Assessment Schedule – 2017

Scholarship Biology (93101)

Evidence Statement

Question One: Kākāpō: Evidence Statement

Reproductive behaviour and genetic factors of the kākāpō that account for its critically endangered status.

Evidence	Justification
Ground nesting in hollow trees / under logs means kākāpō vulnerable to introduced mammalian predators, e.g. stoats.	
Nests / birds very smelly which attracts predators to the nest.	
Males vulnerable to predators when booming / on lek.	
Birds freeze when disturbed which increases chance of predation by introduced ground dwelling predators.	Freezing was a good defence against native airborne predators.
Only female incubates eggs and raises young.	Increased chances of chick not surviving, as more likely to be poorly nourished as only one parent providing food. Increased chances of chick not surviving, due to predation when female absent.
Breeding dependent on masting of canopy trees and as masting is infrequent, kākāpō do not breed each year reducing chick numbers.	
Clutch size is small so limited numbers of offspring produced.	
Sex of young determined by female weight.	Can result in gender imbalance, restricting ability for population increase / maintenance.
Reproductive rate is low overall, so population size is unable to be maintained / increase in size.	
	Lek breeding typically results in a small number of dominant males contributing their alleles to the gene pool further reducing diversity / these males may have harmful / lethal alleles.

Lack of genetic diversity / small population size due to bottleneck / inbreeding depression / genetic drift in small populations.	Results in increased risk of harmful recessive alleles being passed on, e.g. defective MHC allele / increased risk of alleles being lost / increased homozygosity / reduced heterozygosity. Results in increased risk of disease killing offspring, e.g. fungal infection killing Rooster or Results in the high infertility rate of eggs, e.g. 52% in 2016 / inviable embryos / 40% of all kākāpō eggs infertile.

Combined two areas reproduction and genetics, as there is overlap, e.g. lek breeding is a reproductive behaviour while consequences are genetic.

How genome sequencing and analysis may be used in managing kākāpō populations to try and ensure that kākāpō do not become extinct.

Evidence	**Justification**
Identify individuals with harmful alleles / genotypes OR Identify individuals with beneficial alleles / genotypes OR Identify relatedness between kākāpō.	Do not use these individuals in breeding programmes. Allow these individuals to remain in breeding programmes. Prevent breeding between closely related kākāpō / only mate distantly related kākāpō.
Identify potential genetic causes of infertility.	Test the birds in the breeding programmes to see if they have genetic predisposition to infertility and don't use them for breeding if they do.
	Analyse genome of Rooster / dead young to identify MHC allele variants that compromise immune system.
	Identify variants not present in Stewart Island kākāpō, which may be beneficial / increase survival and / or reproduction. Translocate other Fiordland birds to all three islands in an attempt to increase genetic diversity. Analyse genome / STRs / polymorphisms / marker genes of Fiordland birds / Sinbad / Gulliver / Kuia for allele variants.
	Use gene editing techniques such as CRISPR to alter genome by e.g. removing harmful alleles / inserting beneficial alleles / knocking gene out / knocking genes in OR Insert alleles / knock genes in or delete alleles / knock genes out from birds with identified fertility problems.

Judgement statement (the two areas are reproductive and genetic factors).

8	Provides an in-depth response using information in the resource material and *Nature of Science* and *Living World* strands up to and including Level 8 in *The New Zealand Curriculum* using independent thought and relevant biological concepts. The response is indicative of thorough planning with ideas that are well thought through. The reproductive behaviour and genetic factors of the kākāpō that account for its critically endangered status are discussed and a fully integrated, coherent analysis on how genome sequencing and analysis may be used in managing kākāpō populations is presented. 8 Js. Must have 2 Js in each area. Answer displays: • perception and insight • sophisticated integration and abstraction • independent reflection and extrapolation • convincing communication.
7	Provides an in-depth response using information in the resource material and *Nature of Science* and *Living World* strands up to and including Level 8 in *The New Zealand Curriculum* using independent thought and relevant biological concepts. The response is indicative of thorough planning with ideas that are well thought through. The reproductive behaviour and genetic factors of the kākāpō that account for its critically endangered status are discussed and a fully integrated, coherent analysis on how genome sequencing and analysis may be used in managing kākāpō populations is presented. 7 Js. Must have 2 Js in each area. Answer displays aspects of: • perception and insight • sophisticated integration and abstraction • independent reflection and extrapolation • convincing communication.
6	A coherent and well written discussion is presented involving selecting relevant reproductive behaviour and genetic factors. Relevant biological concepts are applied to develop a well-reasoned argument of how genome sequencing and analysis may be used in managing kākāpō populations. 6 Js or 5 Js and 2 descriptions or 4 Js and 4 descriptions. Must have 1 J in each area. Answer displays: • analysis and critical thinking • integration, synthesis and application of highly developed knowledge, skills and understanding • logical development, precision and clarity of ideas.

