



Urban trees as habitats

Arthropod diversity in canopies of street trees





Need of more urban tree species !



tree species

2009: 20

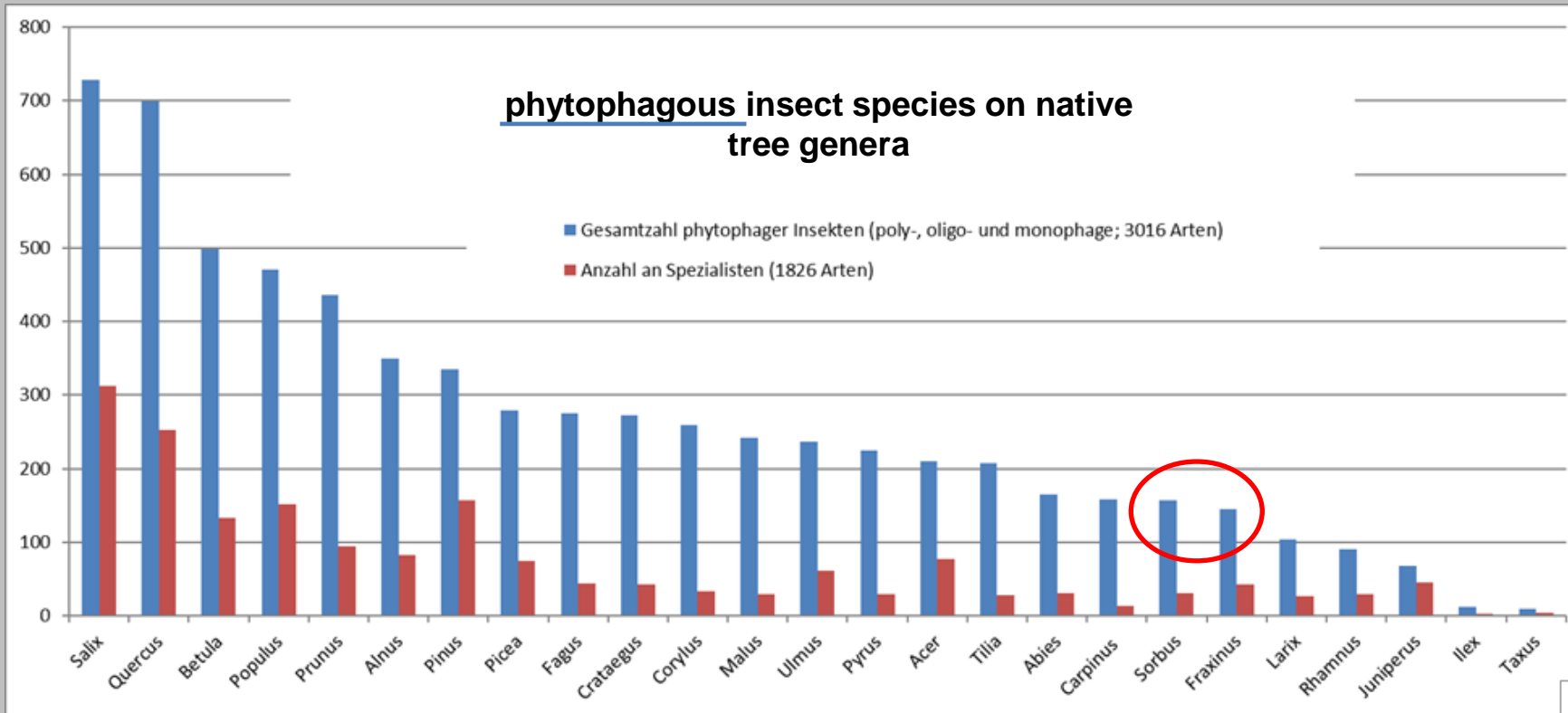
Versuchsbaumarten	dt. Name	Herkunft
<i>Acer buergerianum</i>	Dreizahnhorn	Bergwälder Japans
<i>Acer monspessulanum</i>	Frz. Ahorn	Mittel-/Südeuropa
<i>Alnus x spaethii</i>	Purpurerle	Späth, Berlin, 1908
<i>Carpinus betulus</i> Frans Fontaine	Hainbuche	GA Eindhoven, NL, 1983
<i>Celtis australis</i>		Afrika
<i>Fraxinus ornus</i>		Asien
<i>Fraxinus pennsylvanica</i>		Sorte 1957
<i>Ginkgo biloba</i>		
<i>Gleditsia triacanthos</i>		Sorte 1957
<i>Malus tschonoskii</i>		Schwarznuss
<i>Parrotia persica</i>		Wollapfel
<i>Platanus orientalis</i>		Morgenländische Platane
<i>Quercus cerris</i>		Kleinasien
<i>Quercus x hispanica</i>	Henk Vink	Sorte, NL 1979
<i>Quercus frainetii</i>	Redmond	Sorte 1979
<i>Sophora japonica</i>		Sorte USA 1964
<i>Tilia tomentosa</i>		Asien, 1930
<i>Ulmus Lobelii</i>	Ulme	Wageningen, NL 1973
<i>Zelkova serrata</i> Green Vase	Jap. Zelkove	China, Korea, Sorte USA 1983

2015: 10 test tree species

Do non-native street tree species show a comparable arthropod diversity as native trees ?



Biodiversity potential of native tree genera



(O. Schmidt 2021, cf. Brändle & Brandl, 2001)

Native tree species

2017: case study with 3 pairs of closely related tree species (5 trees/ species)

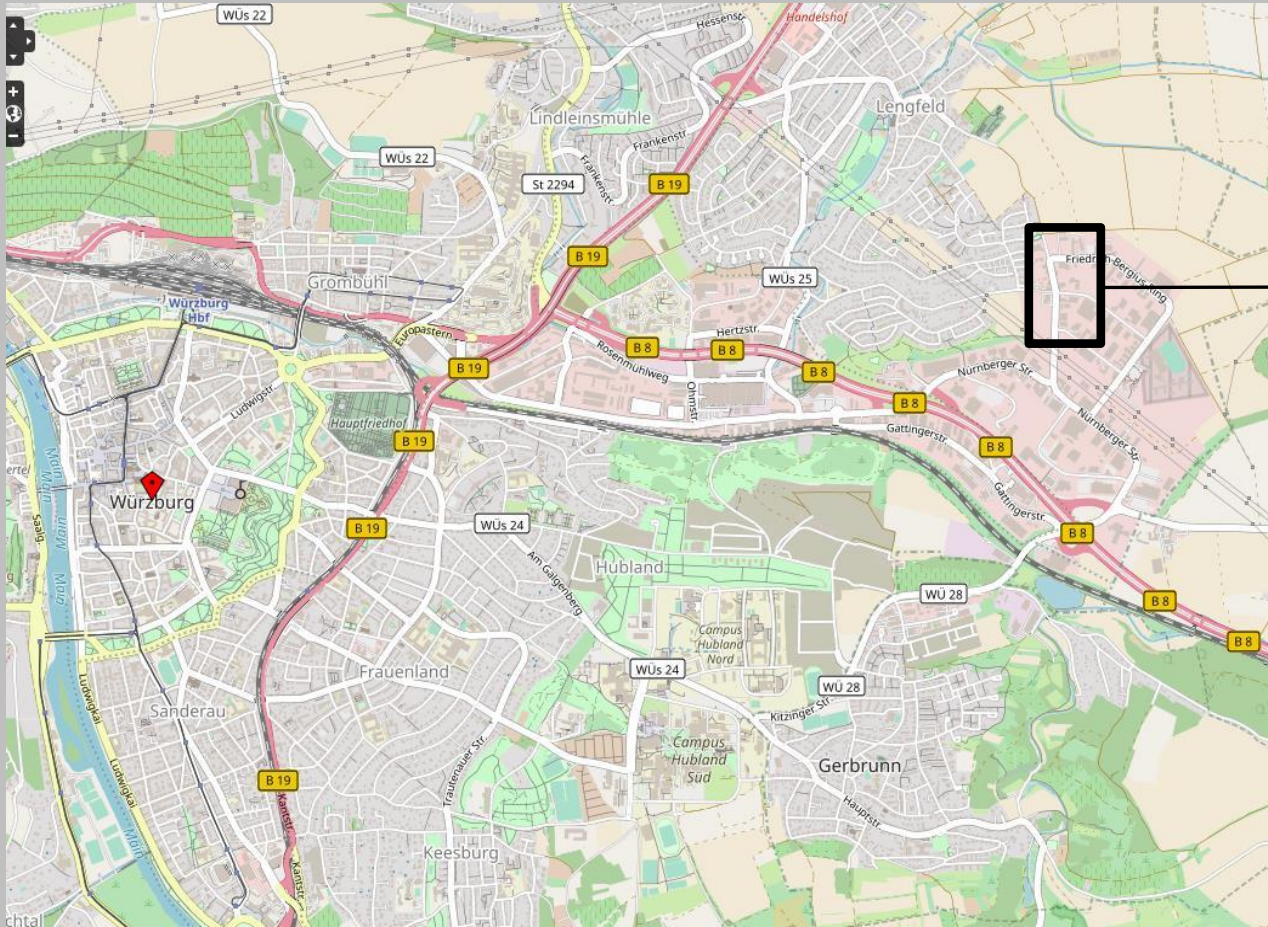
native tree species	Southeastern European tree species
<i>Tilia cordata</i> Greenspire	<i>Tilia tomentosa</i> Brabant
<i>Fraxinus excelsior</i> Westhofs Glorie	<i>Fraxinus ornus</i>
<i>Carpinus betulus</i> Frans Fontaine	<i>Ostrya carpinifolia</i>

Do non-native street tree species show a comparable arthropod diversity?

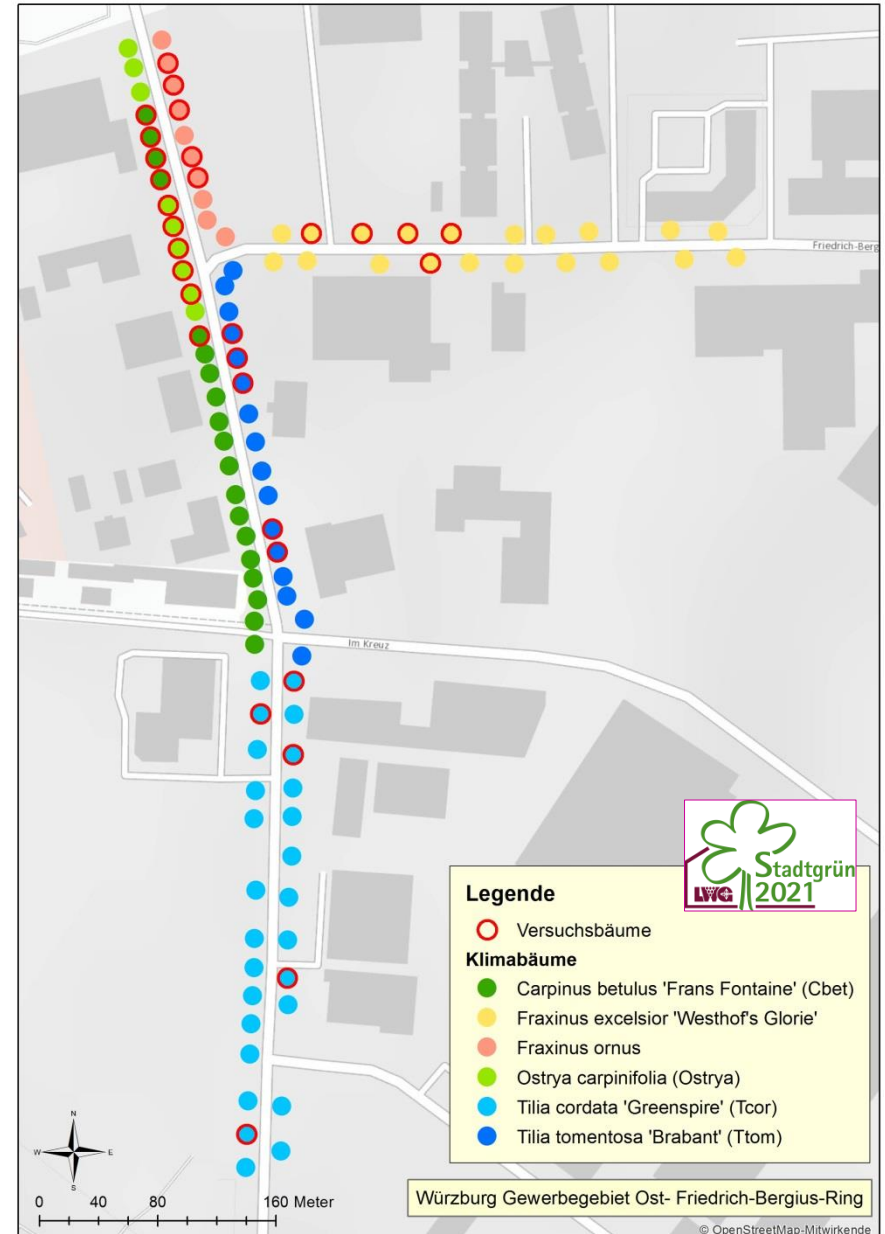
Urban Green 2021+

stress-tolerant urban trees

Study site: Würzburg, industrial area



OpenStreetMap



Datenmaterial: ArcGis Basemap, Bearbeitung: Lisa Wasitschek



Julius-Maximilians-
**UNIVERSITÄT
WÜRZBURG**

Dr. Susanne Böll

Stadtbäume als Lebensraum



Methods





gefördert durch
Bayerisches Staatsministerium für
Umwelt und Verbraucherschutz



cooperation: Dr. D. Mahsberg
master student R. Albrecht

Comparative studies on insect diversity in the canopies of native and South-eastern European urban tree species, April - October 2017



Window trap



Sticky traps



Knocking device



Do non-native urban tree species show a comparable insect diversity?





Species determination by taxonomists:

Predators: spiders

Herbivores: leaf beetles and weevils

Sucking insects: cicadas, bugs

Nectar collectors, predators: hymenoptera
(wild bees, wasps, bumble bees ...)

Urban Green 2021+

stress-tolerant urban trees



804 window traps
390 knocking samples
416 yellow sticky traps



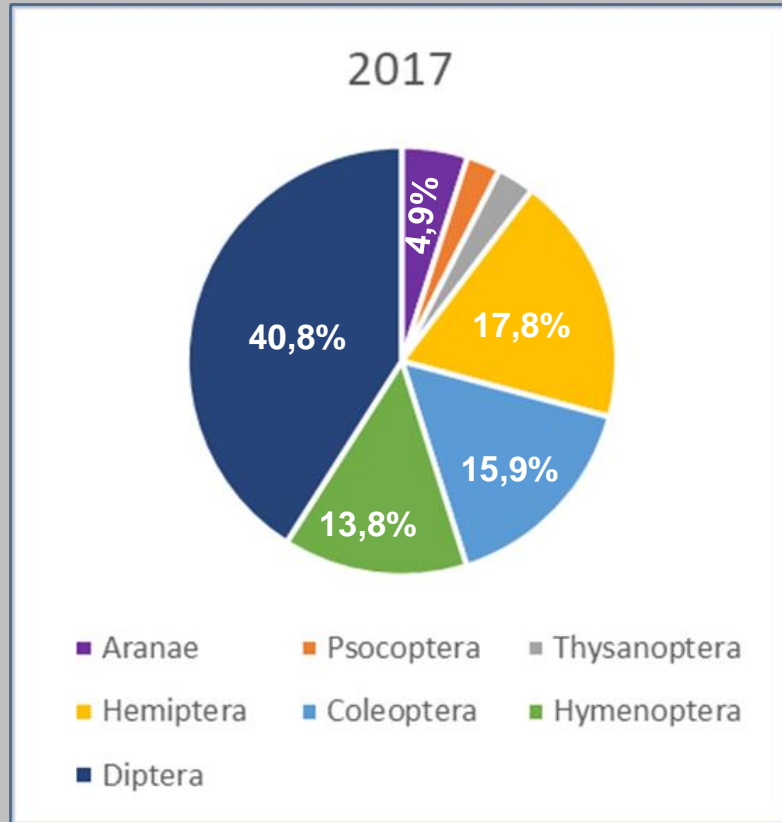
23.883 insects und spiders from window traps and knocking samples
ca. 70.000 from yellow sticky traps

=

A total of more than 90.000 arthropods!

