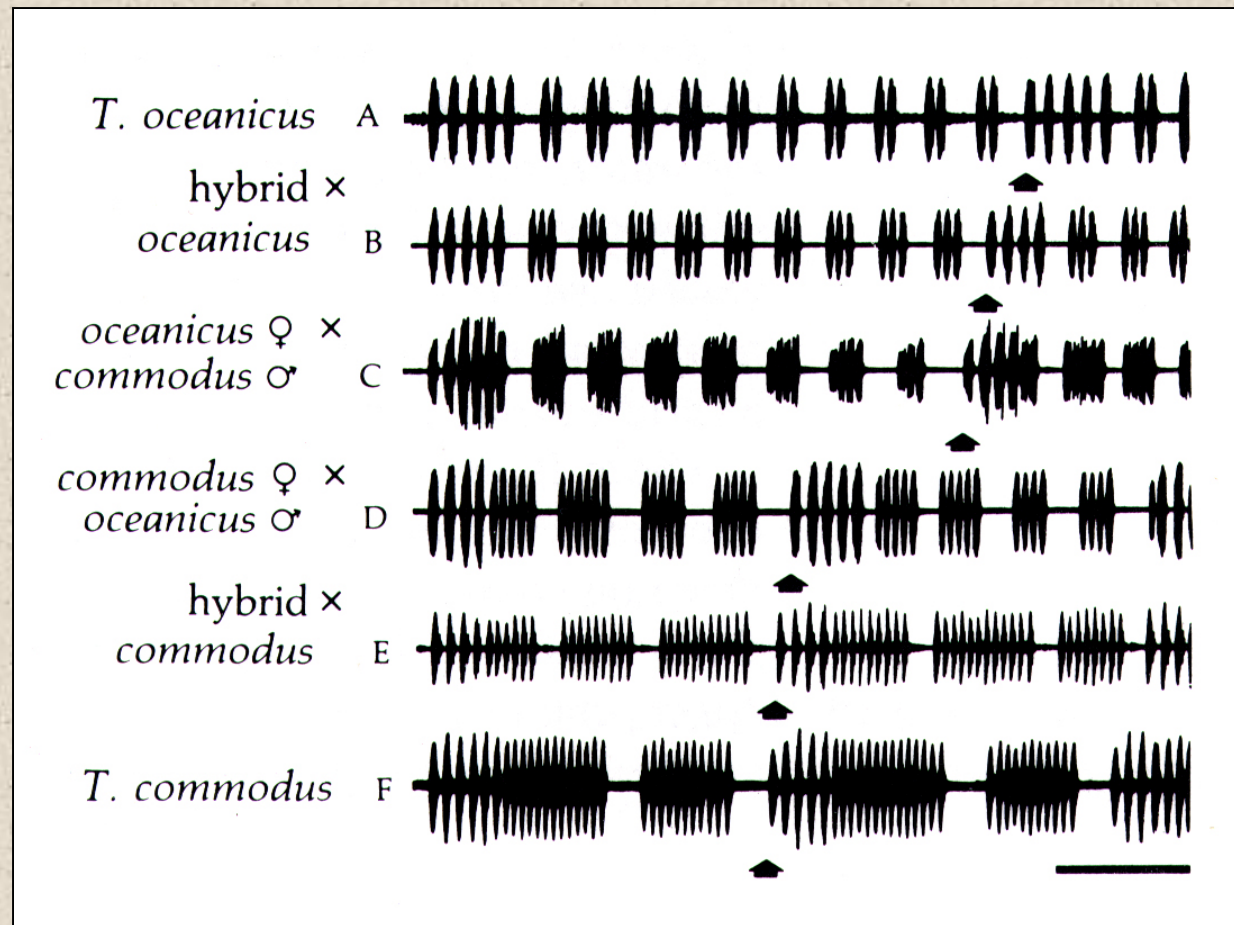


Gryllus field crickets as models of song and preference evolution



David A. Gray
California State University Northridge

Bentley & Hoy 1972: *Teleogryllus*

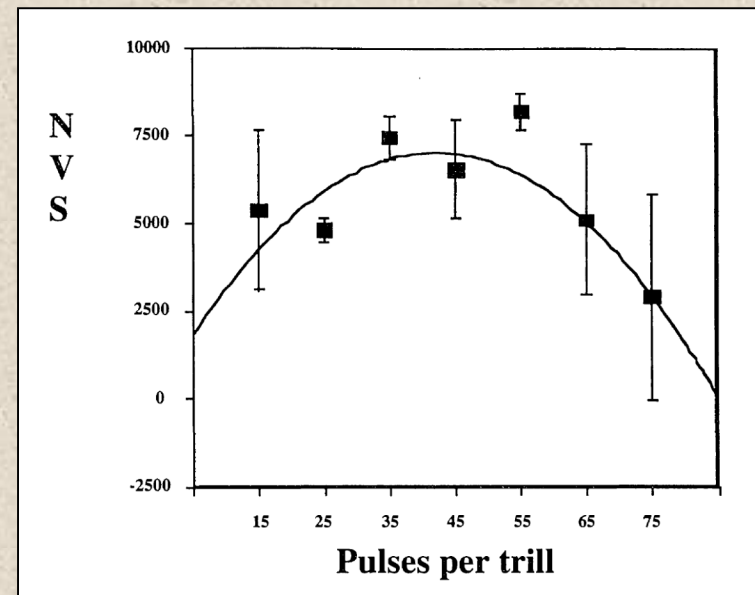
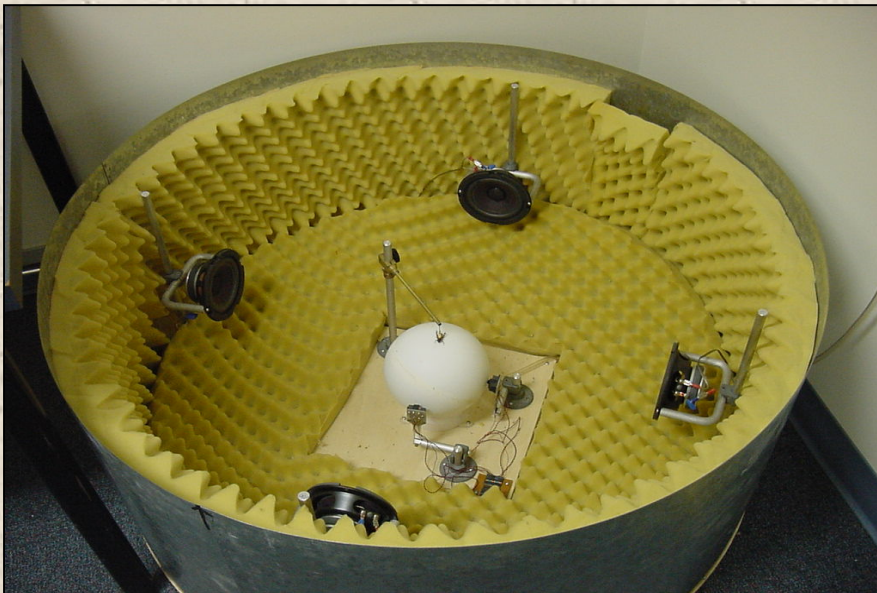


