

## Sexual Dimorphism: Evolution and biomedical implications

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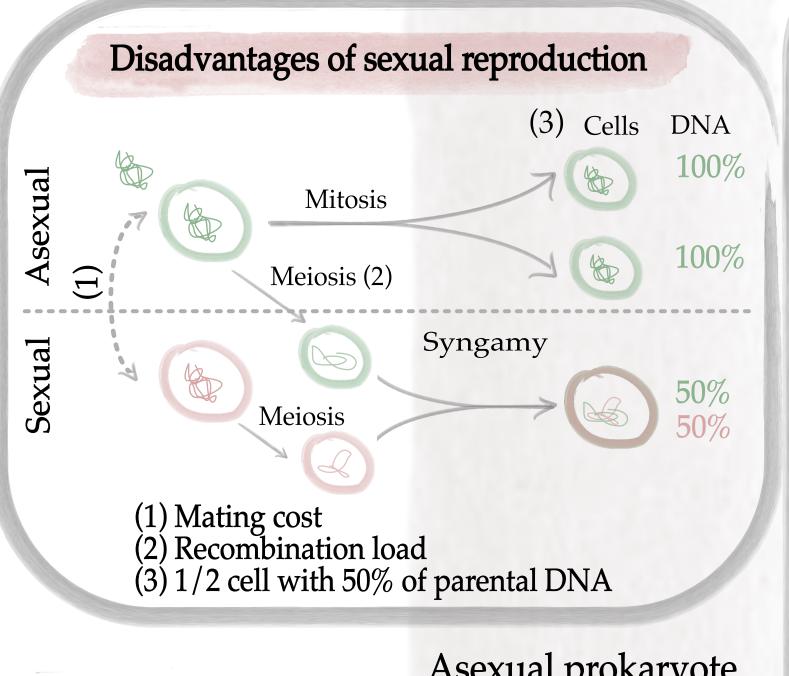
disproportion-ately large subset of alleles.

## "Nothing in Biology makes sense except in the light of Evolution"

### Introduction

Evolution is to biological diversity what development is to an organism's organizational complexity or sociopolitical history to its current dynamics. As Theodosius Dobzhansky stated already in 1973, "Nothing in biology makes sense except in the light of Evolution": what a biological event means cannot be fully understood without the whys and hows of its evolutionary records. Analyzing sexual dimorphism from this perspective is not only an ideal excuse to illustrate the mechanisms and potential outcomes of an evolutionary process, but also the only way to understand the origin and roles of males and females in biological terms.

Evolution of sexual reproduction (1)(2) Avantages, disadvantages and origin of sex



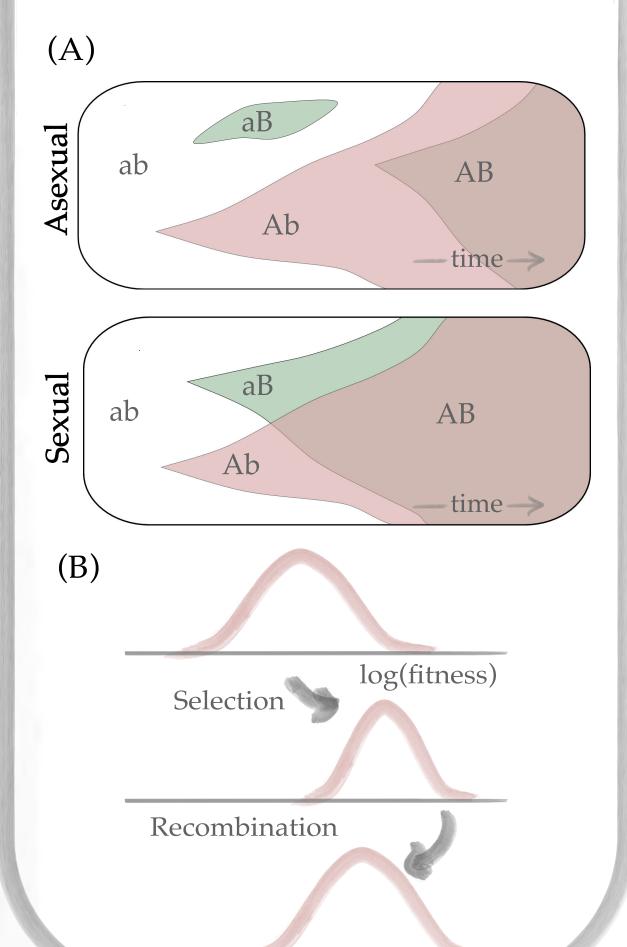
Asexual prokaryote

How? Sex, evolving as a result of cell fusion, chromosome segregation and recombination out of processes already present in the internalized bacteria, was the way out to survival under the stress of the early **symbiosis**. Engulfed bacteria Host cell Endosymbiosis

Evolution of sexual dimorphism (5) From isogamic eukaryotes to mating types

# Advantages of sexual reproduction

Sex increases the rate of adaptation and speeds up evolution by (A) bringing together favorable mutations appearing in different organisms and (B) increasing the variance in fitness.