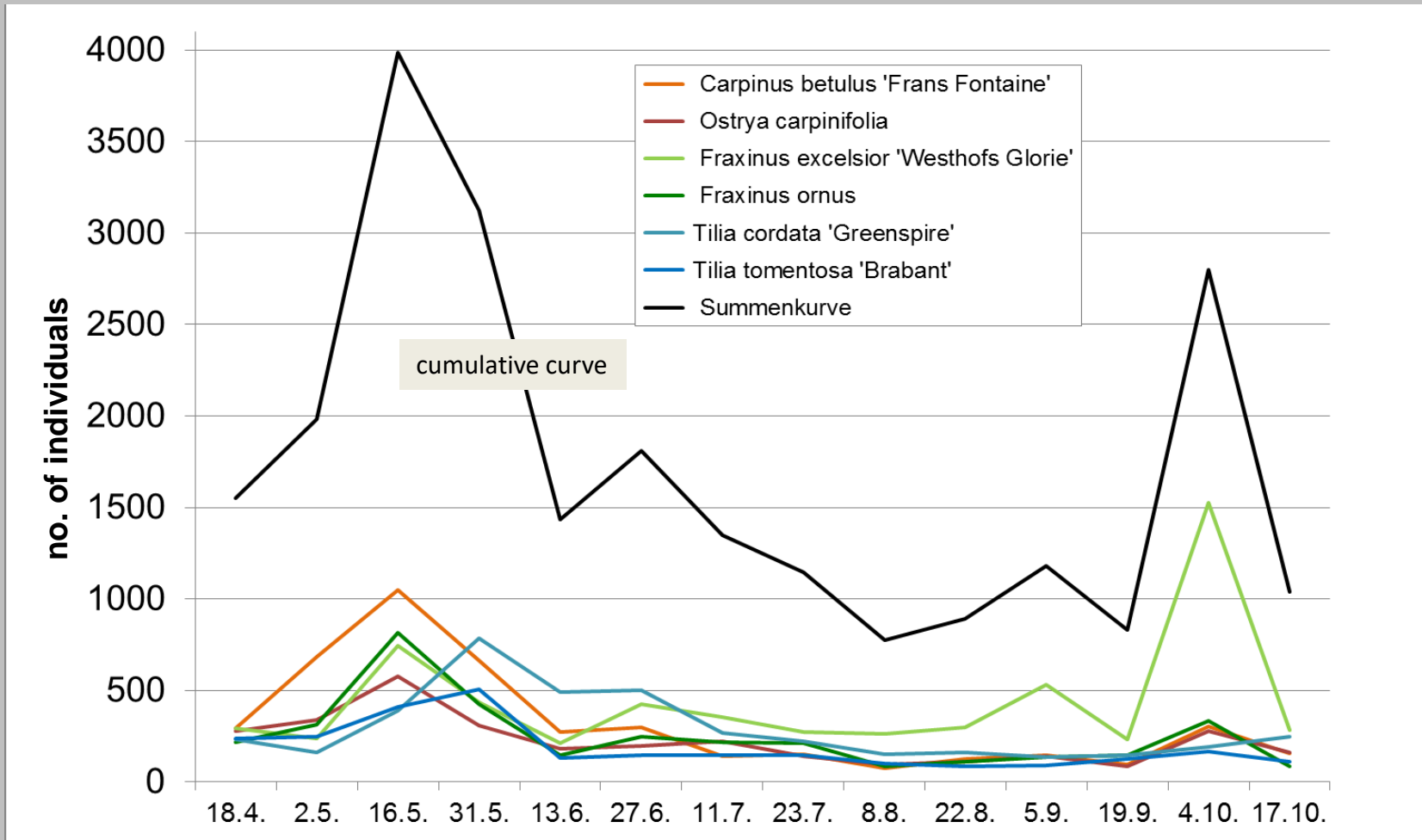
Composition of the tree canopy communities at order level

Window traps + knocking samples: n=23.883 individuals



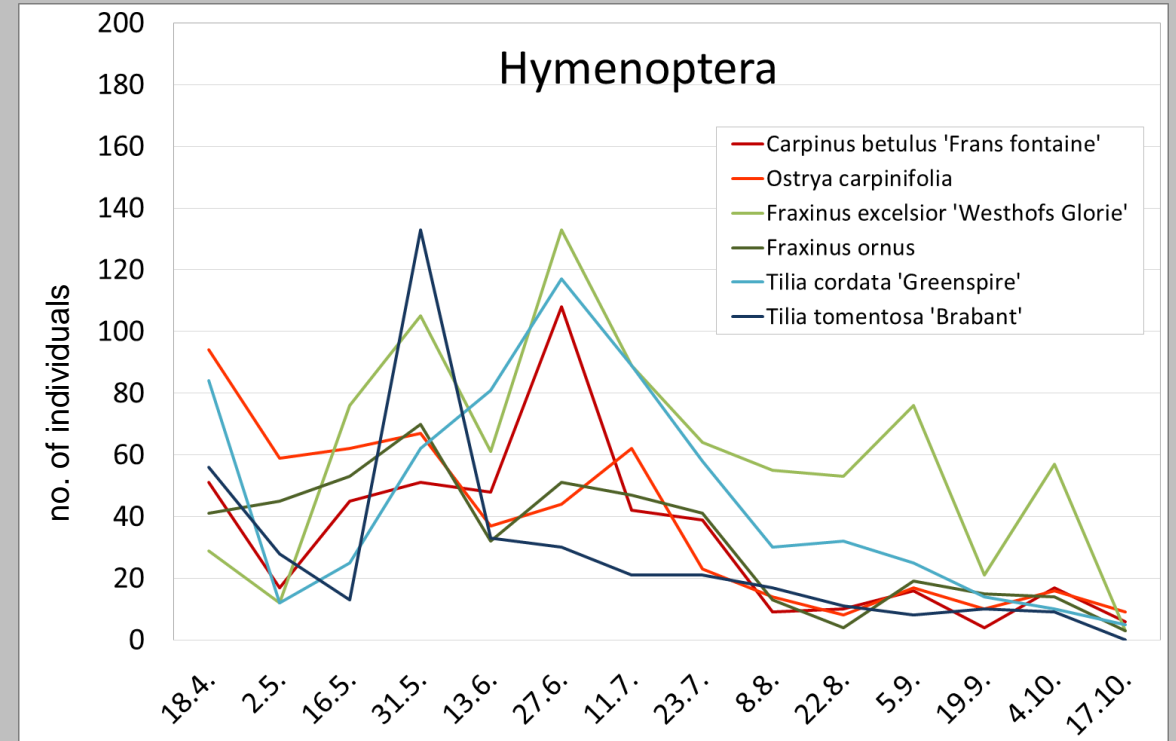
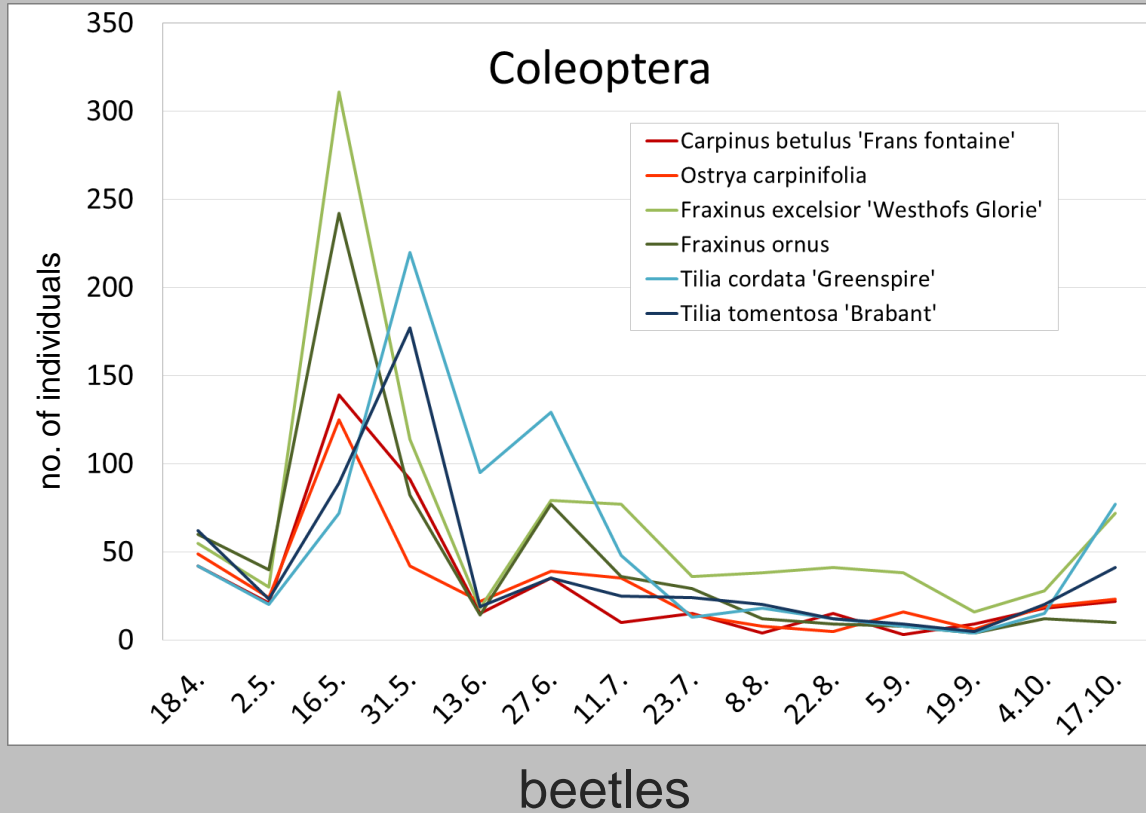
▶ 17 insect orders
+ spiders

Abundance ratios



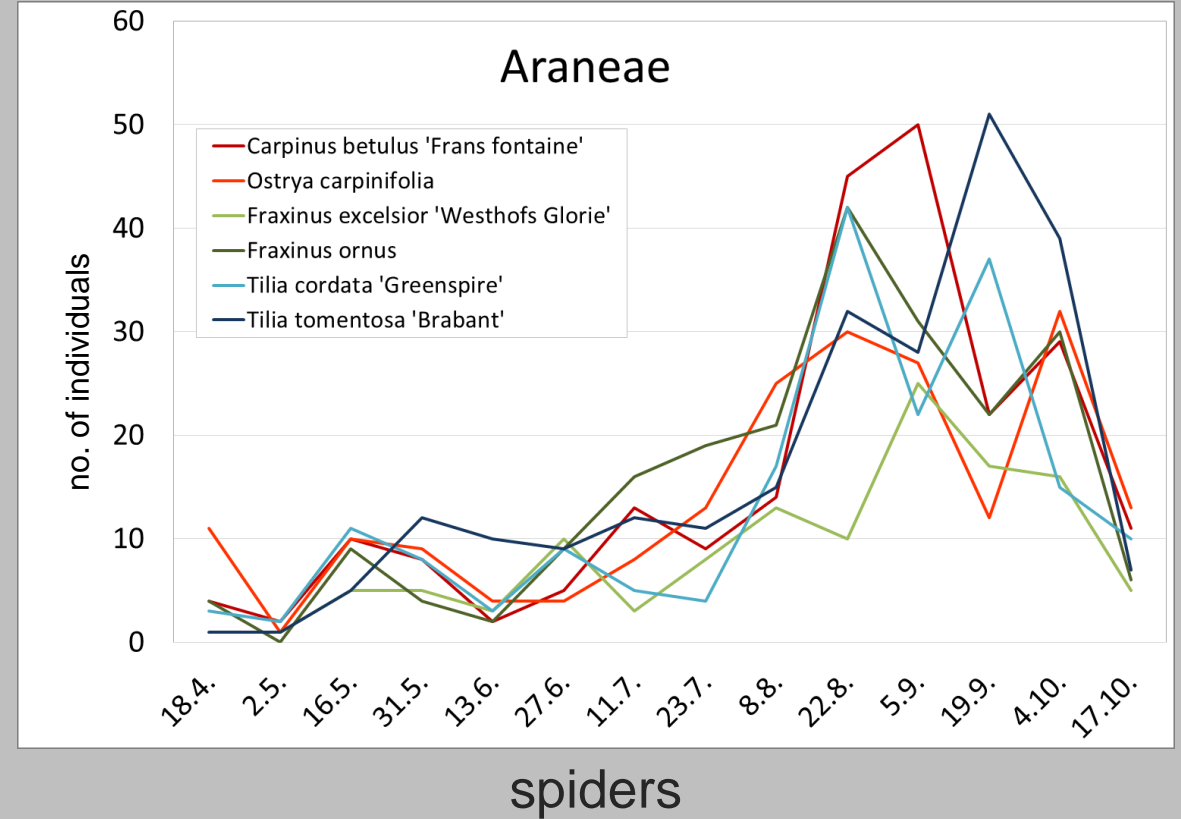
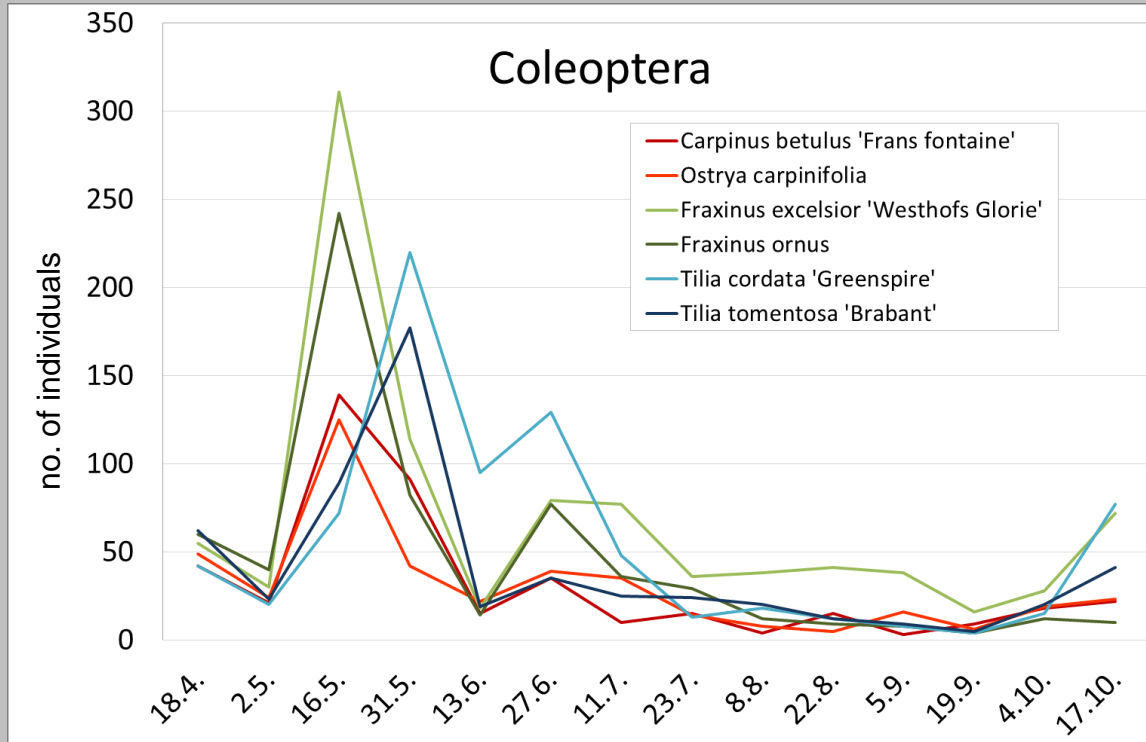
Seasonal dynamics of arthropod communities

