

Gametic selection, meiotic drive, sex ratio bias, and transitions b/w sex determination systems

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Evolution 2017



Sex determination systems are remarkably dynamic

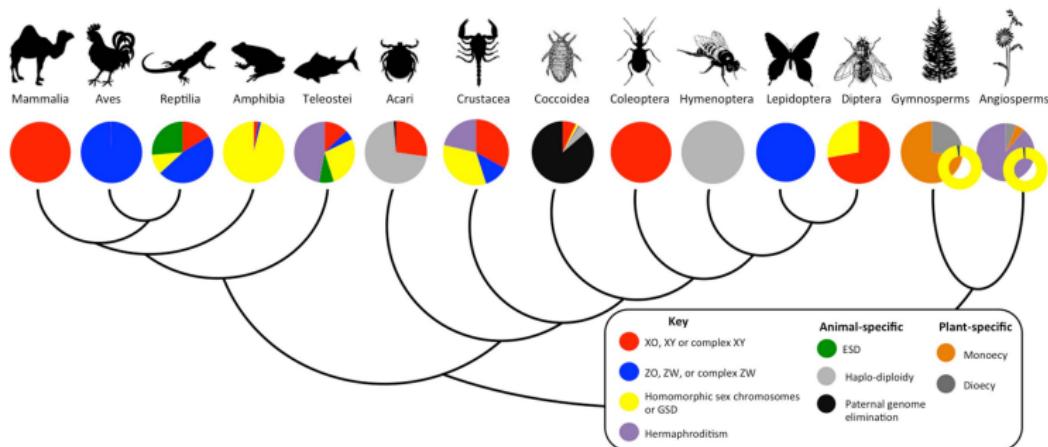


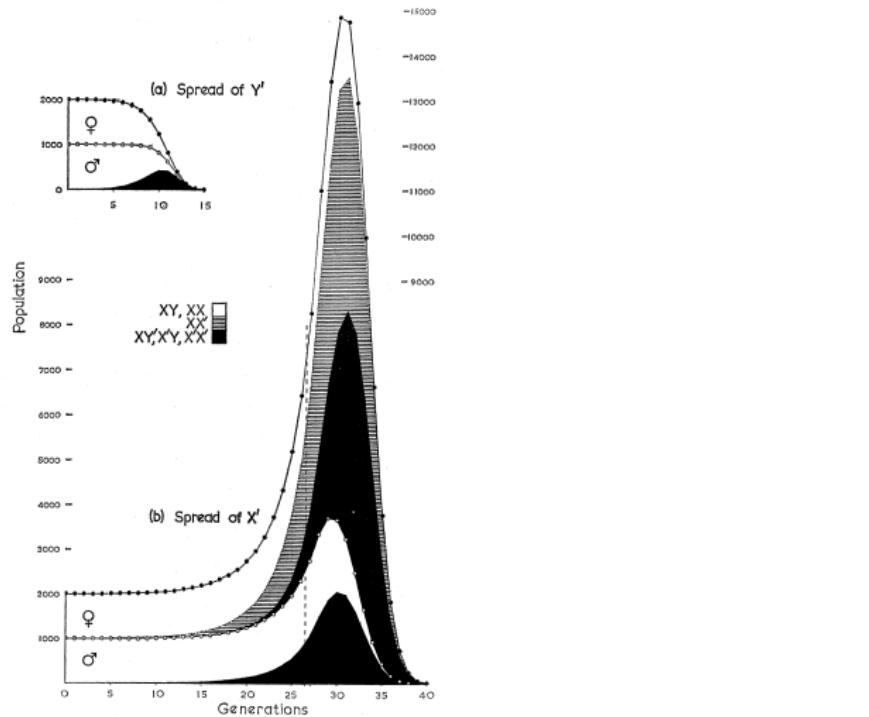
Figure 3. Diversity of sex determination systems for representative plant and animal clades. The bubble insert graph for the plant clades represents the relative proportion of species with documented sex chromosomes within plants with separate sexes. Vertebrates: Mammalia (placental, marsupial, and monotreme mammals), Aves (birds), Reptilia (turtles, snakes, crocodiles, lizards), Amphibia (frogs, toads, salamanders), and Teleostei (bony fishes). Invertebrates: Acari (mites and ticks), Crustacea (shrimps, barnacles, crabs), and Insects, which include Coccoidea (scale insects), Coleoptera (beetles), Hymenoptera (ants, bees, and wasps), Lepidoptera (butterflies), and Diptera (flies). Plants: Gymnosperms (non-flowering plants) and Angiosperms (flowering plants).

