VII. Variation Among Populations

A. Geographic variation

1. Ecogeographic rules

2. Clines

B. What causes clines?

1. Reciprocal transplant experiments

Species and Speciation

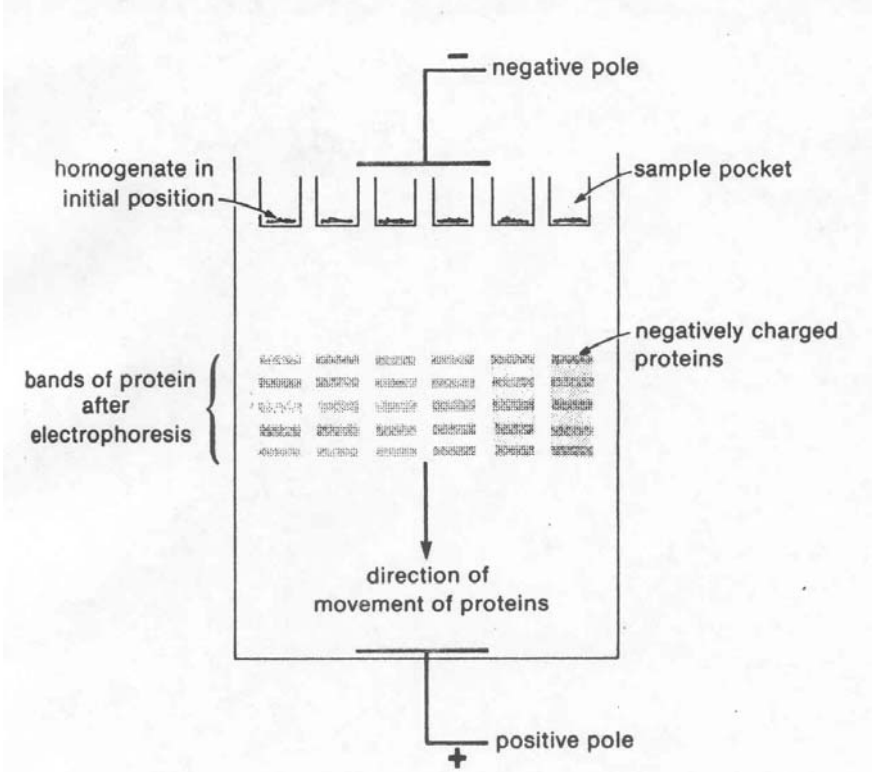
I. What is a species

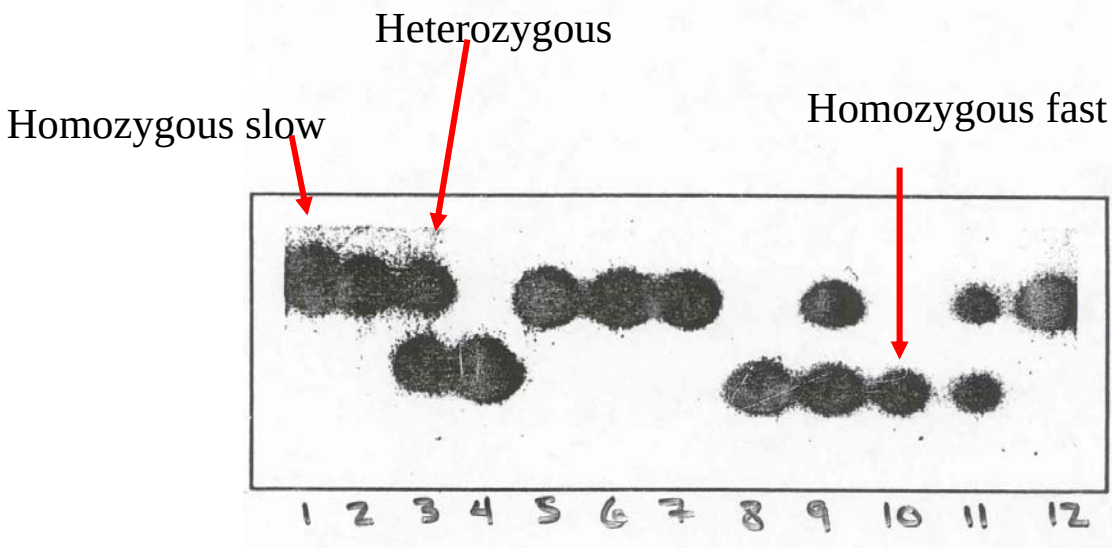
A. Binomial nomenclature

B. The Morphological species concept

C. The Biological species concept

Electrophoresis - separates proteins based on differences in size and electrical charge





