Assessment Schedule – 2023

Scholarship Biology (93101)

QUESTION ONE: THE IBERIAN LYNX

Evidence statements

(F) Discusses the different factors that have led to the decline and endangered status of the Iberian lynx.

	Evidence		**Justification**
FF	Food available for lynx was greatly reduced by the decline in rabbits due to epidemics, such as myxomatosis / the haemorrhagic disease.	**FF$_J$**	Reduced food leads to increased competition, increasing mortality / many deaths / greater decline in lynx population.
FR	Slow rate of reproduction, resulting from TWO of: • only three kits in average litter • often only two survive weaning (so replacement levels only) • rarely breed until a territory becomes vacant (up to 5-year wait)	**FR$_J$**	Leads to a much greater population decrease / there is slow population growth.
FI	Antibiotic-resistant bacteria within its digestive tract reduces overall health of lynx.	**FI$_J$1**	Lynx have a reduced lifespan / survival rate / an increased death rate from infections. This leads to a decline in population numbers.
		FI$_J$2	Due to reduced effectiveness of treatment for infections, thus leading to a population decline.
FB	The lynx population declined in the 20th century, resulting in an evolutionary bottleneck.	**FB$_J$1**	The remaining small population increases the frequency of harmful alleles coming together as a result of inbreeding.
		FB$_J$2	The resulting small population has reduced genetic diversity due to genetic drift changing allele frequencies.
		FB$_J$3	The remaining small population (especially only 25 females left) has reduced genetic diversity, so is less able to adapt to a changing environment.
		FB$_J$4	Due to human activity such as hunting, vehicle strike, habitat loss.
FH	Habitat destruction by humans.	**FH$_J$1**	Reduction of the number of territories restricts the numbers of lynx that can breed successfully, leading to slow replacement of lost numbers.
		FH$_J$2	Human encroachment reduces available territory size, making it harder to obtain sufficient resources (rabbits) for rearing a litter successfully.
		FH$_J$3	Populations are isolated, which restricts gene flow / breeding and means fewer new alleles / mutations can be passed from one population to another, thereby further reducing genetic diversity. This leads to increased inbreeding and possible reduction in fitness / survival.
		FH$_J$4	Reduction of breeding sites / territories for lynx / splits territories.

	Evidence		Justification
FP	Lynx are K-selected.	**FP_J1**	There are few kits and there is a high energy investment from parents / mother, so low food availability means a higher risk of death / poor health for the mother / kits, which leads to lower survivability for the kits.
		FP_J2	Parents' time away from kits to gather sufficient food (three rabbits per day compared to one rabbit per day) increases the chance of kits being vulnerable to predation.

(G) Discusses how the different interventions already undertaken have helped to avoid the extinction of the species.

	Evidence		Justification
GH	Habitat interventions, for example (one of): • creation of protected areas • wildlife corridors / highway tunnels • restocking of rabbits.	**GH_J1**	Increased access to new / bigger territories results in increased chances of reproductive success / breeding at a younger age, so lynx produce more offspring over their lifetime, leading to faster population recovery / growth.
		GH_J2	Populations experience different selection pressures in each geographical region, which increases genetic diversity (of species overall).
		GH_J3	Wildlife corridors / highway tunnels maintain gene flow between populations.
		GH_J4	Wildlife corridors / highway tunnels reduce death / injury of lynx and population decline.
GP	Population interventions, for example (one of): • captive breeding programme • translocation of individuals • storage of oocytes / embryos.	**GP_J1**	Captive breeding removes many of the risk factors (e.g. predators, food scarcity, adverse weather) so increasing their chances of survival.
		GP_J2	Storage of frozen embryos and oocytes may allow future breeding and speeding up of reproduction compared to the wild, thus reintroducing lost alleles / increasing genetic diversity. (*Only one of GP_J2 and VO_J.*)
		GP_J3	Translocated individuals are carefully chosen (through genetic testing) to maximise outbreeding / breeding with unrelated individuals.
GL	Increase population numbers to 3000–3500 with 750 breeding females.	**GL_J**	Population needs to be large enough, with sufficient breeding pairs, to reduce effects of inbreeding / genetic drift, to ensure sufficient genetic variation (in gene pool).

(V) Discusses management strategies to ensure the long-term viability of the species and achieving a favourable conservation status.

