Lake Malawi National Park

2020 Conservation Outlook Assessment

SITE INFORMATION

Country: Malawi
Inscribed in: 1984
Criteria: (vii) (ix) (x)

Located at the southern end of the great expanse of Lake Malawi, with its deep, clear waters and mountain backdrop, the national park is home to many hundreds of fish species, nearly all endemic. Its importance for the study of evolution is comparable to that of the finches of the Galapagos Islands. © UNESCO

SUMMARY

2020 Conservation Outlook

Finalised on 01 Dec 2020

SIGNIFICANT CONCERN

Since its inception in 1984, Lake Malawi National Park has largely retained its four outstanding universal values. With regard to aesthetics, it remains a region of outstanding natural beauty. However, there has been some decline in this value. Aquatic biodiversity and endemism among nearshore fishes remain high. However, there is evidence that fish diversity has declined in some areas of the park.

The major current threats include: poaching, deforestation, overfishing, water and solid waste, poorly managed tourism, invasive species, oil exploration and climate change. Major potential threats include: continued deterioration of nearshore water quality associated with deforestation and agriculture in the lake's watershed, invasive alien species, oil extraction and continuing climate-driven changes. The park's major management challenges include: lack of financial resources, need for better tourism management and staff training in aquatic conservation, coordination with other sectors (e.g. Fisheries, Forestry, Agriculture) to address management of Lake Malawi as a whole, and weaknesses in monitoring and enforcement.

The trends of most threats and metrics are such that there is significant concern about the park's long-term conservation status. However, there have been several very positive developments in the past decade with regard to park management. The granting of concessions to private agencies has led to the development of tourist facilities on three of the park's islands (Domwe, Mumbo, Nankoma). These tourist operations have resulted in localized improvement of environmental conditions, have created employment, and have allocated a portion of their profits for the benefit of local communities. Park management has facilitated the development of Village Natural Resource Committees, which serve as a liaison between park management and local communities for the purpose of natural resource management and the disbursement of funds received from the tourist concessions. Park management has finalized an updated park management plan and a fish monitoring protocol (although these are not yet being implemented) and have made progress in

identifying conservation priorities within the broader Lake Malawi/ Nyasa/ Niassa catchment with a view to establishing a buffer zone and extending the boundaries to enhance the integrity of the site following requests from the World Heritage Committee to do so. Several new culturally important sites have been identified in and near the park.

Lake Malawi National Park remains an extremely valuable asset and heritage for local communities, for the country of Malawi, and for the entire world. The park's stewards have had to work under the constraints of a severely limited budget. Additional national and international investment is needed to provide these stewards with the resources needed to conserve one of Earth's most beautiful and unique freshwater environments.

FULL ASSESSMENT

Description of values

Values

World Heritage values

▶ Outstanding natural beauty of Rift Valley Great Lake **Criterion:(vii)**

Situated in the Great Rift Valley of Africa, Lake Malawi is the 3rd largest lake in Africa and the 9th largest in the world. It is characterised by crystal clear waters, and high diversity of habitats. On the Mozambique and Tanzanian shorelines the lake is bounded by wooded hillsides of steep escarpments, while on the Malawi coast there is greater variety of habitat with gentler sloping shorelines in many areas, but also extensive rocky islands and shorelines, with massive rounded granite boulders, partially submerged and washed by wave action in many areas. Between the rocky sections are sun-drenched sandy bays, with inflowing rivers and streams creating reedy lagoons and lake-edge swamps. The juxtaposition of these landscape elements creates scenes of outstanding natural beauty (World Heritage Committe, 2010).

▶ Key example of evolutionary processes **Criterion:(ix)**

In the lake, the rapid speciation leading to the species flocks of cichlids and clariids, which challenge evolutionary biologists, are of particular significance (Kornfield and Smith, 2000; Snoeks, 2001; Turner, 2007; Weyl et al., 2010). The speciation of cichlid fishes in Lake Malawi is considered to be of equal or of greater importance for the study of evolutionary processes as the Galapagos Island finches or honeycreepers of Hawaii (IUCN 1984; World Heritage Committee, 2010)

▶ Extraordinary diversity of fish species **Criterion:(x)**

Lake Malawi contains more fish species than any other lake in the world, with estimates of number of species varying widely but most likely in the range of 1,000 species with hundreds of cichlid species still to be described (Turner et al., 2001). Its fishes are a source of food for millions, provide a livelihood for thousands, encourage tourism, fascinate the scientific fraternity, enchant aquarists around the world and maintain ecosystem processes in the lake (Weyl et al., 2010). As a result there is an abundance of peer-reviewed and grey literature available on the limnology, fisheries and ichthyofauna of the lake (Oliver, 2017).

▶ Extremely high levels of species endemism **Criterion:(x)**

Endemism is extremely high, with >99% of cichlid fish and an entire clariid species flock (Bathyclarias spp.) known only from Lake Malawi

Other important biodiversity values

▶ Terrestrial biodiversity

The terrestrial component comprises wooded hillsides that protect part of the catchment of the lake. The biodiversity of these terrestrial habitats includes a few notable species. Mammals include hippopotamus (Hippopotamus amphibius, VU) (particularly in the Monkey Bay area) grey duiker (Sylvicapra grimmia, LC), Sharpe’s grysbok (Raphicerus sharpei, LC), klipspringer (Oreotragus oreotragus, LC), baboon (Papio spp., LC), vervet monkey (Chlorocebus pygerythrus, LC), bush pig (Potamochoerus larvatus, LC) and warthog (Phacochoerus africanus, LC) (Carter, 1987; Lewis et al., 1986). The elephant population, over 70 animals, that used to frequent wooded areas inland from the park and occasionally come down to drink in the lake, has been relocated to Majete Wildlife Reserve, with a small remnant remaining in the area. Leopard (Panthera pardus, VU), greater kudu (Tragelaphus

strepsiceros, LC), bushbuck (Tragelaphus scriptus, LC), zebra (Equus quagga, NT) and samango (Cercopithecus mitis, LC) are rare, probably greatly reduced but with no recent data. The park is rich in birdlife including fish eagle (Haliaeetus vocifer, LC) along the shoreline. The islands, especially Mumbo and Boadzulu, are important nesting areas for white-throated cormorant which number several thousand (Linn & Campbell, 1992). Reptiles include crocodiles and abundant monitor lizards on Boadzulu Island (World Heritage Committee, 2010).

Assessment information

Threats

Current Threats

Very High Threat

The major current threats to the property include: oil exploration, ecological disruption by invasive alien species, overfishing, and land use change (including deforestation) with associated impacts on nearshore water quality. Pollution is on the rise through expanding human populations and increasing tourism development, especially along the shorelines near the enclave villages.

▶ **Changes in traditional ways of life and knowledge systems that result in negative impact, Identity/social cohesion/ changes in local population and community that result in negative impact**

(Changes to traditional way of life)

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

The traditional way of life in Chembe Village - fishing and subsistence farming - has been irretrievably changed by the influx of tourists and outsiders seeking employment in the tourism and service sector and an increase in human population. Other enclave villages have been impacted by rising human populations, overcrowding, and declining fish populations.

▶ **Mining/ Quarrying**

(Sand and clay mining)

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

Sand and clay mining for building materials, brick production, etc. is a potential threat inside the park and causes land degradation and loss of aesthetics in surrounding areas. Brick-making in and adjacent to the park relies in part on fuel wood harvested from the property, which is collected illegally.

▶ **Solid Waste**

(Litter, both on land and in the lake)

High Threat
Inside site, throughout(>50%)
Outside site

Litter, both on land and in the lake, is a major growing problem. In particular, plastic is becoming more prevalent along the shores of the lake along encalve villages, with most of it in the form of plastic bags (Mayoma et al., 2019).

