

**Schmetterlinge bald nur
noch in Museen zu sehen?**

**Gefährdung des Monarch-
Falters (*Danaus plexippus*)
durch Neonikotinoide**

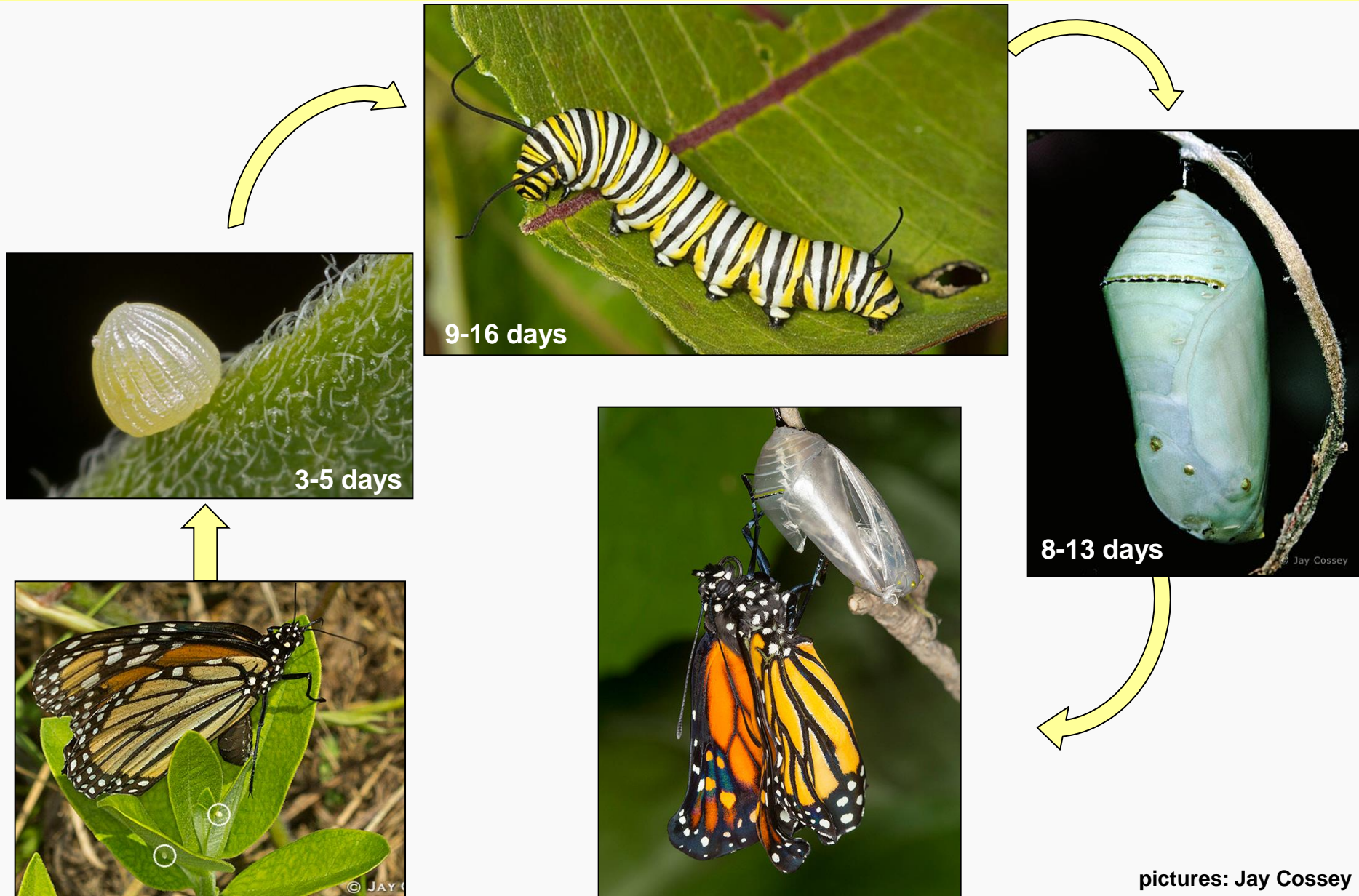


Dr. Hartmut Kretschmer
Landesumweltamt Brandenburg

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1. Biology of *Danaus plexippus*
2. Decline of the monarch butterfly
3. Pathways of Neonicotinoids to the butterflies
4. Impact of Neonicotinoids on butterflies: recent studies to the monarch butterfly
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1. Biology of *Danaus plexippus*: Life cycle



pictures: Jay Cossey

1. Biology of *Danaus plexippus*: habitat



1. Biology of *Danaus plexippus*: feeding plants

27 of the 108 North American species of the milkweed genus *Asclepias* (family: Apocynaceae) are recorded as larval food plants

(MALCOLM and BROWER 1986)

Asclepias syriaca, Common Milkweed

habitat

prairies, old fields, and margins of woods, in the flood plains of lakes, ponds, or waterways, and along creek banks, roadsides, and railways, rows in sandy, clay, or rocky calcareous soils



XERCES 2013

1. Biology of *Danaus plexippus*: feeding plants



Feeding plants:

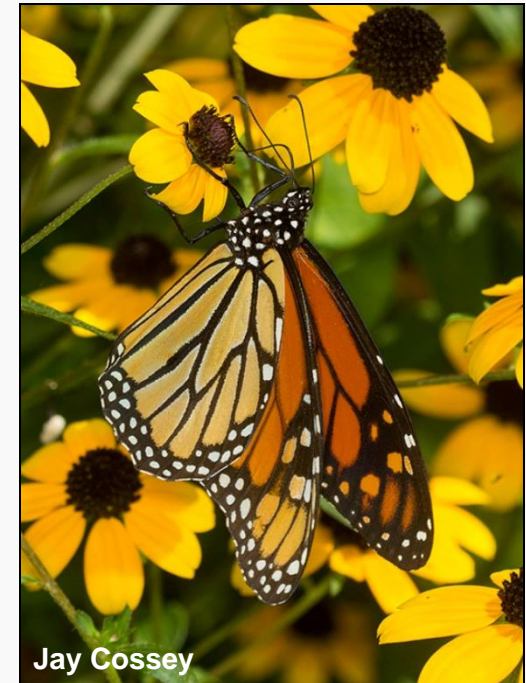
Caterpillar: leave tissue only of milkweed

