

IN-DEPTH FILM GUIDE

OVERVIEW

The Guide is set in Gorongosa, an iconic African Safari Park devastated during Mozambique's civil war in the 1990s. The film invites students to consider important themes in ecology and conservation biology through the story of Tonga Torcida, a young man coming of age on Mount Gorongosa and in the newly revitalized Gorongosa National Park. Mozambique's government and the nonprofit Gorongosa Restoration Project are working together to bring the park back into a natural balance and give members of the community like Tonga a livelihood and a new perspective on the biodiversity of their homeland. The film also captures the transforming power of mentorship; after Tonga gets the chance to work with biologist and biodiversity champion Dr. Edward O. Wilson, who visited Gorongosa in 2011, Tonga decides to pursue a career in science.

KEY CONCEPTS

- A. A person interested in nature and science may pursue many possible career paths, from lab technician to park ranger to field researcher.
- B. Mentors can be very important as a source of inspiration, experience, and information; as role models; and as a connection to a professional community. Mentors can also be critical in influencing training and career choices that fit an individual's needs, interests, and talents.
- C. Methods for protecting habitats, species, and biological communities include designating and protecting nature reserves, maintaining genetic diversity in small endangered populations, and, importantly, reconciling conservation concerns with the needs of local people.
- D. Community-based conservation is an approach to conservation biology that takes into account the needs of people living in and near natural areas and involves them directly in aspects of the planning and management of these areas, including economic activities that depend on or affect a wildland.
- E. The tendency for human populations to continually increase in size places ongoing pressures on protected wildlands.
- F. Diverse human activities negatively affect biodiversity to varying degrees. These activities range from hunting and trapping animals to large-scale warfare, from selective logging to clearing forests for agriculture, from diverting streams to damming large rivers, and from point source pollution to climate change.
- G. Damaged ecosystems can be surprisingly resilient if people take action to halt ongoing damage, or take even relatively small conservation steps. However, more intensive measures such as reintroduction of species may sometimes be desirable.
- H. The interactions among all plants and animals, including small organisms such as insects and microorganisms, are important to maintaining an ecosystem's health.
- I. Understanding the natural world is an important part of personal, societal, and ethical decision-making.
- J. Cooperation between local and national governments and nongovernmental organizations is often necessary to solve environmental and ecological problems.



CURRICULUM AND TEXTBOOK CONNECTIONS

Curriculum	Standards
NGSS (2013)	MS-LS2-4, MS-LS2-5, MS-ESS3-3, MS-ESS3-4 HS-LS2-6, HS-LS2-7, HS-ESS3-4
AP (2012–13)	2.D.1, 2.D.3, 4.A.5, 4.A.6, 4.B.3, 4.B.4
IB (2009; 2016)	G.3.3, G.4.3, G.4.4; C.3, C.4
AP Environmental Science, Themes and Topics (2013)	Themes: 1, 4, 5, 6 Topics: II.A, II.C, IV.D.3, IV.D.4, IV.D.5, VII.C.1, VII.C.2
C3 Framework for Social Studies State Standards	D2.Eco.15.9-12, D2.Geo.5.9-12, D2.Geo.6.9-12, D2.His.14.9-12

Textbook	Chapter Sections
Miller and Levine, <i>Biology</i> (2010 ed.)	3.1, 5.2, 6.1, 6.2, 6.3,
Reece <i>et al.</i> , <i>Campbell Biology</i> (AP ed., 9th ed.)	52.2, 54.3, 55.5, 56.1, 56.2, 56.3, 56.5

PRIOR KNOWLEDGE

It would be helpful for students to

- be familiar with the basic geography of southern Africa, including the location of Gorongosa Mountain and park in relation to the Great Rift Valley and the Indian Ocean.
- know some general facts about Mozambique, such as population, languages, literacy rate, life expectancy, and per capita income—which can be obtained from the CIA *World Factbook* <https://www.cia.gov/library/publications/the-world-factbook/geos/mz.html>

SUGGESTED AUDIENCE

The Guide has strong curricular connections to both science (biology, environmental science) and social studies. It can be used as a centerpiece in either arena or as part of a cross-curricular unit. It can also be used in a number of activities and assignments aligned with the Common Core curriculum.

