ISSN: 2976-7687

Journal of Waste Management & Recycling Technology

SCIENTIFIC Research and Community

Review Article

Open Access

A Review of Major Threats and Challenges to Conservation Management of Mammals in East Africa Incase of Nech Sar National Park, Southern Ethiopia

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ABSTRACT

Nech Sar National Park is one of protected areas (PAs) found in the southern Ethiopian rift valley. The park was established in 1974 with the objective to protect forests and wildlife, and the large mammals, in particular, to ensure that the overall biodiversity is conserved and ecosystem provisioning services are sustained. The aim of this paper is to review a number of previous scientific and grey literatures reported pertaining the threats and challenges facing the mammalian population over the last few decades. Thorough examinations of these documents reveal that Nech Sar National Park is believed to harbour more than 103 species, 28 families and 10 orders of mammals. Equus quagga and Hippopotamus amphibious are flagship species in the terrestrial and aquatic habitats, respectively. Sadly, however, currently six endemic mammals are designated a critically threatened IUCN conservation status. Furthermore, five mammals such as Cercopithecus aethiops, Alcelaphusbuselaphus swaynii, Syncerrus caffer, Litocranius walleri and Ourebia ourebi are currently believed locally extinct. Major conservation threats are habitat destruction and fragmentation caused by wood collection, charcoal production, illegal overgrazing, fishing, settlement, and farming, poaching, and invasion and encroachment by exotic and native plant species. Overcoming these problems has been further constrained by underlining challenges such as poverty, changes in land use management plan, and lack of political commitments

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Received: May 31, 2025; **Accepted:** June 09, 2025; **Published:** June 16, 2025

Keywords: Challenges, Conservation Management, Mammals, Nech Sar National Park, Threats

Introduction

Mammals are among the major groups of the animal kingdom with diverse environmental and social benefits [1-3] . They constitute among the most attractive iconic landscape features in the tourism industry and contribute to the food, clothing, and medicinal requirements of society since antiquity [2,4]. Recent reports indicate that class Mammalia contains 1,314 genera and ca. 6,382 living species placed under 27 orders and 167 families golobally, the majority of which are found in tropical Africa [5]. For example, estimates show that more than 1,150 species of mammals are found in Africa, of which ca. 360 species are found in East Africa [5]. Yet, these diverse mammalian population are increasingly threatened by habitat loss and degradation, overexploitation, climate change, and consequences of invasive alien species worldwide [6-8]. Habitat degradation and destruction is currently ranked as the primary cause biodiversity loss, and mammalian species extinction, in particular, worldwide, and this has further accelerated in the last half of the 20th century [1]. An estimate of changes in global forest cover, for example, showed that ca. 3.1% forestland was lost witihin only five years between 2000 and 2005. In the humid tropics, in particular, where forest loss is often primarily results from timber extraction ca. 272,000 km2 of forest (i.e., ca. 2.4%) was lost. In the tropics, these losses also represent the extinction of species because of high levels of endemism [9,10]. In Africa, in particular, habitat degradation and loss, both inside and outside the protected areas, is associated with human settlement, infrastructure development, and gricultural expansion among others factors, strongly threatening wildlife resources [11,12]. For example, Ethiopia presents conspicuous consequences of human-induced habitat degradation resulting in a decline of forest cover from 40% in the 1900s to less than 3% by 2000 [13].

In order to conserve and protect wildlife and their habitats from improper human activities Ethiopia has established a number of protected areas since the 1960s [14]. At present, there are 27national parks, 2wildlife sanctuaries, 5wildlife reserves, 4community conservation areas, 5open hunting areas, 25 controlled hunting areas, and 4biosphere reserves areas [15,16]. The oldest protected areas in the country are the Menagesha-suba community-managed forest, Awash National Park, Simen Mountain National Park, and the Abijatta-Shalla Lakes National Park [15,17]. Protected areas in the southern part of Ethiopia includes Omo National Park, Nech Sar National Park, Mago National Park, Maze National Park, Chebera Chuchura National Park, Loka Abya National Park, Gibe Sheleko National Park, Tama community managed wildlife reserve area [15,17]. It is well recognized that PAs are cornerstones of biodiversity conservation as they provide relatively safe sanctuaries for wildlife, and this is more so in the heavily human dominated Ethiopian landscapes [18,19]. For example, PAs in Ethiopia harbor ca. 326 species, under 144 genera, 43 families and 14 orders and the eight endemic large mammals are Canis simensis, Theropithecus gelada, Tragelaphus scripus Meneliki,

Tragelaphus buxtoni, Lepus Starcki, Alcelaphus buselaphus, and Capra walie, which significantly adds to the country's status as a global biodiversity [16, 17, 20-22]. These incredibly diverse mammalian populations are the primary source of attraction for domestic and oversea tourists, significantly contributing to the local and national economy Yet, mammals in PAs are facing increasing anthropogenic pressures resulting from overgrazing, shifting cultivation, human settlements, increasing demand for wood and wood products, uncontrolled fires, and poaching, threatening wildlife they [16, 23-25]. Additionally, invasion by exotic species or encroachment of native plant species is becoming a new upcoming threat to mammals in PAs by narrowing their home range and causing adverse changes in their forage availability [24,26,27]. Furthermore, the loss and degradation of PAs are further exacerbated by population growth, unsustainable natural resource management, poor enforcement of existing legislation, and limited public awareness of the importance of biodiversity [24,28].