	Evidence		Justification
VI	Reinstate / reclaim / increase protected habitat areas.	**VI_J1**	Expansion of habitat areas and legal protections of those areas.
		VI_J2	Improvement of protected areas, e.g. re-vegetation programmes to make habitat more suitable for the European rabbit and, by extension, the lynx.
VC	Provide more overbridges / underpasses / highway tunnels	**VC_J**	Reduce injury and death of lynx on the roads / highways.
VH	Ban hunting.	**VH_J**	No-hunting / no-trapping zones around lynx populations to reduce death of lynx.
VB	Studying antibiotic-resistant bacteria.	**VB_J**	To develop new / effective antibiotics, increasing survival / health of lynx.
VF	Continue to monitor rabbit numbers.	**VF_J1**	To reduce the decline in the main food source of the lynx and, therefore, its survival.
		VF_J2	By studying treatment of myxomatosis / the haemorrhagic disease to reduce death of rabbits.
VT	Continue to translocate / transfer individuals between populations.	**VT_J**	Ensure gene flow between geographically separated populations and those bred in captivity to maintain / increase genetic diversity.
VN	Continue with / instigate a captive breeding programme.	**VN_J1**	Release adolescent lynx into the wild until the wild population numbers are large enough to be self-sustaining.
		VN_J2	Genetic testing can be carried out on embryos / oocytes or the breeding population to reduce the risk of inbreeding / passing on deleterious alleles (or the converse).
VO	Continue to freeze / store oocytes and embryos	**VO_J**	Storage of frozen embryos and oocytes may allow future breeding, speeding up reproduction compared to the wild/reintroducing lost alleles/increasing genetic diversity. (Only one of GP_J2 and VO_J2)

Judgement statement (the three areas are **F, G, and V**).

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 various factors that have contributed to the decline and critical status of the Iberian lynx, interventions already undertaken to prevent extinction, and management strategies that may ensure the long-term viability of the population and reclassification to a favourable conservation status. 8 Js OR 7 Js and 2 descriptions OR 6 Js and 4 descriptions. Must have 2 Js from each of the THREE areas F, G, V. Answer displays: • perception and insight • sophisticated integration and abstraction • independent reflection and extrapolation • convincing communication • ideas not already included in the schedule.
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 various factors that have contributed to the decline and critical status of the Iberian lynx, interventions already undertaken to prevent extinction, and management strategies that may ensure the long-term viability of the population and reclassification to a favourable conservation status. 7 Js OR 6 Js and 2 descriptions OR 5 Js and 4 descriptions. Must have 1 J from each of the THREE areas F, G, V. Answer displays: • 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 various factors that have contributed to the decline and critical status of the Iberian lynx, interventions already undertaken to prevent extinction, and management strategies that may ensure the long-term viability of the population and reclassification to a favourable conservation status. 6 Js OR 5 Js and 2 descriptions. OR 4 Js and 4 descriptions Must have 1 J from TWO of the areas F, G, or V. 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 various factors that have contributed to the decline and critical status of the Iberian lynx, interventions already undertaken to prevent extinction, and management strategies that may ensure the long-term viability of the population and reclassification to a favourable conservation status. 5 Js OR 4 Js and 2 descriptions OR 3Js and 4 descriptions. Must have 1 J from TWO of the areas F, G, or V. Answer displays: • 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 OR 0 J and 4 descriptions.
1	1 J OR 2 descriptions.
0	Lack of relevant evidence.

QUESTION TWO: THE LANCEWOOD / HOROEKA AND THE MOA

Evidence statements

(H) Discusses the role of the moa in the evolution of heteroblasty in the life cycle of the New Zealand lancewood / horoeka.