Survey of electrophoretic variation in natural populations

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Organisms	Number of species studied	Average number of loci studied per species	Proportion of polymorphic loci per population*	Proportion of heterozygous loci per individual
Invertebrates				
Drosophila	28	24	0.529	0.150
Wasps	6	15	0.243	0.062
Other insects	4	18	0.531	0.151
Marine	14	23	0.439	0.124
Land snails	5	18	0.437	0.150
Vertebrates				
Fish	14	21	0.306	0.078
Amphibians	11	22	0.336	0.082
Reptiles	9	21	0.231	0.047
Birds	4	19	0.145	0.042
Mammals	30	28	0.206	0.051
Average values				
Invertebrates	57	21 .8	0.469	0.134
Vertebrates	68	24 .1	0.247	0.060
Plants	8	8	0.464	0.170

Fig 14.11 **Epistasis** can hide dominant alleles from natural selection

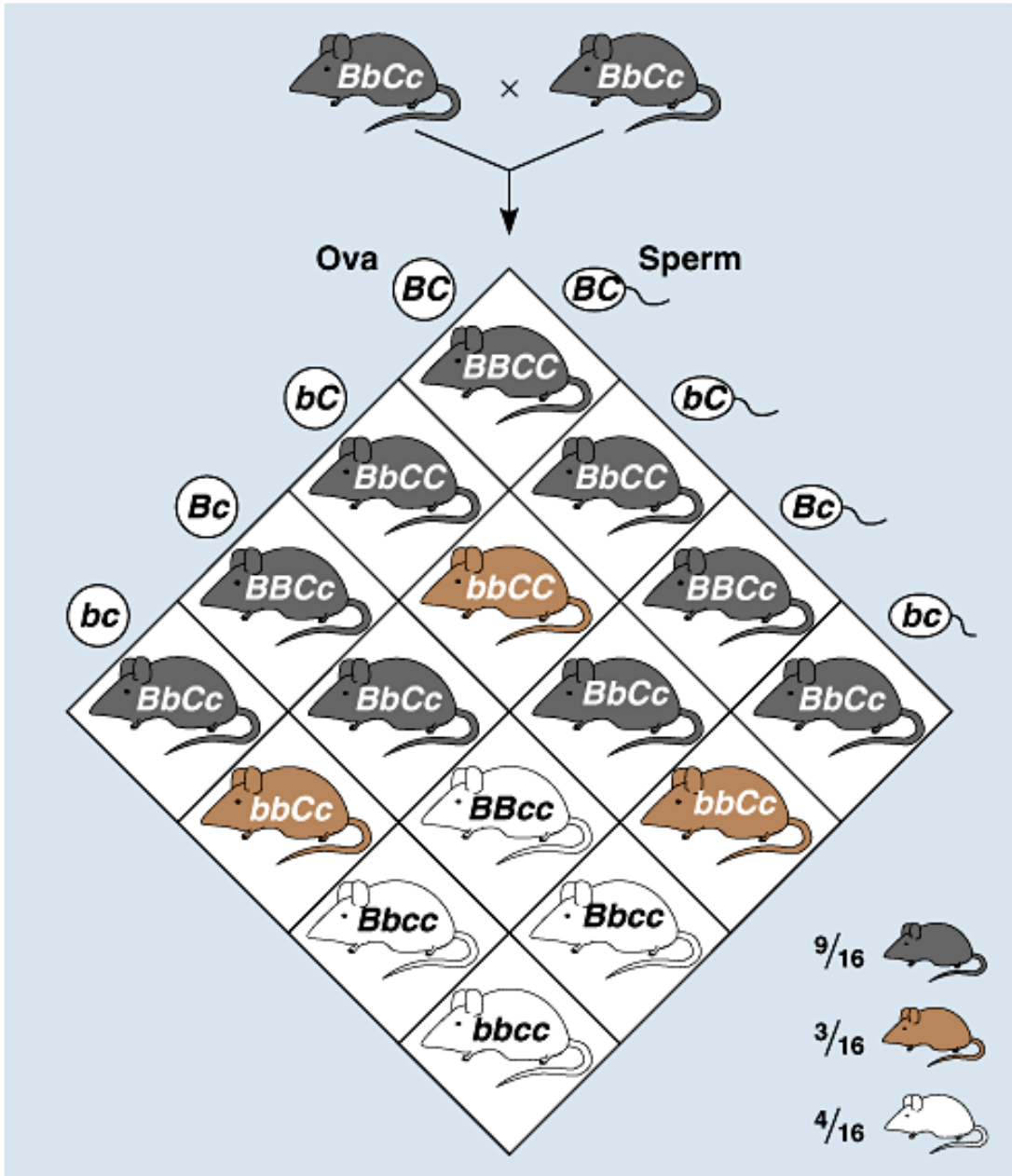
C= pigment

c = none

B = deposition of lots of pigment (black)