▶ **Tourism/ visitors/ recreation**

(Tourism capacity)

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

While tourism activity within the park has declined since its inception due to the deterioration of facilities at the Golden Sands camp (Bootsma, 2018), there has been an explosion of tourist facilities adjacent to the camp in Chembe Village over the past two decades. Litering along the park entra road to Chembe encalve village is evident (IUCN Consultation, 2020). Operators of some of these facilities are making efforts to minimize environmental impacts, but the increased number of visitors and permanent residents has likely led to increased pollution. Of particular concern is the effect of sewage on nearshore water quality, which may contain high concentrations of fecal bacteria and other human pathogens

(Tyner et al., 2018). Other tourism impacts include increased disruption of nearshore fish communities by scuba divers and boat noise (Harding et al., 2018), and loss of local culture and tradition.

▶ Fire/ Fire Suppression

High Threat
Inside site, throughout(>50%)
Outside site

(Uncontrolled veld fires)

Uncontrolled burning of almost the entire terrestrial component of the park estate is an annual occurrence, with major impacts on woodland density and species composition, animal habitat, soil erosion, and nutrient mobilization (Bootsma et al., 1999; Abbot and Mace, 1999).

▶ Forestry/ Wood production

High Threat
Inside site, throughout(>50%)
Outside site

(Deforestation)

The denudation of the hills of the LMNP is clearly apparent in satellite photos in the 2014 mission report (UNESCO & IUCN, 2014) and in more recent photos (Bootsma 2018). This is due to excess harvesting of fuelwood as well as regular burning. Abbot (1996) showed that collection of firewood (fallen dead branches and twigs of small diameter) for domestic use was less to blame than harvesting large trees and branches for use in smoking fish. As the population density in the enclave villages has increased by more than 5X since the park's inception (UNESCO & IUCN, 2014), the rate of tree loss has likely increased, although this may be tempered to some degree by the provision of electrical power to some enclave villages, which was not available when the park was first established. The increased turbidity of nearshore waters resulting from soil erosion has a negative effect on fish behavior, and may lead to loss of diversity (Seehausen et al., 1997; Rusuwa et al., 2006).

▶ Water Pollution, Household Sewage/ Urban Waste Water, Air Pollution

High Threat
Inside site, localised(<5%)
Outside site

(Water and air pollution)

Due to limited industrialization within the Lake Malawi watershed, the concentration of toxins is relatively low (e.g. Kidd et al., 2003). However, nearshore concentrations of fecal coliform bacteria in much of the nearshore water around the property are very high (Tyner et al. 2018). Sources may include seepage from septic tanks and pit latrines and run-off from contaminated soils through use of the bush for defaecation, particularly early in the rains when accumulated human waste is washed into the lake. The most recent date (Madsen et al., 2011; Nagoli et al., 2019) indicates that the prevalence of schistosomiasis is much greater in park enclave villages than in villages located further inland. Localized pollution also results from spillage of boat fuel and oil. Conventional forms of air pollution are not a serious problem for most of the year, but air pollution can be locally and temporally severe during the dry season when biomass burning is widespread. Apart from the direct effects on human health, biomass burning also transports large amounts of nutrients through the atmosphere into the lake, promoting eutrophication (excessive growth of algae; Bootsma et al. 1999).

▶ Agricultural effluents

High Threat
Inside site, localised(<5%)
Outside site

(Soil erosion and nutrient leaching)

Leaching and runoff of fertilisers is not a major threat, as agriculture is limited primarily to Chembe Village, and the application of fertilisers is moderate. Of greater concern is soil erosion resulting from deforestation and poor agricultural practices. Sediment loading to the lake from the Nankumba Peninsula is moderate, due to the small watershed area and granitic geology of the region. However, deforestation and agricultural expansion have resulted in increased loads of sediment and nutrients to the lake from larger tributaries (Hecky et al., 2003). The effect of these loads on the Nankumba Peninsula appears to be relatively small (Vundo et al., 2019), but the Maleri Islands, which are near the mouth of the Linthipe River, are heavily impacted by turbid plumes (McCullough et al., 2007) which are a major threat to fish abundance and diversity in the nearshore waters around these islands (Rusuwa et al., 2006).

▶ Oil/ Gas exploration/development

Very High Threat
Inside site, throughout(>50%)
Outside site

(Off-shore oil exploration.)

Offshore oil exploration activities have commenced in the northern part of the Lake (Africa Oil and Power, 2017). Although this is some distance from the World Heritage property it presents the risk of oil and other pollutants spilling into the lake, which would have far-reaching consequences. In late 2013, a second oil concession was awarded, which covers the southern part of the lake, including the entire property. An Environmental Impact Assessment has been conducted, but it is not widely available. More recently, Hamra Holdings Inc. has been licensed to explore for oil in the lake until 2022. This concession is incompatible with the property's World Heritage status and should be adjusted to exclude the property (UNESCO and IUCN, 2014). Confidential correspondence between conservation organisations and government offices has yet to clarify the situation, and some government offices appear to believe that the threat is minimal because any extraction that is done will be offshore and in the northern part of the lake (Bootsma, 2018). Oil extraction is a particularly severe threat for two reasons: 1) Lake Malawi is essentially a closed system. It has a flushing time of more than 600 years, so any oil spilled in the lake will stay in the lake and will affect the entire lake. 2) Limited local infrastructure and expertise would prevent a rapid, effective response to any major oil spill. Oil drilling anywhere in the lake represents a significant threat to the unique assemblage of endemic fish species and associated evolutionary processes (Verheyen et al., 2016), which are the basis for the property's inscription on the World Heritage List (World Heritage Committee, 2016). In January 2020, the State Party reported that oil exploration in Block 4, which overlaps with the property and owned by RAKGas, has been cancelled (State Party of Malawi, 2020). However, block 4 is still mentioned on the website of RAKGas and therefore clarity is still needed.

▶ Fishing / Harvesting Aquatic Resources

Very High Threat
Inside site, throughout(>50%)
Outside site

(Overfishing and illegal fishing)

Overfishing and illegal fishing is a major problem throughout the park waters. The zonation plan developed by Tweddle et al. (1984), designed in consultation with the fishing communities to reduce conflict and restore fishers' rights to some key fishing sites, was never implemented. Fishing activities to not specifically target mbuna (the 13 genera of cichlids that make up the majority of the nearshore biodiversity), which are relatively small, but mbuna are caught in nets that are set for other species. Since its inception in 1984, there has been a decline in cichlid diversity in most park waters, with the exception of Chinyamwezi and Chinyankhwazi Islands (Kanyumba et al., 2012). In addition to negatively affecting biodiversity, nearshore fishing in park waters results in the capture of spawning fish and immature fish, including chambo (three species of Oreochromis), lowering the productivity of these commercially important species (Bell et al. 2012). The only areas where significant protection occurs are those around tourist lodges on Mumbo and Domwe Islands, and the southern end of Thumbi West Island (which is frequented by scuba charters based in Chembe Village). Earlier attempts to reduce fishing in park waters using anti-netting devices were successful, but met with so much protest from local fishers that they had to be abandoned (Konings, 2017). Park authorities are working on these challenges and the procurement of a speed boat through the African Development Bank can assist in law enforcement activties. Apart from two brief surveys (Rusuwa et al., 2006; Kanyuma et al., 2012), there has been no monitoring of fish abundance and species composition within park waters.

▶ Livestock Farming / Grazing

Low Threat
Inside site, extent of threat not known
Outside site

(Livestock overgrazing)

While there is a significant amount of agriculture (primarily maize production) in some of the enclave villages, grazing and foraging within park boundaries is limited primarily to small groups of goats and chickens in some of the enclave villages. These have some influence on vegetation in park land

immediately around the villages but have a minimal impact on the parks terrestrial habitat as a whole.

