Lesson Plan: Ecological Niches and Biogeography: Mountain Gorillas, Bamboo and Climate

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As an **Undergraduate Environmental Sciences** or **Biological Sciences** teacher, you can use this set of computer-based tools to teach **about ecological niches-** their **characteristics** and the **factors** that affect them- and the **biogeography** of a species. More specifically, this lesson plan will teach your students about the implications of climate-induced **disturbed ecosystems** on the ecological niches and the biogeographical distribution of **Mountain Gorillas**; and about the scientific strategies employed to prevent this and thereby, aid in their **conservation**.

Mountain Gorillas inhabit sub-montane and montane habitats in two regions of Central Africa- the Bwindi and the Virunga areas bordering the countries of Democratic Republic of Congo (DRC), Rwanda and Uganda. These isolated populations are effectively **ecological islands,** as the lower reaches of these regions are inhabited by rural communities. **Environmental degradation** due to climate change and anthropogenic activities is severely affecting the natural dietary and ranging patterns of Mountain Gorillas, and thereby endangering their survival in the wild. This lesson plan includes resources to help understand these issues. The lesson plan will describe how **Bamboo**, their preferred food and an integral component of their diet, is now extensively being planted in Uganda to restore degraded forest ecosystems and provide resources for sustainable living and economically viable livelihoods to local human settlements. Thus, Bamboo cultivation helps in restoring the natural habitat and provides sustainable livelihoods to local communities and thereby, help to conserve Mountain Gorillas.

This lesson plan, thus, allows you to integrate the teaching of a climate science topic with a core topic in **Environmental Sciences** or **Biological Sciences** (Conservation of Endangered Species).

Use this lesson plan to help your students find answers to:

1. What is an ecological niche? Describe the factors affecting it.
2. What is the biogeography of a species? Explain how it can be affected by climate related factors.
3. Describe the ecological niche occupied by Mountain Gorillas in Central Africa.
4. How can the Mountain Gorillas of Central Africa be affected by climate change?
5. Explain how extensive planting of Bamboo in Uganda can contribute towards Mountain Gorilla Conservation in Africa.

6. Using the example of integrated Bamboo planting as a supplement to natural resources, explain how a scientifically well-planned program could help achieve the United Nations defined Sustainable Developmental Goals (SDGs).

About the Lesson Plan

Grade Level: Undergraduate

Discipline: Environmental Sciences, Biological Sciences

Topic(s) in Discipline: Ecological Niche, Biogeography, Habitat Use, Species Distribution, Dietary Habits, Ranging Patterns, Group Sizes, Feeding Competition, Reproductive Strategies, Habitat Degradation, Bamboo Plantation, Mountain Gorillas, Conservation

Climate Topic: Climate and the Biosphere, Climate and the Anthroposphere

Location: Africa, Uganda, Rwanda, Democratic Republic of Congo (DRC)

Access: Online, Offline

Language(s): English

Approximate Time Required: 70 min

1 Contents

1. Reading (15 min)

A reading to define and introduce the topic of ecological niches and the biogeography of a species. It also explains how ecological niches determine the stability of ecosystems and the biodiversity of a region.

This can be accessed at:

https://www.britannica.com/science/community-ecology/The-process-of-succession#ref70598

2. Reading (25 min)

A reading that describes how climatic and non-climatic anthropogenic factors can affect the natural ecosystems and biodiversity of Uganda.

This can be accessed at:

https://www.climatelinks.org/sites/default/files/asset/document/Uganda%2520CC%2520and%2520Biodiversity%2520Overview_CLEARED_0.pdf page 10, 11,12, section 2.2 & 2.3.

3. Reading (15 min)

A case study of climate-induced habitat changes for Mountain Gorillas in Uganda that is putting their survival at risk.

This can be accessed at:

http://www.fao.org/3/a-i2498e.pdf Page 21, Box 5.

4. Reading (10 min)

A reading to describe the climate adaptation strategies outlined for Mountain Gorilla conservation, ecosystems restoration, and the provision of livelihoods in Uganda, Rwanda and DRC.