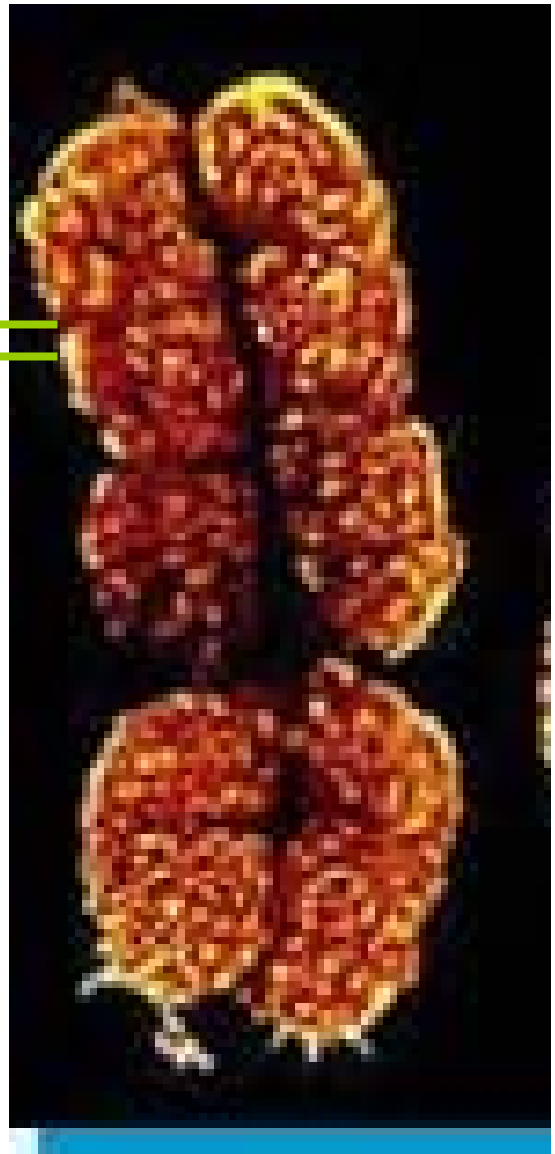
b = less deposition (brown)

If cc, fur is white regardless of genotype at B locus



Genetic hitchhiking: tight linkage to a favorable gene can protect a less favorable gene from selection.

Good gene
Bad gene



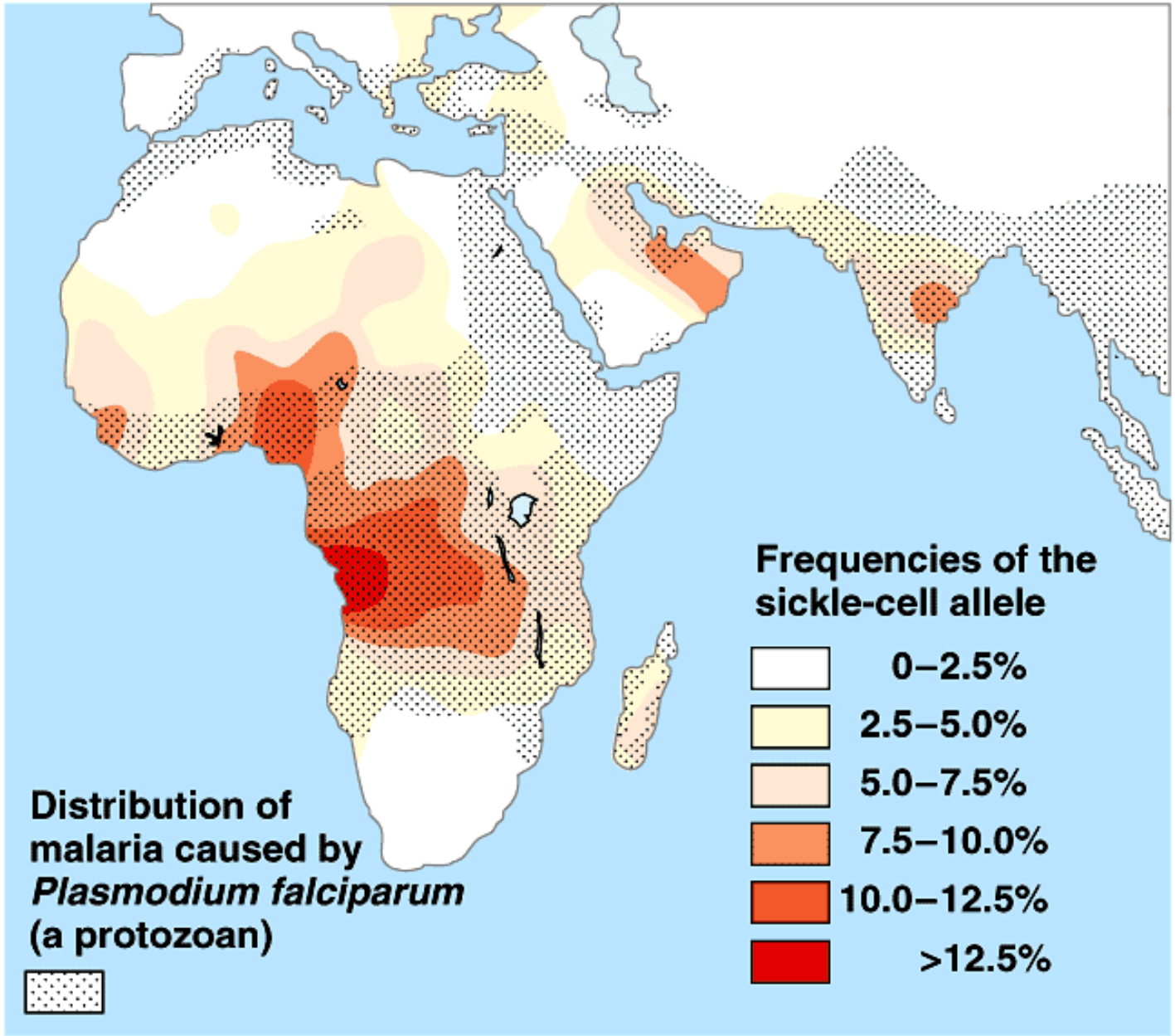
Heterozygote advantage in Sickle cell anemia:

