NATIONAL SENIOR CERTIFICATE EXAMINATION
NOVEMBER 2023

LIFE SCIENCES: PAPER II

SOURCE MATERIAL BOOKLET FOR QUESTIONS 1, 2 AND 3

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SECTION A

QUESTION 1

Read the information below. Refer to this information, as well as your own knowledge, to answer Question 1 in the question paper.

LITTLE FOOT UNVEILED IN SOUTH AFRICA

1. Sterkfontein Caves

The Sterkfontein Caves are just one set of the many caves in the Cradle of Humankind, found about 40 km west of Johannesburg. These caves were formed in a type of rock called limestone. The caves started forming around 20 million years ago when slightly acidic rainwater started soaking through the limestone rocks. This eventually dissolved pieces of the rock, forming hollow spaces underground. Over time, these spaces increased in size forming caves that are many kilometres long. As the caves got larger, the ceilings of some collapsed, forming openings at ground level. This created a dangerous situation for many animals as they could easily fall into the caves. This is why so many fossils have been found inside the caves.

Over time, the material (bones, sand, stones and rocks) that fell into the caves built up on the cave floor. These deposits, when mixed with rainwater containing calcium carbonate from the limestone, formed a concrete-like substance called breccia.

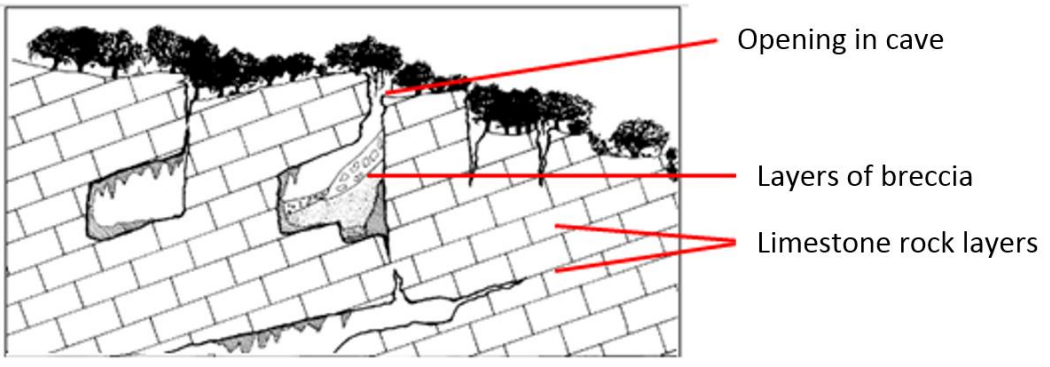

Figure 1.1 – Diagram showing the formation of the Sterkfontein Caves

Figure 1.2

Modern-day entrance into Sterkfontein Caves – through an opening in the ceiling

Another opening in the ceiling of the Sterkfontein Caves

[<https://www.pickingupthetab.files.wordpress.com>]; [<https://www.sterkfonteincountryestates.org>]

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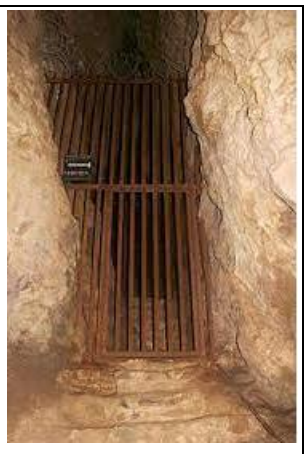
2. Little Foot Discovery

In 1994, Ronald Clarke, a paleoanthropologist (a scientist who studies the history and evolution of life on earth through looking at fossils) at the University of the Witwatersrand, found some small bones in a collection of fossils recovered from a section of Sterkfontein Caves called the Silberberg Grotto.



Clarke and another palaeontologist at Wits University, Professor Philip Tobias, realised that these bones belonged to an unknown species of *Australopithecus*.

Figure 1.3 – The gate guarding the entrance to the Silberberg Grotto in the Sterkfontein Caves
[<https://www.encrypted-tbn0.gstatic.com>]

In 1997, Clarke was again going through a box of bones at Wits University. These bones had also been collected from the Silberberg Grotto and were labelled 'monkey fossils', however, some bones were clearly not monkey bones. Clarke realised that they belonged to the same species as the first set of bones he had studied. As the foot bones were relatively small, he dubbed the newfound specimen 'Little Foot'.

One of the leg bones, a shin bone, appeared to have been broken, probably by miners who had mined the caves for limestone in the early 20th century. Clarke guessed that because there were bones from both left and right feet and legs, the rest of the skeleton might still be in the Silberberg Grotto.

Clarke asked his assistants, Stephen Motsumi and Nkwane Molefe, to search the Silberberg Grotto for the piece of bone matching the leg and foot bones. Astonishingly the men found the matching bone sticking out of some breccia in the wall of the grotto after just two days.

Figure 1.4 – Stephen Motsumi & Nkwane Molefe holding the piece of foot bone from Little Foot
[Image copyright Paul Myburgh]

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3. Excavation

The team excavated the fossil using hammers and chisels and then with a thick vibrating needle called an airscribe, as the fossil had very soft bones. The process of removing the bones was therefore extremely slow. 'It was like excavating thin paper out of concrete,' Prof Clarke said.

After more than 20 years' excavating, cleaning and putting together the skeleton, Prof Clarke published a paper describing the skeleton for the first time, in the *Journal of Human Evolution*. He stated that it was a new species, proposing the name *Australopithecus prometheus*.

Palaeoanthropologists recovering Little Foot from breccia inside the Silberberg Grotto
[Credit: Patrick Landmann. Barras, C. 2018. '"Little Foot" hominin emerges from stone after millions of years'. *Nature* 564: 169–170]

Little Foot skull and clavicle trapped in breccia
[<https://www.smithsonianmag.com>]

Prof Ronald Clarke with some parts of Little Foot
[<https://www.mg.co.za/article>]

Complete Little Foot skeleton on display
[<https://www.wits.ac.za>]

Figure 1.5

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4. Characteristics

It is thought that Little Foot was a young girl. The first objective of Clarke and his team was to determine how she got into the cave. The two hypotheses he considered were the following:

1. **She fell into the cave and died inside the cave;**
2. **She died outside the cave and her remains were washed into the cave over time.**

Clarke stated that the reason for the bones being so soft is possibly because parts of the skeleton lay in a pool of water in the cavern. This resulted in the bones losing calcium and becoming very thin. After this, breccia slowly built up around her skeleton.

The skeleton is 93% complete, with many bones still connected. No predator markings are present on the bones. In 2015 the age of the breccia containing the skeleton was dated to be 3,67 million years old. This would mean Little Foot was alive about 500 000 years before Lucy, the famous skeleton of an ancient human relative found in Ethiopia.

