

Mating behavior, sperm competition, and reproductive protein evolution in *Agelaius* blackbirds

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1. DOES POPULATION VARIATION IN MATING BEHAVIOR AFFECT THE STRENGTH OF SPERM COMPETITION?

- Most hypotheses for extra-pair copulation (EPC) focus on indirect genetic benefits to females (1). These hypotheses (such as good genes, genetic compatibility, and genetic heterogeneity) share the assumption that extra-pair and within-pair males differ genetically.
- If population genetic profiles shape the relative payoffs of EPC, then a key prediction is that population genetic diversity and the frequency of EPC are related.
- To test this prediction, I am measuring levels of genetic diversity and EPC in eight populations of red-winged blackbirds (*Agelaius phoeniceus*), a socially polygynous bird with varying levels of EPC.

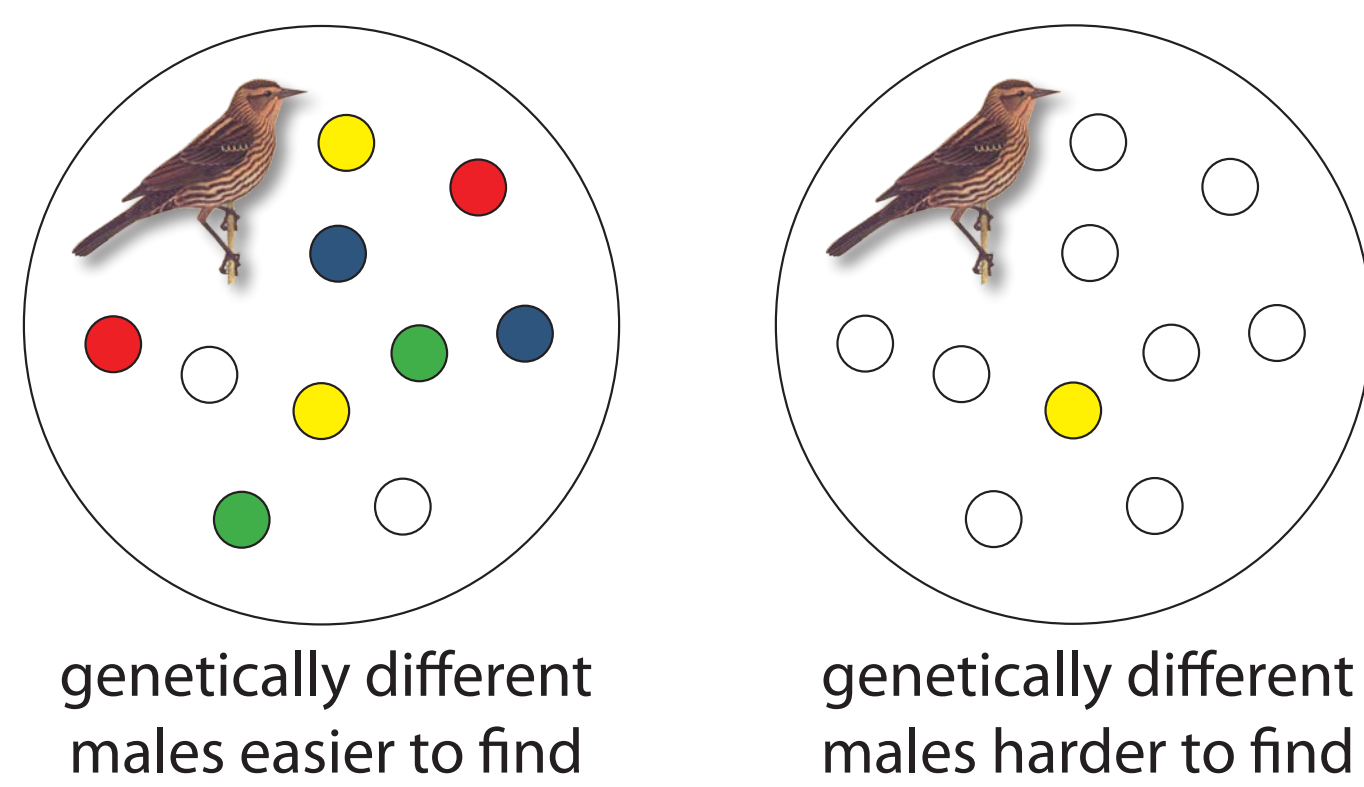


Figure 1. Costs and benefits of EPC may vary in different populations. Females in a genetically diverse population might enjoy higher odds and lower search costs of finding genetically different extra-pair mates (left), while females in a uniform population might face lower odds and higher costs of EPC (right).