▶ Housing/ Urban Areas

High Threat
Inside site, localised(<5%)
Outside site

(Increased human population)

Human population in the enclave villages has increased from an estimated 6000 in the 1970s to more than 25,000 (State Party of Malawi, 2018). The population in the largest town outside of the park, Monkey Bay, has also increased, from 5,649 in 1987 to 14,955 in 2018 (Malawi Government Statistics Office, 2019). Population growth in the enclave villages is due to both reproduction and migration from other regions, primarily for the purpose of fishing. This places major strain on the natural environment as well as the social and physical health of the communities themselves. In addition to increased demand on the park's natural resources, population growth within the enclave villages has resulted in the encroachment of houses within the park boundaries, even where these boundaries are well marked (Bootsma, 2018).

▶ Tourism/ Recreation Areas

High Threat
Inside site, localised(<5%)
Outside site

(Poorly managed tourism, and excessive localised development.)

The tourism focal point of the park is Cape Maclear, at the northern end of the Nankumba Pensinsula. This area included the park's largest enclave village, Chembe. The village's economy historically relied primarily on agriculture and fishing. There was limited tourist accommodation within the village, and most tourists stayed in tents and rondavels at the Golden Sands Holiday Camp, which is within the park. In the past 20 years Golden Sands has deteriorated to the point where it receives few visitors, while the Chembe Village beachfront has seen the development of numerous tourist facilities, including several scuba charter companies and Kayak Africa, a company that operates tourist camps within the park on Mumbo Island and Domwe Island. The tourist camps have resulted in a net benefit to the park, including the reduction of illegal fishing near the camps and income that benefits park management as well as local communities through the legally recognized Mangochi Salima Lake Park Association (MASALAPA). By contrast, the increased tourism in Chembe village has produced mixed results. While it has likely resulted in a net increase of income to the village, it has altered village culture in negative ways. Unofficial tour guides from the village escort tourists into the park, often without payment of park admission fees. The high density of tourist facilities along the beach front may also result in deterioration of nearshore water quality due to the leaking of fecal bacteria and human pathogens from septic systems. There is currently little data to assess the magnitude of this impact, but it is known that nearshore fecal coliform counts are extremely high in other areas close to the park (Tyner et al., 2018). According to a State Party report (2020), assessments are currently underway for the development of tourist facilities within the park at Cape Maclear, with support from the African Development Bank. Providing these facilities are scaled to minimize any environmental impact, they may increase park income while also enhancing the park's role as a regional and global biodiversity education centre; however an Environmental Impact Assessment needs to be undertaken with a particular focus on OUV to determine its potential implications on the WH property and therefore its suitability.

▶ Marine/ Freshwater Aquaculture

High Threat
Outside site

(Introduction of diseases through introduction of invasive alien species and through overcrowding.)

The Malawi Department of Fisheries actively promotes aquaculture within the country, utilizing indigenous species. The aquaculture operation closest to Lake Malawi National Park is that operated by Maldeco Aquaculture, which was initiated in 2004 and operates close to the park's southernmost component, Boadzulu Island. This operation poses little direct threat to the park's fish community, although if it is expanded it may have some effect on water quality in the area around Boadzulu Island (Gondwe et al., 2012). Of greater concern is the presence of two non-indigenous species of Oreochromis that are being grown on fish farms in the Tanzanian portion of the Lake Malawi watershed – O. niloticus and O. leucostictus (Genner et al., 2013). O. niloticus in particular is likely to compete and hybridize with native species. No observations of these species have been reported in Lake Malawi, but

because they are being grown in ponds that have a direct connection to the lake's largest tributary – the Ruhuhu River – their introduction into the lake seems inevitable. Farming of common carp (Cyprinus carpio) was previously promoted by the Malawi Government. Although it has since been banned, its re-introduction is still being considered (Chirwa et al., 2019). Being a shallow-water benthic feeder, its introduction to Lake Malawi could be devastating for nearshore biodiversity.

▶ **Roads/ Railroads** — **Low Threat**

(Upgrading of road to Cape Maclear)

Inside site, localised(<5%)
Outside site

When the park was first established, the road from Monkey Bay to Cape Maclear was mostly dirt and was occasionally unusable in the rainy season. Much of the road was paved between 2010 and 2012, and currently most of the road is paved, although there remain some rough areas. Road upgrading has resulted in easier access to the park's interior, which may have accelerated the extraction of park resources, especially wood (and charcoal), but also facilitates patrolling and provides easier access to the park by tourists.

▶ **Hunting and trapping** — **High Threat**

(Poaching)

Inside site, throughout(>50%)
Outside site

Poaching is a major problem in the park. The mammalian fauna, with the exception of vervet monkeys and baboons, has been reduced to a fraction of that when the park was established, which was itself impoverished (Carter,1987; Chafota et al., 2005).

Potential Threats — Very High Threat

There are two immediate potential threats and two longer-term potential threats. The immediate threats are the introduction of non-indigenous species and the deterioration of nearshore water quality. The longer term threats are oil exploration / extraction and climate change. The biggest alien threat is the presence of Nile tilapia in the lake catchment for aquaculture. Escape and colonization of the lake is inevitable without urgent action to remove the threat. There is strong evidence the loading of sediment and nutrients (phosphorus and nitrogen) to the lake have increased over time, and data from other African lakes, particularly Lake Victoria, demonstrate the negative impact this can have on fish diversity. Oil exploration and extraction is a major threat, as exploration licences have been granted throughout the lake to several companies. For all practical purposes, Lake Malawi is a closed system. Any oil spills will remain in the lake for decades, and will spread throughout the entire lake. Long-term records indicate that Lake Malawi and the other African Great Lakes are warming as a result of climate change. The current and future effects of this warming are uncertain. Climate warming in nearby Lake Tanganyika has resulted in a decline in fish production. Recent large-scale fish kills in Lake Malawi may also be the result of changes in lake circulation resulting from lake warming.

▶ **Oil/ Gas exploration/development** — **Very High Threat**

(Spillages from oil exploration and extraction)

Inside site, extent of threat not known
Outside site

An oil spill has the potential to have a significant negative impact on the lake including its fish population, and may take a considerable time to recover.

▶ **Invasive Non-Native/ Alien Species** — **Very High Threat**

(Introduction of invasive alien species and diseases)

Inside site, extent of threat not known
Outside site

The threat of alien / invasive species related to aquaculture is described above. The primary species of concern are Oreochromis niloticus (Nile tilapia), O. leucostictus, and Cyprinus carpio (common carp). Other reports on LMNP have discussed the risk of introduction of predators such as Nile perch and tigerfish (UNESCO & IUCN, 2014). The risk of the former species is minimal as it would require a coordinated multinational project to succeed, but there is a risk of accidental introduction of tigerfish through the canals of the proposed Lower Shire Irrigation Scheme. In addition to affecting ecological and

evolutionary processes, the introduction of non-indigenous fish species may lead to the spread of disease.
An invasive gastropod, Melanoides tuburculata, has recently entered Lake Malawi and is present within park waters, where it has altered the composition of the native benthic invertebrate community (Van Bocxlaer and Albrecht, 2015). To date its impact on the lake's fish fauna appears to be minimal, but continue monitoring of this and other benthic invertebrates species is critical.
Within Lake Malawi there is local endemism, with many cichlid species confined to specific islands or rocky reefs. In the past there has been relocation of species within the lake, due primarily to the release of fish from aquarist collectors (Trendall, 1988). This poses a threat to local biodiversity, as relocated species may compete with locally endemic species, and may also hybridize (Kanyumba et al., 2012). The aquarist trade has become more sensitized to this problem over time, and it is believed to be less serious than in the past, but the lack of monitoring data makes it difficult to determine whether this is still occurring.

