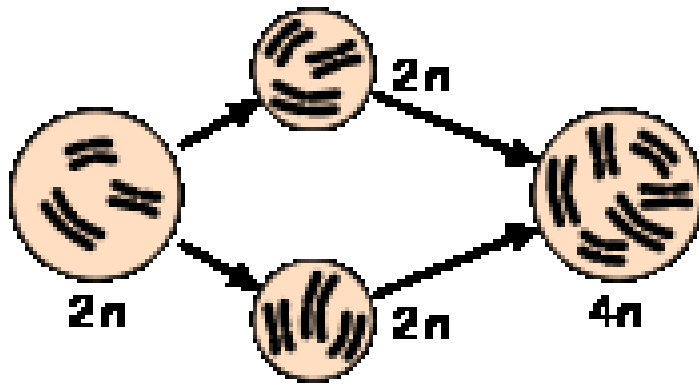
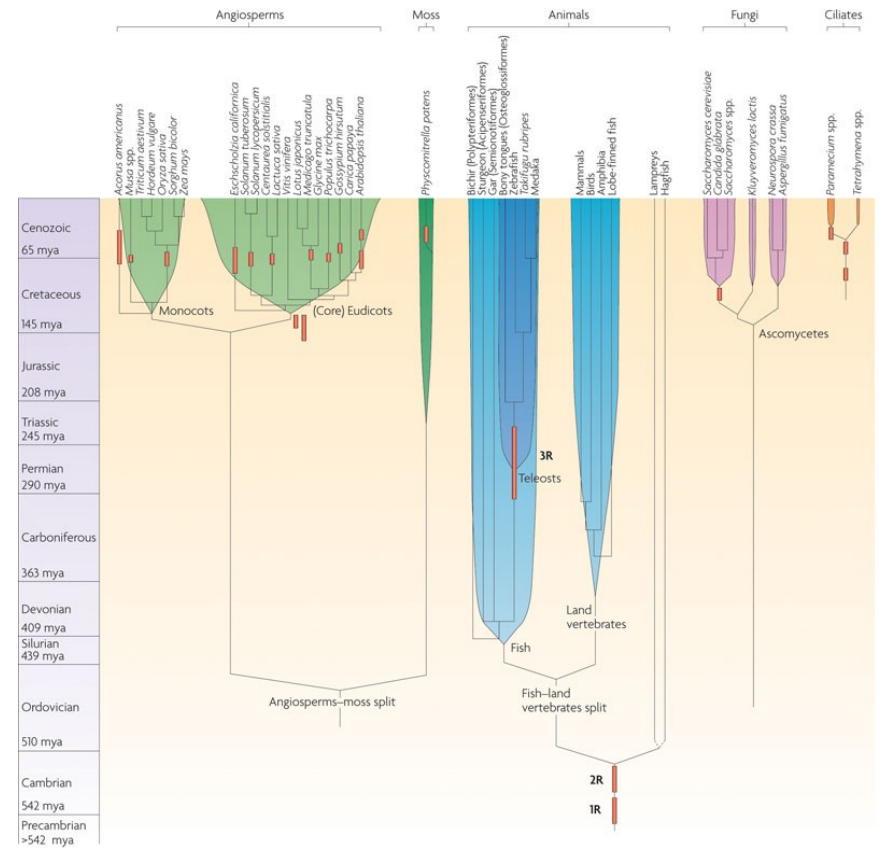


Genome duplications (polyploidy) / ancient genome duplications (paleopolyploidy)



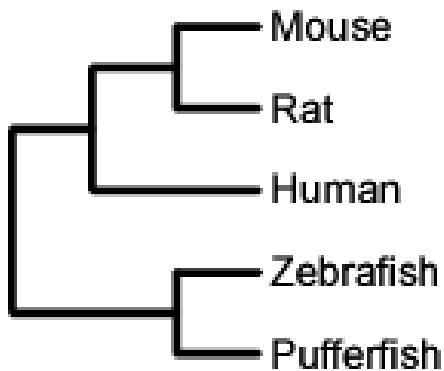
Mechanism? e.g. a diploid cell undergoes failed meiosis, producing diploid gametes, which self-fertilize to produce a tetraploid zygote.

How to detect paleopolyploidy?

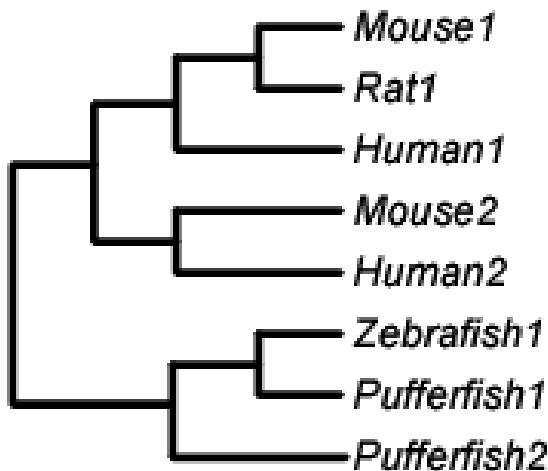


Timing of duplication by trees (phylogenetic timing)

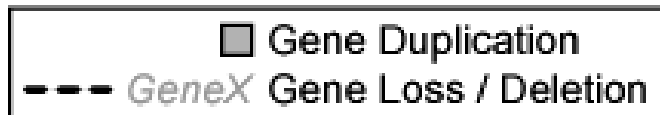
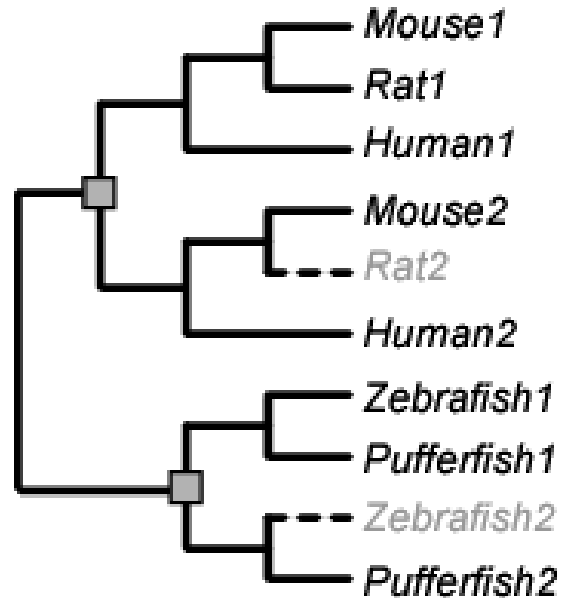
(a) Species Tree



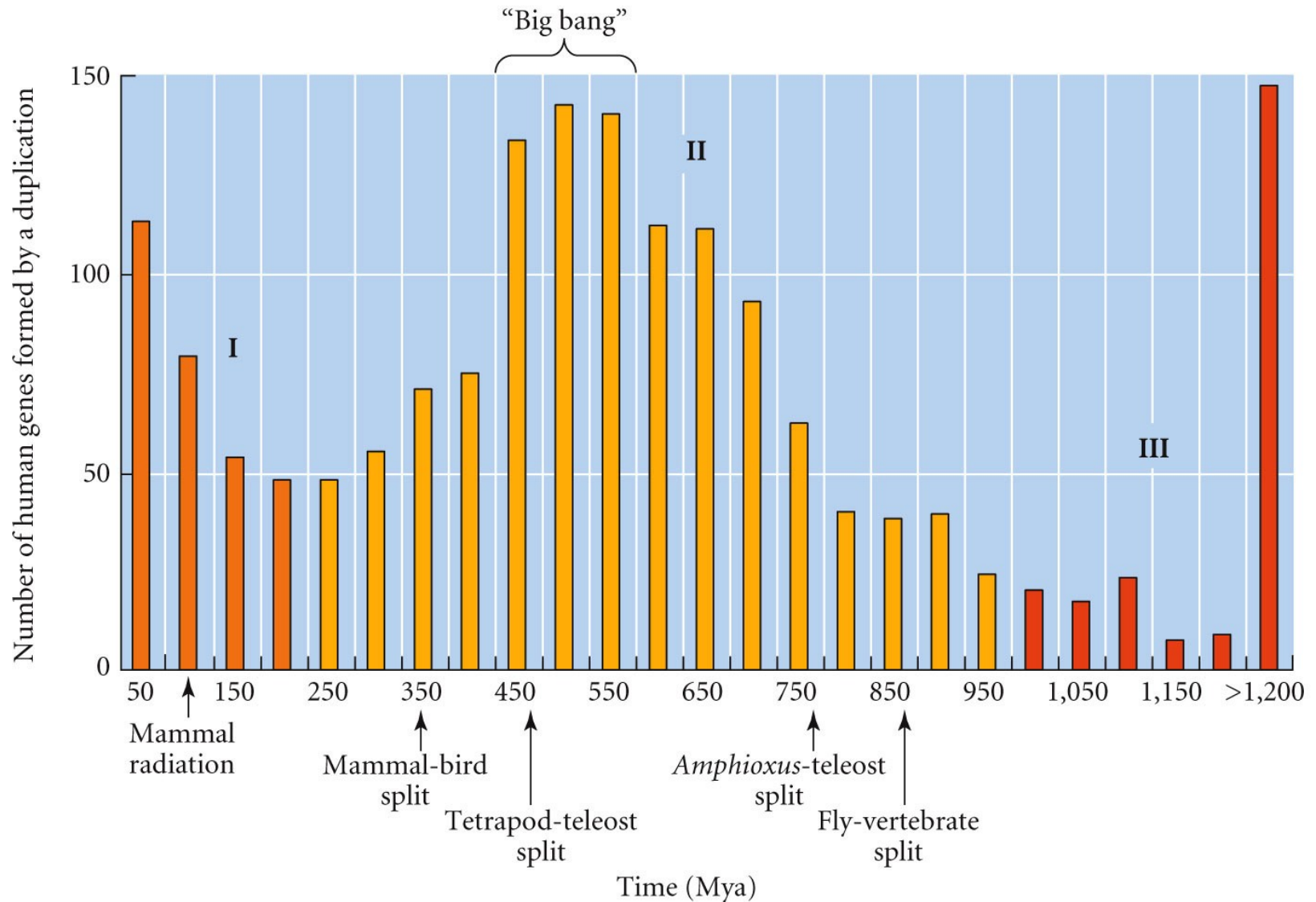
(b) Gene Tree



(c) Reconciliation



Phylogenetic timing of duplicates



b

Paramecium genome duplications

Vol 444 | 9 November 2006 | doi:10.1038/nature05230

nature

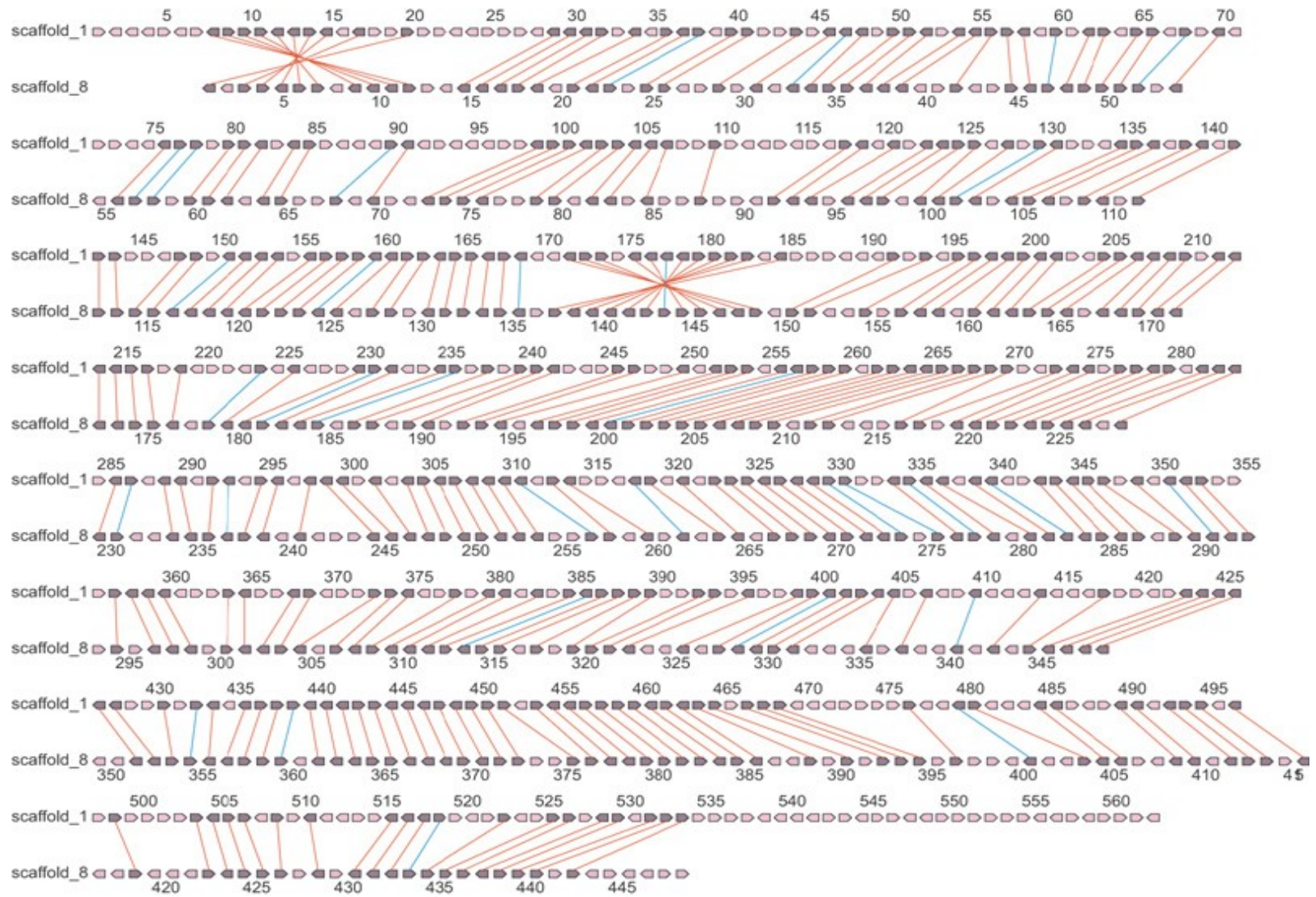
ARTICLES

Global trends of whole-genome duplications revealed by the ciliate *Paramecium tetraurelia*

