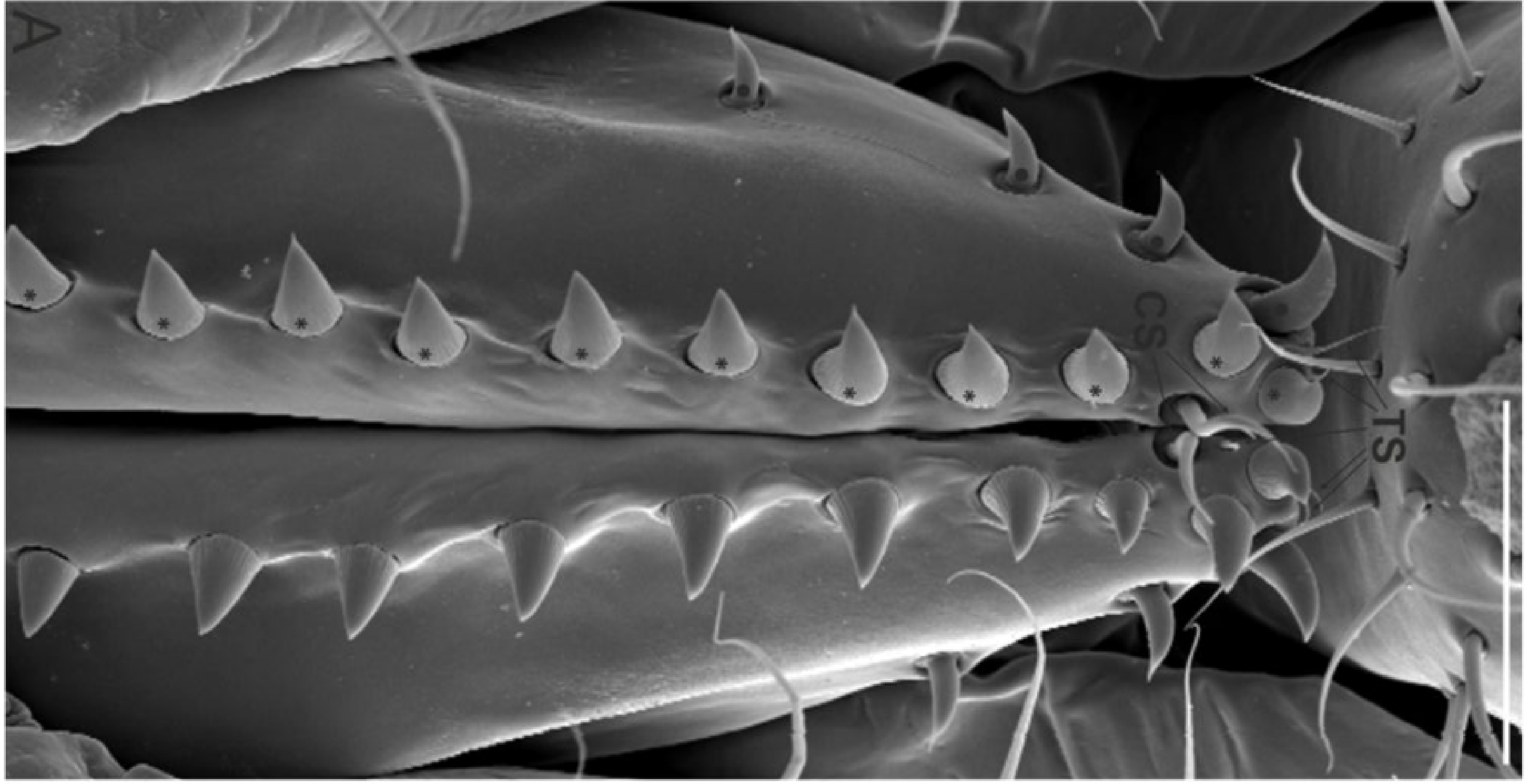

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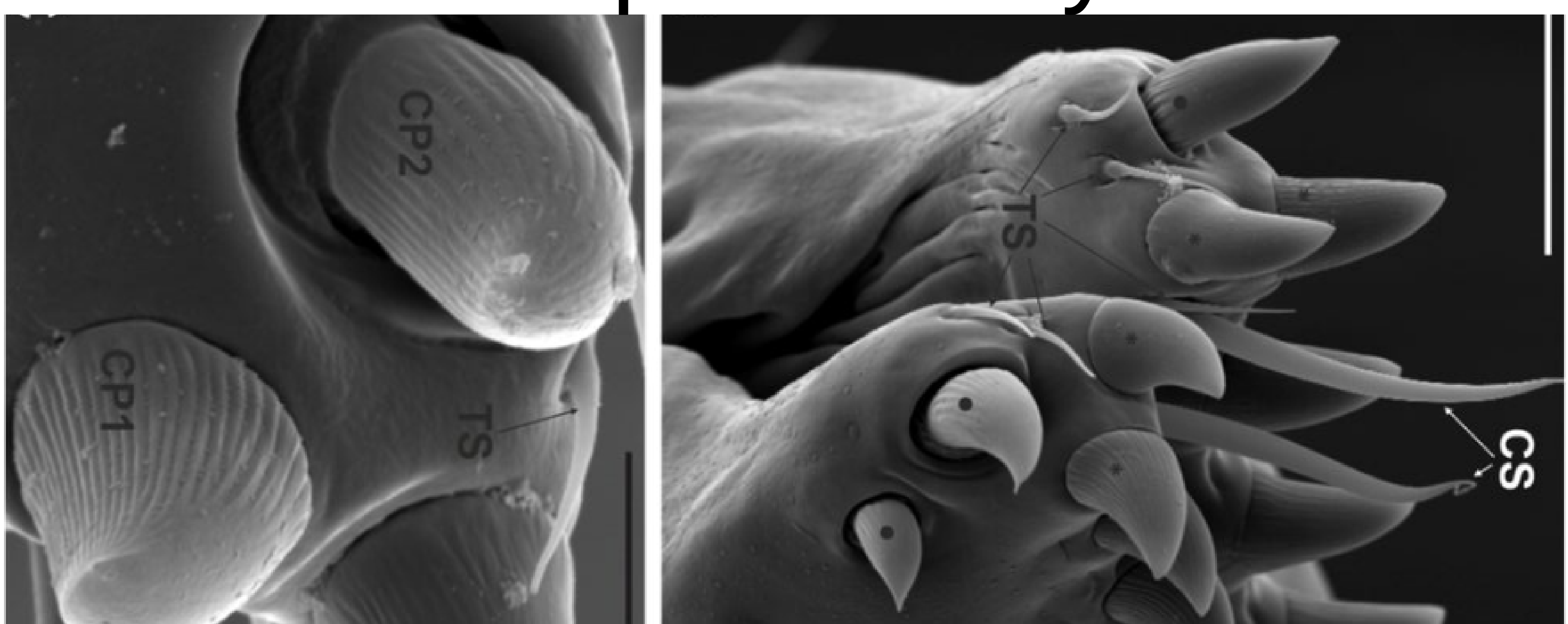

Bénédicte

Figure from Crava et al., BioRxiv, 2019

Key words:
Drosophila evolution, left right asymmetry, drosophila courtship, drosophila genitalia, genitalia evolution, drosophila morphogenesis, drosophila bristle, drosophila pachea, glue, 3D printing

Journals:
Cell, Nature, Science, Plos, Current biology, PNAS, Development, Evolution, Evolution and Development, BioRxiv...

