BIO 4102/BIO6102/MSB315

Evolutionary Ecology
(Varsha 2023)

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MODULE: RECAPITULATION OF FUNDAMENTAL CONCEPTS

Evolution

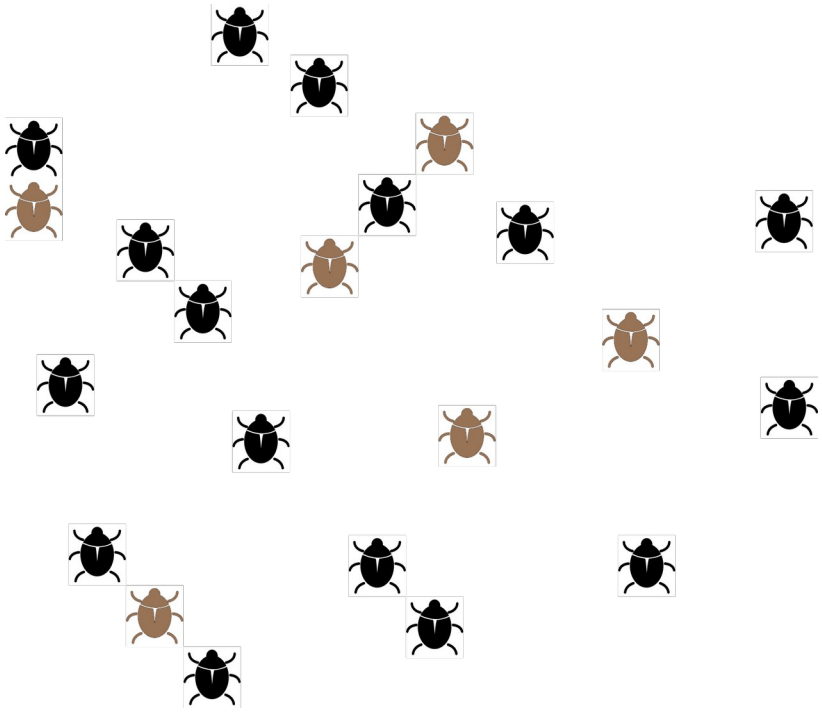
Change in *frequency of alleles* within a *gene pool* from one generation to the next

Consider an insect species with colour morphs (or colour 'types'). Colour in this species is determined by a particular **gene** with 2 variants. Each variant has a unique DNA sequence. The variants are the '**alleles**' of that particular gene. Individuals with the first allele are black – lets call this *black.* Ones with the second allele are brown – lets call this *brown*.

Black : '.....ATGGATCACTTGGAG.....'

brown : '.....ATCGATCACTTGGAG.....'

The insect lives in a habitat dominated by brown sand that matches the colour of the *brown* allele phenotype. What happens to allele frequencies if predators selectively feed on black ones?



Frequency of *brown*: 6/22 = 27.3%
Frequency of *black*: 16/22 = 72.7%

After some generations of selection, the frequency of *brown* will increase and may even reach 100%.

Populations evolve, not individuals

Tree illustrations from http://clipart-library.com

In an island population of a palm trees species, taller trees are more likely to die due to wind damage.

Over several generations, shorter tree height could be favoured, and the proportion of short trees may increase, leading to a change in the **average tree height of the population**. Thus, the **tree height of the population has evolved.**

Fitness

Related to **the number of offspring of an individual, i.e. Fecundity.**

To reproduce, one has to **survive**

Selection favours traits (or trait variants) that increase fitness

- **Fitness function**
- **Fitness proxy**

Difference between fitness and fecundity

- E.g. Offspring size v/s number ***trade-off***

  - Is a mother's fitness directly proportional to her fecundity?

Adaptation

Adaptation is a **trait that helps an organism to maintain or increase fitness of an organism in a given environment.**

Adaptations are the result of past selection pressures

Prerequisites for evolution by natural selection

1) Variation (acts on *existing* variation)

2) Heritability (only heritable traits can be selected)

3) Differences in fitness

Frequency Distribution & Histogram

E.g. ***Frequency distribution of heights of students in the class***

Mean, Variance, Range

(Mode), (Median)

Types of selection

- Directional
- Stabilizing
- Disruptive

Natural v/s sexual

Apart from selection, populations can also evolve through....