This can be accessed at:

https://unfccc.int/sites/default/files/biodiversity_climate_change_sustainable_development_technical_report.pdf page 45, 46 & 47, section 9.8.

5. Reading and Associated Audio File (~5 min)

A brief reading and an associated audio file that describes how Bamboo planting can be useful for Mountain Gorilla conservation.

This can be accessed at:

https://news.un.org/en/audio/2014/10/593482

6. Suggested questions/assignments for learning evaluation

- What is an ecological niche? Describe the factors affecting it.
- What is the biogeography of a species? Explain how it can be affected by climate related factors.
- Describe the ecological niche occupied by Mountain Gorillas in Central Africa.
- How can the Mountain Gorillas of Central Africa be affected by climate change?
- Explain how extensive planting of Bamboo in Uganda can contribute towards Mountain Gorilla Conservation in Africa.

- Using the example of integrated Bamboo planting as a supplement to natural resources, explain how a scientifically well-planned program could help achieve the United Nations defined Sustainable Developmental Goals (SDGs).

2 Step-by-step User Guide

Here is a step-by-step guide to using this lesson plan in the classroom/laboratory. We have suggested these steps as a possible plan of action. You may customize the lesson plan according to your preferences and requirements.

1. Topic introduction and discussion

Use this reading, 'Ecological niches' by Britannica.com, to define the ecological niche of a species, describe its characteristics and explain the factors involved in defining it. Use the examples given in the text to explain how natural selection works on the physical and biological constraints of a species in a given environment, and thereby determines the 'niche' that it occupies within elaborate ecosystems. Discuss how this 'niche' cannot be shared with another species competing for the same resources. Further, discuss how the biodiversity of a region is defined by these ecological niches that permit a wide variety of species to coexist with a finite set of resources.

Navigate to the section on 'Biogeographic aspects of biodiversity' and use it to define the biogeography of a species. Use the embedded link to help explain 'island biogeography' and to describe the factors involved in the colonization of this controlled area of study, by different species of flora and fauna. Explain how isolated land areas like mountaintops and fragmented forests also follow the rules of island biogeography for species colonization. Discuss the examples given in the text to support this theory.

This can be accessed at:

https://www.britannica.com/science/community-ecology/The-process-of-succession#ref70598

2. Develop the topic further to discuss the influence of climate change on the biodiversity of Uganda

Use section 2.2, page 10 and 11, of the reading, 'Climate Change and Biodiversity in Uganda' by Climatelinks (USAID), to discuss how a changing climate is likely to influence the natural ecosystems of Uganda. Use the points enumerated to describe different scenarios of climate change and

the subsequent disruptions in the ecological balance between species and the flora and fauna distribution in Uganda. Discuss how these disturbances could affect the ecological niches occupied by various species and their abilities to adapt to such changes within a short span of time.

Use section 2.3, page 12, of the same reading to also describe the possible effects of non-climatic (anthropogenic) factors on Uganda's biodiversity and ecosystems. Explain how the effect of these factors may be exacerbated by climate related factors: for example, droughts leading to exploitation and agricultural expansion into forest habitats.

This can be accessed at:

https://www.climatelinks.org/sites/default/files/asset/document/Uganda%2520CC%2520and%2520Biodiversity%2520Overview_CLEARED_0.pdf page 10, 11,12, section 2.2 & 2.3.

3. Discuss the case study of the effect of climate change on Mountain Gorillas in Uganda

Use the reading, 'Box 5: Mountain gorillas in the Virunga mountains face new threats as their habitat changes' on page 21 from 'Wildlife in a changing climate' by the Food and Agricultural Organization (FAO), to discuss the case study of how climate change and anthropogenic activities are affecting the natural habitat and range distribution of Mountain Gorillas in Africa.

