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Environmental Planning
Professor Stephan Schmidt

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The Serengeti Road

An Analysis of Environmental and Social Impact Assessment (ESIA)

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Introduction

In 2010, a remote wilderness area in East Africa attracted international concern and a whirlwind of controversy when the government of Tanzania proposed to construct a 385-kilometer commercial road that would cut through the northern section of Serengeti National Park. While just 55 kilometers would pass through the park, the project came to be commonly referred to as the Serengeti Road. Scores of environmental and conservation organizations sparked a worldwide campaign against the construction of the road. Foreign governments, including the United States and Germany, and international institutions, such as the World Bank, later became involved in direct diplomatic discussions with Tanzania's government about the road.

The government's main argument for constructing the road included a desire to link the populous Lake Zone regions around Lake Victoria with other commercial zones in the country, such as other large towns and cities in northern Tanzania. With nearly 5,000,000 combined residents (National Census 2002), Mara and Mwanza Regions alone have the second largest urban populations in Tanzania after Dar es Salaam, and they are home to a large fishing industry among other markets. However, the infrastructure and roads connecting the Lake Zone regions to other cities and regions are extremely poor. As far back as 2005, the Tanzanian government suggested constructing a commercial paved road from the booming town of Mto wa Mbu to Natta in Serengeti District near the Lake Zone area. Mto wa Mbu is already connected to several other northern towns and cities, such as Arusha, Moshi, and Karatu, via commercial roads. A dirt road actually currently exists between Mto wa Mbu and the Lake Zone along the proposed route, but it is in extremely poor condition does not allow for more than one-way unhindered traffic. Thus, the government's primary motivations to construct the road could be summarized as

commercial interests, employment, and improved links between regions.

The international outcry about the project focused on the ecological impact of the road primarily in Serengeti National Park. Many conservationists expressed fears that the road would cut off the famed Great Migration of wildebeest, zebra, and antelope that passes through the northern Serengeti each year. A number of other environmental impacts were also considered, including habitat loss and fragmentation, the introduction of invasive species, increased road kill, increased poaching, and threats to endangered species. Prominent conservation organizations and institutions, understanding Tanzania's aims of increasing development and commercial activity, pressed for the country to develop an alternative commercial road that would not pass through the Serengeti. The government countered that it would continue with its plans for the road but would mitigate negative impacts by leaving the Serengeti portion of the road unpaved.

In October 2010, a draft of an Environmental and Social Impact Assessment (ESIA) as prepared by a consultancy agency and the Tanzania National Roads Agency (TANROADS) was completed and was later leaked to the media. The document, in six parts and more than 100 pages long, provides a baseline for more detailed environment and socioeconomic impact analysis. To the surprise of some conservation organizations, the ESIA was seen as being more balanced in its analysis of both environmental and socioeconomic impacts than anticipated. Note that the draft only analyzed some 172 kilometers of the total road, or the portion that starts in the Loliondo Game Controlled Area, itself part of the Serengeti greater ecosystem, extends through Serengeti National Park, and continues to the Lake Zone regions. The ESIA referred to this section as the Natta-Mugumu-Tabora B-Kleins Camp-Loliondo (NMKTL) Road after the key

towns and park gates through which the road passes. For simplicity, the commonly recognized name, the Serengeti Road, will continued to be used in this document.

In November 2011, an ESIA study team at Cornell University was called upon to review the ESIA draft and the Serengeti ten-year management plan, so as to analyze some of the greater ecological and socioeconomic impacts of the proposed project. The team also examined other commercial roads passing through wilderness areas in Tanzania, other African countries, and throughout the world. The environmental impact assessment process in Tanzania as well as the larger international controversy and media attention were also taken into consideration.

Executive Summary

The ESIA study team broke down their analysis into three parts:

Part I: Social & Economic Impacts

Part II: Environmental & Ecological Impacts

Part III: A Comparative Analysis

Here is a summary of some of the team's key findings and examinations:

Socioeconomic Impacts

* Economic Benefits: Improved infrastructure and roads often do lead to increasing economic benefits and the Serengeti Road would link two key economic hubs, in Arusha Region and the Lake Zone regions. Locals along the route might have more access to markets for selling agricultural produce and livestock as well. Investment might also increase along the route. It has not been shown how these activities will directly benefit residents along the route and tourism might actually suffer from the project due to how it

is perceived in the media and how it might negatively impact the Serengeti ecosystem and its wildlife.

* Overlooked Social Impacts: As much as the impact analysis in the public debate focuses on positive socioeconomic benefits and negative environmental impacts, some of the negative socioeconomic impacts can be overlooked. For example, there might be increases in communicable diseases, such as HIV/AIDs, and increased security threats. The ESIA also leaves out several social variables as to how the road will affect structures and values in communities.

* Alternative Route Benefits: The full benefits of an alternative southern route need to be explored, as potential benefiting districts in the south have a more productive agricultural sector and have up to seven times the population of districts in the current proposed route.

Environmental Impacts

* Habitat Fragmentation: If a commercial road were built through Serengeti National Park, the habitat that is critical to the survival of so many species would no longer be a safe and secure place for them to live.

* Serengeti 10-year General Management Plan & Loss of Unique Quality: According to the Serengeti 10-year General Management Plan, the zones through which the proposed road will be constructed are considered to be highly sensitive and should have minimal visitors and traffic. The negative effects on the wildlife caused by the construction of this road would certainly be irreversible, and Serengeti National Park would never be the same.

* Impact on the Great Migration: Increasing traffic would cut off the Great Migration of wildebeest and other animals and lead to species decline. Fences put up for safety as mitigation

would bring about the end to the Great Migration and leave animals with no access to water. The population of 1.3 million wildebeest could be reduced to 200,000 animals.

Other External Impacts: The cars traveling through would also bring in invasive plant seeds and diseases. Furthermore, there would be increased poaching and vehicle collisions with animals.

Comparative Analysis

* Etosha National Park: Concerning the Serengeti Road and potential isolating impacts, destruction of animal corridors and isolation of wildlife can lead to drastic declines in populations and significant losses in biodiversity. Estosha National Park in Namibia is examined.

* Banff National Park: Concerning the Serengeti Road's effects on wildlife corridors, it is not always predictable how animals will react when their migration routes are altered. Banff National Park in Canada provides an example.

* Masai Mara and Kgalagadi: As far as possible socioeconomic benefits, the socioeconomic impact of putting roads through parks is not always good for local populations, case in point Masai Mara Game Reserve in Kenya and Kgalagadi Transfrontier Park in Botswana.

* Mikumi National Park: Some of the impacts that the Serengeti Road could cause are already observable in another Tanzanian national park, Mikumi, which has a paved commercial road running through the middle of it.

The international debate surrounding the environmental and social impact of the proposed

Serengeti Road has been well publicized and heated in recent years. In June 2011, the Tanzania government officially tabled the project, putting it on hold until it could continue discussions with all stakeholders and analysis of all impacts. The final outcome of this project will likely be a watershed moment for Tanzania in how it will deal with controversial development projects and EIAs in the future. An update to this analysis will be completed once the outcome of the Serengeti Road is final.

Environmental Impact Assessments in Tanzania

Before the analysis of the ESIA, a brief explanation should be given concerning the process of conducting environmental impacts assessments (EIAs) in Tanzania in general. In 2004, Tanzania adopted its first ever comprehensive legal and institutional framework for conducting EIAs in the country, the Environmental Management Act (EMA) (Sosovele 2011). Prior to this act, there were absolutely no clear requirements for EIAs in Tanzania, although some had been conducted going back to the 1980s. Many international institutions praised Tanzania, which is one of the most bio-diverse nations on the planet, for passing the act and striving to safeguard its environment. None the less, the EIA process has drawn a number of concerns about its implementation and overall effectiveness.