In this review, we focus on the Nech Sar National Park (NSNP) and attempt to reveal the extent of human disturbance impacts on wildlife, and mammals in particular, as a demonstrative urgent call for rescuing the park from ultimate destruction. The park is located in the south Ethiopian rift valley and was established in 1974 to protect wildlife and its distinct habitats from human interference [14]. Its broad ecological units consist of 85% terrestrial and 15% aquatic ecosystems, where the latter represents lakes such as Lake Abaya and Lake Chamo, which are part of the main Ethiopian rift valley lakes system [29]. The terrestrial landscape consists of evergreen riverine and groundwater forests and savannah plains, and deciduous woodlands and shrublands [30-32]. This highly diverse landscape is known to harbour a wide range of wildlife such as Grant's zebra (Equus quagga), Grant's gazelle (Nanger granti), Greater kudu (Tragelaphus strepsiceros), Lesserkudu (Tragelaphus imberbis), Waterbuck (Kobus ellipsiprymnus), Bushbuck (Tragelaphus sylvaticus), Hippopotamus (Hippopotamus amphibius), Nile crocodile (Crocodylus niloticus), Lion (Panthera leo), Leopard (Panthera pardus), Hunting dog (Lycaon pictus), and Black–backed jackal (Canis mesomelas), Warthog (Phacochoerus africanus), Black and white colobus monkey (Colobus guereza), Anubis baboon (Papio anubis), Vervet monkey (Chlorocebus pygerythrus), Gunther's dik–dik (Madoqua guentheri), Spotted hyena (Crocuta crocuta), and about 351 bird species, including the illusive endemic bird Nechsar nightjar (Caprimulgus solala) [14,30,33]. This rich biodiversity and the unique landscape scenery have qualified the NSNP as one of the most preferred tourist destinations in Ethiopia [23,33,34]. A wide range of studies nevertheless show that the park and its wildlife are under ever-increasing anthropogenic pressure, perhaps leading it to an ultimate collapse to function as an ecologically viable system [32,35-38]. Here, we collate a large number of published and grey literature as well as data from direct field observations to show the level of threats and underlying challenges to biodiversity conservation in NSNP with a focus on mammals.

Taxonomic Composition of Mammals in Nech Sar National Park

A review of the literature reveals that a total of more than 103 different small to large mammals belonging to 10 orders and 28 families occur in Nech Sar National Park, Whereas Table 1 below depicts the taxonomic composition of mammals occurring in NSNP, Figure 2 shows changes in the population status of some mammals [4,39-41]. This change in mammal population seems mixed while most showed severe descrease and the others improvements over time. For example, Equus quagga, Gazella granti, Tragelaphus strepsiceros, Panthera Leo, and Caracal caracal on the one hand, and Papio Anubis, Tragelaphus scriptus, Cercopithecus pygerythrus, and Colobus guereza, on thother, respectively showed severe decrease and susbtantial increase in their population status. Overall, the mammal population for the described species (Table 2) declined by 42% between 2013 and 2022. Furtheremore, here it is worth noting that the increase in population status of some of the mammals is not related to any particular conservation measure targeted to these species. On the constrary, the severe decline in population status of some of the sepcies is strongly related to a combination of a facet of human induced pressures [36,42]. Cercopithecus aethiops, Alcelaphusbuselaphus swaynii, Syncerrus caffer, and Litocranius walleri were not observed during the last recent inventories [42,43] .

Figure 1: Image of Some Mammalian Species in NSNP Since its Establishment in 1974 G.

Table 1: Mammal's Order, Family & Numbers Species of Nech Sar National Park [39,44].

