

Linking conservation with agriculture

fruit crop productivity of NE South Africa depends on savanna biodiversity

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Crop pollination limitation



~70% of major global crops
Improved by animal pollination

Klein et al. 2007 PNAS 274: 303–313

Agricultural expansion



**Decline of
pollinators**



**rebound effects on
agriculture production**

**Evidences in Europe and
North America**

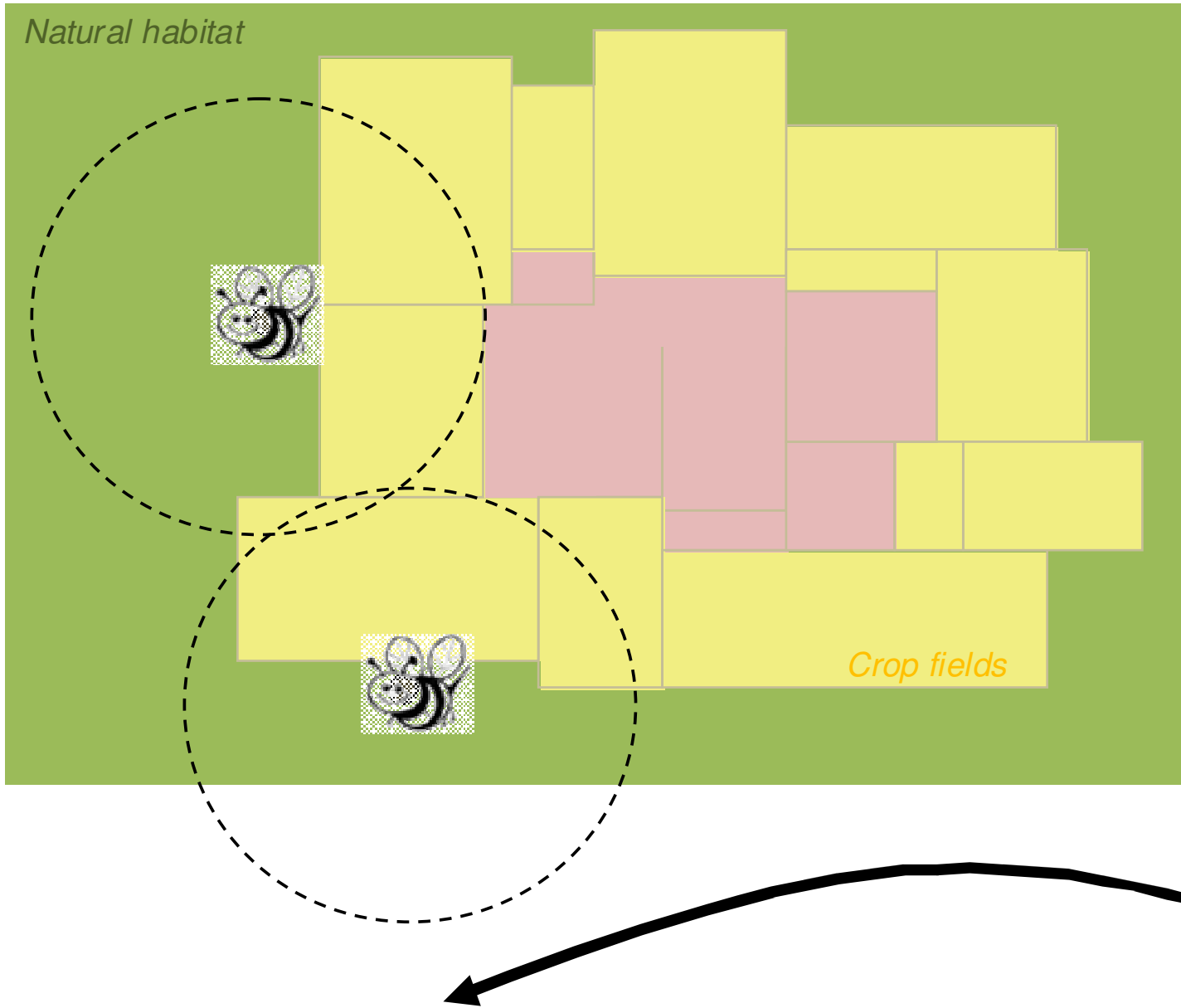
Biesmeijer et al. 2006. Science 313: 351.

