

# Biodiversity Status & Conservation Challenges of Protected Areas of Ethiopia: Awash & Nechisar National Parks in Focus

Fitsum Temesgen<sup>1</sup> Bikila Warkineh<sup>2</sup>

1.Semera University, College of Dry Land Agriculture, Afar, Ethiopia

2.Addis Ababa University, Center of Environmental Sciences, Addis Ababa, Ethiopia

## Abstract

Protected areas particularly parks are the main home of biodiversity worldwide. The Awash and Nechisar National Parks are among the protected areas of Ethiopia under the category of Somalia-Massai Regional Center of Endemism in Africa with Acacia-Commiphora woodland. Awash park was established in 1966 while Nechisar was in 1974 and supporting high levels of species richness & endemism. In Awash National Park, ~78 mammal species, 472 bird species (6 endemic) & 43 species of reptiles have been recorded. Similarly, the Nechisar national park harbors 37 mammals (one endemic) & 350 (3 endemic) bird species. Furthermore, the parks are an important source of rivers, lakes and recognized plant biodiversities. In spite of the great potential of the areas, agricultural land is expanding rapidly, grazing areas are heavily degraded, forests are being cleared, charcoal production, habitat conversion, conflict between settler and park manager for natural resources and water systems disrupted. There is no effective resource responsible body and the communities are taking advantage as open access resource management regimes in the areas. Consequently, the flora & wild mammal species richness and diversity of the parks are gradually declining from time to time. To solve the problems action taken for conservation of the park resources are minimal from the government and other stake holders. Therefore, awareness creation and Strengthen capacity building on protected areas sustainable resource conservation should be mandatory.

**Keywords:** Biodiversity, PAs, conservation challenges, Awash & Nechisar national parks

## 1. Introduction

Ethiopia is one of the top 25 biodiversity rich countries in the world, and hosts two of the African 8 and world's 34 biodiversity hotspots, namely; the Eastern Afromontane and the Horn of Africa hotspots (CI, 2011). It comprises highland massive surrounded by arid lowlands and contains various wildlife and their habitats ranging from 110 m below sea level at Afar depression to over 4,500 m at Ras Dshen (Shibru, 1995). Most highlands harbor many endemic plants and animals, but possess fewer species diversity than the lowlands. The main reason for the presence of diverse wildlife and large number of endemic species is the rugged topography, diverse habitat & variable climatic condition of the country (Yalden & Largen, 1992).

Ethiopia is also the centre of origin for many cultivated plants such as Teff (*Eragrostis tef*), noug (*Guizotia abyssinica*), Ethiopian mustard (*Brassica carinata*), enset (*Ensete ventricosum*), anchote (*Coccinia abyssinica*) & coffee (*Coffea arabica*). The country is also centre of diversity for species like wheat (*Triticum sp.*), barley (*Hordeum vulgare*), sorghum (*Sorghum bicolor*), pea (*Pisum sativum*), cowpea (*Vigna unguiculata*), chickpea (*Cicer arietinum*), lentil (*Lens culinaris*), chat (*Catha edulis*), shiny-leaf buckthorn (*Rhamnus prinoides*), cotton (*Gossypium herbaceum*), castor bean (*Ricinus communis*), oats (*Avena abyssinica*) and clovers (*Trifolium sp.*) (Vavilov, 1926).

Most of the biological resources particularly wildlife's are concentrated in protected areas (IUCN, 1994). However, Ethiopia efforts have increased in establishments of national parks, wildlife sanctuary and reserves to gain environmental and economic benefits but the value obtained from the protected areas is very low (Solomon & Dereje, 2015). Because most of the protected areas of the country are degrading and has faced serious challenges from illegal settlement, illegal poaching of wildlife, deforestation & degradation, illegal agricultural expansion, conflicts on competing park resources, habitat destruction, grazing of livestock, soil degradation, bush fire by cultivators around the park, charcoal production and over exploitation of natural resources (Getachew & Weldemariam, 2016).

Awash and Nechisar national parks are from the beginner protected areas of the country with high biological diversity of richness and conservation challenges (Young, 2012). Even though Awash NP is legally gazetted in 1969, the park still has many problems. The most important ANP threats include grazing by domestic animals, shortage of funding for conservation; expansion of invasive alien species; weak law enforcement; encroachment of human settlement, human wildlife conflict, and lack of alternative livelihood activities for the community (Malede & Girma, 2015). Therefore it has been facing a great challenge in protecting the continuous decline of both faunal and floral of ANP (Solomon, 2014). While illegal activities like illegal fishing, fire, fuel wood collection, charcoal wood production, deforestation, livestock grazing, poaching and settlement are the major threat to NSNP (Solomon & Dereje, 2015).