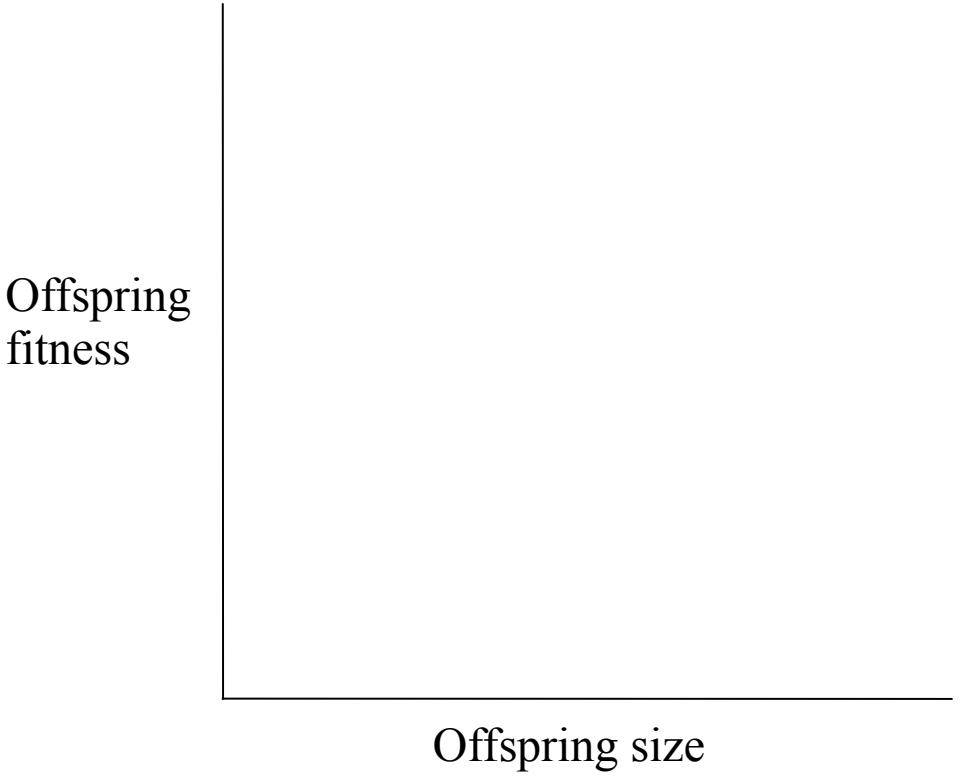
- Genetic drift
- Gene flow from another population (or even another species)

Important point

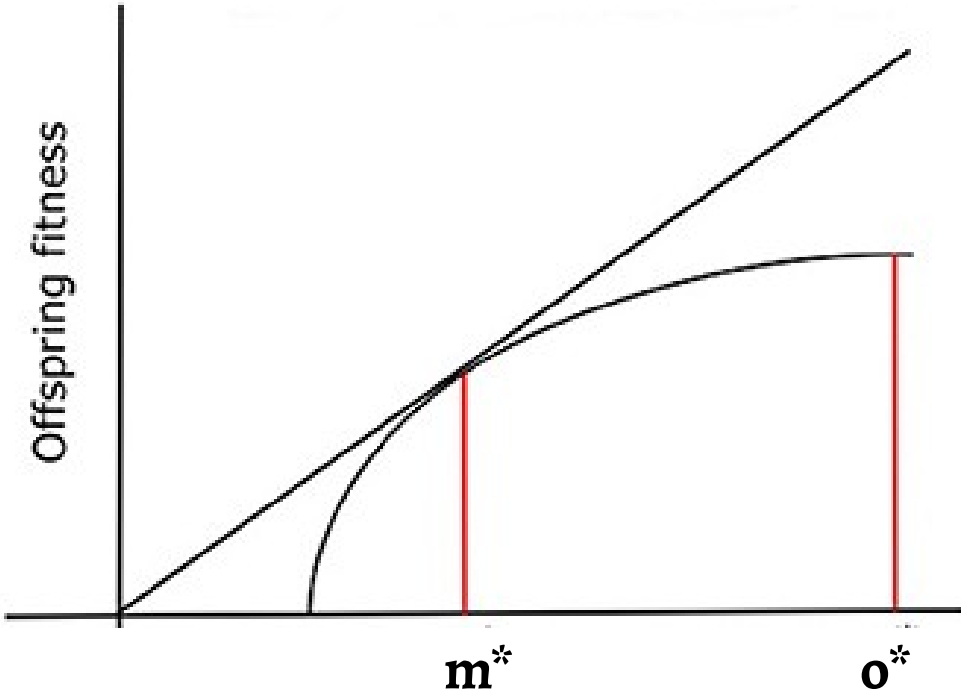
Not all traits that we see today are adaptations

Continuing with offspring size optimization.....

How would you predict offspring size to be distributed?


Offspring
fitness
Offspring size

Smith-Fretwell model



Smith & Fretwell (1974). The optimal balance between size and number of offspring. *American Naturalist* 108, 499–506. doi: 10.1086/282929

m^* = offspring size for maximum maternal fitness

o^* = offpspring size for maximum offspring fitness

What might be the reasons for a difference between the predicted and the observed size?

Think of experiments to test your hypotheses.