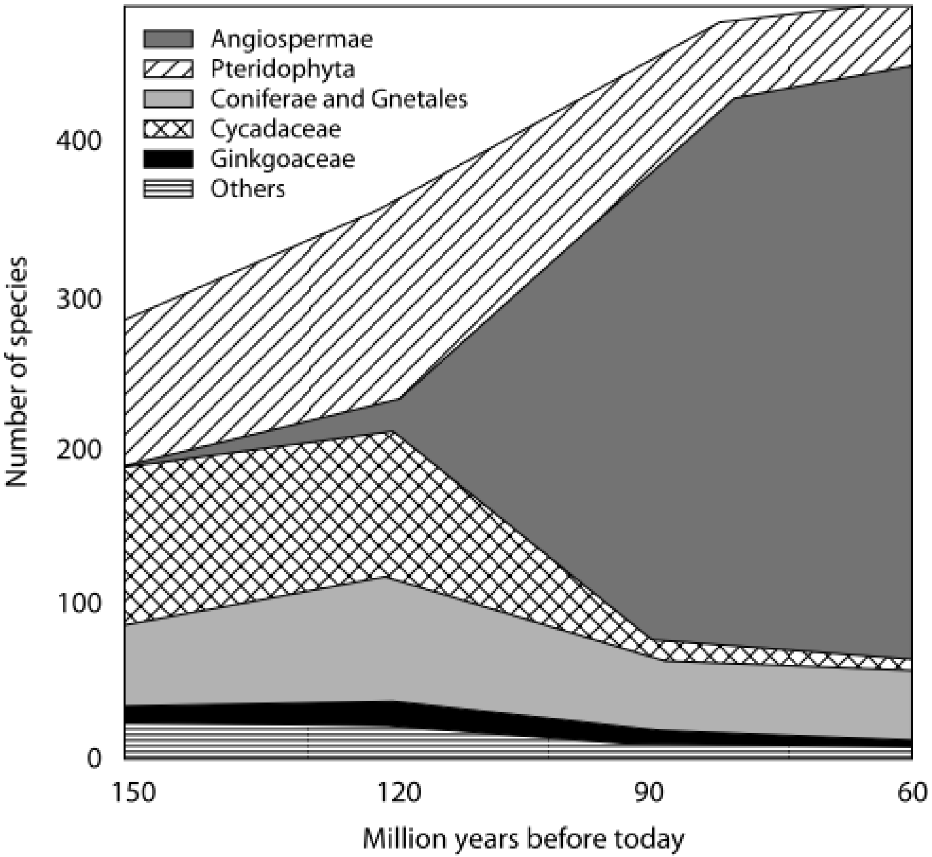


Figure 4.5 The timing of major radiations in the land plants, with angiosperm radiation becoming dominant from about 120 million years ago. (Redrawn from Lunau 2004.)

Willmer (2011) Pollination and Floral Ecology. Princeton Univ. Press

...pero les fue muy bien

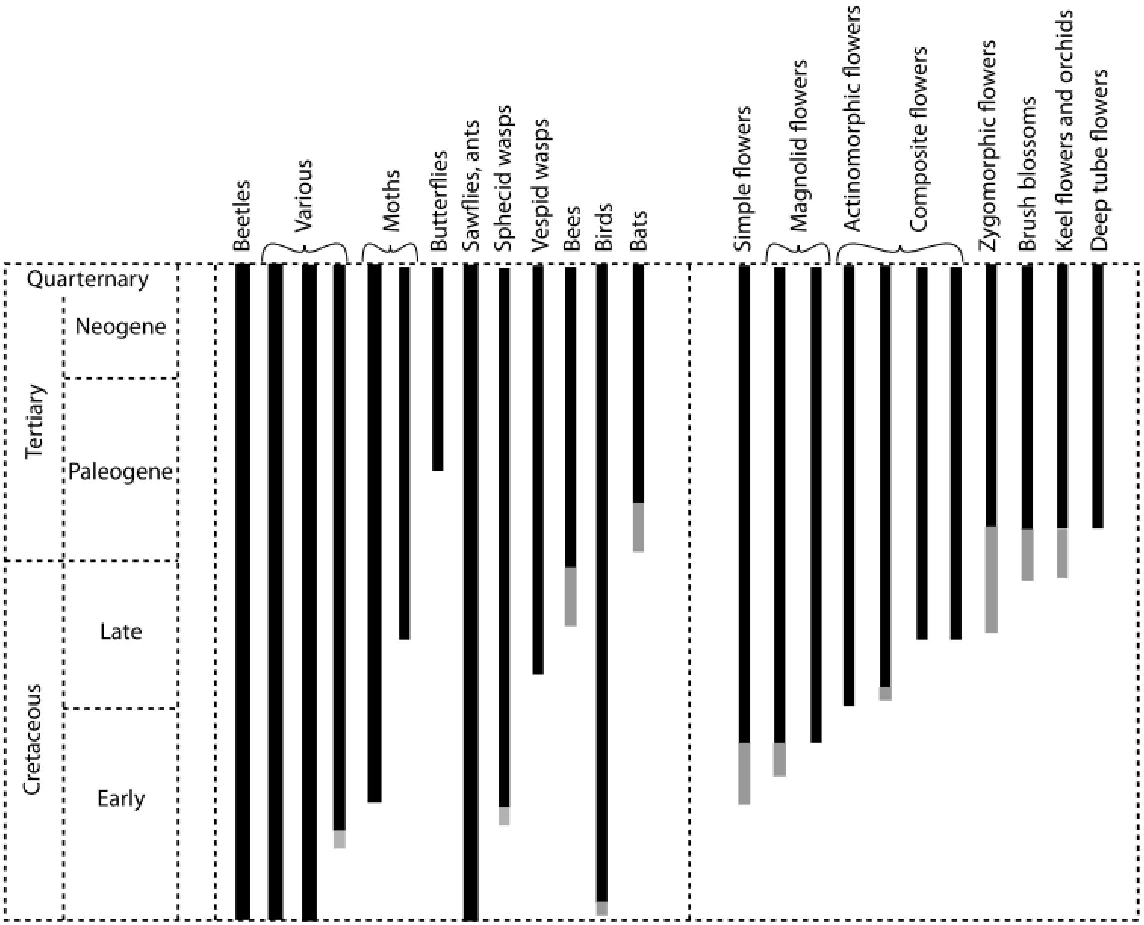
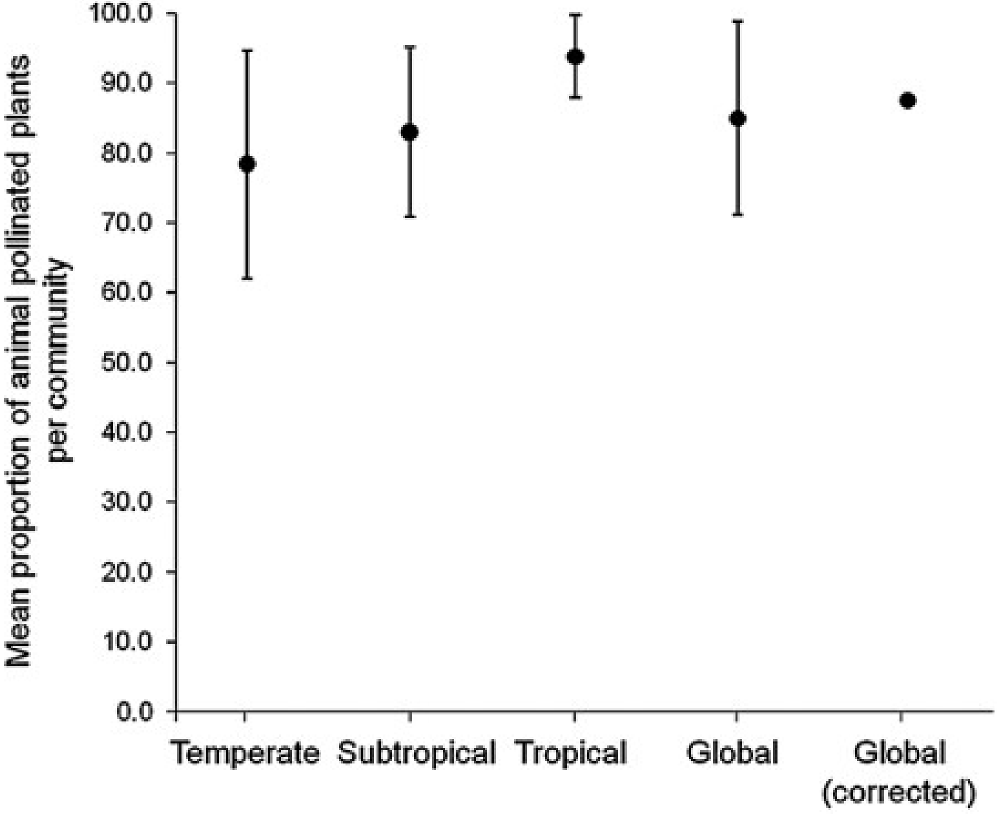


Figure 4.6 Timings of radiations in insect evolution, with major pollinating taxa appearing between 85 and 50 million years ago, at similar times to the appearance of zygomorphic flowers and brush blossoms and then keeled papilionate flowers. Origins of vertebrate groups containing pollinators are also shown; functional pollinators within these groups appeared rather later. (Modified from Schoonhoven et al. 2005, based on earlier authors.)

Willmer (2011) Pollination and Floral Ecology. Princeton Univ. Press

Muchas plantas son polinizadas por animales (sobre todo insectos)

Figure 1. The mean (±SD) proportion of animal pollinated plant species found in terrestrial communities at different latitudes. The global average represents the mean of all studies used in the analysis. The global (corrected) average takes into account the relative distribution of plant diversity in the different zones. Data for the three latitudinal zones were analyzed with a one way ANOVA: $F_{2,39} = 5.9$, $p = 0.006$. LSD post-hoc test indicates that the only significant differences are between tropical and the other latitudinal zones.



Ollerton et al. (2011) Oikos 120: 321-326

Las interacciones forman redes complejas...

…y el desafío es entender las causas de esta estructura y sus consecuencias ecológicas y evolutivas

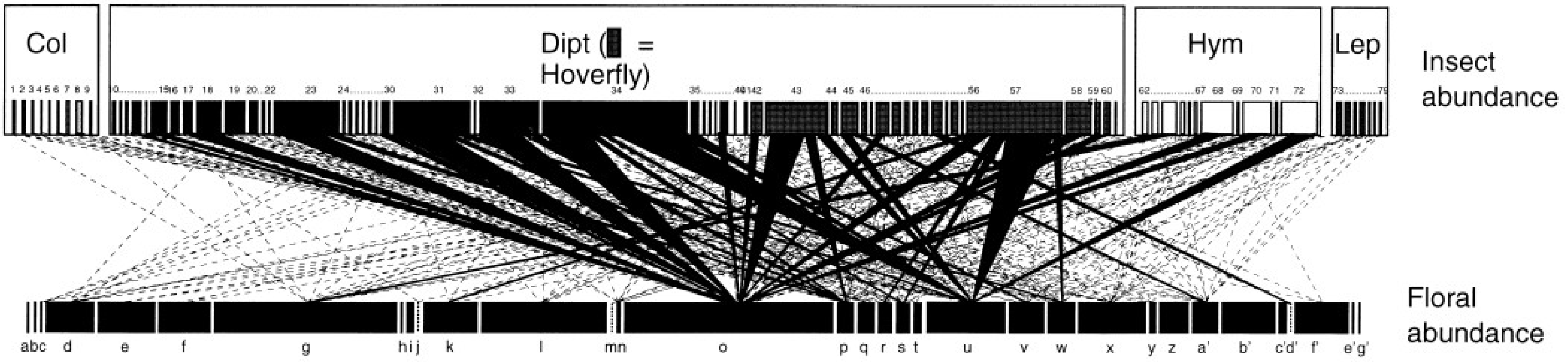


Figure 1 The results of the quantitative sampling for a plant-pollinator community showing the trophic links (pollen and/or nectar feeding) during July 1997. Each species of plant and insect is represented by a rectangle: the lower line represents flower abundance, the upper line represents insect abundance (Col, Coleoptera; Dipt, Diptera; Hym, Hymenoptera; Lep, Lepidoptera). The width of the rectangles and the size of the interaction between them is proportional to their abundance at the field site. Plants shown as a dotted line were present at the field site, but not recorded by the sampling. Interactions shown as a dotted line were observed less than 10 times during the sampling period. The plant and pollinator species are listed in the Appendix.

Memmott (1999) Ecology Letters 2: 276-280

Esquema de la charla

0. Introducción: Interacciones planta-polinizador para dummies

1. **¿Especialización recíproca?**

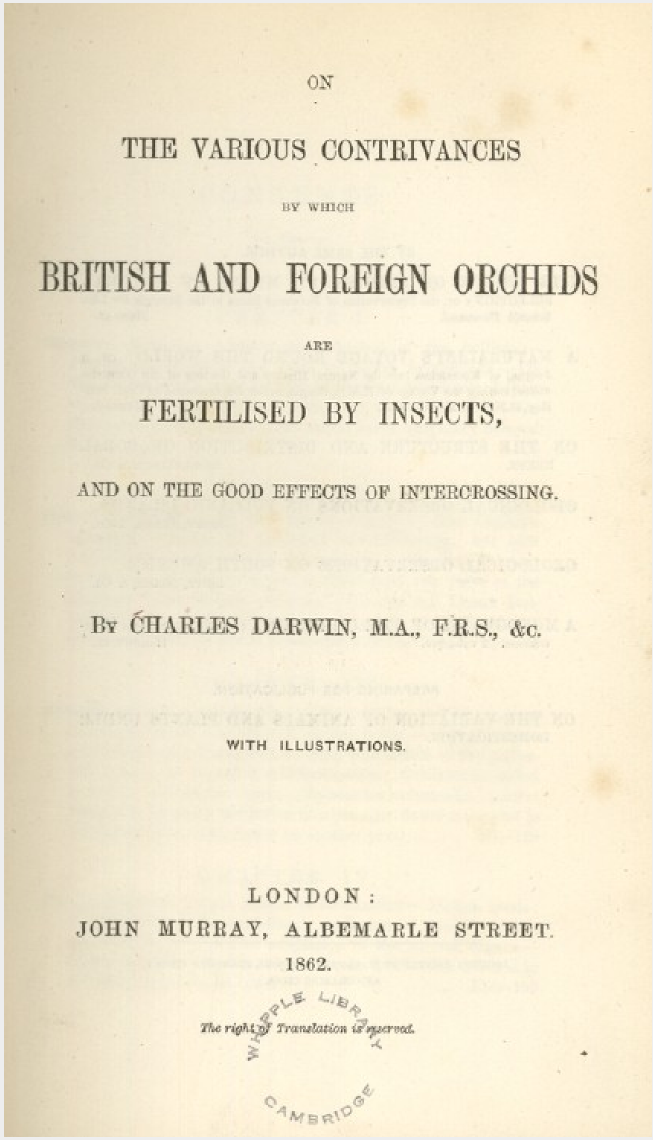
2. ¿Beneficio mutuo?

