Workshop on population and speciation genomics

Walter Salzburger

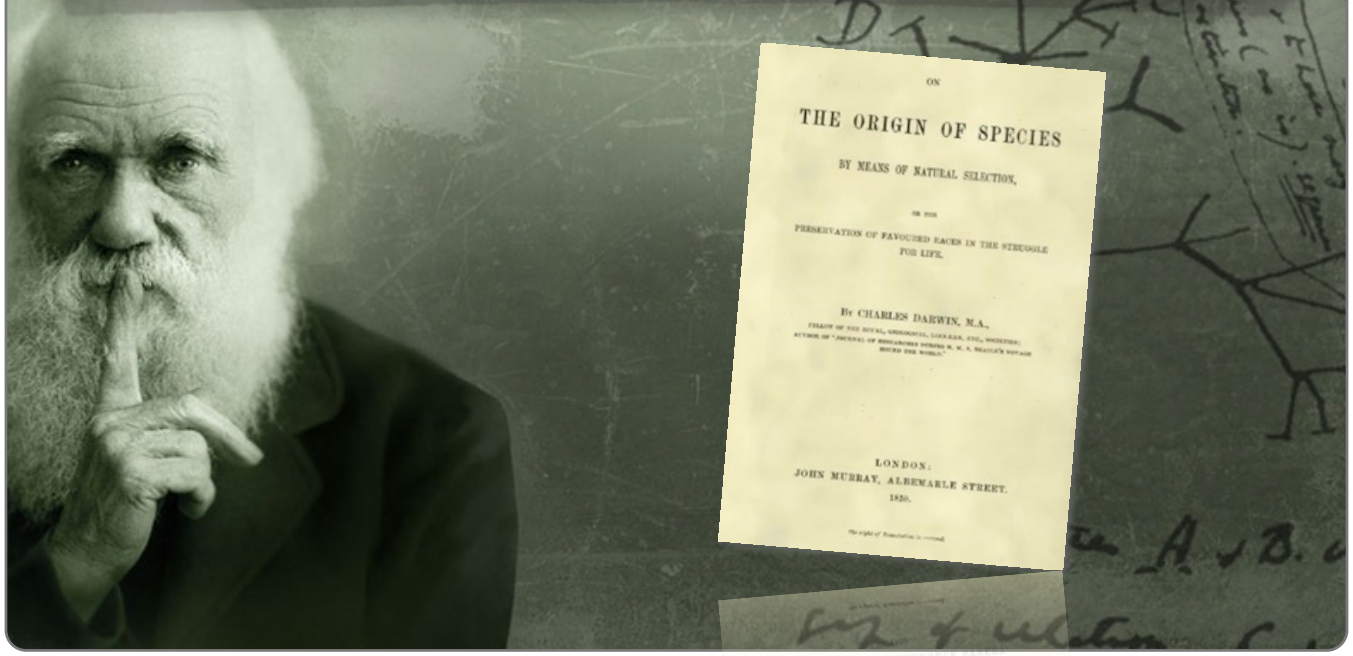
Zoological Institute
University of Basel, Switzerland

UNI BASEL

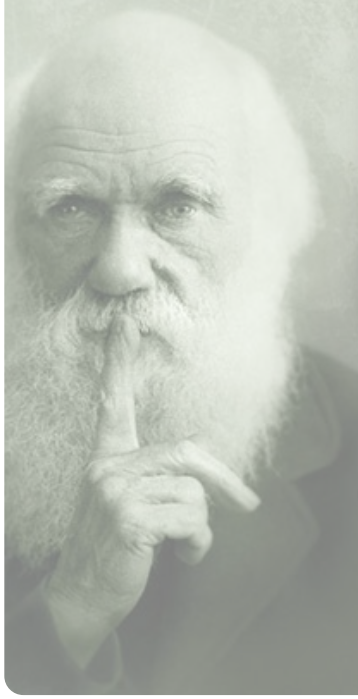
evolution

"The process by which different kinds of living organism are believed to have developed from earlier forms during the history of the earth."

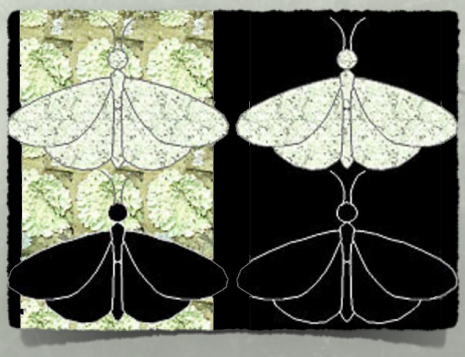
The Oxford Advanced Learner's Dictionary



