Synapsis and recombination in intra- and interspecies hybrids between two voles species *Microtus (Alexandromys) evoronensis* и *M. maximowizcii*

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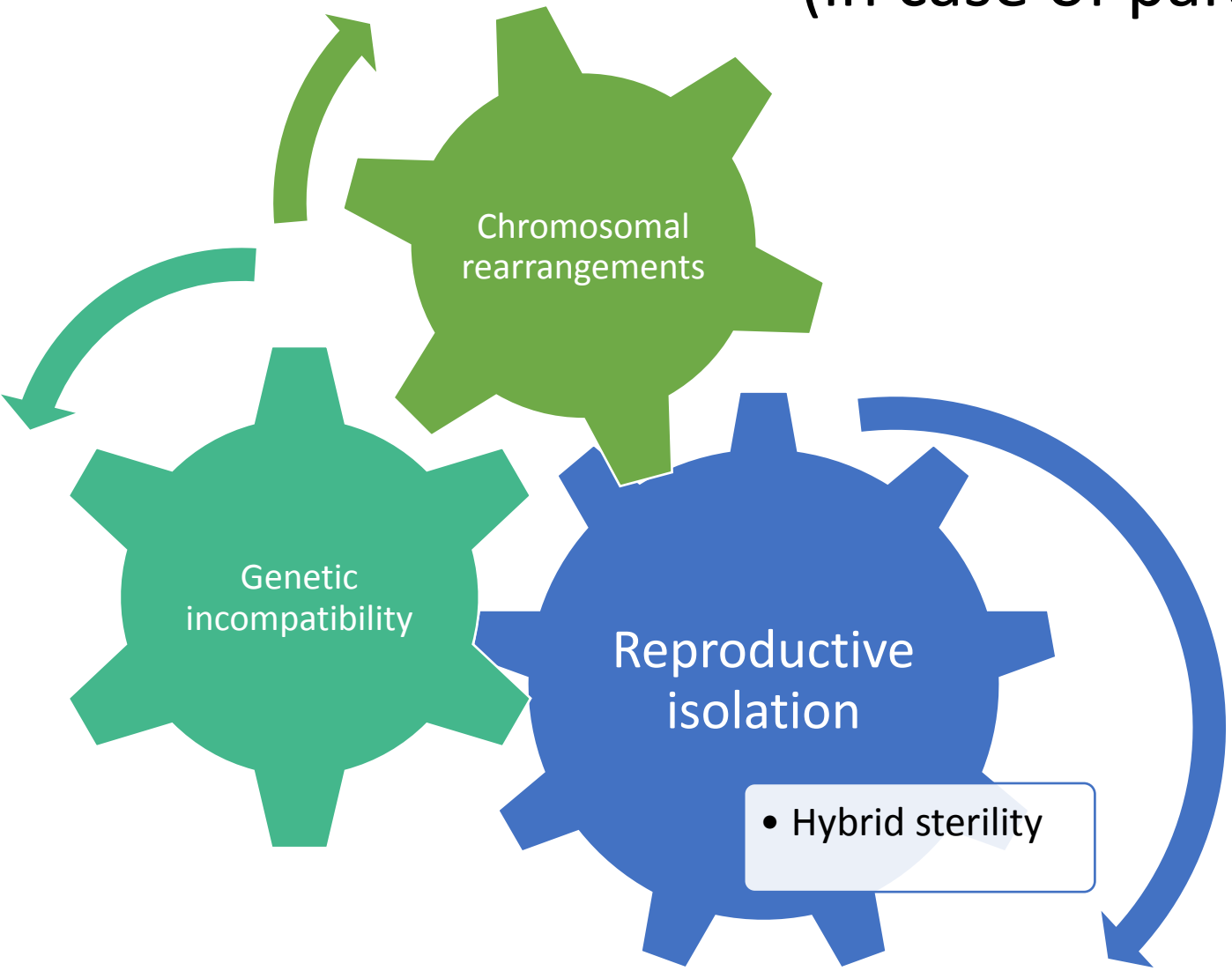
Long way to speciation
(in case of parapatry)



Steps to speciation

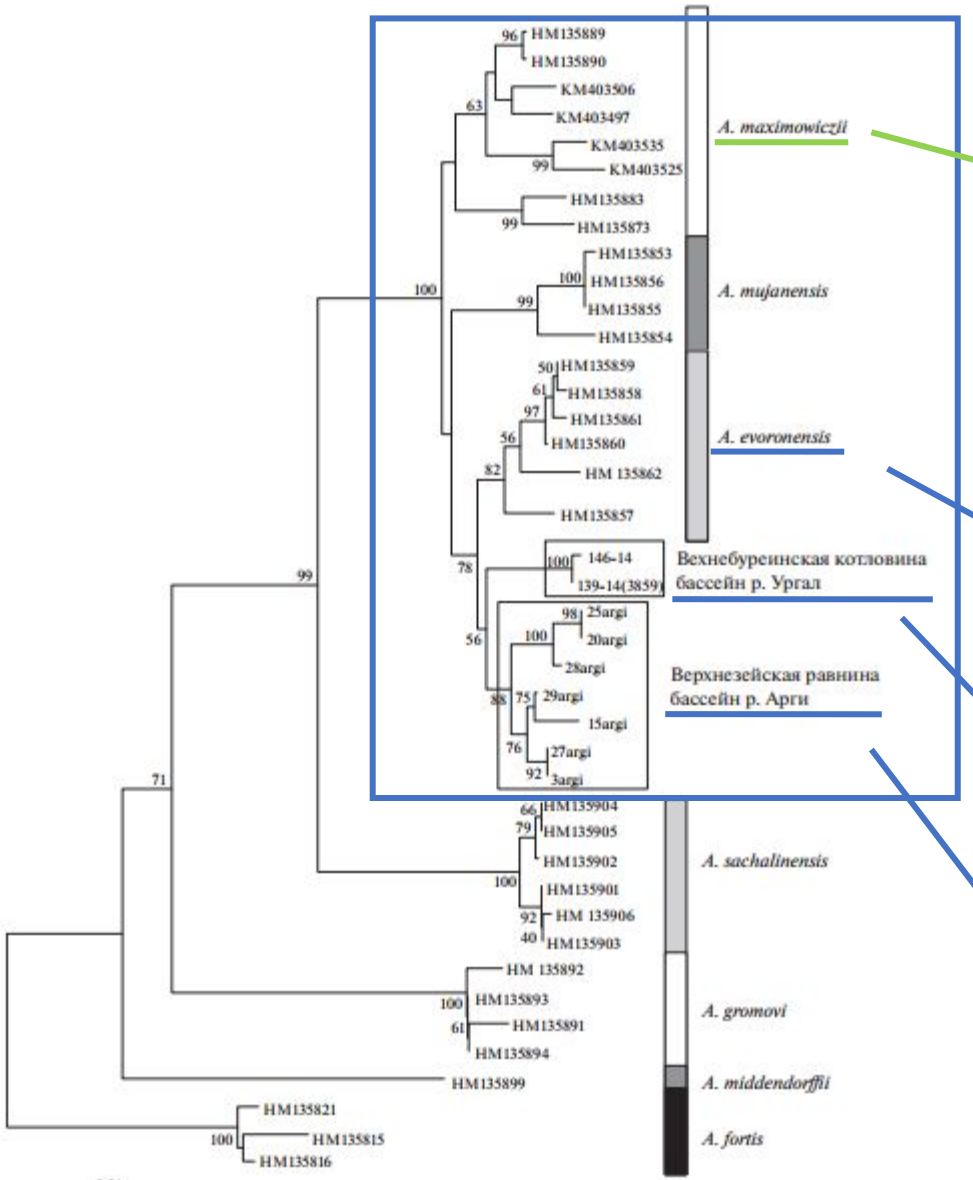
Complete sterility

Genetic and chromosomal divergence: disruption of synapsis and recombination at early meiotic stages

Heterozygosity for rearrangements:

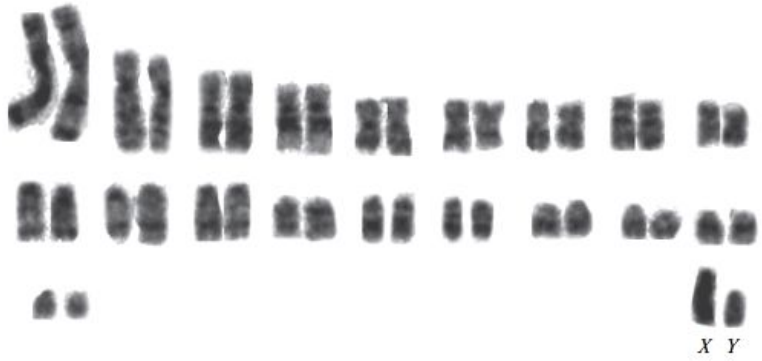
reduction of gene flow

Alexandromys genus as a good model of the early stages of formation of hybrid sterility



Sheremet'eva et al.,2017; DOI:10.7868/S0044513417020076

A. maximowiczii (2n=36-44, NFa=50-60)



M(2n=40)

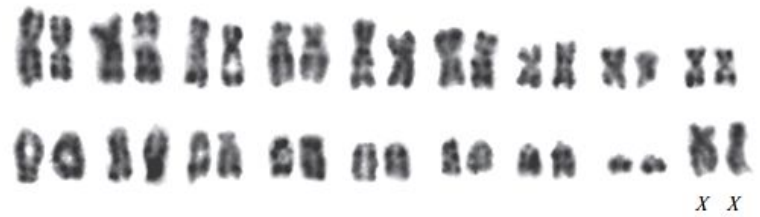
A. evoronensis evoronensis (2n=38-40, NFa=51-52)

E (2n=40)