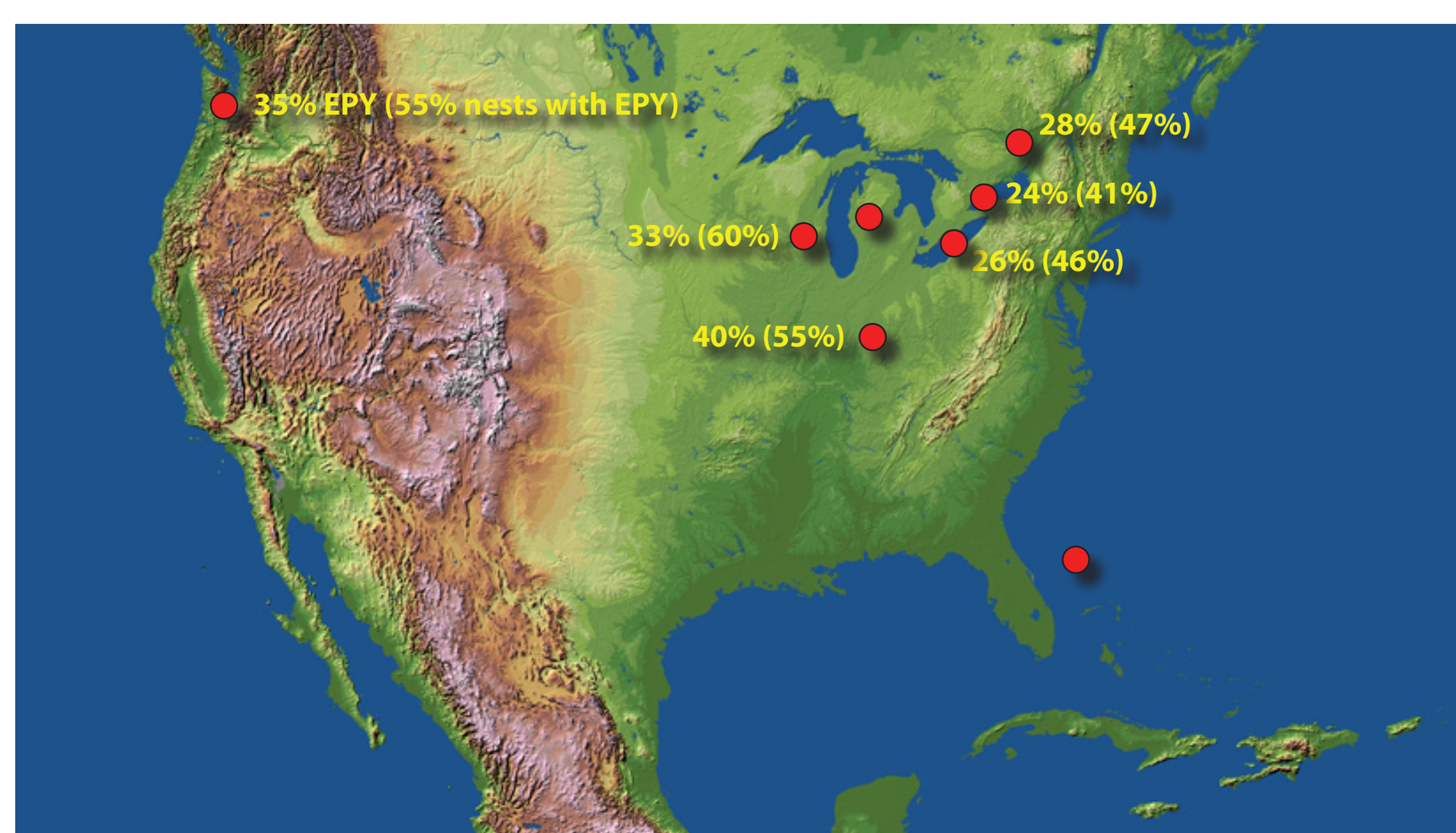


Figure 2. Rates of extra-pair mating vary across populations. Marked circles, west to east: Percentage of extra-pair young (EPY) and percentage of nests with EPY from