Water hyacinth (Eichornia crassipes), an invasive aquatic plant that originated in South America, has caused serious problems in the Shire River, which drains Lake Malawi. The plant is present in the lake, although its abundance is low, likely due to the relatively low nutrient concentrations in the lake (Bootsma and Jorgensen, 2004). However, in areas that experience high nutrient loads, such as the Maleri Islands which are near the mouth of the Linthipe River, the expansion of water hyacinth is a real threat. Lake Victoria serves as an object lesson in the devastating impact this plant can have on biodiversity, water quality and local economies (Masifwa et al., 2001).

▶ **Habitat Shifting/ Alteration, Temperature extremes, Storms/Flooding**

High Threat
Inside site, throughout(>50%)
Outside site

(Changes in lake nutrient dynamics that affect plankton and fish productivity. Changes in river discharge and lake level.)

Like other lakes around the world, Lake Malawi is warming (Vollmer et al., 2005). The effects of this warming on lake biota and ecosystem processes remains uncertain. However, in neighboring Lake Tanganyika there is evidence that warming has affected lake stratification and nutrient cycling in a way that has led to reduced fish production (Cohen et al., 2016). Since 1999 there have been several lake-wide fish kills in Lake Malawi, and one potential cause of these kills is rapid mixing within the lake that brings anoxic, sulphide-rich waters to the surface. If the lake's deep waters are warming more quickly than its surface waters, thermal stratification will weaken, increasing the frequency and magnitude of such events in the future. Alternatively, if surface waters are warming more quickly than deep waters, as appears to be happening in Lake Tanganyika, plankton and fish production will decline. Simulation models suggest that Lake Malawi will experience extreme rainfall, river inflow, and lake levels as climate continues to change (Bhave et al., 2020). Increased river inflow will result in greater soil erosion and nutrient loading, negatively affecting nearshore water quality. Large fluctuations in lake level may result in changes in the distribution of nearshore habitat types, which may lead to species loss in some areas and opportunities for speciation in other areas.

▶ **Water Pollution, Agricultural effluents, Air Pollution**

High Threat
Inside site, extent of threat not known
Outside site

(Nearshore water quality)

Studies have documented the deterioration of nearshore water quality in Lake Malawi, which is due primarily to sediment and nutrient inputs from tributary rivers (Hecky et al., 2003; McCullough et al., 2007). Cichlid fishes are highly dependent on visual cues for mate selection, and declines in water clarity have been shown to results in loss of biodiversity (Seehausen et al., 1997). While the Nankumba Peninsula region is somewhat less susceptible to these impacts, due to the absence of large tributary rivers in the region, other parts of the park, especially the Maleri Islands, are highly susceptible (McCullough et al., 2007). An increase in water turbidity will also likely result in the reduction of benthic algal production, which is the source of primary production that supports much of the nearshore fish community (Bootsma et al., 1996). Continued expansion of agriculture onto marginal land will increase this threat, which will be especially severe in years of high rainfall.

Overall assessment of threats

Very High Threat

Most changes that have occurred within the park since its inception in 1984 are the result of overfishing and over-exploitation of its terrestrial resources, including trees. These are long-term threats that have small impacts within a given year, but large cumulative impacts over time. Changing nearshore water quality is less well quantified, but a very serious threat considering its potential to impact nearshore biodiversity. The risk posed by some invasive species may be compounded by changes in nearshore water quality. For example, water hyacinth is not currently a severe threat within the lake because nutrient concentrations in the lake are relatively low. Increased nutrient input from rivers and the atmosphere will result in water hyacinth becoming a more severe threat. The risk posed by oil exploration / extraction is high; while the likelihood of oil pollution currently appears to be relatively low (no major reserves have been discovered in the lake), its impact would be catastrophic.

Protection and management

Assessing Protection and Management

▶ Management system

Mostly Effective

Park management is organised around four departments responsible for (a) conservation management (b) research and monitoring (c) education and extension and (d) administration. The park's initial management plan was developed in 1980, and it has gone numerous revisions since then, although not all of these revisions were implemented. This plan was recently revised with support from UNESCO (Bootsma, 2018) and is currently being finalized (State Party Report, 2020). The most recent plan includes a Fish Monitoring Protocol, which was developed in collaboration with the Malawi Fisheries Department.

▶ Effectiveness of management system

Some Concern

The 2014 monitoring report (UNESCO and IUCN, 2014) stated that the mission was impressed by the resourcefulness of the management team, and that with a modest level of additional finance much more could be achieved. This was reiterated in a 2018 management assessment report (Bootsma, 2018). Better education of the staff in management of aquatic ecosystems is essential for effective management of the property, along with improved environmental education for communities and improved relationships between park management and the enclave communities. Improved tourism management has the potential (if carefully and sensitively undertaken) to provide needed financial resources to support management.

▶ Boundaries

Some Concern

Satellite imagery shows that the terrestrial boundaries are relatively well- defined, but it is clear that the aquatic boundaries are totally ignored by fishers. Some aquatic boundary markers have been placed near the Maleri Islands, but there is a need for more demarcation of aquatic boundaries in other parts of the park. Previous deployment of anti-netting devices by conservation groups provoked a strong backlash from fishers, due to damage of their fishing gear. If the location of these devices is clearly indicated with surface markers, this may result in less gear damage and better compliance with fishing restrictions. In the pipelines are plans to also improve terrestrial markers where encroachment is a problem. The WH Committee has requested the State Party, in consultation with Mozambique and Tanzania, to examine the feasibility of establishing a buffer zone and extending the property's boundary to strengthen its integrity (WH Committee, 2018). In 2019 an IUCN led workshop on prioritizing conservation action for freshwater biodiversity in the Lake Malawi catchment, conducted in collaboration with various Ministries of Malawi, led to the identification of 18 new Key Biodiversity Areas (KBAs) in the catchment, located in and surrounding the WH site (Sayer et al., 2019). These KBAs provide information

towards addressing the Committee decision to extend the WH site boundaries to incorporate additional important conservation areas (World Heritage Committee, 2018).

▶ Integration into regional and national planning systems

Serious Concern

There is still a lack of integration of biodiversity in general into regional and national planning systems. The fish and fisheries of Lake Malawi are vital natural resources for the countries around the lake. The lack of integration is highlighted in Malawi's National Biodiversity Strategy and Action Plan II (2015 – 2025), which states that: "Despite their economic, social and environmental importance, biodiversity and its ecosystem services are poorly understood and undervalued. It is important that relevant sectors are aware of the value of biodiversity so that they are fully engaged to ensure protection, conservation and restoration of biodiversity. Mainstreaming biodiversity conservation and its value into sectoral policies and accounting systems will improve the management of biodiversity in Malawi." The plan has a very modest target, in that: "By 2025, biodiversity values are integrated into national, sectoral and local development policies and plans." The situation with regard to fisheries management and protection of the lacustrine environment is critical and cannot wait until 2025 to be resolved.

▶ Relationships with local people

Some Concern

There has been a tense relationship between park management and enclave villages since the park's inception in 1984. This is due primarily to the park's restrictions on the use of natural resources, including woodlands, terrestrial game, and the protected 100-meter zone within the lake. In the Chembe Village region this tension has been ameliorated to some degree by the increased tourism in the village, which has grown the local tourism economy. In addition, the relationship between park management and enclave villages has been improved somewhat through the creation of Village Natural Resource Committees (VNRCs), which are coordinated under the Mangochi Salima Lake Park Association (MASALAPA). These committees serve as a liaison between park management and enclave residents, facilitating outreach and education (Bootsma, 2018). They also serve as a mechanism for a portion of park revenue to be allocated to villages in and around the park, which has led to a more favorable impression of the park. However, illegal wood cutting, poaching, and fishing continue to occur in the park, and population growth in the villages has increased the demand for land to build houses. According to the State Party Report (2020), the African Development Bank is will be providing business management training opportunities to local communities, with the intent of diversifying the local economy and reducing the need to exploit the park's natural resources.

