## Stage 1 Biology

## Investigation Folio Task 2: Science as a Human Endeavour

Topic 4: Biodiversity and Ecosystem Dynamics

Introduction and Purpose of task:

The term keystone species was created by American zoologist [Robert T. Paine](http://www.britannica.com/biography/Robert-Paine) in 1969. He likened these species to the pillars of a bridge, as without these the bridge would not stand.

A keystone species

* is a species that has a disproportionately large effect on its ecosystem relative to its abundance (population’s size).
* can be described as playing an important role in maintaining the structure the community.
	+ Such [species](http://www.britannica.com/science/species-taxon) help to maintain local [biodiversity](http://www.britannica.com/science/biodiversity) within a [community](http://www.britannica.com/science/community-biology) either by controlling populations of other species that would otherwise dominate the community or by providing critical resources for a wide range of species.

This task provides the opportunity to

* investigate the importance of a keystone species and how humans impact these species
* determine the effect of these activities from various perspectives (e.g. economic, social or environmental)
* evaluate the solutions that could be used to reduce the impact of human activities on these species and their ecosystem
* communicate your findings as either an article in a scientific journal or a report providing an expert’s point of view
* use and acknowledge a variety of relevant sources to find data and information

To complete this task you will need to consider the following stimulus materials and follow the steps outlined.

1. Go to the following URL

http://www.australiangeographic.com.au/topics/wildlife/2014/09/australias-keystone-endangered-species

The URL provided, is to guide your search, and is not an extensive list of keystone species. You may choose to investigate other keystone species identified from other sources.

1. Choose a keystone species that may be endangered due to human activities.
2. Investigate the research that scientists are undertaking into the various effects human activities have on the species and its ecosystem
3. Evaluate the potential solutions for reducing the impact of human activities on these species and their ecosystem, suggesting, with reasoning, which may be the most effective.
4. Choose at least one of the Science as a Human Endeavour key concepts (see Appendix I) and link it to the information you have researched as a focus for your scientific communication. Consider how the key concept is demonstrated by the information you have found.

*An example of a possible connection between Science as a Human Endeavour 3: ‘The acceptance and use of scientific knowledge can be influenced by social, economic, cultural, and ethical considerations’ is:*

*The economic impact of not using a fertiliser for farmers has not been assessed. While it is clear that the fertiliser is likely to be responsible for contamination of water sources, no suitable replacement has yet been developed.*

1. Prepare a scientific communication, using a format of your choice and the information you have researched, analysed and connected to the Science as a Human Endeavour key concept.

Your report must include the following:

* An introduction, which links the focus of your analysis to the SHE understanding(s) chosen
* Relevant biological concepts and background information
* An explanation of the impact or significance of the keystone species and related activities and/or the ethical, cultural, economic, political and social considerations
* A conclusion. You must include how the SHE key concept(s) has been addressed.
* In text referencing and Reference list using Harvard Referencing

Your report *could* also include information related to:

* Research being undertaken into the keystone species, its ecosystem and the role it plays in its community
* Scientists predictions of what could happen if this species was to become extinct
* Scientific findings about the current status of the keystone species
* The human activities that impact the community of the keystone species
* Solutions or suggestions made by scientists for how these activities could be better managed- could be technology based
* Issues relating to the impact humans have on this species and its environment

Assessment Conditions:

3 weeks to complete. Class time provided for research and support.

Students may submit one draft for feedback.

Word Count: maximum of 1000 words for Part C, if written, 6 minutes for an oral presentation, or equivalent if a multimodal product.