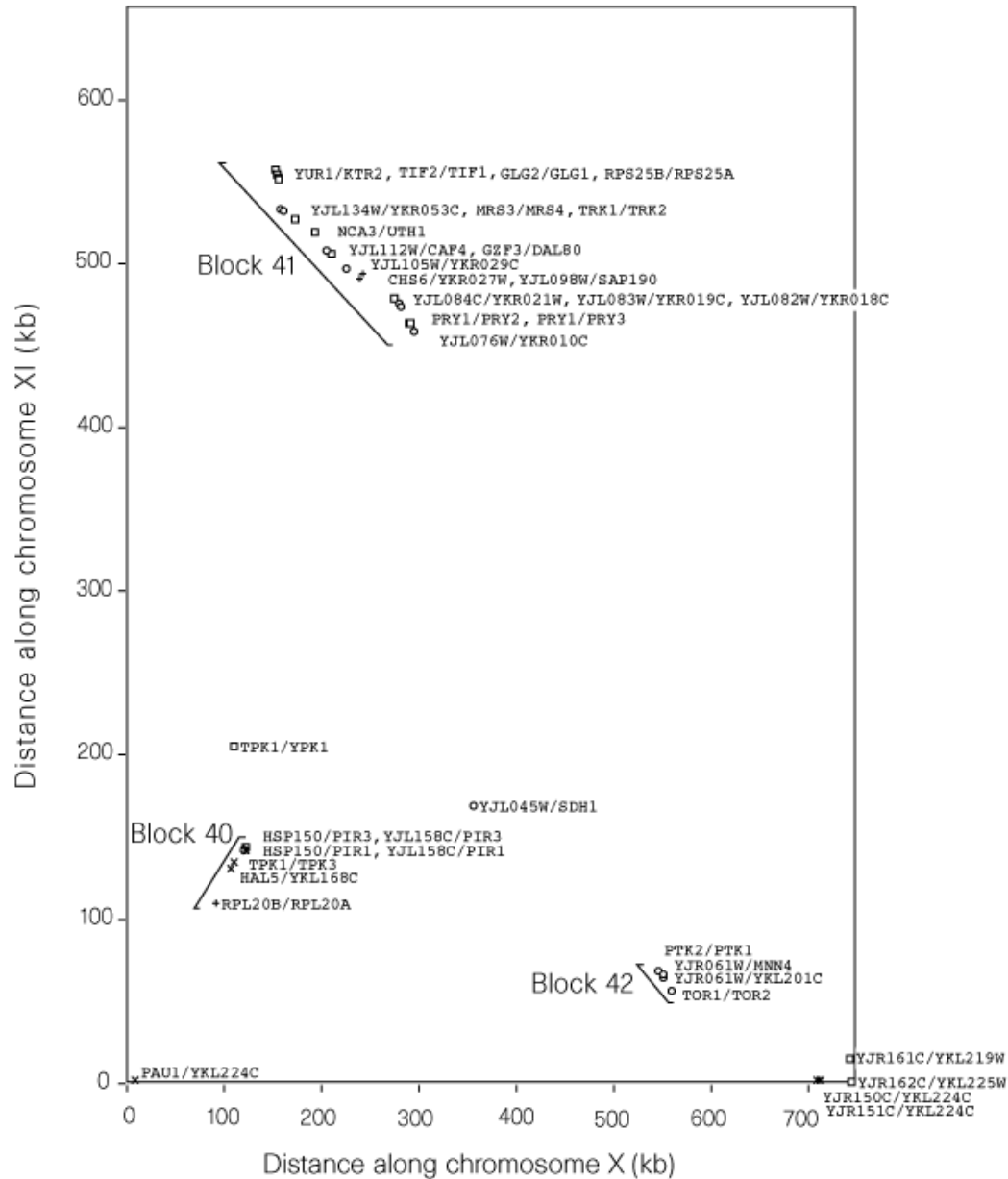
Jean-Marc Aury^{1*}, Olivier Jaillon^{1*}, Laurent Duret², Benjamin Noel¹, Claire Jubin¹, Betina M. Poindexter¹, Béatrice Ségurens¹, Vincent Daubin², Véronique Anthonard¹, Nathalie Aiach¹, Olivier Arnaiz³, Janine Beisson³, Isabelle Blanc³, Khaled Bouhouche⁴, Francisco Câmara⁵, Sandra Duhaucourt⁴, Delphine Gogendeau³, Michael Katinka¹, Anne-Marie Keller³, Roland Kissmehl⁶, Catherine Klotz¹, Anne Le Mouél⁴, Gersende Lepère⁴, Sophie Malinsky⁴, Mariusz Nowacki⁴, Jacek K. Nowak⁷, Heide Poulain¹, Françoise Ruiz³, Vincent Serrano⁴, Marek Zagulski⁷, Philippe Dessen⁸, Mireille B. de Souza¹, Jean Weissenbach¹, Claude Scarpelli¹, Vincent Schächter¹, Linda Sperling³, Eric Meyer⁴, Jean-Claude Drenth¹ & Patrick Wincker¹



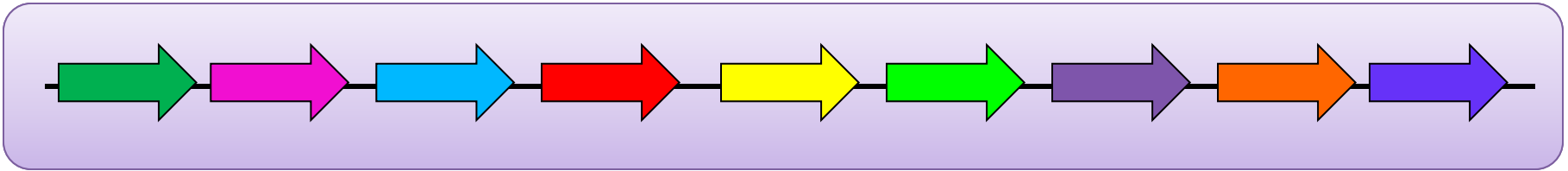
Comparison of two scaffolds originating from a common ancestor at the recent WGD



