Serengeti National Park

2020 Conservation Outlook Assessment

SITE INFORMATION

Country: Tanzania (United Republic of)
Inscribed in: 1981
Criteria: (vii) (x)

The vast plains of the Serengeti comprise 1.5 million ha of savannah. The annual migration to permanent water holes of vast herds of herbivores (wildebeest, gazelles and zebras), followed by their predators, is one of the most impressive natural events in the world. © UNESCO

SUMMARY

2020 Conservation Outlook

Finalised on 01 Dec 2020

SIGNIFICANT CONCERN

Serengeti is facing increasing threats from development and management perspectives. The proposed series of dams upstream of Serengeti on the Mara River Basin, combined with the unpredictability of rainfall patterns due to climate change, will modify water availability in Serengeti. Such changes will likely impact the exceptional natural phenomenon of the mammal migration in the Serengeti-Mara ecosystem. The hardening of the protected area boundaries combined with increased illegal grazing on the perimeters causing the redistribution of animals within the ecosystem are resulting in a loss of ecosystem resilience over the last two decades, making the system unusually susceptible to sudden shocks such as climate change or disease spread. Whilst Serengeti is uniquely surrounded by many protected areas, changes in land use in some of these adjacent areas due to increasing human population (twice the national average rate) places huge demands on the natural resources and is leading to continued human-wildlife conflict. Tourism infrastructures are increasing inside Serengeti with seemly little – if at all – cumulative impacts being considered on wildlife and its ecosystem. Wildlife have been demonstrated to be avoiding high impact areas, and more development will exacerbate the situation. Tourism is of course essential and provides a valuable contribution to the conservation of Serengeti, but at the same time, the heavy reliance on tourism revenue is also high risk. The Arusha-Loliondo road on the eastern boundary of Serengeti is under construction and one can expect traffic to increase, with pressure from trucks and buses very probable. Increased vehicle access brings additional threats such as the spread of invasive species, especially those that are already prevalent in adjacent protected areas. The large size of Serengeti National Park and its location at the core of a trans-boundary complex of protected areas (which together cover most of the wider ecosystem) has great potential to ensure the long-term protection of its values if well managed.

FULL ASSESSMENT

Description of values

Values

World Heritage values

▶ Greatest terrestrial mammal migration on Earth **Criterion:(vii)**

The Greater Serengeti Mara Ecosystem supports the greatest large mammal migration on Earth - sometimes referred to as the Serengeti-Mara Migration - involving approximately 1.4 million wildebeest, 200,000 zebra and 300,000 Thomson's and Grant's gazelle (TAWIRI Aerial Census, 2010). The predators are dependent on the abundance of grazers, and the ecosystem harbours 7,500 hyenas, 3,000 lions and other predators. The straight line annual migratory route is around 650 km, with some animals routinely travelling more than 2,600 km/year, following a circuit between key dry-season water points and grazing lands along the Mara river (in Kenya's Masai Mara Reserve) and short-grass pastures and calving grounds to the south (in the Ngorongoro Conservation Area; a mixed World Heritage site contiguous with Serengeti) (World Heritage Committee, 2012).

▶ Outstanding savanna scenery **Criterion:(vii)**

Serengeti means 'endless plains' in the local Masai language, and the vast expanse of short-grass savannas provide a spectacular setting for the phenomenal congregations of wildlife. The plains are punctuated by impressive outcrops of massive weathered granite 'kopjes', seasonal wetlands, low hills and a diversity of woodland types (World Heritage Committee, 2012).

▶ Complex and complete mammalian community **Criterion:(x)**

The mammalian community is the most diverse and complex savanna community on Earth, including wildebeest, zebra, Thomson's and Grant's gazelle and large numbers of other species such as buffalo, eland, topi, giraffe, warthog, elephant, hippopotamus, and black rhino (TAWIRI Aerial Census, 2010). The complex community of large grazing mammals is accompanied by an equally impressive diversity of large and small predators including hyenas, lions, leopards, cheetahs and wild dogs (World Heritage Committee, 2012; State Party of Tanzania, 2011).

▶ Diversity of savanna communities **Criterion:(x)**

The 'endless plains' of Serengeti experience a remarkable spatial complexity of abiotic factors (rainfall, temperature, soils, topography), resulting in a diverse array of savanna grassland, forest and woodland communities. These include short-grass plains, Terminalia and Acacia woodlands, gallery forests and communities associated with saline pans, other wetlands and rocky kopjes. The General Management Plan (2006-16) distinguishes 7 major vegetation types and a number of sub-types (World Heritage Committee, 2012).

▶ Diversity of other fauna and flora **Criterion:(x)**

The park's flora and fauna has not been systematically surveyed, but species diversity is expected to be high for a wide range of taxa. The park lies within one of the world's Endemic Bird Areas, and is also categorised as an Important Bird Area, with over 500 bird species recorded (World Heritage Committee, 2012; BirdLife International, 2017; UNEP-WCMC, 2011).

▶ Rare and endangered species **Criterion:(x)**

Rare and endangered species include cheetah (VU), elephant (VU), black rhino (CR), African wild dog (EN) and hippo (VU), as well as 6 endemic bird species (World Heritage Committee, 2012; UNEP-WCMC,

2011).

▶ Large, ecologically dynamic self-sustaining ecosystem **Criterion:(x)**

Serengeti National Park (14,763 km2) lies at the core of the Greater Serengeti Mara Ecosystem, which includes a complex of protected areas covering a total area of 35,567 km2. Other components of the complex cover an additional 20,804 km2 and include Ngorongoro Conservation Area (8,094 km2; a mixed World Heritage site that is contiguous with Serengeti), Maswa Game reserve (2,200 km2), Ikorongo-Grumeti Game Reserves (5,000 km2), Loliondo Game Controlled Area (4,000 km2) and Masai Mara National Reserve in Kenya (1,510 km2). The protected status of adjacent areas ensures that the entire ecosystem used by the migrating herds is maintained in an ecologically viable state (World Heritage Committee, 2012; UNEP-WCMC, 2011).

Assessment information

Threats

Current Threats

Very High Threat

Changes to water availability pose the largest current threat to the Outstanding Universal Value of the property. The Mara River is the only location with sufficient water to sustain over 1.5 million migratory wildebeest, zebra, and gazelle during the dry season and is a major event for Serengeti's wildlife migration spectacle. However, the recent development of large irrigation farms using Mara River water, the proposed dams on the main tributaries of the Mara River, and the proposed diversion of the Mara River water towards Lake Natron, all raise major concerns for the survival of the Serengeti ecosystem. Increasing tourism pressures are also threatening the site’s Outstanding Universal Value through overcrowding, tourism infrastructures, road kills, invasive plants and road erosion, and stricter controls are required demarcating where and what type of infrastructure can be built. Anti-poaching efforts have been strengthened and its operations successful, but with the continued loss of elephants to poachers, sustained anti-poaching efforts are needed throughout the Serengeti ecosystem. Landuse change and especially the rise of electrified fencing on the edges of the ecosystem have already led to the collapse of the Loita-Mara wildebeest migration and a similar series of policy and political changes in other areas could threaten the main migration. In addition, the rapid rise of the human population around the ecosystem (twice as fast as the national average) has resulted in over 1.2 million livestock which poses a very large demand on grazing resources, human food security, and increased potential for disease transmission.

