Topic 10 – data-based questions

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1. coloured, starchy both dominant traits Cc; white, waxy recessive traits Ss; F₁ are all CcSs; so F₁ × F₁: CcSs × CcSs produces typical dihybrid ratio of 9 coloured starchy: 3 coloured waxy: 3 white starchy: 1 white waxy in F₂;

2. the actual frequencies do not follow the 9:3:3:1 ratio and so the genes must be linked as they differ from the theoretical ratio for dihybrid crosses;

3. coloured, shrunken CCnn; white, non-shrinken ccNN; F₁ coloured, non-shrunken is CcNn are test-crossed with homozygous recessive: ccnn; CcNn × ccnn; typical ratio of 1 coloured non-shrunken: 1 white non-shrunken: 1 white shrunken

4. actual frequencies frequencies differ from typical ratio of 1:1:1:1, so genes must be linked;

5. if starchy/waxy and non-shrunken/shrunken are both linked to colour, then they must also be linked to each other;

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1 and 2.

<table>
<thead>
<tr>
<th></th>
<th>White Crested</th>
<th>Non-white, Non crested</th>
<th>Non-white Crested</th>
<th>White Non-crested</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>observed</td>
<td>337</td>
<td>337</td>
<td>34</td>
<td>46</td>
<td>754</td>
</tr>
<tr>
<td>expected</td>
<td>188.5</td>
<td>188.5</td>
<td>188.5</td>
<td>188.5</td>
<td>754</td>
</tr>
</tbody>
</table>

3. 3 degrees of freedom expected;

4. critical value for 3 df = 7.815;

5. X² >>7.815;

6. H₀ the traits are not linked and differences between observed and expected are due to sampling error; H₁ the traits are linked and differences between observed and expected are not due to sampling error; X² >>7.815, therefore p<<0.05; reject H₀ and accept H₁;

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a) negative correlation / mean length declining with time;

b) the longer the horns, the more likely the sheep will be shot; advantage to having short horns; long horns removed from reproductive pool; mean length becomes shorter with time; shorter horn alleles become more common in population with time; this is directional selection;

c) long horns more likely to win in courtship battles and become more common in reproductive pool; long horns more likely to be hunted and removed from the pool; the latter seems to be the most relevant factor;

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a) any value from 3.25 to 3.49 kg;

b) any value from 3.50 to 3.74 kg;

c) initially as birth mass increases up to 3.5 kg, survival increases, hence mortality decreases; then, as birth mass further increases beyond 3.5 kg, survival decreases and mortality increases; further from mode the higher the mortality, the highest survival and lowest mortality nearest to mode value;

d) birth mass shows variation; selection against very low / very high birth weights;

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a) (i) sneaking approximately 80 cm

(ii) fighting approximately 200 cm
b) (i) >60 cm body size for fighting
   (ii) 25–29 for sneaking;

c) 45–49 / 40–44;

d) extreme size forms reproduce; intermediate size forms are selected against;

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1. *C. lucasina* has uniform loudness whereas the *C. mediterranea* grows louder and then softer; the *C. lucasina* song lasts longer; individual notes would be more audible in *C. lucasina*;

2. lacewings with certain songs will attract some mates, but not others; over time, gene pools become isolated within the population; this would lead to sympatric reproductive isolation;

3. a) allopatric speciation is reproductive isolation due to geographic barriers; founder populations may differ in allele frequencies; the source and founder populations are subjected to different selection pressures; leading to increasing differences between the two;

   b) sympatric speciation is reproductive isolation within the same geographic area; it could be caused by behavioural or temporal isolation; variables prevent interbreeding of sub-populations; the same selection pressures present in the habitat may affect the two sub-populations differently.
Topic 10 – end of topic questions

1. anaphase I (figure 13) and telophase II (figure 14)

2. a) except for *S. arcticum* and *S. olafii*, the mass of DNA is similar between the varieties;
   b) the ancestral species had 19 chromosomes; they are descended from a common ancestor;
   c) (i) because they have double the mass; the 2n chromosome number is 38; a leaf cell will be
       2n/will have 38 chromosomes;
       (ii) more resources required to create a new cell;
   d) mosses have alternation of generations in their life cycle; the gametophyte is dominant and is a
       haploid;

3. a) the *Polypodium* (species) are (completely) isolated in different parts of the continent and the
   *Pleopeltis* (species) much closer together, physically overlapping and sharing the same habitats;
   *Polypodium* grows in more northerly / temperate locations;
   b) (i) *Polypodium* as it has lower similarity / genetic identity values / *Pleopeltis* has higher
       similarity / genetic identity values;
       (ii) *P. polylepis* and *P. conzatti*;
   c) geographic / ecological isolation / isolated by distance / by glacial periods / climatic changes;
      reproductive or genetic separation of gene pools (led to speciation) / adaptive radiation;
   d) *Polypodium*, as more genetic difference between all three species than between the species of
      *Pleopeltis*; takes time to accumulate mutations / genetic changes; distance may have facilitated
      the process of reproduction isolation;

4. a) C c W w; all are coloured starchy;
   b) gametes are C W, C w, c W, c w and c w; F₂ genotypes are CcWw, Ccww, ccWw and ccww;
      1 coloured starchy: 1 coloured waxy: 1 colourless starchy: 1 colourless waxy;
   c) chi-squared test;
   d) (autosomal) linkage / genes are on the same chromosome / genes do not assort independently;
      coloured starchy and colourless waxy are parentals / coloured waxy and colourless starchy are
      the recombinants; recombinants produced by crossing over.