Assessment Design Criteria

 Knowledge and Application: KA1 3, 4

Performance Standards

| - | Investigation, Analysis, and Evaluation | Knowledge and Application |
| --- | --- | --- |
| A | Critically deconstructs a problem and designs a logical and coherent biological investigation with detailed justification.Obtains, records, and represents data, using appropriate conventions and formats accurately and highly effectively.Systematically analyses and interprets data and evidence to formulate logical conclusions with detailed justification.Critically and logically evaluates procedures and their effect on data. | Demonstrates deep and broad knowledge and understanding of a range of biological concepts.Applies biological concepts highly effectively in new and familiar contexts.Critically explores and understands in depth the interaction between science and society.Communicates knowledge and understanding of biology coherently, with highly effective use of appropriate terms, conventions, and representations. |
| B | Logically deconstructs a problem and designs a well-considered and clear biological investigation with reasonable justification.Obtains, records, and represents data, using appropriate conventions and formats mostly accurately and effectively.Logically analyses and interprets data and evidence to formulate suitable conclusions with reasonable justification.Logically evaluates procedures and their effect on data. | Demonstrates some depth and breadth of knowledge and understanding of a range of biological concepts.Applies biological concepts mostly effectively in new and familiar contexts.Logically explores and understands in some depth the interaction between science and society.Communicates knowledge and understanding of biology mostly coherently, with effective use of appropriate terms, conventions, and representations. |
| C | Deconstructs a problem and designs a considered and generally clear biological investigation with some justification.Obtains, records, and represents data, using generally appropriate conventions and formats, with some errors but generally accurately and effectively.Undertakes some analysis and interpretation of data and evidence to formulate generally appropriate conclusions with some justification.Evaluates procedures and some of their effect on data. | Demonstrates knowledge and understanding of a general range of biological concepts.Applies biological concepts generally effectively in new or familiar contexts.Explores and understands aspects of the interaction between science and society.Communicates knowledge and understanding of biology generally effectively, using some appropriate terms, conventions, and representations. |
| D | Prepares a basic deconstruction of a problem and an outline of a biological investigation.Obtains, records, and represents data, using conventions and formats inconsistently, with occasional accuracy and effectiveness.Describes data and undertakes some basic interpretation to formulate a basic conclusion.Attempts to evaluate procedures or suggest an effect on data. | Demonstrates some basic knowledge and partial understanding of biological concepts.Applies some biological concepts in familiar contexts.Partially explores and recognises aspects of the interaction between science and society.Communicates basic biological information, using some appropriate terms, conventions, and/or representations. |
| E | Attempts a simple deconstruction of a problem and a procedure for a biological investigation.Attempts to record and represent some data, with limited accuracy or effectiveness.Attempts to describe results and/or interpret data to formulate a basic conclusion.Acknowledges that procedures affect data. | Demonstrates limited recognition and awareness of biological concepts.Attempts to apply biological concepts in familiar contexts.Attempts to explore and identify an aspect of the interaction between science and society.Attempts to communicate information about biology. |

Appendix 1:

Your research and article/report should have a focus on at least one of the key concepts of Science as a Human Endeavour listed below:

Communication and Collaboration

* Science is a global enterprise that relies on clear communication, international conventions, and review and verification of results.
* Collaboration between scientists, governments, and other agencies is often required in scientific research and enterprise.

Development

* Development of complex scientific models and/or theories often requires a wide range of evidence from many sources and across disciplines.
* New technologies improve the efficiency of scientific procedures and data collection and analysis. This can reveal new evidence that may modify or replace models, theories, and processes.

Influence

* Advances in scientific understanding in one field can influence and be influenced by other areas of science, technology, engineering, and mathematics.
* The acceptance and use of scientific knowledge can be influenced by social, economic, cultural, and ethical considerations.

Application and Limitation

* Scientific knowledge, understanding, and inquiry can enable scientists to develop solutions, make discoveries, design action for sustainability, evaluate economic, social, cultural, and environmental impacts, offer valid explanations, and make reliable predictions.
* The use of scientific knowledge may have beneficial or unexpected consequences; this requires monitoring, assessment, and evaluation of risk, and provides opportunities for innovation.
* Science informs public debate and is in turn influenced by public debate; at times, there may be complex, unanticipated variables or insufficient data that may limit possible conclusions.

**A Special Study: A race against time- the survival story of Gilbert’s Potoroo.**

Introduction:

In 1994, the discovery of a small rat-kangaroo mammal, shocked society as it had long been considered extinct. In a small area known as Two Peoples Bay Nature Reserve, the Gilbert’s Potoroo (*[Potorous gilbertii](http://www.australiangeographic.com.au/topics/wildlife/2014/09/gallery-australias-keystone-endangered-species/gilberts-potoroo)*) was rediscovered and so started the local communities campaign to prevent the actual extinction of this rare marsupial species. With collaboration between the local community, government agencies and international groups including ecologists and other scientists, the Gilbert’s Potoroo Action Group was born (Group, 2003-2016). With numerous strategies possible for conservation, including captive breeding, other factors including economic and environmental considerations will influence the directions taken to save this species. It will also be important to consider the limitations of the strategies employed to design a sustainable plan of action.

Relevant topic and SHE key concepts identified

Consensus: Critically Endangered

Gilbert’s Potoroo are found only in Western Australia on Mt Gardner near Albany where 30-40 individuals were found (Group, 2003-2016). However, in 2015- a fire may have caused the loss of a number of individuals it is thought there may be as few as 6 individuals left in the wild habitat (Morrison, 2017) and consequently it has been universally agreed by various organisations including Commonwealth Environment Protection and Biodiversity, a federal government agency, and the International Union for Conservation of Nature (ICUN), that the Gilbert’s Potoroo is a critically endangered species (Woinarski, 2016). Using agreed protocols, and a common understanding of the data needed to define what constitutes a species that is critically endangered, these organisations have collaborated to enable action to be taken by society and scientists to prevent the extinction of this unique and rare species.