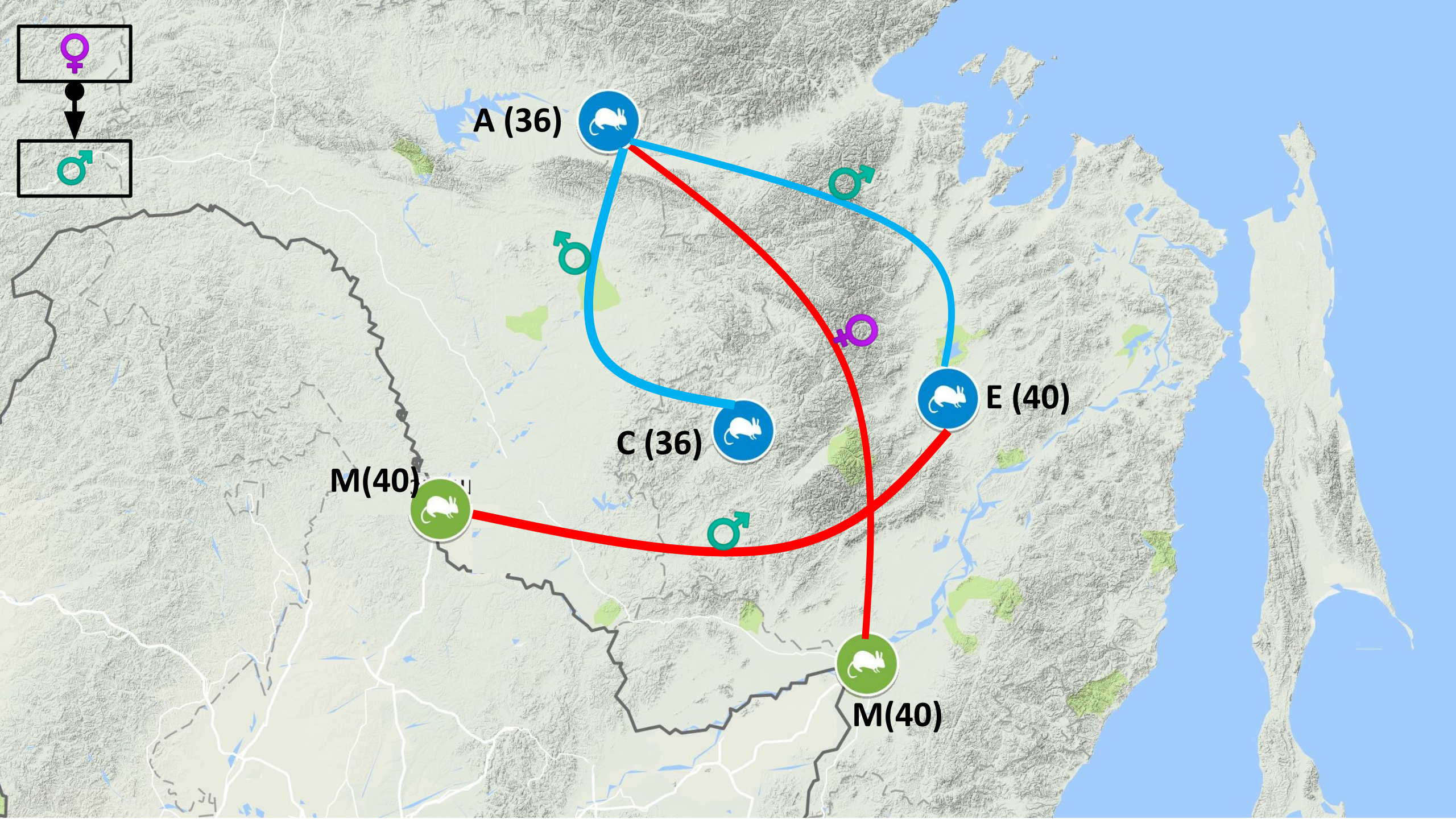
A. evoronensis chegdomin (2n=36, NFa=52)

C (2n=36)

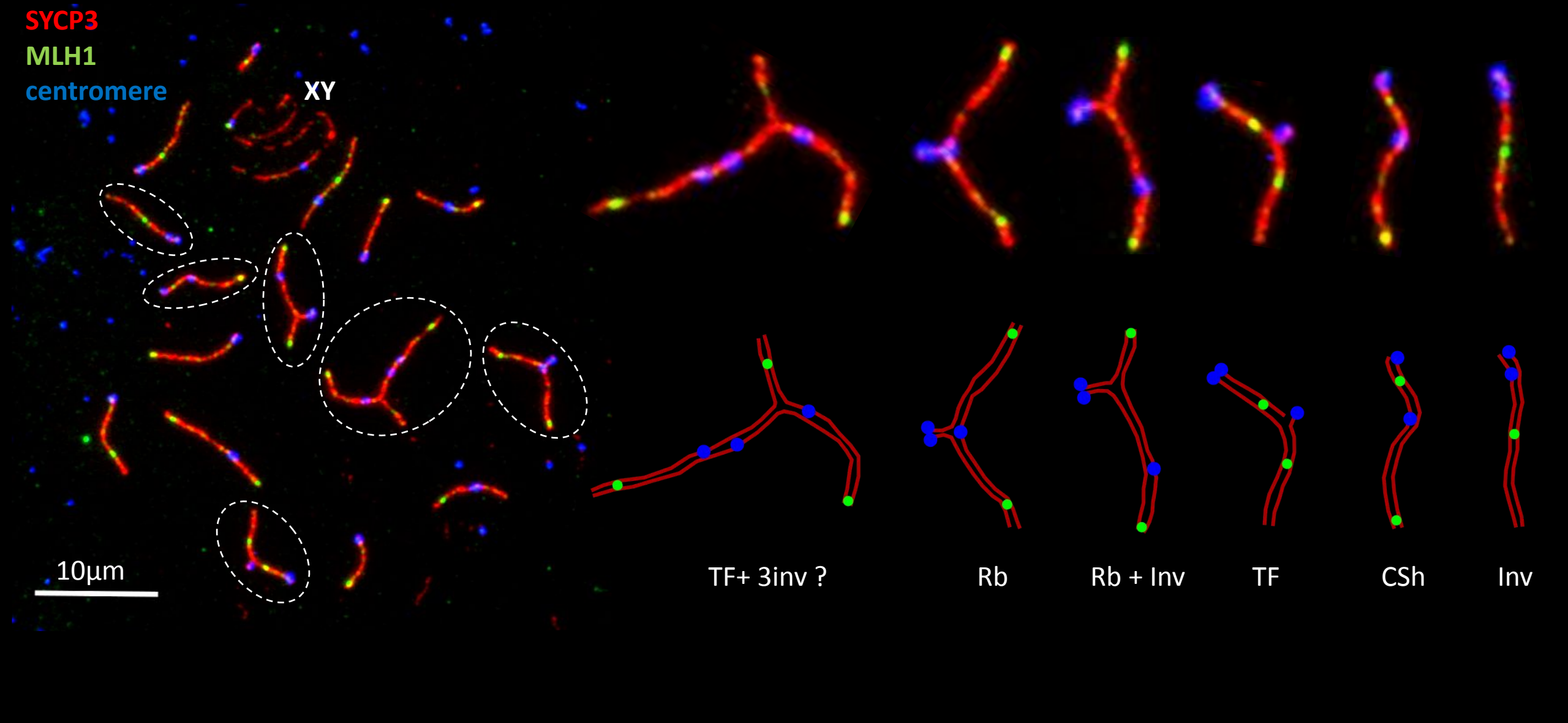
A. evoronensis argi (2n=36, NFa=51-52)



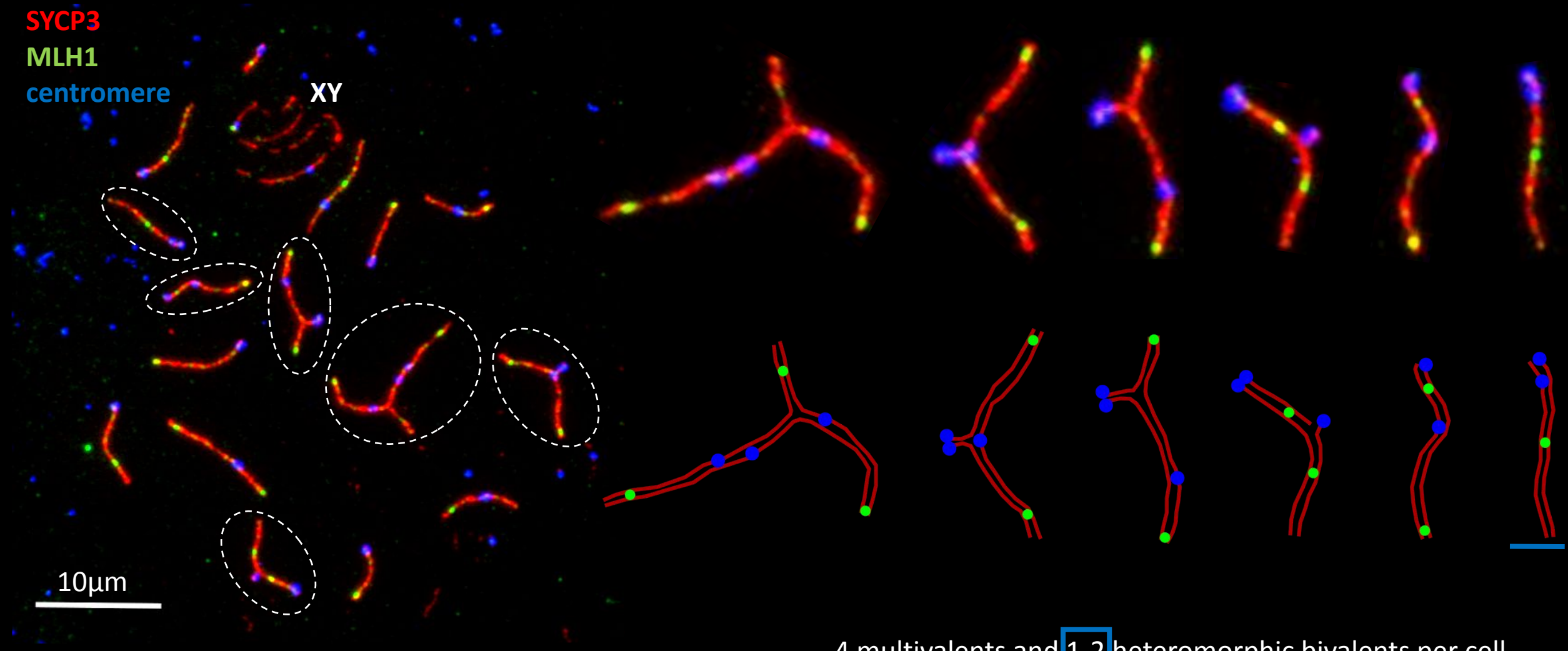
A (2n=36)


♀
♂
A (36)
C (36)
E (40)
M(40)
M(40)

