Although meiotic recombination is required for successful gametogenesis in most species that reproduce sexually, the rate of crossing over varies among individuals. Differences in recombination rate between females and males are perhaps the most striking form of this variation.

Nevertheless, existing data fail to directly address the extent to which recombination experiences similar evolutionary pressures in the two sexes. + the fact that closely related species don’t have both sexes

To fill this gap – we measured meiotic recombination in both sexes for a panel of three house mouse subspecies. (leveraging the advantages of closely related species to uncover evolutionary patterns.

--we applied // there were multiple considerations – for creating the most equal comparisons (of this meiotic process across males and females)

i)inbred strains raised in standard lab environments – equal comparison of male and female genomes / genetic variation – wild derived natural genetic variation sampled from diverse geographic locations of this species< WE USED wild derived inbred strains (the closets comparison for males and females)

Raising mice in standard lab conditions, allowed us to compare the genetic variation for the genome wide recombination rates.>

ii) -immunocytology of single cells – (/placed the gwRR counts within the same meiotic context) (across sexes) < Using immunofluorescent cytology to visualize crossovers and meiotic chromosome morphology >

iii) -Additionally we decomposed the gwRR into single chromosomes components, and compared sex differences in the general recombination landscape of single chromosomes using Image analysis tools

WE found highly discordant evolutionary patterns in the two sexes. Whereas male recombination rates show evidence of rapid evolution over short evolutionary timescales, female recombination rates measured in the same inbred strains are mostly static.

In male specific gwRR divided into two groups, high and low recombining – which allowed us to ask what other patterns correlated with this variation in gwRR. These results point to rapid sex specific evolution in the genome wide recombination rate in house mouse.

The number of double strand breaks and spacing of double crossovers signiciantly distinguish the groups of high and low recombining male strains.

<However the relative spacing of double crossovers in the high recombining group is greater compared to the low recombining group – intedacting that (the relative recombination landscape – is less dense – but has more recombination>

Our findings reveal that recombination experiences distinct evolutionary pressures in females and males. To explain these findings, we propose a model based on sex differences in bivalent and meiotic spindle structure.

0. Abstract

(strong **hook** and first sentence)!!

-sex differences in recombination rate, house mouse, closely related species

-Closely related species (there are more gwRR measures), but for both sexes is rare

-why gwRR important

Method

-single cell cytology (co counts) and chromosome morphology

- empirical measures from

-surveyed panel of house mouse inbred strains , spanning 3 subspecies

Summary of results

- but evolutionary patterns for the variation for why sexes differ is not understood.

**1. importance of recombination**

**2.variation in recombination rate**

**3.  The House Mouse is a great model for uncovering evolutionary patterns at a short timescale.**

Commensal with humans -- World-wide distribution – found on every continent – the house mouse is a greater evolutionary biology model.

* The House mouse complex is comprised of (3 main subspecies, molossinus is an ‘artificial’ hybrid (of a combination of musculus and castaneaus).
* The divergence times spanning 0.5 mya (cite / Geraldes et al 2008 and Geraldes et al 2010) – related murid species divergence 3 mya for (x and Z) and 5 mya for caroli
* This short evolutionary time – provides an opportunity to interrogate natural variation (ie there are fewer mutations that would be causing hereitable variation in the genome wide recombination rate).
* Classical lab strains of mice have generated extensive knowledge central to meiosis and outcomes on recombination through extensive studies on the genes involved in the meiotic recombination pathway (cite) and previous crosses for understanding the genetic architecture of recombination rate variation (Dumont, Murdoch, Wang).
* **Same genome**  \*\*Wild derived inbred strains generate the best comparison of females and males, besides the sex chromosomes, the mouse for each genome are almost identical.

Inbred strains enable one of the most direct comparison of both female and male -- versions of meiosis

--enable use to conclude that sex is a primary factor --

Additionally due to their global distribution allows us to compare samples of natural diversity from a broad geographic range. (wild derived inbred strains – will capture genetic diversity not represented in classical lab strains.)

* While there are strains with Robertsonian translocations, in house mouse and related murid species it is possible to assemble sets of strains with identical karyotypes, 20 pairs of acrocentric chromosomes.
* House mouse is well suited for single cell cytology approaches. The single cell level allows integration of data at a closer connection to the molecular pathway and meiotic program. In addition to the quantification of gwRR. This study quantifies precursors to crossovers, double strand breaks (DSBs), and meiotic chromosome morphology across stages of meiosis which would not be accessible to with genetic linkage data and crosses.

**3. What we Did in this study**

* For the first time in many of these strains, We report a rare, direct, evolutionary comparison of recombination rate in females and males for this short evolutionary scale.
* We use rare strains from a broad range of geographic locations of the species territory.
* The gwRR is made up of crossovers occurring on individual chromosomes within cells. Thus we quantified meiotic chromosome morphology (SC length) and placement of crossovers to comprise an approximate picture of the recombination landscape.
* Our results indicate rapid male specific evolution of gwRR occurred in a subset of house mouse lines. We observed up to a 30% difference (translating into approximately ~7 more crossovers per cell), a surprising amount considering the short evolutionary time scale.