Hb+ = normal RBC

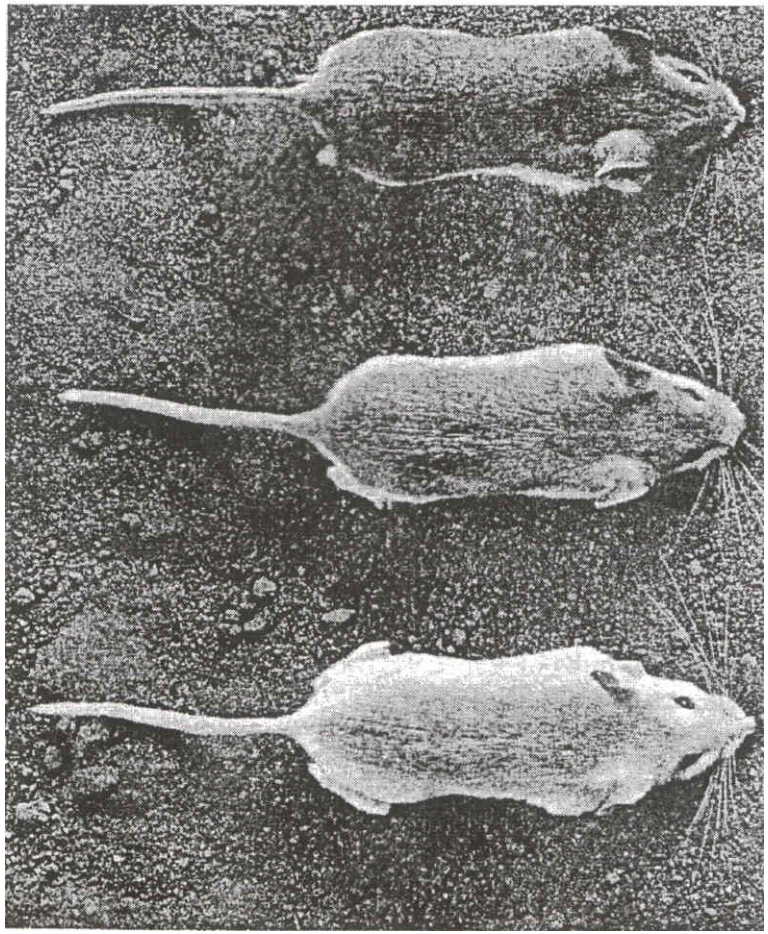
(co-dominant) Hbs = sickled RBC

Genotype	RBC	Susceptibility to malaria	Relative fitness
HB+ Hb+	normal	highest	intermediate
Hb+ Hbs	normal*	lower	highest
Hbs Hbs	sickled	lower	lowest

* Carriers can be identified by subjecting a blood sample to very low oxygen conditions - some cells will sickle



