Assessment Schedule – 2019

Scholarship Biology (93101)

Evidence Statement

QUESTION ONE: POSSUMS: Evidence Statement

Discusses the factors that have contributed to the success and pest status of the brushtail possum (**S**).

	Evidence		**Justification**
SC	Greater competition in Australia (for food, habitat type, denning sites) due to the presence of other possum and glider species.	**SCJ1** **SCJ2**	In Australia *T. vulpecula* is not found in wetter areas where *T. caninus* and *T. cunninghamii* are found, but lives in rain forest in New Zealand. New Zealand forested ecosystems evolved in the absence of browsing mammals, so minimal competition here / vacant niches on its arrival.
SD	Large component of the diet in Australia is *Eucalyptus*, which has low palatability or contains toxins, compared with a broad diet in New Zealand, consisting of palatable tree species as well as invertebrates / birds / eggs.	**SDJ1** **SDJ2**	New Zealand forested ecosystems evolved in the absence of browsing mammals, so few adaptations against browsing by possums (palatability / toxins). New Zealand bird species and invertebrates not adapted to predation by mammals such as possums.
SP	Large number of predator species in Australia (e.g. snakes, eagles, dingoes) compared to limited number of species (e.g. humans and cats) in New Zealand.	**SPJ1** **SPJ2**	Predation by lots of species in Australia puts greater pressure on the population, which can reduce population densities / limited predation in New Zealand allows for greater population densities. Wide range of different types of predator (nocturnal / diurnal, aerial / ground, mammal / reptile / bird) puts further downward pressure on possum populations in Australia.
SS	Sixty different parasite species found in Australian possums, compared with only nine in New Zealand.	**SSJ**	Parasites reduce the health of the host / could increase risk of disease spread; therefore greater parasite diversity in Australia could limit population densities.
SH	Much higher possum population densities / numbers / rapid growth in New Zealand compared with Australia.	**SHJ1** **SHJ2**	Greater density/numbers/rapid growth of possums puts more pressure (due to browsing / predation) on prey species. Greater density/numbers/rapid growth of possums puts more pressure on NZ species due to competition (for food etc)
SE	Possum browsing in New Zealand changes the structure of the ecosystem by targeting highly palatable species (e.g. rātā).	**SEJ**	Change in community structure has flow-on effects on food web and broader ecosystem.
SV	Possible hybrid vigour in New Zealand possums as introduction (especially in North Island) and interbreeding of two subspecies (Tasmanian and mainland Australia).	**SVJ**	Contribution of genetic diversity from two subspecies may provide New Zealand populations with greater adaptability and genetic fitness.

Discusses the levels of genetic diversity in the New Zealand populations of possums when compared to those in Australia. (**G**).

	Evidence		**Justification**
GF	Founder effect occurred with introduction of ~300 individuals from Australia.	**GFJ**	Small reduction in genetic diversity between Australian and NZ populations due to genetic drift.
GS	South Island has less genetic diversity than the North Island due to introduction of mainly Tasmanian subspecies.	**GSJ**	Greater diversity in NI due to introduction and hybridisation of two subspecies from different areas in Australia (Tasmanian and mainland), (which can increase heterozygosity in hybrid offspring).
GI	Island populations (Stewart / Chatham / Codfish) show least diversity of all, due to founder effect.	**GIJ1**	Serial founder effect (Tasmania to SI then SI to offshore island) leads to genetic drift and lost diversity, with some alleles being fixed (e.g. locus Tv58).
		GIJ2	Island populations are geographically isolated, so lack of gene flow and no further introductions of new variation.
		GIJ3	Islands are smaller in size, so can't support as large a population, meaning genetic drift can have a bigger impact, causing loss of diversity.
GR	Rapid growth of populations in New Zealand following introduction (300 to 70 000 000 in around 100 years).	**GRJ1**	Rapid population growth limits the impact of genetic drift and loss of diversity as these have more of an impact in small populations (New Zealand populations of possums weren't small for long).
		GRJ2	Better conditions for possums in New Zealand (e.g. reduced predation / competition / parasites meant increased survival chances here so less likely for loss of genetic diversity.
GM	Mutations unlikely to have a big impact on increasing diversity in New Zealand possums, due to short time frame since introduction.		
GH	Humans have translocated possums around New Zealand, rather than possums dispersing naturally.	**GHJ**	Mixing of possum populations as a result of human influence has reduced the loss of diversity, particularly in North Island.