Washington, Wisconsin, Kentucky, Pennsylvania, New York and Ontario (2-6). Unmarked circles: EPC rates in Michigan and the Bahamas are to be calculated.

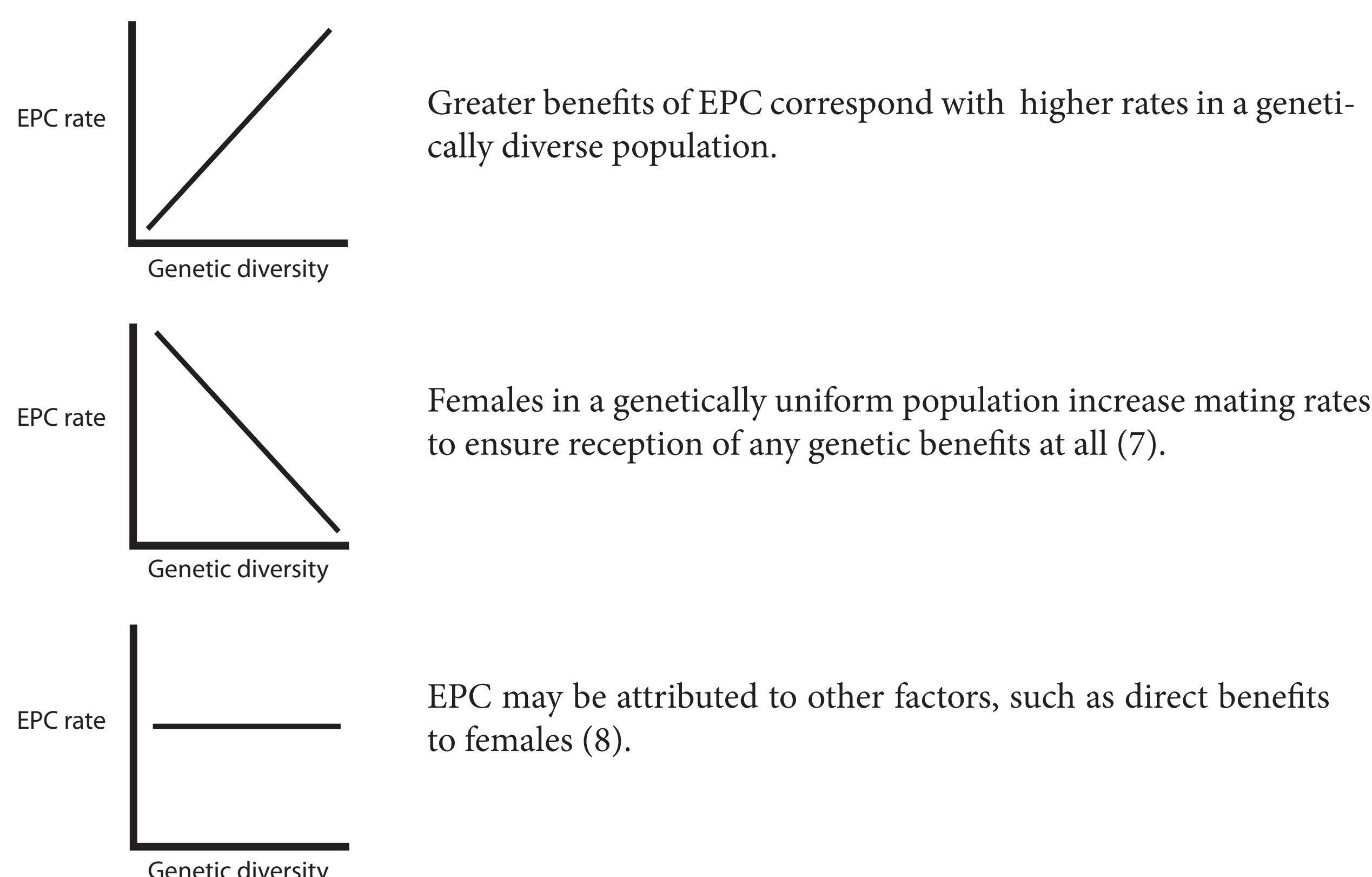
(A) Measure genetic diversity and EPC across populations