Heritability Studies: Song

- Cade 1981, *G. texensis*, calling time/night, $h^2 \sim 0.5$
- Hedrick 1988, *G. integer*, calling bout duration, $h^2 \sim 0.75$
- Webb & Roff 1992, *G. firmus*, pulse rate, $h^2 \sim 0.35$
- Gray & Cade 1999, *G. texensis*, pulses/trill, $h^2 \sim 0.4$
- Gray & Cade 2000, *G. texensis*, pulse rate, $h^2 \sim 0.4$
- Simmons 2004, *T. oceanicus*, pulse interval, chirp duration, song duration, long chirp duration, $h^2 \sim 0.15$ to ~ 0.25
- Hunt et al. 2007, *T. commodus*, pulses/chirp, trill number, inter-call duration, chirp inter-pulse duration, dominant frequency, $h^2 \sim 0.15$ to ~ 0.7

Heritability Studies: Female Preference

- Gray & Cade 1999, *G. texensis*, pulses/trill, $h^2 \sim 0.34$
- Gray & Cade 2000, *G. texensis*, pulse rate, $h^2 \sim 0.38$
- Simmons 2004, *T. oceanicus*, %long chirp, $h^2 \sim 0$



Genetic Correlation: Song & Preference

- Gray & Cade 2000, *G. texensis*, pulse rate, $r_G \sim 0.5$
- Gray & Cade 1999, *G. texensis*, pulses/trill, $r_G \sim 0.5$
 - After random mating, $r_G \sim 0.0$
 - Suggests assortative mating drives correlation
(evidence of physical linkage or pleiotropy in *Laupala*)

World *Gryllus* diversity

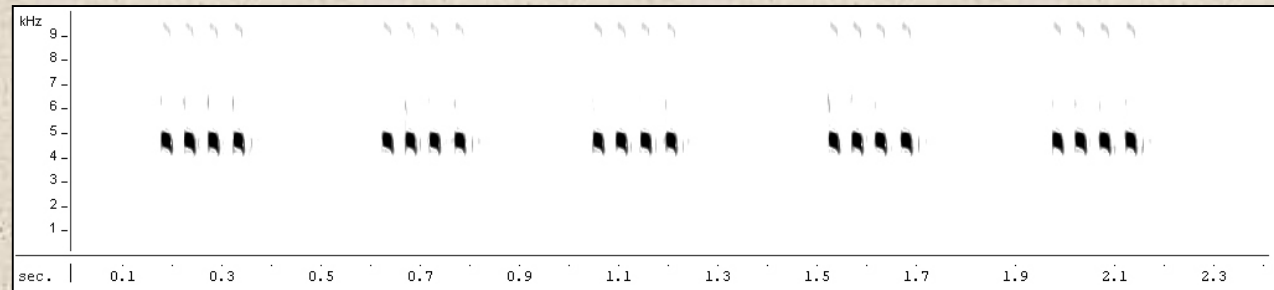
About 80 named species

- ~ 23 Africa
- ~ 9 Eurasia
- ~ 23 North America
- ~ 5 Central America/Caribbean
- ~ 20 South America/Galapagos



African and Eurasian species' songs

G. campestris



African spp.

