S

93101Q

931012

NZQA
NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

Scholarship 2012
Biology

2.00 pm Saturday 10 November 2012
Time allowed: Three hours
Total marks: 24

QUESTION BOOKLET

There are THREE questions in this booklet. Answer ALL questions.

Write your answers in Answer Booklet 93101A.

Start your answer to each question on a new page. Carefully number each question.

Check that this booklet has pages 2–5 in the correct order and that none of these pages is blank.

YOU MAY KEEP THIS BOOKLET AT THE END OF THE EXAMINATION.

You have three hours to complete this examination.

QUESTION ONE: THE BLACKCAPS

Blackcaps are small songbirds found throughout Europe. A large population of blackcaps inhabits the forests of Germany.

These blackcaps have typically migrated southwest over two mountain ranges to overwinter in Spain, where they feed on fruits and berries. However since the 1960s, blackcaps have been seen in Britain after migrating northwest from Germany. The number of blackcaps migrating to Britain has increased and today about 10% of the German population migrate there, instead of to Spain. In Britain, the blackcaps feed on birdseed provided by local bird-lovers.

For copyright reasons, this resource cannot be reproduced here.

http://science-on-the-edge.blogspot.co.nz/2011/02/migration-is-in-genes.html

In spring the birds from both Britain and Spain leave at the same time to fly back to Germany to the same breeding grounds. On arrival they select a mate for that season and breed.

Hybridisation has been recorded between the two groups (those that fly to Britain and those that fly to Spain) but is very rare. These hybrids migrate in a direction about halfway between the routes of their parents.

Scientists have found that the migratory behaviour of the two groups is causing them to evolve separately and already genetic differences are evident. For example, the British group has narrower, longer beaks and also rounder wings (increases ability to manoeuvre). Also the British migrants have browner backs and beaks while the Spanish migrants are greyer.

Discuss reasons for the change in migratory behaviour and the impact this is having on the evolution of these blackcaps.

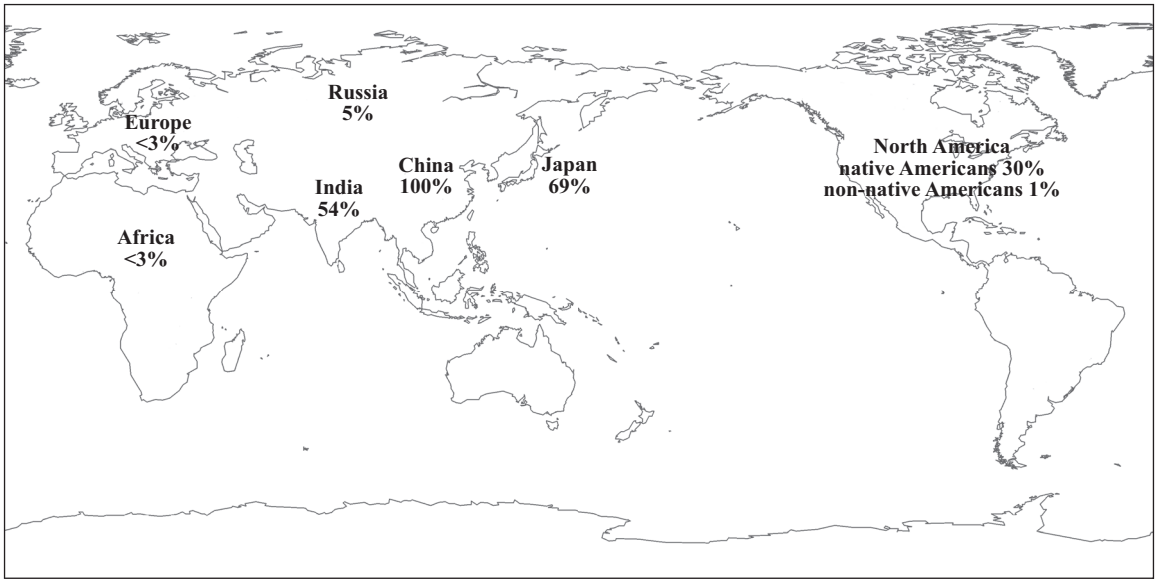
QUESTION TWO: THE ABCC11 GENE

Wax in the external canal of the human ear may be wet or dry.

Whether earwax is wet or dry has been traced to a gene called ABCC11, found on chromosome 16 in humans. The ABCC11 gene codes for a protein involved with the transport of secretory products across cell membranes. Which products are secreted determines the type of earwax present in humans. Earwax is wet unless an individual has Adenine (A) at a particular site instead of Guanine (G), in which case the wax becomes the dry form. People who inherit the version of the gene that has A from both parents have dry earwax. People who inherit two of the G versions, or one G and one A, have wet earwax.

Dry earwax is very common in East Asians, for example in China 100% of the population has dry earwax. However, it is very rare in both Europe and Africa (less than 3% of the population). Dry earwax is intermediate in frequency in the populations of Central Asia, for example in India 54% of the population has dry earwax. In Japan, 69% of the population has dry earwax. In North America, 30% of native Americans have dry earwax, while it is present in no more than 1% of Americans of European or African descent.

Estimated percentage of population with dry earwax



www.clarkeresearch.org/resources/World_Map.jpg

Use biological knowledge, together with information from the above resource material, to discuss:

- the origins and inheritance patterns of dry earwax
- the evolutionary factors that may have resulted in the present-day distribution of both types of earwax.

QUESTION THREE: SURVIVAL OF THE SADDLEBACK

The North Island saddleback or tieke, *Philesturnus rufusater,* is an endemic New Zealand bird. Saddlebacks inhabit the middle or lower layers of the forest, and eat small invertebrates found on the forest floor, as well as a variety of fruits and nectars.