5	A coherent and well written discussion is presented involving selecting relevant reproductive behaviour and genetic factors. Relevant biological concepts are applied to develop a well-reasoned argument of how genome sequencing and analysis may be used in managing kākāpō populations. 5 Js or 4 Js and 2 descriptions or 3 Js and 4 descriptions. Must have 1 J in each area. Answer displays aspects of: • analysis and critical thinking • integration, synthesis and application of highly developed knowledge, skills and understanding • logical development, precision and clarity of ideas.
4	4 Js OR 3 Js and 2 descriptions.
3	3 Js OR 2 J and 2 descriptions.
2	2 Js OR 1 J and 2 descriptions.
1	1 J OR 2 descriptions.
0	Lack of relevant evidence.

QUESTION TWO: Kiwi: Evidence Statement

Evolution of the distinctive niche of the kiwi.

Evidence	**Justification**
	Flightlessness selected for by lack of large ground dwelling predators prior to human arrival. Flightlessness resulted in energy savings which could be used for other life processes, e.g. strong legs for digging for food / burrows / defence / production of a large egg.
	Nocturnal behaviour selected for as a result of presence of predatory birds such as eagles, falcons / competing moa. Nocturnal behaviour decreases chances of predation from diurnal / visual hunters. Nocturnal behaviour increases chances of finding food, as competitively excluded by moa.
Invertebrate diet of kiwi selected for as a result of competition from moa.	All moa species were herbivorous, so kiwi specialising on invertebrates reduced interspecific competition ensuring food requirements are met.
Shaggy hair-like feathers of kiwi selected for due to cold / to increase warmth / increase insulation.	Flight feathers no longer needed.
The very long beak with nostrils and sensory pits located at the end are adaptations to finding invertebrates in soil.	
The long tactile whiskers at top of beak and face are adaptations for finding their way on the forest floor at night.	
Changes in brain areas with reduction in sight / increased touch and smell are adaptations for nocturnal behaviour / successfully finding food.	

How changes in the land mass of New Zealand have contributed to the evolution of the 5 species of kiwi within New Zealand and the presence of varieties of brown and tokoeka kiwi.

Evidence	**Justification**
Oligocene drowning saw New Zealand land mass reduced to isolated islands.	Prevented gene flow between populations isolated on islands as kiwi were likely flightless by this time.
Formation of Manawatu Strait / Cook Strait isolated brown kiwi from ancestral population / other kiwi.	Straits provided a geographical / sea barrier to gene flow leading to allopatric speciation of brown kiwi from the ancestral population.
Mountain formation / rise of Southern Alps separated populations.	Prevented gene flow through formation of glaciers / rivers as no east-west division of species.
	(Following the change in land mass) isolated populations in different habitats / environments experienced mutations in gene pool / differing selection pressures / genetic drift / no gene flow leading to genetic differences in the gene pools resulting in reproductive isolation and allopatric speciation to give the five extant species.
Geographical barriers occurred to separate brown kiwi populations.	Different selection pressures / genetic drift / mutations leading to changes in allele frequencies / genetic differences, resulting in the varieties. Volcanism (e.g. Taupo Volcano ash fallout disrupting probe feeding, digging burrows) / Formation of mountain ranges (e.g. Tararuas) / Formation of straits (e.g. Ahipara Strait which created Aupouri Island).
Geographical barriers occurred to separate tokoeka populations.	Mutations / genetic drift / sexual selection in the isolated gene pools resulted in the variations in colour patterns / sizes within tokoeka. Glaciation (e.g. Franz Josef), rivers (e.g. Haast, Grey, Buller), island formation (Stewart / Rakiura), strait formation (Foveaux).
Species and varieties result from divergence / divergent evolution / adaptive radiation.	