	Evidence		**Justification**
HC	The seedling's brown / mottled / colouration is to camouflage it on the forest floor.	**HC$_J$1**	The moa would have difficulty seeing the seedling. This increases the seedling's chance of survival, due to reduced browsing / herbivory.
		HC$_J$2	Photosynthesis is reduced due to a reduction in green / chlorophyll / photosynthetic pigments (that are repurposed to provide camouflage colouration). This trades photosynthetic capacity for reduced herbivory.
HN	The low nutritional value reduces their attractiveness to browsers.	**HN$_J$1**	The low nutritional value might mean the leaves would not be able to maximise / may not have maximised photosynthesis. However, this is an advantage overall, as it decreases the chances of being eaten.
		HN$_J$2	Moa / browsers / herbivores less likely to eat these leaves due to the reduced energy / nutrition they provide, thus increasing survivability.
HW	The young tree uses spikes / warning colouration to avoid being eaten.	**HW$_J$1**	Aposematic colouration deters herbivores / moa. Warning colouration reduces the risk of losing a leaf because the moa recognises the warning.
		HW$_J$2	The moa's method of swallowing left them very vulnerable to leaves sticking in their throat. Consequently, moa would have avoided eating juvenile lancewood.
		HW$_J$3	Warning colouration is a form of mimicry to resemble toxic / unpalatable plants and reduce herbivory
HM	Once above the height of the moa, the leaves resemble the leaves of other forest trees.	**HM$_J$1**	The strategy is now to maximise photosynthesis. The leaves are no longer vulnerable to the moa so can now be structured to maximise photosynthesis.
		HM$_J$2	Leaves are broad and soft as they are not at risk of browsing. The leaves don't provide enough energy to sustain active, flying birds, which tend to go for more energy-rich sources (e.g. nectar).
HS	Moa and horoeka co-evolved / show co-evolution where each is a selection pressure on the other.	**HS$_J$1**	Moa were visual browsers and would have identified their food using colouration. The risk of herbivory when the plant is a seedling / juvenile is the selection pressure which leads to the adaptation of cryptic colouration / camouflage.
		HS$_J$2	Phenotypes / features that reduce herbivory (e.g. spikes, colouration, and low nutritional value) were selected for, and these alleles became more frequent in the gene pool over time.
HL	Moa and horoeka co-evolved / show co-evolution where each is a selection pressure on the other.	**HL$_J$**	Herbivory would damage the leaves and reduce the lancewood / horoeka's chances of survival and reproduction. Defensive measures against herbivory would have increased the fitness / survival of the lancewood / horoeka. Individuals with more effective defences at each stage of the life cycle were more likely to be selected for / pass on the alleles for these defensive features.

	Evidence		Justification
HJ	Moa were leaf eaters, and the lancewood / horoeka needed to protect itself as it was at an ideal browsing height for moa.	**HJ_J**	The warning colouration is only found in the lancewood / horoeka and not the Chatham Islands lancewood. This colouration would only appear if necessary. Moa were the only birds in New Zealand which would be likely browsers of the lancewood, therefore the strategy is almost certainly a defence against moa.
HI	Chatham Island horoeka did not show heteroblasty / this unique lifecycle.	**HI_J**	Due to the absence of moa as a selection pressure.

(R) Discusses the reasons the New Zealand lancewood / horoeka has retained the heteroblastic life cycle, despite the extinction of the moa. [R = retention].

	Evidence		Justification
RT	Time: the moa has only been extinct for a few centuries, so there has not been enough time.	**RT_J**	Evolutionary change / biological evolution requires many generations, and there would not have been enough reproductive cycles of the lancewood / horoeka for changes to accumulate and heteroblasty to disappear.
RP	Lack of selection pressure: the heteroblastic phenotype has not been selected against / is neutral / is not a disadvantage to survival.	**RP_J**	The New Zealand lancewood / horoeka is surviving in its niche without being disadvantaged by its phenotype, nor is it under negative competitive selection pressures.
RA	Other advantages: heteroblasty may offer another advantage.	**RA_J1**	Conditions in New Zealand are different to the Chatham Islands, so there is no guarantee that the lancewood / horoeka will change its form to that of the Chatham Island species, now the moa is extinct.
		RA_J2	Introduced, mammalian herbivores confer the same selection pressure on the horoeka so the heteroblastic phenotype / alleles for heteroblasty remain.

