NZQA

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

Scholarship 2013
Biology

9.30 am Thursday 14 November 2013
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 2–7 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: CHIMPANZEES

Chimpanzees are great apes belonging to the genus *Pan* and found only in the rainforests of West and Central Africa. There are considered to be two species of chimpanzee living today: the common chimpanzee (*Pan troglodytes*) and the pygmy chimpanzee or bonobo (*Pan paniscus*).

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Source: *National Geographic*, March 2013, vol 223, no 3.

Bonobos and common chimpanzees diverged from each other around 2 million years ago, and differ in many ways. However, researchers have sequenced the genome of both species and discovered they have 99.6% of their DNA in common. This genetic difference alone would not be enough to classify them as separate species. The researchers also discovered that both bonobos and the common chimpanzee share over 98% of their DNA with modern humans; however it is not all the same DNA. Humans share 1.6% of their DNA with bonobos and not the common chimpanzee, and 1.7% with the common chimpanzee and not bonobos.

The common chimpanzee is found on the northern side of the Congo River, with many different populations living throughout many countries. In some of these countries, their range overlaps with another great ape, the gorilla. The bonobo are the only great ape living on the southern side of the Congo River.

The Congo River formed 1.5–2 mya and is the third-largest in the world by volume of water. Its width ranges between hundreds of metres to kilometres wide.

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Source (adapted): www.kurzweilai.net/hippie-chimp-genome-sequenced

The table below describes some of the physical, behavioural, and social differences between the two species of chimpanzee.

	Bonobo (*Pan paniscus*)	Common chimpanzee (*Pan troglodytes*)
Appearance	• gracile / slender build, bright pink lips, black face	• robust build, dark lips, face colour changes with age
Sexual dimorphism	• not obvious	• very obvious
Social organisation	• females are dominant over males • mother–son and female–female bonds important	• males are dominant over females • male–male bonds important • a linear hierarchy of males
Diet	• omnivores (infrequently hunt)	• omnivores (males frequently co-operatively hunt)
Vocalisation	• not known to hoot, scream, grunt	• known to hoot, scream, grunt
Territoriality	• no obvious aggression between groups • group territories can overlap • mating occurs freely between groups	• obvious aggression between groups • aggressive patrolling of territory boundary
Sexual behaviour	• for conceiving offspring • frequent non-conceiving sexual interactions occur between all ages and both sexes • no obvious aggression when competing for mates	• only for conceiving offspring • high-ranking males monopolise and guard females in oestrus
Infanticide	• not known to occur	• known to occur

Justify whether these two chimpanzees should be classified as different species or whether they should be re-classified as sub-species.

In your justification, discuss:

•   the factors that have contributed to the existence of two species of chimpanzee

•   the reasons that may have led to the marked difference in behaviour of the two species.

QUESTION TWO: CALIFORNIA CONDORS

The California condor (*Gymnogyps californianus)* is
a vulture, and the largest North American bird with a
wingspan of up to 3 m and a weight of up to 12 kg.

The condor is a scavenger and can fly up to 250 km a day
in search of food, preferring to feed off the carcasses of
large mammals such as deer, bears, cougars, cattle, goats,
pigs, sheep, and horses, though they will also feed on the
bodies of smaller mammals such as rabbits and coyotes.

Condors have a long lifespan and may reach up to 60 years
of age in the wild. Sexual maturity is reached at around
6 years old. The male displays to attract a female, and a
pair mates for life, with the female laying one egg every

Adult condor

Source; www.manataka.org/images/california-condor-in-flight.jpg

other year. Nests are made in shallow caves and rock crevices on cliffs or rocky outcrops. If an egg or
chick is lost, the parents 'double clutch' (lay another egg that season). Ravens are potential predators of
condor eggs, while golden eagles and bears may predate the chicks.

When feeding at a carcass, large groups of condors display a pecking order, with dominant birds feeding
before the younger ones.

Chondrodystrophy is a lethal condition which results in severely deformed embryos. It is inherited
as an autosomal recessive allele. The allele is present in the gene pool of the California condor, and its
frequency today is estimated as being as high as 9%.

Condors were widespread across the North American continent prior to the end of the last ice age.
Climatic changes associated with the end of the ice age and the extinction of the very large fauna that
lived in the Pleistocene, led to a subsequent reduction in numbers, and the range of condors was reduced
to western America.

Main condor range after the end of the Pleistocene ice age

Source (adapted): www.fws.gov

Condor numbers further decreased greatly during the 20th century as a result of many factors, including
habitat destruction, lead (in bullets) poisoning, cyanide poisoning (of coyotes), shooting, and power lines.
They had become critically endangered by the 1980s, and a Government conservation programme, the
California Condor Recovery Plan (CCRP), was established.

In 1987, only 22 condors remained in the wild. These were captured and placed in the Los Angeles and San Diego zoos. Captive breeding programmes were started in both zoos, with scientists taking advantage of the double clutching behaviour to remove eggs and hand-rear the chicks using puppets (shown in the photo on the right).

In 1991 and 1992, condors were released into the wild again in California, and in 1996 into Arizona, where they are now regularly seen in the Grand Canyon. While the birth rate in the wild remains low, numbers in the wild populations are steadily increasing from the regular release of captive-reared adolescents. As of May 2012, the total condor population was 405, of which 226 were living in the wild, and 179 in captivity. Lead poisoning remains a leading cause of death in condors in the wild, with 25 condor deaths confirmed since 2000.