Adult: nectar of a wide variety of plant species

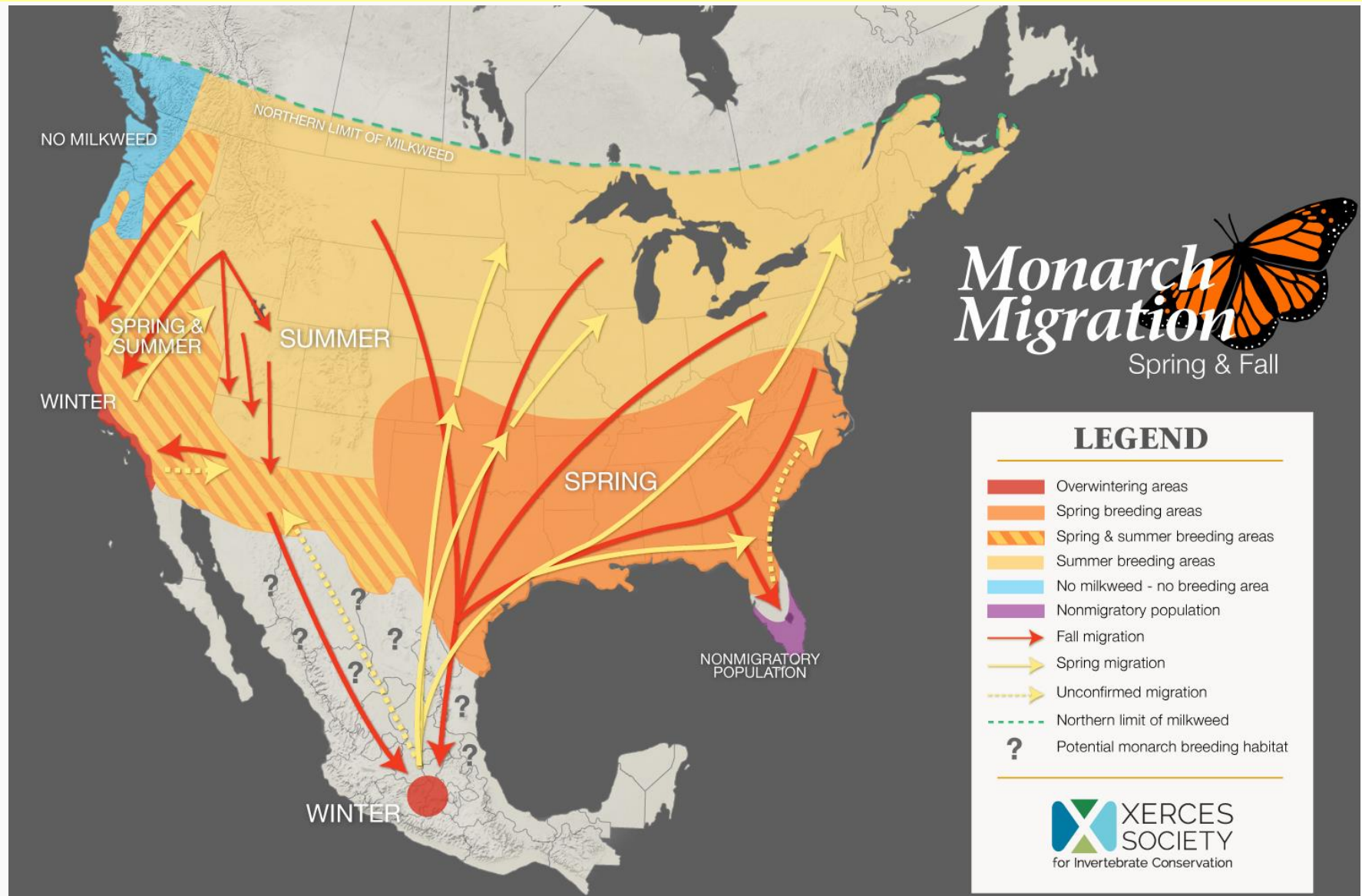
Using of a broad nectar sources (polyphag):

- goldenrods
- asters
- gayfeathers
- coneflowers

also **cultivated alfalfa, clover, and sunflowers**



1. Biology of *Danaus plexippus*: migration behavior



Migration routes, breeding and overwintering areas of monarchs in North America

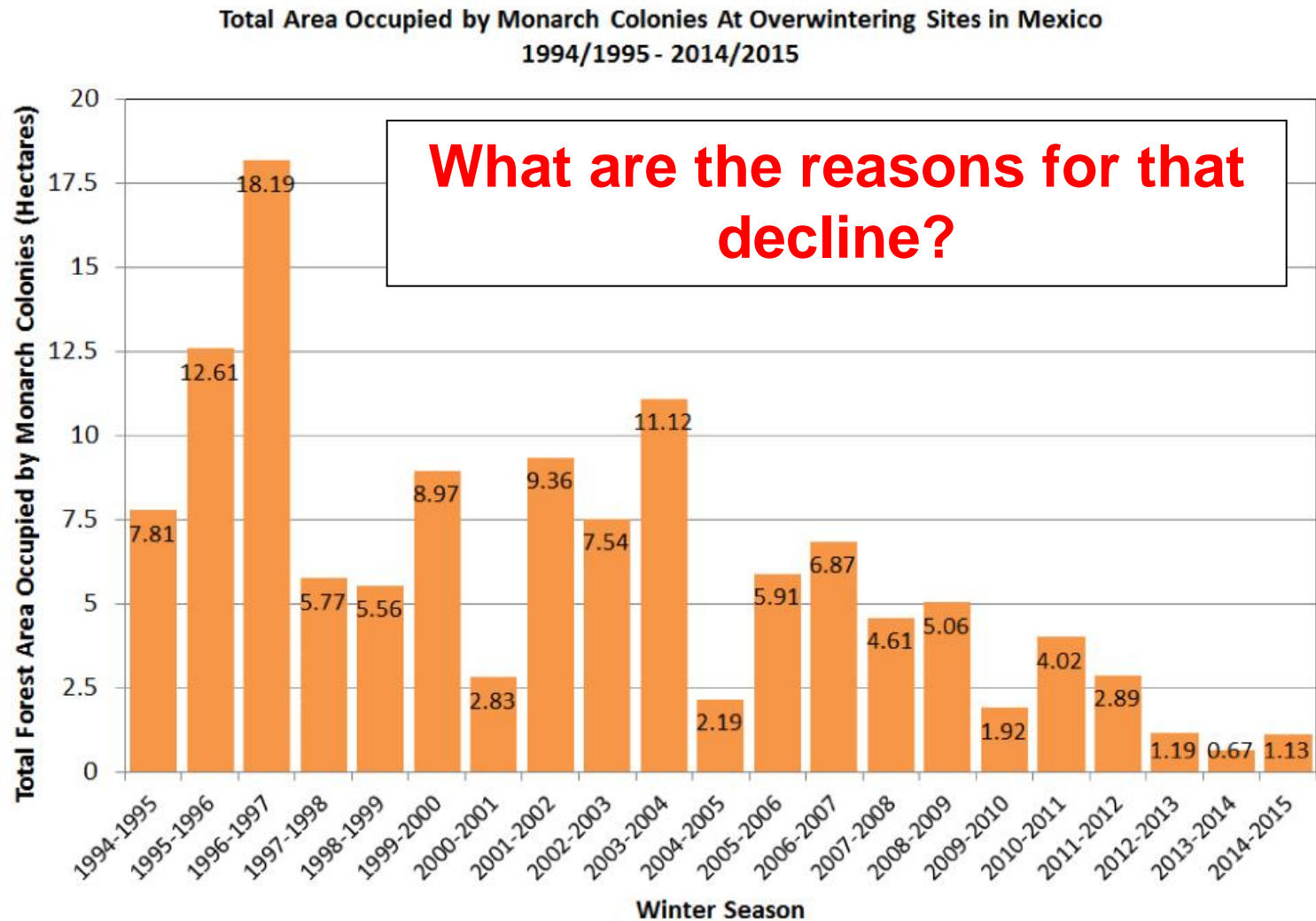
1. Biology of *Danaus plexippus*: migration behavior



Sacred Forest of the Monarchs, with Monarch Butterflies, *Danaus plexippus*,
Leona and Socorro, Michoacán, Mexico, picture: hspauldi

Decline of the monarch butterfly

2. Decline of the monarch butterfly



data from 1994-2003 were collected by personnel of the Monarch Butterfly Biosphere Reserve (MBBR) of the National Commission of Protected Natural Areas (CONANP) in Mexico. Data from 2004-2015 were collected by the WWF-Telcel Alliance, in coordination with the Directorate of the MBBR. 2000-01 population number as reported by Garcia-Serrano et. al (The Monarch Butterfly: Biology and Conservation, 2004)

JEPSEN et al. 2015

2. Decline of the monarch butterfly

Causes are manifold:

land-use changes in the United States

herbicide & pesticide use (Neonicotinoide, Glyphosat, ...)

