Microevolución

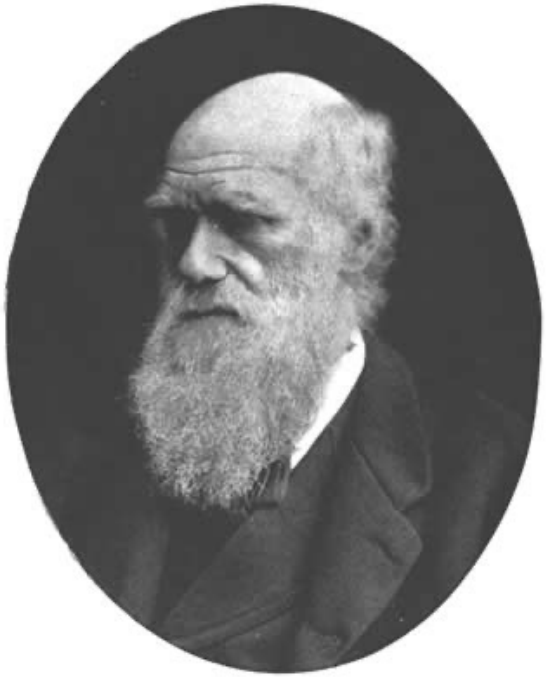
Genética de poblaciones

eric.fuchs@ucr.ac.cr

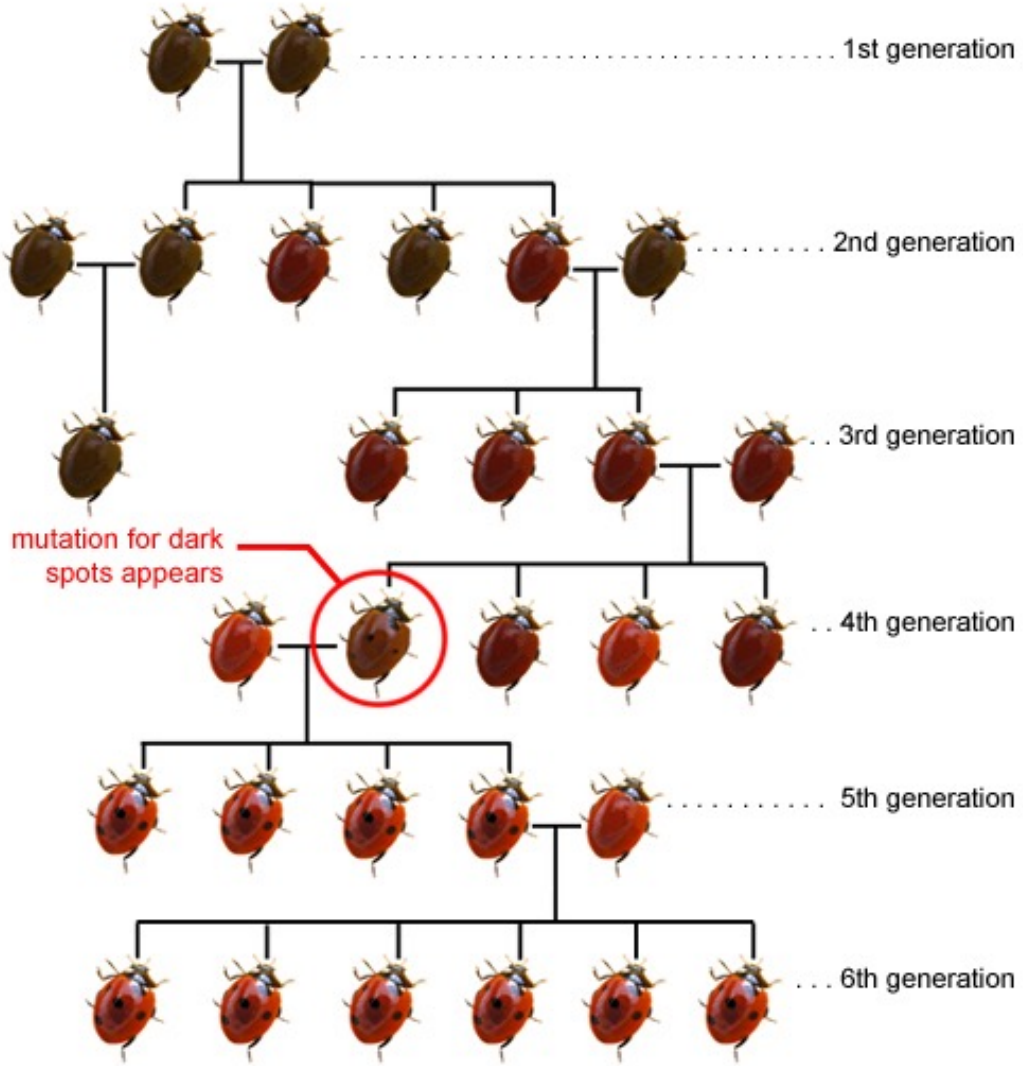
Agosto, 2022

Evolución

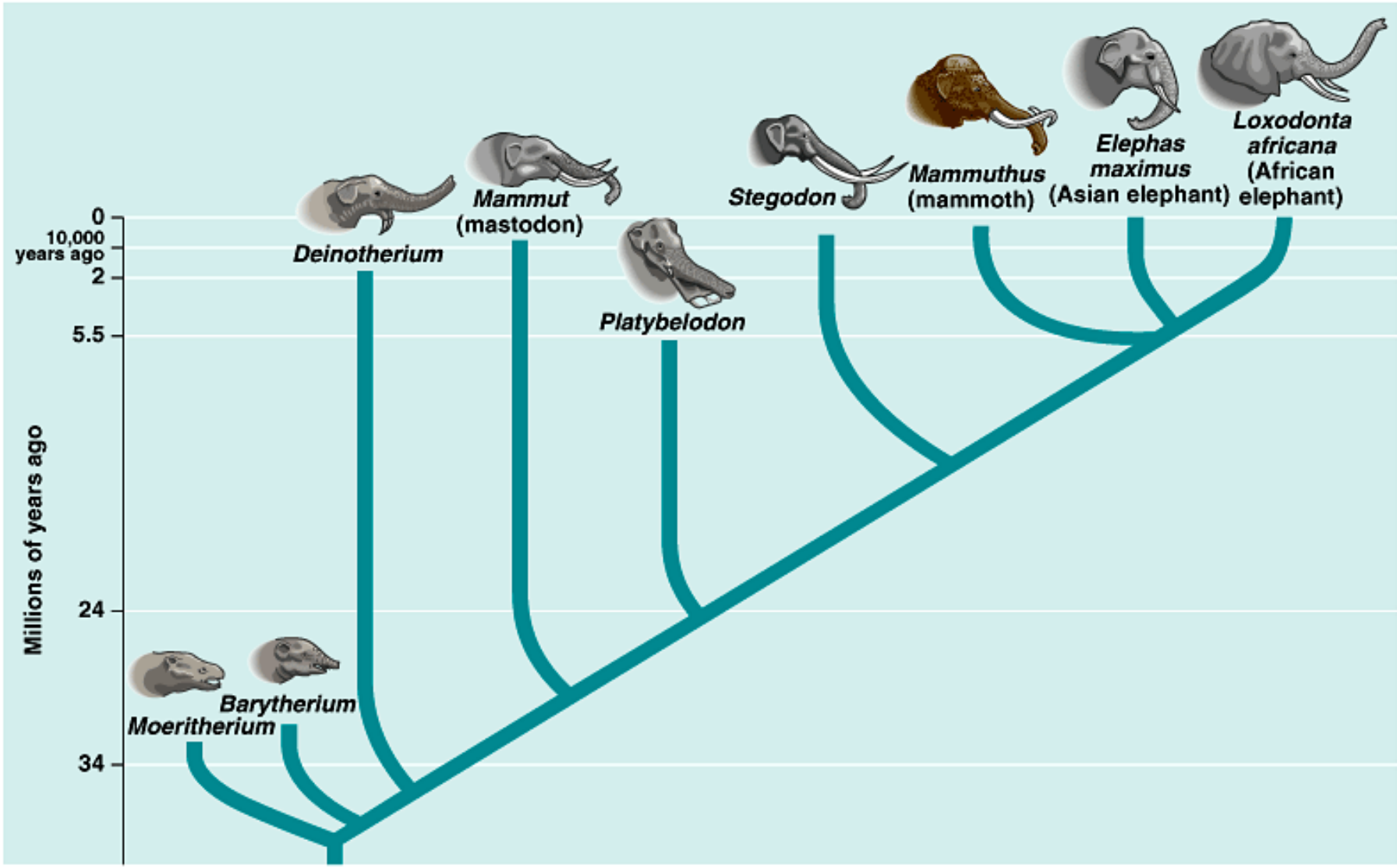
Proceso por el cual una especie, a través de una serie de cambios graduales, adquiere caracteres morfológicos o fisiológicos que la hacen más apta para el ambiente en el que vive



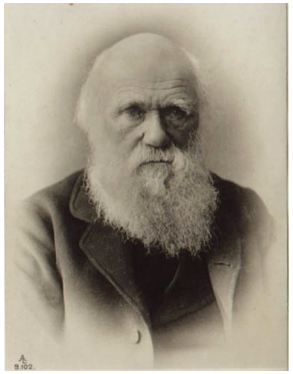
Descendencia con modificación



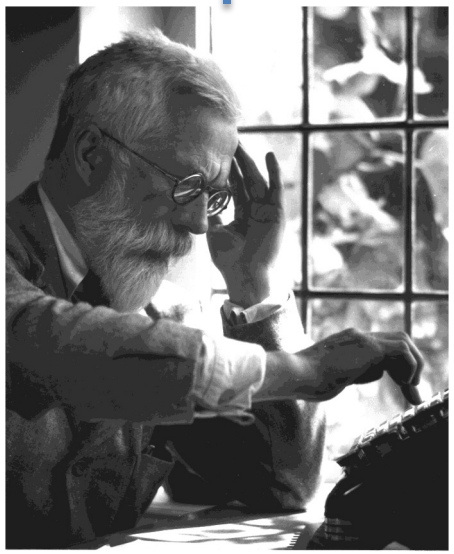
Descendencia con modificación



Neo-Darwinismo



Mendel



Ronald A. Fisher

Sewall Wright

¿Quién evoluciona?

Microevolución

Genes responsables por herencia de rasgos.

Las poblaciones evolucionan

Cambios ocurren en la poza génica por fuerzas evolutivas

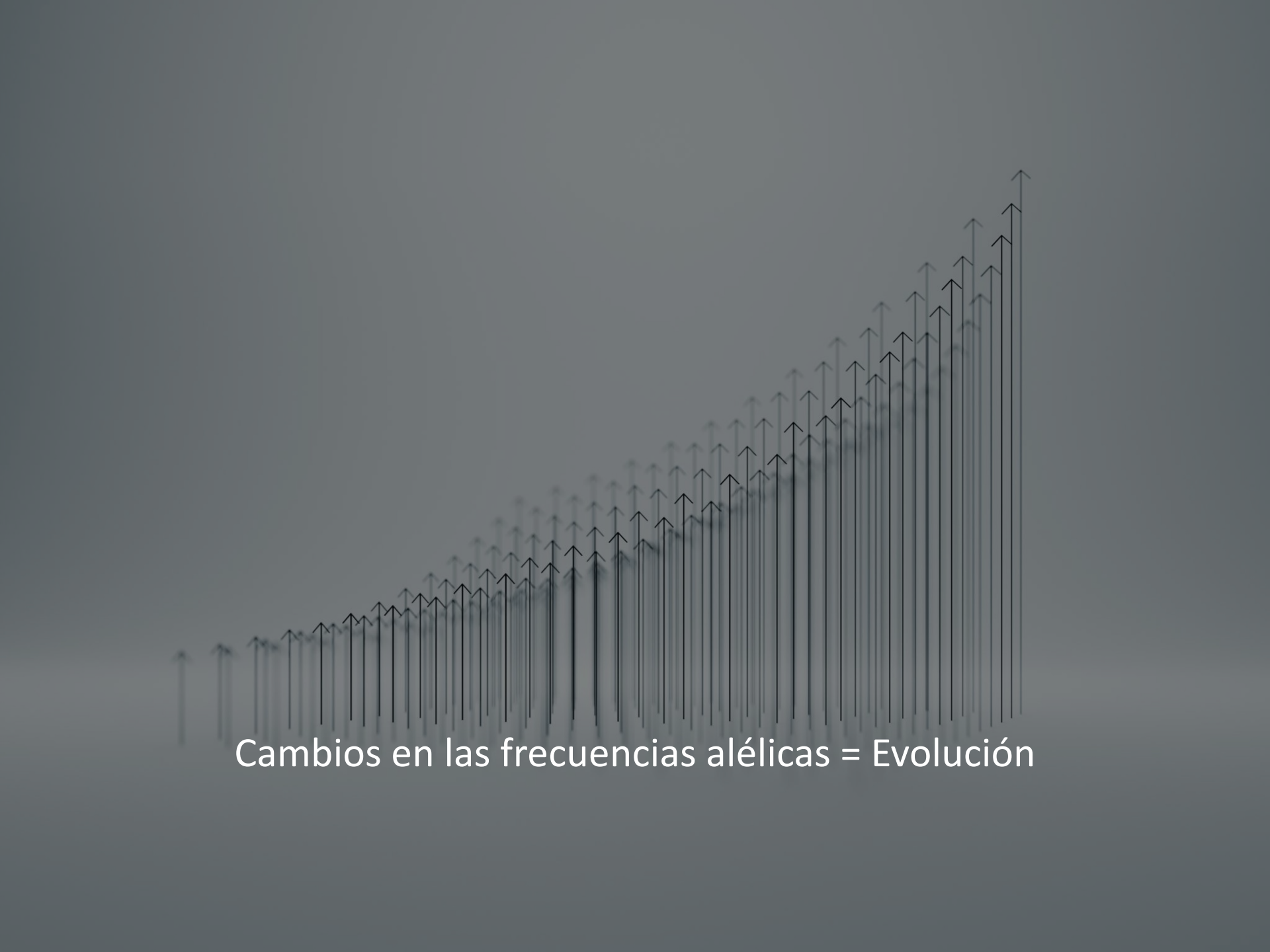
Este proceso se conoce como Microevolución