3. ¿Complejidad predecible?

4. ¿Establilidad espacio-temporal?

5. ¿Coevolución?

Orquídea estrella de Madagascar,
Angraecum sesquipedale



ON

THE VARIOUS CONTRIVANCES

BY WHICH

BRITISH AND FOREIGN ORCHIDS

ARE

FERTILISED BY INSECTS,

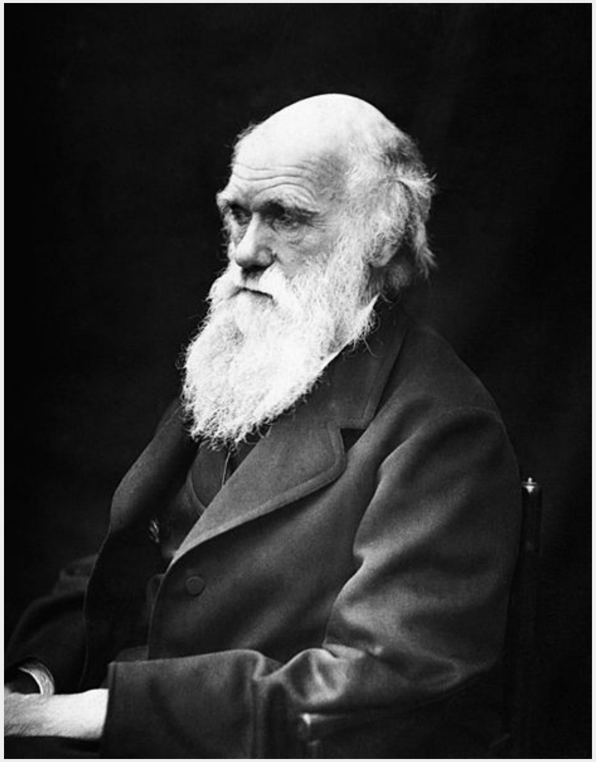
AND ON THE GOOD EFFECTS OF INTERCROSSING.

BY CHARLES DARWIN, M.A., F.R.S., &c.

WITH ILLUSTRATIONS.

LONDON:
JOHN MURRAY, ALBEMARLE STREET.
1862.

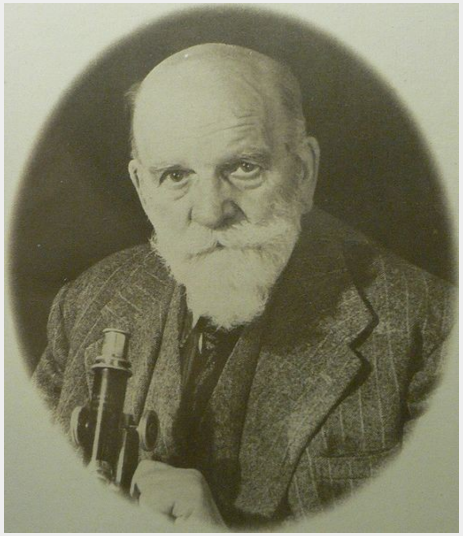
The right of Translation is reserved.



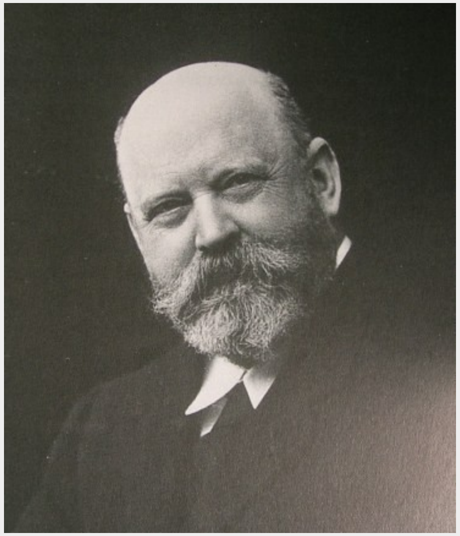
Charles Darwin

1. ¿Especialización recíproca?

Xanthopan morgani praedicta



Karl Jordan



Lionel Walter
Rothschild

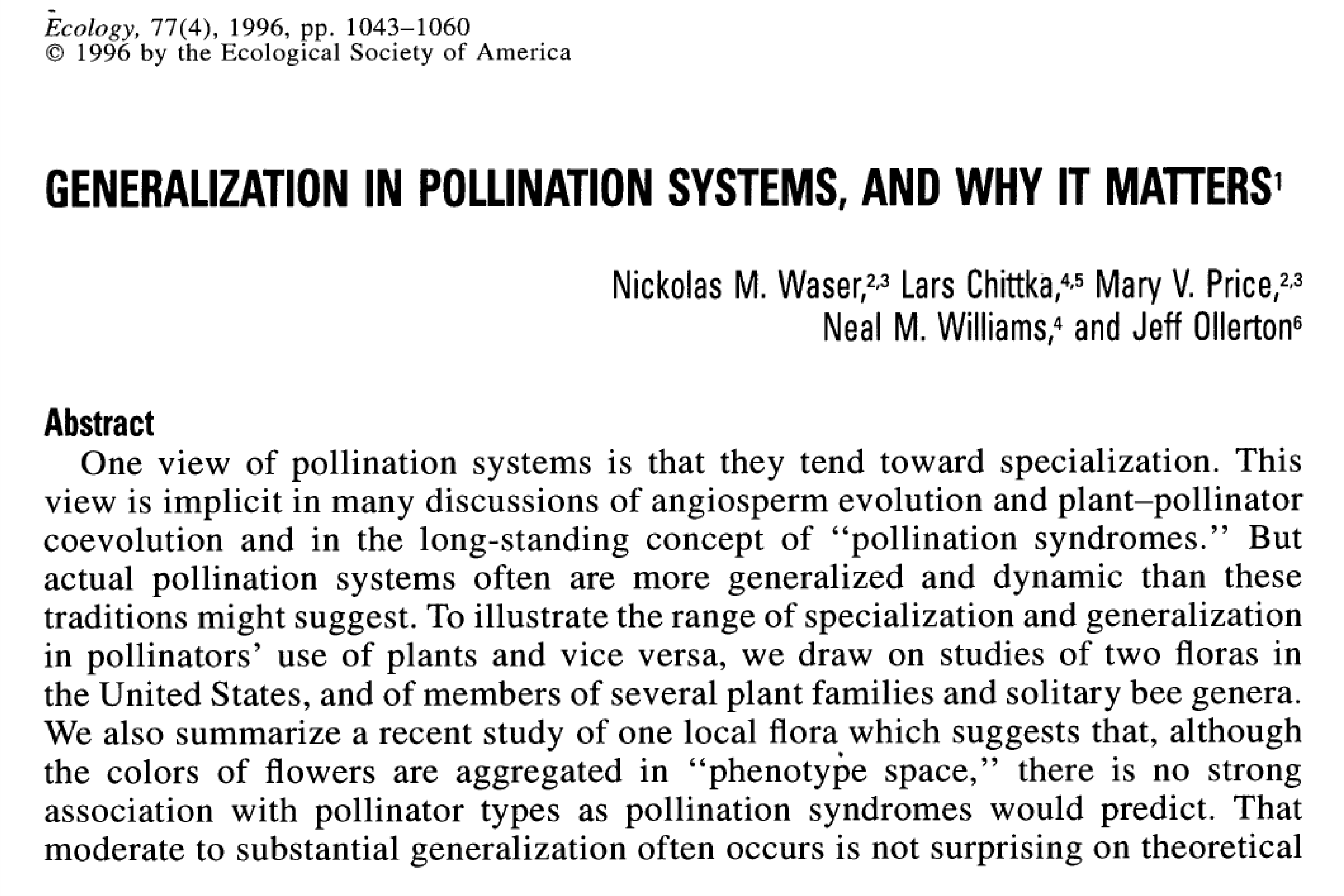
1. ¿Especialización recíproca?

¿Especialización recíproca?

Las relaciones entre las flores y los insectos polinizadores son los arquetipos de los resultados de las interacciones coevolutivas (Crepet 1983).

Las flores de cada especie de insecto están adaptadas en su forma, estructura, color y olor a los agentes polinizadores particulares de los que dependen. [...] Evolucionando juntos, las plantas y sus polinizadores se ajustan más y más a las peculiaridades del otro (Keeton y Gould 1993).

La belleza visual característicamente asociada a las flores es el efecto de su coevolución con insectos u otros animales polinizadores (Anónimo, Wikipedia).



Ecology, 77(4), 1996, pp. 1043–1060

GENERALIZATION IN POLLINATION SYSTEMS, AND WHY IT MATTERS[1]

Nickolas M. Waser,[2,3] Lars Chittka,[4,5] Mary V. Price,[2,3]
Neal M. Williams,[4] and Jeff Ollerton[6]

Abstract

One view of pollination systems is that they tend toward specialization. This view is implicit in many discussions of angiosperm evolution and plant–pollinator coevolution and in the long-standing concept of "pollination syndromes." But actual pollination systems often are more generalized and dynamic than these traditions might suggest. To illustrate the range of specialization and generalization in pollinators' use of plants and vice versa, we draw on studies of two floras in the United States, and of members of several plant families and solitary bee genera. We also summarize a recent study of one local flora which suggests that, although the colors of flowers are aggregated in "phenotype space," there is no strong association with pollinator types as pollination syndromes would predict. That moderate to substantial generalization often occurs is not surprising on theoretical

1. ¿Especialización recíproca?

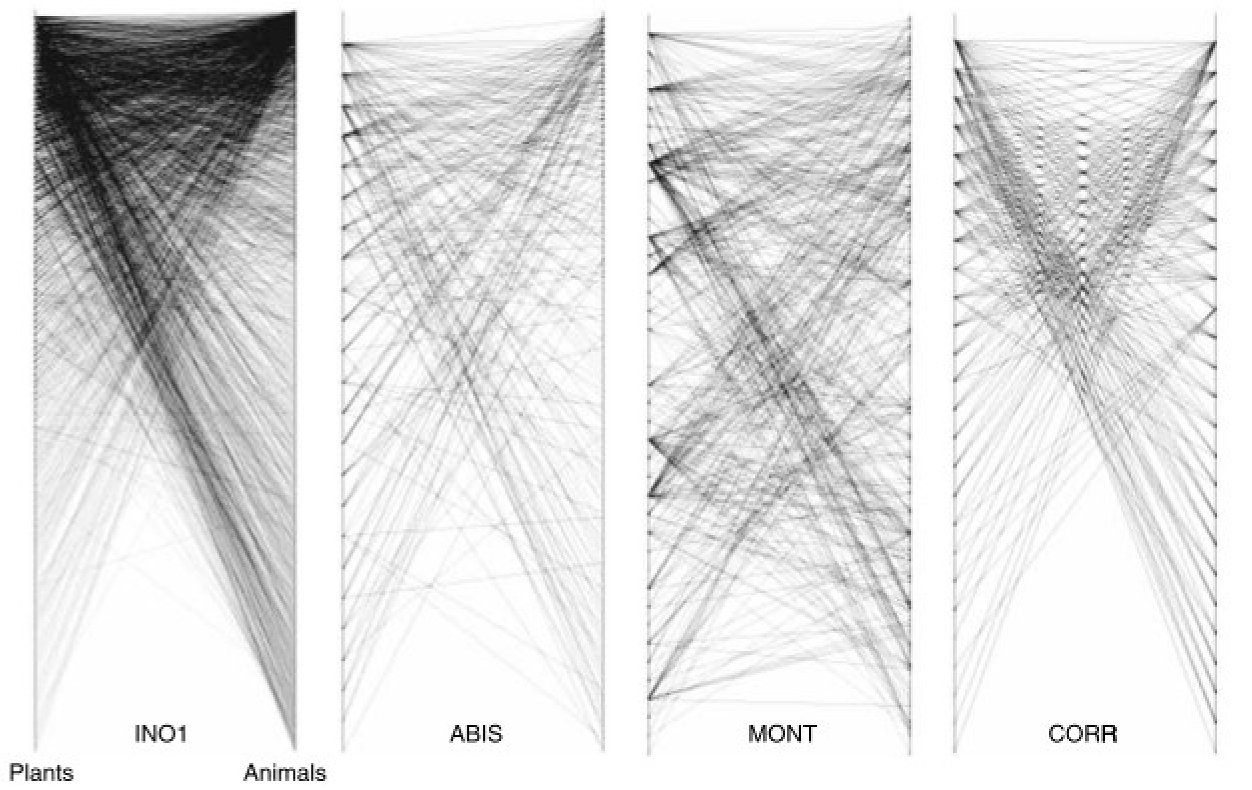
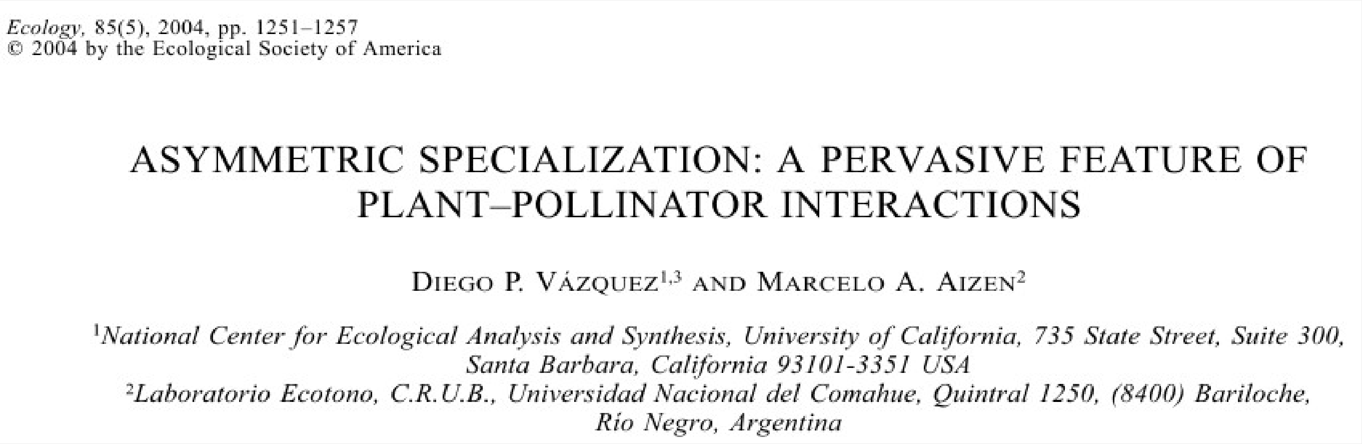


Figure 1 Bipartite graphs depicting two-mode networks characteristic of plant–animal mutualistic interactions. Species in each set (nodes arranged along the vertical lines and connected by thin oblique lines) are sorted in decreasing number of interactions per species. Plant–pollinator networks (Olesen & Jordano 2002): INO1, temperate forest, Kibune forest, Kyoto, Japan ($S = 952$, $k = 1876$); ABIS, arctic tundra, Abisko, Sweden ($S = 142$, $k = 242$). Plant–frugivore networks: MONT, neotropical montane rainforest, Monteverde, Costa Rica ($S = 210$, $k = 436$) (Wheelwright *et al.* 1984); CORR, high-elevation Mediterranean forest, Sierra de Cazorla, SE Spain ($S = 58$, $k = 148$) (P. Jordano, unpubl. data).