deforestation & forest degradation in overwintering sites in Mexico

extreme climate conditions in Canada, the United States and Mexico

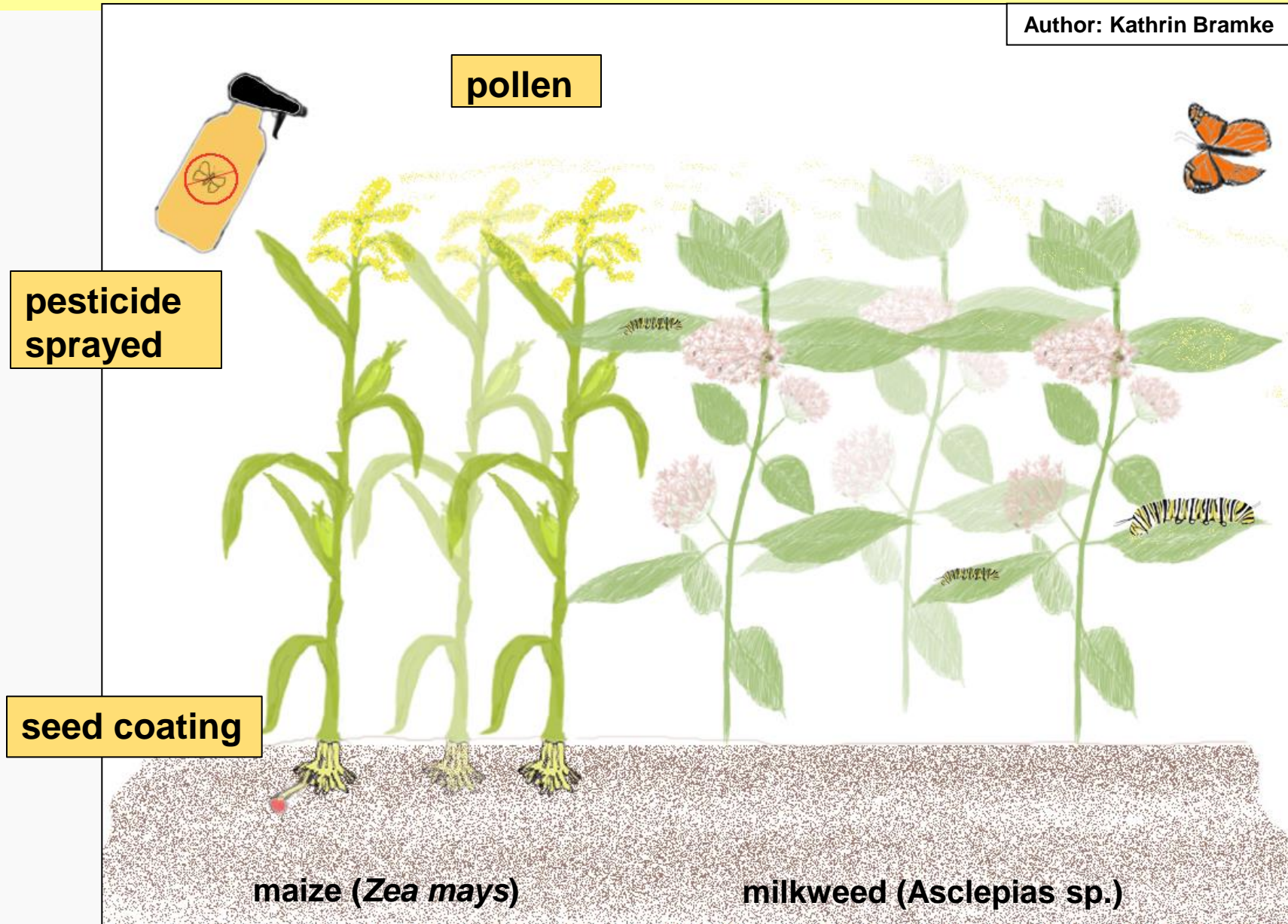
→ **steady decline in the abundance of monarch butterflies**