Interpopulation hybrids A x E ♂ (2n=38) reveals the types of rearrangements

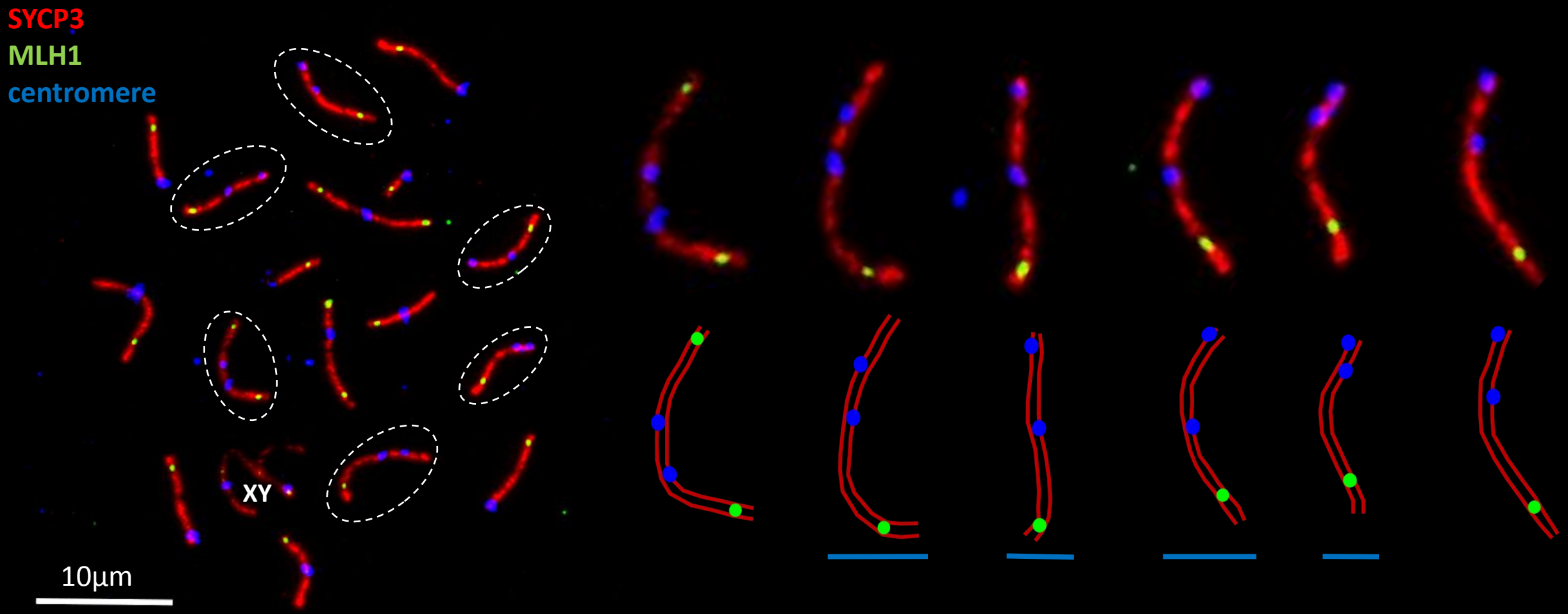


Interpopulation hybrids A x E ♂ (2n=38) show normal synapsis and recombination



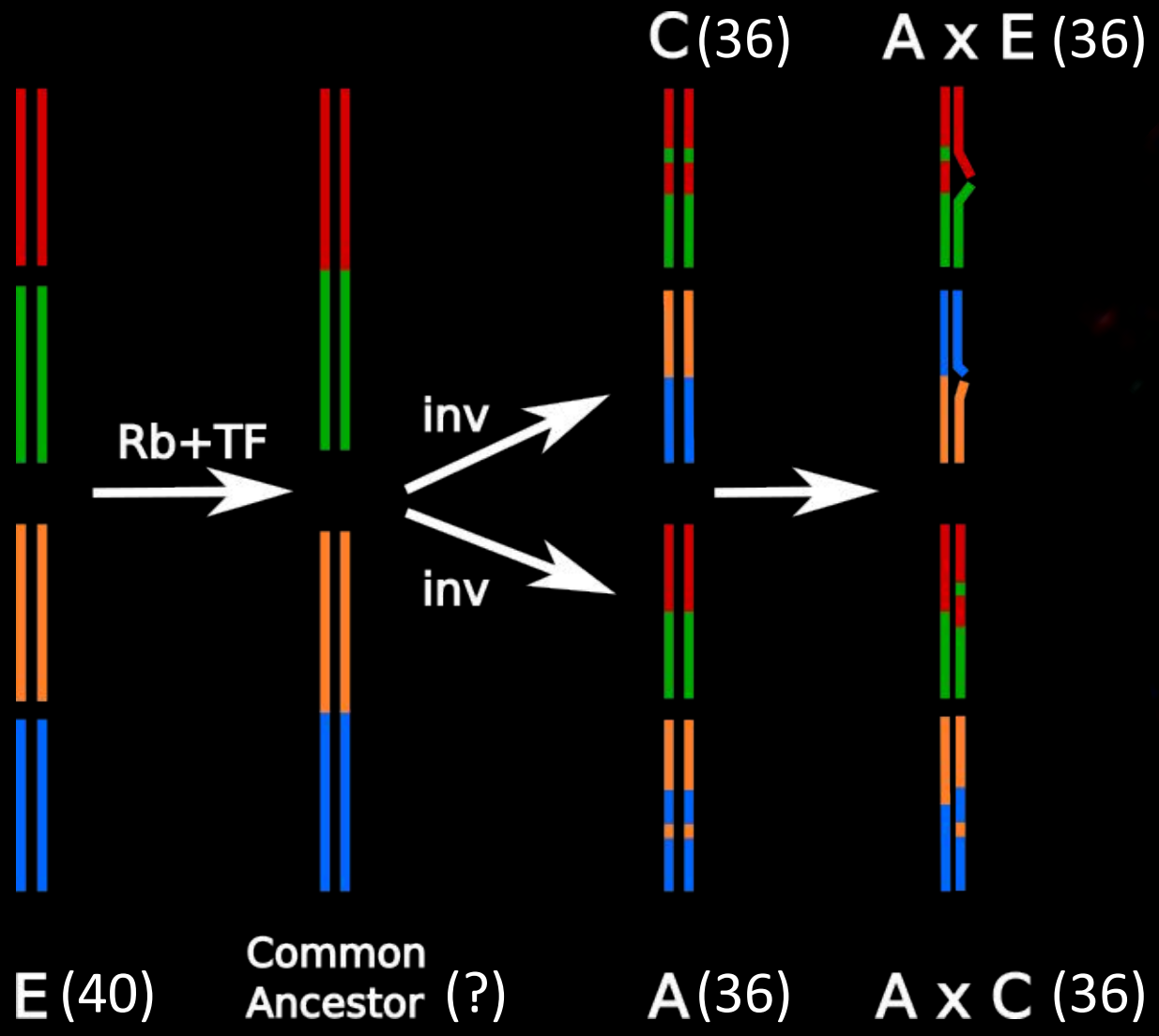
4 multivalents and 1-2 heteromorphic bivalents per cell

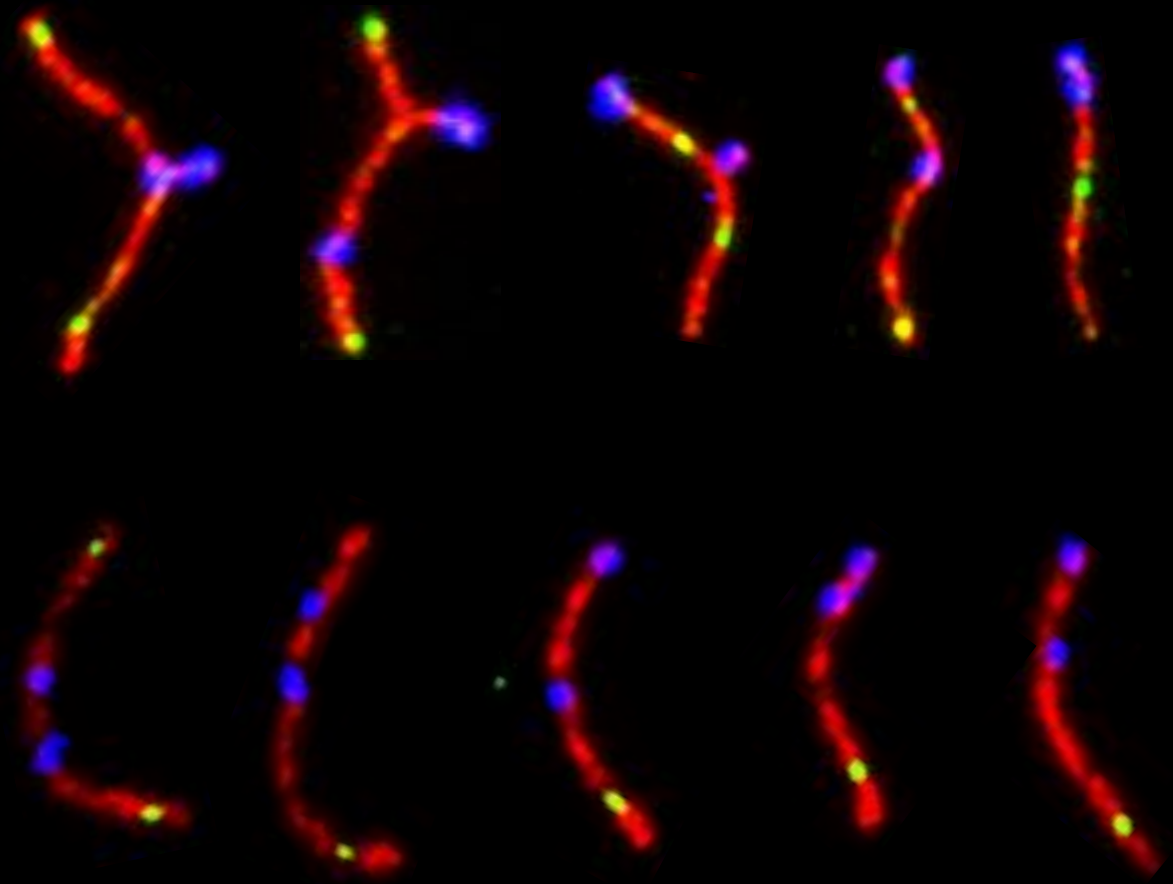
Interpopulation hybrids A x C ♂ (2n=36) show normal synapsis and recombination