In Science Class

The Guide provides a good launch point for many topics covered in environmental science, conservation biology, and biology courses (including AP), such as the interdependence of organisms within ecosystems, the water cycle, the importance of biodiversity, population ecology, land use, natural resource management, and the connection between societal needs and the success of conservation efforts. *The Guide* and supporting resources about Gorongosa National Park can serve as a case study for students to examine the key elements of a conservation effort and propose their own conservation plan for the park and surrounding areas.

The film could also be used at the beginning of any science course, as it encapsulates many of the ideas covered in an introductory chapter or unit. For example, it demonstrates how science is both a way of knowing and a body of knowledge, and the importance to scientists of collaboration, curiosity, and open-mindedness. Although the film certainly documents some terrible effects of human activity on the biosphere, the overall and lasting impression is one of optimism, as we are left understanding that humans have the potential to positively affect the environment, right some wrongs, and build a sustainable future.

In Social Studies/History Class

The Guide can be used as a resource in a variety of history or government lessons. Several additional resources, including informative texts, can be used in conjunction with *The Guide* to create a document-based assessment or mini-unit. Connections can be made with many of the topics, such as the effects of civil war, the roles of local and national governments and nongovernmental organizations to effect change, the



responsibilities of citizens, the challenges faced by postcolonial nations, the importance of the environment to a people and their culture, and the power of individuals to effect change.

PAUSE POINTS

The film may be viewed in its entirety or paused at specific points to review content with students. The table below lists suggested pause points, indicating the beginning and end times in minutes in the film.

	Begin	End	Content description	Review Questions	Standards
1	0:00	5:19	<ul style="list-style-type: none"> In the 1960s Gorongosa was a famous and popular national park. In 1977 a civil war started in Mozambique. Soldiers lived in the park and killed off animals. A conservation entrepreneur created the Gorongosa Restoration Project and teamed up with Mozambique to help restore the park, one of the biggest national parks in Africa. A young man who grew up on the mountain, Tonga Torcida, explains his desire to be a tour guide in the park. 	<ul style="list-style-type: none"> Where is Gorongosa National Park? Why does Tonga want to be a tour guide? 	NGSS (2013) MS-LS2.C, MS-ESS3.C HS-LS2.C, HS-ESS3.C AP (2012–13) 2.D.1, 2.D.3, 4.A.5, 4.A.6, 4.B.3, 4.B.4 IB (2009) G.4.3, G.4.4
2	5:20	9:09	<ul style="list-style-type: none"> Biologist E.O. Wilson visits the park, flying in over the Great Rift that extends into Mozambique. He comments that the part is like the Pleistocene, that visitors will see the world as it was 20,000 years ago. Taxonomy is the branch of science in which scientists identify and classify organisms. Although many large animals were killed during the civil war, there is a great biodiversity of other organisms – even the “small species” - in Gorongosa, which provides a platform for the natural environment. The interactions among all plants and animals, including small organisms such as insects and microorganisms, are important to maintaining an ecosystem’s health. 	<ul style="list-style-type: none"> What is the Great Rift Valley? What does Dr. Wilson mean when he says that Gorongosa is the world as it was in the Pleistocene? What is taxonomy? Why is it useful? How are the “little organisms” valuable? 	NGSS (2013) MS-LS2.C, MS-ESS3.C HS-LS2.B, HS-LS2.C, HS-ESS3.C AP (2012–13) 2.D.1, 2.D.3, 4.A.5, 4.A.6, 4.B.3, 4.B.4 IB (2009) G.3.3, G.4.3, G.4.4
3	9:10	14:15	<ul style="list-style-type: none"> People poach in Gorongosa because they need income. Increasing human populations place pressure on protected wild lands. A focus on community relations is important. Community-based conservation is an approach to conservation biology that takes into account the needs of people living in and near natural areas and involves them directly in aspects of the planning and management of these areas, including economic activities that depend on or affect a wild land. 	<ul style="list-style-type: none"> Why are people poaching the big animals? Why is it so important for park staff talk to the people in local communities? What are some of the goals of the Gorongosa Restoration Project? 	NGSS (2013) MS-LS2.C, MS-ESS3.C HS LS2-C, HS-ESS3.C AP (2012–13) 2.D.1, 2.D.3, 4.A.5, 4.A.6, 4.B.3, 4.B.4 IB (2009) G.4.3, G.4.4
4	14:15	19:26	<ul style="list-style-type: none"> Symbiosis is a long-term interaction between two species. In a mutualistic relationship, organisms from two different species have a relationship in which both benefit. Humans are still just beginning to understand nature. We have identified 1.9 million species, but the actual number of species may be ten times that. Gorongosa’s height allows it to maintain pristine rainforest. The forest ecosystem has soils that can absorb precipitation and control how much water flows down the mountain. Water is slowly released throughout the 	<ul style="list-style-type: none"> What is symbiosis? Why are people cutting down the forest? What impact does that have? 	NGSS (2013) MS-LS2.A, MS-LS2.C, MS-LS4.D, MS-ESS3.C HS-LS2.B, HS-LS2.C, HS-LS4.D, HS-ESS3.C AP (2012–13) 2.D.1, 2.D.3, 4.A.5, 4.A.6, 4.B.3, 4.B.4