Dominant taxa



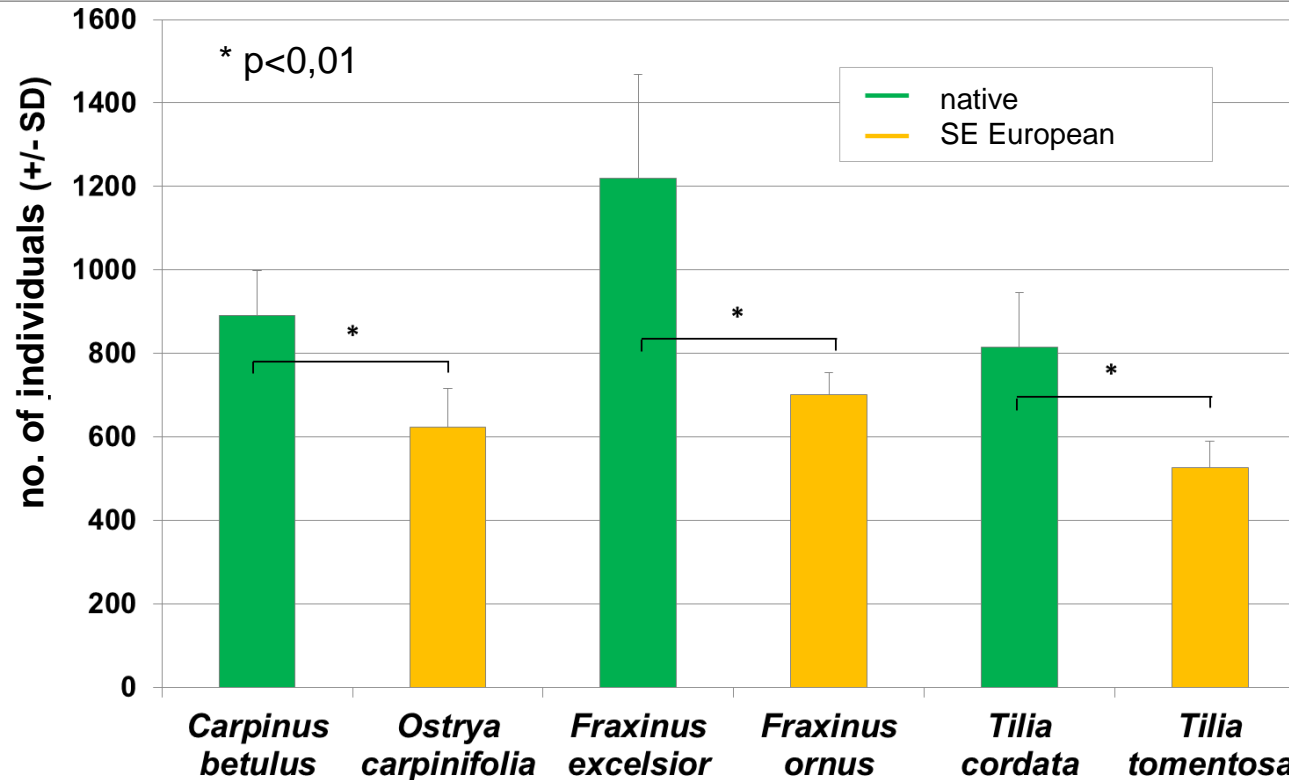
Seasonal dynamics

Dominant taxa

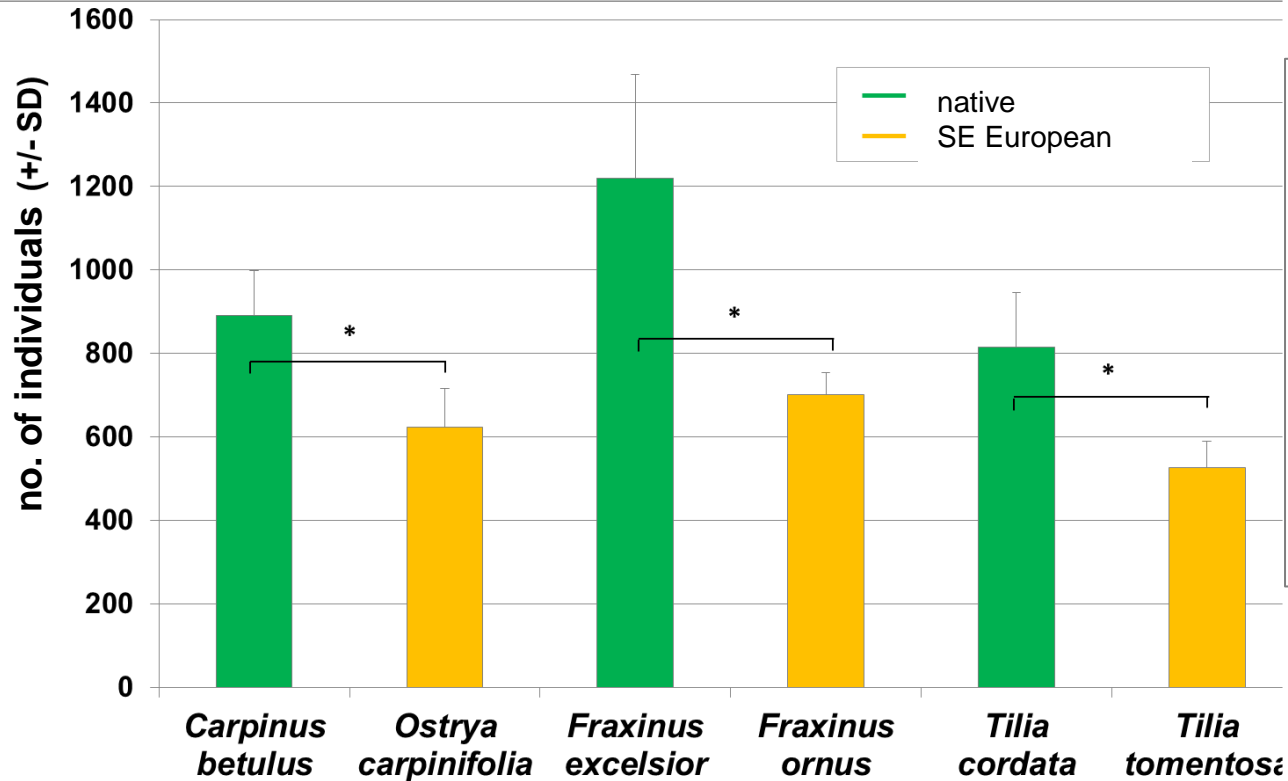


Seasonal dynamics

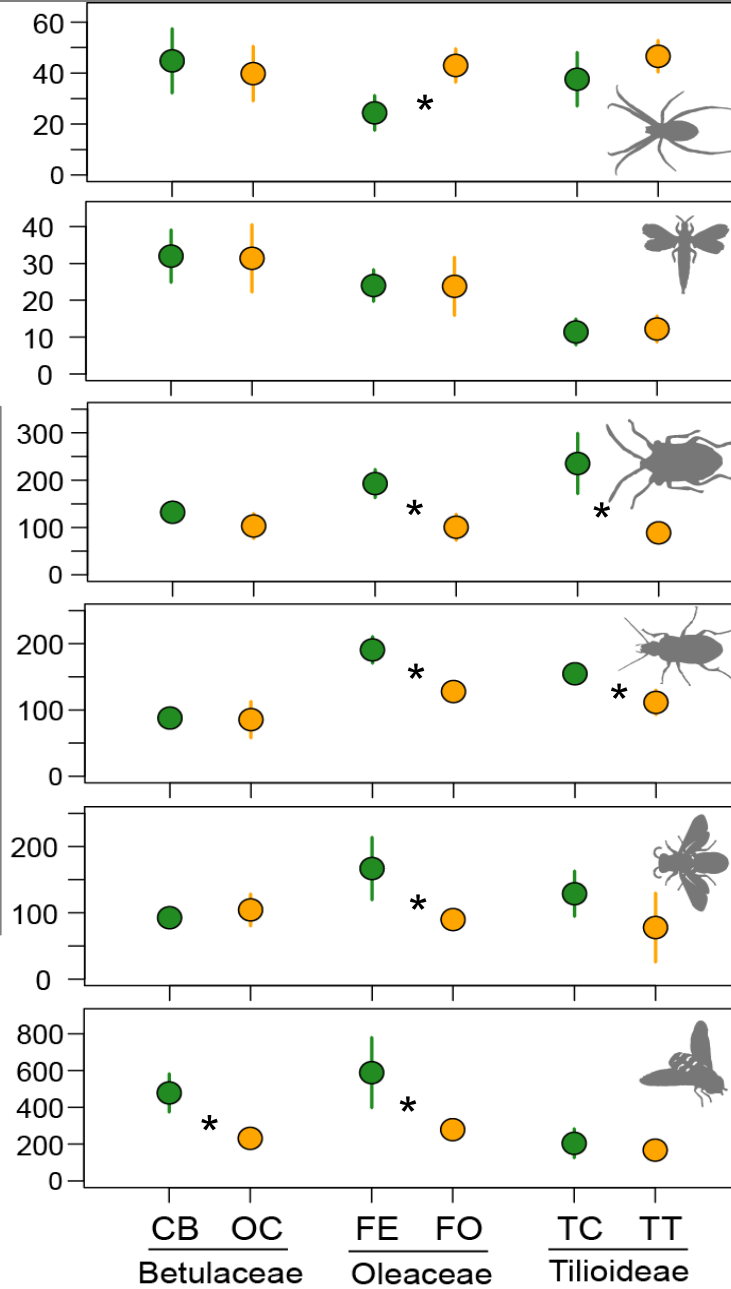
► Native urban trees harbour significantly more individuals than Southeastern European species



... but not in all taxa



no. of individuals



tree species

spiders
N=1181

thrips
N=674

sucking insects
N=4264

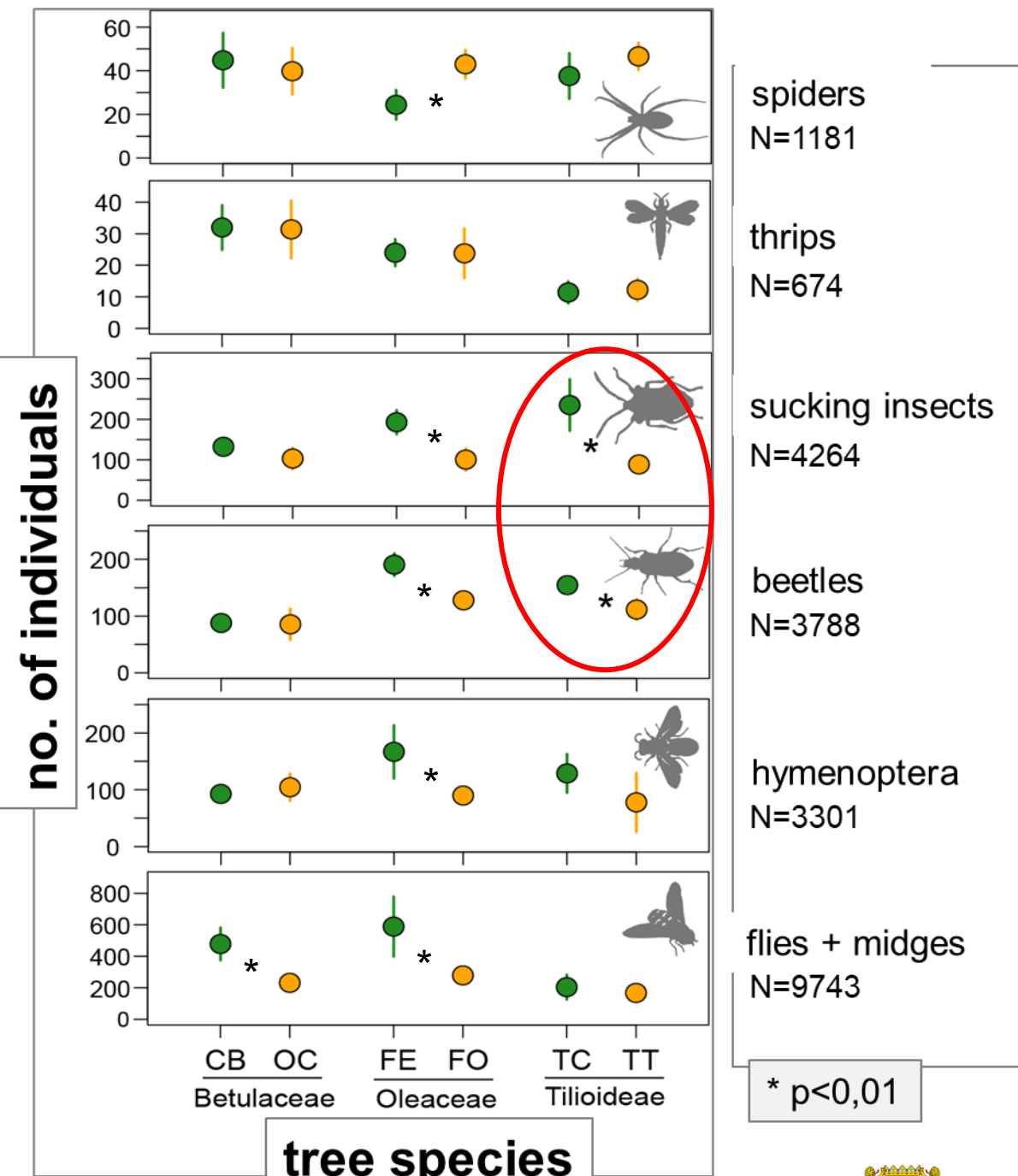
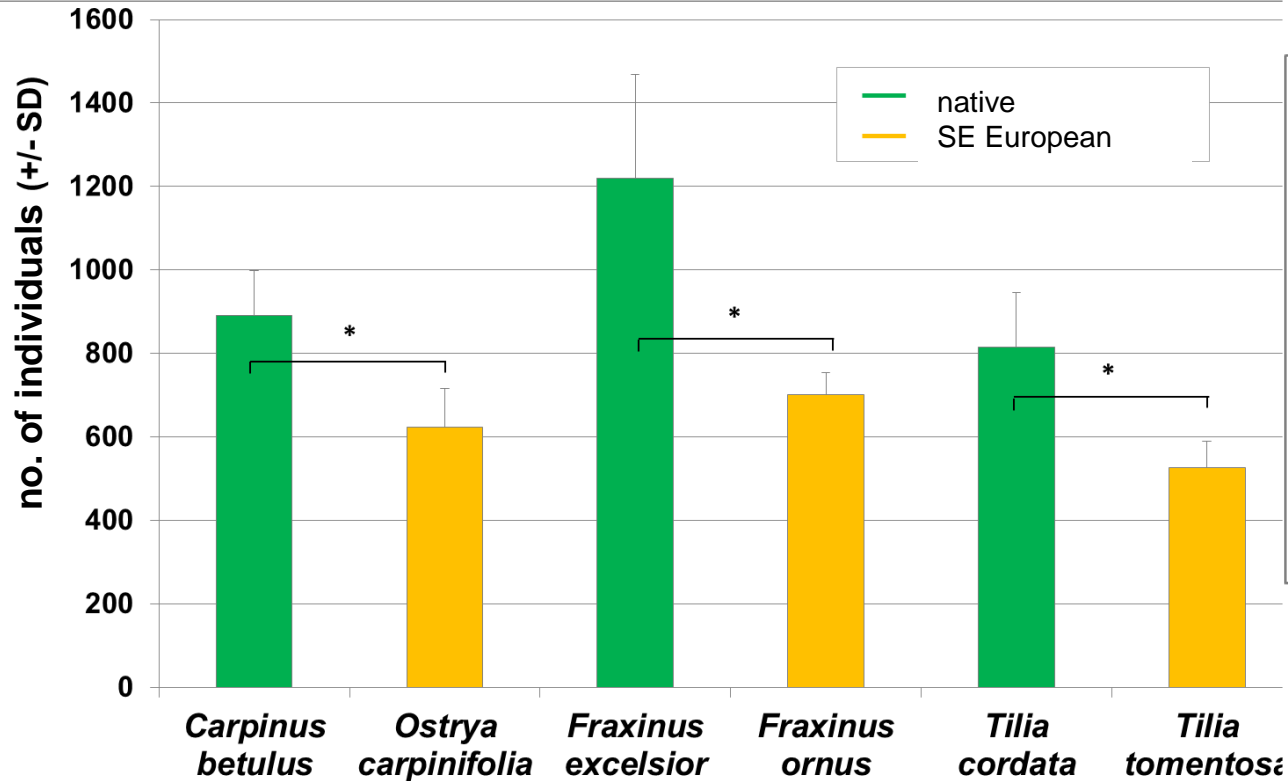
beetles
N=3788