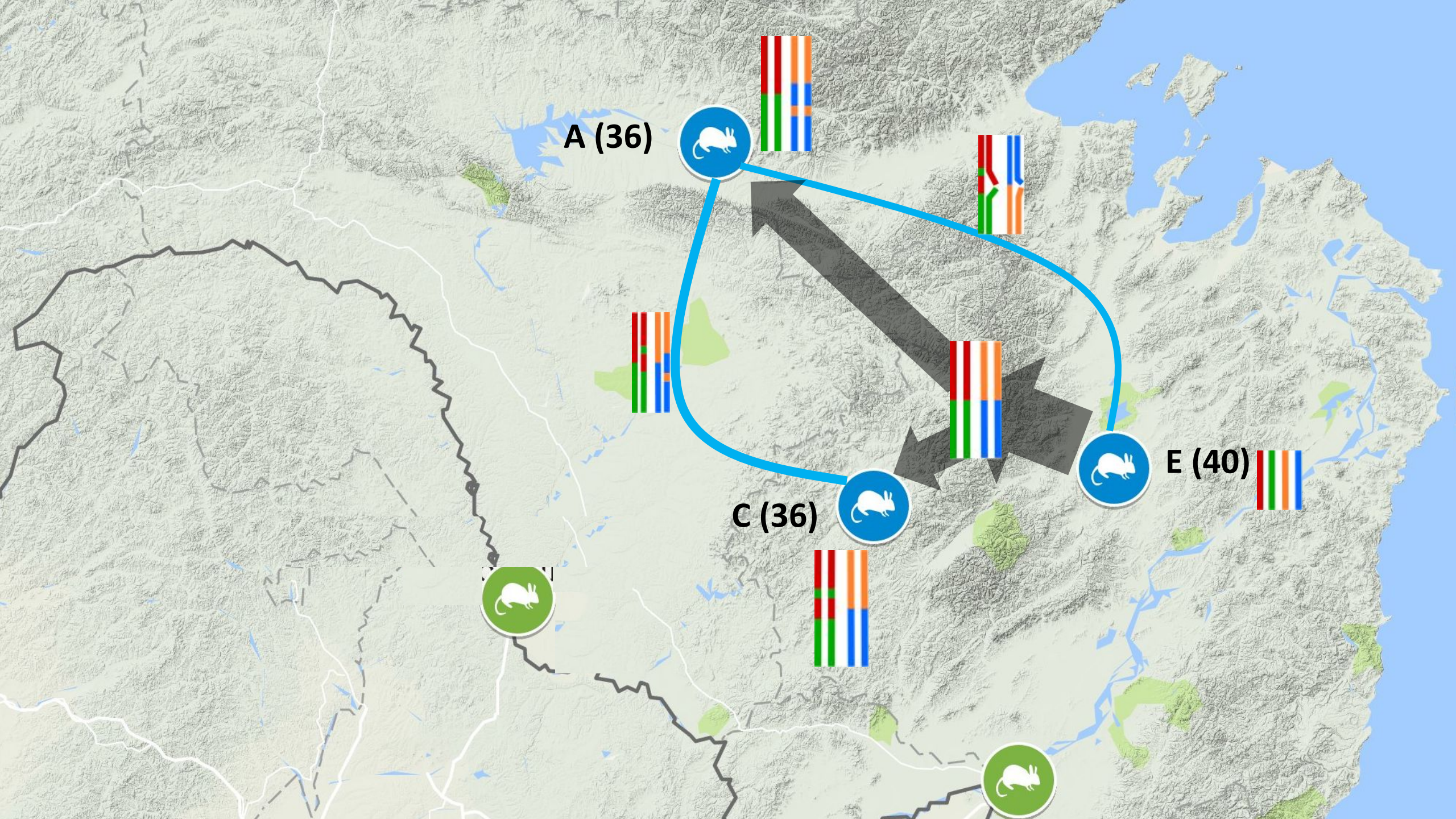


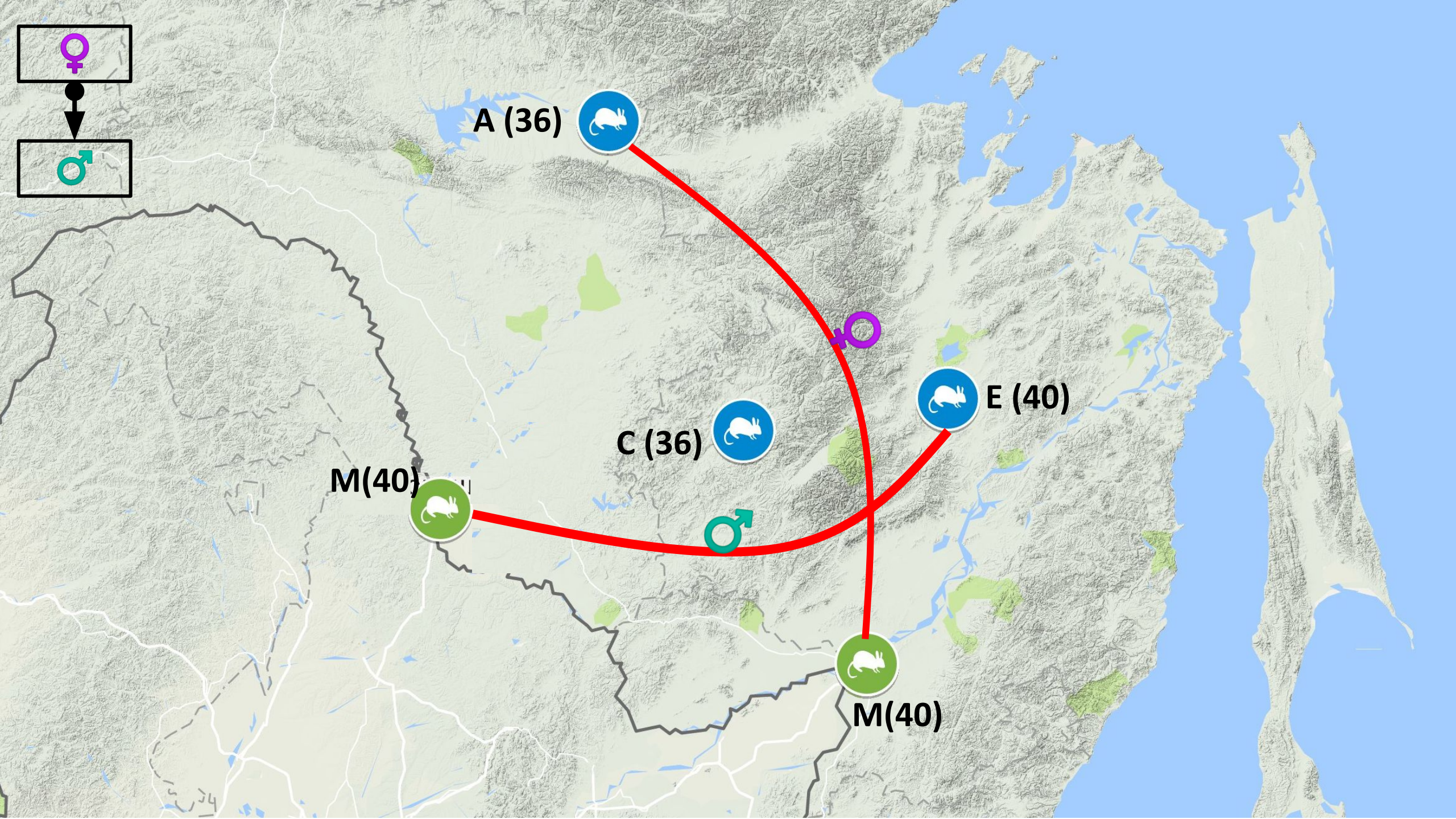
3-4-6 heteromorphic bivalents per cell

Chromosome shuffling:
Robertsonian fusions followed by inversions

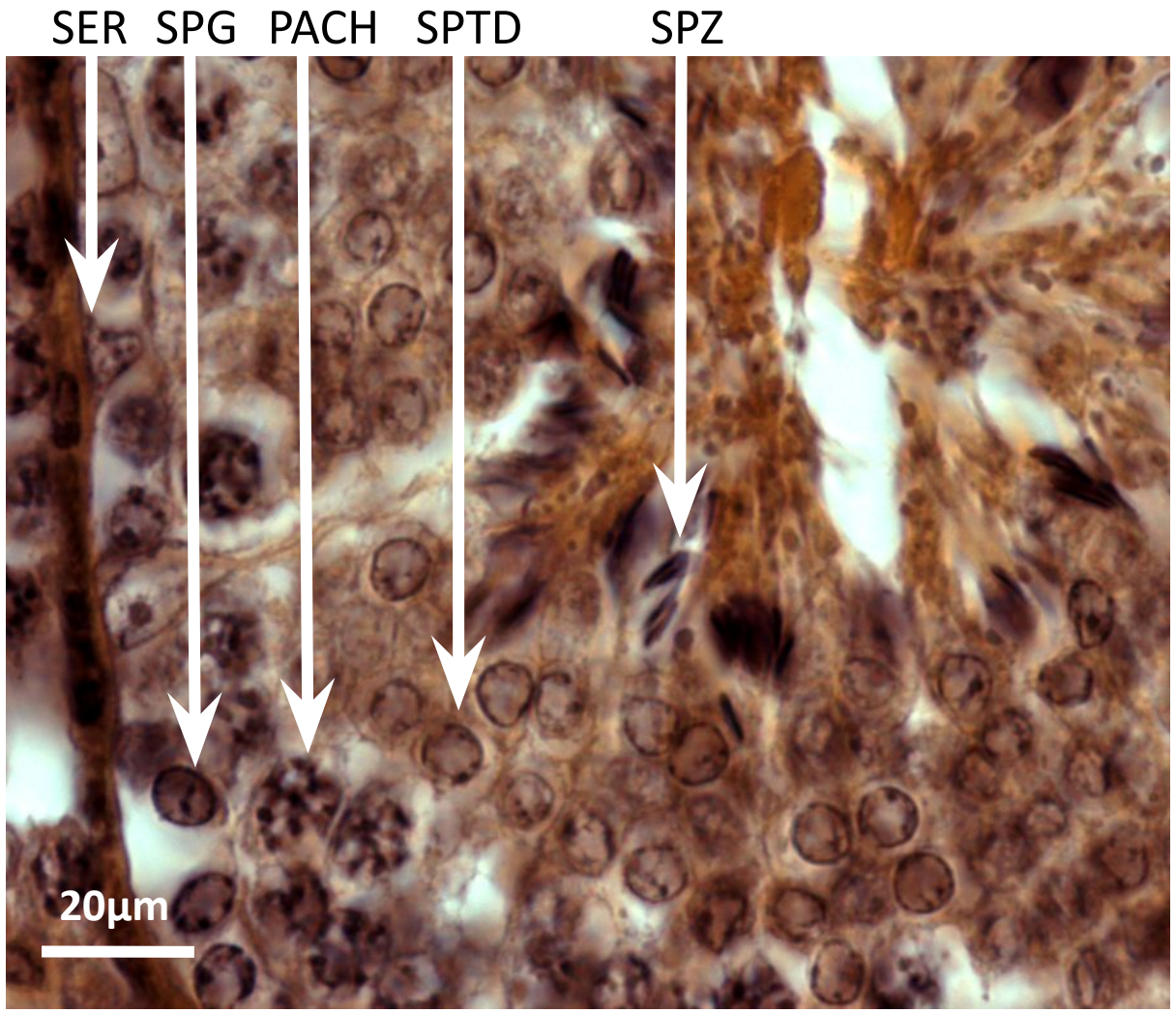




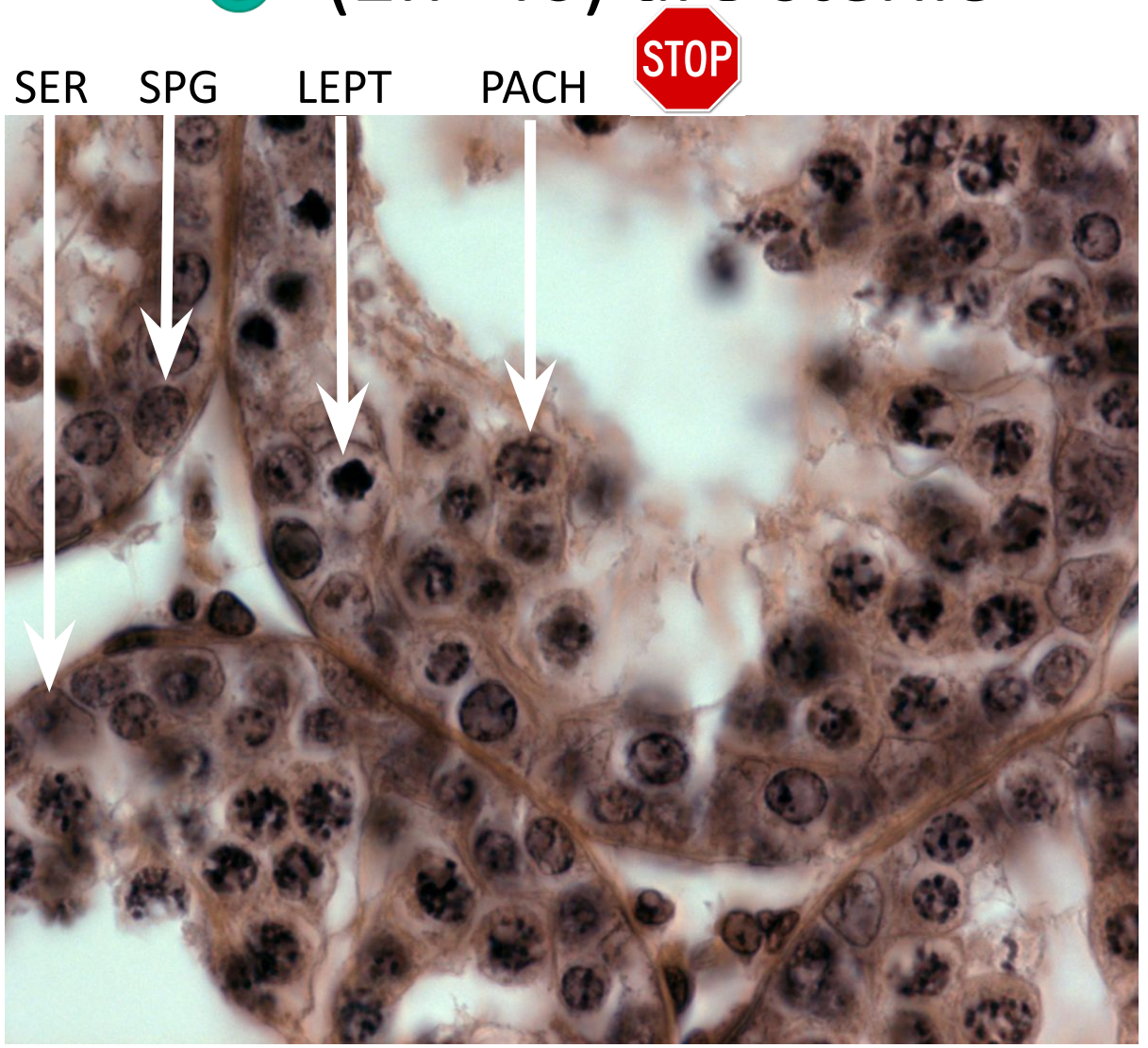

A (36)
C (36)
E (40)