The process of EIAs is spelled out in Part IV, starting with Section 81 of the 2004 EMA. The National Environment Management Council (NEMC) is the body that ultimately enforces compliance, review, and monitoring of EIAs. Ultimately, the law falls under the Minister of Environment, which in turn is within under the office of the vice president. Furthermore, each EIA might involve several different ministries given the nature of the proposed project and

ministries sometimes have contradicting regulations. Acting like a lead agency, as identified early on in the process, a given central government ministry can be the ultimate authority for a given EIA. So, for example, the Serengeti Road falls under the Ministry of Infrastructure Development and its agency, the Tanzania National Roads Agency. The National Environmental Advisory Committee (NEAC) in turn advises the minister of the environment and the head ministry on the EIA process. Necessary criteria are specified as short term and long term socioeconomic benefits, detriments to the environment, national environmental standards, mitigation and alternatives, public comments, and any other criteria as established by the main ministry involved (Environmental Management Act 2004). Public participation in the decision-making process is required by law. One point that stands out in the act is that it is up to the given investor or developer to pay the entire cost of the EIA. Other EIAs, especially with major government development initiatives, often receive considerable international funding.

Under the Third Schedule to the EMA, some 16 types of projects are listed as requiring an EIA, however, the descriptions are extraordinarily broad and all-encompassing. For example, general projects might include "(a) any activity out of character with its surrounding, (b) any structure of scale not in keeping with its surrounding, (c) major changes in land use," (Environmental Management Act 2004). Other project types listed that might require EIAs include urban development, transportation, dams, rivers, and water resources, aerial spraying, mining, forestry, agriculture, manufacturing, electrical infrastructure, management of hydrocarbons, waste disposal, natural conservation areas, nuclear reactors, major biotechnology development, and "any other activity as prescribed in the regulations" (Environmental Management Act 2004).

In theory, it would seem that almost any project imaginable requires an EIA in Tanzania. Ultimately, however, it is up to the discretion key ministry and its specific regulations on the environment and how EIAs will be enforced by NEMC, which has not been viewed as a strong regulatory agency whatsoever. Some have called it a lion without teeth or claws.

In practice, there certainly has been an increase in EIAs in recent years, although perhaps not as many as some would think. Approximately 112 EIAs were conducted in Tanzania from 2005-2009, with some 30% involving the energy sector, 21% in tourism and manufacturing, and 18% in the mining sector (Sosovele 2011). Only 8% of all EIAs in that period involved the construction of roads and other infrastructure. However, studies have noted that by law thousands of other development projects should have been up for an EIA review and that many stakeholders are completely unclear as to when an EIA is required. One of the ESIA study team members has interviewed investors in Tanzania in the past. Some investors have remarked that EIAs in Tanzania are only seen as an added investment cost and in no way threaten the viability of a given development project.

All of this being said, the Serengeti Road ESIA draft is rather thorough, complete with statistics and detailed analysis and a balance of socioeconomic benefits and environmental detriments. In fact, when the draft was released, it did assist in slowing down the Serengeti Road development process and, after international reactions, the government has tabled the project. It certainly was far from a "rubber stamp" process of guaranteed approval. Mitigation factors and alternatives, some of which were later championed by international conservation organizations and other institutions, were clearly listed in the ESIA. From here, a more detailed analysis of the ESIA and

other factors follows, starting with an examination of social and economic impacts.

PART I

The Serengeti Road: Social and Economic Impacts

As the Tanzanian government's main purpose of building the Serengeti Road is to boost commercial activity in the country and provide economic and social benefits for its citizens, this analysis of the ESIA and other issues begins with an examination of the social and economic impacts. The section of the Serengeti Road analyzed in the ESIA covers 172 kilometers across two districts in Tanzania: Serengeti and Ngorongoro. Serengeti District is 10,373 square kilometers, 68% of which is Serengeti National Park. Two other buffer zones and game reserves make up another 3% of Serengeti District. All of Ngorongoro District is under some form of protected government status, primarily the Ngorongoro Conservation Area and the Loliondo Game Controlled Area; all of Ngorongoro District is part of the greater Serengeti ecosystem. This means that at least 85% of the two districts through which the Serengeti Road would pass are a part of the greater Serengeti ecosystem.

While the cities and districts the road would theoretically connect, such as Arusha and Musoma, have large populations, the populations of both districts through which the Serengeti Road would directly pass are minimal, with Serengeti District having 176,609 people and Ngorongoro having 169,362 (National Census 2002). Both districts have population growth rates between 2.5-4.9%. The predominant tribe in Ngorongoro is the Maasai and in Serengeti it is the Kurya tribe and

other related groups.

One potential impact that is not addressed in the ESIA concerns the potential for population growth due to increased migration to these districts. Improved roads and infrastructure and increased commercial activity often lead to increased migration to such areas. There might also be an influx of temporary workers and more seasonal workers who will inhabit these districts because of the new road. Such changes in population, permanent, temporary, and seasonal, are central to a social impact analysis (Burdge 2003). They should have been considered in the ESIA process of the Serengeti Road.

There are also other variables that were not taken into account, such as community composition and how the current residents of the districts might have conflicts with newcomers with changes the communities' power structure and image. In "The practice of social impact assessment — background," Rabel Burdge provides a useful table for some of these variables. See below. By Tanzanian law, EIAs do not need to include these specific variables but only more general negative and positive socioeconomic impacts.

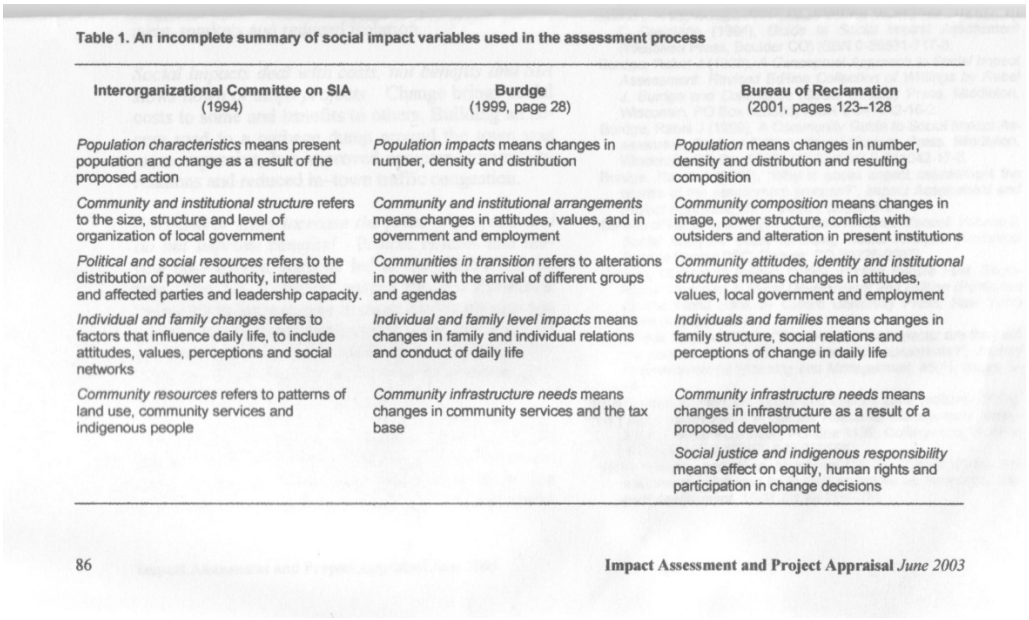

Table 1. An incomplete summary of social impact variables used in the assessment process