Judgement statement (the two areas are **H and R**)

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 development and retention of heteroblasty in the New Zealand lancewood / horoeka and the influence of the moa in the development of this life cycle. 8 Js OR 7 Js and 2 descriptions OR 6 Js and 4 descriptions. Must have 2 Js in each of the TWO areas H and R. 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 development and retention of heteroblasty in the New Zealand lancewood / horoeka and the influence of the moa in the development of this life cycle. 7 Js OR 6 Js and 2 descriptions OR 5 Js and 4 descriptions. Must have 1 J in each of the TWO areas H and R. Answer displays: • 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 evolution of heteroblasty in the life cycle of the New Zealand lancewood / horoeka. Also discusses the biological implications that might occur with the extinction of the moa. 6 Js OR 5 Js and 2 descriptions OR 4 Js and 4 descriptions. Must have 1 J in each of the TWO areas H and R. Answer displays: • perception and insight • sophisticated integration and abstraction • independent reflection and extrapolation • convincing communication.
5	Biological evidence is selected and organised into a discussion of the evolution of heteroblasty in the life cycle of the New Zealand lancewood / horoeka. Also discusses the biological implications that might occur with the extinction of the moa. 5 Js OR 4 Js and 2 descriptions OR 3 Js and 4 descriptions. Must have 1 J in each of the TWO areas H and R. Answer displays: • perception and insight • sophisticated integration and abstraction • independent reflection and extrapolation • convincing communication.
4	4 Js OR 3 Js and 2 descriptions OR 2 Js and 4 descriptions.
3	3 Js OR 2 J and 2 descriptions OR 1 J and 4 descriptions.
2	2 Js OR 1 J and 2 descriptions OR 0 Js and 4 descriptions.
1	1 J OR 2 descriptions.
0	Lack of relevant evidence.

QUESTION THREE: THE PĀRERA AND THE MALLARD

Evidence statements

(S) Possible circumstances in which the biological species concept may be insufficient to distinguish species, as with the pārera and mallard, with examples from candidate's own knowledge.

	Evidence		**Justification**
SR	Species reproduce asexually or self-fertilise.	**SR_J**	Asexual populations are not interbreeding / one parent / no genetic mixing, so interbreeding to produce fertile offspring requirement cannot be met.
SH	Hybridisation.	**SH_J**	RIMS may or may not significantly reduce the fitness / survivability of offspring / not show hybrid breakdown (e.g. pārera and mallard / Chatham Island kakariki / transient and resident orca).
SE	Species may be extinct.	**SE_J**	We cannot observe reproductive behaviour in extinct species so cannot conclusively determine reproductive isolation / whether or not interbreeding was successful. (This would apply to all species known from fossils (e.g. trilobites, dinosaurs, etc.) and can be inferred from DNA (e.g. interbreeding between *Homo species*)).
SC	Cline or ring species.	**SC_J**	Species boundaries are blurred when adjacent species may breed, but not non-adjacent species / linked by reproduction. (Possible example: sequence of gull species around the Arctic Circle gives rise to the herring and black-backed gull species / greenish warbler from the Tibetan Plateau / song sparrow from Nevada.)
SA	Allopatric speciation / geographical separation.	**SA_J**	Populations are geographically separated (e.g. by a flood) but are still the same species, even though the two groups cannot interbreed (e.g. dingo and coyote).
ST	Horizontal gene transfer, especially in bacterial species.	**ST_J**	Genes may be transferred between species (e.g. antibiotic resistance genes in bacteria, with gene flow between distinct groups of bacteria, and consideration is given to whether those bacteria can now be considered the same species).
SP	Phenotypic plasticity / wide range of phenotypes within the species.	**SP_J**	Individuals may show huge difference in form yet still be considered the same species (e.g. in regard to domestic dogs, a chihuahua would struggle to fertilise a Great Dane, but they are still considered the same species).
		SX_J1	First example (other than pārera and mallard) for any of the above species concept ideas.
		SX_J2	Second example (other than pārera and mallard) for any of the above species concept ideas.

(D) Alternative evidence which could be used to distinguish the two duck species from one another.

	Evidence		Justification
DM	Morphology / phenotype differences / named physical feature showing difference.	**DM$_J$1**	This would be difficult as phenotype differences are small / slight (e.g. blue vs green feathers / feet colour).
		DM$_J$2	Due to almost all of the ducks having features of both species / being hybrids, the line is blurred when using phenotypic features to distinguish species.
DB	Behavioural / reproduction difference.	**DB$_J$1**	This would be difficult as the behavioural differences (e.g. clutch size / breeding month / egg-laying dates / incubation period) are small / slight.
		DB$_J$2	Hybrids have behavioural features of both species so it would be difficult to use these to distinguish one species from another.
DG	Genetics / differences in DNA.	**DG$_J$**	DNA sequences which are distinct / unique in each species would need to be isolated / identified.
DN	Niche / habitat preference.	**DN$_J$1**	The pārera and the mallard have differing niches / habitats, with pārera preferring wetlands with trees and bush and mallards preferring open shallow grassland.
		DN$_J$2	Their ranges would likely abut, possibly leading to gene flow between the populations, which could result in parapatric speciation / interbreeding / hybridisation.