Press report – May 2019

Evolution

- Tracking Five Millennia of Horse Management with Extensive Ancient Genome Time Series
A. Fages et al. - Cell
DOI:https://doi.org/10.1016/j.cell.2019.03.049

- The Role of Mutation Bias in Adaptive Evolution
E I. Svensson & D Berger - Trends in Ecology & Evolution
DOI:https://doi.org/10.1016/j.tree.2019.01.015

- Coevolution of Genome Architecture and Social Behavior
D R. Rubenstein et al. - Trends in Ecology & Evolution
DOI:https://doi.org/10.1016/j.tree.2019.04.011

-Transposable element dynamics are consistent across the Drosophila phylogeny, despite drastically differing content
T Hill - BioRxiv
DOI : https://doi.org/10.1101/651059

Press report – May 2019

Evolution

-Molecular Origins of Complex Heritability in Natural Genotype-to-Phenotype Relationships
C M. Jakobson & D F. Jarosz - Cell systems
DOI:https://doi.org/10.1016/j.cels.2019.04.002

- Common cuckoo females may escape male sexual harassment by color polymorphism
Jin-Won L, Hae-Ni K, Sohyeon Y & Jeong-Chil Y - Scientific reports
DOI :https://doi.org/10.1038/s41598-019-44024-6

- The loci of behavioral evolution: evidence that Fas2 and tilB underlie differences in pupation site choice behavior between Drosophila melanogaster and D. simulans
A Pischedda, M P. Shahandeh, T L. Turner - bioRxiv
DOI : https://doi.org/10.1101/494013

Press report – May 2019

Reproductive behavior in *Drosophila*

- **Reproductive Capacity Evolves in Response to Ecology through Common Changes in Cell Number in Hawaiian Drosophila**
D.P. Sarikaya et al. - Current biology
DOI: https://doi.org/10.1016/j.cub.2019.04.063

- **Evolution of Mechanisms that Control Mating in *Drosophila* Males**
O M. Ahmed, A Avila-Herrera, K M Tun,P. Serpa, J Peng, S Parthasarathy, J-M Knapp, D L. Stern, G W. Davis, K S. Pollard, N M. Shah - Cell Report
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- A Neural Circuit Encoding the Experience of Copulation in Female Drosophila
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-Costs and benefits of giant sperm and sperm storage organs in Drosophila melanogaster
Zajitschek et al. - bioRxiv
DOI : https://doi.org/10.1101/652248

Press report – May 2019

Reproductive behavior in *Drosophila*

- Genetic architecture and sex-specific selection govern modular, male-biased evolution of doublesex
S Baral, G Arumugam, R Deshmukh and K Kunte - ScienceAdvances
DOI : 10.1126/sciadv.aau3753

-Reproductive capacity evolves in response to ecology through common developmental mechanisms in Hawai'ian Drosophila
D. Sarikaya et al. - BioRxiv
DOI: https://doi.org/10.1101/470898

-An exposition of ejaculate senescence and its inhibition in Drosophila
I. Sepil et al. - BioRxiv
DOI : https://doi.org/10.1101/624734

-**Exploring multiple sensory systems in ovipositors of Drosophila suzukii and related species with different egg-laying behaviour**
CM Crava et al. - BioRxiv
DOI : https://doi.org/10.1101/651091

Press report – May 2019

Drosophila behavior

- Visually Guided Behavior and Optogenetically Induced Learning in Head-Fixed Flies Exploring a Virtual Landscape
H Haberkern et al. - Current biology
DOI:https://doi.org/10.1016/j.cub.2019.04.033

- Drosophila Acquires a Long-Lasting Body-Size Memory from Visual Feedback
T Krause et al. - Current biology
DOI:https://doi.org/10.1016/j.cub.2019.04.037

- Diverse Food-Sensing Neurons Trigger Idiothetic Local Search in Drosophila
R A. Corfas, T Sharma, MH. Dickinson - Current biology
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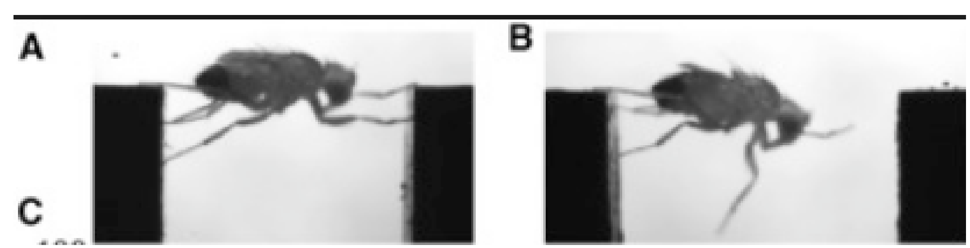
-The neuropeptide Drosulfakinin regulates social isolation-induced aggression in Drosophila
P Agrawal et al. - BioRxiv
DOI : https://doi.org/10.1101/646232



T Krause et al.