hymenoptera
N=3301

flies + midges
N=9743

* p<0,01

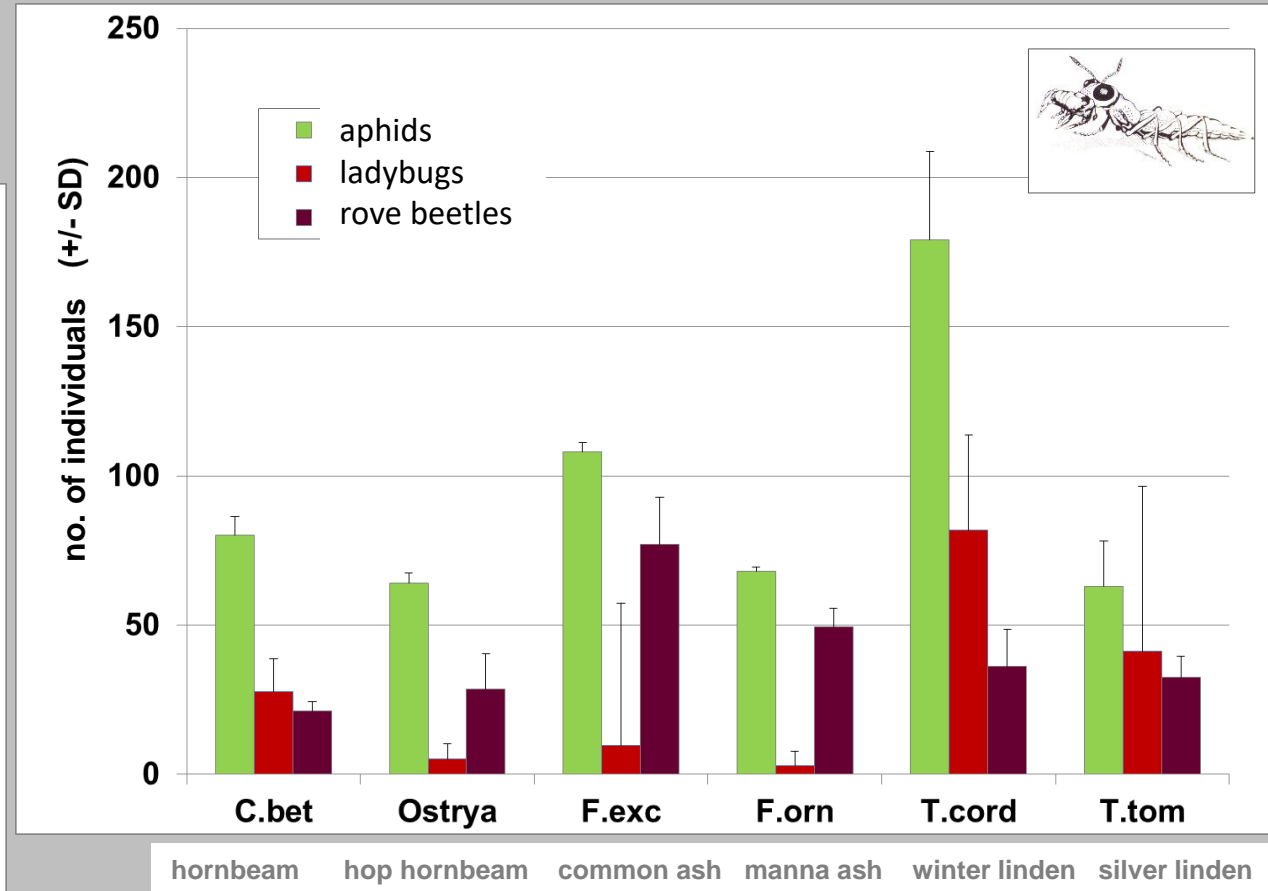
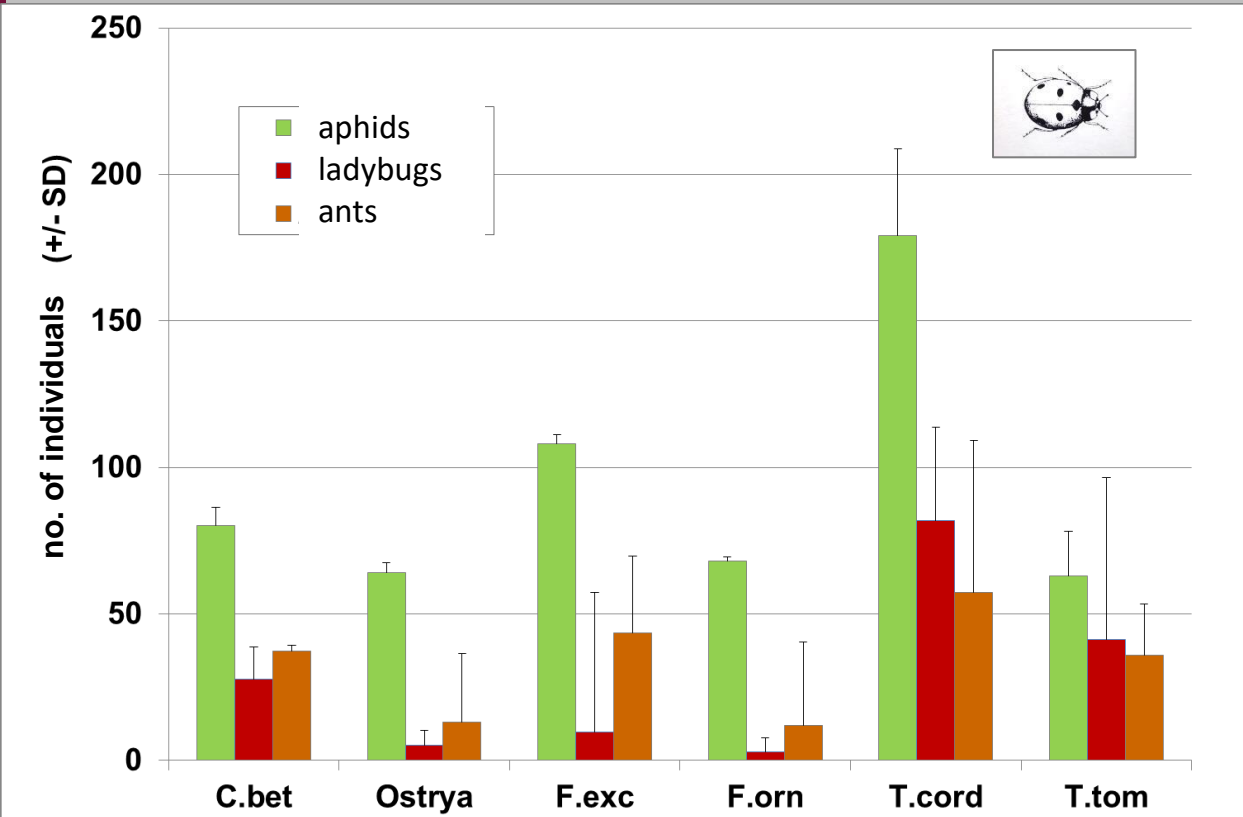
... but not in all taxa



* p < 0,01

► Bsp. ladybugs + rove beetles

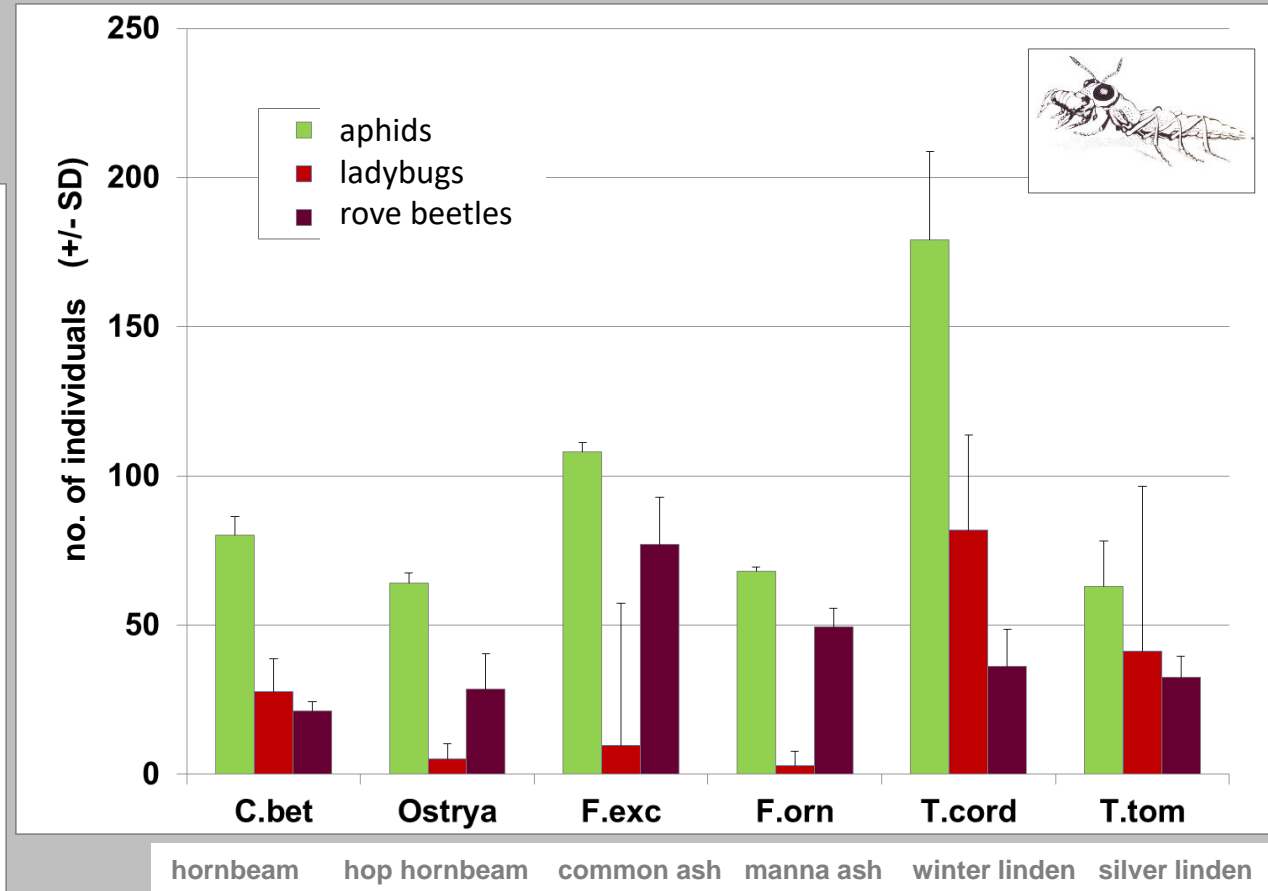
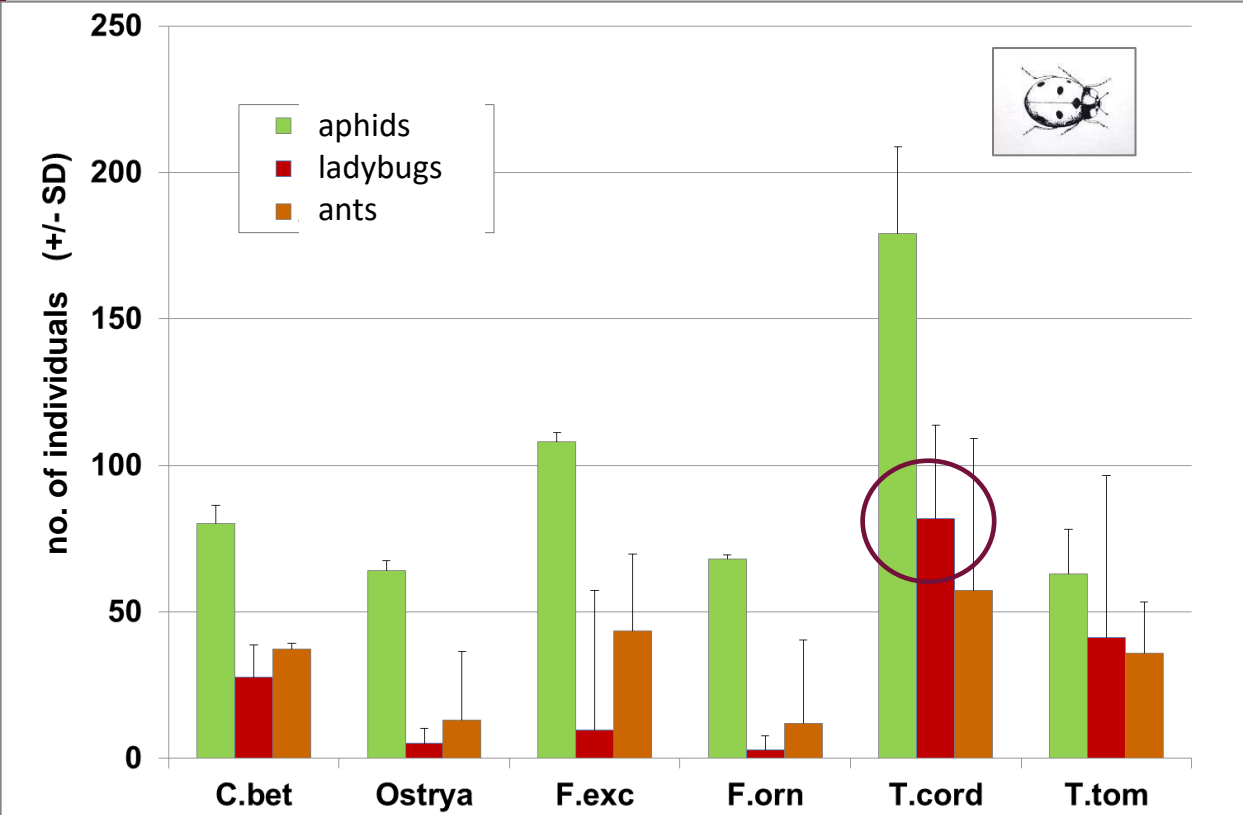
http://www.lwg-design3.bayern.de/weinbau/rebschutz_lebensraum_weinberg/12957/