Order	Family name	Common name	Scientific names
Primates	Cercopithecidae	Vervet monkey, Grivet monkey, & Anubis Baboon	Cercopithecus pygerythrus, Cercopithecus aethiops & Papio Anubis
	Colobidae	Colobus monkey	Colobus guereza
	Lorisidae	Bush baby	Galago senegalensis
Perissodactyla	Equidae	Burchell's zebra	Equus barchellii
Artiodactyla	Bovidae	Swayne's Hartebeest, Greater kudu, Lesser kudu, Bushbuck, Defassa Waterbuck, Bohor Reed Buck, Mountain Reedbuck, Grant's Gazella, Gerenuk, Orbit, Klipspringer, Guenther's Dik- dik, & Bush Duiker	Alcelaphus buselaphus swaynii, Tragelaphus strepsiceros, Tragelaphus imberbis, Tragelaphus Scriptus, Kobus ellipsiprymnus, Redunca redunca, Tragelaphus fulvorufula, Gazella granti, Litocranius walleri, Ourebia oureb, Oreotragus oreotragus, Medagua guentheri, & Sylvicapra grimma
	Hippopptamidae	Hippopotamu	Hippopotamus amphibious
	Suidae	Bushpig & Common Warthog	Potamochoerus Larvatus & Phacochoerus africanus
Tubulidentata	Orycteropodidae	Aardvark	Orycteropus afer
Hyracoidea	Procaiida	Rock Hyrax & Yellow spotted Hyrax	Procavia capensis & Heterohyrax brucei
Lagomorpha	Leporidae	Abyssinian Hare	Lephus habessinicus
Carnivora	Mustelidae	Striped polecat & Honey Badger	Ictonyx striatus & Mellivora Capensis
	Canidae	African Hunting dog, Bat eared Fox, Side - striped Jackal, Golden Jackal, & Black - backed Jackal	Lycaon pictus, Otocyon megalotis, Canis adustus, Canis aureus, & Canis mesomelas
	Viverridae	African civet, Common Genet, Southern Dwarf mongoose, Lion-tailed mongoose, White tailed Mongoose, Rusty Spotted Genet, Egyptian mongoose, & Banded mongoose	Viverra civetta, Genetta geneta, Helogale parvula, Herpestes sanguineus, Geneta maculata, Ichneumia albicauda, Herpestes ichneumia, & Mungos mungo
	Hyeanidea	Spotted Hyena	Crocuta crocuta
	Felidae	Cheetah, Wild cat, Serval cat, Caracal, Leopard, & Lion	Acinonyx jubatus, Felis silvestris, Serva serval, Caracal caracal, Panthera paradus, & Panthera Leo
Rodentia	Sciuridae	Gambian sun squirrel, Geoffrey's Ground squirrel, & Un striped Ground squirrels	Heliosciurus gambianus, Xerus erythrophus, & Xerus rutilus
	Hystricidae	Crested porcupine	Hystrix cristata
	Rhizomayidae		Tachyoryctes Splendens
	Muridae	Common mole rat, Large Gerbil, Black - tailed Gerbil, African Pigmy mouse, African meadow Rat, White footed Rat, Multi-mammate mouse, Tree rat, common Spiny mouse, Lowland Grass Rat, Somali grass Rat, Ethiopian grass mouse, Punctuated Grass mouse, Stripped Grass Mouse, Harsh furred Mouse, Grey mouse, Mahomet's mouse, Woodland thicket rat	Cryptomys hottentotus, Rhombomys opimus, Gerbilliscus nigricaudus, Mus minutoides, Myomyscus verreauxii, Conilurus albipes, Mastomys natalensis, Callistomys pictus, Acomys cahirinus Arvicanthis ansorgei, Arvicanthis Ieumanni, Lemniscomys zebra, Lemniscomys striatus, Lemniscomys striatus, Lophuromys melanonyx, Pseudomys albocinereus, Mus mahomet, & Grammomys dolichurus
Insectivora	Soricidae	Bicolored musk shrew, African giant shrew, & Greater White-toothed Shrew	Crocidura fuscomurina, Crocidura Oliver, & Crocidura Pheura
	Macroscelidea	Rufus Elephant shrew	Elephantulus rufescens
Chiroptera	Pteropidae	Egyptian Fruit Bat, long haired fruit Bat, Silky Bat, Ethiopian epauletted fruit bat, Gambian epauletted fruit Bat & Bacages fruit Bat	Rousettus aegyptiacus, Rousettus lanosus, Rousettus angolensis, Epomophorus anurus, Epomophorus gambianus, & Micro pteropus pusillus
	Megadermatidae	Yellow-winged bat & Heart-nosed bat	Lavia frons & Cardioderma cor
	Nycteridae	Heart nosed Big-eared Bat & Yellow winged Bat	Nycteris thebaica & Nycteris hispida
	Hipposideridae	Common slit - faced Bat, Hariyslr - faced Bat, & Triple nose-leaf Bat	Hipposideros caffer, Hipposideros ruber, & Triaenops persicus

	Vespertilionidae	Sundevall's African leaf - nosed Bat, Noack's African Leaf Nosed Bat, Persian Leaf nosed Bat, Somali serotine bat, Banana Bat, & Schreiber's long - fingered Bat	Pipistrellus tenuipinnis, Pipistrellus Somalicus, Pipistrellus nanus, Miniopterus Schreibersii, Scotoecus hindei, Myotis Scotti, & Scotophilus dinganii
	Molossidae	Little free-tailed bat & Kuhl's pipistrelle	Tadarida pumila & Pippstrellus kuhli
	Rhinolophidae	Rueppell's horseshoe bat, Lander's horseshoe Bat, & Peters's flat-headed bat	Rhinolophus famigatus, Rhinolophus Landeri, & Platy mops Setiger