Unregulated tourism also has become a threat to the dwindling colonies in Mexico

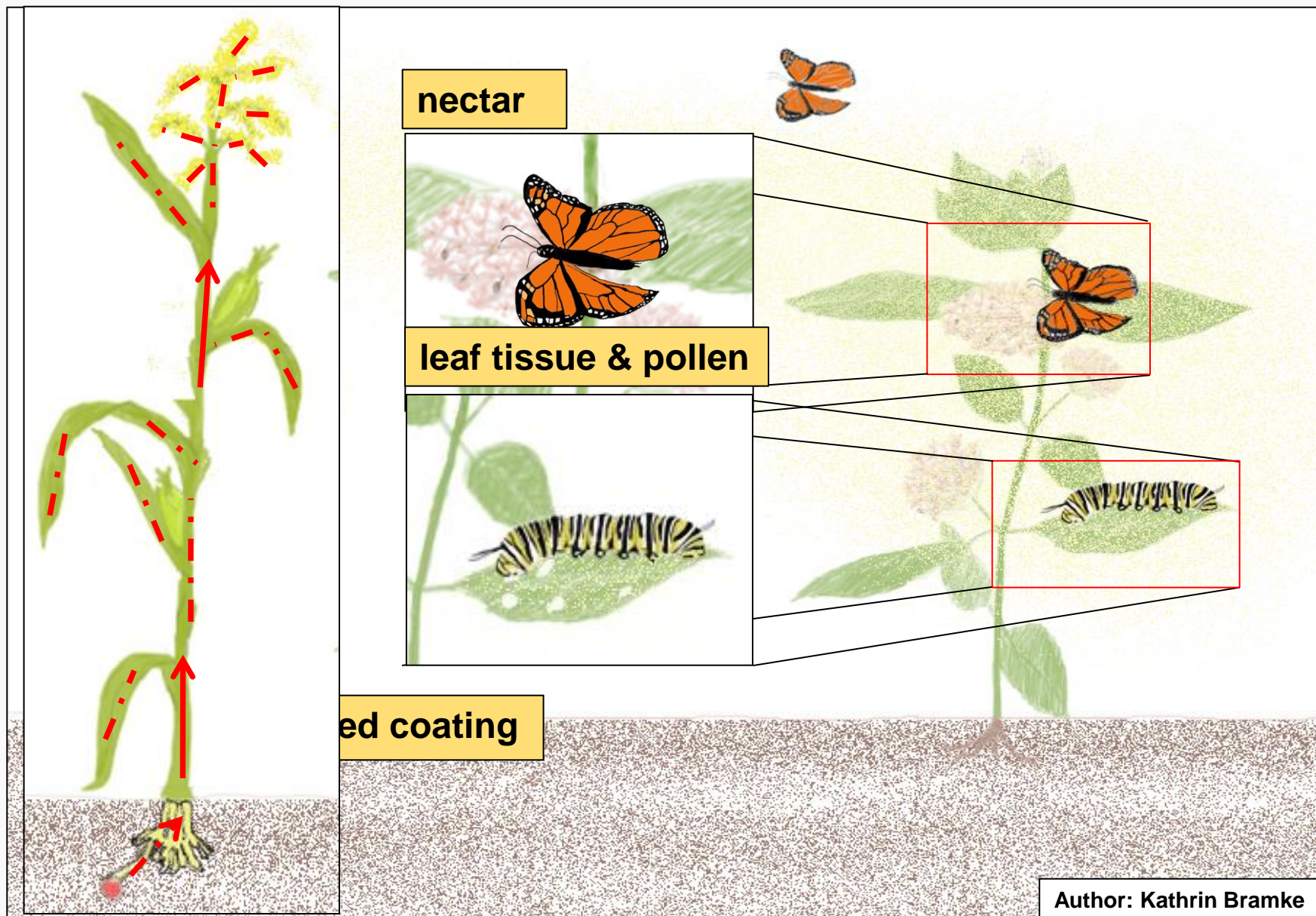
Pathways of Neonics to the butterflies

3. Pathways of Neonicotinoids to the butterflies: systemic effect

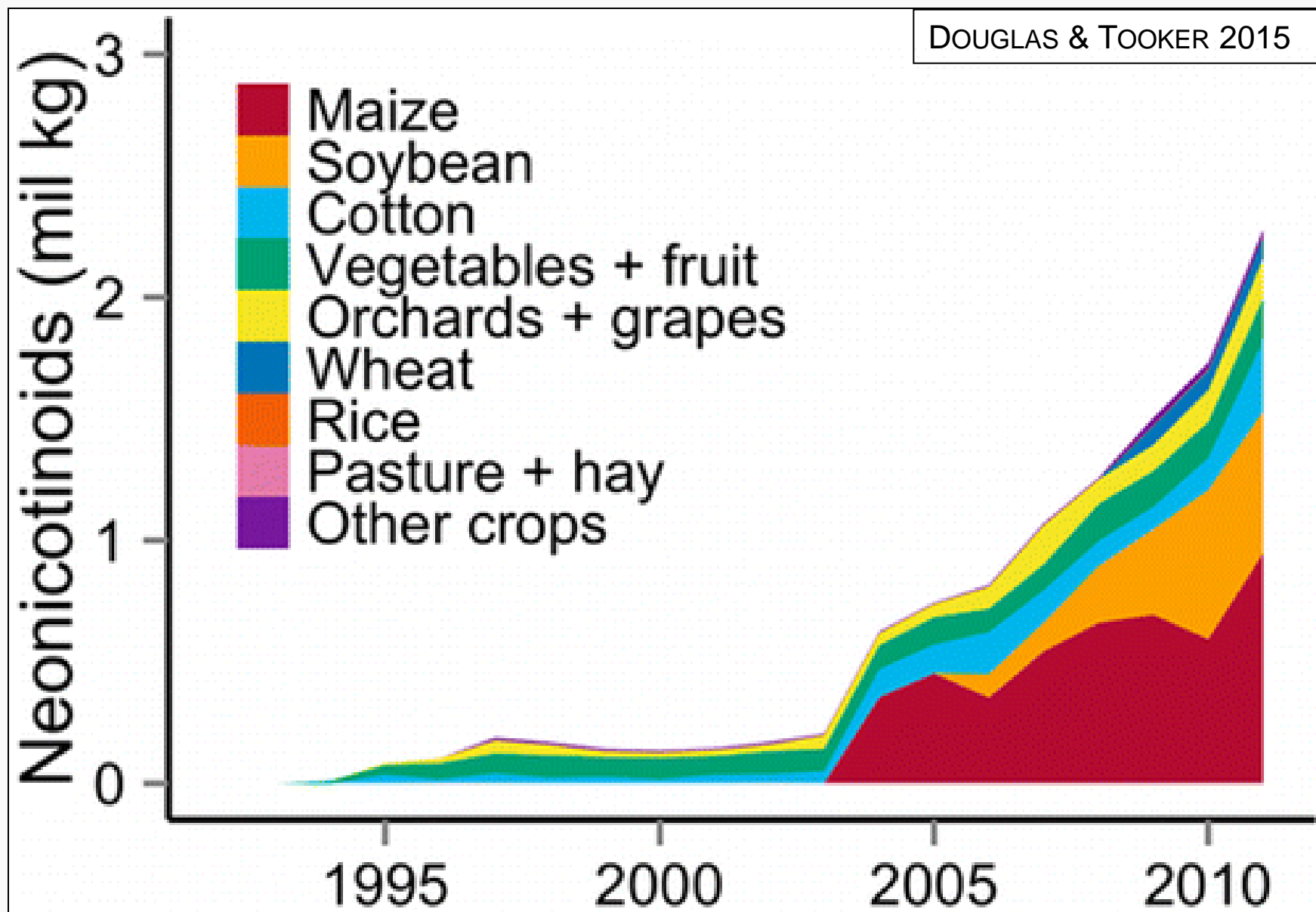
Author: Kathrin Bramke



3. Pathways of Neonicotinoids to the butterflies: systemic effect



Einsatz Neonics in USA



Impacts of Neonics on butterflies: recent studies to the monarch butterfly

4. Impact of Neonicotinoids on butterflies: recent studies to the monarch butterfly

PRECENKA & LUNDGREN 2015

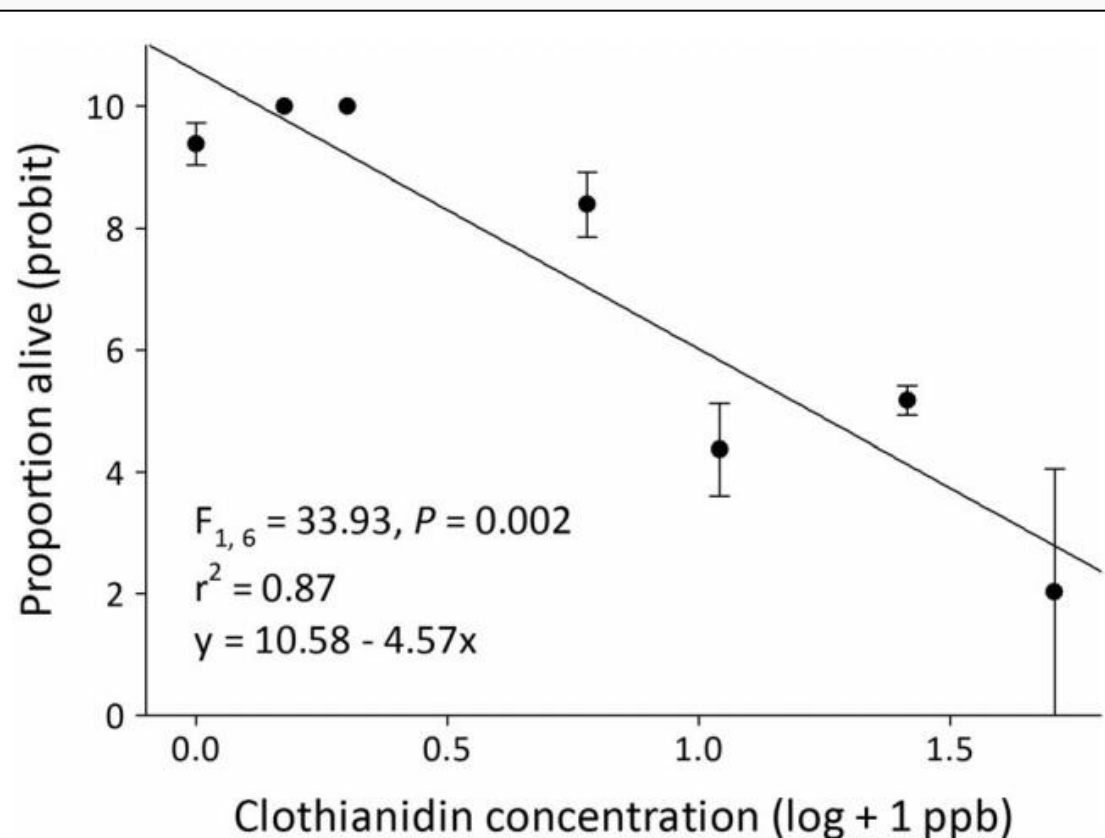


Fig. 1 Cumulative mortality (to the third instar) of monarchs (*Danaus plexippus*) fed clothianidin. Bars represent SEM

active substance
Clothianidin

dose-response-Study &
tests of toxicity

feeding of larvae over 36 h

sublethal impact at 1ppb

mean of 1.14 ± 0.10 ppb
Clothianidin in milkweed,
max: 4 ppb in a single
plant

4. Impact of Neonicotinoids on butterflies: recent studies to the monarch butterfly

OBERHAUSER et al. 2006 Growth and Survival of Monarch Butterflies (Lepidoptera: Nymphalidae)