Jordano et al. (2003) Ecology Letters 6: 69-81

1. ¿Especialización recíproca?



Ecology, 85(5), 2004, pp. 1251–1257

ASYMMETRIC SPECIALIZATION: A PERVASIVE FEATURE OF PLANT–POLLINATOR INTERACTIONS

Diego P. Vázquez[1,3] and Marcelo A. Aizen[2]

[1]*National Center for Ecological Analysis and Synthesis, University of California, 735 State Street, Suite 300, Santa Barbara, California 93101-3351 USA*

[2]*Laboratorio Ecotono, C.R.U.B., Universidad Nacional del Comahue, Quintral 1250, (8400) Bariloche, Río Negro, Argentina*

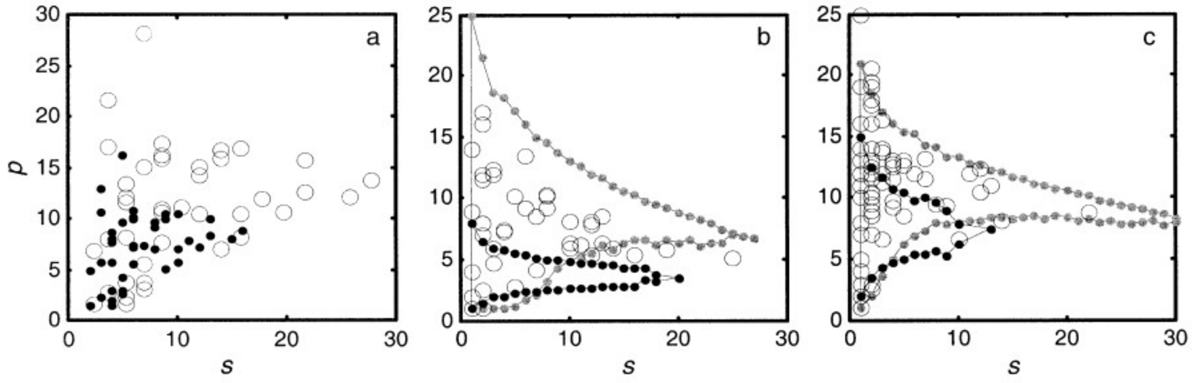


Fig. 1. Distribution of asymmetric specialization in plant–pollinator interaction networks. Plots show the average specialization of interaction partners (*p*) vs. the degree of specialization (*s*). (a) An example to illustrate the inability of the correlation coefficient to characterize asymmetric specialization. Heuristic data are shown for two communities with identical correlation coefficients ($r = 0.4265$), one with higher values of *s* and *p* (large open circles) than the other (black dots). Data for the Inouye and Pyke (1988) data set are shown for plants (b) and pollinators (c). Large open circles represent observed *s*-*p* values; black dots and line indicate the null space for model 1; gray dots and line indicate the null space for model 2. Notice that most extreme specialists (species with low values of *s*) do not have reciprocally specialized interaction partners (low values of *p*); a similar pattern was observed for all data sets (see Appendix B).

1. ¿Especialización recíproca?

PNAS | August 5, 2003 | vol. 100 | no. 16 | 9383–9387

The nested assembly of plant–animal mutualistic networks

Jordi Bascompte[†‡], Pedro Jordano[†], Carlos J. Melián[†], and Jens M. Olesen[§]

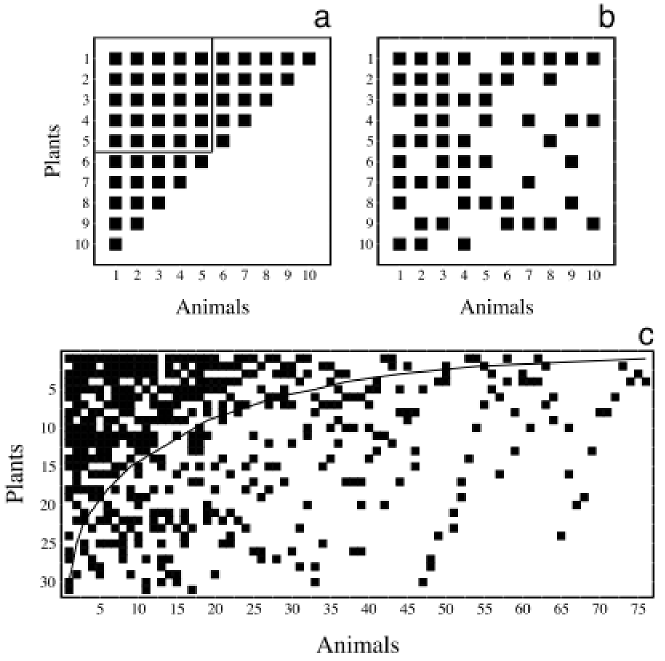


Fig. 1. Plant–animal mutualistic interaction matrices. Numbers label plant and animal species, which are ranked in decreasing number of interactions per species. A filled square indicates an observed interaction between plant *i* and animal *j*. *a*–*c* correspond to perfectly nested, random, and real mutualistic matrices [plant–pollinator network of Zackenberg (J.M.O. and H. Elberling, unpublished work)], respectively. Values of nestedness are $N = 1$ (*a*), $N = 0.55$ (*b*), and $N = 0.742$ ($P < 0.01$) (*c*). The box outlined in *a* represents the central core of the network, and the line in *c* represents the isocline of perfect nestedness. On a perfectly nested scenario, all interactions would lie before the isocline (on the left side).

1. ¿Especialización recíproca?

¿Especialización recíproca?

- La especialización recíproca es (muy) rara.
- Pero… hay muchos especialistas especializados asimétricamente en generalistas.
- Esta estructura tiene implicancias importantes para la dinámica ecológica y evolutiva.

Esquema de la charla

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Tipos de interacciones planta - animal

Tipo de interacción	Especie 1	Especie 2	Situación
Predación	+	-	Conflicto
Parasitismo	+	-	
Competencia	-	-	
Amensalismo	-	0	
Neutralismo	0	0	
Comensalismo	+	0	
Mutualismo	+	+	Alianzas (simbiosis)

Modificado de Perry et al 2008

AMER. ZOOL., 41:825–839 (2001)

The Costs of Mutualism[1]

JUDITH L. BRONSTEIN[2]
Department of Ecology and Evolutionary Biology, University of Arizona, Tucson, Arizona 85721

- La mayoría de los mutualismos involucran tanto costos como beneficios.
- Los mutualismos están moldeados no solo por sus beneficios sino también por sus costos.

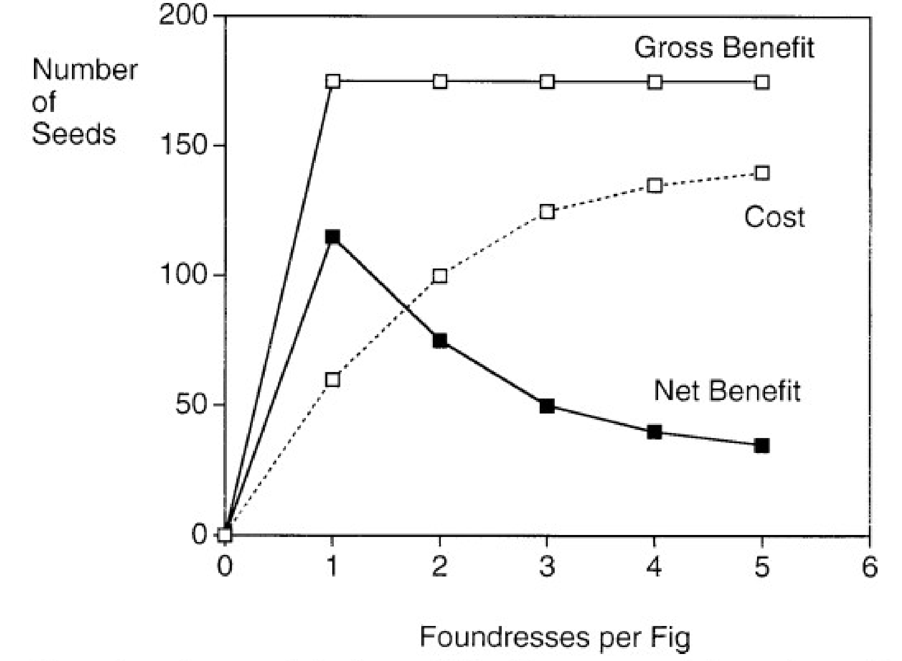
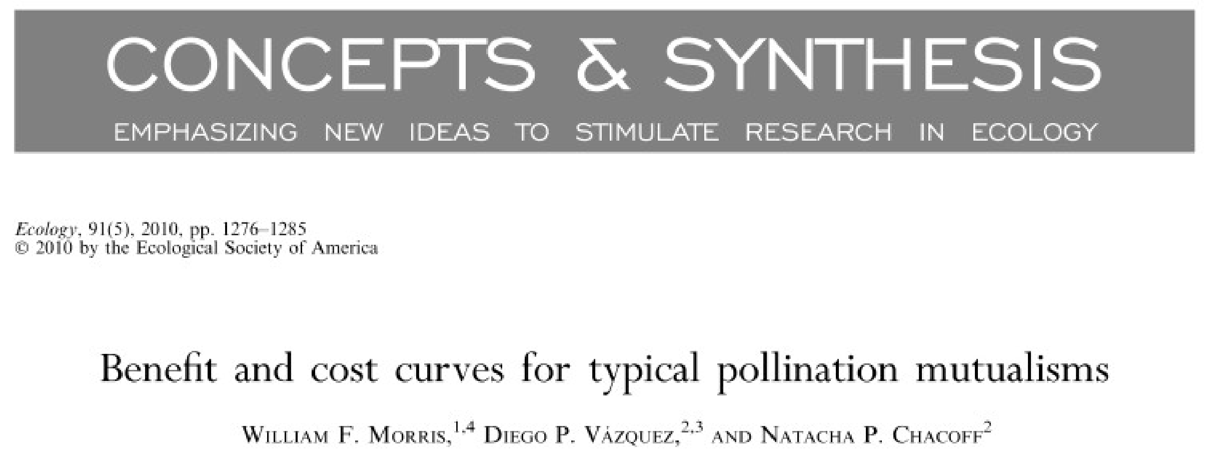


FIG. 2. A graphical model of costs and benefits of mutualism to *Ficus aurea* female function (seed production). Gross benefits quickly saturate since a single foundress imports sufficient pollen into a fig to initiate a full complement of seeds; costs (seed loss to foundress offspring) rise and then saturate as available oviposition space fills up. The net benefit (*i.e.*, gross benefits minus costs) is therefore maximal when a single foundress enters each fig.



CONCEPTS & SYNTHESIS

EMPHASIZING NEW IDEAS TO STIMULATE RESEARCH IN ECOLOGY

Ecology, 91(5), 2010, pp. 1276–1285
© 2010 by the Ecological Society of America

Benefit and cost curves for typical pollination mutualisms

William F. Morris,[1,4] Diego P. Vázquez,[2,3] and Natacha P. Chacoff[2]