Relevant science discussed

A Keystone Species

Gilbert’s Potoroo, are unique to the environment and critical to the stability of their food web (Figure 1), as they have a diet of 40 different fungi and importantly have a symbiotic relationship with these fungi- The potoroo spreads the spores for these fungi, and the fungi provide specialised nutritional needs to the potoroo. It for this reason, that this rather small animal with its small population has a role as a keystone species in its environment, as without it, many species of fungi and other associated species that rely on the fungi are adversely impacted (Jantos, 2014).



Figure 1: The food web of Gilbert’s Potoroo. (Anon., n.d.)

Vulnerable to Nature and Humans

Upon discovering the small population of Gilbert’s potoroo, scientists were concerned for the survival of this population due to the fact that their habitat was thick scrub lands, which were at high risk of fire. These concerns turned into a grim reality when in 2015 there was a catastrophic bush fire that all but wiped out the remaining potoroos in the wild (Morrison, 2017). The consequences are that the habitat will take years to recover and in the meantime, the remaining potoroos have limited resources, and the impact of a small gene pool may also limit the survival of the species. Unfortunately, other factors may also potentially affect the survival of the potoroo and these too were of a concern to the members of the Gilbert’s Potoroo Recovery Program which had formed to collaborate on the future survival of this unique species, and included the WA Department of conservation and Land Management (CALM), Perth Zoo, universities, conservation groups, community groups and the Gilbert’s Potoroo Action Group, the original community group that fought to protect the species from extinction (Network, n.d.). These other factors include diseases that affect plants- e.g. dieback disease, as this affects food sources, predation by introduced species like the fox and cat, and land clearing by humans, which further reduces the habitat where the potoroo’s live, breed and source food (Jantos, 2014).

Illustration of how this shows a link to **Communication and Collaboration**

Sustainable Plan for the future

In 1994, the Gilbert’s Potoroo Action Group showed how direct interaction, collaboration and communication between community members, scientists and other organisations enabled a captive breeding program, as a part of the Gilbert’s Potoroo Recovery Program, to be started to save this species (Jantos, 2014). Without this breeding program, it is possible that the species could now be extinct, and is demonstration of how the understanding of the science and all the factors involved resulted in relevant predictions which enabled plans to be made for various consequences, resulting in some individuals of the species to be removed and protected, ensuring a captive population to exist. With the program considering both the environmental (protecting the habitat) and economic (costs involved) perspectives, as well as other influences including the intrinsic value of saving a species for the future this collaboration can be considered to be a very successful example of the interaction between society and science.

Explanation of the link between the SHE concepts and the solution

Illustration of the She key concept: **Influence**

The battle to save the potoroo continues. As habitat issues continue to be of great concern, both due to human caused land clearing and natural events like bushfires, the approach moves to creating an offshore captive populations where foxes and cats are not a threat, and where the habitat provides vital resources, like food and the likelihood of fire is reduced, as fire prevention strategies are more easily implemented (Network, n.d.). This strategy has been made possible with $250,000 in Federal Government funding. It involved the removal of the remaining individuals from Two Peoples Bay Nature Reserve, and shows some signs of being the best way to secure a sustainable future for the species, with successful population breeding on Bald Island (1.5 km offshore) and one at Waychinicup National Park inside an 8-kilometre fox and cat-proof fence. However, even this strategy showed some unintended consequences, including the predation of the potoroo by carpet pythons and the potoroo preferring granite over limestone terrain, even if they cannot find food, resulting in some potoroo deaths. The search for another location which is fox, cat and python free has led to a possible alternative home in the Recherche Archipelago, a group of 105 islands between Esperance and Israelite Bay (Morrison, 2017).

Further explanation of relevant biology

The Gilbert's Potoroo Action Group received the funds after Gilbert's potoroo was added to the National Threatened Species trajectory list in 2016.This means that the potoroo is now a part of a larger government plan (The Threatened Species Strategy Action Plan) to protect 20 Australian mammals most at risk of being wiped out. This opens new doors for further collaboration as shown when federal Environment Minster Josh Frydenberg included the Gilbert's potoroo on a prospectus inviting businesses and philanthropists to donate $500,000 over three years towards conservation efforts (Morrison, 2017).

The effort to save the Gilbert’s potoroo is a good example of how society and science interact to solve problems through successful collaboration and how the plan to prevent the extinction of Gilbert’s potoroo was influenced by the understanding of the science through various perspectives including economic and environmental ones. Through the collective understanding of the issues facing this species, community, scientists and other organisations have developed a potential plan for the sustainable conservation of Gilbert’s potoroo.

Conclusion shows the connection between the SHE key concepts and the solution

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