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3

91603



916030



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Level 3 Biology 2022

91603 Demonstrate understanding of the responses of plants and animals to their external environment

Credits: Five

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of the responses of plants and animals to their external environment.	Demonstrate in-depth understanding of the responses of plants and animals to their external environment.	Demonstrate comprehensive understanding of the responses of plants and animals to their external environment.

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

You should attempt ALL the questions in this booklet.

If you need more room for any answer, use the extra space provided at the back of this booklet.

Check that this booklet has pages 2–12 in the correct order and that none of these pages is blank.

Do not write in any cross-hatched area (▨). This area may be cut off when the booklet is marked.

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

Excellence

TOTAL

23

QUESTION ONE: INTRASPECIFIC RELATIONSHIPS

The stitchbird or hihi (*Notiomystis cincta*) is an endemic species that is now found only on islands or mainland regions to where it has been moved, due to predation from animals, such as domestic cats. Hihi have an unusual breeding system that includes **pair or group nesting**.

They **defend a territory in the mating season** of spring and summer, and have known **dominance hierarchies**. Older birds are dominant over the younger ones, especially those of the **same sex**. **Males are dominant over females**, except when **chicks are present at the nest**.

At the start of the breeding season, the males sing loudly until the end of the egg laying season. They also perform flight displays at the nesting area, which enhances their **white and yellow colours**.

Male hihi

Source: <https://nzbirdsonline.org.nz/species/stitchbird>

Female hihi

Source: <https://nzbirdsonline.org.nz/species/stitchbird>

Discuss how behaviours of the hihi work together to support the population size of the species.

In your answer:

- describe the terms hierarchy, predation, and territory
- explain how a **courtship strategy**, such as singing or flight displays, can be both an advantage and a disadvantage for the male bird
- evaluate how behaviours in **bold** above (group nesting and defending territory in the mating season) work together to maintain population size in protected areas.

A hierarchy is a social 'pecking' order with the most dominant bird being at the top & essentially having first access to things such as food & mates, then in an order the subordinates follow. territory is an area that is defended from other organisms & it is located inside the home range which is where all their food is & their nest would be in their territory which is a safe place the hihi can raise their young. predation is an

exploitation relationship where the predators are positively ^(cats & animals) effected as they catch & perhaps eat their negatively effected prey ^(the Hiti). The courtship behaviours shown by the male Hiti show loud singing & displays to attract the female Hiti's attention so they can pass on their genes. These rituals can be disadvantageous & advantageous to the male Hiti. It shows the females that they are of the same species & their displays would essentially attract the female Hiti to them so that they can pass on their genes, courtship ^{may} also show suppressed aggression so that the birds can get close enough for mating if this was previously an issue. This courtship ^{strategy} also means that the birds (males) will only pass on their genes if they are fit ^(as they will have best display) (natural selection) positively impacting the entire species. Some of ^{as the best genes will be passed} the costs of this courtship strategy for the males is that ^{↑ survival of whole species} essentially it uses a lot of energy, meaning that while it may attract mates for breeding, it may also mean that they have less energy for mating & as well as this since it is designed to attract the female Hiti, it may also attract unwanted predators which negatively effects the bird as it could die & therefore not be able to pass on its genes.

~~Group nesting~~ However the advantages outweigh the disadvantages as these rituals allow them to mate at all & pass on their genes. Group nesting & defending territory in mating season are beneficial & keep the species alive & allow for more protected mating. By nesting together as a group with potential hierarchies, they have the advantages of safety in numbers as the Hiti can work together to

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fight off predation such as domestic cats, they also can hunt together in groups & therefore collectively waste less energy & have more energy for parental care meaning the species is more likely to survive, as the offspring have a higher chance of survival in a group. In the nests they have a hierarchy, which means that the fittest males can pass on their genes to the females as they are at the top of the hierarchy.

This essentially improves the fitness of the entire population, as it means they are more likely to survive, if they didn't group nest, it would be much more likely for predation to kill the birds essentially not maintaining population size. By having a territory

it means they are actively defending the nest & because it's a group nest they have this safety in numbers. ^{Territory} ~~That~~ means that there is a safe place to

~~nest~~ raise young, meaning that more young are likely to survive & pass on their different genes increasing genetic variation & therefore total survival of the population in changing environmental conditions.

Having a territory also means they have a reliable

source of food which means more energy & they know where the food is so they ~~ea~~ don't have to waste energy

on looking for food as much & due to shared nesting

they can split the duties even more, meaning they have more energy for mating, while territories require energy to

maintain the benefits outweigh the costs & overall nesting together

& territory together mean greater survival rate & therefore ~~population size~~.