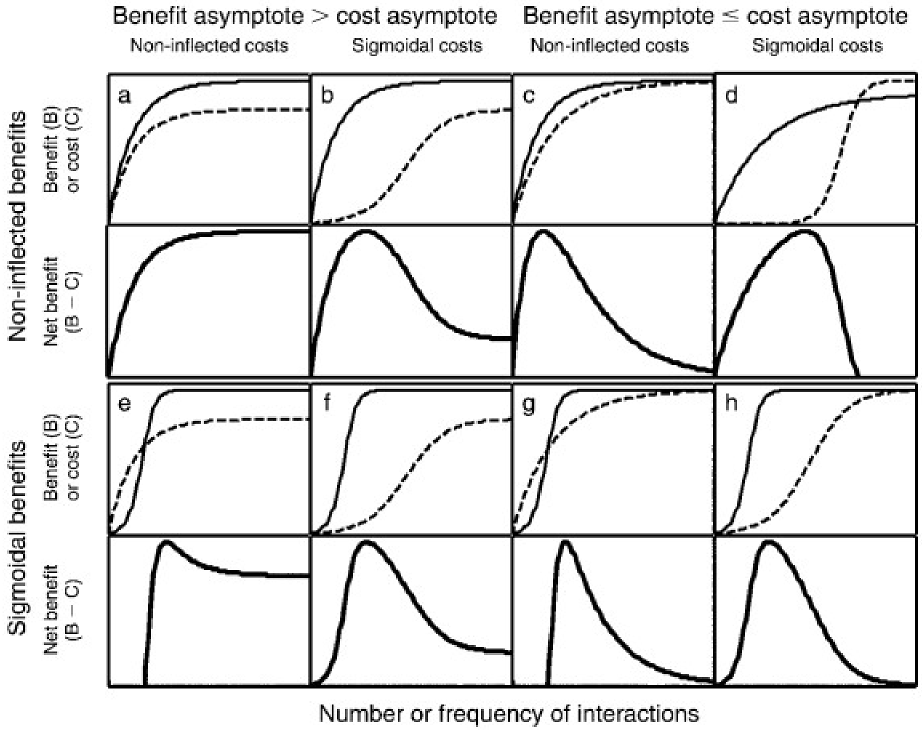
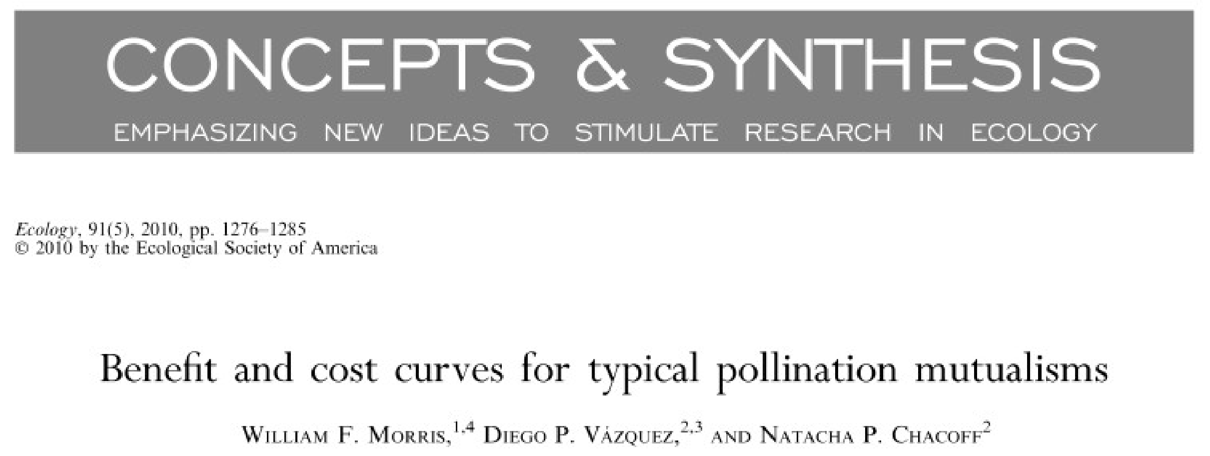


Fig. 1. A wide variety of net-benefit curves can result from combinations of saturating benefit and cost curves. Solid lines are benefit curves; dashed lines are cost curves.

2. ¿Beneficio mutuo?



CONCEPTS & SYNTHESIS
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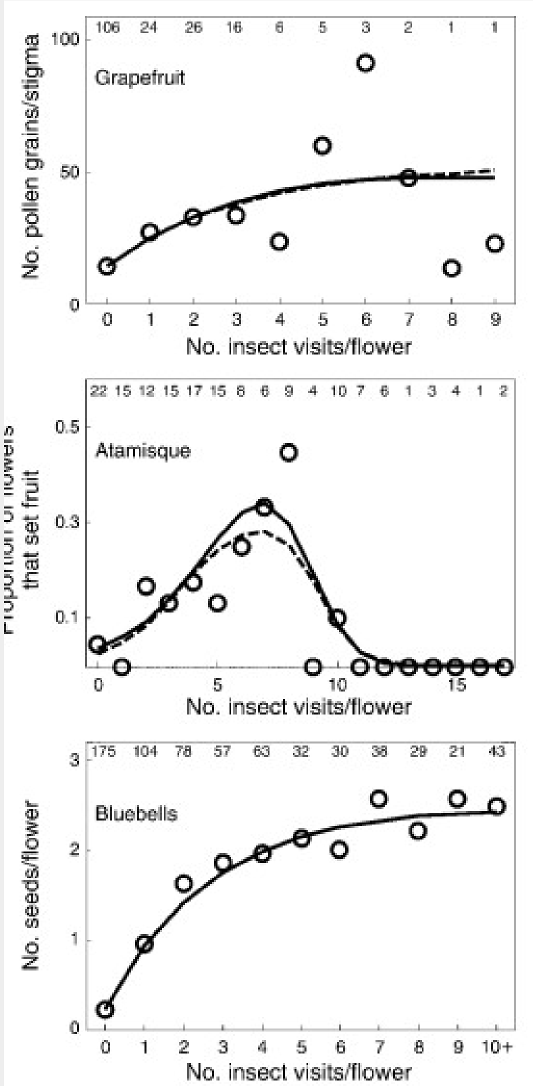

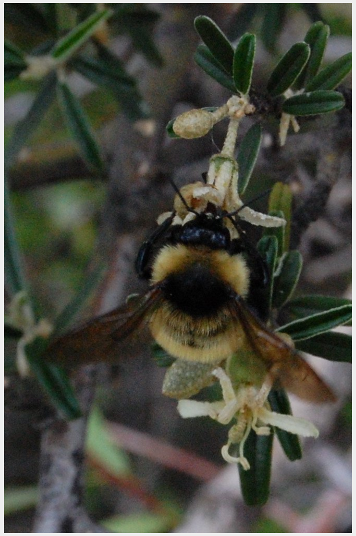

Fig. 3. Net-benefit curves for female reproductive success of three plants in typical pollination mutualisms. Circles represent the data (among-flower means are shown for grapefruit and bluebells). Numbers at the top of each panel indicate the number of flowers that received each number of insect visits. Curves represent the predictions of all models with ΔAIC ≤ 2. For grapefruit, the simple saturating (solid line) and unimodal (dashed line) models shared the lowest AIC. For atamisque, a model with sigmoidal benefit and cost curves with the same asymptote (solid line) had the lowest AIC, followed by the model with sigmoidal cost and benefits curves with different asymptotes (dashed line, ΔAIC = 1.97). For bluebells, the simple saturating model outperformed all others. AIC values and parameter estimates for all models are in Appendix C: Table C2.

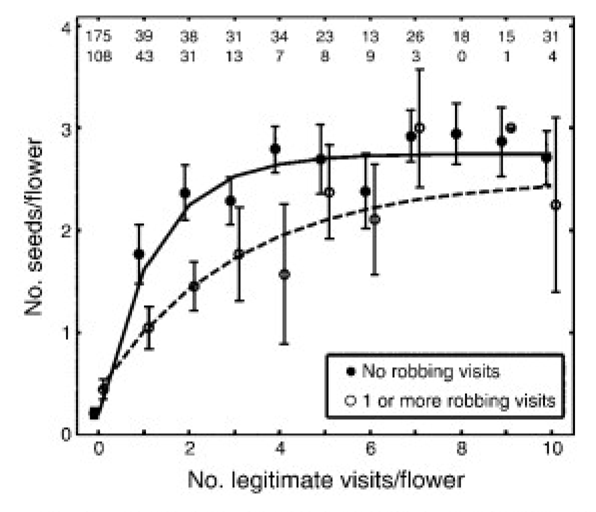

Fig. 4. For a given number of legitimate visits, bluebell flowers that also received robbing visits produced fewer seeds than did flowers that were only visited legitimately. Data are means ± SE. Curves are the best-fit simple saturating net-benefit model in which robbed and unrobbed flowers have different parameters (see maximum-likelihood parameter estimates and AIC values in Appendix C: Table C3). The numbers at the top are numbers of unrobbed (first row) and robbed (second row) flowers that received each number of visits.

¿Beneficio mutuo?

- Los mutualismos, incluyendo las interacciones planta-polinizador, involucran tanto costos como beneficios.
- En ese sentido, los mutualismos son en realidad antagonismos balanceados que involucran costos y beneficios.
- El beneficio neto es dinámico y depende de la acumulación de costos y beneficios.

Esquema de la charla

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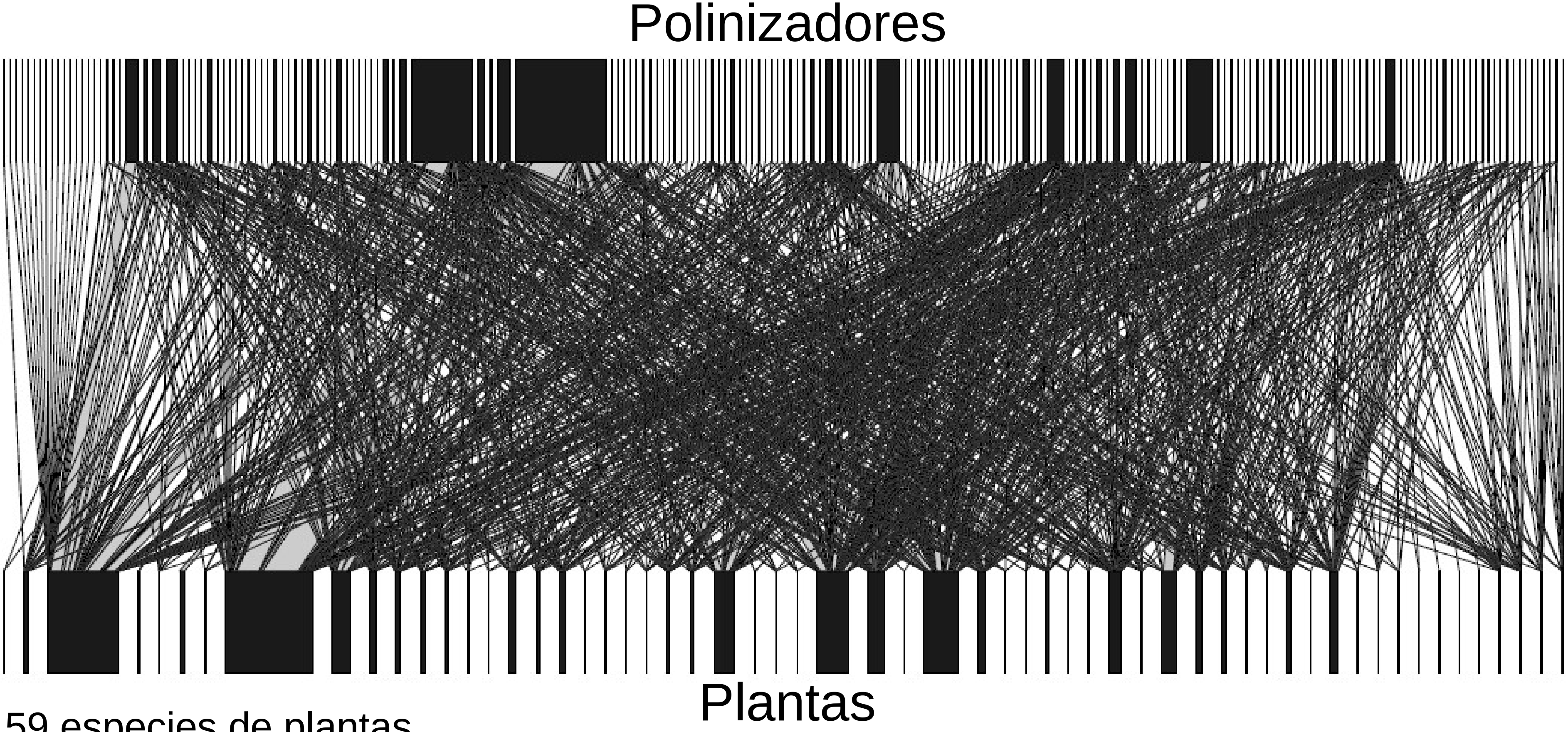
Red planta-polinizador de Villavicencio (6 años)



59 especies de plantas
196 especies de visitantes florales
1050 interacciones interespecíficas (links)
28015 visitas

Vázquez, Chacoff, Cagnolo (2009) Ecology 90: 2039-2046
Chacoff et al. (2012) J An Ecol 81: 190-200
Vázquez et al. (2012) Ecology 93: 719-725
Chacoff, Resasco, Vázquez (2018) Ecology 99: 21-28

¿Podemos predecir las interacciones en una red?

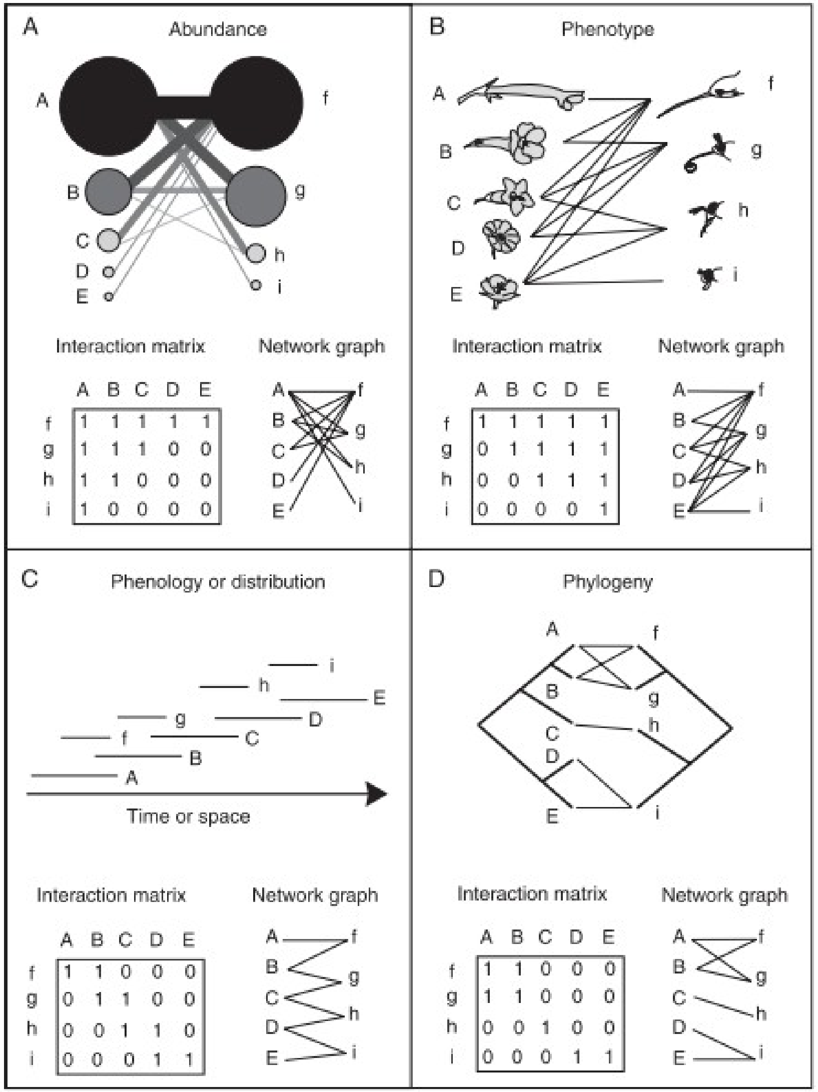
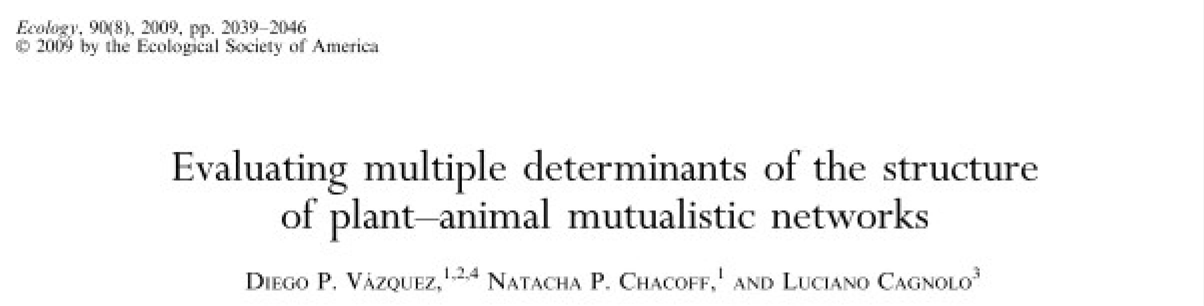


FIG. 2. Illustration of how network structure can result from (A) species abundance, (B) trait matching, (C) species spatio-temporal distribution and (D) phylogenetic relationships.

