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A PRACTICAL APPLICATION OF GOOGLE EARTH IN CONSERVATION AND GEOGRAPHIC EDUCATION

SARAH ELIZABETH SHARP
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Reviewed and approved* by the following:

Robert Crane
Director of AESEDA/ Professor of Geography
Thesis Supervisor

Roger Downs
Professor of Geography
Honors Adviser

* Signatures are on file in the Schreyer Honors College.

ABSTRACT

The purpose of this project is to develop a tool that will provide educators and teachers with a hands-on resource that can be used to teach students the importance of conservation within South Africa. This tour is focused toward educators and students 8th grade and above. Since South Africa is a country rich with biodiversity hotspots–crucial areas for conservation—South Africa is an important topic on which to focus. Although many protected areas have been established to further conservation work in South Africa, education is essential for people to understand the importance of the conservation of bio-diversity. The main question this project seeks to answer is: *How can Google Earth be used to educate students in the importance of conservation?* The following sub-questions help refine the study: (1) How can Google Earth be used as an educational tool? (2) What role does education play to further conservation efforts? (3) What are the different biomes in South Africa that need to be conserved? (4) Why are only three biomes considered biodiversity hotspots? (5) and why are these biodiversity hotspots significant to conserve? (6) Finally, I will show how this educational tool can be applied to other areas of conservation around the world.

Key Words: Google Earth, Geography Education, Conservation Education, Hotspot Biodiversity, Biomes of South Africa.

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Chapter 1

Google Earth's Role in Geographic and Environmental Education

As technology advances, the world has become increasingly connected. Airplanes enable people to travel anywhere in the world in less than two days. The use of the internet and telephones further decreases that distance significantly, connecting people from around the world in seconds. Since technology has decreased the perceived distance between two locations on Earth, a global economy has developed and has been able to flourish. The increased reliance on global connections has led many companies to emphasize the value of geographic knowledge and global understanding during the hiring process. This global connection has amplified the relevancy of geographic knowledge and education.

With the advent of computer-based technologies, geographic education has advanced past the traditional paper maps hung in classrooms. Although GIS (Geographic Information Systems) can be used for geographic and environmental education, special software and knowledge of this software is required to develop and use GIS for education. The amount of time and knowledge required to implement this geographic tool in K-12 curricula has prevented any significant, widespread use of this tool outside of higher education settings (Patterson 2007). Google Earth, an easily downloaded virtual globe, allows educators to utilize interactive computer-based software. This has emerged as a significant tool for geographic education.

Currently, Google Earth is primarily used to advertise different businesses or tourism opportunities; yet, this paper will emphasize the utility of Google Earth in the classroom. Its ability to demonstrate multiple scales and spatial relationships through a dynamic and interactive tool, enhances the progress of geographic education. Geographic education encourages viewing the world in multiple ways, critical thinking about the patterns and processes that have shaped the world and general knowledge of people and places on Earth (National Geographic Education 2014). In addition, Google Earth can be used to teach the five themes of Geography: An understanding of location, place, human-environmental interaction, movement and regions (Boehm & Petersen 1994).

This interactive program provides users with a tool to freely and easily explore different areas of the world, broadening global knowledge. When using the program, users have full control of where they go and what they see. With the tools provided in Google Earth, users can rotate the globe in any direction, zoom in and out of specific locations and search place names or geographic coordinates to pinpoint a specific location on the globe. Other features in this program allow users to add place markers on the map and identify places of interest for particular purposes. There are tools that can be used to modify or create layers in Google Earth, enabling users to save details and information as a file. Since this program is freely downloaded and can be modified, students could potentially complete homework assignments by creating and modifying new layers in Google Earth.

Google Earth is adept at capturing the multiple spatial scales crucial for the study of geography. This program has the capabilities to show a global extent and then zoom to a street panoramic view. This scalar versatility enables students to observe a location at

the global scale, providing them with the continental context of a particular location. Students can then zoom in to observe the regional position of a location of interest, observing the surrounding countries and major landscape features such as large rivers, mountain ranges and deserts that will influence a particular location. Further honing to a particular area can begin to produce satellite imagery of the particular landscape of a location. In addition to the satellite imagery, Google Earth provides street maps and panoramic street views, which further enhances exploration of a location. The exploration of different geographic scales provides students with a platform for critical thinking about how a location is impacted by its position on the globe. This engagement with locations at different scales provides students with a broader understanding of a particular area.

Spatial relationships can be defined as the interactions between two or more objects or locations in space. Tobler's first law of Geography states "everything is related to everything else, but near things are more related than distant things," (Miller, 2004) which emphasizes the importance of spatial relationships in understanding geography. By investigating the different scales, it is possible for students to see the spatial relationships between different areas and locations around the world. The ability to virtually spin the globe in Google Earth allows students to investigate spatial relationships present throughout Earth. Students would be able to observe how Tobler's first law is supported by the spatial composition of Earth. This assessment will lead students to think more critically about spatial relationships and will further enable students to decipher other spatial links between different areas.

In addition to demonstrating multiple scales and spatial relationships, Google Earth can also be used to teach the five themes of geography. The first of these themes is

location, the position on Earth's surface. Clearly, this program allows users to explore different locations on Earth. Along with the ability to find locations on a virtual globe, it can also give a glimpse into a place. Unlike a location, a place is more than just a dot on a map. A place has been shaped by the culture, people and environment of the area. Through the use of embedded pictures, information from satellite images and the ability to zoom to see the area around a location, a user can start to develop an idea of what shaped the place.

Composited satellite images making up the globe in Google Earth also enable viewers to see the relationships between the human and protected landscapes. Viewers can see where these two landscapes either collide or meld seamlessly to combine these different landscapes. Alterations of the landscapes can also be seen through these aerial views, or in some cases street-level views, of the worlds.

