

O continuum antagonismo-mutualismo nas interações inseto-planta: aspectos ecológicos e evolutivos

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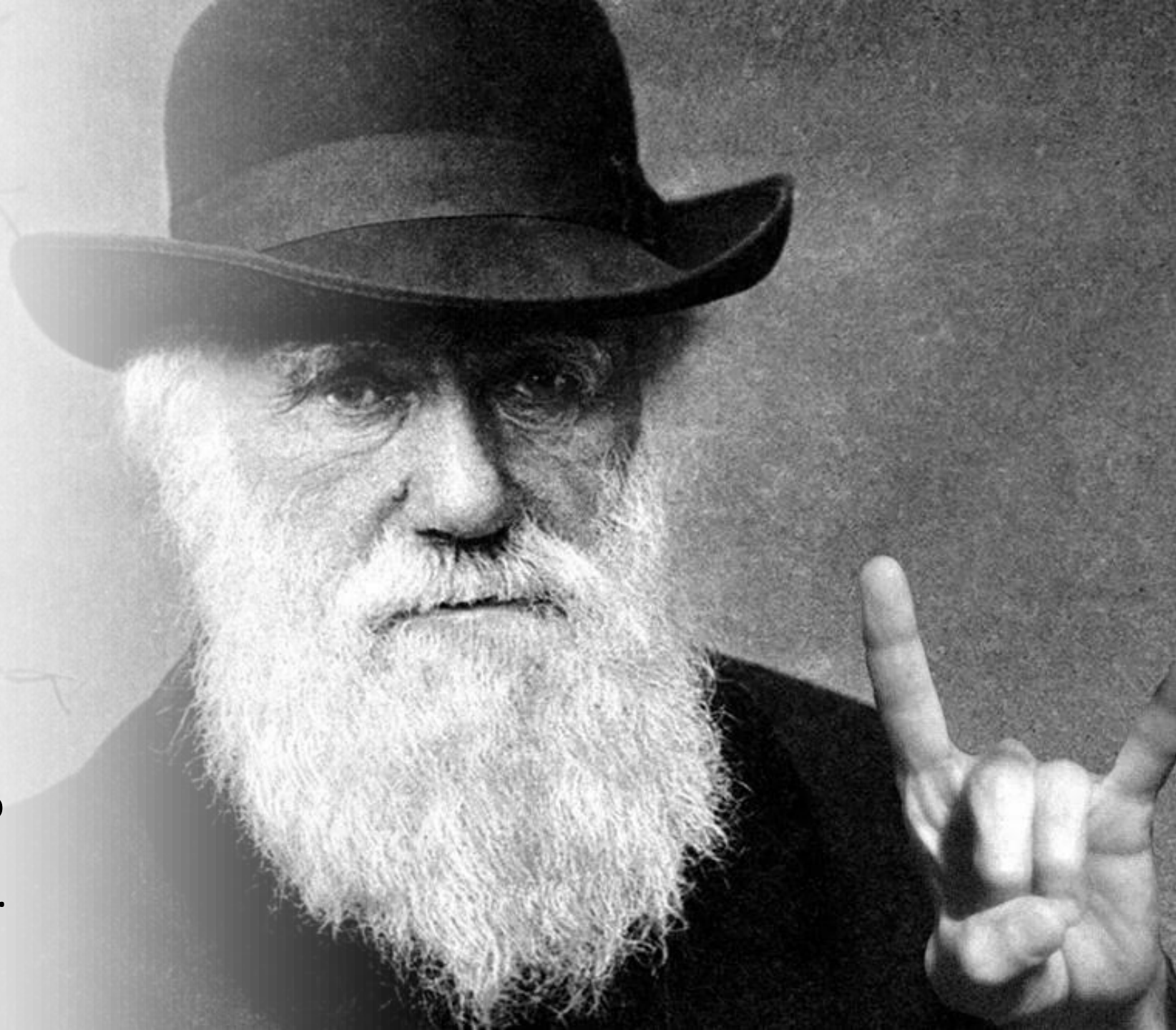


Objetivos da aula

- Entender o que são mutualismos através de exemplos
- Entender como mutualismos podem oscilar para antagonismos e vice-versa
- Entender o papel de outras interações sobre o resultado de interações mutualísticas

Nos tempos de Darwin e um pouco depois...

- Darwin trata da luta (“struggle”) pela sobrevivência.
- Livro sobre polinização de orquídeas por insetos
- Mais enfoque na competição e outros antagonismos: florescimento do liberalismo.

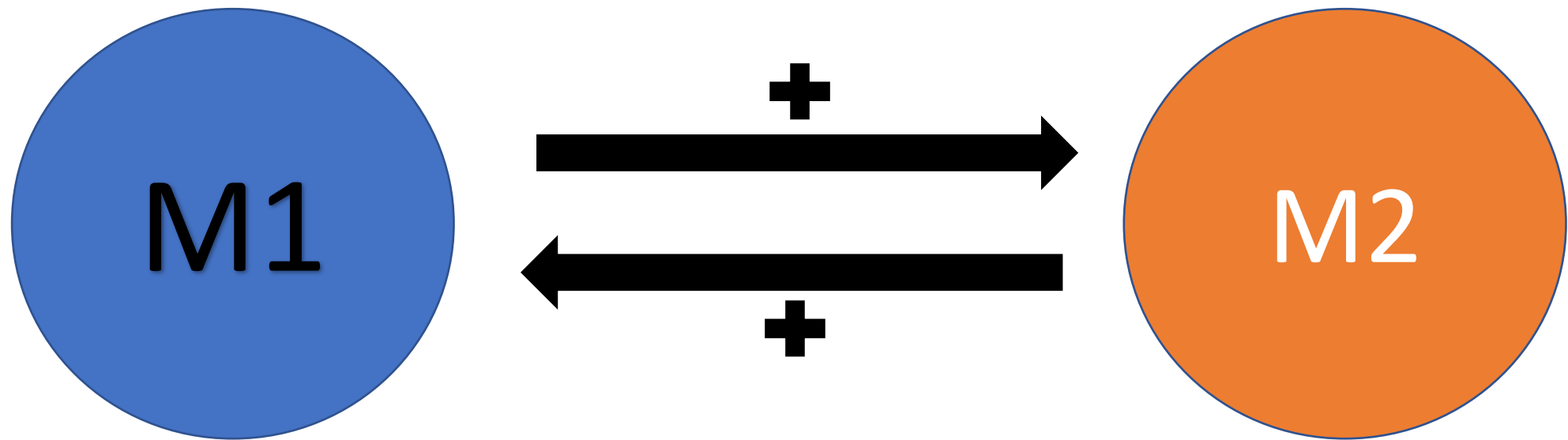


Piotr Kropotsky

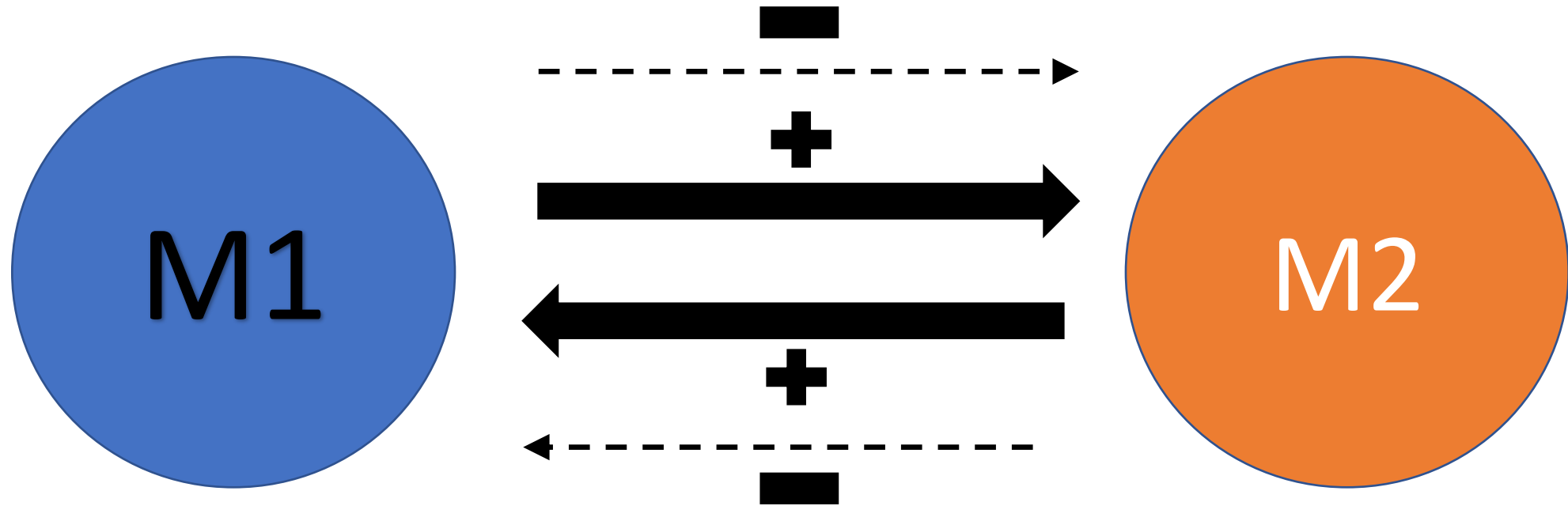
- Mutual Aid:
a Factor of Evolution
- Primeiras divergências
sobre a importância dos
antagonismos



Definição de mutualismo



GOOD
VIBES
ONLY



Muitos mutualismos têm um componente antagonista:
A interação tem benefícios, mas também traz custos

“Parasitismo recíproco” (Daniel Janzen)

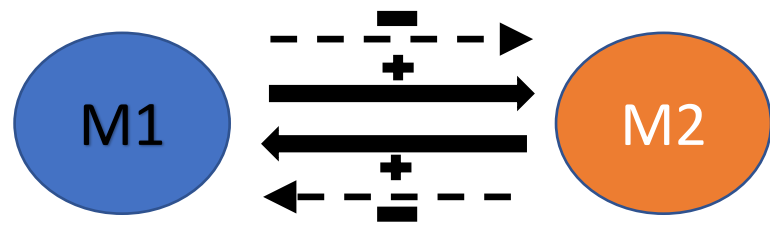
“Exploração mútua” (outros autores)