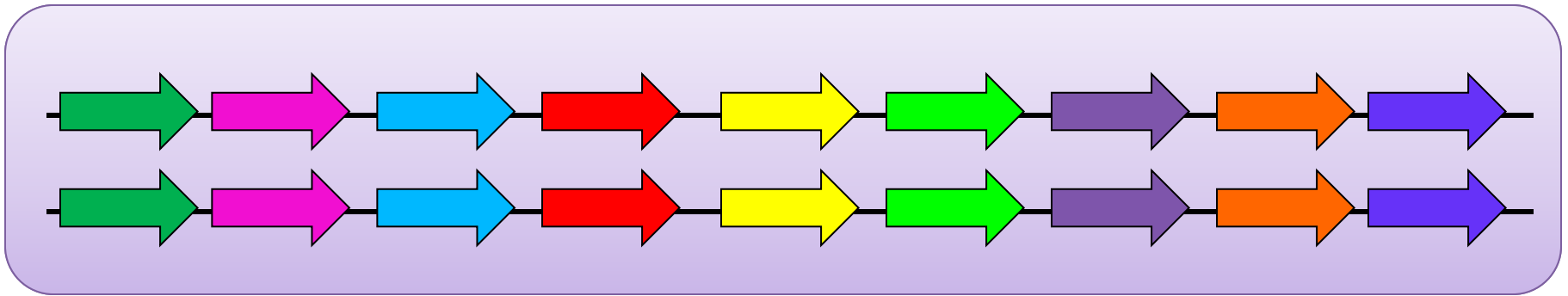
Saccharomyces cerevisiae



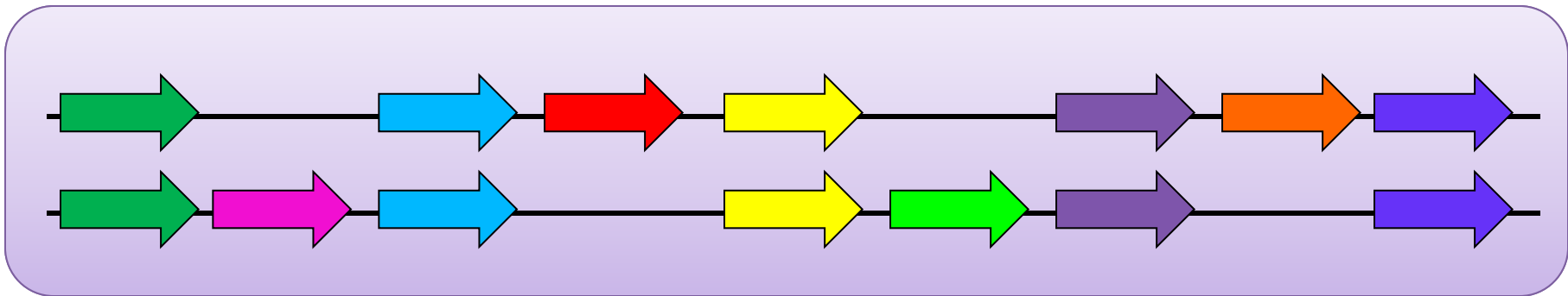
Just before genome duplication



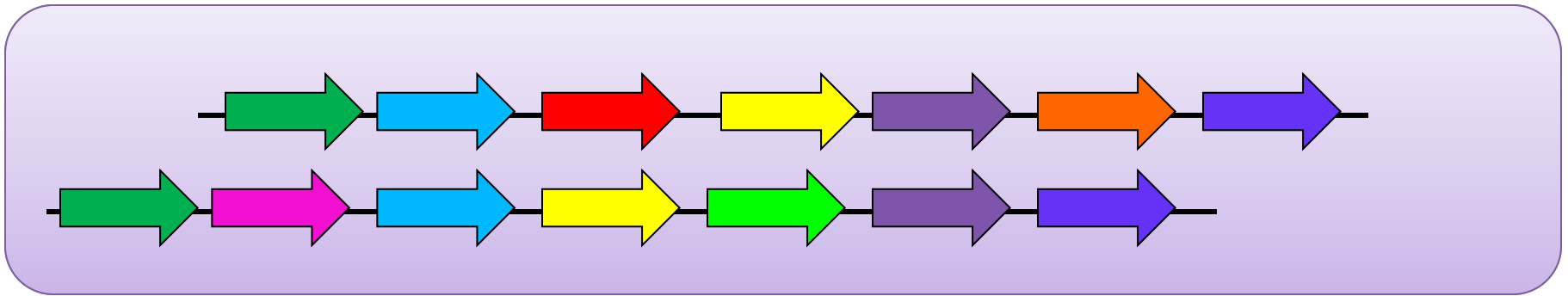
Just after genome duplication

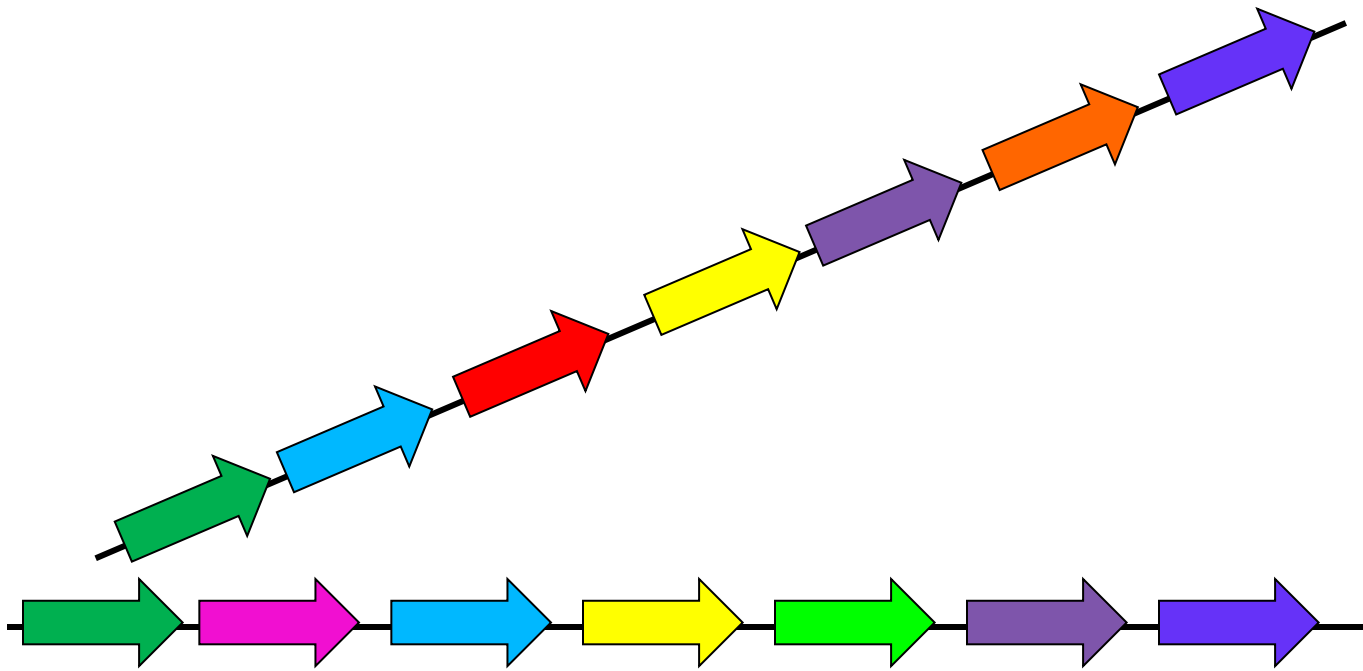


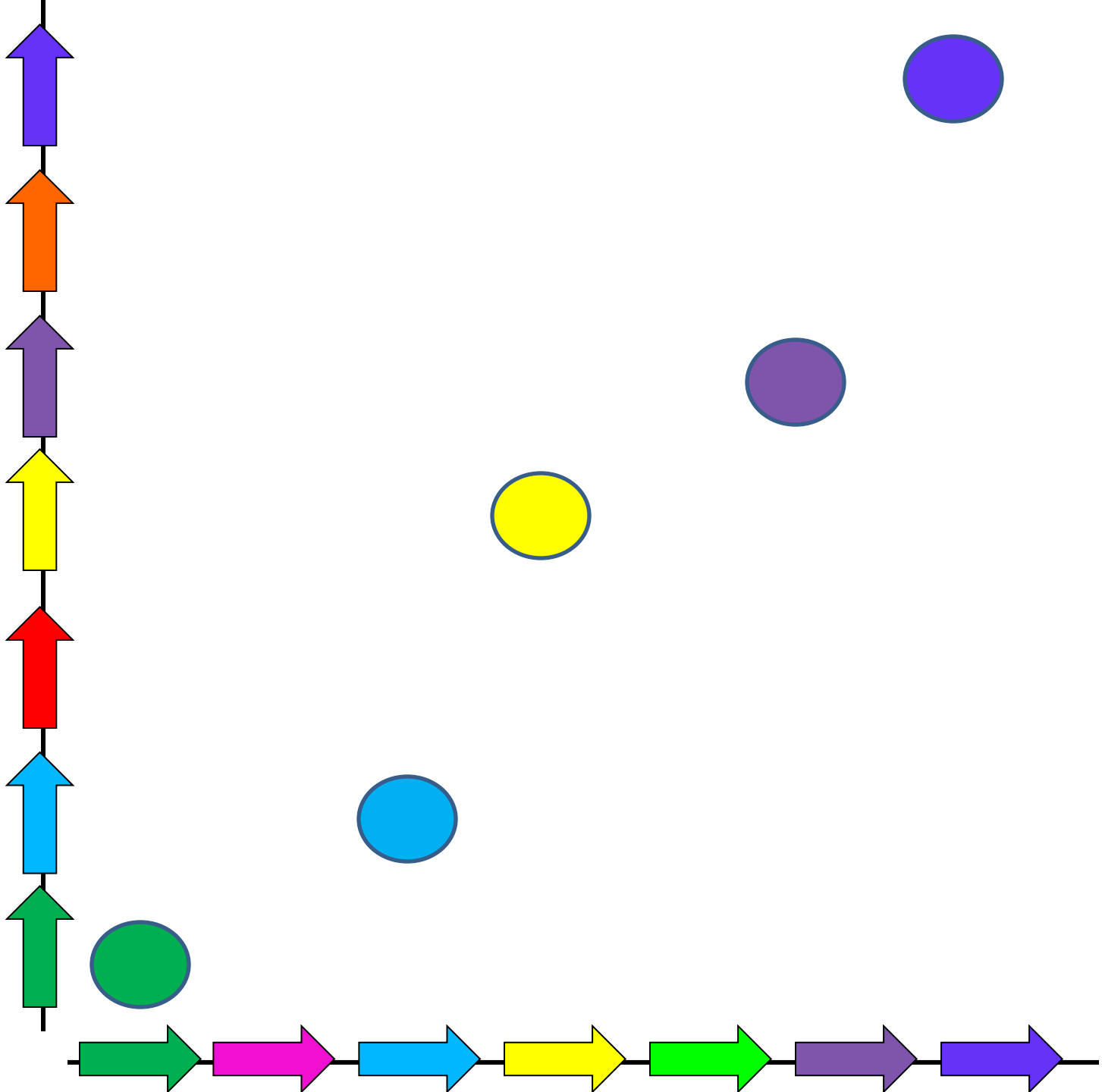
More time after genome duplication



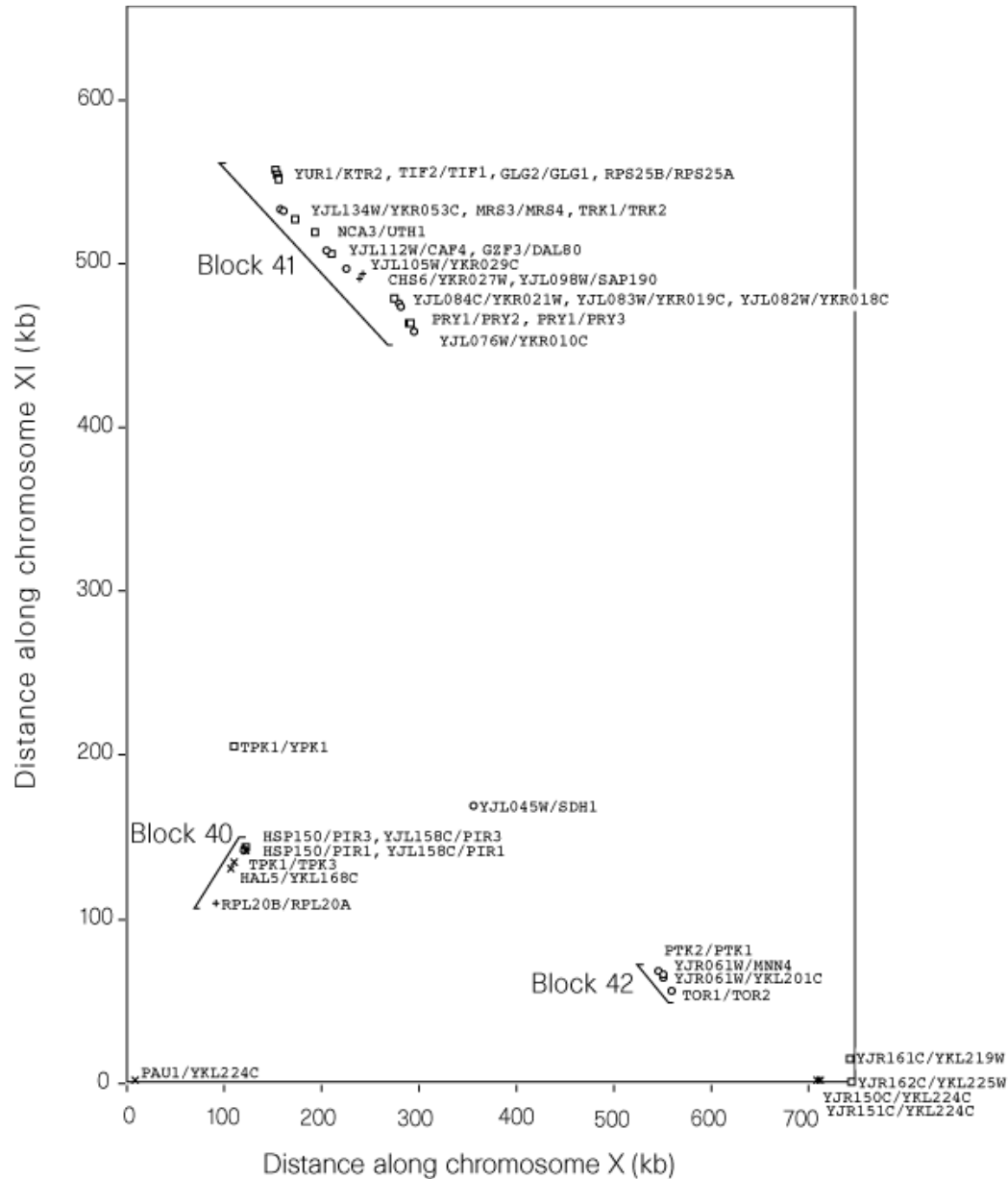
Unaligned view (removing gaps just like in cerev has occurred)



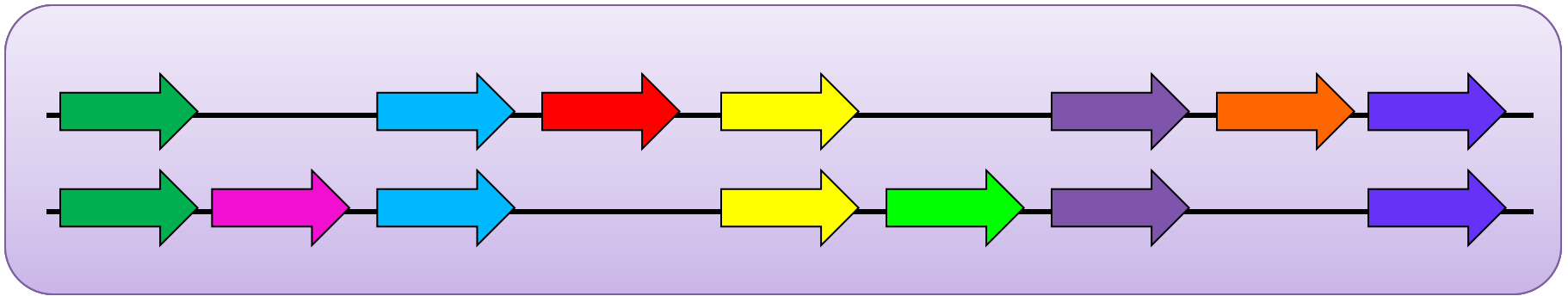




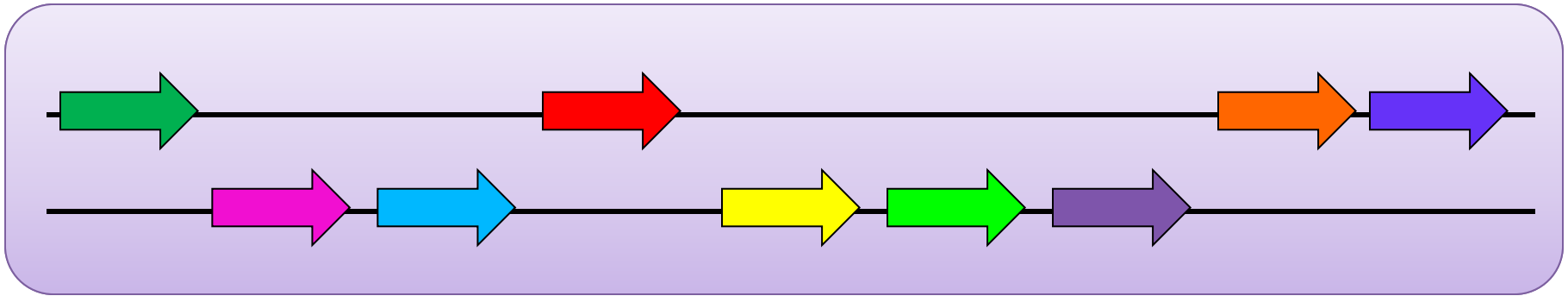
Saccharomyces cerevisiae



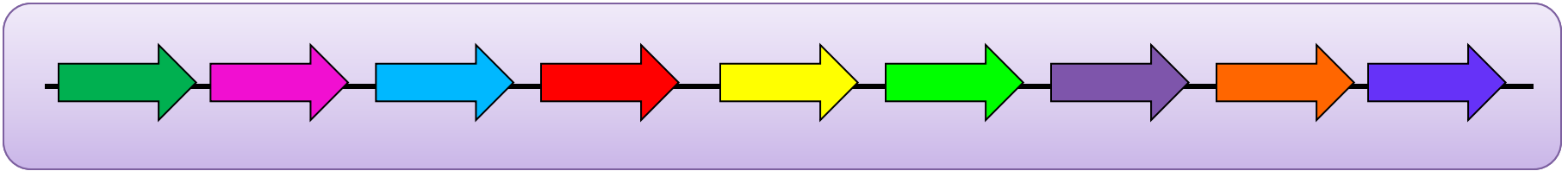
Problem reciprocal gene loss (extreme case); how to solve?



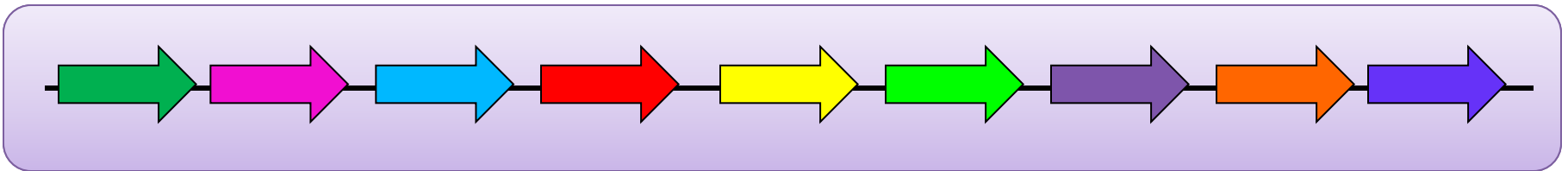
Problem reciprocal gene loss (extreme case); how to solve?



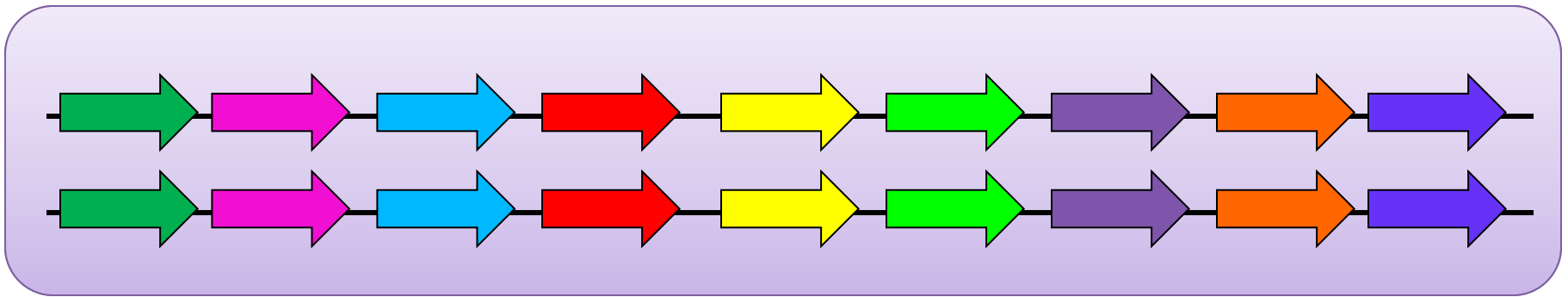
Just before genome duplication



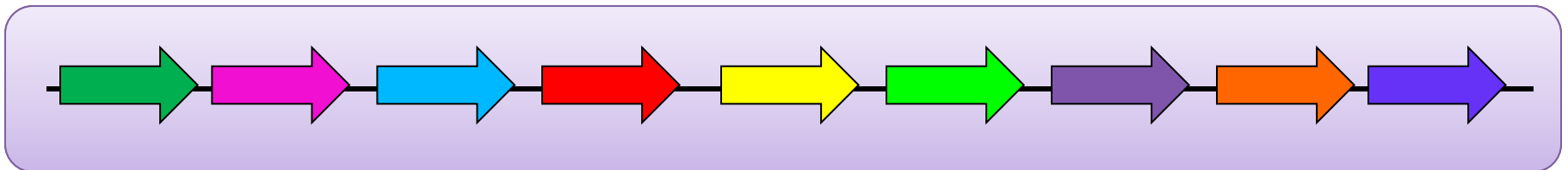
Outgroup!



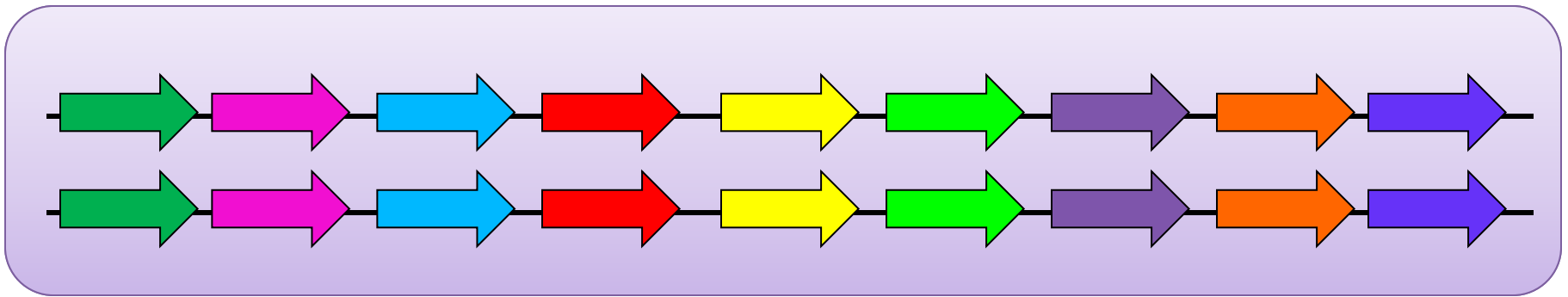
Just after genome duplication



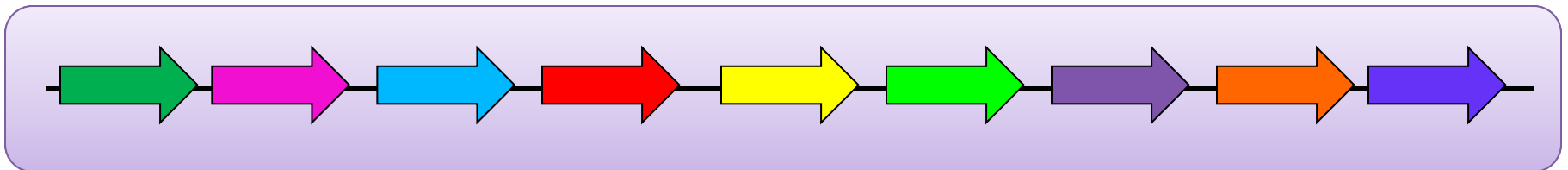
Outgroup



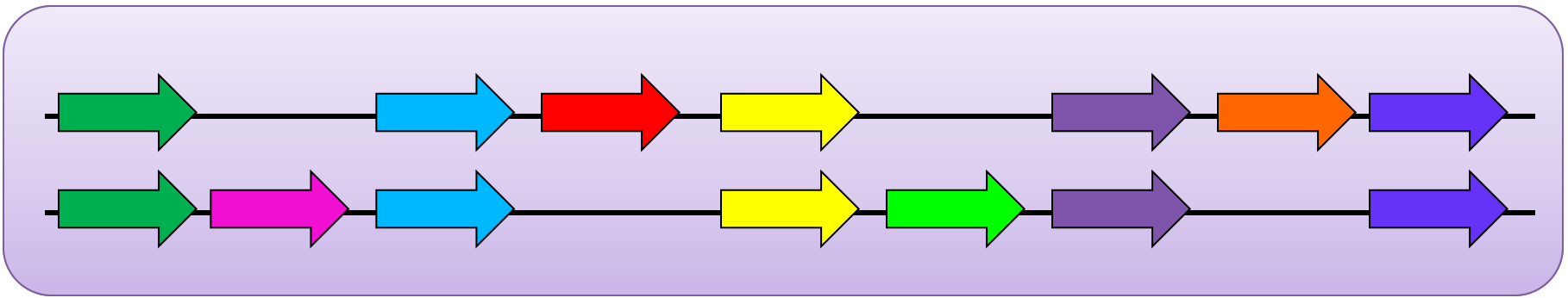
Just after genome duplication



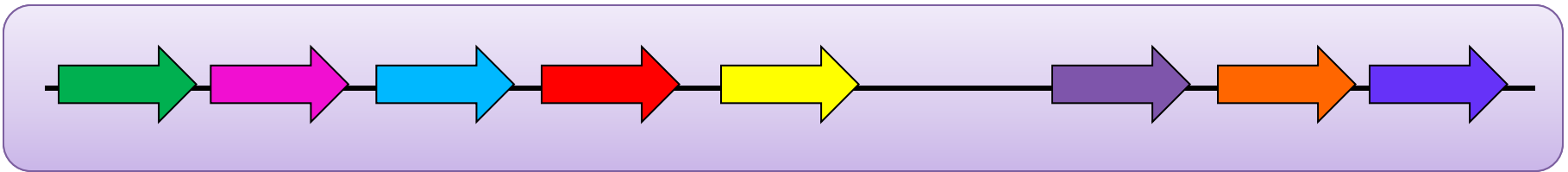
Outgroup



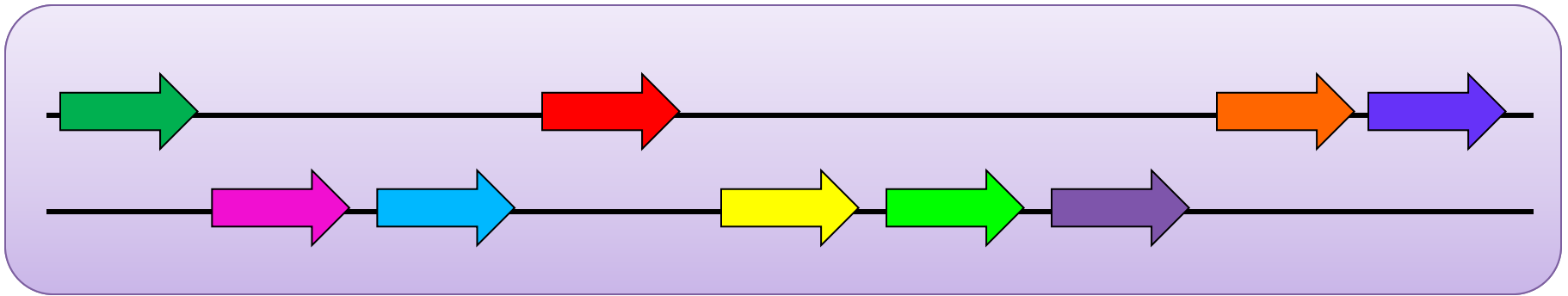
More time after genome duplication



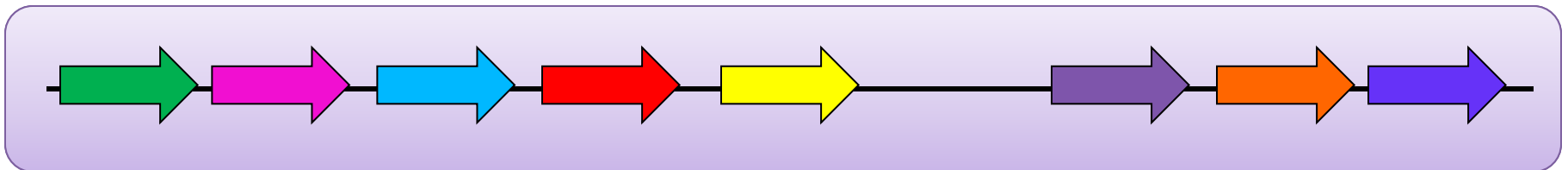
Outgroup

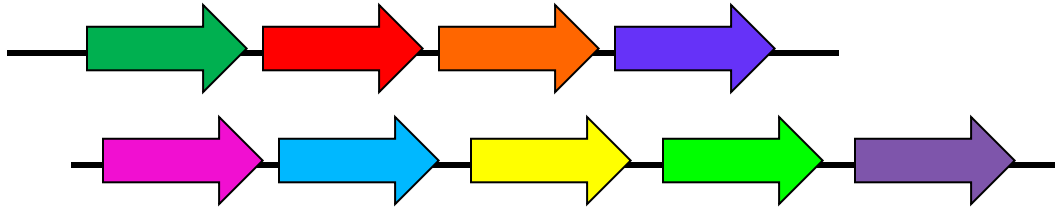


Problem (extreme case); how to solve?