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Sex Determination: Why So Many Ways of Doing It?

Bachtrog et al. 2014

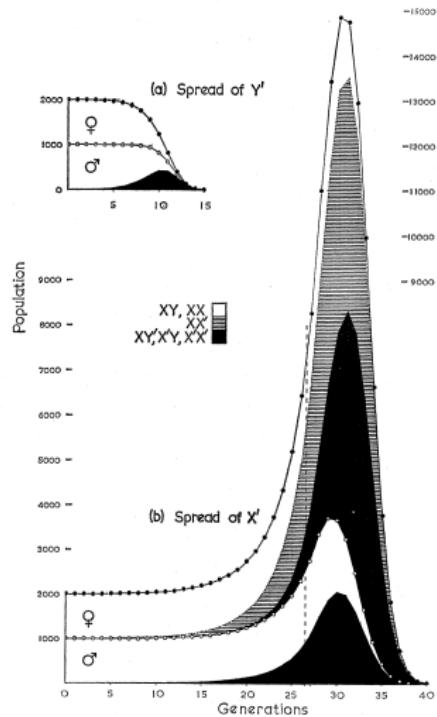
Theory 1: Turnover caused by sex-ratio selection



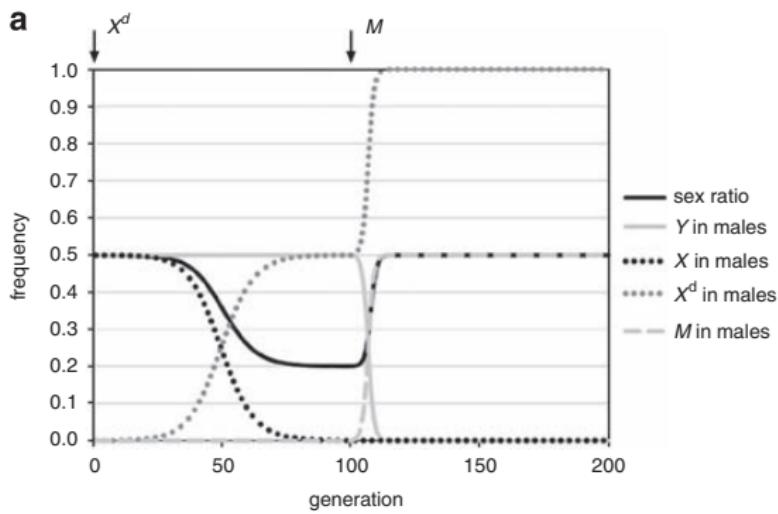
Extraordinary Sex Ratios

Hamilton 1967

Theory 1: Turnover caused by sex-ratio selection



Segregation distortion and the evolution of sex-determining mechanisms

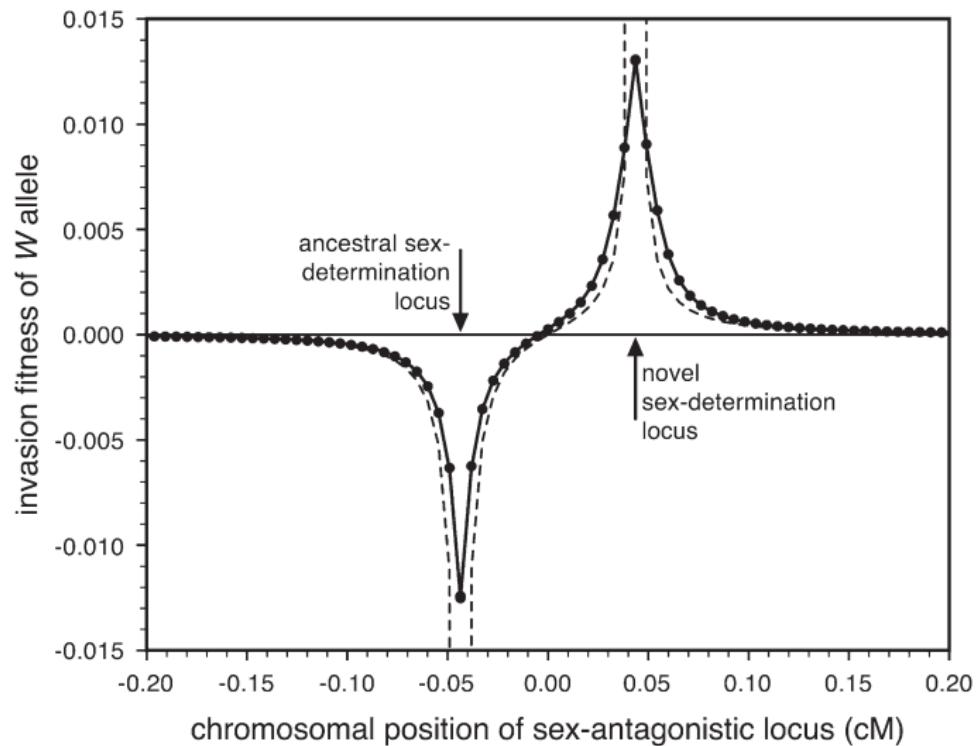


Extraordinary Sex Ratios

Hamilton 1967

Kozielska et al. 2010

Theory 2: Turnover caused by sex-antagonistic selection



**Transitions Between Male and Female Heterogamety
Caused by Sex-Antagonistic Selection**

van Doorn & Kirkpatrick 2010

Adding haploid selection

Gametic competition and meiotic drive

Biased transmission of gametes, typically sex-specific
⇒ can impart both sex-ratio **and** sex-antagonistic selection

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Question

How does haploid selection influence sex-determination turnover?

Model

“FOR MOTION DISCOMFORT AND BABY DIAPER DISPOSAL”

$\bar{p} = \bar{p} +$

$y_A^S = Y_A W_A / \bar{W}_H \times \frac{1}{\tan(\theta)} - x_{m1}$

“FOR MOTION DISCOMFORT AND BABY DIAPER DISPOSAL”