♀
♂
A (36)
C (36)
E (40)
M(40)
M(40)

Interpopulation hybrids are fertile



Interspecies hybrids M x E ♂ (2n=40) are sterile



Interspecies hybrids show sex difference in synapsis and crossingover suppression

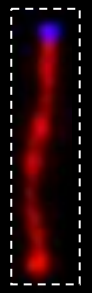
M x E ♂
(2n=40)

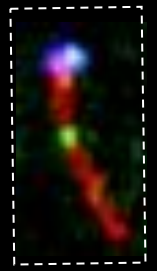
A x M ♀
(2n=38-39)

SYCP3
MLH1
centro
mere

XY

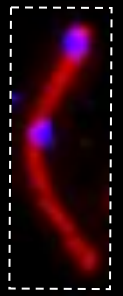
10µm

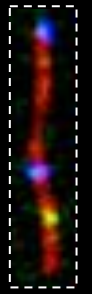




Homomorphic bivalents

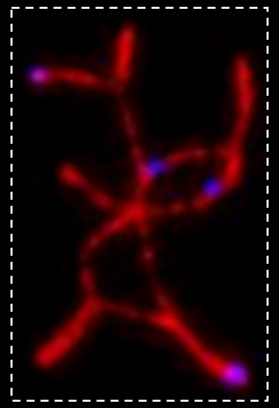
6-11 9

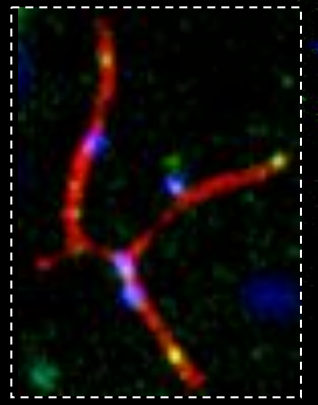




Heteromorphic bivalents

0-4 1-3



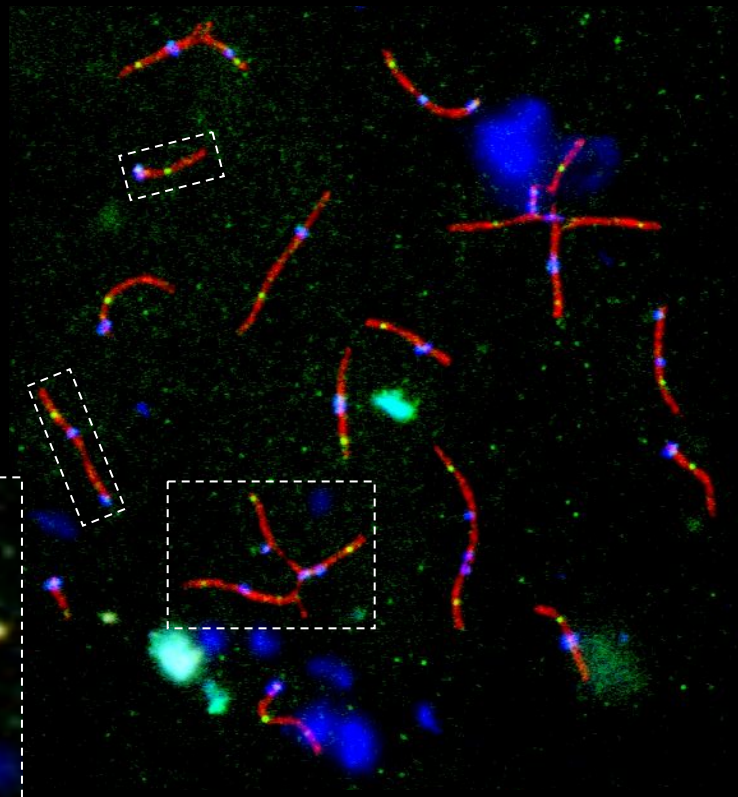


Multivalents

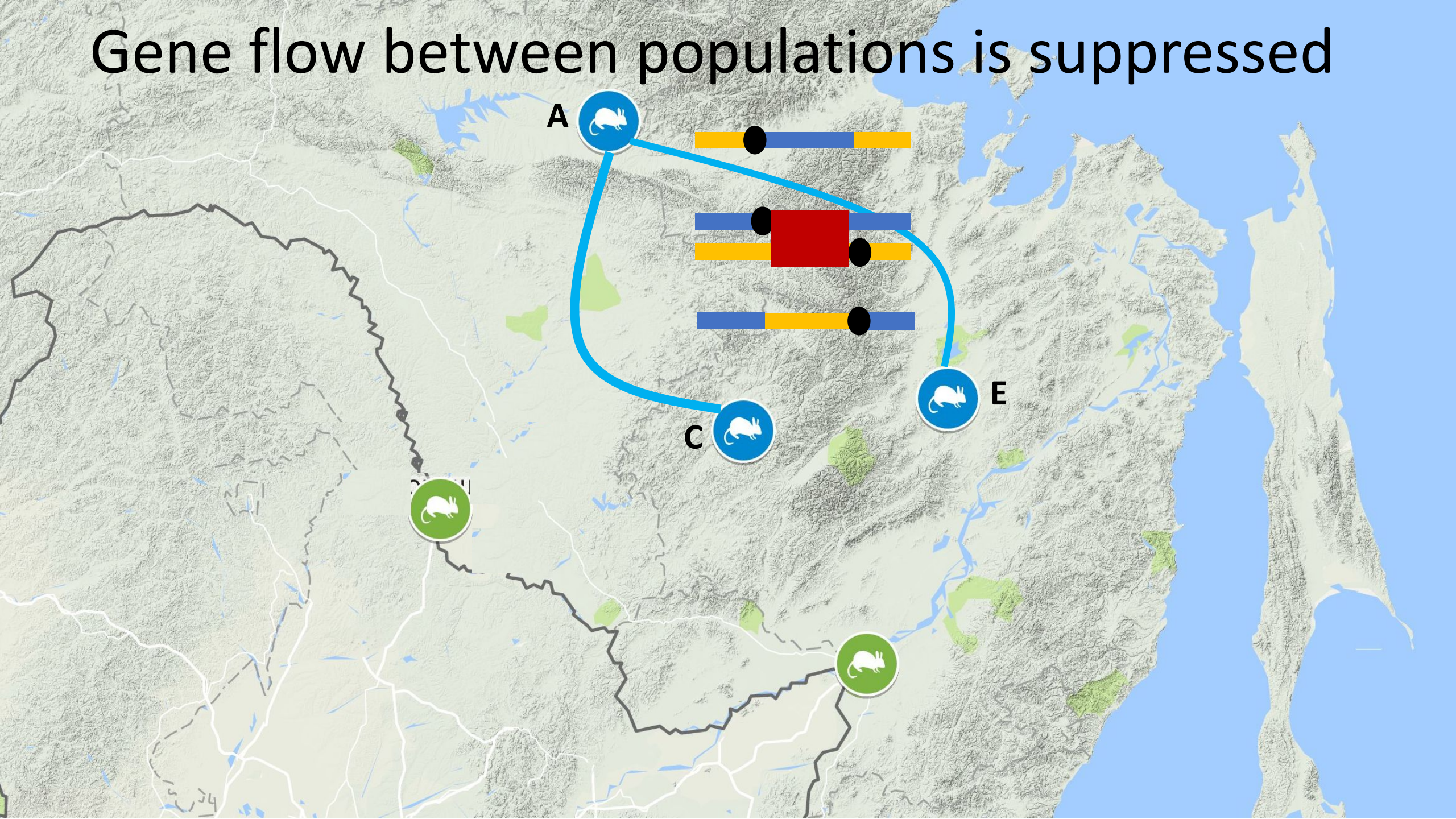
2-7 2-7

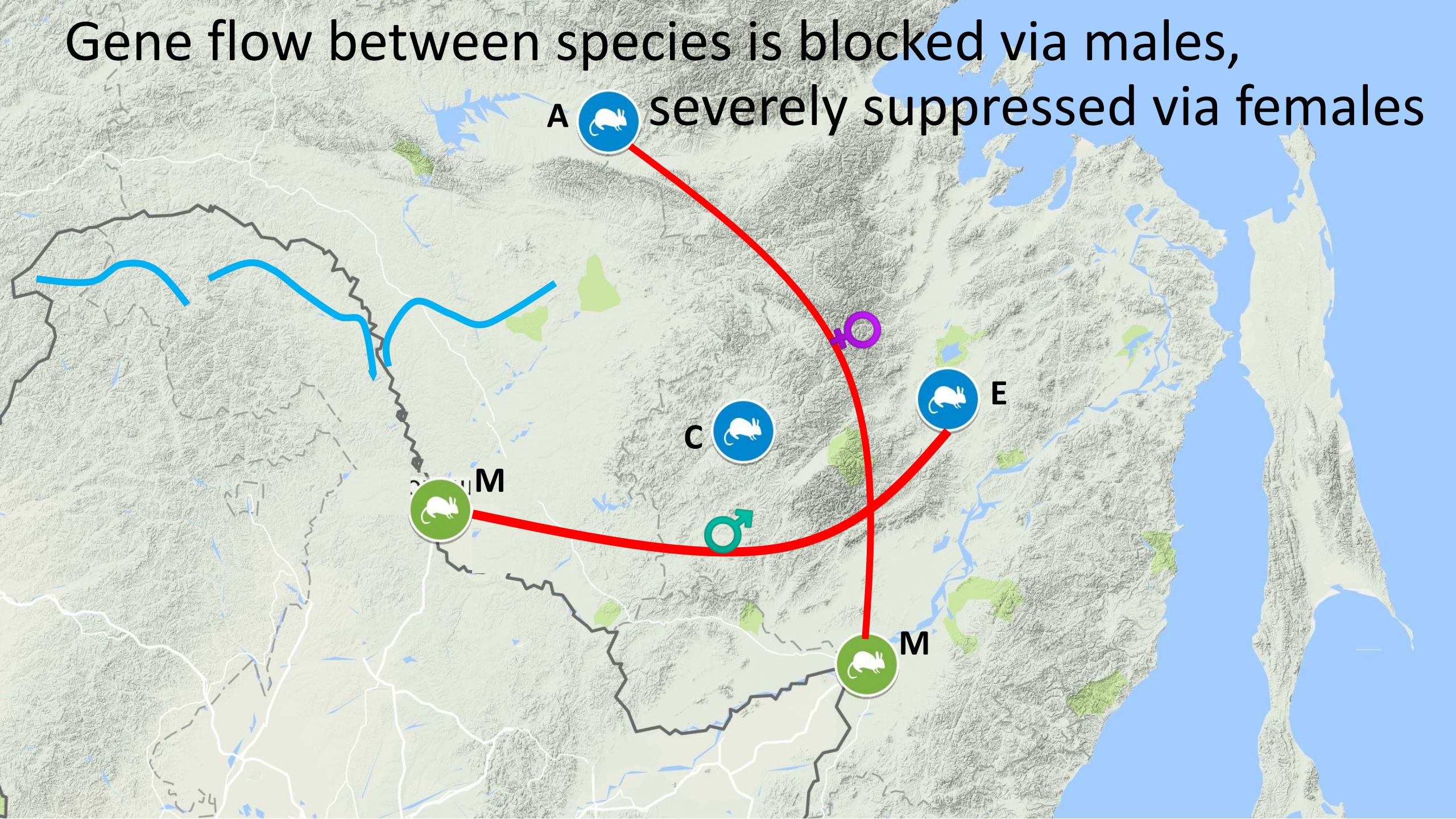
