

Assessment Schedule 2025**Scholarship Biology (93101)****QUESTION ONE: Thylacines****Evidence statements**

(E) Ecological consequences of thylacine extinction on its ecosystem.

	Evidence		Justification
EK	Thylacine was a keystone species so reduction in population numbers / extinction will have a disproportionate / large impact on its environment / ecosystem.	EK_J	Thylacine extinction, therefore, likely had a significant impact on the structure and function / maintaining ecological balance of the Australian ecosystem.
EP	Thylacine were predators / preyed upon by <i>one named prey species</i> (possums, rodents, lizards, and birds).	EP_{J1}	Removal of a predator disrupts the regulation of prey populations / predator-prey cycle so prey numbers increase .
		EP_{J2}	Trophic cascade / indirect effect on lower / other levels / species in the ecosystem. (Accept reasonable explanation of wider effect on food web).
EW	Thylacine were prey species for wedge-tailed eagles and tiger snakes.	EW_J	Fewer prey would lead to decreased predator population numbers. OR Fewer prey would lead to increased predation of other prey species lowering their population numbers.
	Thylacine were scavengers of carcasses, so they broke down / recycled dead animals.	EN_{J1}	Thylacine contributed to the redistribution of nutrients / nutrient cycling.
		EN_{J2}	Preventing buildup of dead animals / carcasses preventing disease.
ES	Thylacine extinction led to a vacant niche / niche availability in the ecosystem.	ES_J	In the absence of thylacine, introduced predators (such as foxes / cats) were able to occupy available niche and exploit a niche that has not adapted with them, leading to further disruption to native Australian ecosystem.
EB	Extinction of thylacine reduces biodiversity .	EB_J	Reduces resilience and stability of ecosystem.
EI	Interspecific competition with Tasmanian devils for food / prey.	EI_{J1}	Thylacine extinction may have increased Tasmanian devil (TD) population sizes / density .
		EI_{J2}	Increased density of the TD population may have facilitate the spread of the devil facial tumour disease (DFTD).
EC	Thylacines dug burrows that could have created a habitat for other species.	EC_J	Extinction could mean that other animals could utilise burrows left behind, increasing their population numbers . OR Extinction would mean these habitats would no longer get created , which could reduce the populations of animals / burrowers.
ED	Digging burrows would have aerated / turned over the soil.	ED_J	Extinction would reduce soil aeration / turnover possibly impacting vegetation / ability of plants to gain nutrients / oxygen from the soil / reduce capacity of water filtration.

(G) Genetic manipulation and reasons why the Australian Museum project failed, with justified opinion on whether Colossal Biosciences will be successful.

	Evidence		Justification
GD	Thylacine DNA extracted from various specimens .	GD_{J1}	Can be amplified using polymerase chain reaction (PCR) and can be used to construct genetic library / thylacine genome.
		GD_{J2}	This DNA is needed from many specimens because the DNA from each may have gaps / be degraded.
GO	Cloning process requires a donor egg cell / oocyte from a closely related species .	GO_J	The most closely related species is the dunnart, so these eggs are likely to have the greatest chance of cloning success.
GU	Cloning process requires a surrogate female / uterus / womb to implant the blastocyst / foetus / embryo.	GU_J	The surrogates (for uterus) considered by the Australian Museum were not the closest living relative of thylacine so may not have been able to successfully come to term / be birthed / implant successfully / survive.
		GM_J	Possible marsupial surrogates are endangered (according to IUCN Red List) so undesirable to use / preference for conservation of extant species.
GF	Dunnarts / quolls / Tasmanian devils are not in the same family as thylacines.	GF_J	Genetic differences / incompatibility may limit successful cloning / surrogacy. (Accept family names.)
GJ	Dunnarts / quolls / Tasmanian devils / dasyuridae are smaller than thylacines.	GJ_J	May not be able to nurture thylacine joeys to full development in their pouches (as the joeys will be too large).
GE	Cloning requires a complete set of thylacine DNA to be inserted into the enucleated egg.	GE_J	DNA used may have been incomplete / degraded by ethanol and therefore not able to produce a viable clone.
GS	No suitable surrogate mother / parent to rear offspring	GS_J	Offspring imprinting on mother, so the de-extincted animals won't recognise the correct species to breed with / will attempt to breed with members of the surrogate species.
GB	Colossal Biosciences could use CRISPR technology to build full genome.	GB_{J1}	Cas9 protein is a molecular tool that seeks out the specified genetic location / DNA sequence and cuts at that point.
		GB_{J2}	The missing sections of thylacine DNA can be replaced by dunnart DNA using CRISPR technology.
GH	The resulting clone (from Colossal Biosciences) would be a hybrid .	GH_J	The DNA / genome produced would be a combination of thylacine and dunnart DNA so the resulting individual / clone cannot be considered a thylacine.
GC	Colossal Biosciences will be successful because...	GC_{J1}	There is now a near-complete set of DNA to use in a de-extinction attempt.
	AND / OR	GC_{J2}	Biotechnology / genetic engineering is now much more advanced than it was.
	Colossal Biosciences won't be successful because...	GC_{J3}	Current technology is not advanced enough to clone marsupials / can't use the same technique as cloning mammals as their biology / reproductive strategy is too different.