## Objective

To review the flora and fauna diversity resources, conservation status and challenges of Great Rift Valley protected areas (Awash and Nechisar national parks) of Ethiopia.

## Methodology

This paper was organized based on the extensive review of different journals, articles, news papers. The selection criterion was in accordance to their relevant to the review objectives. Wisely Awash and Nechisar national parks were selected for the review which is representative for protected areas based on ecotourism potential status, available information, biodiversity richness, mosaic natural resources & conservation challenges.

## 2. Biodiversity potential & conservation status of Awash & Nechisar NPs

Protected areas are the main focus for the maintenance of biological diversity and contribute for economic developments of a nation. In the past few decades, the numbers of protected areas in developing countries are expanding (Bruche *et al.*, 2012). Ethiopia is one of few countries where the establishments of protected areas are increasing. For example, before 40 years Ethiopia had only two protected areas (Awash & Simen Mountains National Parks) and now a day has more than 55 protected areas (including 21 national parks) (Fig.1) which cover 17.1% of the country to protect and conserve the natural ecosystems and wildlife heritage of the country (Young, 2012).

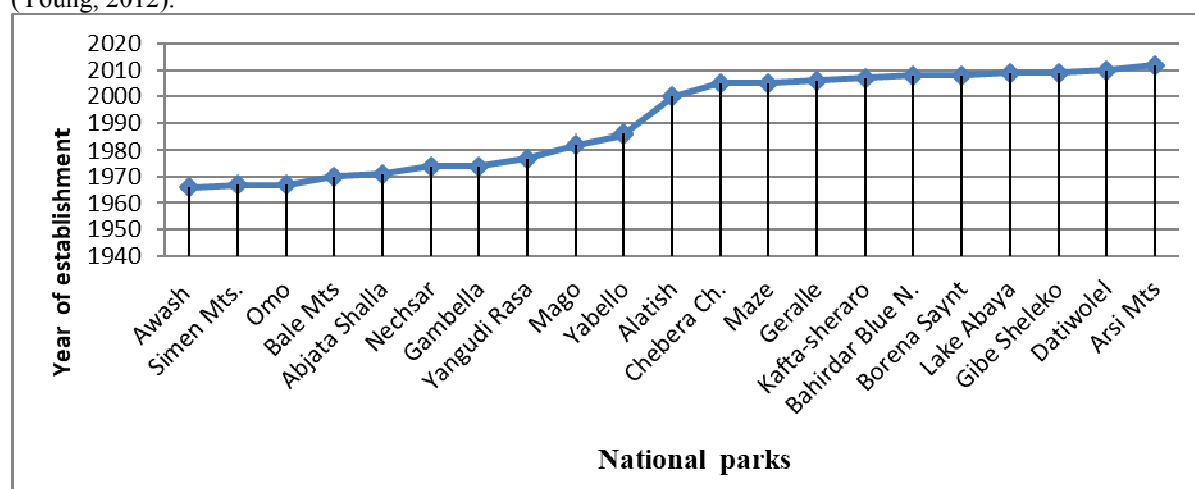


Fig.1 Expansion & establishment years of national parks in Ethiopia (Young, 2012)

However, the coverage of protected areas are increased in Ethiopia, the value obtained is very low when it is compared to Kenya, Tanzania and South Africa (Solomon and Dereje, 2015). Conversely, those protected areas are exposed to severe pressure, which threatens their existence and sustainability due to anthropogenic effects (Reddy and Workeneh, 2014).

Therefore, for this review I selected two National Parks based on their ecotourism potential, natural resources richness, available information and their management challenges.

### 2.1 Awash national park

Awash National Park (ANP) was the first national Park to be established in the country and only one of the two gazetted National Parks in Ethiopia (Blower, 1968). It was established in 1966 and gazetted in 1969 (IBC, 2007). ANP previously had an area of 760 km<sup>2</sup>, but since 2002 it was reduced to 598 Km<sup>2</sup> (Yirmed and Girum, 2013) which is characterized by semi-arid rangeland ecosystem (Tessema *et al.*, 2012). At the time of establishment the park was given a classification of “strict conservation area” and defined as excluding all kinds of human use in the area like settlement, exploitation of natural resources, and grazing (Moore, 1982).