QUESTION TWO: MIGRATION OF INDIGO BUNTING



Source: <https://ebird.org/science/status-and-trends/indbun/range-map>

Source: www.flickr.com/photos/slingher/4522490194/

The indigo bunting (*Passerina cyanea*) is a bird that flies a long distance during its yearly migration, migrating only at night. Indigo buntings fly about 2000 km each way between breeding grounds in eastern North America (shown in red), and wintering areas from southern Florida to southern Central America (shown in blue).

Discuss how the behaviours mentioned above combine to help ensure the success of the species.

In your answer:

- define the term **migration**
- describe the **biological rhythm** shown, and give the likely **environmental cue for migration**
- explain a **navigational method** for the night migration of the bunting
- discuss how, despite the difficulties of a long journey, this repeated journey has enabled the indigo bunting population to be maintained.

migration is the ^{returnable} movement of an organism, in this case a bird, from one geographic location to another, often for a purpose such as escaping weather or for breeding. The biological rhythm shown is a ^{circannual} ~~circadian~~ rhythm and this means it is a yearly biological rhythm with the environmental cue of weather in the form of colder & harsher conditions, which is evident in the fact that they move away from

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the harsher conditions. Since they migrate only at night a navigational method that they probably use would be stellar navigation. This means they follow the stars, which can commonly be the North celestial pole. for ~~this~~ ^{stellar navigation} they may also require an internal biological clock to make up for the movement throughout the year, & they could also benefit from a map sense of knowing the latitude & longitude of where they are ~~at~~ in regards to the stars. Some of the benefits and costs of migration of the indigo bunting, include, with first the costs that it requires a lot of energy & there is always the chance they could get exhausted & not be able to continue, this also means less energy for mating & producing offspring than if they just stayed at ^{their} home-land, There is also the chance that they may get lost & not be able to mate at all. However the benefits must outweigh the costs and some of the benefits include how the indigo bunting have more options for breeding & by flying over to a different breeding ground despite the costs of less energy, it can positively impact their species, because essentially they are going to a different population, which would have a slightly different gene pool & by breeding with this different population they could be introducing new genes into their population essentially increasing genetic diversity of their population when they return, and this means with greater genetic diversity, if the environment was to change their species is much less likely to die out due to

a larger variety of genes, so therefore there is more likely to be one that is beneficial for the new environment. Another benefit of migrating for the indigo buntings is that because it happens during the winter months, they are escaping harsher weather & going to an optimum climate, this means that despite losing energy ^{from} travel, they may also potentially save energy as they don't need to utilise their energy for keeping warm & if this energy save happens to outweigh the energy lost from travel, they would have more energy for mating, they are also more likely to have food constantly, if they move/migrate before winter & then migrate back before the conditions of their new geographic location get bad, & they are also less likely to die from the weather if they migrate. This means by having food & optimum weather they are less likely to die & have the ability to pass on their genes, meaning that the benefits of increased genetic diversity & survival to pass on genes outweigh the costs of harsh travel conditions & large energy & loss from the migration, as overall it leads to greater survival of the indigo bunting species. On top of this by putting the birds under the stress of migration, as they are subject to possible exhaustion & loss of energy & getting lost, only the strongest of the birds will make it to the breeding grounds & have the ability to pass on their genes, which is natural selection, & this means that the population would be made stronger as a whole. All these factors mean migration has an adaptive advantage for the indigo buntings & the benefits outweigh the costs.

QUESTION THREE: DODDER

Source: https://upload.wikimedia.org/wikipedia/commons/4/42/Cuscuta_campestris_covering_host01.jpg

Source: <https://bygl.osu.edu/node/1682>

The golden dodder (*Cuscuta campestris*) is a leafless and rootless plant that lives off other plants.

It has a growth response, enabling it to wind up and **around a host plant**, branching to form a tangled mass, which can spread from the initial host to nearby plants. It uses a special organ, the haustorium, to attach itself to the host and grow into host tissues. Through the haustorium, it gains water and nutrients from the host plant.

The flowering time is critical for the successful reproduction of the dodder. Various environmental cues, especially changes in **night length** (photoperiod), are perceived by the plant. Very little is known about how flowering of the dodder is triggered to start; however it is known that the dodder has both short-day plant (SDP) hosts and long-day plant (LDP) ^{upx} hosts. Scientists have found that the flowering of the dodder seems to be synchronised with the flowering of their hosts, as they flower when the host does.

Discuss reasons for the success of the dodder.

