Assessment Schedule – 2022

Scholarship Biology (93101)

Evidence Statement

QUESTION ONE: FLIGHTLESS BIRDS: Evidence Statement

Discusses the ecological and evolutionary processes that have led to the diversity of both extinct and living species of these flightless seabirds (D).

	Evidence		**Justification**
DA	Penguins show **adaptive radiation / divergence / divergent evolution** after their split from Procellariiformes / 66 mya with more than 50 extinct and 20 current species / many species from a common ancestor. (not 'diverged')	**DAJ1**	This was due to the **extinction** of marine apex predators / sharks and reptiles, which left a range of **unoccupied / vacant niches.**
		DAJ2	Niche differentiation / different niches allowed penguin ancestor to adapt and evolve in a wide range of habitats from Antarctica to the Equator.
		DAJ3	Homologous structures **with example** (such as wings for swimming rather than flight) show common ancestry with different function
DP	Likely to have undergone **punctuated equilibrium**-with rapid speciation occurring.	**DPJ**	This was due to the **extinction** of marine apex predators / sharks and reptiles, which left a range of **unoccupied / vacant niches.** **(Can't have DPJ *AND* DAJ1)**
DN	(Natural) **selection / selection pressures** for traits that increased the reproductive success of individuals.	**DNJ1**	Wings no longer needed for flight, so penguins with 'flipper like' wings for increased speed / agility / movement underwater to help catch prey were selected for.
		DNJ2	Light / less dense bones not needed for flight, so selection for penguin bones to become denser, changed buoyancy in water / made diving easier.
		DNJ3	Flight feathers not needed, so selection for more streamlined contour feathers to reduce drag / energy cost of swimming.
		DNJ4	Flight feathers not needed, so selection for dense mat of plumules for insulation / reduce heat loss / to conserve heat in cold water.
		DNJ5	Modified eye lens due to needing to spot prey more clearly underwater (rather than in air).
		DNJ6	Enhanced thermoregulation / genetic differences in thermoregulatory genes increased survival in cold (southern ocean) waters (because birds are endothermic / homeotherms / warm blooded).
		DNJ7	Changes to osmoregulation selected for due to saltwater environment, which would upset water balance in the body.
		DNJ8	Larger body mass in colder waters / habitat (gives smaller SA:V ratio) reduces heat loss / conserve heat (or inverse for warmer waters).
DM	Beneficial **mutations** selected for.	**DMJ**	Beneficial mutations selected for as they provided a selective advantage / increased the reproductive success of the penguins. These increased in frequency in the population.

DW	Selection for small bodies in warmer water / habitat / Galapagos (or larger bodies in cooler water / habitat / Antarctic).	**DWJ**	For thermoregulation / more efficient heat loss (or heat retention).
DE	Extinct species of / giant / large penguins went extinct due to increases numbers of marine mammals.	**DEJ1** **DEJ2**	Leading to increased **interspecific competition for food**. Selection for smaller penguins, which reduced competition with marine mammals for food.
DG	**Gauses Principle / competitive exclusion** principle applies between penguin species / penguins and marine mammals.	**DGJ**	Competition for food / resources due to same niche led to extinction / relocation / change of niche.
DR	Second **adaptive radiation** event around 22 mya.	**DRJ1** **DRJ2**	Due to circumpolar current (ACC) Australia / SA and Antarctica being fully separated, also meant decreased gene flow, as populations dispersed / separated from each other. Circumpolar current event led to cooling / temperature change and new / vacant niches formed, resulting in speciation.
DS	Circumpolar Current event (ACC) led to **allopatric speciation** of penguins.	**DSJ**	Geographical isolation (islands), no gene flow, different selection pressures resulting in reproductive isolation / speciation.
DF	Speciation of penguins on isolated islands due to **founder effect**.	**DFJ1** **DFJ2** **DFJ3**	Small population has allele frequencies that may not be representative of the original group. No gene flow, different selection pressures (with example such as temperature, competition, etc.) results in speciation. Genetic Drift acts on the small population to randomly change allele frequencies / fix or eliminate alleles (with example such as body size, etc.).
DB	Biogeographic evidence shows southern hemisphere origin of penguins.		
DC	Penguins show **convergent evolution / convergence**.	**DCJ1** **DCJ2** **DCJ3**	Convergence between penguins and sharks / marine reptiles / marine mammals due to similar niche of marine predator. Because sharks do not share a recent common ancestor with penguins OR penguins and auks do not share a recent common ancestor. Convergence between penguins and great auks due to similarities in their niche / selection pressures.
DX	Penguins show **parallel evolution**.	**DXJ**	Between penguins and great auks
DU	Penguins and auks have **analogous structures**.	**DUJ**	No common ancestry, but similar phenotype due to same selection pressures **with example** (flipper wings, etc.).