Table 2: Trends in Some Mammal Populations in NSNP from 2013-2022 G.C

Scientific Names	2013	2015	2016	2017	2017	2018	2019	2020	2021	2022	Change (%)
Equus quagga	3203	3886	3665	2277	1249	1131	908	907	668	660	-79.4
Gazella granti	1253	1812	1854	934	530	531	397	260	238	312	-75.1-54.4
Tragelaphus strepsiceros	114	162	175	155	82	110	38	18	68	52	-54.4
Tragelaphus imberbis	20	59	32	37	3	28	-	6	7	14	-30.0
Alcelaphusbuselaphus swaynei	6	4	4	2	0	0	0	0	0	0	-100
Tragelaphus Scriptus	9	194	145	111	65	46	8	34	29	69	666.7
Cercopithecus pygerythrus	35	112	87	486	450	292	382	244	221	252	620.0
Papio Anubis	141	387	588	1858	465	808	901	1067	507	1253	788.7
Phacochoerus africanus	60	198	231	262	295	120	32	23	18	38	-36.7
Medagua guentheri	45	88	53	33	27	32	19	17	2	25	-44.4
Kobus ellipsiprymnus	570	500	410	197	128	205	134	90	141	243	-57.4
Hippopotamus amphibious	77	64	66	59	36	41	12	32	34	52	-32.5
Sylvicapra grimma	6	20	15	12	10	4	15	43	9	19	216.7
Canis mesomelas	6	13	9	5	3	6	3	2	4	5	-16.7
Panthera paradus	2	6	5	4	7	9	2	1	3	4	100.0
Panthera Leo	8	8	12	18	8	7	4	5	4	3	-62.5
Caracal caracal	7	3	8	2	5	12		4	8	3	-57.1
Crocuta crocuta	7	9	15	7	8	10	3	4	36	7	0.0
Viverra civetta	8	15	7	4	8	9	4	2	2	5	-37.5
Colobus guereza	91	208	119	406	488	223	103	157	234	262	187.9

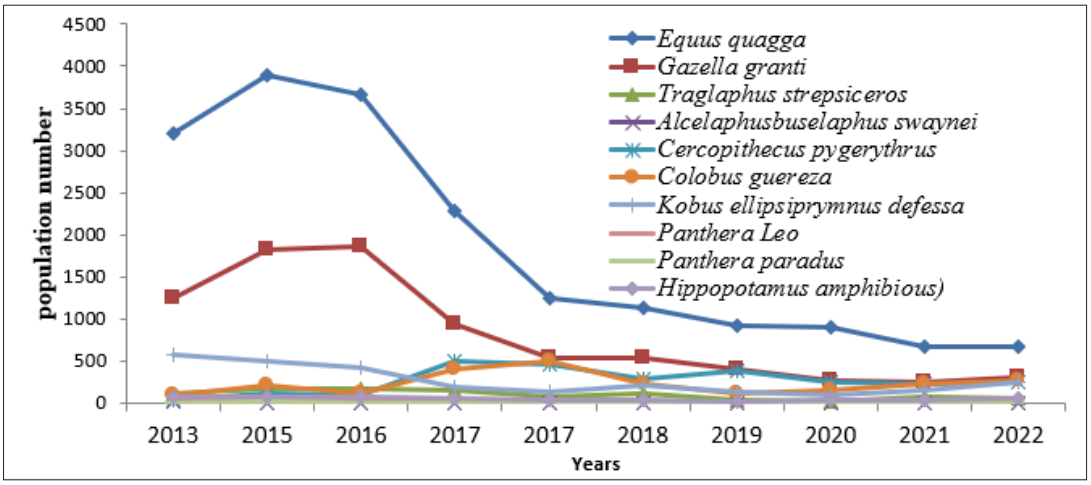

Figure 2: Population Trend of Some Selected Large Mammals for a Period of 2013 to 2022: Source Park Inventory Data [43].

Endemic and Exotic Mammals in Nech Sar National Park

Nech Sar National Park harbors a variety of mammals, of which six species are endemic (10.52%) to Ethiopia [4,45-47]. The endemic mammals of NSNP include Alcelaphus buselaphus swaynii, Praomys eryhtroleucus, Arvicanthis abyssinicus, Mus Mahomet, Crocidura Pheura, and Myotis scotti [4,41,44,48]. Nevertheless, Swayne's Hartebeest (Alcelaphus buselaphus swaynii) has reportedly become locally extinct due to habitat distruction [43].

Table 3: Endemic Mammals Recorded from Nech Sar National Park

Order	Family	Scientific names	Authors
Artiodactyla	Bovidae	Alcelaphusbuselaphus swaynei	[46,49]
Rodentia	Muridae	Praomys eryhtroleucus, Arvicanthis abyssinicus, Mus Mahomet	[41,44]
Insectivora	Soricidae	Crocidura Pheura	[41,44]
Chiroptera	Vespertilionida	Myotis Scotti	[41,44]

Major Threats to Mammals in Nech Sar National Park

Nech Sar National Park experiences severe manmade threats to biodiversity and the provisioning of ecosystem services [50]. These include habitat destraction and fragmentation, overexploitation, climate change, pollution, and invasion by exotic and native plant species [14,31,32,36,38,51-54].