Interações entre interações

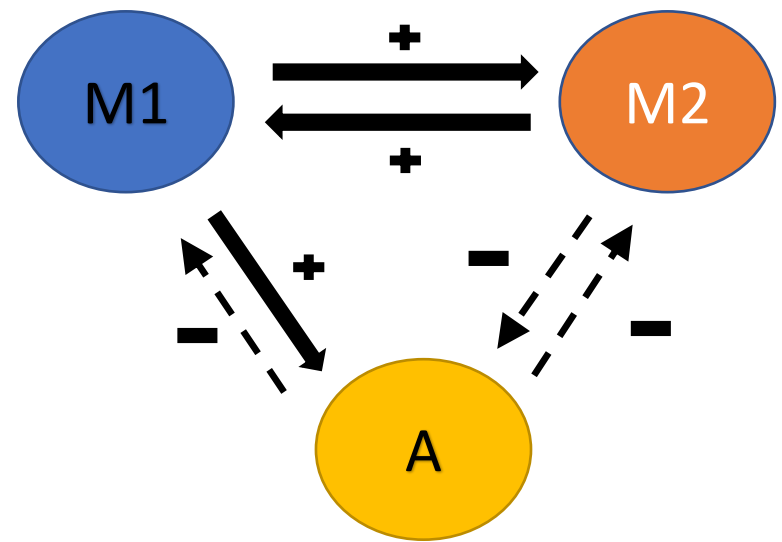
- Relações predação-mutualismo raramente exploradas
- 4 caminhos nos quais diferentes interações animais-plantas interagem entre si e são interpostas

Interações entre interações

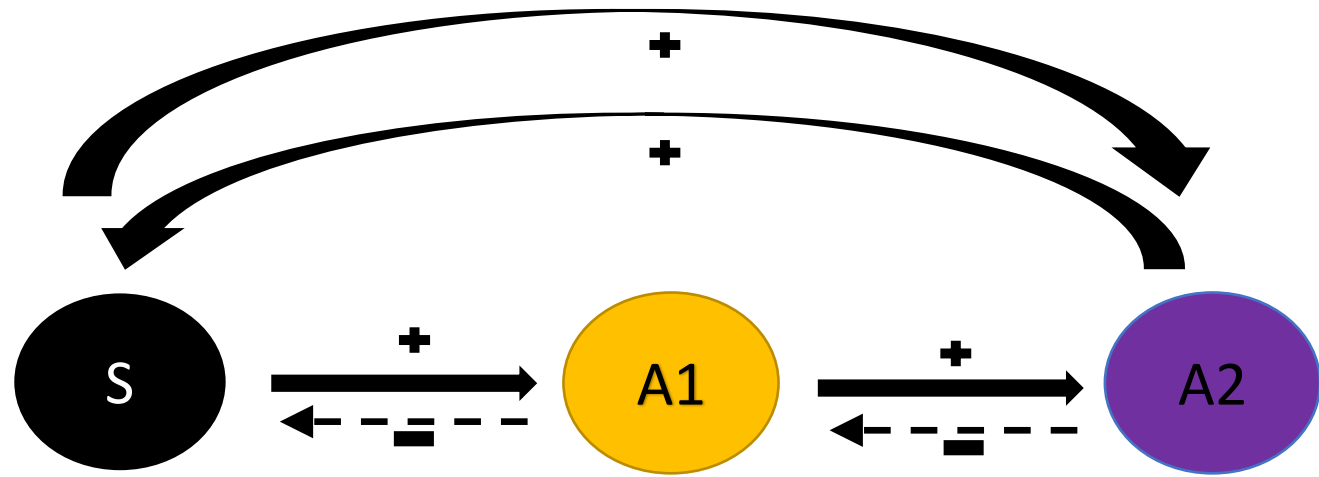
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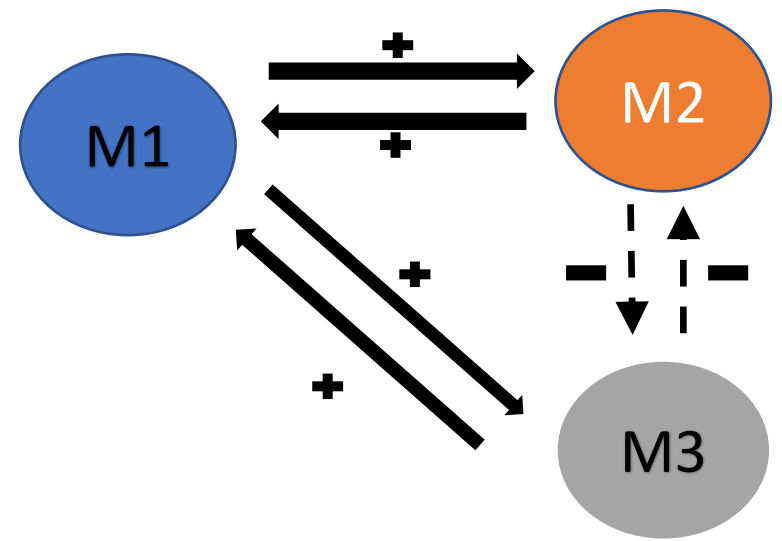
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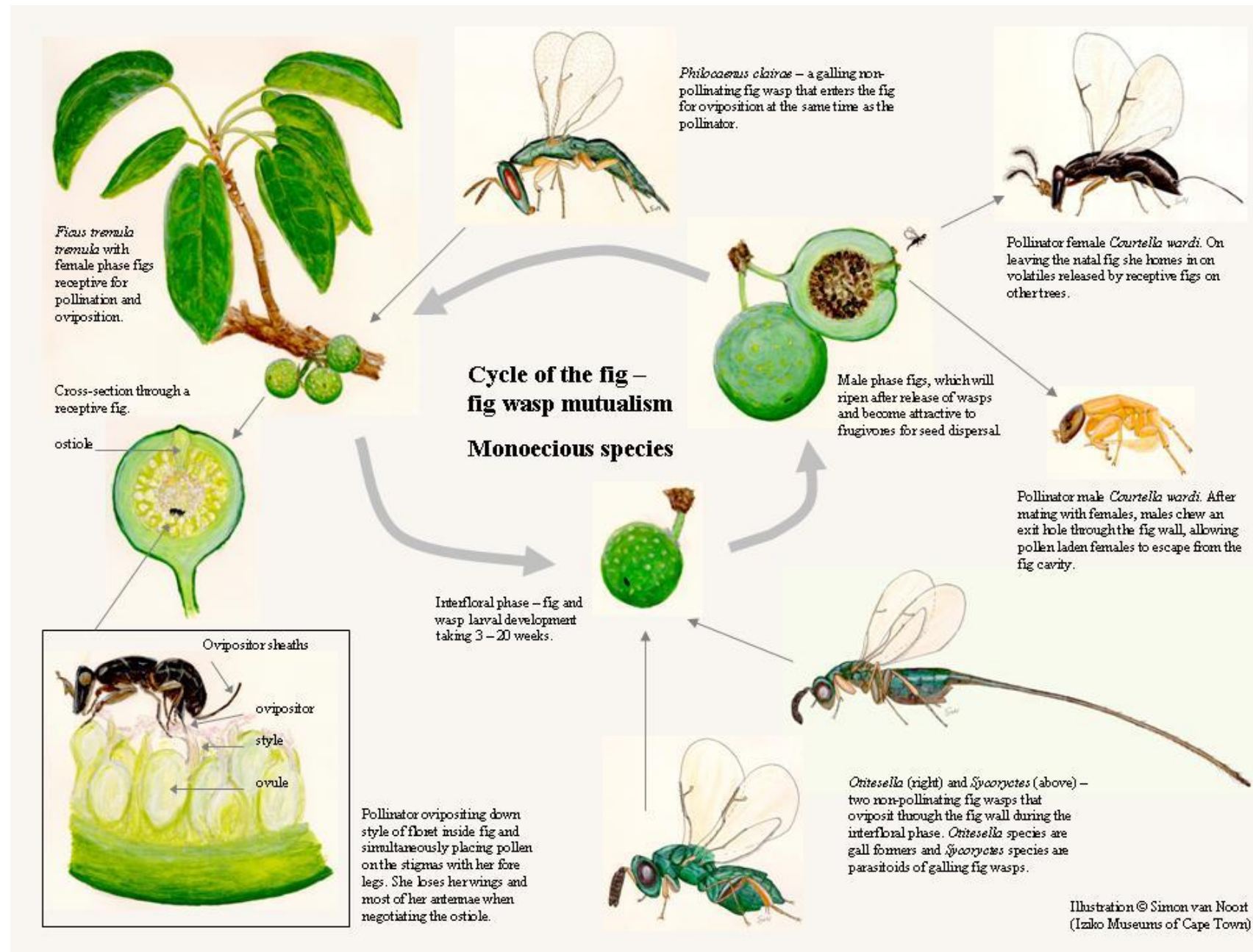
Mutualismos muitas vezes atraem antagonistas

