

“It is the combination of life forms and their interactions with each other and with the rest of the environment that has made Earth a uniquely habitable place for humans.”

Convention on Biological Diversity

Ensuring food Production

Native biodiversity provides
pollination and biological control services

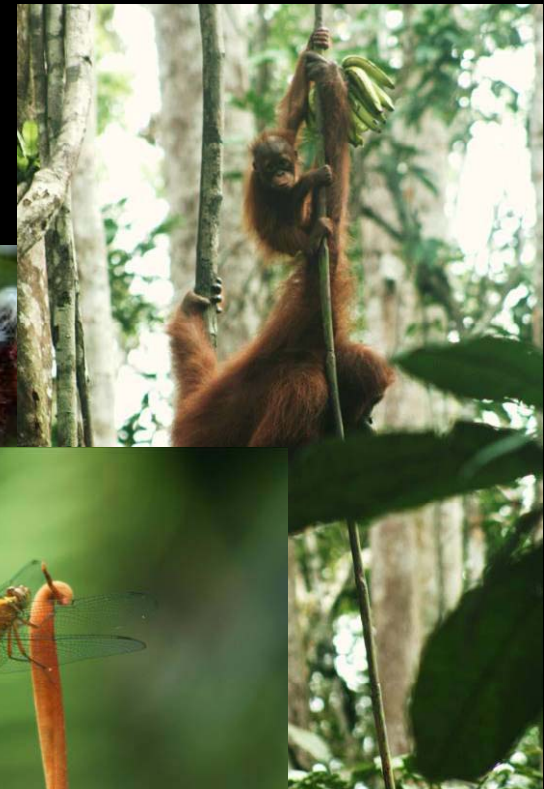


Jason M. Tylianakis
School of Biological Sciences
University of Canterbury
New Zealand

Biodiversity loss



- Land use change drives extinctions
- Extinction rates 100-1000 times pre-human.
- Intrinsic importance





*“What good are all those species
that man can not eat nor sell”?*

Odum (1971)

Ecosystem services



76% of our food crops (35% of food volume) depend on animal pollination.

Natural enemies provide \$400 billion worth of pest/disease control each year.

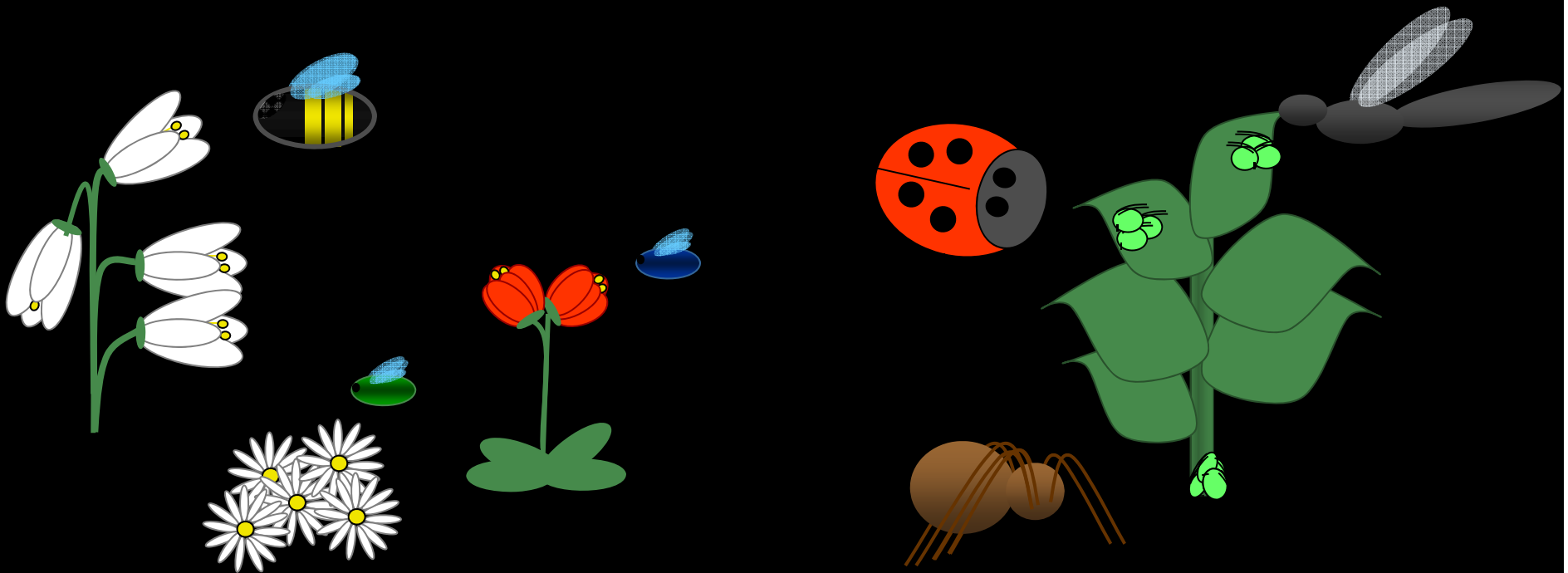


Does biodiversity affect these services?

Biodiversity and ecosystem functioning



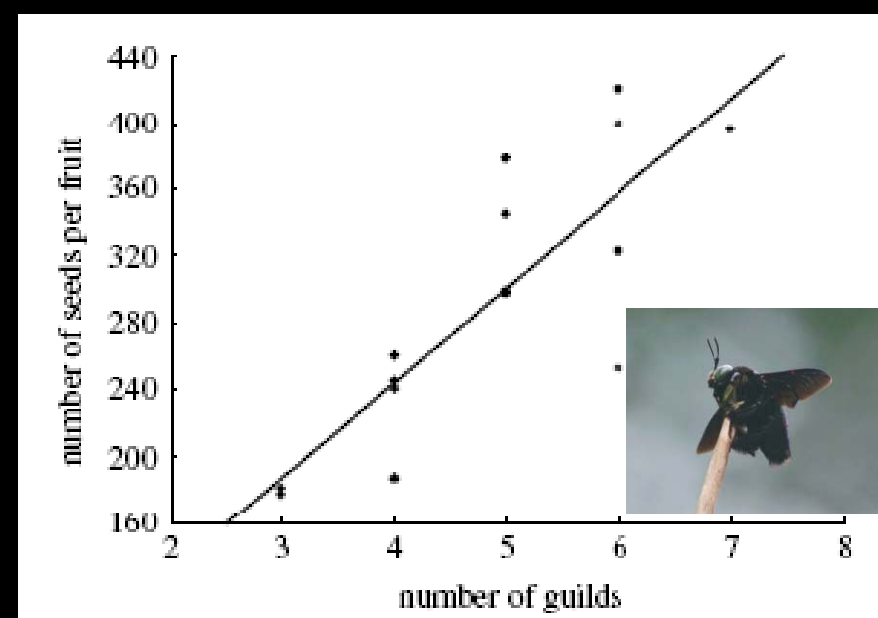
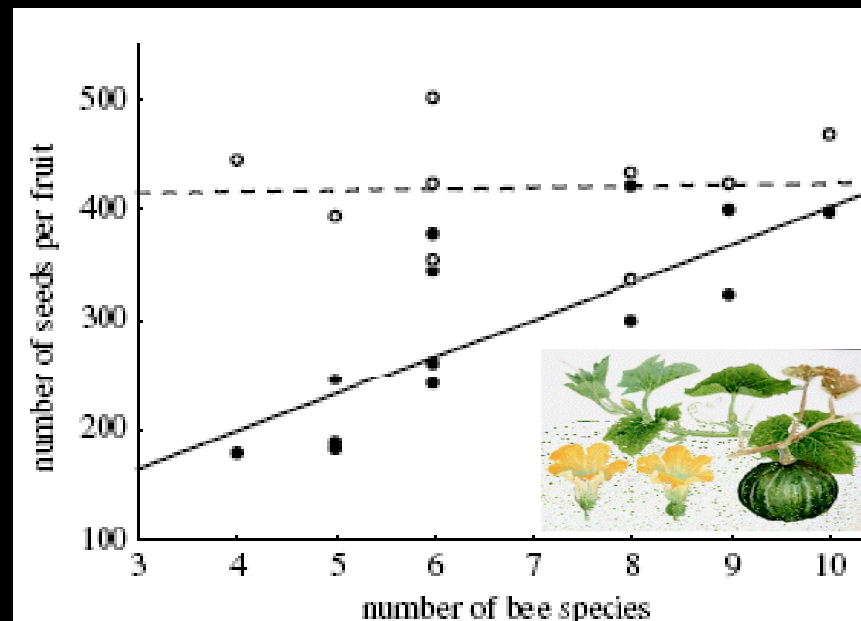
- Niche complementarity among species.