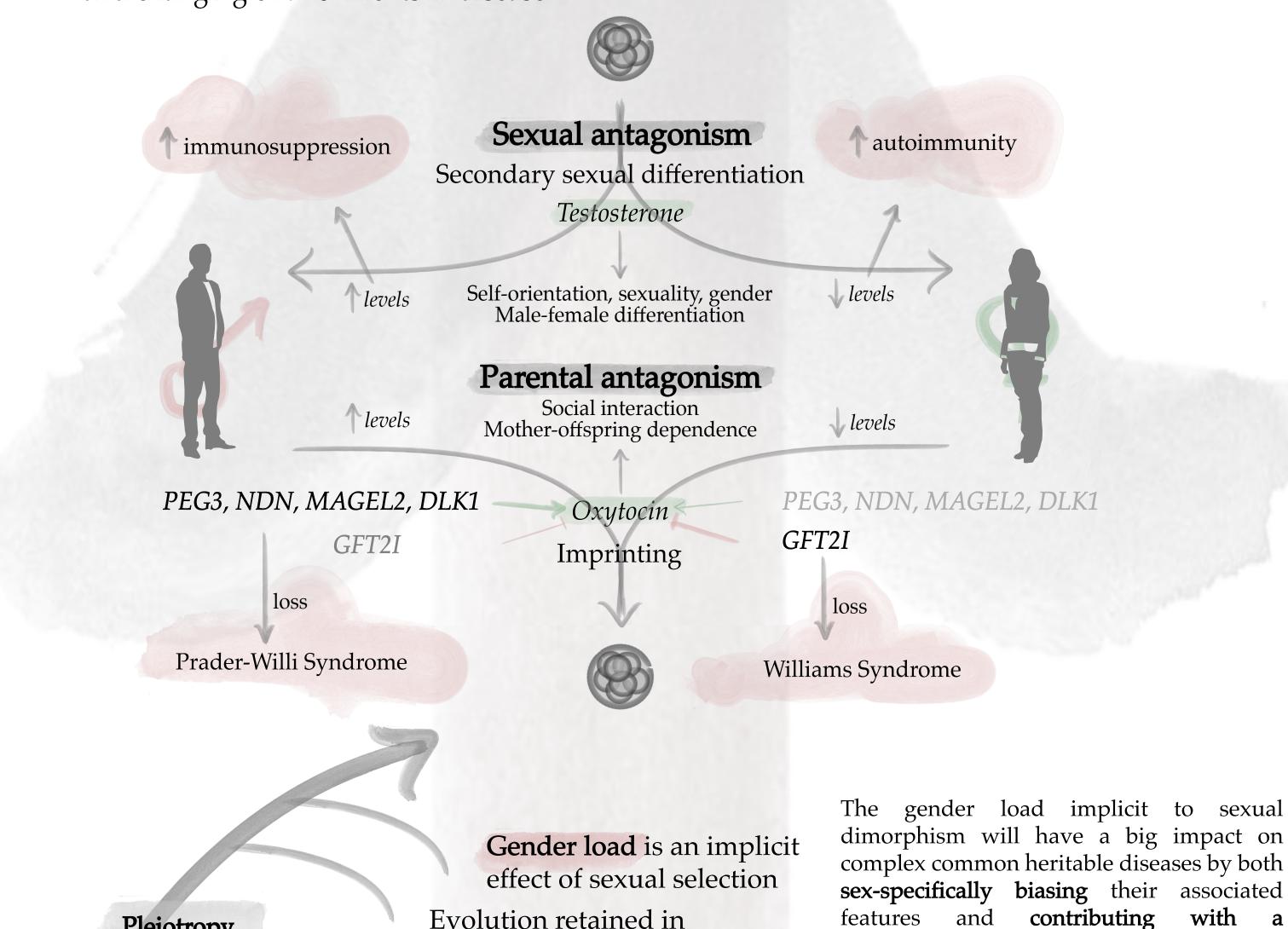
### Discussion

Who could have predicted that a primary advantage found in genetic exchange and diversifi cation would have evolved into the systematic division of a vast number of populations in two reproductive counterparts in response to a trade-off between size and amount?

The retrospective journey through sexual dimorphism is essential to be able to dig into the most challenging questions about sexuality and sex differences, both in health and society, using the principles that operated in their generation. To base present understanding and future action on past comprehension, this is what we are to learn from the evolutionary approach.