Press report – May 2019

Drosophila/insect behavior

- High Dietary Sugar Reshapes Sweet Taste to Promote Feeding Behavior in Drosophila melanogaster
C E. May et al. - Cell reports
DOI:https://doi.org/10.1016/j.celrep.2019.04.027

- Intraspecific Competition Affects the Pupation Behavior of Spotted-Wing Drosophila (Drosophila suzukii)
C Sade Bezerra Da Silva, et al. - Scientific reports
DOI: https://doi.org/10.1038/s41598-019-44248-6

-Mechanosensory circuits coordinate two opposing motor actions in Drosophila feeding
Yao Zhou et al. - ScienceAdvances
DOI: 10.1126/sciadv.aaw5141

Press report – May 2019

Genitalia development

-Formation and development of the male copulatory organ in the spider Parasteatoda tepidariorum involves a metamorphosis-like process
F S C Quade et al. - Scientific reports
DOI :https://doi.org/10.1038/s41598-019-43192-9

Drosophila development

- Evolution of Larval Segment Position across 12 Drosophila Species
G. Kalay et al. - BioRxiv
DOI : https://doi.org/10.1101/653121

Tools

-**DeepFly3D: A deep learning-based approach for 3D limb and appendage tracking in tethered, adult Drosophila**
Günel et al. - BioRxiv
DOI : https://doi.org/10.1101/640375

-A large-scale resource for tissue-specific CRISPR mutagenesis in Drosophila
F Port et al. - BioRxiv
DOI :https://doi.org/10.1101/636076

Common cuckoo females may escape male sexual harassment by color polymorphism

Cherre Sade Bezerra Da Silva, Kyoo R. Park, Rachel A. Blood & Vaughn M. Walton
DOI: https://doi.org/10.1038/s41598-019-44248-6

Abstract

Sexual conflict over mating rate is widely regarded as a selective force on the evolution of female-limited color polymorphism in invertebrates, such as damselflies and butterflies. However, evidence confirming its use in higher vertebrates remains limited. The common cuckoo, Cuculus canorus, is an avian brood parasite that does not provide parental care and represents a rare example of female-limited polymorphism in higher vertebrates. Specifically, males exhibit a monomorphic gray morph, while females are either gray or rufous colored, like juveniles. To test a prediction from the hypothesis that the rufous plumage of female cuckoos may help avoid excessive sexual harassment by males (the harassment avoidance hypothesis), we investigate color morph preference in male cuckoos. Mate choice experiments using playbacks of female calls with decoys mimicking both color morphs indicated that the attracted males immediately copulated with decoys without courtship displays, recognizing both color morphs as a sexual partner. However, the males attempted to copulate more frequently and excessively with the gray morph, which is consistent with the prediction from the harassment avoidance hypothesis. We propose that the absence of parental care augments sexual conflict over mating in cuckoos, resulting in the unusual evolution of female-limited polymorphism in this higher vertebrate.

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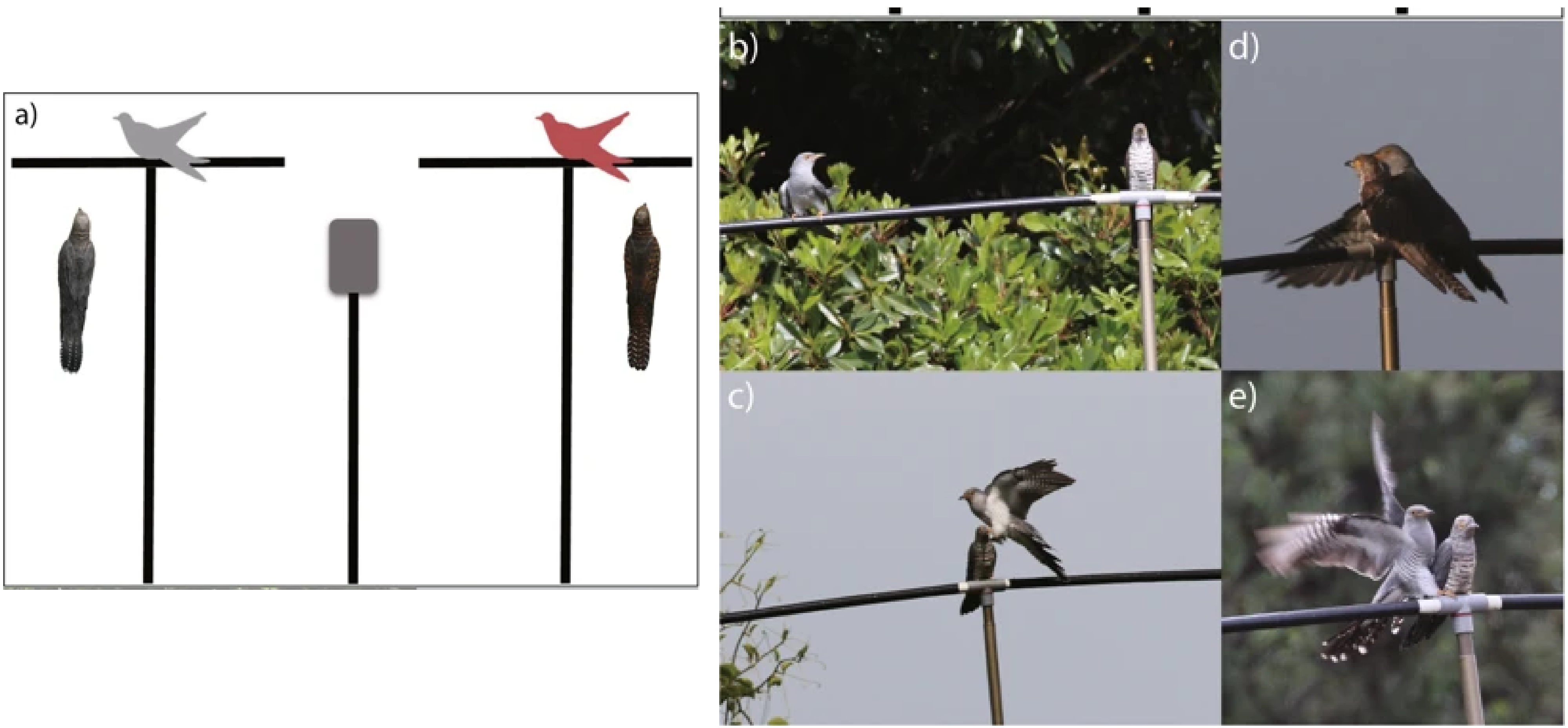