Habitat Loss

Human-induced habitat destruction, the clearance of forests and conversion of savannahs to agriculture, in particular, is the leading source of biodiversity loss worldwide [55,56]. Habitat destruction and fragmentation are widespread and occur in all habitat formations in NSNP. Forests and woodlands, in particular, are facing strong human-induced pressure from agricultural expansion, wood cutting and collection, charcoal making, and forest grazing [31,32, 57]. An official resport by NSNP local admin indicate that ca. 20 ha of forests were cleared between 2019 -2022, causing problems to arboreal and ground duwlelling wildlife [43].

Figure 3: Woodcutting and Charcoal Production in the Arba Minch Riverine and Groundwater Forests

Furthermore, illegal cattle deployment and farming, and the establishment of settlements within NSNP have been a significant threat to the savannah grasslands, in the eastern flank of the park, incurring severe consequences to savannah wildlife. Settlement and expansion of farmland largely by about 9,552ha (35.38%) of the park [31,35,37,38,49,51,58-60].

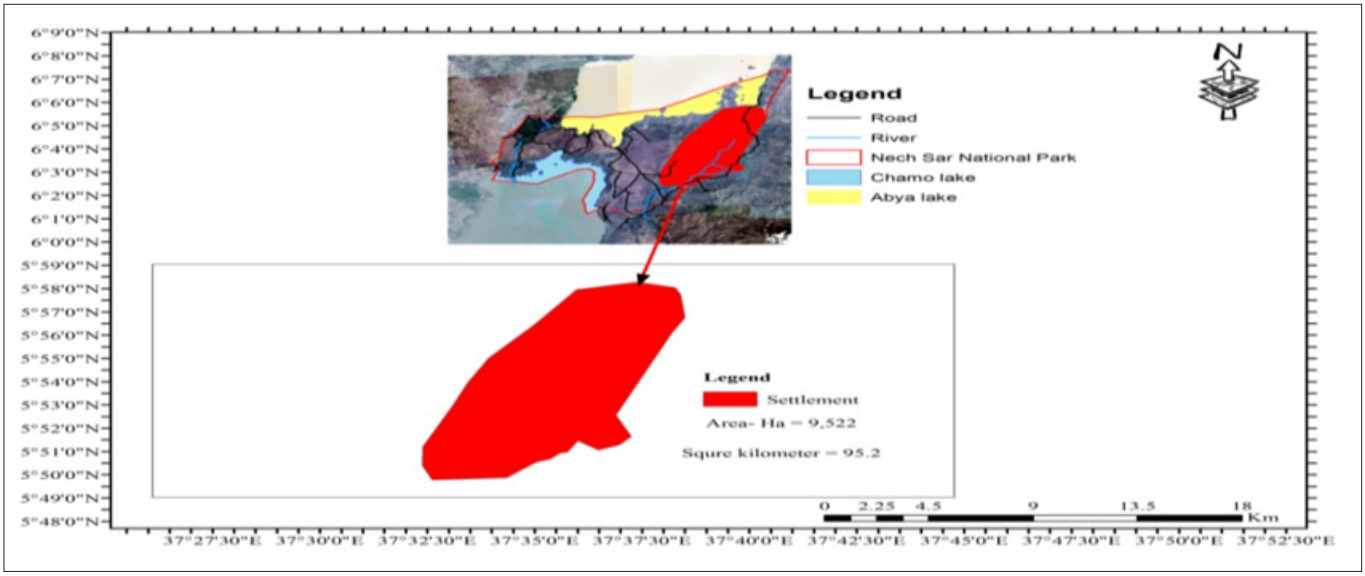

Figure 4: Setlemment Areas in Nech Sar National Park

Figure 5: Community Settled Trend in the Eastern Part of the Park, a) 2017, b) 2019, c) 2022

Figure 6: Grazing Activies in the Park

Overexploitation

Overexploitation by targeting on individual species or groups of species threatens wildlife, large mammals, in particular, worldwide is a major threat in NSNP [60-62]. As illustrated in figures 7 & 8 poaching and overfishing have substantially declined and in some instances caused the local extinction of species such as Hippopotamus amphibiou, Gazella granti, Phacochoerus africanu, Traglaphus imberbis, Alcelaphusbuselaphus swaynei, and Lates niloticus [43].

Table 4: Number and Types of Wildlife Species Poached in Nech Sar National Park from 2017-2022 (NSNSP Office Report).

