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**ECOSYSTEMS AND SOCIETIES
STANDARD LEVEL
PAPER 2**

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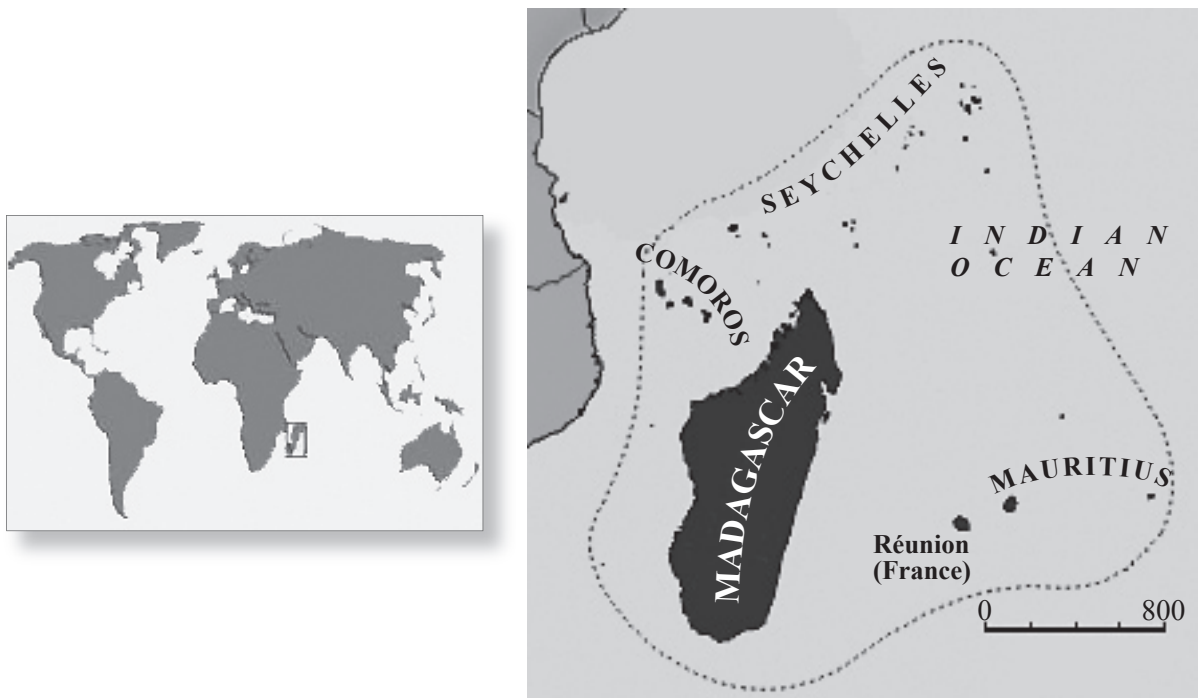
2 hours

RESOURCE BOOKLET

INSTRUCTIONS TO CANDIDATES

- Do not open this booklet until instructed to do so.
- This booklet contains **all** of the resources required to answer question 1.

Figure 1 Location map of Madagascar



[Source: adapted from www.biodiversityhotspots.org]