▶ Legal framework

Mostly Effective

The policy and legislative framework is strong, as laid out in Section 2 of the 2014 monitoring mission (UNESCO and IUCN, 2014) and in the Lake Malawi National Park Management Plan, which was recently revised (State Party Report 2020). There is an overarching statute, i.e. the Environmental Management Act of 1996. The National Parks and Wildlife Act was reviewed in 2017, which is the framework under anyone illegally collecting resources within the site will be fined.

▶ Law enforcement

Serious Concern

Enforcement is carried out through the collaboration of park staff, local communities, and the private sector (e.g. Kayak Africa, which operates tourist concessions on two of the park's islands provide information of illegal activities). However, enforcement is hampered by limited staff, equipment, and funds (Bootsma, 2018). Enforcement of park and fisheries regulations is unfortunately very weak, severely handicapped by inadequate recurrent budgets and insufficient vehicles, boats and other equipment (UNESCO and IUCN, 2014; Bootsma, 2018). Furthermore, the park staff have terrestrial backgrounds and have minimal or no training in fish taxonomy / ecology and aquatic resource management. Compliance with regulations has been improved to some degree through education facilitated by the Village Natural Resource Committees, as well as a business partnership between Kayak Africa and the Chembe Trust (now the Village Natural Resources Committee, which formed an umbrella body called the Mangochi Salima Lake Park Association), which has increased the willingness

of Chembe Village leaders to help regulate fishing around Cape Maclear and Mumbo Island.

▶ Implementation of Committee decisions and recommendations

Some Concern

Some of the previous recommendations have been acted on. For example, some aquatic boundary markers have been placed around the Maleri Islands, and most of the park boundaries around the enclave villages are well marked. The park management plan has been revised, and it now includes a fish monitoring protocol. According to the State Party Report (2020), monitoring equipment has been procured, but it appears that no formal monitoring program has been initiated. An environmental impact assessment of oil exploration has been conducted, but its availability is limited, and the Malawi Department of National Parks and Wildlife does not have a copy of this report. It was recommended by UNESCO (2018) that the State Party develop a strategy to address the issue of population growth in the enclave villages. This is addressed to some degree in the Nankumba Peninsula Strategic Plan, which is summarized in the Lake Malawi National Park Management Plan. This Plan proposes intensive and medium development sub-zones in areas adjacent to the park. However, the fact that population growth in the park villages has been more rapid than that in Monkey Bay (the largest town adjacent to the park) raises doubts as to whether this plan is being successfully implemented. Currently, the State Party's main response to this recommendation has been to increase patrols and boundary inspections to minimize encroachment. It was also recommended that the State Party consider the feasibility of establishing buffer zones and extending the boundaries around the property. The State Party has indicated that this would be difficult considering the population growth in the area and the heavy reliance of local communities on fishing as a source of food and income. Rather, the State Party's response has been to promote increased community participation in the development and implementation of management strategies.

▶ Sustainable use

Serious Concern

The park's terrestrial resources are over-utilized, resulting in the loss of trees and alteration of woodland composition, with fire-resistant species becoming dominant in many areas (Abbot and Mace, 1999). Deforestation also accelerates soil erosion, which in turn has a negative effect on nearshore water quality. There is a permitting system for the collection of wood within the park, but it is easily circumvented. Collection of fish within park waters by the aquarium fish trade is not permitted in the site and is considered illegal accordin to the Wildlife Act of 2004, revised in 2009 and 2017.

▶ Sustainable finance

Serious Concern

Lack of finance is a serious concern, affecting management effectiveness. The park and its surrounding communities are benefitting from the income generated by tourist concessions, such as Kayak Africa. This is a very positive development. However, there is evidence that the increased income from tourist concessions has been partly, or completely, offset by reduced allocations from the national treasury. Park income from tourism would likely benefit substantially from the development and promotion of facilities at the Golden Sands Holiday Camp so long as it does not have any impacts of the OUV of the property, demonstrated through an EIA.

▶ Staff capacity, training, and development

Serious Concern

Management staff are well-motivated according to the 2014 monitoring report, but their training is largely terrestrial and thus aquatic ecology knowledge is lacking. This is being remedied to some degree through collaboration with the Malawi Fisheries Department and the University of Malawi. However, even the Fisheries Department has limited expertise in the area of mbuna taxonomy.

▶ Education and interpretation programs

Serious Concern

The environmental education programme in the GEF/SADC Lake Malawi/Nyasa Biodiversity Conservation Project had an environmental education component that trained 22 people from the three countries that

border the lake, but none of these trainees have been retained in Lake Malawi National Park. An Environmental Education Centre with aquaria, meeting rooms, a display building, and rondavels for accommodation, was constructed at the Golden Sands site in the early 1990s. It was rehabilitated in 1998 with support from the GEF/SADC Lake Malawi/Nyasa Biodiversity Conservation Project. Since then it has been neglected and is once again in need of major renovation. There are reports of plans for the African Development Bank to support the rehbilitation of the education centre. The rondavels are in reasonably good condition, as is the meeting hall, but the display building is somewhat run down, and the aquarium is not functional. The Education Centre has great potential, both for public education and as a tourist attraction, but it has not been used effectively to target local communities.

▶ Tourism and visitation management — Serious Concern

Small eco-lodges on the islands in the park appear to be well-managed and beneficial to the park on the whole, as their presence inhibits (but does not eliminate) illegal activities, they provide income to the park, and they provide employment for local communities. The large-scale, low-end tourism along the beach occupied by Chembe Village has both positive and negative impacts. The sector has impacted on the lifestyle of the indigenous Chembe community and led to an influx of people from outside seeking employment and servicing the tourists. It has also led to unregulated access to the park. At the same time, the park benefits from some of this tourism, as tour facility operators are required to charge clients park admission fees.

The Golden Sands site has great capacity for hosting tourists and has been a focal point of tourism within the park in the past. It is currently run down and almost completely unused. The possibility of having the Golden Sands site managed through concession to a private operator has been considered numerous times since the park's inception, but no concrete steps have been made toward this goal (Bootsma, 2018). According to a State Party Report (2020), the African Development Bank is currently funding an assessment of the site for the construction of improved tourist facilities.

▶ Monitoring — Serious Concern

Some monitoring of terrestrial resources is carried out through regular patrols by park scouts. However, this is semi-quantitative at best, and will not detect long-term trends in vegetation cover or woodland composition. This could be remedied to some extent through the use of historical satellite imagery. Of greater concern is the complete lack of monitoring of aquatic resources. The only data with which to assess long-term trends of fish within park waters is that from several short-term, localized studies (Trendall, 1988; Rusuwa et al., 2006; Kanyumba et al., 2012) which can provide site-specific comparisons with the baseline data collected by Ribbink et al. (1983). In addition to fish monitoring, there is a critical need to monitor nearshore water quality, as this serves as an integrative measure of changes within the watershed, and has a direct effect on fish diversity (e.g. Seehausen et al., 1997). The establishment of a nearshore water quality monitoring program was a key recommendation that came out of the Lake Malawi/Nyasa Biodiversity Conservation Project (Bootsma and Hecky, 1999), due to the recognition that sediment and nutrient loads to Lake Malawi have been increasing (Hecky et al., 2003). This need is underscored by the fact that there have been several major whole-lake fish kills that have occurred since 1999 (1999, 2005, 2010, and 2014). There are several potential causes of these large-scale kills, including toxic algae and the upwelling of anoxic, sulphide-rich water following periods of high winds, but the cause remains open to speculation because there is no monitoring data that might be used to determine the conditions in the lake at the time of these kills.

A major step that park management has made toward aquatic monitoring is the completion of a fish monitoring protocol, which was developed with assistance from the Malawi Fisheries Department. While some equipment has been procured for this purpose, a critical impediment remains the training of park staff in the areas of fish taxonomy, fish ecology, and limnology. This needs to be a high priority for the park.

Despite these limitations, park staff have the capacity (with support from the Fisheries Department) to monitor fish catches in the enclave villages, with the primary purpose of ensuring that the mbuna are not being illegally exploited in park waters.