Winfrey et al. 2009 Ecology, 90, 2068–2076

South Africa, Cape Town region

Pauw 2007, Ecology, 88: 1759–1769

Pollination crisis - Why is crop pollination at risk?



➤ **managed flower visitors**
(honeybees)



➤ **highly bio-diverse**
landscapes
can support diverse
pollinator communities

Less
negative effects?



Mango (*Mangifera indica* L., Anacardiaceae)



Highly economically important in Africa
and worldwide **tropical/subtropical regions**
>3000% increase plantation area in 40 years
FAO 2009



**rich in well preserved
natural areas**



Study area

Farms

- 4 with pesticides
no managed honeybees
- 4 with pesticides
managed honeybees
- 4 No pesticides (organic)
managed honeybees

Blyde River Canyon
Nature Reserve

South Africa
Limpopo



Hoedspruit

Kruger NP
and
Private
game reserves

- Farms
- ▨ Disturbed areas

Aim

To make management recommendations that can maximize benefits to both agriculture and conservation



Are insects pollinating?




Do landscape and farming practices affect mango pollinators?



Is production affected by pollinator declines?

Are insects pollinating? – Methods

- Exclusion experiment (90 trees – 270 immature inflorescences)


Flying & crawling
insects




Flying
visitors



No insects



10 trees x 6 farms
with managed honeybees

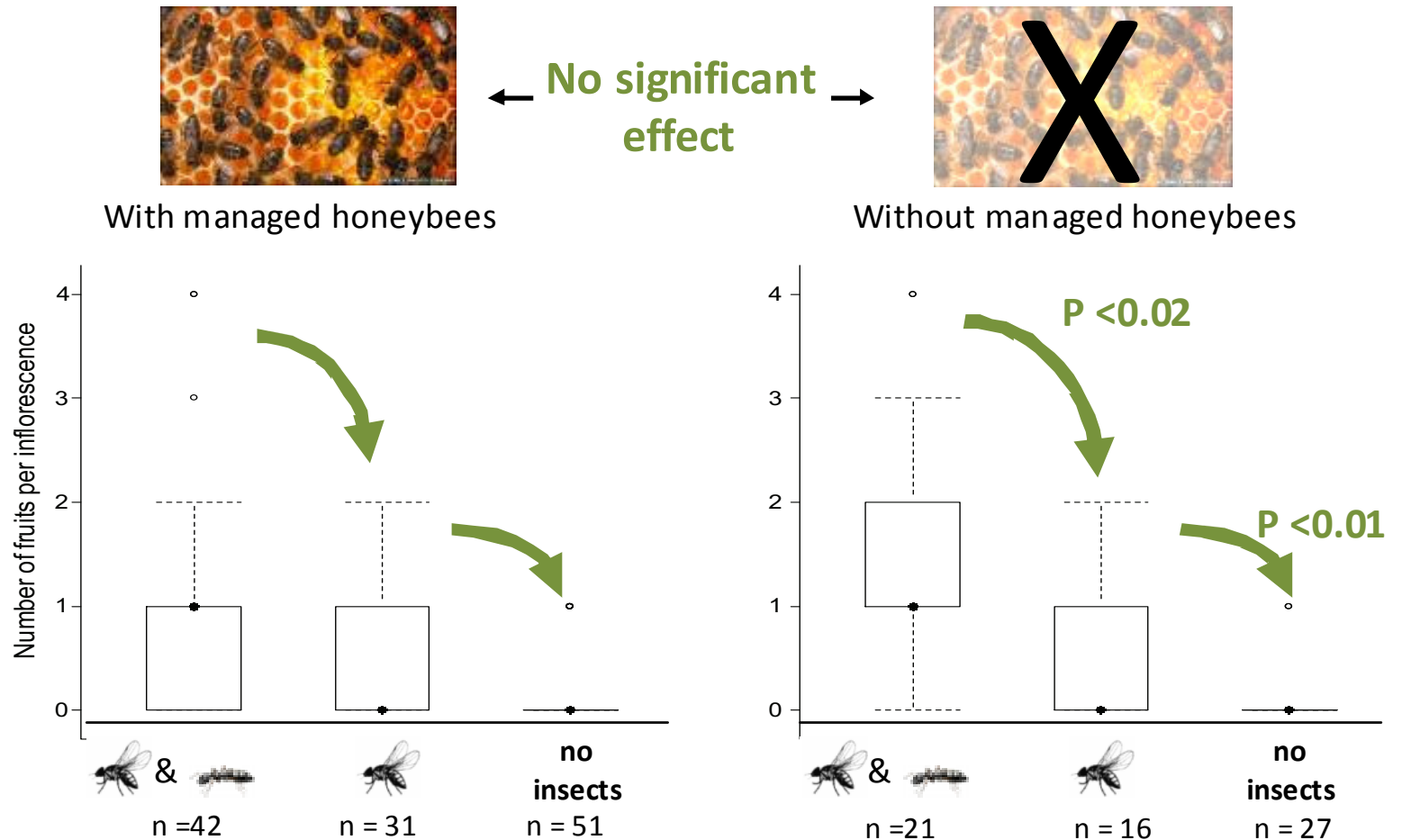


10 trees x 3 farms
without managed honeybees



- Check every month
- Fruit count in November

Are insects pollinating?



➤ Both ants and flying insects were efficient mango pollinators
83% of fruit set is due to insect visitation

➤ Managed honey bees do not contribute for mango pollination

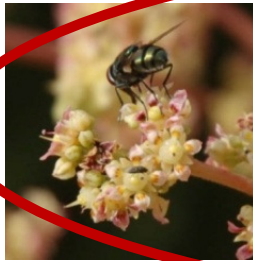
Aim

To make management recommendations for mango production based on landscape



Are insects pollinating?

Yes, wild insects are!



Do landscape and farming practices affect mango pollinators?



Is production affected by pollinator declines?