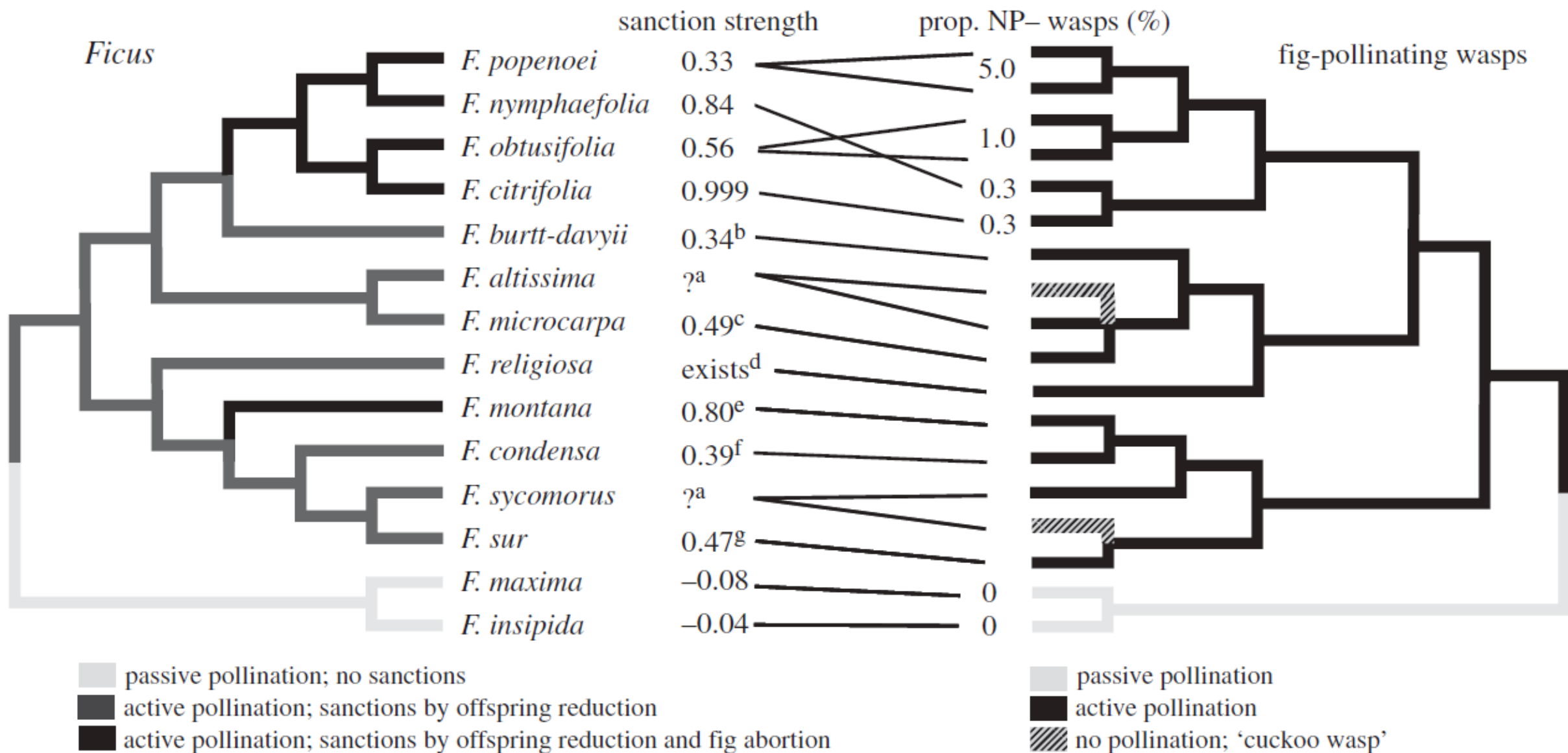
Tres tipos de antagonismos podem ser encontrados dentro de mutualismos:

1. Espécies exploradoras
2. Orquídeas enganadoras
3. Exploradoras condicionais



1. Espécies exploradoras





A close-up photograph of several pink orchids with delicate, veined petals and some buds on a dark stem. The background is a soft, out-of-focus white.

2. Orquídeas enganadoras

Orchidaceae



[Published: 05 October 2015](#)

Faecal mimicry by seeds ensures dispersal by dung beetles

[Jeremy J. Midgley](#) , [Joseph D. M. White](#), [Steven D. Johnson](#) & [Gary N. Bronner](#)

[Nature Plants](#) **1**, Article number: 15141 (2015) | [Cite this article](#)

6462 Accesses | **36** Citations | **424** Altmetric | [Metrics](#)



The real
thing



The
trickster



The
dupe



Stapelia
spp.

3. Exploradoras condicionais



Sophora



Andira



Swartzia



Schizolobium



Schizolobium



Senna

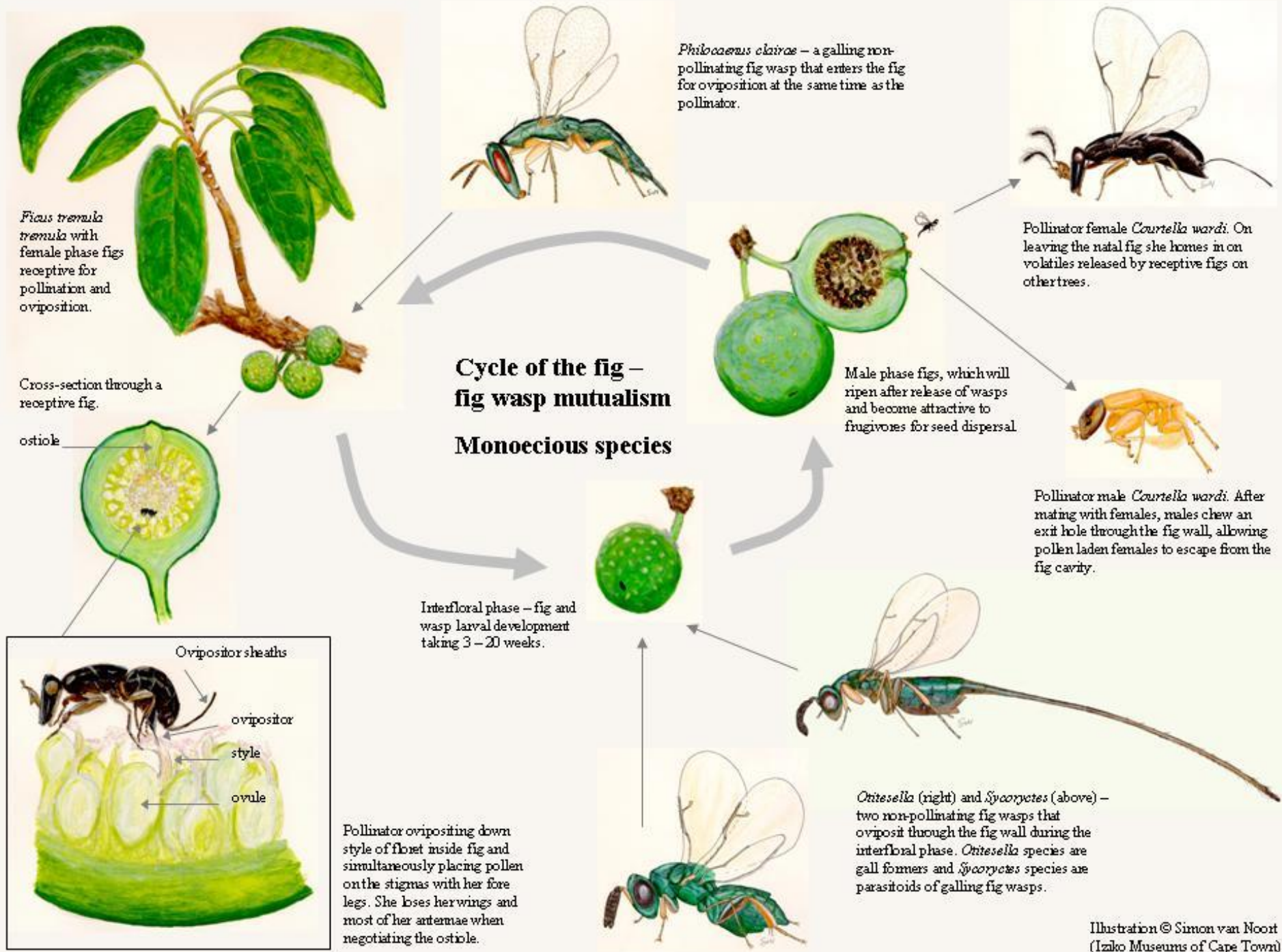
- Plantas e abelhas podem apenas explorar recursos
- Contexto-dependente
- Variação intraespecífica e intraindividual



Quando herbivoria
& polinização
fazem as pazes (??)