Loss of function



- Functional niche complementarity among pumpkin pollinators in Indonesia.

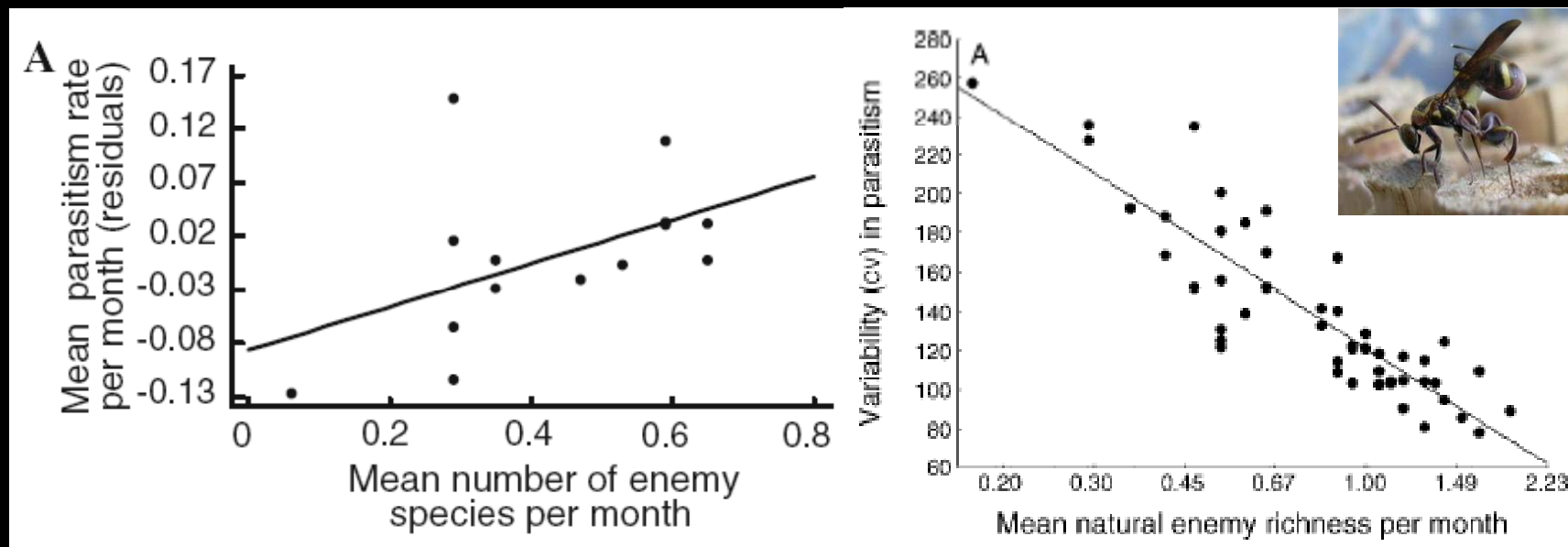


Hoehn, Tscharntke, Tylianakis & Steffan-Dewenter (2008) *Proc. Roy. Soc. Lond. B*

Loss of function



- Parasitoid diversity affects parasitism rates and stability in Ecuador.



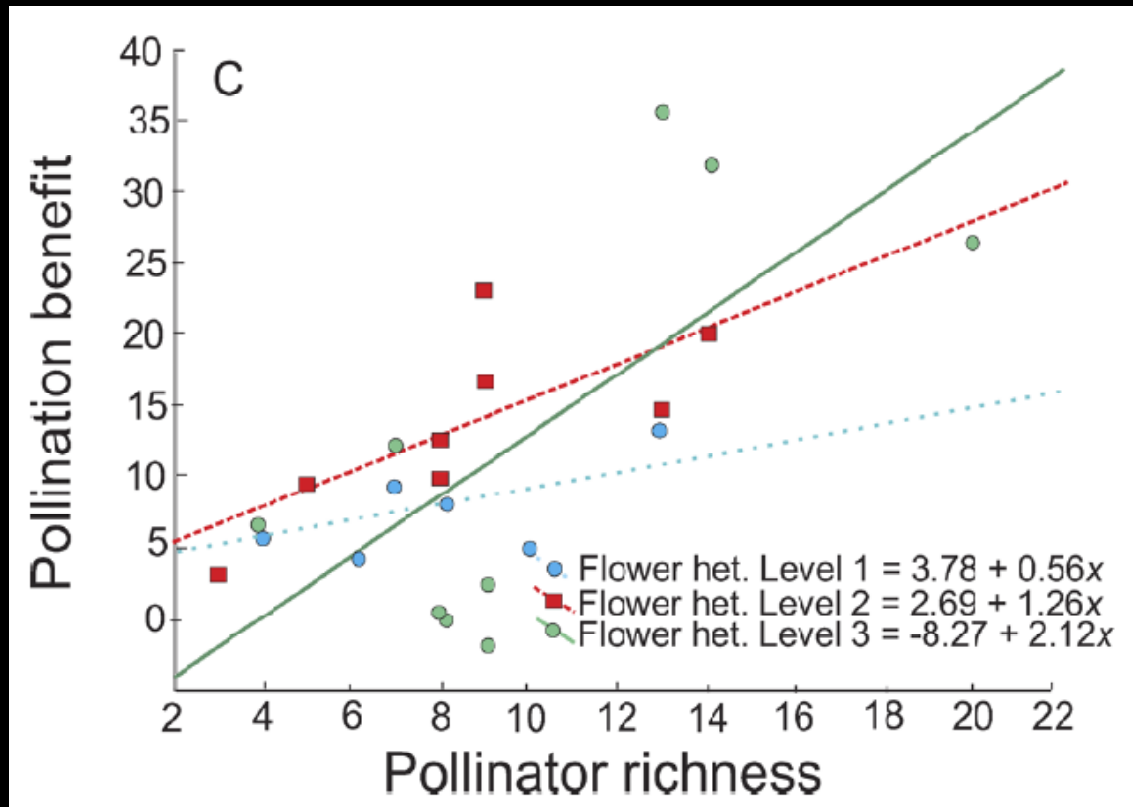
Tylianakis, Tscharntke & Klein (2006) *Ecology*