Predatory antagonists of aphids

► Bsp. ladybugs + rove + beetles

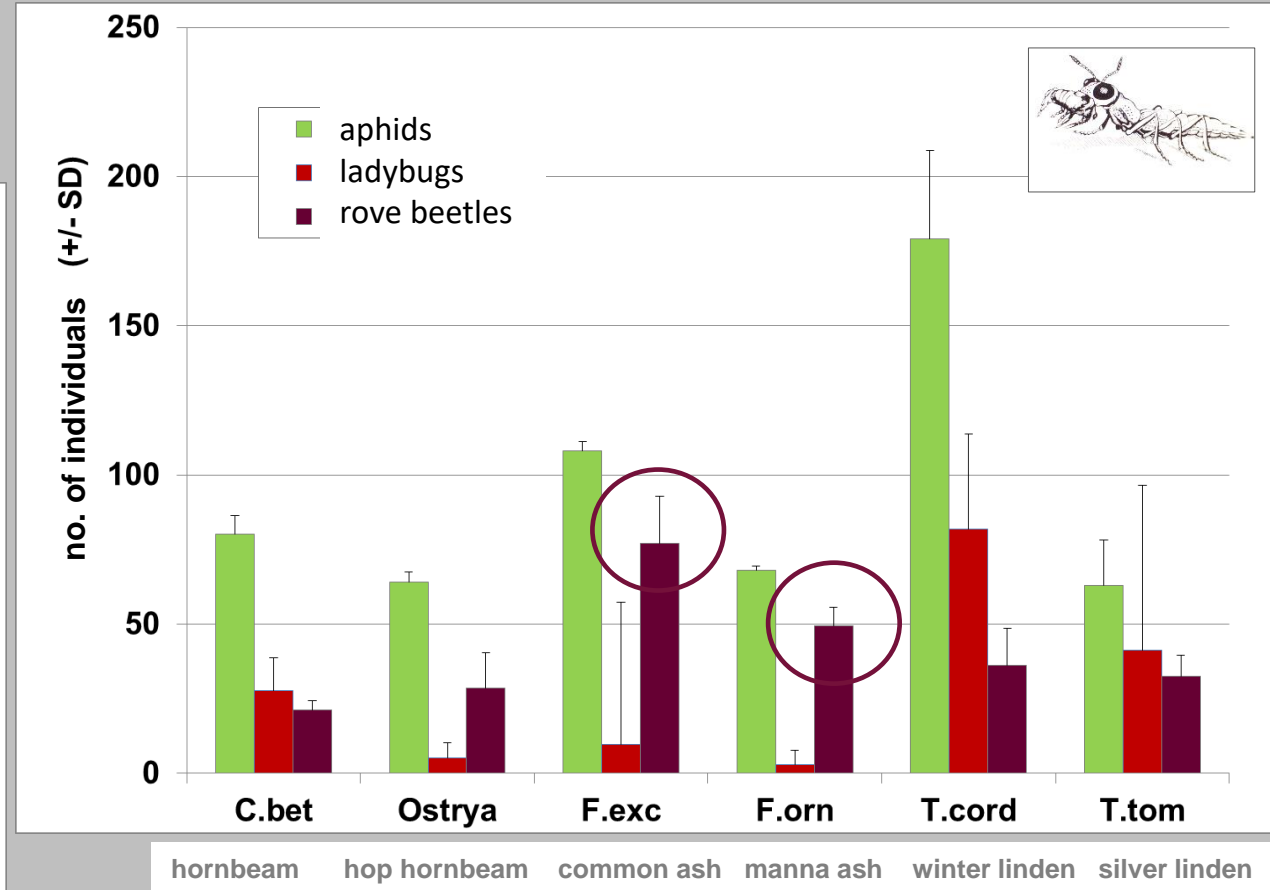
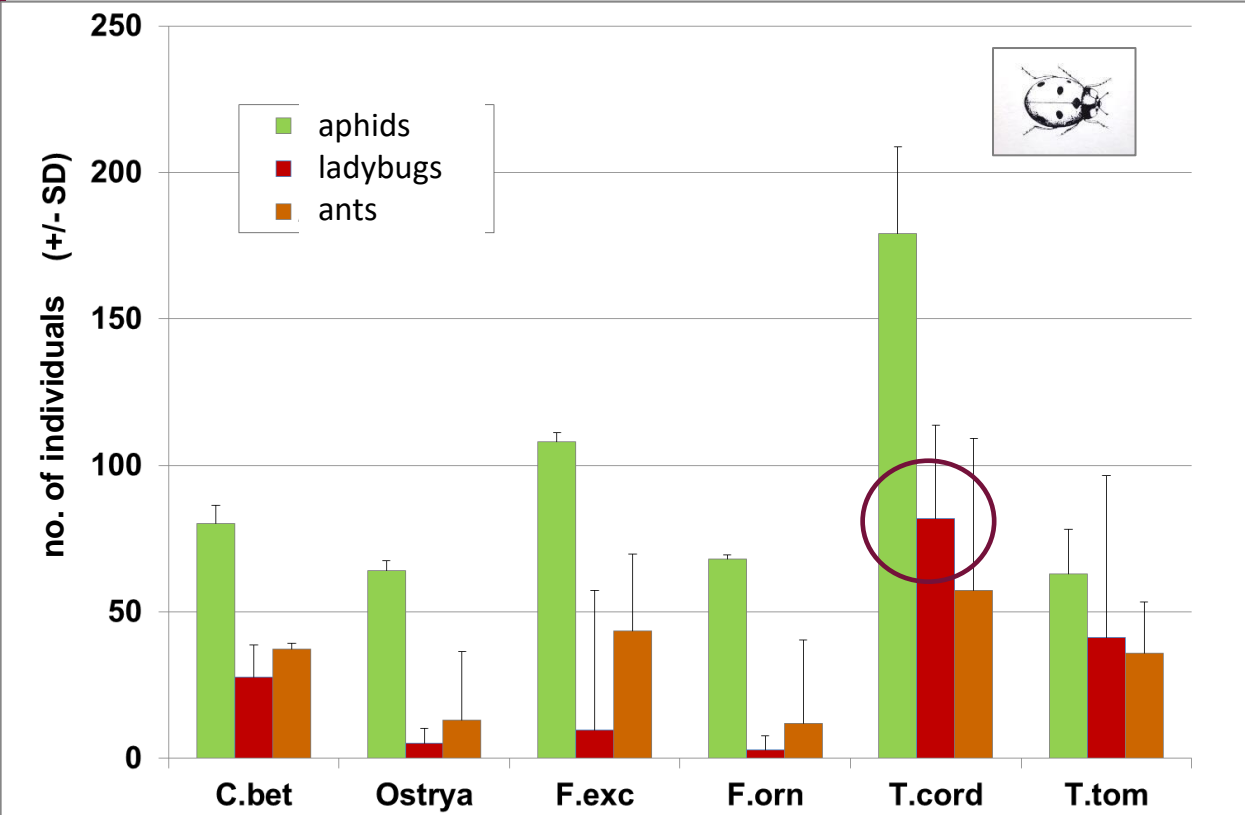
http://www.lwg-design3.bayern.de/weinbau/rebschutz_lebensraum_weinberg/12957/



predatory antagonists of aphids

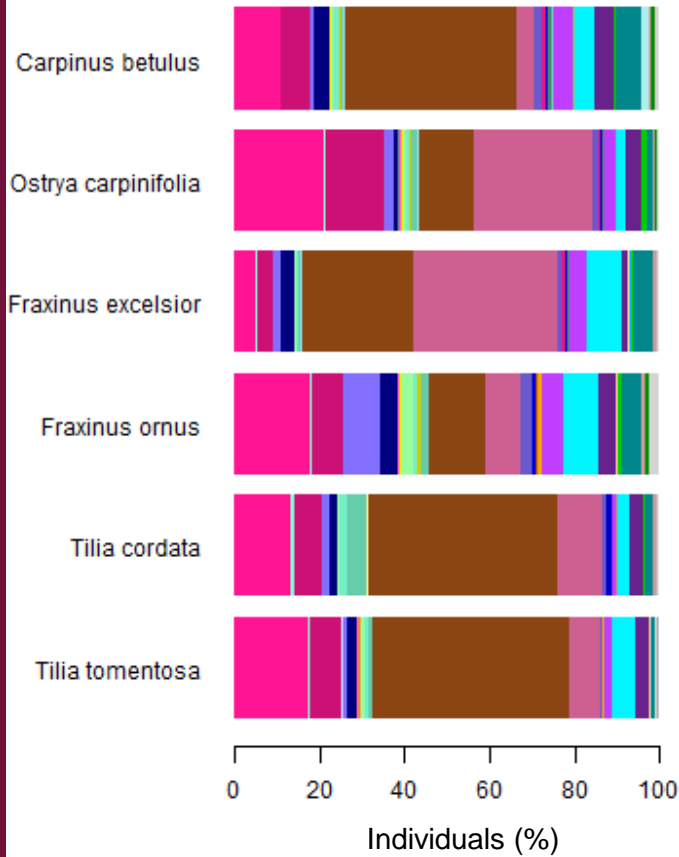
► Bsp. ladybugs + rove beetles

http://www.lwg-design3.bayern.de/weinbau/rebschutz_lebensraum_weinberg/12957/



predatory antagonists of aphids

Hymenoptera 42 families, 3301 individuals



- | | |
|---------------|-------------------|
| Andrenidae | Megaspilidae |
| Aphelinidae | Mymaridae |
| Apidae | Nyssonidae |
| Bethylidae | Ormyridae |
| Braconidae | Orussidae |
| Ceraphronidae | Pemphredonidae |
| Charipidae | Perilampidae |
| Chrysididae | Platygasteridae |
| Colletidae | Pompilidae |
| Crabronidae | Proctotrupidae |
| Cynipidae | Pteromalidae |
| Diapriidae | Rotoitidae |
| Encyrtidae | Scelionidae |
| Eucharitidae | Symphyta Larve |
| Eucoilidae | Tanaostigmatidae |
| Eulophidae | Tenthredinidae |
| Eurytomidae | Torymidae |
| Figitidae | Trichogrammatidae |
| Formicidae | Vespidae |
| Halictidae | Xyelidae |
| Ichneumonidae | n.b. |
| Megachilidae | |



Fotos:
A.c., *A.n.*, *H.s.*, *L.m.*, *L.p.*
 aus: Scheuchl & Willner (2016);
B.t. Dieter Mahsberg

Hymenoptera

Wild bee species (n=57) in canopies of the trees



Wild bees

Apis mellifera

Eucera nigrescens

Bombus bohemicus
Bombus hortorum
Bombus hypnorum
Bombus lapidarius
Bombus pascuorum
Bombus pratorum
Bombus rupestris
Bombus sylvarum
Bombus terrestris

Halictus maculatus
Halictus scabiosae
Halictus simplex
Halictus subauratus
Halictus tumulorum

Heriades truncorum

Hylaeus communis
Hylaeus gredleri

Andrena

chrysoceles
Andrena cineraria
Andrena dorsata
Andrena flavipes
Andrena fucata
Andrena fulva
Andrena gravida
Andrena haemorrhhoa
Andrena jacobii
Andrena labialis
Andrena minutula
Andrena mitis
Andrena nigroaenea
Andrena nitida
Andrena ovatula
Andrena praecox
Andrena tibialis
Andrena vaga
Andrena varians

Lasioglossum calceatum
Lasioglossum glabriusculum
Lasioglossum interruptum
Lasioglossum laticeps
Lasioglossum lativentre
Lasioglossum leucozonium
Lasioglossum cf. lineare
Lasioglossum malachurum
Lasioglossum morio
Lasioglossum nitidulum
Lasioglossum pauxillum
Lasioglossum politum
Lasioglossum pygmaeum
Lasioglossum xanthopus