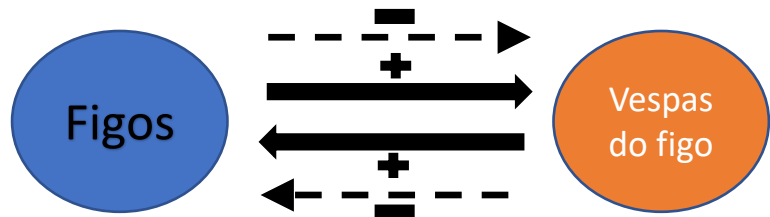
Sistemas de polinização
de berçário



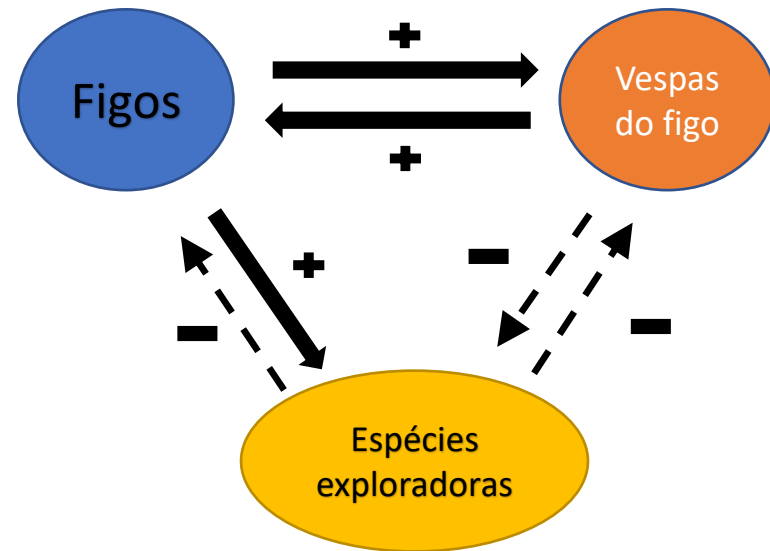


How to be a fig

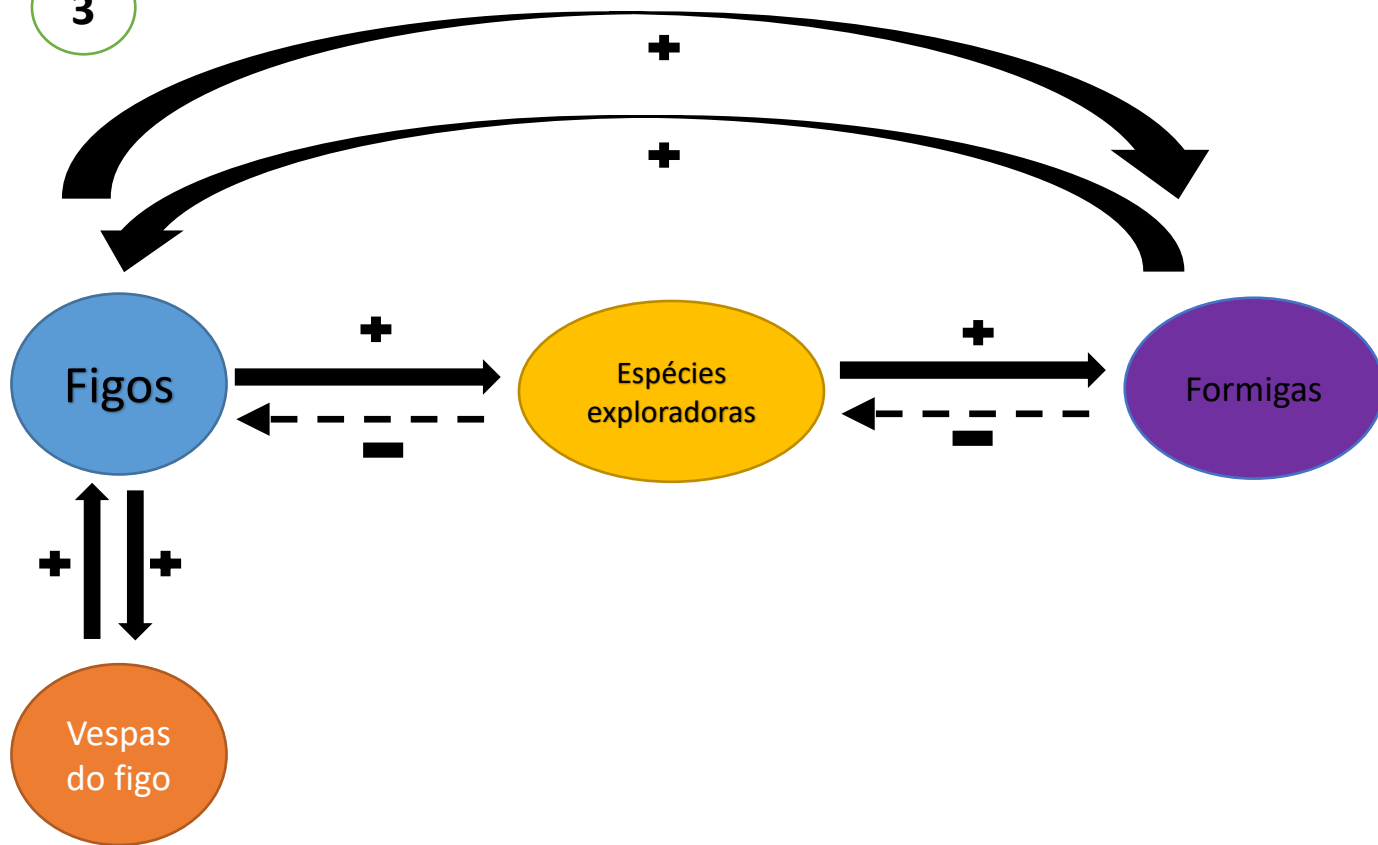
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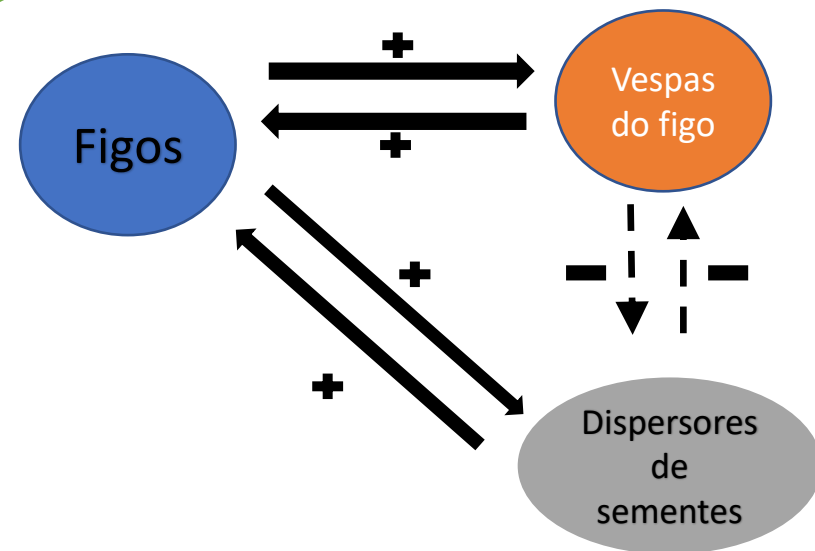
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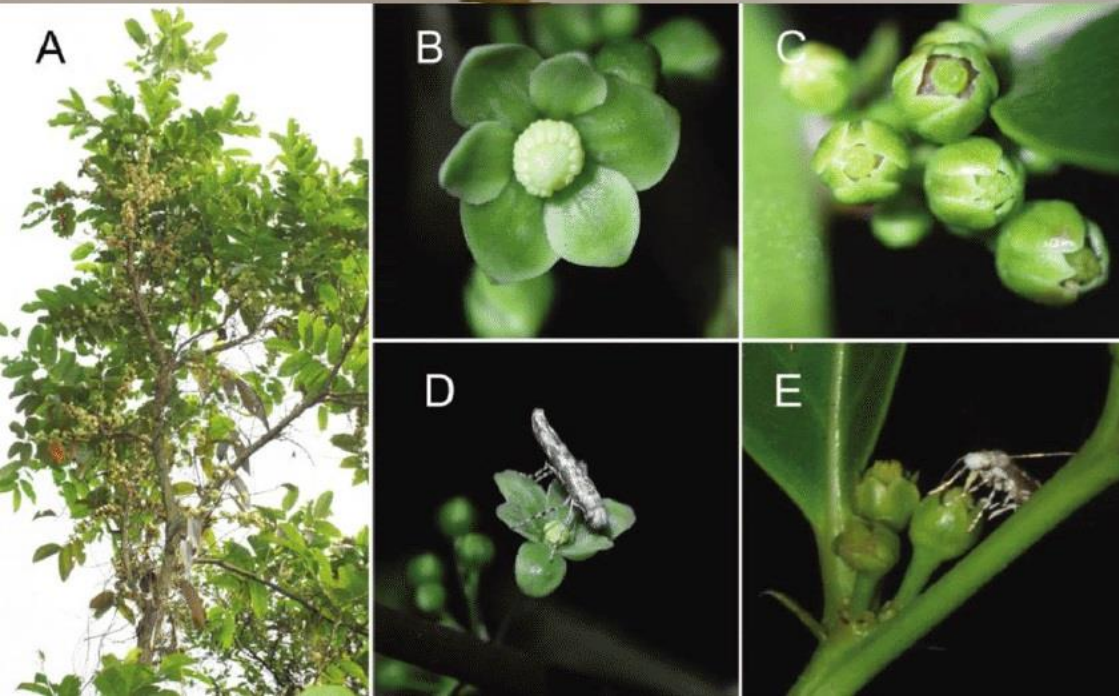


4



Outros
sistemas





Árvore *Glochidion lanceolarium*
(Phyllanthaceae) e mariposa
polinizadora *Epicephala lanceolaria*

Sanções da planta hospedeira

Host sanctions and pollinator cheating in the fig tree–fig wasp mutualism

K. Charlotte Jandér^{1,2,3,*} and Edward Allen Herre²

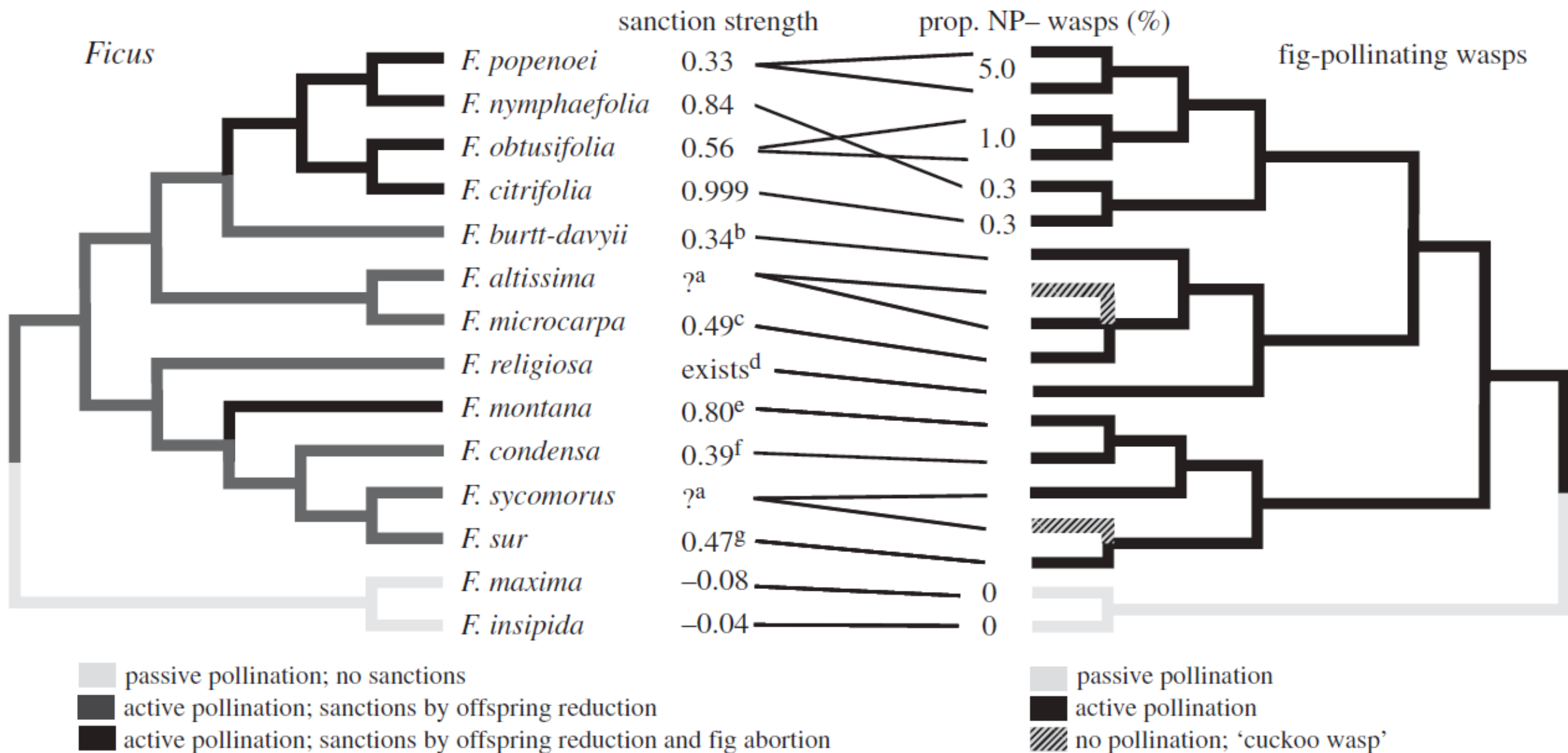
¹*Department of Neurobiology and Behavior, Cornell University, Ithaca, NY 14853, USA*