Please place in waste receptacle after use

Not for toilet disposal

Do not place in seat back pocket after use

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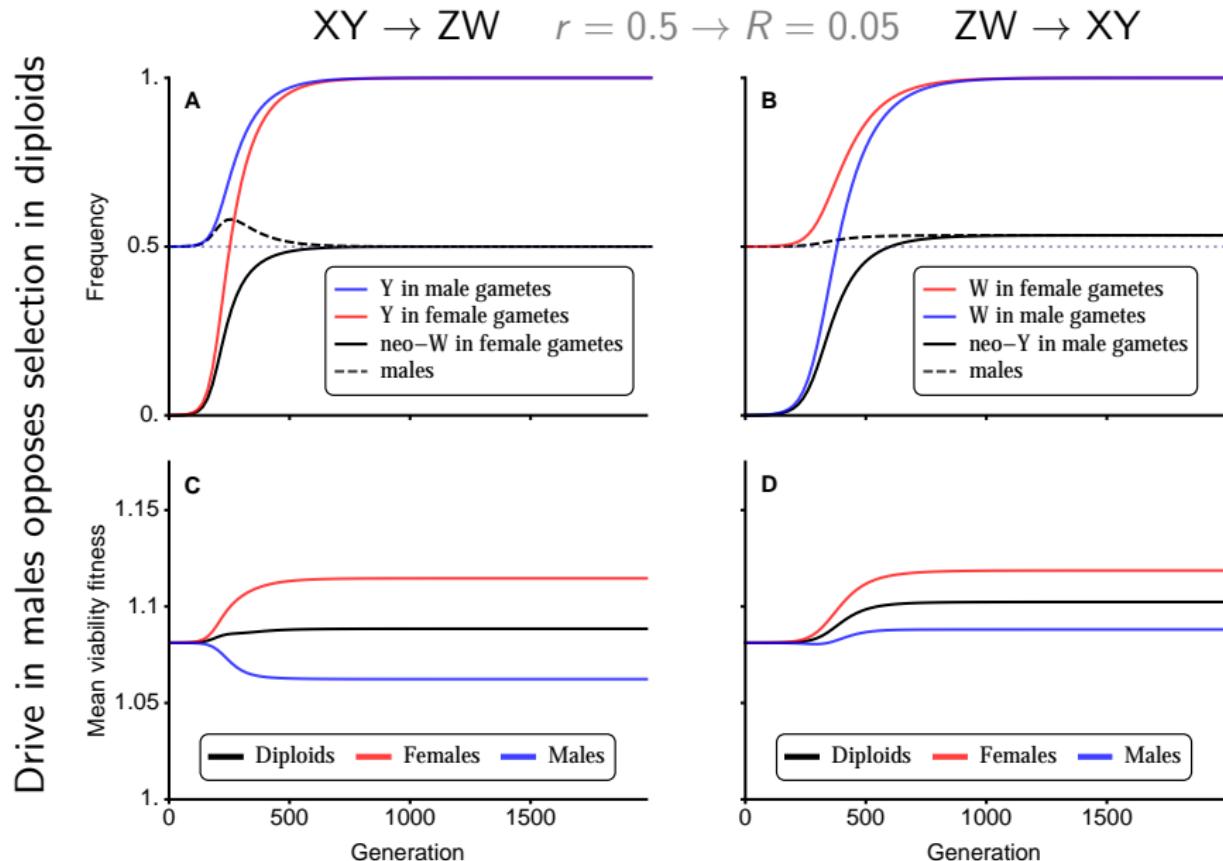