1. ex
op

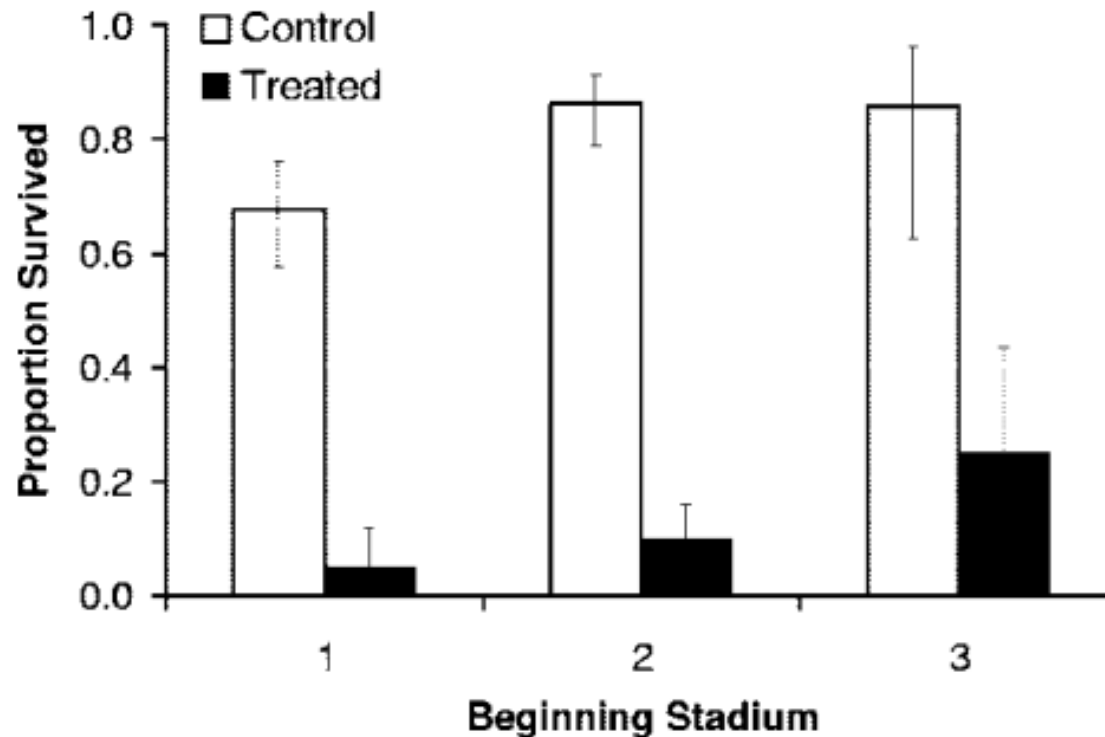


Fig. 1. Overall survival on leaves from permethrin-treated and nontreated milkweed in experiment I, combining all experimental and control monarchs. Error bars represent 95% CIs.

eds in

4. Impact of Neonicotinoids on butterflies: recent studies to the monarch butterfly

KRISCHIK et al. 2015: Soil-Applied Imidacloprid Translocates to Ornamental Flowers and Reduces Survival of Adult *Coleomegilla maculata*, *Harmonia axyridis*, and *Hippodamia convergens* Lady Beetles, and Larval *Danaus plexippus* and *Vernonia cardui* Butterflies

~~Arctopis~~ *curassavica*

Mexican milkweed = C

- 1st butterfly spread soil was applied to the soil 3 weeks prior: 15 ppb
- 1st treatment: 303 ppb of 2X treatment twice a week (1g)
- 2nd treatment was applied 7 month after the first application
- 1st treatment was 31.67 ppb 2X treatment 45.89 ppb of the larvae remained

4. Impact of Neonicotinoids on butterflies: recent studies to the monarch butterfly

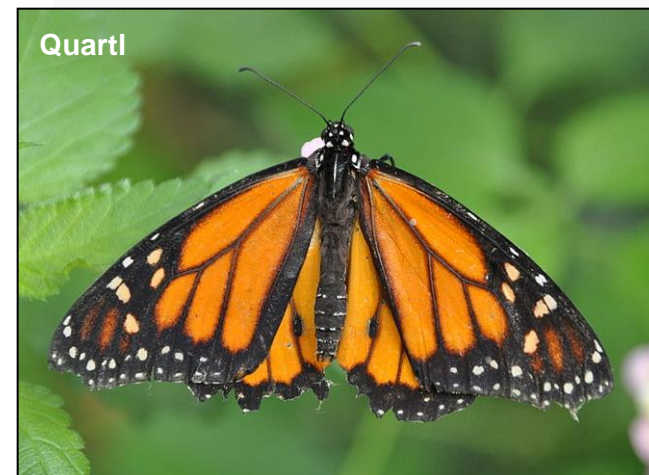
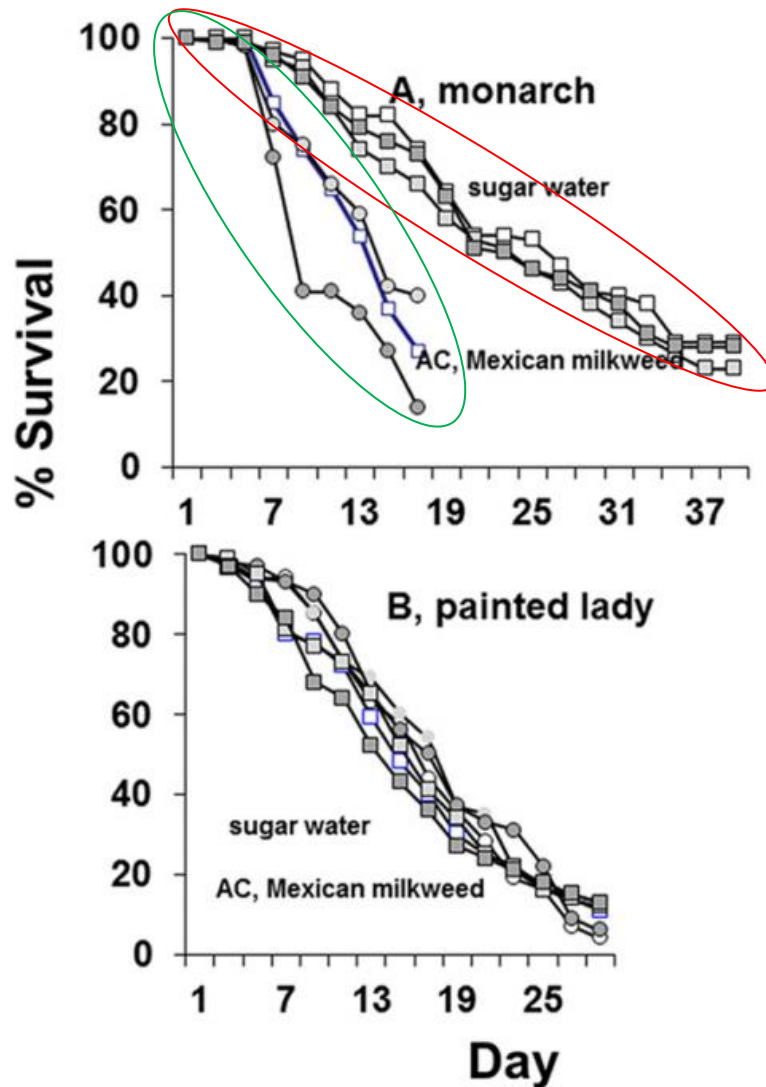
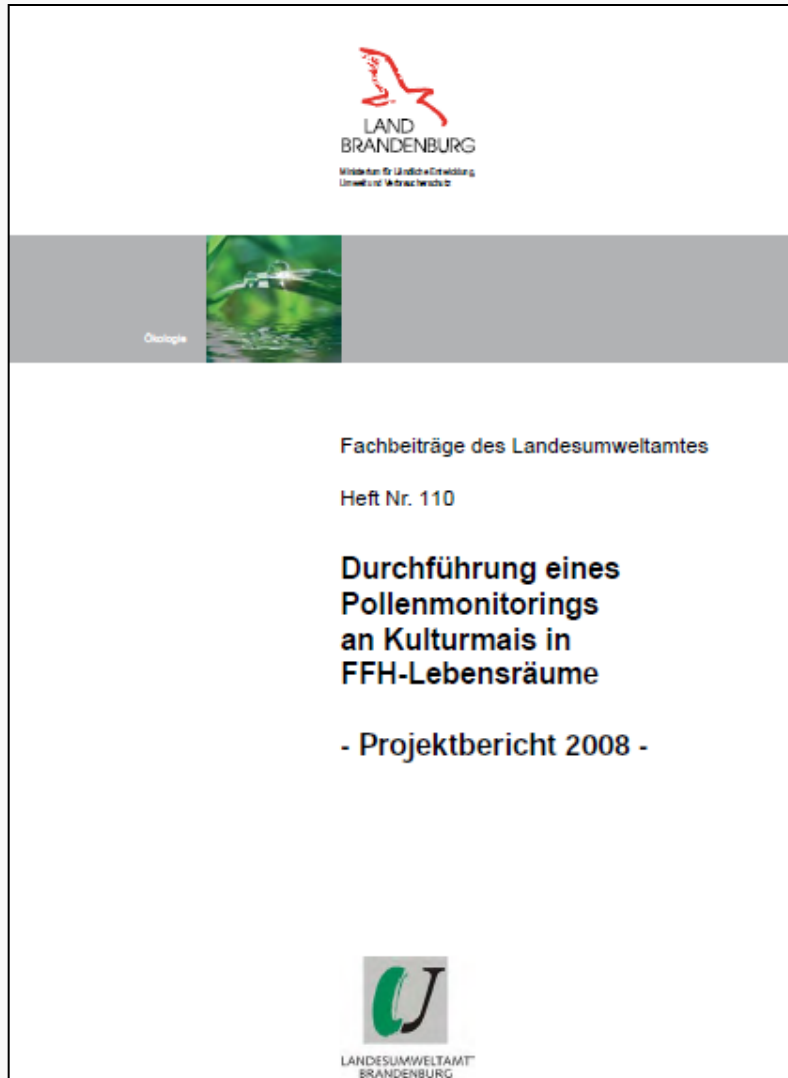