Along with the human and environmental interactions, Google Earth, allows users to interact with movement around the world: mapping migration patterns, routes of navigation and other movements through space. With the help of the satellite imagery, users can visually detect possible impediments that might restrict movement through a landscape.

Lastly, regions, particularly political boundaries, are demarcated in Google Earth at multiple scales. At the largest scale, continents and country boundaries are shown; at smaller scales, state, township and municipalities are shown. Regions can also be defined by physical boundaries such as deserts, bodies of water and mountain ranges, which are also displayed at certain scales within this program. The identified markers that denote

political and physical regions of the world make it easy for users to locate and see the extent of various regions that help organize the world.

Despite some limitations, such as the requirement of a high speed computer and basic computer knowledge, Google Earth is a great tool for geographic and environmental education. Providing an interactive way to explore the world, Google Earth does not restrict travel to those with money and time. Google Earth is accessible to everyone with a computer and internet, although high speed internet provides the most effective use of Google Earth. This access enables educators to take their students on virtual field trips around the world without leaving the classroom. An introduction to global interactions may spark a desire for travel and further gathering of knowledge, creating an interest in geographic and environmental studies.

Chapter 2

Importance of Education for Conservation Efforts

Many changes have taken place in the last century, pushing countless delicate ecosystems near if not past the brink of destruction. As land becomes developed for industrial, agricultural, commercial or residential purposes and urban sprawl begins to dominate many landscapes, many natural landscapes have slowly started to shrink. Both Natural and human caused changes in regional and global climates have begun to alter the stability of many ecosystems. The overconsumption and extraction of natural resources also contributes to the uncertainty many ecosystems are currently facing. The combination of all of these factors has greatly influenced the need for environmental conservation.

According to the Merriam-Webster dictionary, conservation is the "careful preservation and protection of something; *especially***,** planned management of a natural resource to prevent exploitation, destruction, or neglect." The goal of environmental conservation, as opposed to historical or cultural conservation, is to prevent unalterable changes from occurring in natural landscapes around the world. In order to effectively conserve particular landscapes, it is important to provide education highlighting the need for conservation. Providing education, particularly to younger generations, will instill the importance of conservation, developing an appreciation of the natural landscape, encouraging action toward further conservation, supplying future generations with the

knowledge to maintain the natural environment and instilling the desire to protect natural landscapes and the species within these landscapes.

One study, conducted in 2004, analyzed the impacts of conservation education on the reported knowledge, attitude and behavior of American campers after receiving hands on conservation education and experience (Kruse & Card 2004). This study indicated that the higher levels of conservation education and experience resulted in more positive attitudes and behavior toward conservation. In addition, this paper refers to other studies that provide further support to the importance of conservation education to the goal of global conservation. This study demonstrated that attitudes are shaped early in life−the study focused on campers aged 10-18−and are often carried into adulthood (Basile 2000; Eagles & Muffitt 1990), further increasing the need to educate students on the importance of conservation.

By emphasizing the importance of environmental conservation to younger generations, it is possible that a deeper appreciation will form, fueling the motivation to conserve the natural environment. Without a deeper knowledge of the natural world students will not understand the importance of its conservation. One of the dominant ideas taught to past generations encouraged the utilization of natural resources for human development. Exposure to environmental and conservation education can help shift the views of natural resources from being a commodity to an area to protect.

Conservation education is not only important to instill a sense of appreciation for the natural environment, but it will also provide future generations with the knowledge and skills to encourage conservation actions. By providing the proper education and skills to recognize and mitigate environmental problems, conservation efforts may grow and

intensify. Increased knowledge of conservation efforts may also spark an interest in the development of new knowledge that will propel the field of conservation forward. New discoveries of knowledge will help improve current conservation practices and in some cases develop new methods to effectively conserve and even reverse negative impacts on a landscape or species.

Without an increase in conservation and environmental education, it is not likely that the current efforts will be enough to save a significant number of ecosystems. More passionate minds are needed to shed new light on current environmental problems. Educated, passionate and determined people are needed to advance the actions of current conservation attempts and education on the importance of proper land management can help inspire new leaders in the conservation movement.

Chapter 3

Why is the use of Google Earth suitable for Conservation efforts in South Africa?

To demonstrate the viability of Google Earth for geographic, environmental and conservation education, a virtual tour was designed to exhibit the capabilities of Google Earth as an education tool for teachers and students at the 8th grade level or above. This tour focuses on three distinct biomes in South Africa; the fynbos biome, the Karoo Biome–both succulent and nama–and the coastal forest biome. South Africa was chosen as the focus of this tour because it currently houses three biodiversity hotspots, that encompass the fynbos, Karoo and coastal forest biomes, and has been confronted with many of the same challenges occurring in other conservation areas around the world. Like other bio-diverse countries still working to develop a strong economy, South Africa has to find a balance between economic development and environmental conservation. This balance often takes the form of ecotourism, which focuses on economic development through the conservation of unique landscapes. The three biomes, fynbos, Karoo and coastal forest, are suitable to focus in this project because of their biodiversity hotspot classification, the proximity of human dominated landscapes and their impacts on the landscape and finally the balance between development and conservation.