Judgement statement (the two areas are the evolution of the niche and changes to New Zealand's landmass).

8	Provides an in-depth response using information in the resource material and *Nature of Science* and *Living World* strands up to and including Level 8 in *The New Zealand Curriculum* using independent thought and relevant biological concepts. The response is indicative of thorough planning with ideas that are well thought through. The evolution of the niche of the kiwi is discussed, and a fully integrated, coherent discussion on how changes in the land mass of New Zealand have contributed to the evolution of species and varieties of kiwi is presented. 8 Js. Must have 2 Js in each area. Answer displays: • perception and insight • sophisticated integration and abstraction • independent reflection and extrapolation • convincing communication.
7	Provides an in-depth response using information in the resource material and *Nature of Science* and *Living World* strands up to and including Level 8 in *The New Zealand Curriculum* using independent thought and relevant biological concepts. The response is indicative of thorough planning with ideas that are well thought through. The evolution of the niche of the kiwi is discussed, and a fully integrated, coherent discussion on how changes in the land mass of New Zealand have contributed to the evolution of species and varieties of kiwi is presented. 7 Js. Must have 2 Js in each area. Answer displays aspects of: • perception and insight • sophisticated integration and abstraction • independent reflection and extrapolation • convincing communication.
6	A coherent and well written discussion is presented on the evolution of the kiwi niche and relevant biological concepts are applied to develop a well-reasoned argument on how changes in the land mass of New Zealand have contributed to the evolution of species and varieties of kiwi. 6 Js or 5 Js and 2 descriptions or 4 Js and 4 descriptions. Must have 1 J in each area. Answer displays: • analysis and critical thinking • integration, synthesis and application of highly developed knowledge, skills and understanding • logical development, precision and clarity of ideas.

5	A coherent and well written discussion is presented on the evolution of the kiwi niche, and relevant biological concepts are applied to develop a well-reasoned argument on how changes in the land mass of New Zealand have contributed to the evolution of species and varieties of kiwi. 5 Js or 4 Js and 2 descriptions or 3 Js and 4 descriptions. Must have 1 J in each area. Answer displays aspects of: • analysis and critical thinking • integration, synthesis and application of highly developed knowledge, skills and understanding • logical development, precision and clarity of ideas.
4	4 Js OR 3 Js and 2 descriptions.
3	3 Js OR 2 Js and 2 descriptions.
2	2 Js OR 1 J and 2 descriptions.
1	1 J OR 2 descriptions.
0	Lack of relevant evidence.

QUESTION THREE: *Homo erectus*: Evidence Statement

Compare the differences in the rate of change for biological and cultural evolution shown by the graph.

Evidence	**Justification**
Timespan A (7 – 3 mya): Biological evolution is occurring at a slow steady rate during the timespan while there is no apparent cultural evolution.	Change in biological evolution is linked to bipedalism changes in hominins (e.g. foramen magnum more centralised) and no evidence for cultural evolution for hominins during this timespan.
Timespan B (3 – 1.8 mya): Biological evolution has a slow increase during the timespan while cultural evolution starts to occur.	Biological evolution has a slight increase due to brain development / height / hand manipulation linked to improved diet due to tools while cultural evolution begins linked to Oldowan tool development by *H. habilis* (and later Australopithecines).
Timespan C (1.8 mya – 300,000 yrs ago): Biological evolution has greatly increased, as has cultural evolution.	Cultural evolution increases due to more sophisticated Acheulean tools and development of controlled use of fire, which allowed for increased learning / sharing of ideas. There is a rapid similar increase in both biological and cultural evolution as a result of feedback loops between the two of them / reciprocal effect on each other.
Timespan D (300,000 yrs ago – present): Biological evolution continues to rise and then levels off while cultural evolution continues to rise.	Biological evolution increases due to continued brain development / height / hand (precision grip) linked to continued improvement in diet and Mousterian / Upper Paleolithic tools. Biological evolution levelling off with *H. sapiens* as a result of cultural evolution becoming relatively more significant than natural selection as *H. sapiens* develops control of the environment. Cultural evolution continues to rise due to development of more sophisticated Mousterian / Upper Paleolithic tools / language / settlements / agriculture.