Diversifying selection in space in deer mice



Dark color is favored on rich soil

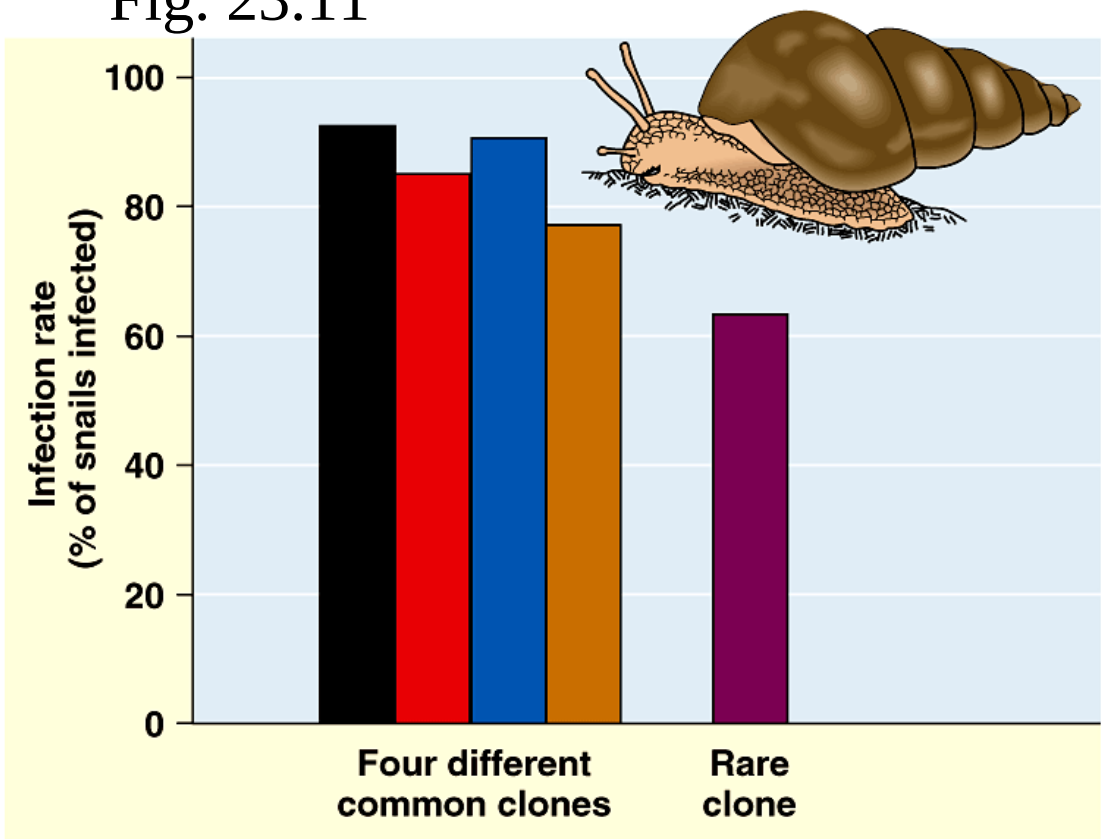
Light color is favored on sandy soil