Scientific names	Total counted	Remark
Kobus ellipsiprymnus	4	Guji community side
Hippopotamus amphibious	9	Guji, Amaro and Arba Minch side
Tragelaphus strepsiceros	19	Guji community side
Gazella granti	35	Guji community side
Crocodylus niloticus	3	Arba Mich side
Panthera Leo	7	Five in Guji and two Amaro side
Tragelaphus imberbis	11	Guji community side
Phacochoerus africanus	14	Guji community side
Python sebae	1	Guji community side
Total	103	

Figure 7: Different Wildlife Poached by Local Communities in the Park (a) Hippopotamus Amphibiou, (b) Gazella Granti, (c) Phacochoerus Africanu, (d) Tragelaphus Imberbis

Figure 8: Illegal Fishing in Lake Chamo

Pollution

Solid wastes generated by the fast-growing adjacent town, Arba Minch town, posses a mojor concern to the health of NSNP. Studies show that Arba Minch town lack proper solid waste management scheme, and consequently all sorts of soild wastes are dumped into the Kulfo river that feeds into Lake Chamo [37,63]. Although rigorous scientific evidence is hardly avalabile on the impacts of solid waste on the wildlife, their potential consequences nonetheless were witness by mass fishkills and death of Equus quagga and Hippopotamus amphibious following algal blooming [37,53,63].

Figure 9: Waste Disposals in the Park. Source: Tamirat Haile field photo

Figure 10: Killed Defassa Waterbuck

The other threat often recorded in the NSNP is pest and disease-associated wildlife death. For example, tsetsefly is a common disease vector in the park perhaps mediating the spread of diseases killing some wildlife such as Equus quagga and others [63,65]. It is also reported that E. quagga was affected by epilepsy disease and heavy loads of ectoparaistes such as ticks [63,65]. Overall, pests and wildlife diseases commonly reported in the NSNP include virus, bacteria, fungial, parasitic, biotoxic and chemical. The main wildlife diseases in the Park are anthrax, algae blooms, parasitic [43].

Table 5: Wildlife Disease and Pest in the Nech Sar National Park from 2017-2022

Species Name	Number of Animal Dead
Equus quagga	92
Potamochoerus larvatus	3
Kobus ellipsiprymnus	4
Hippopotamus amphibious	7
Nile perch & chat fish	> 100
African Great White Pelican	> 100
Tragelaphus strepsiceros	5
Gazella granti	2
Crocodylus niloticus	7
Felis Serval	2
Caracal caracal	2
Hystrix Cristata	1
Medagua guentheri	1
Cercopithecus pygerythrus	1
Phacochoerus africanus	3
Tragelaphus imberbis	1
Python sebae	1
Colobus guereza	1
Tragelaphus Scriptus	1
Total	334

Figure 11: Wildlife Disease and Pest in the Nech Sar National Park from 2017-2022

Fire and Flood

Fire and floods resulting from surface and overflow of Feeder Rivers, mainly of Kulfo River that feeds into L. Chamo, constitute another source of threat to wildlife in NSNP (Fig 13 & 14). For example, it has been reported that fire is ignited by illegal fishermen or other groups (e.g., wood collectors, charcoal makers, smokers), as a revenge or unintended fire misuse Floods following occasionally torrential rainfal from the upper heavily degraded watershed were reported to have negative effects on the water quality of L. Abya and L. Chamo, often resulting in severe

consequences to wildlife thourhg eutrophication [14,37,53,66,67]. Furthermore, damage to waterways of Kulfo River and subsequent overflow into the riverine and groundwater forests have been found to damage ca. 192.7 ha of these forests, killing mother trees and suppressing the regreneration and grourth of seeds and seedlings resulting in severe changes in demographic structure in some common tree species [32,43].