Poza génica

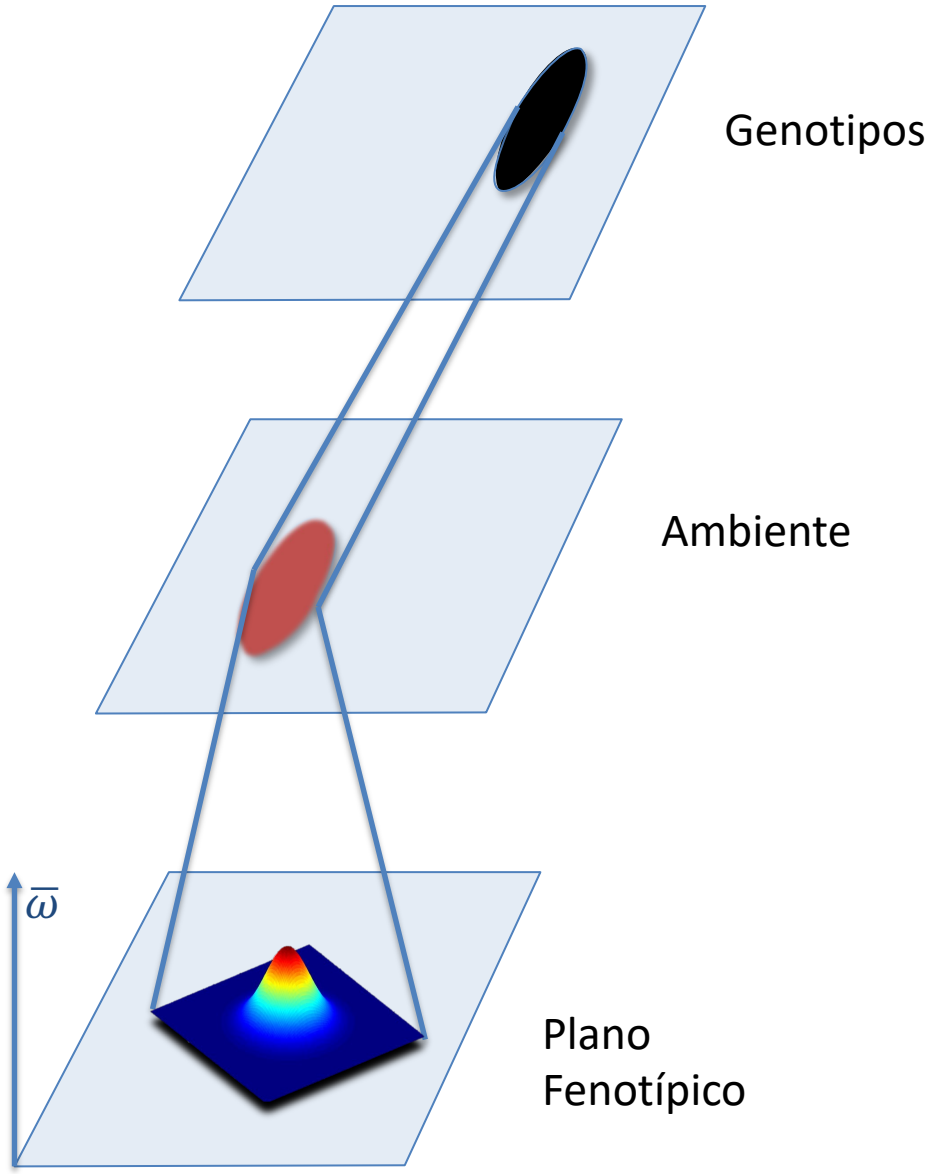
Alelos disponibles para la siguiente generación

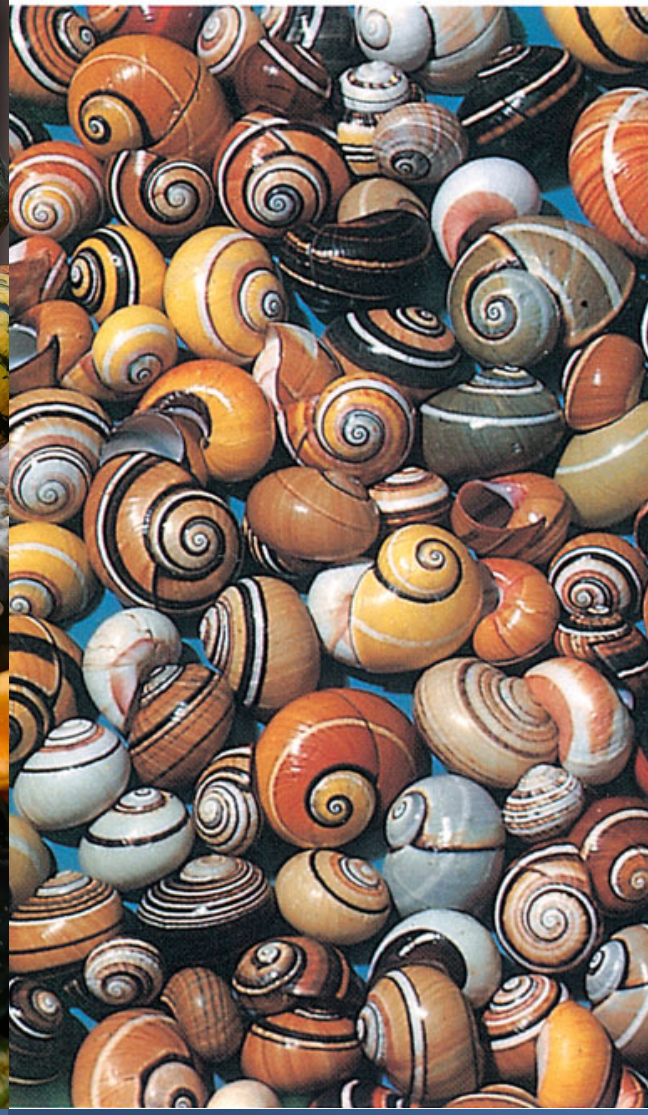
Frecuencias alélicas en poza

Poza génica



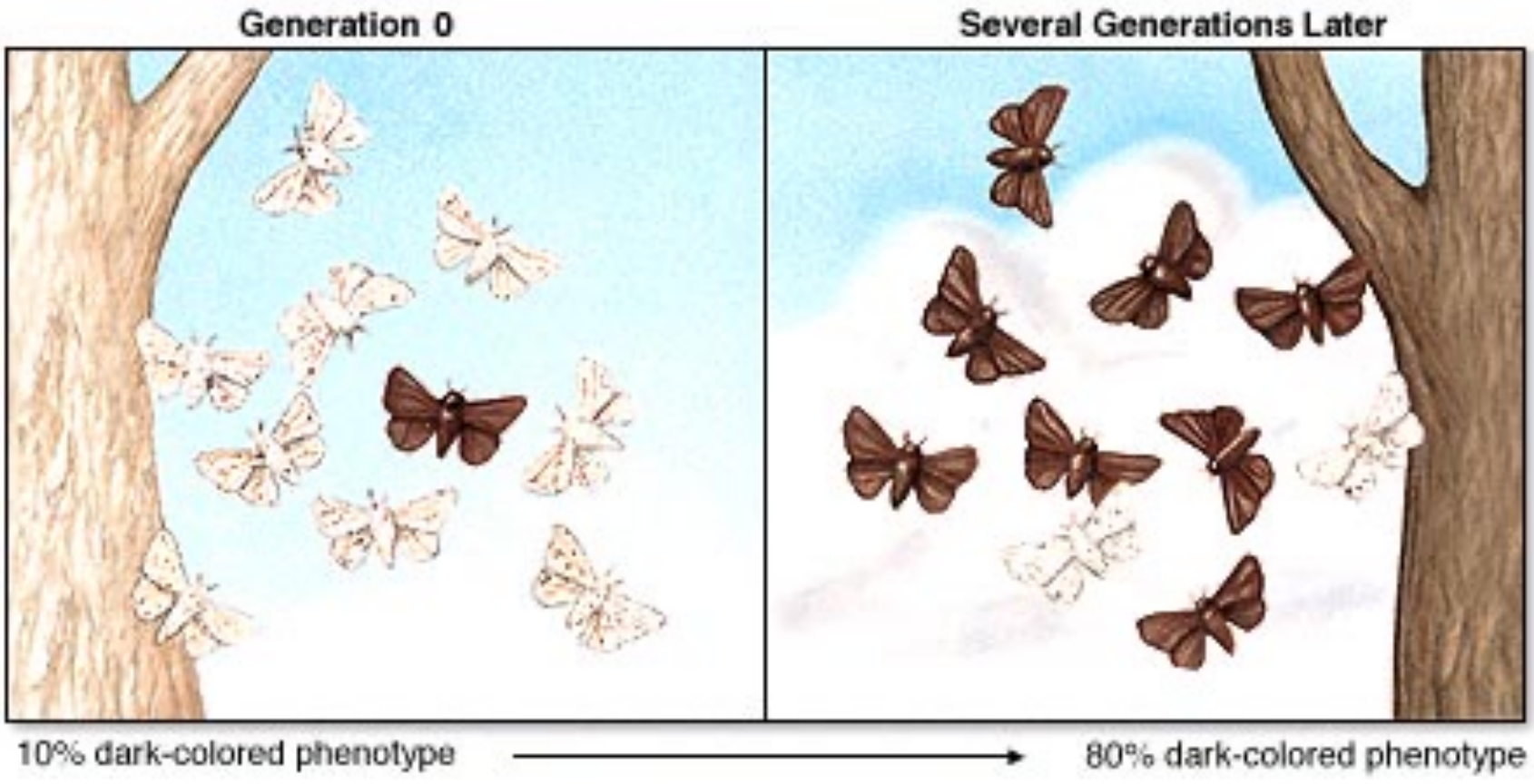
Cambios en las frecuencias alélicas = Evolución


Genotipos
Ambiente
$\bar{\omega}$
Plano
Fenotípico



Diversidad genética

Melanismo industrial


Generation 0
Several Generations Later
10% dark-colored phenotype
80% dark-colored phenotype

Selección

Supervivencia o reproducción diferencial de algunos genotipos

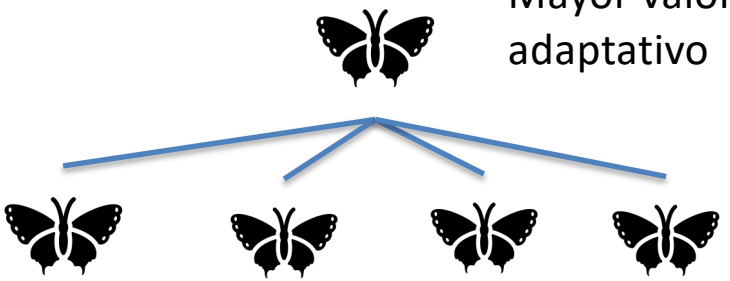
Valor Reproductivo (Fitness)

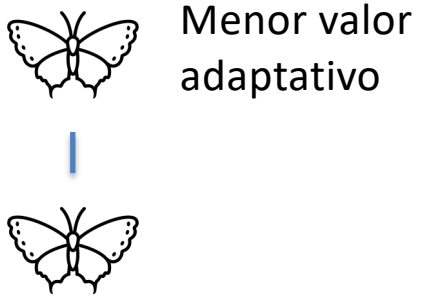
Habilidad competitiva de un genotipo

Número promedio de progenie que sobrevive de un genotipo en relación con otro genotipo

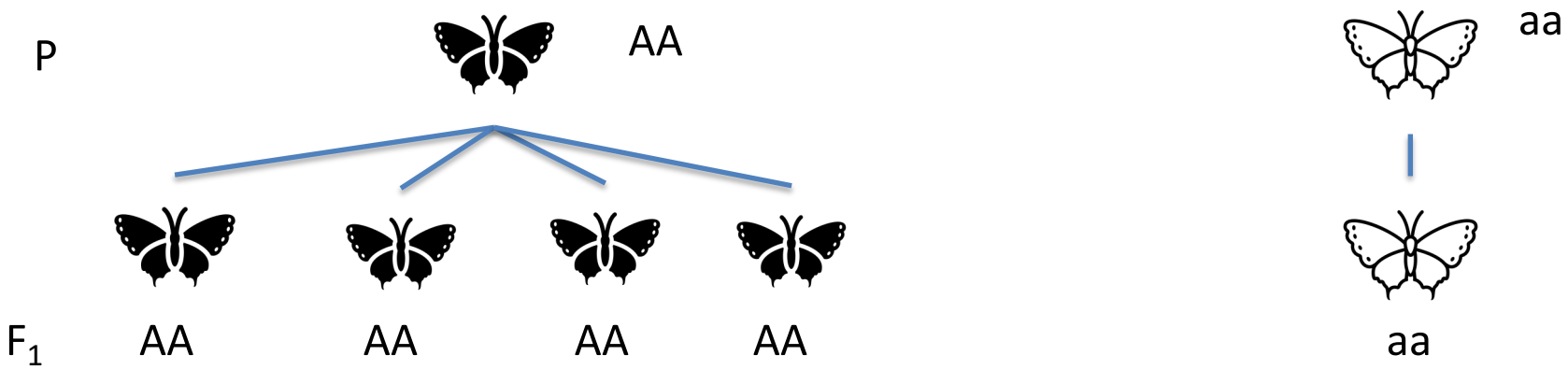
Muy difícil de medir en el campo. ¿ideas?