Otte & Cade 1984

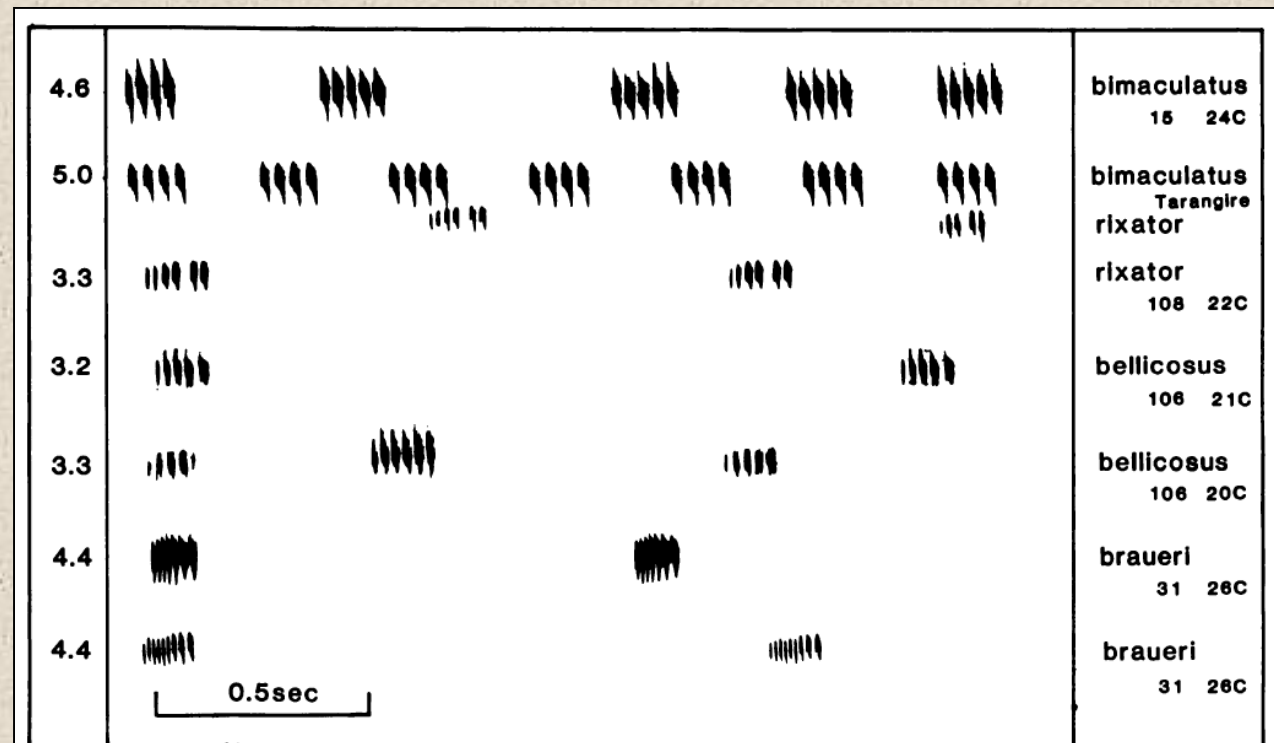
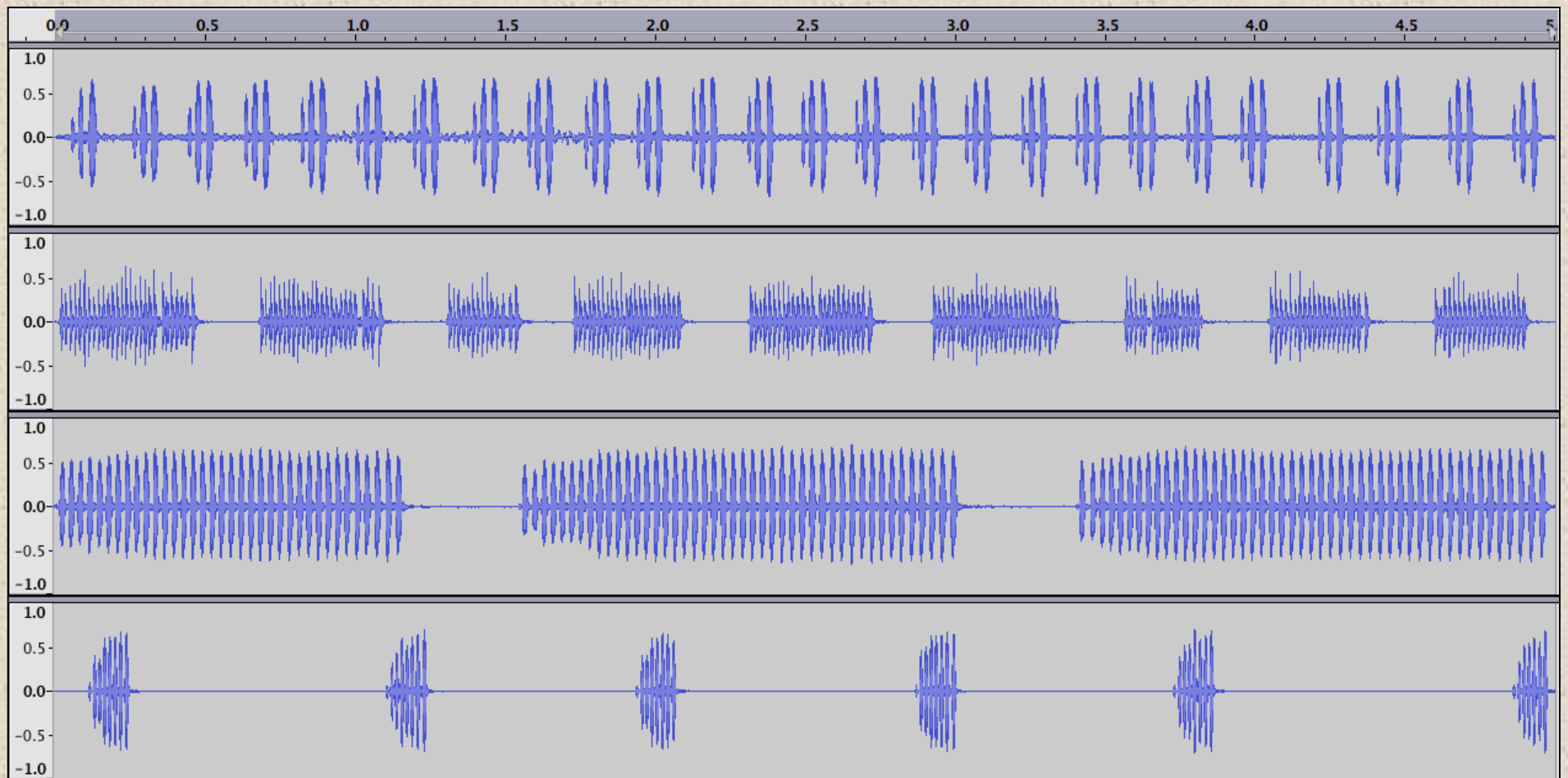
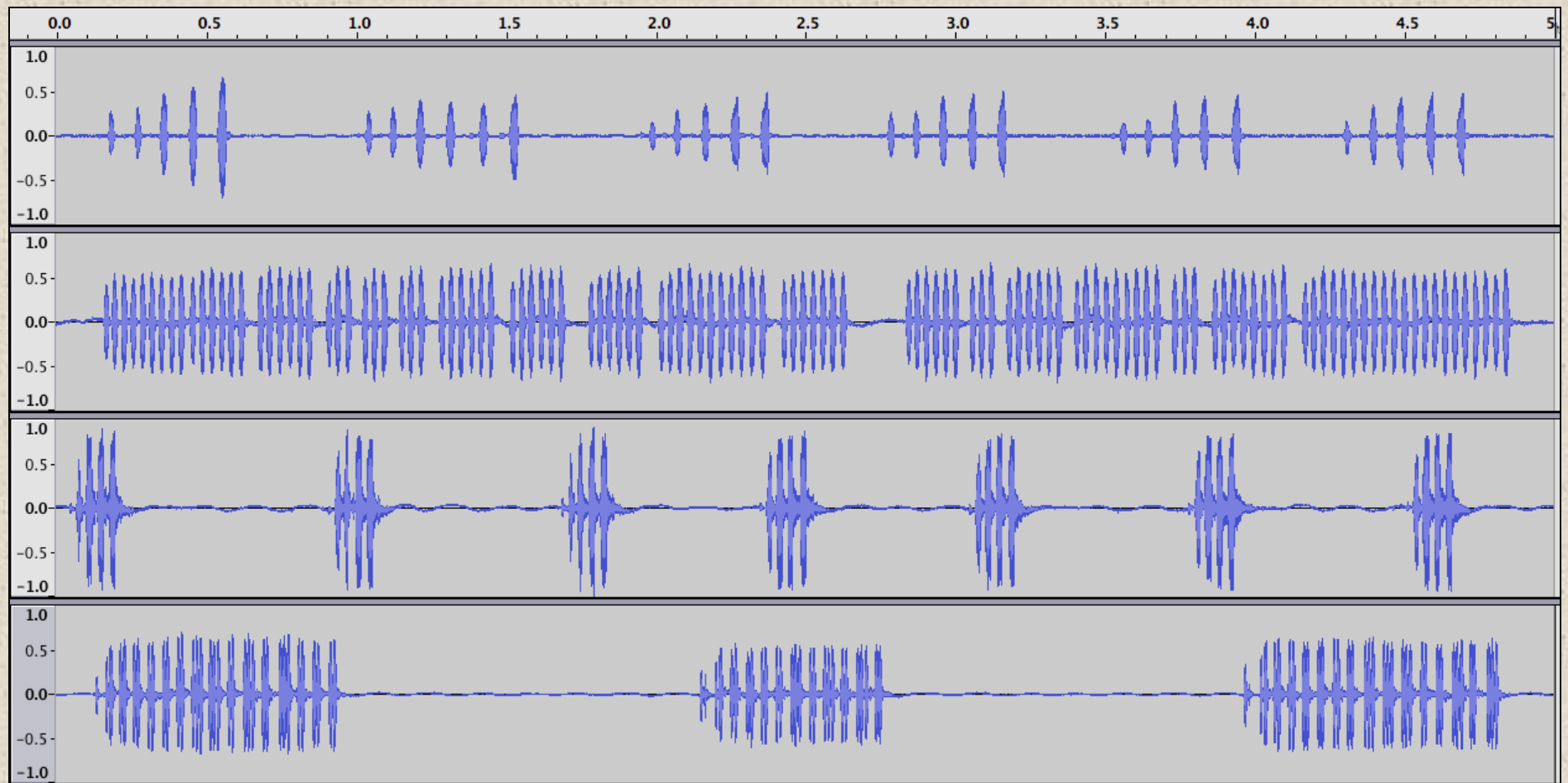


