Non-ecological speciation, sexual selection and colour polymorphisms: insights from odonates

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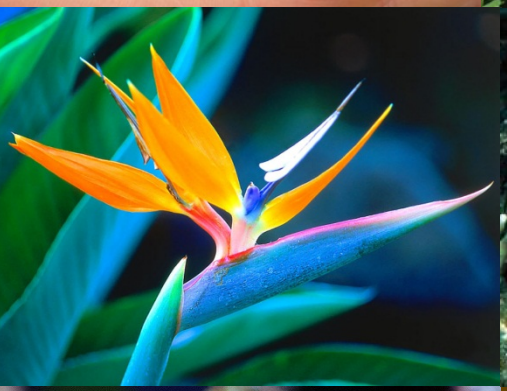


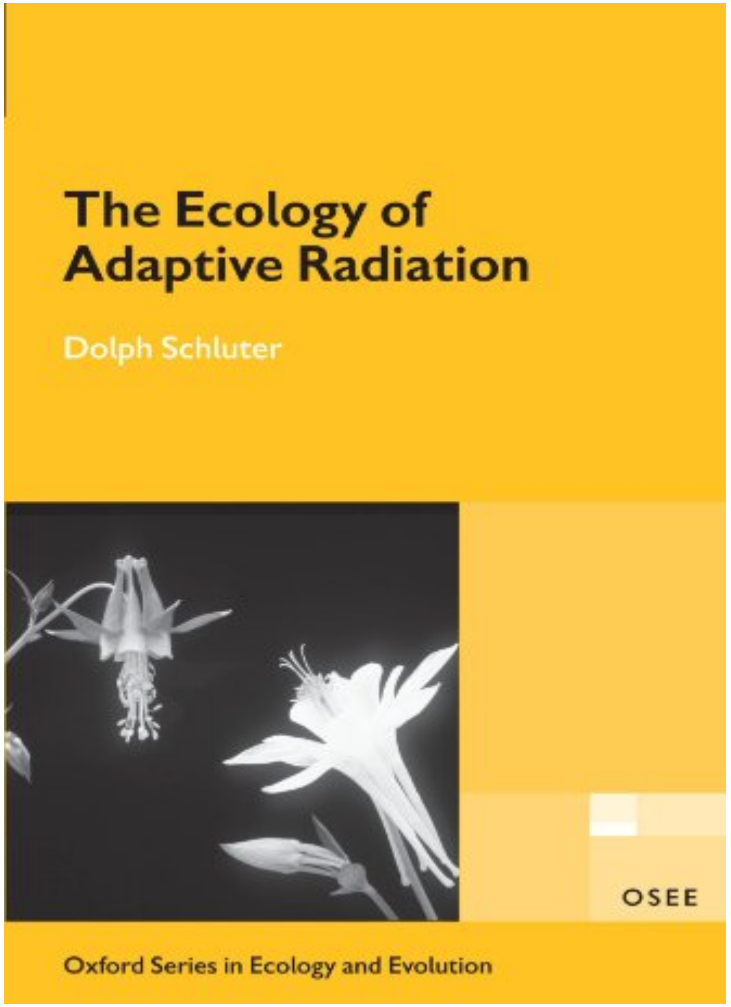




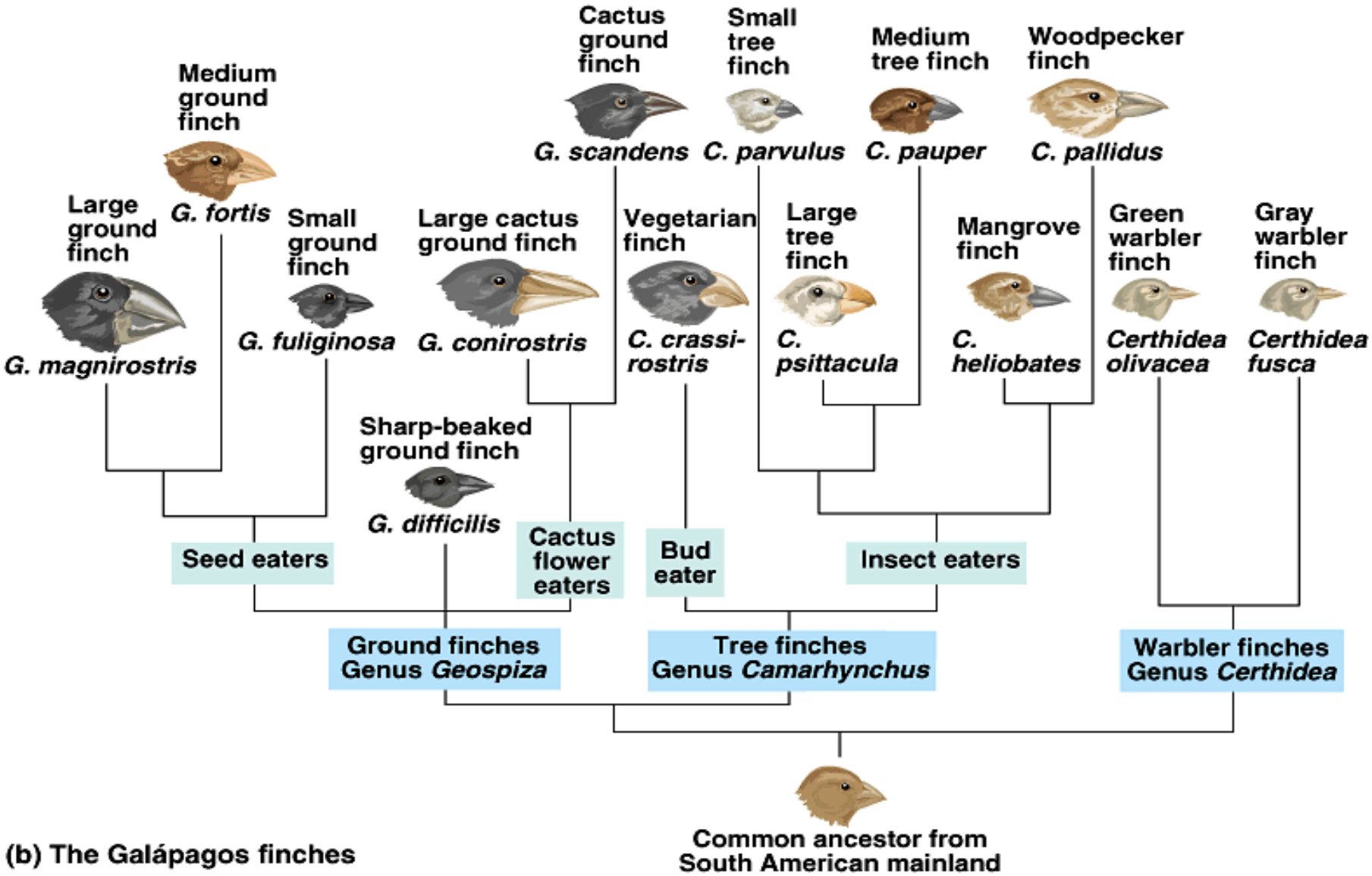





The ecology of adaptive radiations

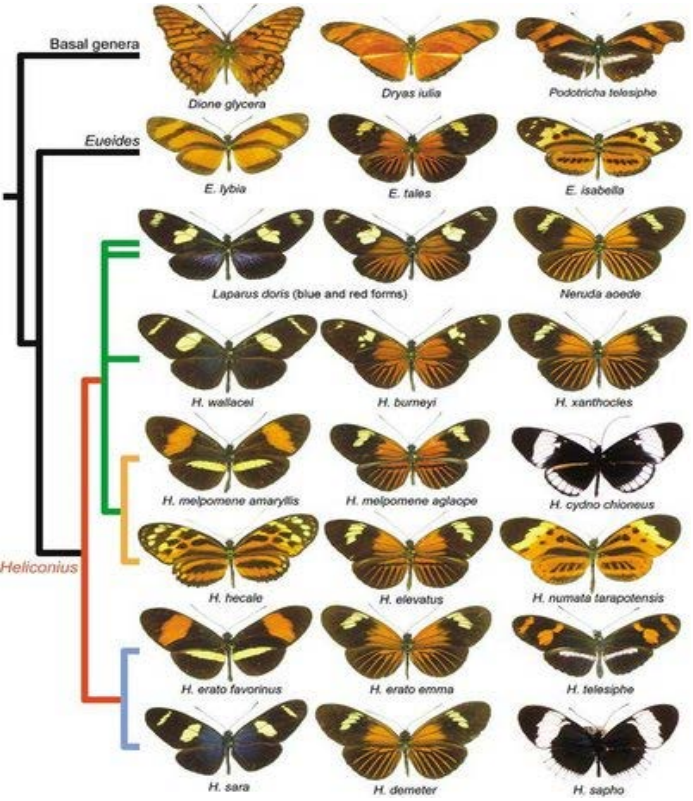


Darwin's finches in the Galapagos



(b) The Galápagos finches

Closely related species often differ in both phenotypes and ecological niches



Radiation of Triplefin Fishes

New Zealand has the greatest diversity of triplefin fishes in the world

Sympatric distribution