Valor adaptativo

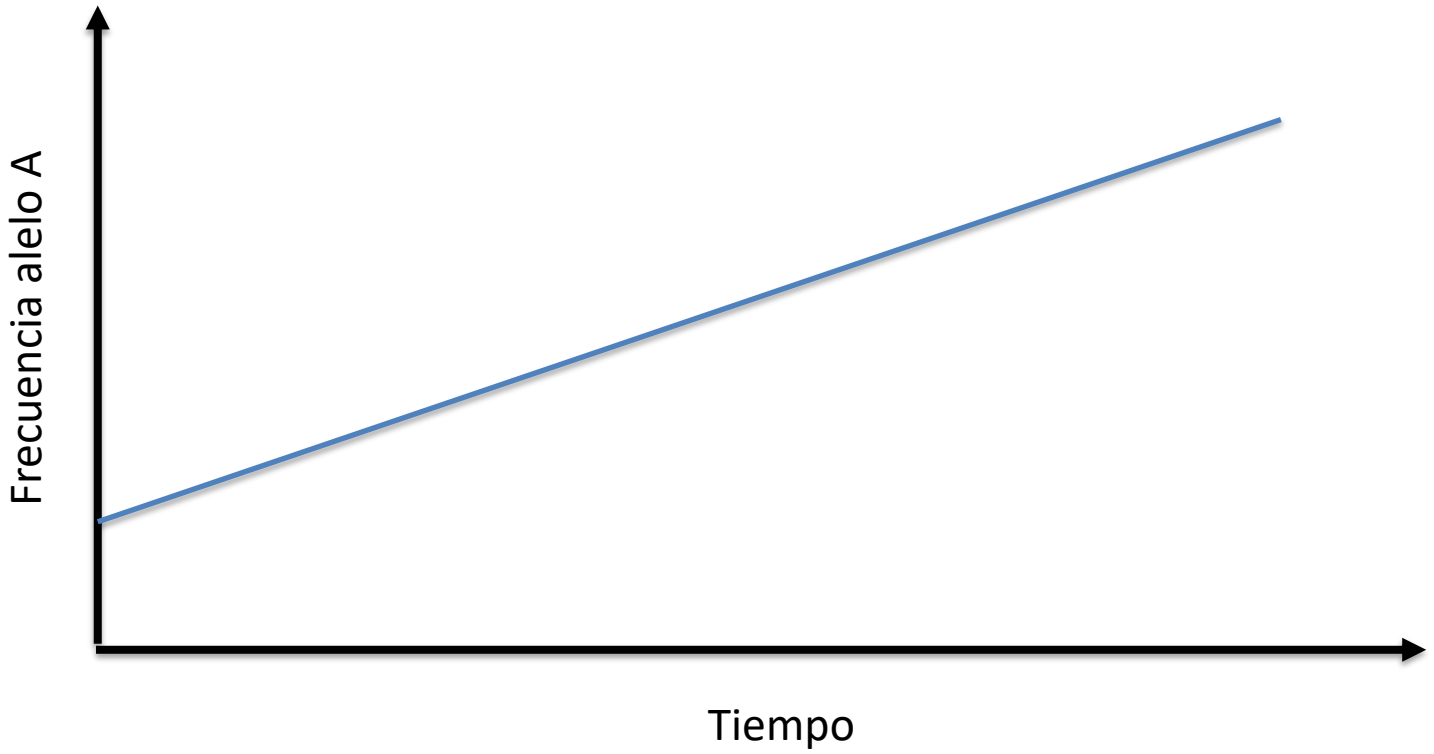




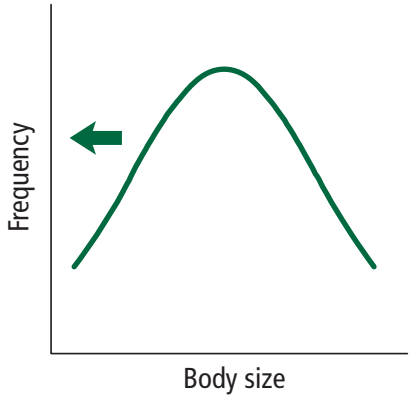
Frecuencias alélicas

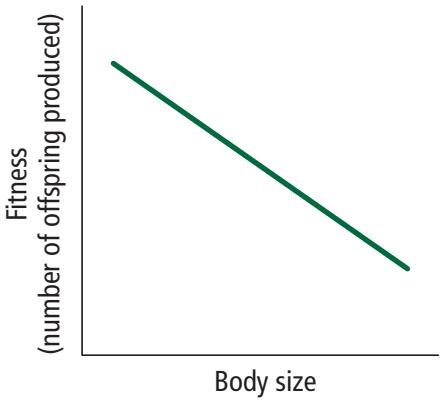


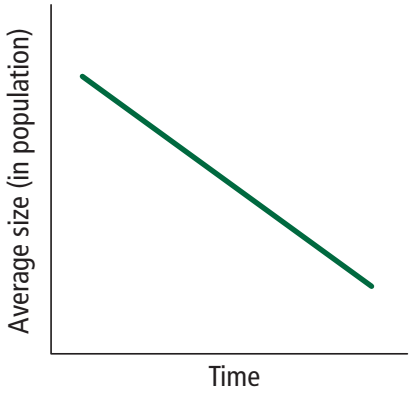
Frecuencias alélicas



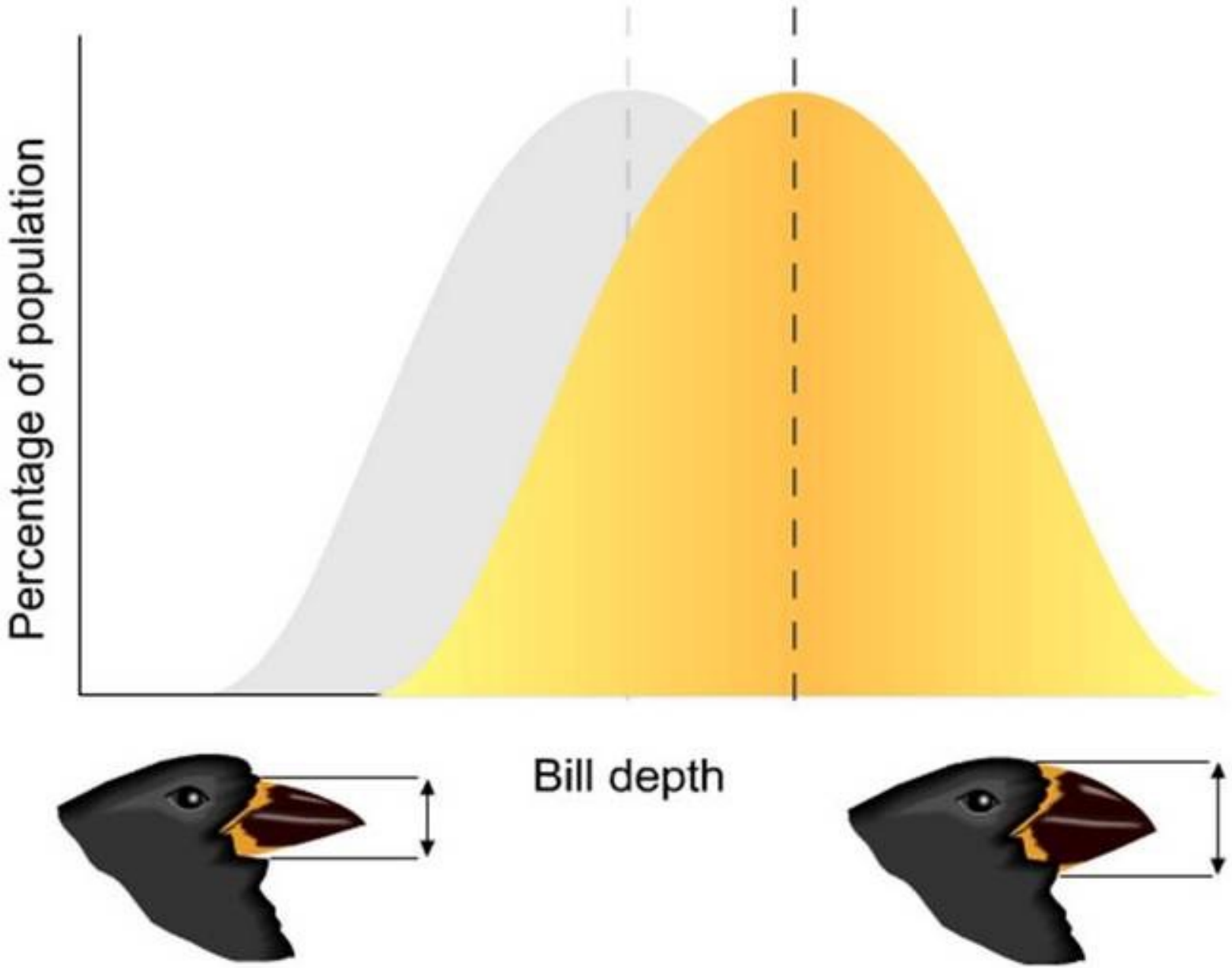
(a) **Directional selection**