- In 2009, I sampled birds in the Bahamas and Pennsylvania and measured genetic diversity at four microsatellite loci. I also measured EPC rate in Pennsylvania.
- Birds in the Bahamas had fewer alleles per locus than did birds in Pennsylvania, possibly reflecting the occurrence of island founding events (Table 1).
- I will measure genetic diversity for all populations with published EPC data (Fig. 2).

Population	Locus	N	N _a	N _e	I	H _{obs}	H _{exp}	F
Pennsylvania	<i>Aph54</i>	64	35	14.8	3.2	0.95	0.94	0.05
	<i>FhU2</i>		13	7.1	2.2	0.94	0.87	-0.06
	<i>LTMR6</i>		15	8.2	2.4	0.94	0.88	-0.08
	<i>QM10</i>		18	8.1	2.4	0.84	0.89	-0.01
Bahamas	<i>Aph54</i>	24	17	11.2	2.6	0.75	0.91	0.18
	<i>FhU2</i>		6	2.8	1.4	0.71	0.64	-0.1
	<i>LTMR6</i>		6	2.3	1.2	0.58	0.57	-0.02
	<i>QM10</i>		6	3.6	1.5	0.83	0.72	-0.15
Paired t-test P =			0.02	0.001	0.007	0.07	0.05	0.99

Table 1. Birds in the Bahamas exhibit lower genetic diversity than birds in Pennsylvania. Number of alleles, effective number of alleles (sample-size adjusted), Shannon diversity index, observed and expected heterozygosity, and fixation index values for four microsatellite loci from Bahama and Pennsylvania red-winged blackbird populations.

(B) What are the possible outcomes?



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2. DO SPECIES WITH DIFFERENT LEVELS OF SPERM COMPETITION EXHIBIT DIFFERENT RATES OF PROTEIN EVOLUTION?

- Mating systems may influence the intensity of sperm competition and the rate of protein evolution. Reproductive proteins, targets of selection from sperm competition and antagonistic sexual selection, frequently evolve faster in polyandrous than monogamous species (9).
- Because of their mating system variation, *Agelaius* blackbirds are an ideal system with which to detect the effect of sexual selection on protein evolution. I will compare rates of evolution across the five *Agelaius* species, predicting that species with multiple mating by females will show elevated rates of male protein evolution relative to species where multiple mating is less prevalent.