Figure 2 Introduction

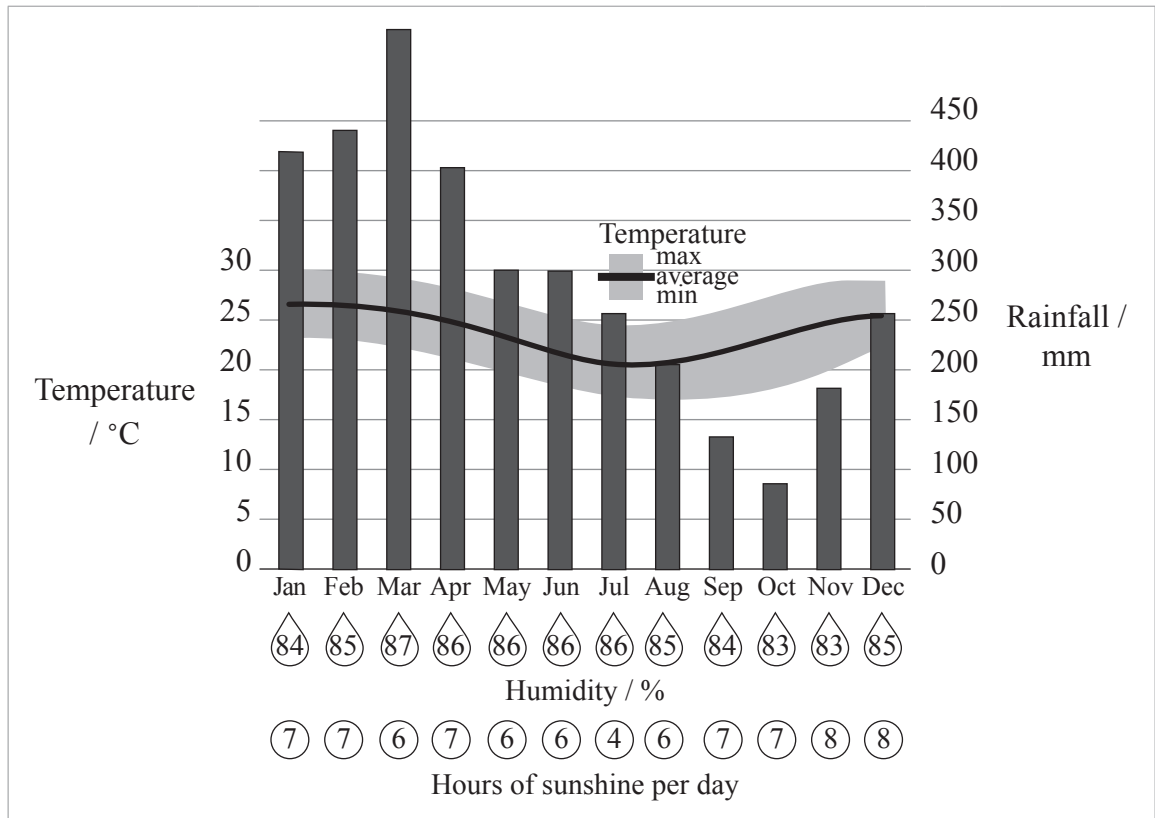
Madagascar has an astounding total of eight plant families, four bird families, and five primate families that are endemic, that is they live nowhere else on Earth. Madagascar's more than fifty lemur species are the island's charismatic worldwide ambassadors for conservation, although, tragically, fifteen more species have been driven to extinction since humans arrived.

Madagascar broke off from the Gondwanaland super continent more than 160 million years ago and is an example of species evolution in isolation. Despite close proximity to Africa, the island does not share any of the typical animal groups of nearby Africa. Instead, Madagascar has evolved unique species, with high levels of endemism (species unique to a geographical location).

The natural vegetation of the island is diverse. On Madagascar, tropical rainforests in the east give way to dry deciduous forests along the western coast. A unique spiny desert covers the extreme south. The island also has several high mountain ecosystems, which are characterized by forest with mosses and lichens.

[Source: adapted from www.biodiversityhotspots.org]

Figure 3 A climate graph for Toamasina, a major seaport in Madagascar. It has an elevation of five metres.



[Source: adapted from www.worldtravelguide.net/a/main/8f350f44-1a25-476a-9457-1c431cc20c8b/563a7dd0-d7f1-4216-8070-81dd4a9981d1/ca1fd421-5405-456e-a14b-f7c65f6c6941.gif]

Figure 4 Madagascar: key environmental facts

Area / km ²	600 461
Vegetation remaining / km ²	60 046
Endemic* plant species	11 600
Endemic threatened bird species	57
Endemic threatened mammal species	51
Endemic threatened amphibian species	61
Extinct species [☆]	45
Human population density / people/km ²	32
Area protected / km ²	18 482

Key: * endemic: species found only in this location
[☆] recorded extinctions since the year 1500

[Source: adapted from www.biodiversityhotspots.org]

Figure 5 Human impacts

The geographic isolation that allowed Madagascar to evolve diverse and unique species also contributed to its environmental degradation. Because humans did not arrive on the islands until 1500–2000 years ago, the native animals were not initially afraid and were easily hunted by the colonists.