Conforms to the criteria of an adaptive radiation

Ecological factors associated with speciation in NZ triplefin fishes

1) What are the ecological traits under selection?

2) Which traits are potentially available for reproductive isolation?




Triplefins have diversified ecologically…

rockpools

deep shelf <500m

estuaries

rocky reefs

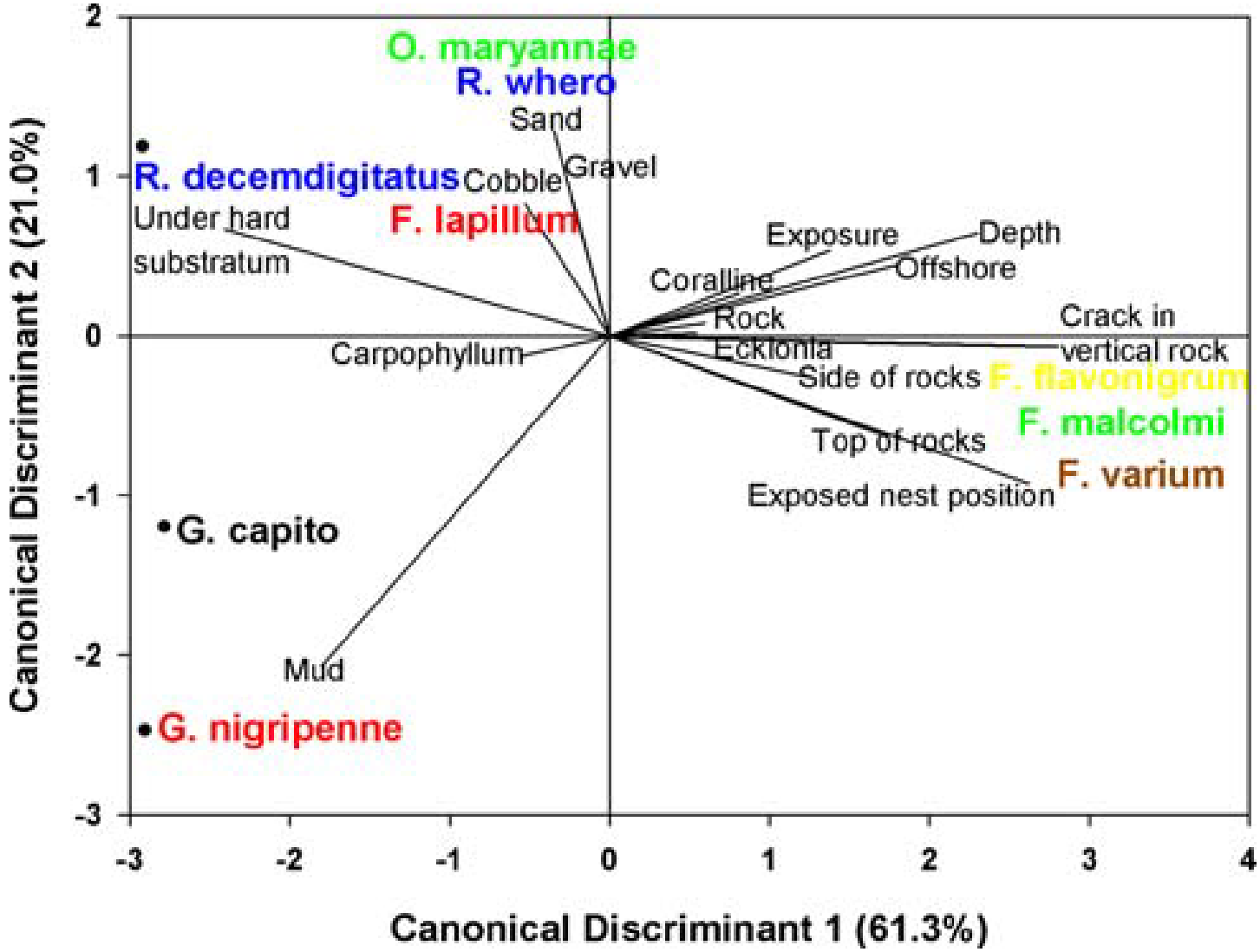
pelagic

harbours & bays

Wellenreuther, Syms & Clements (2008) *Ecography*

Wellenreuther, Barrett & Clements (2007) *Marine Ecology Progress Series*

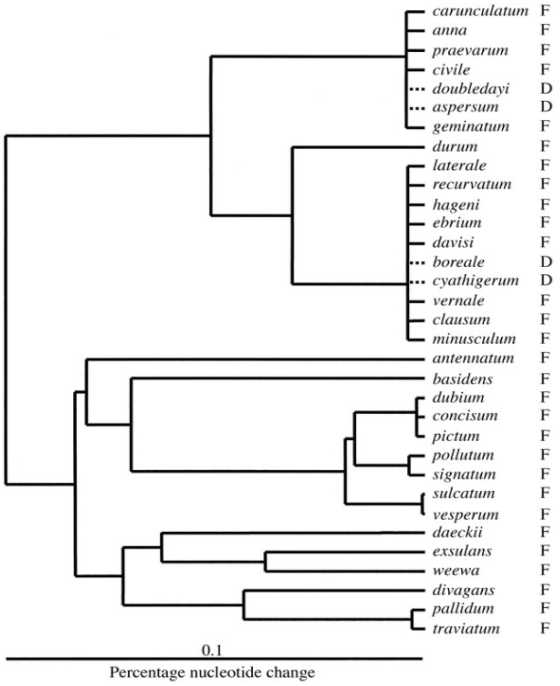
Habitat diversification leads to reproductive isolation