The goals of the recovery plan are to establish two geographically isolated, self-sustaining populations, one in California and the other in Arizona (separated by a distance of at least 700 km). Each population will have 150 birds with at least 15 breeding pairs.

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Chick being fed by a condor puppet
Source: http://melanyafeast.files.wordpress.com/2013/01/5299-california-condor-chick-s3.jpg
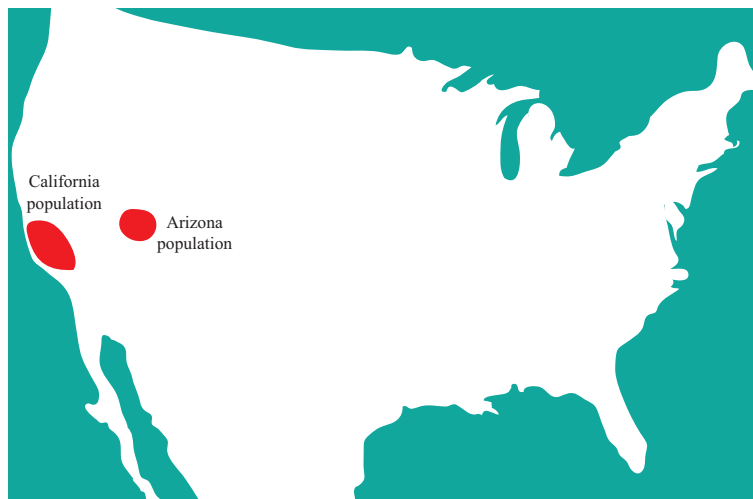
Present-day location of condor populations
Source (adapted): www.fws.gov

Use the information in the resource material AND your biological knowledge to discuss:

- the factors that have contributed to the California condors becoming critically endangered

- the goals of the California Condor Recovery Programme and how these are being achieved.
  In your discussion, include any recommendations for the future management of the birds to improve their critically endangered status.

QUESTION THREE: THE PRIMROSE

The common evening primrose (*Oenothera biennis*) is a small plant, which flowers in spring. The offspring of the primrose are mostly clones of the parent, due to self-pollination and very limited recombination. This allows researchers to track changes in genotype frequencies in an isolated population over multiple generations.

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Source: http://upload.wikimedia.org/ wikipedia/commons/8/8e/Antioch_Dunes_ Evening_Primrose.jpg

Researchers set up a controlled study to investigate the evolutionary responses to insect herbivory in the primrose. They dug 16 identical plots of fresh soil, and planted 60 evenly spaced seedlings of primrose in each plot. Eight of the plots were sprayed with an insecticide twice a week (sprayed group). The remaining eight plots were not sprayed with insecticide (control group). Plots were not weeded or otherwise manipulated throughout the 5-year experiment, from 2007 to 2011.

The photos below show the community composition at the end of the experiment. All the yellow flowers in the photos are a colonising plant called dandelion (*Taraxacum officinalle*). Dandelion was more than twice as abundant in the sprayed plots compared to the control plots after 5 years.

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A control plot

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A sprayed plot

Common insect herbivores in this community include:
- the caterpillar of the moth *Mompha brevivittella,* which eats the seeds contained in primrose fruit
- the beetle *Glocianus punctiger*, which eats the seeds contained in dandelion fruit
- the caterpillar of the moth *Noctua pronuba*, which eats leaves of both primrose and dandelion.

At the start of the experiment, there were identical frequencies of 18 different genotypes planted in each plot. After 5 years, the sprayed group of plots had significantly different frequencies of each genotype present compared to the control group of plots. The 18 genotypes were selected because each produces a readily identifiable phenotype. Therefore, the phenotype frequency can be accurately used to calculate the frequency of the genotypes in the population.

One of the primrose phenotypes selected for analysis was 'early' or 'late' flowering.

At the end of the experiment, researchers recorded the timing of flowering in the sprayed and control groups. They found that the sprayed group:

- flowered significantly earlier than the control group
- grew significantly faster than the control group.

Another phenotype investigated was the production of the defensive chemical Oenothein A, which is harmful to herbivorous insects.

Primrose leaf and fruit tissue for each of the genotypes was dried and the concentration of Oenothein A was measured. The differences in Oenothein A production were calculated between the control and sprayed group, based on the genotype frequencies present after 5 years.

Data showing the concentration of Oenothein A in leaves and fruit of primrose
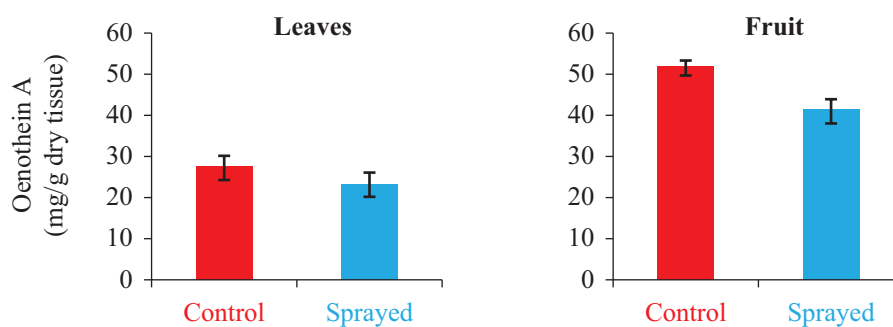
I = margin of error

Use ecological and/or evolutionary concepts to account for **changes** over the 5-year study in:

- the composition of the community in the sprayed and control plots
- the phenotypes of the primrose plants.