Veddeler, Tylianakis, Tscharntke & Klein (2010) *Oecologia*

Loss of function

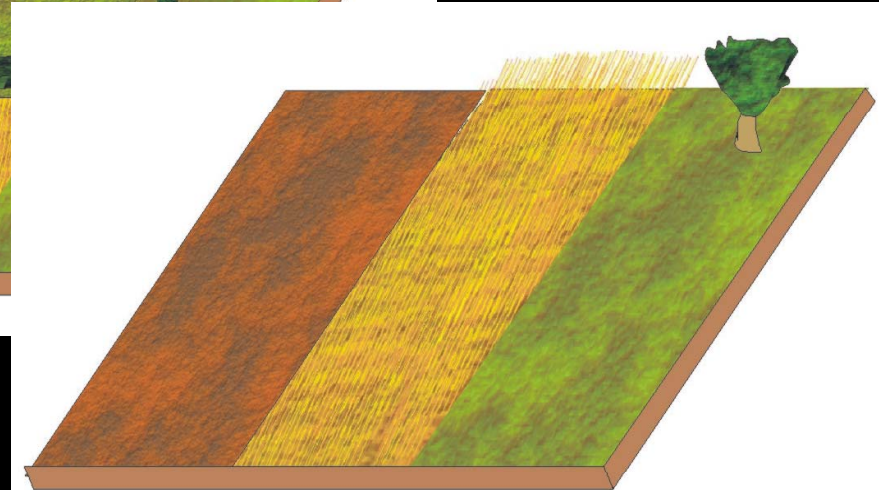
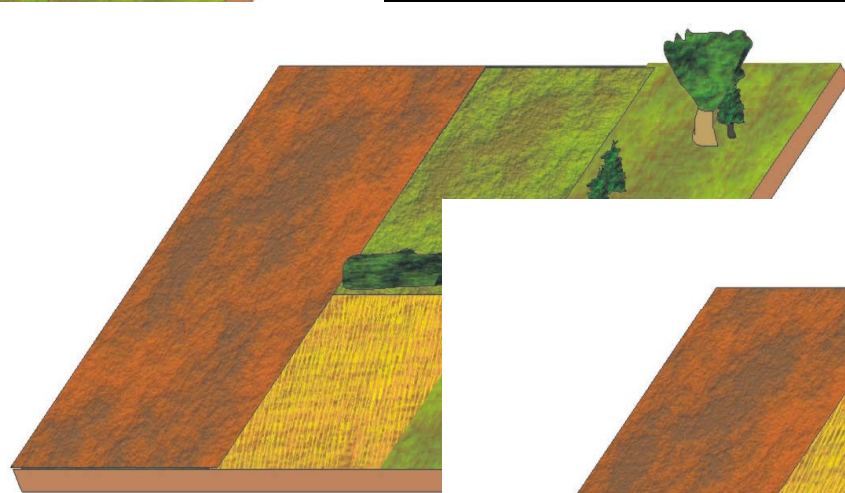
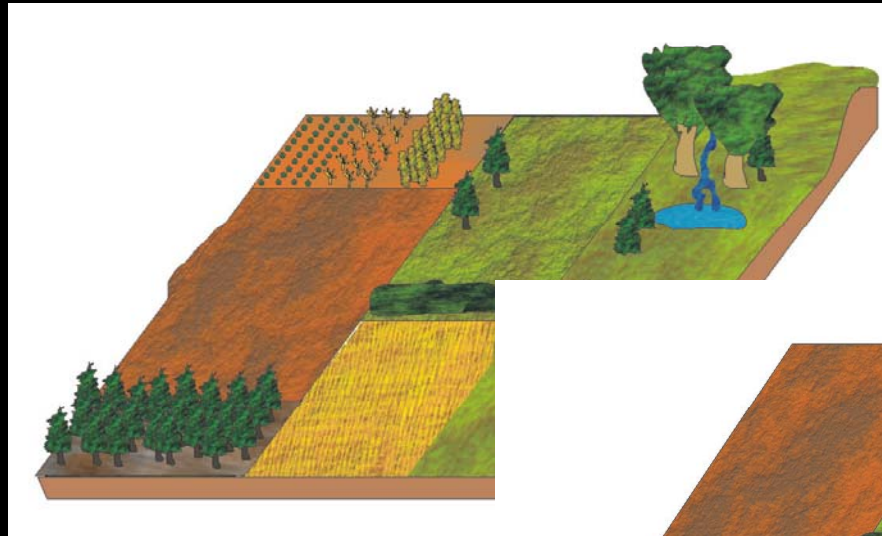


- Biodiversity loss can reduce ecosystem process rates, particularly in natural environments.