Figure 12: Fire Incedents in the park, 2019 & 2020

Figure 13: Over Flooding Inside the Park

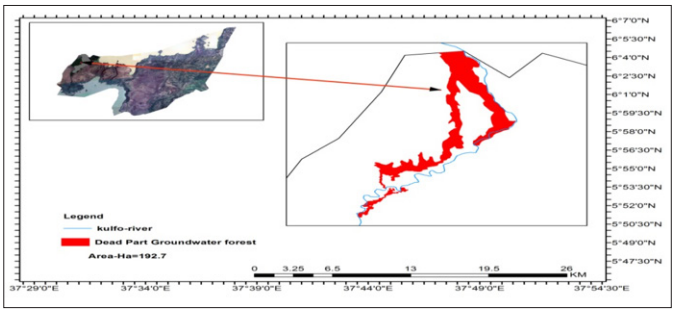

Figure 14: Map of Damaged Dueto Flooding Under Groundwater Forest Areas in Park

Challenge to Conservation Management of Nech Sar National Park

Lack of Management Plan/ Formal Boundary

The Nech Sar National Park, since establishement, experienced unstable management regimes due to recurrent shifts in management responsibilities between different organizations, the transitions being noted as the most damaging periods to wildlife and manmade resources in the park [14,43]. Moreover, the park has not been officially gazetted, although repeated thorough discussions and negotiations have been convened among key stakeholders including representatives from adjoining communities, further jeopardizing management planning, law enforcement, and implementation of conservation management activities [68,69]. The latter, in particular, has been a significant challenge to the conservation management of the park for two cardinal reasons. First, a strong dependence of local communities on the park for various ecosystem provisioning services and second, a lack of strong political commitment to formally gazette the park and subsequently address the social cost of the gazettement. Additionally, disregard of local communities' role to nature conservation and failing to consider their survival and livelihood needs has been proven to negatively affect success of PAs in achieving the desired goals [19,70]. The NSNP is not an exception, and studies indicate that both community participation and their concerns and grievances have not been taken as an integral part of conservation management efforts by the exising exclusivist fence-and-fine approach, suggesting the need for rethinking PAs management beyond their geographic boundaries [35,71,72]. Within the park boundary there is settlements with high pressure of encroachment as well as expanded farmlands. As a result the initial boundaries are not respected, and the park resources are at great risk due to antropogenic pressure Currently, Even though the kore people are out of the park, they are trying to re-enter into the park and continuously practicing wildlife poaching and farmland expansion while the Guji people are illegally living in the park with expansion of settlement, farmland expansion and overgrazing [14,68].

Table 6: Management History of Nech Sar National Park (Compiled from Various Local NSNP Admin Reports)

Year	Management of Nech Sar Park	Institutions	Period
1960	Recommendation of Nech Sar as Game Reserve	UNESCO	Empire
1974	Designation as a National Park	EWCO	Derg Regime
1984	Arba Minch forest and aquatic ecosystem included	EWCO / SFCD	Derg Regime
1985	Guji moved out of park by force	Military & Scouts	Derg Regime
1991	Return of Guji, Kore, and Ganta people to NSNP	-	Transition
1995	Management was handed to SNNPRS	SNNPRS	Fed. Republic
2004	Kore resettled 15 km South Eastern parts of the park	SNNPRS	Fed. Republic
2005	African Parks Network assumes management	APN	Fed. Republic
2008	APN withdraws from NSNP	APN - SNNPRS	Fed. Republic
2009	Management was handed to EWCA	SNNPRS - EWCA	Fed. Republic

Poverty and Competing Resource Needs

The relationship between poverty and PAs is controvertial or mixed, exisinting evidences suggesting that PAs can have positive, negative or even neutral impacts on the local communities [73-76]. Yet, the success and failure of conserving biodiversity in PAs is strongly affected by the socio-economic and cultural characteristics of communities neighbouring PAs [70,74]. In African PAs, such as the NSNP, local communities strongly depend on PAs for livelihoods and survival [70,71,77,78]. Exclusion of neighbouring communities without recognition of their concerns and grievances and taking no actions to sufficiently address the social costs of exclusions have been reported to negatively orient people's perception and attitude towards PAs [35,71,79]. Studies reported that NSNP experienced the severest form of community revenege against the park and its biophysical resources, for example, following the downfall of the derg regime in 1991 and

during every interim adnminstrative transition periods [14,72]. By contrast, an alternative approach would be actively involving local communities in PAs management and governance and addressing their livelihood and survival needs that originates from the PAs [80]. In this connection, although scientific evidence is yet to be generated for, local communities neihbouring NSNP were organized to engage in various alternative livelihood businesses presumably to mitigate their direct dependence on nature [34,50].

Table 7: Nech Sar National Park Ecotourism and Small Enterprise Associations, Park report, 2022

Name of associations	Association members			Working area (Kebele
	Male	Female	Female	
Rift Valley Boat service Association	15	-	15	Chamo lake
See us Local Tour guide Association	42	7	47	Arbaminch
Arbaminch Fishermen Association	150	-	150	Chamo lake
Chamo Fishermen Association	80	-	80	Chamo lake
Leto Fishermen Association	80	-	80	Chamo lake
Sedie Fishermen Association	80	-	80	Chamo lake
Arora Fishermen Association	80	-	80	Chamo lake
Walesa Fishermen Association	80	-	80	Chamo lake
Pultto Recreational Association	7	-	7	Doyisa kebele in Arbamich
Arba Minch Beekeeping Association	8	2	10	Doyisa kebele in Arbamich
Mountain Arba Minch Beekeeping	8	3	11	Doyisa kebele in Arbamich
Nursery Site & Bereket Sericulture	5	5	10	DelFana & Wuha Minch
Home garden Agro forestry	-	60	60	Abullo and Alefacho kebele
Alfacho Beekeeping	41	8	49	Alfacho kebele
Nursery Business Abullo	10	27	37	Abullo kebele
Total	686	110	796	

Climate Changes

Studies revealed strong positive correlation between increased atmospheric carbon dioxide level and mean annual rainfall on the one side, and woody plants proliferations on the other, in tropical savannahs worldwide [81-84]. In African savannahs, for example, a recent study based on a high–resolution satellite imagery showed that woody plant cover increased by 8% over thirty years (from 1986 to 2016), which, in turn, strongly correlated with increased level of carbon dioxide and mean anual rainfall [85]. Moreover, given that climate change projections indicate an increase in mean annual rainfall in sub–Saharan Africa, it is expected that this increase will further aggravate woody encroachment, in semi-arid East–African savannahs, in particular, due to the combined effects of land management and climate change [85-88]. The savannah of NSNP is not an exception and has experienced strong increase in the abundances of woody plants such as Dichrostachys cinerea, severely affecting its biodiversity and ecosyste funtions [8,38,51,89-92].