Judgement statement (the two areas are S and G)

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 factors that have contributed to the success and pest status of the brushtail possum. 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.
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 factors that have contributed to the success and pest status of the brushtail possum. 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 factors that have contributed to the success and pest status of the brushtail possum. 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	Biological evidence is selected and organised into a discussion of the factors that have contributed to the success and pest status of the brushtail possum. 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.
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: CATFISH AND CICHLIDS: Evidence Statement

Discusses the evolutionary and ecological processes that may have resulted in the different outcomes for each cichlid species in the presence of *Synodontis multipunctatus* (**D**).

	Evidence		**Justification**
DP	*S. multipunctatus* is a parasite / exploits mouthbrooding cichlids.	**DPJ1** **DPJ2**	*S. multipunctatus* is an obligate brood **parasite** / *S. multipunctatus* can only reproduce with a mouthbrooding cichlid host / catfish require their host for protection and to provide a food source during early development. Developing catfish fry prey directly on host eggs and young which is a more effective strategy than host brood elimination (as seen in many avian brood parasites).
DH	Mouthbrooding cichlids are **host** species.	**DHJ1** **DHJ2**	Adult catfish eat some cichlid eggs during spawning as a food source / to reduce competition from the host offspring. There is a delicate balance between removing some of the host eggs while leaving enough to make sure there are sufficient numbers to sustain the young catfish later on.
DO	Providing parental care can increase offspring survival / mouthbrooding protects offspring from predation / *K*-selected strategy of high parental investment.	**DOJ**	However, providing parental care exposes parents to the risk of exploitation by brood parasites.
DS	Cichlids from Lake Tanganyika / *S. diagramma* are sympatric / co-exist/live in same lake with *S. multipunctatus.*	**DSJ**	Sympatric hosts / or named species are parasitised (substantially) less than allopatric hosts, suggests that the sympatric host has evolved strategies to minimise catfish parasitism. OR Allopatric hosts / named species are parasitised (substantially) more than sympatric hosts suggesting that the allopatric host has no evolved strategies to minimise catfish parasitism.
DA	Cichlids from Lakes Victoria (*Haplochromis sp*. 44) / George (*Haplochromis aeneocolor*) / Malawi (*Copadichromis borleyi*) / are allopatric with/live in different lakes than *S. multipunctatus.*		
DR	Rejection of catfish eggs by sympatric *S. diagramma* females (90%) was significantly higher than rejections by *H. aeneocolor* from Lake George (7%)		

DC	Lake Tanganyikan mouthbrooding cichlids / *S. diagramma* coevolved with *S. multipunctatus*/acted as a selection pressure on each other.	**DCJ1** **DCJ2** **DCJ3** **DCJ4**	Previous individual experience by hosts with catfish brood parasitism had no effect on rejection of parasite eggs. (i.e. not a learned response in sympatric species). Yolk absorption by the cuckoo catfish has **coevolved** to coincide with cichlid hatching. Sympatric host species have **coevolved** with the catfish, and should have developed counter-adaptations against brood parasitism, whereas host species that have never been exposed to the catfish should not have adaptations to combat parasitism. Brood parasitism provides a strong selection pressure on the host / *S. diagramma* to avoid parasitism. This in turn puts a reciprocal selection pressure on the parasite / catfish to overcome the defences

Evaluates any costs and / or benefits to each species of maintaining these behaviours and relationships. (**E**).

