0.   **Importance of recombination rate**

* The total number of COs per (4n meiotic) cell = genome wide recombination rate (gwRR)
* The gwRR regulates populations responses to selection, and determine the fate of novel mutations.
* This process shapes the genomic patterns of genetic variation.
* It is an integral part for proper chromosome segregation. With an obligate crossover per bivalent may act as the lower bound for gwRR.

**1. Understanding levels of variation in gwRR**

1a. There is substantial in gwRR variation within species (across populations) and (across individuals)

* While there are fewer measures from closely related species, variation at this level is more restricted to finer scales (hotspot level / recombination landscape level).

1b. Sex is one of the most notable ways in which individuals vary from each other

* Long history since the discovery.
* Not due to sex chromosomes, but pattern of achiasmy evolution is different case.
* Most species have more recombination in females than males, but there are exceptions.
* Crossover placement is sexually dimorphic; male telomeric, female uniform placement
* SC length / meiotic chromosome length is longer in females of a few mammal species, but there are exceptions, Celegean (not much different) and A.thalnia (opposite direction) (Cahoon and Libdua).

1c. There are still gaps missing from the field

* More Measures at individual level
* More empirical measures of both sexes.
* Comparisons across sexes important, but understanding that the meiotic program is fundamentally different and may complicate some cross sex comparisons
* Integration of cell biology with general patterns of the recombination landscape

H*ow do fundamental differences in meiotic program translate into conserved sexually dimorphic patterns in the recombination landscape?*

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

* House mouse complex comes from a recently radiation providing an opportunity to interrogate variation at short evolutionary scales.
* Wild derived inbred strains generate the best comparison of females and males, besides the sex chromosomes, the mouse for each genome is highly similar.
* Unlike some house mouse strains, all strains have the same karyotypes, 20 pairs of acrocentric chromosomes.
* Classical lab strains of mice have generated a mountain of knowledge regarding the genetics and molecular pathway of meiosis.
* House mouse is suited for single cell cytology approaches.

**3. What we accomplished in this paper**

* We quantify gwRR of both sexes, from 3 subspecies and outgroups.
* We use rare strains with a recent origin from multiple geographic locations of the species territory.
* 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.

Introduction outline / ideas

1. importance of RR

* the recombination rate can shape a populations response to selection (and the fate of novel mutations)
* correlation with genetic diversity
* scales that it acts across

**1. Background and interesting questions**

-what we know about RR evolution

-rapid evolution (dumont), response to selection in the lab (Arrgawal)

-genetic variants identified (some act in opposite directions)

-what we know about sex differences

Common – multiple scales (RR) (number n placement shows consistent sex differences across a wide range of species

Other related traits (chromatin compaction) (gametogenesis?)

-gap in the literature (however most

-most empirical measures patterns (for both sexes!) (duthiel)

(from large evolutionary scales – (Segura)

(connection of evolutionary patterns – with ideas / frame work of the cell mechanism (use these to help interpret)

2. **House Mouse as an amazing evolutionary model**

- Inbred lines give a direction comparison for males and females

- Available strains collected from natural populations -- enable sampling from a large geographic range

- molecular and genetic work in house mouse – gives a huge base for knowledge of how the pathway works

3. **what we do in this paper**

-both sexes, short evolutionary timescale

-considered related traits