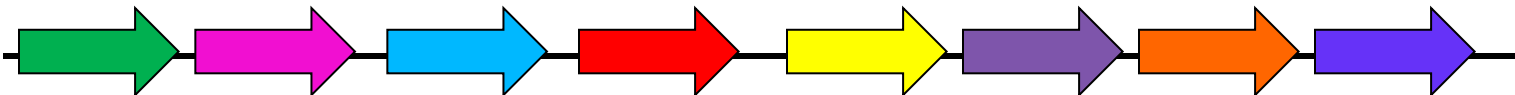


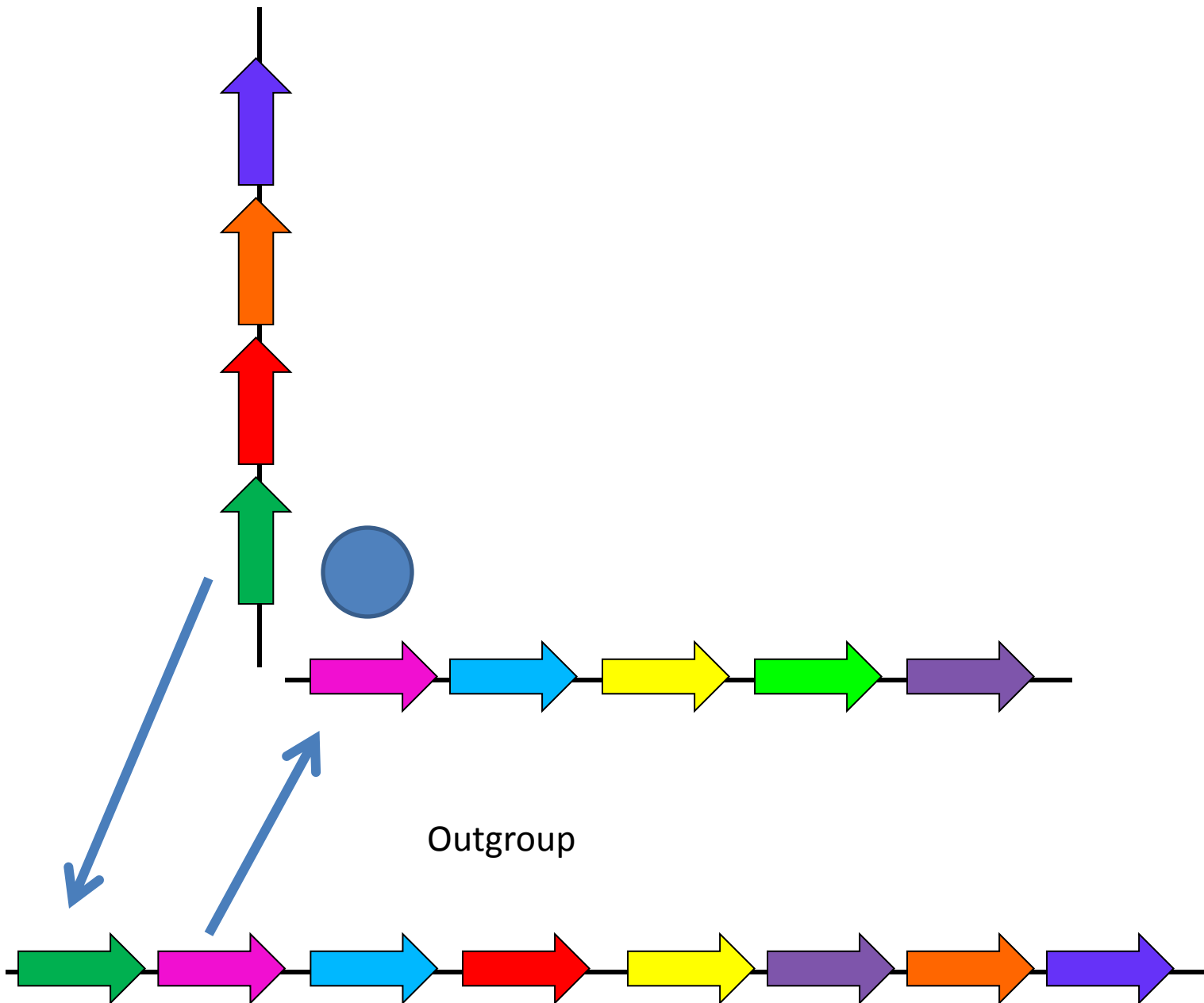
Outgroup

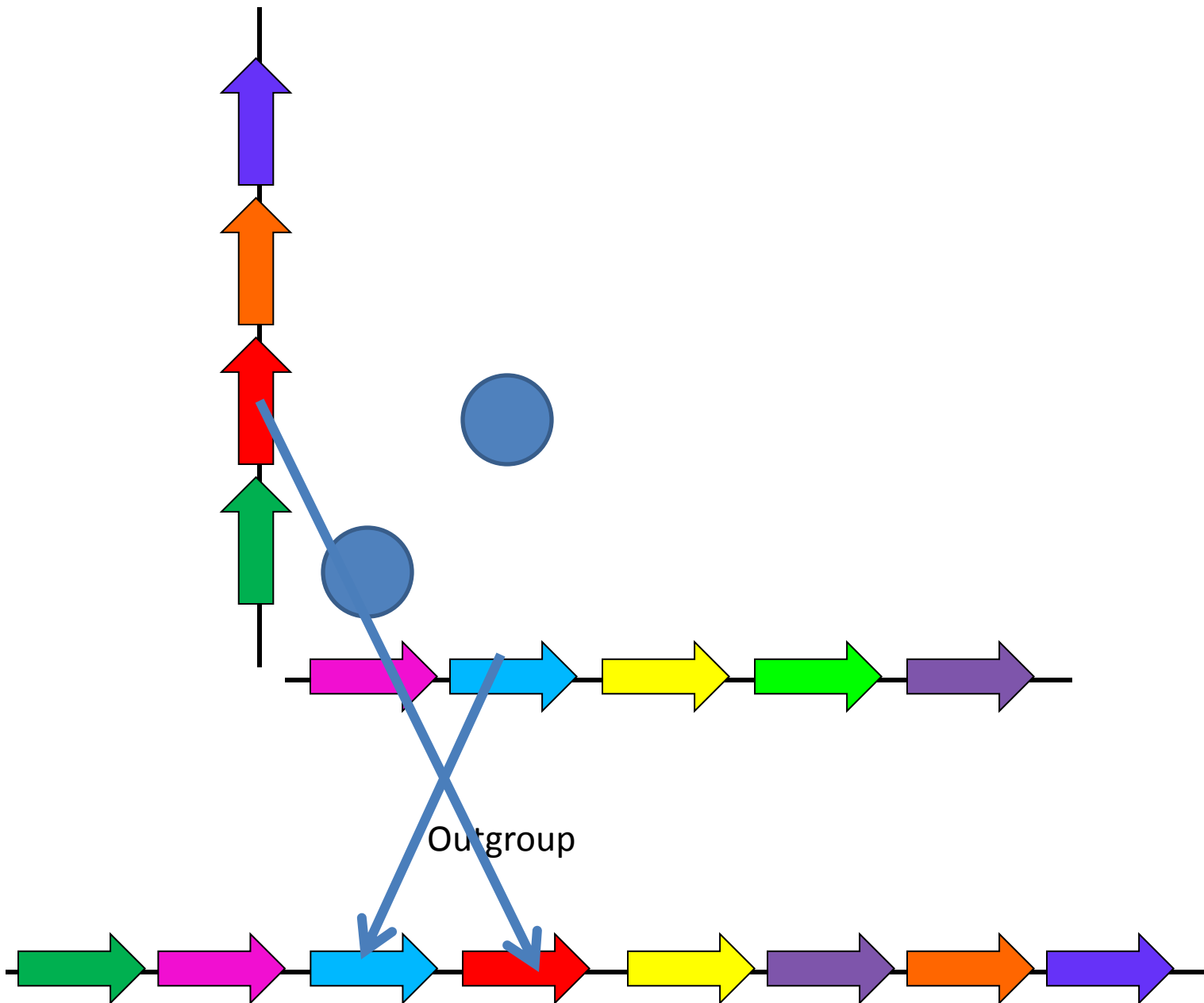


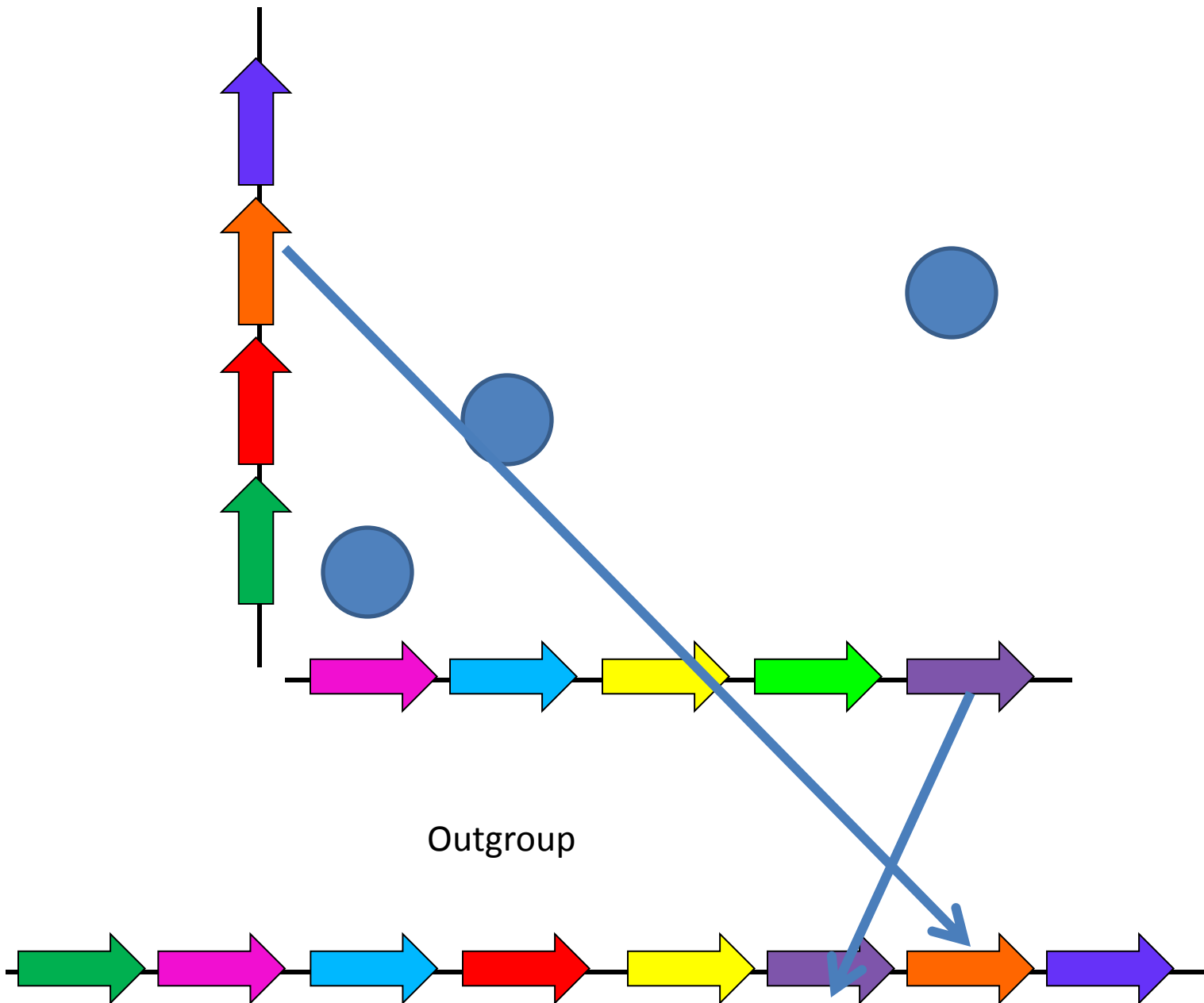


Outgroup



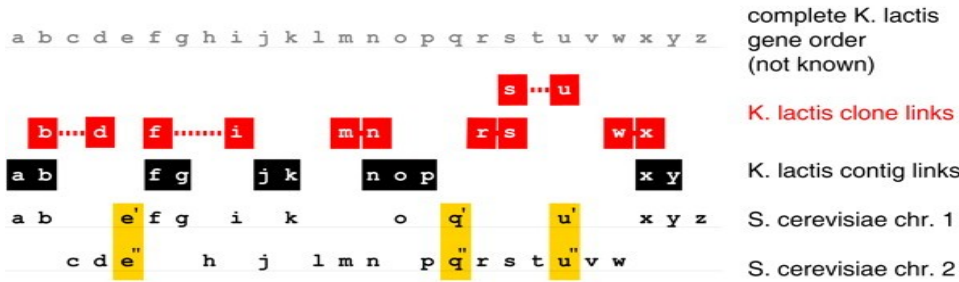




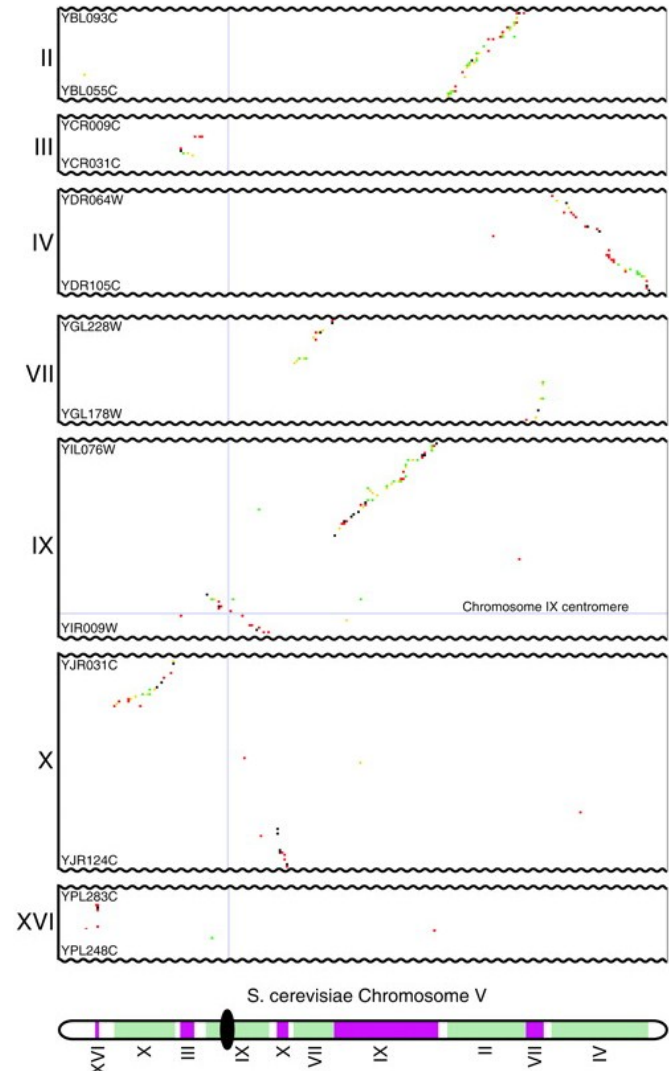
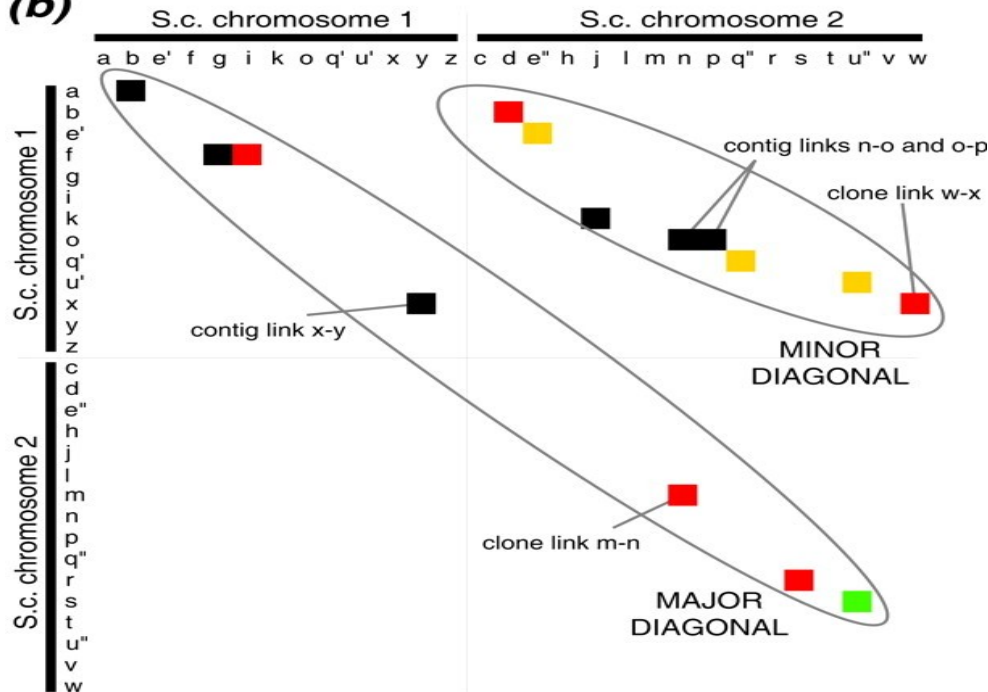


Using other genomes

(a)

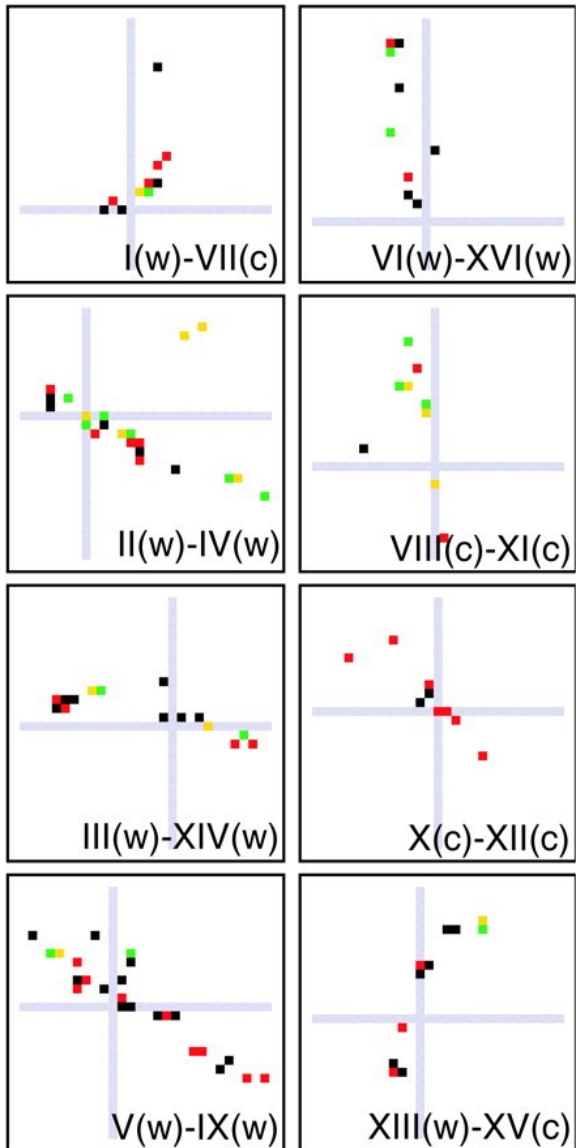


(b)



Centromeres

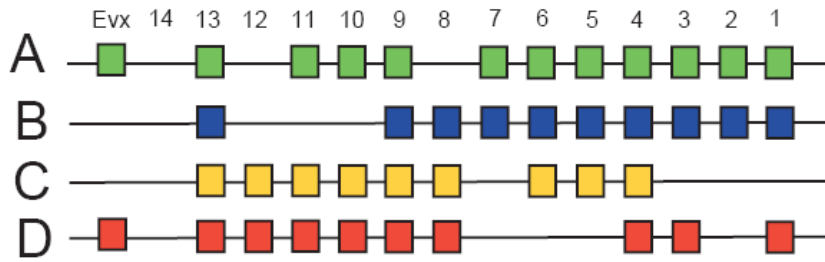
(a)



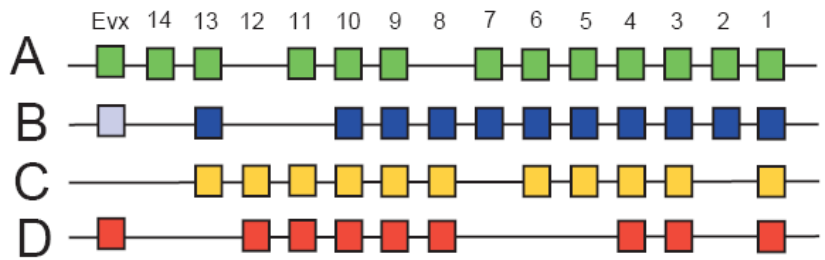
(b)

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI
I							3									
II				4	1											
III														4		
IV		9					1			1						