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³*Department of Animal Ecology, Evolutionary Biology Centre, Uppsala University, 752 36 Uppsala, Sweden*

Theory predicts that mutualisms should be vulnerable to invasion by cheaters, yet mutualistic interactions are both ancient and diverse. What prevents one partner from reaping the benefits of the interaction without paying the costs? Using field experiments and observations, we examined factors affecting mutualism stability in six fig tree–fig wasp species pairs. We experimentally compared the fitness of wasps that did or did not perform their most basic mutualistic service, pollination. We found host sanctions that reduced the fitness of non-pollinating wasps in all derived, actively pollinated fig species (where wasps expend time and energy pollinating), but not in the basal, passively pollinated fig species (where wasps do not). We further screened natural populations of pollinators for wasp individuals that did not carry pollen (‘cheaters’). Pollen-free wasps occurred only in actively pollinating wasp species, and their prevalence was negatively correlated with the sanction strength of their host species. Combined with previous studies, our findings suggest that (i) mutualisms can show coevolutionary dynamics analogous to those of ‘arms races’ in overtly antagonistic interactions; (ii) sanctions are critical for long-term mutualism stability when providing benefits to a host is costly, and (iii) there are general principles that help maintain cooperation both within and among species.

Keywords: mutualism; cooperation; exploitation; cheating; sanctions; fig



Mecanismos de regulação (densidade- dependentes)

Functional Ecology

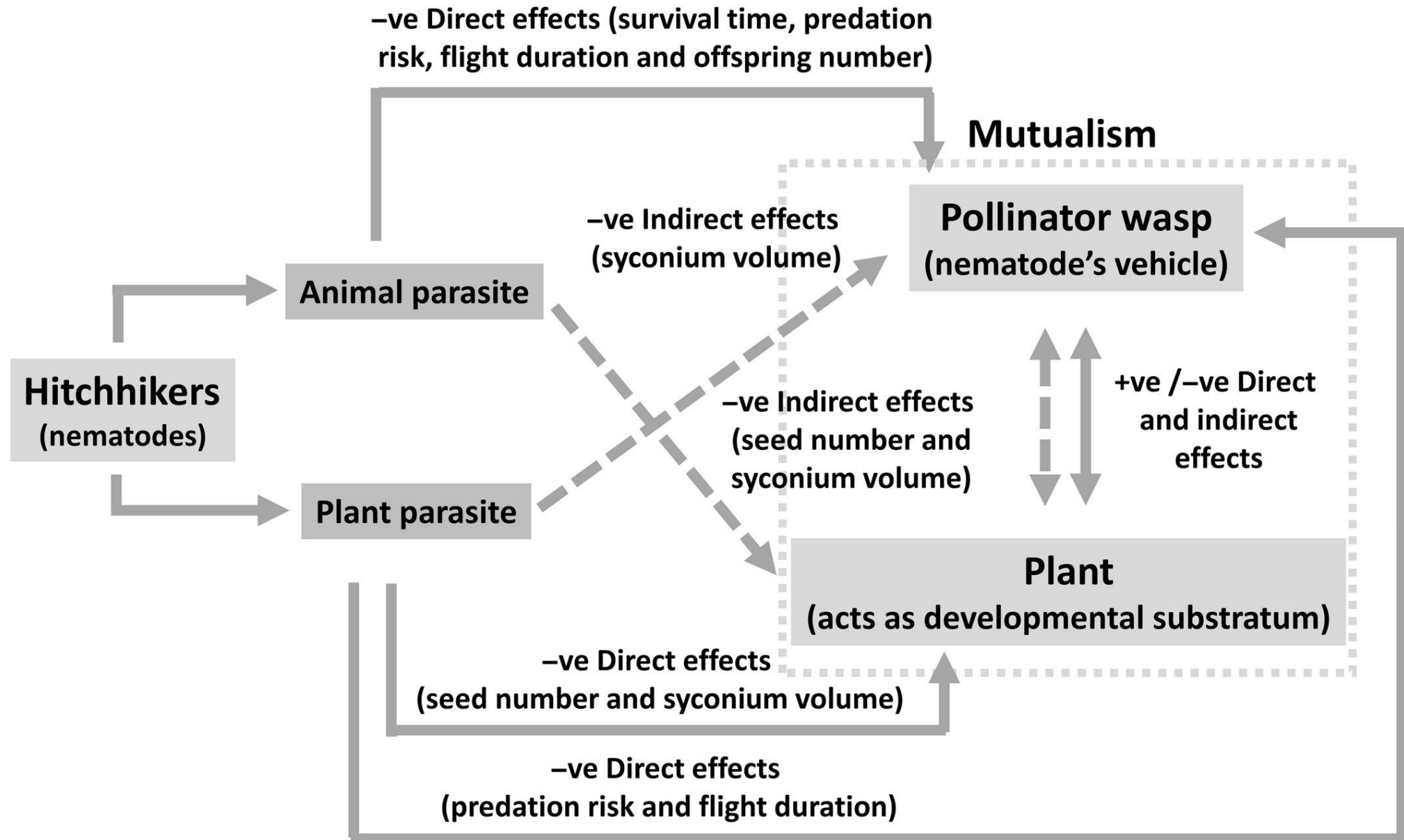


RESEARCH ARTICLE | [Free Access](#)

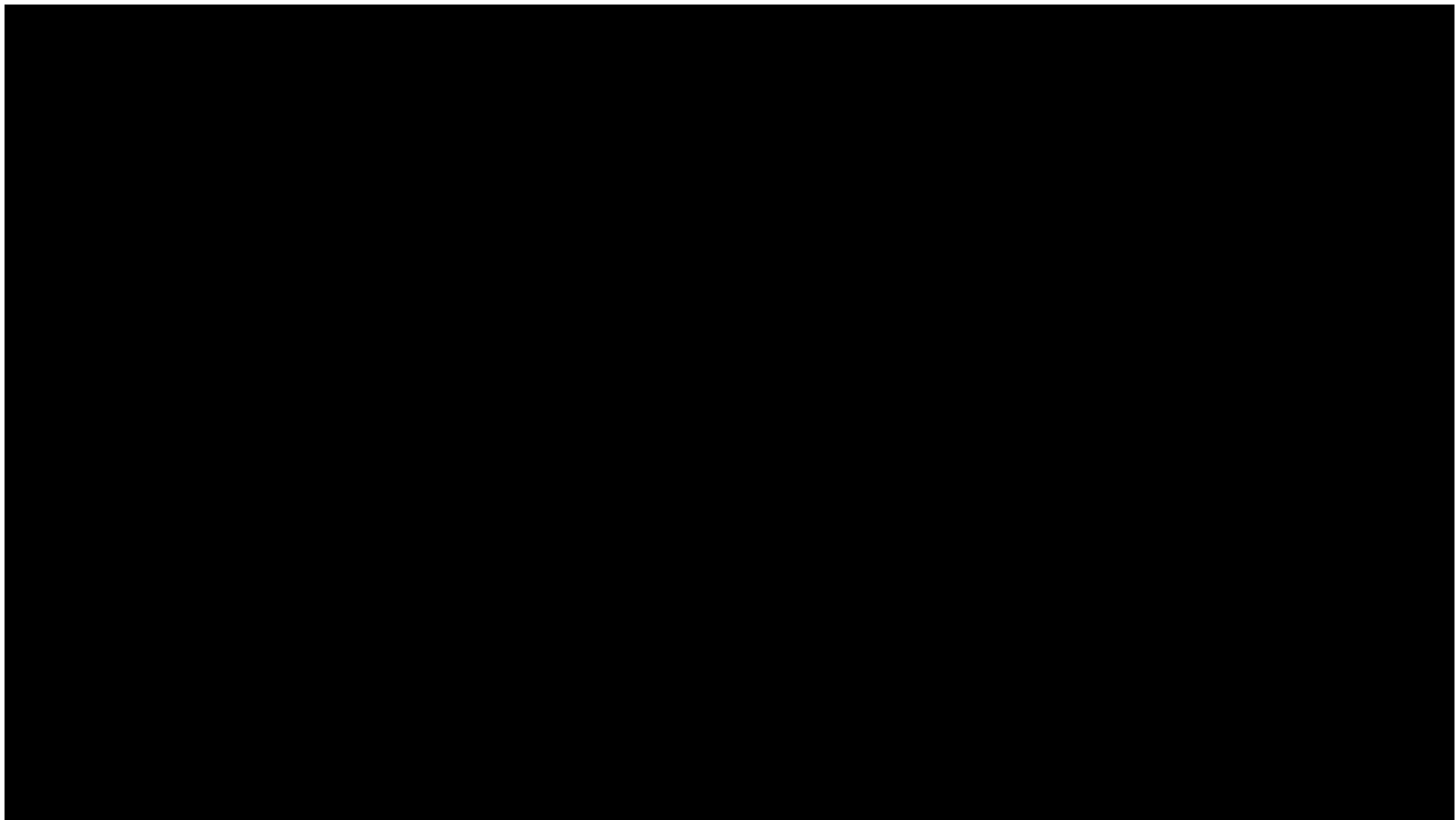
Density-dependent fitness effects stabilize parasitic hitchhiking within a mutualism