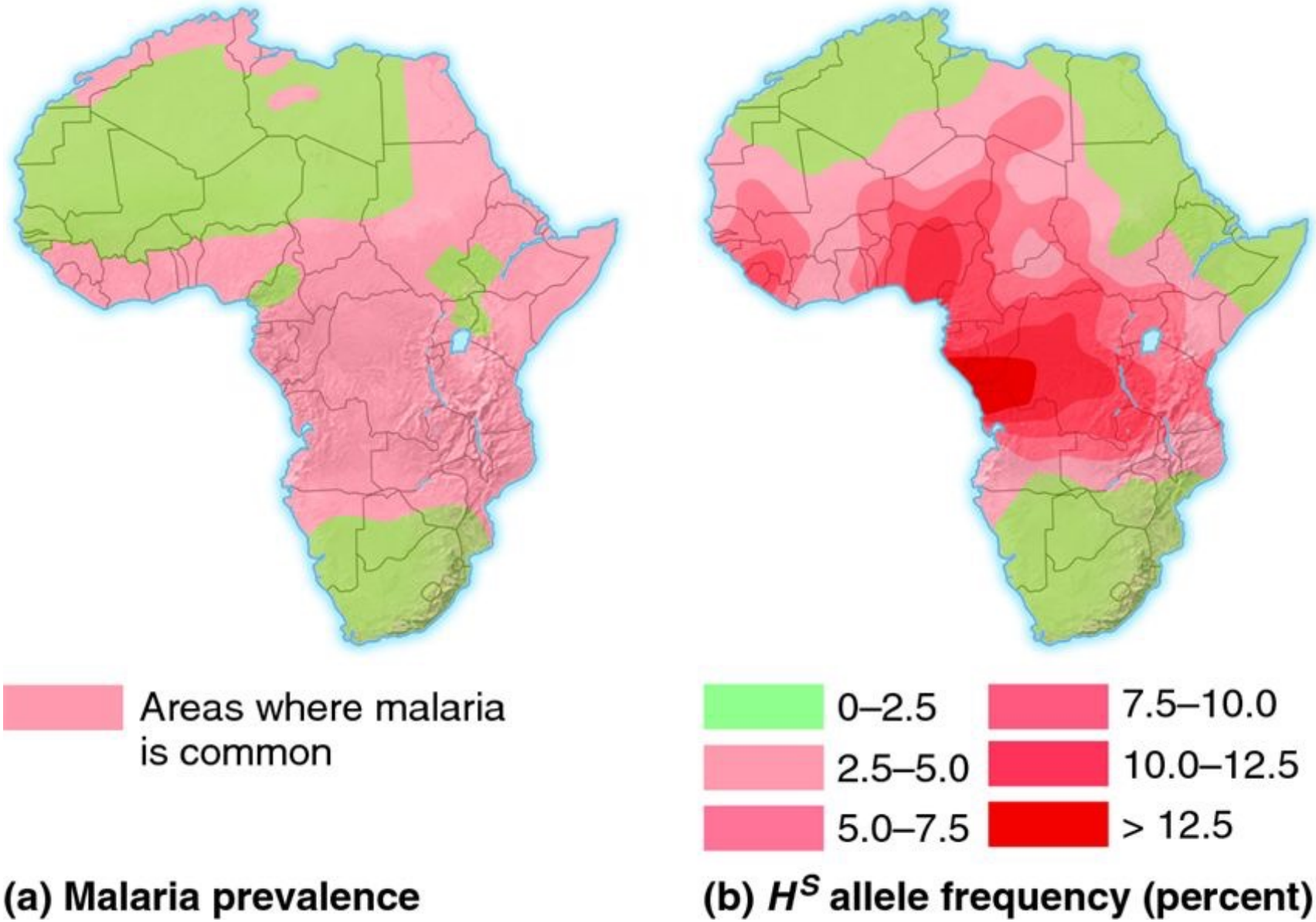


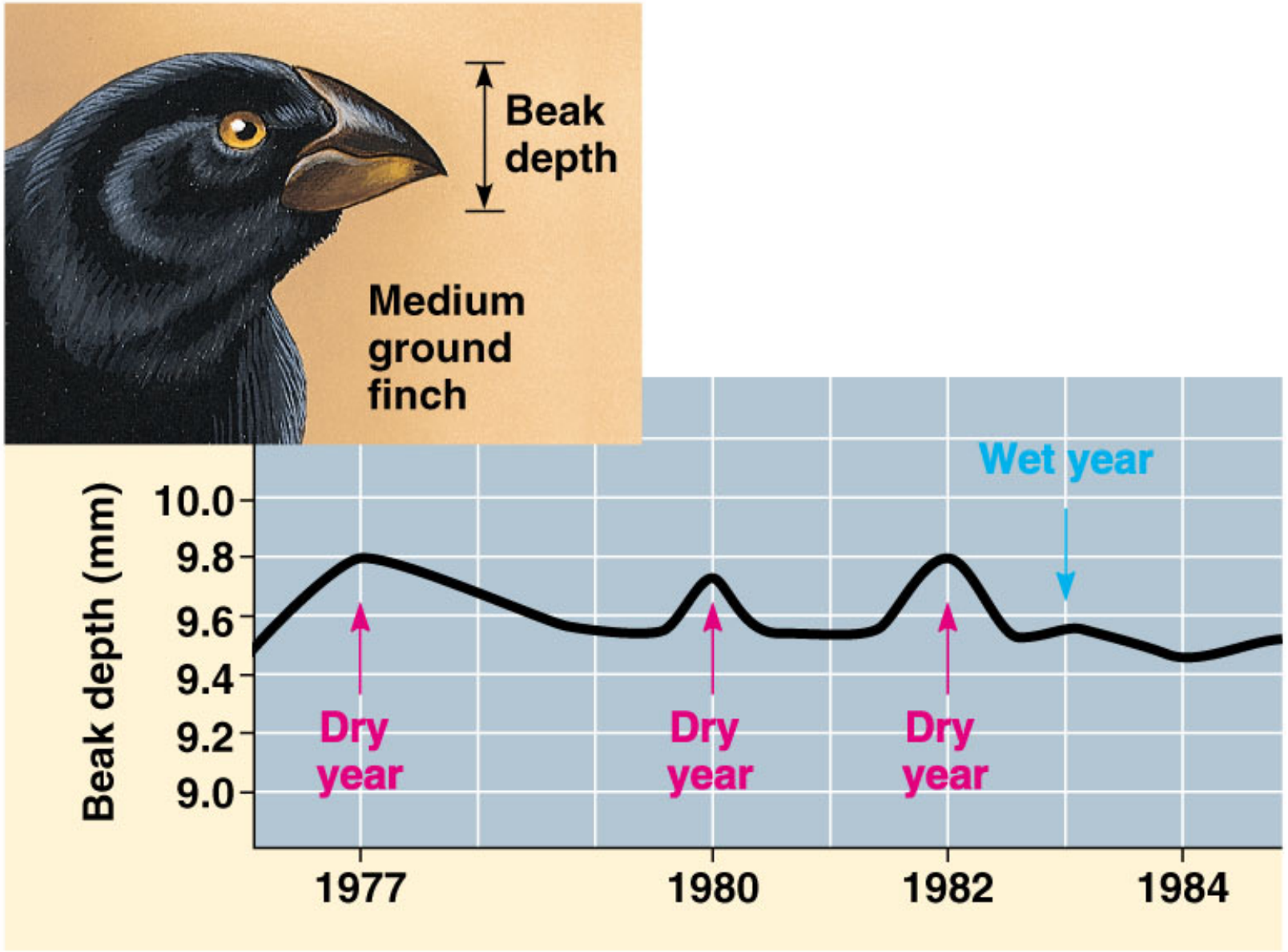


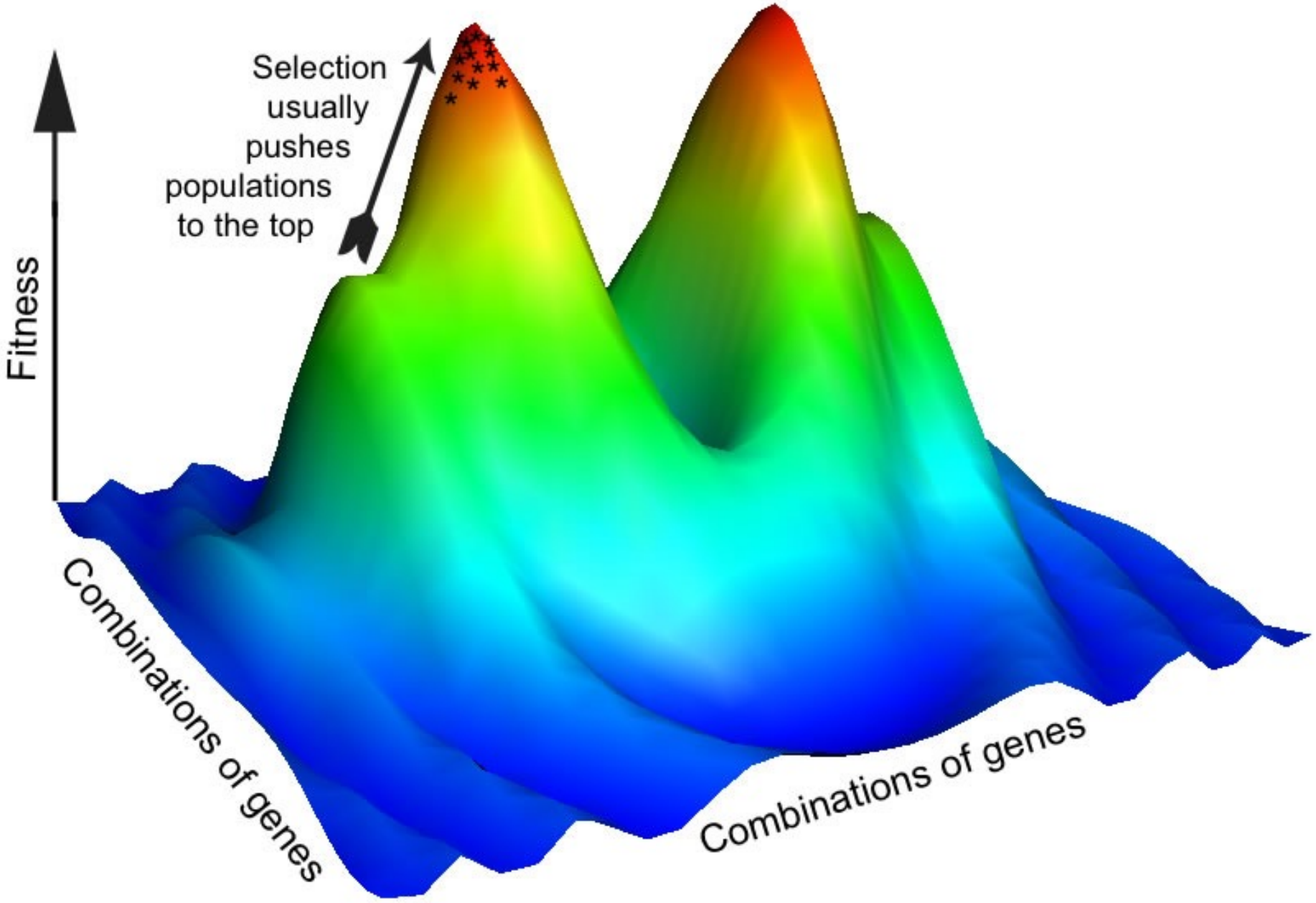
Directional Selection

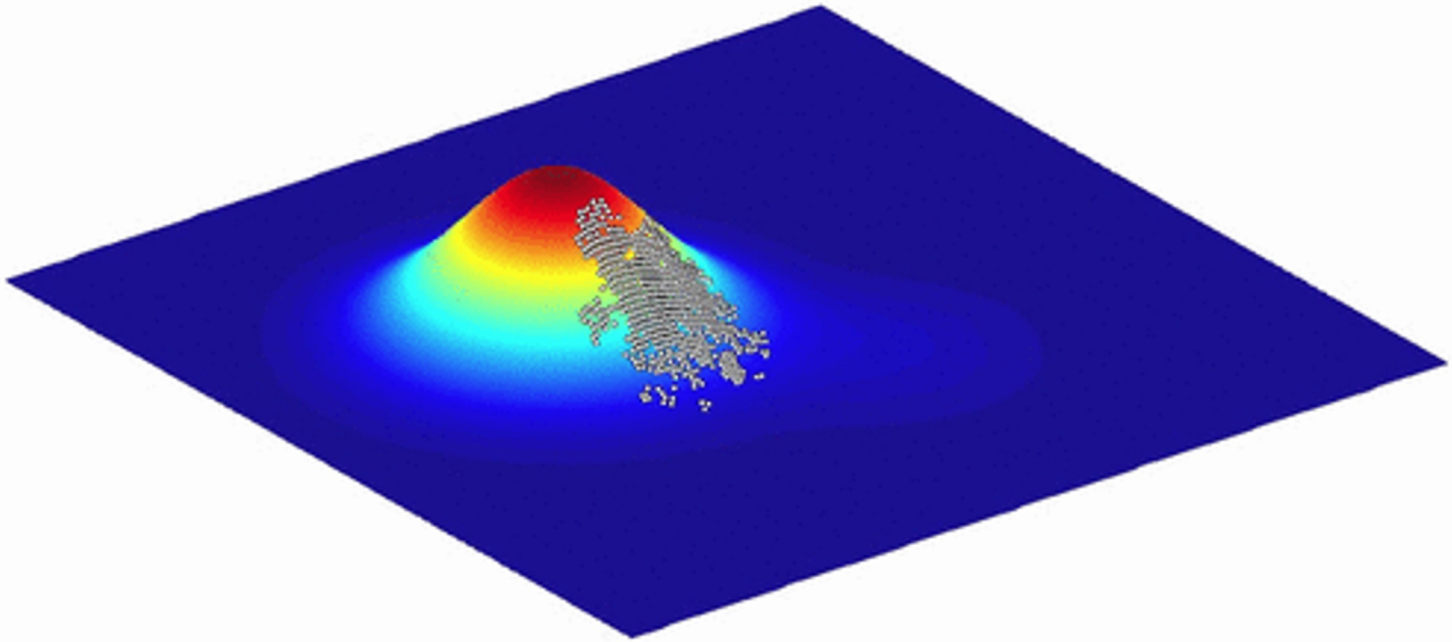


Selección divergente o balanceadora






Selection
usually
pushes
populations
to the top
Fitness
Combinations of genes
Combinations of genes