Awash National Park is one of the most important conservation areas of Ethiopia. The park is found in the Great Rift Valley Region of Ethiopia. It is situated between 8 40' and 9 9' North and 39 50' to 40 10' East at about 225 kilometers to the south east of Addis Ababa (Tezera, 2015). The altitude of the park ranges from about 712 meters at its lowest point at Sabure to its highest point at 2007 m.a.s.l. at the peak of Mount Fentale and average annual rainfall is 619 millimeters and the park has relatively hot temperature which varies from 22°C at nights to 42°C during the day. It has a savannah ecosystem and contains varieties of endemic, rare and endangered wildlife resources. The national park was designated to protect these natural heritages that have national and international values (Habtamu, 2014).

### Flora diversity

From the nine vegetation types of Ethiopia, the vegetation type of ANP is classified as Acacia-Commiphora woodland (Sebsebe & Friis, 2009) in the Somali-Masai Regional Center of endemism in Africa (White, 1983).

The bushland and woodland are most commonly found vegetation types in areas with shallow andosols and alluvial soil (Jacobs and Schloeder, 1993). The vegetation is dominated by grasses, shrubs, and Acacia woodland that are well adapted to periods of long drought (Abule *et al.*, 2005; Sebsebe & Friis, 2009). The total abundance of woody species in the Park is not influenced by grazing pressure (Tessema *et al.*, 2011).

There are 8 major vegetation types dominated by grass and acacia species (Jacobs & Schloeder, 1993; Solomon, 2014; Tezera, 2015).

**a.** Open grass land: characterized by no trees and shrubs, and predominantly covered by grasses. The dominant species are *Chrysopogon plumulosus* and *Bothriocloa radicans*

**b.** Grassland with scattered trees: the unit is mostly found in the lower central part of the park. It is characterized by trees (<5 %), shrubs (2-5%), grasses (70-90%).

**c.** Bush land: are dispersed along the eastern side, south western and central part of the park. It is characterized by trees (<10%), shrubs (25-55 %) and grasses (20-70%).

**d.** Thicket/shrub grass land: has a composition of trees (5-20%), shrub (10-15%), and grass 25-55% between. *Acacia senegal*, *Acacia tortolis* *Dobera glabra* and *A. mellifera*.

**e.** Shrub land: occurs in area where there is a moderate to heavy grazing pressure.

**f.** Dense tree/riverine trees: is located along the Awash river. *Acacia etbaica*, *Celtis africana*, *Ficus sur*, *Grewia bicolor*, *Tamarindus indica*, *Ziziphus muro* and *Z. mucronata*

**g.** Palm trees: are located in the northern and north eastern part of the park, around the hot spring

**h.** Low vegetation cover: This habitat where soils may not be suitable for vegetation growth or this may be an area denuded by over exploitation.

#### **Fauna diversity & trends**

The Awash national park (ANP) was protected firstly as a private hunting reserve for the majesty of Emperor Haile Selassie I (Petrides, 1961) and was designed to protect wild animals such as Beisa Oryx (*Oryx beisa*), Lesser kudu, Soemmerring's gazelle (*Gazella soemmerringi*), Hamadryas baboon (*Papio hamadryas*) and Swanes Hartebeest (*Alcellaphus biselaphus swaynei*). Beisa Oryx (*Oryx beisa*) is the flagship species which is commonly found in Illalsala grassland and wooded grassland of the Park year round. Moreover, ANP is home to five vulnerable animal species (Lesser horseshoe bat (*Rhinolophus hiposiderose minimus*); Trident leaf-nosed bat (*Asellia patrizii*); Spot-necked otter (*Lutra macuricollis*); lion, (*Panthera leo*) and Soemmerring's gazelle (*Gazelle soemmerringi*) (Jacobs & Schloeder, 1993).

Awash national park supports had at least 81 species of mammals, 453 species of birds and 43 species of reptiles but the exact figure of species of amphibians and invertebrate in the Park is unknown (Jacobs and Schloeder, 1993). After 20 years re-assessment the status of ANP wild animal has changed, and harbors 78 mammals, and more than 472 bird species, including six endemic species (Yirmed and Girum, 2013).

**a. Endemic species:** An 'Endemic Species' is one that is only found in that region and nowhere else in the world. As such they are of conservation concern because they are not widespread and may be confined to only one or two protected areas (IUCN, 2001).

**Mammals:** according to Petrides, 1961 the endemic mammal in ANP were Swayne's Hartebeest (*Alcellaphus biselaphus swaynei*) which had totally absent after 1966.

