No part of the candidate evidence in this exemplar material may be presented in an external assessment for the New Zealand Scholarship award.

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SUPERVISOR'S USE ONLY

OUTSTANDING SCHOLARSHIP EXEMPLAR

NZQA

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

QUALIFY FOR THE FUTURE WORLD
KIA NOHO TAKATŪ KI TŌ ĀMUA AO!

Tick this box if you have NOT written in this booklet

Scholarship 2021
Biology

Time allowed: Three hours
Total score: 24

ANSWER BOOKLET

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

Write your answers in this booklet.

Start your answer to each question on a new page. Carefully number each question.

Check that this booklet has pages 2–26 in the correct order. Pages 2–4 are blank and are to be used for planning. Pages 5–26 are lined pages for writing your answers.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

Question	Score
ONE	
TWO	
THREE	
TOTAL	

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PLANNING

(i)

Adaptive radiation. - punctuated equilibrium.

↳ divergent evolution.

due to wide range of niches.

Sympatric speciation → niche differentiation

land bridge allowed for migration

North american camels became extinct.

↳ changing climate.

↳ migration of humans - intraspecific competition. Predation.

Old world camelids adapted for hot, sandy environment...

- humps
- long legs
- hyperglycemic blood

} selected for via natural selection

differences in genes from mutations.

New world camelids adapted for cooler, high altitude regions...

- small
- lack of humps

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humans added selection pressure

- specific coat for desired wool / milk...
- social behaviours - easier to control.

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PLANNING

(2)

smaller population - less intraspecific competition
- more resources
→ can grow larger.

Aren't diving as deep. - different prey.
↳ less energy. more energy to find food, grow.

founding population.
alleles don't represent original population
- overrepresentation.

K stategiests.

Predators. seal and prey.
seal and orca / shark.

↳ one male, multipule female relationship. poly...

- fittest male reproduces.
- long gestation period.
- breeding beach - saves time and energy finding a mate.

Allopatric speciation?

PLANNING

(3)

- R stratagists.

lots of offspring, little parental care.

fast acting.

↳ wasp colinies are large.

- no known effect on honey bees.

don't eat honey due. ✓

- Parasitism.

wasps ↓

honeydew more, nutrients. ... species can survive.

rely on it. do not go extint.

could become out of control. R stratagists so keep reproducing quickly.

- pollen? bees rely on pollen.

what else do wasps effect?

unforseen consequences? → adaptability. mutation.

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Question One:

Adaptive radiation is a type of divergent evolution where a number of species sharing a common ancestor diverge over a short period of time. This pattern of evolution occured 45 mya where the ancestral camelid quickly diverged into a number of species. This is via sympatric speciation where one species gave rise to multipule species without prior geographical isolation. The camelids underwent speciation due to the wide range of unoccupied niches. Differences in allele frequencies and mutations accumulate in the populations and changes create reproductive isolating mechanisms creating different species. Camelids can no longer reproduce together to give rise to viable, fertile offspring. This rate of evolution is punctuated equilibrium as there is rapid divergence after longer periods of stasis and then followed by a period of stasis.

The land bridge forming between North America and Asia allowed for camelids to migrate across Asia, Eurouope and Africa forming the beginnings of the populations we see today. The varying environmental / climate conditions in these continents select for and against different traits. Accounting for the differences in camelid phenotypes in populations across the globe. The bactrian camel has humps as lives in ~~cooler~~ ~~snowy~~ enviroments with limited food and water supply (uses humbps to store ~~fat~~ which can be used for energy and water). Increased chance of survival when does not come across food and water for days. Differences are seen in llama, alpaca, guanaco and vicuña who do not have humps as they live in cooler enviroments with water sources available. The ~~extra~~ weight ~~from~~ humps costs the species energy and makes traveling in alpine enviroments less efficient, so is selected against.

Camelids became extinct in North America due to the changing climate resulting in the camelids not being well adapted for the new current environment. Also land bridges reappeared between Asia which allowed humans to migrate co-existing in North America with the camelids. There may have been interspecific competition between the two species (camelids and humans) for resources and space for shealter. With humans larger brains - tools and abstract thought they may have outcompeted camelids for vaital resources. A predation relationship may have contributed to the North American camelid extinction around 10 to 12000 years ago. Predation is a type of explotation where one species, humans benifit from gaining energy a from ~~as~~ killing and eating another, camelids. These camelids may have been domesticated by humans for a source of meat and wool to allow them to have energy, warmth and survive in the changing climate. These combinations of poorly adapted to new environment and preyed upon by humans likely lead to the extinction of the North American camelid.

Old world camelids are well adapted to living in hot, sandy environments with limited water supplies and vegetation. Large fat deposits (humps) can be metabolised for energy and a source of water. This trait is advantages so as camelids do not have easy access to water and vegetation at all times so will rely on their fat deposits to survive up to 10 days without drinking. Other traits such as hyperglycemic blood allows camelids to tolerate a wide range of internal body temperatures that they will likely face living in the desserts. Long legs, thick coats and efficient kidneys are other phenotypes common in Old world camelid populations.