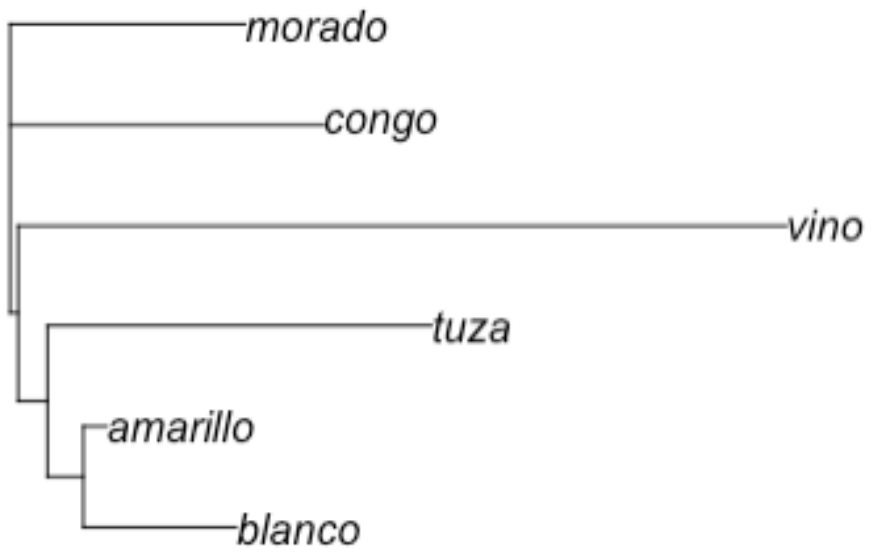


Population size, N = 2,304
Mutation rate, μ = 0.5 per trait

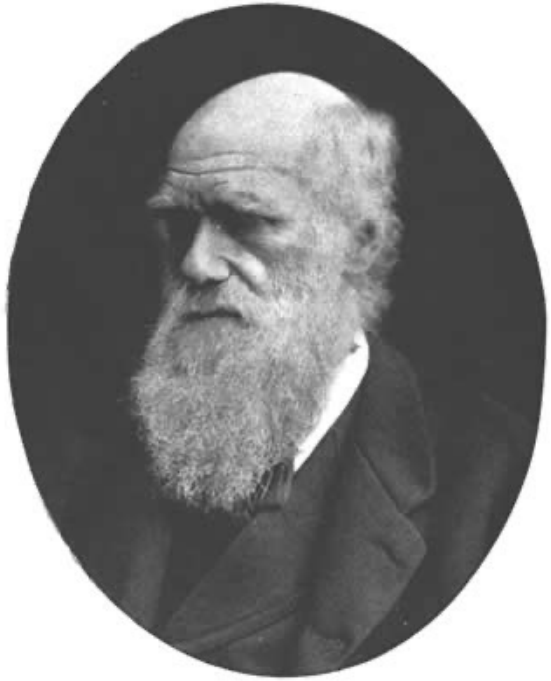
SEXUAL SELECTION

Because when you are this FINE, being the "most fit" does not matter


Selección Artificial


morado
congo
vino
tuza
amarillo
blanco

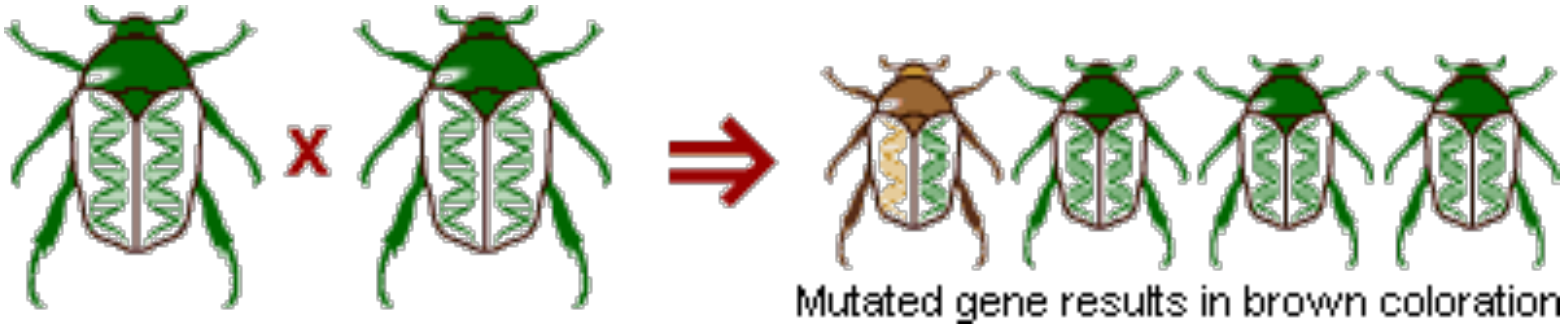
FUERZAS EVOLUTIVAS



Mecanismos Evolución

Evolución existe cuando la diversidad genética en una población se ve alterada por fuerzas evolutivas:

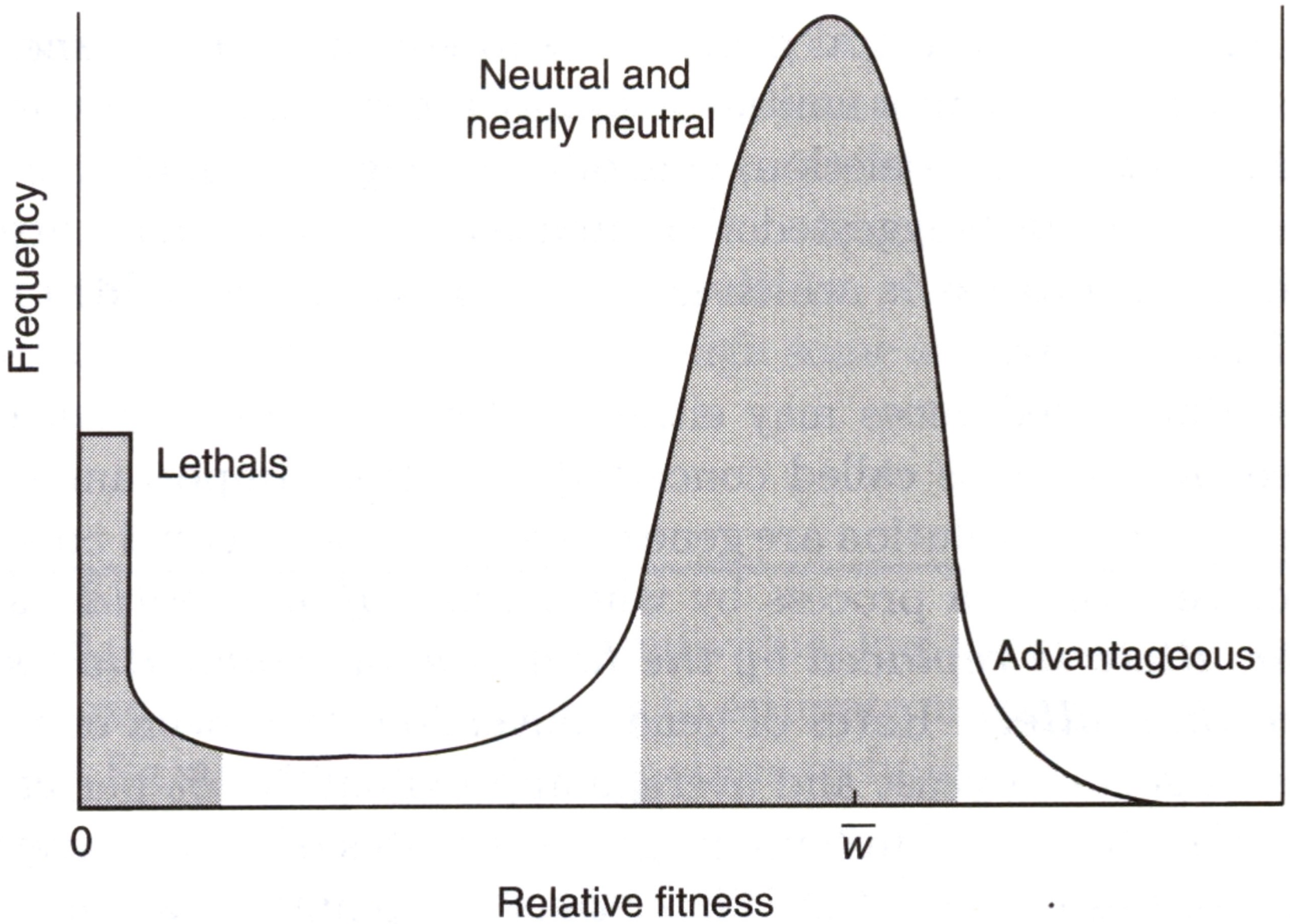
- Selección
- Mutación
- Deriva génica (Poblaciones pequeñas)
- Flujo génico



Mutación

Fuente original de variación genética

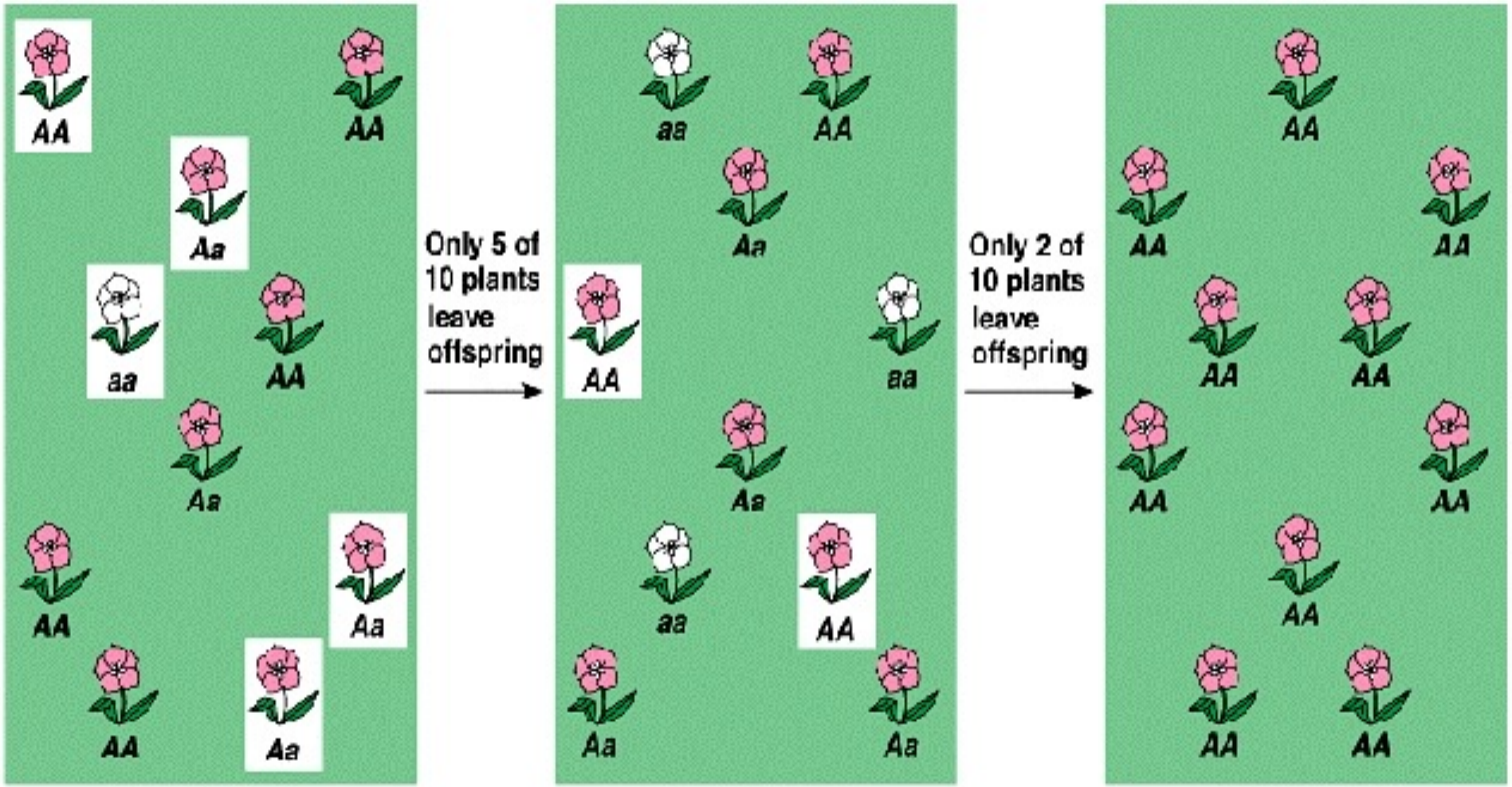
Introduce variantes en ADN


Neutral and
nearly neutral
Frequency
Lethals
Advantageous
0
$\overline{w}$
Relative fitness

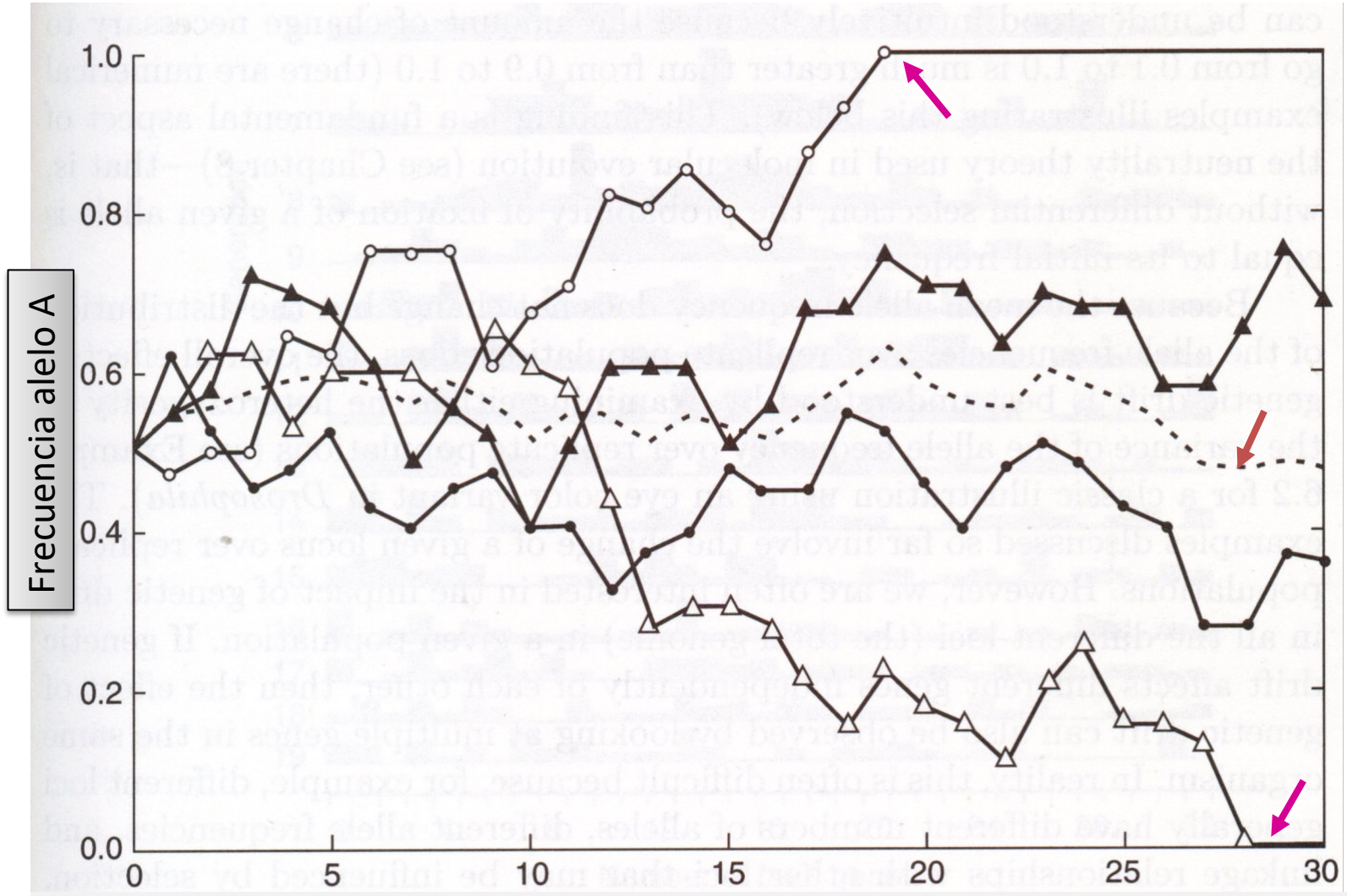
Deriva Génica

Cambios aleatorios en frecuencias alélicas.