			<ul style="list-style-type: none"> year. Human activities – especially cutting down the trees - negatively affect biodiversity to varying degrees. On Gorongosa, the ecosystem on mountain has changed due to human use. 		IB (2009) G.3.3, G.4.3, G.4.4
5	19:27	26:26	<ul style="list-style-type: none"> A bioblitz – part social event and part biodiversity hunt – involves local children doing science and appreciating biodiversity. Dr. Wilson identified 61 species, including a number new species the children found. Nature is valuable for many reasons, including helping us understand what it means to be human. 	<ul style="list-style-type: none"> Why was the bio blitz so useful? 	NGSS (2013) MS-LS2.C, MS-LS4.D, HS-LS2.C <u>AP (2012–13)</u> 2.D.1, 4.A.5, 4.A.6, 4.B.3 IB (2009) G.3.3, G.4.3, G.4.4
6	26:47	34:20	<ul style="list-style-type: none"> Science offers many possible career paths, from lab technician to park ranger to field researcher. 	<ul style="list-style-type: none"> What made Tonga change his mind about becoming a tour guide? 	NGSS (2013) MS-ETS1.B, HS-ETS1.B, HS-ESS3.C <u>AP (2012–13)</u> 4.A.5, 4.A.6, 4.B.3, 4.B.4 IB (2009) G.4.3, G.4.4

BACKGROUND

Mozambique was a colony of Portugal from about 1500. In 1920, 386 square miles were set aside as a hunting reserve by a private business on behalf of the Portuguese government. Expanded in 1935, and again in 1960 when it was made into a national park, Gorongosa became a tourist destination for celebrities and adventurers. The first organized attempt to document Gorongosa's biodiversity occurred in 1969, when a team of ecologists counted 200 lions, 2,200 elephants, 14,000 African buffaloes, 5,500 wildebeests, 3,000 zebras, 3,500 waterbucks, 2,000 impalas, and 3,500 hippos.

Portuguese rule of Mozambique ended in 1975 at the conclusion of a 10-year war for independence. Unlike the civil war to follow, this war had little impact on Gorongosa's wildlife. In fact, a wildlife survey conducted in 1976 documented *increases* in the elephant and lion populations.

Mozambique's civil war (1977–1992) and subsequent poaching, however, decimated the megafauna of Gorongosa. A 1994 survey documented just 108 elephants, 65 zebras, and 129 waterbucks and noted a complete loss of buffaloes, wildebeests, impalas, and hippos. Efforts to rebuild the park began in 1994, but the real turning point was when Greg Carr came for his first visit in 2004. Carr founded the Gorongosa Restoration Project, a nonprofit organization that has partnered with the Mozambican government to restore and stabilize Gorongosa's biodiversity.

In the film *The Guide: A Biologist in Gorongosa*, Carr explains the project's three-pronged approach to Tonga: science (restocking and relocating wildlife), tourism (building of modern tourism amenities), and community relations (establishment of schools and clinics, regular community meetings, and returning tourism profits to the communities). In 2008, the Mozambican government and the Gorongosa Restoration Project signed a 20-year agreement to jointly manage the park.

In 2010, the park expanded as Mount Gorongosa was incorporated into the park along with a large buffer zone. All of the efforts seem to be working, and many of the marquee species have rebounded. Dr. Edward O. Wilson came to the park in 2011 to research a new book, *Life on Earth*. It was on this trip that he met Tonga and conducted the bioblitz seen in the film. (The table below lists the organisms identified during the bioblitz.) In 2014, Dr. Wilson attended the opening of the new Edward O. Wilson Biodiversity Laboratory in Gorongosa.

The park's restoration continues today and has commanded international attention thanks to *The Guide* and other productions and articles that have documented the momentous efforts to reclaim the lost biodiversity of Gorongosa.