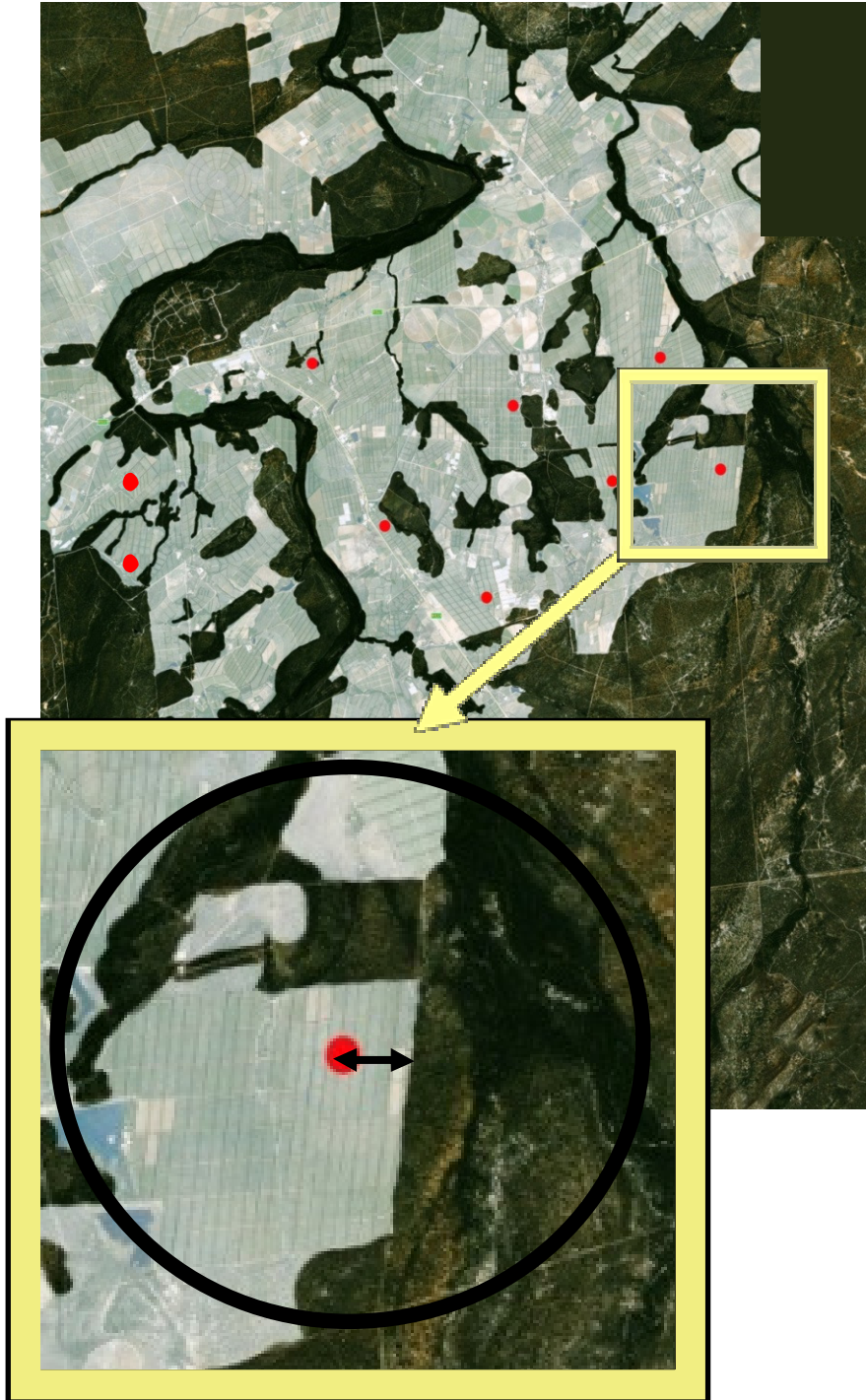
Do landscape and farming practices affect mango pollinators? - methods

Pollination surveys in 12 plots
2008

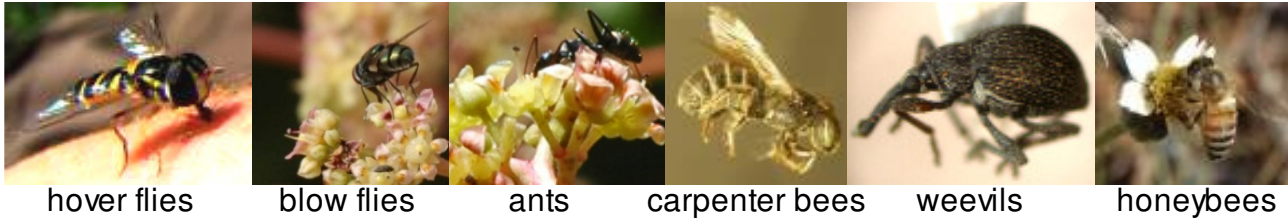


Variables:

- 1 – Distance to natural habitat
- 2 - Use of pesticides (Organic vs. Conventional)
- 3 – Presence of managed honeybees
- 4 – % of natural habitat around the crop field
(1km radius)