▶ Dams/ Water Management or Use **Very High Threat**

(Water shortage due to upstream dams, irrigation and diversion)

Inside site, throughout(>50%)
Outside site

Surface water is scarce throughout Serengeti in the dry season, the only permanent source being the Mara River in the north. A continuous flow in the Mara River is essential for the migration during the dry season and especially during droughts. The Mara river is threatened by unsustainable activities as evidenced by a decrease in the minimum observed flow of the Mara River in the Serengeti National Park during droughts compared between 1972 (1 m3/s) and 2016 (0.16 m3/s). The decrease can in part be attributed to deforestation of the Mau forest in Kenya (Gereta et al., 2002). Water extraction from the Mara River is increasing, especially via large-scale irrigated farms in Kenya e.g. irrigation farming now withdraws about 80% of the available Mara River water during a drought (Kihwele et al., 2020). This is in addition to all other water usage in Kenya.

At the local level, there are very few perennial springs in Serengeti. The most important one for the Park's biodiversity and its Outstanding Universal Value is at Bologonja. Although the spring has very little water flow during the dry season, in October 2017, plans were already in place to lay a substantial pipe to divert some of that water to Seronera. Based on the size of the water pipe, >50% of that water could be extracted. No EIA can be found but impacts on Outstanding Universal Value is likely.

The proposals for several more dams upstream of Serengeti raises great concern for the cumulative

impacts on water and sediment flow.

The Loliondo Game Conservation Area is increasingly overgrazed and unsustainably managed (TAWIRI, 2017; Veldhuis et al., 2017). This area drains westward in small streams to the Serengeti National Park. The flow in those streams now occurs as very short flash floods that cause severe gully erosion; the rest of the time these streams are dry (Kihwele et al., 2020). The eroded sediment is carried by the streams during intense flash floods to Serengeti National Park where it is predicted to silt the few river holes on the eastern side of the Park, and thus make them unavailable as a source of drinking water; these water holes are now an important source of water for resident and migrating animals in the dry season.

▶ **Hunting and trapping** — **Low Threat**

(Commercial poaching for trophies and illegal trade of animal parts)

Inside site, throughout(>50%)
Outside site

Anti-poaching efforts have been strengthened in recent years, and its operations have been successful at the site. The number of elephants poached is in decline (16 elephants poached in 2014/15 compared to 8 in 2016/2017) and no rhinos have been poached. There has been an increase in the elephant population, likely due to a compression effect (e.g. immigration from surrounding areas and from Kenya; Morrison et al., 2018). However, the situation can change quickly and could mount beyond low risk.

▶ **Hunting and trapping** — **Low Threat**

(Subsistence poaching)

Inside site, scattered(5-15%)

Subsistence poaching for meat targets the migration of wildebeest and constitutes a steady drain on the animal population especially during a drought when several tens of thousands of wildebeest wander out of protected areas in search of fodder and are killed (Gereta et al., 2009; UNESCO and IUCN, 2010). Thousands of wire snares (10 tons of snares) set by poachers have been removed and destroyed by rangers and NGOs during the last 3 years (FZS, 2019). Previous to this, studies by Rentsch et al (2014) estimated more than 100,000 wildebeest were being harvested illegally per year (ie 6-10% of the population). Clearly the poaching pressure is un-ending; the recent declines in poaching illustrates the need for sustained anti-poaching effort throughout the Serengeti ecosystem (Hilborn et al 2006). However, as populations of most target species within the Park are stable or increasing, this does not appear to be affecting their overall viability. Several species are caught as by-catch in snares aimed at migratory wildebeest and zebra. Unpublished data from road transects by the Serengeti Biodiversity Program (TAWIRI) suggest declines of several populations of resident herbivores but primarily bushbuck across the system and hyena in the western corridor. Snare injuries in the lion and hyena populations remain high as these predators follow snare-lines in search of scavenging opportunities. In the buffer zones, animal diversity decreases outside the protected area with increasing distance from the Park boundaries and with increased land-use (e.g. Kyando et al., 2019) so that in some places only rodents are now found (Shilereyo et al., 2019). Targeted snaring for giraffe (i.e. heavy cables attached to the canopy of trees) has led to declines of the population in many regions of the ecosystem from 1.5-2.6 individuals / km^2 to 0.3-0.4 / km^2 (Strauss et al., 2015). Dried giraffe meat is likely sold as wildebeest meat. The focus on giraffe is likely because a large amount of meat can be harvested from a single carcass making it very profitable, however giraffe are Tanzania's national animal and therefore the penalties for poaching are much larger. Circling columns of vultures scavenging from carcasses at poacher camps are a clear flag used by rangers and other law enforcement personnel to identify illegal activity (Rija et al., 2020). In response to this, poachers are poisoning vultures en masse. Furthermore, livestock killed by predators are often laced with poison as a way of removing problem animals, however these carcasses are also eaten by vultures which subsequently die. Combined with an increasing trade in vulture parts for traditional medicine, many populations of vultures have declined in the Serengeti despite being one of the key breeding locations (Ol Karion gorge) in East Africa (Ogada et al., 2016).

▶ **Other** — **High Threat**

(Human-wildlife conflict)

Inside site, widespread(15-50%)
Outside site

Human-wildlife conflicts are frequently recorded in adjacent villages, of which about half involved

elephants (State Party of Tanzania, 2012). The State Party of Tanzania reported in 2014 that land use plans are being implemented in affected communities, research on best practice human-elephant conflict control approach through the use of chili fences has been implemented, and communities adjacent to the property are being assisted (State Party of Tanzania, 2014). Carnivores also attack cattle in the buffer zones (Blackburn et al., 2016; Lyamuya, 2017) and this is making some of the population hostile to the Park. It should be noted that many positive initiatives to engage and bring benefits to the local communities do exist however, such as introducing conservation-compatible livelihoods. In 2019 the Grumeti Fund built 35 km of electrified fencing on the northern border of the Ikorongo Game Reserve in western Serengeti in an attempt to reduce human-wildlife conflicts (primarily elephants), and to keep livestock out of the reserve as well as to ensure re-introduced rhino do not enter village lands. This is a controversial intervention as Tanzania has been consistently opposed to the use of fencing in protected areas. In addition, the fence poses some threat to migratory animals that may get stuck on the opposite side. The fence was erected in December 2019 so its long-term impacts have yet to be assessed.