Satyajeet Gupta, Renee M. Borges

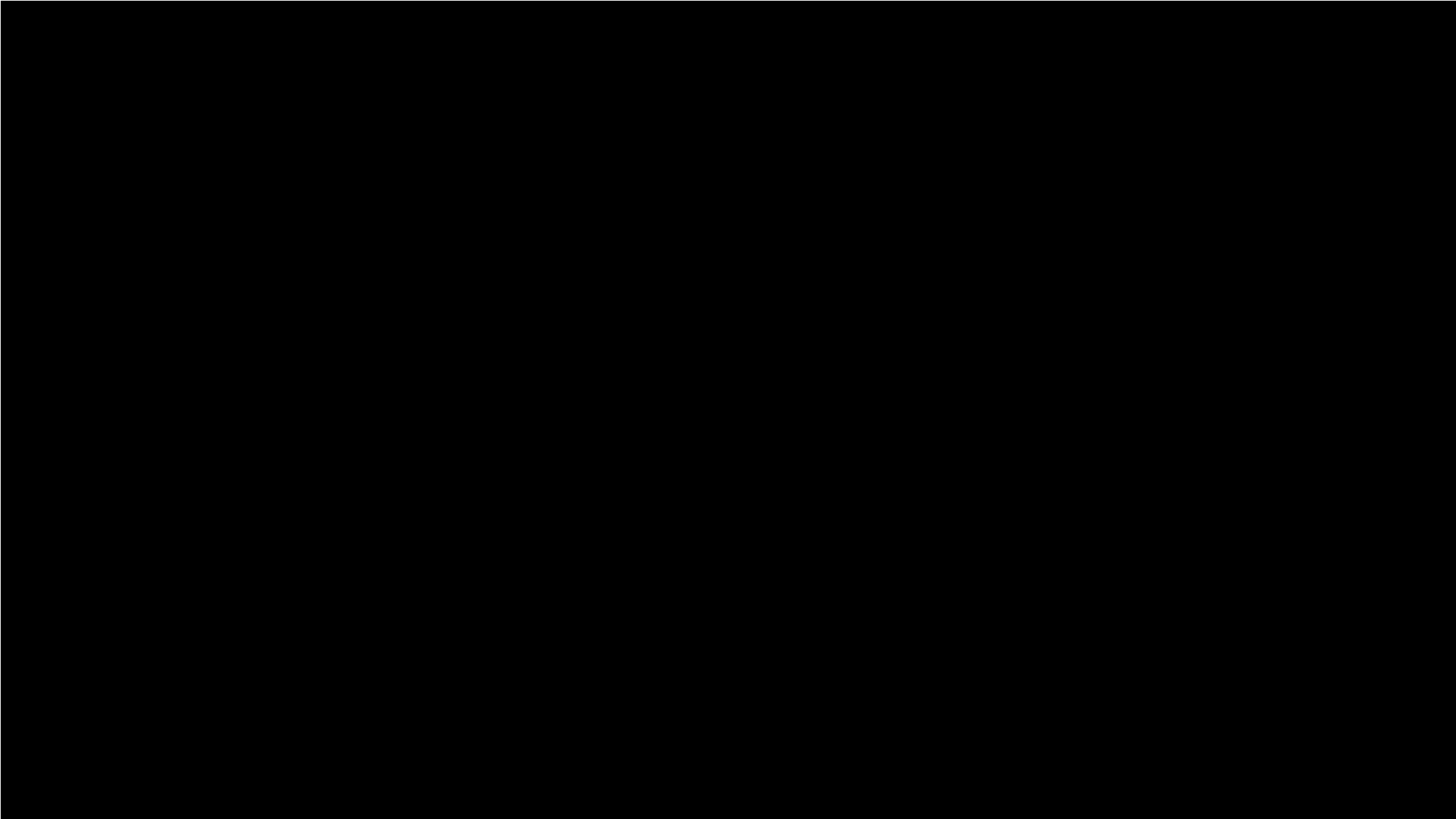
First published: 10 September 2019 | <https://doi.org/10.1111/1365-2435.13451> | Citations: 8



Video 1



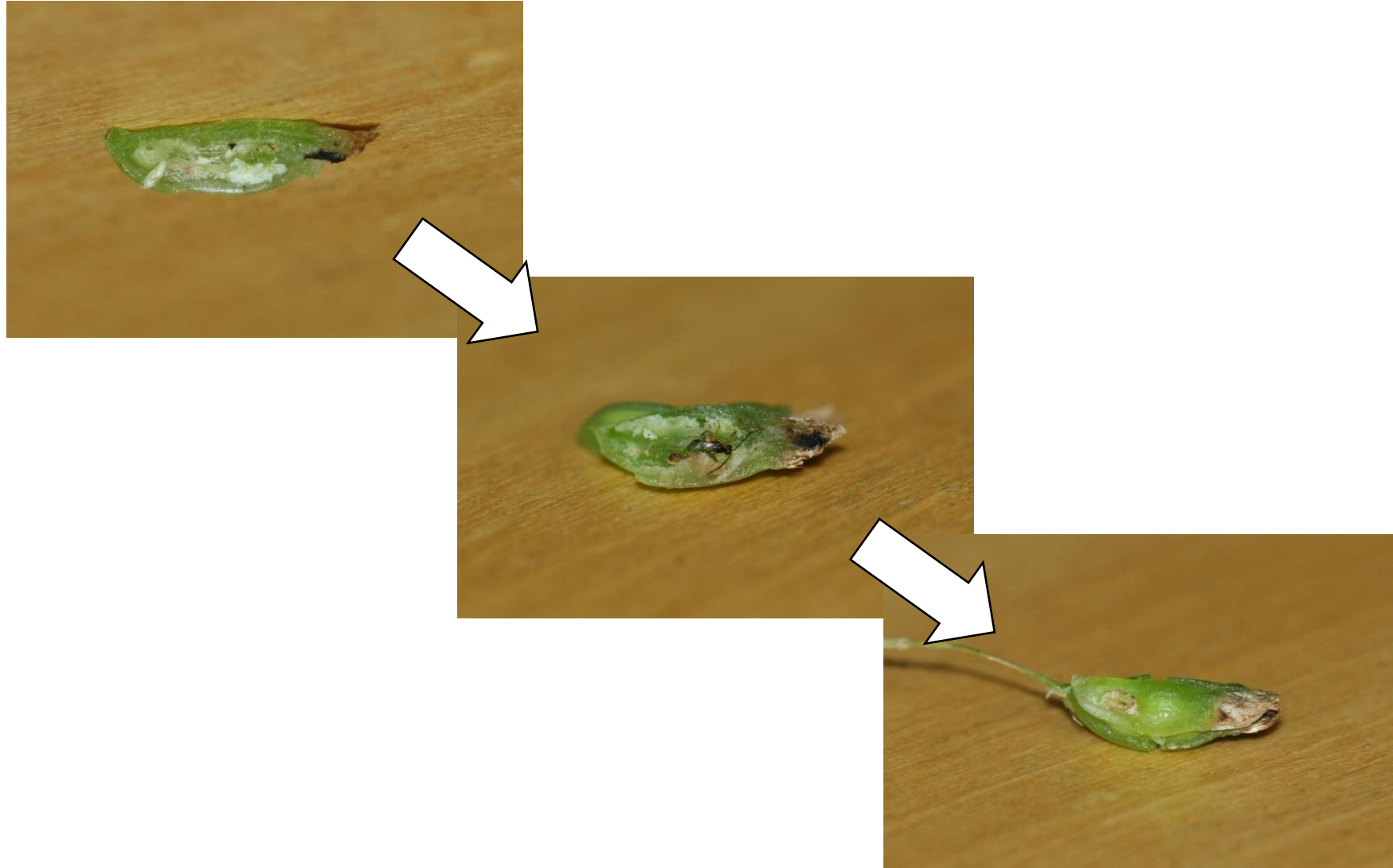
Video 2



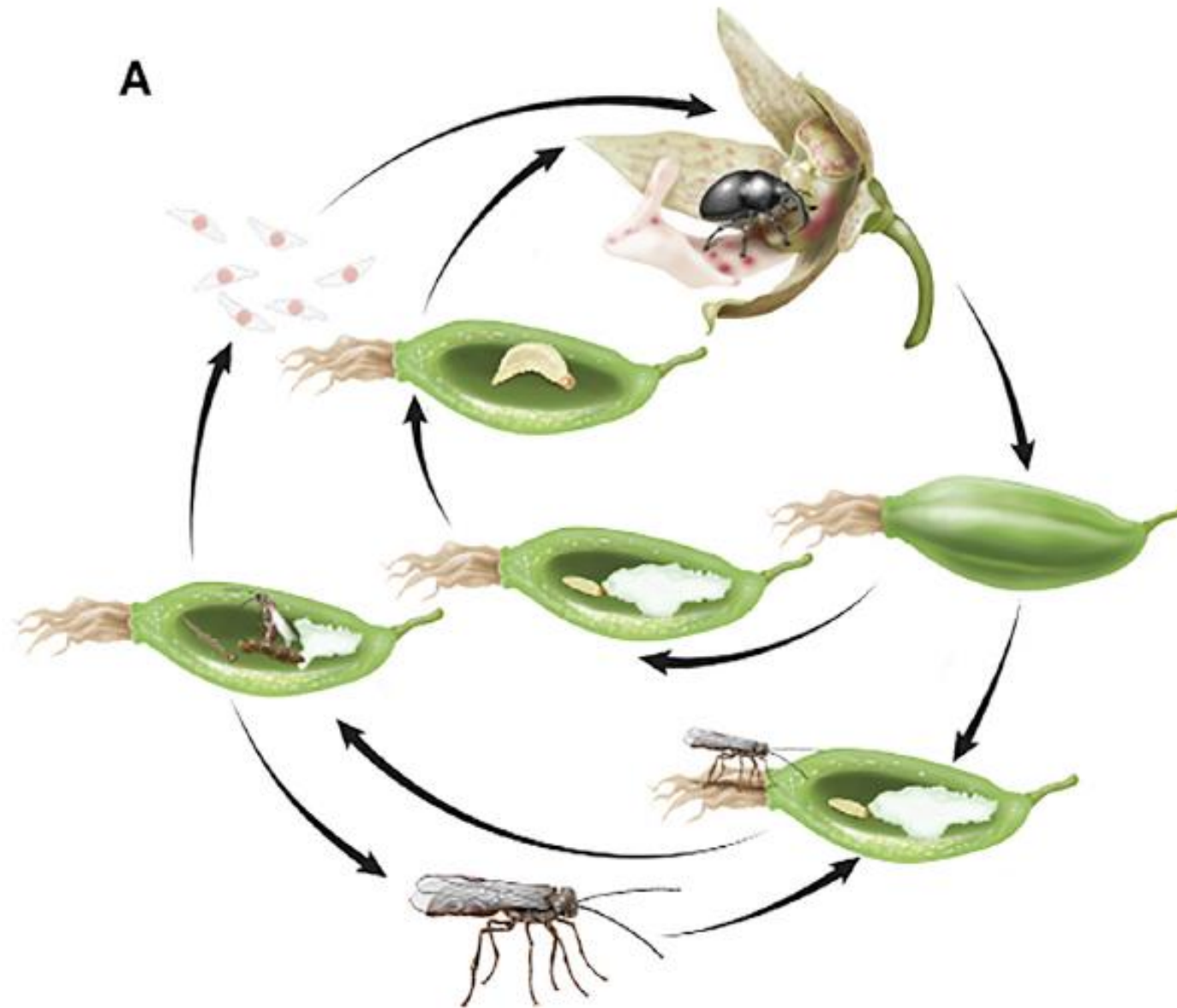
Ciclo de *Montella* sp. nov.