FIG. 4. Songs of four *Gryllus* species. Numbers at left indicate frequency in kiloHertz. Numbers beneath names indicate taping locality and temperature in °C.

Song Variation in North America



More Song Variation



Multidimensional Axes of Song Variation in *Gryllus*

- Pulse Rate
- Frequency (Hz)
- Pulses/chirp-trill
- Chirp rate
- Secondary structure

The Challenge of *Gryllus*

“To the systematic orthopterist, the crickets of the genus *Gryllus* have proven to be one of the greatest stumbling-blocks in the order..... The different manifestations of the only native American species, *Gryllus assimilis*, are in no case sufficiently differentiated or constant to be considered geographic races. They constitute mere variations...” Rehn & Hebard (1915)

Taxonomic/Phylogenetic Progress

- 1920-2012

 - 17 USA taxa recognized, ~23 North America

- After ~40 years (Weissman) and ~12 years (me)

 - Taxonomic paper(s) major revision will describe many new species

 - song, geography/habitat, morphology
 - mtDNA assisted species id

 - Phylogeny paper

 - mtDNA (COI and 16s)
 - Nuclear (ITS2 and EF1a)

What changed from 1915 to now?

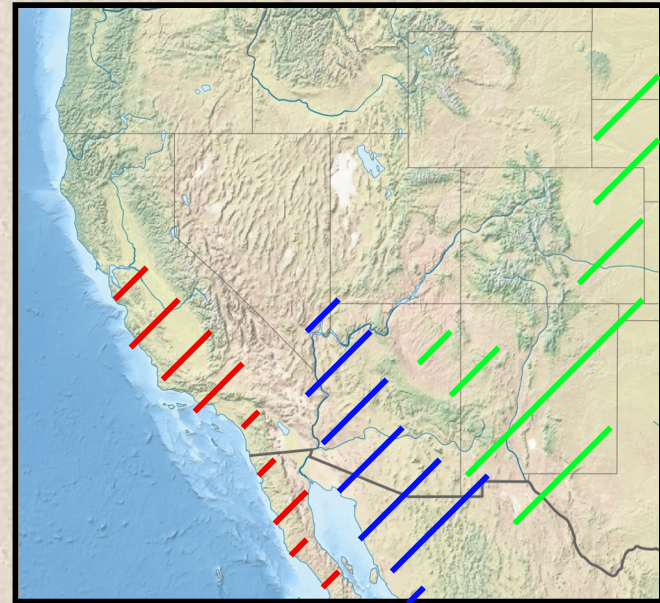
- Portable audio recorders
- Importance of song
 - Drives assortative mating
 - Song (and hydrocarbons) is how crickets know who they are
 - Diverges at speciation

