CROSSING FITNESS-VALLEYS WITHOUT THE HELP OF MENDEL

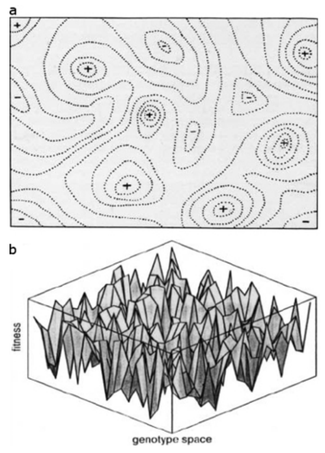
Matthew M. Osmond & Sarah P. Otto

Department of Zoology, University of British Columbia, Vancouver, Canada

mmosmond@zoology.ubc.ca

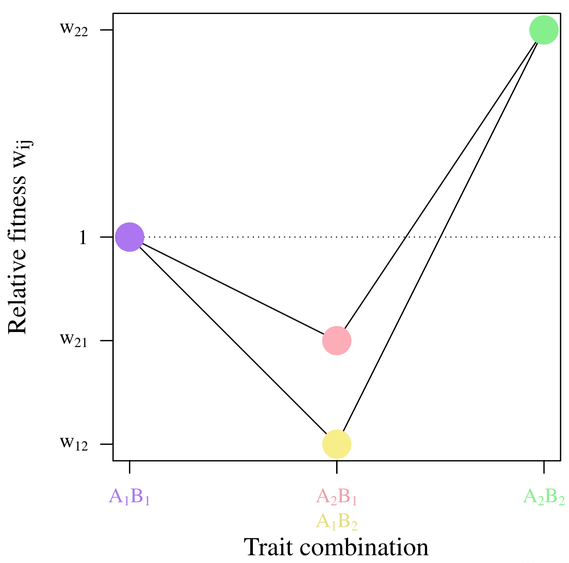
MOTIVATION

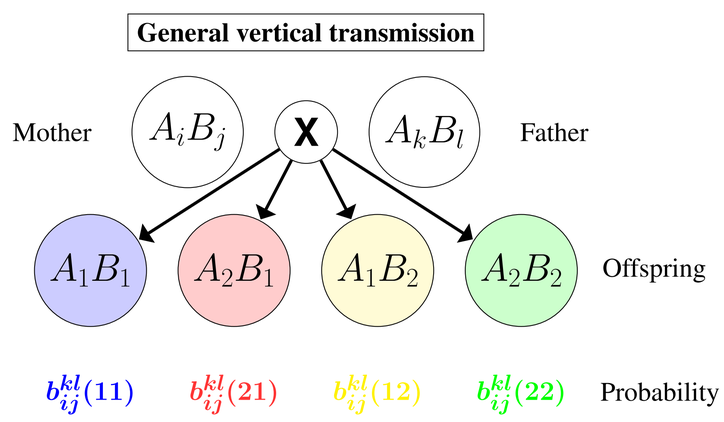
- Epistasis gives rise to rugged fitness landscapes
- Surpassing local peaks requires crossing valleys of low fitness
- Theory has thus far been limited to the simple, symmetrical, Mendelian genetic case
- **We extend the theory to allow for TRANSMISSION BIAS, capturing phenomena such as:**
  - **SEGREGATION DISTORTION (e.g., meiotic drive)**
  - **epistasis and selection in CULTURAL TRAITS**



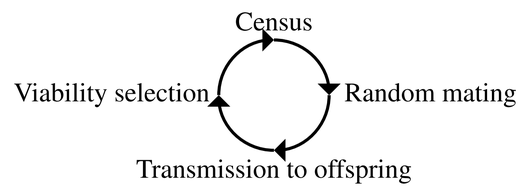
Rugged fitness landscapes *à la (a)* Wright (1931) and *(b)* Kauffman & Levin (1987). From Johnson 2008 *Nature Education* 1:52.

MODEL



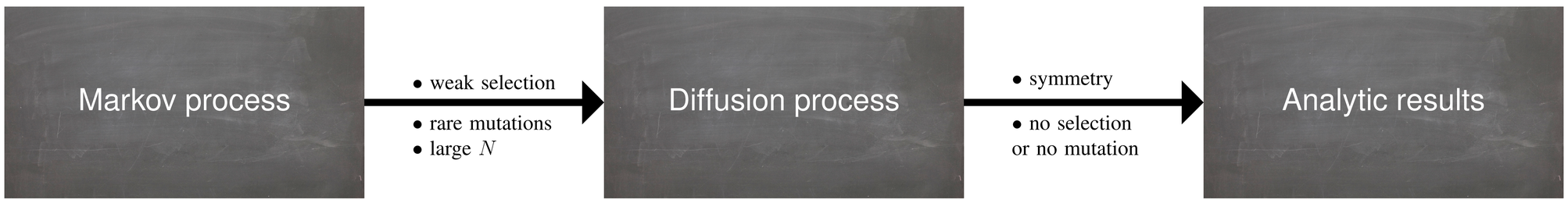


$x_{ij}(t)$ = frequency of A_iB_j in generation t
$\bar{w}(t)$ = mean population fitness