**Birds:** Although more endemic species of birds have been added to Ethiopia but until now a total of 24 endemic species of birds are registered (Weldemariam, 2016). This list combines with the status of IUCN and distribution of the species for serious conservation concern (IUCN and UNEP-WCMC, 2014). ANP comprises 6 endemic bird species, these are Wattled ibis (*Bostrychia carunculata*), Black-winged lovebird (*Agapornis taranta*), Banded barbet (*Lybius datus*), Golden-backed woodpecker (*Dendropicus abyssinicus*), White-billed starling (*Onychognathus albirostris*) and Thick-billed raven (*Corvus crassirostris*) (Weldemariam, 2016).

#### **b. Status of large wild animals**

Awash national park (ANP) had 31 large animals (30 mammals and one bird species) during its establishment. However the existences of these animals were changed after 40 yrs period assessment. The number and species richness of the wild mammals is greatly reduced when compared the study of Robertson (1968) with Molla *et al.* (2008) study. Thus, Grevy's Zebra, Bush buck, Leopard, Cheetah, Ostrich, Giraffe Grey duiker were totally absent (Table 1).

Moreover, after two years assessment of large mammals available census data indicate that the number of Beisa Oryx (*Oryx beisa*) and Soemmerring's gazelle (*Gazelle soemmerringi*) population has declined between 2008 and 2010 (Tezera, 2015).

Table 1: Diversity of large wild mammals list and trends between 1968 and 2008 at ANP

S.no	English name	Scientific Name	Status		Status on IUCN (2008) Red List
			1968	2008	
1	Grevy's Zebra	<i>Equus grevyi</i>	+	-	Endangered
2	Bush buck	<i>Tragelaphus scriptus</i>	+	-	Least Concern
3	Leopard	<i>Panthera pardus</i>	+	-	Near Threatened
4	Cheetah	<i>Acinonyx Jubatus</i>	+	-	Vulnerable
5	Giraffe	<i>Giraffa camelopardalis</i>	+	-	Least Concern
6	Ostrich	<i>Struthio camelus</i>	+	-	Least Concern
7	Grey duiker	<i>Sylvicapra grimmia</i>	+	-	Least Concern
8	Beisa Oryx	<i>Oryx beisa beisa</i>	+	+	Near Threatened
9	Soemmerings gazelle	<i>Gazella soemmeringi</i>	+	+	Nd
10	Defassa waterbuck	<i>Kobus defassa</i>	+	+	Nd
11	Lesser Kudu	<i>Strepsiceros imberbis</i>	+	+	Near Threatened
12	Greater Kudu	<i>Strepsiceros strepsiceros</i>	+	+	Least Concern
13	Cordeax's dikdik	<i>Madoqua cordeauxi</i>	+	+	Nd
14	Chanler's Reedbuck	<i>Redunca fulvorufula</i>	+	+	Nd
15	Klipspringer	<i>Oreotragus oreotragus</i>	+	+	Least Concern
16	Mongoose	<i>Viverra civetta</i>	+	+	Nd
17	Warthog	<i>Phacochoerus aethiopicus</i>	+	+	Least Concern
18	Ethiopian hare	<i>Lepus habessinicus</i>	+	+	Least Concern
19	Hippopotamus	<i>Hippopotamus amphibious</i>	+	+	Nd
20	A. Baboon	<i>Papio anubis baboon</i>	+	+	Nd
21	H. Baboon	<i>Papio hamadryas</i>	+	+	Least Concern
22	Vervet monkeys	<i>Cercopithecus aethiops</i>	+	+	Least Concern
23	Tortoises	<i>Testudo pardalis</i>	+	+	Nd
24	Lion	<i>Panthera leo</i>	+	+	Vulnerable
25	Caracals	<i>Felis caracal</i>	+	+	Nd
26	Wild cats	<i>Hystrix cristata</i>	+	+	Least Concern
27	Spotted hyena	<i>Crocuta crocuta</i>	+	+	Least Concern
28	Striped hyena	<i>Hyaena hyaena</i>	+	+	Near Threatened
29	Golden backed	<i>Jackal Canis avreus</i>	+	+	Nd
30	Black backed	<i>Jackal Canis mesomelas</i>	+	+	Least Concern
31	Crocodiles	<i>Crocodylus cataphractus</i>	+	+	Nd
32	Porcupine	<i>Hystrix cristata</i>	+	+	Least Concern

Source: Robertson (1970); Molla *et al.* (2010); IUCN (2008) + = presence of spp. - = absence of spp.; Nd=no data in IUCN red list

## 2.2 Nechsar national park

The Park was established in 1974 in the scenic part of the Rift Valley floor between two lakes namely: Abaya and Chamo. It covers an area of 514 km<sup>2</sup> of which 78 km<sup>2</sup> is covered with water bodies (Duckworth *et al.*, 1992). Although it was designated, the park has not yet been legally gazetted (Aramde *et al.*, 2012). The park falls within one of the IUCN's global diversity hotspots (APF, 2007), namely the "Horn of Africa" and the original habitats of the park are highly degraded hotspots in the world with only about 5% remaining (Yisehak *et al.*, 2007).