Biodiversity hotspots have been established around the world as priority conservation areas and are regions with high levels of plant endemism facing intense habitat loss. This concept, developed by Norman Myers, a British environmentalist, has been adopted by many of the world's leading conservation groups, such as Conservation

International, the World Wildlife Fund and the MacArthur Foundations to name a few (Myers et al. 2000). As defined by Myers et al. (2000), "[a] 'Biodiversity hotspot' [is] where exceptional concentrations of endemic species are undergoing exceptional loss of habitat." In order to accomplish the goal of conserving the most species for the lowest cost, highly threatened areas of elevated species diversity and richness have been targeted around the world and conservation plans have been established prioritizing these critical areas. Originally, Myers argued for the establishment of 25 biodiversity hotspots; however, nine new hotspots were designated by Conservation International (Roach 2005). Of these now 34 biodiversity hotspots, three are located in South Africa. *These three are the Cape Floristic Provence, the Succulent Karoo and the newest hotspot, the Maputaland-Pondoland-Albany hotspot, which extends into Mozambique*. In regards to South Africa, the hotspot directly corresponds with the related biome; therefore, the entire fynbos biome is considered a hotspot. The same is true for the Succulent Karoo and forest biome. All of these hotspots are located in areas where human threats such as logging, urban expansion and resource extraction have impacted these ecosystems.

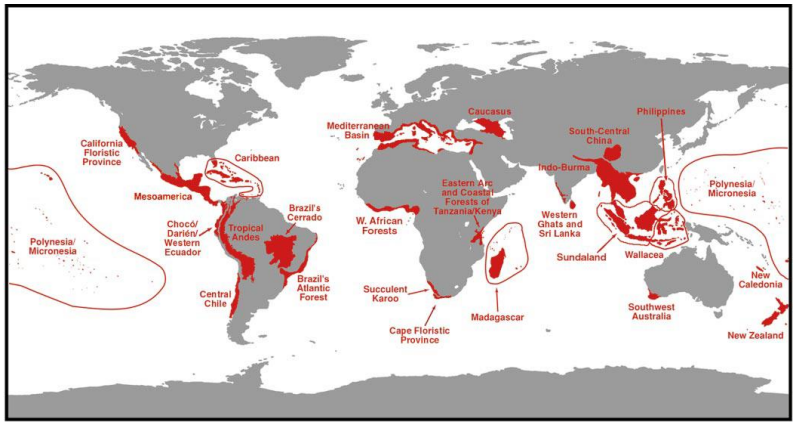


Figure 1 Global distribution of biodiversity hotspots

Like many other countries that include a biodiversity hotspot, South Africa is still developing important infrastructure and economic stability, while possessing a large population living under the poverty level. Although there is not a standard global definition of a developing country, most agree that there needs to be a certain level of economic stability, quality of life and infrastructure to be deemed a developed country. Since South Africa is still developing important infrastructure, the country has fewer funds to contribute to conservation compared with other developed countries. It is important to find a balance between the economic needs of the community and the environmental needs of the surrounding ecosystems.

In South Africa, this balance takes the form of ecotourism. Ecotourism, as its name suggests, is a form of tourism that focuses around experiencing the natural landscape while contributing to the further conservation of the ecosystem. When properly administered, ecotourism can provide economic development to the local community, while promoting conservation (Laverack & Thangphet 2007). In essence, the conservation of a particular ecosystem could lead to economic development in the surrounding community, assuming ecotourism is properly managed.

Since South Africa contains three vastly different biodiversity hotspots, it is a good example of the struggles and triumphs different areas endure to effectively conserve unique biomes around the world. By looking at three different biomes in the same country, users can see how the government, faced with the same challenges, has confronted the conservation of these areas.

Biomes in South Africa

Seven major biomes dominate the landscapes in South Africa, three of which are now considered biodiversity hotspots: the fynbos, Succulent Karoo and forest biomes. The seven biomes include savanna, grassland, thicket, forest, Nama Karoo, Succulent Karoo and fynbos. A brief description of these biomes will presented in the following section, with an emphasis on the fynbos, forest and Karoo biomes. The patchwork created by these biomes is represented by the images produced for this Google Earth Tour (Figure 2).

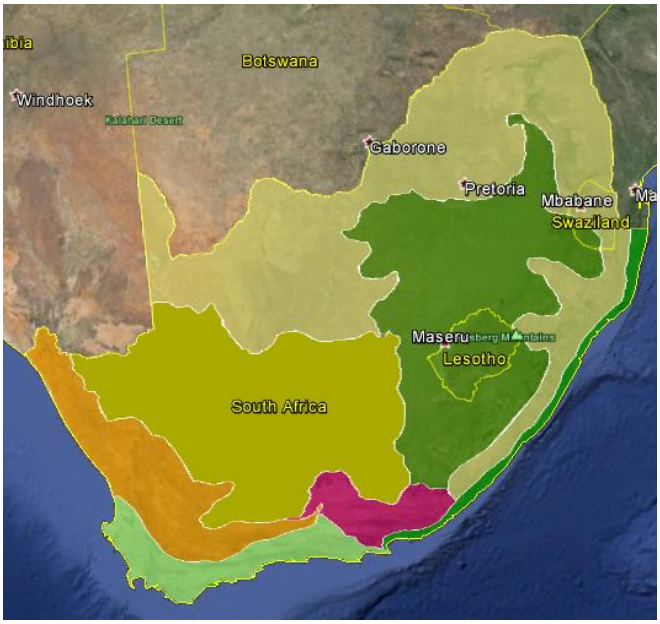


Figure 2: This image represents the polygon layers in Google Earth, showing the extent of the different biomes in South Africa

Of these biomes, the savannah biome is the largest and takes up a third of South Africa. It covers the lowveld and Kalahari regions of South Africa. The savanna can be described as grassland that contains scattered trees (Cowling et. al 1997). Since the savanna provides significant grazing land, it is able to support a large number of animals

including the big five: Cape buffalo, elephant, rhino, lion and leopard. Unlike the savanna biome, the grassland biome lacks trees and is dominated by two different grasses. This biome has a high level of biodiversity much like the fynbos biome; however, it occurs in other regions of Africa making it less of a conservation priority (van den Berg 2002).

