

**Unraveling the adaptive  
significance of mitochondrial  
genome variability of  
*Drosophila obscura***

**Pavle Erić, Aleksandra Patenković, Katarina Erić, Marija Tanasković,  
Slobodan Davidović, Mina Rakić, Marija Savić Veselinović, Marina  
Stamenković-Radak and Mihailo Jelić**

Genetics of Populations and Ecogenotoxicology

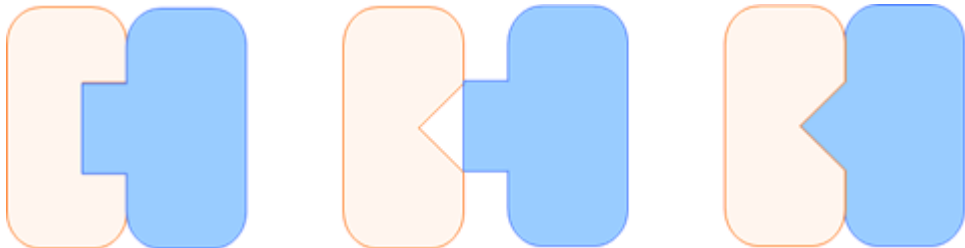
University of Belgrade

**Institute for Biological Research "Siniša Stanković"**

National Institute of Republic of Serbia

# Mitochondrial DNA

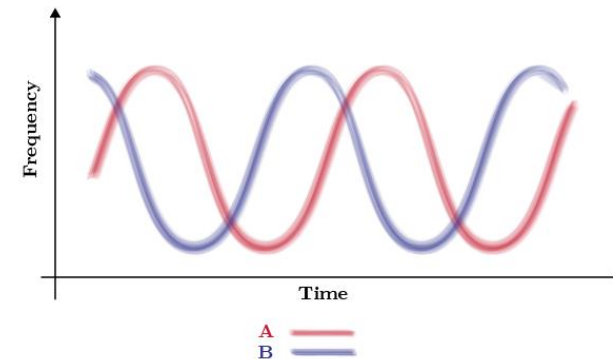
- ❖ Haploid, no dominance
- ❖ Uniparental inheritance
- ❖ No recombination
- ❖ Codes for small number of genes
- ❖ Very important products enrolled in energy metabolism
- ❖ Interactions with Nuclear genome:
  - Cellular respiration, mtDNA replication, transcription and translation



# Intrapopulation mtDNA variability

❖ Maintaining of **sympatric** mtDNA variation by balancing selection:

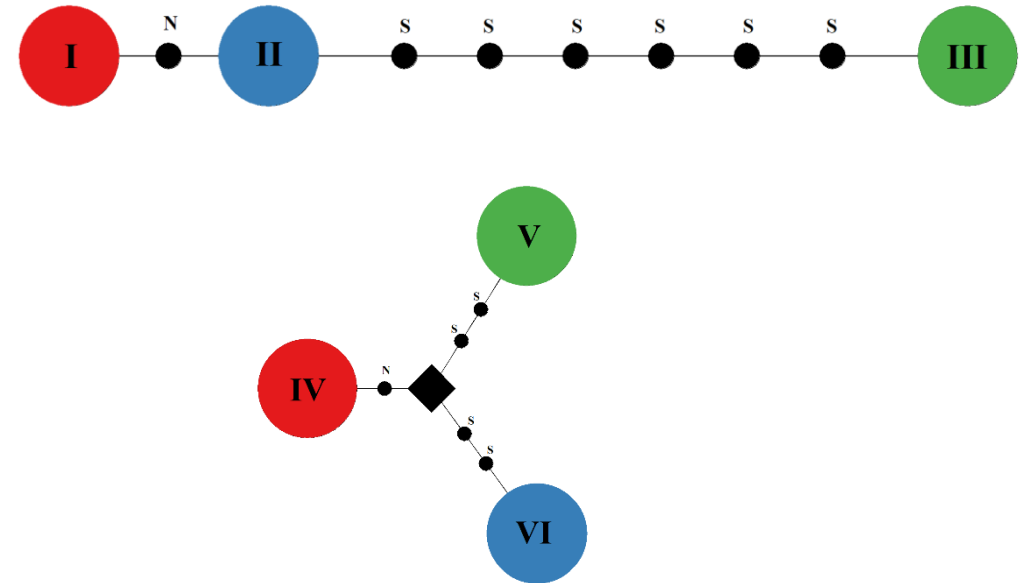
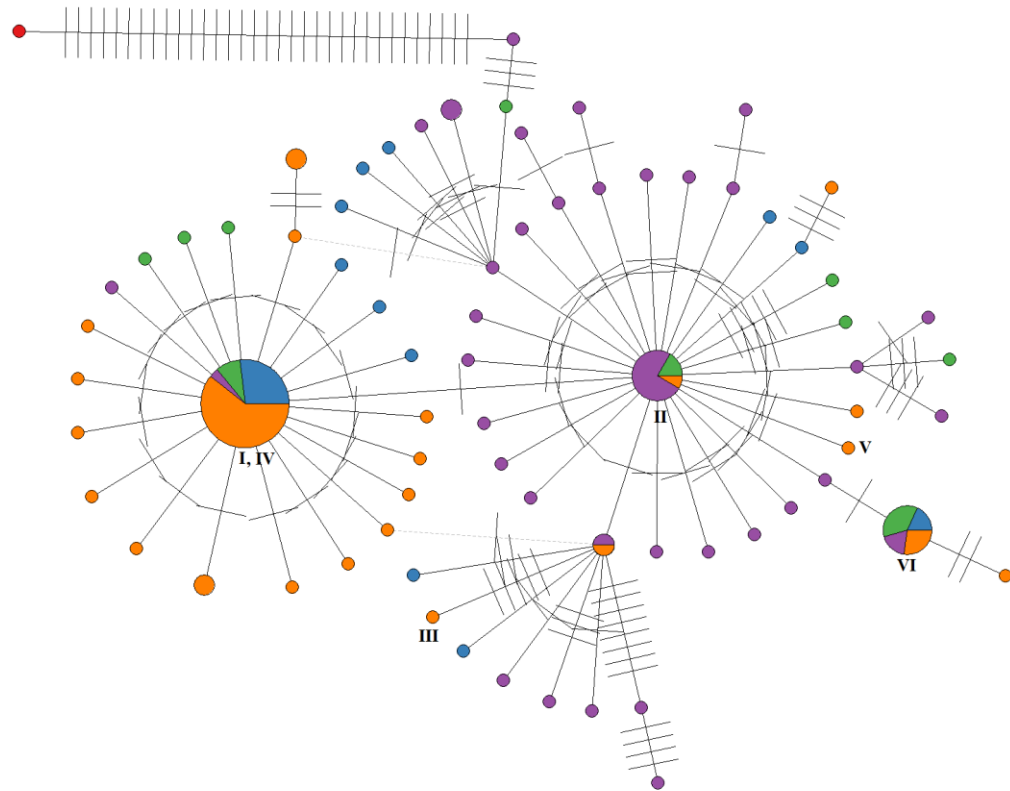
- Sex-specific selection
- Negative frequency dependent selection
- Fluctuations in the environment



