

premature babies have reduced survival because their body systems are not fully developed; large babies present problems with delivery as the birth canal can only accommodate babies up to a certain (head) size.

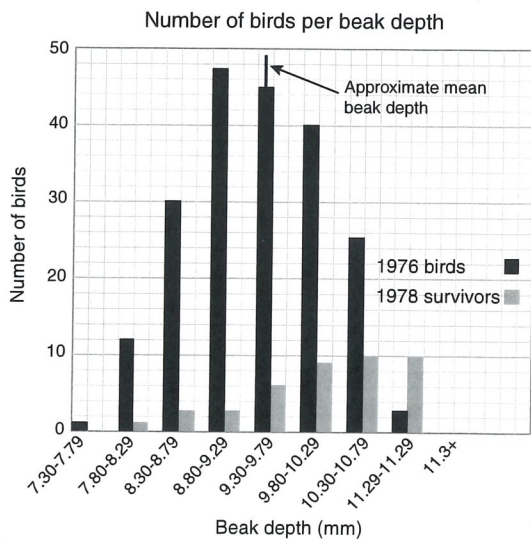
- Medical intervention can now allow babies that are very premature to survive (babies as small as 1.5 kg have a good chance of survival today, but this has not historically been the case). Caesarean deliveries have also allowed larger babies to be born. **Note:** This technology is available to wealthy societies thereby reducing the effect of this selection pressure. Developing countries still experience this selection pressure.

**86. Directional Selection in Moths (page 117)**

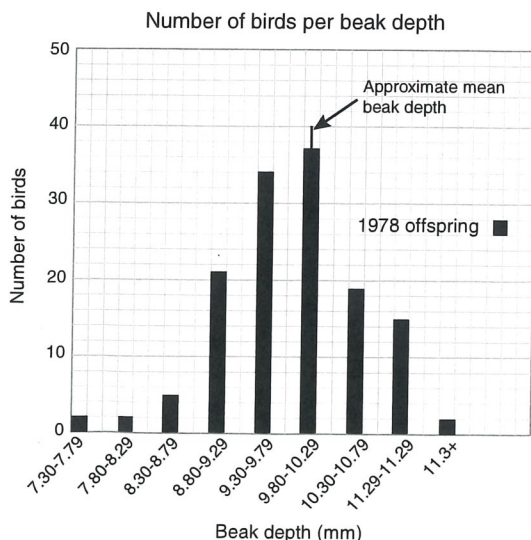
- The appearance of the wings and body (how speckled and how dark the pigmentation).
- The selection pressure (the differential effect of selective predation on survival) changed from favouring the survival of light coloured forms in the unpolluted environments (prior to the Industrial Revolution) to favouring the dark morph (over the light morph) during the Industrial Revolution (when there was a lot of soot pollution). In more recent times, with air quality improving, the survival of the light coloured forms has once again improved.
- As the frequency of the M allele increased so did the frequency of the dark form. Similarly as the frequency of the m allele decreased so did the grey morph.
- The frequency of the darker form fell from 95% to 50%.

**87. Directional Selection in Darwin's Finches (page 118)**

- (a)



- (b)



- See graphs for means.
  - Approximately 0.5 mm
  - Yes, beak depth is heritable. If the drought continues the population may become increasingly dominated by individuals with deeper beaks. Smaller beak sizes will become increasingly rare or absent.
- Smaller seeds were probably eaten first (as beaks were smaller). This left the birds competing for larger seeds such that birds with larger beaks were more successful and were more likely to survive.

**88. Disruptive Selection in Darwin's Finches (page 119)**

- Large and small seeds became relatively more abundant.
  - The change in the relative abundance of seed sizes produced a negative selection pressure on finches with intermediate sized beaks. Those with smaller and larger beaks fared better during the drought because they could exploit the smaller and larger seed sizes.
- Beak size determines fitness, which shows a bimodal distribution. Birds with small beaks (-1.0 single measure) or larger beaks (single measure 1.25) show higher fitness (leave more offspring) than birds with intermediate beak sizes.
- Mate selection is non-random.
  - The graph shows that birds tend to choose mates with a similar beak size. This relationship is strong when the environmental conditions are more extreme.

**89. Selection for Skin Colour in Humans (page 120)**

- Folate is essential for healthy neural development. **Explanatory note:** A deficiency causes (usually fatal) neural tube defects (e.g. spina bifida).
  - Vitamin D is required for the absorption of dietary calcium and normal skeletal development. **Explanatory note:** A deficiency causes rickets in children or osteomalacia in adults. Osteomalacia in pregnancy can lead to pelvic fractures and inability to carry a pregnancy to term.
- Skin cancer normally develops after reproductive age and therefore protection against it provides no reproductive advantage and so no mechanism for selection.
  - The new hypothesis for the evolution of skin colour links the skin colour-UV correlation directly to evolutionary fitness (reproductive success). Skin needs to be dark enough to protect folate stores from destruction by UV and so prevent fatal neural defects in the offspring. However it also needs to be light enough to allow enough UV to penetrate the skin in order to manufacture vitamin D for calcium absorption. Without this, the female skeleton cannot successfully support a pregnancy. Because these pressures act on individuals both before and during reproductive age they provide a mechanism for selection. The balance of opposing selective pressures determines eventual skin colouration.
- Women have a higher requirement for calcium during pregnancy and lactation. Calcium absorption is dependent on vitamin D, making selection pressure on females for lighter skins greater than for males.
- The Inuit have such abundant vitamin D in their diet that the selection pressure for lighter skin (for UV absorption and vitamin D synthesis) is reduced and their skin can be darker.
- Higher chances of getting rickets or (the adult equivalent) osteomalacia due to low UV absorption.
  - The simplest option to avoid these problems is for these people to take dietary supplements to increase the amount of vitamin D they obtain.

**90. What You Know So Far: Processes in Gene Pools (page 122)**

Student's own summary.