Fig 3. Survival of two species of adult butterflies that were free-ranging and allowed to feed on flowers from Mexican milkweed, *Asclepias curassavica* (AC), that were untreated (C), treated with label rate (1X), or twice label rate (2X) of soil-applied imidacloprid (Marathon 1%G) or that were force-fed 30% syrup syrup (S) containing 0 ppb (C), 15 ppb (1X), or 30 ppb (2X) imidacloprid.

**The Path of Neonicotinoids by pollen for caterpillars
is underestimated until now**

5. The Path of Neonicotinoids by pollen for caterpillar

HOFMANN et al. 2009 & 2011



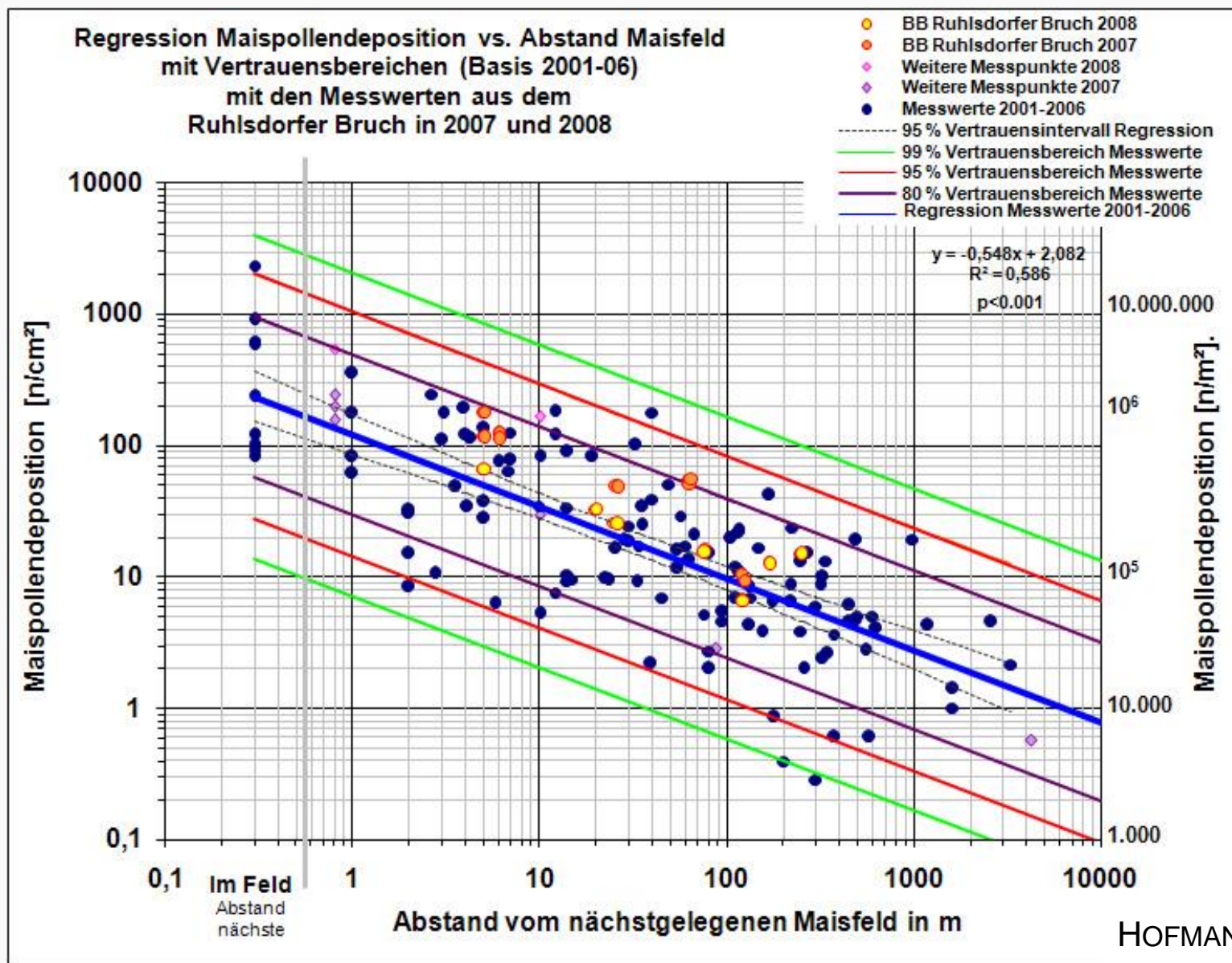
- risk assessment of possible non-target effects from Bt maize
- Bt proteins from the soil bacterium *Bacillus thuringiensis*
- Bt maize pollen deposition
- exposure of non-target Organism (NTOs) with Bt protein via pollen

5. The Path of Neonicotinoids by pollen for caterpillar



Pictures: Frieder Hofmann

Maize pollen deposition in response to the distance from the cornfield



HOFMANN et al. (2009)

Maize pollen deposition in response to the distance from the cornfield

measurment of Bt maize pollen deposition in the field

values around 100 to 300 pollen/cm² (HOFMANN et al. 2011)