Tylianakis, Rand, Kahmen, Klein, Buchmann, Perner & Tschardt (2008) *PLoS Biol.*

Loss of plant diversity

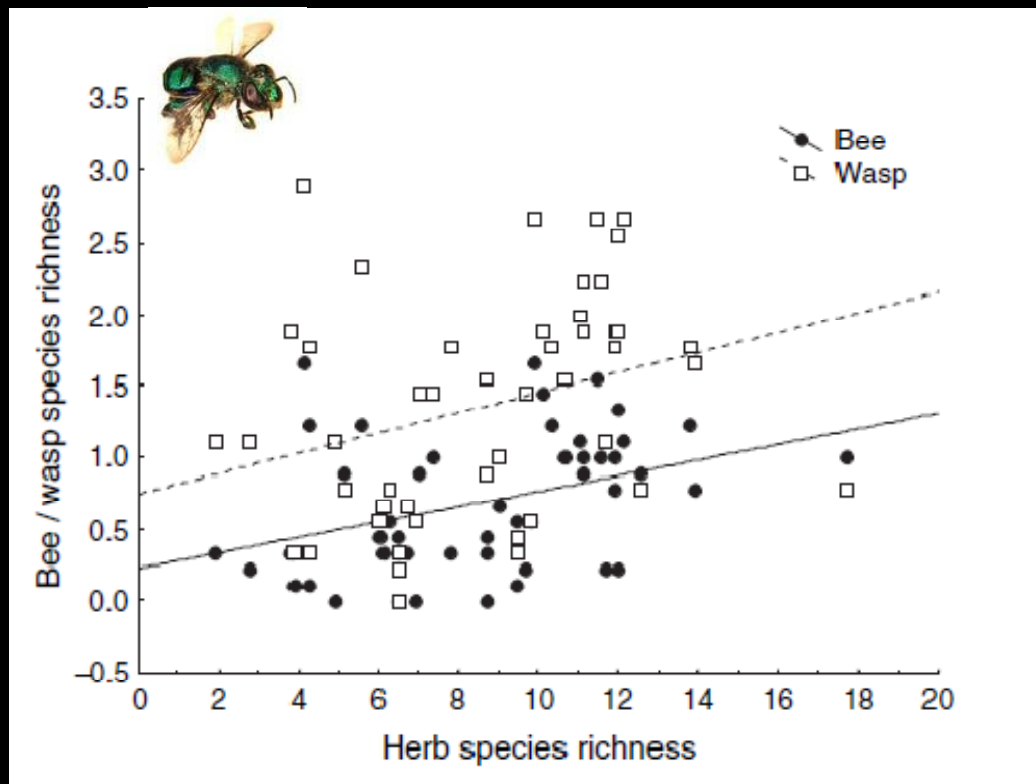


Tscharntke et al. (2006)

Diversity begets diversity



- Plant diversity correlated with insect diversity



Bees: $F_{1,77.6} = 23.09$, $P < 0.0001$
Wasps: $F_{1,67.0} = 10.46$, $P < 0.002$

Tylianakis, Klein, Lozada & Tschamntke (2006) *J. Biogeogr.*

Biodiversity loss



“What escapes the eye, however, is a much more insidious kind of extinction: the extinction of ecological interactions”

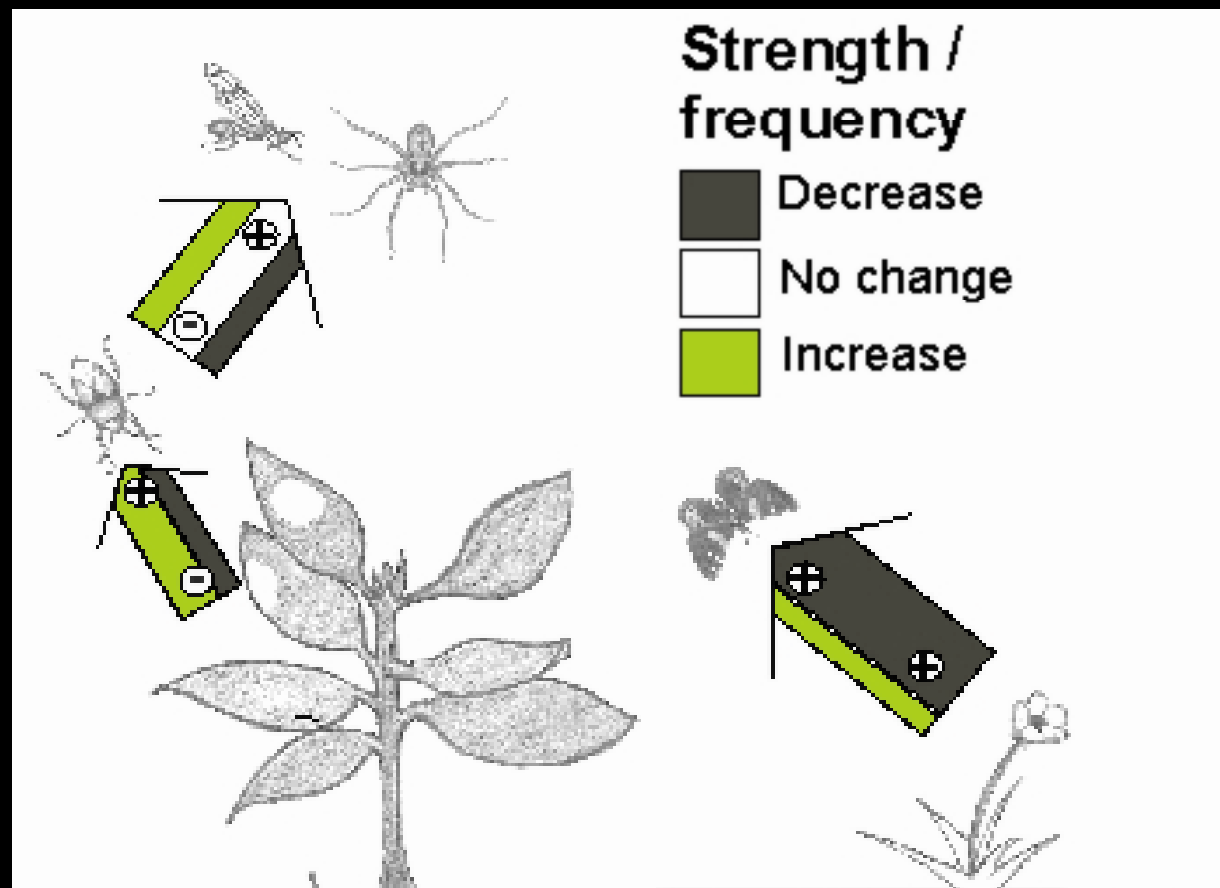
Daniel Janzen (1974)



Plant-animal interactions



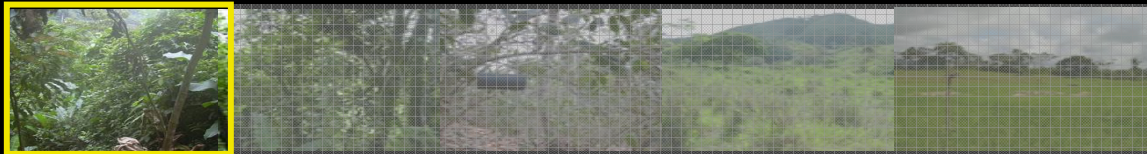
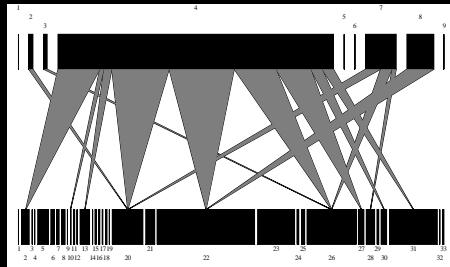
Land use change affects interactions:



Tylianakis, Didham, Bascompte & Wardle (2008) *Ecol. Lett.* 11, 1351-1363

Habitat loss

Parasitoid-host webs in Ecuador

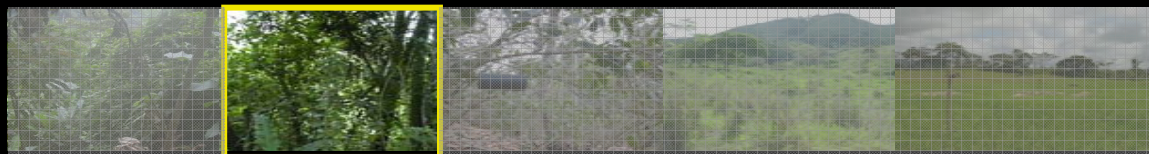
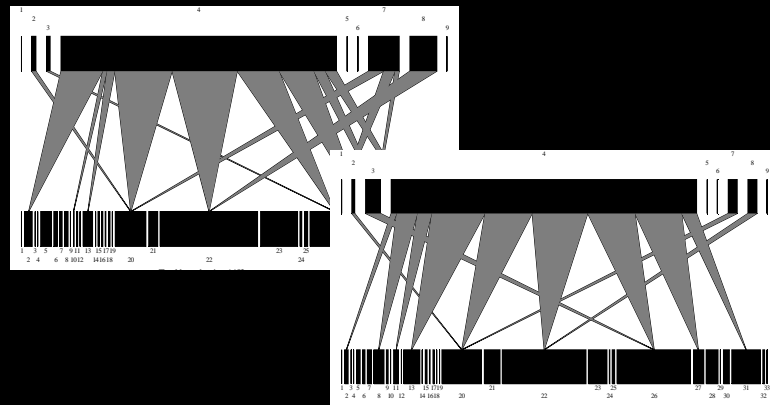


Management intensity

Tylianakis, Tscharntke & Lewis (2007) *Nature*

Habitat loss

Parasitoid-host webs in Ecuador

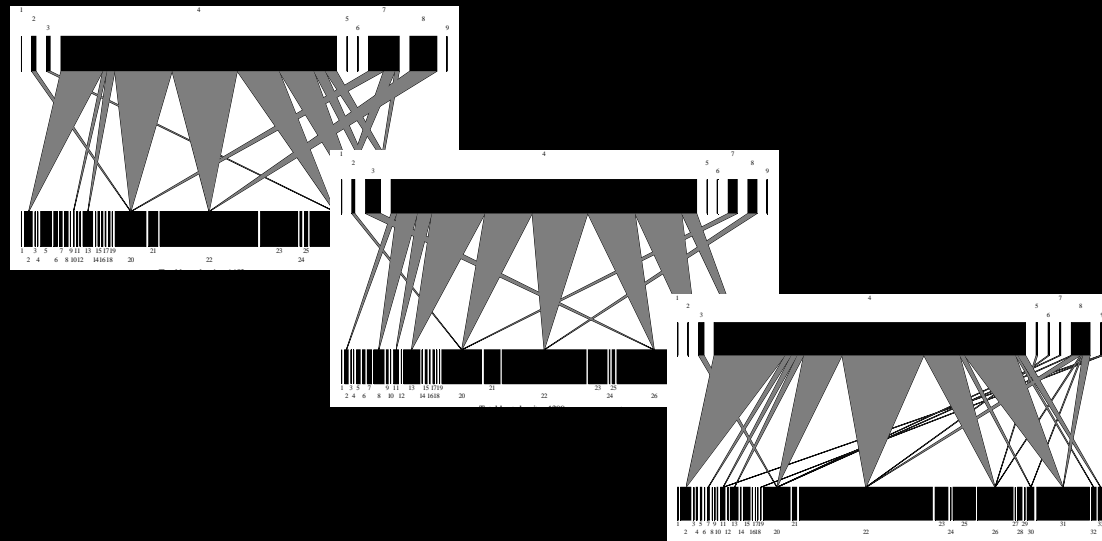


Management intensity

Tylianakis, Tscharntke & Lewis (2007) *Nature*

Habitat loss

Parasitoid-host webs in Ecuador

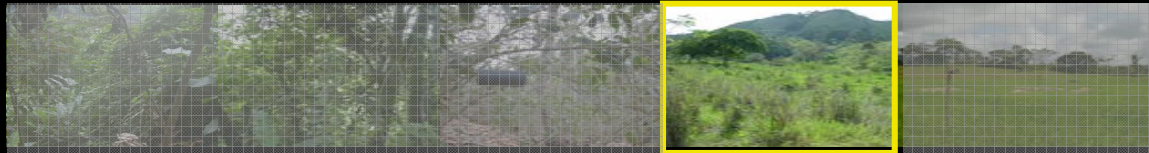
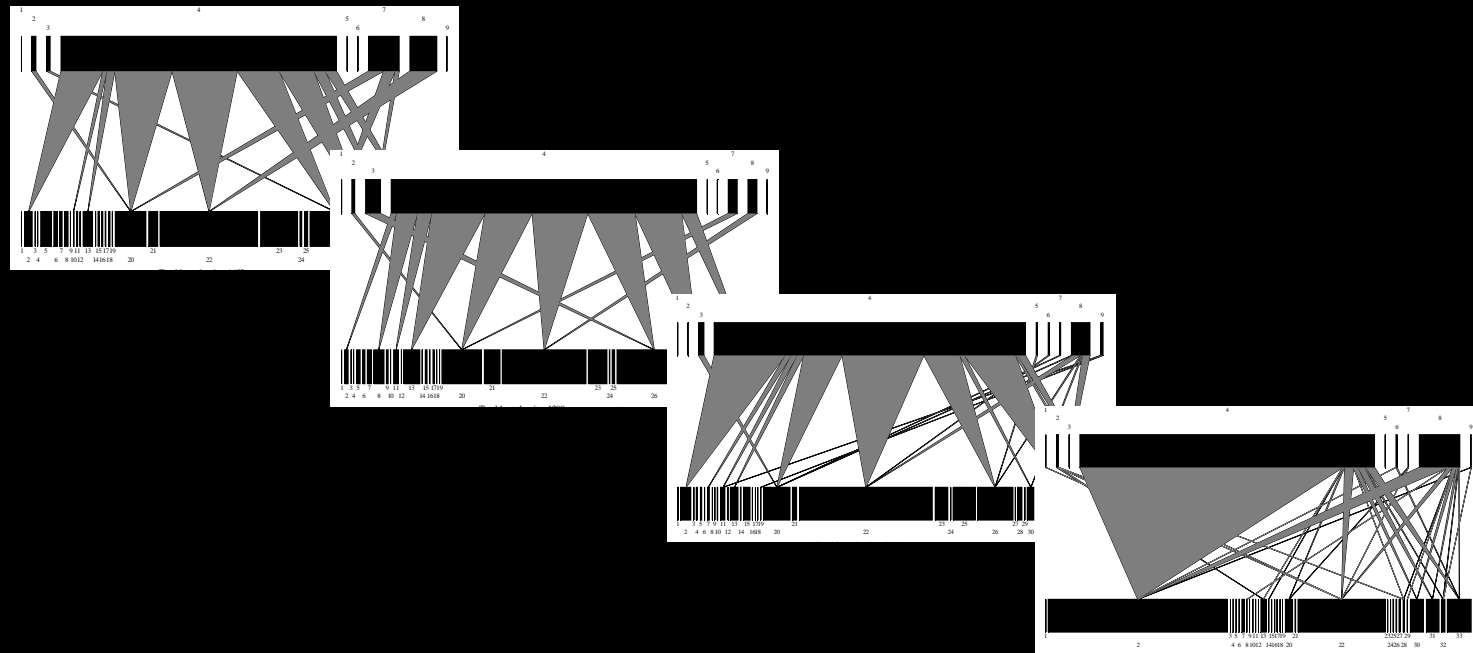