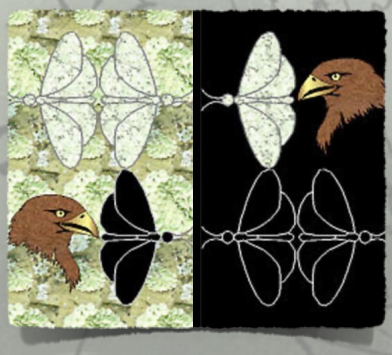
evolution



heritable variation



selection



ADAPTATION

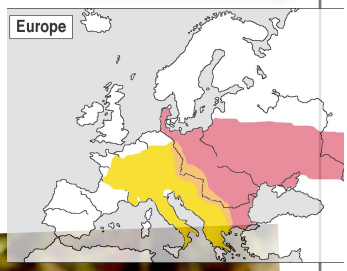
INNOVATION

SPECIATION

species

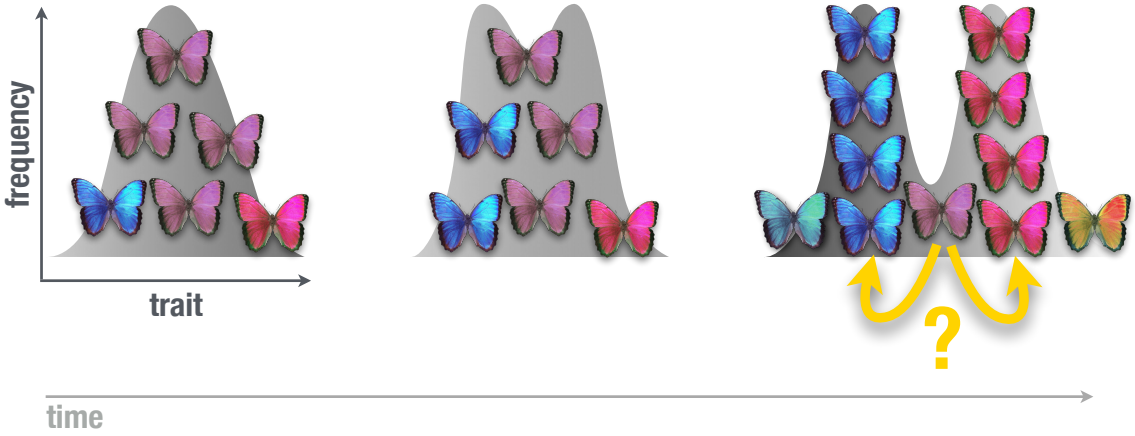
- …are fundamental (real) natural units

distribution map



species

- …are varied

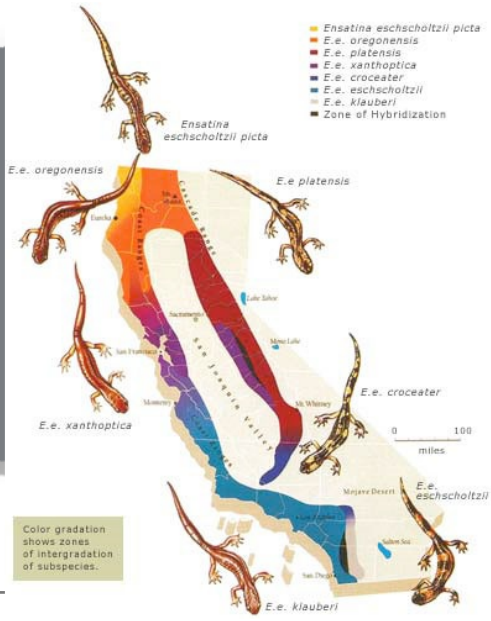


species

- …are not (always) easy to define

Ring Species:

Two species appear to be present at one place, but those two “species” are connected by a series of forms that are geographically arranged in a ring. No phenetic character could be used, except arbitrarily, to divide the ring into two species. A division would be meaningless, as there really is a continuum, not a number of clear-cut, separate species.



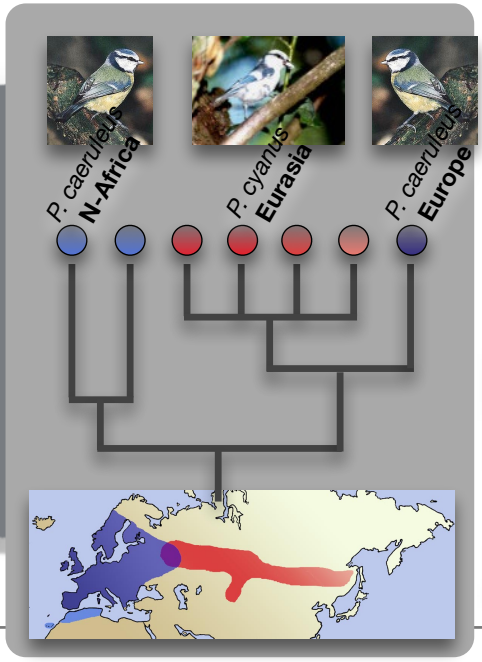
Stebbins (1994)

species

- …are not (always) easy to define

Paraphyletic Species:

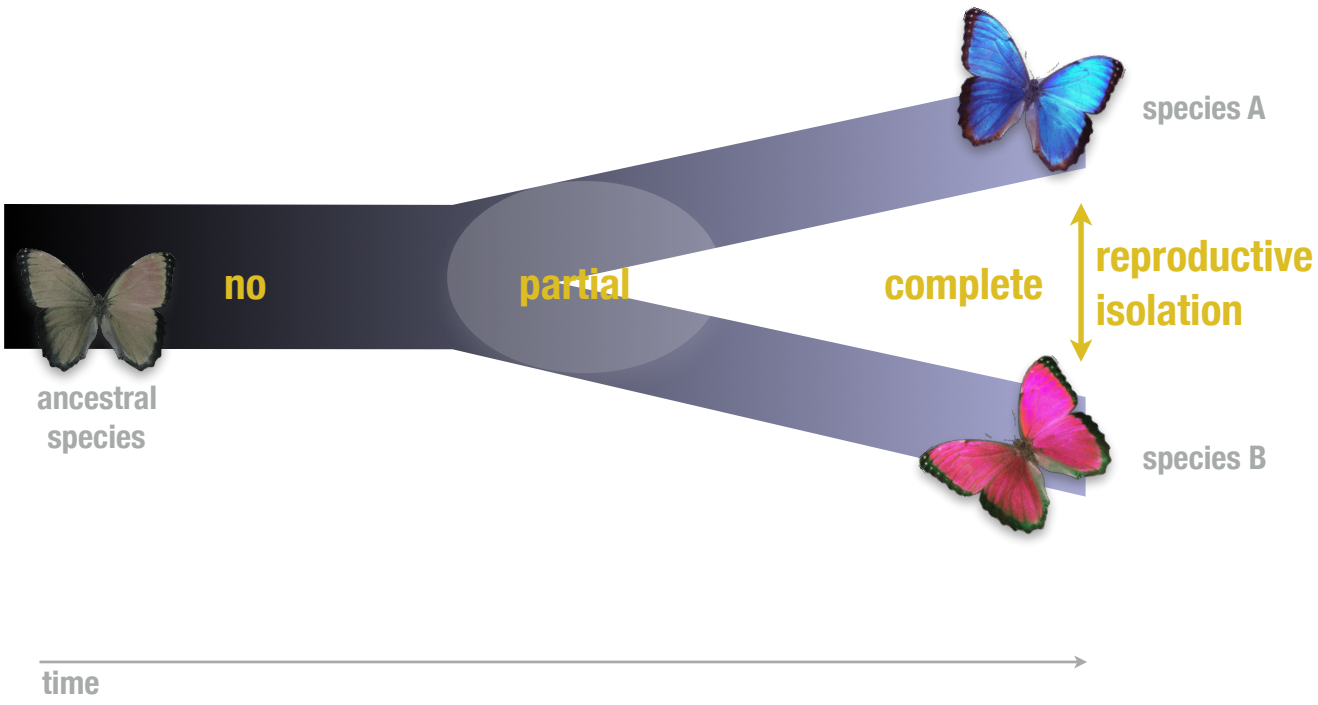
The evolution of part of the original species into a new one renders the remaining populations paraphyletic. For example, the Blue Tit (*Parus caeruleus*) is a paraphyletic species. The North African subspecies *P. c. degener* and *P. c. ultramarinus* are the sister group to the European Blue Tit (*P. c. caeruleus)* plus the Eurasian Azul Tit (*P. cyanus*) with four subspecies (*P. c. cyanus*, *flavipectus*, *tianshanicus*, and *yaniseensis*).



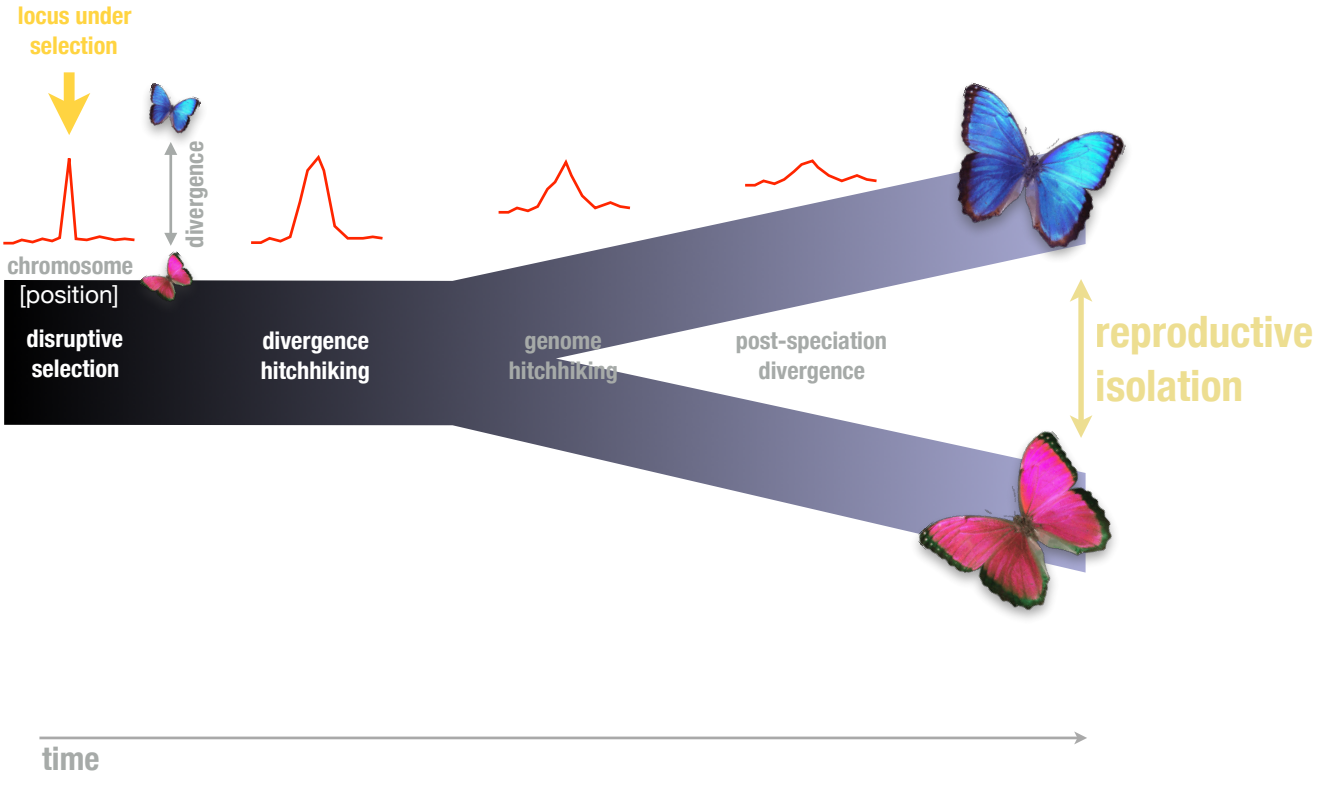
species

- **"Species are groups of interbreeding natural populations that are reproductively isolated from other such groups"** (Mayr 1963)