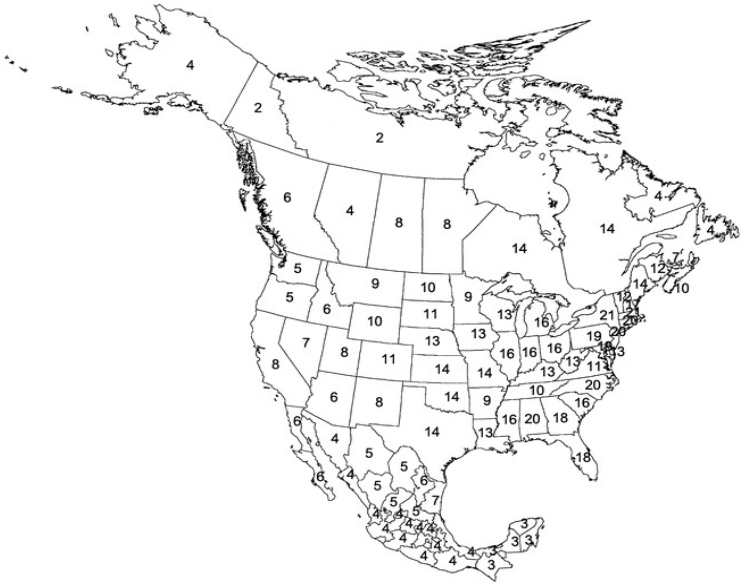


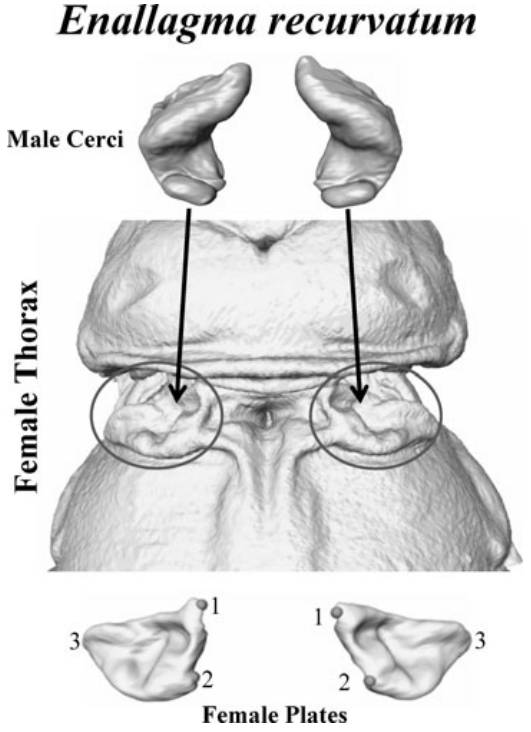
Wellenreuther M & Clements K D (2007) *Marine Biology*


By E.Nurcombe

”Neutral” community ecology: rapid speciation by sexual selection?







McPeek et al. (2008) *Am. Nat.*

McPeek and Brown (2000) *Ecology*

McPeek, Shen and Farid (2009) *Evolution*

Talk outline: Three aspects

1. Ecological differences
2. Reproductive isolation
3. Colour polymorphism

1. Ecological differences in *Calopteryx*

	Females	Males
Calopteryx splendens		
Calopteryx virgo		

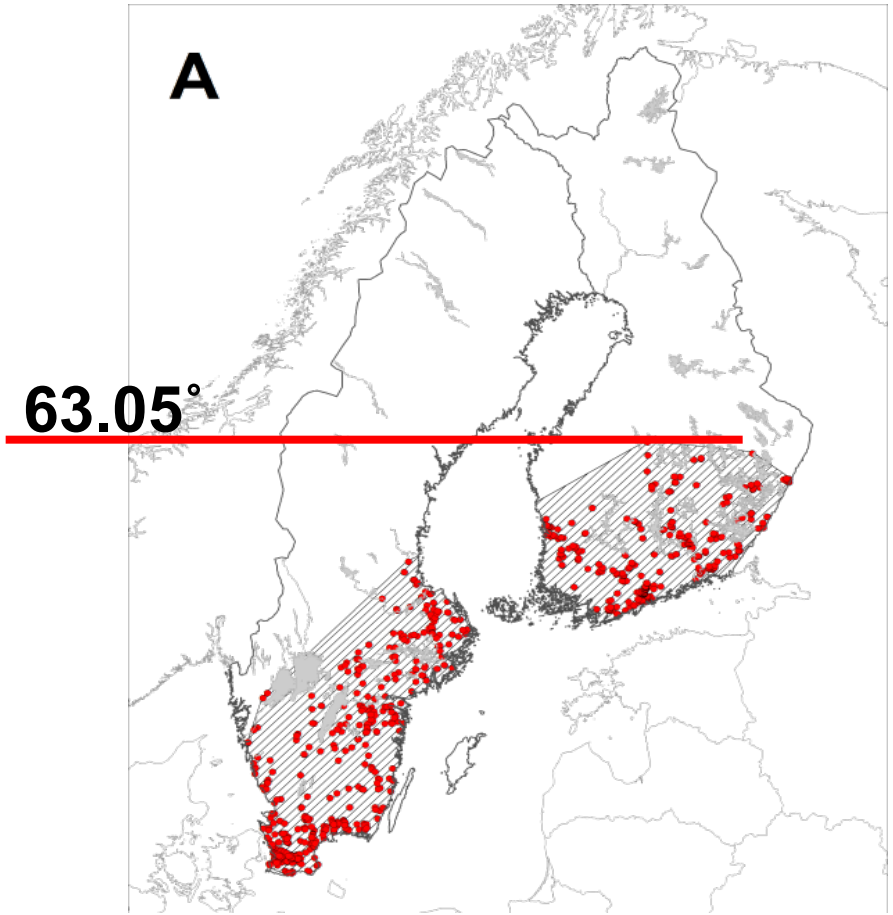
Larval phase≈2 years, adult stage≈ 2 weeks