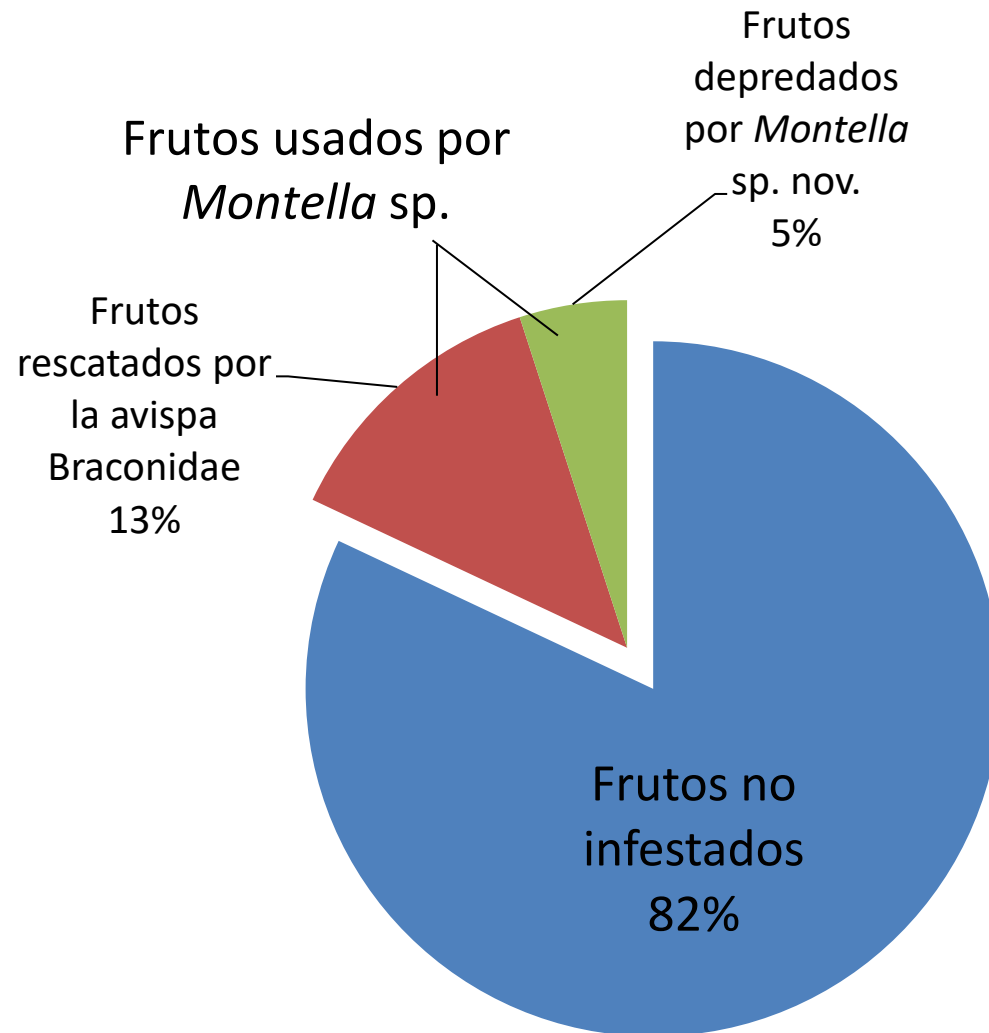
Ciclo da vespa parasitoide Braconidae



Ciclo de *Montella* sp. nov.

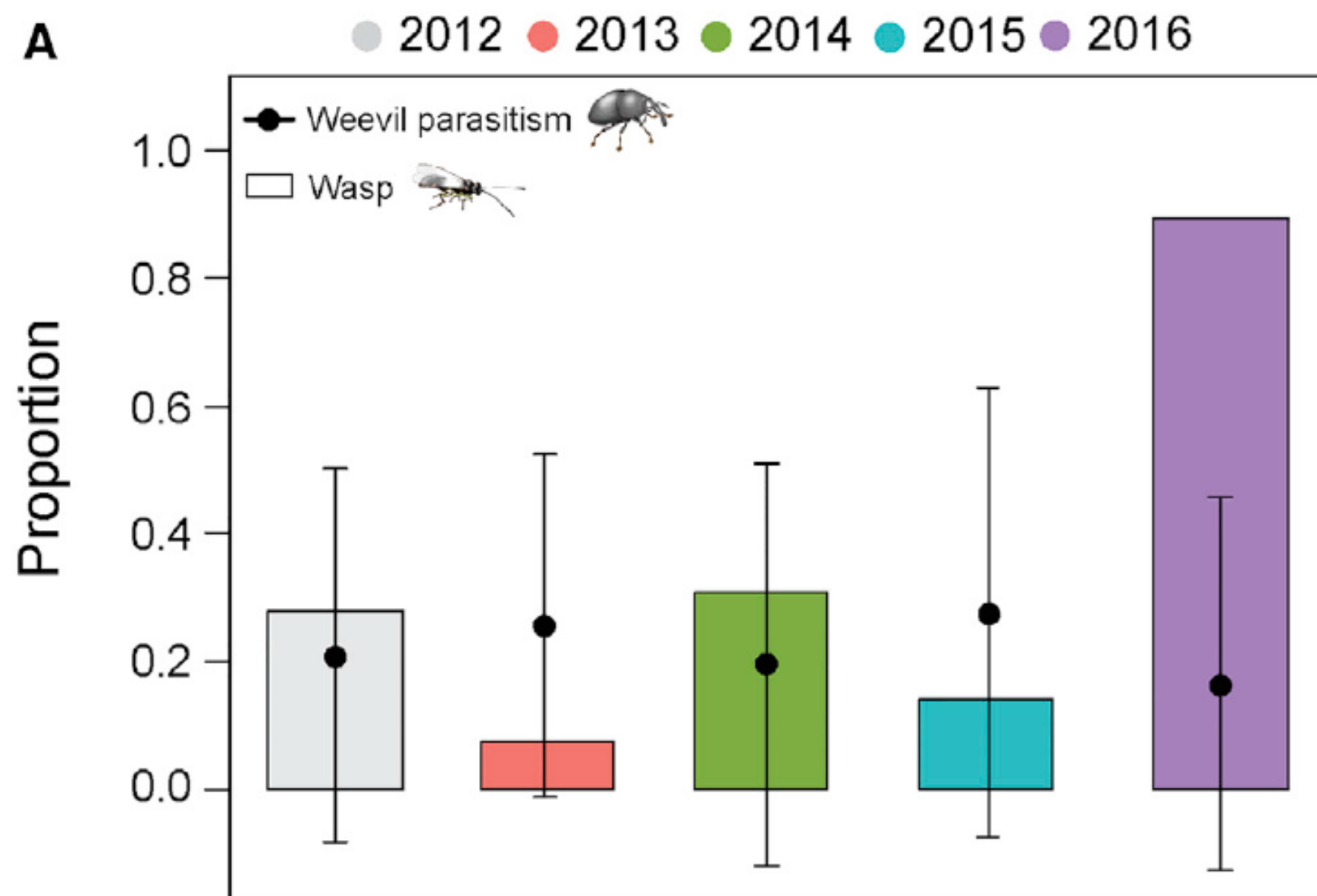


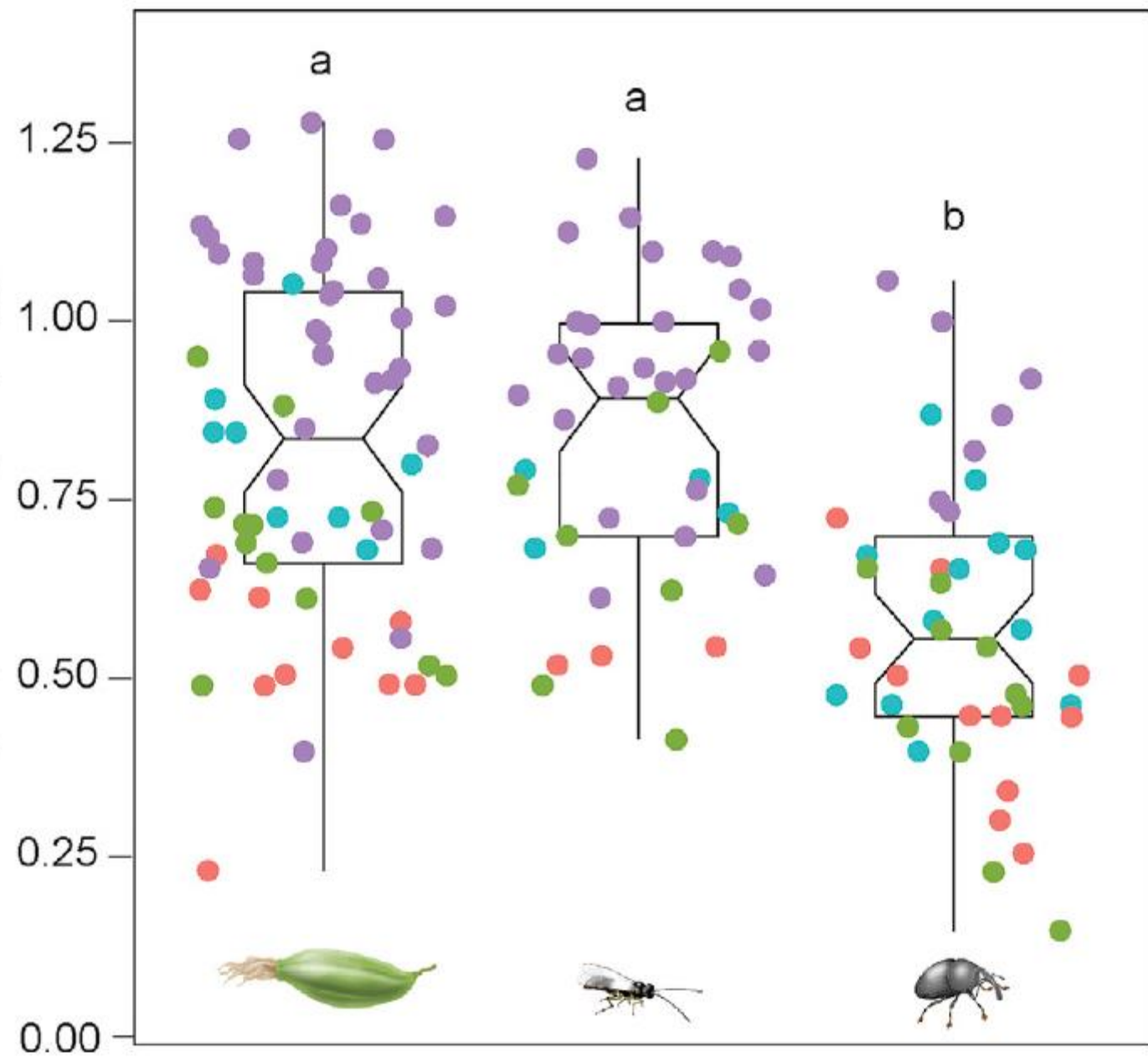
Balance de las interacciones entre *Dichaea cogniauxiana* y *Montella* sp.