	Evidence		**Justification**
EH	Cichlid host is providing both protection and a food resource for catfish fry.		
EC	Parasite is passing on its reproduction cost to the host / reduces the cost of reproduction	**ECJ**	Brood parasitism allows greater allocation of resources toward mating / producing more eggs rather than defending eggs / incubating eggs / protecting offspring.
EF	Host cichlids suffer significant costs to their reproductive success through catfish brood parasitism.	**EFJ1** **EFJ2** **EFJ3**	Hosts can reduce the parasite's fitness by rejecting the eggs of the parasite. By laying eggs over several days, the catfish adults are able to parasitise more broods and increase the chances of a successful parasitism event. The catfish fry completely eliminating the host offspring monopolises parental care, which increases catfish reproductive success / survival.
ET	The female not eating while she carries her young has a fitness trade-off for the female and for progeny fitness.		
ER	Sympatric hosts (or named species) had higher overall rejection rates of their own eggs compared to allopatric hosts.	**ERJ1** **ERJ2** **ERJ3** **ERJ4**	A high rejection frequency of parasitic catfish eggs by sympatric hosts came at a cost of increased rejection of their own eggs. Individuals with previous experience of catfish parasitism had even further elevated levels of rejection of their own eggs. The trade-off between rejection and acceptance by cichlids arises from a compromise between parasite-imposed costs and the cost associated with rejecting own eggs. An increase in the rejection rate of their own eggs in experienced females was associated with a high rate of rejections of parasitic eggs (80%).
ES	Parasite offspring showed poor survival to independence in sympatric hosts (13%), but good survival in allopatric hosts (86%).	**ESJ**	Previous host experience at the individual level had no effect on survival of catfish fry to independence.
EB	The temporal window for brood parasitism is very brief.		

Judgement statement (the two areas are D and E)

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 analyse and discuss the evolutionary and ecological processes that may have resulted in the different outcomes for each cichlid species in the presence of *Synodontis multipunctatus*. Informed judgements are used to evaluate any costs and / or benefits to each species of maintaining these behaviours and relationships in a fully integrated response. 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.
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 analyse and discuss the evolutionary and ecological processes that may have resulted in the different outcomes for each cichlid species in the presence of *Synodontis multipunctatus*. Informed judgements are used to evaluate any costs and / or benefits to each species of maintaining these behaviours and relationships in a fully integrated response. 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 evolutionary and ecological processes that may have resulted in the different outcomes for each cichlid species in the presence of *Synodontis multipunctatus*. Well-reasoned judgements are used to evaluate any costs and / or benefits to each species of maintaining these behaviours and relationships. 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	Biological evidence is selected and organised into a discussion of the evolutionary and ecological processes that may have resulted in the different outcomes for each cichlid species in the presence of *Synodontis multipunctatus*. Well-reasoned judgements are used to evaluate any costs and / or benefits to each species of maintaining these behaviours and relationships. 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.
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1	1 J or 2 descriptions.
0	Lack of relevant evidence.

QUESTION THREE: THE PEOPLING OF AUSTRALIA: Evidence Statement

Discusses the evolutionary and ecological implications of *Homo sapiens* dispersal to Sahul (**D**).