▶ **Tourism/ Recreation Areas**

High Threat

(Tourism infrastructure development)

Inside site, widespread(15-50%)
Outside site

The central part of Serengeti (around Seronera) appears to be overwhelmed by visitors (State Party of Tanzania, 2011), partly because tourism infrastructure and facilities are concentrated in this relatively small area. A recent survey by Serengeti National Park staff suggests there are now 3,766 beds available which is a 6-fold increase in the last decade. This is comprised of 7 lodges, 9 permanent tented camps, 9 public campsites, 217 ‘premium’ and ‘special’ campsites, 4 rest houses and a youth hostel. The construction of the permanent (i.e. not a seasonal camp) Belabela Lodge in the Western Corridor in the Msabi-Kirwaira area is underway as well as Melila Lodge in the Mbalageti Valley. The EIA for Belabela Lodge (State Party of Tanzania, 2019) presents the location of the lodge in the high use zone, whereas previously the exact location was presented as a low use zone (i.e. where such permanent structures would not be permitted) according to the Project Brief. The 2014-2024 GMP has not been submitted to UNESCO but all sources report this GMP to have changed much of the zonations within Serengeti to give way to tourism development (IUCN Consultation, 2020), which creates clear discrepancies between the ecological priorities of the park and the pressure to build new tourist infrastructure. Further, there are already several tourists tented camps and bandas lodges nearby including Kirawira, Handajega, Serena Kirawa and Grumeti River, so the low use zones of the Western Corridor will likely become crowded in the near future. Finally, many of the sites for construction are in the middle of the migration route.

The majority of the new lodges and tourist infrastructure occur in important wildlife areas (i.e. areas with water access or in areas where the forage quality is exceptional) (unpublished data, Serengeti Biodiversity Program). Perhaps the most noteworthy development is the recent construction of a large lodge adjacent to the Moru Rhino Protection Zone which stands to displace these secretive animals from the area. In addition, the sudden increase of tourism in the north along the Mara River (Kogatende) has led to an insurgence of permanent tented camps built on the river bank and extending the road network. These tourist facilities have recently been re-positioned away from the river bank to allow free access by migrating herds that cross the river en mass during the dry season. There are 9 airstrips in Serengeti, of which 6 are regularly used by tourist traffic. The Seronera airstrip has been upgraded and extended. The air traffic has increased significantly (i.e. more planes of larger size) raising concerns that the Tanzania Aviation Authority will need to establish an air traffic control to manage the demand. Overall the infrastructure such as water, toilets, food, waste, road maintenance and staff required to maintain the tourism demand is placing very large pressure on the ecosystem overall and is changing the way animals are distributed and move through the ecosystem (IUCN Consultation, 2020).

▶ **Tourism/ visitors/ recreation**

High Threat

(Tourist numbers, distribution and carrying capacity)

Inside site, localised(<5%)

The park receives ca.160,000 non resident visitors per annum, (350,000 travel through, but mostly just crossing the park without visiting) (State Party of Tanzania, 2011), which would not be excessive if they were well distributed around the park (Larsen et al., 2020). However, visitors tend to concentrate

around Seronera where there is an attractive visitor centre and other facilities. There are few opportunities for visitors to get out of their vehicles elsewhere, and the number of game viewing tracks is limited, so those that exist become quickly over-crowded. The SNP General Management Plan 2014-2024 (State Party of Tanzania, 2019) shows that 3,728 beds are needed to cater for increasing visitors. As of 2020 there are currently 3,766 beds. There are 217 seasonal campsites in the Park with a capacity of approximately 3,000 beds.

A recent analysis of 20 years of GPS collaring data from migratory wildebeest suggests the migration is spending less time in areas with a large tourist footprint, despite many of these areas having prime grazing conditions; this suggests that animals are being displaced and forgoing access to critical resources (Morrison, Torney and Hopcraft, in prep). The most extreme case of this pattern is seen in the Masai Mara where tourist density is 10 times that of the Serengeti; the migration now spends about 35 days less per year compared to the previous decade, which amounts to over 25% of Kenya's prime wildebeest viewing time. Thus, more tourism pressure will likely threaten the Outstanding Universal Value of the Park. Nevertheless the State Party of Tanzania (2019) informed that the EIA's were certified through the Ministry of Environment Vice President Office and that the State Party will monitor and mitigate any potential adverse impact. How that would be done is not explained. With increasing tourist numbers, increasing road kills and road erosion are being observed. Stricter speed limit enforcement is needed to avoid fatal collisions.
The road network used for game viewing is limited, and much of it is heavily used, especially around Seronera and more recently in the north along the Mara River. There are efforts to distribute tourism pressure more evenly in the Park, however recent changes that restrict multiple-entry in a single day on the same pass have seriously undermined the viability of tourist facilities on community land outside the park, while increasing the demand for tourist infrastructure inside the park.

▶ **Fire/ Fire Suppression** — **Low Threat**

(Fire) — Inside site, localised(<5%)

Although the Serengeti ecosystem is adapted to fire, hot burns (which occur at the end of the dry season and are often lit by poachers to detract attention from their activities; other fires originate in the buffer zones and spread in the Park) can cause extensive long-term damage to woody vegetation (State Party of Tanzania, 2011) and they have been shown to have altered the savannah landscape within the Park (Probert et al., 2019). Interestingly the number of fires around the edges of the National Park are significantly reducing primarily as a result of illegal grazing by surrounding communities that effectively removes the fuel load. In these areas, fire frequency is an accurate metric of the grazing pressure (Veldhuis et al., 2017).

▶ **Invasive Non-Native/ Alien Species, Problematic Native Species** — **Data Deficient**

(Invasive species) — Inside site, extent of threat not known

Three invasive alien weed species are already established in the park (Argemone mexicana, Datura stromonium and Opuntia species) and two others are reported in neighbouring parts of the wider ecosystem. The highly aggressive and damaging weed Parthemium hysterophorus is already found in Ngorongoro Conservation Area and Masai Mara National Reserve, while Chromolaena odorata is in Grumeti Game Reserve (UNESCO and IUCN, 2010). Fire regulates the abundance of invasive species near roads and settlements (Bukombe et al., 2018) but there are insufficient data for areas away from roads and settlements; this study also shows that to effectively control invasive species other measures than just using fires are necessary, including physical removal and biological control agent. The role of cars in dispersing seeds including those of invasive alien species is well known, and therefore with increased visitor numbers and pressures to expand roads, the risk of spreading invasive plant species increases. In addition, the recent expansion of two native invasive species (Bidens schimperi and Gutenbergia cordifolia) have been associated with changes in the grazing pressure that alters the competitive balance between grasses and forbs. It is likely that high grazing pressure as a result of livestock incursions and high densities of wild animals that were displaced from the edges of the ecosystem has removed grass and allowed these invasive forbs to rapidly expand across the range.