The forest biome in South Africa is usually found along the coast where rainfall occurs frequently. The moisture and humidity found in the forest biome reduces the frequency of fires, allowing the trees to grow. These forests generally grow in patches and often do not cover more than 1 km², because human land and resource use restricts the forest cover (Low & Rebelo 1996). The thicket biome often replaces the forest biome when higher levels of fire prevent the development of larger trees. Since the thicket biome is influenced by fire, the thicket is characterized by low forests and shrubland. This biome is often considered a transitional zone since it shares characteristics with many of the other biomes that comprise South Africa (Low & Rebelo 1996).

Figure 3: This is an example of a coastal forest in South Africa.

Figure 4: This image shows an example of thicket. As show giraffes tower over the small trees which would not occur in the forest.

Unlike the forest and thicket biome, the Karoo is comprised of two arid and semi-arid biomes, the Nama Karoo and Succulent Karoo. The Succulent Karoo is a semi-arid desert located in the lowlands along the western coast of South Africa (Milton et al. 2004). This biome extends into southern Namibia and is bordered by the Namaqualand Mountains on the east. Despite its small size, the Succulent Karoo has a large floral biodiversity. About 6,356 different recorded species of flora and fauna are found within this region. Of these species, about 40 percent are endemic, only found in this region, while 17 percent of these species have been added to the Red Data List, which is a list of threatened species (Brownlie et al. 2005).

Figure 5: This is an image of some succulent plants found in the Succulent Karoo.

The Nama Karoo biome is the second largest desert biome in Southern Africa and covers about 607,235 km^3 of land in the western portion of South Africa. (Palmer, A. & Hoffman, M p. 167). This biome reaches from the Cape Fold Mountains through the Great Karoo Basin and North into Namibia. The vegetation is often characterized by dwarf open shrub land, because of the little amount of rain in the area.

Figure 6: This image is an example of a landscape seen in the Nama Karoo.

The final biome in South Africa is the fynbos biome. The fynbos biome is a floral region located along the tip of Africa in the Western Cape Provence of South Africa. Although fynbos is the smallest of the six floral kingdoms in the world, it is considered the most bio-diverse. This biome has over 8,700 species, 68% of which are endemic species– making this a significant area for conservation. Fynbos is primarily shrubland, with over 600 species of the erica shrubs (Low & Rebelo 1996).

Figure 7: This image shows a characteristic fynbos biome. This a view of the top of Table Mountain.

These seven diverse biomes make up the complex patchwork that characterizes the South Africa landscape. The diversity found within these biomes intensifies the importance of conservation and enhances ecotourism in South Africa. Drawing people from all around the world, these biomes and the unique plants and animals they house are of great importance to the further development of tourism in South Africa.

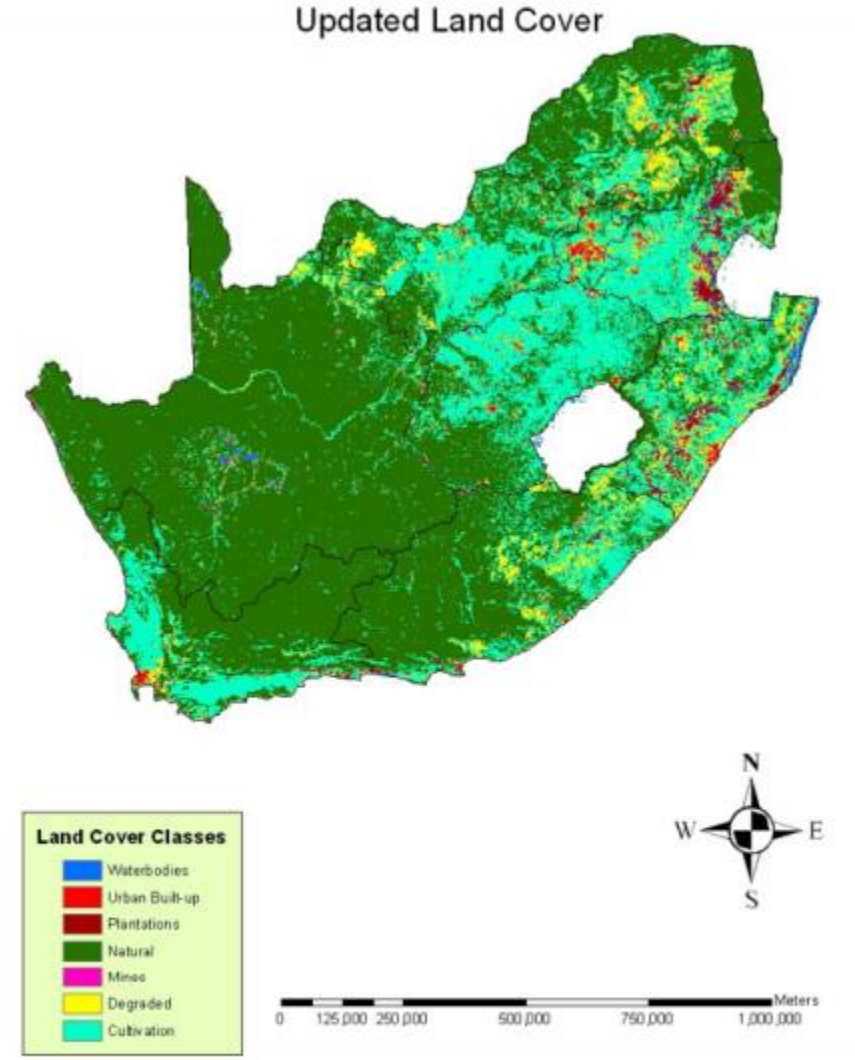
Impacts and Threats to the Three Biodiversity Hotspots

Fynbos Biome

The fynbos biome has a lot to contend with for its survival. Trapped between the Cederberg mountain range and the Atlantic Ocean, the fynbos biome is being reduced by the growing city of Cape Town. The use of Google Earth can highlight these spatial barriers, enabling users to see the relationships between the city of Cape Town and the natural barriers, such as the ocean and mountains. In addition to the natural barriers impacting the spread of Cape Town, Google Earth can also show the structured, organized patchwork of agricultural land spreading around the outskirts of Cape Town.