Saddlebacks only fly short distances and mainly leap between low branches. They usually nest near the ground, and their fledglings will leave the nest to hop around on the ground while they build up strength in their wings. Individuals can start reproducing from one year of age and can live up to 17 years. They are monogamous and each pair defends a territory all year round. In predator-free conditions, one pair can produce two or three clutches of eggs, each with two or three young, in a breeding season.

For copyright reasons, this resource cannot be reproduced here.

http://en.wikipedia.org/wiki/File:Saddleback_tiritiri.jpg

Saddlebacks were once widespread throughout the North Island, but by the late 1800s they had been reduced to just one natural population of about 500 birds on Hen Island in the Hauraki Gulf (see following diagram). A conservation programme was set up to increase the numbers of the saddleback and also to maintain the genetic diversity of the species.

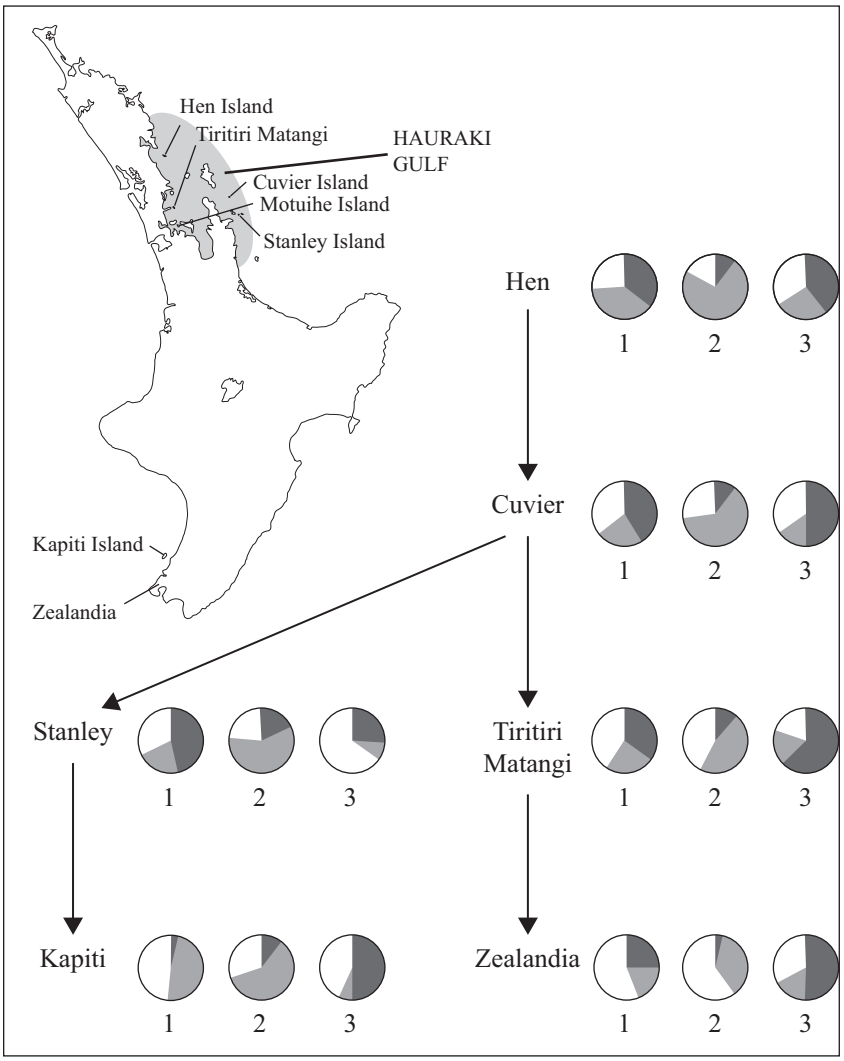
Starting in the 1960s, groups of between 20 and 50 birds from the Hen Island population were relocated to other islands. This resulted in the establishment of different populations on 11 Hauraki Gulf islands. Then, from the 1980s onwards, birds from various islands were relocated to start new populations in areas outside the Hauraki Gulf, such as Kapiti Island and the mainland refuge Zealandia, in Wellington.

Two very different recent studies have been carried out to assess the success of the conservation programme and make recommendations for the future.

One study gathered evidence about diversity in saddleback populations. Mating and territorial songs from birds on different Hauraki Gulf islands were recorded. 202 different songs were identified. Of these, only 30% are heard on more than one island. Recordings of both familiar and unfamiliar songs were played to 10 pairs of saddlebacks on one of these islands, Motuihe Island, and their reactions observed. In cases where the mating or territorial song was not recorded on Motuihe but only heard on a different island, the birds did not respond.

The second study aimed to establish whether genetic diversity has been maintained in saddleback populations after relocation. Differences in three noncoding regions of DNA were used as indicators of genetic diversity in several populations, as shown on the opposite diagram. Each noncoding region has three different versions.

North Island saddleback relocation and genetic diversity



The arrows show the movement of birds from one island to another. The numbers 1, 2 and 3 refer to the three noncoding regions of DNA. The pie charts represent the frequency of each of the three different versions (black, white and grey) in each population.

Adapted from data from http://www.newzealandecology.org/nzje/new_issues/NZJEcol35_3_220.pdf

Discuss how aspects of the North Island saddleback's ecological niche, AND human impact and intervention have influenced the bird's evolutionary success over the past 200 years.

Analyse the implications of the two recent studies on the future conservation management of the North Island saddleback.