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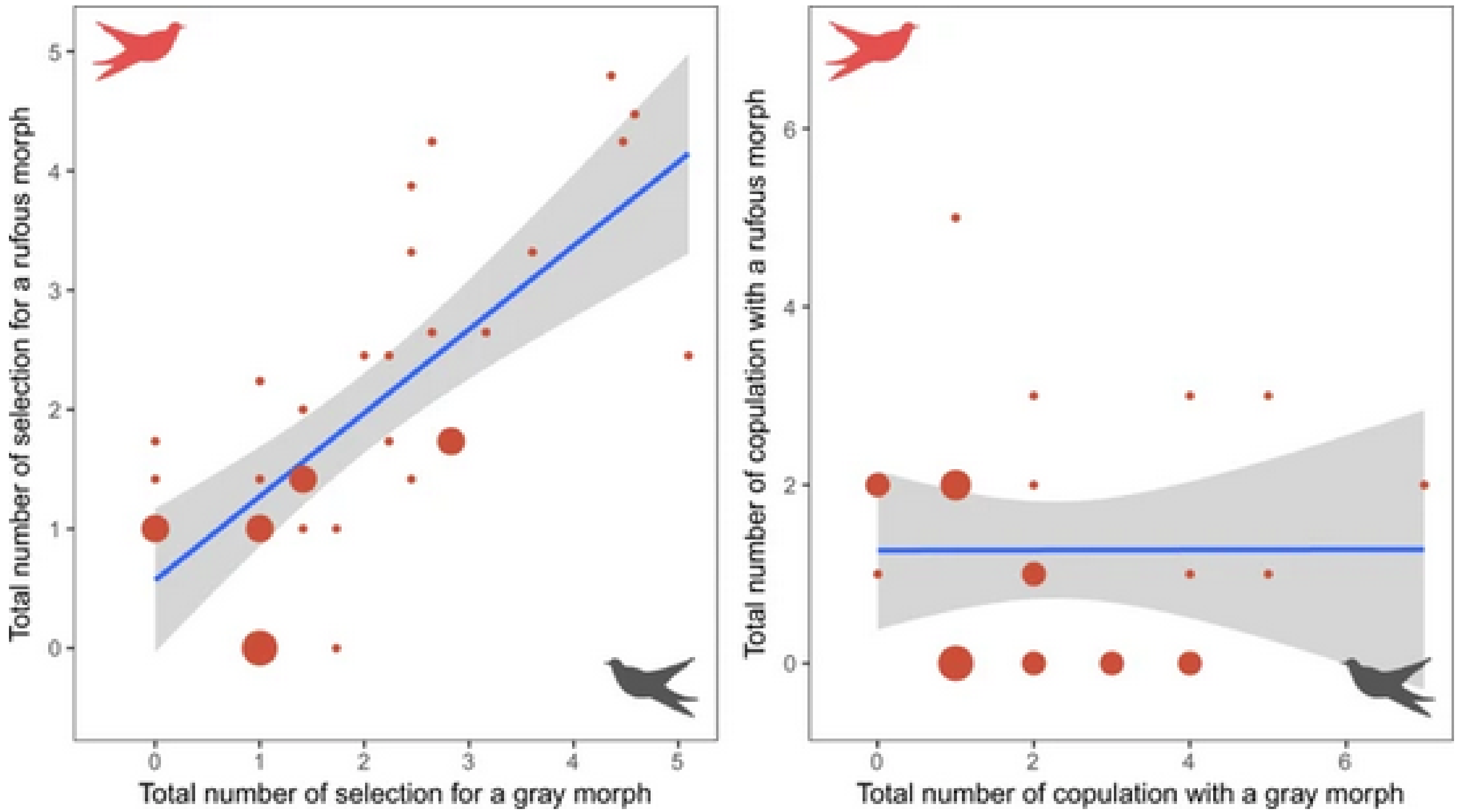

Scatter plots with fitted lines and 95% confidence intervals, showing the correlation between the gray and rufous morphs for the total number (square-rooted) of selections (left) and the total number of copulations (right). Circle size varies according to sample size.

The loci of behavioral evolution: evidence that Fas2 and tilB underlie differences in pupation site choice behavior between Drosophila melanogaster and D. simulans

A Pischedda, M P. Shahandeh, T L. Turner - bioRxiv

DOI : https://doi.org/10.1101/494013

Abstract

The recent boom in genotype-phenotype studies has led to a greater understanding of the genetic architecture of a variety of traits. Among these traits, however, behaviors are still lacking, perhaps because they are complex and environmentally sensitive phenotypes, making them difficult to measure reliably for association studies. Here, we aim to fill this gap in knowledge with the results of a genetic screen for a complex behavioral difference, pupation site choice, between *Drosophila melanogaster* and *D. simulans*. In this study, we demonstrate a significant contribution of the X chromosome to the difference in pupation site choice behavior between these species. Using a panel of X-chromosome deletions, we screened the majority of the X chromosome for causal loci, and identified two regions that explain a large proportion of the X-effect. We then used gene disruptions and RNAi to demonstrate the substantial effects of a single gene within each region: *Fas2* and *tilB*. Finally, we show that differences in *tilB* expression correlate with the differences in pupation site choice behavior between species. Our results suggest that even complex, environmentally sensitive behaviors may evolve through changes to loci with large phenotypic effects.

The loci of behavioral evolution: evidence that Fas2 and tilB underlie differences in pupation site choice behavior between Drosophila melanogaster and D. simulans

A Pischedda, M P. Shahandeh, T L. Turner - bioRxiv
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Despite the importance of behavioral traits, we know little about the genetic basis of their evolution. GePheBase, the most extensive compilation of natural genetic variants associated with trait differences, currently catalogs over 1800 associations, of which only 22 are for behavior (**Martin & Orgogozo, 2013**). From these 22, and others in the literature, it is clear that individual genes can sometimes have large effects on evolved differences in behavior (**Leary et al., 2012**; **McGrath et al., 2011**; **Prince et al., 2017**).

The loci of behavioral evolution: evidence that Fas2 and tilB underlie differences in pupation site choice behavior between Drosophila melanogaster and D. simulans

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Depending on the strain and species, larvae vary from pupating directly on their larval food source to traveling more than 40 cm away from it (Stamps et al., 2005). This behavior has been extensively studied, and is exquisitely sensitive to environmental conditions— individuals alter their behavior in response to light, moisture, pH, the presence of other species, parasitism, and more (Hodge & Caslaw, 1998; Markow, 1981b; Sameoto & Miller, 1968a; Seyahooei et al., 2009). Despite this environmentally induced variation, the effects of genotype on preference are considerable. Within species, strains and populations often differ in how far they travel from their food source before pupating, although the most consistent experimentally demonstrated differences are between species (Markow, 1979; Vandal et al., 2008).