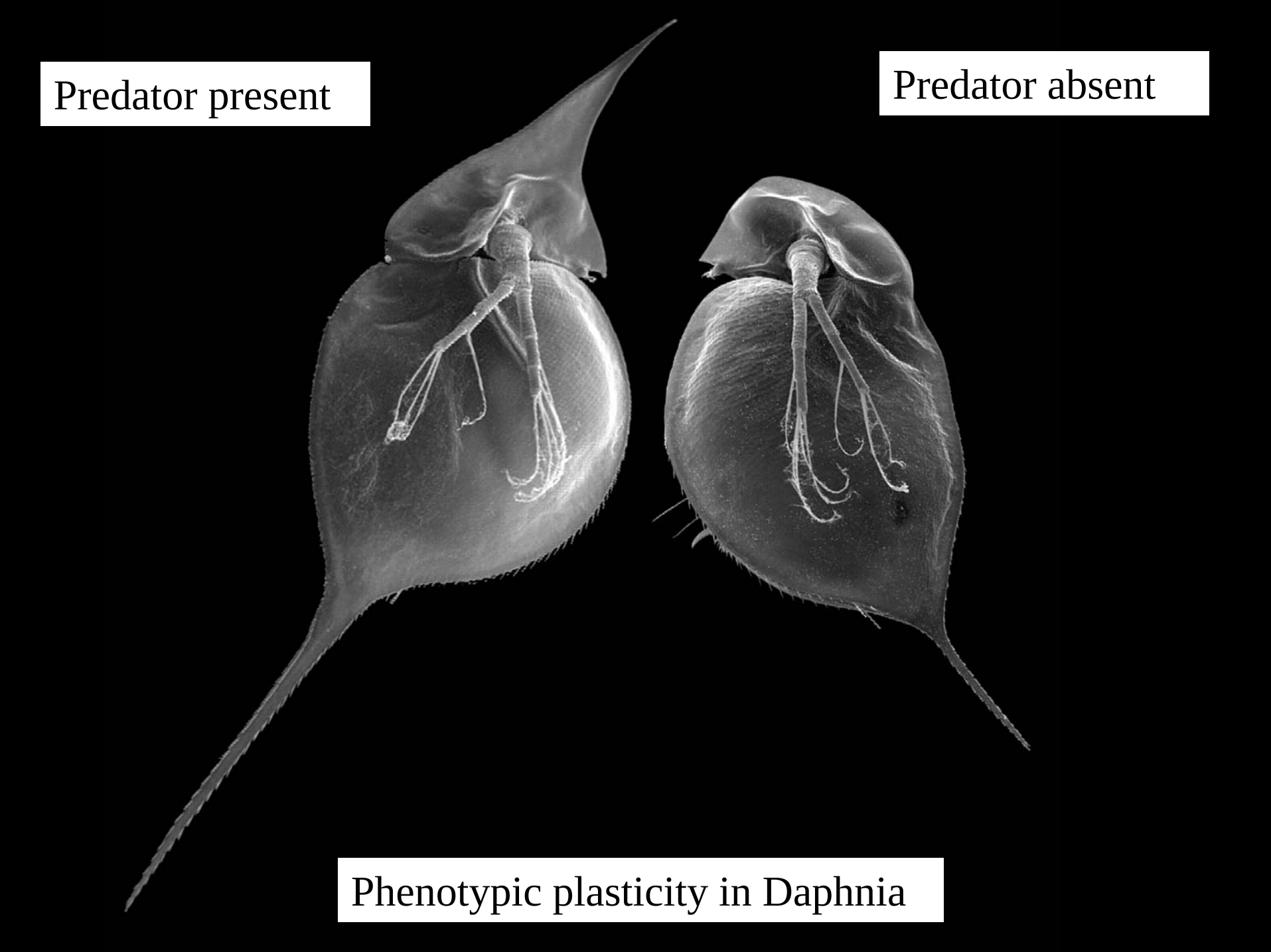
Diversifying selection in time in the snow goose

Nesting habitat

Frequency-dependent selection: the relative fitness of a genotype depends on how common it is.