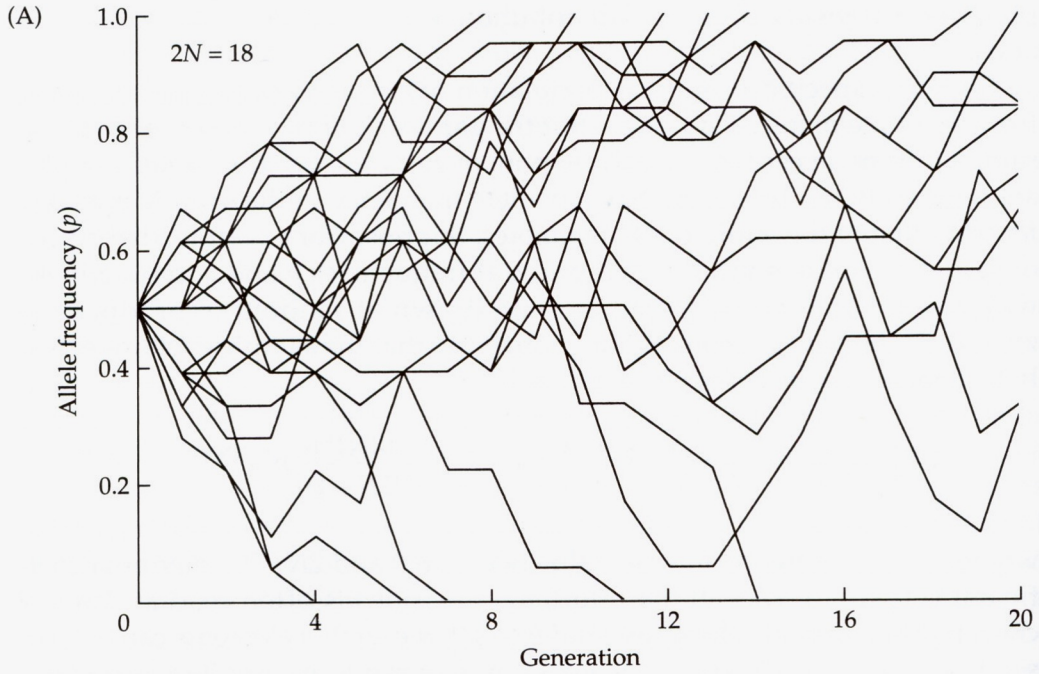
Ocurre en todas las poblaciones



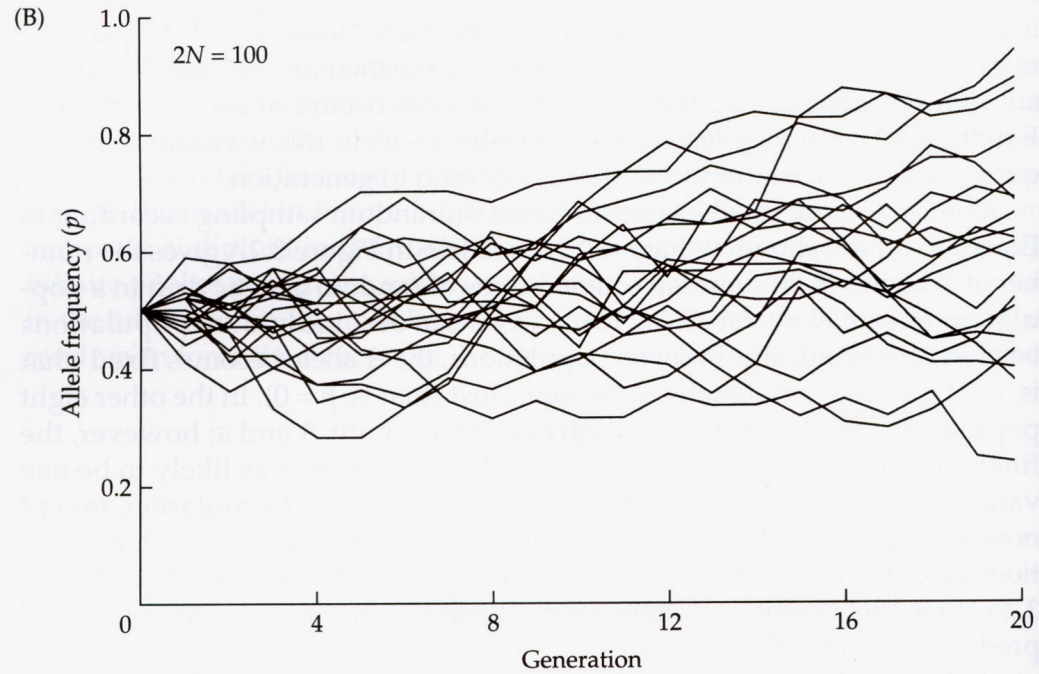
Simulación



Deriva y N

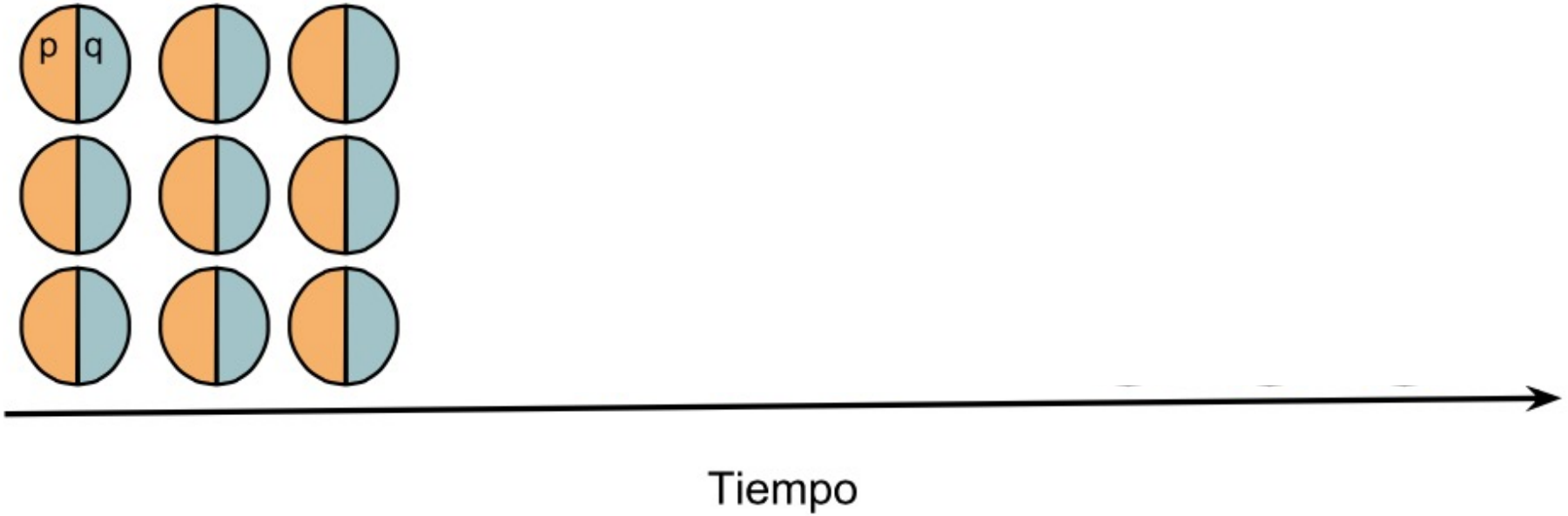


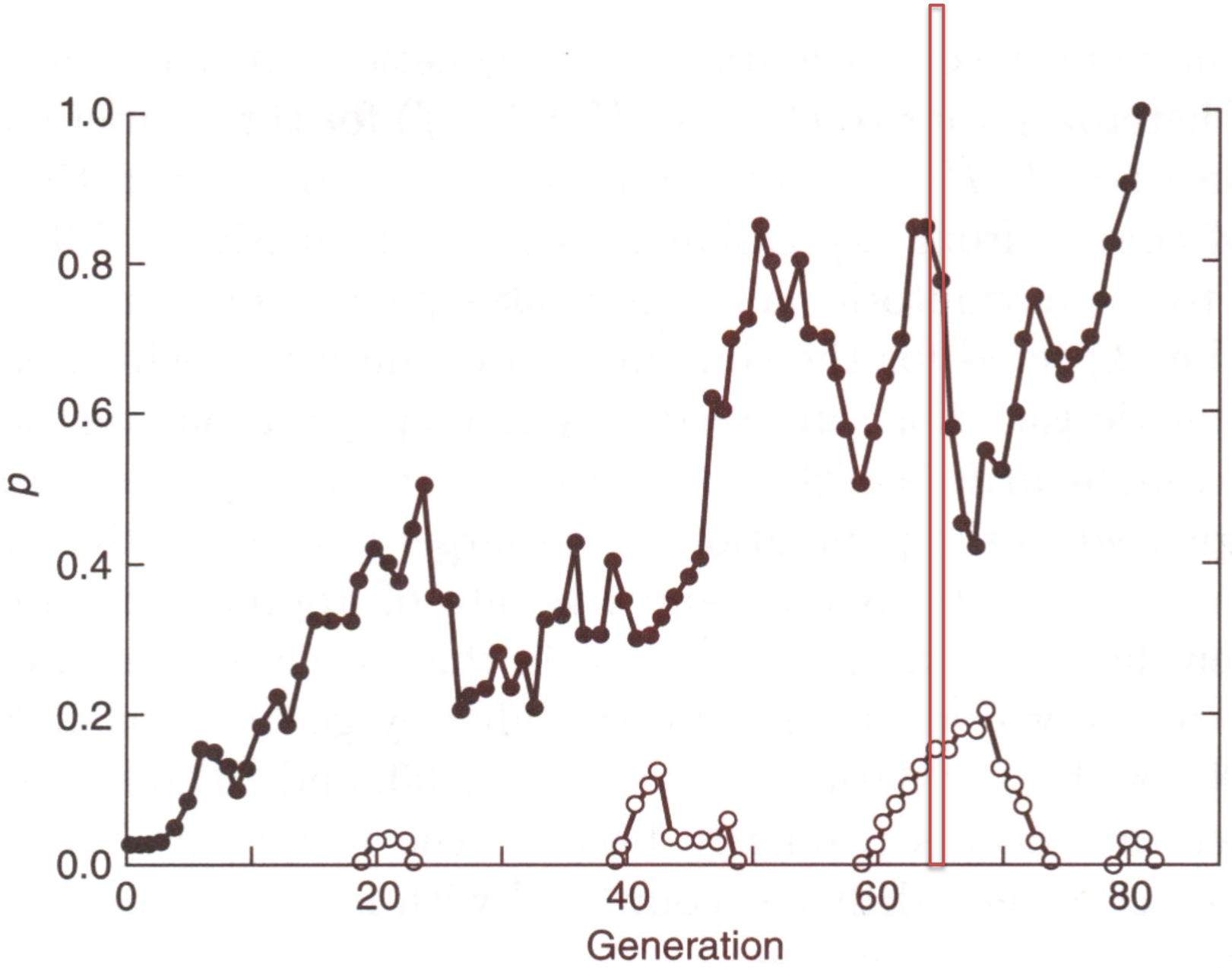
2N=18



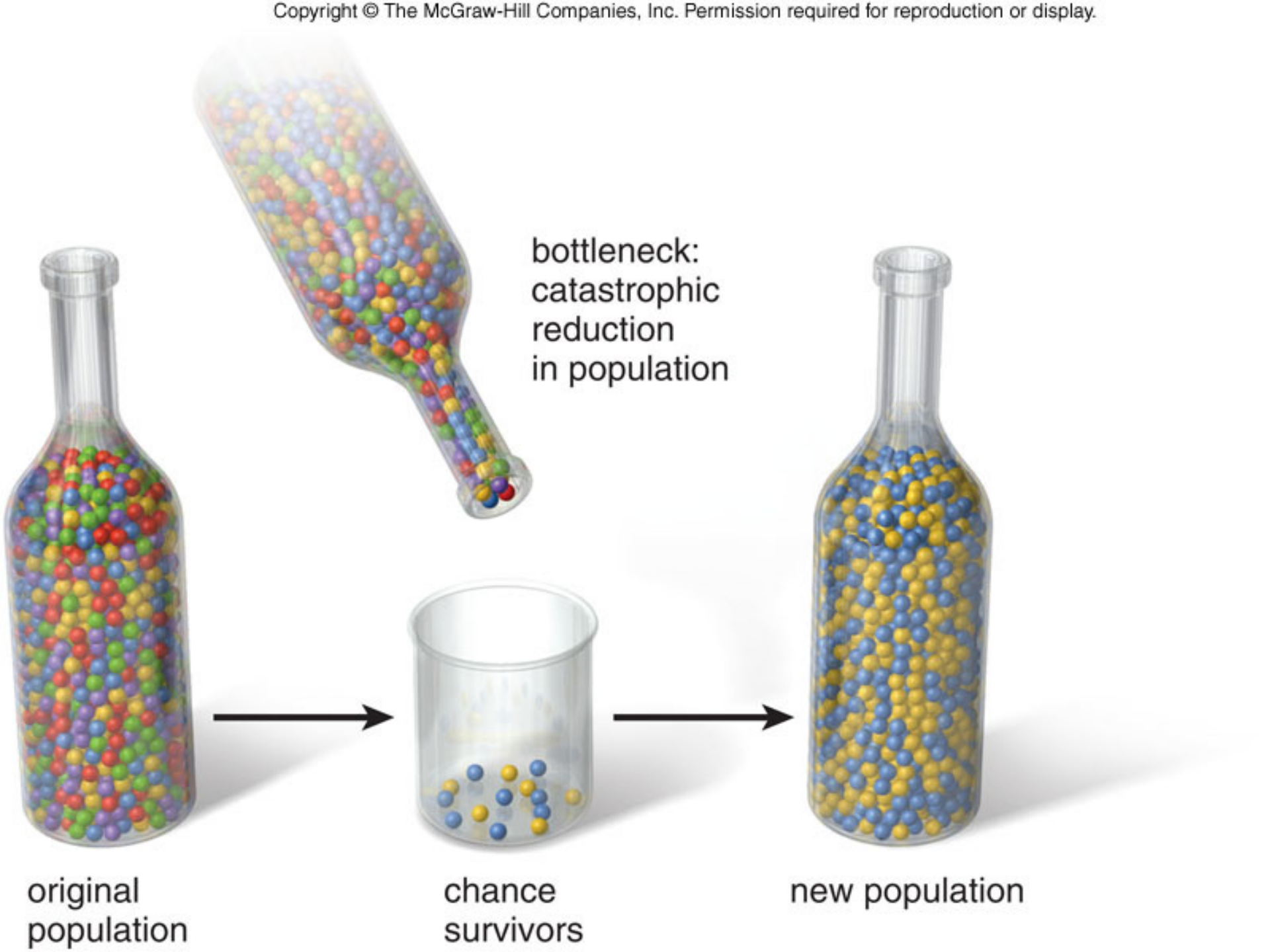
2N=100

Metapoblación



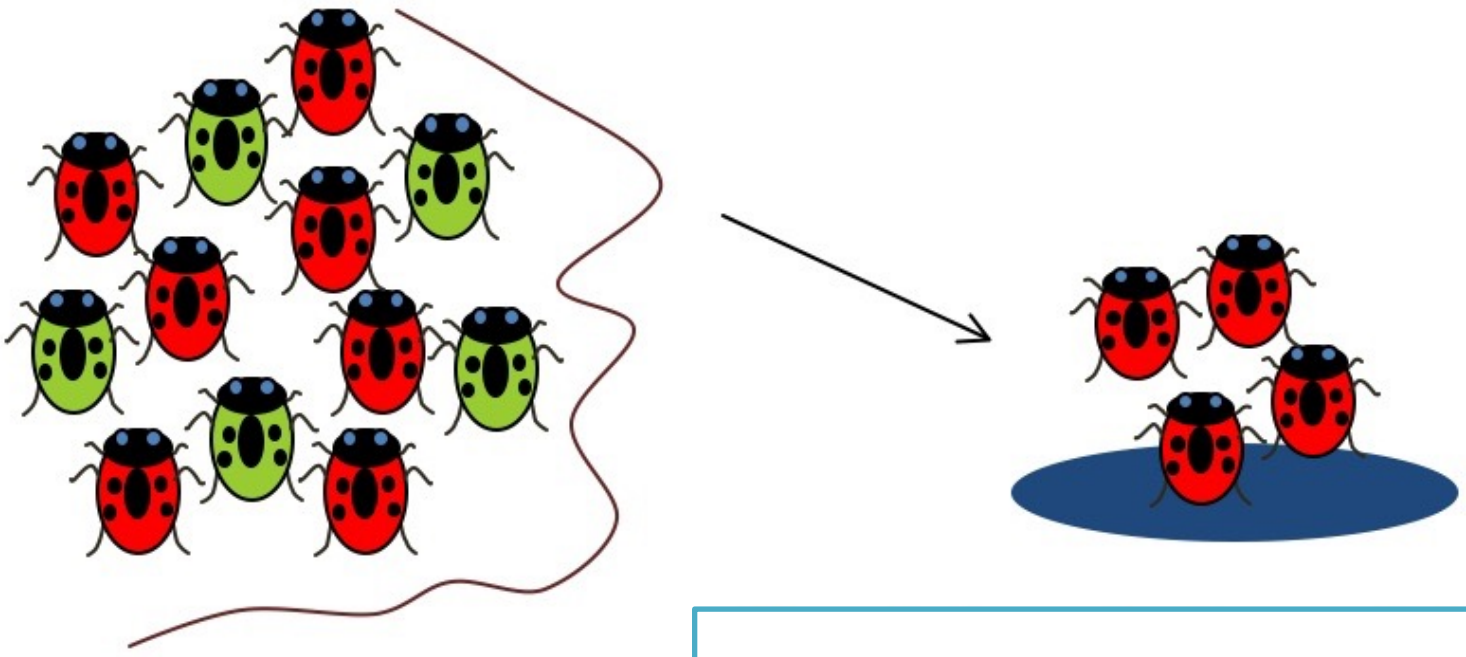

1.0
0.8
0.6
0.4
0.2
0.0
p
0
20
40
60
80
Generation

https://cartwrig.ht/apps/genie/

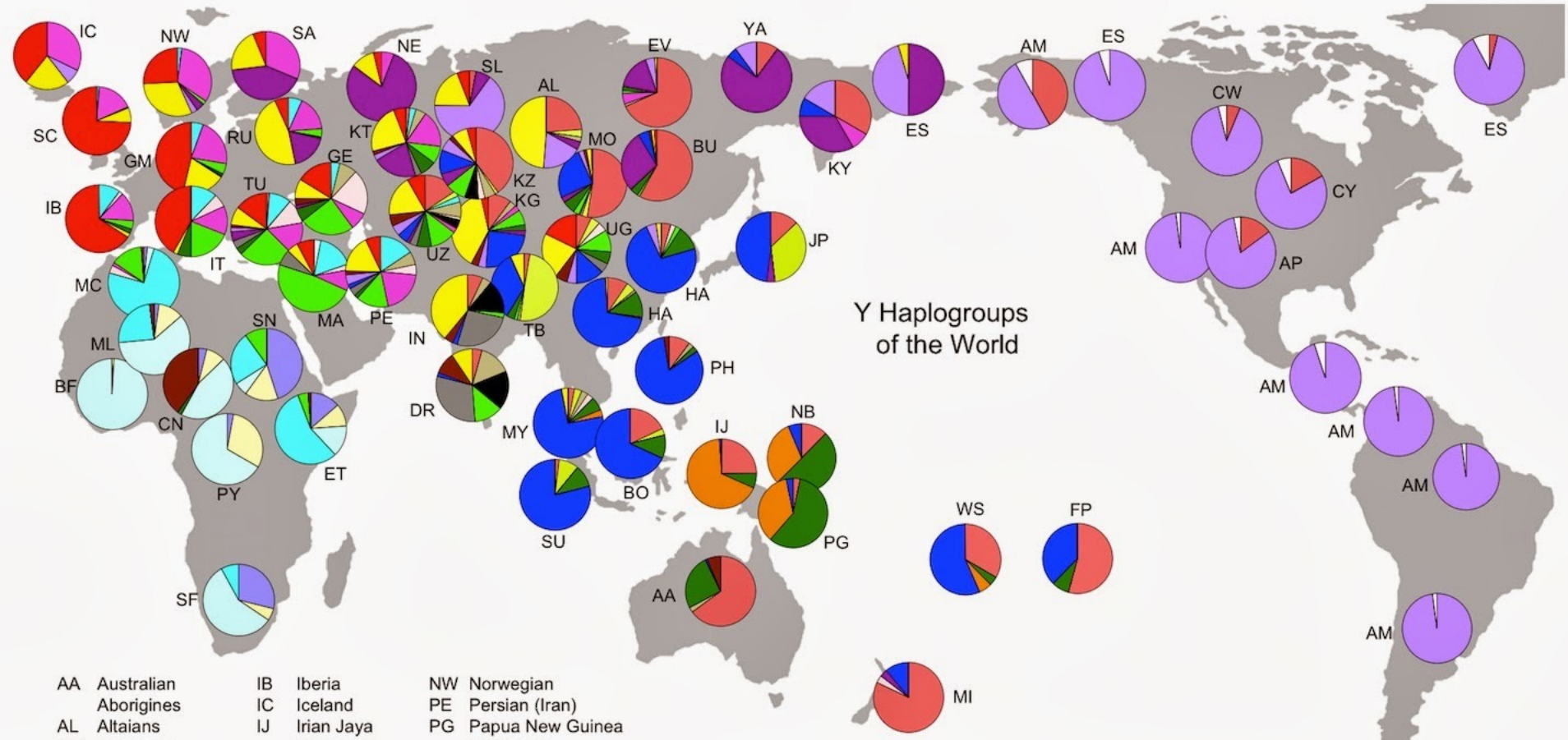


Alouatta palliata

Efecto fundador



Población fundada no siempre representa la diversidad genética de la población original. Usualmente pierde diversidad.



AA	Australian Aborigines	IB	Iberia	NW	Norwegian
AL	Altaians	IC	Iceland	PE	Persian (Iran)
AM	Amerinds	IJ	Irian Jaya Highlands	PG	Papua New Guinea Highlands
AP	Apache (N-D)	IN	Indo-European	PH	Philippines
BF	Burkina Faso	IT	Italy	PY	Pygmy
BO	Borneo	JP	Japan	RU	Russia
BU	Buryats	KG	Kyrgyzstan	SA	Saami
CN	Cameroon	KT	Kazan Tatar	SC	Scotland
CW	Chippeway (N-D)	KY	Koryaks	SL	Selkups
CY	Cheyenne	KZ	Kazakhstan	SF	South Africa
DR	Dravidian	MA	Mideast Arabs	SN	Sudan
ES	Eskimos	MC	Morocco	SU	Sumatra
ET	Ethiopia	MI	Maori	TB	Tibet
EV	Evenks	ML	Mali	TU	Turkish
FP	French Polynesia	MO	Mongols	UG	Uygurs
GE	Georgia-Armenia	MY	Malaysia	UZ	Uzbek
GM	Germany	NB	New Britain	WS	Western Samoa
HA	Han Chinese	NE	Nenets	YA	Yakuts