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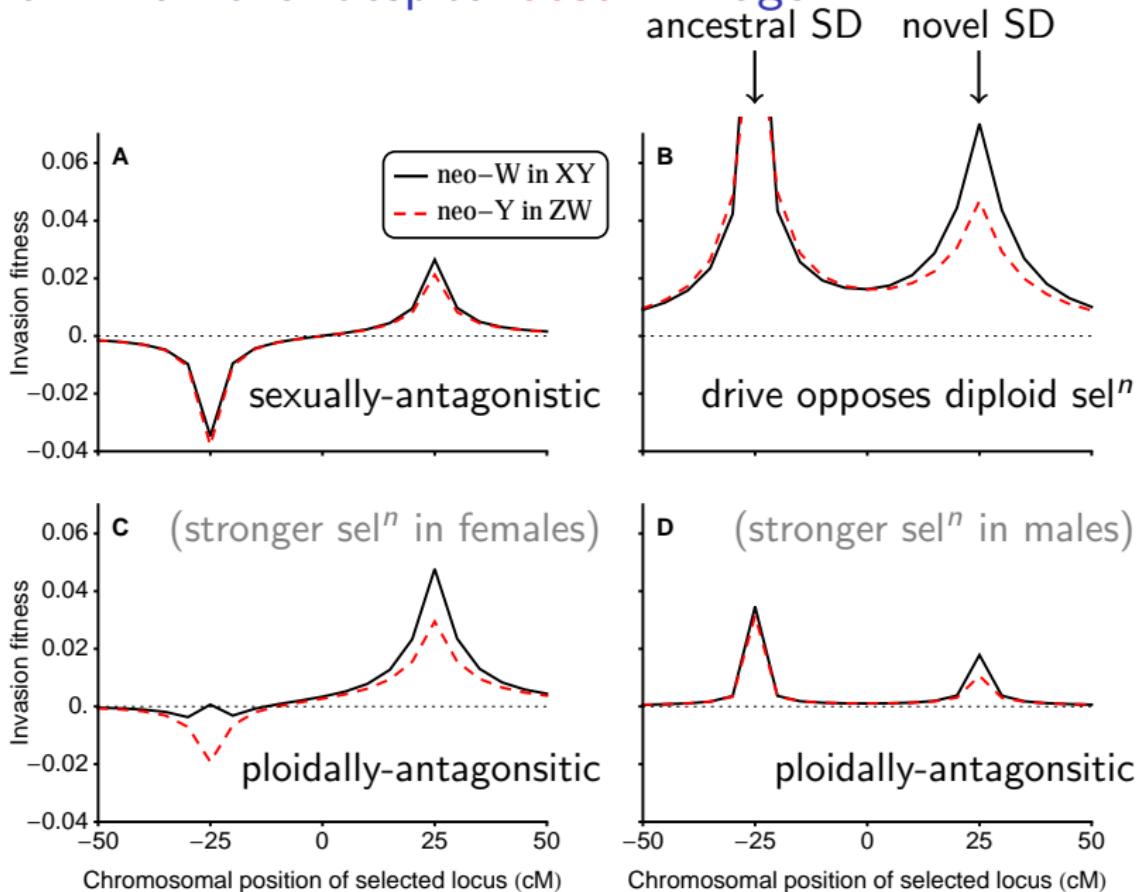
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Results