### Sexual selection and disease (3)

Darwinian medicine: conflicts, constraints, side effects, trade-offs, defense mechanisms and changing environments in disease



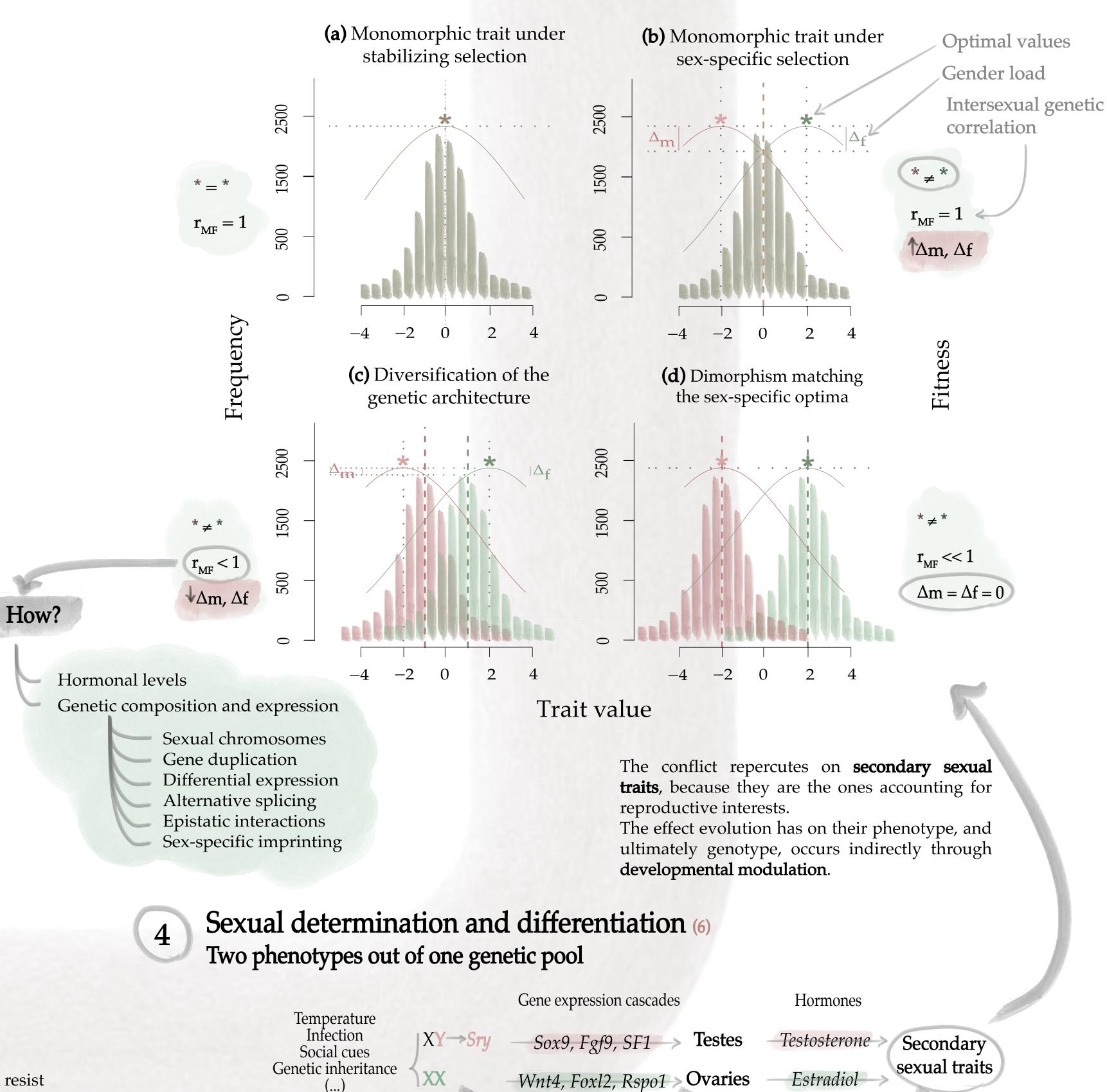
### Evolution of sexual dimorhpism over four stages (4) Molecular resolution of the conflict