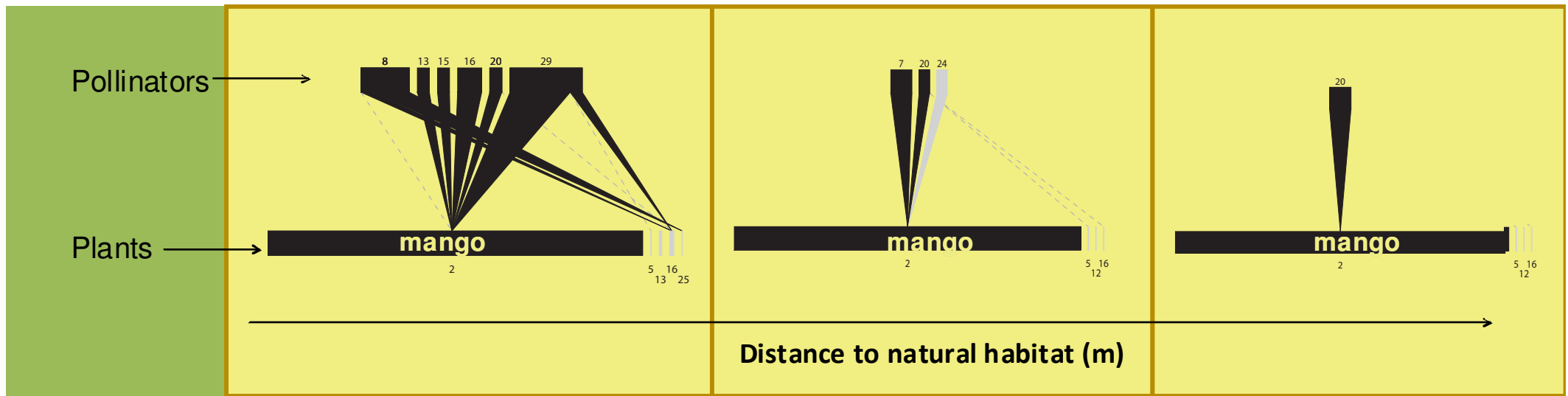


Do landscape and farming practices affect mango pollinators?



- **Pesticides: no effect**
- **Managed honeybees: no effect**
- **% natural habitat around the farm: no effect**
- **Distance to natural habitat: Significant negative effect ($P < 0.001$)**

~75% less
species and abundance
at 500m



Aim

To make management recommendations for mango production based on landscape



Are insects pollinating?

Yes, wild insects are



Do landscape and farming practices affect mango pollinators?

Yes, distance to natural habitat affects



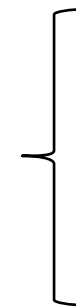
Is production affected by pollinator declines?

Is production affected by declines on pollinator's abundance?