Number of Species Identified During the 2011 Bioblitz

Order	Family	Number of Species
ODONATA	Libellulidae (damselflies)	1 species
NEUROPTERA	Chrysopidae (lacewings)	1 species
ORTHOPTERA	Acrididae (grasshoppers)	6 species
	Gryllidae (crickets)	1 species
DICTYOPTERA	Mantidae (praying matises)	4 species
PSOCOPTERA	Psocidae (bark lice)	1 species
HEMIPTERA	Reduviidae (assassin bugs)	5 species
	Belostomatidae (giant waterscorpions)	1 species
	Coreidae (squash bugs)	2 species
	Pentatomidae (stink bugs)	1 species
	Cicadellidae (leafhoppers)	1 species
COLEOPTERA	Tenebrionidae (darkling beetles)	1 species
	Silvanidae (flat grain beetles)	1 species
	Coccinellidae (ladybird beetles)	1 species
	Carabidae (ground beetles)	1 species
	Cerambycidae (longhorn beetles)	1 species
	Staphylinidae (rove beetles)	2 species
	Curculionidae (weevils)	1 species
	Gyrinidae (whirligig beetles)	1 species
	unidentified	1 species
	Tipulidae (crane flies)	1 species
DIPTERA	Drosophilidae (vinegar flies)	1 species
	Formicidae (ants)	3 species
HYMENOPTERA	Ichneumonidae (ichneumon wasps)	1 species
	Vespidae (paper wasps)	1 species
	Lycaenidae (blues)	1 species
LEPIDOPTERA	Pieridae (whites)	3 species
	Julidae (julid millipedes)	1 species
CRUSTACEA	Potamonautidae (freshwater crabs)	1 species
ARANEA	Thomisidae (crab spiders)	1 species
	Heteropodidae (huntsman spiders)	1 species
	Salticidae (jumping spiders)	1 species
	Tetragnathidae (long-jawed spiders)	1 species
	Araneidae (orb-weaving spiders)	2 species
	Linyphiidae (sheetweb weavers)	1 species
	Lycosidae (wolf spiders)	1 species
AMPHIBIANS	Ranidae (true frogs)	1 species
REPTILES	Agamidae (agamid lizards)	1 species
AVES	flying in immediate area, not identified	3 species
MAMMALIA	Muridae (mice)	

DISCUSSION QUESTIONS

- Ask your students whether they'd rather be a field guide or a scientist and why, or to give advice to Tonga on what he should do. Discuss the factors that probably influenced Tonga to pursue further studies in science, including his upbringing, his personality, his work, and various people he's met. What was it about his time with Dr. Edward O. Wilson that got Tonga thinking about becoming a scientist? Did he have the common misconception that all scientists work in labs separated from nature? Was it seeing Wilson out in the field exploring and discovering that changed Tonga's mind? *Challenge your students' preconceptions of what "doing science" looks like. Does seeing Dr. Wilson "in action" make them more or less excited about a career in science? Further, ask your students how Tonga comes to conclude that he can have a greater impact on Gorongosa's restoration as a scientist rather than a tour guide. For example, Tonga says in the film that someone has to teach the tour guides and that if people don't help the locals gain knowledge, then the mountain will be gone in five years.*
- Tonga stresses how central Mount Gorongosa is to the park and its ecosystem. Why is Mount Gorongosa, and in particular, its forest, so important? How are human activities affecting the forest? *Moisture evaporates from the Indian Ocean and rains on Mount Gorongosa's forest. The forest ecosystem has soils that can absorb precipitation and control how much water flows down the mountain. Water is slowly released throughout the year, feeding several rivers, some of which flow into Lake Urema, the main watering hole for many of the animals living in Gorongosa National Park. Without a protected and forested Mount Gorongosa, the water would flow rapidly down the mountain during wet periods and then dry up during dry periods. Local people have been clearing the forest to grow potatoes, corn, and other crops to feed themselves.*
- Tonga's favorite animal changes over the course of the film. Initially, it's the lion, but by the end of the film it's the emerald-spotted wood dove, whose call sounds to Tonga like a plea for help. Explore with your students how this change is indicative of a shift in how Tonga sees the park. Ask students what attributes of various plants or animals interest them or make them admire them. Does knowing that so many species depend on each other change the way they think about their favorite plant or animal? Can an ugly animal be important and worth conserving? *Lions are the animal that most tourists want to see. It makes sense that Tonga, as a prospective tour guide, would be interested in these big attractions. But by the end, Tonga has realized that there is still so much left to know about the park, and he wants to learn about it, to be in a better position to aid its recovery. To Tonga, his interest is no longer focused on the animals that will bring the tourists, but rather on helping and understanding the entire ecosystem—"there is no [choosing]," he says.*
- Dr. E. O. Wilson defines "nature" as "[the] part of the world that doesn't need us and [that was] there before we came along." But he also says that by understanding nature, we can "fill out what it means to be human." How do your students define nature? Can humans be part of nature?
- Dr. Wilson says that "small creatures run the world." Ask your students what they think he means by that statement. What are some examples of small creatures that run the world? *In terms of their diversity, distribution, and abundance, invertebrates are even more important in the maintenance of ecosystems than vertebrates. A particularly well-known example of an insect that is critical to an ecosystem is the bee. Changes in the landscape and farming practices have caused*