. For example, *D. melanogaster* and *D. simulans* shared a common ancestor 2-3 million years ago (Lachaise & Silvain, 2004), and are extremely similar in terms of their ecology, morphology, and physiology (Parsons, 1975). Previous work shows, however, that they differ markedly in terms of pupation site choice, with *D. simulans* pupating closer to the larval food source, on average (Markow, 1979, 1981a). This difference is not due to laboratory adaptation, as freshly collected individuals show the same pattern (Markow, 1979,

The loci of behavioral evolution: evidence that Fas2 and tilB underlie differences in pupation site choice behavior between Drosophila melanogaster and D. simulans

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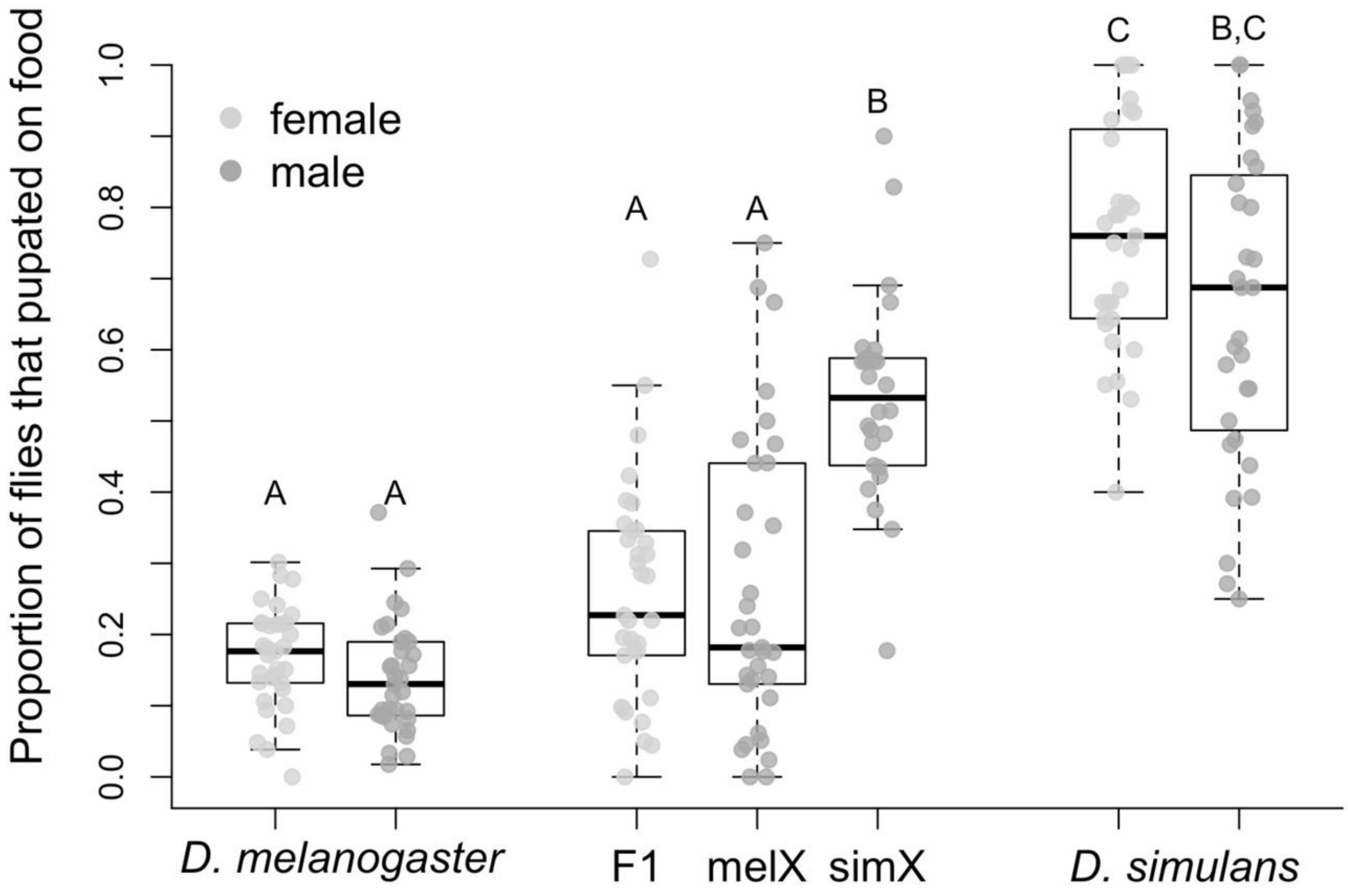


Intraspecific Competition Affects the Pupation Behavior of Spotted-Wing Drosophila (*Drosophila suzukii*)

Cherre Sade Bezerra Da Silva, Kyoo R. Park, Rachel A. Blood & Vaughn M. Walton

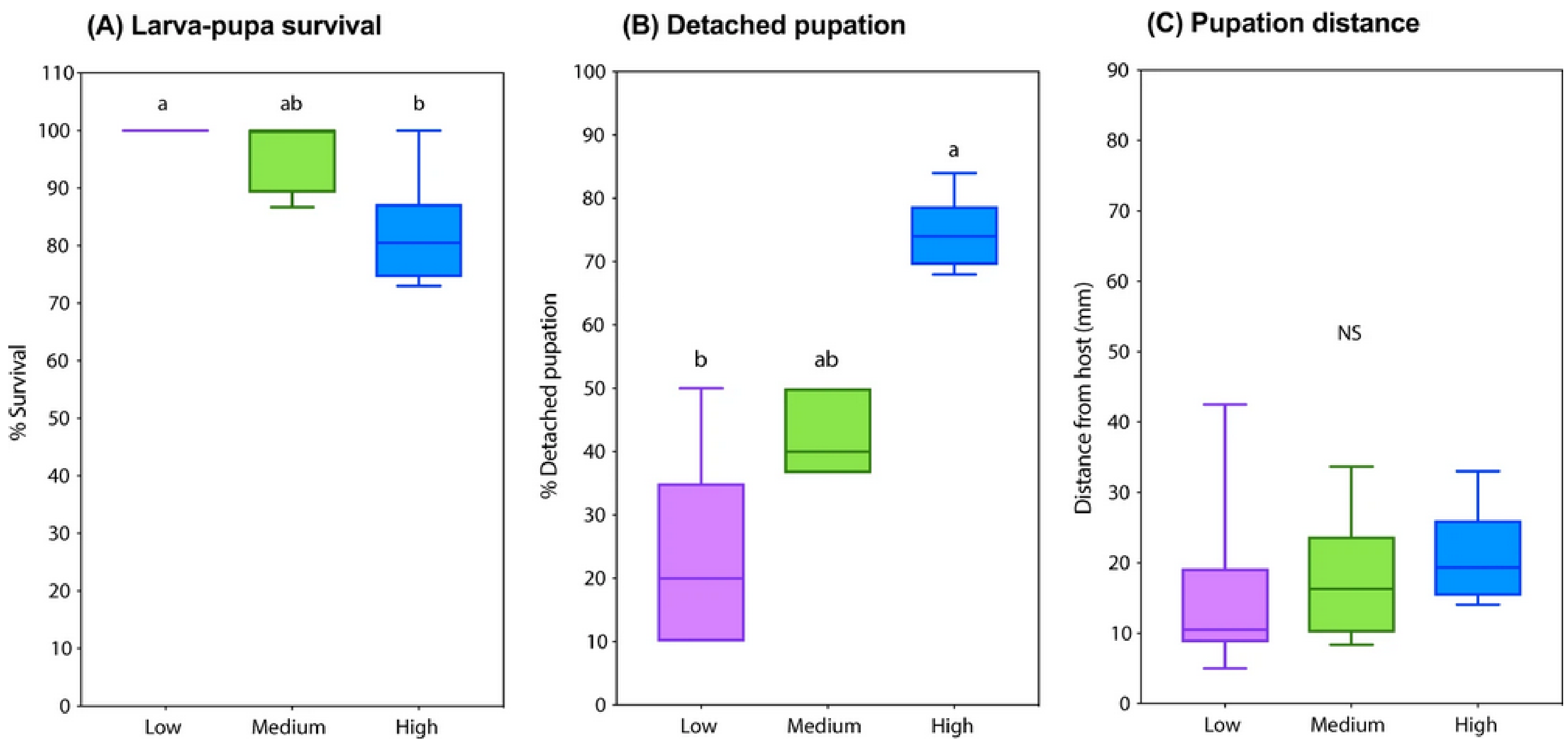
DOI: https://doi.org/10.1038/s41598-019-44248-6