**Production data from
Provided by farmers**

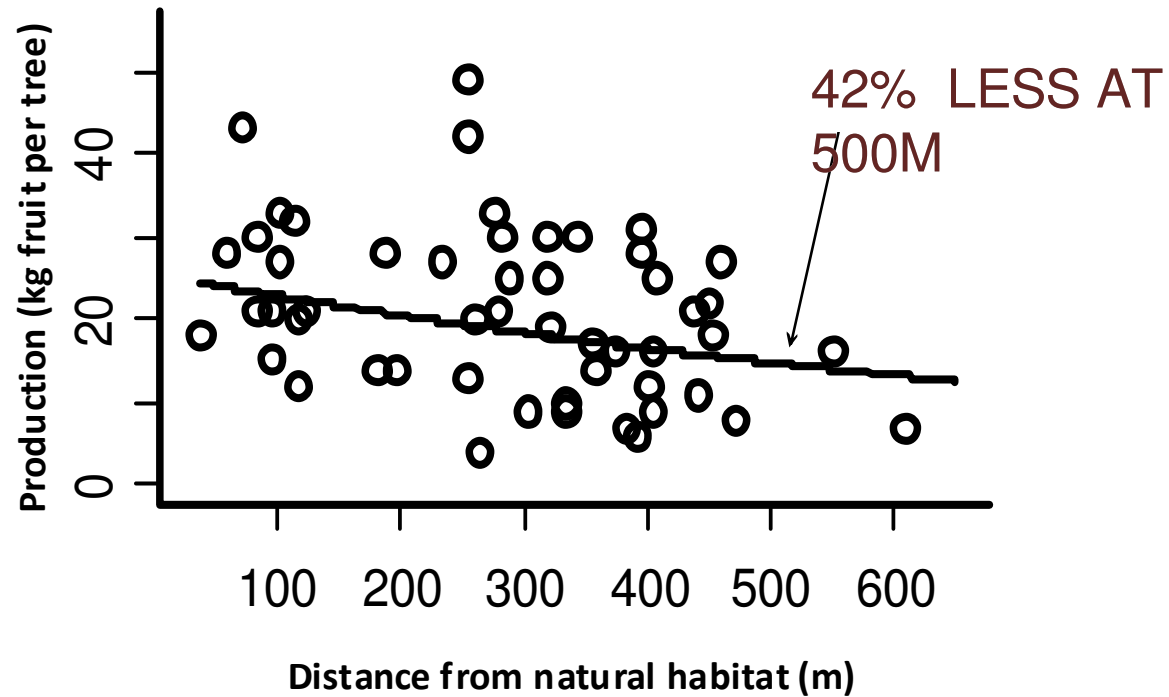
95
plots



0.4 to 1.1 ha,
planted between 1993-1996
550 to 960 trees per ha
consistently productive

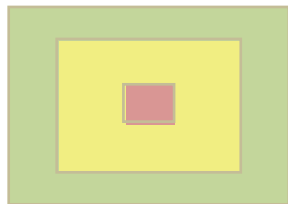
Is production affected by declines on pollinator's abundance?