Nechsar National Park lies within the floor of the Ethiopian Great Rift Valley & extends from 5°51'N to 6°50'N and from 37°32'E to 37°48'E with an elevation varying between 1,108-1,650 meters above sea level (Israel & Mundanthra, 2016). The area has a bimodal rainfall pattern with the rainy seasons from March to May and from September to October with a mean annual rainfall of 800-1000 mm. The temperature ranges from 12.2 to 34.3°C (Sintayehu *et al.*, 2011).

### Flora diversity & status

Nechsar national park (NSNP) lies within the Somalia-Masai Regional Center of Endemism vegetation description (White, 1983). Out of the 2,500 plant species of this regional center of endemism, around 800-1000 species are estimated to be found around the NSNP (Evans *et al.*, 1992). According to (Bolton, 1970; White, 1983; Kirubel, 1985; Duckworth, 1992; Evans *et al.*, 1992; Hillman, 1993) the Park habitats can be grouped under four major types of vegetation.

a. Acacia commiphora deciduous bushland & thicket: Bush land is the dominant vegetation of the park, covering most of the hills and greater gentle slopes with scattered shrub and low bushy tree set in grass land, denser impenetrable areas of bush land, termed thicket (White, 1983), are not so extensive, generally occurring one

escarpments, steep rocky slopes and gullies throughout the park, as well as on the marginal vegetation zone of lake Abaya.

**b. Grassland:** Grassland covers the Nechisar plains, a flat or undulating area of about 270km<sup>2</sup> at 1200m elevation extending from Degabule in the west and the Haro hills in the east and from Dache in the north down to the course of the dried up Mio river in the south the grass land also extend onto the hill slopes surrounding the plains.

**c. Riverine forest:** occurs as narrow strips along the Kulfo and Seremele rivers and also as small area of spring fed ground water forest along the base of the scarp at the eastern edge of Arba Minch. From the east bank of the Kulfo river the hill rise steeply and almost all the forest lies to the west of the river

**d. Herbaceous fresh water swamp and aquatic vegetation:** The Kulfo River supports extensive swamps at its mouth in lake, dominated by *Thypha angustifolia*. Tall water side grasses and lush flood plains with *Sacchaarum spontaneum* occur along Seremele river. The margins of lakes Abaya and Chamo are mainly support a rich marginal vegetation of species such as *Thypha angustifolia*, *phargamites sp.* and *Juncus sp.*; with tall waterside grasses such as *Loudetia phargmitoides* and bushes of *Sesbania sesban*. The hot springs drain very shallowly west from a point near the base of the Yaro hills producing a small marsh with reed bed and other marginal vegetation.

NSNP vegetation is being lost by mismanagement, increasing competition for settlement, deforestation (fuel wood collection and charcoal production) and overgrazing (Fig.2) (Solomon and Dereje, 2015).