Co-exist along rivers

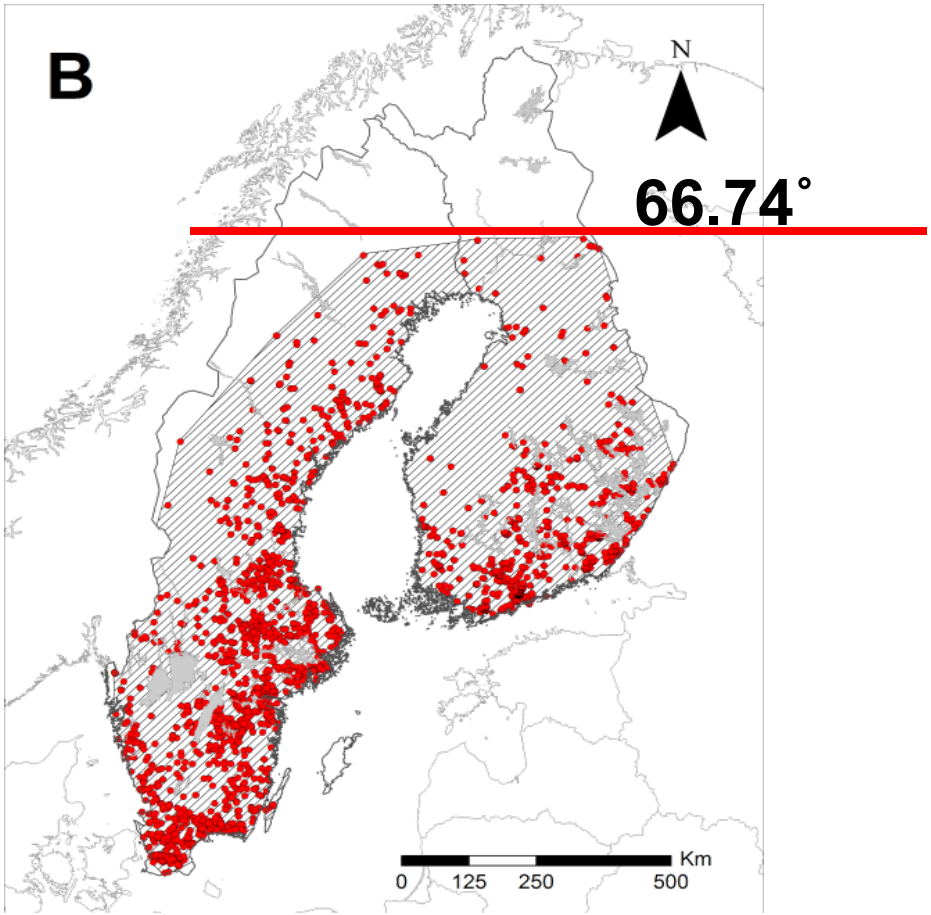
Field sampling: Sweden and Finland

Niche modeling

Calopteryx splendens

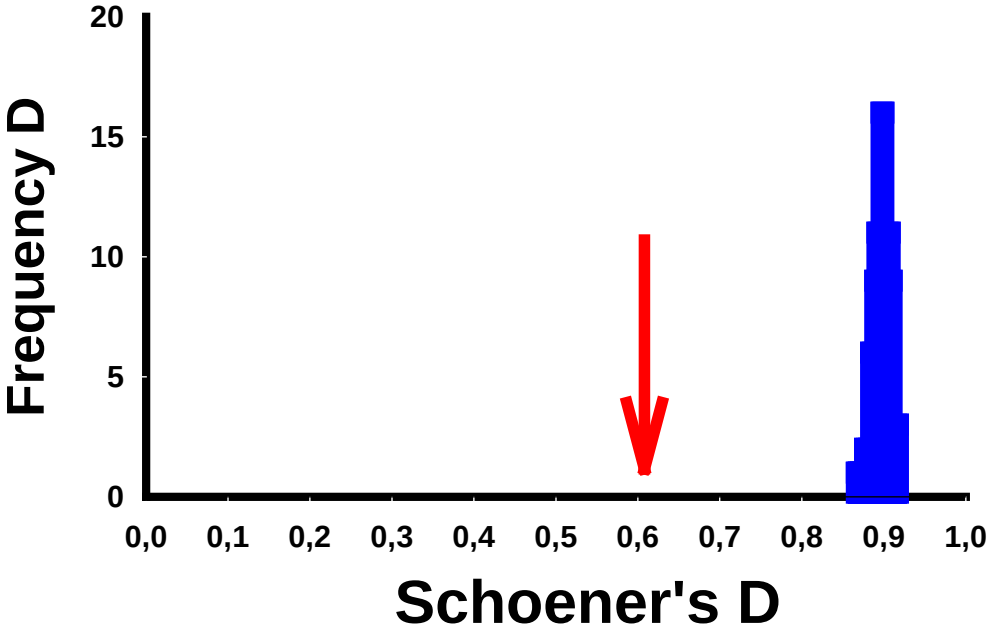


Calopteryx virgo



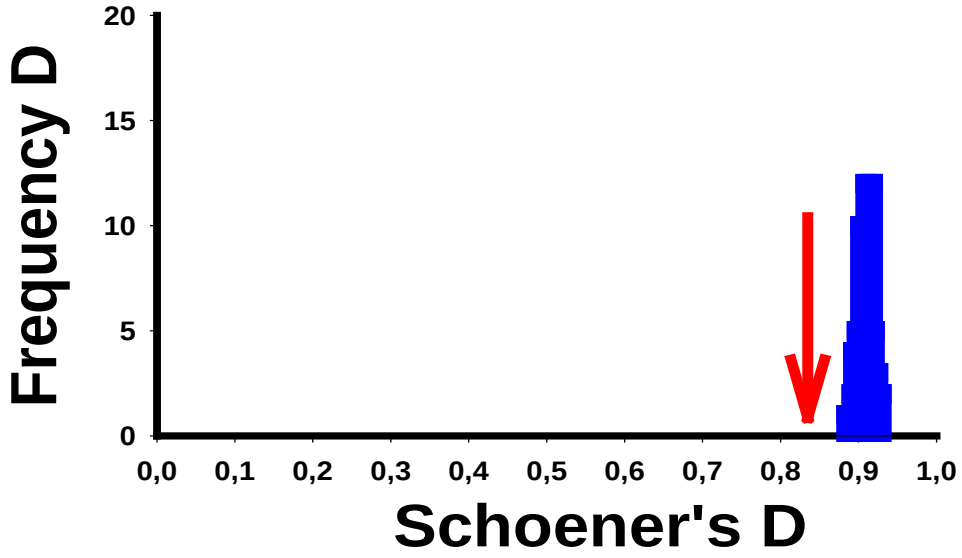
Wellenreuther, Larson and Svensson (2012) Ecology