En 2012



A

$\log_{10}$ (Fruit weight [mg])

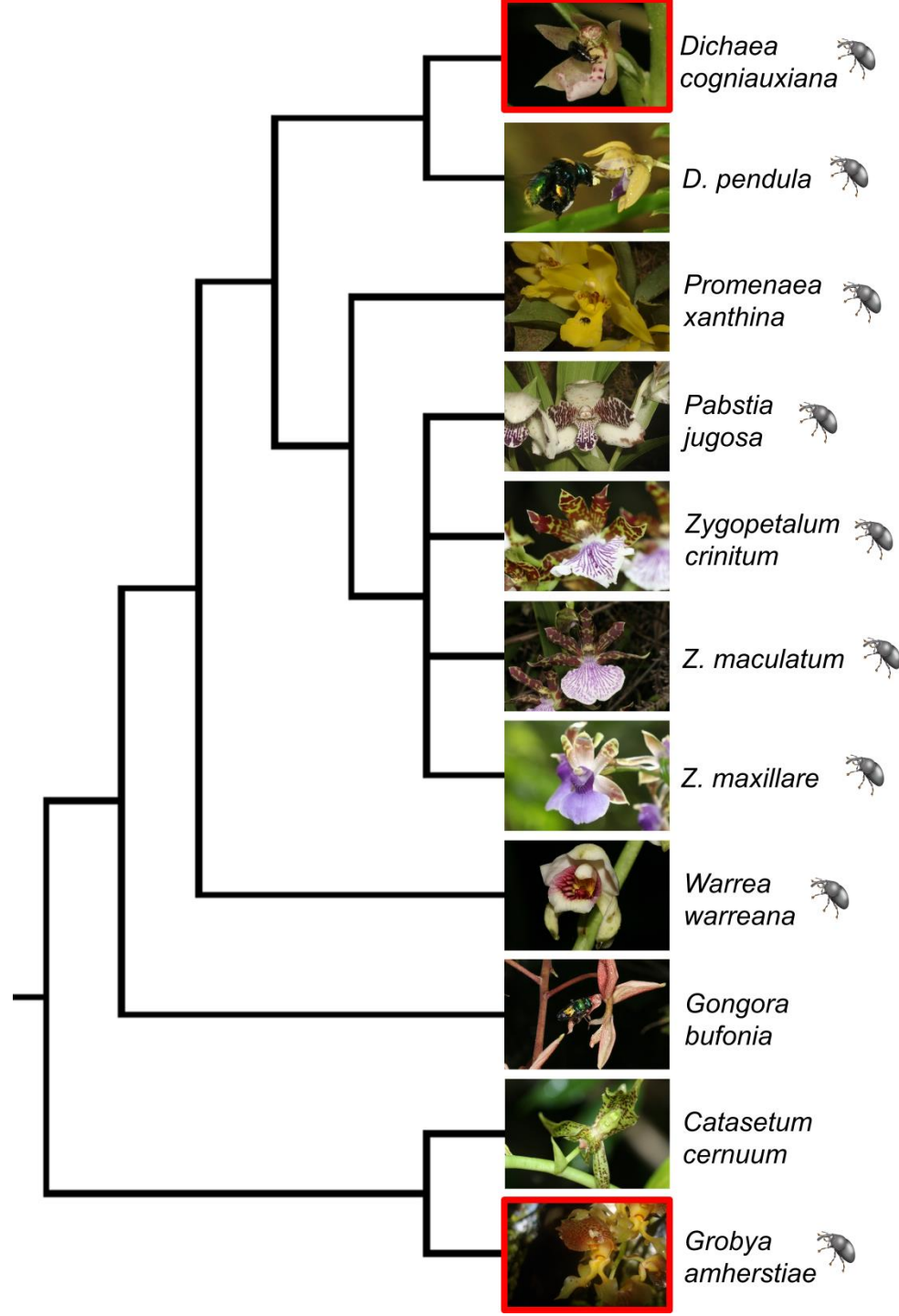
Todavía...

- La producción de frutos de *D. cogniauxiana* por **autopolinización** fue de solo **13.4%**
- TODAS las flores polinizadas por gorgojos se convierten en frutos.
- **Polinización natural** de flores control resulta en **57.5%** de frutos.

Em *Dichaea pendula*

- *Montella* sp. poliniza, mas não há frutos para as larvas
- Ciclo não se completa
- Autoincompatibilidade
- Polinização por machos Euglossini
- Mal reconhecimento?



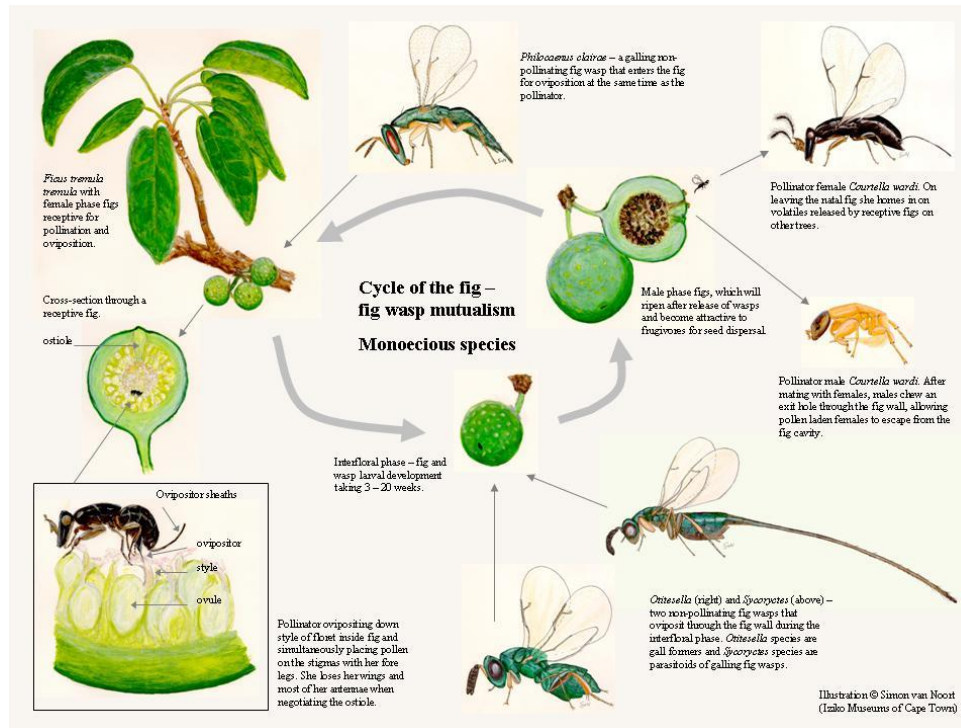


Gorgulhos similares
interagem com
diferentes espécies
de plantas com
diferentes
resultados

Polinização ativa

“Comportamento ritualizado apresentado por insetos que realizam *polinização de berçário* quando transferem pólen das anteras para os estigmas”.

- Antes conhecida em apenas 4 linhagens de plantas



Evolution, 55(10), 2001, pp. 2011–2027

THE EVOLUTION OF AGRICULTURE IN BEETLES (CURCULIONIDAE: SCOLYTINAE AND PLATYPODINAE)

BRIAN D. FARRELL,^{1,2} ANDREA S. SEQUEIRA,¹ BRIAN C. O'MEARA,¹ BENJAMIN B. NORMARK,^{1,3}
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Conclusões

- Mutualismos têm custos (elementos antagonistas)
- Mutualismos atraem espécies e comportamentos antagonistas
- Mutualismos funcionam diferente em diferentes contextos de uma comunidade
- Diferentes mutualismos que compartilham parceiros interagem indiretamente em vias inesperadas e interessantes



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Muito obrigado!

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Parasitoids Turn Herbivores into Mutualists in a Nursery System Involving Active Pollination

Highlights

- Female weevils actively pollinate orchids prior to having their larvae fed on fruits
- Weevil larvae often consume all contents of infested fruits
- Parasitoid wasps kill weevil larvae before all fruit content is consumed
- Rescued fruits present seed viability and biomass similar to those of intact fruits



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Marlies Sazima

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In Brief

Nunes et al. describe in detail a nursery pollination system involving orchids and weevils that actively self-pollinate flowers prior to have their larvae fed by the resulting fruits. In this work, they show that the outcome of this plant-floral visitor interaction can be mediated by a third party: parasitoid wasps.