They are geographically isolated in two populations in the Bwindi and the Mgahinga National Parks and are restricted to the higher reaches of the volcanic mountaintops. Surrounded by rural communities that are heavily dependent on forest resources at the lower altitudes, these gorilla populations are an 'archipelago of ecological islands' and therefore, highly vulnerable to ecological disturbances. They occupy different ecological niches in these forest ecosystems. Bamboo stands are highly sought after by the Virunga Gorillas for their tender shoots and high protein content while the Bwindi Gorillas eat more fruit and are arboreal. In season, Bamboo forms nearly 90% of the Mountain Gorilla's diet. Nevertheless, Mountain Gorillas feed across a wide variety of plants that helps towards the rich biodiversity and maintenance of healthy ecosystems in these regions (For more information on their habits, feeding and ranging patterns, check the additional resources section of this lesson plan). However, warmer temperatures and change in precipitation patterns affect the vegetation and thus, the habits of these mammals.

Apply the understanding from the previous section to explain how climate and non-climate stressors can affect the ecological balance and thus, the natural feeding and ranging patterns of the Mountain Gorillas. Explain that increased temperatures may move the growth of vegetation to higher altitudes and force them to inhabit higher areas. However, due to the tapering nature of the mountaintops, Gorilla habitat gets further restricted. Discuss how climate induced shifting bamboo cover not only adversely affects food availability for the Gorillas but also resource availability for people dependent on it thus, bringing them in direct conflict with each other. Further, explain that changing climatic conditions

and heavy reliance on forest resources by humans has resulted in large scale habitat degradation putting further constraints on the physical and biological well-being of the species, making them more vulnerable to climate change.

This can be accessed at:

http://www.fao.org/3/a-i2498e.pdf Page 21, Box 5.

4. Improve understanding of the Mountain Gorillas' habitat degradation due to climate related factors

Use the reading, 'Case #8 Mountain Gorillas, Ecosystem Services and Local Livelihoods in Rwanda, Uganda and DRC', section 9.8, pages 45-47 of the report, 'BIODIVERSITY, CLIMATE CHANGE AND SUSTAINABLE DEVELOPMENT- HARNESSING SYNERGIES AND CELEBRATING SUCCESSES' by Guy Midgley et al, provided by UNFCC, to discuss the implications of climate change on Mountain Gorillas and the livelihoods of local communities in the Virunga region. Initiate classroom discussions on the findings of the report that mainly point towards restoration of Gorilla habitat through reforestation efforts for Gorilla conservation. Also, explain how the burden on forest resources due to human activity, can be reduced by using alternative resources like fast growing renewable Bamboo plants that can be creatively harnessed for sustainable living and for providing livelihoods in local communities. Finally, discuss how large-scale Bamboo planting could not only provide adequate food for Gorillas but also help restore degraded forest ecosystems and thus, be an effective climate adaptation strategy.

This can be accessed at:

https://unfccc.int/sites/default/files/biodiversity_climate_change_sustainable_development_technical_report.pdf page 45, 46 & 47, section 9.8.

5. Extend the understanding of the benefits of Bamboo as a natural resource

Use this brief news report 'Bamboo can help to "combat climate change"' and the associated audio file (interview of the Director General of the International Network for Bamboo and Rattan (INBAR), Hans Friedrich), by UN News to explain the benefits of growing Bamboo as a fast-growing renewable natural resource to offset the adverse effects of climate change. Use this tool to explain how Bamboo is highly effective in reforestation and preventing soil erosion. Further, discuss the different ways in which Bamboo can be used in sustainable living and for providing economically viable livelihoods. Finally, discuss how restoration of disturbed natural ecosystems and the provision of new resources and livelihoods by Bamboo planting can reduce the burden on other forest resources, prevent further habitat degradation and thereby, aid Mountain Gorilla conservation.

This can be accessed at:

https://news.un.org/en/audio/2014/10/593482

Read about the potential benefits of Bamboo by exploring item 3 and about an extensive Bamboo planting programme in Africa- Bamboo For Good (B4G)- by exploring item 4, in the additional resources section of this lesson plan.

6. Questions/Assignments

Use the tools and the concepts learned so far to discuss and determine answers to the following questions:

- What is an ecological niche? Describe the factors affecting it.
- What is the biogeography of a species? Explain how it can be affected by climate related factors.
- Describe the ecological niche occupied by Mountain Gorillas in Central Africa.
- How can the Mountain Gorillas of Central Africa be affected by climate change?
- Explain how extensive planting of Bamboo in Uganda can contribute towards Mountain Gorilla Conservation in Africa.
- Using the example of integrated Bamboo planting as a supplement to natural resources, explain how a scientifically well-planned program could help achieve the United Nations defined Sustainable Developmental Goals (SDGs).