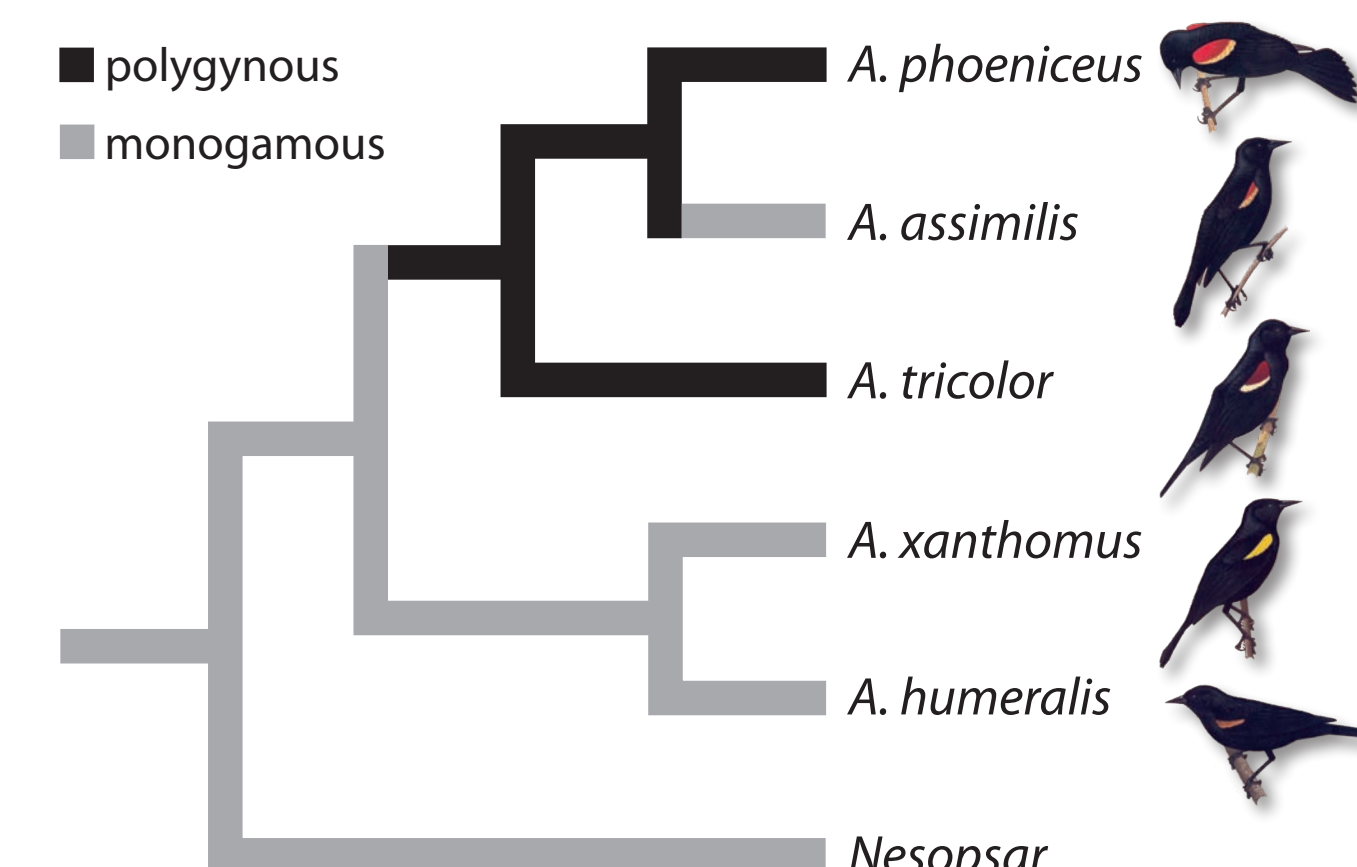
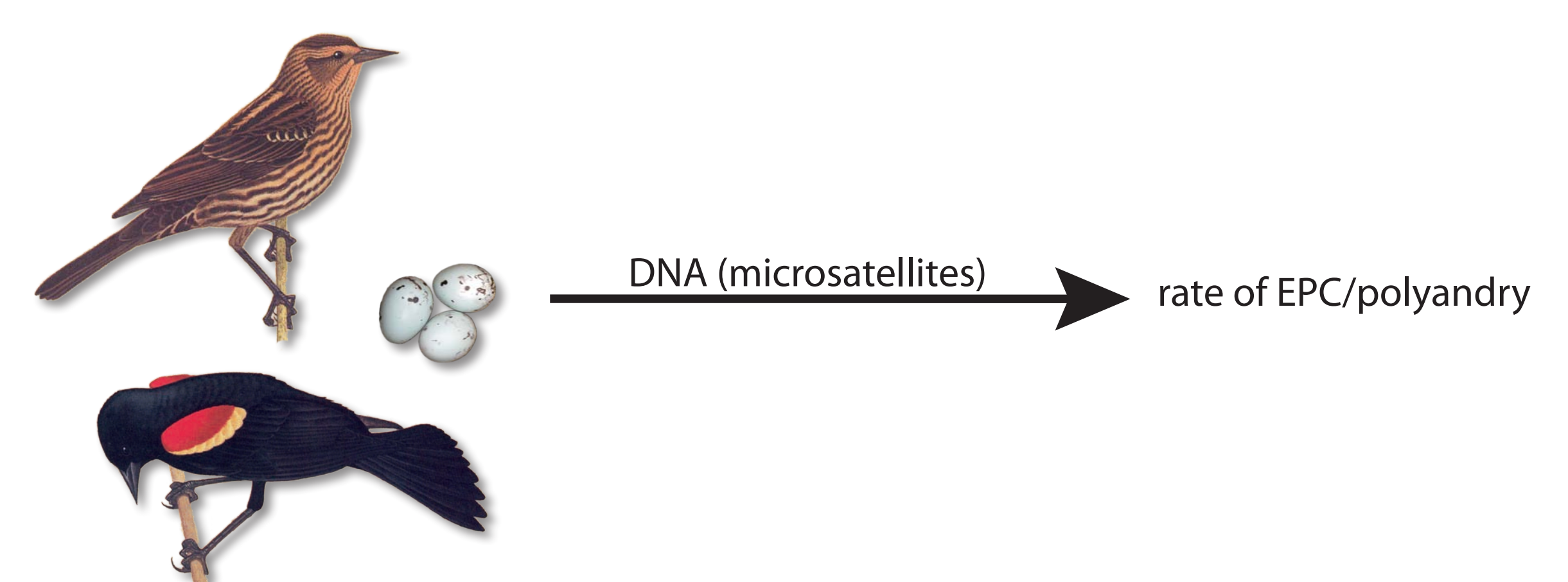