N of elements

4-21 7-19

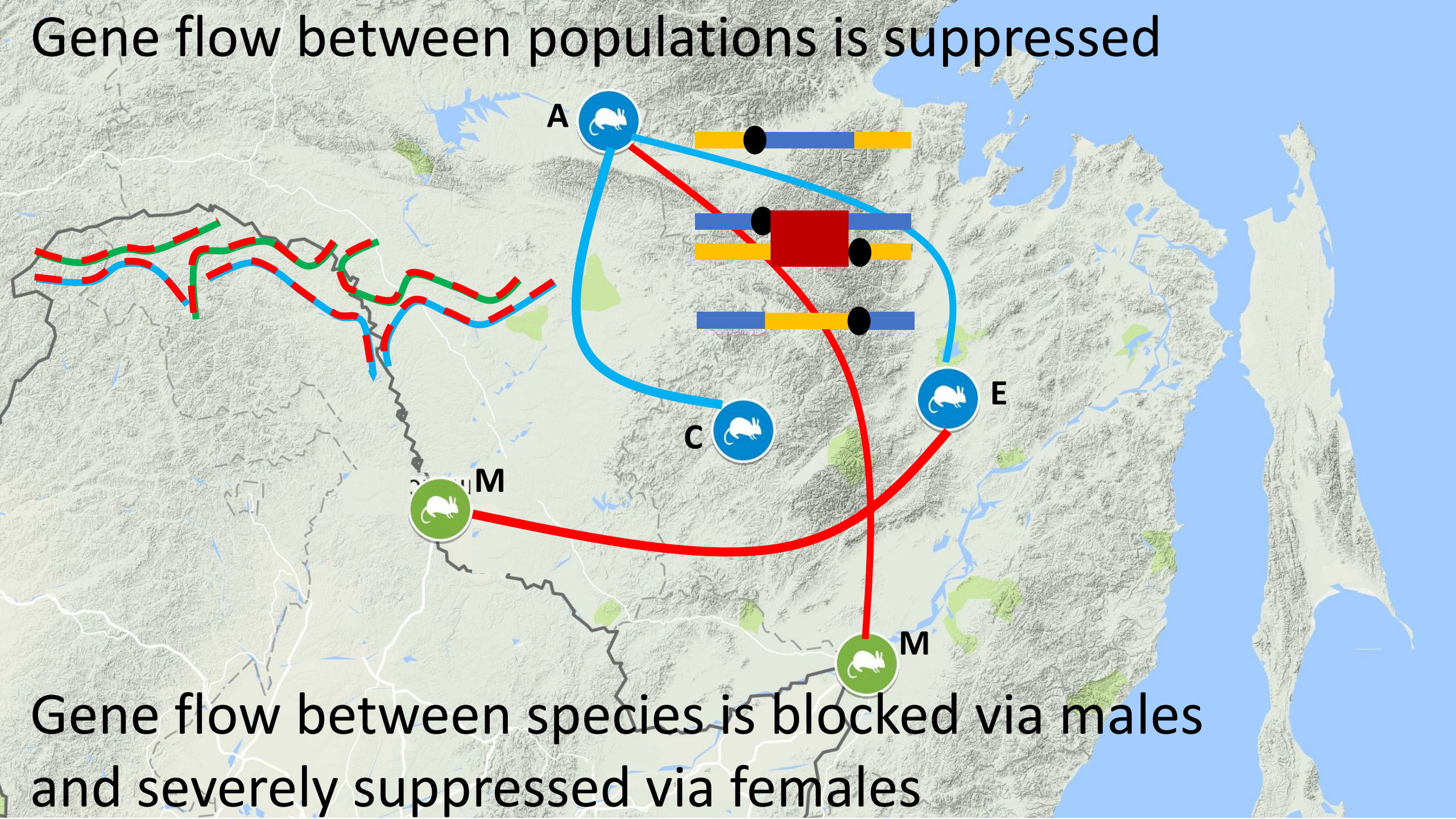


Gene flow between populations is suppressed

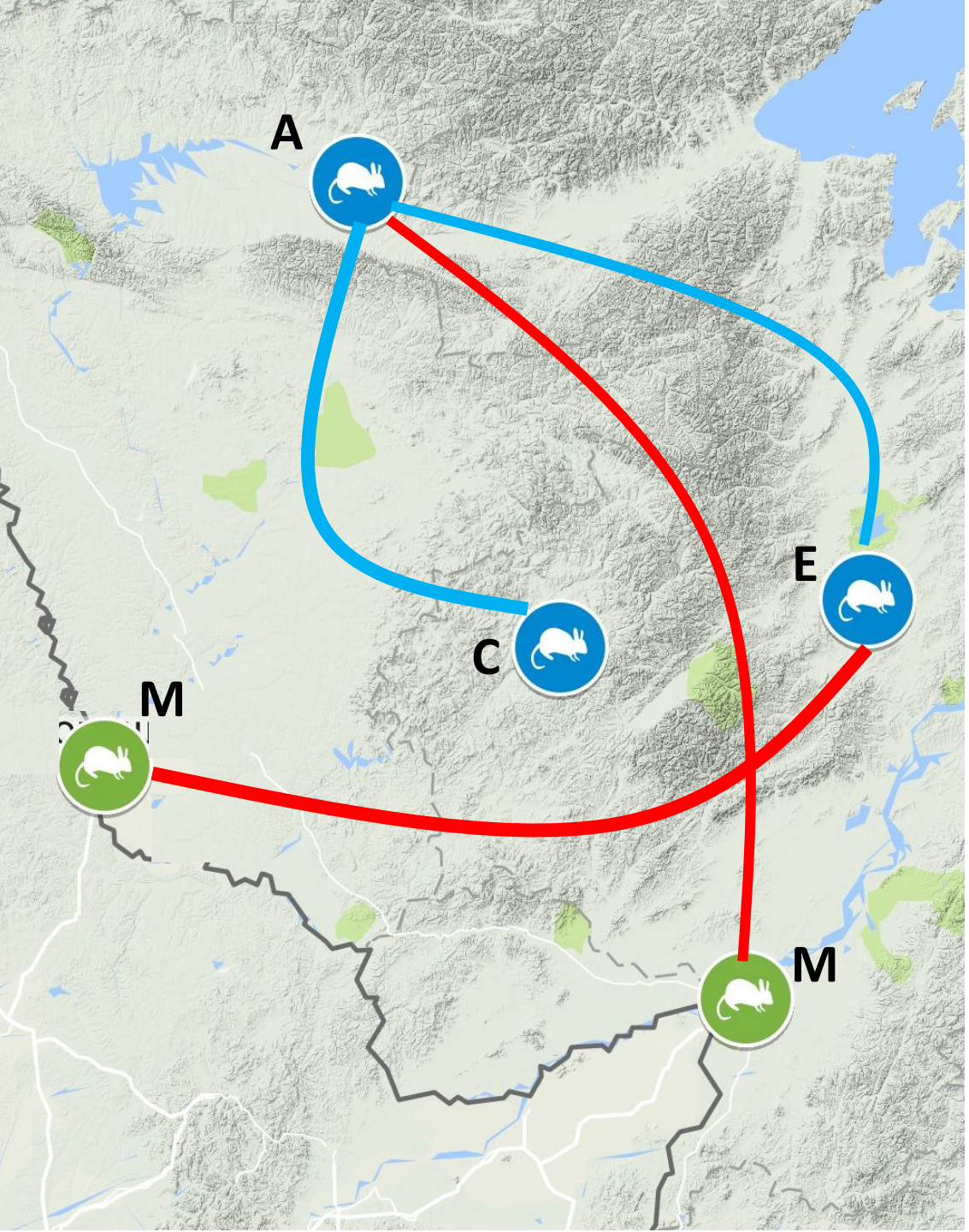



Gene flow between species is blocked via males,
severely suppressed via females
A
C
E
M
M

Gene flow between populations is suppressed



Gene flow between species is blocked via males and severely suppressed via females



Steps to speciation

M
E

Complete sterility

A. maximowiczii
A. evoronensis evoronensis

E
C

Genetic and chromosomal divergence: disruption of synapsis and recombination at early meiotic stages

A. evoronensis evoronensis
A. evoronensis chegdomin

A

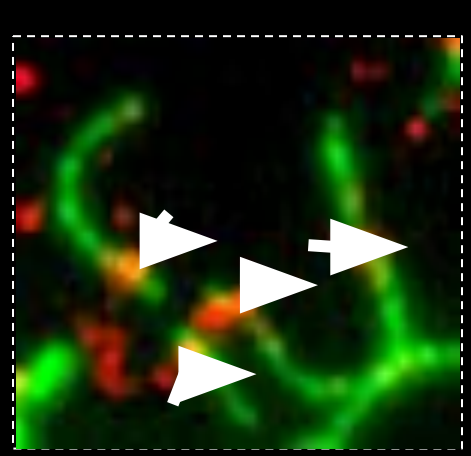
Heterozygosity for rearrangements:

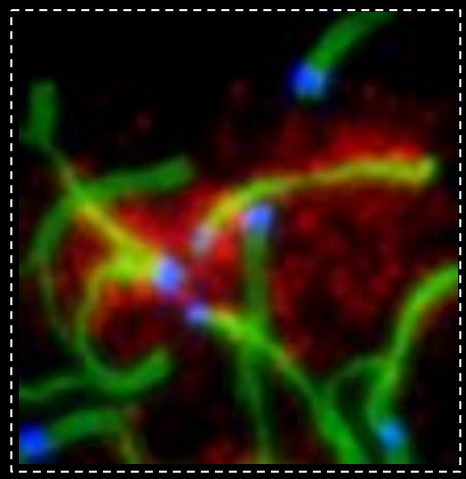
reduction of gene flow

A. evoronensis argi

Parental species
vs
Interspecies hybrids

SYCP3
RAD51





SYCP3
γH2A.X
centromere

XY

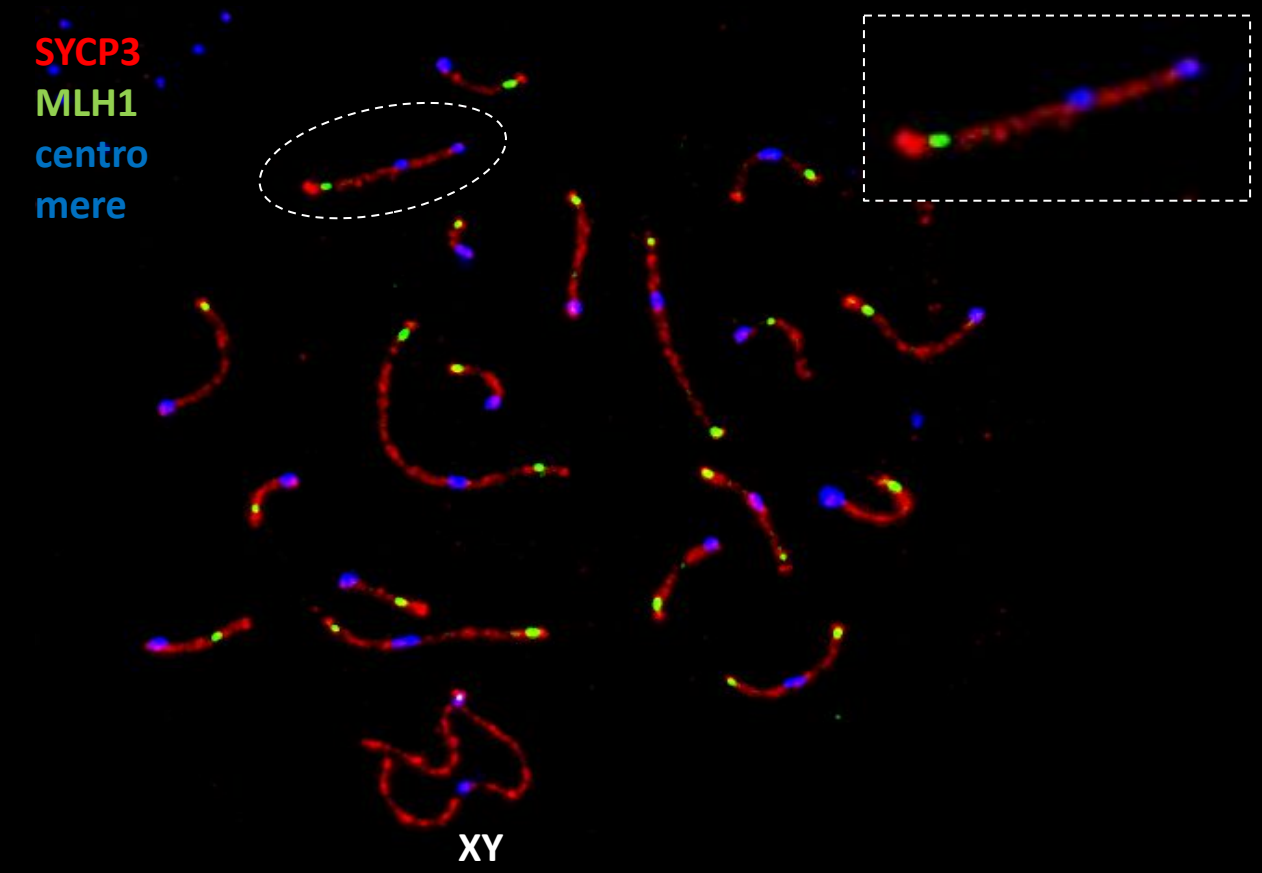
XY

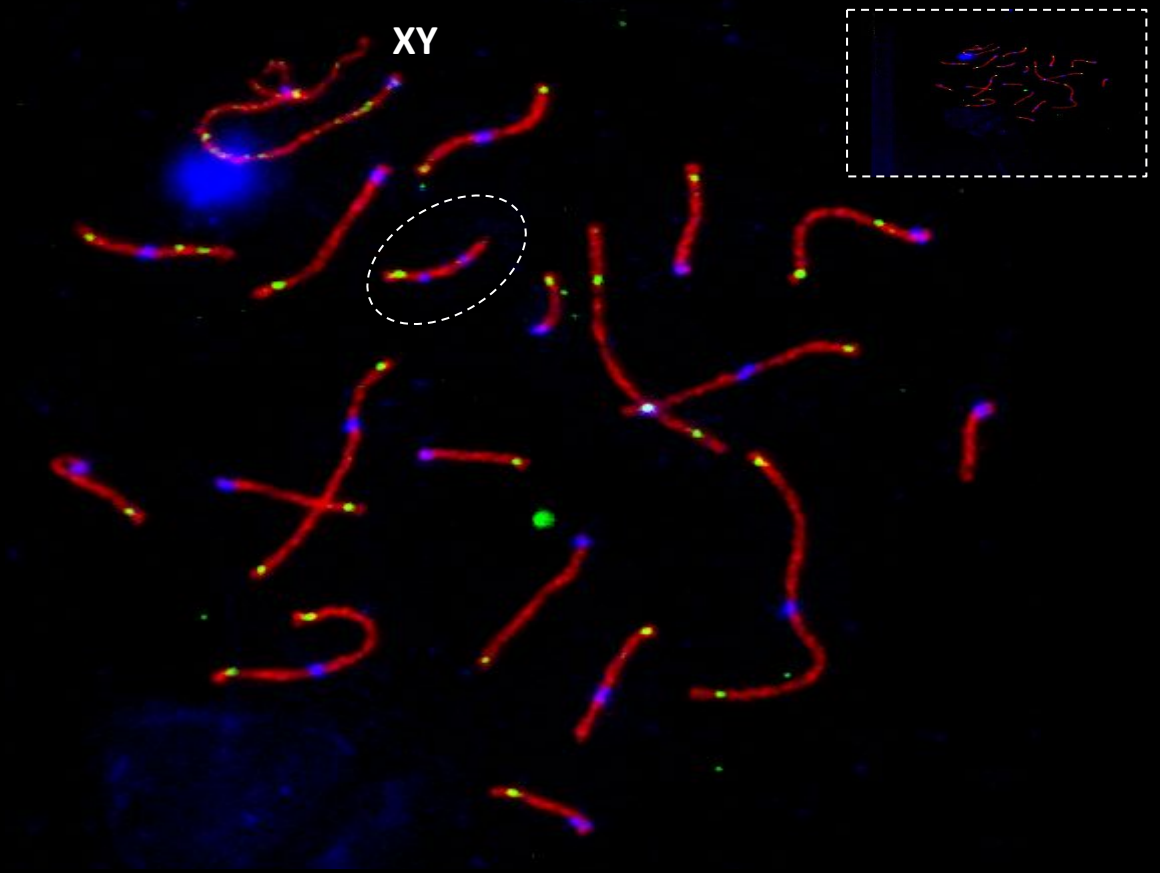
10µm

Caryotype polymorphism of the parental species

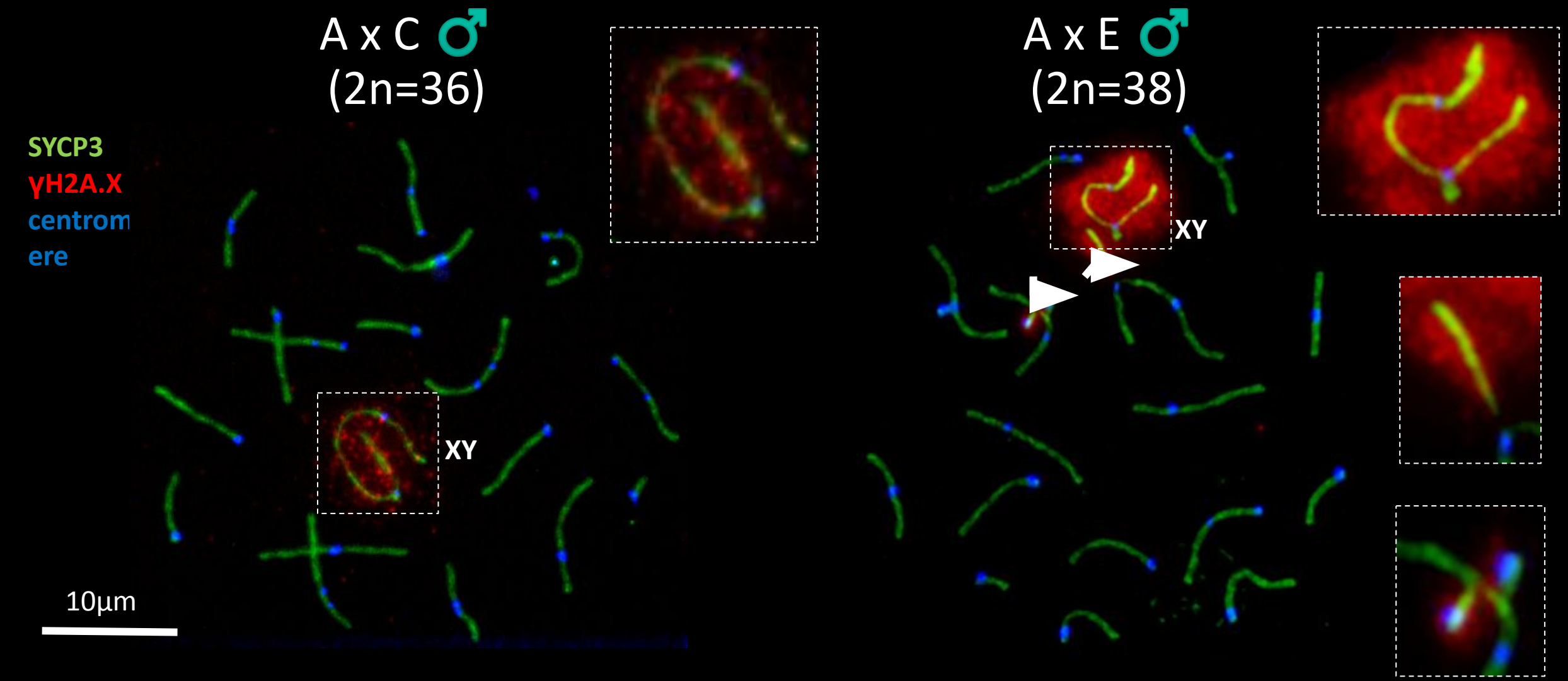
A. ev. evoronensis

A. maximowiczii



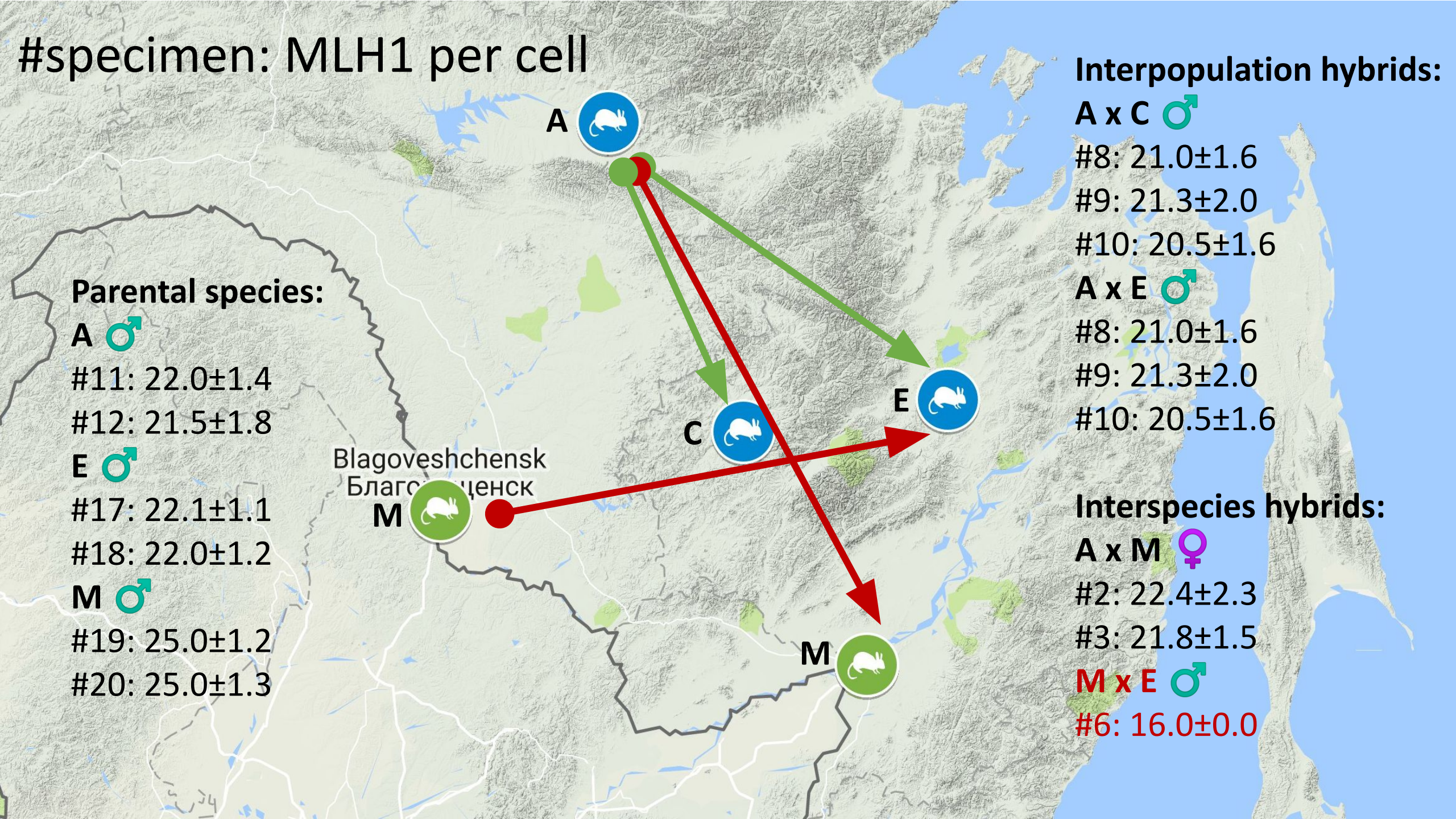


Interpopulation hybrids show transient inactivation of asynapsed regions



	A. ev. argi ♂ **2n = 36**	**A. ev. chegdomin ♂** **2n = 36**	**A. ev. evoronensis ♂** **2n = 40**	**A. maximowiczii ♂** **2n = 40**
A. ev. argi ♀ **2n = 36**	№ of specimen = 2 № of cells = 103	№ of specimen = 3 № of cells = 163	№ of specimen = 3 № of cells = 118	№ of specimen = 2 № of cells = 33