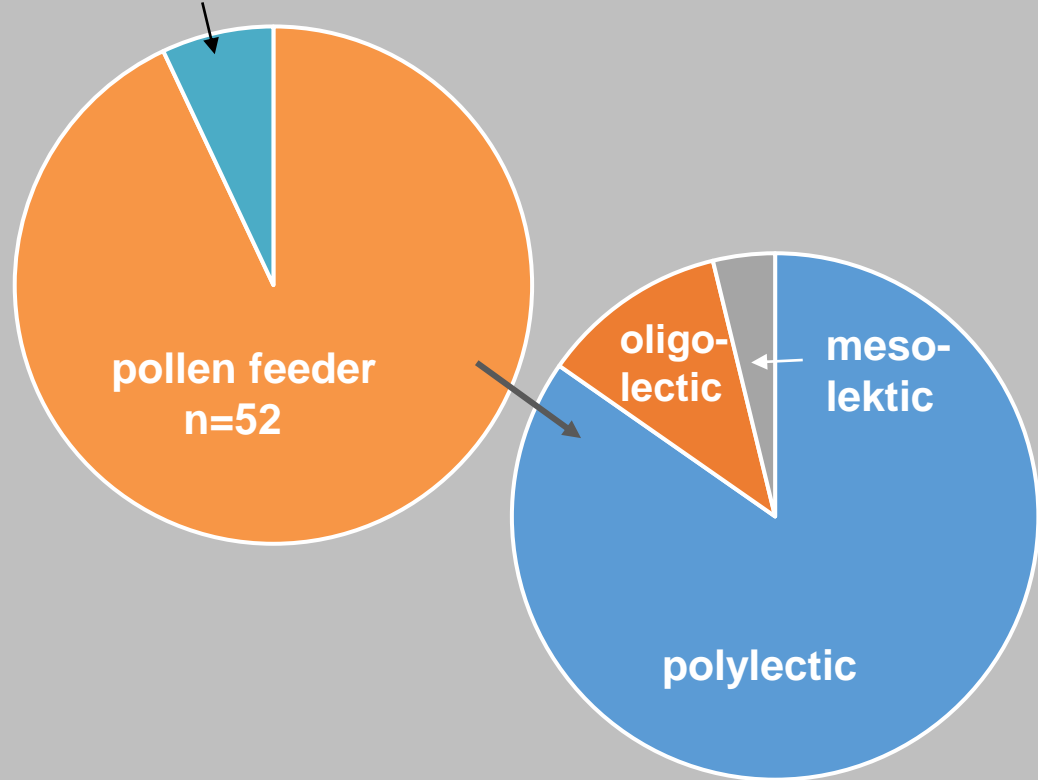
Osmia bicornis
Osmia cornuta

Sphecodes ephippius
Sphecodes ferruginatus

Colletes cunicularius

Wild bee species (n=57) in canopies of the trees

brood parasites



pollen feeder
n=52

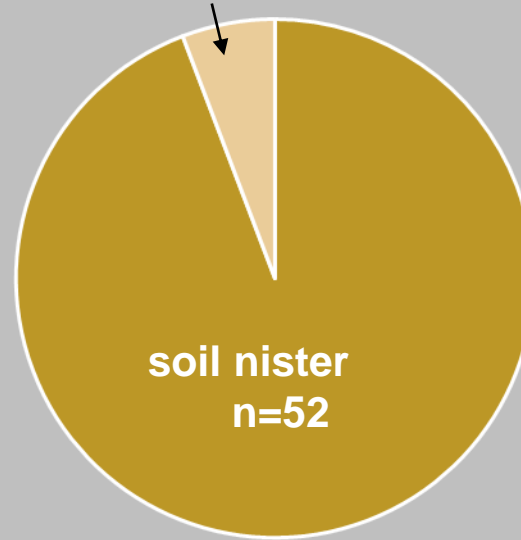
oligo-
lectic

meso-
leptic

polylectic

Degree of pollen specialisation

others



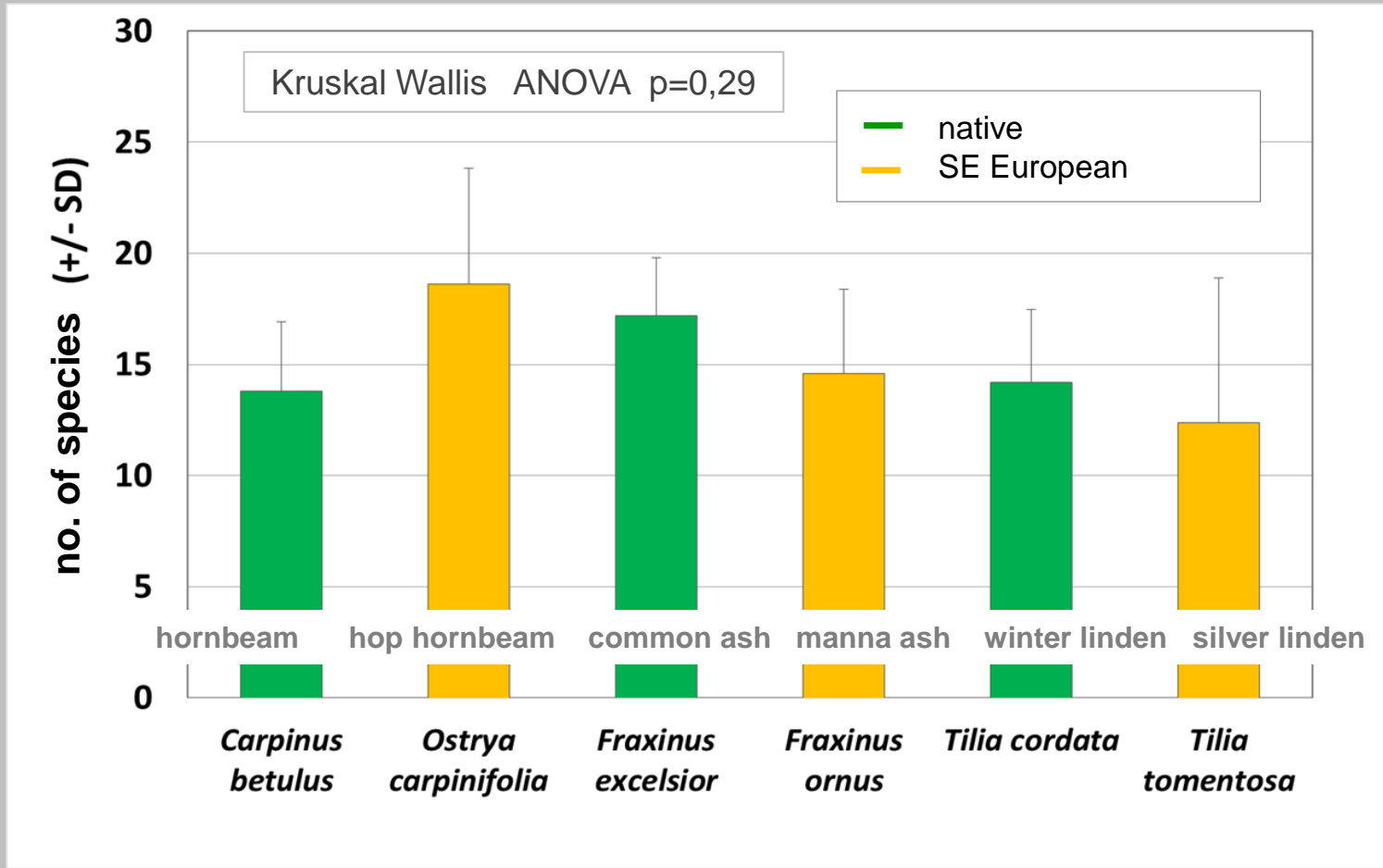
soil nister
n=52

Nesting sites



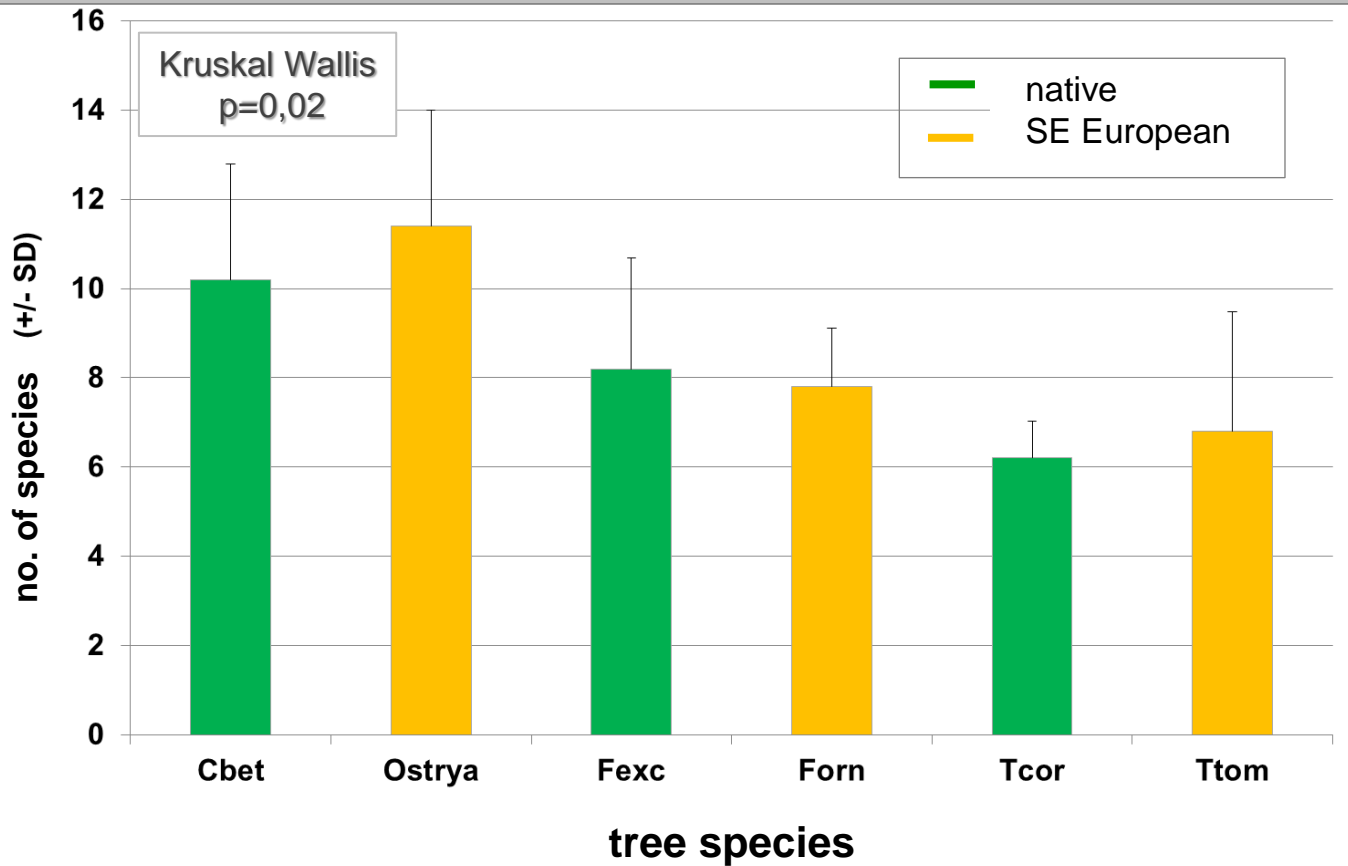
Wild bees

Wild bee species (n=57)



Species diversity

Cicada 58 species, 555 individuals

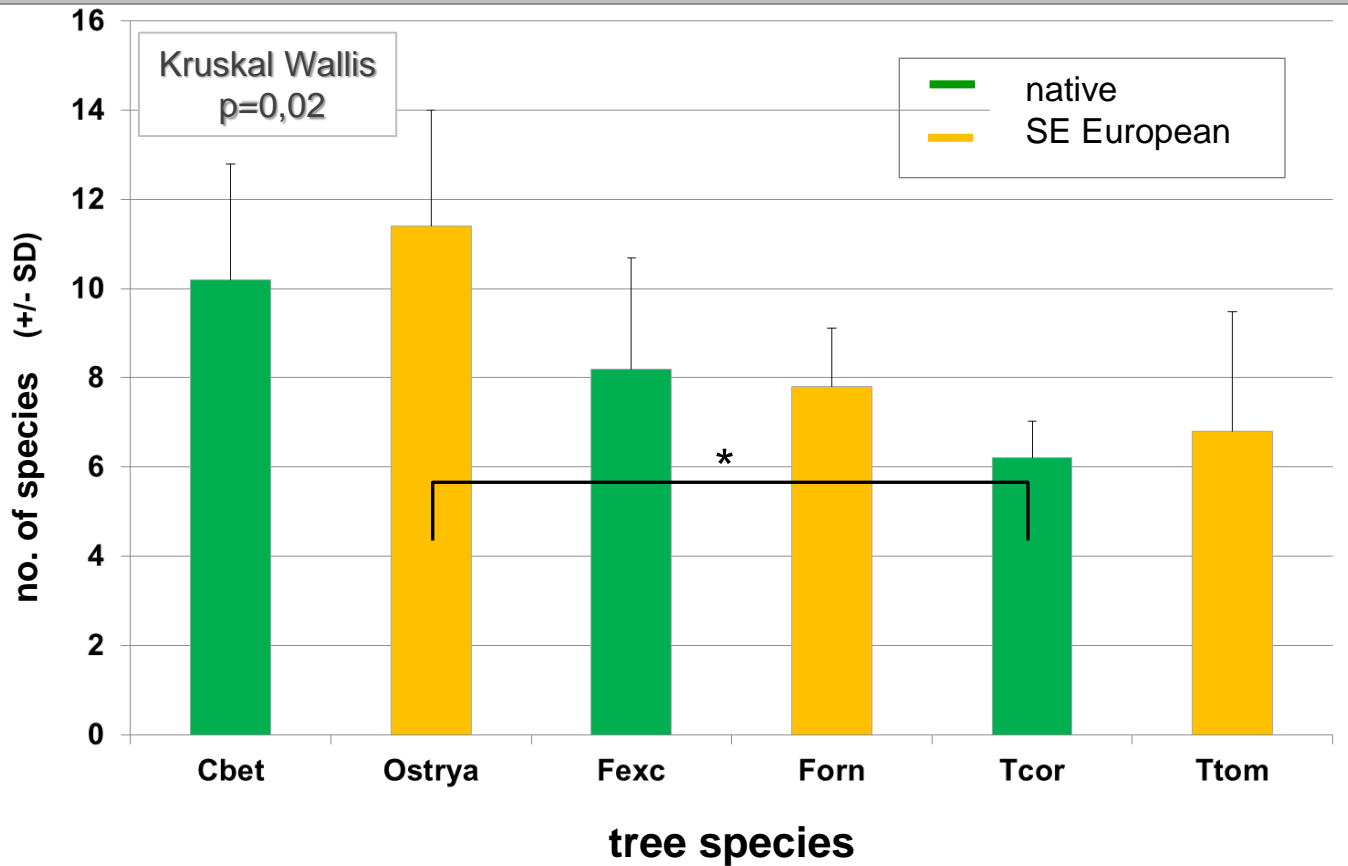


Fotos: R. Albrecht



Species diversity

Cicada 58 species, 555 individuals

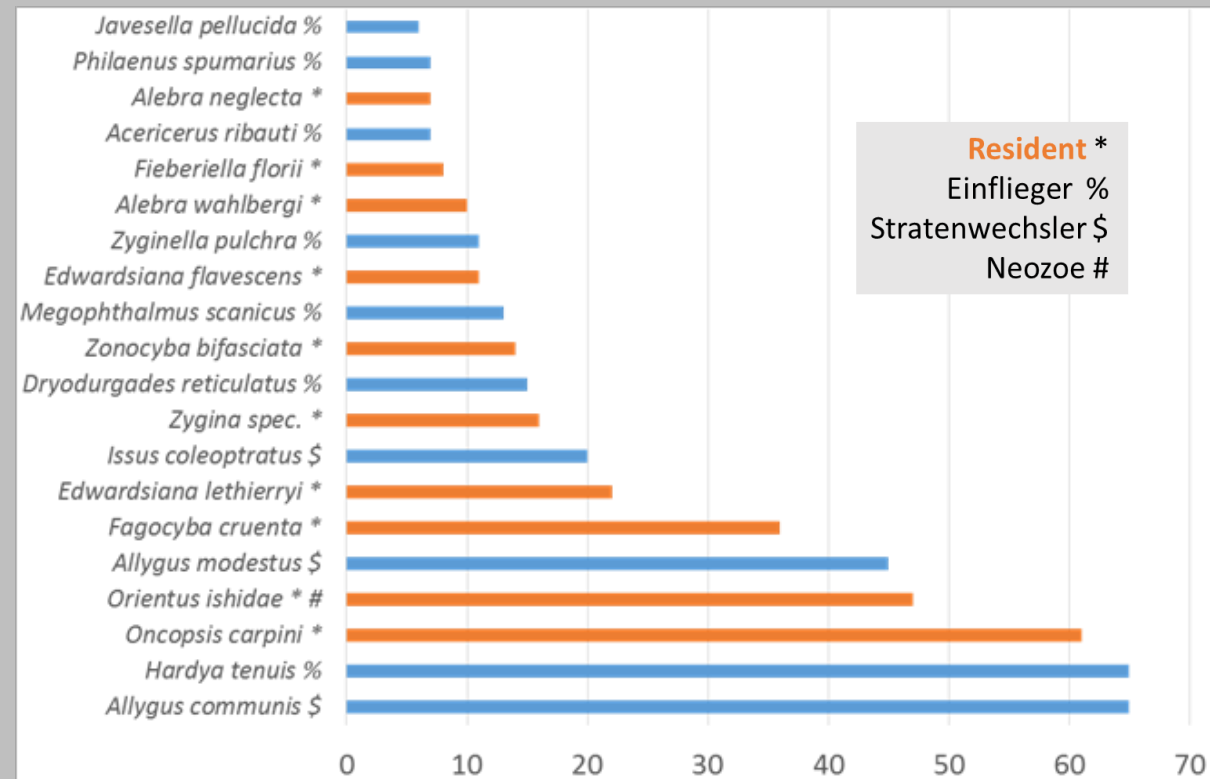
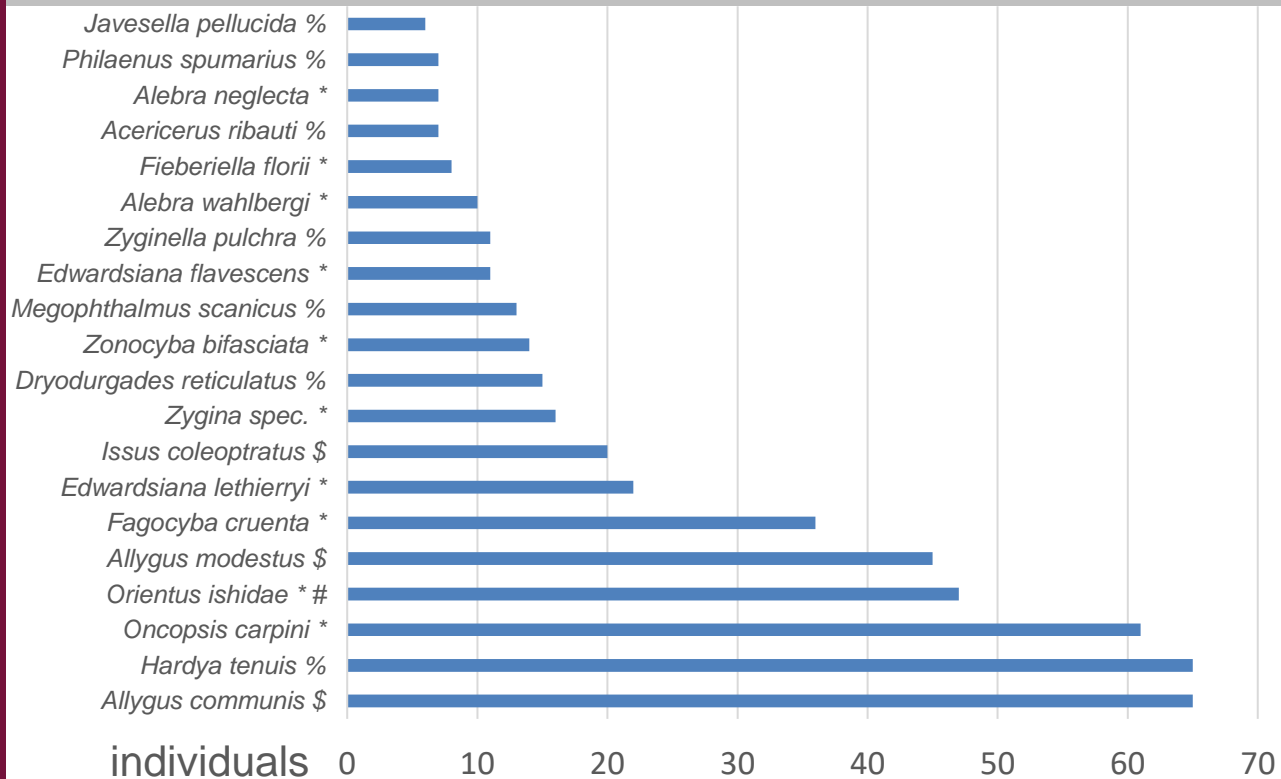