Judgement statement (the three areas are **I** and **P**).

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* to discuss the ecological and evolutionary processes that have led to the diversity of both extinct and living species of these flightless seabirds. 8 Js or 7 Js and 2 descriptions. 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* to discuss the ecological and evolutionary processes that have led to the diversity of both extinct and living species of these flightless seabirds. 7 Js or 6 Js and 2 descriptions (or 5 Js and 4 descriptions). Answer displays aspects of: • perception and insight • sophisticated integration and abstraction • independent reflection and extrapolation • convincing communication.
6	Biological evidence is selected and organised into a discussion of the ecological and evolutionary processes that have led to the diversity of both extinct and living species of these flightless seabirds. 6 Js or 5 Js and 2 descriptions (or 4 Js and 4 descriptions). 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	Biological evidence is selected and organised into a discussion of the ecological and evolutionary processes that have led to the diversity of both extinct and living species of these flightless seabirds. 5 Js or 4 Js and 2 descriptions (or 3 Js and 4 descriptions). 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 (or 2 Js and 4 descriptions).
3	3 Js or 2 Js and 2 descriptions (or 1 J and 4 descriptions)
2	2 Js or 1 J and 2 descriptions.
1	1 J or 2 descriptions.
0	Lack of relevant evidence.

QUESTION TWO: BLACK-FOOTED FERRETS (BFFs): Evidence Statement

Discusses the likely role and interaction of named factors that have contributed to the critically endangered status of the black-footed ferrets (**E**)

	Evidence		**Justification**
EB	BFFs have gone through a **population bottleneck** when numbers dropped to 18 animals / 7 breeding individuals in 1986.	**EBJ1**	This resulted in a loss of genetic diversity, as alleles would have been lost / fixed through **genetic drift**.
		EBJ2	Loss in genetic diversity means species is less able to adapt to environmental change.
		EBJ3	Low number of survivors increases risk of **inbreeding** (depression), leading to reduced fertility as seen sperm quality / pregnancy rates / litter size.
		EBJ4	**Inbreeding** (depression) could have led to reduced immune function, increasing risk of catching / dying from Sylvatic plague (SP) / CDV (canine distemper virus).
EK	BFFs are a **K**-selected species due to low reproductive rate / only 3–4 kits per year with lots of parental care.	**EKJ**	Being a K-selected species means it may take a long time for population numbers to increase, and a lot of energy invested in parental care.
EL	BFFs have a short average lifespan (1 year).	**ELJ**	Only one breeding cycle per BFF / may not breed in their short lifespan leading to slow population growth
EP	BFFs **exploit / prey upon** Prairie Dogs (PDs) and are highly dependent on them for food and burrows.	**EPJ1**	BFFs and PDs show a predator / prey relationship. Because they make up 90% of diet, low numbers of PDs / the prey species lead to low numbers of BFFs / predators.
		EPJ2	BFFs highly specialised to exploit PDs, so unable to adapt to reduction in prey numbers by prey switching / changing diet / narrow ecological niche.
		EPJ3	Lower numbers of PDs mean BFFs need a larger territory, therefore fewer BFFs could survive in an area / carrying capacity of area reduced.
		EPJ4	Loss of PD burrows means fewer sites available for dens for raising young (who each need own burrow), so reduced survival of kits.
		EPJ5	Loss of PD burrows means greater mortality rates / decreased survival due to increased risk of predation / exposure to harsh weather.
ED	Diseases such as SP / CDV increase mortality rates in populations of BFFs.	**EDJ1**	SP spread by fleas, so likely to catch it from PDs when they use their burrows / catch their prey.
		EDJ2	Deaths of PDs from SP reduces food availability for BFFs decreasing survival / ability to raise offspring.
EH	**Humans** have impacted prairie habitat.	**EHJ1**	Reduction of 95% of prairie habitat means less habitat available for PDs **and** so less food **and** burrow sites for BFFs.
		EHJ2	Poisoning of PDs by humans reduces food availability for BFFs / could lead to secondary poisoning of BFFs.
		EHJ3	Human disturbance due to oil / gas extraction / causing seismic disturbance collapses burrows which increases mortality of young kits.
		EHJ4	Fragmentation of PD habitat reduces **gene flow** between BFF populations, further impacting genetic diversity.