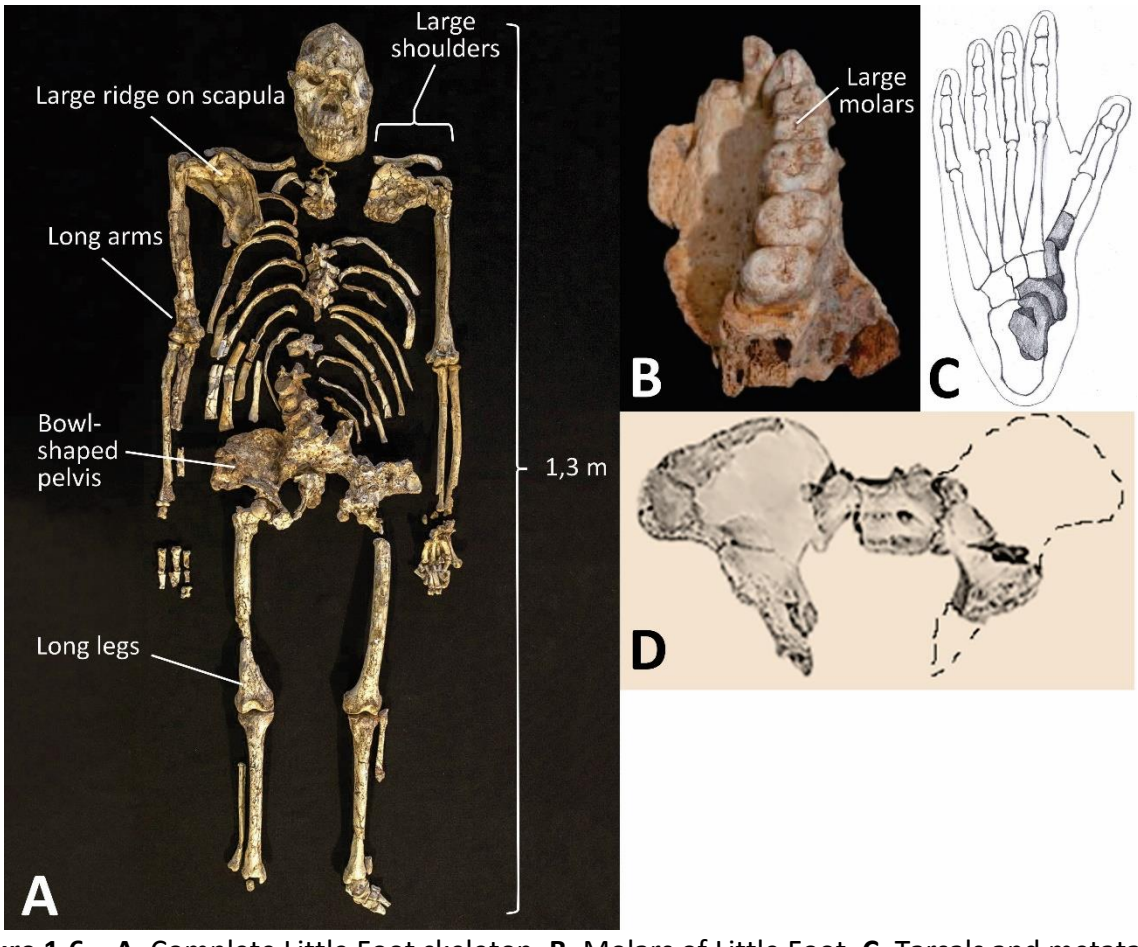

Figure 1.6 – A. Complete Little Foot skeleton. **B.** Molars of Little Foot. **C.** Tarsals and metatarsal portion of Little Foot. **D.** Hip bones.
[<https://www.scx2.b-cdn.net>]; [<https://www.i.pinimg.com>]; [<https://www.wits.ac.za>]

Analysis of Little Foot shows that *A. prometheus* was probably bipedal but had many quadrupedal characteristics as well. She would have been at home in trees as well as walking on two legs.

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5. Philip Tobias

World-famous palaeoanthropologist.

Led excavations at Sterkfontein Caves, now a world heritage site known as the Cradle of Humankind – Sterkfontein has produced more than a third of the world's hominid fossil finds.

Nominated 3 times for a Nobel Prize.
Degrees in cell biology, physiology and medicine.

Professor and Head of Department of Anatomy and Human Biology at University of the Witwatersrand

Figure 1.7 – Prof Philip Tobias
[<https://www.cdn04.allafrica.com>]

In the year that Philip Tobias was born, the anthropologist Raymond Dart established that the Cradle of Humankind was in Africa and not in Asia or Europe. Tobias eventually worked with Dart.

In 1959, the archaeologists Louis and Mary Leakey sent Tobias a skull to examine, which they had discovered in Olduvai Gorge in Tanzania. In 1964, Tobias confirmed it as a new hominid species and named it *Homo habilis*.

Tobias was an extremely brave opponent of apartheid. He regarded it as a deeply important political fact that humans evolved in Africa and believed it was the duty of science to expose the truths about race that ran counter to the ideas of apartheid, saying: 'The colour of someone's skin is genetically of no scientific importance whatsoever.'

Philip Tobias died in 2012 and is buried in West Park Jewish Cemetery in Johannesburg.

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6. Cladogram

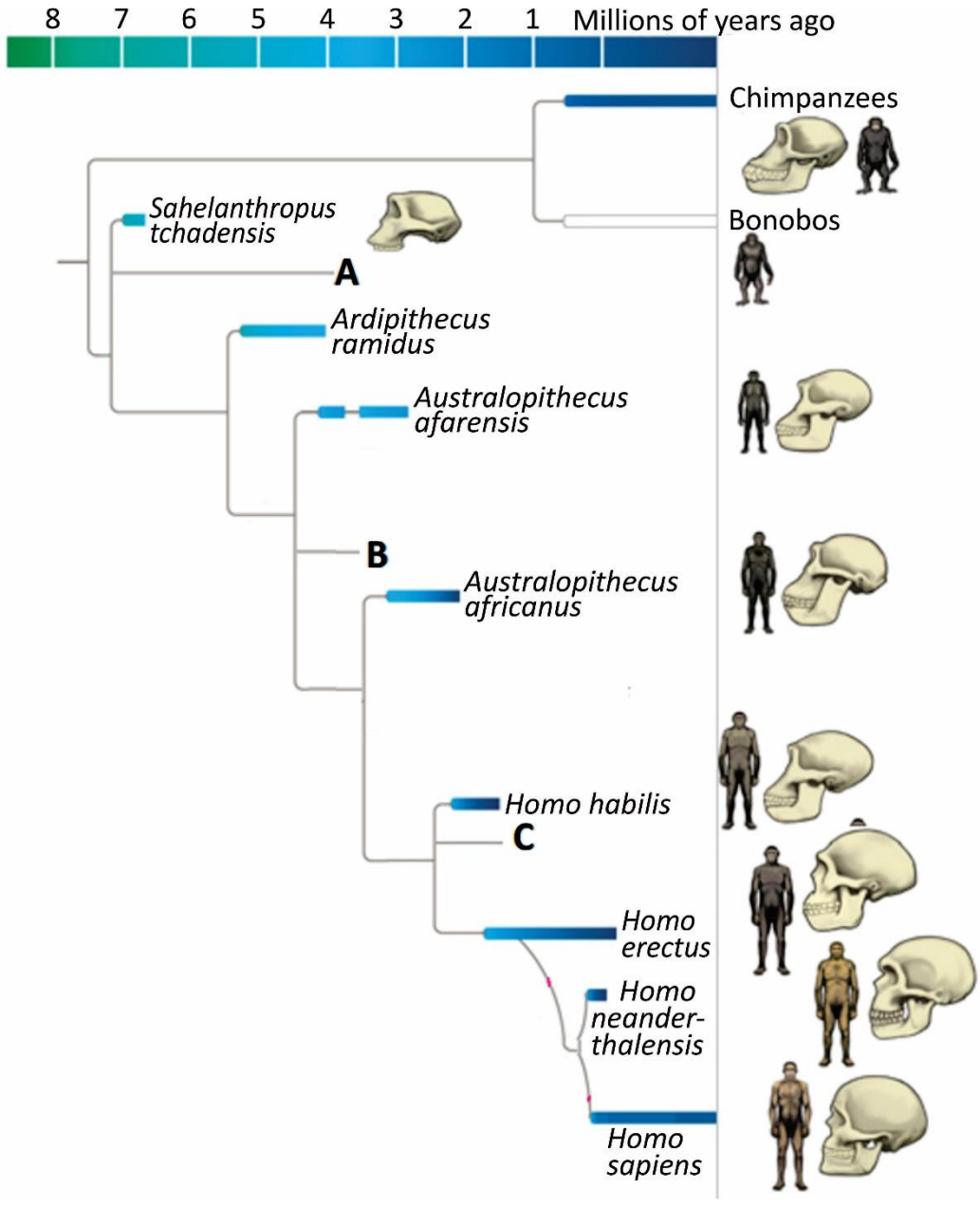

Figure 1.8 – Cladogram showing relationships between certain hominids and modern apes

[Source: <https://www.evolution.berkeley.edu>]

References for Question 1

[Adapted: Clarke, R. J. 1998. First ever discovery of a well-preserved skull and associated skeleton of an *Australopithecus*. *South African Journal of Science* 94: 460–463]
[Crompton, R. H., et al. 2021. *Australopithecus prometheus*: Its significance for an Australopith Bauplan. *Folia Primatol.*92:243–275]
[Adapted: Geggel, L. 2018. 'Miracle' Excavation of 'Little Foot' Skeleton Reveals Mysterious Human Relative. *Livescience*]
[Adapted: Mining and the discovery of the Sterkfontein Caves. <https://www.maropeng.co.za>]
[Philip Vallentine Tobias. <https://www.theguardian.com>]
[Adapted: Price, M. 2018. Identity of Little Foot fossil stirs controversy. *Science* 362(6419)]
[Adapted: Little Foot's history revealed for the first time. 2018. Wits University <https://www.wits.ac.za>]
[Adapted: <https://news.usc.edu>]
[Adapted: <https://www.biorxiv.org>]

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QUESTION 2

Read the information below. Refer to this information, as well as your own knowledge, to answer Question 2 in the question paper.