The Malagasy people came to Madagascar from Africa and Asia and imported rice cultivation, slash-and-burn farming and cattle grazing, which are inappropriate for infertile, lateritic soils and were devastating to the fragile ecosystems of the island. The central plateau of Madagascar is almost completely deforested – and is now a lifeless land of infertile, baked red earth. It is estimated that only about 17% of the original vegetation of Madagascar remains.

The 18 million people who live in Madagascar today do not represent a very large number considering the land area of the island. However, the population is growing at more than 3% per year and is expected to double by the year 2025. In an area that is already one of the most economically disadvantaged in the world, this growth rate is putting tremendous pressure on the natural environment. In addition to agriculture, hunting and logging, industry and small-scale mining are growing threats.

On the other Indian Ocean Islands, these same threats have been worsened by the introduction of invasive alien species, brought as food sources, pets or for pest control. Rats, cats and mongooses have devastated populations of birds and small reptiles, while grazing rabbits, goats, pigs, and deer have stripped many landscapes. In addition, exotic plant species such as water hyacinth (*Eichhornia crassipes*) threaten the biodiversity of freshwater ecosystems.

[Source: adapted from www.biodiversityhotspots.org]

Figure 6 Soil degradation on the central plateau

Madagascar suffers from some of the worst land degradation and erosion in the world as seen by the dark areas of the aerial photograph below.



[Source: www.photos.wildmadagascar.org]

Figure 7 Non-native species “cause havoc”

Conservationists have warned that non-native species of animals and plants are causing havoc around the globe after escaping, often with human help, from their native habitats.



Feral pig

Looking down the list, one finds the attractive-sounding water hyacinth and the rosy wolfsnail; the brown tree snake and the feral pig. All of which have proved destructive pests when taken out of their natural environments and introduced into new habitats.

The South American water hyacinth does indeed have lovely purple flowers; but on five continents it has spread from ornamental ponds to choke waterways, stop boat traffic, fishing and swimming, and prevent sunlight and oxygen from reaching plants in deeper water.

Intention or accident

Some pests were originally spread deliberately by humans; the small Indian mongoose was taken from Asia to the West Indies to control rats, but it has wiped out several native birds, reptiles and amphibians, as well as carrying rabies.

Others spread accidentally, hitchhiking in ships’ holds or in packing cases.

Crazy ants, so called because of their erratic movements, killed three million land crabs in eighteen months on Christmas Island in the Indian Ocean.

The World Conservation Union is calling on such bodies as the World Trade Organization to recognise the threat posed by globalization of trade – and even by development aid, as agricultural materials can contain the seeds of non-native weeds.

It also wants sea and airports to watch out for invading species, and says authorities must be ready to act quickly when an infestation is detected.

[Source: adapted from A Craig, British Broadcasting Company, (2005)]

Figure 8 Logging tables

Conventional logging
<ul style="list-style-type: none"> ▪ Too many roads and skidtrails ▪ Too many landings that are too large ▪ Substantial canopy opening ▪ Subsequent invasion by vines and pioneer plant species ▪ Significant damage to other vegetation, including future crop trees ▪ Large number of lost logs
Reduced-impact logging
<ul style="list-style-type: none"> ▪ Reduces soil disturbed in roads, landings, and skidtrails by almost 50 % ▪ Significantly less canopy opening ▪ Better survival of residual trees ▪ Faster recovery; shorter cutting cycles ▪ Total cost is 10–15 % lower ▪ Wood waste is reduced by more than 60 %

[Source: adapted from www.tropicalforestfoundation.org/ril.html]

Figure 9 Conservation in Madagascar

About 2.7% of Madagascar's land area is officially protected in national parks, strict nature reserves established to conserve ecosystems and special reserves designed to protect a particular species or a group of species.