Song divergence and speciation: condition dependence & evolutionary lability

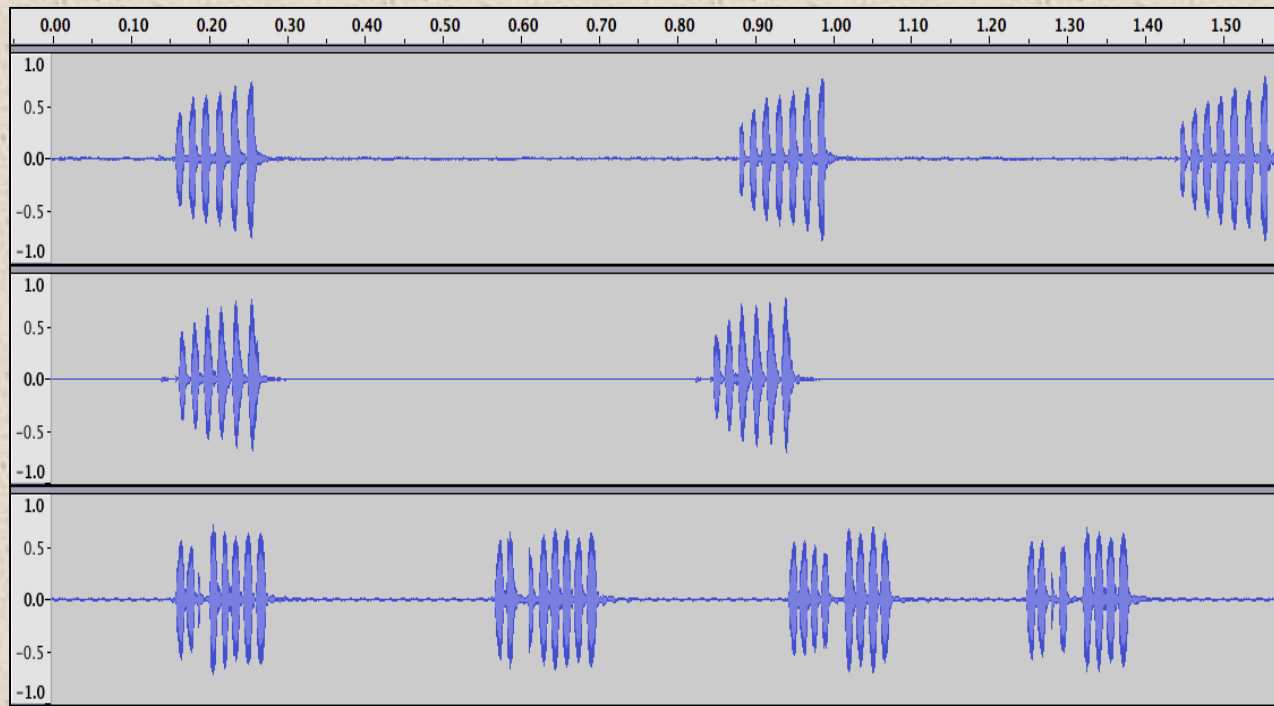
- Some song traits differ between sister taxa, others nearly constant
- Within taxa, some song traits highly variable, others nearly constant
 - Static & dynamic traits *sensu* Carl Gerhardt