STICK INSECT CONVERGENT EVOLUTION

1. Stick Insects

Stick insects are a group of insects related to praying mantises. They belong to the insect order *Phasmatodea*, which consists of approximately 3 000 species. Stick insects resemble the twigs among which they live, providing them with one of the most efficient natural camouflages on Earth.

These insect species range in size from the tiny, 1,5 cm long *Timema cristinae* of North America, to the very large 33 cm long *Phobaeticus kirbyi* of Borneo, measuring over 52 cm with its legs outstretched, making it one of the world's longest insects.

Stick insects are generally brown or green in colour, although some species are brilliantly coloured. They are mainly found in forests and grasslands in tropical areas and mostly feed on leaves.

Figure 2.1 – An example of a stick insect (*Acanthoxyla inermis*) [<https://www.3.bp.blogspot.com>]

2. Lord Howe Stick Insect

Certain species of stick insect have a much sturdier body structure – often with large powerful legs (see Figure 2.2). These species are found in New Guinea, Australia, New Caledonia and associated islands.

The Lord Howe stick insect (*Dryococelus australis*) is one of the most famous of these stick insects. This species is a large (up to 130 mm) ground-dwelling insect that was once common on Lord Howe Island, a small island 600 km east of Australia. The only other place that this species occurred was on an even smaller island called Ball's Pyramid. The closest land to Ball's Pyramid is Lord Howe Island (see Figure 2.3).

The accidental introduction of rats from a shipwreck in 1918 led to the assumed extinction of the species by the 1960s. However, a small population consisting of 24 individuals was rediscovered under a single small bush in 2001 on Ball's Pyramid. This makes the Lord Howe stick insect one of the world's rarest insects.

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Figure 2.2 – Lord Howe stick insect
[Adapted: <https://www.islandconservation.org>]

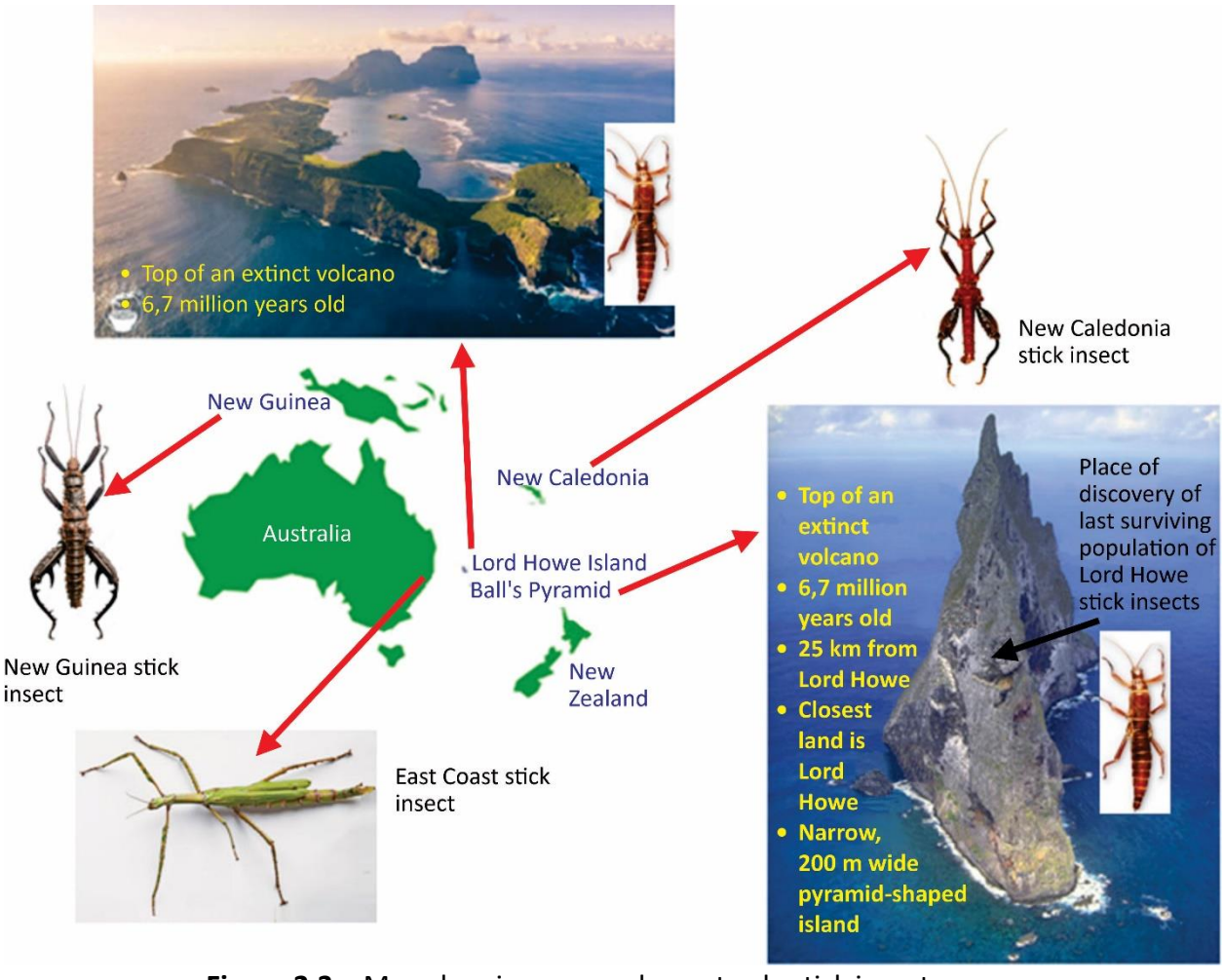

Figure 2.3 – Map showing areas where sturdy stick insects occur
[Adapted: <https://www.virtualoceania.net>]; [<https://www.i0.wp.com>]; [<https://www.i.dailymail.co.uk>]; [<https://www.media.australian.museum>]

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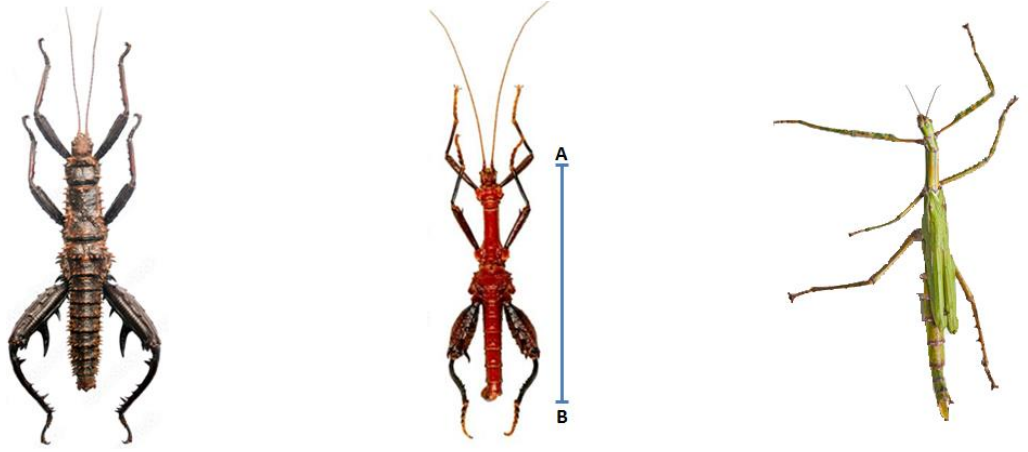
Scientists have two hypotheses regarding the origin of the Lord Howe stick insect:

- The Lord Howe stick insect is closely related to other stick insects from New Guinea and New Caledonia due to their similarity in structure. They therefore evolved from a small population of the New Caledonia stick insect that managed to reach Lord Howe Island.
- The sturdy body structure present in the Lord Howe and New Caledonia stick insects are the result of convergent evolution and therefore the Lord Howe stick insect is more closely related to the East Coast stick insect from Australia.