honeybee populations to decline, resulting in potential problems for the production of fruit crops through a lack of pollination. The biomass of small creatures is greater than the biomass of big animals, as is their diversity. Wilson also says that small creatures run the world because they can survive ecological disasters. Whereas big animals were destroyed during the civil war in Mozambique, the underlying biodiversity of small organisms was left in place and allowed the recovery of the larger species. You might also encourage some students to research the impact of losing the large mammal species, including top predators like lions and huge herbivores like elephants. They often play a very important role in the overall balance of ecosystems; for example, a lack of predators may lead to overgrazing by herd mammals, and a lack of elephants may lead to the drying up of small watering holes.

- Tonga feels both anger and empathy for the poachers and farmers that are featured in the film. He understands that these people are not acting out of malice but out of their need to survive, but he also understands that their long-term survival depends on the health of Gorongosa's natural resources. Why is it important to see both sides of this issue when working on conservation?

Having grown up near Gorongosa, Tonga understands the locals, their poverty, and their lack of formal education. (Remember, Tonga was the first in his village to graduate high school.) But as a keen observer, Tonga has noticed that as the trees are cut down, the clouds disappear, the watering holes dry up, and animals and crops die. He knows that ultimately, everyone will lose if Gorongosa is destroyed—even if some prosper in the short term, the prosperity cannot be sustained. Empathy for people's need is necessary because local communities cannot contribute to the restoration effort when their own needs are not being met; anger is sometimes necessary to spur people, and in particular governments, into action.
- Greg Carr is an American working to protect resources in Africa. Discuss this with your students—should Carr be focusing his efforts in the United States instead of Africa? Who does biodiversity belong to? Is it right for people from one country to try to effect change in another country?

Healthy, functioning ecosystems provide many valuable goods and services, such as clean water and air, raw materials, and protection from floods. These goods and services can be local, but some are international—watersheds cross national boundaries, and Earth has only one atmosphere and ocean. Biodiversity may be viewed as something that belongs to everyone. It's also something that should be protected on moral rather than economic or political grounds.
- Mateus Mutemba, the Gorongosa National Park warden, holds a community meeting in a village in which Tonga translates. Would the efforts of the Gorongosa Restoration Project be as successful if it did not make an effort to engage the community? Why is it important to listen to the concerns of villagers, such as the woman who worries about elephants destroying her crops?

Elephants are powerful creatures that can have a huge impact on people and natural systems—an entire portion of the restoration project's website is devoted to the issue of mitigating and preventing crop disruption by elephants. There is an excellent "Ranger Diary" entry on this topic (<http://www.gorongosa.org/our-story/conservation/preventing-human-elephant-conflict>) that explains how Mutemba's team is trying to find the balance between the rights of people and the rights of wildlife. It is unlikely that Mutemba can guarantee that the woman won't lose any crops, but

it’s important that she be heard and understood, which is why community meetings (with Tonga there to speak the native tongue!) and the work of the rangers is so important to gaining the locals’ trust.

- In the film, we are introduced to poachers who were caught and then sentenced to work in the park. The poachers explain that they broke the law because of “suffering.” Do your students think working in the park is an adequate and fair punishment? Some African parks use paramilitary troops to fight poachers. Why is this kind of punishment potentially more effective than jail? Do they think it’s likely these men will poach again? What ideas do they have for stopping poaching?

The film makes the connection between the “suffering” of the poachers and the efforts of the restoration project to provide jobs for the locals. If people don’t have food, clothing, or housing, can they be expected to care about insects or elephants? Working in the park may help these men develop a sense of ownership or respect for the land.