Three allopatric sisters

- *Gryllus lineaticeps*
- *Gryllus* n.sp. 'G15'
- *Gryllus personatus*

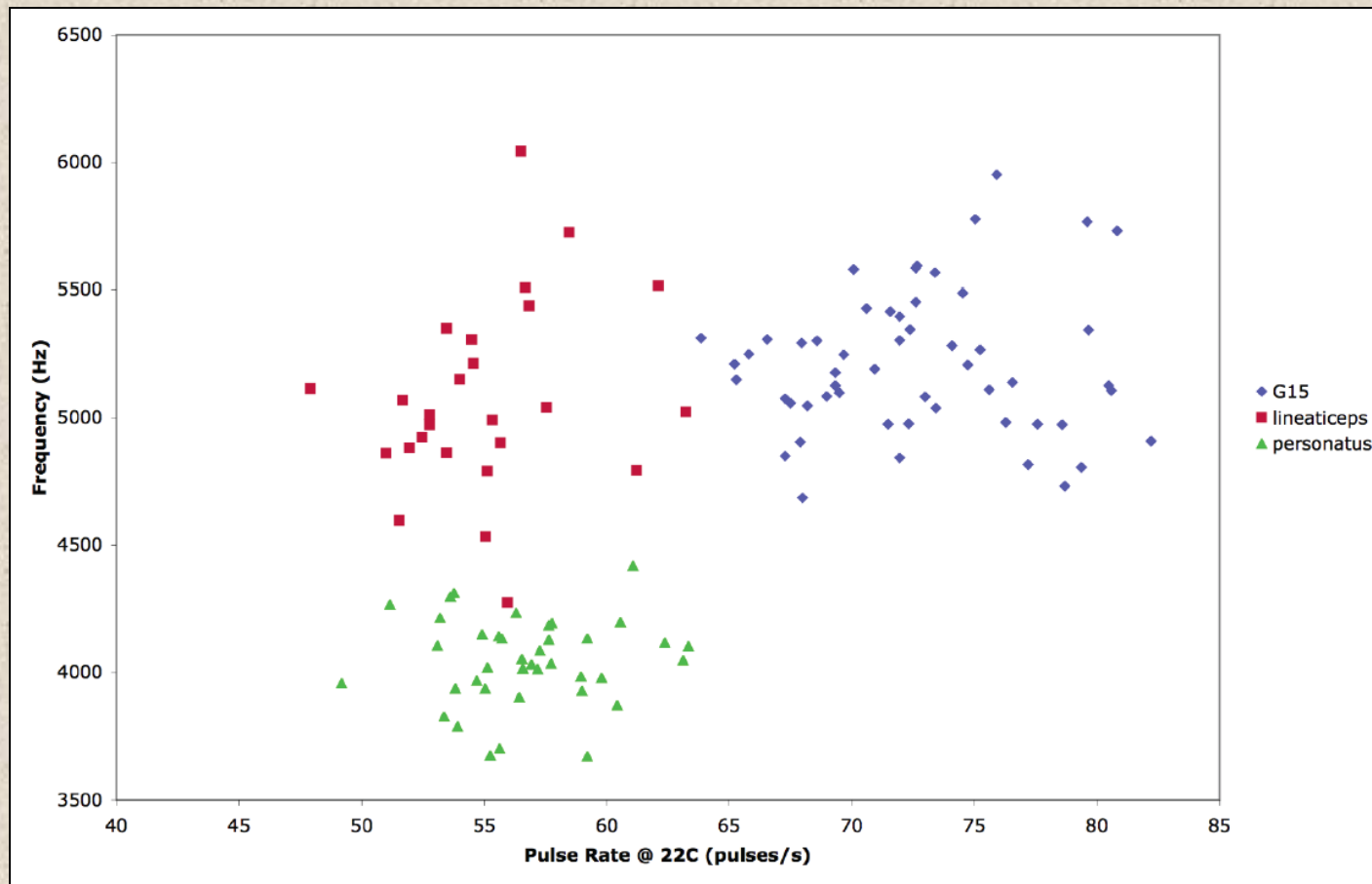


Similar song structures

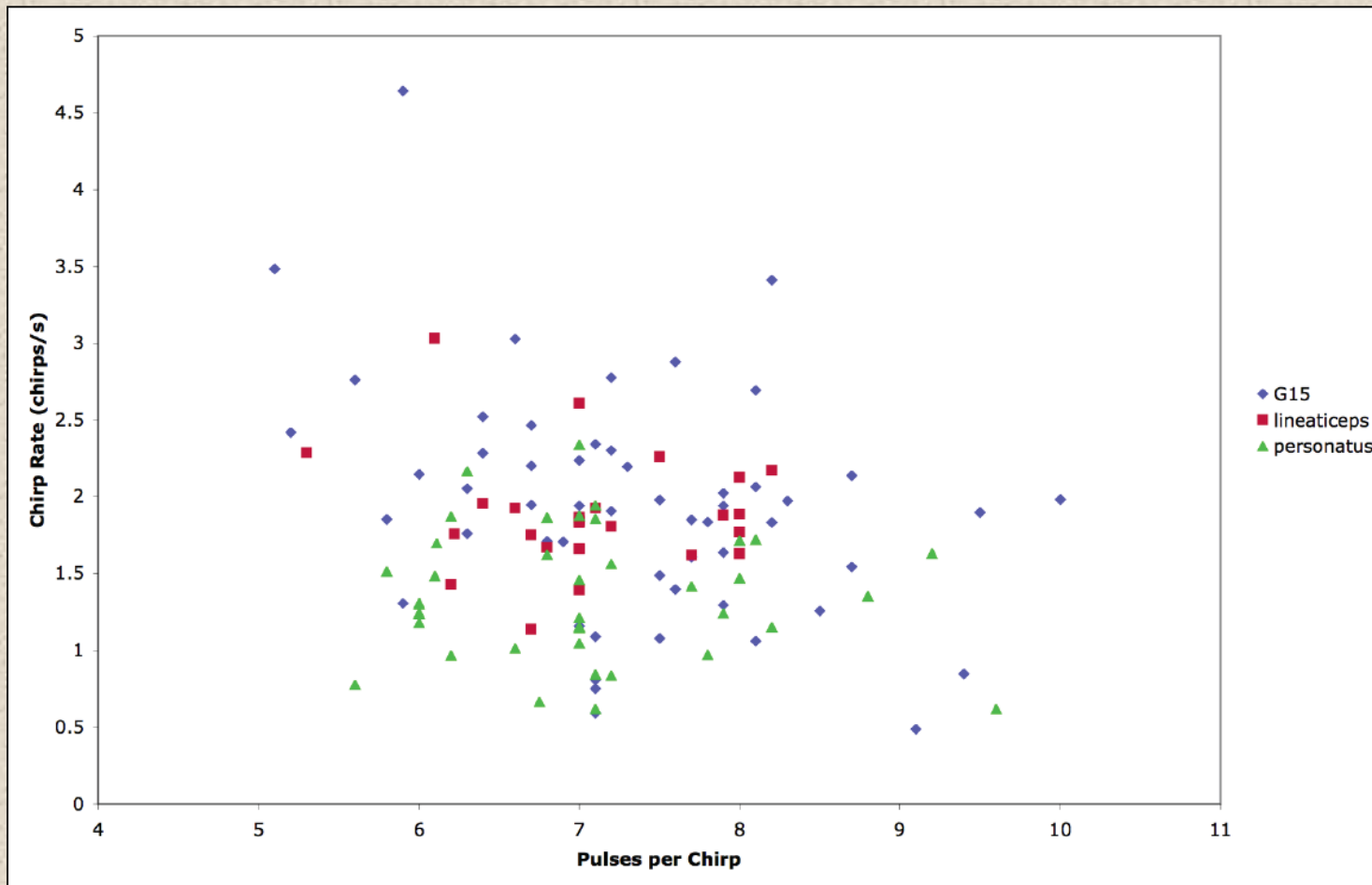


Coefficient of Variation:	Pulse Rate	Freq. (Hz)	Pulses/chirp	Chirp Rate
<i>G. lineaticeps</i>	0.06	0.07	0.10	0.20
G15	0.06	0.05	0.14	0.39
<i>G. personatus</i>	0.06	0.04	0.13	0.31