V		1	1				1		10							
VI										1						3
VII	7	2		1	1											
VIII											1					
IX					16											
X				1		1						2				
XI								2				1				
XII				1						9	1		1			
XIII												1				
XIV			6											1		6
XV														9		
XVI						4			1							

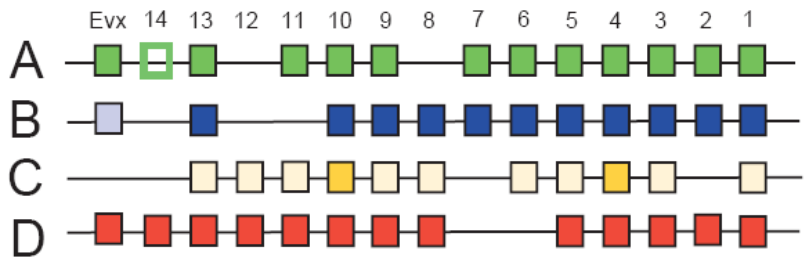
Vertebrate genome duplication



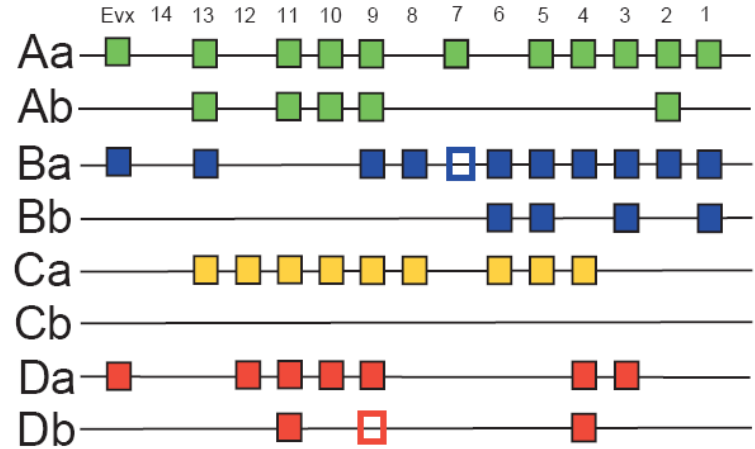
Human



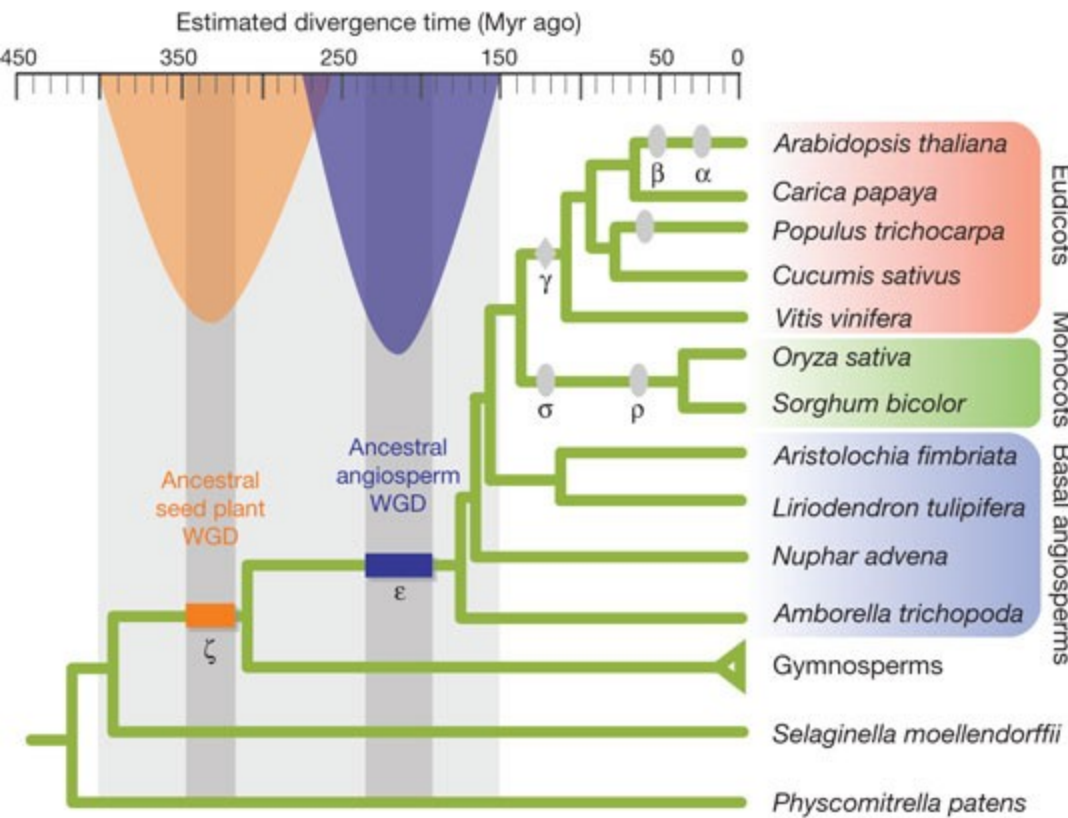
Coelacanth



Shark



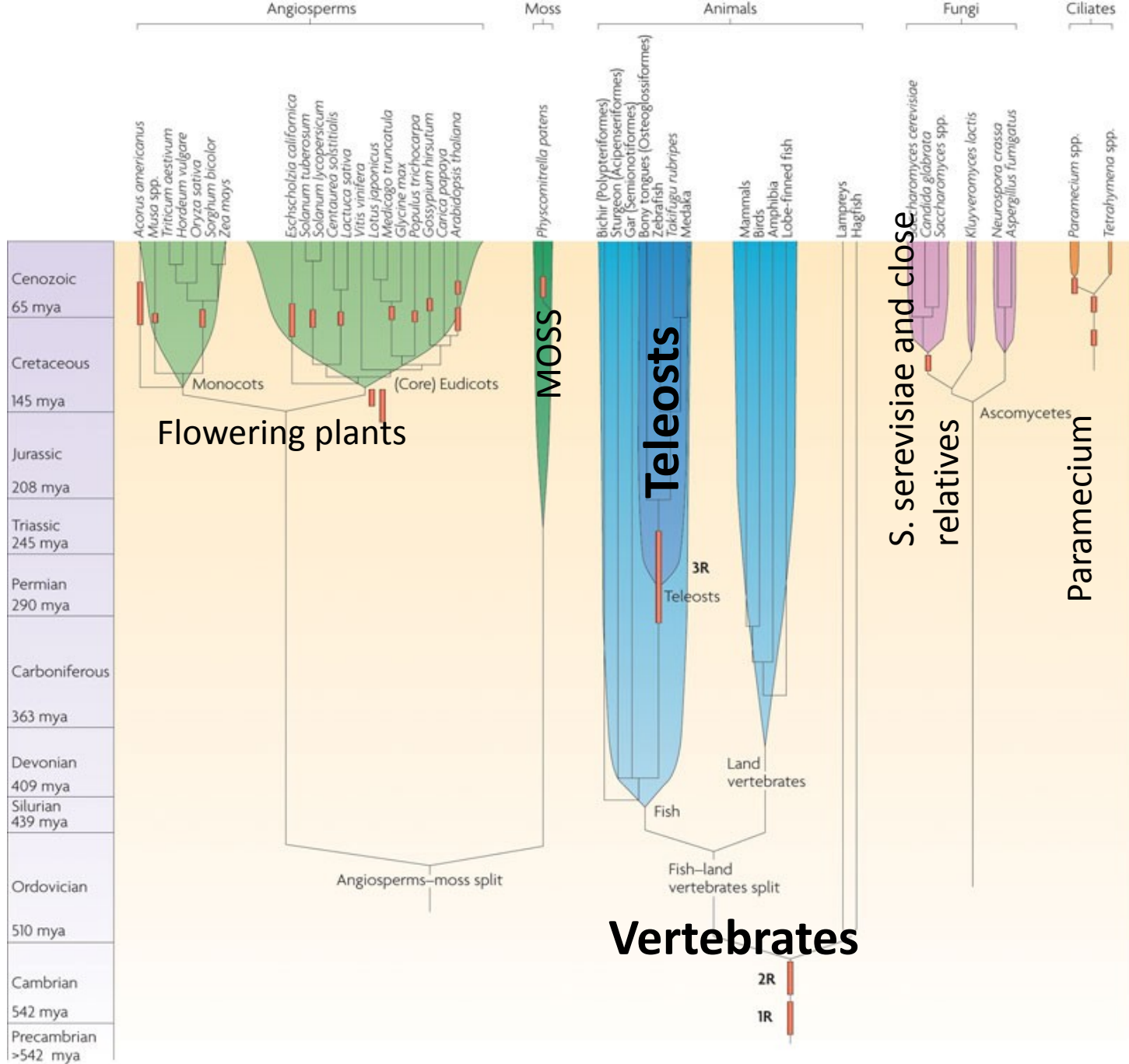
Spotted green pufferfish



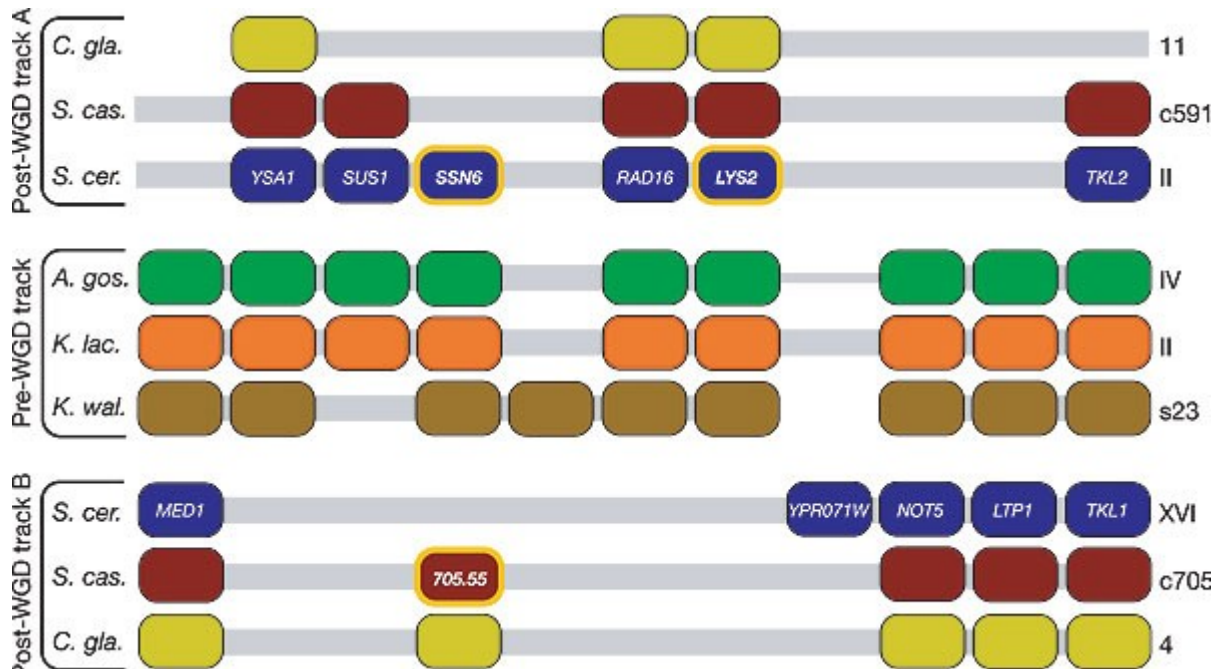
Nature. 2011 Apr 10. [Epub ahead of print]

Ancestral polyploidy in seed plants and angiosperms.