▶ Other

High Threat

(Increased competition with domestic livestock and potential for disease transmission)

Inside site, widespread(15-50%)
Outside site

Disease transmission between domestic stock and wildlife can be catastrophic. The present population of wildebeest fluctuates inter-annually between 1.2 and 1.4 million (Hopcraft et al., 2015), and is the result of long-term recovery starting around 1960 from a rinderpest outbreak, transmitted by cattle, which had decimated the population. Wild dogs disappeared from the park in 1991, when a rabies outbreak killed three packs (UNEP-WCMC, 2011). Over 1000 lions, a third of the population, were killed in a canine distemper virus epidemic in 1993/94, and this virus also affected uncounted hyaenas, bat-eared foxes and leopards (Roelke-Parker et al., 1996). In addition, several gastrointestinal parasites are shared between livestock and wild grazers as well as Foot and Mouth Disease (FMD) primarily between buffalo and cattle. A livestock survey conducted by TAWIRI in 2017 established there were over 1,200,000 cattle within 20km (ie within 2 days walk) of the park boundary. This is the first time in recorded history that the number of livestock is almost equivalent to the number of wildebeest. The wildebeest alone remove approximately 4,400 tons of grass / day. If one adds to this the removal of grass by cattle, it is evident that increasing competition for grazing resources will likely lead to domestic and wild animals overlapping more in the near future. Aside from the demographic repercussions of reducing the amount of food per capita, this increased rate of contact raises serious concerns about the potential for disease transmission.

▶ Livestock Farming / Grazing

Very High Threat

(Change of land use in adjacent areas)

Inside site, scattered(5-15%)
Outside site

Human and cattle population densities are increasing very rapidly in all areas around the protected area complex, limiting wildlife migration routes in the buffer zones and exacerbating human-wildlife conflicts, and the effect is felt even within the Park for charismatic animals such as lions and cheetah (Blackburn et al., 2016; Durant et al., 2017; Snyder et al., 2019; Walelign et al., 2019). The human population on the perimeter of the Serengeti is growing at twice the national average which has led to rapid changes in land use (Estes et al., 2012; Veldhuis et al., 2019). The border conflicts with agriculturalists is perhaps most evident on the Kenyan side of the ecosystem in the conservancies to the north of the Masai Mara. In these areas approximately 50% of the landscape has been fenced with high tensile agricultural wire (often 11 strand and electrified). This has led to the complete collapse of the Loita-Mara wildebeest migration from 140,000 animals in the mid 1990s to under 10,000 now (Ogutu et al., 2016) which once shared the dry season range with the Serengeti migration. Currently the Serengeti migration encounters these fences along the northern edge of their dry season range. These areas have the highest quality grass during the dry season; the continued agricultural fencing in the Mara conservancies could preclude the main migratory herds from accessing these resources as well as removing the prospect of generating revenue from selling tourism opportunities. The recent construction of 35 km of electrified conservation fence along the northern border of the Ikorongo game reserve (an area heavily used by the wildebeest and zebra migration as they transit from the Western Corridor towards the northern dry season refuge) has unknown consequences currently. Construction was completed in January 2020 and this year will be the first time the migration encounters it. The fence is linear along the boundary (i.e. open at both ends) and therefore the risk is that groups of migratory animals get stuck on the opposite side in areas occupied by agropastoralists. There are plans to extend this fence for an additional 35 km to separate village grazing lands from conservation areas.

Potential Threats

High Threat

Commercial road development constitutes the greatest potential threat at present. Construction of the proposed road bypassing Serengeti to the South has not started. In the meantime however, the paved road linking Arusha (Mto wa Mbu) with Loliondo is under construction. The State Party has confirmed that the extension of that road crossing the Park will remain gravel and under control of Tanzania National Parks. However, due to cost and time saving, there will likely be pressure from trucks and buses to utilise the road to go from Arusha to Lake Victoria (Mwanza and Musoma). This would adversely affect the

wildebeest migration and could endanger the ecosystems and wildlife populations of the Serengeti and its wider ecosystem, and constitutes a very high threat to the park. Climate change also poses a threat but its extent is currently unknown. Tourism infrastructure such as the Belabela lodge and several others also pose environmental risks. There is evidence (20 years of GPS collaring data from migratory animals) suggesting that the tourism footprint is disrupting the migration route and movement corridors. The changes to the GMP zonation definitions, possibly based on economic and political pressure, rather than on ecological principles is a great concern.

▶ **Roads/ Railroads**

Very High Threat

(Development of road and other infrastructure corridors)

Inside site, localised(<5%)

There have been a series of development proposals to link the heavily-populated parts of the Lake Victoria basin to the west of Serengeti with the port city of Dar es Salaam and Tanga as well as buisiness centres to the east of the park. These include an early proposal to construct a railway through the park (IUCN, 1981), to pass fibre-optic cables through the park (State Party of Tanzania, 2010), and to build a major paved highway through the park to connect Musoma with Arusha (UNESCO, 2009). This highway would transect northern Serengeti from Tabora 'B' (park gate) and Klein's Gate (UNESCO and IUCN, 2010). This project was predicted to have a major impact on Serengeti (Dobson et al., 2010; Holdo et al., 2011; Hopcraft et al., 2015). The project was shelved by the State Party and replaced by a proposal to construct a Serengeti southern bypass paved road (either the Lake Eyasi route or the Mubulu Route) while at the same time constructing a paved road for commercial use from Arusha (Mto wa Mbu) to Loliondo, and a gravel road from Loliondo through Serengeti; the State Party advised that the gravel road would remain under control of Tanzania National Parks. It is of concern that the construction of this bypass road around the Serengeti is still waiting for engineering feasibility and design reports after 10 years, while construction of the access paved road east of the Park (Mto ma Mbu to Loliondo) has commenced. The Mto wa Mbu to Loliondo road is for commercial activities. It is of concern that in the absence of the bypass paved road linking Arusha with Mwanza and Musoma, the Mto wa Mbu to Loliondo paved road and the gravel road through the Park may be opened up for moving freight and people from Arusha to Musoma and Mwanza. Should this proceed, even only while waiting for the bypass road to be built (which will take several more years), it would constitute a major threat to the property's Outstanding Universal Value due to the likely adverse impact of the road on wildebeest migration (Dobson et al., 2010; Holdo et al., 2011). The World Heritage Committee has recently requested the State Party of Tanzania to conduct an EIA for the heavily used Naabi Hill- Seronera road through the property (World Heritage Committee, 2016). The State Party has now advised that this project will be evaluated based on the impact of a similar road being built near Ngorongoro Crater.

▶ **Droughts**

Data Deficient

(Climate change)

Inside site, extent of threat not known
Outside site

The potential impact of climate change is unknown within the Park, but may affect critical aspects of ecosystem dynamics including water availability and the quality and quantity of grazing. Within the Mara River basin in Kenya, the effect of climate change on the Mara River discharge has been documented by USAID (2019) mainly as increasing variability (more inter-annual variability with potentially more severe occasional droughts and floods). One of the primary threats of climate change is that it alters the rainfall patterns or the rainfall gradient that drives the seasonal migration of wildebeest, zebra, Thompson's gazelle, Grant's gazelle, eland and elephant (Hopcraft, 2016; Veldhuis et al., 2019). If rainfall become less predictable then migratory animals are more likely to mismatch the timing of their movement to the availability of forage. Furthermore, if the entire gradient shifts to an area beyond the protected area boundary, animals will not be able to relocate in order to find food and water.