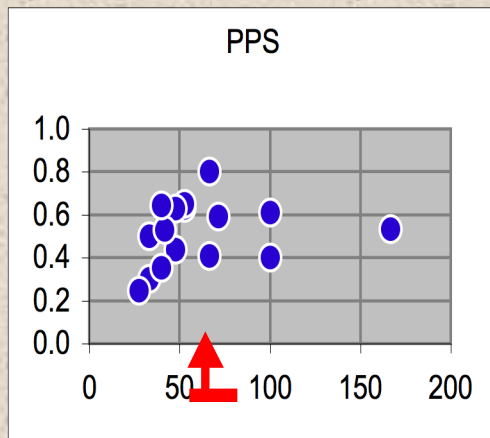
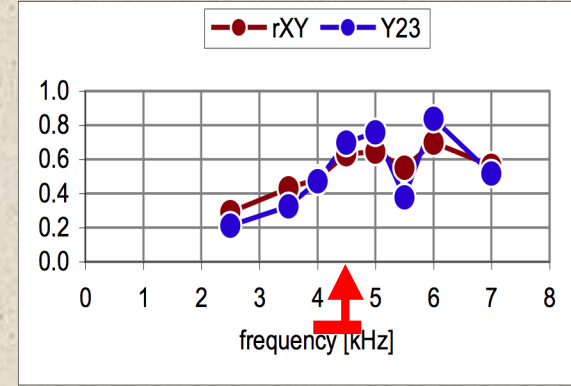
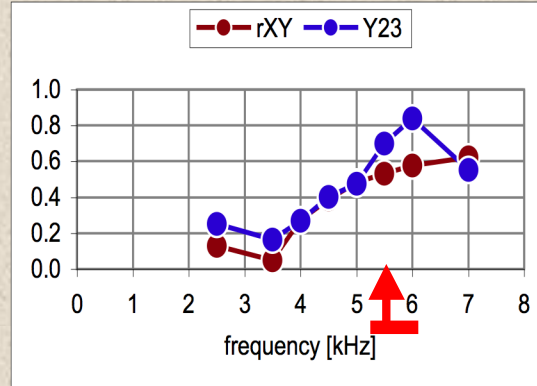
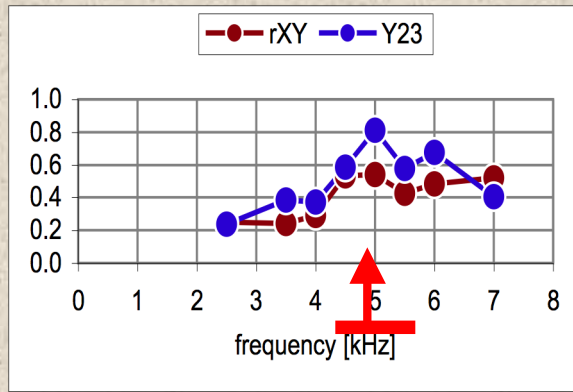
Static song traits strongly divergent



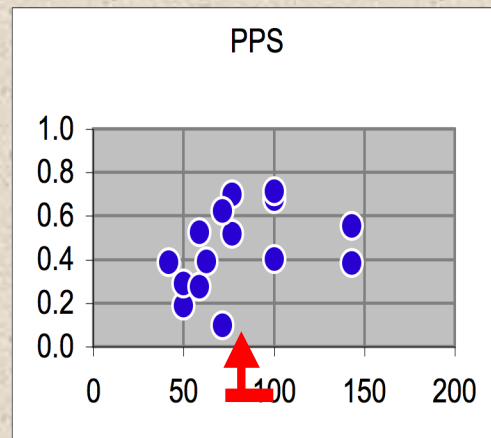
Dynamic song traits not strongly divergent