[Jiao Y](#), [Wickett NJ](#), [Ayyampalayam S](#), [Chanderbali AS](#), [Landherr L](#), [Ralph PE](#), [Tomsho LP](#), [Hu Y](#), [Liang H](#), [Soltis PS](#), [Soltis DE](#), [Clifton SW](#), [Schlarbaum SE](#), [Schuster SC](#), [Ma H](#), [Leebens-Mack J](#), [Depamphilis CW](#).



Reconstructed map of genome duplications allows unprecedented mapping of evolutionary history of genes in genomes



Vol 440|16 March 2006|doi:10.1038/nature04562

nature

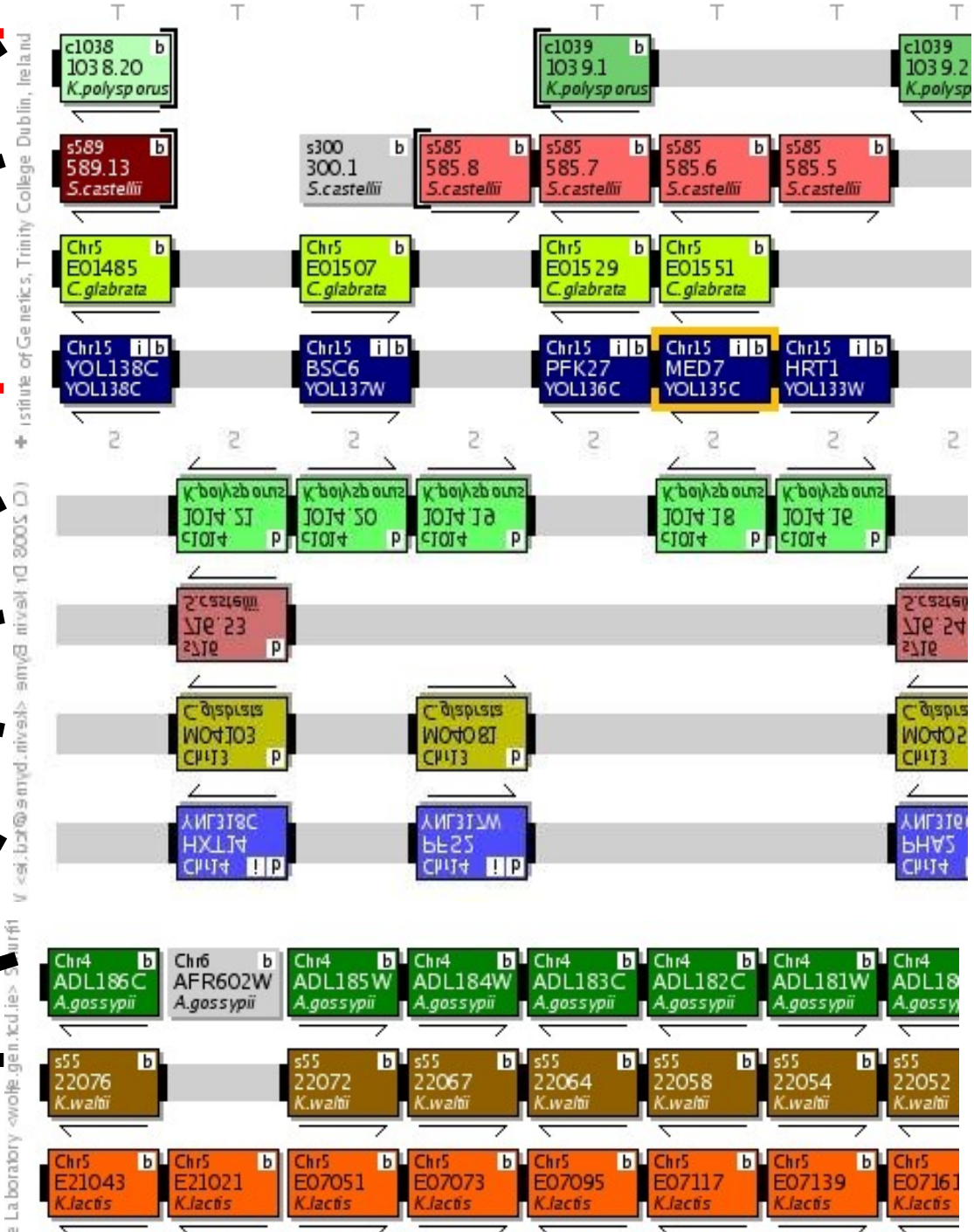
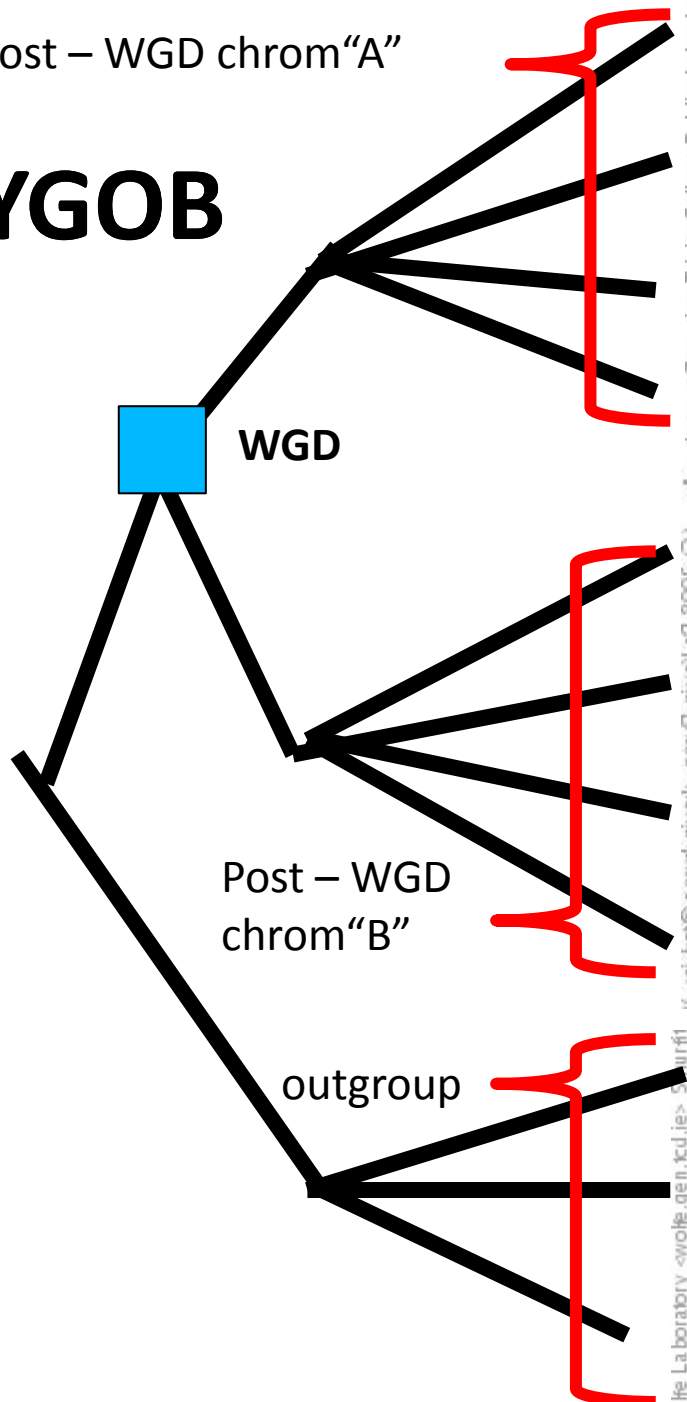
LETTERS

Multiple rounds of speciation associated with reciprocal gene loss in polyploid yeasts

Devin R. Scannell^{1*}, Kevin P. Byrne^{1*}, Jonathan L. Gordon¹, Simon Wong¹ & Kenneth H. Wolfe¹

Post – WGD chrom “A”

YGOB



Institute of Genetics, Trinity College Dublin, Ireland
 © 2008 Dr. Kevin Byrne <kevin.byrne@tcd.ie>
 The Laboratory <woltf.gen.tcd.ie>

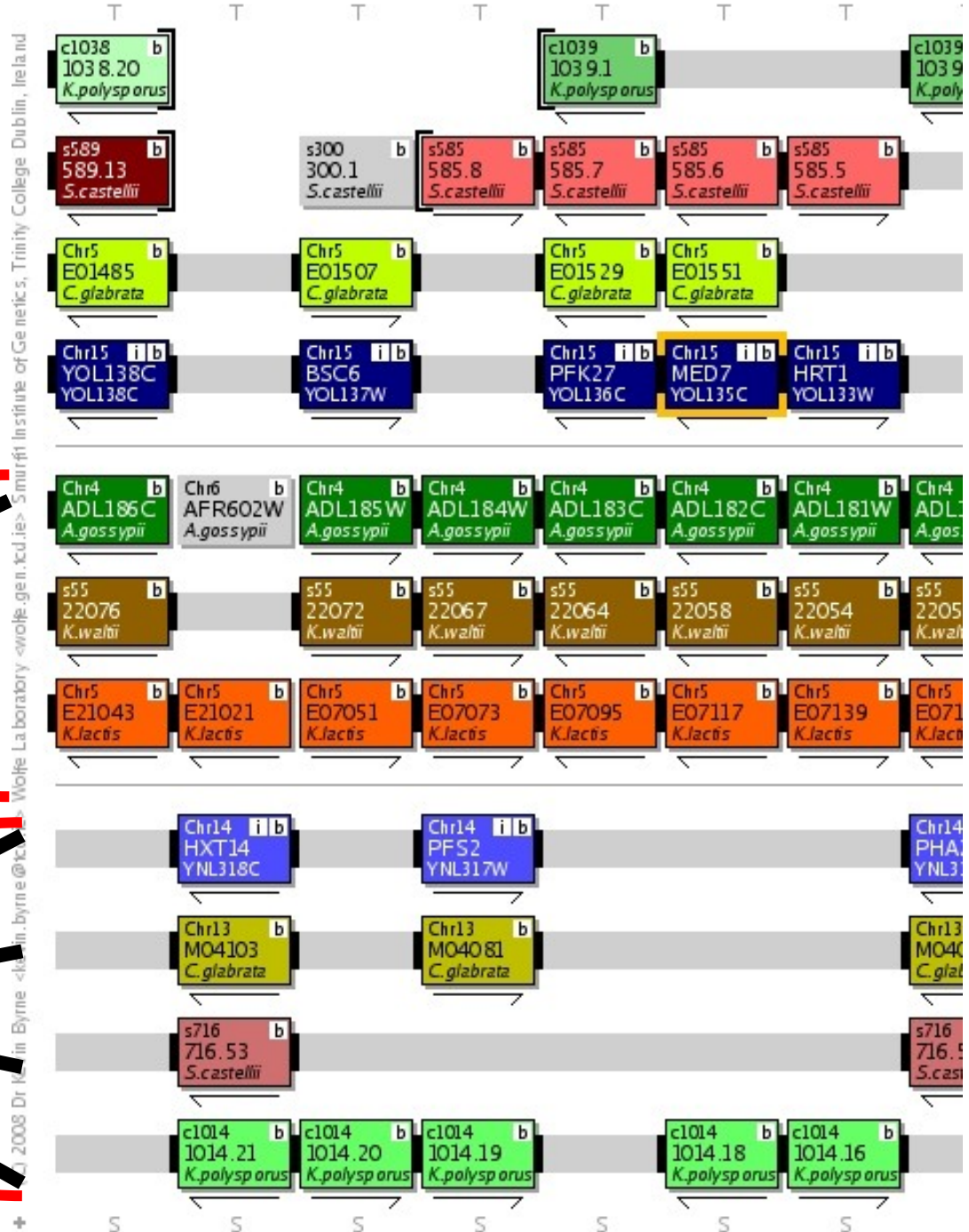
Post – WGD chrom“A”