Fig. 3. Hypothesis for social mating system evolution in *Agelaius* (10). Mating system diversity within this genus reflects the variation across Family Icteridae, in which social polygyny has independently arisen six times across 57 species (11).

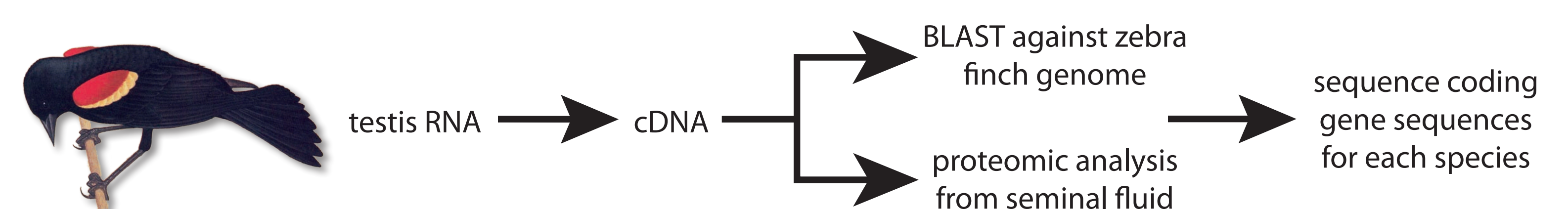


Figure 4. Geographic distribution of *Agelaius* blackbirds. West to east: *A. tricolor* is found along the west coast of the United States; *A. phoeniceus* is found across North America; *A. assimilis* is endemic to Cuba; *A. humeralis* is found in Cuba and Haiti; and *A. xanthomus* is endemic to Puerto Rico.