In either case, the establishment of a small population of stick insects on Lord Howe Island resulted in a population with a unique set of alleles compared to the source population.

New Guinea stick insect | New Caledonia stick insect | East Coast stick insect



Magnified: 0,3 X

Figure 2.4 – Three different species of stick insect
[<https://www.as2.ftcdn.net>] [<http://www.phasmida.speciesfile.org>]
[<https://www.upload.wikimedia.org>]

3. Experiment

The following two hypotheses were tested:

Hypothesis 1: The Lord Howe stick insect is closely related to the New Caledonia stick insect and therefore shares a recent common ancestor with them.

Hypothesis 2: The Lord Howe stick insect is not closely related to the New Caledonia stick insect and is more closely related to the East Coast stick insect.

Method: Mitochondrial DNA was taken from all four species of stick insect (New Guinea, New Caledonia, Lord Howe and East Coast). The DNA sequence of the gene coding for an enzyme called cytochrome oxidase (CO) was analysed. This gene codes for making an enzyme used in cellular respiration. There are slight differences between the DNA sequence for this enzyme in different species of organisms. Therefore, counting the number of mutations between two species can also be used to determine when they last shared a common ancestor.

Results: The following table shows a section of the CO gene code for each species (nucleotides in red are those that differ from the DNA sequence in the Lord Howe stick insect)

Species	DNA sequence
New Guinea	**C G G A T A G T**
New Caledonia	**C G G A C A G T**
Lord Howe	**C G G G A A T A**
East Coast	**C G G G A C T A**

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The researchers used these results to draw a cladogram to show the relatedness between the four species (shown in Question 2.4 on page 7 of the Question Paper).

4. Fossils

Many fossils have been found of the different species of stick insect that have existed on New Caledonia. The images below show some of the fossils that have been found, related to the environment in which they lived, and how long ago the stick insects were alive.

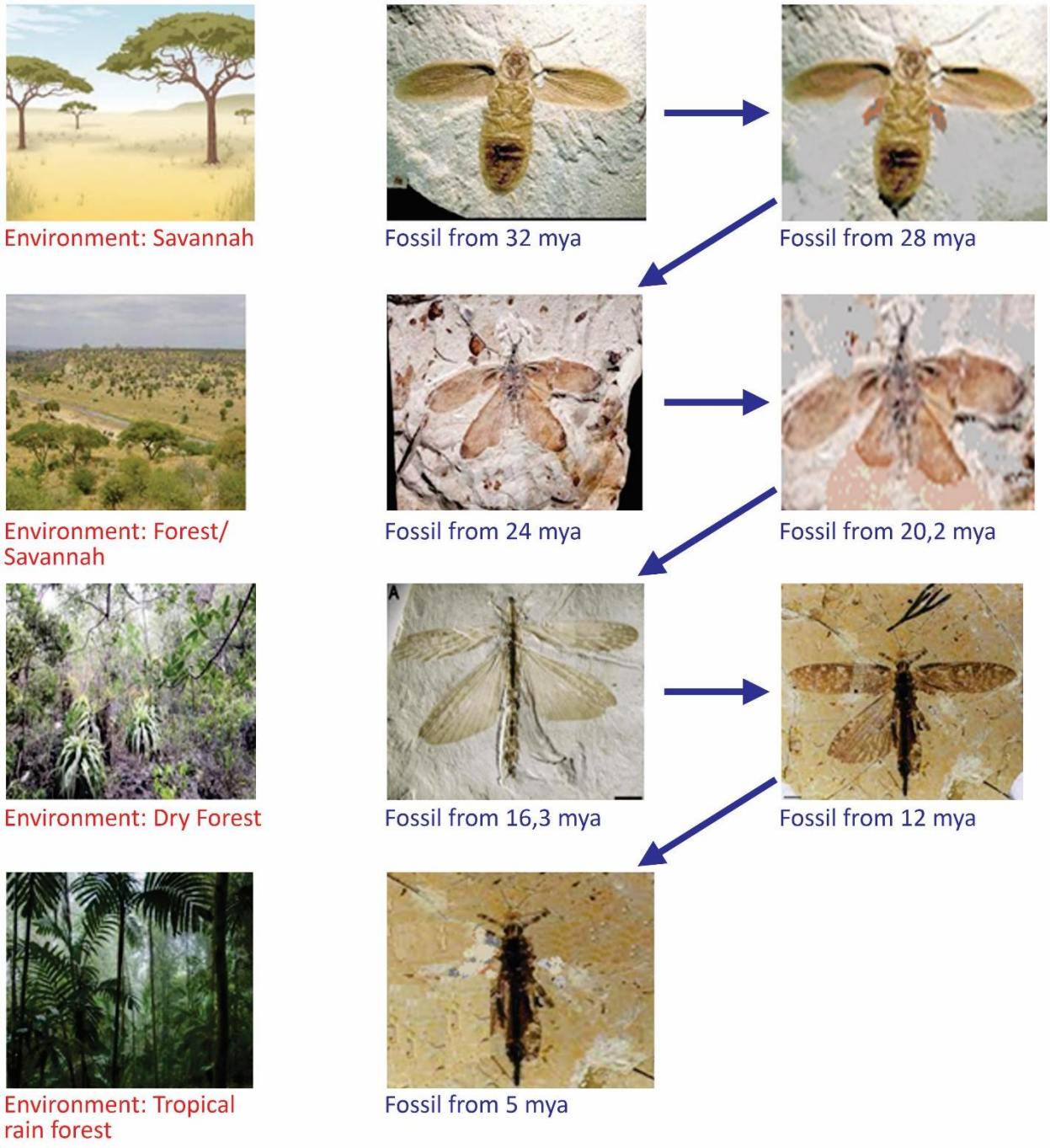

Figure 2.5 – Diagram showing different fossils of extinct relatives of New Caledonian stick insect, together with changes in the environment of New Caledonia over time
[Adapted: <https://www.media-sldnry.s-nbcnews.com>; <https://www.encrypted-tbn0.gstatic.com>]

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5. Conservation

The pet trade presents a potential threat to the survival of many stick insects, including the Lord Howe stick insect, along with the popular practice of framing and displaying their carcasses, like those of butterflies.

A program to wipe out the exotic species, including rats, on Lord Howe Island began in 2011. Since the rediscovery of the Lord Howe stick insect, a population was established at Melbourne Zoo in Australia and plans are in preparation to re-introduce many of the species on Lord Howe Island.

Lord Howe Island has also been declared a World Heritage Site in 1982 because it has an outstanding number of rare and endemic species.