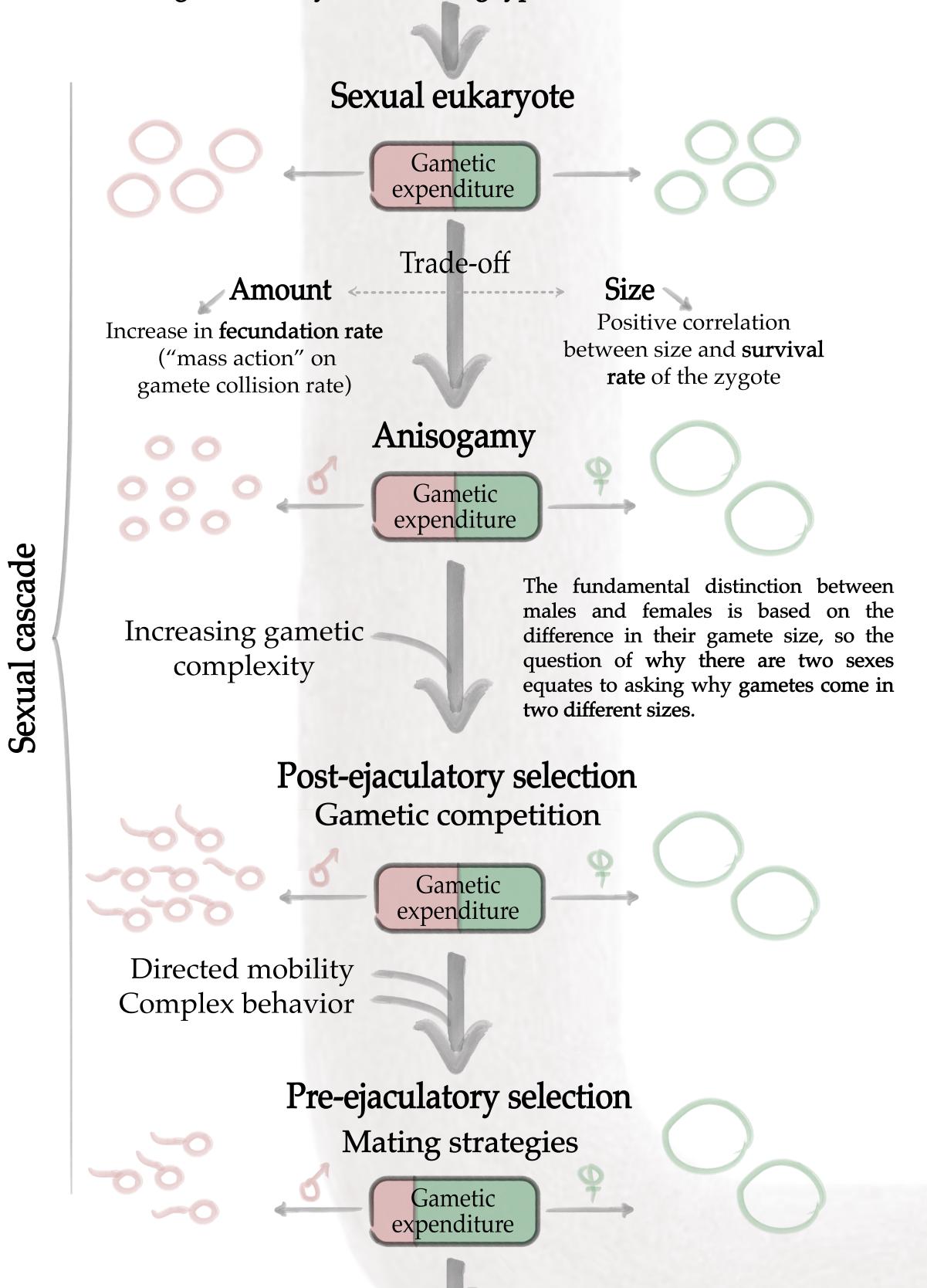
Pleiotropy

Polygenic characters

Evolution retained in

middle steps - (B) and (C) -





Darwin-Bateman Paradigm (4) Establishment of the conflict of interests

Number of matings

Males will fight for quantity while females will resist for quality, triggering the eternal conflict of indiscriminating eagerness vs discriminating passivity.

Sexual dimorphism is paradoxical from a genetic point of view because two phenotypes are, on the one hand, generated from a common genetic pool and, on the other hand, under sex specific or antagonistic selection pressures.

Sexual determination Sexual differentiation Secondary sexual differentiation and conflict resolution

Key references: (1) Barton, N.H., Charlesworth, B. 1998. Why sex and recombination? Science 281:1986-1990. (2) Lane, N. 2009. Life Ascending: the Ten Great Inventions of Evolution. WW Norton & Co. Chapt. 5: Sex. (3) Mokkonen, M., Crespi, B.J. 2015. Genomic conflicts and sexual antagonism in human health: insights from oxytocin and testosterone. Evol Appl 8:307-325. (4) Morrow, E.H. 2015. The evolution of sex differences in disease. Biol Sex Differ 6:5 (5) Parker, G.A. 2014. The sexual cascade and the rise of pre-ejaculatory (Darwinian) sexual selection, sex roles, and sexual conflict. Cold Spring Harb Perspect Biol 6:a017509. (6) Rigby, N., Kulathinal, R.J. 2015. Genetic Architecture of Sexual Dimorphism in Humans. J Cell Physiol 230:2304-2310.

Sexual

differentiation

Secondary

Primary

Sexual

determination

or 🎱