This restricted biome has struggled to adjust to its changing surroundings, impacted by urbanization, climate change and increased agriculture. As a result, many of the species commonly found in this biome have either completely disappeared or are endangered. Since the fynbos biome is located in a highly populated region and is highly impacted by human influences, it is more susceptible to city expansion, the spread of agricultural lands, invasive species, impacts of the changing climate and rapidly spreading fires.

The expanding urban areas around Cape Town have put significant pressures on this biome and there is a constant struggle between the need to protect this biome and the need to accommodate this expanding city. There is currently a competition over space and it appears that the city is winning. Between 1996 and 2007, the population of Cape Town has grown 36% from 2,563,095 to 3,497,097 people (City of Cape Town demographic scenario 2012). This struggle has been intensified by the growing farming industry in the area. By 2003, the Western Cape produced 20.9% of South Africa's national agriculture output, making this province the leading agricultural region in South Africa (Geyer et al. 2011). These two forms of human expansion are slowly taking away land from this delicate biome.



Map A1: Updated national land cover map.

Figure 8a: (above) This map shows the general land cover types present in South Africa with red showing urban build-up, yellow depicting degraded lands, light blue showing cultivated lands and green, natural lands.

Figure 9: (left) This map shows a larger view of the area dominated by the fynbos biome. As shown, much of this area is dominated by human development (cultivation, urban build-up and degraded lands).

Human expansion is not the only threat to this biome; the vegetation in the fynbos biome is also competing with invasive species for land and resources, namely water and nutrients. These invasive or alien species, introduced by humans, have been slowly stealing resources from the indigenous fynbos species. These invasive species can alter the levels of nutrients and other resources available for indigenous species, endangering the persistence of local species.

This alteration, in addition to impacts caused by human settlement, can also lead to fire instability. Although the fynbos needs fire periodically to rejuvenate many of the species, some of these outside threats can lead to a higher number or more widespread fires. When fires occur too frequently, the original vegetation of the fynbos cannot recover in time to survive another fire. The presence of invasive species in this area contributes to this biome's susceptibility to fire in a number of ways. For instance, invasive species impact the amount of nutrients available to the fynbos species, weakening their ability to survive fires. In addition to nutrient depletion, invasive species that are not adapted to withstanding fires, add extra fuel, intensifying the fire. Climate fluctuations also enhance the damaging effects of fire to this biome. Fires are more of a threat to the biome, during extended and more intense dry periods.

In addition to human expansion, competition with invasive species and higher susceptibility to fire, the fynbos biome must also struggle against: pollution, human recreational activities and the harvesting of plant products. All of these pressures have reduced the extent and resilience of the fynbos biome (Richardson et al. 1995). As the threats to this biome increase, this unique biome has been rapidly shrinking, being

restricted to protected patches. If these threats remain, this biome could disappear forever.

Karoo Biome

For many years, the only significant threat to the Succulent Karoo hotspot was agriculture. Unlike the fynbos biome, only about 10% of this biome is dominated by human settlement. The rest of this biome is used for the natural grazing of livestock. While overgrazing can significantly impact the health of the biome, natural grazing has a limited impact on the Succulent Karoo biome. "Natural grazing is based on the principle of year-round grazing and the natural phenomenon that the land is only able to sustain as many animals as can find sufficient food in times of food scarcity, especially in late winter" (Helmer & Ark 2002) . Since the practice of natural grazing attempts to keep a balance between the amount of animals grazing and the amount of vegetation available, it provides a more sustainable form of land use. Although for year's agriculture and livestock grazing were the only potential threats to this biome, the recent discovery of a large deposit of shale gas could significantly impact the conservation of this biome.

As in Pennsylvania and other parts of the United States, South Africa has encountered the contentious debate over the need for and potential threats from extracting shale gas. This natural resource can be used as an alternative form of energy and is believed to emit a much smaller amount of greenhouse gases into the atmosphere compared to other forms of energy. South Africa's energy intensive economy is currently

fueled primarily by coal. In an effort to reduce carbon emissions, the South African government has begun to look for alternative forms of energy.

Although there appears to be benefits from extracting this resource such as job creation, a cheaper more secure energy source, infrastructure development and other related business and service development, there are several concerns about the impacts of the extraction on the environment and populations in the area. Fracking, formally known as hydraulic fracturing, is the process of drilling straight down into the Earth and then blasting a high-pressure mixture of water, sand and chemicals to release the gas from the rocks (The Geological Society of America N/A). This common method used to extract these resources−can potentially have negative environmental impacts such as, water contamination, air pollution and impacts caused by infrastructure development. In addition, fracking requires large amounts of water which is mixed with dangerous chemicals, like methanol, benzene, diesel fuel, lead, hydrogen fluoride, sulfuric acid and many others that can cause ground water contamination seriously impacting the local community (Brown 2007).

In terms of environmental impacts and the effects on the biodiversity in the Karoo, the process of shale exploration and extraction can significantly impact the health and biodiversity found in parts of the Karoo. Since water is scarce in this arid biodiversity hotspot, the contamination of water resources could significantly and negatively impact the region. In addition to water quality, the infrastructure needed to extract and transport these gases can also negatively impact the conservation of areas in the Karoo.

Supporters of shale fracking in the Karoo argue that with careful conservation planning, environmental impacts can be significantly reduced. Despite these assurances,

many of the risks and negative impacts are unknown in this area. This uncertainty makes it difficult to make an informed decision and prepare for the negative environmental impacts.