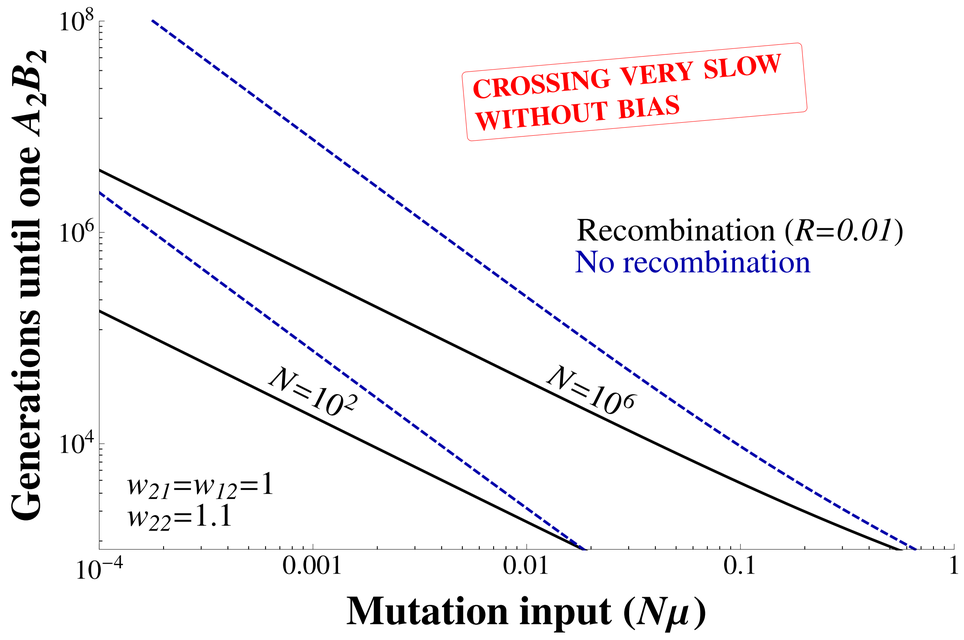
$$x_{ij}(t+1) = \frac{w_{ij}}{\bar{w}(t)} \sum_{k,l,m,n=1}^{2} x_{kl}(t)\, x_{mn}(t)\, b_{kl}^{mn}(ij)$$

Q. *How long will it take to cross the valley, if ever?*

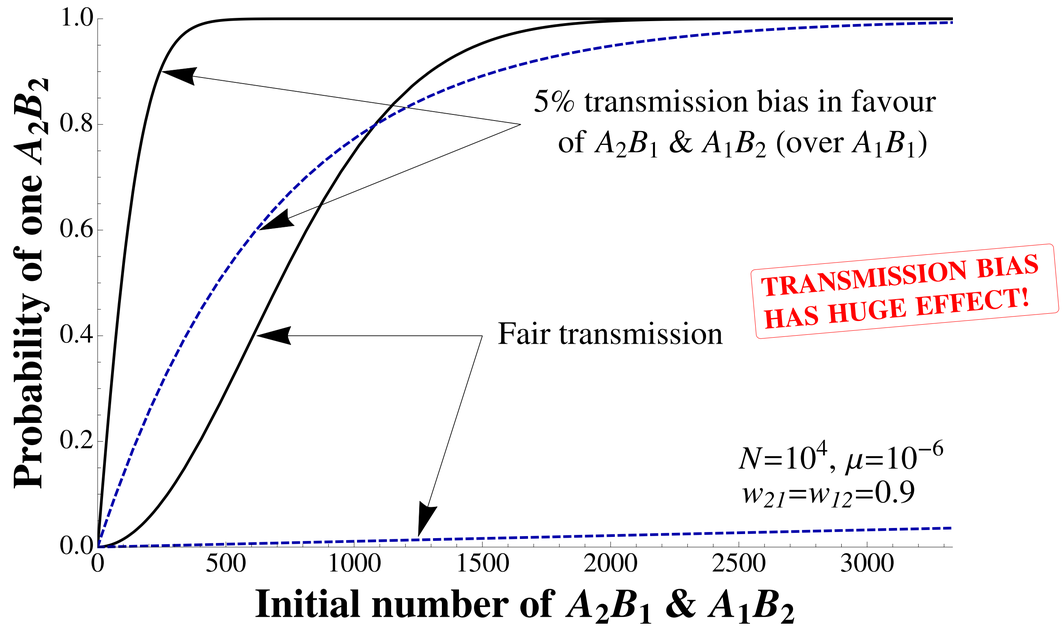


RESULTS

Crossing time, from new mutations



Crossing probability, from standing variation



CONCLUSIONS

- Drift, mutation, and recombination speed crossing, but it generally remains unlikely
- Meanwhile, **TRANSMISSION BIAS can greatly increase the probability of crossing**

Acknowledgements

Thanks to the Otto, Doebeli, and Gyllenberg labs. For the Mendelian case see Christiansen *et al.* 1998 *TPB* 53:199.