Niche Null Models-Entire Range



Wellenreuther, Larson and Svensson (2012) *Ecology*

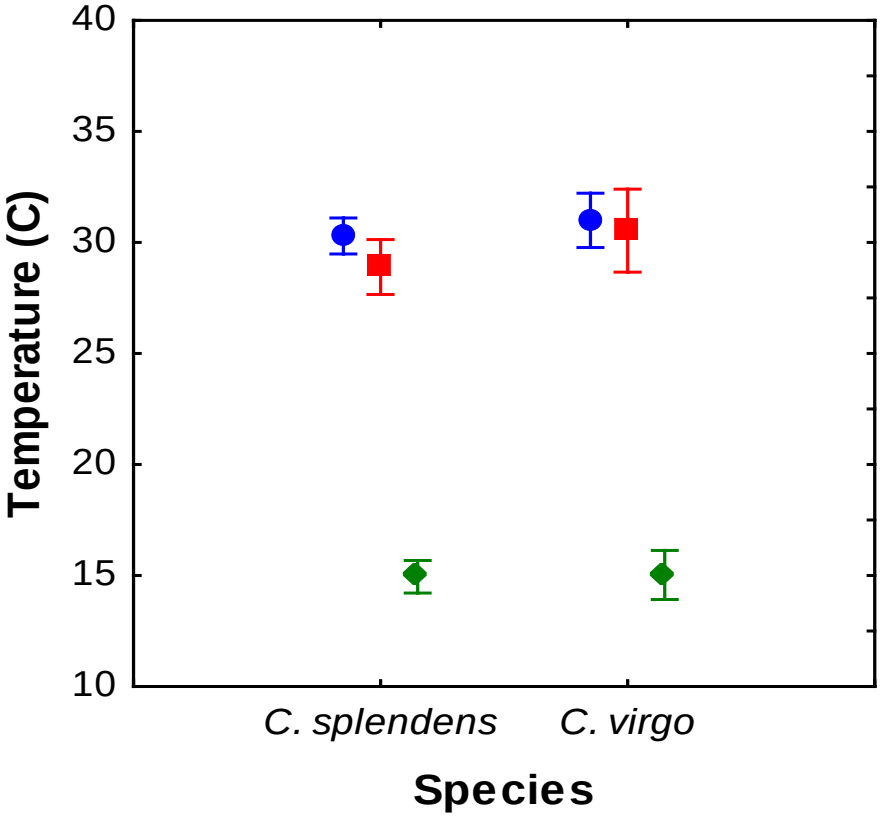
Niche Null Models-Sympatry

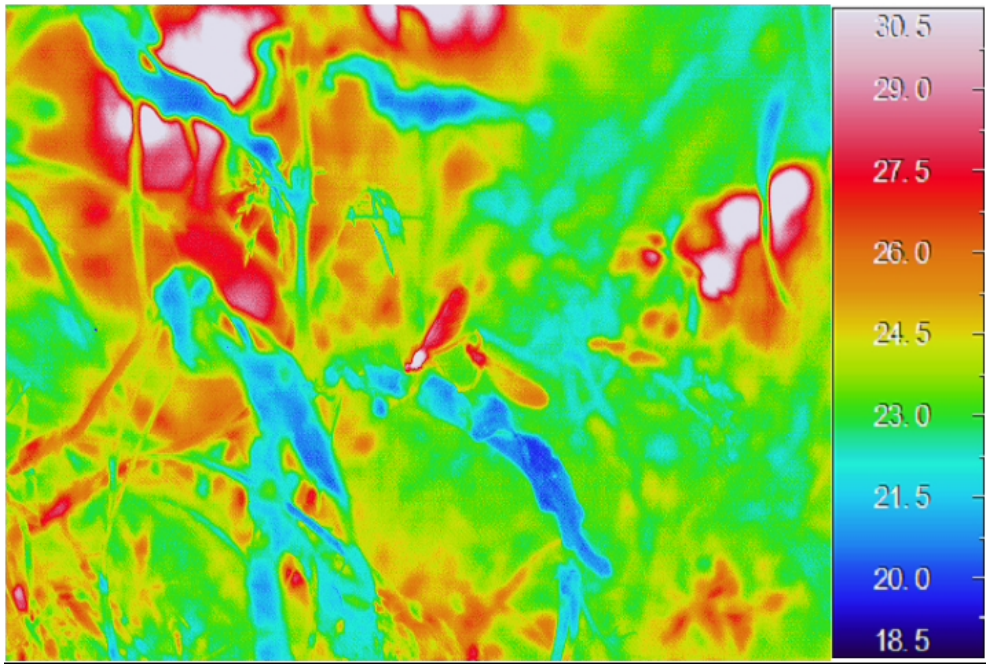


Wellenreuther, Larson and Svensson (2012) *Ecology*

Weak (ns) thermal niche divergence in sympatry

Effects of species: Wilks Lambda = 0.978; F(3,122)= 0.895, P = 0.45



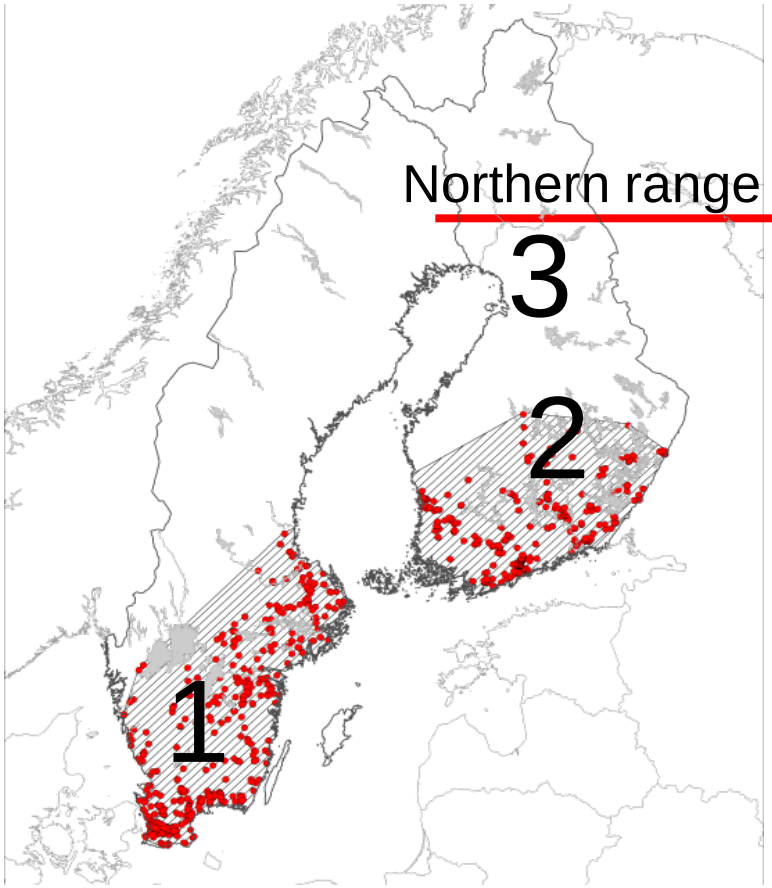


Air temperature
Maximum substrate temperature
Minimum substrate temperature

Svensson (2012) *Organisms Diversity & Evolution*

2. Reproductive isolation

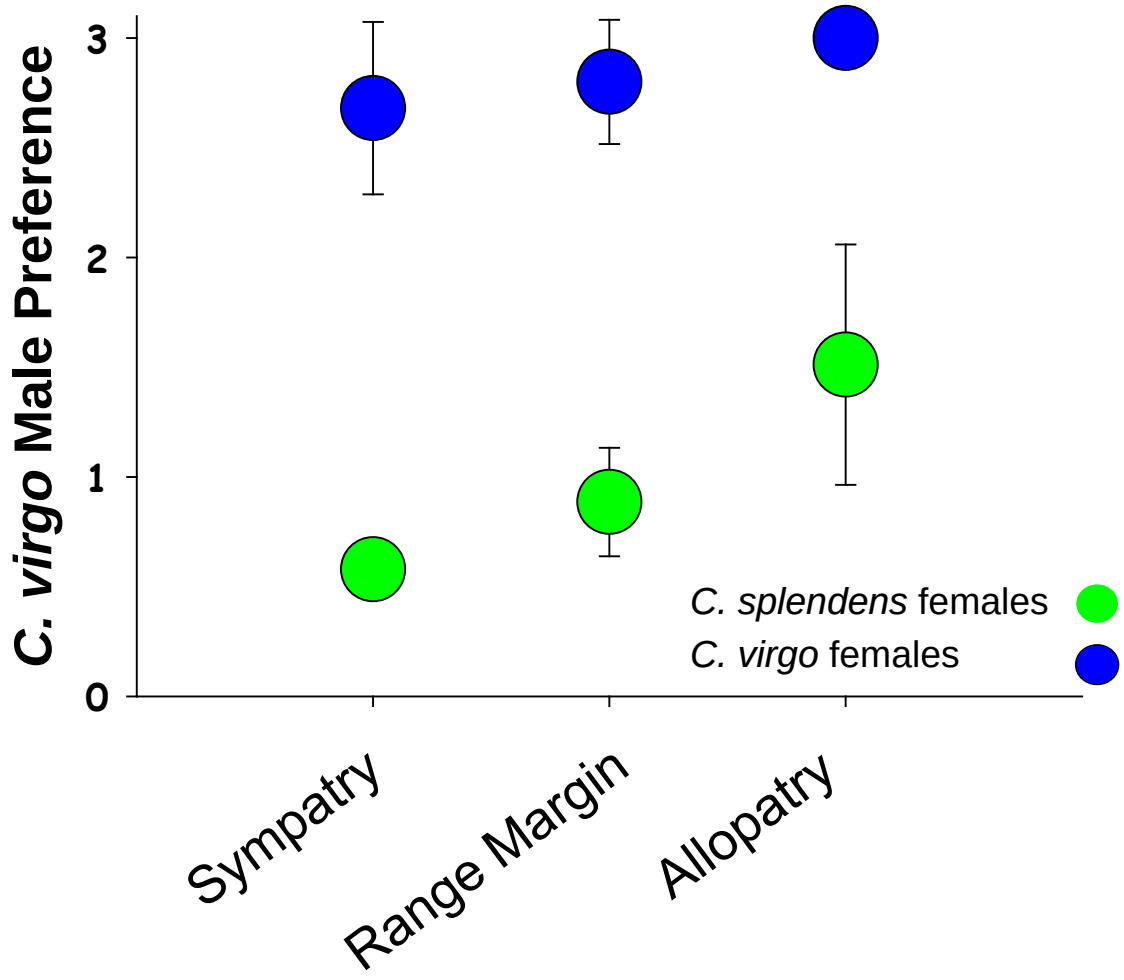
Map of the distribution of the *C. splendens*