# Model organism: *Drosophila obscura*

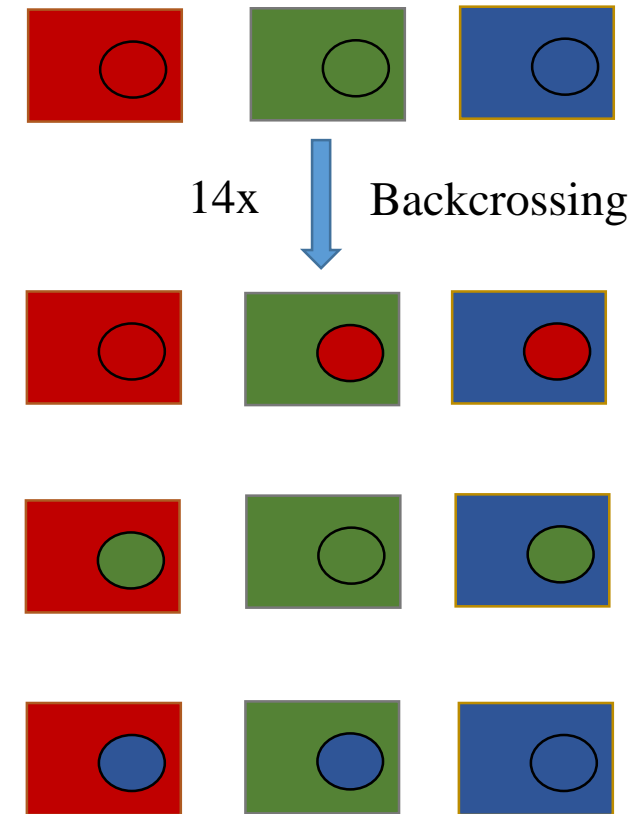
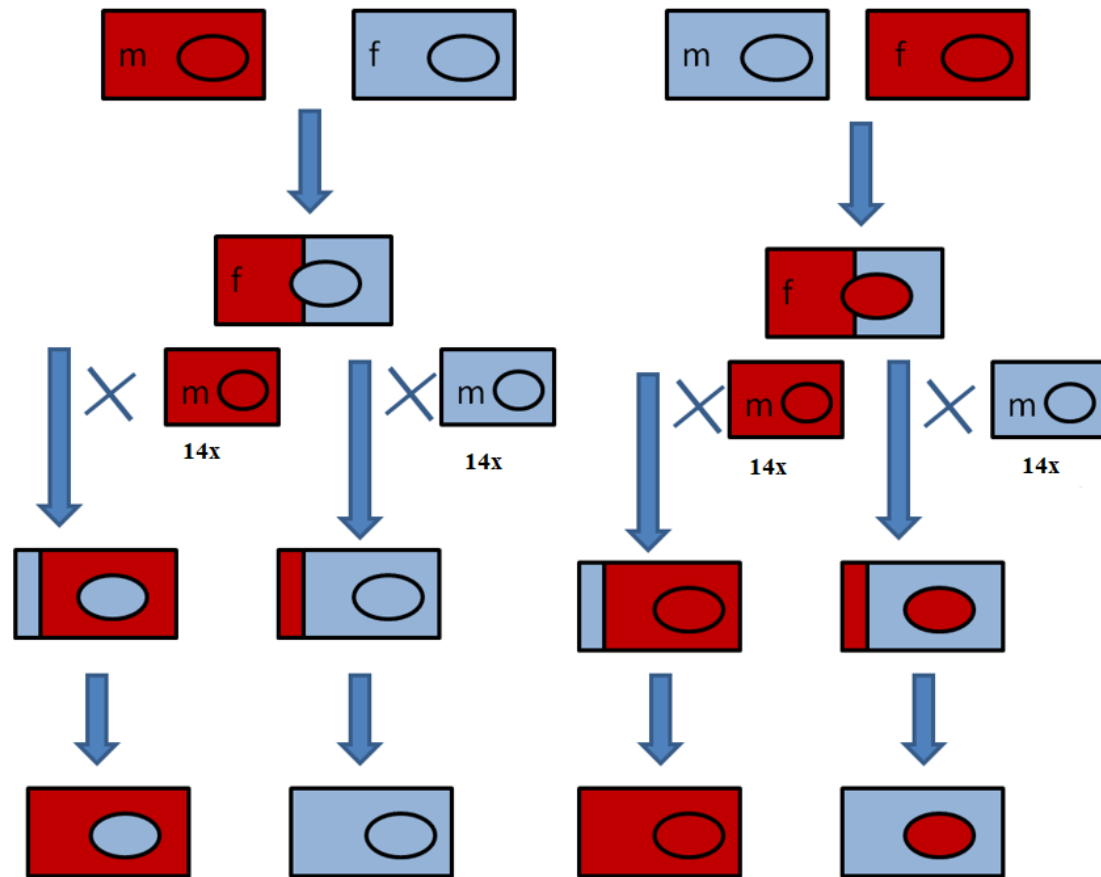




- ❖ Large number of Cytochrome b haplotypes
- ❖ Three isofemale lines with distinct haplotypes from each of the two populations from Serbia



