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SCHOLARSHIP EXEMPLAR



NEW ZEALAND QUALIFICATIONS AUTHORITY
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QUALIFY FOR THE FUTURE WORLD
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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

In North America camelids underwent adaptive radiation where ancestral camelid underwent rapid speciation to fill a range of niches that had suddenly became available. This may have been due to a catastrophic event that caused the extinction of other species.

6 mya a temporary land bridge formed. This may have been due to cooling of the climate causing water levels to drop. Same as 3 mya.
Founder effect - new population

Allopatric speciation as land bridge only temp causing diversity of the camelidae family

Genetic drift since small groups migrate

PLANNING

Otago - prey is in more shallow water due to living on coast. less likely to encounter predators due to being closer to shore line.

Auckland - must swim deeper to get to prey further out so more likely to encounter predators so want to be smaller to be more agile to try and get away from areas. diving that deep also means very cold water, want to be small and compact to conserve heat and energy

less intra comp due
to space

Breeding

- late sexual maturity not good for survival
- polygyny
 - ↳ only fittest mate → ↑ chance of survival
 - ↳ if best male is infertile then bad for all
 - ↳ genetic drift for Otago ↳ one male is bad because ↓ genetic diversity
 - ↳ okay for auckland because many harems
 - ↳ still lots of genetic diversity

~~in population
of 150 than
on 23 harems
so all pups from
only 2-3 males
in auckland like
200 breeding males
so much more genetic
diversity~~

slow birth rate
only one baby

high energy costs for males, can be dangerous
worse for auckland because diving depths =
greater effort for food which difficult when injured.

only mums raise babies - no one to protect them
when of hunting

great comp for auckland
because less space more to fight

PLANNING

Wasp nest beetle:

brood parasite

exploitation parasitism ~~gives~~ relationship

short lived do not feed

1

wasp nest beetle lay hundreds of eggs but no common wasp in winter in over abundance of eggs

lay eggs in wood and bark

honey dew on bark

R accidentally ingested by other creatures

Q1: Evolution of Camelids //

There are many ecological and evolutionary processes that have led to the diversity of the camelidae family. //

45 mya camelids underwent adaptive radiation where the ancestral camelid rapidly speciated to fill a wide range of niches that had suddenly become available. This may have been due to a catastrophic event that resulted in the extinction of many other organisms. This allowed the camelidae family to diversify and form new species. Both 6mya and 3mya land bridges formed due to cooling of climate causing water levels to drop. This would have caused founder effect where a small group ~~of~~ breaks off from the main population. The alleles of the small group are not representative of the original population so selection pressures are different, causing the populations to evolve separately increasing the diversity of the camelidae family. Furthermore the land bridges are only temporary so when they were gone the populations were geographically isolated and no gene flow could occur. This would cause allopatric speciation due to the geographic isolation causing different selection pressures, causing the camelid populations to evolve differently increasing camelidae diversity. The populations that migrated would be more susceptible to genetic drift where alleles are fixed or lost due to a chance event, causing the groups to be even more different to the original ancestral camelid. These migrations resulted in many genetic changes to help the camelids survive in their environments impacting their evolution. Camelids 6mya migrated to Asia, Europe, and Africa where the climate was

was dry and hot with limited water and vegetation. This would result in Natural selection where individuals with traits best suited to their environment would survive and go on to reproduce causing those alleles to increase in frequency ~~in~~ in the population. These genetic changes such as to the ERP44, NFE2G2, MGST2, for heat stress and water loss would help the camelids to survive high temperature without causing stress to their body and retain water for long periods of time for when they are unable to water sources. This would cause further diversity in the camelidae family as camelids in different geographical areas, evolve and adapt differently to thrive in their environment. New word camelids which are in much cooler climates would evolve to be much smaller to retain heat and energy to stay as warm as possible. As a result of the different selection pressures the different camelid populations would no longer recognise each other as the same species and most likely would not breed due to prezygotic reproductive isolating mechanisms such as behaviour differences, and different ecological niches. Humans have also had a significant impact on the evolution of camelids. Humans domesticated camelids to help them to survive in difficult environments. They would have used selective breeding to choose the traits that were beneficial to them and only breed those ones. This would lead to ^{new} domesticated species of camelids that have speciated from their original wild ancestors like with the llama and alpaca evolving from the

wild guanaco and vicuña. Domesticated camelids would have evolved to have a higher milk production, be much more docile, and have fluffier coats of colours desirable to humans. This would result in ~~far~~ less genetic diversity in domesticated camelids compared to wild camelids, making them much more susceptible to extinction as a result of disease or ~~or~~ natural disaster. This ~~human~~ controlled evolution would result in domesticated and wild camelids no longer recognising each other ^{as same species} due to RIM's like prezygotic behaviours and as well as post zygotic hybrid sterility in offspring. //

Q2: NZ sea lion.