YGOB

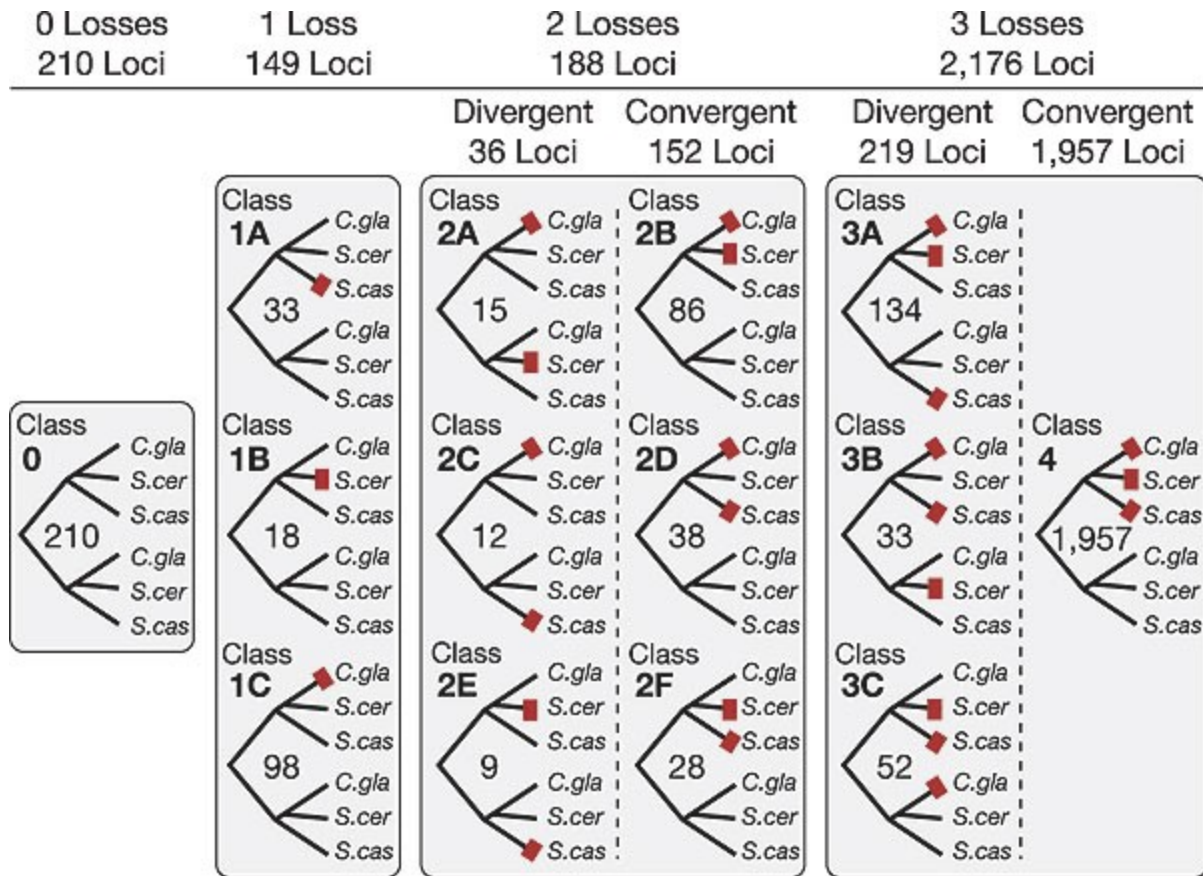
WGD

outgroup

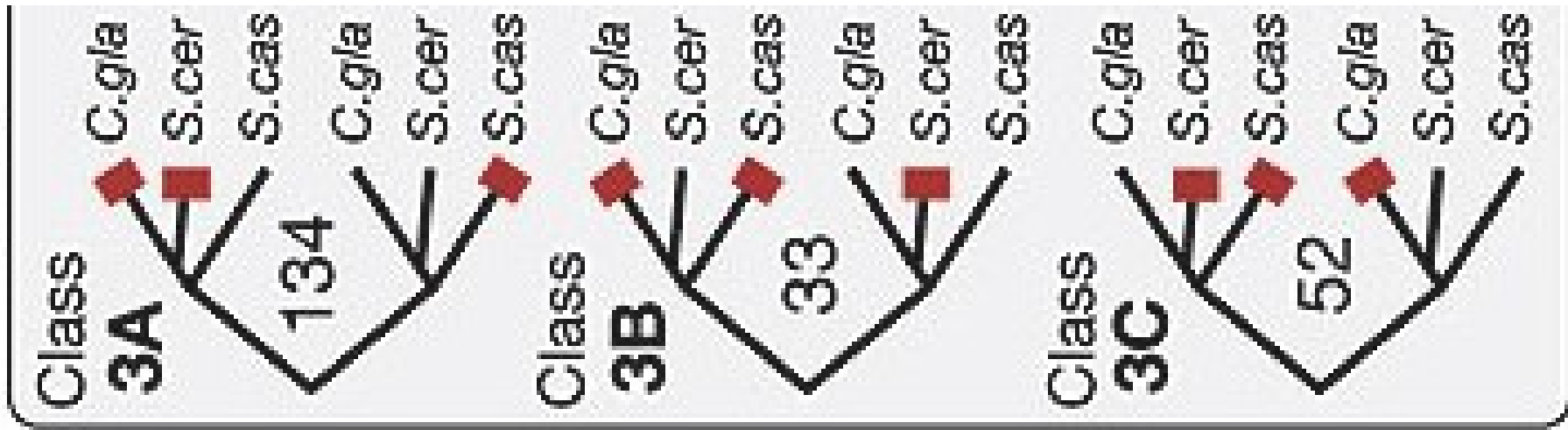
Post – WGD
chrom“B”



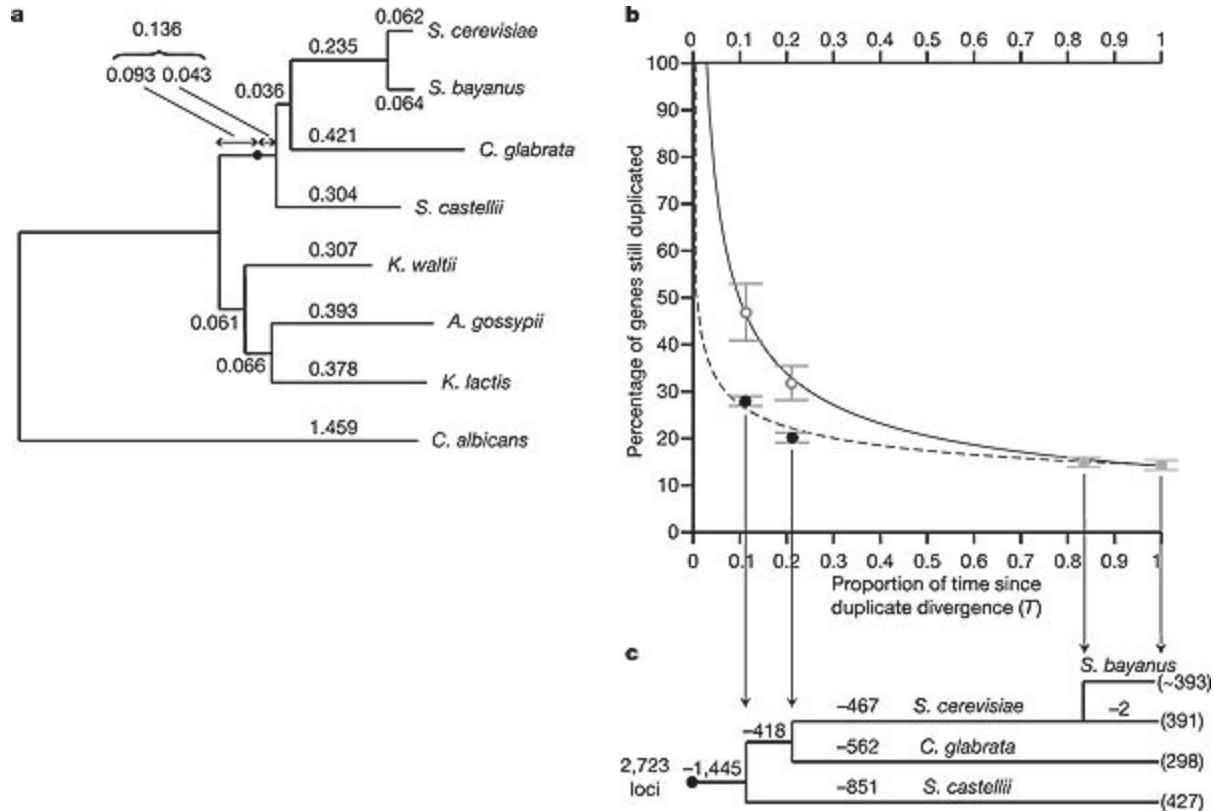
Reconstructed map of genome duplications allows unprecedented mapping of evolutionary history of genes in genomes



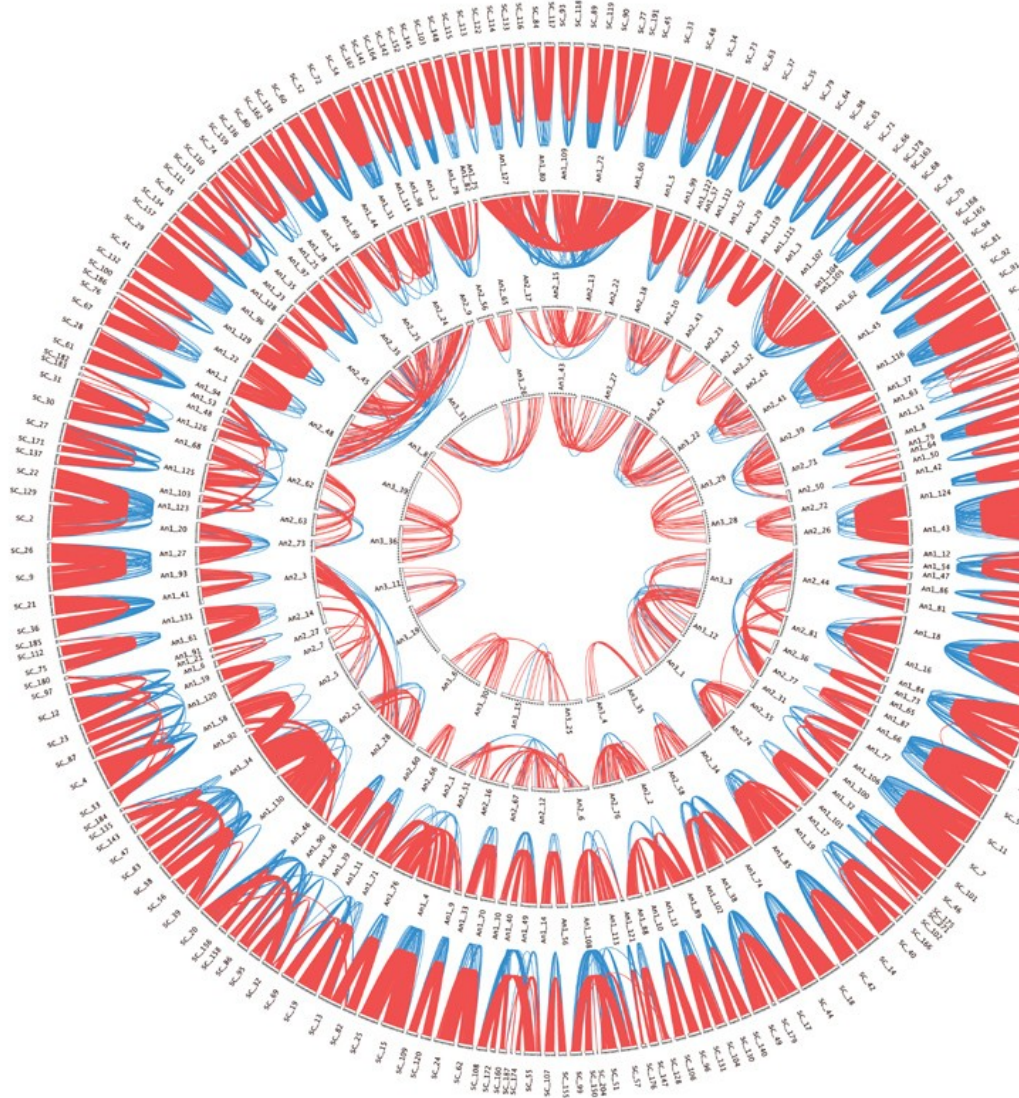
Reconstructed map of genome duplications allows unprecedented mapping of evolutionary history of genes in genomes



Major fate is gene loss



In paramecium 3 or 4 genome duplications!



Vol 444 | 9 November 2006 | doi:10.1038/nature05230

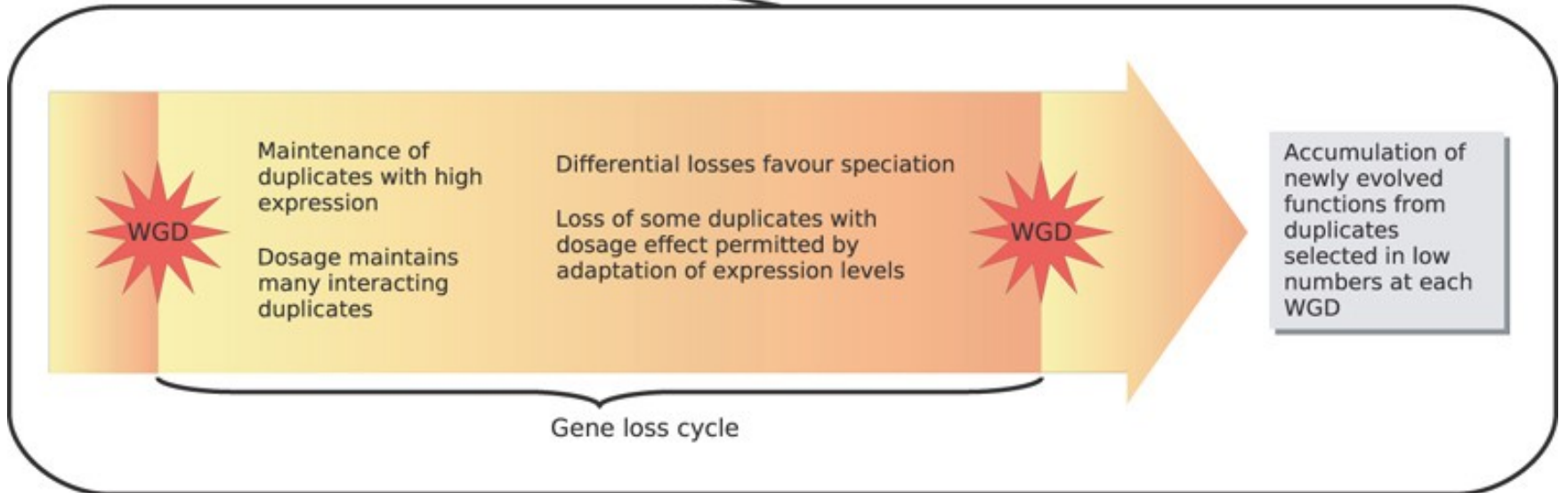
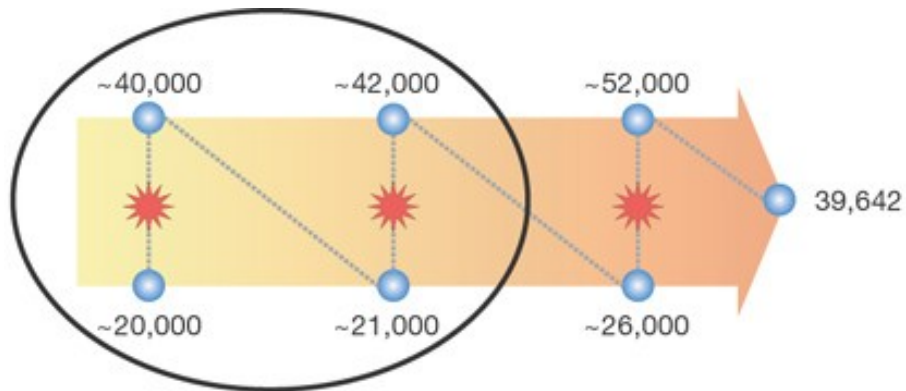
nature

ARTICLES

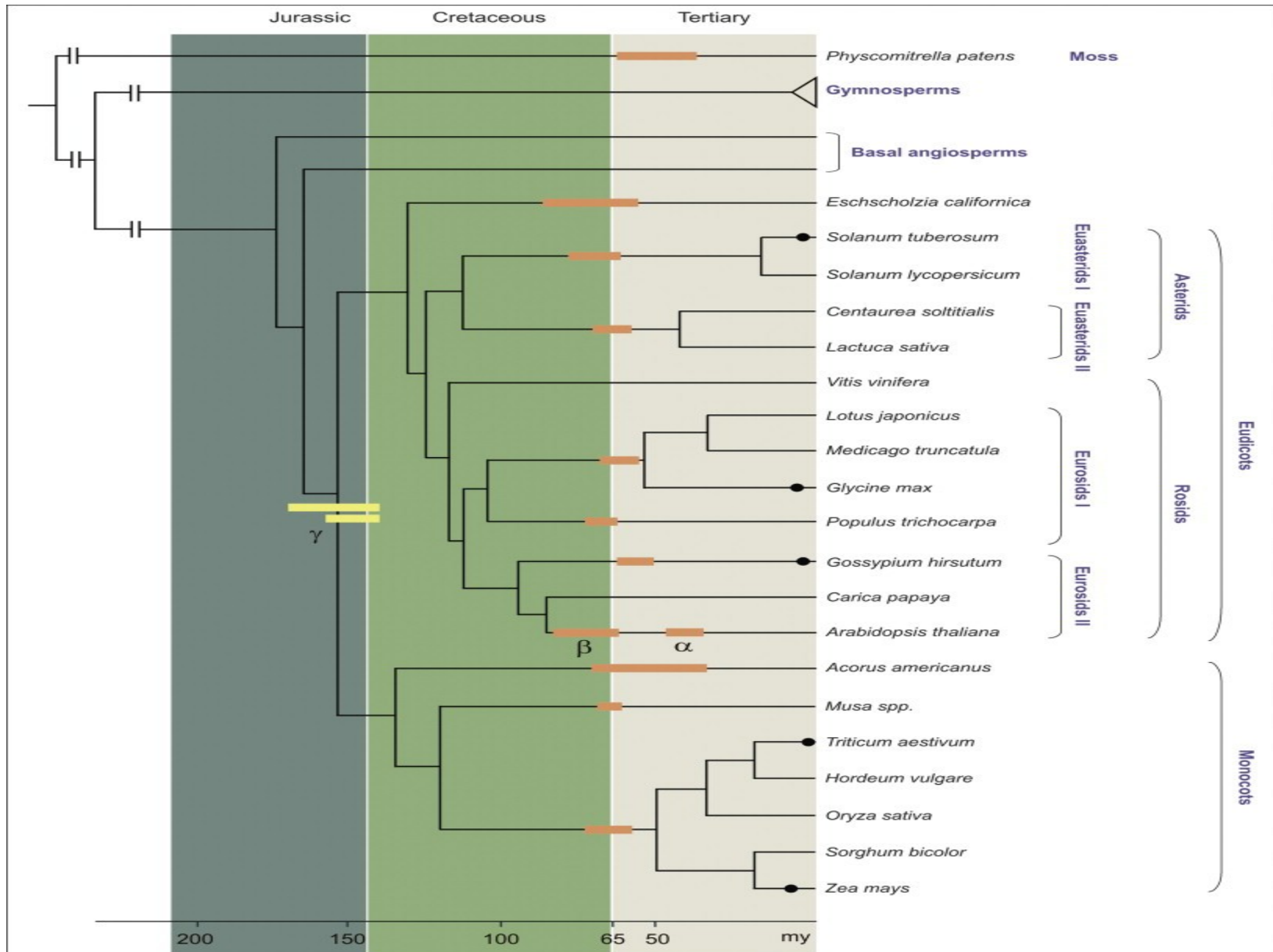
Global trends of whole-genome duplications revealed by the ciliate *Paramecium tetraurelia*