Management intensity

Tylianakis, Tscharntke & Lewis (2007) *Nature*

Habitat loss

Parasitoid-host webs in Ecuador

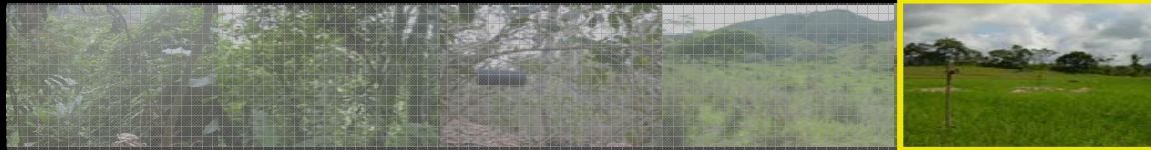
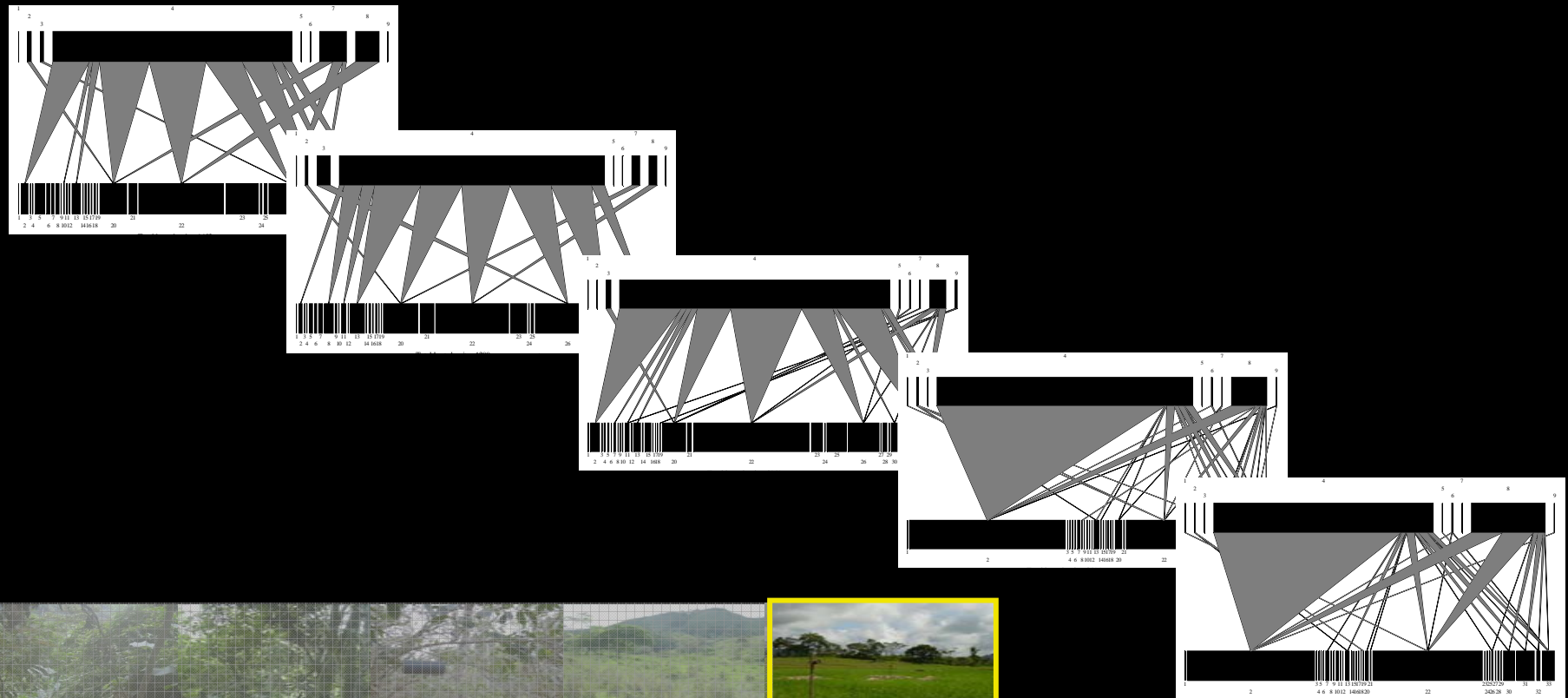


Management intensity

Tylianakis, Tscharntke & Lewis (2007) *Nature*

Habitat loss

Parasitoid-host webs in Ecuador



Management intensity

Tylianakis, Tscharntke & Lewis (2007) *Nature*

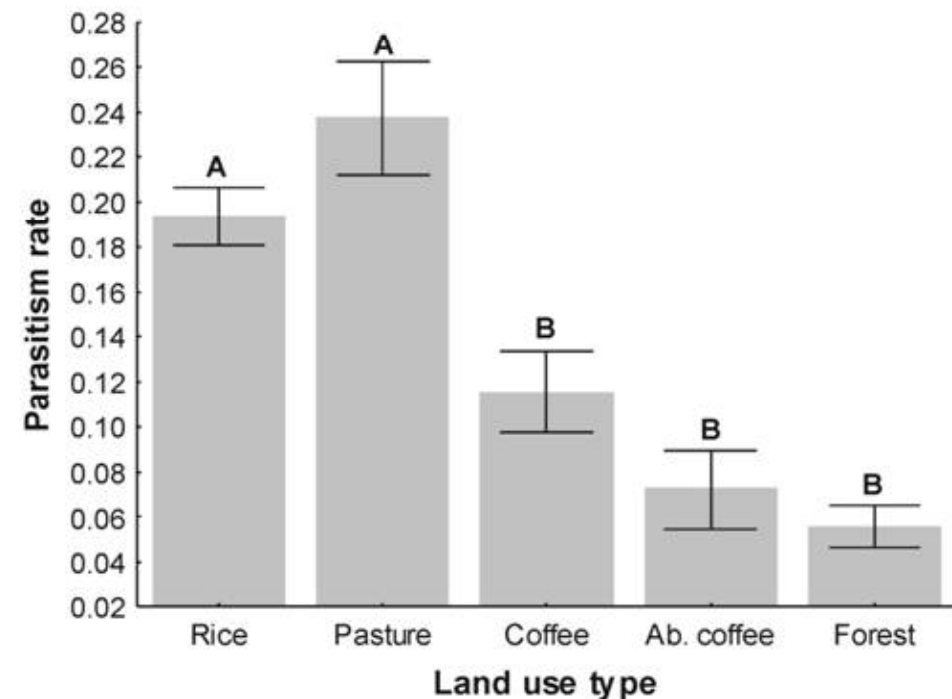
Food web structure



With increasing habitat modification:
diversity of parasitoids attacking each bee or
wasp species increased.