References for Question 2

[Adapted: Buckley, T. R., et al. 2008. Stick insect evolution: phylogenetic placement of the Lord Howe Island tree lobster. *Proceedings of the Royal Society B.* 276, 1055–1062]
[Adapted: Harris, P. T., et al. 2011. Habitats and benthos of a deep-sea marginal plateau, Australia. *Seafloor geomorphology as Benthic Habitat: GeoHAB Atlas of Seafloor Geomorphic Features and Benthic Habitats*]
[Adapted: Mikheyev, A. S., et al. 2017. Museum genomics confirms that the Lord Howe Island Stick Insect survived extinction. *Current Biology* 27(20): 3157–3161]
[Adapted: Rare tree lobster in a class of its own. <https://www.abc.net.au>]
[Adapted: <https://www.dpi.nsw.gov>]
[Adapted: <https://www.education.nationalgeographic.org>]
[Adapted: <https://www.islandconservation.org>]
[Adapted: <https://www.nationalgeographic.com>]
[Adapted: <https://www.sciencelearn.org>]

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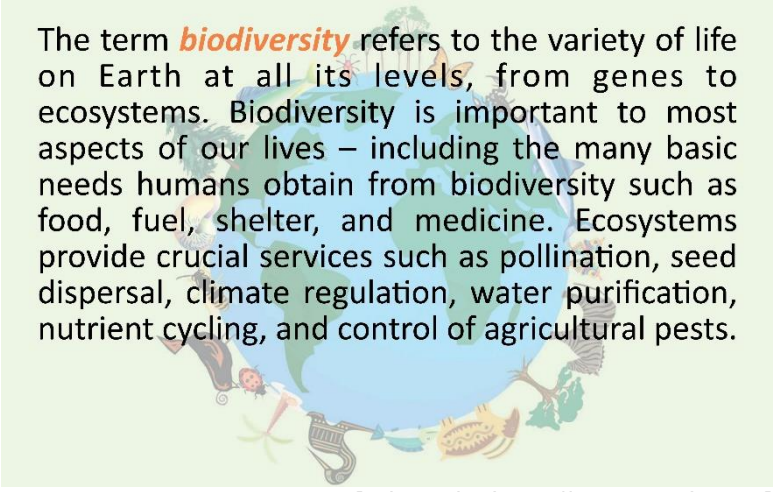
SECTION B

QUESTION 3

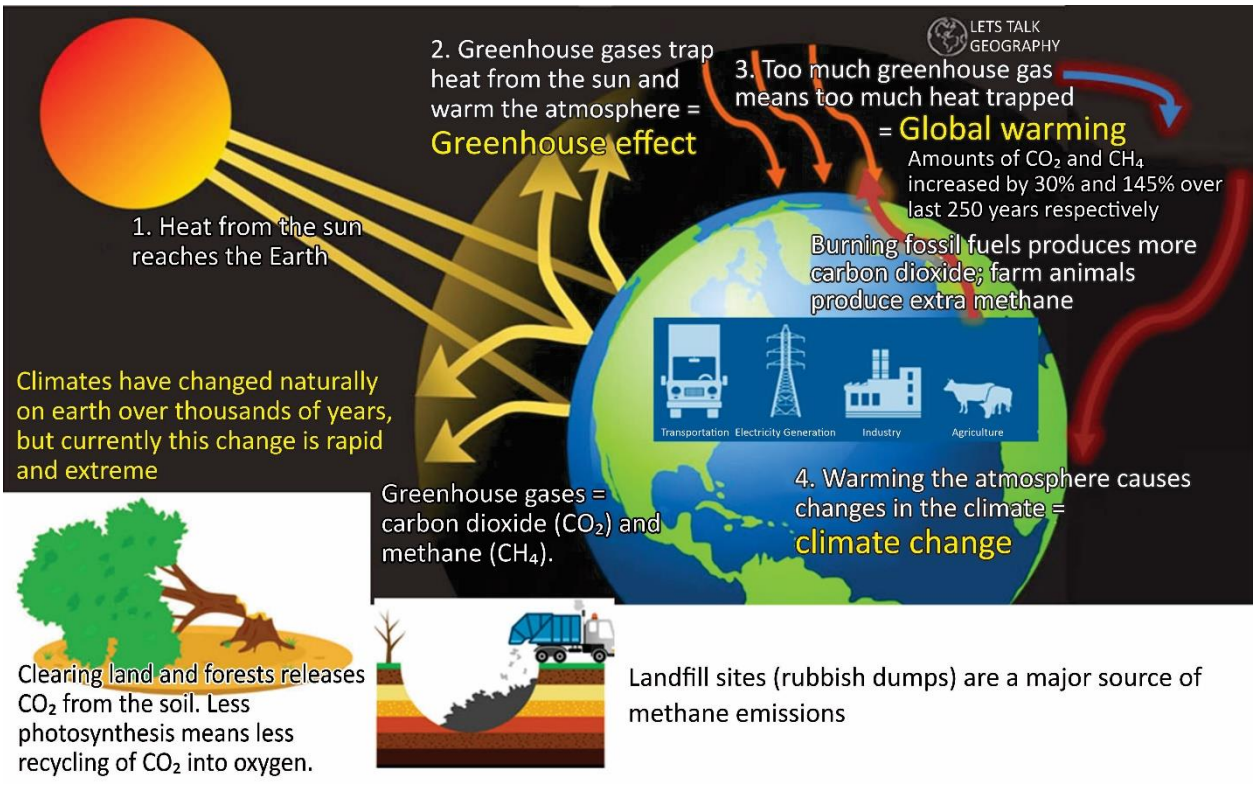
Read the information below. Use this information, as well as your own knowledge, to answer Question 3 in the question paper.

SOURCE A Climate change, biodiversity, natural and artificial selection



[Adapted: <https://www.amnh.org>]

WHAT IS CLIMATE CHANGE?



Infographic showing the cause of the greenhouse effect, global warming and climate change

[Adapted: <https://www.letstalkgeography.com>]; [<https://www.us.123rf.com>]

As a result of climate change, the Earth is now about 1,1 °C warmer than it was in the late 1800s. The last decade (2011–2020) was the warmest on record.

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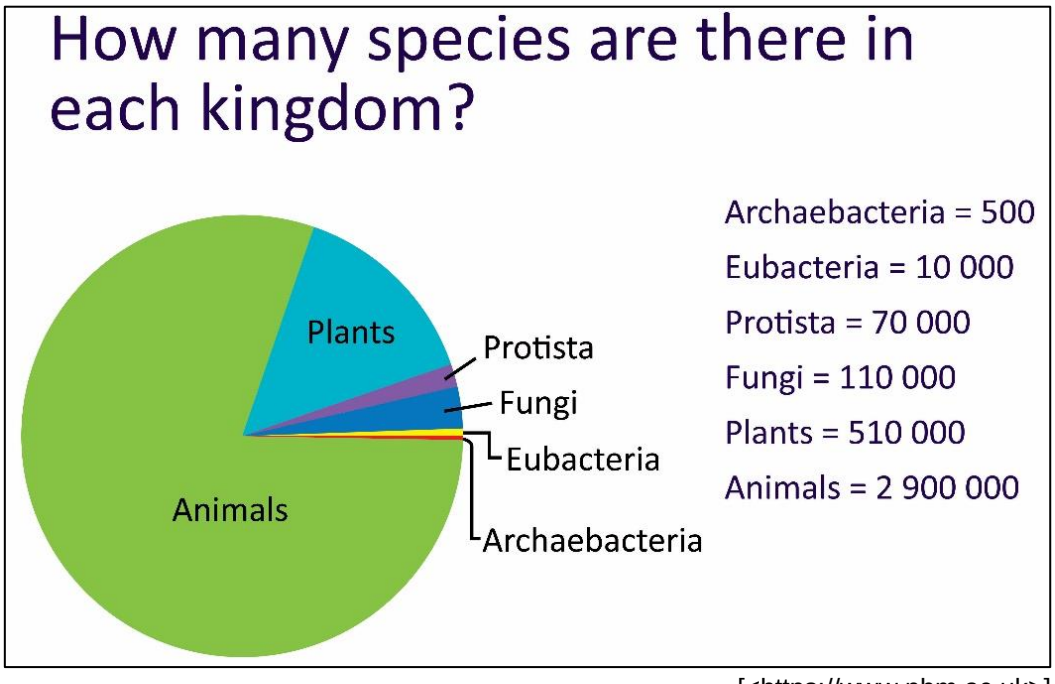
Effects of climate change
[<https://marketbusinessnews.com>]

Climate scientists state that limiting global temperature rise to no more than 1,5 °C would help avoid the worst climate impacts. Yet policies currently in place point to a 2,8 °C increase by the end of the century.