Analyses the options for the management of the BFF to improve their vulnerable status (**M**).

	Evidence		**Justification**
MC	Captive breeding increases reproductive success of BFFs.	**MCJ1**	Can increase chance of offspring surviving compared to in the wild.
		MCJ2	IVF techniques can overcome low fertility issues due to reduced sperm quality in males.
		MCJ3	Allows you to pair up individuals who are good genetic matches to improve genetic diversity in the population.
		MCJ4	Selective breeding / marker assisted selection for specific alleles / traits (to increase genetic diversity).
MI	**Insecticide** control of fleas reduces the spread of SP between PDs / from PDs to BFFs / increases PD survival.	**MIJ**	This directly reduces mortality in BFFs from SP / ensures PDs survive so sufficient food for BFFs.
MV	**Vaccination** reduces spread of CDV / SP increases survival of BFFs.	**MVJ1**	Over time, vaccination could cause the diseases affecting them to become extinct.
		MVJ2	Maintain population numbers and existing genetic diversity.
MH	Habitat protection / conservation through one of: • converting land back to / restoring prairie • stopping poisoning of PDs • banning oil / gas exploration in PD habitat.	**MHJ**	This would improve the vulnerable status of BFFs by one of: • providing more habitat for PDs which would increase their numbers and support larger numbers of BFFs • reducing chances of secondary poisoning of BFFs • preventing loss of burrows which would increase survival of BFFs.
MG	Researchers could use genetic tools to improve vulnerable status of BFFs.	**MGJ1**	Cloning of Willa / SB2 would increase the genetic diversity of BFFs, which could improve fertility / immunity / ability to adapt to changes in environment.
		MGJ2	Would have to make sure cells from SB2 were free from CDV / remove CDV before using them.
		MGJ3	Genetic modification of BFF gametic cells by taking genes for immunity / MHC genes from closely related species / other mustelid species to improve resistance to disease.

Judgement statement (the two areas are E and M)

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* to discuss the likely role and interaction of named factors that have contributed to the critically endangered status of the black-footed ferrets and analyse the options for their management. 8 Js or 7 Js and 2 descriptions. Must have 2 Js from 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* to discuss the likely role and interaction of named factors that have contributed to the critically endangered status of the black-footed ferrets and analyse the options for their management. 7 Js or 6 Js and 2 descriptions or (5 Js and 4 descriptions). Must have 2 Js from each area. Answer displays aspects of: • perception and insight • sophisticated integration and abstraction • independent reflection and extrapolation • convincing communication.
6	Biological evidence is selected and organised into a discussion of the likely role and interaction of named factors that have contributed to the critically endangered status of the black-footed ferrets and analysis of the options for their management. 6 Js or 5 Js and 2 descriptions or (4 Js and 4 descriptions). Must have 1 J from 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	Biological evidence is selected and organised into a discussion of the likely role and interaction of named factors that have contributed to the critically endangered status of the black-footed ferrets and analysis of the options for their management. 5 Js or 4 Js and 2 descriptions (or 3 Js and 4 descriptions). Must have 1 J from 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. (2Js and 4 descriptions)
3	3 Js or 2 Js and 2 descriptions. (1 J and 4 descriptions)
2	2 Js or 1 J and 2 descriptions.
1	1 J or 2 descriptions.
0	Lack of relevant evidence.

QUESTION THREE: THE HOBBIT: Evidence Statement

Discusses the Evolution of the *H. floresiensis* from its earlier ancestor, both biological and cultural (**P**).

	Evidence		**Justification**
PD	This is a form of **divergent evolution.**	**PDJ**	*Homo floresiensis* was formed from either *Homo erectus* or *Homo habilis.*
PF	This is a form of **founder's effect.**	**PFJ1** **PFJ2**	The ancestors that first arrived on Flores were isolated and could only breed within the population as they were separated by the ocean. Small population with non-representative alleles and genetic drift will be powerful.
PS	Selection pressure / selection for small / dwarf body size.	**PSJ1** **PSJ2**	This is directional selection because the selection pressure is towards a smaller form. Limited food sources leading to reduced energy (or implied through food / nutrient) requirements leading to small body phenotype.
PA	**Allopatric speciation** occurred due to geographical isolation.	**PAJ**	No gene flow with other hominins due to ocean barrier, selection pressures / natural selection led to speciation into *Homo floresiensis.*