Vázquez et al. (2009) Annals of Botany 103: 1445-1457



Ecology, 90(8), 2009, pp. 2039–2046

Evaluating multiple determinants of the structure of plant–animal mutualistic networks

Diego P. Vázquez,[1,2,4] Natacha P. Chacoff,[1] and Luciano Cagnolo[3]

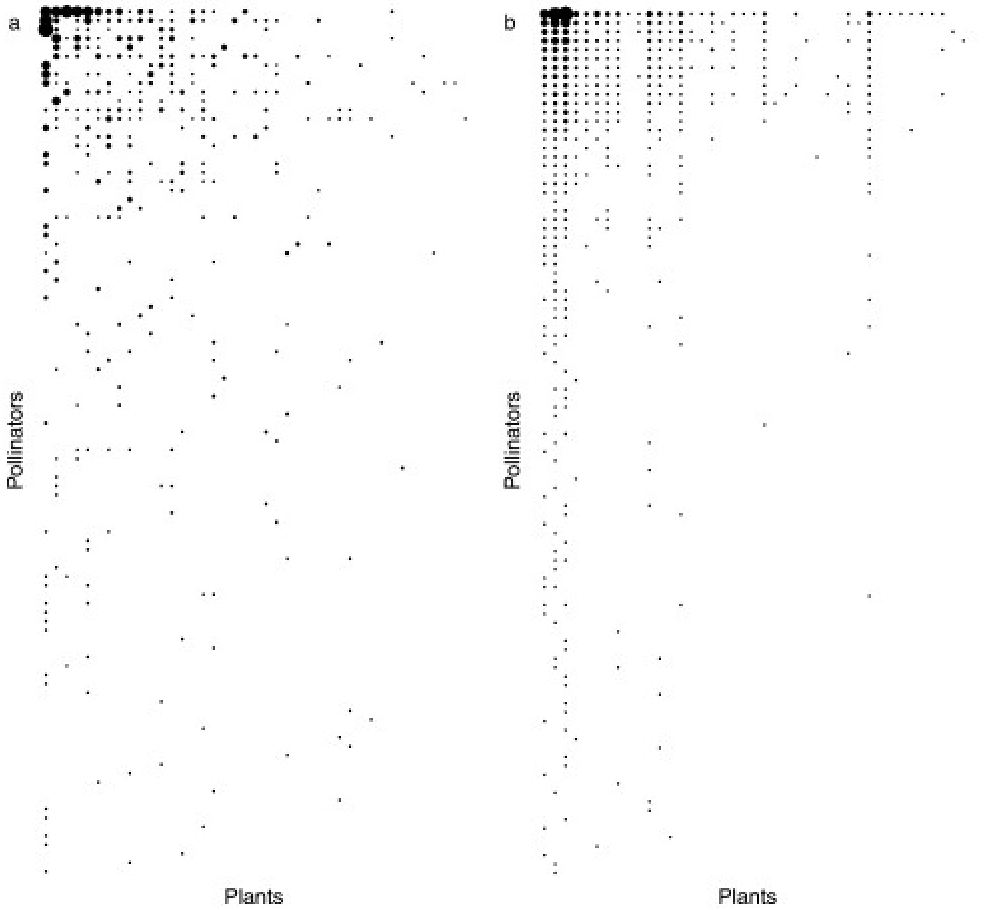


Fig. 1. Plant–pollinator interaction matrices. (a) Observed plant–pollinator matrix in the Monte Desert of Villavicencio Nature Reserve (Mendoza, Argentina). (b) Interaction matrix resulting from one iteration of the randomization algorithm, using the $\overline{\mathbf{NT}}$ probability matrix (resulting from all possible combinations of abundance **N** and temporal overlap **T**) to assign interactions. In each matrix, rows represent pollinator species, columns represent plant species, and circle diameter of a matrix element y_{ij} is proportional to the square root of the number of interactions between pollinator i and plant j.

Oikos 000: 001–009, 2014
doi: 10.1111/oik.014
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Subject Editor: Anna Traveset. Editor-in-Chief: Dries Bonte. Accepted 26 June 20

Species traits and abundances predict metrics of plant–pollinator network structure, but not pairwise interactions

Colin Olito and Jerem

C. Olito (colin.olito@gmail.co
1N4, Canada.

Annual Review of Ecology, Evolution, and Systematics

Identifying Causes of Patterns in Ecological Networks: Opportunities and Limitations

Carsten F. Dormann,[1] Jochen Fründ,[1]
and H. Martin Schaefer[2]

ECOLOGY LETTE

Ecology Letters, (2012)

LETTER

Phenology drives mutualistic network structure and diversity

Francisco Encinas-Viso,[1]* Tomás A. Revilla[2†] and Rampal S. Etienne[1]

PROCEEDINGS OF THE ROYAL SOCIETY B

Processes entangling interactions in communities: forbidden links are more important than abundance in a ngbird – plant network

ntin-Bugoni[1], Pietro Kiyoshi Maruyama[1] and Marlies Sazima[2]

Oikos 120: 1351–1356, 2011
doi: 10.1111/j.1600-0706.2011.19477.x
© 2011 The Authors. Oikos © 2011 Nordic Society Oikos
Subject Editor: Regino Zamora. Accepted 2 February 2011

The relative contribution of abundance and phylogeny to the structure of plant facilitation networks

Miguel Verdú and Alfonso Valiente-Banuet

VOL. 183, NO. 5 THE AMERICAN NATURALIST MAY 2014

Species Abundance, Not Diet Breadth, Drives the Persistence of the Most Linked Pollinators as Plant-Pollinator Networks Disassemble

Rachael Winfree,[1,*] Neal M. Williams,[2] Jonathan Dushoff,[3] and Claire Kremen[4]

¿Complejidad predecible?

- Las interacciones planta-polinizador están determinadas por los caracteres fenotípicos de las especies, su historia filogenética, su distribución espacio-temporal, y una buena cuota de azar (neutralidad).

Esquema de la charla

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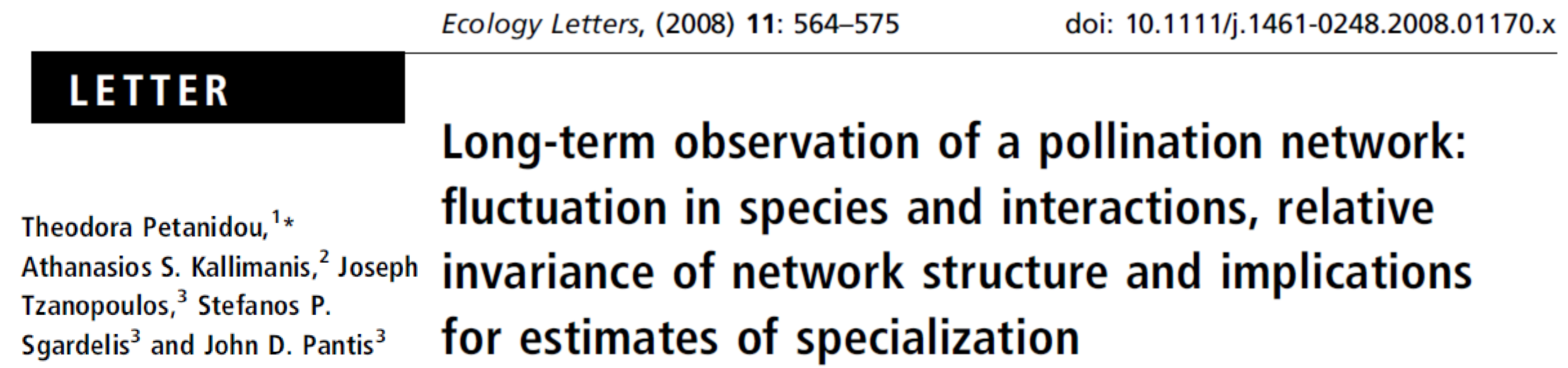
4. ¿Establilidad espacio-temporal?

5. ¿Coevolución?

> *We may perhaps regard the organisms, both plants and animals, occupying any given habitat, as woven into a complex but unstable web of life. The character of the web may change as new organisms appear on the scene and old ones disappear during the phases of succession, but the web itself remains.*
>
> R. Yapp (1922, *Ecology* 10: p. 11)



Ecology Letters, (2008) **11**: 564–575 doi: 10.1111/j.1461-0248.2008.01170.x

LETTER

Long-term observation of a pollination network: fluctuation in species and interactions, relative invariance of network structure and implications for estimates of specialization

Theodora Petanidou,[1]* Athanasios S. Kallimanis,[2] Joseph Tzanopoulos,[3] Stefanos P. Sgardelis[3] and John D. Pantis[3]

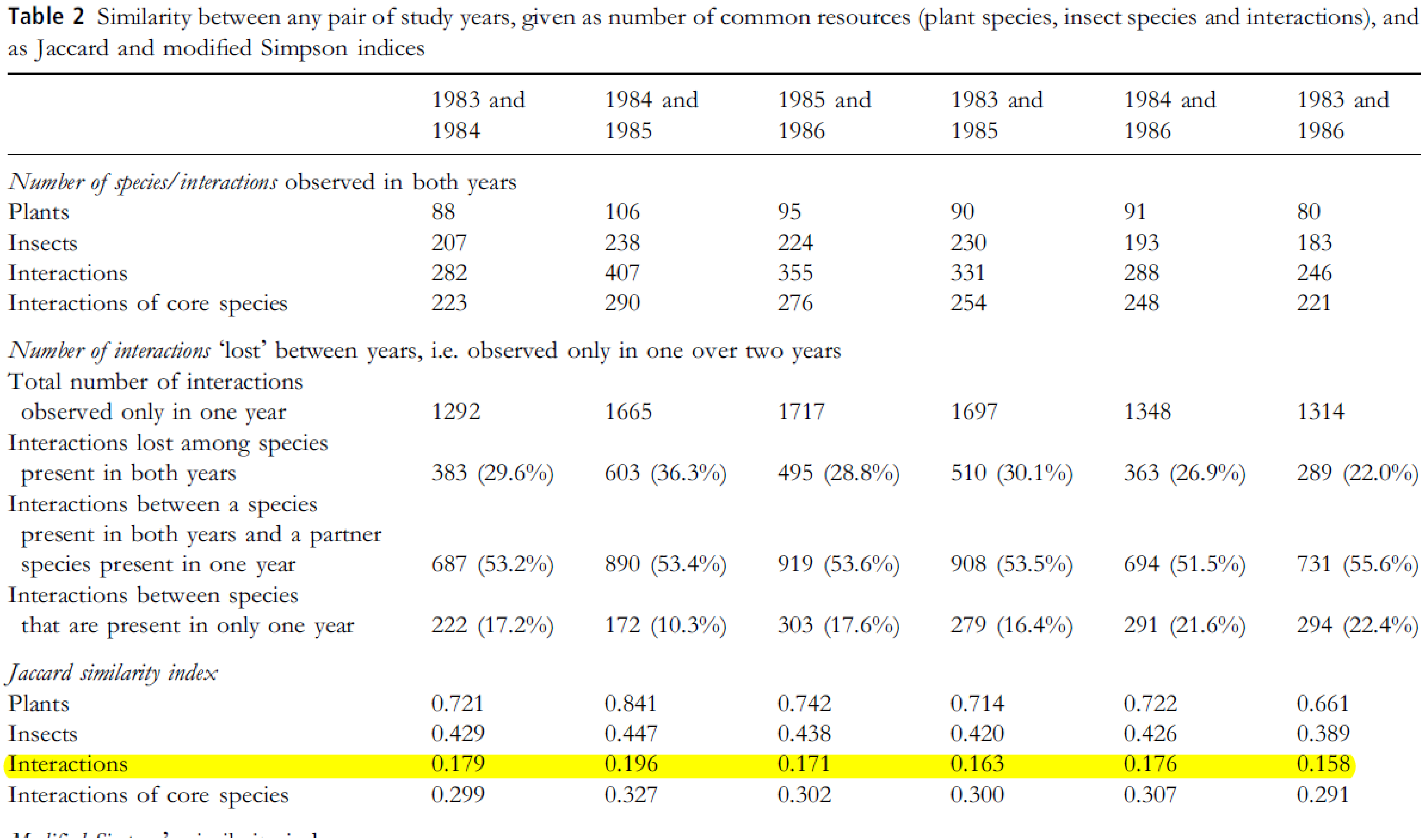


Table 2 Similarity between any pair of study years, given as number of common resources (plant species, insect species and interactions), and as Jaccard and modified Simpson indices