▶ Research

Some Concern

In the past, high quality research has been conducted in the park into a wide range of aquatic topics and a very large body of scientific literature is available. Much of this research has been driven by outside interests, particularly evolutionary biologists attracted by the globally important cichlid species flock. However, it is encouraging to note that the capacity for aquatic research within Malawi has grown, primarily within the university system and the Fisheries Department. The Department of National Parks and Wildlife has been supportive of this research, and the provision of scuba equipment along with the construction of accommodation facilities for visiting scientists adjacent to the Environmental Education Centre has helped to facilitate research within the park. However, the park's ability to capitalize on research results has been hampered by the limited scientific expertise among the park staff.

Overall assessment of protection and management

Serious Concern

While there is serious concern about the site's protection and management, the park retains most of the features that qualify it as a World Heritage Site. Specifically, the diverse nearshore fish community remains largely intact, due to the fact that this community is not specifically targeted by fishers. Woodlands have been altered, but the park still retains regions of relatively dense woodland. Water quality is slowly changing in Lake Malawi, and while the Maleri Islands have been heavily impacted, water remains relatively clear around the Nankumba Pensinsula, due to paucity of large rivers draining this area. Most of the challenges the park faces with regard to protection and management have existed since its inception. The primary challenges include: (i) over-exploitation of the park's terrestrial resources, including woodland, grasslands, and fauna; (ii) minimal protection of fish within the 100 meter zone; (iii) inadequate tourist facilities (resulting in part from failure to engage with potential partners for tourism development); (iv) weaknesses in monitoring and enforcement; and (v) weaknesses in environmental education.

The key underlying causes of these challenges are lack of sufficient funding, lack of expertise (especially with regard to fish taxonomy and ecology), and challenges that result from the presence of densely populated enclave villages within the park. In addition, despite its status as a World Heritage site, the park appears to be given lower priority than some of Malawi's other parks and game reserves with regard to management, protection and tourism development. Ironically, this may be because Lake Malawi Park in an aquatic park. As such, it requires an approach to protection and management that is fundamentally different from that used in the more conventional terrestrial parks, and for which there is limited expertise. In the past two decades, additional threats have arisen that are relevant to the entire Lake Malawi ecosystem, including oil exploration, climate change, land use change (with associated inputs of sediment and nutrients), over-fishing, and alien species introductions. These challenges cannot be addressed by the park alone, or by the State Party alone, as they are trans-border issues that must be addressed at the watershed level through cooperation with multiple sectors and the other riparian states – Mozambique and Tanzania.

▶ Assessment of the effectiveness of protection and management in addressing threats outside the site

Serious Concern

Large scale threats to the site that originate beyond its boundaries include oil exploration / extraction, over-fishing, deteriorating water quality due to nutrient and sediment loads, and climate change. These threats need to be addressed at the Lake Malawi watershed scale, and require multi-sector, international collaboration. While the Malawi Department of National Parks and Wildlife and the Malawi Forestry Department manage large terrestrial ecosystems, the primary agency responsible for the management of Lake Malawi is the Fisheries Department. Cooperation among the three riparian nations (Malawi, Tanzania, Mozambique) is facilitated through the SADC Protocol on Shared Water Courses, and the Zambezi Water Commission (ZAMCOM). However, even at the national level the management of natural resources is highly fragmented, with minimal coordination

among sectors and uncertainty about responsibilities that is due in part to confusion related to the government decentralization process (Kamoto, 2014; Ngochera et al., 2018).

▶ **Best practice examples**

Management of Lake Malawi National Park may benefit from lessons being learned in the Lake Niassa Reserve, which was established on the Mozambique side of the lake in 2011. This reserve has taken a management approach that allows various levels of fishing based on park zonation, and which relies heavily on collaboration between park staff and local communities.

State and trend of values

Assessing the current state and trend of values

World Heritage values

▶ **Outstanding natural beauty of Rift Valley Great Lake**

High Concern
Trend:Deteriorating

Lake Malawi, including the lake Malawi National Park, is an exceptional lake, with outstanding beauty and incredible biodiversity. The combination of steep hills, diverse woodland, clear water, multiple islands, and a diverse community of colourful fishes in the nearshore waters make this a truly unique environment. At the whole-lake scale, major concerns with regard to natural beauty are deforestation, sediment loading that creates turbid nearshore waters, and occasional dense algal blooms resulting from nutrient (nitrogen and phosphorus) inputs. Within Lake Malawi National Park, the natural beauty of the area has generally deteriorated since the park's inception, with the major causes being deforestation, pollution (especially plastic), and the decline of the Golden Sands Holiday Camp. Depending on perspective, some might also argue that the proliferation of tourist facilities along the Chembe Village beach has detracted from the area's cultural attraction. However, there are exceptions to the general trend. Specifically, the establishment of the Environmental Education Centre at Cape Maclear has added to the aesthetics of the area (when the Centre is properly maintained), and the areas around the tourist concessions on Domwe and Mumbo Islands have become more attractive, with less deforestation, less pollution, and the development of hiking trails.

▶ **Key example of evolutionary processes**

Low Concern
Trend:Stable

There is no current threat for this value. The lake remains an ecosystem of remarkable global significance for understanding of evolutionary processes. There is a potential future threat in the form of catastrophic pollution resulting from accidental spillages during oil exploration/production. Likewise, eutrophication and increased turbidity in the nearshore zone may be disrupting the evolutionary process and negatively affecting biodiversity by accelerating habitat loss and promoting hybridization, similar to what has been observed in Lake Victoria (Seehausen et al., 1997).

▶ **Extraordinary diversity of fish species**

High Concern
Trend:Data Deficient

Species diversity remains high within Lake Malawi National Park, and within Lake Malawi as a whole. However, a quantitative assessment of any diversity trends is difficult because so little monitoring has been conducted. Some reports suggest that diversity has remained unchanged over the past several decades (State Party, 2020), while others indicate it has declined, at least in some areas (Kanyumba et al., 2012). Threats to diversity include invasive species, nutrient / sediment loading with associated loss of habitat and decreasing water clarity, and oil pollution. Over-fishing may also be resulting in loss of

diversity in some areas. While fishers typically do not target the nearshore mbuna fishes, they are included as bycatch when gill nets and beach seines are used in the nearshore zone.

▶ **Extremely high levels of species endemism**

High Concern
Trend:Data Deficient

While species endemism is currently stable, there is a real threat due to alien / invasive species. A non-indigenous gastropod has already been introduced to the lake, and the effects of this on the endemic invertebrate community require further study (Van Bocxlaer and Albrecht, 2015). Similarly, Nile tilapia are present within the Lake Malawi watershed (Genner et al., 2013), and this species has significant potential to affect the abundance and distribution of other tilapiine species. There is also renewed interest in farming common carp in the catchment (Chirwa et al., 2019). This bottom feeder is an invasive species in many parts of the world, and has the potential to dramatically affect water quality and food web structure in shallow, nearshore systems.

Summary of the Values

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

High Concern
Trend: Stable

With regard to its four defining values, Lake Malawi National Park is quite similar to when it was first established in 1984. At that time there had already been significant deforestation, the Golden Sands Holiday Camp was a poorly managed menagerie of rondavels, caravans and campsites, and there was tension between park management and the enclave villages resulting from deforestation, small-scale poaching of terrestrial animals, encroachment of enclave housing, fishing in park waters, and squatting and fish smoking on some of the park island. Since that time, some of the aesthetic aspects have deteriorated (e.g. increased deforestation; further decline of the Golden Sands Holiday Camp), while others have improved (e.g. construction of an Environmental Education Centre; tourist concessions on the islands). Based on limited data, it appears that evolutionary processes, fish diversity, and the high level of fish species endemism have either not been impacted or have been impacted to a small degree. However, several threats have increased over the past several decades, due primarily to human population growth, the potential for oil extraction within Lake Malawi, and changing climate. Hence while the park's World Heritage values remain largely intact, there is an urgent need to establish monitoring programs to better assess the status and trends of these values, and to implement the park's recently revised management plan to address the most serious threats.