- A lot of attention is paid in the media and in the research to the ways in which humans have had a negative impact on Earth’s environment. How does *The Guide* help us understand that the same human energy, technology, and activities can be used to repair and even reverse human damage to Earth’s environment? Do your students have an overall pessimistic or optimistic feeling about humanity’s relationship with nature after viewing the film?

The film offers examples of three individuals—Tonga, Dr. Wilson, and Greg Carr—who are making tremendous impacts on repairing the damage that has been done in Gorongosa. Challenge your students to come to the realization that a single person is capable of effecting change at the largest scales. Students may point out that the activities of the Gorongosa Restoration Project would not be necessary had damage not been done in the first place. What are some ways that we can protect the Earth and prevent damage to ecosystems?

USING THE LEARNING ASSESMENT

The learning assessment, available as a separate file, includes a preview / postview activity and questions designed to asses student understanding of the key concepts addressed in the film. However, some teachers use the assessment during the film to guide students as they watch the film. Teachers should use as best fits their learning objectives and their students’ needs. Teachers are encouraged to modify the assessment (e.g., only ask some of the questions, explain vocabulary or concepts for ELL students).

LEARNING ASSESSMENT ANSWERS

Table 1. Preview and postview exercise for *The Guide*.

	Preview	Postview
1. Yellowstone is an 898,317-ha (3,468-sq.-mi.) national park in Wyoming (U.S.). There are over 6,500 national parks in countries around the world. Describe two reasons for establishing national parks.	<i>Student answers will vary. Note that some students might have very little prior knowledge about national parks.</i>	<i>Parks create protected habitat for many different species of organisms, promote tourism, and create jobs for the local community. Parks promote biodiversity, provide a place for humans to enjoy, preserve landscapes, and provide a place to learn more about native species.</i>
2 a. The film you will watch is about a national park in Mozambique, a	<i>Student answers will vary.</i>	<i>Answers will vary. U.S. National Parks are funded by the national government.</i>

country in Africa. Describe what you think might be different about a national park in Mozambique and one in the United States		<i>The funding model for Gorongosa involves private philanthropy. Students will probably note that the organisms are very different in the two countries' parks.</i>
2 b. What might be the same about a national park in Mozambique and one in the U.S.?	<i>Student answers will vary.</i>	<i>A primary objective for parks in the two countries is probably very similar: wildlife and habitat conservation.</i>
3. Describe what you think a national park tour guide's role is.	<i>Student answers will vary.</i>	<i>A park tour guide's role includes helping tourists (giving directions, attending to safety), sharing science and community relations. A guide must understand the natural world and explain it to visitors.</i>
4. Describe what you think a national park biologist's role is.	<i>Student answers will vary.</i>	<i>A park biologist's job can include a variety of tasks related to wildlife management, conducting scientific research to protect and conserve organisms in the park, and implementing habitat management or restoration plans. A biologist probably works with a team of people.</i>
5. Describe an argument a person might make against the establishment of a national park.	<i>Student answers will vary.</i>	<i>Student answers will vary. Local people might not like the protection of large, destructive organisms like elephants. Students could argue that land should be privatized, the land could be put to more profitable use, or that wildlife conservation is not a government task.</i>

6. Which of the following actions would *decrease* biodiversity in a protected land like Gorongosa National Park?
- Increasing sizes of human populations.***
 - Increasing sizes of populations of small animals like insects and amphibians.
 - Decreasing pollution like acid precipitation.
 - Decreasing the amount of poaching of large animals.
7. List three human activities that have negatively affected biodiversity in Gorongosa National Park.
Human activities that have negatively affected Gorongosa's biodiversity include war, poaching / killing animals for food, and cutting trees for fuel or to clear land for agriculture.
8. In the film, Dr. E. O. Wilson and Tonga Torcida help the local children conduct a bioblitz in a small section of Gorongosa National Park. What is the purpose of a bioblitz?
A bioblitz is part social event and part biodiversity hunt. It involves local children doing science and appreciating biodiversity as the children find organisms and bring them to a Dr. Wilson to identify. Dr. Wilson identified 61 species, including a number new species the children found.

9. From 1977 to 1992 there was a civil war in Mozambique. Figure 1 shows the number of large animals in Gorongosa before and after the civil war. Study the graph and answer questions a – c.