speciation continuum

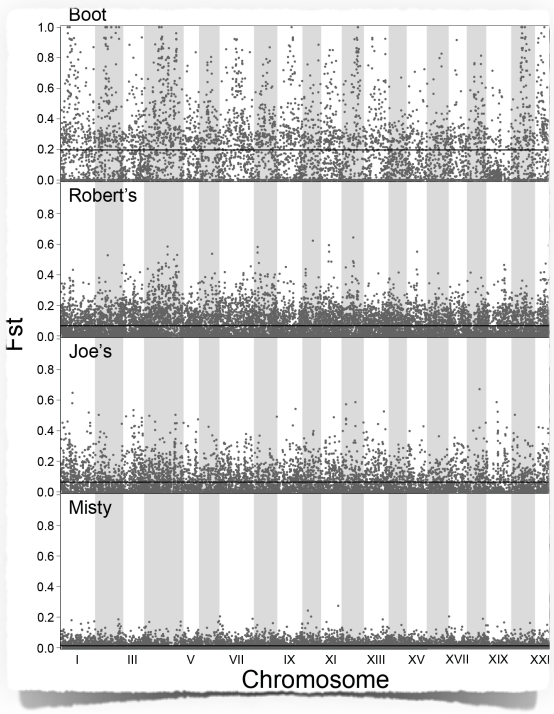


speciation continuum

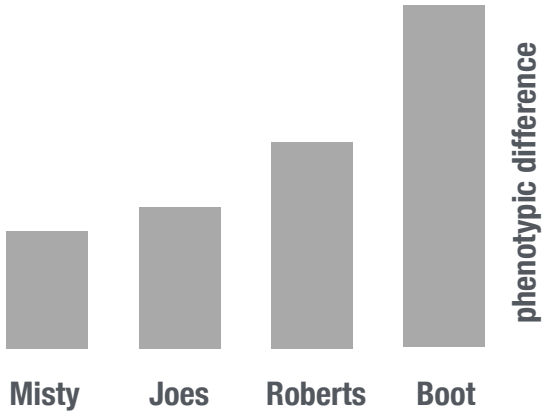


••• JL Feder, SP Egan & P Nosil (2012) TREE

speciation continuum

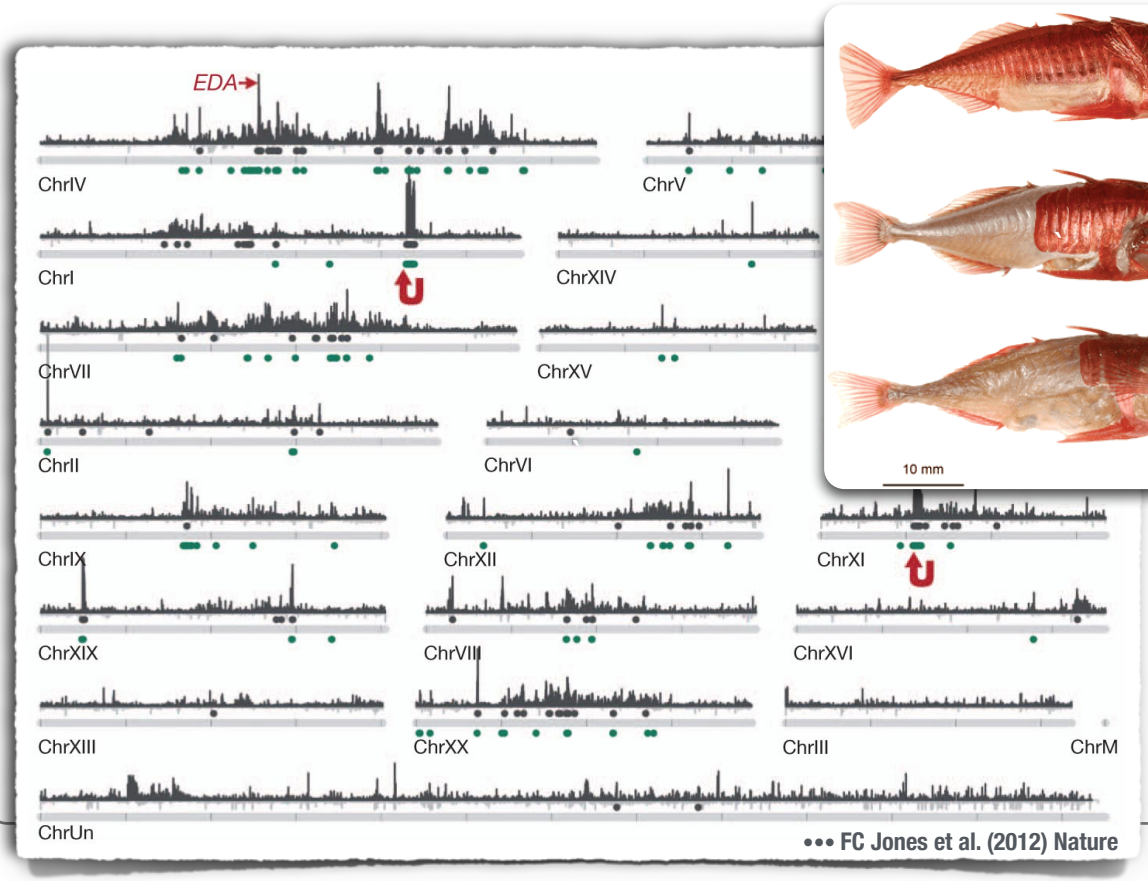


RAD genome scans



••• M Roesti, A Hendry, W Salzburger & D Berner (2012) Molecular Ecology

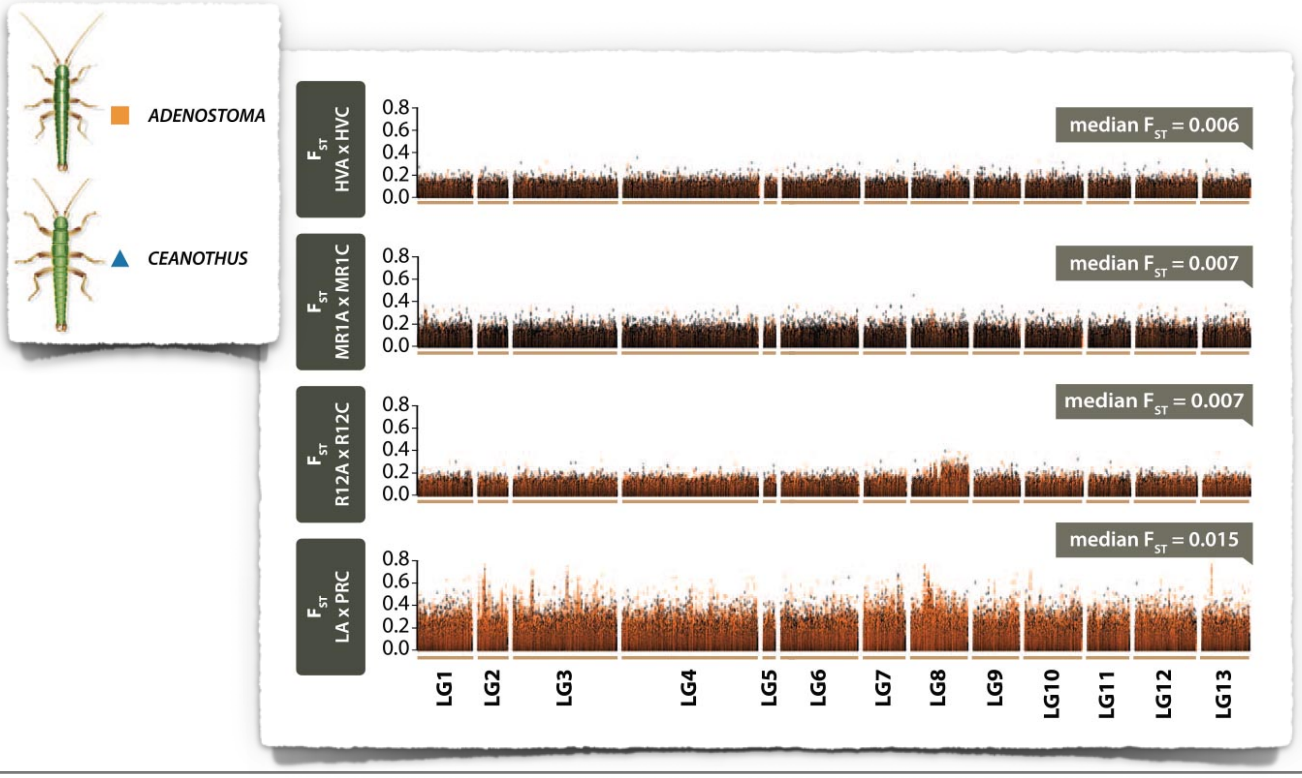
speciation continuum



Barrett et al. (2008) *Science*

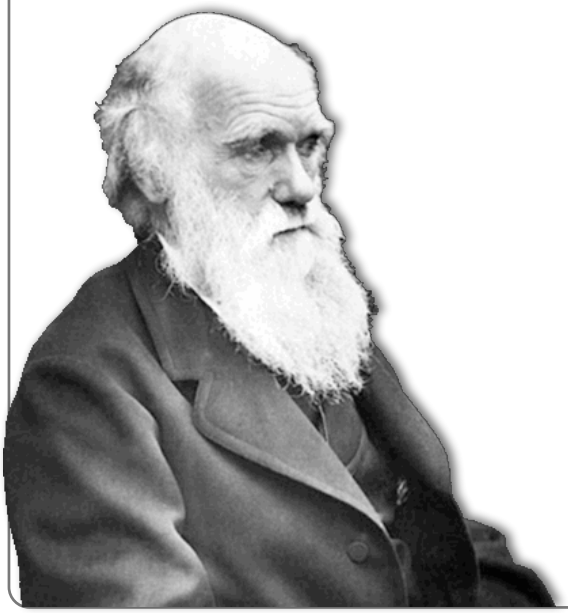
••• FC Jones et al. (2012) Nature

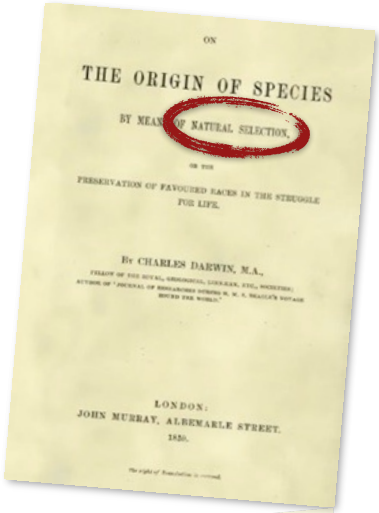
speciation continuum



••• V Soria-Carrasco et al. (2014) Science

selection





Charles R. Darwin (1809-1882)

natural selection