Analyse the biological and cultural evolution of *H.erectus* to discuss why *H.erectus* could be considered a pivotal species in the evolution of modern humans.

Evidence	**Justification**
Brain size significantly larger than preceding hominins.	*H.erectus* brain size 50% larger than *H.habilis* / 70% size of modern humans indicates a large developed brain or Compares brain volumes to *H.habilis* / *H.sapiens* or Presence of Broca's area for organisation of sounds and Wernicke's area for interpretation of sounds indicates ability to communicate and share ideas and information.
A significant increase in height.	(Height of 1.8 m with) longer legs and arched feet allowing an efficient bipedal gait.
First hominin to leave Africa.	Allowed access to a wider range of resources / habitats / reduced competition.
Acheulean tool development / technology.	More sophisticated than Oldowan, providing a much wider range of uses.
Hunter-gatherer lifestyle.	Co-operative hunting allowed for capture of large prey, ensuring improved diet.
First species to control / manipulate the use of fire.	Fire increased survival / fitness / life expectancy of *H.erectus* by its many benefits: • Providing heat, which allowed dispersal into colder climates of Europe and Asia. • Providing light, which extended hours of daytime, allowing for increased socialisation / time for tool making / associated activities. • Cooking of food, softens / releases nutrients / kills parasites / detoxifies poisons, resulting in improved diet allowing for brain development / complexity.

Judgement statement (the two areas are the timespan and consideration of *H.erectus* as a pivotal species)

8	Provides an in-depth response using information in the resource material and *Nature of Science* and *Living World* strands up to and including Level 8 in *The New Zealand Curriculum* using independent thought and relevant biological concepts. The response is indicative of thorough planning with ideas that are well thought through. The rate of change of biological and cultural evolution is compared and accounted for. A fully integrated, coherent discussion on why *H.erectus* could be a pivotal species is presented following an analysis of the biological and cultural evolution of *H.erectus*. 8 Js. Must have 2 Js in each area. Answer displays: • perception and insight • sophisticated integration and abstraction • independent reflection and extrapolation • convincing communication.
7	Provides an in-depth response using information in the resource material and *Nature of Science* and *Living World* strands up to and including Level 8 in *The New Zealand Curriculum* using independent thought and relevant biological concepts. The response is indicative of thorough planning with ideas that are well thought through. The rate of change of biological and cultural evolution is compared and accounted for. A fully integrated, coherent discussion on why *H.erectus* could be a pivotal species is presented following an analysis of the biological and cultural evolution of *H.erectus.* 7 Js. Must have 2 Js in each area. Answer displays aspects of: • perception and insight • sophisticated integration and abstraction • independent reflection and extrapolation • convincing communication.
6	A coherent and well written discussion is presented on why *H.erectus* could be a pivotal species and relevant biological concepts are applied to develop a well-reasoned comparison of the rate of biological and cultural evolution in *H.erectus*. 6 Js or 5 Js and 2 descriptions or 4 Js and 4 descriptions. Must have 1 J in each area. Answer displays: • analysis and critical thinking • integration, synthesis and application of highly developed knowledge, skills and understanding • logical development, precision and clarity of ideas.

5	A coherent and well written discussion is presented on why *H.erectus* could be a pivotal species and relevant biological concepts are applied to develop a well-reasoned comparison of the rate of biological and cultural evolution in *H.erectus*. 5 Js or 4 Js and 2 descriptions or 3 Js and 4 descriptions. Must have 1 J in each area. Answer displays aspects of: • analysis and critical thinking • integration, synthesis and application of highly developed knowledge, skills and understanding • logical development, precision and clarity of ideas.
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