Interorganizational Committee on SIA (1994)	Burdge (1999, page 28)	Bureau of Reclamation (2001, pages 123–128
Population characteristics means present population and change as a result of the proposed action	*Population impacts* means changes in number, density and distribution	*Population* means changes in number, density and distribution and resulting composition
Community and institutional structure refers to the size, structure and level of organization of local government	*Community and institutional arrangements* means changes in attitudes, values, and in government and employment	*Community composition* means changes in image, power structure, conflicts with outsiders and alteration in present institutions
Political and social resources refers to the distribution of power authority, interested and affected parties and leadership capacity.	*Communities in transition* refers to alterations in power with the arrival of different groups and agendas	*Community attitudes, identity and institutional structures* means changes in attitudes, values, local government and employment
Individual and family changes refers to factors that influence daily life, to include attitudes, values, perceptions and social networks	*Individual and family level impacts* means changes in family and individual relations and conduct of daily life	*Individuals and families* means changes in family structure, social relations and perceptions of change in daily life
Community resources refers to patterns of land use, community services and indigenous people	*Community infrastructure needs* means changes in community services and the tax base	*Community infrastructure needs* means changes in infrastructure as a result of a proposed development
		Social justice and indigenous responsibility means effect on equity, human rights and participation in change decisions

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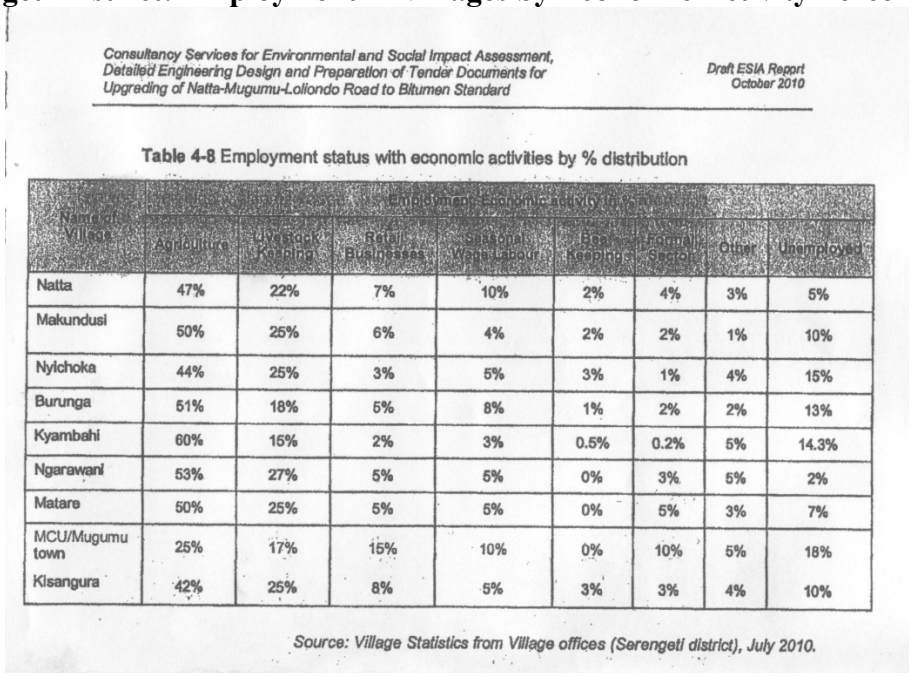
Source: "The practice of social impact assessment " *Impact Assessment and Project Appraisal*. Vol. 1, No. 2. June 2003

In terms of socioeconomic impact addressed, the ESIA primarily focuses on benefits that would be realized in terms commercial activity and social services. As far as current economic activity, almost 80% of inhabitants in both districts engage primarily in either agriculture or livestock keeping. In Ngorongoro, the Maasai, semi-nomadic pastoralists, who have largely maintained their traditional lifestyles, only practice small-scale farming and more than 80% of their economic activity is livestock keeping. In Serengeti District, most villages focus on farming, from 50-60% of their economic activity, combined with livestock keeping, which ranges from 15-25% of economic activity. For both districts, all other economic activities and formal employment, is less than 10%, except for in towns such as Mugumu and Loliondo where retail businesses and district and local government agencies are up to 10% each in terms of economic activity. Refer to the tables below and on the next page.

Serengeti District: Employment in Villages by Economic Activity Percentages



Consultancy Services for Environmental and Social Impact Assessment, Detailed Engineering Design and Preparation of Tender Documents for Upgrading of Natta-Mugumu-Loliondo Road to Bitumen Standard

Draft ESIA Report October 2010

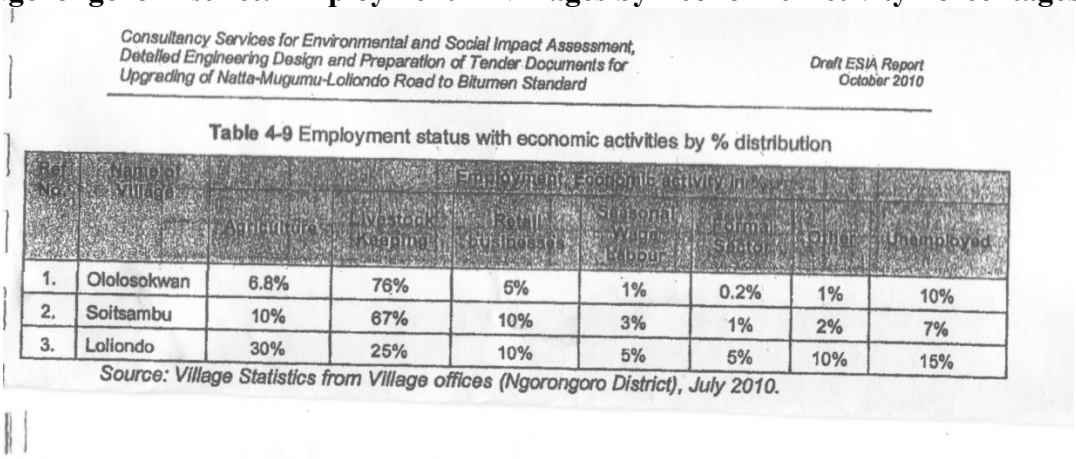
Table 4-8 Employment status with economic activities by % distribution

Name of Village	Agriculture	Livestock Keeping	Retail Businesses	Seasonal Wage Labour	Bee Keeping	Formal Sector	Other	Unemployed
Natta	47%	22%	7%	10%	2%	4%	3%	5%
Makundusi	50%	25%	6%	4%	2%	2%	1%	10%
Nyichoka	44%	25%	3%	5%	3%	1%	4%	15%
Burunga	51%	18%	5%	8%	1%	2%	2%	13%
Kyambahi	60%	15%	2%	3%	0.5%	0.2%	5%	14.3%
Ngarawani	53%	27%	5%	5%	0%	3%	5%	2%
Matare	50%	25%	5%	5%	0%	5%	3%	7%
MCU/Mugumu town	25%	17%	15%	10%	0%	10%	5%	18%
Kisangura	42%	25%	8%	5%	3%	3%	4%	10%

Source: Village Statistics from Village offices (Serengeti district), July 2010.

Village Agriculture Livestock Retail Seasonal Beekeeping Formal Other Unemployed

Ngorongoro District: Employment in Villages by Economic Activity Percentages



Consultancy Services for Environmental and Social Impact Assessment, Detailed Engineering Design and Preparation of Tender Documents for Upgrading of Natta-Mugumu-Loliondo Road to Bitumen Standard

Draft ESIA Report October 2010

Table 4-9 Employment status with economic activities by % distribution

Ref No.	Name of Village	Agriculture	Livestock Keeping	Retail Businesses	Seasonal Wage Labour	Formal Sector	Other	Unemployed
1.	Ololosokwan	6.8%	76%	5%	1%	0.2%	1%	10%
2.	Soitsambu	10%	67%	10%	3%	1%	2%	7%
3.	Loliondo	30%	25%	10%	5%	5%	10%	15%

Source: Village Statistics from Village offices (Ngorongoro District), July 2010.