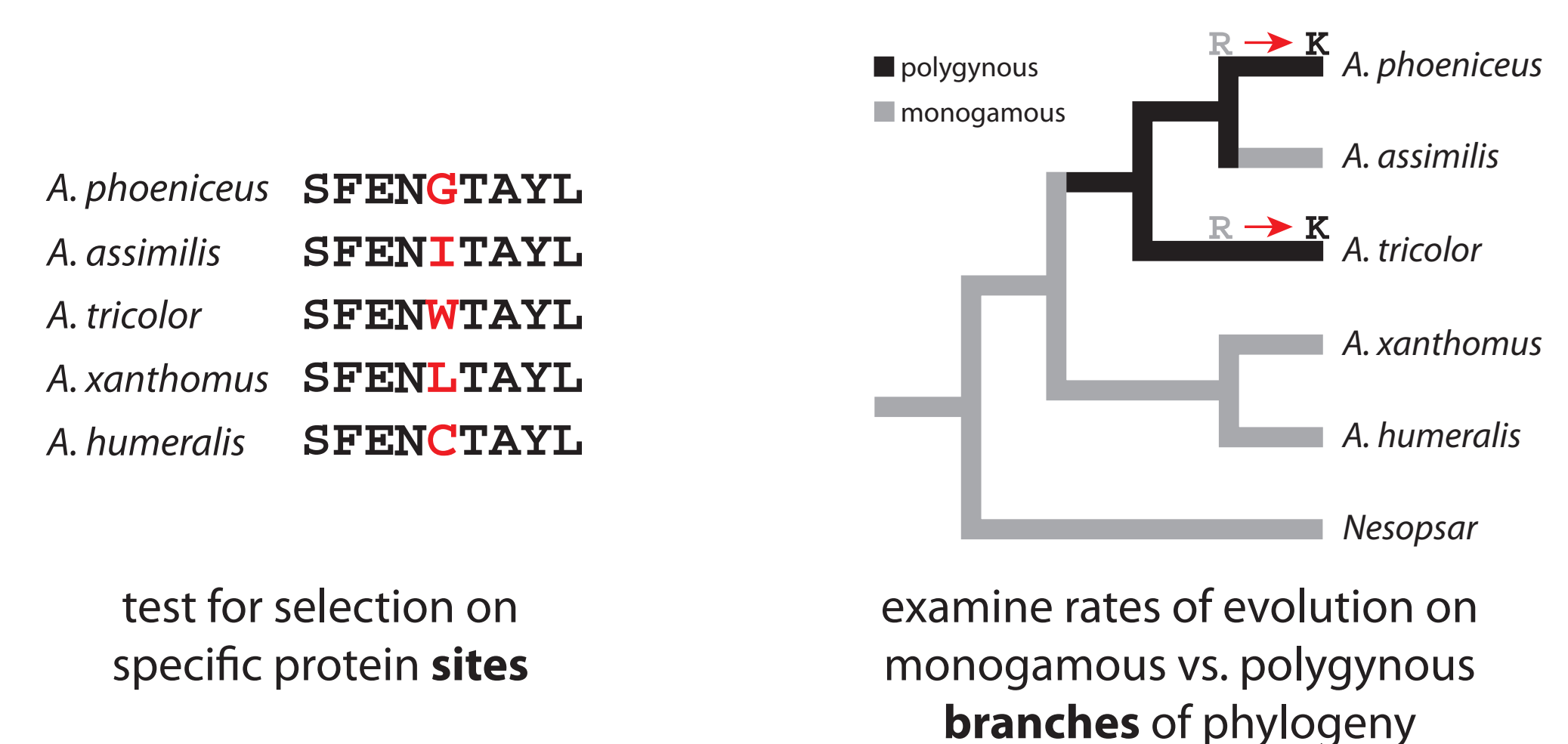
(A) Measure sperm competition across species



(B) Identify reproductive proteins



(C) Compare protein evolutionary rates across species



WHERE WILL THIS WORK TAKE US?

Little is known about the interactions between mating systems, sperm competition and sequence evolution, yet this complex interplay affects the evolutionary interests of the sexes. These studies address two objectives: to understand how mating strategies evolve in populations and species experiencing different levels of sexual selection, and to examine how sexual selection influences evolution on the molecular level. Documenting the link between behavioral and genetic responses to sperm competition holds rich potential for our understanding of sexual coevolution and highlights the importance of addressing biological questions from multiple levels of organization.

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