Increasing total
rates of parasitism

$$F_{4,43} = 9.323$$
$$P < 0.0001$$



Conserving biodiversity



“We are obviously past any point where strategies that focus on conservation of pristine habitat are sufficient for the job”

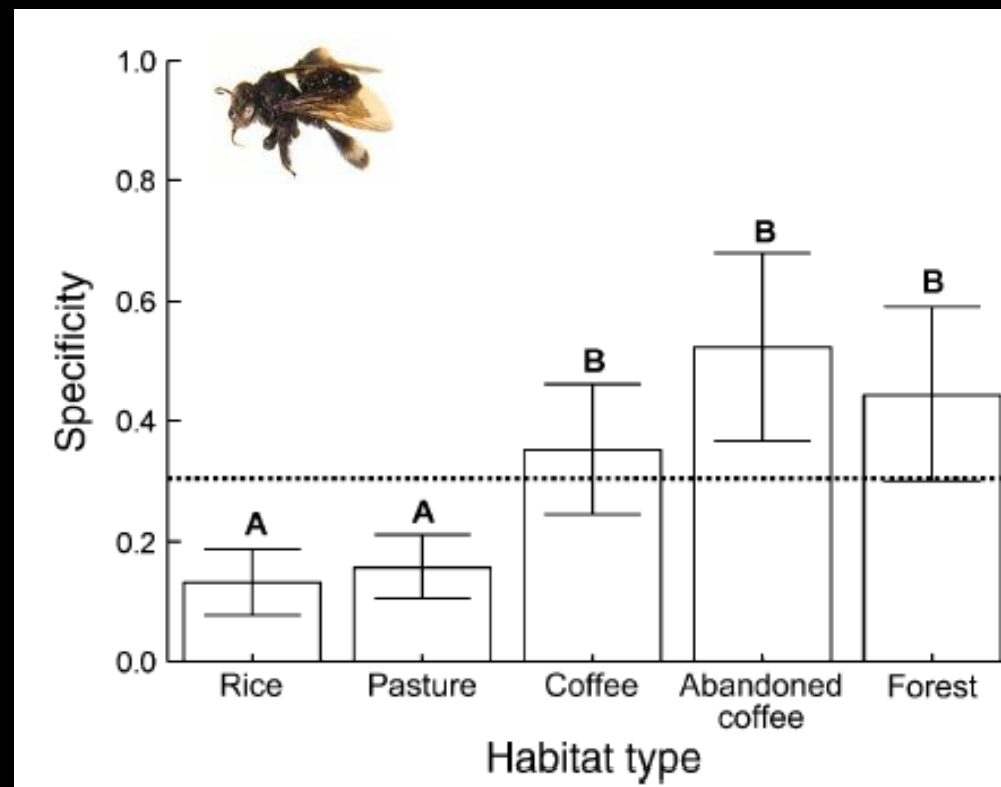
Novacek & Cleland (2001)



Agroforestry



- Softer effects on biodiversity in Ecuador.



Tylianakis, Klein & Tscharntke (2005) *Ecology*

Agroforestry



- Softer effects on biodiversity in Ecuador.



Teodoro *et al.* (submitted)



Ants, spiders and beetles highest diversity in managed coffee agroforests.

Agroforestry



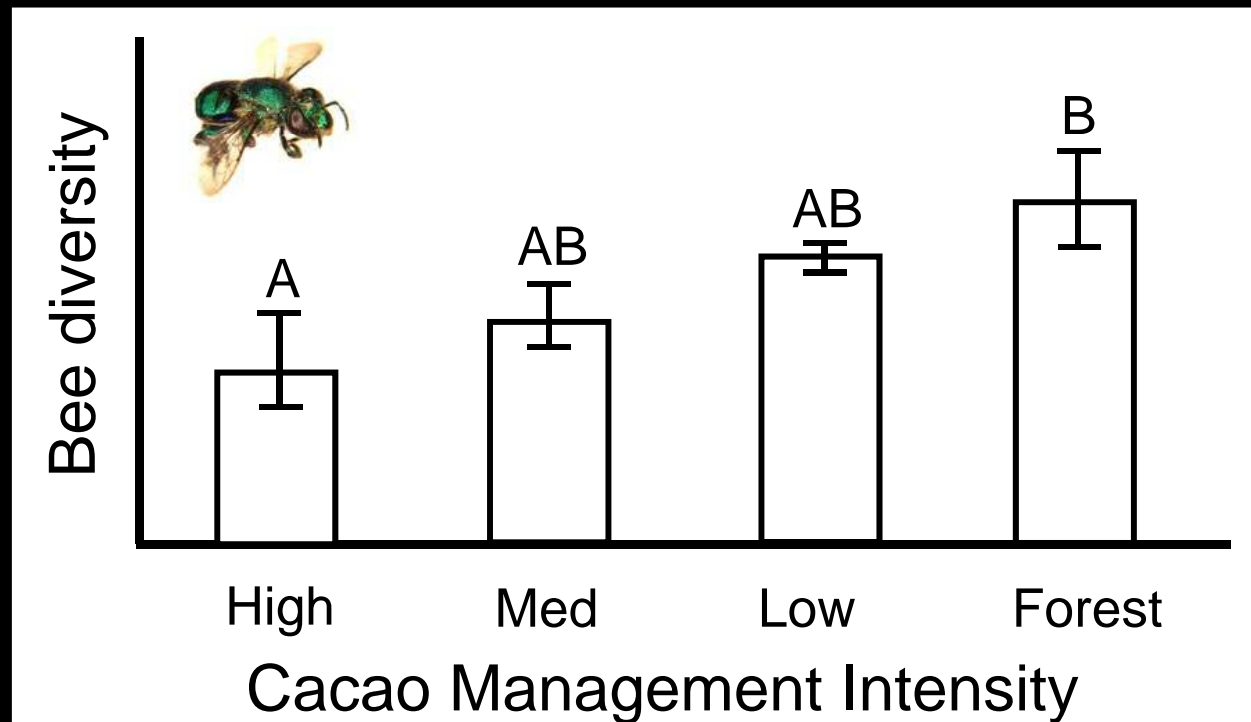
Agroforest intensification: shade-sun grown



Agroforestry



- Cacao intensification reduces bee biodiversity in Sulawesi.