	Evidence		**Justification**
DE	Extinction of large mammals / megafauna in south-west Australia may be caused by over-hunting.	**DEJ1** **DEJ2** **DEJ3**	Large mammals / megafauna are vulnerable to hunting pressure owing to their typically low reproduction rates and low population growth. Megafaunal extinction may have caused major changes to vegetation and the functioning of ecosystems. Harvesting of *Genyornis* eggs by *H. sapiens* would have decreased reproductive success, contributing to the bird's extinction.
DM	Megafaunal populations were present under a range of climatic conditions.	**DMJ**	*H. sapiens* caused megafaunal extinction in south-west Australia rather than climate change.
DT	There was temporal overlap of *H. sapiens* and megafauna.		
DC	Presence of hearthstones/burnt eggshell indicate *H. sapiens* in Sahul had **controlled** use of fire.	**DCJ**	*H. sapiens* cooked *Genyornis* / emu eggs.
DS	*H. sapiens* developed the capacity for long sea journeys / built watercraft, enabling the establishment of a (viable) population in Australia.	**DSJ1** **DSJ2** **DSJ3** **DSJ4**	Sea travel was purposeful / deliberate. Colonisation of Flores and Luzon indicate that *H. floresiensis* and/or *H. luzonensis* also developed the capacity for long sea journeys. Denisovan introgression in New Guinea suggests that Denisovans were capable of crossing significant geographical barriers such as the sea crossing from Asia to New Guinea. That four species made significant sea crossings supports that this endeavour was deliberate.
DV	The colonisation of Sahul may have taken place at a time of lower sea levels.	**DVJ1** **DVJ2** **DVJ3**	Which reduced the distance between islands / Sundra and Sahul, which increased the chance of a successful voyage. Which increased the number of islands / land area, which increased the chance of a successful voyage. Which increased visual connectivity between islands, which increased the chance of a successful voyage.
DF	A viable initial founding population size was required.	**DFJ1** **DFJ2**	This could be achieved by numerous voyages. This could be achieved by a genetically diverse founding population.
DG	Grindstone indicates seed / pigment processing.		
DP	Mortar was used to pound hard plant materials.		
DA	Motif on mortar / ochre indicates art.		
DB	There were high levels of *Sporormiella* from 150 to 45 kya / *Sporormiella* levels declined rapidly between 45 to 43 kya.	**DBJ**	Reduction in levels of *Sporormiella* due extinction of megafauna resulting in a lack of dung (to complete the fungus life cycle).
DO	Aboriginal Australians likely represent one of the oldest continuous populations outside Africa.		

		DIJI	Madjedbebe date sets minimum age for the dispersal of *H. sapiens* out of Africa or across south Asia.
		DIJ2	Madjedbebe date supports an age of more than 65 ky for the incorporation of Neanderthal and Denisovan DNA into the *H. sapiens* genome.
		DIJ3	Interbreeding with Denisovans may have occurred in island Southeast Asia.
		DIJ4	Madjedbebe date extends the period of overlap of *H. sapiens* and *H. floresiensis* (in eastern Indonesia) and *H. luzonensis* (in the Philippines) to at least 15 ky.
		DIJ5	*H. sapiens* in island Southeast Asia / Flores may have contributed to the extinction of *H. floresiensis.*
		DIJ6	Neanderthal ancestry across all non-African populations suggests that the admixture occurred in a population that was ancestral to all of these, which is evidence in favour of a single out-of-Africa event.

Justifies an opinion on the timing of *Homo sapiens* dispersal to Sahul. (**J**).

	Evidence		Justification
JL	*H. sapiens* may have colonised Sahul ~47 kya.	**JLJ1**	Supported by timing of megafauna / *Genyornis* extinction ~43 kya.
		JLJ2	Supported by the time range burnt *Genyornis* / emu eggshells are found.
		JLJ3	Supported by other archaeological sites in island Southeast Asia and Wallacea with similar dates.
		JLJ4	The Madjedbebe evidence may be an outlier and requires close scrutiny before acceptance.
		JLJ5	If *H. sapiens* arrived in Sahul ~65 kya they may not be the ancestors of the current Aboriginal Australian population as this early population may not have persisted.
JE	*H. sapiens* may have colonised Sahul ~65 kya.	**JEJ1**	Low sea levels at this time made the voyage shorter and more likely to be successful.
		JEJ2	The presence of *H. sapiens* on Sumatra 73 – 63 kya supports a colonisation date of ~65 kya.
		JEJ3	The Madjedbebe evidence consists of advanced artifacts, most likely linked to *H. sapiens*, which supports a colonisation date of ~65 kya.

Judgement statement (the two areas are D and J)

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Cut Scores

Scholarship	Outstanding Scholarship
13 – 18	19 – 24