Abstract

In Drosophila, intraspecific competition (IC) may cause stress, cannibalism, and affect survival and reproduction. By migrating to less crowded environments, individuals can escape IC. Larvae of spotted-wing drosophila (SWD, Drosophila suzukii) are often exposed to IC. They are known to pupate either attached to or detached from their hosts. Here, we hypothesized that SWD pupates detached from the larval host as a means to escape IC and increase their survival and fitness. Under laboratory conditions, IC resulted in increased pupation detached from the larval host in both cornmeal medium and blueberry fruit. Males were more prone to detached pupation than females. In blueberry, IC-exposed larvae pupated farther away from the fruit relative to singly-developed individuals. Detached pupation was associated to survival and fitness gains. For example, larvae that displayed detached pupation showed shorter egg-pupa development times, higher pupa-adult survival, and larger adult size relative to fruit-attached individuals. These findings demonstrate that SWD larvae select pupation sites based on IC, and that such a strategy is associated with improved survival and fitness. This information contributes to a better understanding of SWD basic biology and behavior, offering insights to the development of improved practices to manage this pest in the field.

Intraspecific Competition Affects the Pupation Behavior of Spotted-Wing Drosophila (*Drosophila suzukii*)

Cherre Sade Bezerra Da Silva, Kyoo R. Park, Rachel A. Blood & Vaughn M. Walton



Response of spotted-wing drosophila (*Drosophila suzukii*) to low, medium, and high larval densities (respectively 10, 30, and 100 3rd instar larvae per assay tube containing 3 g of artificial diet) in cornmeal medium. (**A**) Percentage of larva-pupa survival (Kruskal-Wallis $H = 10.18$, $P = 0.0019$; Dunn's $P = 0.0063$). (**B**) Percentage of larvae that displayed pupation detached from the host as opposed to pupation attached to the host ($H = 12.56$, $P < 0.0001$; Dunn's $P = 0.0017$). (**C**) Distance (mm) between detached pupae and host ($H = 3.594$, $P = 0.1682$). $N = 5–6$.

Intraspecific Competition Affects the Pupation Behavior of Spotted-Wing Drosophila (*Drosophila suzukii*)

Cherre Sade Bezerra Da Silva, Kyoo R. Park, Rachel A. Blood & Vaughn M. Walton

Video

Reproductive Capacity Evolves in Response to Ecology through Common Changes in Cell Number in Hawaiian Drosophila

D P. Sarikaya, S H. Church, L P. LagomarsinoK., N. Magnacca, S L. Montgomery, D K. Price, K Y. Kaneshiro, C G. Extavour

DOI:https://doi.org/10.1016/j.cub.2019.04.063

Highlights

- Ecology and development predict fecundity evolution in Hawaiian *Drosophila*
- Where Hawaiian flies lay their eggs influences evolution of reproductive capacity
- Allometric relationship between body and ovary size differs by habitat type
- Changes in somatic gonad cell number explain convergent ovariole number evolution

Reproductive Capacity Evolves in Response to Ecology through Common Changes in Cell Number in Hawaiian Drosophila

D P. Sarikaya, S H. Church, L P. LagomarsinoK., N. Magnacca, S L. Montgomery, D K. Price, K Y. Kaneshiro, C G. Extavour