Attempts to identify and safeguard the areas remaining natural habitats are being implemented with projects that demonstrate the value of this conservation to the country. For example, in much of Madagascar the economic value of the remaining forests is of enormous importance. Eco-tourism has provided a source of income for local communities.

Efforts at species-focused conservation represent important progress for the future of several unique species. A number of lemur species have been bred successfully in captivity, and, in 1997, the first lemur reintroduction program introduced captive-born black and white ruffed lemurs into the Betampona Nature Reserve.

[Source: adapted from www.biodiversityhotspots.org]

Photograph of a black and white ruffed lemur



[Source: adapted from www.images.wildmadagascar.org/pictures/1997/sifaka1.gif]

Lemurs have been the focal point of species-based conservation efforts in Madagascar.

[Source: adapted from www.biodiversityhotspots.org]

Figure 10 Tropical forest ecosystem

The diagram below represents a tropical forest ecosystem on the north east coast of Madagascar. The climax vegetation type up to the coastal margin is mixed tropical forest.

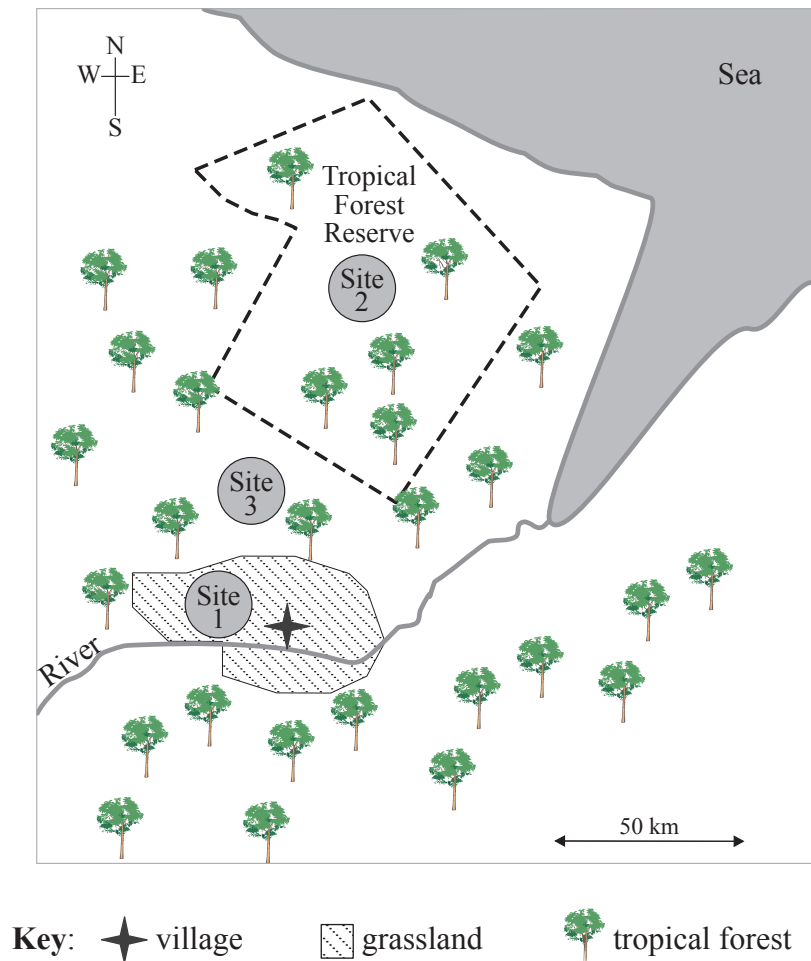


Table of surveyed animal groups present at the three sites shown on the map above.

Animal group	Number of species		
	Site 1	Site 2	Site 3
Lemurs	0	9	2
Tenrecs (rodent-like insectivores)	1	7	3
Geckos and chameleons	3	12	5
Carnivores (fossa, fanaloka, mongoose)	0	1	0
Frogs	0	5	2
Insects	2	14	9
Scorpions	3	0	1

[Source: adapted from www.europe.2007-aliens.org]