	1983 and 1984	1984 and 1985	1985 and 1986	1983 and 1985	1984 and 1986	1983 and 1986
Number of species/interactions observed in both years						
Plants	88	106	95	90	91	80
Insects	207	238	224	230	193	183
Interactions	282	407	355	331	288	246
Interactions of core species	223	290	276	254	248	221
Number of interactions 'lost' between years, i.e. observed only in one over two years						
Total number of interactions observed only in one year	1292	1665	1717	1697	1348	1314
Interactions lost among species present in both years	383 (29.6%)	603 (36.3%)	495 (28.8%)	510 (30.1%)	363 (26.9%)	289 (22.0%)
Interactions between a species present in both years and a partner species present in one year	687 (53.2%)	890 (53.4%)	919 (53.6%)	908 (53.5%)	694 (51.5%)	731 (55.6%)
Interactions between species that are present in only one year	222 (17.2%)	172 (10.3%)	303 (17.6%)	279 (16.4%)	291 (21.6%)	294 (22.4%)
Jaccard similarity index						
Plants	0.721	0.841	0.742	0.714	0.722	0.661
Insects	0.429	0.447	0.438	0.420	0.426	0.389
Interactions	0.179	0.196	0.171	0.163	0.176	0.158
Interactions of core species	0.299	0.327	0.302	0.300	0.307	0.291

Red planta-polinizador de Villavicencio

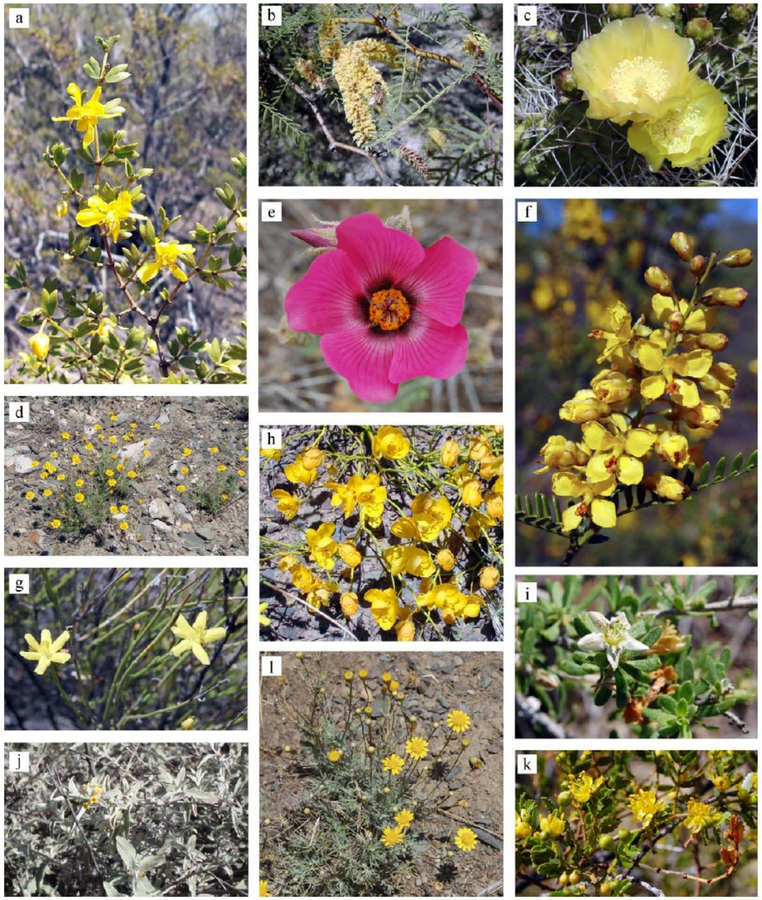
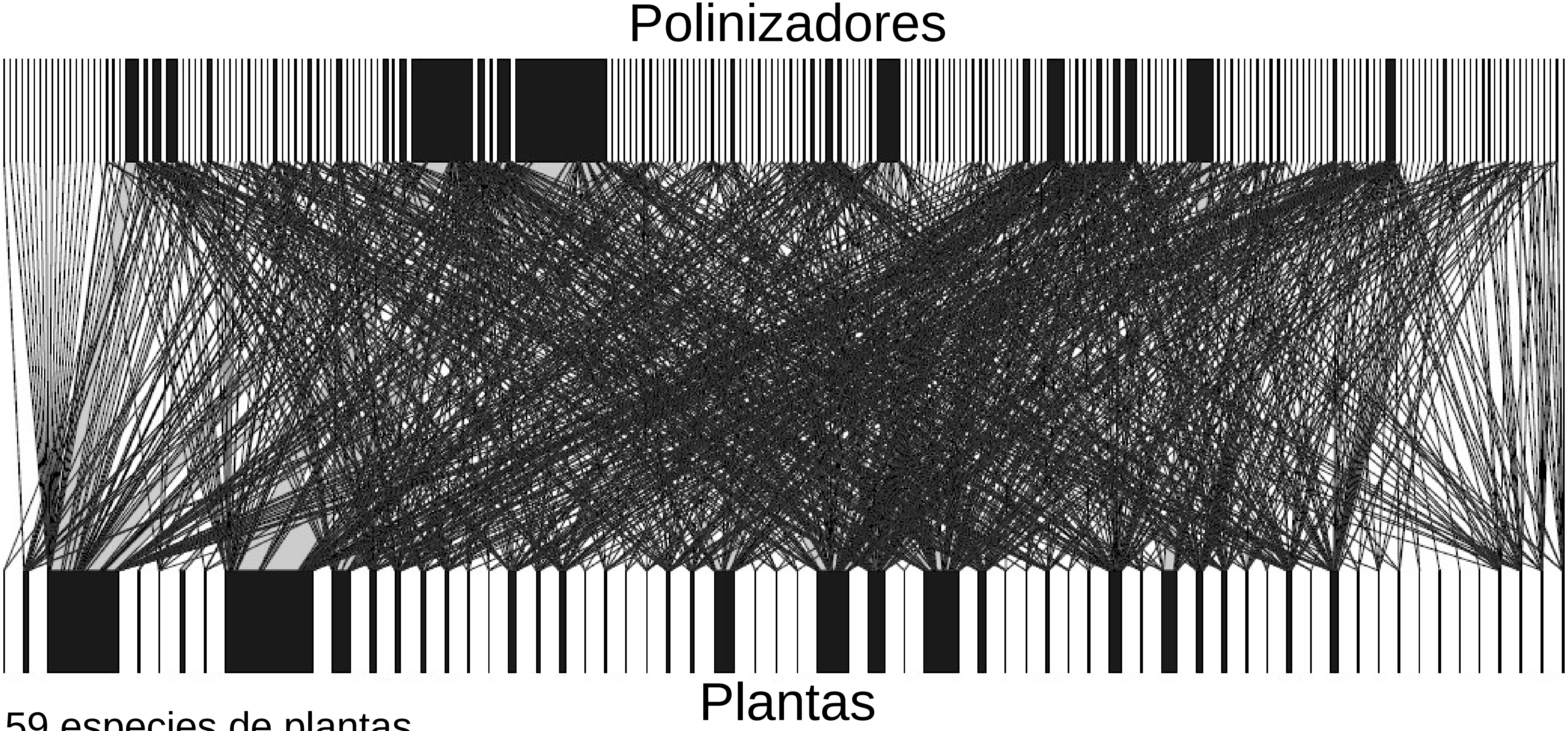



Plate 1. Representative plant–pollinator interactions in the Monte Desert of Villavicencio, Argentina. Clockwise from upper

Vázquez, Chacoff, Cagnolo (2009) Ecology 90: 2039-2046
Chacoff et al. (2012) J An Ecol 81: 190-200
Vázquez et al. (2012) Ecology 93: 719-725
Chacoff, Resasco, Vázquez (2018) Ecology 99: 21-28

4. ¿Estabilidad espacio-temporal?

Red acumulada (6 años)



59 especies de plantas
196 especies de visitantes florales
28015 visitas
1050 interacciones interespecíficas (links)

Vázquez, Chacoff, Cagnolo (2009) Ecology 90: 2039-2046
Chacoff et al. (2012) J An Ecol 81: 190-200
Vázquez et al. (2012) Ecology 93: 719-725
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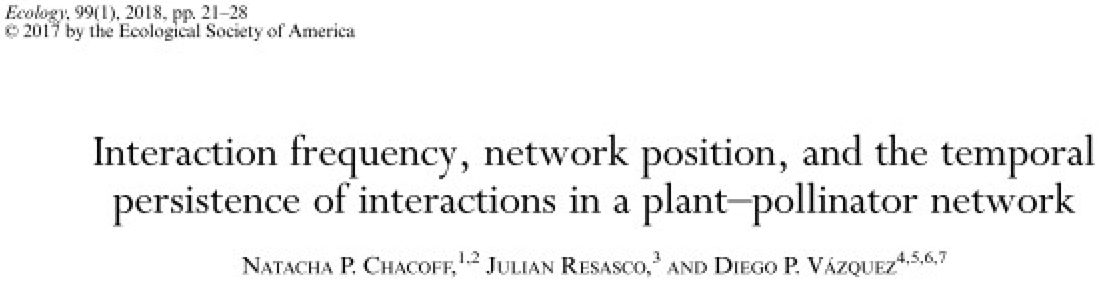
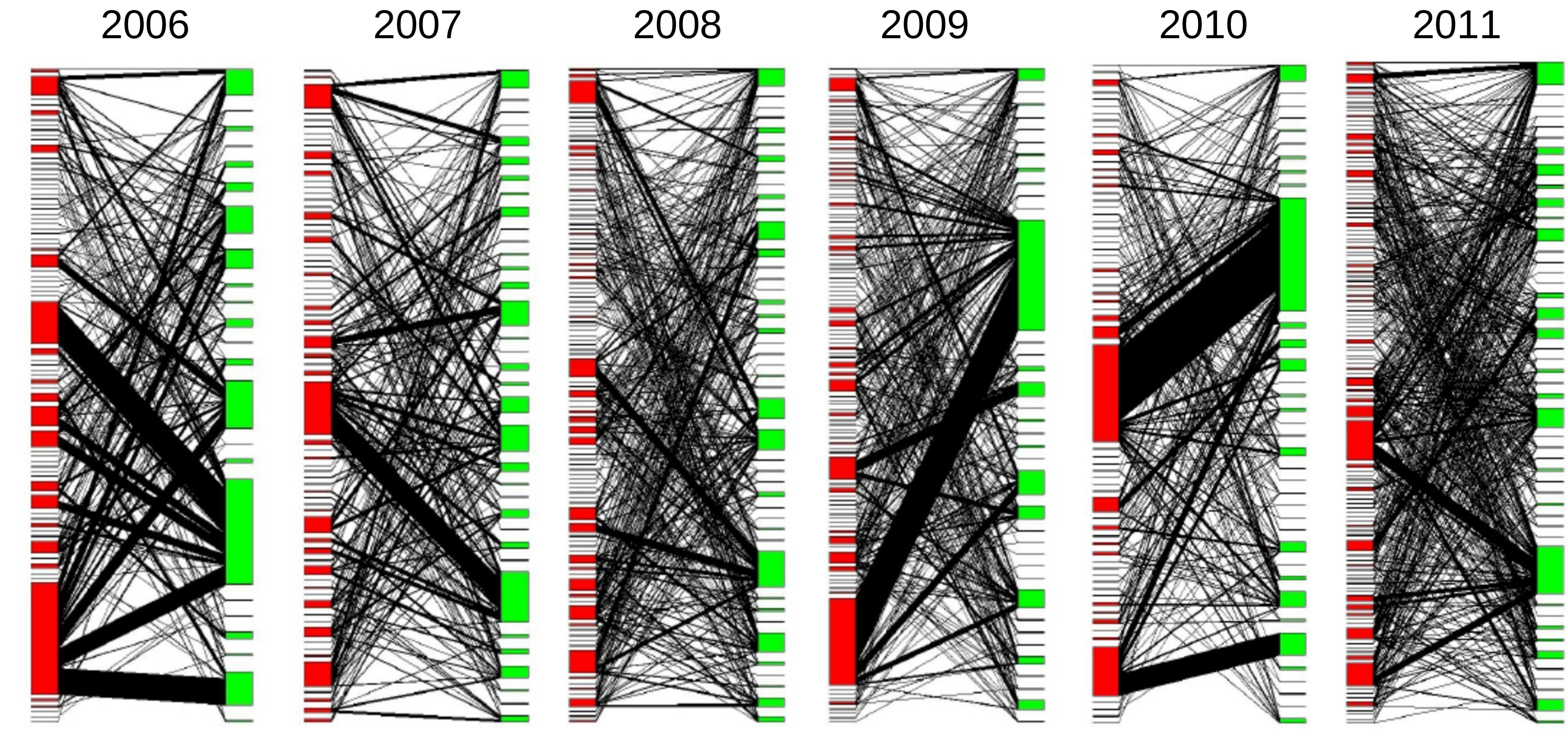


Ecology, 99(1), 2018, pp. 21–28

Interaction frequency, network position, and the temporal persistence of interactions in a plant–pollinator network

Natacha P. Chacoff,[1,2] Julian Resasco,[3] and Diego P. Vázquez[4,5,6,7]



4. ¿Estabilidad espacio-temporal?