Jean-Marc Aury^{1*}, Olivier Jaillon^{1*}, Laurent Duret², Benjamin Noel¹, Claire Jubin¹, Betina M. Porcel¹, Béatrice Ségurens¹, Vincent Daubin², Véronique Anthonard¹, Nathalie Aiach¹, Olivier Arnaiz³, Alain Billaut¹, Janine Beisson³, Isabelle Blanc³, Khaled Bouhouche⁴, Francisco Câmara⁵, Sandra Duhaucourt⁴, Roderic Guigo⁵, Delphine Gogendeau³, Michael Katinka¹, Anne-Marie Keller³, Roland Kissmehl⁶, Catherine Klotz³, France Koll³, Anne Le Mouél⁴, Gersende Lepère⁴, Sophie Malinsky⁴, Mariusz Nowacki⁴, Jacek K. Nowak⁷, Helmut Plattner⁶, Julie Poulain¹, Françoise Ruiz³, Vincent Serrano⁴, Marek Zagulski⁷, Philippe Dessen⁸, Mireille Bétermier^{3,4}, Jean Weissenbach¹, Claude Scarpelli¹, Vincent Schächter¹, Linda Sperling³, Eric Meyer⁴, Jean Cohen³ & Patrick Wincker¹

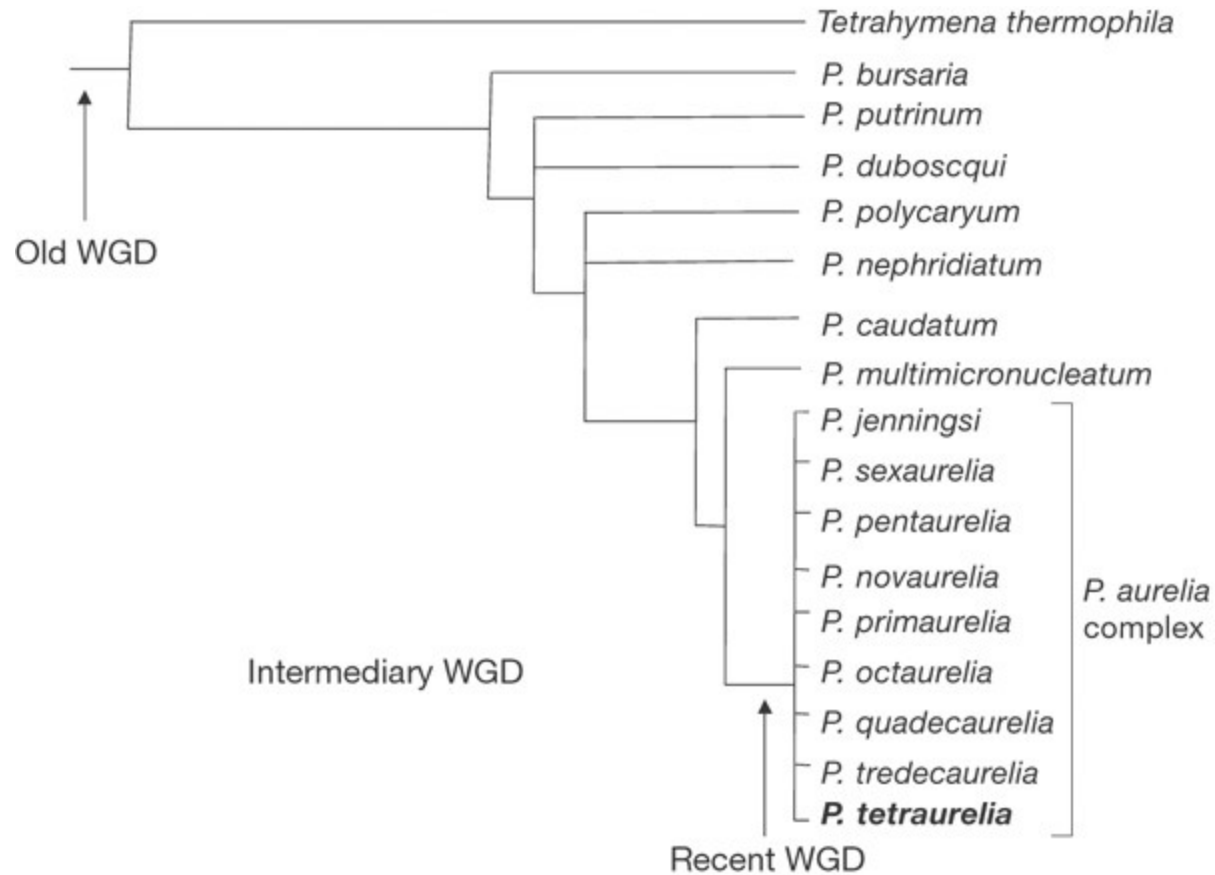
Massive gene loss



Correlation to (adaptive) radiation?

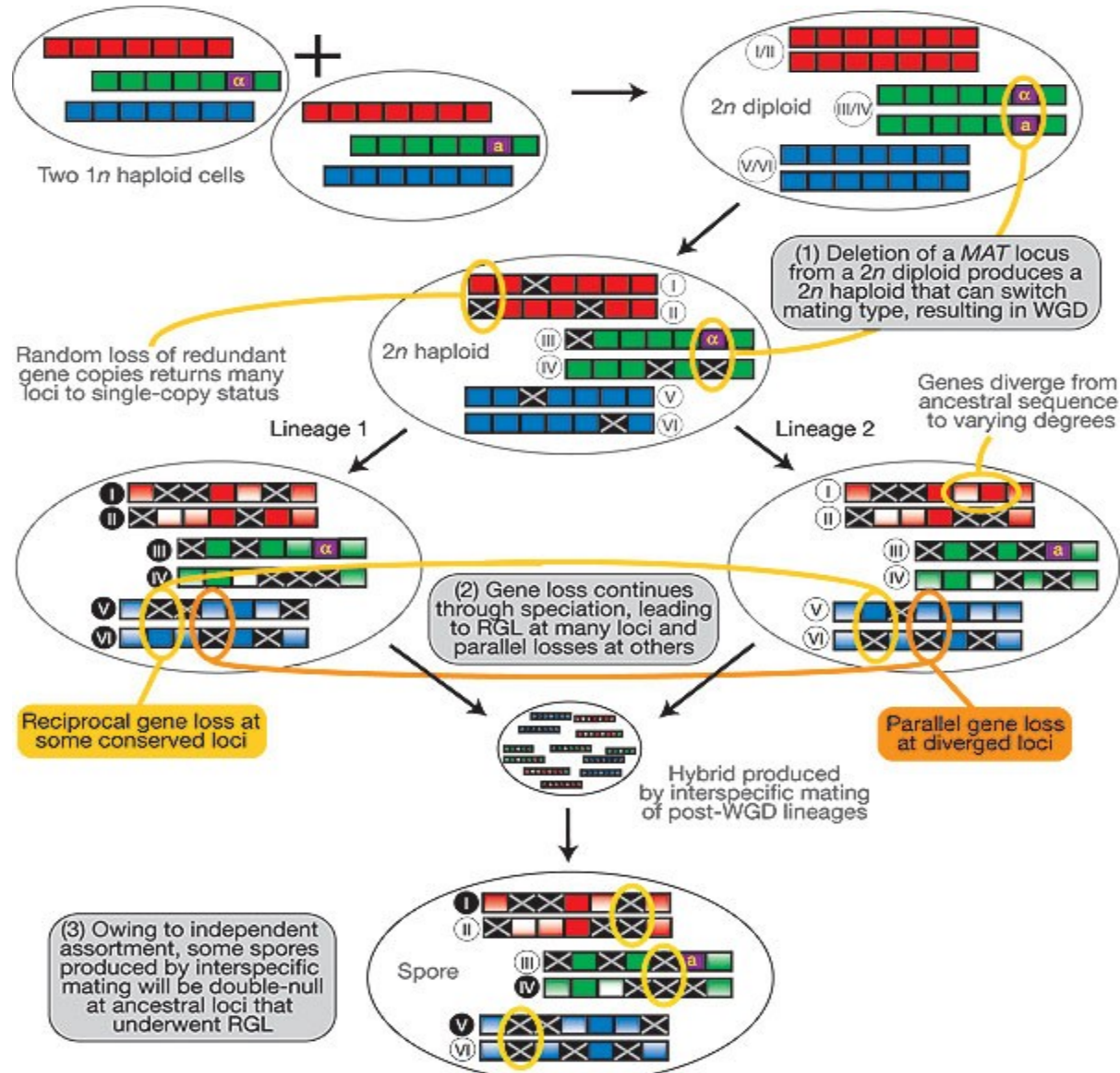


Correlation to (adaptive) radiation?



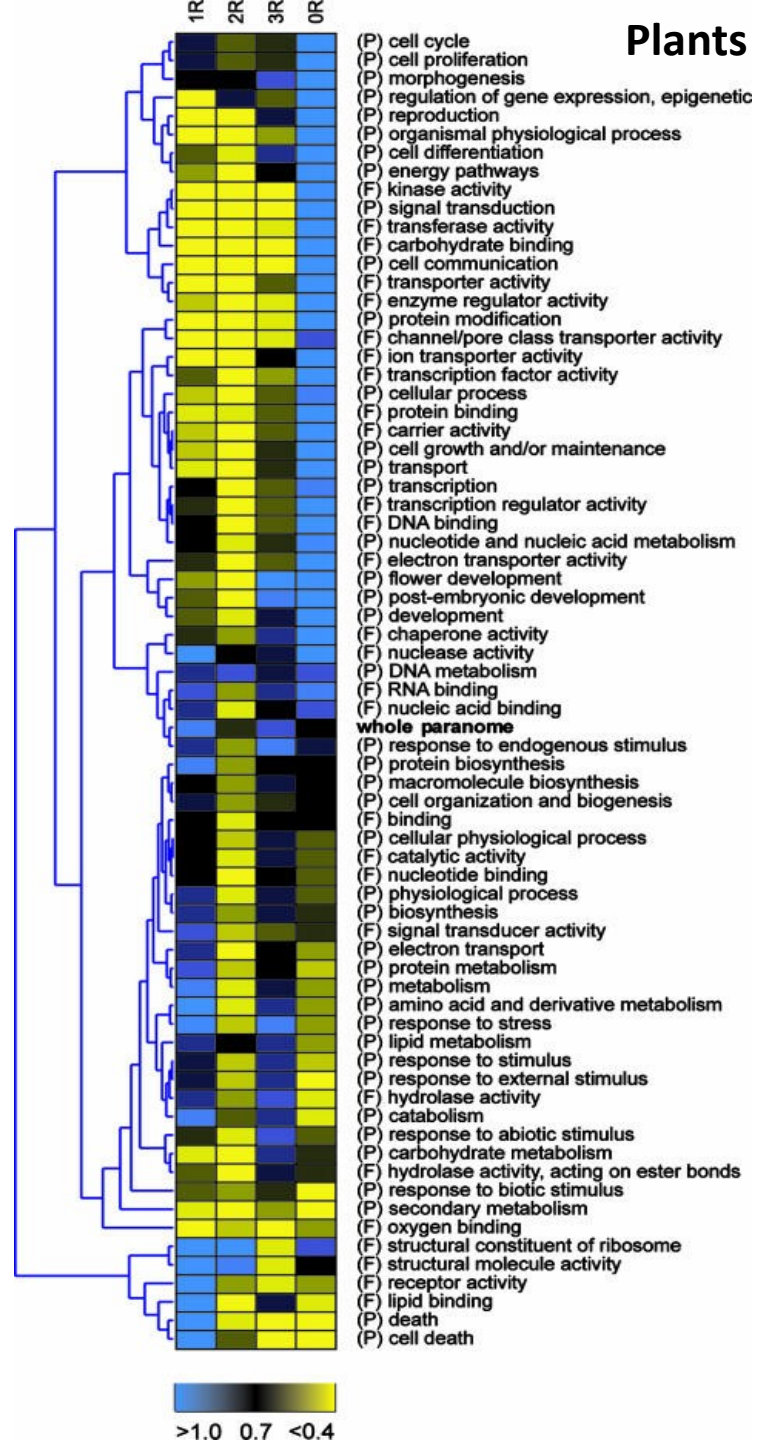
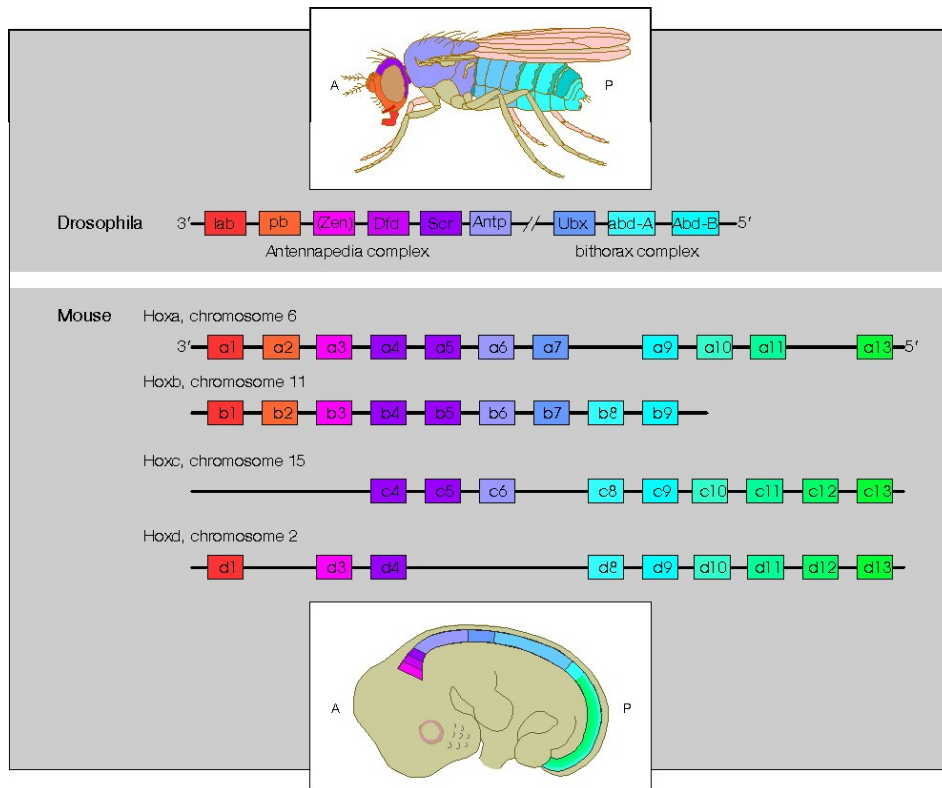
Explanations for adaptive radiation?

Incompatibility at essential loci



Explanations for adaptive radiation?

Regulatory innovations



“Use” of WGD for evolutionary genomics

- To have a set of duplicates that is of the same time
- Study its impacts on the evolution of pathways and complexes