The rapid onset of climate change is limiting the ability of many species to adapt to their environments. The Intergovernmental Panel on Climate Change warns that roughly a quarter of all species may become extinct due to climate change. Some biologists argue that Earth is on the verge of another major extinction event. The big question is whether plants and animals can adapt quickly enough to keep ahead of climate change.

[Adapted: <https://www.ipcc.ch>]
[IPCC = Intergovernmental Panel for Climate Change. This is the United Nations body for assessing the science related to climate change]

SOURCE B How many species are there currently?



[<https://www.nhm.ac.uk>]
[Natural History Museum, London]

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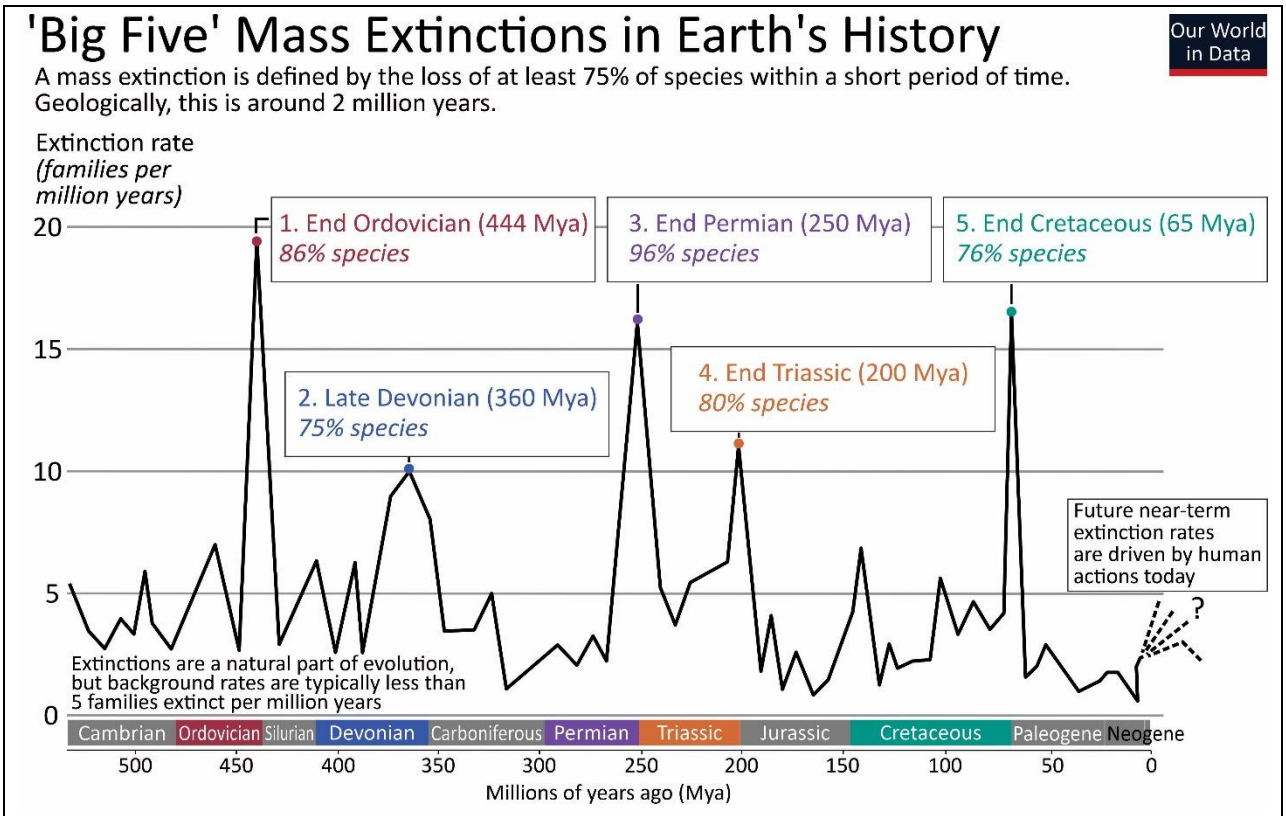
SOURCE C Extinctions



Extinction event	Cause of extinction
End Ordovician	Various Ice Ages creating change in sea levels
Late Devonian	Global cooling
End Permian	Natural climate change
End Triassic	Natural climate change
End Cretaceous	Asteroid impact

[Barnovsky A. D., et al. 2011. Has the Earth's Sixth Mass Extinction already arrived? *Nature* 471: 51–57]
[*Nature* is a British weekly scientific journal. It features peer-reviewed research from a variety of academic disciplines, mainly in science and technology.]

The Bramble Cay melomys (*Melomys rubicola*) is the first mammal reported to have gone extinct as a direct result of climate change. Previously found only on the island of Bramble Cay in the Great Barrier Reef, its habitat was destroyed by rising sea levels.

Warmer temperatures during egg incubation are causing imbalanced female to male sex ratios among endangered green sea turtles (*Chelonia mydas*), with females accounting for 99% of newly hatched turtles on some nesting beaches. This will reduce the reproduction rate.

[<https://www.upload.wikimedia.org>];
[Adapted: <http://www.australiangeographic.com>]
[A magazine focusing mainly on stories about Australia. All articles are peer reviewed.]

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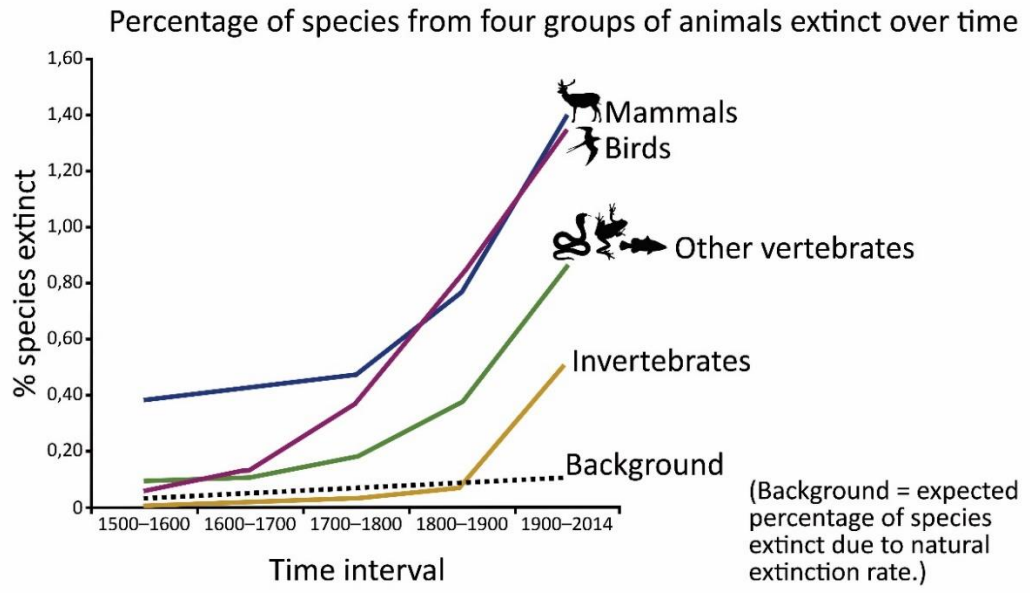
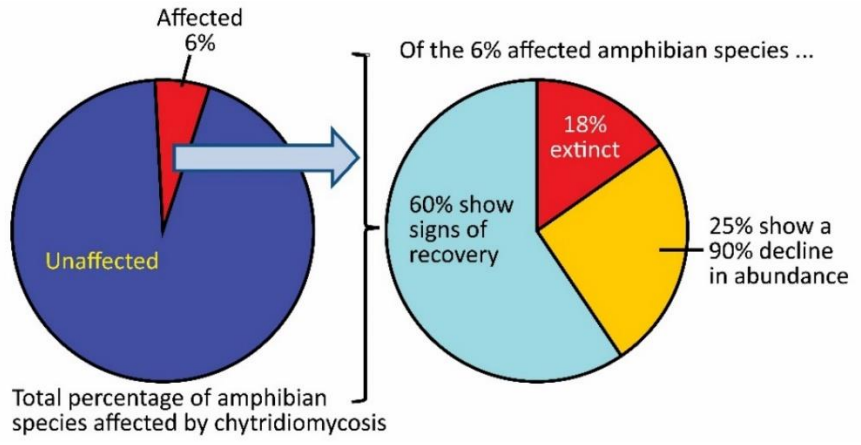


[<https:/www.theconversation.com>]

[*The Conversation* is a network of not-for-profit media outlets publishing news stories and research reports online, with accompanying expert opinion and analysis. Articles are written by academics and researchers.]