Judgement statement (the two areas are E and G)

8	Provides an in-depth response using information in the resource material and <i>Nature of Science</i> and <i>Living World</i> strands up to and including Level 8 in <i>The New Zealand Curriculum</i> to discuss the ecological consequences of thylacine extinction and evaluate the attempts made to manipulate thylacine DNA. Presents a well-planned discussion that is fully integrated and coherent. 8 Js OR 7 Js and 2 descriptions. Must have 2 Js in each area. Answer displays: • perception and insight • sophisticated integration and abstraction • independent reflection and extrapolation • convincing communication • ideas not already included in the schedule.
7	<i>Same descriptor as for judgement statement at 8.</i> 7 Js OR 6 Js and 2 descriptions OR 5 Js and 4 descriptions. 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	Biological evidence is selected and organised into a discussion of the ecological consequences of thylacine extinction and evaluate the attempts made to manipulate thylacine DNA. Relevant evidence is selected and organised to develop and present a well-reasoned response. 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 understandings • logical development, precision, and clarity of ideas.
5	<i>Same descriptor as for judgement statement at 6.</i> Relevant evidence is selected and organised to develop and present a well-reasoned response. 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 understandings • 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 bar-tailed godwit / kuaka**Evidence statements**

(A) Discusses the adaptations that enable the bar-tailed godwit to undertake its journey successfully.

	Evidence		Justification
AF	Physiological adaptations: fat storage.	AF _J	Bar-tailed godwits accumulate large fat reserves, serving as the primary energy source during their non-stop flights.
AE	Physiological adaptations: efficient metabolism.	AE _J	They have a highly efficient metabolism that allows them to utilise fat stores effectively over long periods without food or water. This adaptation is crucial for sustaining energy levels during the long journey.
AW	Structural / physical adaptations: wing structure.	AW _J	Their long, pointed wings are adapted for sustained, long-distance flight, reducing drag / increasing lift / making their flight more efficient.
AD	Structural / physical adaptations: dense muscle fibres.	AD _J	They possess a high proportion of dense muscle fibres, which supports their endurance / efficiency during prolonged flights.
AR	Structural / physical adaptations: bone composition.	AR _J	Strong, hollow / honeycomb bones reduces the mass / weight (light) of bones to increase flight efficiency / reduce energy needed for long flight.
AB	Behavioural adaptations: migration.	AB _{J1}	Their migration is timed to coincide with optimal weather / wind conditions / food availability at stopover sites. This timing ensures they complete their journey successfully.
		AB _{J2}	Godwits have an internal biological clock that enables them to prepare for migration by changing their bodies / behaviours prior to migration.
		AB _{J3}	Migration is an endogenous rhythm that is genetically controlled.
AP	Timing for migration is determined by the photoperiod / daylength / hours of light and dark in 24 hours.	AP _J	Photoreceptors in the brain triggers hormonal changes / initiates chemical pathways that cause the birds to: • moult into new feathers suitable for the vigour of long flight • increase their appetite to enable the deposition of fat reserves • display migratory restlessness / zugunruhe, a behaviour that compels the bird to migrate.
AM	Timing for migration is initiated by sexual maturity / reproductive readiness.		
AT	Timing for migration is initiated by temperature change in the environment.		
AS	Navigation methods: • solar navigation during the day • stellar navigation during the night • magnetic navigation.	AS _{J1}	The birds likely use a combination of the Earth's magnetic field, the sun, and stars (<i>at least two of the three methods</i>) to guide their journey.
		AS _{J2}	The position of the sun / stars changes during the day / night so bar-tailed godwits possess a time-compensated compass (<i>or explanation</i>).
		AS _{J3}	Using the Earth's magnetic field to navigate, the bar-tailed godwits must have the ability to sense the magnetic field using substances in their cells such as magnetite / cryptochrome .
AN	Landmark navigation / visual navigation.	AN _{J1}	Godwits likely able to use landmarks as a way of identifying specific stopover sites.
		AN _{J2}	The godwits cannot use landmarks on the southern migration due to it largely being over the featureless Pacific Ocean (using instead one of, or a combination of the above).