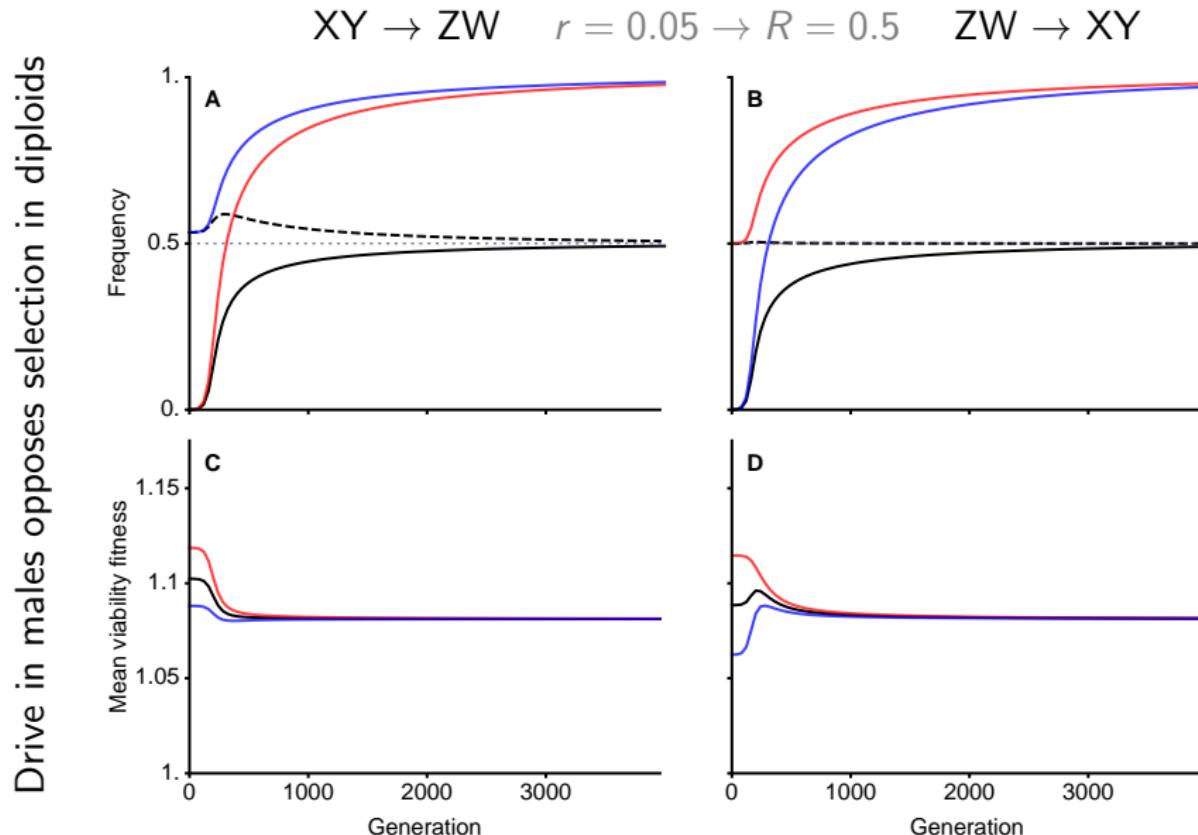
Result 1: Turnover can *create* sex-ratio bias