Summary

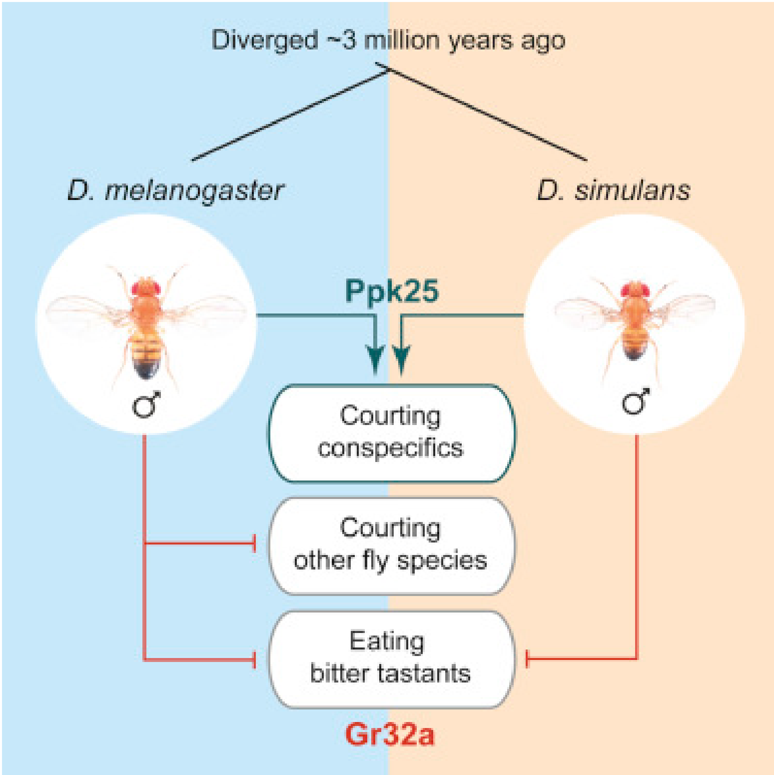
Lifetime reproductive capacity is a critical fitness component. In insects, female reproductive capacity is largely determined by the number of ovarioles, the egg-producing subunits of the ovary [e.g., 1]. Recent work has provided insights into ovariole number regulation in *Drosophila melanogaster*. However, whether mechanisms discovered under laboratory conditions explain evolutionary variation in natural populations is an outstanding question. We investigated potential effects of ecology on the developmental processes underlying ovariole number evolution among Hawaiian *Drosophila*, a large adaptive radiation wherein the highest and lowest ovariole numbers of the family have evolved within 25 million years. Previous studies proposed that ovariole number correlated with oviposition substrate [2 , 3 , 4] but sampled largely one clade of these flies and were limited by a provisional phylogeny and the available comparative methods. We test this hypothesis by applying phylogenetic modeling to an expanded sampling of ovariole numbers and substrate types and show support for these predictions across all major groups of Hawaiian *Drosophila*, wherein ovariole number variation is best explained by adaptation to specific substrates. Furthermore, we show that oviposition substrate evolution is linked to changes in the allometric relationship between body size and ovariole number. Finally, we provide evidence that the major changes in ovarian cell number that regulate *D. melanogaster* ovariole number also regulate ovariole number in Hawaiian drosophilids. Thus, we provide evidence that this remarkable adaptive radiation is linked to evolutionary changes in a key reproductive trait regulated at least partly by variation in the same developmental parameters that operate in the model species *D. melanogaster*.

Evolution of Mechanisms that Control Mating in Drosophila Males

O M. Ahmed, A Avila-Herrera, K M Tun,P. Serpa, J Peng, S Parthasarathy, J-M Knapp, D L. Stern, G W. Davis, K S. Pollard, N M. Shah - Cell Report

Summary

Genetically wired neural mechanisms inhibit mating between species because even naive animals rarely mate with other species. These mechanisms can evolve through changes in expression or function of key genes in sensory pathways or central circuits. Gr32a is a gustatory chemoreceptor that, in D. melanogaster, is essential to inhibit interspecies courtship and sense quinine. Similar to D. melanogaster, we find that D. simulans Gr32a is expressed in foreleg tarsi, sensorimotor appendages that inhibit interspecies courtship, and it is required to sense quinine. Nevertheless, Gr32a is not required to inhibit interspecies mating by D. simulans males. However, and similar to its function in D. melanogaster, Ppk25, a member of the Pickpocket family, promotes conspecific courtship in D. simulans. Together, we have identified distinct evolutionary mechanisms underlying chemosensory control of taste and courtship in closely related Drosophila species.



Genetic architecture and sex-specific selection govern modular, male-biased evolution of doublesex

S Baral, G Arumugam, R Deshmukh and K Kunte - ScienceAdvances
DOI : 10.1126/sciadv.aau3753

Abstract

doublesex regulates early embryonic sex differentiation in holometabolous insects, along with the development of species-, sex-, and morph-specific adaptations during pupal stages. How does a highly conserved gene with a critical developmental role also remain functionally dynamic enough to gain ecologically important adaptations that are divergent in sister species? We analyzed patterns of exon-level molecular evolution and protein structural homology of *doublesex* from 145 species of four insect orders representing 350 million years of divergence. This analysis revealed that evolution of *doublesex* was governed by a modular architecture: Functional domains and female-specific regions were highly conserved, whereas male-specific sequences and protein structures evolved up to thousand-fold faster, with sites under pervasive and/or episodic positive selection. This pattern of sex bias was reversed in Hymenoptera. Thus, highly conserved yet dynamic master regulators such as *doublesex* may partition specific conserved and novel functions in different genic modules at deep evolutionary time scales.

Genetic architecture and sex-specific selection govern modular, male-biased evolution of doublesex