▶ **Flight Paths**

Data Deficient

(Airport development project)

Outside site

According to the 2014 State of Conservation report, there are plans for the construction of an international airport at Mugumu, approximately 40 km away from the World Heritage Site. This airport

would increase the area's capacity for tourism development. The State Party (2020) has informed that the developer is shelving the project for the moment.

▶ **Tourism/ Recreation Areas** — **High Threat**

(Tourist accommodation)

Inside site, localised(<5%)

Several new tourist lodges and permanent tented camps have been proposed inside the property, most likely facilitated by the changes to the zonation scheme of Serengeti, as reported by multiple sources (IUCN Consultation, 2020). It is understood that the 2014-2024 General Management Plan for Serengeti has reclassified many of the low-use zones (where permanent infrastructures were not permitted), to a high use zone, therefore giving way to more development. The Magadi lodge for example, is proposed to sit directly in the rhino protection zone. Pressure for proposals for even more tourist infrastructures in wildlife sensitive areas can therefore be predicted, which will severely threaten the Outstanding Universal Value of Serengeti.

▶ **Dams/ Water Management or Use** — **Very High Threat**

(Dams on the Mara River basin)

Inside site, extent of threat not known
Outside site

A series of proposals by Kenya to both divert Mara (Amala) River water to another river basin (the Ewaso Ng'iro River) and to construct a number of dams on the Mara and its main tributary (the Nyangores River) is a major concern. These include: the Ewaso Ng'iro Project, which would link the Mara River system through a tunnel with the upper drainage of Ewaso Ng'iro (South) River; the Amala dam and Norera dam on the Amala River; and the Mugango dam on the Nyangores River. The Amala and Nyangores are tributaries at the upper reaches of Mara River. The minimum environmental flow in the Mara River downstream of the dams is proposed in the dams' feasibility studies to be 0.1 m3/s (Mnaya et al., 2017). This is upstream of the irrigated areas in Kenya. Once water for the farms are removed, the volume of water reaching Serengeti can be assumed to be extremely low. Finally the diversion of water from the Mara (Amala) River to the Ewaso River (another river basin) will alter the water flow into Lake Natron, which the Committee has been requesting the State Parties of Kenya and Tanzania to consider as a serial transnational extension to Kenya Lake System of the Great Rift Valley, given its critical importance for the conservation of lesser flamingo. Furthermore, the Borenga dam has also been proposed downstream of Serengeti in Tanzania, which will likely have less drastic impact on Serengeti but will still have the potential to impact on land and the river.

Overall assessment of threats — Very High Threat

The availability of Mara River water is a crucial factor and could significantly alter the Outstanding Universal Value of the site. New irrigation farms, hydropower dams and river diversion will lead to a considerable reduction in water reaching the Serengeti, especially vital during the critical dry season. The paved access roads from Arusha (Mto wa Mbu) to Loliondo is being built, while the bypass road is still being planned after waiting 10 years; once the Arusha to Loliondo road is paved and open, pressure to open the road to commercial traffic is probable, which would adversely affect the wildebeest migration and could endanger the ecosystems and wildlife populations of the Serengeti and its wider ecosystem. Tourism demand is growing strongly, creating pressure for further accommodation, game-viewing tracks and other infrastructure developments. Threats from poaching, fire, disease transmission from domestic stock, spread of invasive alien plants and human-wildlife conflicts also pose threats, and the extent of impact from climate change is unknown.

Protection and management

Assessing Protection and Management

▶ Management system — Mostly Effective

The park operates under a General Management Plan (2014-24), with four main management programmes aligned to the park's operational departments (ecosystem management, tourism, community outreach and park operations). Tourism impacts are managed through a system of zonation with high use, low use and wilderness areas. However, the 2014-24 Management Plan has not been submitted to UNESCO for review. The 2010 IUCN/UNESCO monitoring mission team commended TANAPA for the quality of the GMP and considered that it could serve as a model for other parks in the country as well as other World Heritage sites. It is unclear whether this still stands in the current version. The GMP is limited by national issues (highway) and international issues (Mara River water) over which it has no control. Critically, no details are available on the implementation of the GMP.

▶ Effectiveness of management system — Mostly Effective

Management is generally effective. In the past there were significant budgetary constraints as the majority of Serengeti revenues are used to cross-subsidize other parks elsewhere in Tanzania. Capital investment was particularly affected, with insufficient funds available for enough patrol vehicles and road servicing plant (State Party of Tanzania, 2011). The situation has much improved. Anti-poaching patrols increased from 45,180 patrol man-days in 2014 to 45,400 in 2015 (State Party of Tanzania, 2016). These efforts led to confiscation of 28 firearms, 207,479 other weapons and 1,748 arrests (State Party of Tanzania, 2016). There were 51 patrol vehicles in 2016/2017 compared to 42 in 2014/2015 and a second light aircraft was purchased for aerial surveillance. Some vehicles were donated by the international NGO, Frankfurt Zoological Society (FZS), and all vehicles are efficiently serviced and maintained in the FZS mechanical workshop in Seronera. In 2016/2017, 1,028 poachers were apprehended and 9 firearms confiscated, thousands of wire snares were removed and destroyed, and only 8 elephants and no rhinos were poached. No new figures were reported in the 2020 report by Tanzania, except its commitment to maintain zero poaching of rhinos. Anti-poaching efforts have been supplemented by National initiatives to implement paramilitary scheme with a pilot scheme in Serengeti.

Tanzania has reinstated their commitment that the part of the northern road crossing the Serengeti National Park will remain under the management of the Tanzania National Park (TANAPA) but no recent confirmation is given as to whether the road will be reserved for tourism and administrative purposes, as had been reported previously. Compliance with this earlier commitment will require enforcement and a monitoring mechanism.