- **...** “is the process by which the forms of organisms in a population that are **best adapted** to the environment **increase in frequency** relative to less well-adapted forms over a **number of generations**” (Ridley 1996)

images: www.idscaro.net, www.wikipedia.com

sexual selection

- **...**“is the selection on mating behavior, either through **competition among members of one sex** (usually males) for access to members of the other sex or through **choice by members of one sex** (usually females) for certain members of the other sex” (Ridley 1996)

images: www.nrcbs.umd.edu, www.nhm.com.au

selection

	fitness	competitors
sexual selection	individual fitness	other members of the same sex
natural selection	fitness of the genotype	other individuals in the same population

selection

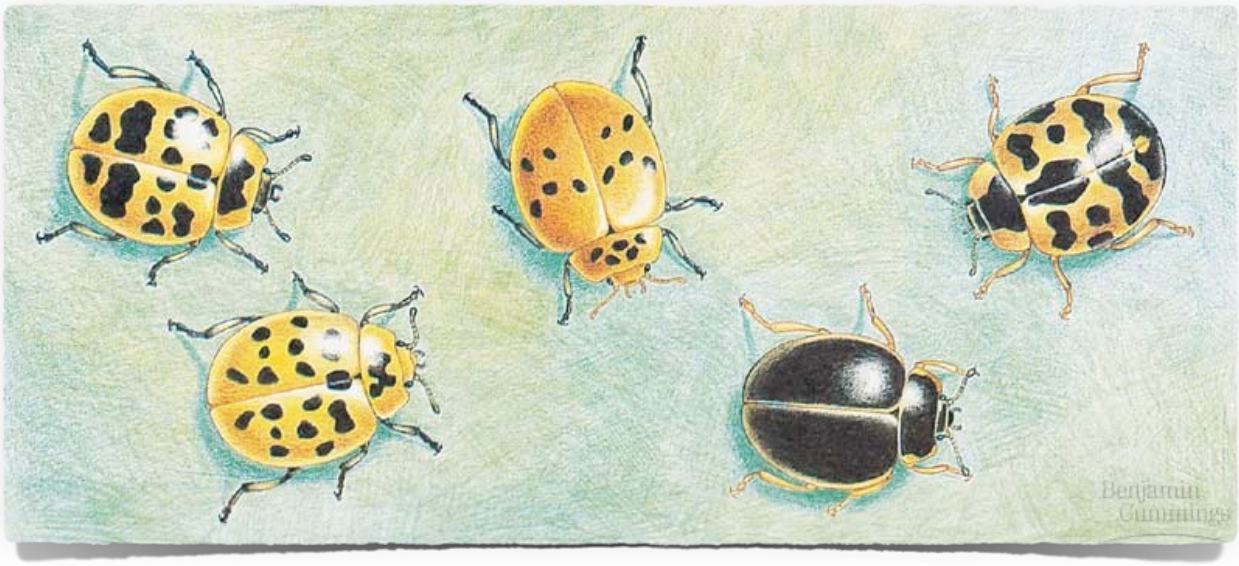
- **...operates** if the following **conditions** are met:

reproduction	organisms must reproduce to form new generations
heredity	offspring resemble parents (“**like must produce like**”)
trait variation	individuals in natural populations vary in (adaptive) traits
variation in fitness	individuals in natural populations vary in the number of their offspring that survive to reproduce (‘**lifetime reproductive success**’)

(Ridley 2004; Stearns & Hoekstra 2005)

natural variation

- **Natural populations** show **variation** at all levels, from gross morphology to DNA sequences. Selection can only operate, if heritable variation exists.



natural variation

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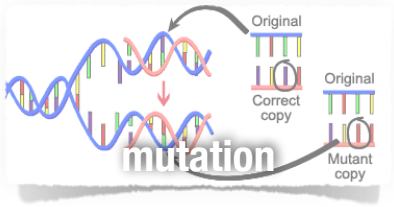
- Natural variation is generated by two processes:

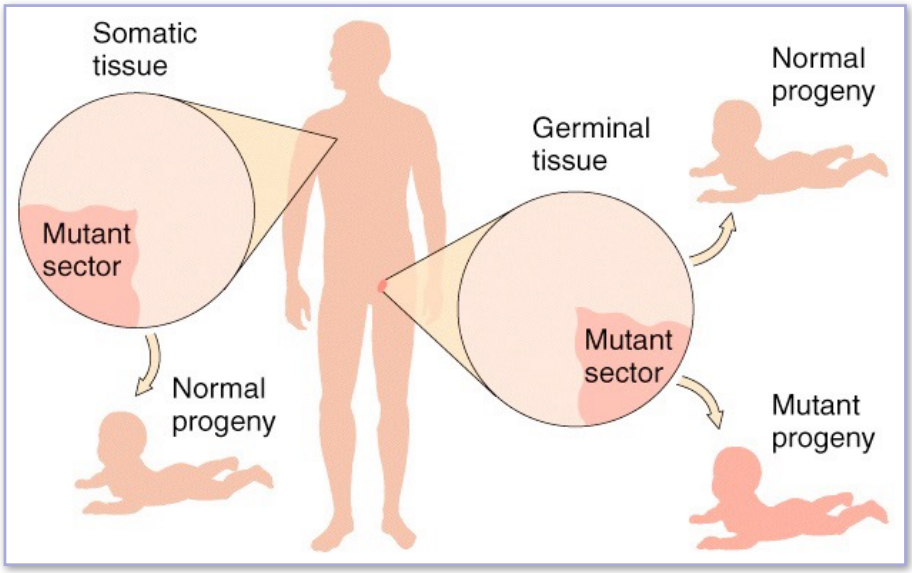
"reshuffling" of genetic material by introducing or breaking up physical linkage



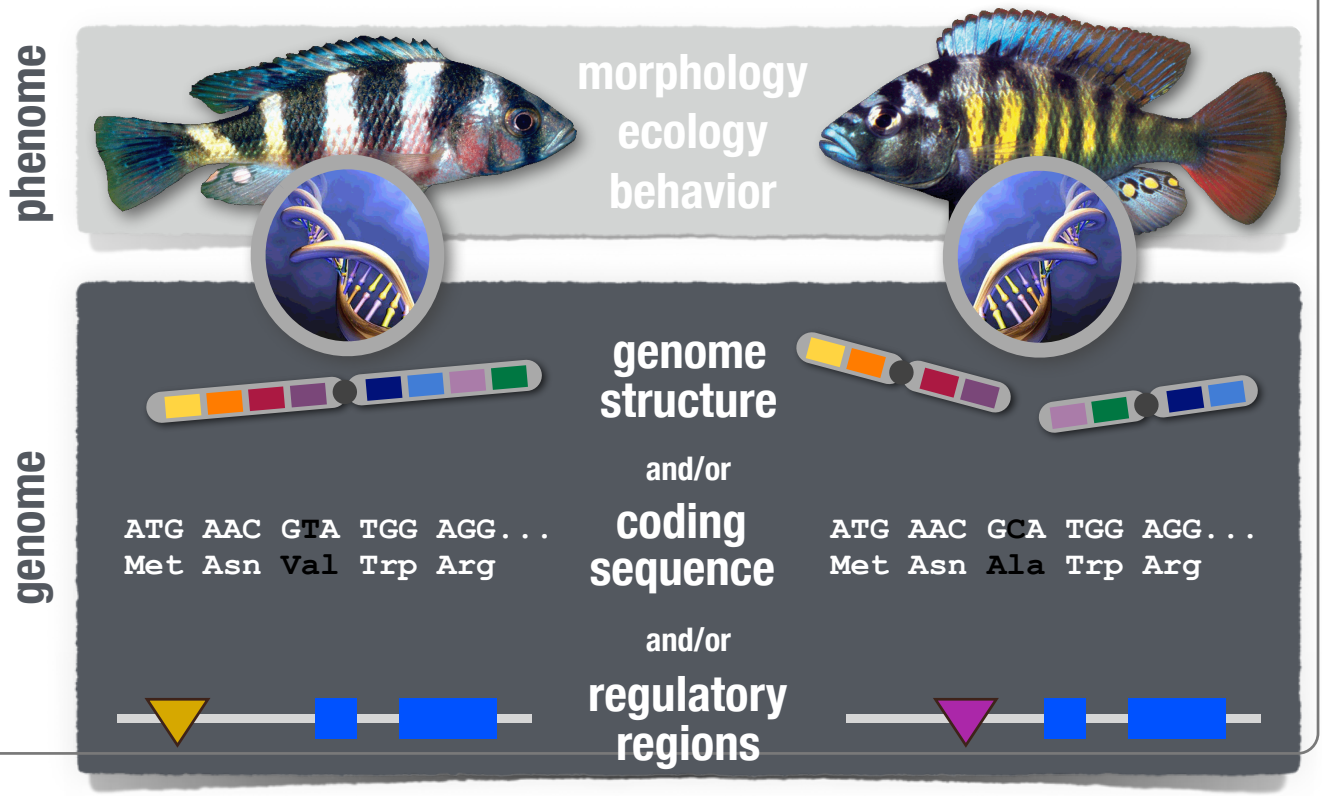
generation of new genetic variation by "mistakes" during the copying of a DNA strand