Evaluates the two models of evolutionary origin of *H. floresiensis* (origin of biological evolution). **(OB)**

OBP	The physical traits suggest that *H. floresiensis* has a more primitive small body and form. Like *H. Habilis*, it may have left Africa 2 million years ago. / The physical traits suggest that *H.floresiensis* has less primitive features. This is like *H.erectus,* who may have left Africa and moved through Indonesia and into Flores, evolving into *H.floresiensis*.	**OBPJ1** **OBPJ2**	This is due to the smaller brain size, large jaw and teeth with primitive features, and body size that is more similar to older hominins, such as *H. habilis*. This is due to the more complex brain / Brodmann area 10, large jaw and teeth, cranium shape, receding and small forehead and flat face that is more similar to *H.erectus.* (at least 3 named features)
OBB	Although the brain is small at 380 / 426 cc, it has an enlarged Brodmann area 10 / frontal lobe / complex of the brain.	**OBBJ1** **OBBJ2** **OBBJ3**	Brodmann area allows planning , making of advanced tools. This could have developed from *H. erectus* who has similar brain complexity. Small brain has evolved through selection pressures of the small islands' limited food sources – selecting for dwarfism so may still be *H. erectus* origin. Small brain is a similar feature to *H. habilis*, so supports Model 1.
OBS	Long foot-to-body size and flat arch.	**OBSJ**	*H. floresiensis* is less efficient at walking / bipedality, as they did not have to travel as far, due to the smaller size / forested habitat of the island. This is more consistent with an older hominin species like *H. habilis.*
OBA	Bones and joints of arm, shoulder and lower limbs archaic / ancient.	**OBAJ**	Supports *H.habilis* origin, due to selection for retention of the more ancient features that enhance climbing in forested habitat to be retained.
OBW	Wrist bones similar to African apes or australopithecines so ancient.	**OBWJ**	Ancestral modern human wrist features evolved about 800 000 years ago, so is consistent with evolution from more ancient hominins such as *H habilis.*
OBF	Forested habitat (of Flores) led to climbing features being selected for.	**OBFJ**	To exploit resources / get food from the trees, in addition to (hunting) on land.

Evaluates the two models of evolutionary origin of *H. floresiensis* (cultural evolution). **(OC)**

OCC	The ability to **control fire** as there were **charred bones**.	**OCCJ**	This shows the ability to cook food. more consistent with *H. erectus* than an older species of hominin like *H. habilis*, which do not show evidence of use of fire.
OCH	**Charred bones** of Stegodon indicates **hunting**.	**OCHJ**	Planning / communication needed for successful hunting which is more in line with *H erectus* origin, as they hunted.
OCT	Stone **tools** with many flakes removed / moderate sophistication used by *H floresiensis.*	**OCTJ1** **OCTJ2**	Stone tools were more developed than oldwan tools used by *H. habilis*, and support the model of *H. erectus* origin, as they had a more advanced acheulean tool culture, more consistent with the types of tools found with *H. floresiensis*. More advanced tools enabled hunting (of stegodon) which supports the *H erectus* origin model.
OCR	**Raft / boat** needed to get to Flores / island.	**OCRJ**	Complex brain / Brodmann area 10 gave planning ability / advanced tool making ability needed for raft / boat making which is more like *Homo erectus.*

Justifies which model is most likely.

JM	Candidate selects **one model** and explains why it is more likely.	**JMJ**	Candidate justifies which model is more likely, based on evidence given for both biological and cultural evolution. (must have one from OBJ and 1 from OCJ)

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* to evaluate the model of the evolutionary origin of *H. floresiensis*, and justifies which evolutionary model is most likely, discussing the possible reasons for the cultural and unusual biological evolution. 8 Js or 7 Js and 2 descriptions. Must have 2 Js from each biological and cultural evolution, 1 J from process of evolution and justifying with a reason for each, why one model is more likely than another. 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* to evaluate the model of the evolutionary origin of *H. floresiensis*, and justifies which evolutionary model is most likely, discussing the possible reasons for the cultural and unusual biological evolution. 7 Js or 6 Js and 2 descriptions or (5 Js and 4 descriptions). Must have 1 Js from each Processes of evolution, biological and cultural evolution, and justifying with a reason for each, why one model is more likely than another. Answer displays aspects of: • perception and insight • sophisticated integration and abstraction • independent reflection and extrapolation • convincing communication.
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Cut Scores

Scholarship	Outstanding Scholarship
13 – 18	19 – 24