Village Agriculture Livestock Retail Seasonal Beekeeping Formal Other Unemployed

Source: Environmental Social Impact Assessment, Tanzania Ministry of Infrastructure Development, Oct. 2010. *

* Note that the top columns are difficult to read. The names for each column have been written a second time below.

It seems highly unlikely that local residents of these districts have the skills and training necessary to take advantage of potential jobs created. The ESIA states that the Serengeti Road would bring benefits to agriculturists and pastoralists. For example, there are only two small weekly cattle markets along the proposed Serengeti Road, in Mugumu in Serengeti District and

Soit Sambu in Ngorongoro District. The only means for livestock keepers to travel between these markets is to do so through a neighboring country, Kenya, usually on foot. Many cattle herders in Loliondo, for example, actually prefer to sell their cattle in Kenya instead of Tanzania. Obviously, a commercial road would allow herders to access more markets in Tanzania and at more competitive prices. Similarly, agriculturists, especially those in Serengeti District, might be able to find new markets for their produce. However, it should also be noted that most of the agriculture and livestock keeping in the districts provides little more than basic subsistence for residents and very little agricultural produce or few cattle go for sale at markets from these areas. However, this could increase with a new paved road.

Overall, the ESIA lists several other primary socioeconomic benefits:

* Employment: primarily temporary workers for surveying and construction.
* Income from Leased Land: primarily along the road route.
* Boost to Tourism: due to easier access of the Serengeti and surrounding areas.
* Investment Opportunities: whether through tourism or other projects along the route.
* Improved Regional & District Links & Reduced Travel Times: In theory, according to the ESIA, this would mean more access to social services for both districts.

From the start, the ESIA study team noted challenges to some of these proposed benefits. For one, the ESIA draft did not provide statistics or data to back up most of these benefit claims. In terms of employment, recent trends in Tanzania show that major infrastructure contracts such as this one often are awarded to foreign companies, some of which bring in their own foreign labor and employ very few locals. If locals are employed, they are usually brought in from urban areas

as a degree of training and education is needed and employers are not willing to provide training. Education levels are low in both Ngorongoro and Serengeti.

Similarly, most land is not titled in Serengeti and Ngorongoro Districts and land conflicts are already rampant. In fact, rather than proper leasing opportunities, the Serengeti Road could open up land-grabbing opportunities, whereby urban elites and foreign investors speculatively buy up, without transparency or due process, land along the route. Investment will not come from the current inhabitants themselves but from outsiders. Both Ngorongoro District and Serengeti District have a long history of failing to receive any substantial widespread benefits from tourism and investment (Sinclair 2008). In theory, tourism might, indeed, increase with easier access to Serengeti National Park and other wilderness areas, however, the impact of increased tourism, and the ultimate beneficiaries of tourism needs to be addressed. Read more on this in Part II. In fact, most tourism companies are against the road, as their clients have said they will not want to travel to Tanzania if the government goes ahead with the project.

Travel times will, indeed, be reduced and key regions will be linked by the Serengeti Road. Tanzania as a whole, might realize socioeconomic benefits from the construction of the road. However, this argument is not backed up by statistics in the ESIA. Such benefits should be explored in greater depth. For example, how will the road help the fishing industry in the districts neighboring the Serengeti to the west? It is true that such socioeconomic data in Tanzania is simply not available and has not been properly studied.

As far as some of the other negative socioeconomic impacts, there are regular issues that go

along with roads almost anywhere, such as the need to compensate and relocate homes and businesses and even relocate graveyards. Increased road deaths, either pedestrian or vehicle passengers, is also mentioned.

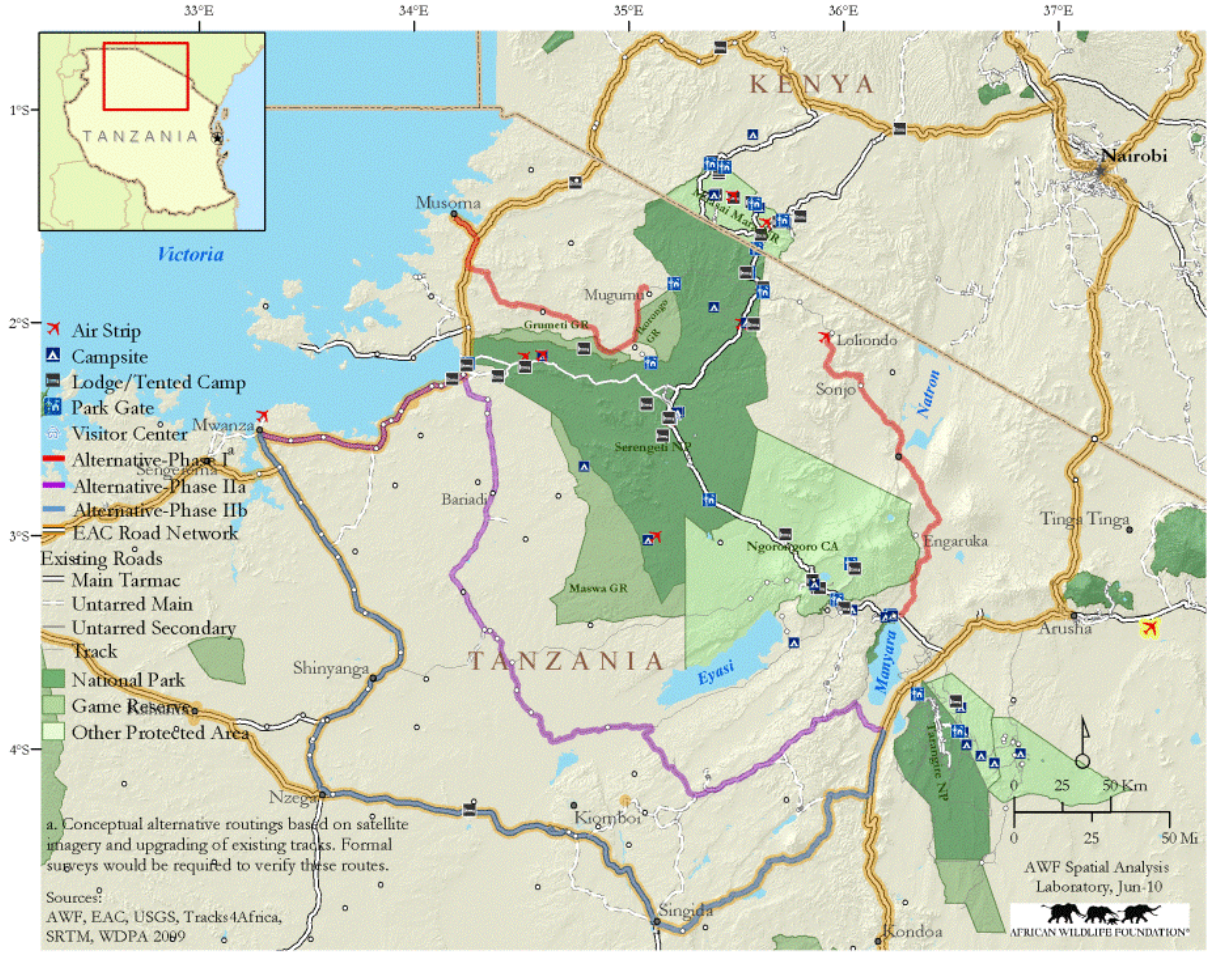
ESIA does mention the rise in communicable diseases due to increased transport. However, the ESIA suggests that the Serengeti Road would give residents better access to HIV/AIDs information and notes one of its mitigation factors as increased seminars for HIV/AIDs awareness and prevention methods. The World Bank and countless studies have recognized that increased transport leads to an increase in the prevalence of HIV/AIDs, especially in rural largely uneducated societies, such as in Ngorongoro and Serengeti. The ESIA fails to explore this possibility and prove how its mitigation factors will keep the HIV/AIDs rate from increasing.