3 Learning Outcomes

The tools in this lesson plan will enable students to:

- learn about ecological niches and the biogeography of a species
- describe the effects of climate related factors on natural ecosystems and biodiversity of a region
- discuss the possible impacts of climate change on the Mountain Gorillas of Central Africa
- explain the importance of growing Bamboo in Africa to restore degraded natural habitats, provide a renewable natural resource, and help conserve Mountain Gorillas.

4 Additional Resources

If you or your students would like to explore the topic further, these additional resources will be useful.

1. Video

A video, 'Baby Gorilla Bamboo Feast: Mountain Gorilla' by BBC Earth, showing Mountain Gorillas feeding on the tender shoots of Bamboo and other plants to meet their dietary requirements.

This can be accessed at:

https://www.youtube.com/watch?v=zut9g6z7KIc

2. Reading

A reading, '3.0 Mountain Gorilla Conservation and Climate Change' from pages 22-26 of 'The Implications of Global Climate Change for Mountain Gorilla Conservation in the Albertine Rift' by the African Wildlife Foundation, the International Gorilla Conservation Programme and EcoAdapt, to learn more about the taxonomy and distribution, ecology, diet, and the ranging pattern of Mountain Gorillas.

This can be accessed at:

http://ecoadapt.org/data/library-documents/The-Implications-of-Global-Climate-Change-for-Mountain-Gorilla-Conservation-in-Albertine-Rift.pdf

3. Reading

A report, 'Bamboo: Africa's untapped potential' by Zipporah Musau, Department of Global Communications, United Nations on the potential of planting and utilization of Bamboo as a fast-growing and renewable natural resource across a wide variety of goods and services in Africa.

This can be accessed at:

https://www.un.org/africarenewal/magazine/april-2016/bamboo-africa%E2%80%99s-untapped-potential

4. Website

A website of Bamboo For Good (B4G)- by Pacific Bamboo Resources- organization of international partners that work together to mobilize bamboo resources for good across East Africa and beyond.

This can be accessed at:

https://pacificbamboo.org/

5 Credits/Copyrights

All the teaching tools in our collated list are owned by the corresponding creators/authors/organizations as listed on their websites. Please view the individual copyright and
ownership details for each tool by following the individual links provided.
We have selected and analyzed the tools that align with the overall objective of our project and have provided the corresponding links. We do not claim ownership of or responsibility/liability for any of the listed tools.

1. Reading; "Ecological niches"

Provided by Encyclopaedia Britannica.

2. Reading; "Climate Change and Biodiversity in Uganda"

Report by Climatelinks (USAID).

3. Reading; "Wildlife in a changing climate"

Report by the Food and Agricultural Organization (FAO).

4. Reading; "BIODIVERSITY, CLIMATE CHANGE AND SUSTAINABLE DEVELOPMENT- HARNESSING SYNERGIES AND CELEBRATING SUCCESSES"

Report by Guy Midgley[1], Sarshen Marais[2], Mandy Barnett[1], and Katinka Wagsaether[3] (1: South African National Biodiversity Institute, 2: Conservation South Africa, 3: Indigo Development and Change), provided by United Nations Framework Convention for Climate Change (UNFCC).

5. Audio File and Associated Reading; "Bamboo can help to "combat climate change"

News report and the associated audio file (interview of the Director General of the International Network for Bamboo and Rattan (INBAR), Hans Friedrich), by UN News.

6. Additional Resources

A video, 'Baby Gorilla Bamboo Feast: Mountain Gorilla' by BBC Earth.

A report, 'The Implications of Global Climate Change for Mountain Gorilla Conservation in the Albertine Rift', by African Wildlife Foundation, the International Gorilla Conservation Programme, and Ecoadapt.

A report, 'Bamboo: Africa's untapped potential' by Zipporah Musau, Department of Global Communications, United Nations.

A website of Bamboo For Good (B4G)- by Pacific Bamboo Resources.