Forest Biome

This Biome located along the coast of the Eastern Cape, occurs primarily in patches surrounded by a landscape similar to the savanna or grassland biomes. In these open spaces, rural communities allow their cattle to freely graze. Since the coastal forests are restricted to patches generally smaller than 1 km^2, species cannot freely move when a portion of their habitat is destroyed. Some of the many animals that can be found in the forests are Bushpigs, Bushbuck, blue deiker, monkeys, and various types of birds. Endangered trees found in the forest include yellowwood, stinkwood, sneezewood and ironwood trees (Mastropieri et al. 2013).

Many of the landscapes in South Africa have been affected by Apartheid, which ended in 1994. The word Apartheid means "apartness" in Afrikaans and is the perfect description of this time period. During this time of cultural and racial segregation, the Apartheid government relocated native black populations to their tribe's 'homeland.' The Eastern Cape Province was a major 'homeland' comprised primarily of the amaXhosa people. These homelands did not experience much if any development under the Apartheid government. This lack of development forced the population to continue to rely on the natural landscape for many of their daily cultural, spiritual and physical needs.

(Further readings: Özler, B. (2007) Not separate, not equal: Poverty and inequality in post-apartheid South Africa. *Economic Development & Cultural Change*. 55(3), 487-529.;

Christopher, A. J. (2001). Urban Segregation in post-apartheid South Africa. *Urban Studies (Routledge)* 38(3), 449-466.; Legassick, M. & Wolpe, H. (Dec. 1976). *Review of African Political Economy*, No. 7, Special issue on South Africa.)

During Apartheid, the government took control of many large patches of coastal forest for both economic and recreational purposes. Restrictions on the resources within these state forests were enforced, making it more difficult for local communities to gain access to areas they had relied on for generations. Many of these communities have not seen the economic benefits from these state forests and nature reserves until recent post-Apartheid years.

Recent conservation efforts have focused on returning these lands to local control with the hopes that the community can maintain the sustainable use of these resources. In 1994, the Land Restitution Act was signed by Nelson Mandela (Fabricius & de Wet 2002). Since many conservation areas and national parks were formed from the land acquired by the Apartheid government, when this act was passed many conservation managers were concerned they would lose control of these managed lands. To prevent the loss of conservation areas, many of these protected forests are being returned to the local communities as areas of community conservation. These protected lands have been slowly converted to areas of co-management: yet, in many it has been difficult to form agreements between the communities and the land managers.

With this transfer of resources comes the transfer of the economic benefits associated with tourism and resource management in these forests. Local knowledge and interest in the conservation of many of these forests can significantly contribute to the successful conservation of these areas. The conservation of these patches of coastal forest

should focus on developing a balance between meeting the needs of the local community while achieving the conservation goals of particular areas.

Chapter 4

Motivation for this Tour

This Google Earth tour has been designed to highlight these unique landscapes and the dynamic impact their conservation has on the surrounding area. This interactive tool can be used to connect information about South Africa and the unique landscapes and people it houses with the rest of the world. By introducing this information through a Google Earth tour, it enables readers to interact with this topic at different scales and to see the relationships that exist between different environments and people within South Africa.

This tool is designed to be used by teachers or American students 8th grade and above, yet it could also engage a general American audience above this grade level with an interest in ecotourism. The use of Google Earth as a medium to present this information enables the audience to see where South Africa and these biomes are located in relation to America and the rest of the world. Since the Succulent Karoo and the fynbos biomes are only located in South Africa and the isolated nature of the forest biome creates unique characteristics only found in the South African forest, it is important to establish these unique biomes in relation to the scale of the rest of the world. Google Earth is able to demonstrate the very small area these biomes cover in relationship to the rest of the world, further showing how unique and important these biomes are, supporting their need for conservation. This medium also shows the reader

the relationship between these biomes. Through this tour, a reader can see the proximity of each biome in relation to the neighboring biomes.

This tour also provides a dynamic, interactive tool that enables users to explore the landscapes on their own with the guidance of the information provided. Because Google Earth uses satellite imagery and ground based imagery, users can zoom in or out of selected areas to get a better look at the landscapes. This enables users to experience the landscapes and form an appreciation for them without traveling across the world to see them in person. The hope of this project is to enable users to acquire a deeper understanding of these biomes and the need for their conservation.

Chapter 5

How this Tour Works

This tour was designed to highlight the spatial patterns, relationships, and needs of land conservation in South Africa with the goal of providing education and awareness to support further conservation. As explained previously, Google Earth provides an interactive way to explore the geographic patterns and relationships present around the world. It can be used to develop an understanding of the ways different landscapes interact and can provide the spatial context needed to enhance the study of geography and conservation.

This specific tour targets an American audience at the eighth grade level and above. It provides basic information about biomes, endangered and endemic species, hotspot biodiversity, conservation, biodiversity and conservation. Also provided in this tour is specific information about conservation in the context of South Africa with a brief explanation of the historical, social and political context that has shaped current conservation. In addition, this tour provides specific information about the conservation needs, threats and importance within the context of South Africa. By applying basic information about conservation to a specific context viewers will be provided with real examples of the applications of these concepts.

Since the audience for this tour is American students, the tour begins by showing the location of South Africa in relationship to the United States. This is established through the use of the line tool in Google Earth which draws a direct route from the

United States to South Africa. By double-clicking on the layer entitled “Where is South Africa?” the globe will spin and move to redirect views toward South Africa following the course demarcated by the line. As the beginning of the tour, this tool establishes the spatial relationship and context between South Africa and the United States, providing viewers with a reference point.