# Experimental design

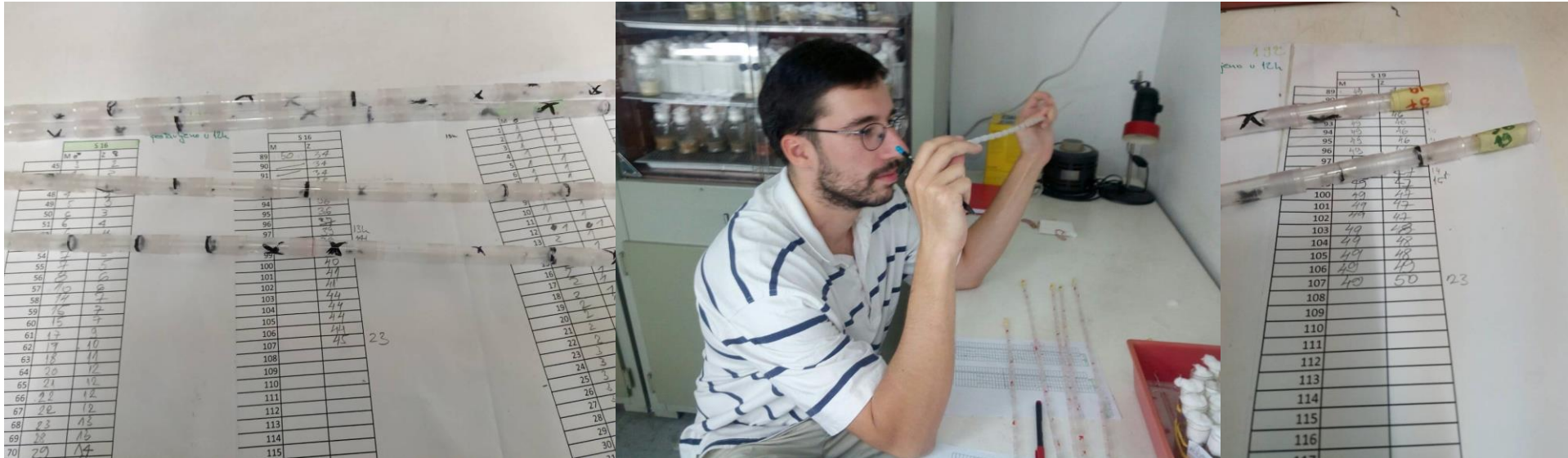
- ❖ Backcrossing
- ❖ All combinations of 3 haplotypes and nuclear backgrounds
- ❖ 9 mito-nuclear introgression lines in each population



 - Nuclear genetic background  
 - Mitochondrial haplotype

# Desiccation resistance

- ❖ Assayed on two temperatures (16°C and 19°C)
- ❖ Individual flies (♀ and ♂) in small plastic compartments with holes for air
- ❖ Around 3000 flies were included in experiment
- ❖ Flies inspected every hour until all died