There are many reasons for the difference in mean mass between auckland and otago colonies. In the otago colonies they are living on a coastline so the water is much shallower and being so far inland means they are less likely to encounter predators. ~~habitat~~ In 3yr olds they on average dive less than 50m with max extreme being 100m. In comparison, the auckland colony is much further off shore so the water is much deeper with 3yr olds diving an average of 200m and max of 300m. They are also much more likely to encounter predators due to being offshore. Therefore auckland sea lions want to be much smaller so they can be compact and save energy trying to keep warm since the water is very cold at 200m. They also want to keep small to be quick and agile when trying to get away from predators like orcas and sharks. Otago colony sea lions ~~are able~~ prey is much closer and in shallower water which means it takes less energy and time to catch prey so they conserve energy and can eat more than the auckland sea lions making them ~~more~~ bigger. Furthermore the otago colony size is much smaller than the auckland colony (150 compared to 10,000) which means there is much less intraspecific competition for food so they are able to eat more and be bigger than the auckland island sea lions who face more competition and food scarcity due to 10,000 sea lions all competing for one prey type. The breeding behaviours of sea lions have many impacts.

on both the Stago Peninsula and Auckland Island colonies. Sea lions become sexually mature quite late which has a negative impact on both colonies because the sea lions are more likely to die before reproducing compared to if they became sexually mature at 1 year old. There is also a very low birth rate due to only having one pup at a time, only giving birth every one or two years, and a long gestation period of 11 months. This has a negative impact on the colonies because if the pup dies which happens often due to male harassment when the mother is away foraging then it is a long time before she next gives birth. Sea lions use the K strategy for mating which increases the chance of the pup surviving due to long term care from the mother but also has a negative impact on the mother because it is a very high energy cost and puts the mum in more danger. Also if the mum were to die then the pup would not be able to survive since completely dependent on its mum for survival. Sea lions use polygyny as their mating strategy. This is beneficial ^{for the colony as a whole} because the males fight for territory and breeding rights and therefore only the fittest will get to reproduce and pass on their genes increasing the chance of survival for offspring. This is a negative for individual males however as they are unable to pass on their genes. An issue with polygyny however is because there is only one male for many females, if he is infertile then a significant number of females will not get pregnant which is bad for

population numbers due to a low birth rate. The stags colony is also very small and has gone through bottleneck effect where the recovery of a population has resulted in reduced genetic diversity ~~most with less~~ and is also susceptible to genetic drift where alleles become fixed or loss decreasing genetic diversity due to a chance event. Therefore the stags colony has very low genetic diversity which is further affected by the polygyny breeding strategy since there is only one male for 25 females which means in a breeding season it is possible that only ~~an~~ 2-4 males will reproduce and pass on their genes. In comparison in the auckland Island colony in each breeding season at least 200 males will pass on their genes resulting in far greater genetic diversity ~~most with less~~ than in the stags colony. This has a negative impact on the stags sea lions as they are more likely for their population to be lost due to disease or a natural disaster. Polygyny also results in a very high energy cost for males as they must defend their territory and harem of females for around a month from other males. This can be very dangerous as they can become injured in fighting which could affect their survival and chance of reproductive success. This intraspecific competition would be much worse for male sea lions in the auckland colony as there is much more limited space and far more males fighting for breeding rights. These energy costs also have a worse impact of the auckland colony.

because hunting and feeding is a much greater energy cost than the stag colonies due to having to dive deeper and greater food scarcity. This means that they must use more energy hunting which means they have less energy to defend their harem. Also due to only one parent caring for pups they are left unprotected when the mother goes off for food, which especially impacts the auckland island colonies as there are thousands of males who could harass and harm their pups. However one positive is all females are pregnant and give birth at the same time which means the pups are safer in ~~many~~ large groups together at breeding beaches while the mothers are off hunting.