Fotos: R. Albrecht



Species diversity

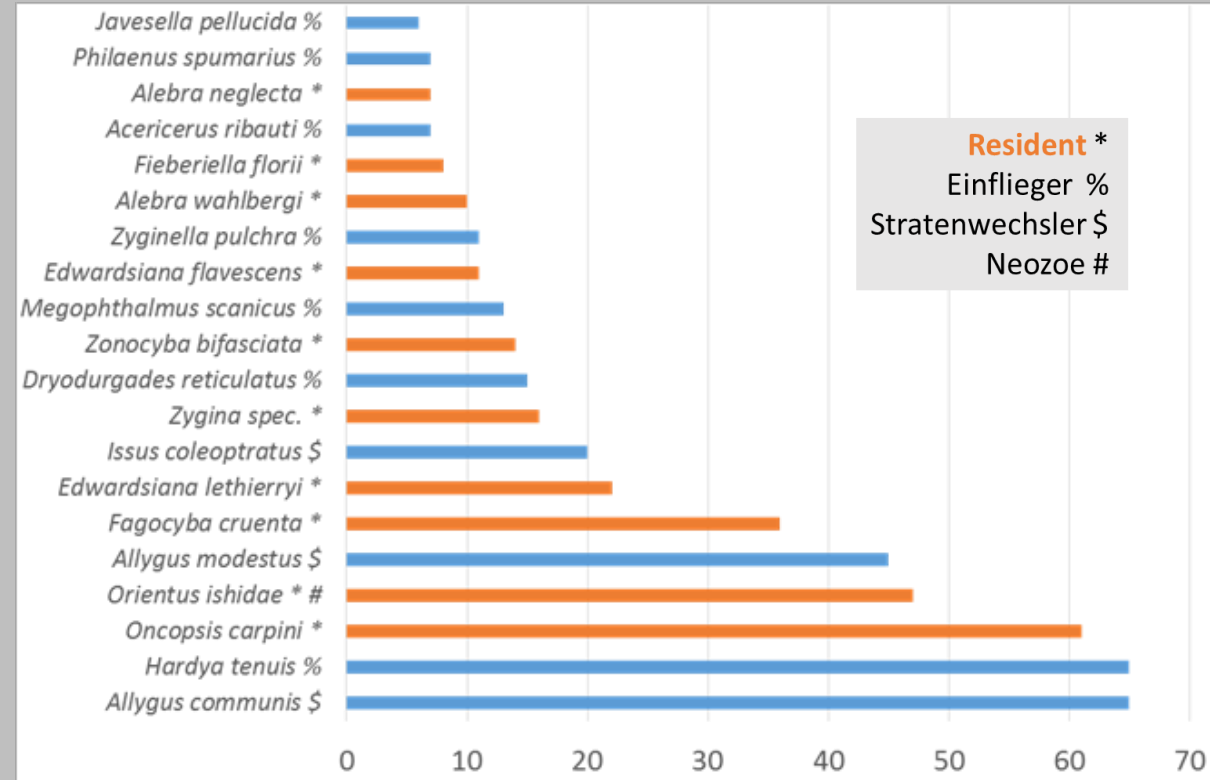
Dominance curve of the 20 most common cicada species



Species diversity

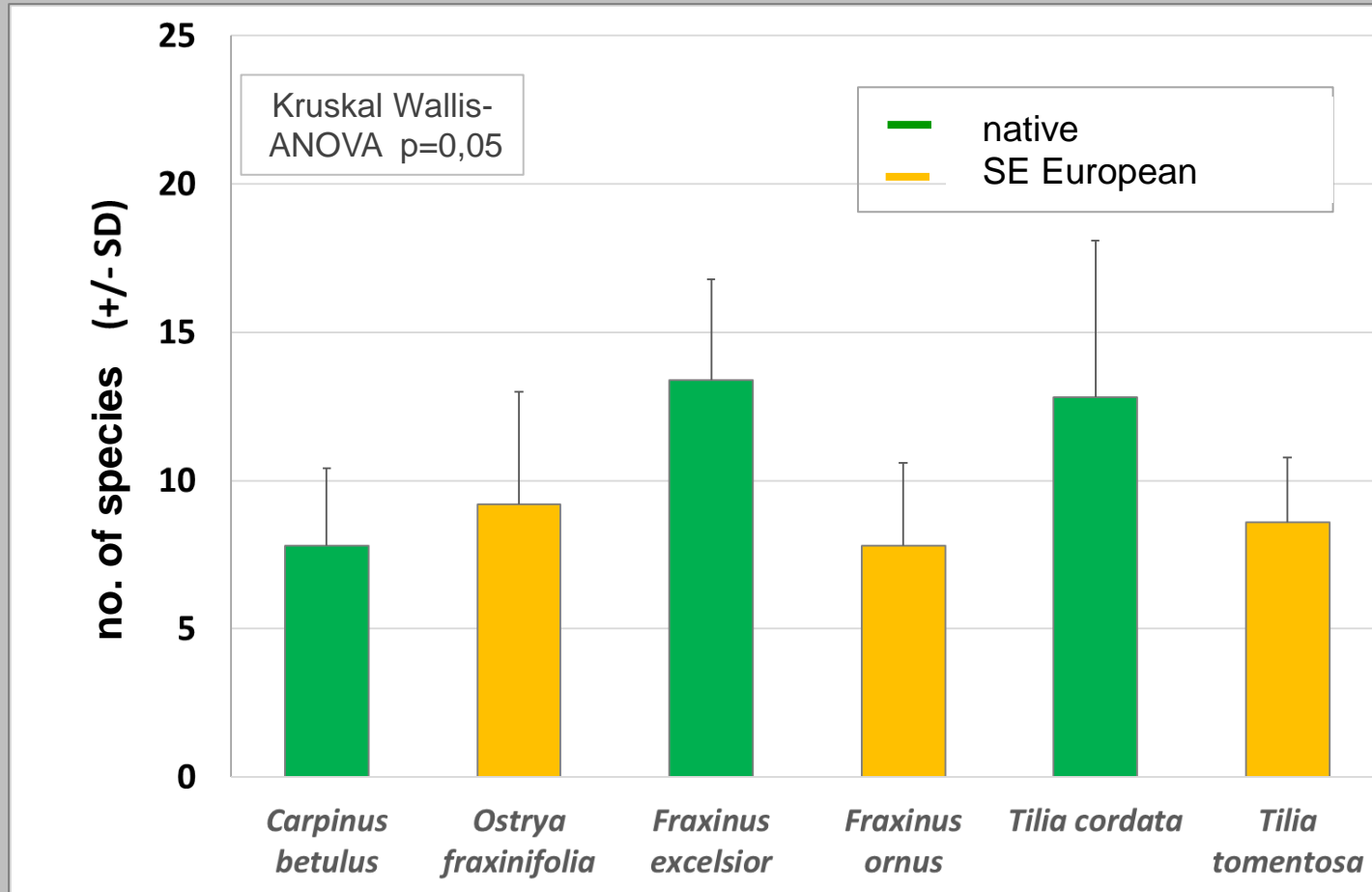


Green strip as an essential partial habitat



Species diversity

Bugs 81 species, 900 individuals



Species diversity

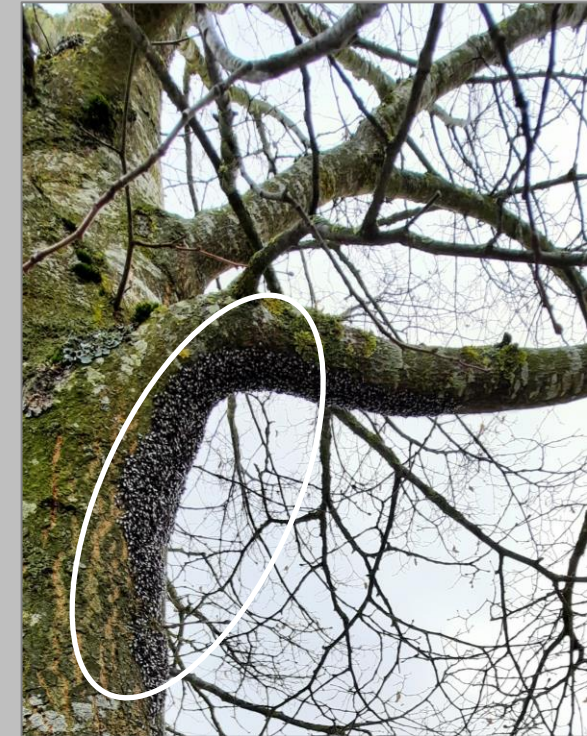
Bugs 81 species, 900 individuals

Missing species: **RL Bayern: 0**



Schmolke et al. 2006, Beiträge zur bayerischen Entomofaunistik 8

Arenocoris waltli



What are they doing in the canopies?

<i>Arenocoris waltli</i>	<i>Tilia tomentosa</i>
<i>Brachynotocoris puncticornis</i>	<i>Fraxinus excelsior</i>
<i>Peritrechus gracilicornis</i>	<i>F. excelsior</i>

dry grassland / peat turf: **RL Bayern**

<i>Megalonotus emarginatus</i>	<i>Fraxinus excelsior</i>
<i>Megalonotus praetextatus</i>	<i>Fraxinus excelsior</i>
<i>Taphropeltus contractus</i>	<i>F. excelsior, Ostrya carpinifolia</i>
<i>Peritrechus gracilicornis</i>	<i>F. excelsior, F. ornus</i>
<i>Emblethis griseus</i>	<i>Ostrya carpinifolia</i>

immigrants

<i>Deraecoris flavilinea</i> (1990)	alle Arten
<i>Orsillus depressus</i> (Ende 1970)	<i>Ostrya carpinifolia</i>
<i>Oxcarenus lavaterae</i> (2004)	<i>Tilia cordata</i>

Heteroptera - species diversity

2021/2022

	native	non-native
2021	<i>Fraxinus excelsior</i> 'Westhofs Glorie'	<i>Alnus x spaethii</i> (AS)
	<i>Ulmus x Lobel</i>	<i>Fraxinus pennsylvanica</i> 'Summit' (NA)
		<i>Liquidambar styraciflua</i> (NA)
		<i>Quercus frainetto</i> 'Trump' (SO-EU)
2022	<i>Acer platanoides</i> 'Emerald Queen'	<i>Acer opalus</i> (S-EU)
	<i>Sorbus latifolia</i> 'Henk Vink'	<i>Eucommia ulmoides</i> (AS)
		<i>Tilia americana</i> 'Redmond' (NA)
		<i>Ulmus</i> 'Rebona' (AS)



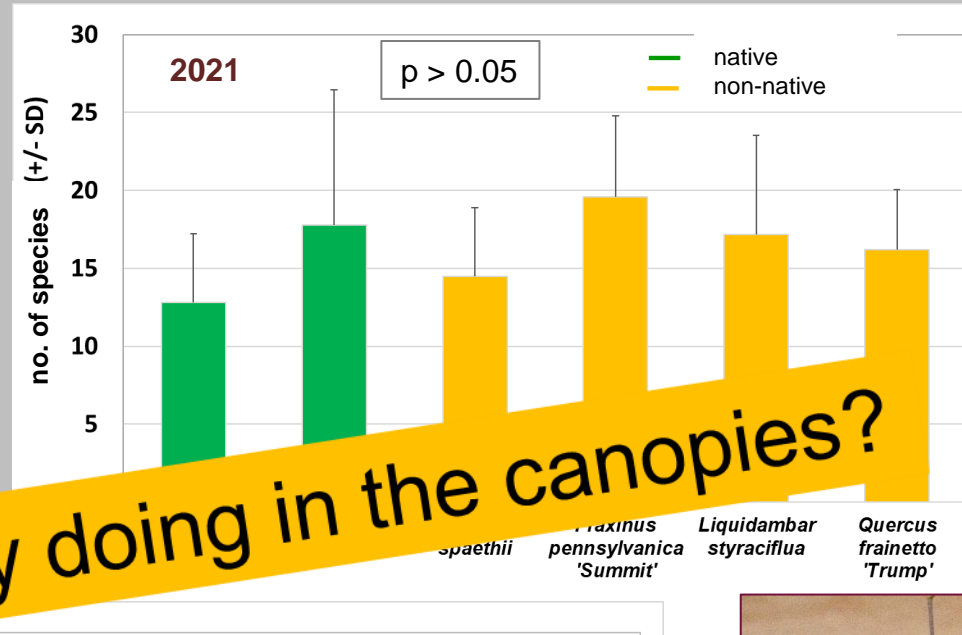
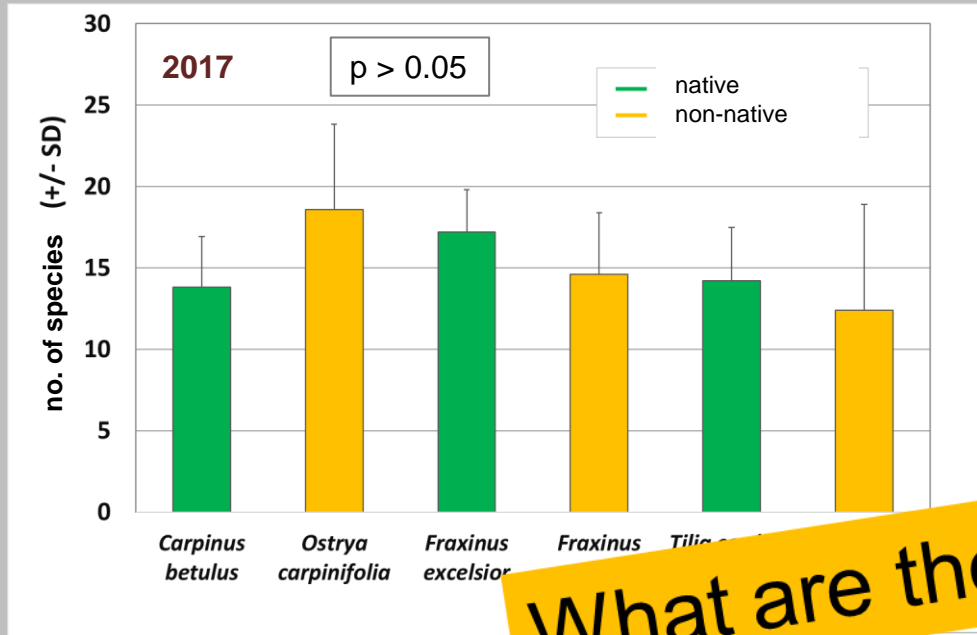
AS Asia
 S-EU S-Europe
 SE-EU SE-Europe
 NA North America



Continued biodiversity studies

Urban Green 2021+

stress-tolerant urban trees



What are they doing in the canopies?