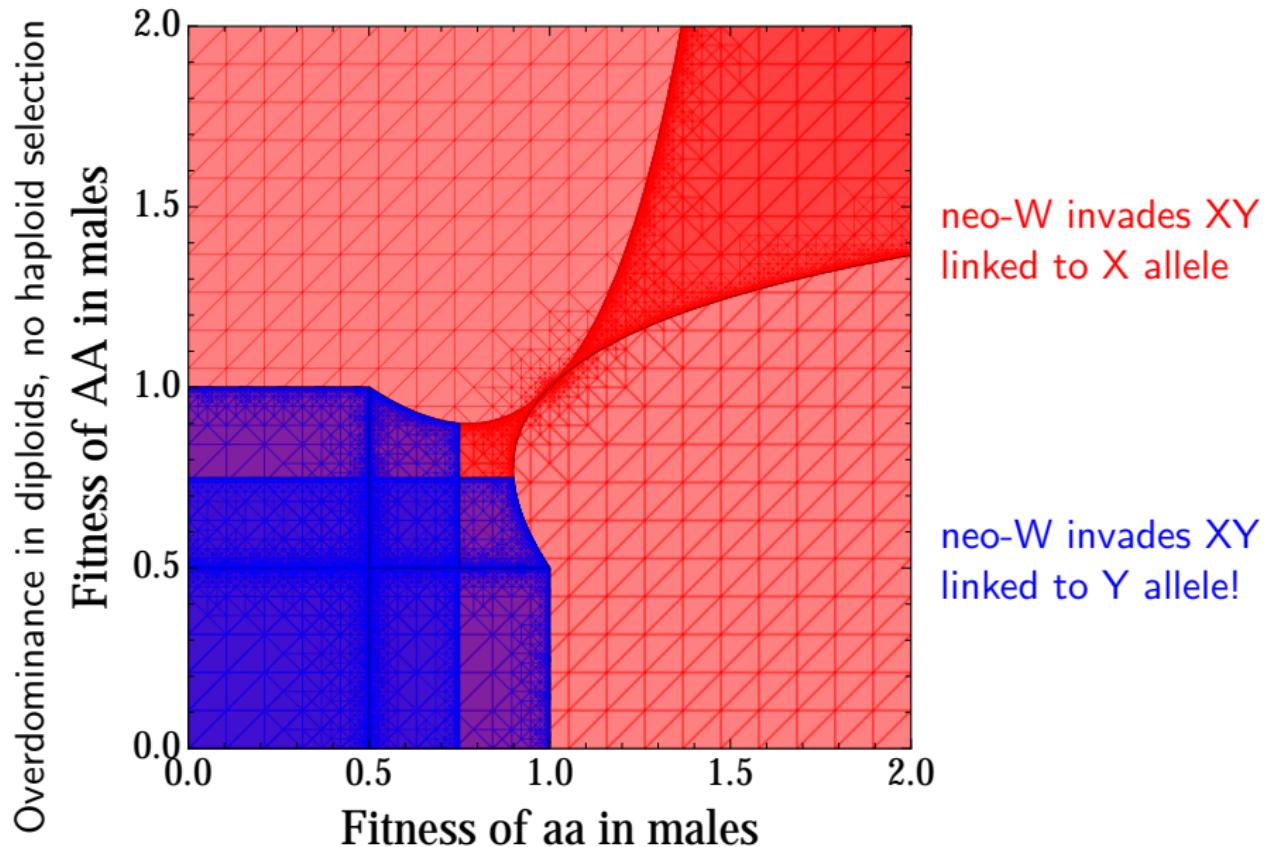
Result 2: Turnover despite *looser* linkage



Result 2b: Looser linkage evolves despite fitness *decline*



Bonus result: Turnover with very tight linkage



Summary

- ▶ Haploid selection creates new avenues for sex determination turnover
 - 1. Turnover can occur **irregardless of sex-ratio bias**, and create it
 - 2. Turnover can **decrease sex-linkage**, and mean diploid fitness

- ▶ Bonus result: Turnover possible with tight linkage, two mechanisms
 - 1. neo-W invades with X allele (female specialist)
 - 2. neo-W **invades with Y allele** (from perverse overdominance equil.)

Thank-you

Michael Scott



Sally Otto