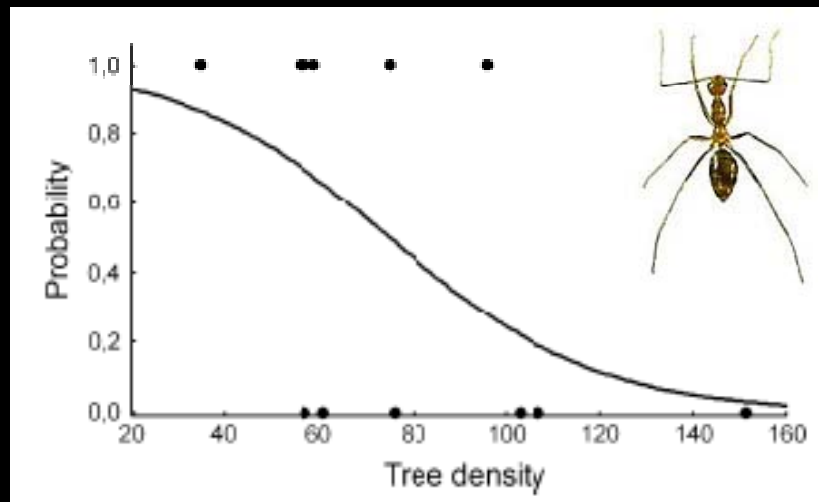


Tscharntke *et al.* (2008) *Ecology*

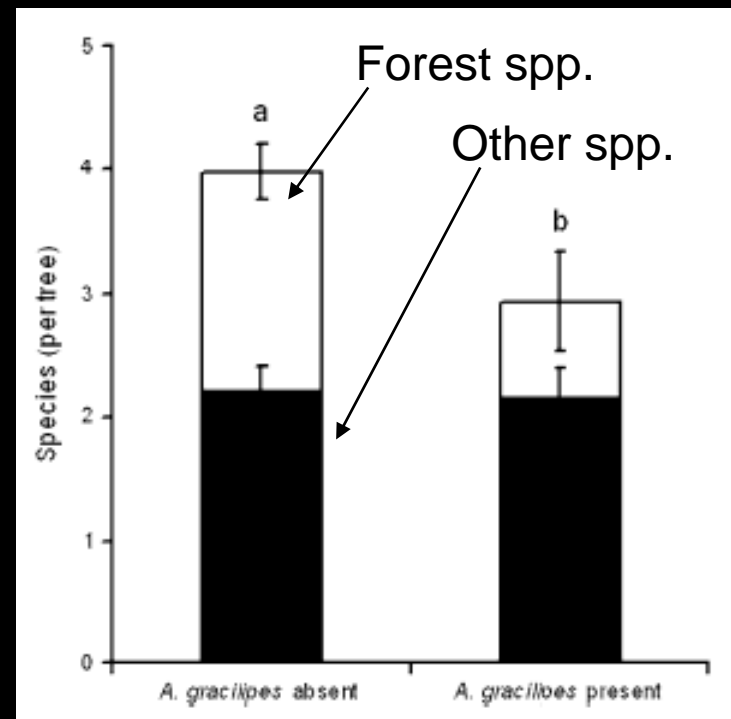
Cacao agroforest intensification



The yellow crazy ant *Anoplolepis gracilipes* in cacao agroforests in Sulawesi.



Probability of Crazy ants being present



Effects on other species

Bos, Tylianakis, Steffan-Dewenter & Tscharntke (2008) *Biological Invasions*

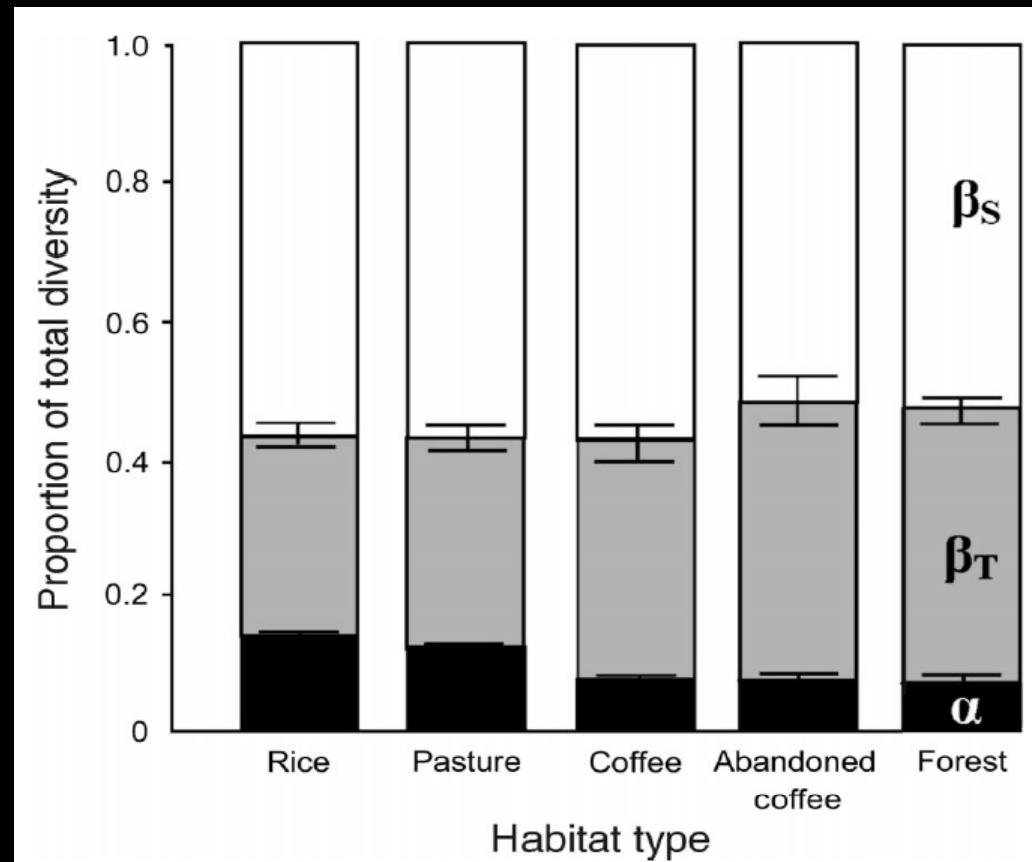
Mosaic landscapes



- Beta diversity and conservation at the landscape scale



Tylianakis, Klein & Tscharntke
(2005) *Ecology*



Summary



- Land use intensification drives extinctions of species and alters the ways they interact.
- Lost biodiversity may result in reduced rates of pollination and biological control.
- In addition to reduced mean rates, stability in ecosystem services may also decline.
- Biodiversity acts as insurance in changing conditions, and altered food web structure may affect resilience to other environmental changes.
- ‘Soft’ management and mosaic landscapes may have benefits in target and adjacent habitats.

Acknowledgements



- **Funding:** OECD, BMBF (Germany), Marsden Fund (New Zealand).
- **Field/ laboratory assistance:** Cesar Calderon, Jubian Casquete, Angel Choez, Jesus Lino, Jose “Pepe” Pico, Gricel Sacoto, C. Oswaldo Valarezo.
- **Collaborators:** Jordi Bascompte, Merijn Bos, Nina Buchmann, Raphael Didham, Patrick Höhn, Ansgar Kahmen, Alex Klein, Owen Lewis, Anders Nielsen, Jörg Perner, Ingolf Steffan-Dewenter, Teja Tscharntke, Dorte Veddeler, David Wardle.