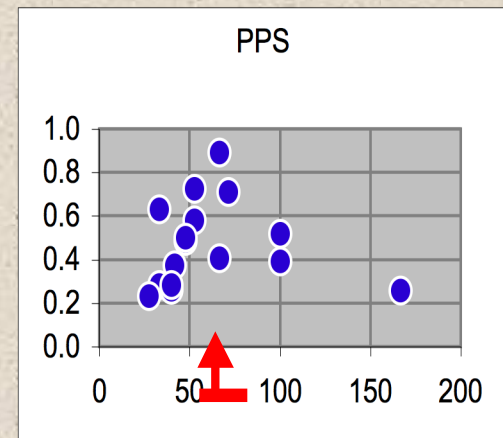
Female Preference: Static Traits



G. lineaticeps

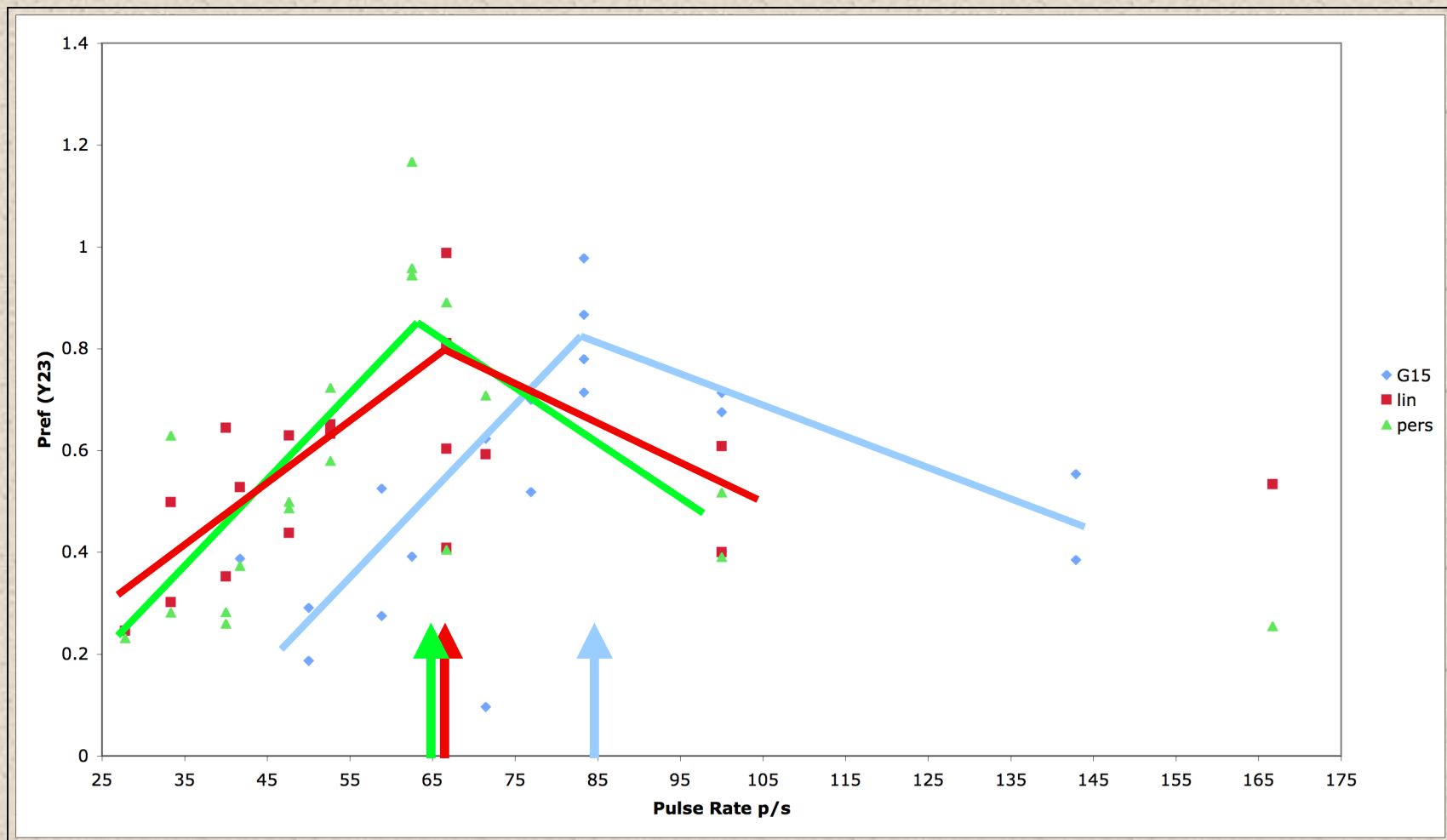


G15

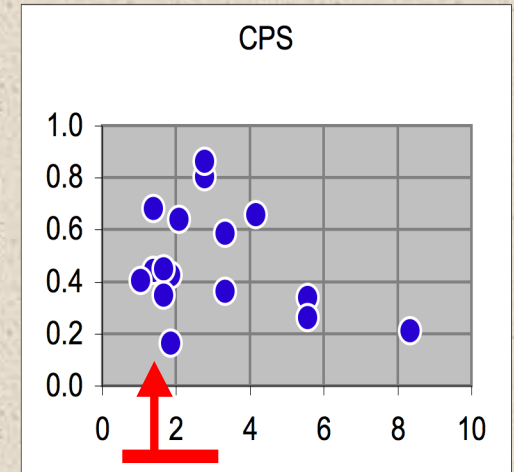
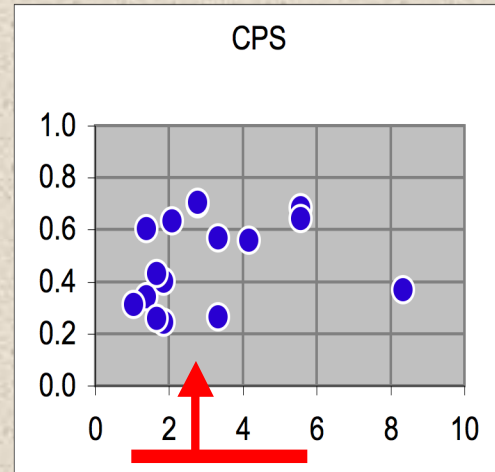
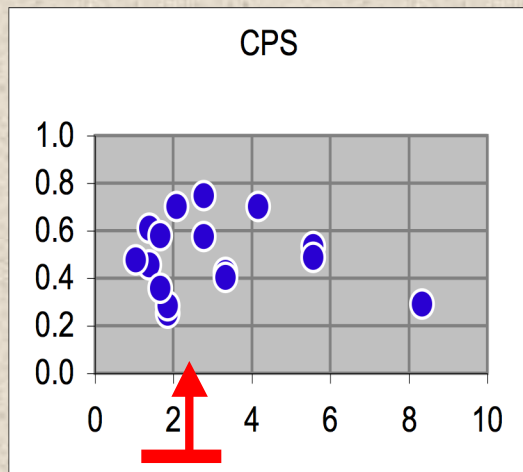
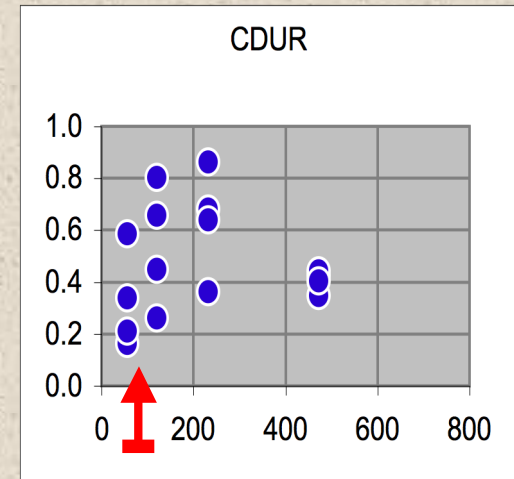
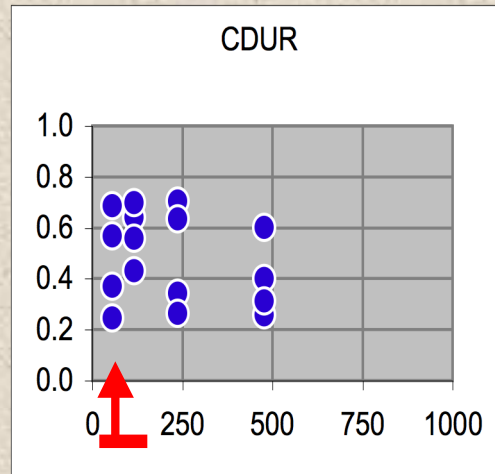
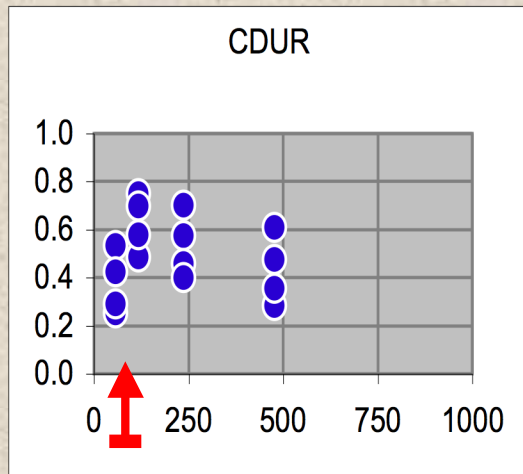


G. personatus

Pulse rate preferences



Female Preference: Dynamic Traits



G. lineaticeps

G15

G. personatus

Conclusions??

- Stabilizing preferences for static traits with lability of static traits and preferences across species
- Directional preferences for dynamic traits with conservation of dynamic traits and preferences across species
- 3 species GxE experiment in progress