Frieder Hofmann

Maize pollen deposition in response to the distance from the cornfield

Rumex obtusifolia



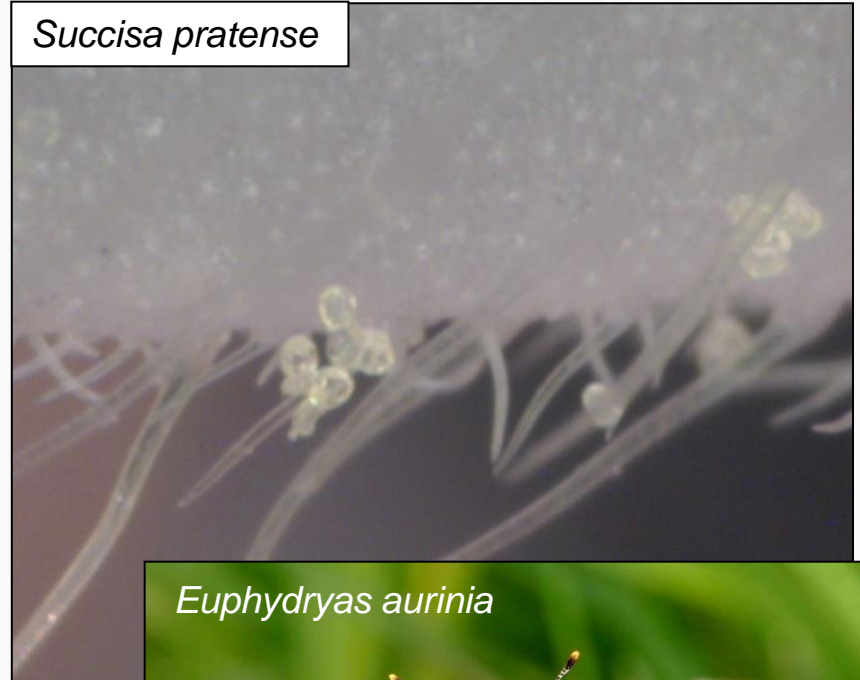
max. 3600 pollen/cm²

Lycaena dispar



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Succisa pratense



Euphydryas aurinia



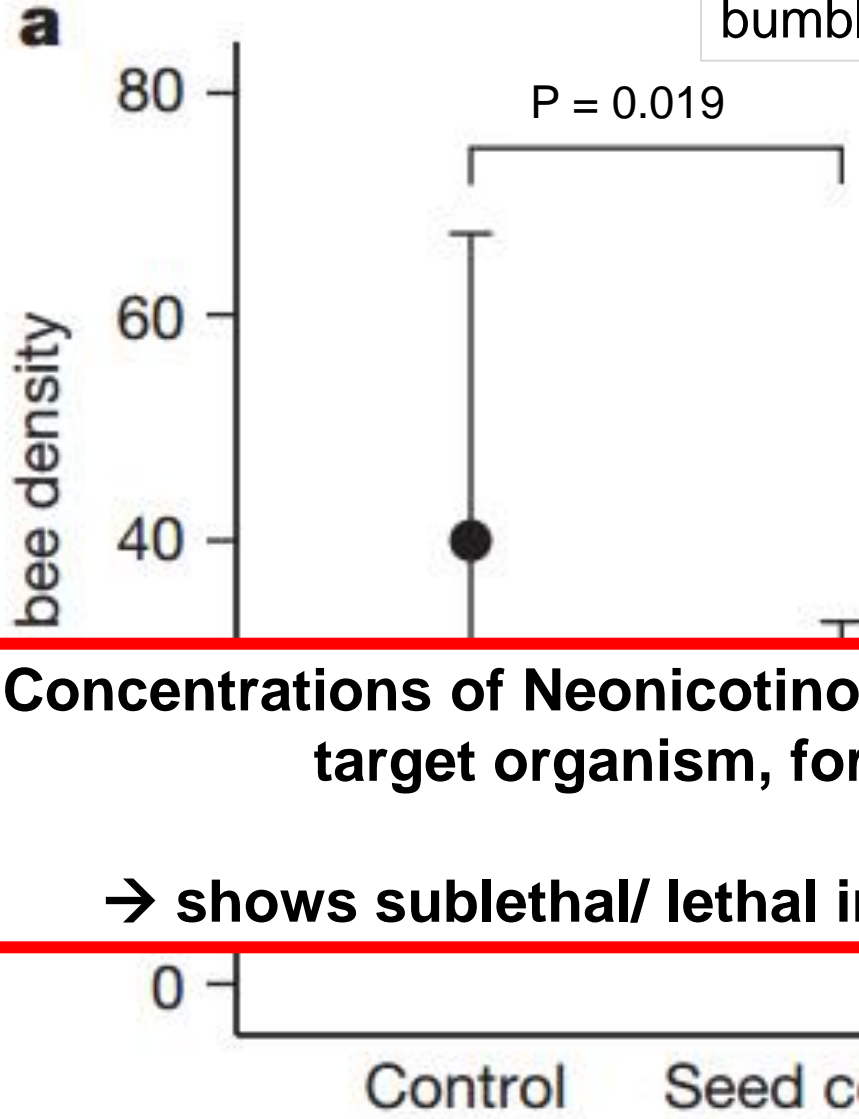
Hartmut Kretschmer

*picture pollen: Frieder Hofmann

5. The Path of Neonicotinoids by pollen for caterpillar

RUNDLÖF et al. 2015, Nature 521

Number of wild bees (solitary bees and bumblebees) per 467 m²



field study in south Sweden on oilseed rape field; seed coating with **Elado** (Bayer), containing the neonicotinoid **clothianidin** & the non-systemic **pyrethroidb-cyfluthrin**

Insecticide seed coating and their path into pollen:

Concentrations of Neonicotinoids in pollen which found in non-target organism, for example in wild bees

→ shows sublethal/ lethal impact in non-target organism

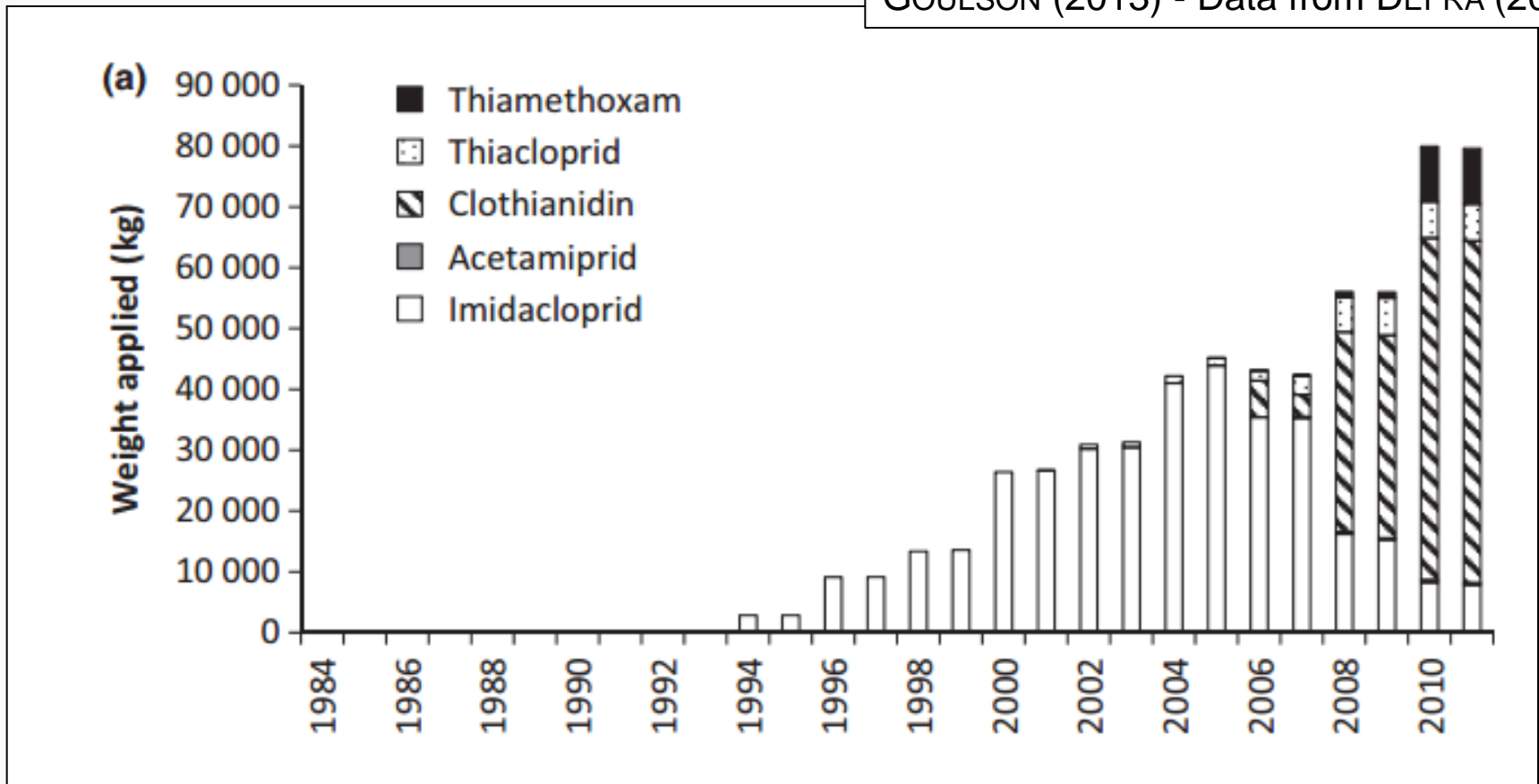
GILBURN et al. 2015, PeerJ

England – decline of abundance of butterflies species by 58% on farmed land between 2000 and 2009

despite both a doubling in conservation spending in the UK & predictions that climate change should benefit most species