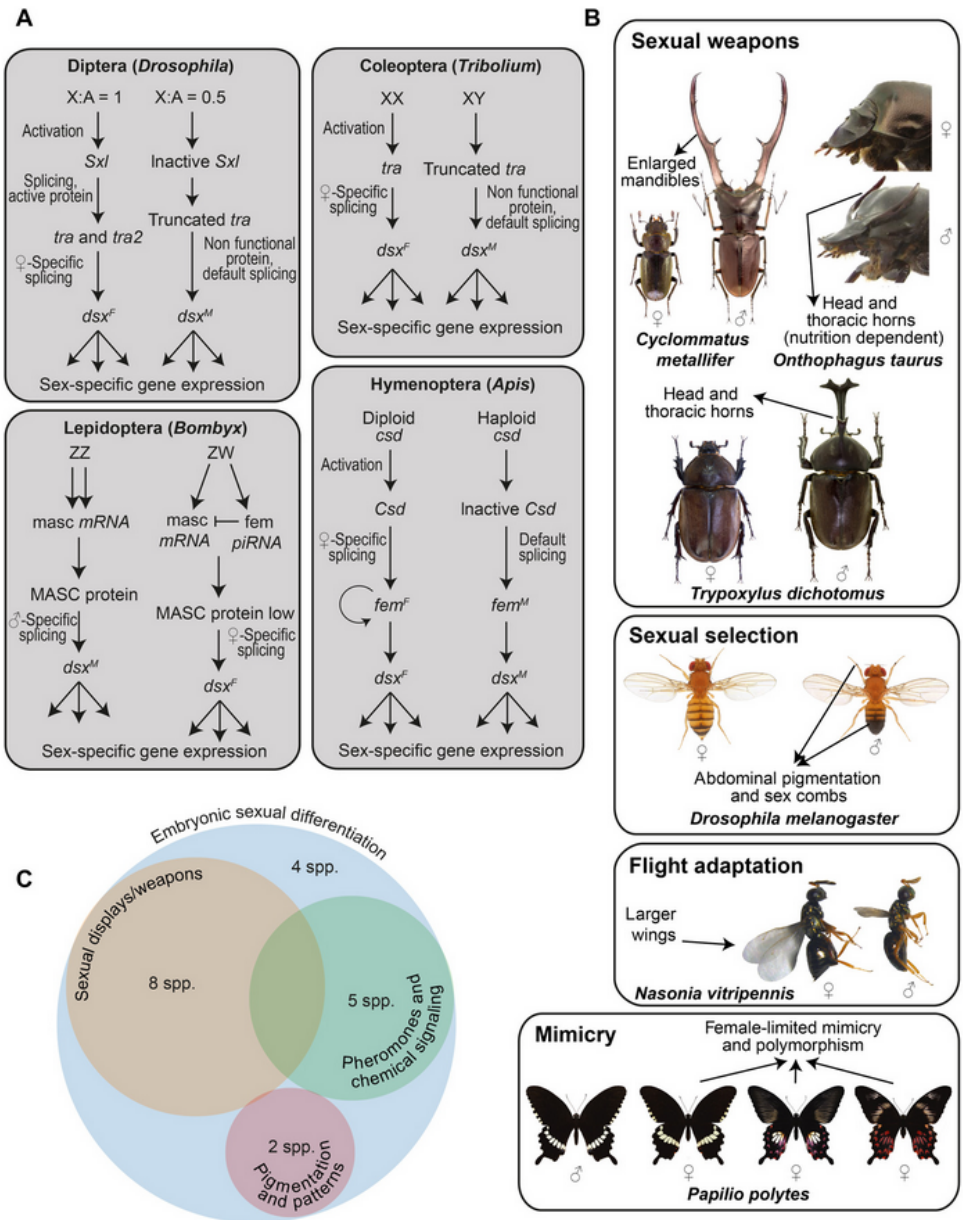
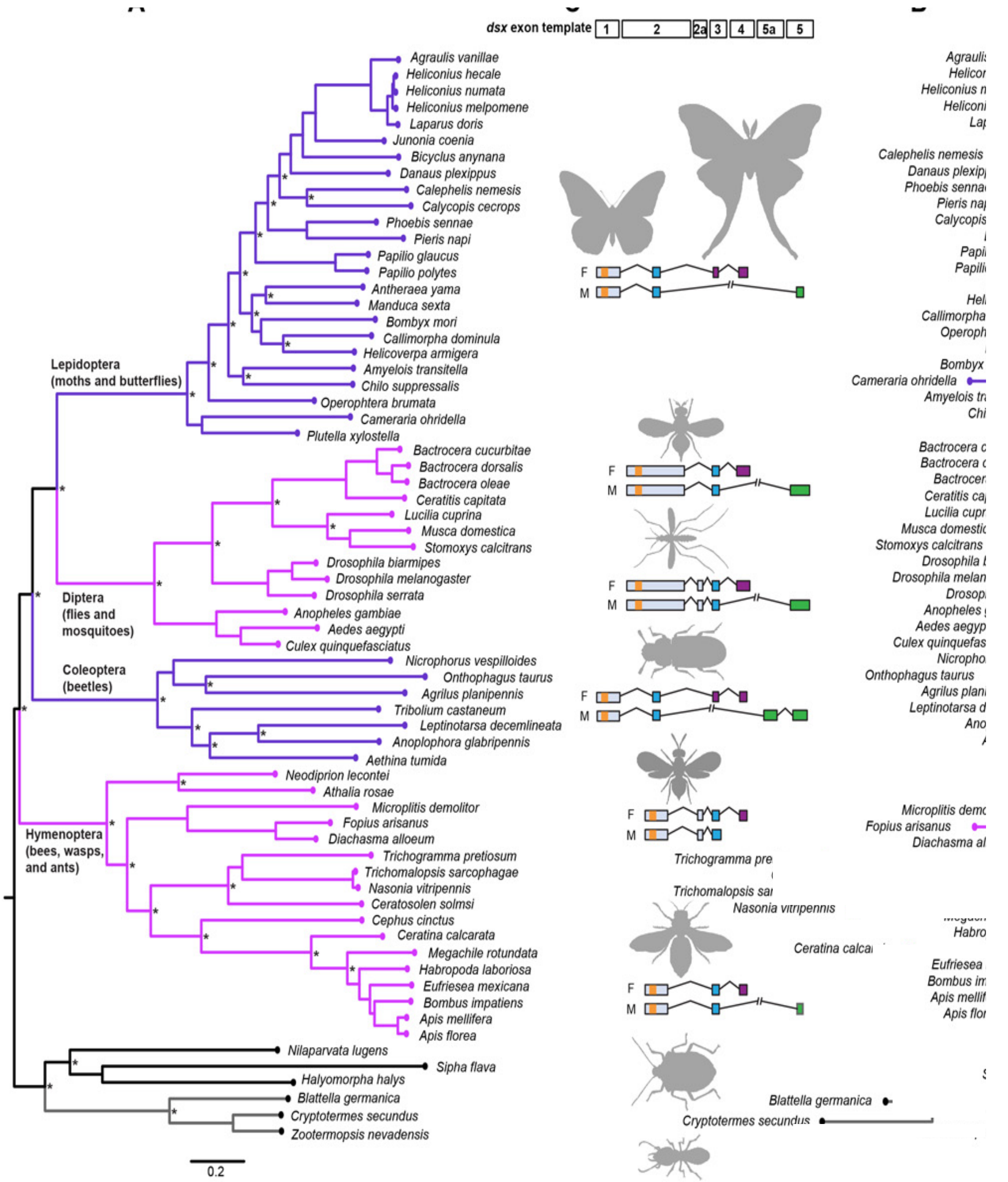


Fig. 1 Functional roles of *dsx* during development of holometabolous insects.

(**A**) The activity of *dsx* in sex-determination pathways illustrated in a representative genus of each insect order. (**B**) Examples of sexual weapons (large mandibles and horns in male beetles), sexual ornaments (sex combs in male *Drosophila*), large wings associated with dispersal in female *Nasonia*, and female-limited mimetic polymorphism in swallowtail butterflies that are developmentally regulated by *dsx* (12, 13, 15). (**C**) Developmental outcomes regulated by *dsx* fall into three broad functional categories apart from early embryonic sexual differentiation. masc, masculinizer; fem, feminizer. [Photo credit: N. Gompel (*Drosophila melanogaster*), A. P. Moczek (*Onthophagus taurus*), R. R. Choudhury (*Nasonia vitripennis*), and M. Yago (*Cyclommatus metallifer* and *Trypoxylus dichotomous*), used with permission, and K. Kunte (*P. polytes*)].

Genetic architecture and sex-specific selection govern modular, male-biased evolution of doublesex



DeepFly3D: A deep learning-based approach for 3D limb and appendage tracking in tethered, adult Drosophila

Günel et al. - BioRxiv

DOI : https://doi.org/10.1101/640375