Homeotic transformations can mimic the evolution of leg bristles in *Drosophila* species

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Introduction

As insects have an exoskeleton, bristles cover most of their body because they use them to perceive their environment. Bristles have proven to be a valuable model system for studying aspects of evolution including evolutionary innovations, developmental constraints and effect of artificial selection.

Sex combs are excellent systems for studying convergent evolution (1,2). A sex comb is a secondary sexual trait, a row of leg bristles, the (Fig 1). To elucidate possible mechanisms of convergent evolution, we investigated the arrangement and organization of leg bristles in different *Drosophila species*.

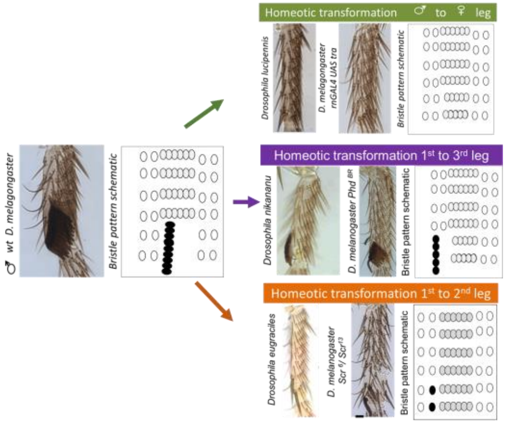
Figure 1. Morphological variation observed in sex combs among Drosophila species. Adult legs of different *Drosophila* species. Modified from 1

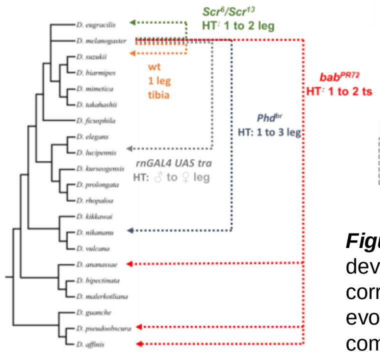
We previously suggested that the existence of *D. melanogaster* mutants which mimic bristle patterns in other insect clades suggest that there may be a basic "ground plan", which can allow rapid changes during evolution. Here, we expand our model and propose a potential cellular and developmental processes responsible for the cases of convergent evolution

Methods

- To study leg chaetotaxy, we studied fruit fly wild type and the following mutant flies: *Sex comb reduced[6] /Sex comb reduced[13]* (*Scr[6]/Scr[13]*), *Polyhomeotic distal (Phd[br]) bric à brac[PR72]* (*bab[PR72]*).
- We used the UAS GAL4 system: *rnGAL4-5* and *UAS Tra[F]*. These legs stocks were dissected, and mounted on slides, and imaged in a light microscope (Olympus BX41M).
- We followed a similar protocol to mount the following *Drosophila species: D. mojavensis, D. ficusphila, D. yakuba, D. guanche*. The length of the bristles was calculated using the imaging software, ImageJ (NIH, http://rsb.info.nih.gov/ij).

Figure 2. *Sex combs resemblance among D. melanogaster mutants and different Drosophila specie s. Black circles represent sex comb teeth and empty circles represent the TR bristles.*





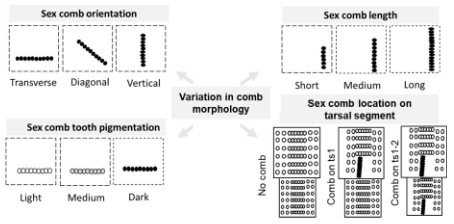
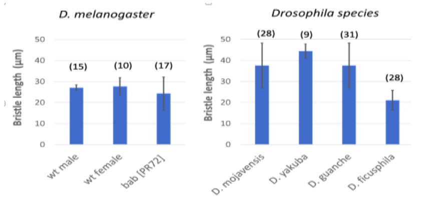


Figure 3. Hypothetical model of the developmental patterns sex comb evolution corresponding phylogenetic analysis of sex comb evolution. Color dotted lines showed similar sex comb phenotype. HT = homeotic transformation, ts = tarsal segment (modified from 1-2).

Figure 4. *D. melanogaster mutations is not able to mimic bristle length observed in Drosophila species. Number of samples are shown above the standard deviation bars.*



Results:

To study how sex comb evolve, we asked how many genetic changes are necessary to produce a sex comb in *D. melanogaster* that resemble a sex comb phenotype from a different species.

- ➢ We found that homeotic mutants reproduce multiple traits found in four different *Drosophila species* (figure 2).
- ➢ We also found that Homeotic transformation in *D. melanogaster* resemble the sex comb phenotypes observed throughout the phylogeny (figure 3).
- ➢ We found that *bab[PR72]*mutant can significantly increase the variation in bristle. length (Stdev wt ♂ =1.3, Stdev *bab[PR72]* ♂ = 7.8). However, this variation is not enough to mimic the bristle length found in the *Drosophila species* studied. (figure 4)

Discussion

The mimicking potential among *D. melanogaster* homeotic mutants and related species is consistent with rapid sex comb evolution. However, this mimicking potential has a limit as shown by bristle length.

Few developmental processes developmental basis of wide variety phenotypic variation (Figure 3)

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