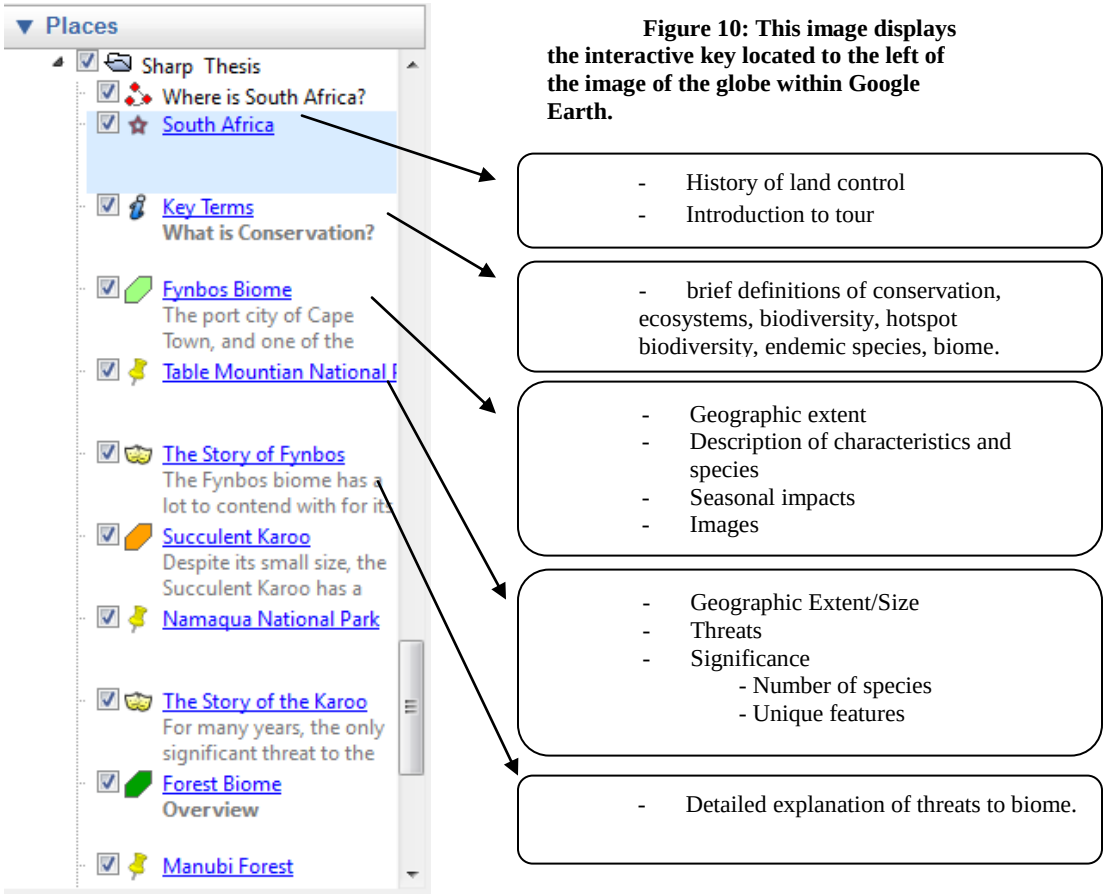


Figure 10: This image displays the interactive key located to the left of the image of the globe within Google Earth.

The first place mark, following the line establishing South Africa’s location, also activated by double-clicking on the title in the key on the left side of the screen, centers the screen on South Africa. An information balloon will appear providing the historical, social and political background of South Africa and a brief description of the goal of the tour. This place mark is intended to set the stage for the remainder of the tour so a deeper

understanding of the multiple dynamics of conservation can be achieved. The next background place mark, with the information icon, activates a pop-up balloon that provides definitions for key terms used in conservation, such as biodiversity, hotspots, ecosystem, biomes etc. This balloon introduces viewers to terms that will be used during the tour. These two introductory balloons aim to provide users with the background information needed to engage with the remainder of the tour.

After the initial introductory place marks, the biomes are introduced. Through the use of the polygon tool in Google Earth, the outlines of each of the seven biomes are traced, spatially displaying the patchwork of landscapes present in South Africa (see Figure 1). For the three biomes highlighted in this tour, if a user double-clicks on the title of the biome in the key, a balloon will pop-up. This balloon will provide information about the specific biome. The other biomes, not focused on in this tour, will be demarcated by an overlaid polygon outlining the extent of the biome. Although the polygon tool is more challenging to use, with practice and patience shapes can be created as layers on top of the imagery compiled through Google Earth.

After each of the biome's introductory slides, there are several place marks that provide more information about the individual biome and the conservation requirements and threats present. Each of the three biomes specified in this tour has one or two place marks that share information about conservation areas or national parks that play a role in conserving the particular biome. In addition to these placemarks, each biome has a placemark entitled " the Story of …", which engages with the outside influences that have been shaping and threatening these landscapes. The final placemark specifically addresses the people living near and relying on resources found in the forest Biome

provides background on the amaXhosa people. The placemarks were included to provide a deeper level of understanding and enhance the knowledge about these biomes.

All of these layers can be turned on or off to reveal different layers and to minimize clutter. By checking or unchecking the white boxes located at the left of each layer, a user can get rid of the placemarks or polygons layered on top of the globe. This function will allow users to focus on particular aspects of this tour without the possible distractions of the other layers.

Chapter 6

Conclusion and Next Steps

This tour, designed to enhance geographic education, focusses on an American audience at the 8th grade level or higher and teachers of American students. With this in mind, the content is limited to basic information concerning conservation, biomes, environmental threats and human interactions with the environment. This basic information aims to reach broader audiences and develop fundamental understandings of these topics and interactions. South Africa was chosen as the focus of this tour because it contains several biodiversity hotspots, variety of landscapes, and the conflict between human development and environmental conservation remains a major theme in South Africa.

Google Earth is an ideal platform to demonstrate the many geographic and environmental elements present in the practice of conservation. Since Google Earth shows spatial interactions, multiple scales, geographic extent and natural barriers, it is an appropriate tool to explain the importance of environmental conservation. The different tools available through Google Earth, such as the polygon tool and the placemarker tool were used successfully to demonstrate the spatial extent of the various biomes as well as the locations of individual conservation area.