Similarly, security is already an issue in both Serengeti and Ngorongoro Districts. Cattle rustling, banditry, and clan and tribal conflicts have led to flashes of armed violence, both with illegal firearms and traditional weapons, leading to dozens of murders and deaths in recent years. Increased transport will likely lead to an increase in such instability and security threats. Refer to Part II to also consider increased poaching that goes along with security issues. The ESIA mentions a need to increase police presence and private security guards in order to mitigate this negative impact. That is problematic considering that the current police in Loliondo and Serengeti have been overall ineffective at mitigating current violence and, according to some media reports, have actually precipitated more violence.

Finally, we should note one of the alternatives listed both in the ESIA and supported by many

conservation and international organization. The ESIA notes that an alternative would be to avoid Serengeti and Ngorongoro Districts altogether and have a road that goes from Mto wa Mbu through more southern regions around Lake Eyasi before heading north toward Mara and Mwanza regions. While longer and thus more costly, this route would actually benefit more communities, districts, and regions, as there more villages and higher populations. For example, Bariadi District alone, which is included in the southern route, has a population of 605,509, almost twice the population of Serengeti and Ngorongoro Districts combined (National Census 2002). Depending on the exact positioning of the southern road, the total population in districts along the route could be up to seven times greater than the current Serengeti Road route. See the map below. These districts have also shown to have higher agricultural productivity than those along the Serengeti Road route.

African Wildlife Foundation (AWF) Map of Current & Alternative Routes



Source: African Wildlife Foundation (**http://www.awf.org/images/PSH_B.gif**)

AWF actually proposed that Tanzania continue with a plan to pave a portion of the roads in the Serengeti ecosystem, from Musoma to Mugumu and from Mto wa Mbu to Loliondo town (both in red on the map), but a significant portion surrounding the park and through the park should remain unpaved. Obviously, the southern alternative route (in purple on the map) would also have less environmental impacts in national parks and other wilderness areas. This study will now move on to examine some of those environmental and ecological impacts.

PART II

The Serengeti Road: Environmental & Ecological Impacts

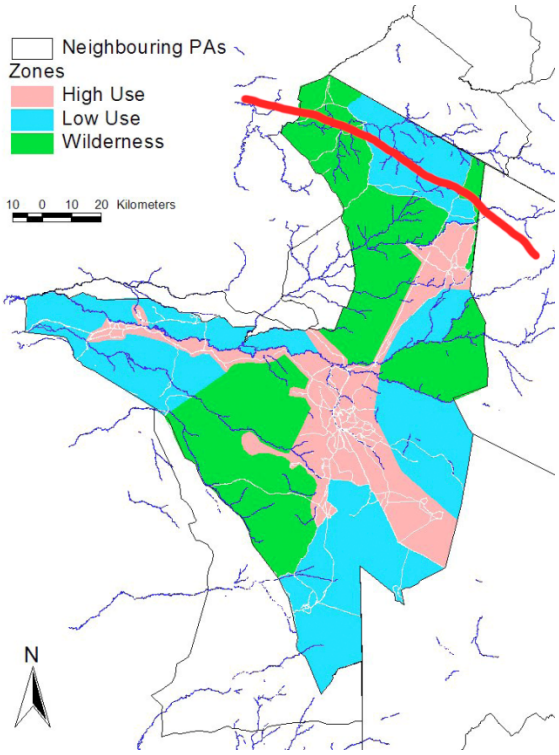
The plan to construct a road through the Serengeti was created to connect different communities and bring economic prosperity to the area. However, while such a project would have positive effects on humans, it would have extremely negative and dangerous effects on the many species that inhabit Serengeti National Park. Currently, the animals are protected within the confines the park and remain separate from human activity. This habitat is critical for some of these animals to survive and altering it would greatly diminish the population of others.

"There are significant management challenges facing the Serengeti National Park and its associated wildlife and the migration that contribute to the Park's uniqueness and global importance. The actions we take in the next ten years to address these pressures are certain to be critical to conserving those unique aspects of the Serengeti that we all hold dear, and to our ability to fulfill the pledge made by Tanzania's First President, Mwalimu Julius Nyerere, to conserve our precious heritage for the benefit of future generations."

— Serengeti 10-year General Management Plan, 2005

In 2005, Park officials, scientists, and members of conservation organizations worked extremely hard to develop a 10-year management plan to protect Serengeti National Park. According to this plan, areas of the Park are categorized according to sensitivity and how critical of a habitat they are for animals ("A World Heritage Site in Danger"). The northern area, in particular, is

designated as very sensitive and is considered a critical habitat for endangered species such as the wild dog and rhino. According to the Management Plan, commercial roads are prohibited in this area ("The Serengeti North"). The Plan splits up the Park into high use, low use, and wilderness zones.

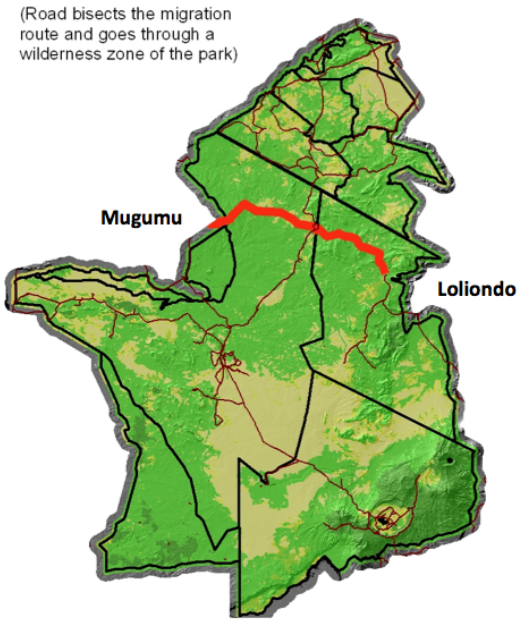


Serengeti Watch: www.savetheserengeti.org

As depicted in the map, the proposed road runs through zones that have been designated at low use and wilderness. As stated in the Management Plan, low use zones are to have, "a lower number and density of visitors," as well as, "more limited road network and lower bed capacity." Additionally, a wilderness zone "is subject to minimal disturbance. As a result, visitor access will be restricted to walking safaris, with game viewing by vehicle prohibited. The only infrastructure permitted will be a limited number of access roads that can be used by Park management and support vehicles for walking safari operations*" (*Serengeti 10-year General Management Plan 2005*)*. Those who crafted the Serengeti 10-year General Management Plan

clearly understood the importance of maintaining these areas to protect the animals that inhabit the region and depend on its resources in order to survive. Constructing a road through these critical areas directly opposes the objectives of Serengeti 10-year General Management Plan and will certainly put the animals in harm's way.

The proposed road passes through the route of migration of over a million wildebeest. During this Great Migration, the wildebeest and other animals travel 500 kilometers from the southern Serengeti in Tanzania to the northern part of the Masai Mara in Kenya (McVeigh 2011).