(K) Key ecological requirements that enable the bar-tailed godwit to successfully undertake its journey.

	Evidence		Justification
KS	Stopover sites have suitable habitats with adequate food / resources.	KS_J	Critical stopover sites must have habitats that are rich in food resources to allow the birds to build up fat reserves for the next leg of their journey.
KG	New Zealand / over-wintering grounds have suitable habitat and food / resources.	KG_{J1}	The New Zealand and Australia habitats are in the southern hemisphere which means a change in season (summer) and a habitat with food / resources while it is winter in Alaska / northern hemisphere winter.
		KG_{J2}	Juveniles / non-breeding birds stay up to 4 years in New Zealand so the habitat and resources must be available over the whole year.
KB	Alaskan breeding grounds have suitable resources for nesting / raising chicks (e.g. Nest sites and food).	KB_J	Breeding / nesting sites in Alaska must provide sufficient food / resources to raise chicks who can make the long journey to New Zealand successfully.
KT	Temperature ranges are favourable at each area.	KT_J	Less energy used for thermoregulation which can be used for successful migration / reproductive success.
KW	Tail winds / wind currents that travel in the same direction / assist as the birds migrate.	KW_J	Reducing the energy expenditure during their long non-stop flights so more birds survive the journey.

(C) Discusses the potential impacts of climate change on the migration patterns of the bar-tailed godwit.

	Evidence		Justification
CG	Sea level rise .	CG_J	Loss of habitat (coastal areas in breeding sites / stopover sites / wintering grounds) can lead to less food availability / rest / nest sites and negatively impact the survival / reproductive success.
CT	Temperature rise .	CT_J	Increasing temperatures can disrupt migration timing so they are ' out of sync ' leading to less reproductive success.
CW	Weather / wind changes.	CW_{J1}	Weather patterns / wind currents changing can affect the tail winds / direction that assist migration with fewer birds completing the long journey successfully.
		CW_{J2}	Increased frequency of extreme weather events during long migration flights can decrease the chance of successful migration due to being blown off course / injured.
CH	Human impact.	CH_J	Human activities and climate change can lead to habitat degradation and less essential resources for resting and refuelling during migration.
CF	Climate change (or example) will change food availability.	CF_J	Changes may disrupt the abundance / distribution of prey species and affect the bar-tailed godwits' ability to build up necessary fat reserves required for successful migration.
CM	Climate change has contributed to population decline .	CM_J	The negative impact on successful reproduction of the bar-tailed godwits due to climate change is shown by the annual population decrease of 2% .
CI	Less successful migration has led to population decline .	CI_J	Annual population decline of 2% due to changes in food availability / habitat loss / extreme weather / wind changes (<i>one example required</i>).