▶ **Assessment of the current state and trend of other important biodiversity values**

High Concern
Trend: Deteriorating

While the park was established primarily to protect the aquatic environment, it also has a sizeable terrestrial component. The area formerly supported a depleted but a diverse mammalian fauna, including lion, leopard, elephant, zebra, kudu, grey duiker, klipspringer, blue monkey, vervet monkey, baboon and dassies. There have been serious declines in most of these, with the probable exception of vervet monkey and baboon. It is likely that lion and zebra were already gone before the park was gazetted, and it is also unlikely that any kudu, blue monkey or leopard remain.

Additional information

Benefits

Understanding Benefits

▶ Collection of wild plants and mushrooms

Enclave communities have high dependence on natural resources, including indigenous plants for food, medicine, etc.

Factors negatively affecting provision of this benefit :
- Overexploitation : Impact level - High, Trend - Increasing
- Habitat change : Impact level - Moderate, Trend - Increasing

High human population growth is causing serious depletion of these resources.

▶ Fishing areas and conservation of fish stocks

Enclave communities have high dependence on natural resources, including fish. Lake Malawi National Park, if properly managed, acts as a Fish Protection Area where breeding can take place to restock surrounding fishing grounds naturally,

Factors negatively affecting provision of this benefit :
- Overexploitation : Impact level - Very High, Trend - Increasing

High human population growth results in increased fishing effort, causing declining catches, to which fishers adapt by increasing the size and number of fishing gears, placing further pressure on the fishery that results in severe overexploitation (Weyl et al. 2010). Loss of larger, traditional species then can result in a switch to smaller species, including the mbuna species the park was set up to protect.

▶ Access to drinking water

Communities around the park and in the enclave villages are totally dependent on the lake for their drinking water.

Factors negatively affecting provision of this benefit :
- Pollution : Impact level - Moderate, Trend - Increasing
- Habitat change : Impact level - Moderate, Trend - Increasing

Increasing nutrient levels and sedimentation in the lake affects water quality. Algal blooms become more frequent. Bilharzia is increasing because of increased human population, poor sanitation, and overexploitation of snail eating fishes (Madsen et al., 2011). Similarly, nearshore waters have high levels of fecal coliform bacteria (Tyner et al., 2018).

▶ History and tradition

Chembe Village is a long-established community originally occupied by local people. The other enclave villagers are migrants from the north of the lake, who moved south to take advantage of the more productive fishing grounds in the south of the lake. The Golden Sands complex includes ruins and a graveyard from the Livingstonia Mission Site, established in 1875.

The traditional livelihood strategies of Chembe village, based largely on fishing, is being impacted by immigration of people from outside the area looking to benefit from the influx of tourists.

▶ Wilderness and iconic features

Wildlife sustainability is dependent on habitat integrity and sufficient relatively undisturbed (i.e. wilderness) natural environments.

Factors negatively affecting provision of this benefit :
- Pollution : Impact level - Moderate, Trend - Increasing

- Overexploitation : Impact level - High, Trend - Increasing
- Habitat change : Impact level - High, Trend - Increasing

High human population growth results in increased encroachment into wilderness areas for exploitation of natural resources, including firewood (thus deforestation), wildlife (poaching). Plastic and other waste pollution is extreme in the enclave villages and surrounding areas and spills over into the park. This is an increasing threat.

▶ Wilderness and iconic features,
Sacred natural sites or landscapes

Mwalawamphini (the rock of the tribal face markings) is a National Monument on the road through the park to Cape Maclear. The carved appearance of this rock is due to natural shrinkage and weathering processes (Carter, 1987), but the site is considered sacred with healing powers by some medicine men. Other culturally important sites have recently been documented by the Department of Museums and Monuments (Bootsma, 2018), including rock paintings near the Monkey Bay jetty and Kankhande.

Vandalism is a potential risk to Mwalawamphini National Monument.

▶ Sacred or symbolic plants or animals,
Cultural identity and sense of belonging

Data deficient

Data deficient

▶ Collection of medicinal resources for local use

Traditional medicinal plants collected from the protected areas

With increasing human populations, harvesting of medicinal plants increases, placing resources under threat. There is no known information on the scale of this problem.

▶ Outdoor recreation and tourism

Tourism is a major contributor to the local economy.

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

Tourism is now a major livelihood contributor, particularly at Cape Maclear and tourist camps/lodges on the islands. While the presence of tourism operations on islands have localized negative impacts due to their development removing some natural environment, they also have major benefits in that their presence inhibits illegal activities on the islands, such as deforestation and illegal fishing. While tourism brings investment and employment into the area, there are some consequences. Demand for fuelwood and fish is greatly increased, exacerbating deforestation and overfishing and illegal fishing. With influx of people from outside the area to the villages, crime increases as well as alcohol and drug misuse. Sewage disposal has potential hazards through septic tank overflows and seepage into the lake, affecting drinking water quality and human health (e.g. Tyner et al., 2018).

▶ Natural beauty and scenery

The park is noted for its outstanding scenery, i.e. forested offshore islands and mainland hills, rocky coastlines, golden sandy beaches, and crystal clear waters supporting an abundant and highly colourful inshore, shallow water fish fauna, most notably the mbuna cichlids.

Factors negatively affecting provision of this benefit :
- Pollution : Impact level - Moderate, Trend - Increasing

- Habitat change : Impact level - High, Trend - Increasing

High human population growth results in degradation of the scenery, through deforestation and overcrowded enclave villages

▶ Importance for research

The lake is world-renowned for its 1000+ species of endemic cichlid species, as well as some endemic catfish species. The phenomenal adaptive radiation of the cichlid species flock has been a major focus of study for evolutionary biologists and fish ecologists, resulting in an enormous amount of cutting-edge publications. The park has been the focus for a great deal of these studies, since the pioneering studies of Fryer and Iles (1972), Ribbink et al. (1983) and Lewis et al. (1986).

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

Overfishing and illegal fishing within the park boundaries, and illegal translocations of fish within the lake by aquarium traders can adversely impact on research activities. Lack of adequate research facilities within the park also impedes national and international research.

▶ Contribution to education

WWF provided sustained low-level support during the early years of the park's development, contributing to the development of a residential Environmental Education Centre at Cape Maclear. The GEF/SADC Lake Malawi/Nyasa Biodiversity Conservation Project had an environmental education component that included training of 22 people from the three countries that border the lake, but none of these trainees were retained in Lake Malawi National Park. Globally, the cichlid flock evolution and adaptive radiation is a major contributor to teaching materials in many universities and a source for postgraduate studies from a wide range of countries.

The Environmental Education Centre at Golden Sands, Cape Maclear, is regularly visited by school groups. However, its condition has deteriorated and its current use for education is much less than previously. Most school groups that have visited the Centre have been from urban areas, and the Centre has been used very little to educate people in the park's enclave villages (Bootsma, 2018).

▶ Collection of genetic material

Data deficient

Data deficient

▶ Carbon sequestration,
Pollination

There is little data with which to assess the park's role in carbon sequestration. However, a recent whole-lake study suggests that Lake Malawi is a net carbon dioxide sink (Ngochera and Bootsma, 2019).

Factors negatively affecting provision of this benefit :
- Climate change : Impact level - Moderate
- Pollution : Impact level - Moderate

The lake's behavior as a carbon sink appears to be due primarily to the fact that it is permanently stratified, which affects how carbon and phosphorus are recycled within the lake. Excessive inputs of phosphorus, or temperature changes that disrupt the lake's stratification, may determine whether the lake is a net carbon sink or carbon source to the atmosphere.