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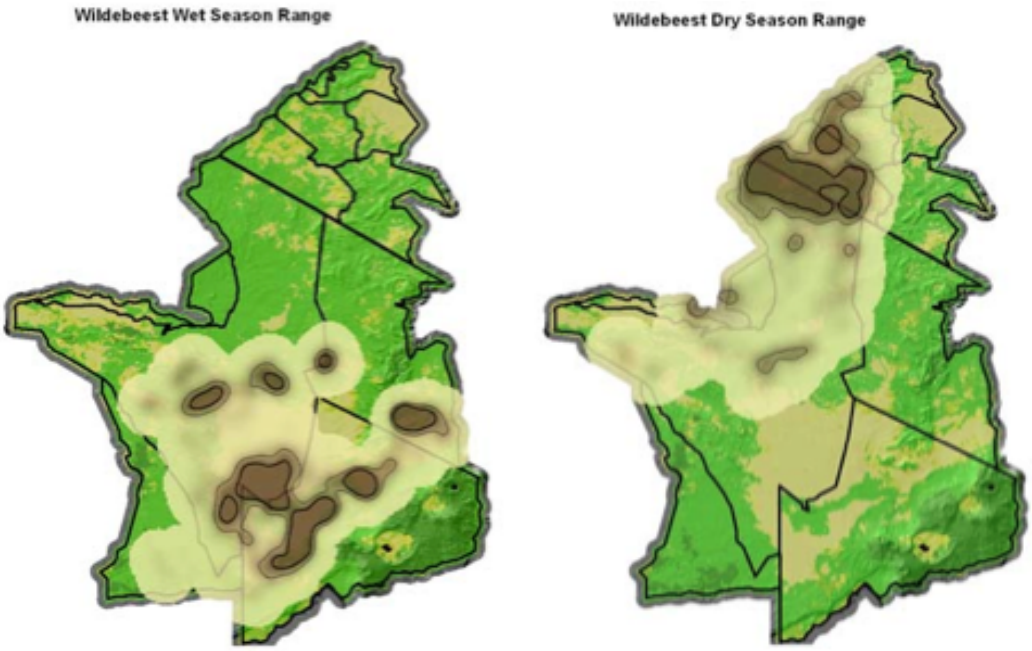
During the wet season, wildebeest, zebras, gazelles, and many other animals remain in the south. However, once the dry season comes along, the animals migrate northward, followed by lions, hyenas, and vultures, over the border into Kenya where there is an existing source of water. The northern area is the sole water source that is available all year round ("FZS Statement" 2010).



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If the wildebeest migration path were blocked, then these populations would be unable to reach the water sources that are so critical during this dry season. A situation like this would have damaging effects on the wildebeest, possibly reducing the current population of 1.3 million animals to 200,000 ("Tanzania's Serengeti Highway" 2011). The animals would be forced to remain in the south, leading to overgrazing in a concentrated area. This would limit the amount of available food and would lead to the dramatic decline in the wildebeest population (McVeigh 2011). This eighty-five percent reduction in the wildebeest population could cause the end of the famous Great Migration ("Tanzania's Serengeti Highway" 2011). A significant decrease in the number of wildebeest could also eliminate the carbon sink generated in this area. Since the wildebeest feed off of the grass, a major decline in its population would then result in a greater amount of uneaten grass, leaving the park more vulnerable to fires. The area that is currently a carbon sink would then to turn into carbon source ("Tanzania's Serengeti Highway" 2011).

Serengeti National Park is also the home of the biggest lion population in the world. Predators, like the lion, depend on the wildebeest for prey ("Tanzania Halts Plan" 2011). Lions and other predators, such as the hyena, accompany the wildebeest throughout the Great Migration (McVeigh 2011). A barrier, such as the proposed road, would not only affect the wildebeest, but also the food chain to which it belongs. The animals depend on each other as part of a greater ecosystem. Taking away the habitat of one animal can have negative effects on many others.

If cars were to pass through an area frequently crossed by animals, there would be an increased risk of collision with the animals. For species that are now considered to be threatened, such as the cheetah, even a marginal loss of the population could be irreversibly dangerous for the species. The habitat in which these animals live would become dangerous if cars were regularly passing through them. Both the animals and people driving would be susceptible to the dangers of a car accident.

As traffic increases, the number of accidents and damage would increase, forcing the highway patrol to consider fencing for safety ("The Serengeti North"). However, constructing a fence would mean bisecting the habitat of so many animals. This would eliminate some of the resources animals need to live, since there would no longer be any way to access them. A physical barrier, like fencing, would guarantee the end of the Great Migration, leaving animals stuck at the fence-line without any water source during the dry season ("FZS Statement" 2010).

In addition to the loss of animals via traffic accidents, mortality rates would more greatly increase due to poaching. Currently, it is not so easy to access the animals, nor is there a

convenient way to transport the carcasses (Pimm 2010). However, if a road were built that directly accessed their habitats, poaching would be made simple. Endangered species, such as the rhino, would no longer be protected. Illegal goods including the rhino horn and ivory could be accessed more and brought to their markets more easily (Pimm 2010). As observed in similar roads that have been constructed all over the world, organized gangs have indeed increased poaching ("FZS Statement" 2010).

Furthermore, if a major road were to pass through the Serengeti, invasive plants would likely be the introduced into the area. The seeds of such plants would be brought into the park due to the fact that they can stick to tires that will pass through. Invasive plants such as the Mexican Marigold, Chromolaena, and Opuntia are known to grown in areas near major roads ("FZS Statement" 2010). If these plants were brought to the Serengeti, they would thrive off of the destruction of the ecosystem and would have adverse effects on biodiversity ("FZS Statement" 2010).

Another concern of having vehicles pass regularly through the Serengeti would be the risk of bringing diseases into the area. Such a road would be used to transport goods, such as livestock, from one side of the park to another. Livestock are known to carry diseases such as African swine fever and Newcastle's disease, and could spread these diseases to the wildlife in the park as they are driven through. In 1958, eighty-five percent of the wildebeest population was lost due to Rinderpest, a disease that was passed to the wildebeest through cattle ("FZS Statement" 2010). These types of diseases are already known to be transmitted from livestock to the wildlife at the

boarders of the park, so allowing these animals to travel directly through the center would certainly increase the transmission ("FZS Statement" 2010).

PART III

The Serengeti Road: A Comparative Analysis

The proposed construction of a road directly through the Serengeti highlights some of the issues that arise when social development and political interests conflict with conservation aims and the need to maintain biodiversity. While the debate over the Serengeti Road will probably continue for quite some time, there are already a number of examples that illustrate quite well what happens when roads or fences are built through national parks and over migration corridors. This section will examine several projects that have already been completed and which are similar to the Serengeti Road in nature. These include a portion of the Trans Canada Highway that runs through Banff National Park, the use of fencing around Etosha National Park in Namibia, and the Trans Kalahari Highway in Botswana. In comparing the Serengeti Road's Environmental Impact Statement with these projects, we will look at how altering migration corridors in these areas has directly impacted wildlife, the ecological implications of preventing migrations, and the socioeconomic impact that these roads have had. Finally, this paper will show how all these issues are reflected in the transnational highway built through Mikumi National Park in Tanzania itself.

The Alteration of Migration Corridors

Much of the controversy generated around the proposed Serengeti Road concerns the

environmental impact that this project will have on a very large and famous migration corridor. Corridors are a fundamental part of ecology in that they enable the movement of organisms within ecosystems. In this sense, there are many different ways in which the term corridor can be used (Hess and Fischer 2001). Many people think of linear corridors when they hear the word in relation to wildlife. However, corridors can take many different forms. Some are seasonal, like floods or ice bridges. Others are patches of habitat spread across a wide area, as birds might use during migration (Puth and Wilson 2001). Corridors are often distinguished from habitat in that animals do not live within corridors so much as use them to get from one point to another.