Fig. 23.11

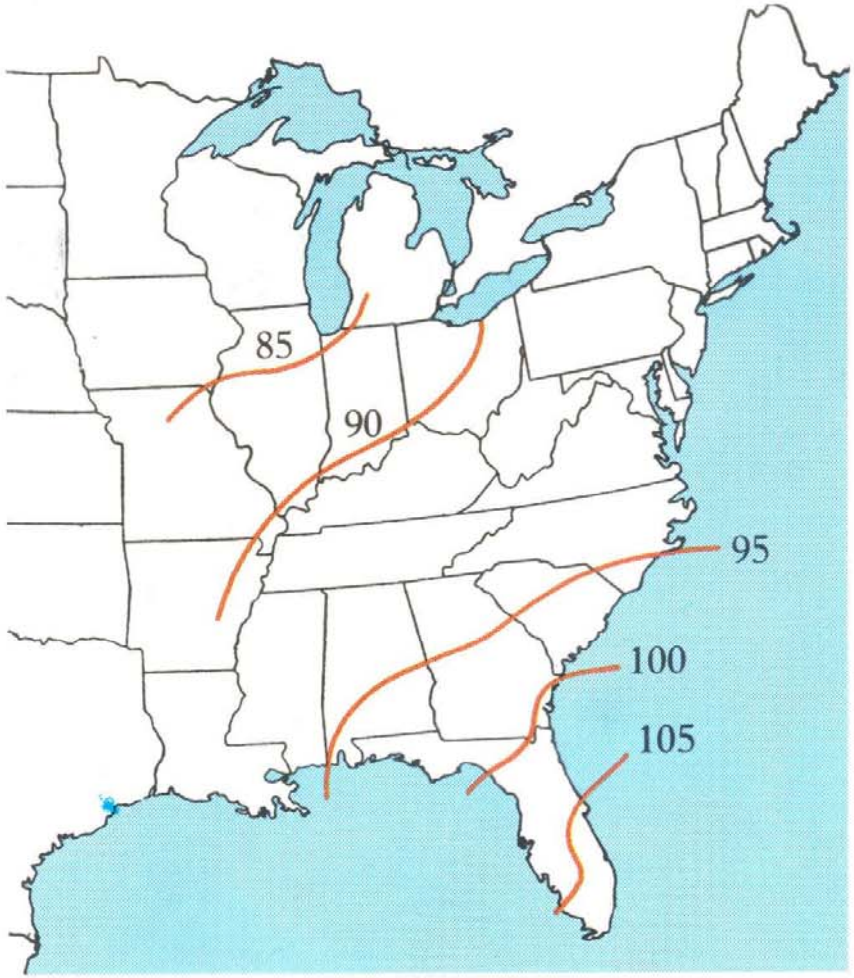



Predator present
Predator absent
Phenotypic plasticity in Daphnia

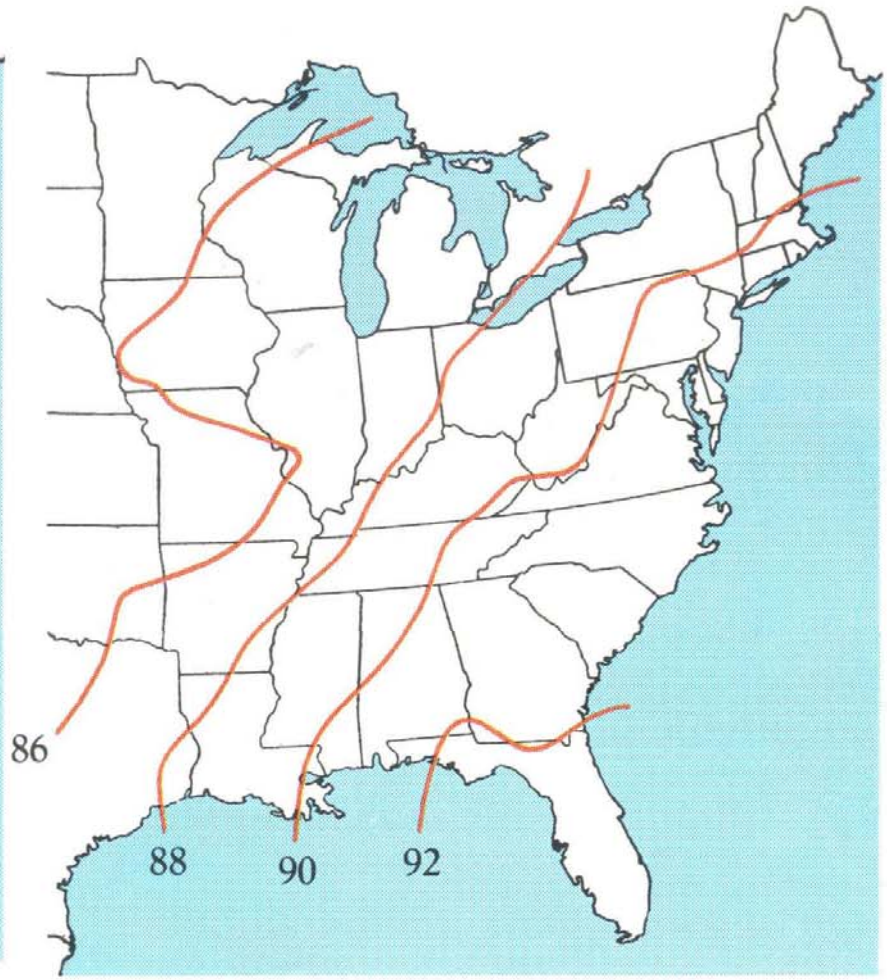
Geographic variation - populations of the same species have different phenotypes in different geographic areas.