natural variation

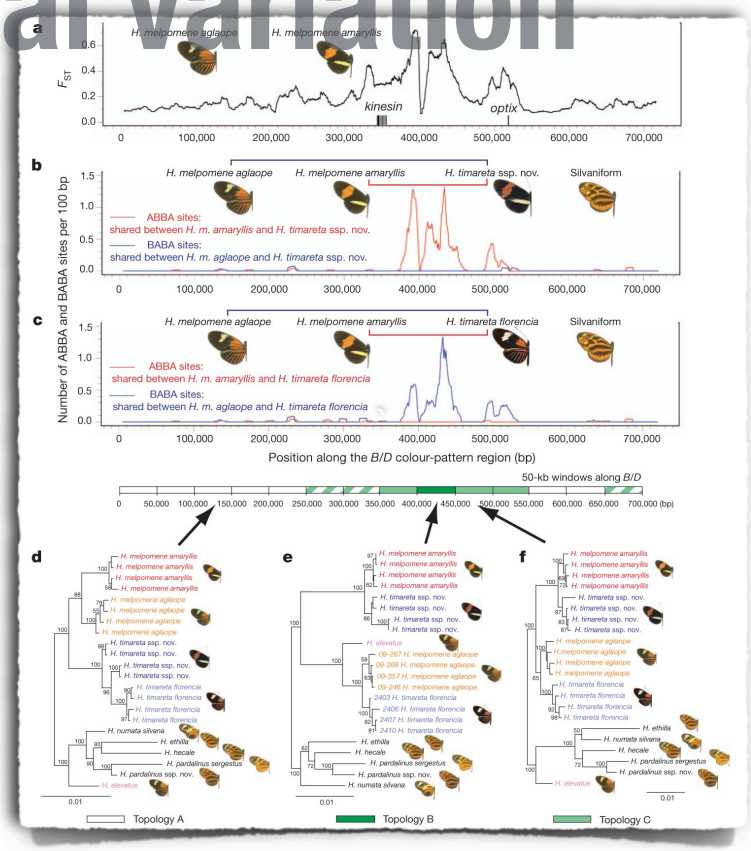
- New mutations are only transmitted to the next generation, if they occur in **germinal tissue**!



natural variation

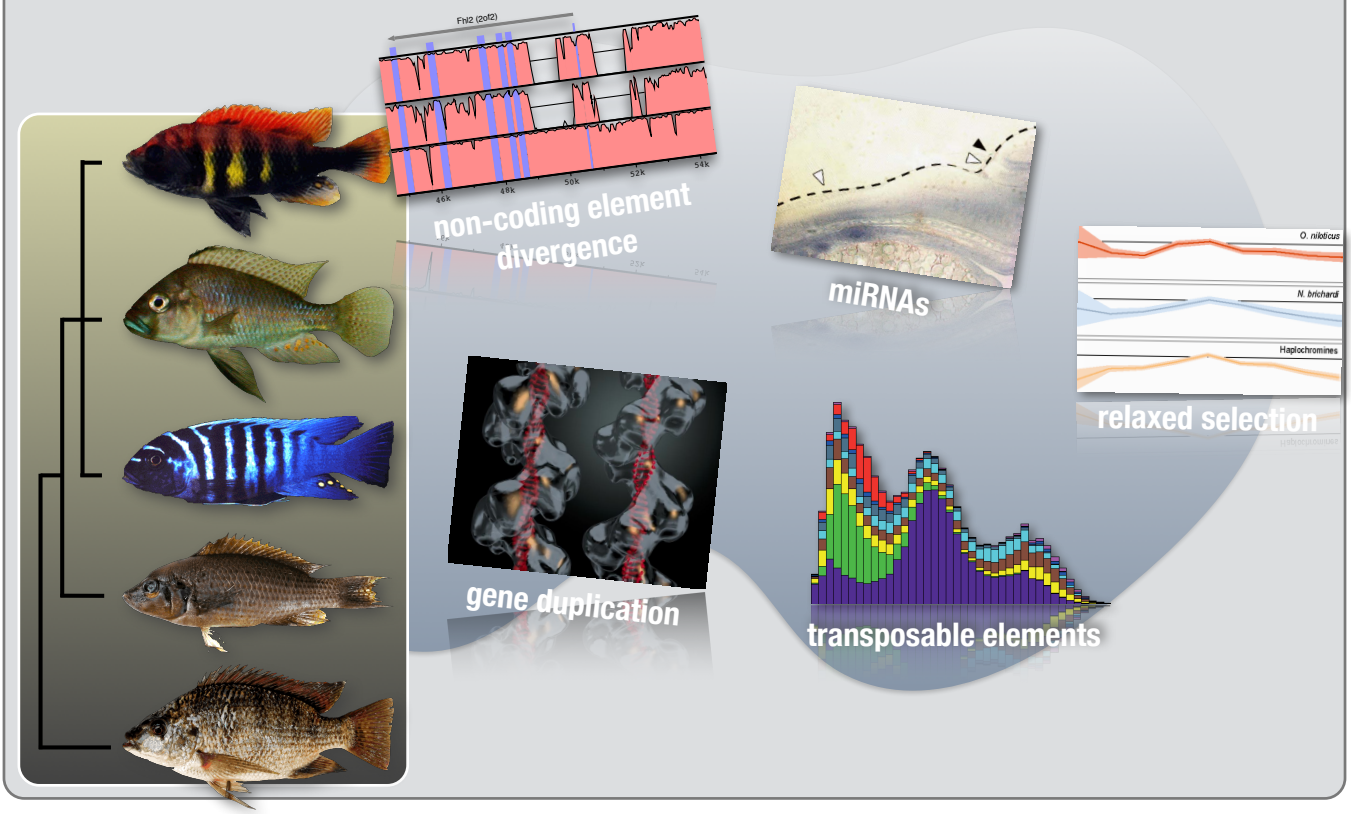


natural variation



••• The Heliconius Genome Consortium (2012) Nature

natural variation



••• D Brawand et al. (2014) Nature