SOURCE D Natural selection

Highly virulent wildlife diseases are contributing to Earth's sixth mass extinction. One of these is the fungal disease, chytridiomycosis, which has caused mass amphibian die-offs worldwide. Chytridiomycosis is caused by a species of mould.



[Adapted: Scheele, B., et al. 2019. Amphibian fungal panzootic causes catastrophic and ongoing loss of biodiversity. *Science* 363 (6434): 1459–1463]

Xenopus laevis
African clawed frog

Surveys of many rivers in KwaZulu-Natal show that the decline of *Xenopus laevis* has stopped. Populations are now increasing due to increasing immunity to chytridiomycosis.

[Adapted: Knapp, R. A., et al. 2016. Large-scale recovery of an endangered amphibian despite ongoing exposure to multiple stressors. *Proceedings of the National Academy of Sciences USA*. 113: 11889–11894]

[*Proceedings of the National Academy of Sciences* is a peer-reviewed multidisciplinary scientific journal.]

[Adapted: Crawford, J, Lips, K. R. & Bermingham, E. 2017. After the epidemic: Ongoing declines, stabilisations and recoveries in amphibians afflicted by chytridiomycosis. *Biol. Conserv.* 206: 37–46]

[*Biological Conservation* is a leading international journal in the discipline of conservation science.]

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The area known as the Houston Ship Channel (HSC), in Texas, USA, is heavily industrialised and contains significant levels of pollutants. Gulf killifish, *Fundulus grandis*, inhabit this area. Individuals were collected from the HSC and from a control population from another unpolluted site. The HSC population was found to be about 1 000 times more resistant to these pollutants than fish from the control population. Crosses between the two populations resulted in offspring with an intermediate level of resistance, confirming that the protection is genetic.

[Adapted: Oziolor, E. M., et al. 2014. Evolved resistance to PCB- and PAH-induced cardiac teratogenesis, and reduced CYP1A activity in Gulf killifish (*Fundulus grandis*) populations from the HSC, Texas. *Aquatic Toxicology* 150: 210–219.]
[*Aquatic Toxicology* is a peer-reviewed scientific journal that publishes research into pollutants in aquatic environments.]

Darwin thought evolution was gradual, and that it would take longer than the lifetime of a scientist to observe even the slightest change. However, evolutionary biologists have demonstrated that natural selection can *sometimes* move swiftly.

[Zimmer, C. 2009. Adapted: <https://www.e360/yaleedu>]
[Carl Zimmer writes about science for *The New York Times* and a number of magazines. He is currently a lecturer at Yale University.]

Certain species take many years to become sexually mature and produce offspring. New heritable mutations and genetic recombinations are obviously passed on to offspring only when fertilisation occurs. Therefore, if the environment is rapidly changing, evolution will probably be too slow for those animals to adapt and survive.

[Steinmark, I. E. 2022. Can cross-breeding protect endangered species from the climate emergency? *The Guardian* newspaper.]

An organism is considered polyploid when it has twice the normal number of chromosomes. This occurs due to mistakes that result during mitosis or meiosis. Polyploidy can potentially increase the ability of a species to respond to environmental changes. This is because there are duplicated genes, which mean they may have many different alleles for different characteristics. Around 80% of plants are polyploid, however, it is very rare in animals and fungi.

[Adapted: van de Peer, Y., Marchal, K. & Mizrachi, E. 2017. The evolutionary significance of polyploidy. *Nature Reviews: Genetics* 18:411–424]
[*Nature Reviews*: *Genetics* is a journal that publishes papers dealing with genetics.]

Algae give corals nutrients in exchange for shelter. A 2004 study found that coral species that contain algae that can withstand high temperatures have become more common.

[<https://www.images.unsplash.com>]

Tawny owls come in two colours – brown and grey. Strong selection against the brown form occurs when winters are cold and snowy. Researchers noted that as winters in Finland become warmer and less snow falls, selection against the brown form has decreased. There are now more brown owls than grey.

[<https://www.luomus.fl>]

[Adapted: Karell, P., et al. 2011. Climate change drives microevolution in a wild bird. *Nature Communications* 2(208)]
[*Nature Communications* is a peer-reviewed scientific journal. It covers the natural sciences.]
[Adapted: Thompson, H. Ten species are evolving due to climate change. <https://www.smithsonianmag.com>]
[*Smithsonian* is a science and nature magazine published by the Smithsonian Institution in Washington, D.C.]

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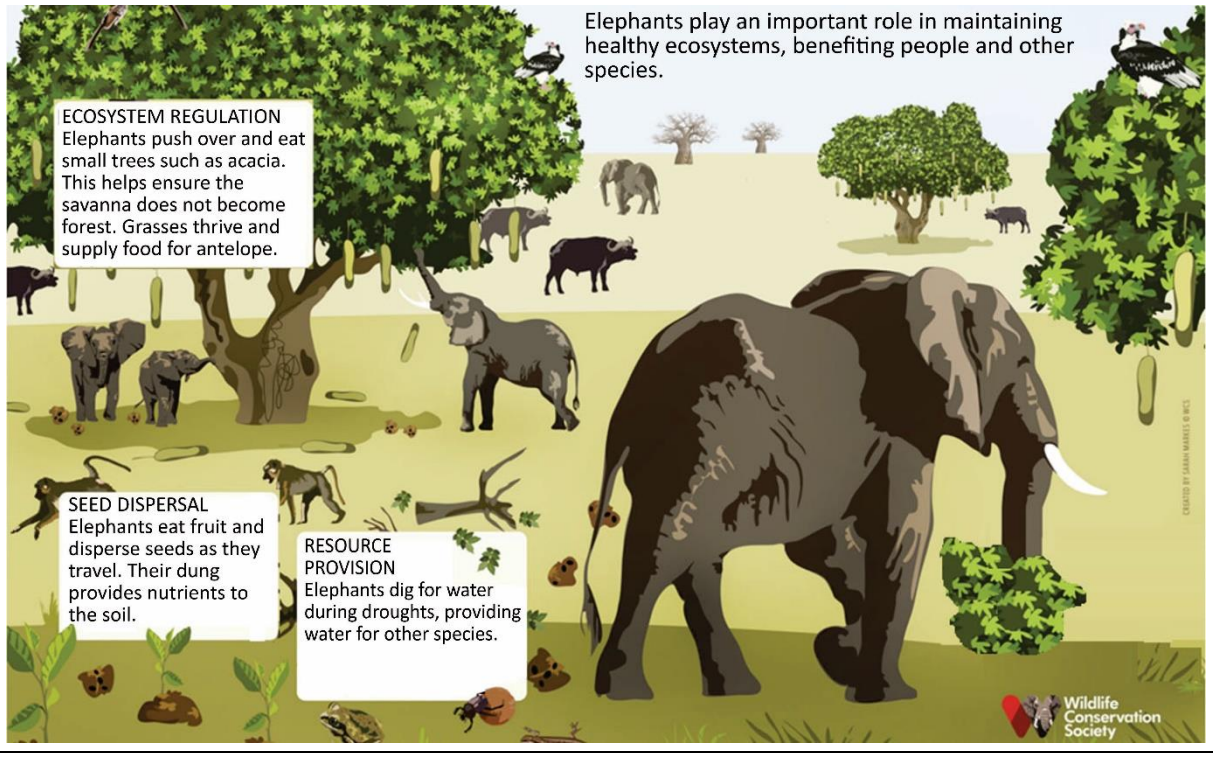
SOURCE E Keystone species