Judgement statement (the two areas are A, K, and C)

8	Provides an in-depth response, using information in the resource material and <i>Nature of Science</i> and <i>Living World</i> strands up to and including Level 8 in <i>The New Zealand Curriculum</i> to analyse and discuss: the key ecological requirements that the bar-tailed godwit needs to successfully complete its migration; the evolutionary adaptations that enable the bar-tailed godwit to undertake such a long and energy-intensive journey; and the potential impacts of climate change on the migration patterns of the bar-tailed godwit and their overall survival. 8 Js or 7 Js and 2 descriptions. Must have 2 Js in each of the 3 areas. Answer displays: • perception and insight • sophisticated integration and abstraction • independent reflection and extrapolation • convincing communication.
7	<i>Same descriptor as for judgement statement at 8.</i> 7 Js or 6 Js and 2 descriptions or 5 Js and 4 descriptions. Must have 2 J in each of the 2 areas. 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 key ecological requirements that the bar-tailed godwit needs to successfully complete its migration; the evolutionary adaptations that enable the bar-tailed godwit to undertake such a long and energy-intensive journey; and the potential impacts of climate change on the migration patterns of the bar-tailed godwit and their overall survival. 6 Js or 5 Js and 2 descriptions or 4 Js and 4 descriptions. Must have 1 J in at least 2 areas. 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	<i>Same descriptor as for judgement statement at 6.</i> 5 Js or 4 Js and 2 descriptions or 3 Js and 4 descriptions. Must have 1 J in at least 2 areas. 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 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: Projectiles**Evidence statements**

(H) Adaptations that have enabled *Homo sapiens*, as opposed to chimpanzees, to utilise projectile weapons, and the advantages these adaptations conferred.

	Evidence		Justification
HD	A tall, decoupled waist / waist that can rotate independently of head and pelvis would have conferred an advantage for bipedalism .	HD_J	This feature is seen in Australopithecines so predates the throwing of projectiles with speed / distance seen in <i>Homo sapiens</i> .
HT	A tall, decoupled waist / waist that can rotate independently of head and pelvis which improves the ability to throwing projectiles .	HT_J	Enables <i>H. sapiens</i> to throw projectiles at vastly larger distance / with more force / with greater speed , which leads to greater hunting success.
HF	The use of projectiles enabled <i>H. sapiens</i> to remain further away from prey.	HF_J	This increased their chances of survival, as it reduced the possibility of being trampled / injured / killed by the prey.
HL	<i>H. sapiens</i> have lower, wider shoulders compared to the chimpanzee.	HL_J	Enables <i>H. sapiens</i> to throw projectiles at vastly larger distance / with more force / with greater speed , which leads to greater hunting success.
HP	The major line of action of the pectoralis muscle / the orientation of the scapula is angled upwards in the chimpanzee and outwards in the human.	HP_J	This enables <i>H. sapiens</i> to have a greater overall range of motion in the shoulder to enable greater distance / precision of projectile throwing making hunting more efficient.
		HG_{J1}	GDF5 variant in humans enhanced rotational range of motion (ROM), compared to reduced rotational ROM in chimpanzees, leading to greater speed / distance of projectile throwing.
		HG_{J2}	ACTN3 humans have a more efficient gene, leading to more / more efficient fast-twitch muscle fibres, whereas chimpanzees have a less efficient variant, leading to greater speed of projectile throwing.
HW	Greater flexibility in human wrists compared with less mobility in chimpanzee wrist.	HW_J	This enables humans' greater dexterity for projectile making / throwing, whereas the limited range in the chimpanzee wrist is due to knuckle walking / quadrupedalism.
HE	Long legs were selected for increasing stride length / efficiency of bipedal locomotion.	HE_J	Enables a long stride to be taken during overarm throws, increasing the speed / distance travelled of a projectile.
HA	GDF5 / ACTN3 modern human variants may have been selected for to develop better throwing ability.	HA_{J1}	Increasing hunting effectiveness / success. (<i>exclusion with HN_{J1}</i>)
		HA_{J2}	This would have enabled greater reproductive success of hominins with these adaptations, ensuring these alleles were passed on to future generations / increasing the allele frequency of advantageous alleles in the gene pool. (<i>exclusion with HN_{J2}</i>)
HN	Features such as (<i>any relevant adaptation</i>) are selected for as they would have enabled better throwing ability.	HN_{J1}	Increasing hunting effectiveness / success. (<i>exclusion with HA_{J1}</i>)
		HN_{J2}	This would have enabled greater reproductive success of hominins with these adaptations, ensuring these alleles were passed on to future generations / increasing the allele frequency of advantageous alleles in the gene pool. (<i>exclusion with HA_{J2}</i>)

	Evidence		Justification
HH	Hand structure of <i>Homo sapiens</i> shows power grip to grasp spear / projectile whereas chimpanzee short thumb length limits this grip.	HH _J	Power grip allows for control / accuracy / speed / strength when throwing projectiles leading to more effective hunting.