▶ Boundaries — Some Concern

The World Heritage site is at the core of the wider Serengeti ecosystem and is surrounded by other protected areas, making up about half the total area. The ecological integrity of the site is therefore dependent on effective management and protection of areas beyond its boundary, which constitute a 'buffer zone'. This seems assured, but it would be advisable to formally recognize the adjoining protected areas as a buffer zone (UNESCO and IUCN, 2010). Physical demarcation of the boundary (with concrete cairns) is ongoing. There has been a plan since 2012 to extend the 'western corridor' of the park (adding 96 km2) to provide wildlife access to permanent fresh water at Speke Gulf (Lake Victoria), especially so during droughts, but this is being resisted by local community representatives (State Party of Tanzania, 2012) and this issue is still discussed in Parliament (State Party of Tanzania, 2020). The area, which includes several kilometers of lake that has critical fish rearing habitat associated with the outflows of the Mbalageti and Grumeti rivers, has already been assessed and mapped for planning purposes. Serengeti is surrounded by lands under different legislation on the Tanzanian side regarding the activities permitted. These are: Game Reserves which are managed for trophy hunting and tourism (Grumeti, Ikorongo, Maswa and Handajega), Game Controlled Areas managed for wildlife and pastoralist people with limited hunting (Loliondo), Conservation Areas managed intensively for wildlife in specific areas and wildlife and pastoralists in others (Ngorongoro), and Wildlife Management Areas managed by communities for wildlife and sustainable livelihoods but aimed primarily at generating tourism revenue for local people (Makao and Ikona). The Makao and Ikona Wildlife Management Areas, Loliondo Game Controlled Area and portions of the Maswa Game Reserve are highly influenced by human activities; some of these activities have direct effect on the Park, i.e. for (1) cheetah and lions, (2) sending fires in

the Park, (3) intensive livestock grazing (often illegal), and (4) silting water holes in the park from gully erosion in Loliondo from cattle overgrazing. Several communities in Loliondo have disputed the location of the boundaries of the Serengeti, arguing that the government's interpretation removes them from their ancestral grounds. The law loosely describes the boundaries (i.e. using ridgelines and river confluences) thus leading to the recent push to demarcate them with concrete cairns based on surveying the area. Further, hunting pressure from some of these protected areas can affect the Serengeti although the demand for trophy hunting seems to be declining and is being replaced by photographic safaris in many areas (e.g. Grumeti and parts of Maswa).

▶ Integration into regional and national planning systems — Serious Concern

Coordination at a trans-boundary level, particularly over sustainable management of the Mara River, is in theory facilitated by the Lake Victoria Basin Commission (State Party of Tanzania, 2012). However the negotiations between Kenya and Tanzania on sharing the water of the Mara River are stalled (Tanzania, 2020).

The other issue is the lack of progress in the last 10 years in constructing the Serengeti southern bypass road, while the access road from Arusha (mto wa Mbu) to Loliondo is now being constructed; once that access road is completed it is expected that truck and bus operators will apply political pressure on the government to open the gravel road in the Park to commercial traffic, as using that road will solve them time and money.

In general, the Serengeti stakeholder's hold an annual meeting to discuss threats and management interventions facing all areas around the park. Inivitees are generally the protected area manager for each location including delegates from Kenya. This meeting serves as a forum to discuss collective strategies for the protection of the ecosystem and the services it provides.

▶ Relationships with local people — Some Concern

The park adjoins other protected areas on all sides, with only those lying to the east (Loliondo Game Controlled Area) and south (Ngorongoro Conservation Area) allowing a resident human population. Nevertheless, Community Outreach is one of the park’s four main programmes of work (GMP, 2006-16) with activities aimed at strengthening relationships with neighbouring communities and local government, and assisting with development of community-based natural resource management programmes in the buffer zones so as to reduce poaching and dependence on park resources. For those communities that chose to get involved, there is much success in avoiding conflicts and improving their livelihoods (FZS, 2019). However in other areas there have been disputes with people in Loliondo regarding the boundary and the right to graze cattle. This could be improved if any new construction of tourism infrastructure was limited to the periphery of the protected area boundary thereby providing local people with employment opportunities.

▶ Legal framework — Mostly Effective

The legal framework is robust, with the Tanzania National Parks Act CAP [282] of 2002 providing for the establishment of a semi-autonomous agency, Tanzania National Parks (TANAPA) with its own Board of Trustees and facility to retain all revenues. TANAPA operates under a comprehensive National Parks Policy, which requires that all national parks operate within the framework of an approved management plan. In addition infrastructural developments throughout Tanzania are subject to Environmental Impact Assessment (EIA) under the Environmental Management Act (2004) and 2005 EIA Regulations. The effectiveness of law enforcement operations, particularly those relating to poaching has been slowly improving, but there are still shortcomings. The park lost 90% of its rhinos to poachers in the 1980s and there had been a surge in commercial poaching for elephant ivory, before the recent increased anti-poaching efforts which has seen a significant decline in elephant carcasses (State Party of Tanzania, 2020).

▶ Law enforcement — Some Concern

TANAPA has instated a comprehensive GIS database for monitoring several aspect of the park operations, including the location and patterns of illegal activities inside the park. This provides

information to managers and assists with planning their resource protection activities. A major component of the annual budget is invested in resource protection (patrol vehicles, rangers, aircraft, informants, etc) (Hilborn et al, 2007). The national penalties and fines for illegal activity such as poaching have been increased in the last 7 years, however many of the fines for poaching still remain less than the value of the meat from an average poaching trip, which is not an effective deterrent. New regulations regarding livestock incursions enable the park to auction the cattle if the fine is not paid within a specified time period. Depending on the size of the herd, this has significantly reduced the rate of illegal grazing inside the park.

▶ Implementation of Committee decisions and recommendations — Serious Concern

Some positive actions have been undertaken to respond to the Committee's decisions such as strengthening its anti-poaching efforts, leading to reduced elephant poaching and zero poaching of rhino. However, no action has been taken by Tanzania to develop a joint management plan with Kenya for the Mara River Basin to sustainably manage water resources that is fundamental to protecting the Outstanding Universal Value of Serengeti, requested by the World Heritage Committee since 2014 (World Heritage Committee, 2014, 2016, 2018). In the 2020 report, Tanzania notes that a joint Water Allocation Plan (WAP) will be based on the WAP for Kenya (developed) and Tanzania (underway) implying that the joint plan has still not started 6 years after the Committee's initial request.

▶ Sustainable use — Some Concern

There is no legal consumptive use of resources within the site, but most of the adjoining protected areas (the ‘buffer zone’) allow some degree of resource use, including trophy hunting (in Maswa Game Reserve), pastoralism (in Loliondo and Ngorongoro) and other compatible activities. Non-sustainable use of resources including poaching and conversion to agriculture is increasing in the buffer zones and has now become a serious threat in all the buffer zones and especially in Loliondo (Blackburn et al., 2016; TAWIRI, 2017; Setsaas et al, 2018; Shilereyo et al., 2019; Probert et al., 2019; Veldhuis et al., 2019; Walelign, 2019a and b; Kihwele et al., 2020). The extraction of water in areas upstream of the Serengeti remains a major problem to the long-term health. In addition, boreholes and diversion of spring water to support tourist camps also needs to be comprehensively assessed in terms of its sustainability.

▶ Sustainable finance — Some Concern

Serengeti is one of TANAPA’s main sources of revenue, and 70% of the US$ 22.4 million generated in 2009/10 was used to support conservation of less profitable parks elsewhere in Tanzania. The remaining 30% (US$6.5 million) was deployed at Serengeti, where it was insufficient to meet all planned expenditures. In previous years, capital investment has been badly affected by budget constraints, leaving the park with insufficient patrol vehicles and heavy plant for road maintenance (State Party of Tanzania, 2011). However the situation has much improved; recently the Park has acquired a 2nd airplane for logistics and anti-poaching patrols as well as a number of vehicles; several of these vehicles were donated by FZS (FZS, 2019) and all the vehicles are efficiently serviced by the FZS mechanical workshop in Seronera. In 2020, media reported of a proposal for the Tanzania Revenue Authority to collect revenues from national parks (AllAfrica, 2020). The decoupling of financial responsability from conservation professionals is dangerous as the allocation of resources may not match the requirement seen on the ground and could make future management interventions very challenging to address. Furthermore, the implications of COVID-19 due to loss of tourism is yet to be seen.