What constitutes a corridor is therefore dependent on the type of wildlife involved. This is important in the context of the Serengeti because many corridors as they relate to savanna wildlife are not well understood. Even the EIS for the Serengeti Road makes the admission, under their cost-benefit analysis (EIS 7-4), that it is not clear how this project will impact the migration of animals within the Serengeti. What can be better predicted is how the Serengeti Road will alter human activity with respect to the environment. According to the EIS, improving the Mugumu-Loliondo stretch of the Serengeti Road, which completely bisects the park, will raise the amount of traffic on the road from 271 vehicles per day to 820 vehicles per day. These numbers assume 135 additional vehicles will be used on the road each day through newly generated traffic and that 414 vehicles will be diverted onto the Serengeti Road from other routes. This will put the total yearly traffic on the road at around 300,000 vehicles per year when the road opens in 2015. As some sources have pointed out, this number could grow drastically as internal trade continues to expand within Africa as a whole (WTO 2011). This projected increase in traffic is a major point of concern, even among those compiling the EIS, because it is the

Serengeti's wildlife that drives much of Tanzania's tourism industry. The area is very rich in biodiversity and many of the animals that could be affected by this project are listed in the EIS itself. They include cheetahs, giraffe, hyenas, gazelles, warthogs, wildebeests, and lions, and a many other species that are iconic of Africa's savanna. While it is unclear how these species would respond directly to a road, much can be inferred from projects similar to the Serengeti Road that have been carried out around the globe.

The Trans-Canada Highway being built through Banff National Park is often presented as a good example of what happens when major migratory corridors are altered. Like the Serengeti, Banff too is rich in biodiversity. It contains over 50 types of mammals including elk, moose, bear, lynx, and bighorn sheep. It also provides habitat for about 280 species of bird (Leeson BF. 1996). While cars first appeared in the park as early as the 1920s, the Trans-Canada Highway (TCH) was not actually built through Banff until the early 1950s. A short while after its initial construction, during which time a number of river courses were altered, the road fell into disrepair. By the early 1970s, the TCH was in bad need of an upgrade and, after much debate, it eventually received one. The upgraded route incorporated several two-lane highways into Banff's landscape in addition to a railroad and a number of side-roads. With better roads traffic within the park increased dramatically. Today roughly 10 million people a year now pass through Banff on the TCH. Half of these people come to visit the park and the other half simply use the highway to travel between cities (Clevenger and Waltho 2000). In the early 1970s, as traffic on the road was growing, incidences of road kills also rose very rapidly. Near the Bow Valley, one of the most controversial points on TCH inside of Banff, one particular section of road came to be known as the 'meat maker', due to the vast number of animals that were hit by vehicles.

The sheer amount of road kill resulting from the upgrade presented a real dilemma for Canada. Banff was touted as being one of the nation's premier national parks and much of the wildlife being killed by motor vehicles was iconic not only of the park but of Canada itself. At the same time, however, the TCH had become an economic necessity for connecting the country internally. In response to this problem, 45km of fence was built along part of the highway. A large portion within the park was also left unfenced and 22 underpasses, as well as two overpasses, were built for wildlife (Clevenger and Waltho 2000). Around the late 1980s, studies began to look at how exactly animals utilized these structures and how effective they were in reducing accidents with wildlife. On the whole this research has indicated that animals' adaptation to and use of these mitigation structures has been quite varied and species dependent. Carnivores, for example, tend to like underpasses near drainage systems whereas hoofed animals usually avoid these areas. That certain species prefer certain types of passes is often enough to deter other animals from using a given route. Some species adapted quite well to the structures. Elk, which are often touted as being one of the species most impacted by the TCH, were actually fairly quick to begin using the underpasses. However, moose and wolves have not been so keen on the artificial migration routes (Leeson BF. 1996). Bears also tend to avoid the passes and sometimes attempt to climb the fences instead (Leeson BF. 1996). They have also been found to change their proximity to the roads in Banff depending on whether it is berry season or not (Chruszcz B et al. 2003). The gender of bears is also a determining factor in how close they get to roads, though all bears generally avoid high volume highways.

Aside from migration and the varying reactions to the road by different species, the TCH has altered the ecosystem in other ways. Because the fences have resulted in fewer herbivores in some areas, grass tends to be higher in these areas, which provides greater cover for rodents. Hence, coyotes have taken to combing along many fenced areas because there is more food. Coyotes have also been observed using the fences to trap bighorn sheep. All of these studies have led to the conclusion that, despite the use of passes for mitigation, the TCH still represents a significant barrier to large mammal movement in North America, especially between Canada and the Central Rocky Mountains (Chruszcz B et al. 2003) and had significantly impacted the ecology of the region.

Comparative Effects of Isolating Wildlife Populations

Eliminating ecological access between areas effectively creates populations of animals that live in isolated communities. Isolation from larger habitats, in turn, often leads to a net loss in biodiversity (Bennett AF 1999). Once confined to a smaller area, animals often have insufficient numbers to reclaim old habitat or give a boost to a declining populations elsewhere. When wildlife does not have room to move about it is then quite hard to maintain an ecosystem. This assertion has been borne out by studies done on insect populations and biodiversity in connection with the manipulation of corridors between grasslands. While these studies have shown that populations of animals do not necessarily increase with the maintenance of animal corridors, there is a trend towards more biodiversity among fragmented habitats that are connected in some way (Collinge SK 2000).

On many African reserves, the result of habitat fragmentation has been quite clear. While the number of reserves in Africa has been on the rise, the effects of fences, development along the edges of parks, and the construction of roads has eliminated many ecological corridors and disrupted the migration patterns of huge numbers of species (Newmark WD. 2008). These observations are important in relation to the Serengeti because there is an increasing tendency for the reduction of habitat in areas around the park. Near the Masai Mara Game Reserve to the Serengeti's north, on the Kenyan side of the border, the surrounding land was largely converted into use for agriculture between the 1970s and 1990s. The loss of this habitat led to an almost 60% reduction in the number of non-migratory species within the Masai Mara Game Reserve. The wildebeest populations that traditionally move in and out of to the northeast of Masai Mara also declined by 81% during this time. To the west of the Serengeti as well, agriculture has been encroaching on the Park itself. Here the types of bird species observed in many of the Park's Western borderlands have declined by as much as 50% (Newmark WD. 2008). This is of interest since, as the EIS notes in its identification of positive impacts, the road itself is expected to result in greater agricultural productivity (EIS 6-4). In this way the road serves not only as a barrier but as a conduit for further development and hence habitat fragmentation. This being an externality, however, it is not really thoroughly addressed in the EIS. Even if one excludes the indirect effects of roads, there are still many examples of how roads and fences contribute directly to isolation.

One example comes from Etosha National Park in Namibia. Starting in 1961, fencing was used in Etosha to control wildlife movement largely in response to a heavy outbreak of foot and mouth disease. By 1973, the park had become entirely enclosed by the 850-kilometer game fence

in addition to a specialized 130-kilometer fence designed to stop elephants. Before the fence was built, the area saw large numbers of animals migrating into the park (Berry HH. 1997) for seasonal forage. After its completion, however, Etosha witnessed a huge loss in its wildlife population and biodiversity. Initially, lions and elephants were almost completely wiped out within the park. The populations of many herbivores dropped as well. Eland went from a population of 3,000 before 1960 to only 250 in 1974. Similarly, the zebra population fell from 22,000 as of 1969 to roughly 5,000 in the span of five years. Of particular note was the 85% decrease in the number of wildebeests which went from a population of 25,000 to only 2,600. This drop was particularly significant given the role these animals play in savanna ecosystems. Even the Serengeti Road EIS leaked from the Tanzanian government identifies wildebeests as a keystone species (4-9) and it is estimated that their numbers in the Serengeti could drop from 1.3 million to 200,000 should the road be constructed (Schenck et al. 2010). Wildebeests are migratory by necessity. Like many savanna animals they essentially follow seasonal grass resources which are dependent on seasonal rainfall (Wilmshurst et al. 1999) and by eliminating the corridors connecting these resources the fencing in Etosha effectively destroyed the wildlife it was designed to contain.