A B C D ExE3b E3b F
G H I J K L M
N O P Q RxR1 R1a R1b Other

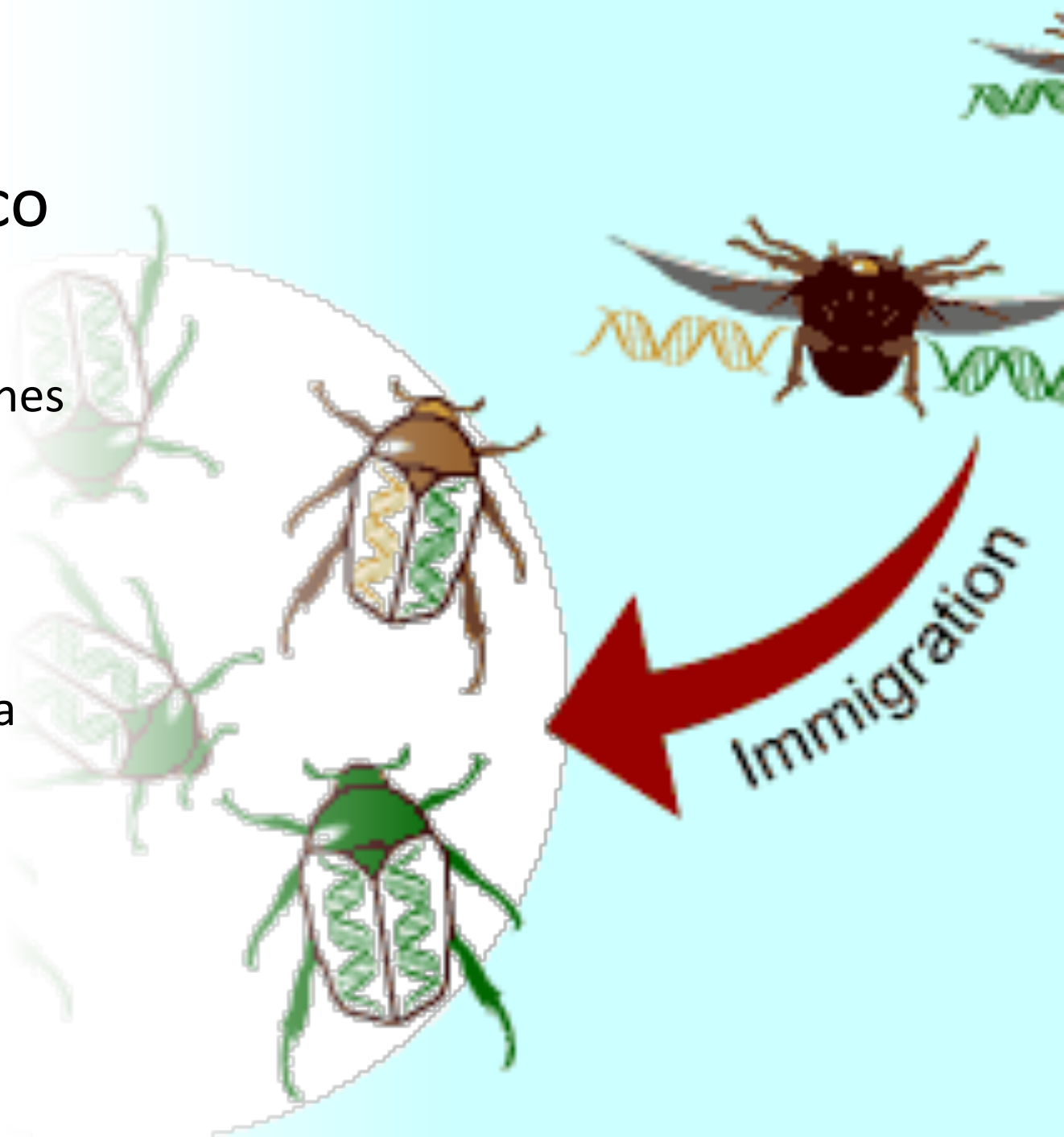
The data in this map is supposed to represent the situation before the recent European expansion beginning about 1500 AD. In some cases such as some Native American tribes and the Maori this can be done reliably because STR typing was done. In other cases, especially in America, it is guesswork. The "Other" sectors in America indicate this. Native American groups are labeled by language group as Amerind, Na-Dene (N-D), and Eskimo. F, K, L, and P are in some cases "catchall" groups because some researchers did not use enough markers for a full haplotype determination.

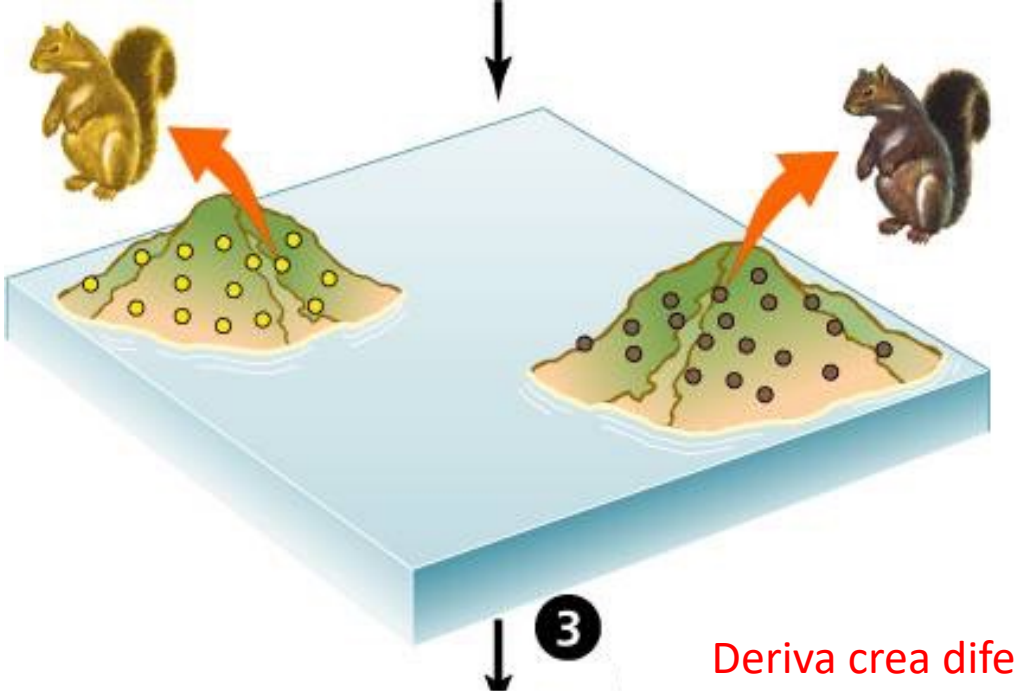
Flujo génico

Movimiento de genes entre poblaciones

Contrarresta los efectos de la deriva

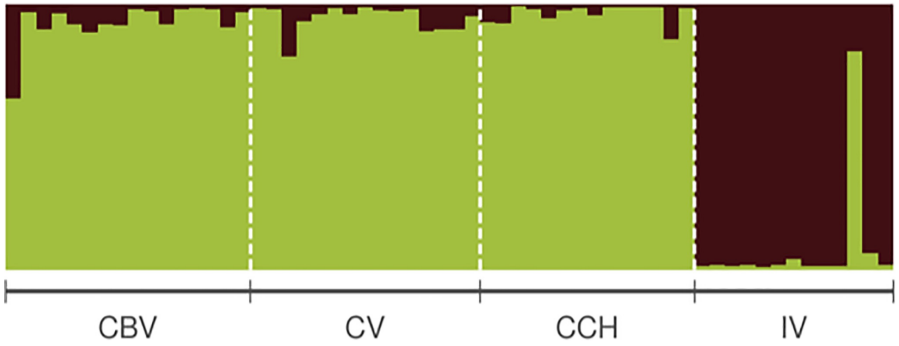
- Aumenta el tamaño poblacional

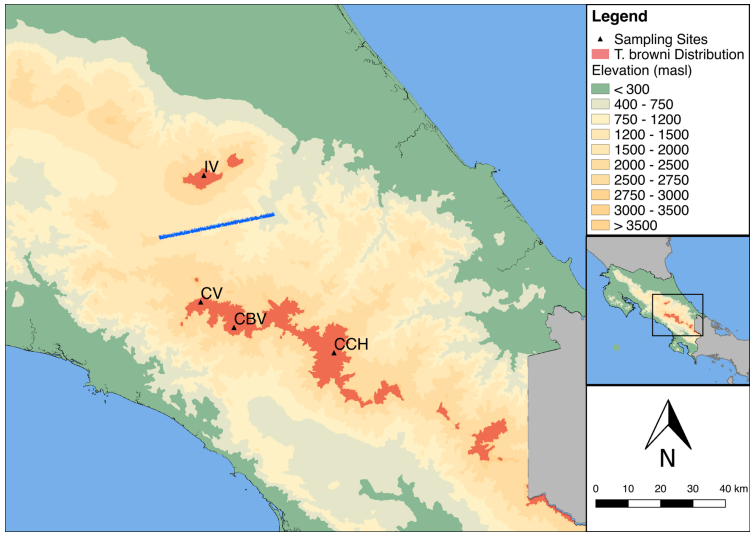


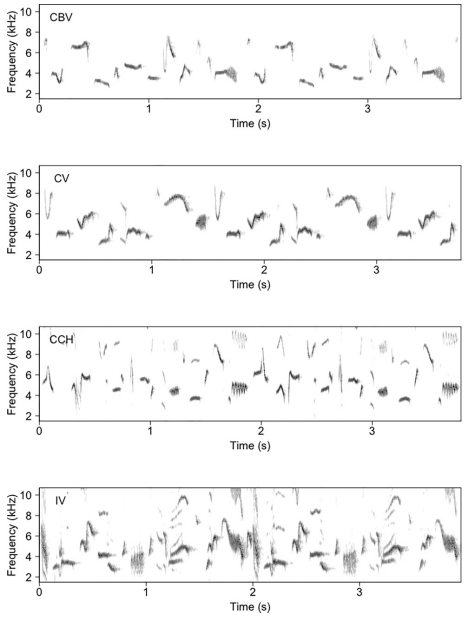


Deriva crea diferencias

Timberline Wren (*Thryorchilus browni*, Troglodytidae)







Evolución de poblaciones naturales

¿QUÉ PASA SI NO HAY FUERZAS EVOLUTIVAS?

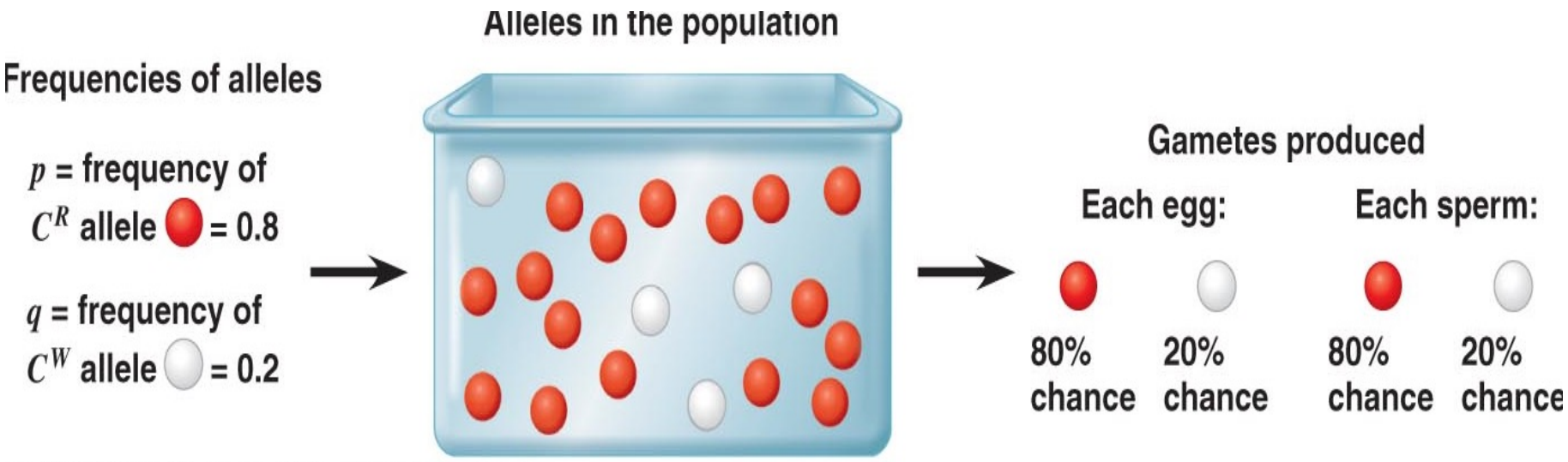
Equilibrio Hardy-Weinberg

Si la poza génica de una población no cambia a través del tiempo

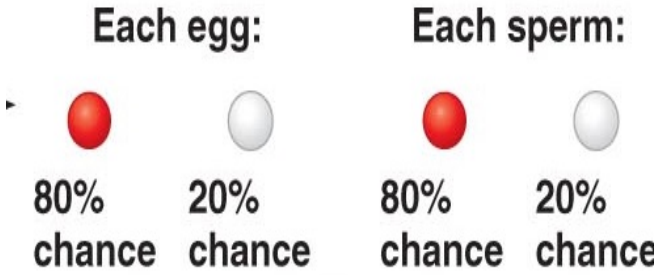
Ausencia de mecanismos de evolución

- Apareamiento aleatorio
- Sin fuerzas evolutivas

Equilibrio en frecuencias alélicas a través del tiempo



G_0


Each egg:
Each sperm:
80% chance
20% chance
80% chance
20% chance

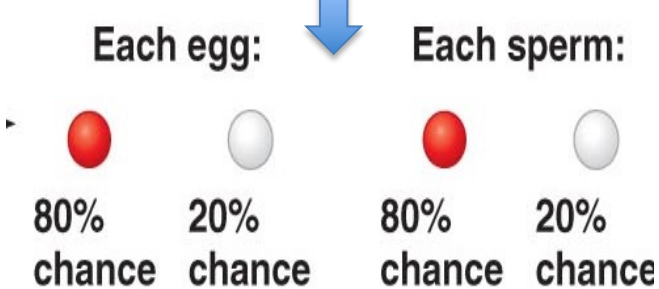
G_1


Each egg:
Each sperm:
80% chance
20% chance
80% chance
20% chance

G_2


Each egg:
Each sperm:
80% chance
20% chance
80% chance
20% chance

G_3


Each egg:
Each sperm:
80% chance
20% chance
80% chance
20% chance

Una generación de apareamiento al azar