Table 8: List of Invasive and Encroaching Plant Species, History Entering Years, and their Location in Park, NSNP Report, 2022

Types plant species	Characteristic	Entered	Location
Amaranthus caudatus	Encroacher	2002	Nech Sar plain and Lake shore
Abutilon theophrasti medicus	Invader	2001	All parts of the park, dominated in Nech Sar plain grassland
Xanthium asteraceya	Encroacher	2000	Nech Sar plain grassland of the park
Water hyacinth	Invasive	2000	Both lake Abaya and Chamo, dominated at lake Abaya especially on the wetland ecosystem
Lantana camera	Invasive	1950	Distributed parts of the park, mainly dominated in riverine forest at Abaya wallo and Chamo leto acacia scattered land
Prosopis juliflora	Invasive	1997	Abaya wallo and kulfo river bank and costal area of lake chamo
Parthenium hysterophorus	Invasive	1982	Every part of the park ecosystem
Dichrostachys cinerea	Encroacher	1950	Plain of the Park and native encroacher not invasive

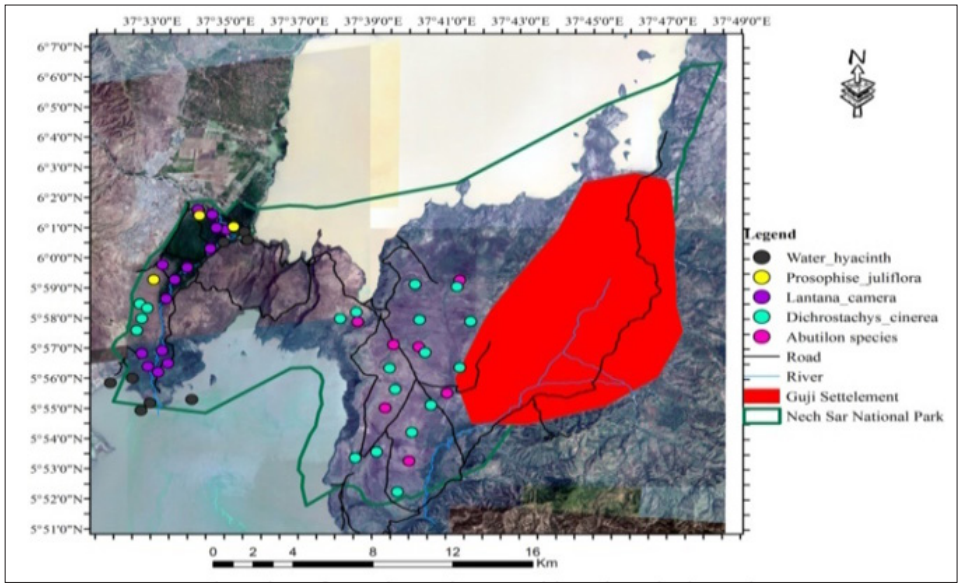

Figure 15: Extent and Patches of Invasive and Encroaching Plants in the Park

Figure 16: Invassive and Encroaching Plants Inside a) Dichrostachys Cinerea, b) Abutilon Theophrasti Medicus, c) Lantana Camera, d) Water Hyacinth, e) Ortho Canta Seyaltula

Conclusion

The Nech Sar National Park is endowed with impressive natural & cultural attractions that require urgent conservation & sustainable utilizations. These resources are wonders of national park unique terrestrial and aquatic features described as grace, brand and prize of Arbaminch and its vicinities. National Park is one of the potential biodiversity areas & conservation of wildlife including the endemic and flagship mammals' specie in Ethiopia. The altitudinal difference ranges from the highest peak at 1650m to (101m), which made the park to be among the biodiversity-rich National Park in the Ethiopia. Five antlopes species was currently was extncited localy from the park such as as Cercopithecus aethiops, Alcelaphusbuselaphus swaynii, Syncerrus caffe), Litocranius walleri & Ourebia ourebi. National Park highly exposed by grazing, illegal fishing, settlement & illegal farming, Fire Wood collection, Wood logging, Grass cutting, charcoal production, illegal hunting, and invasive and encroaching Plant Species.

Resolving boundary issues of the park by two regional is basic minimum reqiurment to protect nature and wildlife resource, from other land use complexes like, investement and threats of the park, developing standard management plan of the park that satisfies National Parks requirement, developing awareness of the community and respective role of them & other stakeholders , Research survy on mammals, Birds, reptile, amphibian, is not updated currently in Nech Sar National Park ,& Political commitment to restore the Nech Sar National Park obeying all the international conservation laws at least for which Ethiopia is signatory is also recommended as the root cause of all the solutions.

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