Since this tour is a kmz file and can be loaded as a layer on any computer with Google Earth, it can be posted and downloaded from any website. This flexibility makes it easy to share tours with a wide audience. With this in mind, the goal for this tour is to

find an organization that encourages geographic and environmental education, willing to make this tour available on their website.

Some of the limitations encountered when producing this tour include the requirement of high-speed internet and the technical nature of the tour development. Without high-speed internet, this tour is not effective or accessible. In addition, a basic knowledge of HTML code is required to develop and edit the content within the information balloons. Lacking a basic knowledge of this computer code will make it difficult to customize a tour.

Further development of Google Earth tours might focus on the remaining biomes in South Africa. In addition, Google Earth can highlight other biomes around the world that are considered biodiversity hotspots. With the extreme versatility and open sourced nature, Google Earth allows users to focus on any region or any topic of interest; therefore, the options are endless.

Appendix A

Key Terms

What is Conservation?

Conservation ensures the protection and maintenance of the world's natural resources, cultures and environments.

Ecosystem

An ecosystem is an environment where specific organisms combine with the physical and chemical environment to form specific food chains and food webs. A healthy ecosystem occurs when all of the living organisms within the ecosystem have a unique role within the ecosystem.

Biodiversity

Biodiversity refers to the amount of different species within a specific ecosystem. According to Cape Nature, biodiversity is important because "it provides economic benefits, protects human health and safety and offers recreational or aesthetic enjoyment."

Hotspot Biodiversity

There are certain areas around the world with significantly higher levels of biodiversity; these areas are referred to as biodiversity hotspots. Since there are so many areas around the world that require conservation, it is important to prioritize.

Endemic Species

An endemic species is a species only found in an isolated area of the world. There many different scales of endemic species. For instance, a species can be endemic to an entire continent or to a very small ecosystem.

Biome

A biome is a part of the world that can be categorized by its unique flora and fauna in the area.

Appendix B

Sample of Coding Used for Tour Design and Images of Final Tour

Below is a sample of the html coding used to create the Balloon Style of each of the layers in Google Earth.

<BalloonStyle> **<body style="background:#BDB76B">** **</BalloonStyle>**	This code was used to customize the background color of the pop-up balloon. The default balloon had a plain black background, which created too much of a contrast between the images and the background. The color chosen, using the code #BDB76B, provides a soft background.
<p>	This code separates paragraphs.
…	This will bold the text within.
<table width="80" border="0" align="right" cellpadding="5" cellspacing="0"> **<tr>** **<td align="center" valign="top"> ** **<img src="http://farm6.staticflickr.com/5492/11316436136_8daba2ff0a_m.jpg" width="240" height="135" alt="Dwesa Week 8 137">** **This picture shows one of the rare mangrove forests located within this reserve. In addition to being beautiful, these trees are great for climbing.** **</td>** **<p>** **</tr>** **</table>**	The series of code corresponds with the images implanted in the text of the balloon. The section of code starting with contains the actual image code. This code was retrieved from the online photo storage website, Flickr. The code encapsulating the picture produces a table that allows text to wrap around the image.

<BalloonStyle>
<body style="background:#BDB76B">
The Dwesa Nature reserve and neighboring Cwebe Nature reserve, separated by the Mbashi River, are located along the coast of the Eastern Cape province. These nature reserves combined protect the largest area of indigenous coastal forest in the Eastern Cape, with an area of a little under 16,000 hectares.<table width="80" border="0" align="right" cellpadding="5" cellspacing="0">
<tr>
<td align="center" valign="top">
<img src="http://farm6.staticflickr.com/5492/11316436136_8daba2ff0a_m.jpg" width="240" height="135" alt="Dwesa Week 8 137">
This picture shows one of the rare mangrove forests located within this reserve. In addition to being beautiful, these trees are great for climbing.
</td>
<p>
</tr>
</table> Although originating as a State Forest and later a nature reserves, current plans will shift the ownership of these reserves back to the communities that encircle it.
<p>
This area is important to protect because it lies in a transitional zone that combine the temperate and sub-tropical biological zones. This area also represents the most southerly distribution of many plant and animal species. It also houses several endangered forests including the threatened mangrove forests.
<p>
</BalloonStyle>

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ACADEMIC VITA

Sarah Sharp
20 Bullock Rd. Chadds Ford PA. 19317
ses5467@psu.edu

Education

Bachelors of Art in Geography — May 2014

-The Pennsylvania State University, Main Campus, State College, PA
- Schreyer Honors Scholar
- Minors in International Studies; Science, Society and the Environment in Africa; Environmental Inquiry

Honors and Awards

Dean's List	Fall 2010-Present
Phi Kappa Phi Honors Society Member	Spring 2013-Present
Gamma Theta Upsilon Society Member	Spring 2013-Present
Jane E. Cooper Honors Scholar, Penn State Brandywine	Fall 2010-Spring 2012

Association Memberships/Activities

Design Team member for "Canstruction" fundraiser — January 2011 to May 2011

-Part of an innovative design fundraiser to combat hunger.
-Built teamwork skills by fundraising for cans that were later donated to a food bank in Philadelphia.

Professional Experience

Student: Study Abroad South Africa — January 27-April 17 2013

- Penn State's Parks and People: South Africa
- Through the Geography department, studied conservation and interacted with rural communities.

Independent Study/Undergraduate Research — Fall 2011- Spring 2012

-Independently produced a Google Earth Tour for the Smithsonian Folkways website, for the aide of students learning about geography and world music.

Professional Presentations

Poster Presenter: Sigma Xi Philadelphia Regional Undergraduate Conference — April 2012

- Independent work on Cultural Influences on Baby Name Trends in America from the 1900 to 2011