Via natural selection individuals carrying alleles to express these phenotypes have a better chance of survival and therefore reproduction passing on alleles to their offspring. Overtime the advantageous allels increase in frequency and become common in the population. Mutations are random permenant changes in the base sequence of DNA and are the only source of new alleles for genes. New world camelids are well adapted to survive and reproduce in their cooler, high altitude environments in South America. Able to adapt as there must be great genetic diversity in the camelid population. They are smaller and lack humps as water sources are available and due to cooler temperatures are less at risk of overheating and dehydration. A smaller frame allows the camelids to easily move in their mountain range habitat and also conserve body temperatures to survive cooler tempetures. Due to the different enviroment and selectation pressures faced by old world and new world camelids different alleles of genes ~~arehow~~ are selected for

The traits expressed by new world camelids (evolution) have been modified by humans as humans ~~exert selection~~ have a preference for coat fibre, colour, and milk production and reproduction, social behaviours. This is as the camelids have been domesticated and used by humans for their wool and milk. Thus there is selective breeding as humans will alter the camelids which get to reproduce dependent if they carry pretered alleles by humans. Such as softer coat, creamier milk, calmer social behaviours. These alleles are passed on to offspring more often so overtime will increase in frequency and become common in the population. Humans have impacted the evolution of camelids by modifing traits through selective breeding

and have hybridisation to achive phenotypes desired by humans (selected for by humans) but not nessasarily advantageous in the environment. Camelids were domesticated by humans as humans could benifit from meat, wool, milk and dried dung produced by camelids.

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Question two

Figure 5 displays the mean mass of juvenile and adult female NZ female sealions are much larger (bigger mass in kg) in the otago peninsula population compared to the Auckland island population. The founder effect is where a small group of individuals establish a new population which is isolated from the orginal population. This has occured where a small population of sea lions started breeding on the otago cost in 1993. There is reduced genetic diversity in the founding population so some alleles may have been lost. The allele frequencies in the founding population do not represent the allele frequencyies in the original population. The alleles for larger mass may be overrepresented in the otago peninsula population creating the difference in mean mass between the colonies. (small mass alleles may have been lost). The population size is around 10000 in the Auckland population compared to 170 in otago. Intraspecific competition is between members of the same species and is very intense as individuals have identical ecological niches. With a smaller population there is likely less intense intraspecific competition for resources such as food and space. Resources to be shared between a smaller population with more resources and less time and energy spent competing the otago sea lions have the energy to grow larger.

Figure 4 displays the diving depths of the sea lion colonies ~~for~~ which for the most part shows the Auckland Island sea lions are diving deaper compared to the otago sea lions. could be due to different prey. Arrow squid occupy deaper depths of the ocean compared to barracoutta and jack mackarel. The extra energy expended to dive further cannot be used for other purposes. Otago sea lions with

shallower dives have more energy to find more food for themselves and young to grow to a larger mass. Due to the different dive depths, different shaped bodies may be selected for. A smaller, streamlined shaped sea lion could be better adapted to traveling greater depths to catch arrow squid prey. Thus a smaller mass allele could be advantageous and selected for in Auckland Island population. Overtime allele increases in frequency and becomes common in the population.

Predation is a type of exploitation where one species benifits from gaining energy from killing and eating another. This relationship exists between orcas and great white sharks which a predators of sea lions. This relationship also exists between sea lions and arrow squid, barracuda and jack mackerel. The selection pressures exerted from these relationships effect the phenotypes selected for in sea lion population, such as body mass.

The breeding behaviour of sealions is polygynous, where one male mates with multipule females establising a breeding beach with territorial behaviours. The dominant male can be challenged by other males by displays, of fighting and vocalising. This ensures the male with the fittest allele is the one reproducing and passing on these advantageous alleles to offspring. The breeding colonies occupy the same site every year which is benifical as it reduces time and energy wasted to find a mate to reproduce with. The sea lions are K strategists as the gestation period is a long 11 months only having one pup at a time. Small number of offspring with alot of parental care as the pups are completly dependent on the mother for food and protection

The cost of this behaviour is it requires a lot of time and energy to care for the pup but can benifit the species as it's more likely that the pup will survive to reproductive age, 5 years for males and 3 to 4 years for females. The impact of this breeding behaviour can reduce genetic variation in the population as only one male for every 25 females is passing on their genetics. This could be detrimental for the small otago population which already lacks genetic diversity due to the founder effect. Some males in the population will not reproduce and could result in alleles being lost from the population. Each individual represents a larger proportion in a smaller population so males not reproducing can have a greater effect. Little genetic variation means the population is less likely to survive if there is a change in the enviroment - could be cause of sea lion population on mainland dissapearing when enviroment changed due to human impact.