Natacha Chacoff

Julian Resasco

Ecology, 99(1), 2018, pp. 21–28

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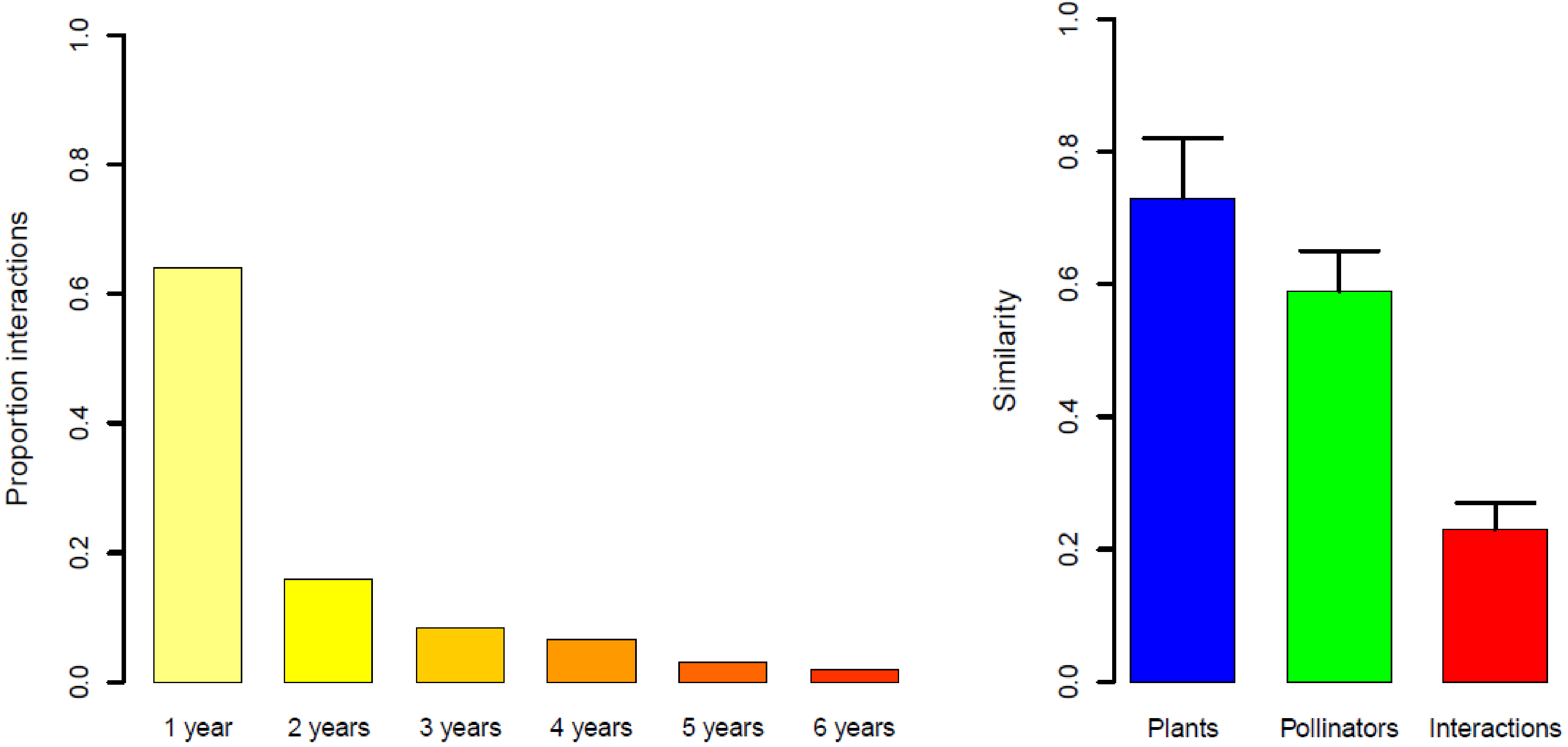
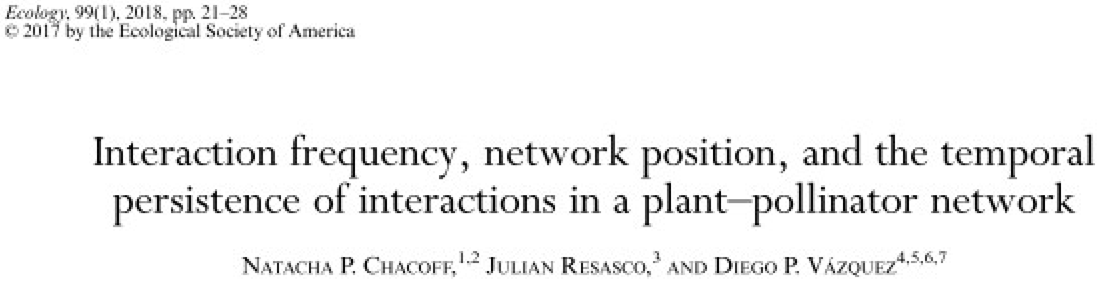


4. ¿Estabilidad espacio-temporal?



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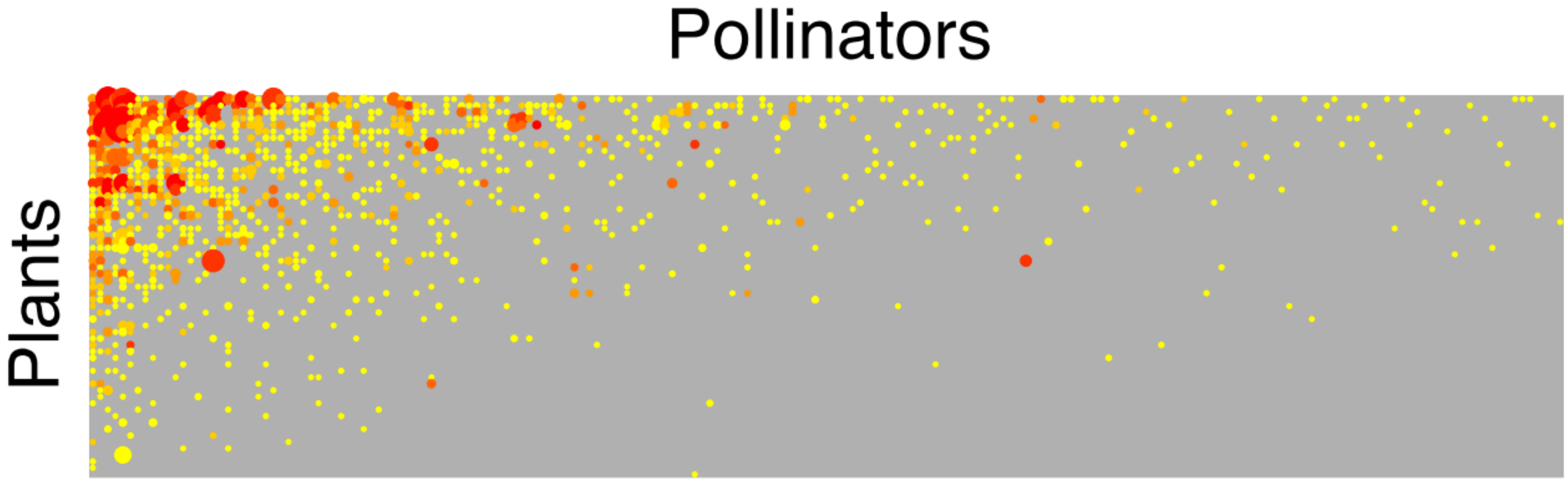
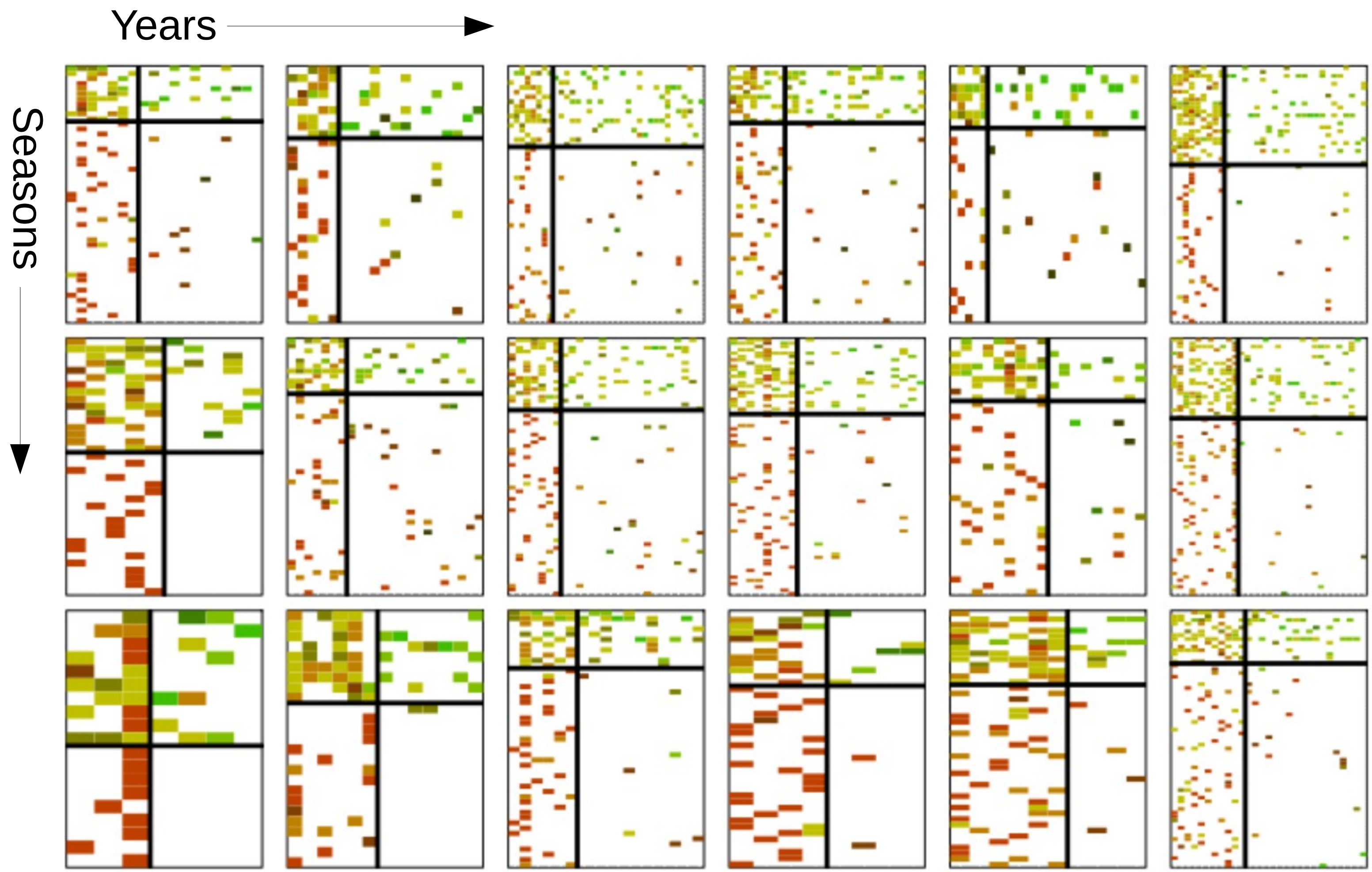


4. ¿Estabilidad espacio-temporal?



Vincent Miele

Rodrigo Ramos-Jiliberto

Miele, Ramos-Jiliberto, Vázquez, ms. no publicado

¿Estabilidad espacio-temporal?

- Las redes planta-polinizador son altamente dinámicas.
- La persistencia temporal (y espacial) de las interacciones es mayor en el núcleo de la red que en la periferia.
- Pero aun las interacciones del núcleo son periféricas en algún momento.

Esquema de la charla

0. Introducción: Interacciones planta-polinizador para dummies

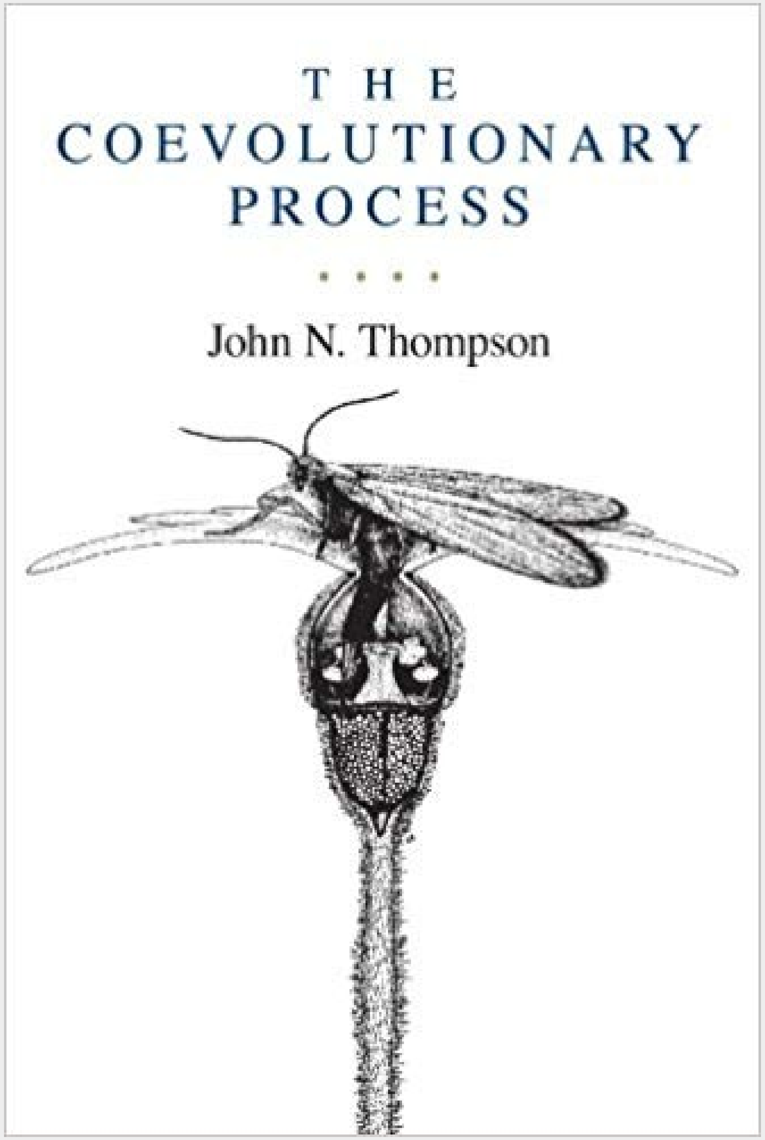
1. ¿Especialización recíproca?

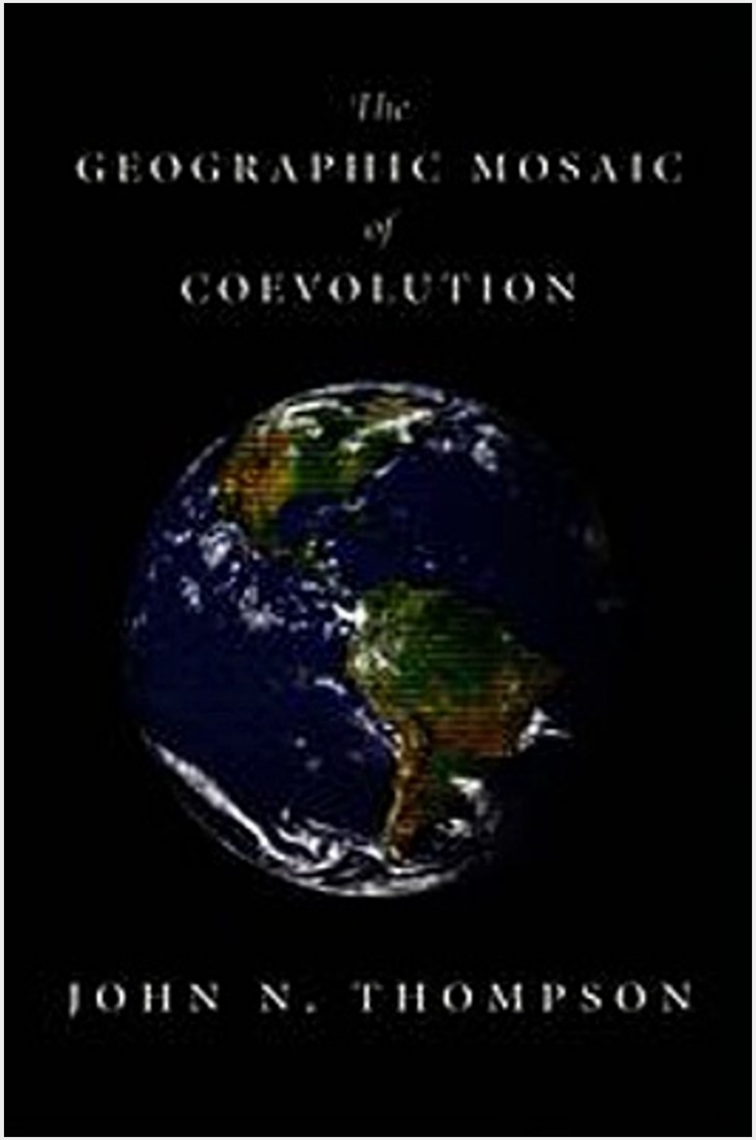
2. ¿Beneficio mutuo?