Wellenreuther, Tynkkynen and Svensson (2010) *Evolution*

Courtship Response with Latitude

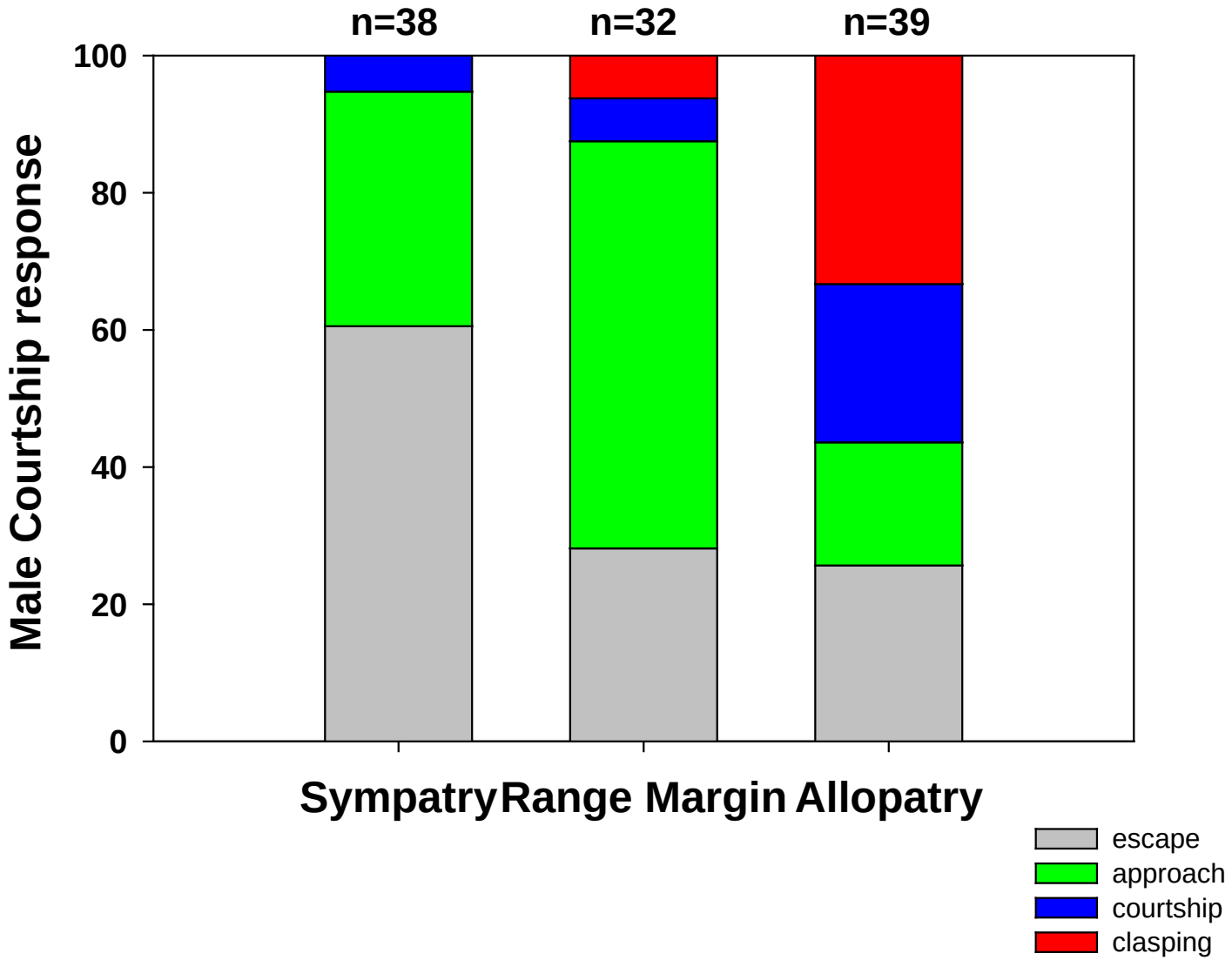
C. splendens females
Regions (population nested)
($F_{2, 103}$=20.88, p<0.001)
Populations
($F_{3, 103}$=1.95; p=0.127)



Wellenreuther, Tynkkynen and Svensson (2010) *Evolution*

A More Qualitative Look

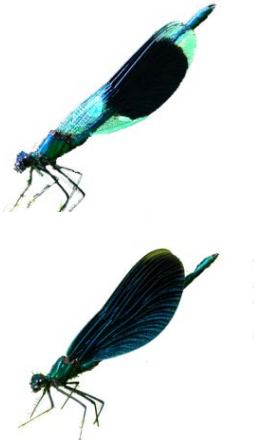
Male *C. virgo* respones to *C. splendens* females

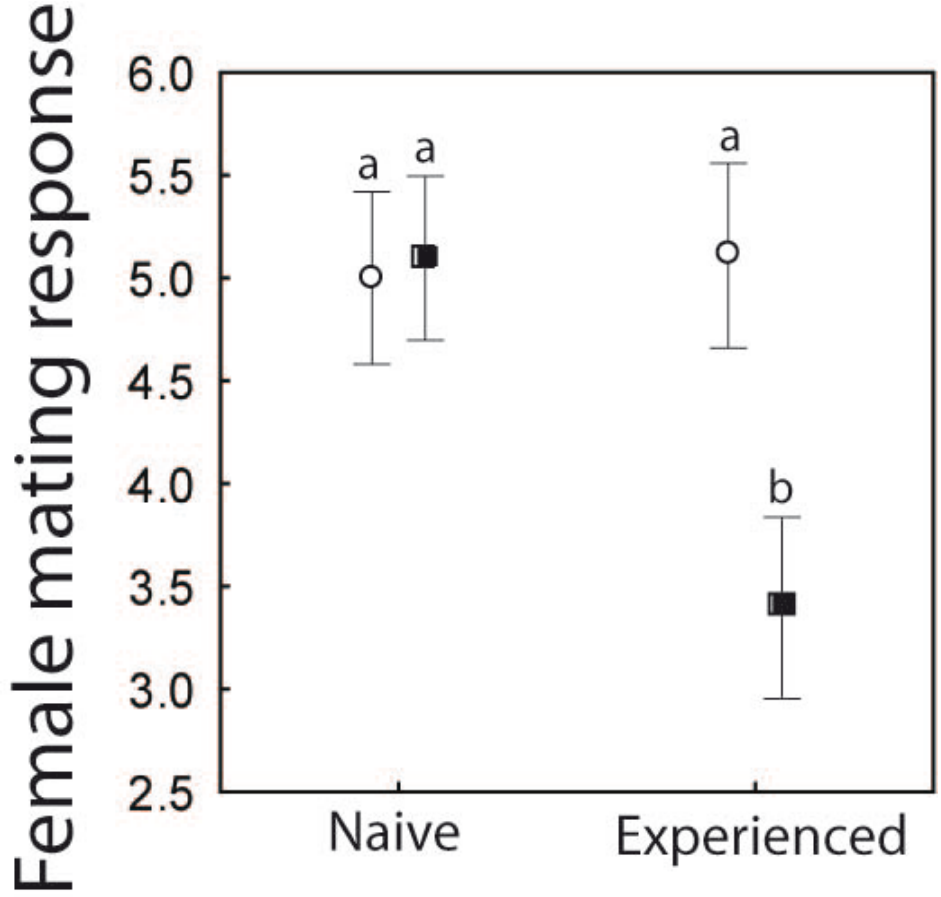


Wellenreuther, Tynkkynen and Svensson (2010) *Evolution*

Isolation through learning?

?