2008 Production



Isolation from natural habitat

500m



Pollinator abundance
75% less



Production
40% less

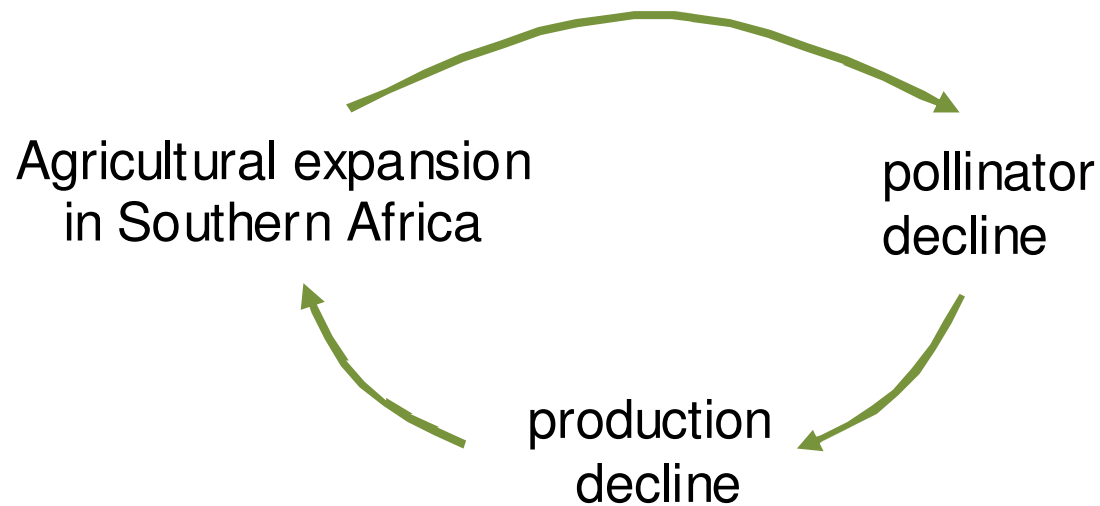


Consequences for farming management



Important tropical crops can be pollinator limited

Managed pollinators did not minimize negative impacts



**Pollinator friendly farming practices
are essential for a sustainable economic
growth of farming**

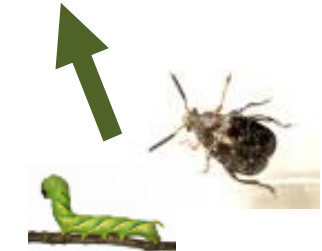
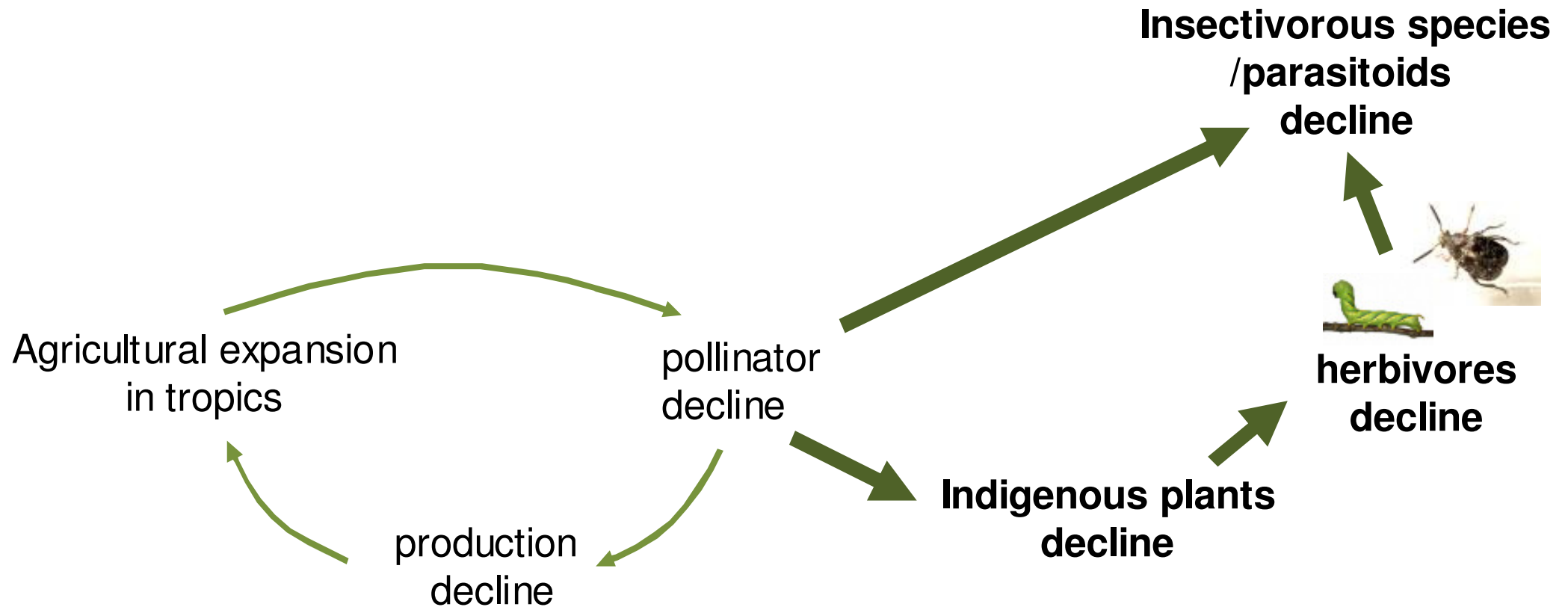
Consequences for Conservation

- 80% of vascular plants depend on pollinators

Buchmann and Nabham 1996

- Negative impacts can easily propagate and be maximized through food webs

e.g. Carvalheiro et al Ecology in press



herbivores decline

Insectivorous species / parasitoids decline

Agri-environmental practices will benefit conservation of natural habitats

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Jaco Fivaz, Frans Louw, Johan van Vuuren and Tjaart van Vuuren

Bavaria Fruit Estates for detailed production data