Q3: biological control

The wasp nest beetle and Hoverfly are good biological control agents of the german wasp and common wasp. It is a parasitism relationship which will benefit the wasp nest beetle and hoverfly and negatively affect the german and common wasp. They are brood parasites that kill off the wasps when they are larvae which prevents the ~~german~~ wasp populations from growing ~~and~~ which prevents them from eating the honeydew.

The interspecific competition between many species for the honeydew is causing a drop in their population numbers and allowing the wasps to take all the honeydew. The introduction of the wasp nest beetle and hoverfly would prevent this. There are many possible positive and negative ecological impacts that scientists need to consider. One positive impact is that the introduction of the biological control agents will reduce the number of german and common wasps. In turn this will positively affect many organisms such as bats, tūī, Kākā and bellbirds who rely on honeydew as a food source over winter. There would also be enough honeydew to provide nutrients to the soil helping more plants to grow in ~~summer~~ spring providing a greater food source for birds, and insects.

A negative of the wasp nest beetle and hoverfly is that there is no way to know the full extent of the biological impact the introduction of these new organisms will have, and if their are unintended negative impacts then it will be too late to reverse

The introduction of the biological control agents just worsening the problem rather than solving it. One of these negative impacts could be that the common wasp colonies die in winter. Therefore there could be an overabundance of wasp nest beetles because while they can also parasitise off the german wasp, they will be competing with the hoverfly. Wasp nest beetles lay several hundred eggs and if they are not entering the nests of the common wasp then there could be negative impacts of other organisms. For example, wasp nest beetles lay their eggs in bark so if there is an overabundance of eggs on the bark of beech trees which may be ingested accidentally by organisms eating the honeydew. This could have a negative impact on the organisms ingesting the eggs. ~~Furthermore several species of beetles and moths eat fungi off the bark of trees. If the population of wasp nest beetles and hoverflies got too large they may look for pollen. Wasp nest beetles do not feed however hoverflies do so if the population thrives they may begin to eat lots of pollen competing with other species which could have a negative impact.~~ A positive of the hoverflies eating pollen is the pollen on their bodies from eating pollen ~~will~~ will spread around help plants to cross pollinate and increase the genetic diversity of the plants. It is also possible that the german and common wasps will evolve to have defenses against the biological control agents, making the agents ineffective to reducing

the wasp populations or cause the agents to co-evolve to overcome their defenses. Scientist cannot predict what these adaptations could be and therefore cannot predict whether they could have positive or negative ecological impacts. Overall it is clear that scientists cannot predict all the ecological impacts the biological control agents will have, ~~now~~ and since there is a history in New Zealand of this backfiring (introduction of rats, stoats, possums and rabbits) it would be ~~now~~ a good idea to consider other wasp population control ~~strategies~~ strategies that could be more contained and controlled by scientists. //

Annotated Scholarship Exemplar Template

Subject	Scholarship Biology	Standard	93101	Total score	15
Q	Score	Annotation			
1	6	<p>This is a well written discussion of the evolution of camelids. The candidate has integrated their own biological understanding with the resource material and developed an in-depth response that clearly outlines the key evolutionary and ecological processes responsible for the diversity of camelids. They have used relevant evidence from the resource to outline the role of domestication and the impact of these factors on the genetics of the various species.</p> <p>A more comprehensive response could have used a wider range of evidence from the resource to illustrate in more detail the impacts of both natural selection and artificial selection on camelid genetics. Consideration of the wider impacts of humans (beyond domestication) would have added more depth to the response.</p>			
2	6	<p>The candidate has considered the biological evidence in the resource and produced a reasoned response with an in-depth discussion of the impacts of the breeding behaviours of sea lions. They have selected some relevant factors to discuss the mean mass difference between the two colonies.</p> <p>A stronger response would have considered the possible impact of diet and genetics and integrated these into the discussion in more detail</p>			
3	3	<p>The response to question three shows some evidence of integrating concepts around parasitism and the consequences of reducing wasp populations.</p> <p>A higher level response would involve more consideration of the wider biological features of the hoverfly and beetle that make them good control agents. It would also include a more insightful discussion of the implications of removing wasps from the NZ beech forest ecosystem</p>			