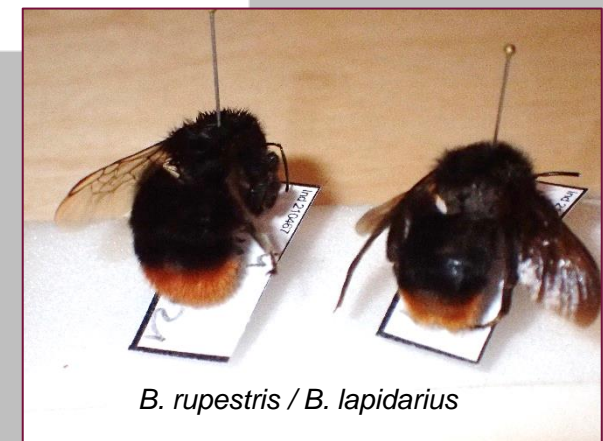
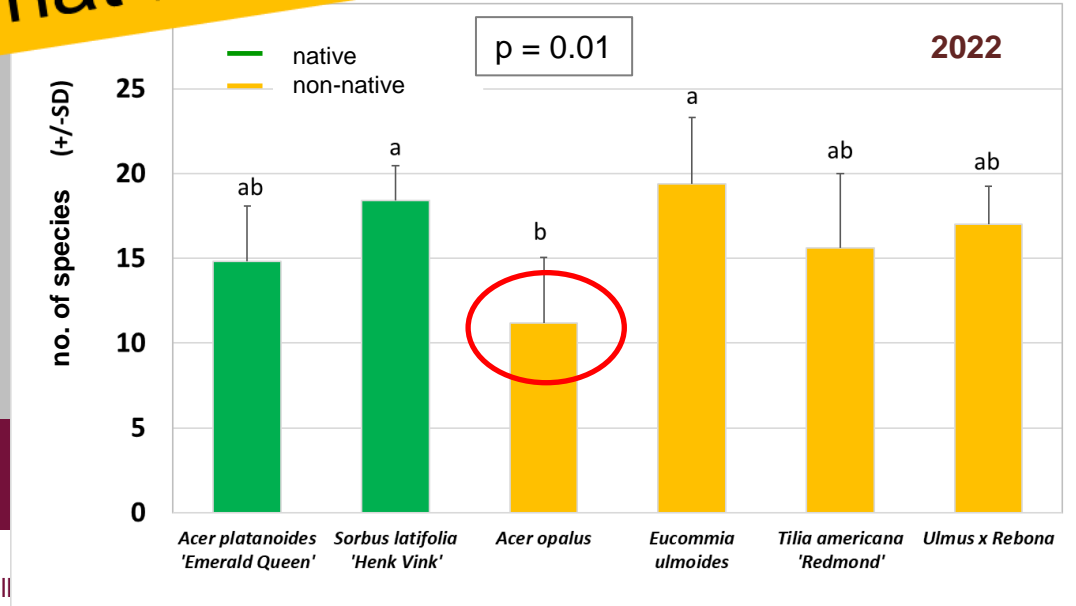


Adrena fulva

Fotos: P. Geisendörfer



Nomada flava



B. rupestris / B. lapidarius

wild bees

species diversity

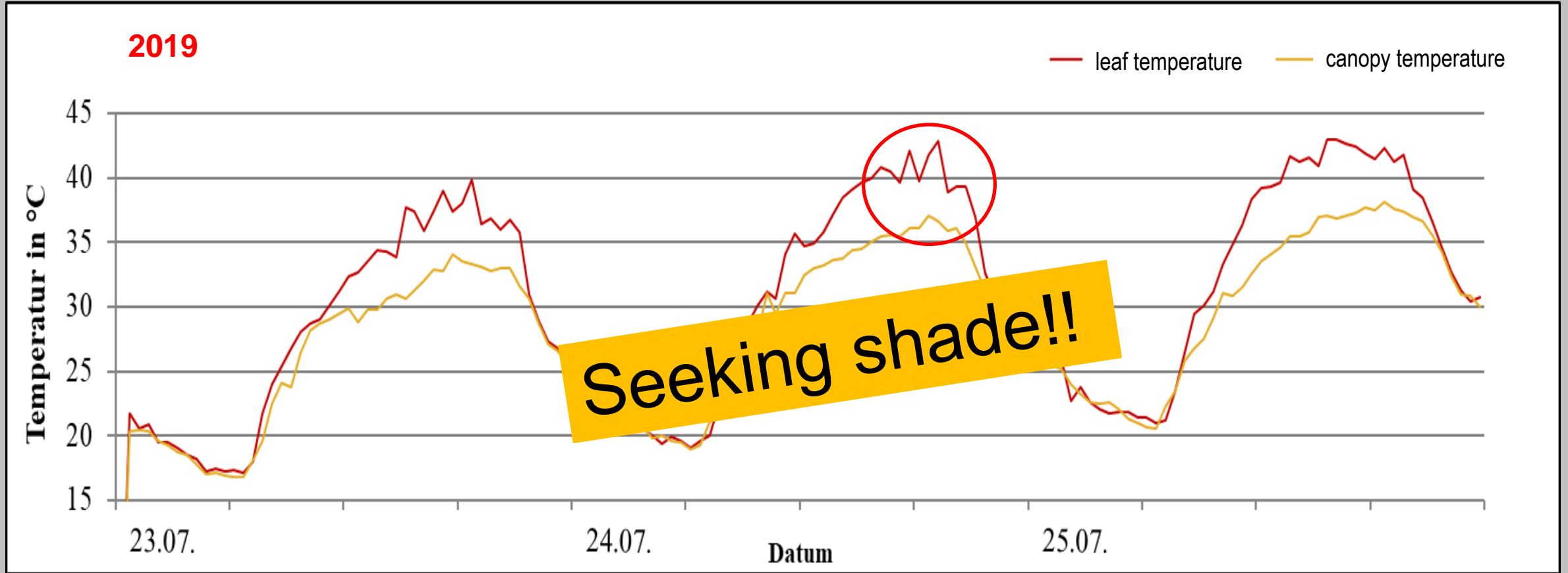


Julius-Maximilians-
UNIVERSITÄT WÜRZBURG

Dr. Susanne Böll

Bayerische Landesanstalt für Weinbau und Gartenbau





Leaf vs. canopy temperatures

	2017	2021	2022
no. individuals	23.883	23.802	23.662

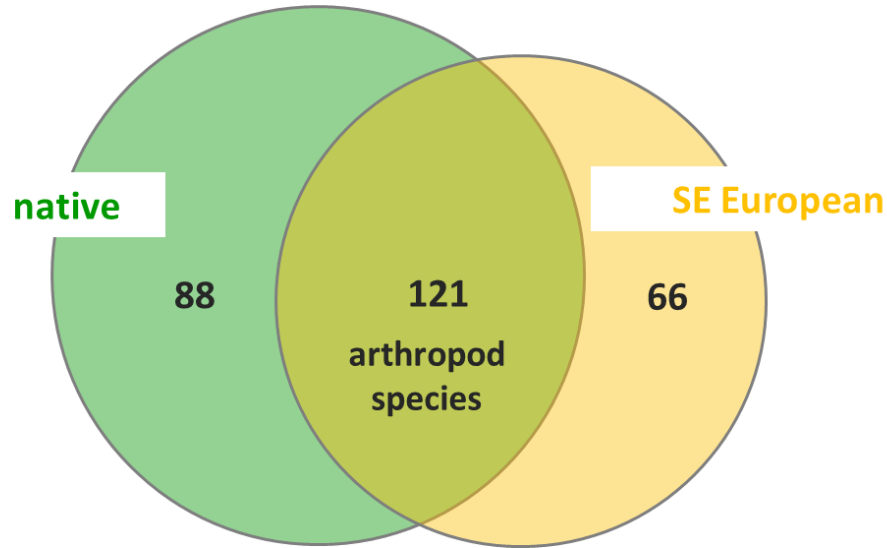
Number of species caught in different taxa in three study years

	2017	2021	2022
spiders	30	37	42
bugs	58	50	64
cicada	81	79	50
phyt. beetles	52	57	56
wild bees	57	60	55
	278	283	267

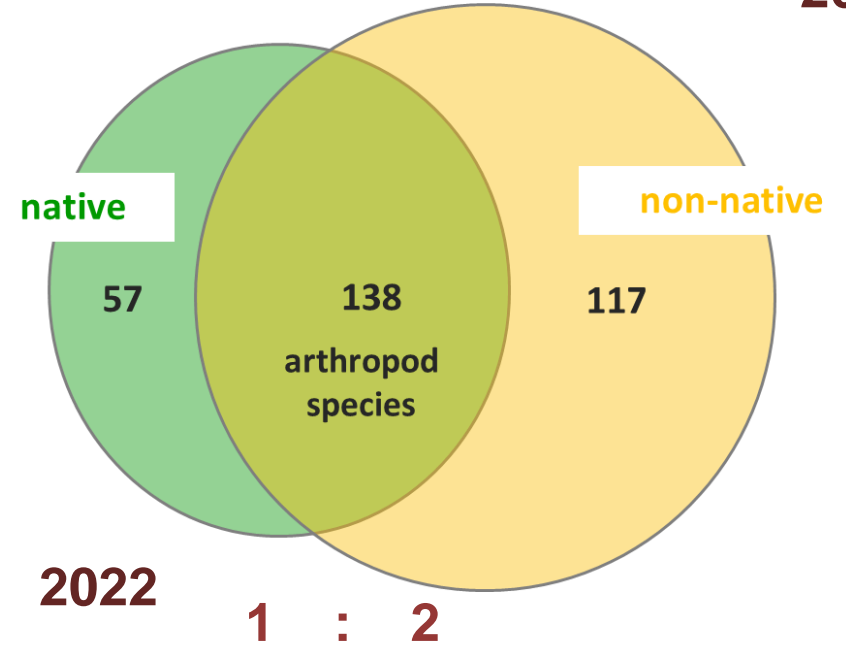


Species diversity

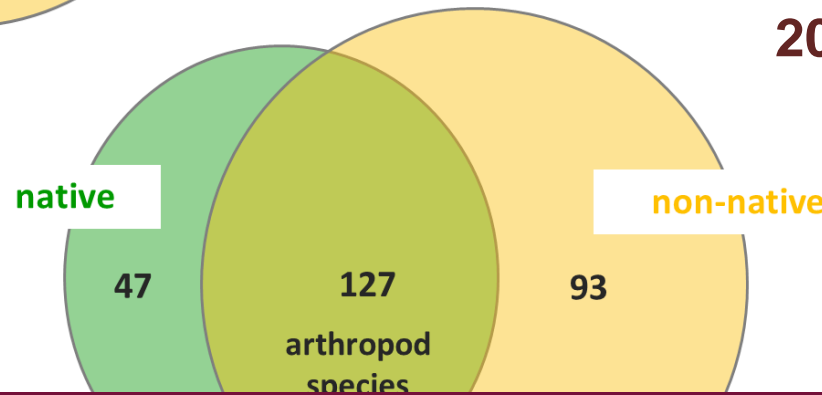
2017



2021



2022



1 : 2

1 : 2

▶ Highest biodiversity: mixed planting of tree species + green strips!

Conclusion

- Connecting **green strips** (instead of individual tree pits) serve as an essential partial habitat for many tree-living insects.
- Street trees not only serve as feeding and nesting sites, but also provide important **shade**.
- Non-native tree species contribute to urban biodiversity in tree canopies.
- Sucking insects show the strongest preferences with regard to the tree species or genus.
- Depending on the genus, non-native tree species are also accepted by oligotrophic plant suckers (e.g. *Alnus x spaethii*).
- **Alleys with mixed tree species** harbor a much higher diversity of arthropods than alleys with only one tree species. They also counteract the spread of steadily increasing new plant diseases and pests.



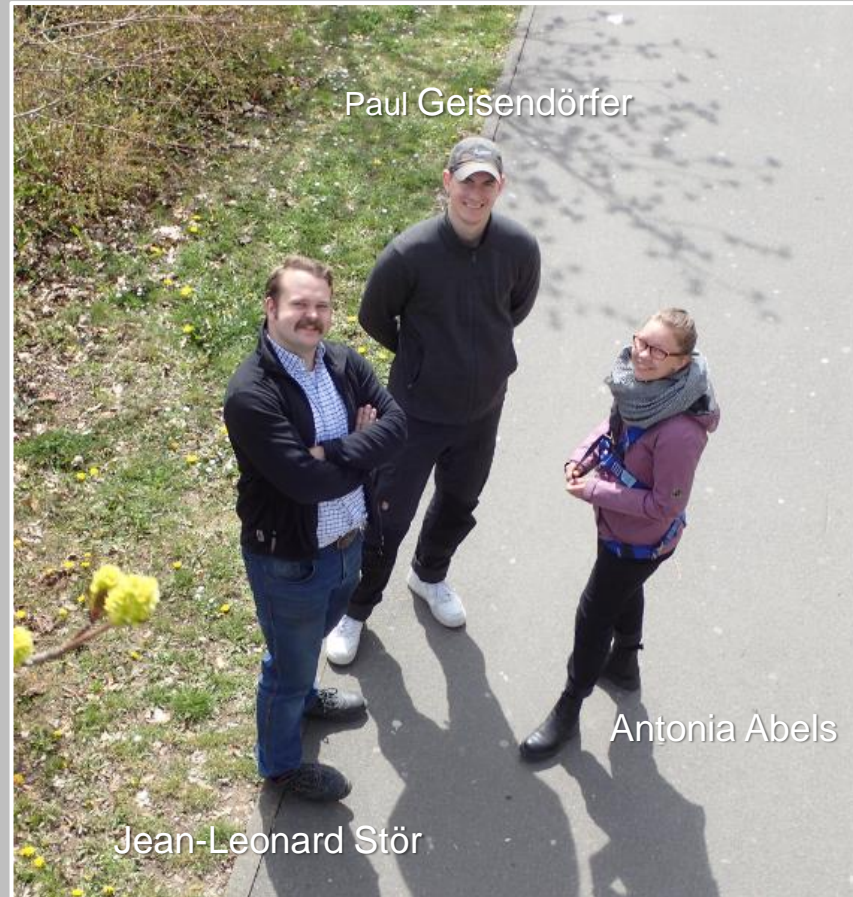
Magnolia kobus

Acknowledgment

Many thanks to my colleagues Dr. Dieter Mahsberg and Dr. Marcell Peters of the University of Würzburg, to our master and bachelor students and all taxonomists!



Rosa Albrecht



Paul Geisendörfer

Antonia Abels

Jean-Leonard Stör



Dr. D. Mahsberg & Dr. M. Peters

A black bird is perched on a branch of a tree. The tree has many thin, bare branches and some small, dark berries. There are also some dried, brown leaves scattered on the branches. The background is a clear, light blue sky. The text "Thanks for your attention!" is overlaid on the bottom center of the image in a white, sans-serif font, enclosed in a thin white rectangular border.

Thanks for your attention!