(T) The trends shown in the design and manufacture of projectiles, and justifications for which hominins may have used projectiles.

	Evidence		Justification
TF	Trend was from simple tools / projectiles to increasingly complex .	TF _J	This would have been driven by increasing complexity in the brain / size of frontal cortex / enhanced communication / Wernicke's area / Broca's area / abstract thought (not brain size).
TC	Increasing tool complexity enabled a more successful hunt .	TC _J	Increasing the nutrient availability / improved diet / more protein / energy for hominins, which could have led to further brain development and so more sophisticated tool technology, e.g. positive feedback loop.
TA	<i>Australopithecines</i> had adaptations enabling better throwing, e.g. tall, decoupled waist.	TA _{J1}	<i>Australopithecines</i> are not known for being hunters, so it is unlikely they used projectiles for hunting .
		TA _{J2}	<i>Australopithecines</i> are not known for any tool culture so, if projectiles were used, they would have been unworked rocks / objects.
TE	<i>H. erectus</i> had adaptations for throwing (genetic and physical).	TE _{J1}	<i>H. erectus</i> are known for Acheulian tool culture which is not consistent with spear / projectile throwing.
		TE _{J2}	They may have used wooden projectiles, but wooden artefacts don't preserve well leaving no evidence in modern day.
TN	Use of untipped spears associated with <i>H. neanderthalensis</i> / <i>H. heidelbergensis</i> / <i>H. erectus</i> .	TN _{J1}	Neanderthals / Heidelbergensis / Erectus are found in Europe 300,000 ybp.
		TN _{J2}	Neanderthals are associated with Mousterian tool culture and would have been capable of making and using untipped projectiles.
		TN _{J3}	Heidelbergensis / Erectus associated with Acheulean tool culture and may have made untipped spears from wood.
TH	Makers of the stone-tipped projectiles are likely to be early <i>H. sapiens</i> .	TH _{J1}	May have been used by <i>H. sapiens</i> due to increased sophistication of the projectiles / two materials used on these spears.
		TH _{J2}	Neanderthals were not found in East Africa 280,000 ybp so these projectiles were not made / used by this species.
TS	Atlatls in France / 21 000–17 000 ybp were used by <i>H. sapiens</i> .	TS _J	Only surviving hominins by this time / upper palaeolithic tool culture.
TB	Bows and arrows found in Germany / dated to between 11 000–12 000 ybp are likely to be <i>H. sapiens</i> .	TB _J	Bows and arrows are an example of upper palaeolithic tool culture with increased sophistication / many materials uses / complex construction.
TP	Use of poison arrows / spears implies very sophisticated / complex thinking.	TP _J	Hominin would need to know (one of), for example: • which plants were poisonous • how to make / manufacture / utilise a poison without harming the human handling the poison • that arrows could be made lighter / smaller / with smaller tips, as they don't need to penetrate as far into the muscle to be deadly • how to process the animal so the poison was not a danger for hominins eating the carcass.
TT	Poison on stone-tipped throwing spears and arrows dated at 54,000 ybp / France are likely <i>H. sapiens</i> .	TT _J	Poison plus multiple materials with complex construction shows upper palaeolithic tool culture even though Neanderthals and humans were co-existing in France at that time.

Judgement statement (the two areas are **H** and **T**).

8	Provides an in-depth response using information in the resource material and <i>Nature of Science</i> and <i>Living World</i> strands up to and including Level 8 in <i>The New Zealand Curriculum</i> to discuss the adaptations hominins had for using projectiles and the trends shown in projectiles manufacture, design and use. Presents a well-planned discussion that is fully integrated and coherent. 8 Js OR 7 Js and 2 descriptions. Must have 2 Js in each area. Answer displays: • perception and insight • sophisticated integration and abstraction • independent reflection and extrapolation • convincing communication • ideas not already included in the schedule.
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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.

Cut Scores

Scholarship	Outstanding Scholarship
13–18	19–24