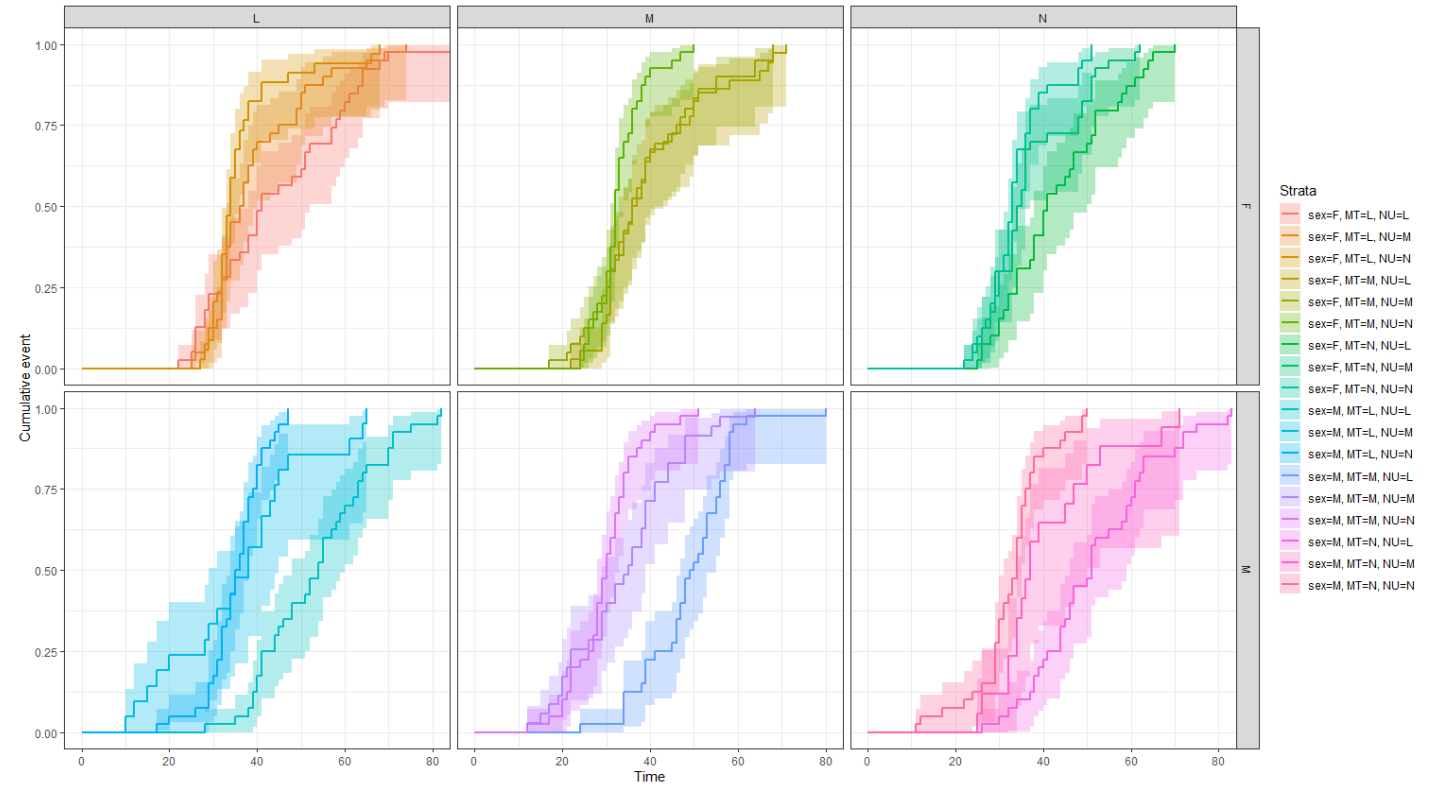


# Survival analysis

❖ Cox proportional hazards

❖ Factors:

- mtDNA
- nuDNA
- Sex
- Temperature
- Interaction terms between factors



# Results

Population 1

comparisons	I vs. II				I vs. III				II vs. III			
	loglik	Shisq	df	p	loglik	Shisq	df	p	loglik	Shisq	df	p
mt	-2531.4	9.2404	1	**	-2536.2	19.5678	1	***	-2566.1	0.3299	1	ns
nu	strata	strata	-	-	strata	strata	-	-	strata	strata	-	-
temp	strata	strata	-	-	strata	strata	-	-	strata	strata	-	-
sex	-2521.6	19.5695	1	***	-2530.5	11.5509	1	***	-2563.9	4.3986	1	*
mt*nu	-2506.3	30.534	1	***	-2521.5	17.9675	1	***	-2562	3.8502	1	*
mt*sex	-2505.4	1.8009	1	ns	-2516.2	10.6697	1	**	-2556.4	11.1001	1	***
mt*t	-2503.6	3.7593	1	.	-2513.9	4.5404	1	*	-2551.5	9.806	1	**
mt*nu*sex	-2503.4	0.2691	2	ns	-2513.6	0.5384	2	ns	-2551.1	0.8387	2	ns
mt*nu*t	-2484.3	38.1587	1	***	-2513	1.2665	1	ns	-2548.7	4.8792	1	*
mt*sex*t	-2476.7	15.2555	2	***	-2505	15.9898	2	***	-2534	29.3755	2	***

Population 2

comparisons	IV vs. V				IV vs. VI				V vs. VI			
	loglik	Shisq	df	p	loglik	Shisq	df	p	loglik	Shisq	df	p
mt	-2873.1	2.0812	1	ns	-3278.7	4.0711	1	*	-2798.6	0.09	1	ns
nu	-2853.4	39.269	1	***	-3219	119.3312	1	***	-2780.6	36.1704	1	***
temp	-2770.2	166.5078	1	***	-3149.5	138.9328	1	***	-2764.8	31.5955	1	***
sex	-2769	2.4158	1	ns	-3149.4	0.3154	1	ns	-2761.2	7.0618	1	**
mt*nu	-2764.4	9.0753	1	**	-3144.6	9.5929	1	**	-2756.8	8.7382	1	**
mt*sex	-2764.4	0.0271	1	ns	-3142.3	4.5495	1	*	-2756.8	0.0614	1	ns
mt*t	-2757.4	14.0732	1	***	-3139.6	5.4025	1	*	-2754	5.6945	1	*
mt*nu*sex	-2754.3	6.0943	2	*	-3132.8	13.5174	2	**	-2752	3.9551	2	ns
mt*nu*t	-2749.2	10.3658	2	**	-3126.8	11.9788	2	**	-2739.8	24.443	2	***
mt*sex*t	-2748.8	0.7144	2	ns	-3117	19.7199	2	***	-2731.5	16.576	2	***

loglik - log likelihood; Shisq - shisquared value; df - degrees of freedom; ns - non-significant; . - p<0.06; \* - p<0.05; \*\* - p<0.01; \*\*\* - p<0.001; strata - variable is stratified



# Conclusions

- ❖ *Drosophila obscura* mtDNA variants differ in fitness values (adaptive significance of intra-population mtDNA variation)
- ❖ Importance of interaction between mitochondrial and nuclear genome on fitness
- ❖ Genotype-by-environment interactions are important for maintaining stable intra-population mtDNA variability
- ❖ Sex-specific mito-nuclear interactions are not as important for maintaining intra-population mtDNA variability

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