▶ Staff capacity, training, and development — Mostly Effective

There are currently 422 staff, somewhat short of the required 608 envisaged in the General Management Plan (State Party of Tanzania, 2012). Approximately half are park rangers, responsible for law enforcement. The 2010 mission team assessed the training levels of park wardens and other professional staff as being ‘good’, and that of technical staff as ‘fair’.

▶ Education and interpretation programs — Data Deficient

The park operates an outreach programme, also supported by FZS, and assists in organizing group visits

by local community members and presentation of movies in villages. In addition, the park has made some recent improvements to the visitor's center to include a lecture/theater as well as interactive displays. The interpretation and education material around the centre is of good quality although needs some improvements.

▶ Tourism and visitation management

Some Concern

The number of visitors has increased strongly over the past ten years, and currently numbers around 300,000 per annum, about half of whom are foreign visitors. There is a total bed capacity of 3,766 and a policy to grow this number through development of low-impact high-value facilities, focused on additional tented camps. Visitor awareness around sustainability remains a major challenge. For instance, the majority of people arriving by road enter the park at Naabi gate which is located in the rainshadow of the Ngorongoro Crater. There is no water at Naabi however this is the first toilet break many visitors get in over 5 hours of driving. The park trucks thousands of liters of water over 60 km every day to maintain the toilets at Naabi at huge expense. In addition, the roads in Serengeti are not paved, however one of the major complaints in the visitor log books at the gates are complaints about the dust. More awareness about the environmental impacts would be justified.

▶ Monitoring

Some Concern

Ecological monitoring involving systematic aerial censuses of the principal large mammals has been undertaken every few years for several decades, providing a sound understanding of population trends for about 20-25 prominent species. Six main ‘ecosystem health indicators’ have been identified in the General Management Plan to serve as a focus for future ecological monitoring activities as follows: migration; Mara river flow; Terminalia and Acacia woodlands, rhino population, kopjes habitat and wild dog. The park was part of the UNESCO pilot project (2007) on management effectiveness, which involved development of a monitoring system to track implementation of management activities, but this has not been used, nor has an effective alternative been developed (UNESCO and IUCN, 2010). There remains a need to develop protocols to monitor management effectiveness and the conservation impacts of management interventions, as a basis for adapting management.

▶ Research

Mostly Effective

The park has been a major centre of ecological research for five decades, and the Serengeti Research Centre has well-established linkages with international academic institutions. It has well-equipped (although rapidly waning) laboratories, a herbarium and accommodation facilities for visiting scientists. There are currently 15 research projects underway, including long-term studies on cheetah, lion, hyena, biodiversity, vegetation dynamics, wildlife diseases and water quality/quantity (State Party of Tanzania, 2011). Most have relevance to management. In addition, the research community has a full-time employee experienced with GIS and database management who is seconded to the national parks. This personnel acts as liaison between research and park management. A primary task is to produce monthly reports about some of the core ecological indicators for the system such as rainfall, grass greenness, movement of animals, and river flow.

Overall assessment of protection and management

Some Concern

Serengeti benefits from a strong policy and legislative environment which enables TANAPA to raise and retain revenues from a rapidly growing number of visitors. However the recent proposal for a role for the Tax Revenue Authority, as well as the consequences from park closure due to COVID-19 are yet to be seen.
Although there are still some shortcomings this is one of the best managed parks in Africa, maintaining a high degree of ecological integrity. The site is surrounded by other protected areas, and although these are subject to some degree of resource use from trophy hunting, pastoralism and overgrazing, as well as some illegal activities including poaching and charcoal making, they serve as a buffer zone maintaining the ecological integrity of the entire ecosystem. Until a long-term agreement is reached between Tanzania and Kenya on the management of the Mara River Basin however, water

availability in Serengeti remains uncertain.

▶ **Assessment of the effectiveness of protection and management in addressing threats outside the site** — **Some Concern**

Serengeti National Park is surrounded by a number of protected areas, which gives a degree of protection from external threats. However, there appear to be conflicts with several communities regarding the park boundaries, and change of land use and cattle grazing pressure are pushing into the Serengeti boundaries. The continued absence of a joint management plan of the Mara River Basin between Tanzania and Kenya remains a critical issue and threat for the protection of the values of Serengeti. The access road from Arusha (mto wa Mbu) to Loliondo is now being constructed, which once completed may be subject to political pressure to open the gravel road in the Park to commercial traffic, which would severely affect the values of the site.

State and trend of values

Assessing the current state and trend of values

World Heritage values

▶ **Greatest terrestrial mammal migration on Earth** — **Low Concern** — **Trend:Deteriorating**

The migration remains intact with all major parts of the route used by the migrating herds included within protected areas. Small areas of the migration route bordering the north-west of the park are unprotected and some poaching occurs here, but populations of the major species are able to withstand this level of off-take (Thirgood et al., 2004). Agricultural fencing in Kenya and conservation fencing in Tanzania cast a concerning shadow about maintaining these migrations, especially considering the role that fences have played in the collapse of many other migratory populations in Africa and around the world (Harris et al., 2009). A recent census of the migratory population suggests the abundance has not changed significantly from 1.3 million wildebeest. The future remains uncertain however in the face of potential hydropower dams upstream of Serengeti, thereby modifying water flow of the Mara River, increasing tourism developments within the park and climate change.

▶ **Outstanding savanna scenery** — **Good** — **Trend:Stable**

The scenic values of the site are being well maintained, with lodge and tented camp developments generally well positioned, concealed, and appropriately designed. There has been a concerted effort to reduce the amount of light pollution and to reduce the amount of noise (generators), especially from lodges that occupy hill tops. More efforts on these fronts are needed, particularly as evidence shows that human activity displaces wildlife from many of these key areas.

▶ **Complex and complete mammalian community** — **Good** — **Trend:Stable**

This is one of the few African parks to have maintained a complete mammalian fauna (with the exception of wild dog, which became locally extinct in 1991, UNEP-WCMC, 2011). Five wildlife censuses of major species conducted between 1996 and 2010 indicate stable populations of 13 species, increasing populations of 5 species and decreasing populations of 1 species (State Party of Tanzania, 2011; TAWIRI Aerial Census, 2010). More recent data are needed to determine the current trend accurately.