3. ¿Complejidad predecible?

4. ¿Establilidad espacio-temporal?

5. ¿Coevolución?

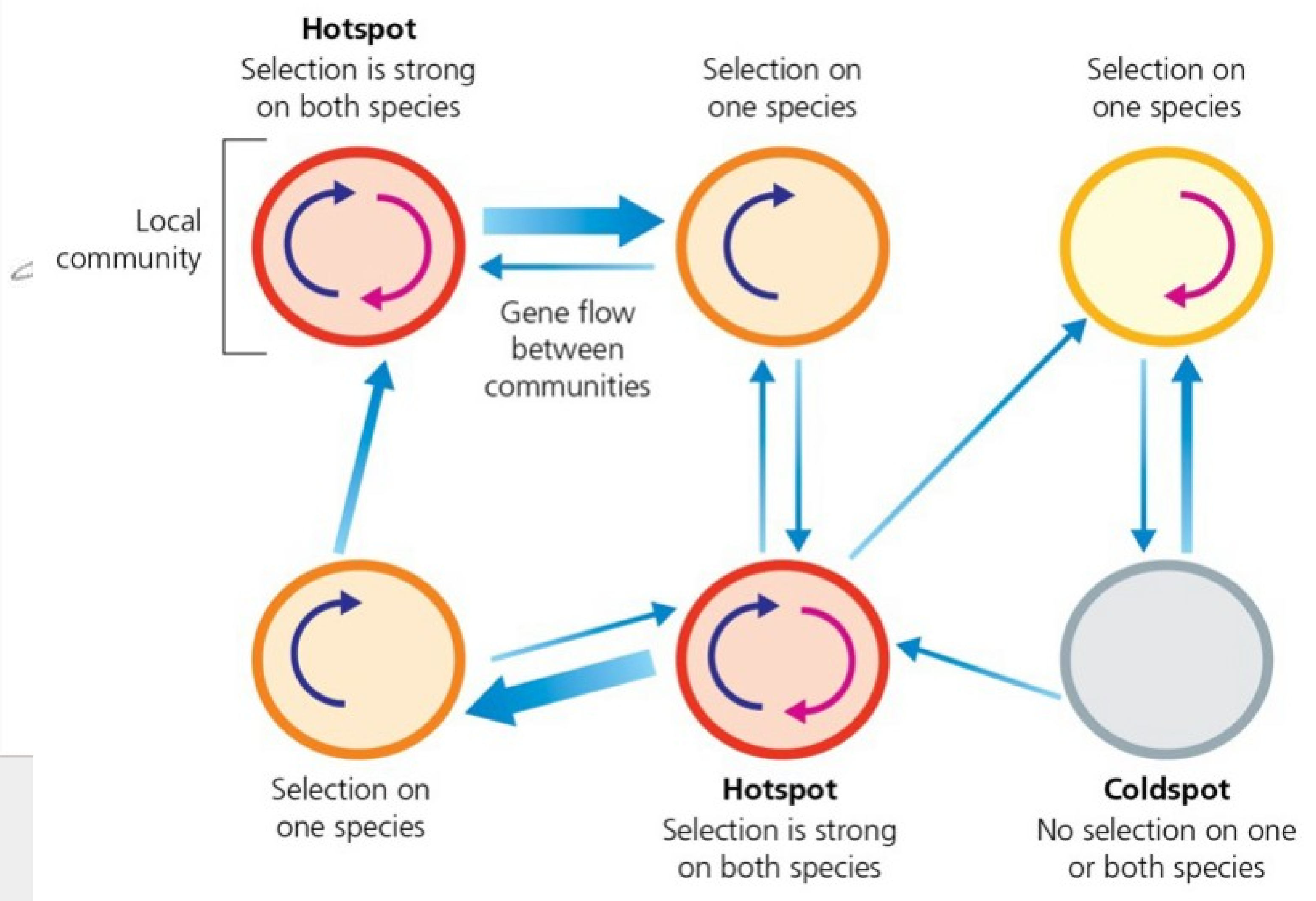




5. ¿Coevolución?

THE
COEVOLUTIONARY
PROCESS

The
GEOGRAPHIC MOSAIC
of



Hotspot
Selection is strong on both species

Selection on one species

Selection on one species

Local community

Gene flow between communities

Selection on one species

Hotspot
Selection is strong on both species

Coldspot
No selection on one or both species

Oikos
00: 1–15, 2019
doi: 10.1111/oik.05960

Inferring coevolution in a plant–pollinator network

Silvia B. Lomáscolo, Norberto Giannini, Natacha P. Chacoff, Rocío Castro-Urgal and Diego P. Vázquez

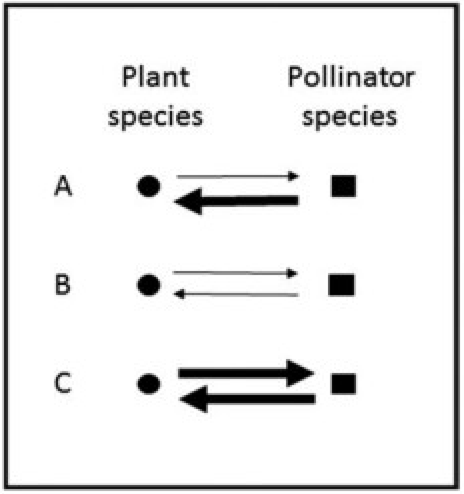
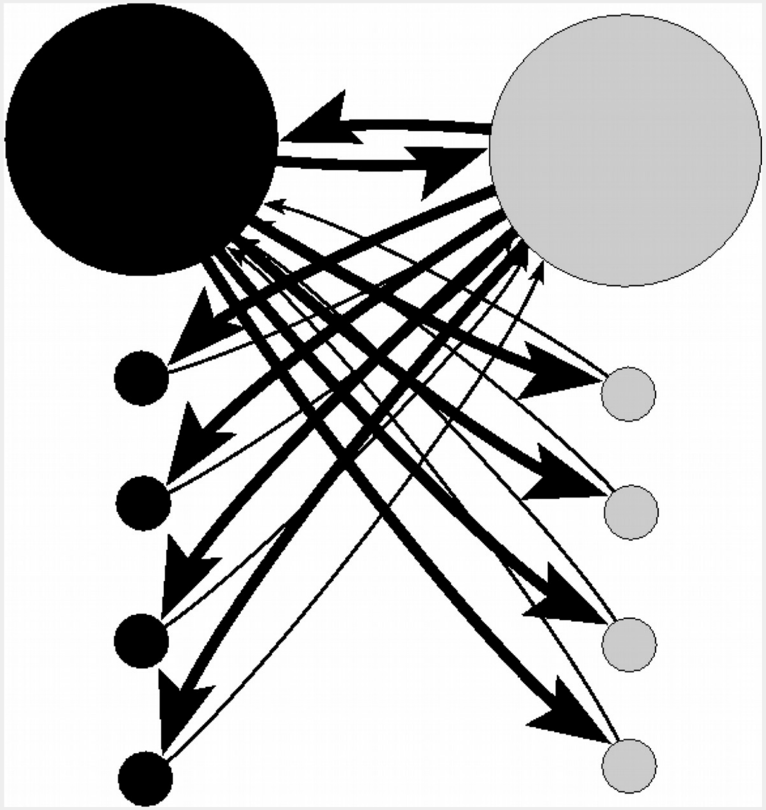


Figure 1. Illustration of symmetry of interaction strength. Circles represent plant species, while squares represent pollinator species that interact with them. This figure only represents the detail of pairwise interactions, but it should be understood that each of these hypothetical species interact with many other hypothetical species. All interactions with other species are not drawn for simplification. Arrows represent the effect of one interactor on the other, measured as the proportion of visits represented by that species to the other, also called interaction strength. The thickness of the arrow is proportional to the strength of the interaction. In the first pair, (A) the interaction is asymmetric, as the thickness of both arrows is different. In the second pair, (B) the interaction is symmetrically weak, as interaction strength is similar for both species, but its low. That means that these species mostly interact with other species, yet, the reciprocal effect is similar. In the third pair, (C) the interaction is symmetrically strong, which means that both interaction partners represent a similarly high proportion of all visits of the other partner.



Silvia Lomáscolo

5. ¿Coevolución?

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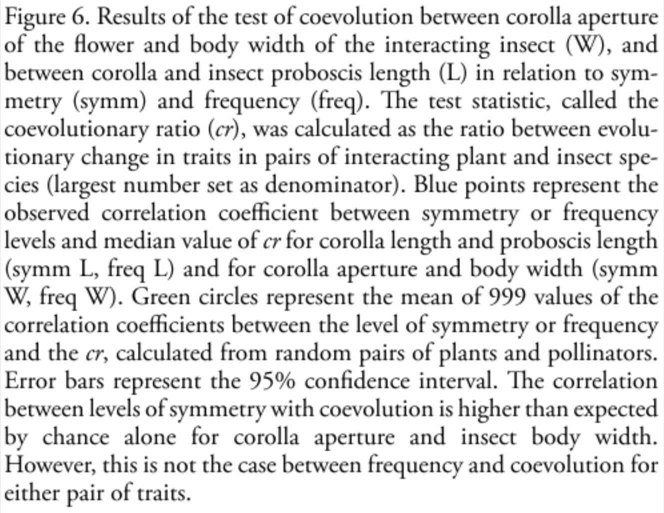
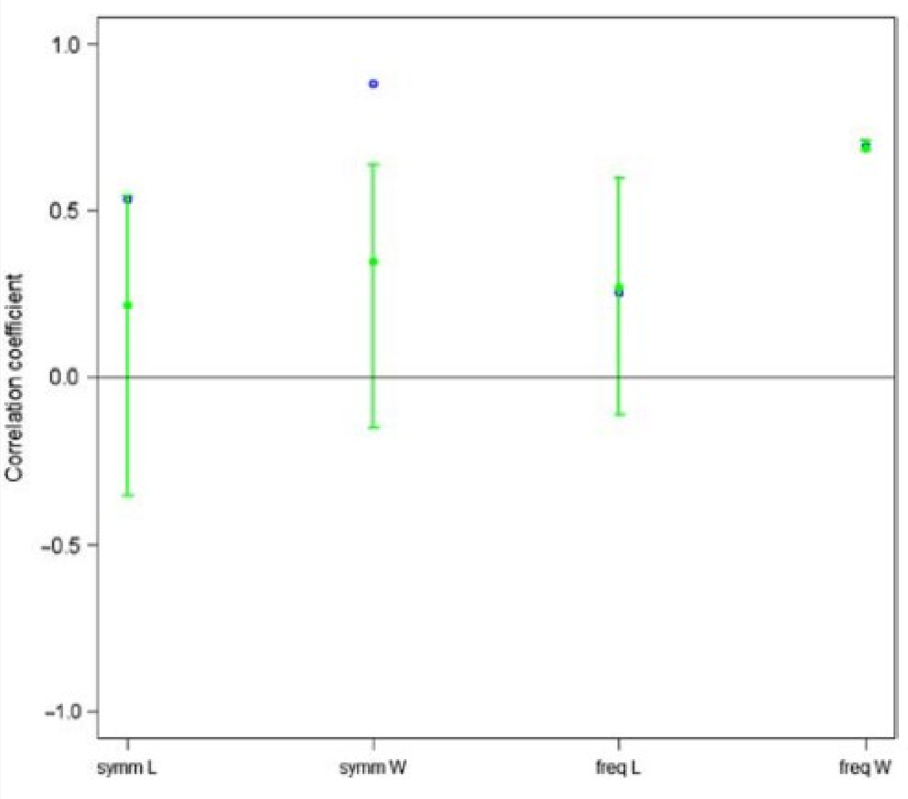


Figure 6. Results of the test of coevolution between corolla aperture of the flower and body width of the interacting insect (W), and between corolla and insect proboscis length (L) in relation to symmetry (symm) and frequency (freq). The test statistic, called the coevolutionary ratio (*cr*), was calculated as the ratio between evolutionary change in traits in pairs of interacting plant and insect species (largest number set as denominator). Blue points represent the observed correlation coefficient between symmetry or frequency levels and median value of *cr* for corolla length and proboscis length (symm L, freq L) and for corolla aperture and body width (symm W, freq W). Green circles represent the mean of 999 values of the correlation coefficients between the level of symmetry or frequency and the *cr*, calculated from random pairs of plants and pollinators. Error bars represent the 95% confidence interval. The correlation between levels of symmetry with coevolution is higher than expected by chance alone for corolla aperture and insect body width. However, this is not the case between frequency and coevolution for either pair of traits.



5. ¿Coevolución?

¿Coevolución?

- Nuestros resultados sugieren que la especialización recíproca no es una condición indispensable para la coevolución.
- Este proceso puede ocurrir entre especies con cuyas fuerzas de interacción recíprocas son de magnitudes similares.

Ursus Wehrli: *Kunst Aufräumen* (*El arte de ordenar*)

Push Lawnmower, 1970s

Suffolk
Component count: 92

L - 99

Todd McLellan: *Things come apart*

Un Mundo De Preguntas

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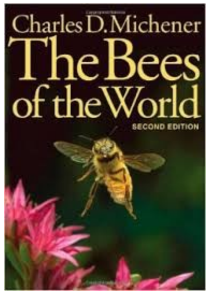
Erica Stevani
Nydia Vitale



Charles D. Michener
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Interacciones Ecológicas

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