In your answer

- identify and describe the interspecific relationship between the dodder and the host plant ^{→ +ve thigmotropism.}
- explain how auxin enables the dodder to grow up and wind around the host plant, and identify and describe this growth response
- discuss how, through the ability to live off other plants and flowering at the same time as their hosts (both SDP and LDP), the dodder species is successful.

The interspecific relationship between the dodder & the host plant is ~~an~~ exploitation in the form of parasitism, & with the dodder being the parasite & the other plant the host plant. The dodder is

positively affected by this interspecific relationship because it gains nutrients & water readily from the host plant which allow it to grow & have water for photosynthesis/^{growth}, which provides adaptive advantage as it has energy + nutrients for growth & survival of the species. The host plant is negatively affected by this relationship because it loses nutrients & water. The dodder also uses the host plant to climb, with a response called positive thigmotropism. Auxin is the plant hormone which allows this to occur. Auxin is produced in the meristems of a plant, and it is a water soluble plant hormone that causes/effects cell elasticity, the thing that essentially occurs is as the plant^{ie. dodder} touches the host plant, the Auxin migrates to the^{cells in the} opposite side of the stimulus, i.e. the side of the shoot not touching the host plant. In shoots a high concentration of Auxin stimulates growth, so in the cells with^{high conc of} Auxin in them, the cell elasticity increases & it causes cell elongation. & in the cells on the opposite side to the touch stimulus, this causes the cells to ~~wrap~~ cause the plant to wrap around & up the host plant. This is called a positive thigmotropic response as the plant is moving towards to the touch & the consequence is the dodder having the ability to grow up its host. ^{tropism is a directional response} This serves adaptive advantage to the survival of the species because by having the ability to grow up the host a plant that may not have usually been stable enough with its stem now has the ability to reach other plants that it can essentially take nutrients & water from so it can continue

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to grow & thrive & continue to take nutrients off other hosts. The flowering of the dodder utilises ~~a~~ photoperiodism since the time of the plant flowering depends on when its host flowers, the cause for the flowering as a SPP or LPP may have an adaptive advantage. due to it having this synchronisation ^{dodders} they can take advantage of the pollinators that are in the environment, as they are in the same environment as the host plant, which would flower when the pollinators that the trees flowers use are active, so therefore by the parasitic plant flowering at the time of year when these pollinators are active, it can take advantage of them. and the ^{dodder} plants will undergo cross pollination, increasing the genetic diversity of the plant since due to photoperiodism ~~these~~ ^{dodders} should all flower at the same time. By increasing genetic diversity when the environmental conditions change, the plant ^{population} will be able ^{more likely} to survive, meaning photoperiodism & flowering at the same time as the hosts, since that's when the pollinators are active, so as to allow for cross pollination at all provide adaptive advantage. essentially all three responses including parasitism, & the positive thigmotropism that allows this to occur & the fact that ~~photoperiodism~~ ^{they can} allows them to synchronise with the flowering of the host provide survival advantage because they can exploit their ^{host's} niche & live off their nutrients for growth & ~~so~~ they can spread to other hosts as well to continue getting water & nutrients for survival so they have the ability to reproduce & continue the survival of the species, & they can also ~~continue~~ use the hosts pollinators for cross pollination so the ~~... in the environment & adaptive advantage~~

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QUESTION
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QUESTION
NUMBER

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Standard	91603	Display ID	NSN:136815664	Total score	23
Q	Grade score	Annotation			
1	E8	This candidate thinks through their answer well, following the structure of the question and the scaffolding bullet points. E8 is awarded as they discuss how the benefits of the bolded behaviours from the question outweigh the costs and enable the population to be maintained through fitter young surviving. Additionally they include the other behaviours of hierarchy and courtship and how ALL the behaviours collectively enable the population to be maintained. Collectively this allows E8 to be awarded.			
2	E8	The candidate again shows that they are reading the question through and taking the time to create a logical structure to their answer. They discuss how the benefits of migration must outweigh the costs, and they include more than 2 costs and 2 benefits, which allows them to gain a full E8 for this question.			
3	E7	<p>Another solid answer, confirming the candidate's ability at the Excellence level. Well structured, the points from the question are tackled in logical order. E7 awarded for discussing the how being able to synchronise with both LDP and SDP enables the dodder to take advantage of pollinators attracted to the host plant, increasing chances of successful pollination and leading to greater success and survival of the species. This was considered to be a borderline E8, with the answer almost providing sufficient evidence for the first Excellence point and would have been awarded if the candidate had made clearer their understanding of how more resources could be devoted to reproduction and greater success and survival of the species.</p> <p>The awarding of E7 made no difference to the candidates overall Excellence.</p>			