▶ **Soil stabilisation, Flood prevention**

The protection of the hillsides in the park boundary theoretically protects against soil erosion, maintaining near pristine aquatic habitat.

Factors negatively affecting provision of this benefit :
- Overexploitation : Impact level - Moderate, Trend - Increasing
- Habitat change : Impact level - High, Trend - Increasing

While satellite imagery shows that vegetation cover in the park is better than in surrounding areas, with the park boundaries still visible on satellite imagery (UNESCO and IUCN, 2014), the vegetation is sparse, lacks large trees, and the impoverished sandy / granitic soils are vulnerable to erosion. Annual burning of grassland throughout the park also exposes the soils to erosion with the first rains.

▶ **Water provision (importance for water quantity and quality)**

All communities in enclave villages and along the entire lakeshore are dependent on the lake water for all purposes.

Factors negatively affecting provision of this benefit :
- Pollution : Impact level - Moderate, Trend - Increasing
- Habitat change : Impact level - Moderate, Trend - Increasing

Increasing nutrient levels and sedimentation in the lake affects water quality. Algal blooms become more frequent. Bilharzia is increasing because of increased human population, poor sanitation, and overexploitation of snail eating fishes.

▶ **Collection of timber, e.g. fuelwood**

The park is the source of fuelwood for the inhabitants of the enclave villages, and for smoking of fish caught around the park

Factors negatively affecting provision of this benefit :
- Overexploitation : Impact level - High, Trend - Increasing
- Habitat change : Impact level - High, Trend - Increasing

Abbot and Mace (1999) showed that fuelwood collection by women from the villages was not the primary cause of deforestation in the park as collection focused on dead branches of small diameter, and annual consumption did not exceed the rate of production. Instead, harvesting of larger trees and branches by men for use in smoking fish was pinpointed as the major culprit for deforestation. With the major increase in village populations (from 6000 when the park was established to 25000; UNESCO and IUCN, 2014), it is likely that the demand on woodlands for both fuel and fish smoking has increased since the study of Abbot and Mace (1999).

▶ **Sustainable extraction of materials (e.g. coral, shells, resin, rubber, grass, rattan, etc)**

The park is a source of thatching grass for roofs and fencing

Factors negatively affecting provision of this benefit :
- Overexploitation : Impact level - Moderate, Trend - Increasing
- Habitat change : Impact level - High, Trend - Increasing

While harvesting of thatching grass might be considered to be detrimental to the park’s terrestrial ecology, this is far outweighed by the problem of annual burning of almost the entire park estate, resulting in loss of soil fertility and woodland diversity. Benefits of grass harvesting to the communities outweigh the negative impacts on environment.

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

The tourism developments in and around the park are a major source of employment, in the hospitality sector, guiding, provision of services such as boat transport, shops, etc.

Factors negatively affecting provision of this benefit :

- Pollution : Impact level - Moderate, Trend - Increasing
- Overexploitation : Impact level - High, Trend - Increasing
- Habitat change : Impact level - High, Trend - Increasing

Negative factors associated with employment opportunities include increased demands on natural resources for the larger population, and loss of cultural identity in some of the enclave villages, especially Chembe.

Summary of benefits

By regulating the exploitation of the regions terrestrial and aquatic resources, the park has made the use of these resources more sustainable in the long term, although eventual depletion of resources, especially wood, will result if current trends continue. The significance of the park's benefits varies according to geographic scale – local vs national vs global. At a global scale, the park's spectacular biodiversity is a heritage the international community should commit to preserve. At the local scale, enclave inhabitants are likely less interested in the preservation of biodiversity as they are in the immediate benefits provided by the park, including its natural resources and the income derived from tourism. As a result, many enclave inhabitants still see the park as a loss of benefits, not a gain, and they continue to question why the park was established (Bootsma, 2018). However, the direct flow of funds from tourism concessions to Village Natural Resource Committees has to some degree heightened awareness of the benefits to be derived from biodiversity conservation. Further appreciation of the park's benefits among the local populations will require increased outreach and education, better collaboration between park management and local communities, and the exploration of further mechanisms by which tourism income can directly and equitably benefit the surrounding communities.

Projects

Compilation of active conservation projects

№	Organization	Brief description of Active Projects	Website
1	USAID / PACT / University of Rhode Island / Emmanuel International / Wildlife Society of Malawi	The USAID/Malawi Fisheries Integration of Society and Habitats Project (FISH) is a five-year endeavor launched in September 2014 with the overall goal to achieve "increased social, ecological and economic resilience of freshwater ecosystems and people who depend on them" in the four freshwater ecosystems of Lakes Malawi, Malombe, Chiuta and Chilwa, working closely with the districts of Mangochi, Balaka, Machinga and Zomba and Department of Fisheries. This project was initiated in 2014, and completed in 2019.	https://www.crc.uri.edu/projects_page/malawifish/ https://www.christianaid.org.uk/about-us/programmes/fish-malawi https://pactworld.exposure.co/fish

№	Organization	Brief description of Active Projects	Website
2	Japan International Cooperation Agency (JICA), and Japan Science and Technology Agency (JST).	An international joint research project titled “A Sustainable Community Development Model Harmonized with Valuable Nature in Lake Malawi National Park, the World Natural Heritage Site,” led by Prof. Tetsu Sato, Faculty of Collaborative Regional Innovation, Ehime University, Japan. This 5-year project will commence in April, 2020 after concluding the required agreements with the counterparts in Malawi. It aims to improve the standards of people’s lives and well-being in Chembe village in the Lake Malawi National Park, registered as a World National Heritage Site, by constructing integrated management systems of rich natural resources for fishery, agriculture, forestry and tourism.	https://www.ehime-u.ac.jp/prof-tetsu-satos-joint-research-project-in-malawi-was-selected-as-a-satreps-program/
3	African Development Bank / Malawi Ministry of Industry, Trade and Tourism	Promoting Investment and Competitiveness in the Tourism Sector (PICTS). The Project is aimed at increasing efficiency and effectiveness of Malawi institutions in tourism sector by strengthening management capacity with a view to generate revenue and create employment for citizens. Implementation of the Project is expected to strengthen governance in management of the tourism sector in Malawi through institutional strengthening. This will include developing a tourism investment master plan to guide tourism planning; building tourism statistical capacity; providing skills on park management, and equipping parks with modern IT for monitoring and combating poaching; educating communities around touristic sites on conservation; strengthening public-private dialogue; and building capacity of small and medium enterprises (SMEs) in the sector. The focus is on Kasungu National Park and Lake Malawi National Park.	https://www.afdb.org/fileadmin/uploads/afdb/Documents/Project-and-Operations/MALAWI_-_Promoting_Investment_and_Competitiveness_in_Tourism_Sector__PICTS__Project.pdf
4	USAID / PACT	Restoring Fisheries for Sustainable Livelihoods in Lake Malawi program (REFRESH). This is a follow-up to the USAID-funded FISH project that concluded in 2019. Pact aims to implement Restoring Fisheries for Sustainable Livelihoods in Lake Malawi (REFRESH) to conserve the freshwater biodiversity of Lake Malawi by restoring the natural fisheries productivity in the lakeshore districts of Karonga, Rumphi, Likoma, NkhataBay, Nkhotakota, Salima, Dedza and Mangochi. Its sub-purposes are: a) the targeted Lake Malawi aquatic habitats are healthy and well-managed; b)the endemic fish populations of targeted parts of Lake Malawi are healthy and self-sustaining; and c) the fisheries in the targeted parts of Lake Malawi are managed sustainably by 2024.	https://www.pactworld.org/country/malawi/project https://www.pactworld.org/country/malawi http://malawifisheries.org/bitstream/handle/20.500.12364/1200/USAID-Pact%20REFRESH%20Malawi%20FactSheet_v2.pdf?sequence=1&isAllowed=y

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