Allopatric speciation could occur between the sea lion colonies where two species arise from a common ancestor due to being geographically isolated. The colonies are at fair distance away thus there is no gene flow between the populations as they breed at different sites. Overtime differences could accumulate in the populations (differences in allele frequencies and mutations). Change can create reproductive isolating mechanisms where even if the geographical barrier is removed, the Auckland island sea lions and otago sea lions cannot not reproduce to give rise to viable, fertile offspring - different species.

Question three

The relationship between M. paradoxus and V. inanis with wasp species is a type of exploitation, parasitism. This is as the wasp nest beetle larva and hoverfly larvae derive the nutrience from wasp larvae to use as energy to grow a develop. This inhibits the beetle and hoverfly species as their offspring survive without any parental care (time and energy). Wasps are not benifited as their offspring don't survive. Both Both requires one wasp larva to complete its development and mainly targets the common wasp. Hoverfly requires two wasp larvae to complete development and targets subspecies families vespinae. This parasite relationship makes the beetles and hoverflies good biological control agents as they prevent the reproduction of wasps while increasing their own population for this to continue. The hoverfly is an effective control agent as it goes unnoticed due to its chemical smell and wasp-like apperance.

Both M. paradoxus and V. inanis are R stratagiests producing lots of offspring (several hundreds) which require no parental care. This makes them good biological control agents as the populations can multiply quickly to quickly reduce wasp populations. Wasp are also R stratagiests which can form large colonies of several thousand individuals. So this feature of the beetale and hoverfly allow them to be successful in controlling the growth of wasp populations with large numbers. The control agents do not feed on the honeydew which is good as the action of wasps feeding on honeydew is affecting a wide range of species which the actions of the biological control agents is trying to reduce.

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The positive ecological impact of releasing the biological control agents is the wasp species will be controlled, decrease in population size. The wasps obtain honeydew from Ultracelostoma spp which creates interspecific competition between the wasps and other species relying on honeydew as a food source in the winter when nectar is scarce. The wasps actions could result in lost of genetic diversity and extinction of ~~birds~~, bats, tui, kaka and bluebells, if there is not enough honeydew for nutrients for energy to carry out life processes such as growth and reproduction to survive. Also, the honeydew droplets leftover contribute to the nutrient makeup of the soil further promoting growth of black sooty mold fungi which is an important food source for a range of animals. After the introduction of wasps removing honeydew less falls to the ground to promote the growth of this fungi so the reduction of wasp populations can have a positive ecological impact for a wide range of species including ~~the~~ bellbirds, tuis, kaka, fungi, bacteria, beetles, mites and other flora and fauna. Reduced interspecific competition for honeydew. *

The negative ecological impact of releasing the biological control agents could be that M. paradoxus and hoverfly populations become out of control. As they are R stategist with large number of offspring their populations can multiple quickly. Hoverflies adult feed on pollen which is a food source for bees and other birds. The introduction of hoverflies will create intraspecific competion for resources such as pollen and could be harmful to bees and birds relying on pollen as a food source. With high reproduction rates and no predators currently known the hoverfly could outcompete important endangered bee species and native birds vital to NZ's ecological enviroment. Scientist must also

consider possible unforseen consequences. Mutations are random permenant changes in the base sequence of DNA and the only source of new alleles. Currently both control species have no known effect on honey bees, bumble bees or native bees but scientists need to consider the possibility of mutation. A mutation could arise allowing the biological control agent to become parasites of bees deriving nutrients from bee larva to complete their development. Possible unforseen consequences could impact the survival of other species which are vital to maintaing the ecosystem.

*

german wasps are of particular concern as they remain alive and active during the winter period when honeydew supply is already scarce. Intensity selection pressure which could push some species to extinction in winter. The control agents can help to ensure honeydew is plentiful and not all removed due to wasps

Wasps

Annotated Outstanding Scholarship Exemplar Template

Subject	Scholarship Biology	***Standard***	93101	***Total score***	20

Q	***Grade score***	***Annotation***
1	6	The candidate has selected relevant evidence from the resource and integrated it with their own understanding of biological processes. They have considered the role of natural selection and the impacts of humans on the evolution of camelids. The candidate could have improved this response with a more detailed discussion of the impact the different habitats on the genetics of the camelids, linking to specific genetic examples from the resource.
2	7	An insightful and well-constructed response. This candidate has integrated a range of relevant biological arguments, supported with evidence from the resource, into an in-depth response showing how competition, energy cost, population genetics have influenced the difference in mean mass of the two colonies, and the impact of polygyny and territoriality on the sea lions. Linking evidence from the resource of the sea lion diet (e.g. abundance and variety of food) into a consideration of the possible consequences of these factors would have further strengthened this response
3	7	In this in-depth answer the candidate has shown perception and insight when discussing factors that would make the hoverflies and beetles good biological control agents. They have shown insight with a good discussion of the impact of a r-selected species on the wasp populations. Their response draws on the biological material in the resource and then extrapolates out to the potential ecological impacts of the release of these species. A more detailed consideration of wider potential implications (such as introduction of pathogens, impact of predators on the control agents or the impact on food webs) would have resulted in a even more perceptive response