A keystone species is a species that plays a vital role in maintaining an ecosystem. Without its keystone species, the ecosystem would be dramatically different or cease to exist altogether. Keystone species have a large influence on the health of food webs. Elephants for example are keystone species:

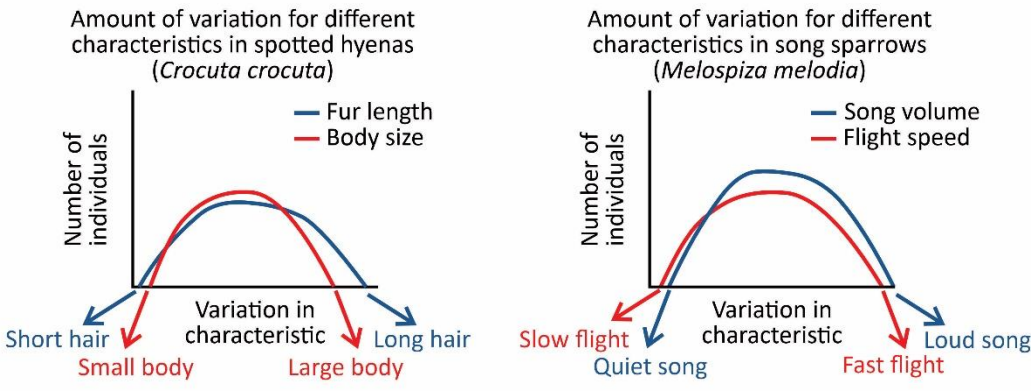


[Adapted: <https://www.education.natgionalgeographic.org>]
[*National Geographic* is a magazine founded in 1888 as a scholarly journal but is now a popular magazine.]

SOURCE F Genetic variation

New research suggests that Darwinian evolution could be happening up to four times faster than previously thought, based on an analysis of genetic variation.

The more genetic differences there are in a species, the faster evolution can take place.



Some species have a lot of genetic variation for different characteristics. This means that there is more chance of some individuals surviving if the environment changes.

[Adapted: Bonnet, T., et al. 2022. Genetic variance in fitness indicates rapid contemporary adaptive evolution in wild animals. *Science* 376: 6596: 1012–1016]
[*Science* is a prestigious journal published by the American Academy for the Advancement of Sciences. The journal publishes papers dealing with all fields of science.]

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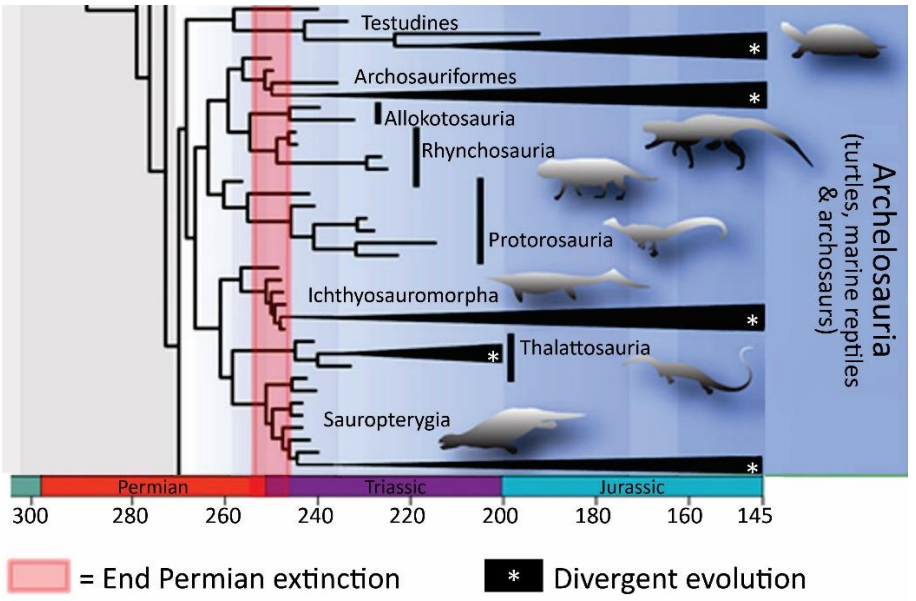
The fossil record can provide direct evidence of past environmental crises and how organisms were affected by and recovered from such events. Reptiles represent one such group with some members who survived the Permian-Triassic extinction. Many new species evolved after this extinction – divergent evolution (see key in image below) occurred after the Permian-Triassic extinction, with new species occupying niches previously dominated by other organisms that became extinct.



Phylogenetic tree for the major groups of reptiles

[Adapted: Simões, T. R., et al. 2022. Successive climate crises in the deep past drove the early evolution and radiation of reptiles. *Science Advances* 9:33]

[*Science Advances* is a peer-reviewed scientific journal published by the American Association for the Advancement of Science. The journal's scope includes all areas of science

SOURCE G Breeding for resistance

Australia's Great Barrier Reef has been damaged by heat waves that have killed half its coral. The sea's absorption of carbon dioxide lowers the pH of seawater, causing coral shells to dissolve. If global temperatures rise by 2 °C, coral reefs will disappear worldwide.

The National Sea Simulator, a R250 million facility on the shore of the Coral Sea was opened in 2013 by the Australian Institute of Marine Science. Here different varieties of various species of coral are cross-bred to try to create heat-tolerant varieties. Different species are also exposed to higher temperatures over many generations to select for strains that can survive these higher temperatures. Researchers reported that a few individuals of a species of coral (*Acrophora tenuis*) tolerated hotter, more acidic water better than other members.

National Sea Simulator
[<https://www.omni.com>]

Acrophora tenuis
[<https://www.researchgate.net>]

[Adapted: Cornwall, W. 2019. Researchers embrace a radical idea: engineering coral to cope with climate change. *Science* 343:(6433):1264–1269]

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SOURCE H No problem?

Humans have also been driving evolution unintentionally over thousands of years.

- Humans sometimes introduce organisms from different areas of the world to foreign continents. These new populations are isolated from one another, and speciation could occur. Humans have also created entirely new ecosystems, such as subway tunnels. These new niches provide places where organisms could live and possibly speciate. For example, at some point during the last 150 years, a small population of mosquitoes settled in the London Underground railway system. The underground population is now unable to breed with the above-ground species of mosquitoes. This is now potentially a new species.
- Humans also destroy environments, leaving isolated, fragmented populations. This isolation could also result in speciation occurring. Thanks to deforestation in Central America, various isolated populations of the giant helicopter damselfly appear to be speciating in the isolated patches of forest.

London underground mosquito
[<https://www.cameronwebb.wordpress.com>]

Giant helicopter damselfly
[<https://live.staticflickr.com>]

Over the last 300 years, more new plant species have appeared in Britain alone than are known to have gone extinct in all of Europe. These are mostly hybrids produced by two once-separated species interbreeding with one another, but also by speciation of isolated populations of alien species from other areas. Overall, the current rate of plant speciation could be thousands of times higher than the natural background rate – we could be creating so many new species that they equal the number of extinctions that we are experiencing.

[Adapted: Thomas, C. D. 2017. The sixth mass genesis? New species are coming into existence faster than ever thanks to humans. <https://www.theconversation.com>]

[*The Conversation* is funded by the National Research Foundation, eight universities, including the Cape Peninsula University of Technology, Rhodes University, Stellenbosch University and the Universities of Cape Town, Johannesburg, Kwa-Zulu Natal, Pretoria, and South Africa.]

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