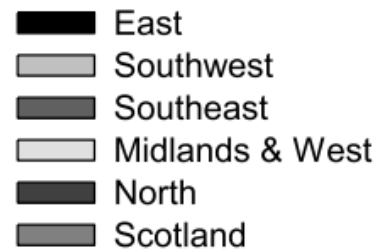
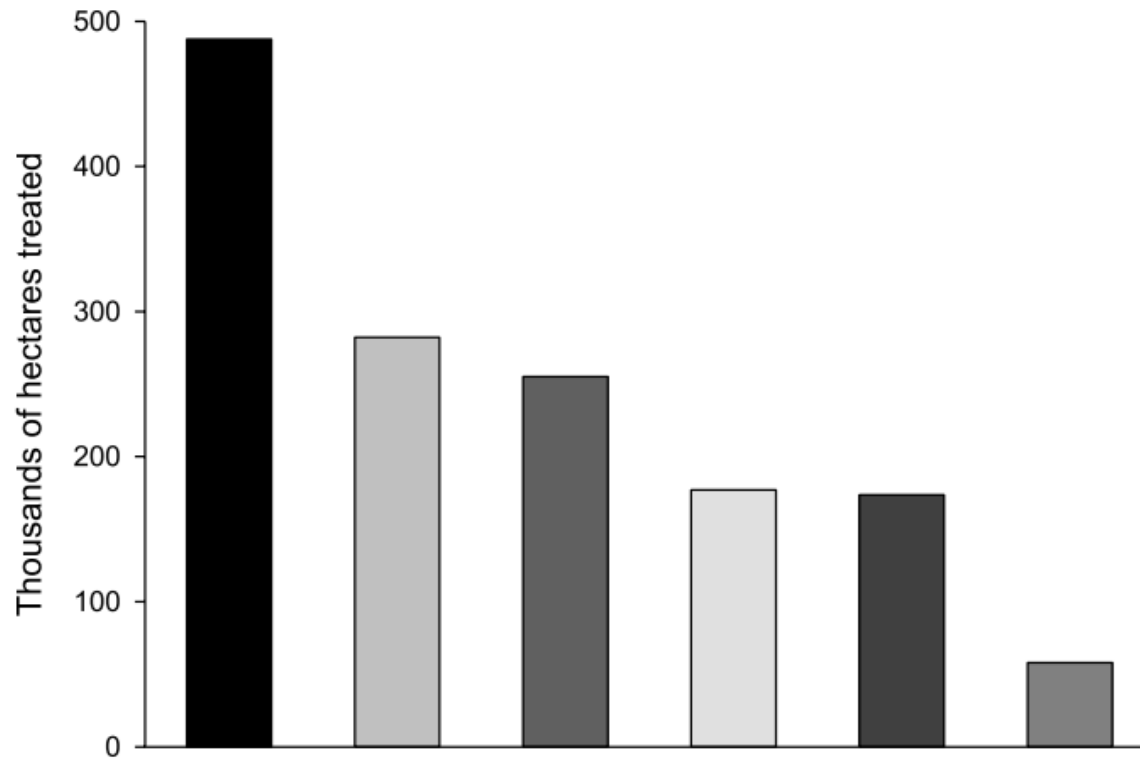
models of the UK population indices from 1985 to 2012 for 17 widespread butterfly species that commonly occur at farmland sites

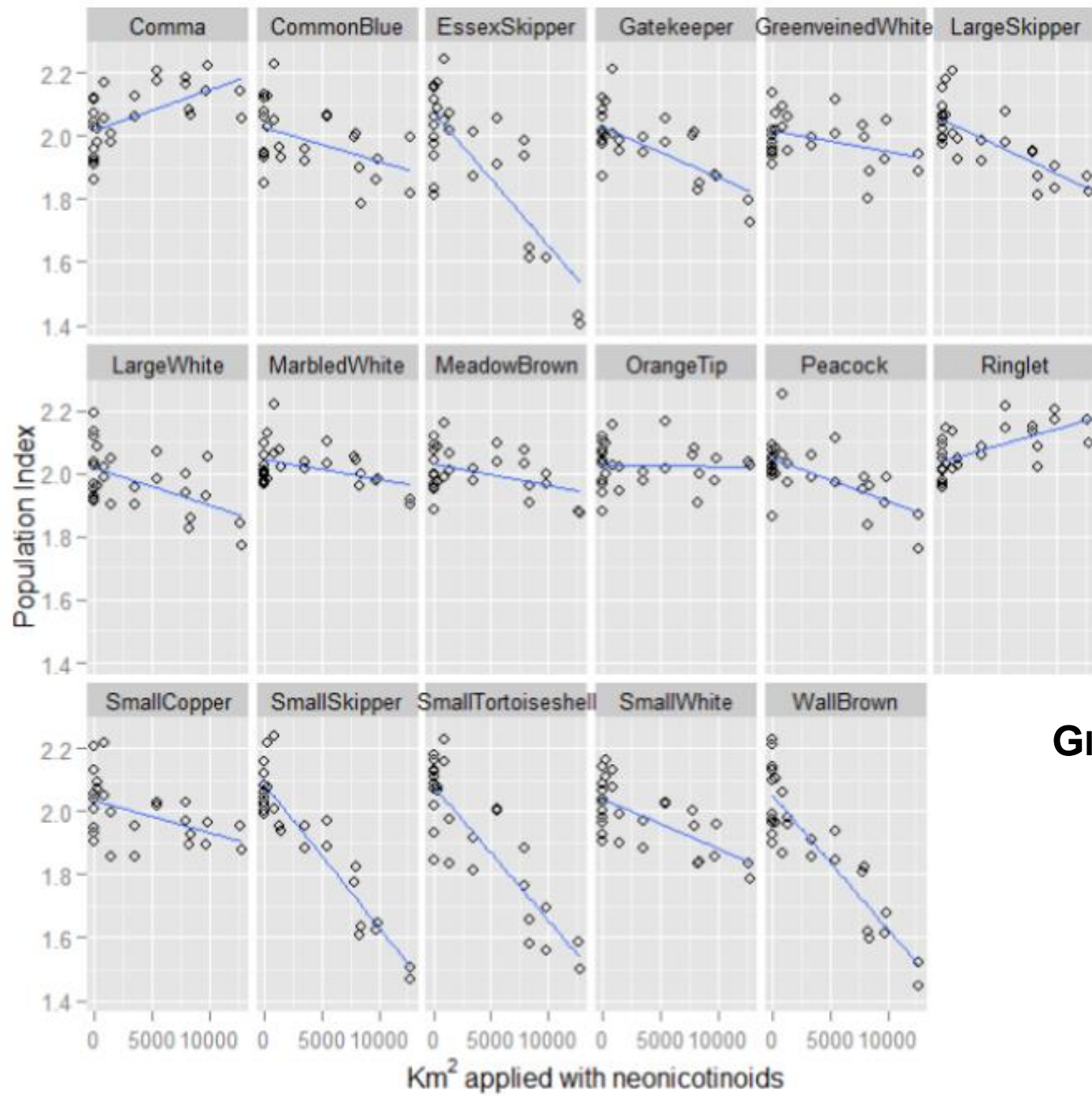
Indices for 15 of the 17 species show negative associations with neonicotinoid usage



Annual usage (kg) of neonicotinoids in agriculture and horticulture in the UK (do not include garden or amenity use). In 2011, the area of land treated was approximately 13 million ha.

GILBOURN et al. (2015) - Data from DEFRA (2014)





GILBURN et al. 2015

Conclusion

6. Conclusion

Based on the results it can be assumed, that Neonics, next to other factors have also a strong influence on the decline of the monarch butterflies

Butterflies are threefold affected by Neonics:

- a) intake of Neonics über nectar of the inflorescence
- b) intake Neonics over larvae food (leaf tissue)
- c) intake Neonics over neonics-containing pollen

the path of Neonicotinoids by pollen to the other butterflies have to be examined in the future



Thanks for your attention.