- Describe in general what happened to these animal populations from 1972 to 2000.
Between 1972 and 2000 the animal populations decreased.
- State the estimated number of wildebeest that lived in Gorongosa before the war. After the war?
Before the war, an estimated 6500 wildebeest lived in Gorongosa. After the war, the number of wildebeest was close to 0.
- Using evidence from the graph, which animal population was most affected by the war? What evidence can you cite from the film that might have led to the decline of this particular animal species relative to the other species?
The buffalo had the largest population decline, from around 14,000 animals before the war to only 100 after the war. One could also make an argument for zebra and wildebeest being most affected, as their 2000 populations are estimated close to zero. It looks like the lion is most impacted because it had a small pre-war population and it looks like there are none after the war. However, there is no data for lions in 2000.

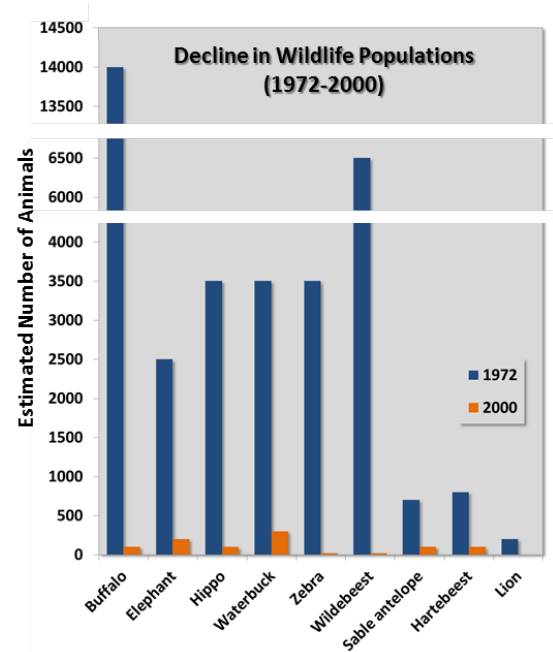


Figure 1. Numbers of large animals living in Gorongosa National Park before (1972) and after (2000) the civil war.

In the film, Tonga explains that Mount Gorongosa is the source of the water that animals in the park drink. The trees on the mountain hold on to the water from the rain and release it slowly down the mountain over time—even during the dry season. Tonga says that when he was little, Mount Gorongosa was always covered with clouds, but there are no clouds anymore. The movement of water and the formation of clouds can be explained by the water cycle. A diagram of the water cycle is shown in Figure 2.

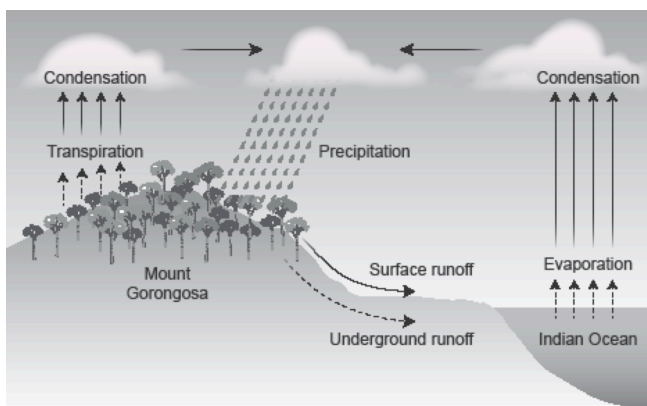


Figure 2. A simplified illustration of the water cycle in Gorongosa National Park.

10. Use the diagram to explain why destruction of the rain forest on Mount Gorongosa would result in a shortage of accumulated water in the park.

Destroying the forest means fewer trees are contributing water vapor to the air via transpiration. As a result, there would be less condensation and subsequent precipitation over the park. Reducing the number of trees results in reduced amounts of moisture falling on the mountain, which reduces the availability of water for other species.

11. Since the end of the civil war in Mozambique in 1992, many animal population sizes have changed. Estimated population sizes for a few of the large animals in the park are included in Table 2 below.

Table 2. Some large animal species population estimates in Gorongosa National Park, Mozambique, in 1972 before the civil war began. Estimates were made again in 2000, eight years after the war ended, and also in 2014.