Svensson, Eroukhmanoff, Karlsson, Runemark and Brodin (2010) *Evolution*

3. Colour polymorphism

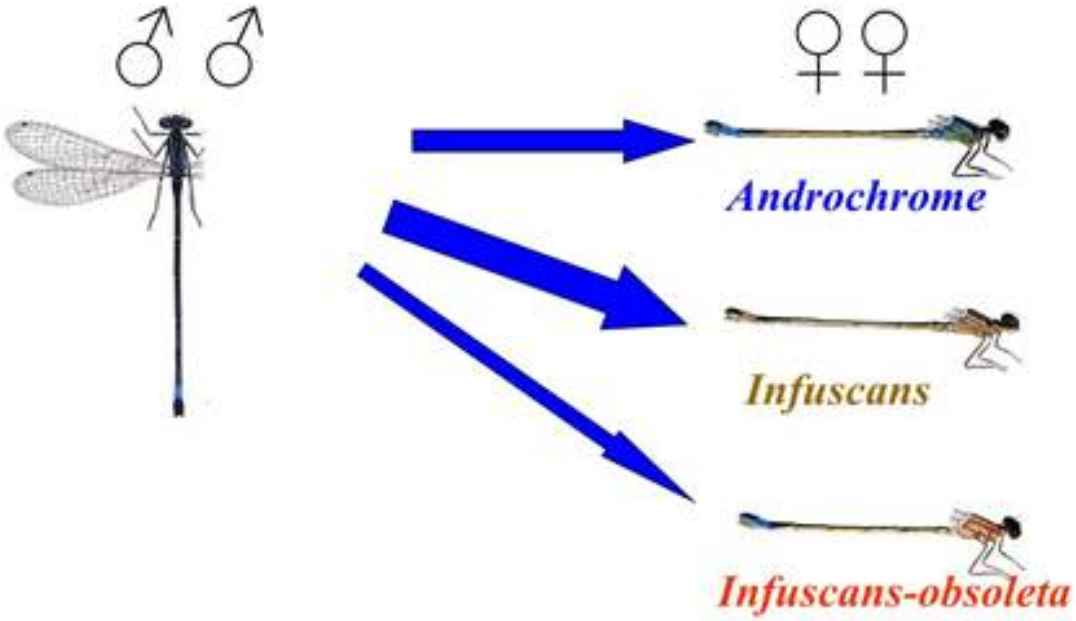
- Consequence of intense mating harassment by males
- Multiple matings common
- Last male sperm precedence
- Penises have brushes, hooks, grabbers and spreaders

A microscope view of the slaty skimmer penis show a bristly median lobe and oarlike lateral lobes on each side.

Colour polymorphic *Ischnura elegans*


Male & androchrome


Male-mimic ”androchrome



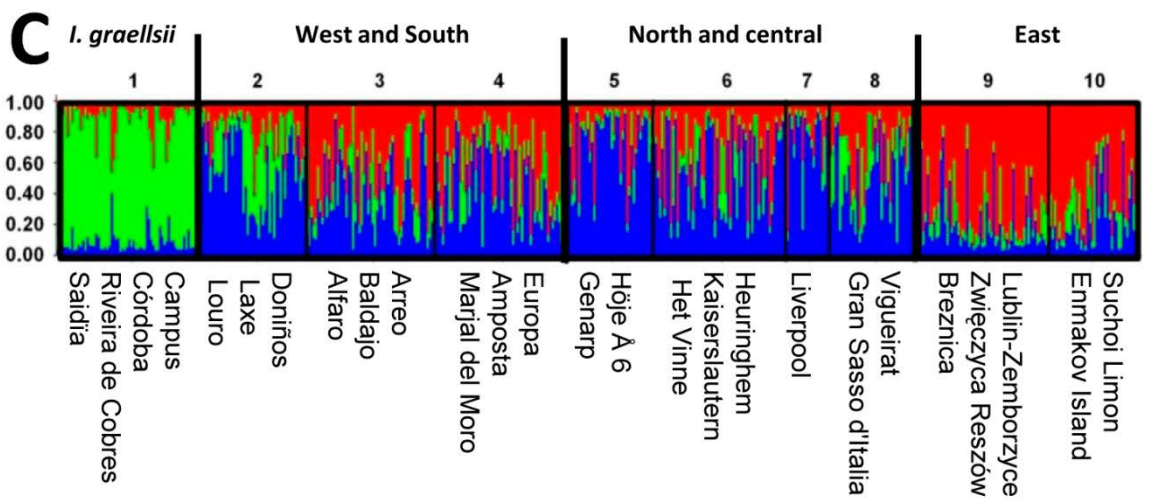

Infuscans

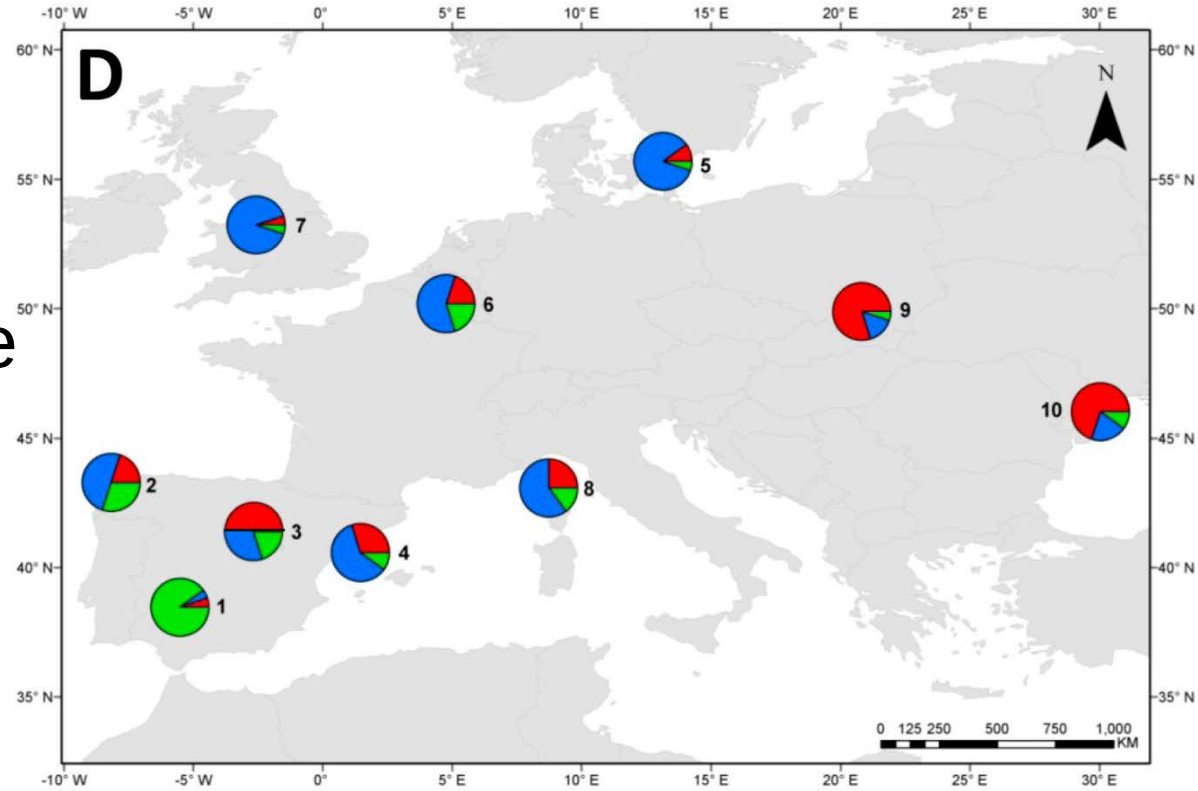

Infuscans-obsoleta

Sánchez-Guillén, Hansson, Wellenreuther, Svensson & Cordero-Rivera (2011) Heredity

Ischnura elegans

- Very widespread
- Wide ecological niche
- Good disperser
- Early coloniser





Wellenreuther, Sánchez-Guillén,Cordero-Rivera,Svensson & Hansson (2011) *PLoS ONE*