▶ **Diversity of savanna communities** — **Data Deficient** — **Trend:Data Deficient**

No data available, but assumed to be stable. Monthly transects conducted by the Serengeti Biodiversity

Program suggest predator and herbivore communities remain largely intact and viable, although the distributions of some species have changed (most notably a few species of birds associated with particlar types of habitats).

▶ Diversity of other fauna and flora

Data Deficient
Trend:Data Deficient

No data available, but assumed to be stable. Inventories of rodents, amphibians, butterflies and some other classes insects occur too infrequently to determine trends, however species lists do exist. These are not up-to-date, however genetic barcoding being conducted by the Serengeti Biodiversity Program for pooled collections of instects will likely reveal a lot more diversity. A herbarium at the Serengeti Wildlife Research Institute started in the 1960s provides an excellent basis for assessing the floral diversity.

▶ Rare and endangered species

Low Concern
Trend:Deteriorating

Poaching of elephant has decreased in recent years leading to possible increase in their population. However, this supposed immigration from surrounding areas and Kenya could be explained by a number of factors such as habitat loss and fencing in the Mara (State Party of Tanzania, 2018). The small black rhino population (remnants of a population that was heavily poached during the 1980s) has been supplemented with additional animals translocated from South Africa (originally from East African genetic stock). A TAWIRI-led project reintroduced about 6 packs of wild dogs into Serengeti National Park from Loliondo, and except for one pack that remained in the Park all the other packs moved outside the Park presumably to avoid conflicts with lions and hyenas that are numerous in the Park and less so in the buffer zones (Jackson et al., 2019). Certain packs had been known to prey on livestock thus attracting persecution from pastoral communities in the area, so populations are being monitored by TAWIRI. Road kills of charismatic animals, such as cheetah, are of concern. Lion populations are recovering well from a disease-induced mortality but there are conflicts with pastoralists in the buffer zones.

▶ Large, ecologically dynamic self-sustaining ecosystem

High Concern
Trend:Deteriorating

The site, with its surrounding protected areas under various management regimes has been well maintained, ensuring the maintenance of ecological integrity of the entire ecosystem. However, this value is under increasing strain and pressure from changing land use in adjacent areas, tourism infrastructure development and upstream dam proposals. Studies have pointed to changing ecological function of Serengeti driven by compression of wildlife (Veldhuis et al., 2019).

Summary of the Values

▶ Assessment of the current state and trend of World Heritage values

High Concern
Trend: Deteriorating

The World Heritage values of Serengeti National Park are being maintained for now as a result of appropriate management of the site and surrounding protected areas (which serve as an essential buffer zone, sustaining the migrating herds for much of the year beyond the boundaries of the park). Nevertheless, human-wildlife conflict with surrounding areas continue with increasing human population growth. The proposed hydropower dams upstream of Serengeti together with climate change modifying rainfall patterns, will alter the natural ecological pattern and therefore possibly the migration of mammals. Tourism development pressure is increasing (until COVID-19) and the combined impacts of such disturbance from the infrastructures and the increased tourist numbers have the potential to damage the Outstanding Universal Value. Wildlife avoiding such disturbed areas have already been recorded. Whilst anti-poaching efforts appear to be effective in general, the status of the park's two most endangered species (black rhino and wild dog) remain a concern.

Additional information

Benefits

Understanding Benefits

▶ **Collection of wild plants and mushrooms,**
Traditional agriculture,
Livestock grazing areas

Indigenous communities in the Serengeti ecosystem have historically depended on their livestock.

Factors negatively affecting provision of this benefit :
- Pollution : Impact level - Low
- Overexploitation : Impact level - High, Trend - Continuing
- Invasive species : Impact level - Moderate, Trend - Increasing
- Habitat change : Impact level - High, Trend - Increasing

Cattle grazing is increasing outside of Serengeti. The Maasai communities in the east and Sukuma communities in the south and west have historically depended on livestock keeping as the mainstay of their economy. There is some collection of fire wood and charcoaling in the protected area as well as a limited amount of gathering of natural plants and medicinal herbs. Illegal harvesting of bushmeat is a major concern with up to 100,000 animals killed around 2010, however estimates suggest this is now declining due to increased patrol efforts.

▶ **History and tradition,**
Wilderness and iconic features,
Sacred natural sites or landscapes,
Cultural identity and sense of belonging

The Serengeti ecosystem harbours cultural and spiritual values for Maasai, Ikona, and Wakuria communities. In particular, there are sites that were once inhabited, rock paintings, and spiritual beliefs about important confuences of rivers.

Historical evidence suggests that the Serengeti has been occupied by humans for millennia. Stone hand tools date back hundreds of thousands of years, whereas obsidian fragments and sharpening stones suggest these areas were important hunting and trading grounds in the order of 10,000 years ago (post ice-age). Masai expanded into the Serengeti displacing hunter-gathering tribes such as the Dorobo in order of 300-400 years ago.

▶ **Importance for research,**
Contribution to education

Serengeti is an important area of research and education. The Serengeti Wildlife Research Centre is one of the longest running biological research institutes in the world and several of the projects have been running continuously since the 1960s. The area now is a text-book example of what we know about ecosystem processes such as population regulation and consumer-resource interactions.

▶ **Soil stabilisation,**
Flood prevention,
Water provision (importance for water quantity and quality),
Pollination

Spanning vast expanses of plains, savannah, savannah woodlands and forests serve as an important water catchment. In addition, evidence suggests the grassland ecosystems are a major contributor to soil carbon sequestration. The system provides a natural regulation to pests such as rodent populations, which flourish outside the park boundaries but are downregulated by a complex trophic web inside the park. The diversity of scarabs and pollinators in the protected area provides a source of beneficial

services, such as dung beetles and bees.

▶ **Tourism-related income, Provision of jobs**

Tourism in Serengeti is the main source of local employment and employment. Overall the greater Serengeti ecosystem (i.e. both Kenya and Tanzania and the buffer zones) generates in the region of 180 million USD/year in gate entrance, concession, hunting and transit fees. In Tanzania, tourism accounts for 16% of the GDP and the majority of this tourism is around the country's rich natural history.

Summary of benefits

Serengeti is a world-class example of how conservation benefits the country economically and socially through community development, promotes international cooperation in science, technology and sustainable tourism, while maintaining Outstanding Universal Value.

Projects

Compilation of active conservation projects

№	Organization	Project duration	Brief description of Active Projects
1	Frankfurt Zoological Society		Support for ecological monitoring, resource protection, and tourism activities, community conservation
2	Tanzania Wildlife Research Institute		Implementation of regular aerial censuses, wildlife research
3	Friends of Serengeti (Switzerland)		Support of resource protection and infrastructure projects
4	WWF		Monitoring and coordination of efforts towards sustainable management of the Mara river
5	Grumeti Fund		Wildlife conservation and community development in synchrony
6	Freidkin Conservation Fund		Conservation particularly focused on endangered species and the protection of the Maswa landscape
7	University of Glasgow		The Serengeti Biodiversity Program, including the Serengeti Tracker
8	University of Minnesota		The Serengeti Lion Project

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