Species	1972 estimates (prewar)	2000 estimates (postwar)	2014 estimates
African buffalo	14,000	100	500
Blue wildebeest	6,500	20	400
Elephant	2,500	200	400
Hippo	3,500	100	200
Lichtenstein hartebeest	800	100	300
Lion	200	No data	30
Sable antelope	700	100	500
Waterbuck	3,500	300	6,000
Zebra	3,500	20	40

- a. Describe in general how the animal population sizes have changed since the year 2000.
Since the year 2000, the population of most of the species listed has increased. Some, such as the wildebeest and waterbuck, have increased quite a lot, while other populations have more modest increases. Because there is no 2000 estimate for lions, the extent of population change is less clear.
- b. Of the species listed, which park species appears to have made the greatest recovery in population size?

The wildebeest and waterbuck appears to have made the greatest recovery.

EXTENSION/CRITICAL THINKING

12. List three human activities that have negatively affected biodiversity in your (city, region, country).

Answers will vary.



13. If you and your classmates conducted a bioblitz like the one in the film, but in the area around your school, list 10 species that you think you might find:

Alternatively, conduct a bioblitz in your schoolyard, like the one conducted in the film. Using reference books and resources provided by your teacher, work in groups to identify at least 10 species:

Answers will vary.

14. Certain animals such as zebra, lion, and wildebeest were reintroduced in the park after the war, but others were not. Based on what you've learned, why do some animal populations have to be reintroduced?

If the population of particular species is significantly reduced, as was the case for the wildebeest, lion and zebra, there might not be enough individuals to successfully breed and restore a large population. If so, then animals are brought in from other areas, or reintroduced. If the organism's ecological role is crucial for the survival of other species, reintroduction efforts to increase the population are especially important.

ADDITIONAL BIOINTERACTIVE RESOURCES

Article: "[Gorongosa: Restoring Mozambique's National Treasure](http://www.hhmi.org/biointeractive/gorongosa-restoring-mozambiques-national-treasure)"

<http://www.hhmi.org/biointeractive/gorongosa-restoring-mozambiques-national-treasure>

This article written by Gorongosa National Project staff explains the project's history, mission, and future goals.

Click and Learn: [Gorongosa National Park Interactive Map](http://www.hhmi.org/biointeractive/gorongosa-national-park-interactive-map)

<http://www.hhmi.org/biointeractive/gorongosa-national-park-interactive-map>

This interactive map of Gorongosa National Park allows users to explore different features of the park, including key components of the conservation strategy.

Click and Learn: [Gorongosa National Park Timeline](http://www.hhmi.org/biointeractive/gorongosa-timeline)

<http://www.hhmi.org/biointeractive/gorongosa-timeline>

Through a combination of text, photos, and videos, this interactive timeline tells the story of the restoration of Gorongosa National Park.

REFERENCES

Gorongosa National Park Website Links:

- Gorongosa Classroom Page <http://www.gorongosa.org/classroom>
- E. O. Wilson Biodiversity Laboratory at Gorongosa National Park <http://eowilsonfoundation.org/e-o-wilson-laboratory-at-gorongosa/>
- Gorongosa Biodiversity Data <http://www.africatravelresource.com/africa/mozambique/central/gorongosa/guide/updates/>
- Vegetation Survey http://www.biodiversityfoundation.org/documents/BFA%20No.23_Gorongosa%20vegetation%20survey.pdf

Magazine articles:

"The Rebirth of Gorongosa" <http://ngm.nationalgeographic.com/2013/06/gorongosa-park/wilson-text>



Writing for *National Geographic Magazine*, Dr. E. O. Wilson describes his 2011 trip to Gorongosa, which was documented in *The Guide*. Accompanying the piece are two photo galleries that highlight some of the park's resident species.

"Greg Carr's Big Gamble" <http://www.smithsonianmag.com/people-places/greg-carrs-big-gamble-153081070/?no-ist>

This *Smithsonian* magazine article by Stephanie Hanes follows Greg Carr as he visits Gorongosa and explains the philosophy behind his commitment to the park's restoration.

"The Monkey and the Fish" http://www.newyorker.com/reporting/2009/12/21/091221fa_fact_gourevitch

New Yorker writer Philip Gourevitch profiles Greg Carr and his work with Gorongosa National Park.

"Saving the Wild Kingdom"

<http://travel.nationalgeographic.com/travel/traveler-magazine/one-on-one/saving-the-wild-kingdom/>

National Geographic Traveler editor Keith Bellows interviews Greg Carr about Gorongosa; his goals for its restoration; and the roles that politics, the local community, and visitors and the travel industry play in the park's future.

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