Of course, not all animals have fared equally. After being brought to extremely low numbers, giraffes and elephant populations grew to the point at which they exceeded the carrying capacity of the park. Like wildebeests, elephants also use migration to address seasonal changes in water and grass cover. In Etosha today the fencing, even with breaks in many areas, severally limits these animals' access to wet season forage land. This means the elephants spend more time continually foraging in specific parts of the park, which severely impacts the flora in the

environment. Artificial watering holes built for wildlife in Etosha as a mitigation measure have also allowed elephants to inhabit areas for longer periods during the dry season then they normally would. This has put excessive pressure on native vegetation that would normally have some sort of reprieve (Loarie et al. 2009) from being grazed. The lack of movement among animals within Etosha has also lead to increased incidences of diseases like rinderpest (Newmark WD. 2008) and anthrax.

Comparative Socioeconomic Impacts

The Serengeti Road will have socioeconomic impacts. Potentially positive socioeconomic impacts are after all the primary justification for the road being built. Some of these impacts are listed in the EIS itself. Among the positive impacts it includes are things like improved investment opportunities, more tourism, reduced travel times, lower operating costs, better access to markets and hospitals, and greater government investment in schools, all of which will presumably help in poverty alleviation. On the negative side it lists the spread of communicable diseases, unwanted pregnancies, and marital conflicts, much of which the document attributes to the sketchy road crews that will be employed to build the road. There are many socioeconomic impacts that are not really addressed in this work and it is unclear from this EIS, among those items listed, what all of the impacts will actually be. The argument that the road itself will help alleviate social problems relating to poverty sounds good in theory but in reality the argument appears questionable. In other parks the socioeconomic impacts of roads have not always been as clear cut.

Like the Trans Canada Highway, the Trans Kalahari Highway is important economically. It was constructed in order to connect Botswana with Namibia and South Africa, after the country gained its independence from Britain in 1966. A portion of the highway that connects two cities in Botswana, Kang and Ghazi, and was upgraded in 2000. This section of the highway cuts directly through the Kgalagadi Transfrontier Park (Archer et al. 2005) (*Kang is about where the third 'A' is in Kalahari on the map below*) and between two of Botswana's larger reserves, the central Kalahari game reserve and the Kalahari Gemsbok National Park. In addition to the socioeconomic promotion of the road, the argument was made that this road would increase traffic safety. These two assertions were not observed in reality. Despite the improved road, the socioeconomic situation has not improved and unemployment within the region is still higher than in other areas of the country and tourism has not expanded. The villages around Kgalagadi still have low populations of people, small market sizes, high levels of poverty, and significant problems with illiteracy and HIV/AIDS (Archer et al. 2005). In terms of road safety, prior to the upgrade, the number of accidents involving animals, both domestic and wild, accounted for roughly 18 percent out of the total number accidents which occurred along the route. Now that the highway was completed, road accidents with animals make up 36 percent of the total. (It should be noted that this number reflects the number of accidents and not the total number of road kills. These often go unreported and are assumed to be much higher.). Human fatalities also went up after road construction, from 250 deaths a year on average between 1992 and 1997 to over 550 deaths per year after that date (Archer et al. 2005). In large part this was due to more people driving at night. The loss of livestock from traffic accidents has had major socioeconomic implications for people living along the route as well. Many of the people near Kgalagadi rely on

livestock for their own survival. Currently, as with Banff and Etosha, Botswana is debating the creation of a fence along the entire route as a possible solution to this problem.

Aside from property loss, with the Serengeti Road there is the concern that the project could actually mean a loss of revenue in terms of tourism should animal populations be decimated through road construction. Even if tourism was to increase however, as predicted in the EIS, this too could have a significant environmental impact and would not necessarily mean more money for the communities bordering the Serengeti. Many National Parks worldwide are based on the Yellowstone model and their design is often referred to as 'fortress conservation'. This is the case in Etosha, Masai Mara, Banff National Park, and the Serengeti as well (Hoole A. 2008). In each of these areas the park itself was created through the exclusion of its original inhabitants who, more often than not, were pastoralists. In Kenya the Masai have been excluded from grazing their cattle in designated conservation areas while at the same time they also see very little of the

revenue generated from tourism. In the case of Masai Mara, the Maasai lost 1,671 square kilometers of grazing land to tourism (Southgate CRJ. 2006). Meanwhile, of many of the jobs created through tourism in this region, very few have actually been filled by Maasai. Even jobs doing so called traditional Maasai dances for tourists are often filled by Kenyans who are not actually Maasai (Southgate CRJ. 2006). Situations similar to this can be seen in other parks, and the majority of communities living near the Serengeti see few benefits from the tourism industry as well (Masilingi WMK. 1996). While these problems are not directly the result of roads themselves, roads do serve as a conduit to reinforce these types of circumstances. In this context, the Serengeti Road EIS labeling the development of tourism and the expansion of investment opportunities resulting from the road as a positive should be viewed very subjectively.

Comparative Examples in Tanzania

In comparing the impacts that the Serengeti Road will have with other parks with respect to wildlife corridors, biodiversity as a result of isolation, and socioeconomic issues, one need not look any further than Tanzania itself to find an example. In central Tanzania agricultural development, mainly along roads, has had severe adverse effects on the *miombo* woodlands (Stromquist and Backeus 2009). These woodlands form a large habitat that used to cover much of South Central Africa but which has been shrinking rather rapidly. They include Mikumi National Park in their fold, where highway construction has also had a major impact. Due to the noise and traffic created by the highway, most animals tend to stay roughly 600m away from the road (Newmark WD. 2008). As with Banff and Kgalagadi, upgrading the highway in the early 1990s allowed people to drive faster and resulted in many more road kills, in Mikumi's case an average of three per day. Animals near watering areas along the road are particularly susceptible

to vehicle traffic. Among baboon packs whose range includes the highway, the road itself is very deadly. A study done in 1995 found that roughly 10% of the total fatalities in these troops each year were caused by vehicle traffic through the park (Drews C. 1995). A total of 52 species have been hit in Mikumi, around 61% of which are mammals. Also fairly common are birds of prey and even some endangered species like the African hunting dog end up as road kill.

At the same time, the people living around Mikumi are not really involved with and see very little benefit from tourism generated by the park itself. 6Some 7% the population around the park still relies on agriculture as their primary source of income and 95% of the population supplements their overall income with agricultural activities. In turn, roughly half of these farmers have problems with wildlife from the park destroying their crops. Producers in the area lose an average of 11% of their total household income per year to wildlife in this manner (Wapalila GJ. 2008). In addition most of these people, excluding those who can afford permits to hunt game, are not allowed to use any of the resources within the park and receive very little in the form of compensation.

Conclusion

Many National Parks around the world have faced difficult choices when social and political interests collide with the goal of conservation. The fact that these three variables are often interlinked does not help matters much. The full impact that creating a road through the Serengeti will have on wildlife and the human populations surrounding the park is hard to estimate. It is particularly hard to express in EIS format as well, given that so many of the impacts are indirect and could occur miles away from the road itself. In this case, comparative

projects that have already been completed in other parks are of considerable use. Development in Banff National Park demonstrates that it is not always predictable how animals will react when their migration routes are altered or how they will utilize any mitigation features that are adopted. Etosha also shows us that the destruction of animal corridors and the resulting isolation of wildlife can lead to drastic declines in populations and significant losses in biodiversity. As Masai Mara and Kgalagadi reveal the socioeconomic impact of putting roads through parks is not always positive and often does not benefit local populations.

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