Gray squirrels in the northern US are much larger than those in the southern US

Cline: variation among populations that is consistent with respect to geography

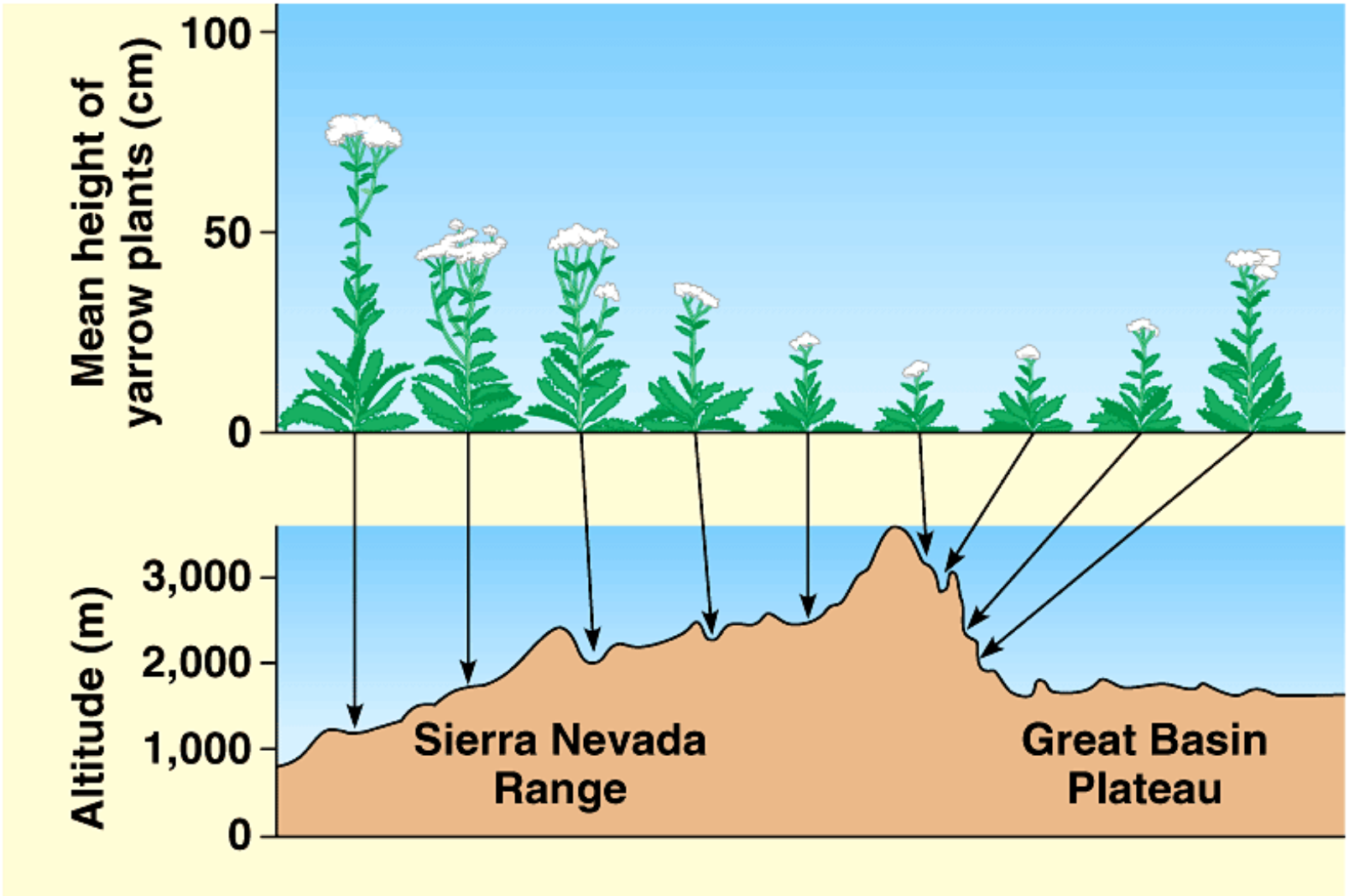


subcaudal scales in racers



Apical taper in milkweeds

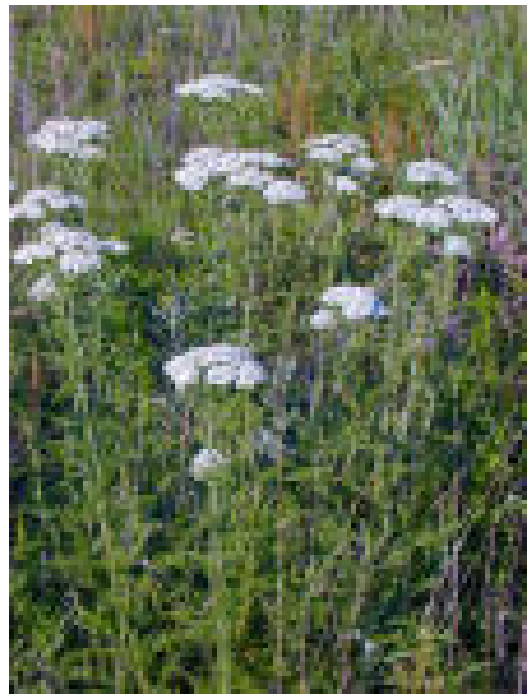
Fig. 23.8: A cline in plant height with altitude



Expected results from reciprocal transplant between low and high elevation sites:

If cline is caused by environment effects:

		FROM	
		Low	high
TO	Low	tall	tall
	High	short	short



If cline is caused by genetic differentiation

		FROM	
		Low	high
TO	Low	tall	short
	High	tall	short