RADLEY

Scholarship Examination

SCIENCE - BIOLOGY

March 2016

Time allowed – 90 minutes for all three science papers

Read the extract from a Biology book and answer the questions which follow. The number of marks for each question is given and the total is 33 marks.

You are expected to be able to write accurate, grammatical, well punctuated prose throughout this paper.

DO WOLVES KILL FOXES?

In fables the Wolf and the Fox are often cast as deadly enemies. What is the reality of their relationship? Although they rarely eat foxes and are generally do not hunt them, there is evidence that wolves kill foxes whenever the opportunity arises. Furthermore, it has been found in a part of Italy where there were wolves, that the foxes were often at pains to give the wolves a wide berth (although foxes can also benefit greatly from **scavenging** at wolf kills).

This enmity appears to be characteristic of interactions between red foxes and other members of the dog family. It may arise because, apart from differences in their size, members of the dog family are very similar. It is a basic principle of ecology that competition will prevent to species from occupying the same **niche**. So, for example, foxes and badgers can live side-by-side because, despite many similarities in their diets, there are sufficient differences to reduce competition. One might expect, therefore, the worst antagonism between the most similar members of the dog family, and there is increasing evidence that this is the case.

The sizes of North American canids descend through wolves (20-80kg), coyotes (11-15kg), red foxes (5-6kg), grey foxes (2.5-6kg), to the small swift and kit foxes (1.8-3kg). Coyotes have spread following the annihilation of the wolf. Similarly, red fox numbers are greater where coyotes are absent. In Canada, one scientist radio tracked red foxes and coyotes where they coexisted, and discovered that fox **territories** abutted, but did not overlap, the larger territories of coyotes. The foxes conspicuously avoided rearing cubs where coyotes were active.

In the 17th century, in the USA large tracts of East Coast Forest were felled and the landscape opened for agriculture. The new habitat favoured the red fox which had originally been confined to open areas north of 40° **latitude**, and red foxes spread south from Canada at the expense of the local grey or tree fox. Red foxes now inhabit the prairie states of the USA where Swift foxes once predominated. In the Californian cotton belt there is a relict population of the endangered San Joaquin kit fox (2kg); the **conservation** of these little foxes is hampered because they are killed, not eaten, by coyotes.

The idea that canine **species** are so similar as to compete directly led scientists to formulate a hypothesis about why the Artic Fox lives further north than the red fox. Previous explanations for this were that Artic foxes could withstand more extreme cold, or that the red fox was not **camouflaged** in the snow. However, red foxes can and do thrive in very cold, snowy conditions, and analysis suggested that the factor limiting the northern extreme of their distribution was cool summer temperatures (not perishing winter ones). Summer temperatures limit plant growth and the primary productivity of the far North; with less plant growth there will be fewer **herbivorous** voles and lemmings. In short, cold summers ultimately limit the food available for foxes. The fact that red foxes are bigger than arctic foxes means that they require more food and conversely the arctic fox can live in conditions too barren to sustain red foxes. Red Fox home ranges in the Arctic are enormous - over 3000 hectares. However, in every respect save size the two species are so similar that where they might otherwise coexist they are likely to compete. It was concluded that the northern limit of the red fox is limited directly by shortage of food (and only indirectly by climate) while the southern limit of the arctic fox is limited by the red fox. In effect, the two are so similar (they can even mate and produce inFertile **hybrids**) that red foxes probably treat arctic foxes as poor quality red foxes.

Competition between red and arctic foxes became obvious as a consequence of fox fur ranching. In the 1830s, the Russian-American company began releasing foxes into previous fox-free sea-bird islands off Alaska. During the 1920s and 1930s, when fox furs were at their most valuable, red or arctic foxes were released on almost every island from the Aleutian Islands to the Alexander Archipelago. For the most part, they were left to look after themselves, and harvested annually. In 1936, 26,000 fox pelts were harvested from the Aleutian Island 'farms'. However, it was soon obvious that the two species of fox could not be kept on the same island: red foxes invariably usurped Artic foxes.

Adapted from "Running with the Fox"
by David MacDonald.

Using the information in the passage and your own knowledge, answer these questions:

1. What is meant in the passage by the words indicated in bold as follows:

i.	Scavenging	vi.	Species	
ii.	Niche	vii.	Camouflaged	
iii.	Territories	viii.	Herbivorous	
iv.	Latitude	ix.	Hybrids	
v.	Conservation	x.	Competition	[10]

2. Name three animals in the passage which are not members of the dog (canid) family. [3]

3. Draw an Arctic food web. [3]

4. Describe the species of canid (dog) in North America. Do they coexist or compete? Explain why. [4]

5. Conservation is very important in the modern world. Explain how the following two issues cause problems for it.

i. Felling East Coast forests for agriculture in the USA [2]

ii. Fox Fur Ranching on Arctic Islands [2]

6. For each of the above two conservation problems, suggest a solution. [2]

7. Fox Fur Ranching was regarded as fine in 1886 but it could be seen as an Animal Welfare issue today. Explain why this might be so. Do you agree? [4]

8. Draw a labelled diagram of the sort of cell you might find in a vole. [3]

[TOTAL = 33 MARKS]