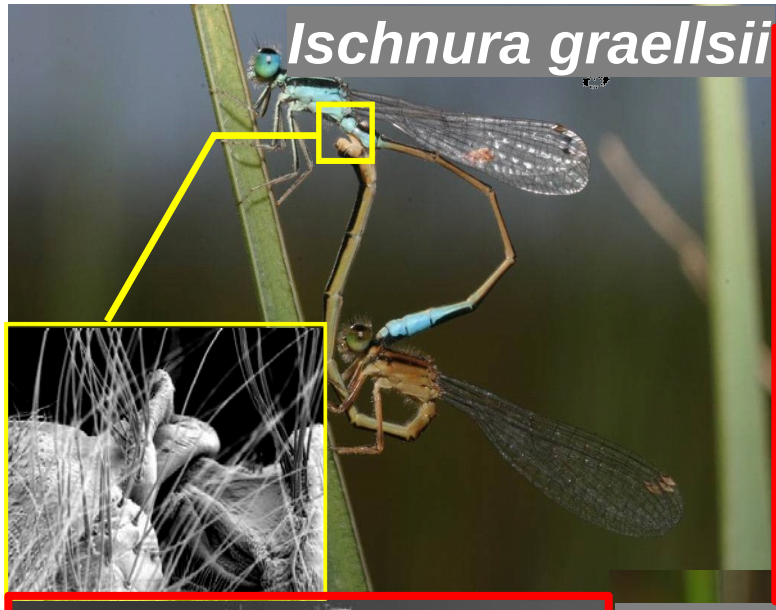
Low ecological divergence & hybrids

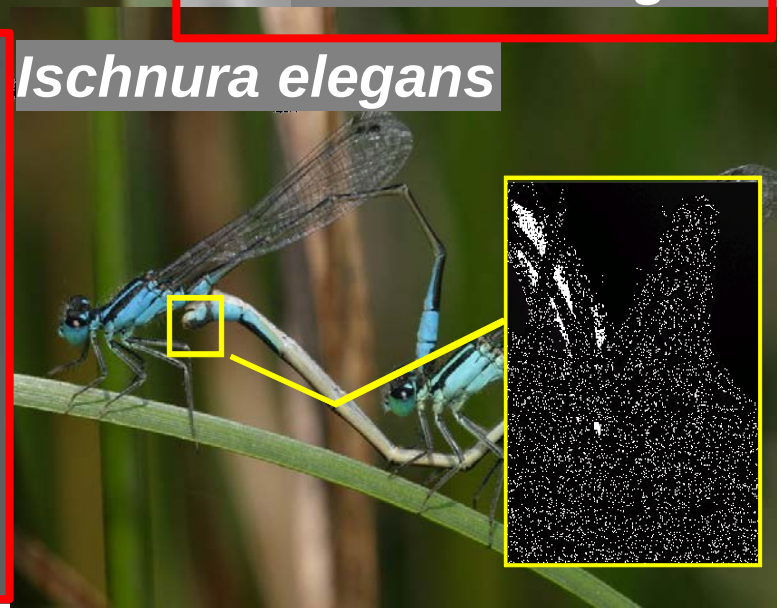
Male abdominal appendages

Lateral view of the pronotum

IE male X IG female low

IG male X IE female high





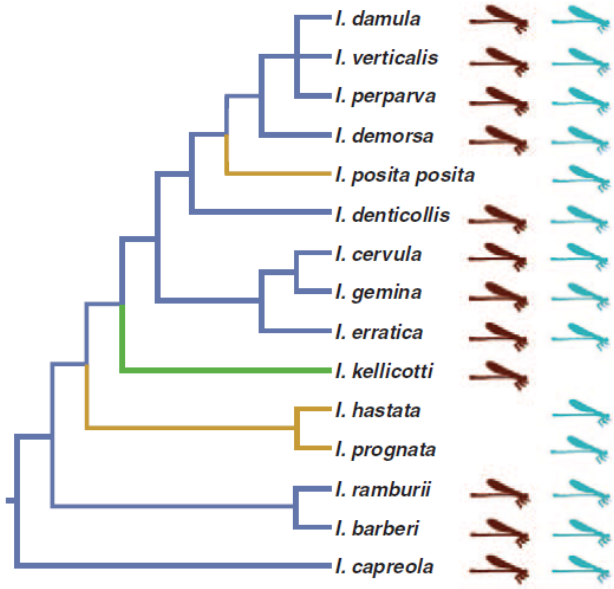
Sánchez-Guillén, Wellenreuther & Cordero-Rivera (2011) Evolution
Sánchez-Guillén, Wellenreuther, Cordero, & Hansson (2011) BMC Evolutionary Biology

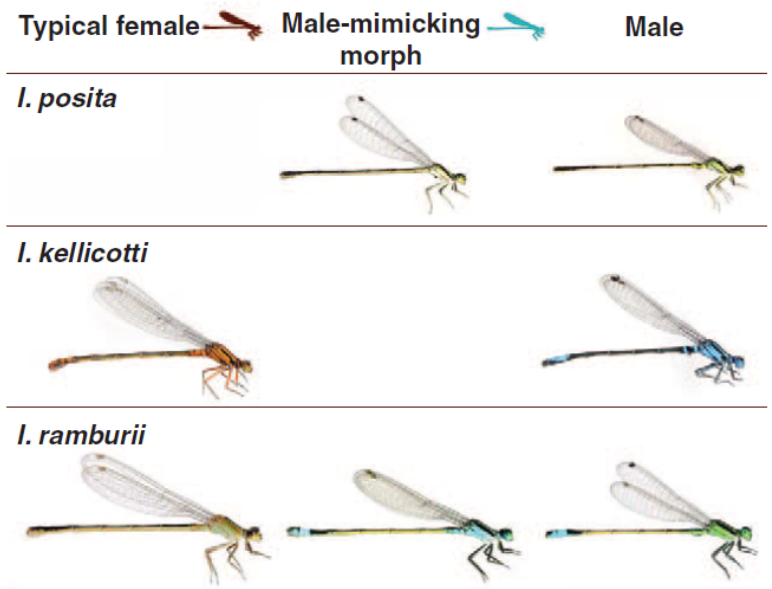
Phenotype-Genotype mapping

1. Genotype males and larvae



2. Macroevolution of a colour polymorphism





Genomic approaches

1. Draft genome *(LGC)*
-annotation, gene function, assembly

2. RAD genotyping of pedigree *(Genepool)*
-detailed linkage map, co segregation between markers and colour

3. Re-sequencing of morphs *(BGI)*
-allele frequencies, validation

4. Transcriptome data *(Leiden)*
-improve draft genome, function

Summary and conclusions

Several features of odonate biology make them suitable for studies of non-ecological speciation

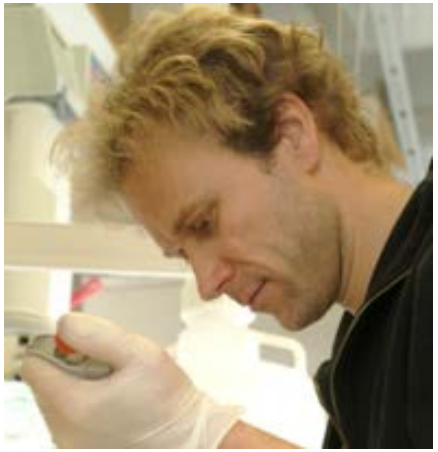
These features include 1/strong sexual selection, 2/strong sexual isolation and 3/weak ecological niche divergence

Learning is a powerful mechanism for the development of sexual isolation

Colour polymorphisms in females reduce male mating harassment

Mapping colour genes will give insights into the processes that maintain natural variation

Erik Svensson



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THE ROYAL SWEDISH ACADEMY OF SCIENCES

Thank you!