A. ev. chegdomin ♀ **2n = 36**				
A. ev. evoronensis ♀ **2n = 40**			№ of specimen = 2 № of cells = 150	
A. maximowiczii ♀ **2n = 40**			№ of specimen = 3 № of cells = 110	№ of specimen = 2 № of cells = 114

#specimen: MLH1 per cell



Parental species:

A ♂

#11: 22.0±1.4

#12: 21.5±1.8

E ♂

#17: 22.1±1.1

#18: 22.0±1.2

M ♂

#19: 25.0±1.2

#20: 25.0±1.3

Interpopulation hybrids:

A x C ♂

#8: 21.0±1.6

#9: 21.3±2.0

#10: 20.5±1.6

A x E ♂

#8: 21.0±1.6

#9: 21.3±2.0

#10: 20.5±1.6

Interspecies hybrids:

A x M ♀

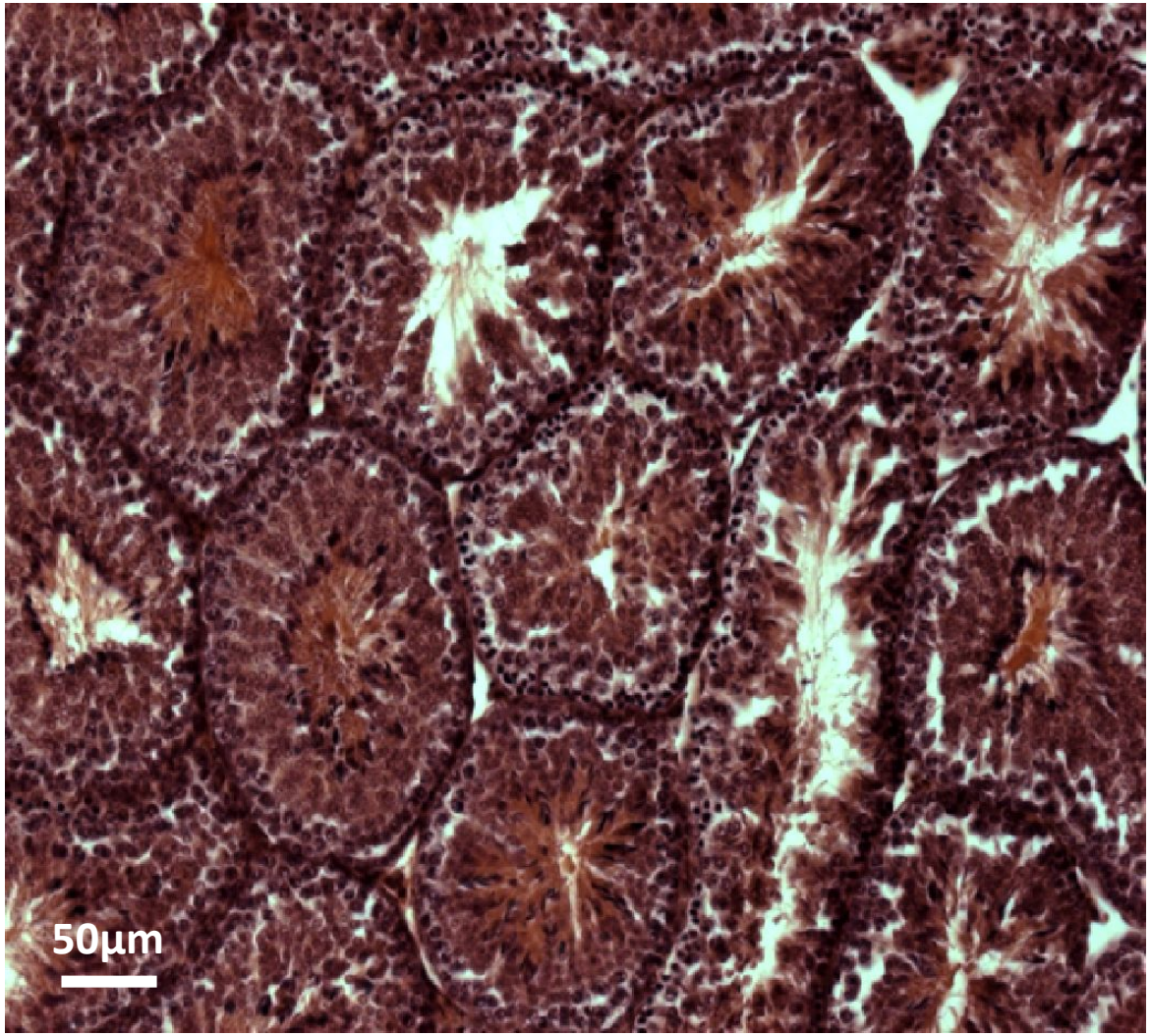
#2: 22.4±2.3

#3: 21.8±1.5

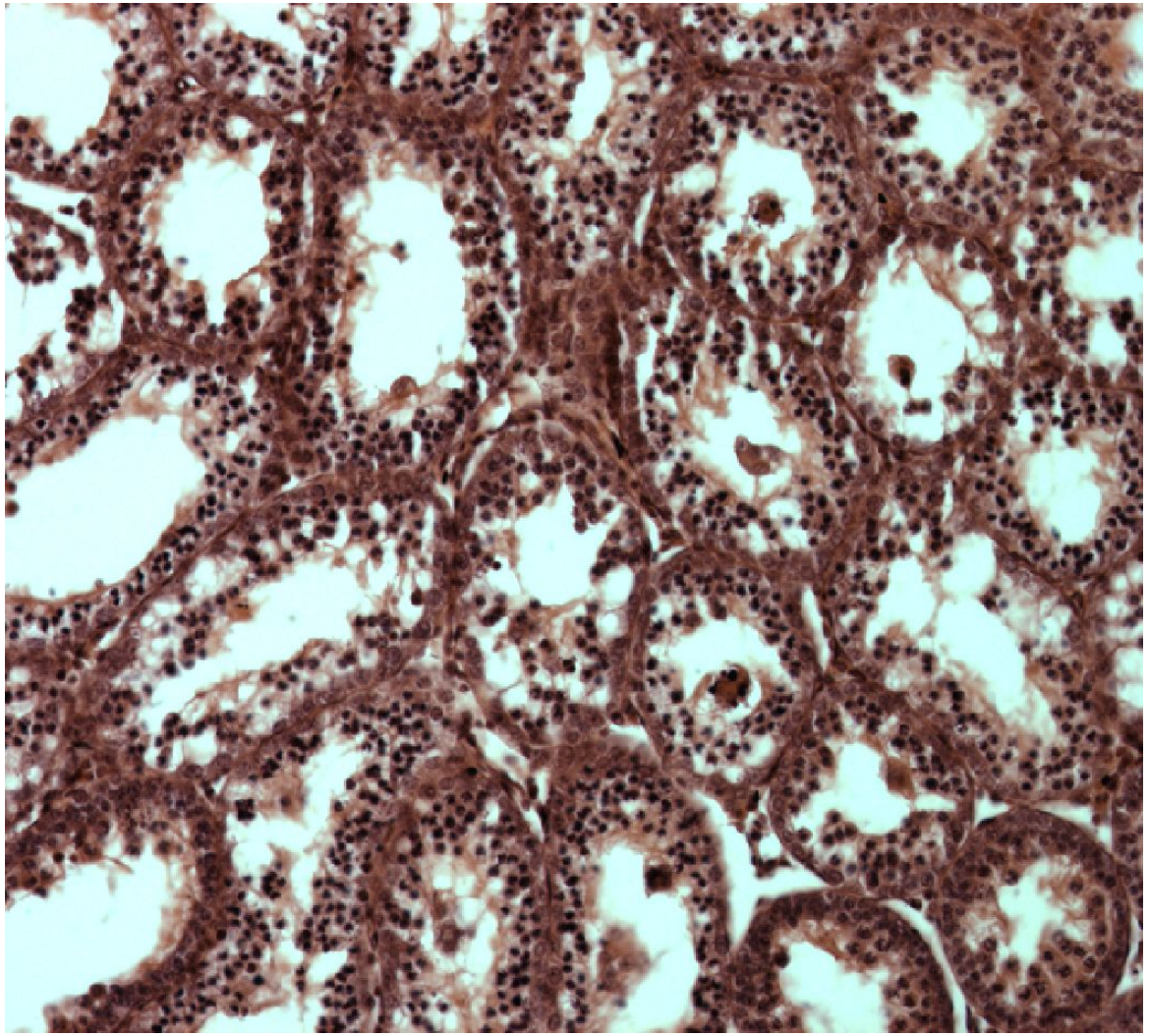
M x E ♂

#6: 16.0±0.0

Interpopulation hybrids are fertile



Interspecies hybrids M x E ♂ (2n=40) are sterile



Gene flow between species is blocked via males, severely suppressed via females