(C) How difficulties with the species concept, arising from hybridisation, may impact decisions regarding management of both the pārera and the mallard in New Zealand.

	Evidence		**Justification**
CP	Few genetically ‘pure’ individuals from which to start preservation / captive breeding program.	**CP$_J$1**	We have no clear starting point to determine exactly what the pārera gene pool is as distinct from the mallard. There would inevitably be some ‘contamination’ from the mallards.
		CP$_J$2	If we captured the most isolated pārera population, using that to start the captive breeding programme, we would be causing a ‘founder’ effect / cause inbreeding.
CH	Hybridise when the two species meet.	**CH$_J$1**	The flight range of both species means that offshore islands cannot be used for this purpose in the same way as for flightless birds.
		CH$_J$2	Hybridisation does not lower fitness, so is not likely to be selected against / hybrids show hybrid vigour.
		CH$_J$3	Pārera could not be reintroduced into the wild as they would hybridise.
CR	The pārera has close relatives in Australia and the Pacific / other parts of the world.	**CR$_J$1**	Conservation funds are more easily justified and would likely have greater species-specific benefit on exclusively endemic species (e.g., kākāpō).
		CR$_J$2	Captive breeding with the Pacific black duck could be tried to breed out mallard alleles / introduce alleles as the pārera are a sub-species of the Pacific black duck.
		CR$_J$3	Pārera is a sub-species of the Pacific Black duck so they are very similar genetically. DNA sequencing from Pacific black duck could be used to identify a potential baseline pārera genome for future breeding.
CG	The mallard cannot be distinguished visually by duck hunters.	**CG$_J$1**	To protect the pārera by banning mallard hunting would be counterproductive, likely leading to a significant increase in the mallard population with no clear benefit to pārera preservation.
		CG$_J$2	Pārera may be shot / hunted by mistake due to similarities in phenotype with the mallard.
CN	This could be viewed as the emergence of a new species rather than the disappearance of an old one (the pārera).	**CN$_J$**	This would result in three species rather than two, so increasing biodiversity.

Judgement statement (the three areas are **S, D, and C**).

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 interactions of the pārera and the mallard in light of the complexities of the biological species concept. Also discusses the biological impacts and implications of hybridisation, and future management for both species. 8 Js or 7 Js and 2 descriptions OR 6 Js and 4 descriptions. Must have 2 Js in each of the THREE areas S, D, C. 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 interactions of the pārera and the mallard in light of the complexities of the biological species concept. Also discusses the biological impacts and implications of hybridisation, and future management for both species. 7 Js OR 6 Js and 2 descriptions OR 5 Js and 4 descriptions. Must have 1 J in each of the THREE areas S, D, C. Answer displays: • 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 interactions of the pārera and the mallard. Also discusses the biological impacts and implications of hybridisation, and future management for both species. 6 Js OR 5 Js and 2 descriptions OR 4 Js and 4 descriptions. Must have 1 J in TWO of the areas S, D, or C. Answer displays: • perception and insight • sophisticated integration and abstraction • independent reflection and extrapolation • convincing communication.
5	Biological evidence is selected and organised into a discussion of the interactions of the pārera and the mallard. Also discusses the biological impacts and implications of hybridisation and future management for both species. 5 Js OR 4 Js and 2 descriptions OR 3 Js and 4 descriptions. Must have 1 J in TWO of the areas S, D, or C. Answer displays: • perception and insight • sophisticated integration and abstraction • independent reflection and extrapolation • convincing communication.
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2	2 Js OR 1 J and 2 descriptions OR 0 Js and 4 descriptions.
1	1 J OR 2 descriptions.
0	Lack of relevant evidence.

Cut Scores

Scholarship	Outstanding Scholarship
13 – 18	19 – 24