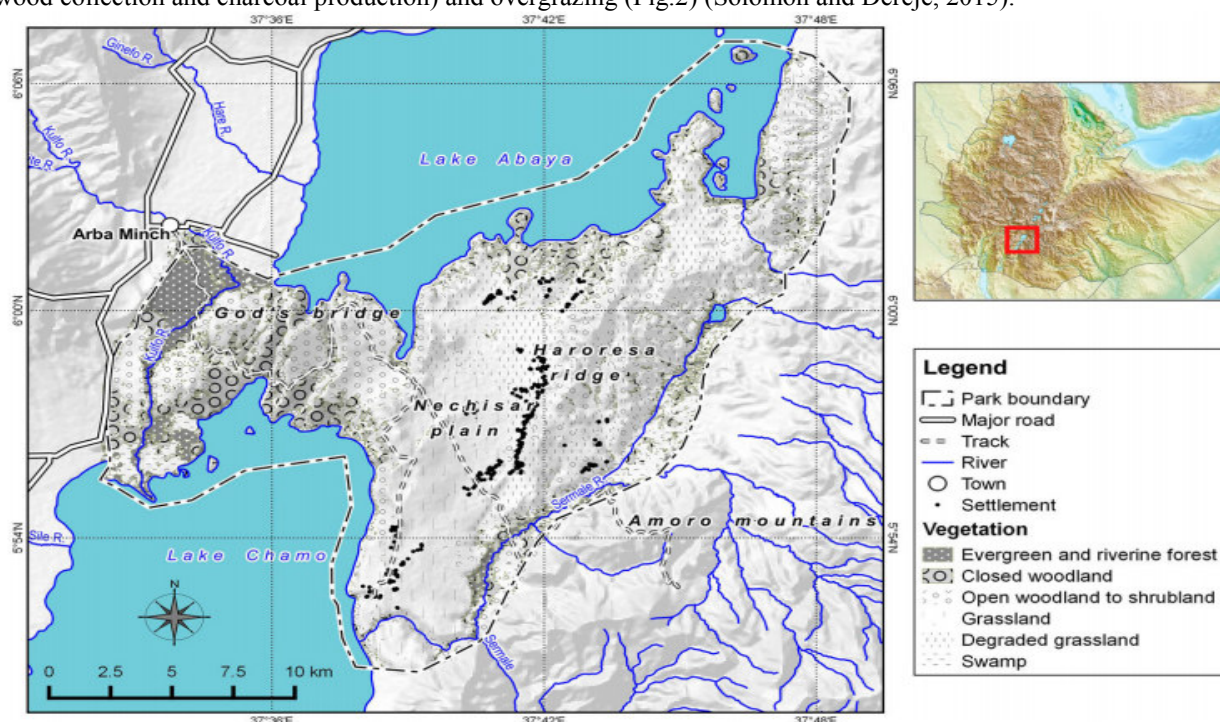


Fig.2 Landscape, vegetation of NSNP & human settlements inside the park (Marsboom, 2014)

### Fauna diversity and trends

Nechisar National Park (NSNP) is one of the globally most important protected areas (PAs) serving as a refuge and providing habitat for numerous wildlife species including, Grant's zebra (*Equus quagga*) which yet widely erroneously called as 'Burchell's zebra' (Clark, 2010). It was specifically established to protect the Swayne's hartebeest (*Alcelaphus buselaphus swaynei*), an antelope endemic to Ethiopia and highly threatened species (Vymyslicka *et al.*, 2011).

The aquatic and terrestrial ecosystem of Nechisar national park harbors a variety of mammalian, avian, amphibian, reptilian and fish fauna (Hillman, 1993). The park supports more than 90 mammals and 350 species of birds and acts as the destination of many Palearctic and intra-Africa migrants (Duckworth *et al.*, 1992). After 20 years census the number of species declined and harbors more than 37 mammals (Vreugdenhil *et al.*, 2012) and 330 bird species (BLI, 2011).

The large mammals of NSNP Including Swayne's hartebeest (*Alcelaphus buselaphus swaynei*) are Burchell's zebra (*Equus burchelli*), Grant's gazelle (*Nanger granti*), Waterbuck (*Kobus ellipsiprymus*), Warthog (*Phacochoerus africanus*), Bohor reedbuck (*Redunca redunca*), Oribi (*Ourebiaourebi*), Greater kudu (*Tragelaphus strepsiceros*), Common Bushbuck (*Tragelaphus scriptus*), Guenther's dik-dik (*Madoqua guentheri*), Grey Duicker (*Sylvicapra grimmia*), Bush duiker (*Sylvicapra oreotragus*), Bush pig (*Potamochoerus larvatus*), and Hippopotamus (*Hippopotamus amphibious*). While Lion (*Panthera leo*), Leopard (*Panthera*

*paradus*), Serval cat (*Leptailurus serval*), Spotted hyena (*Crocuta crocuta*), Common jackal (*Canis aureus*) and Nile crocodile (*Crocodylus niloticus*) are the major predators recorded in the park. Moreover, four primate species, Anubis baboon (*Papioanubis*), Vervet monkeys (*Chlorocebus pygerythrus*) and Black and white colobus monkey (*Colobus guereza*) and 19 bat species recorded (Vreugdenhil *et al.*, 2012).

The aquatic ecosystem of NSNP embraces two lakes offer stunning views and attract many bird species. Lake Chamo is home to a large population of hippos (*Hippopotamus amphibius*) and Ethiopia's largest population of Nile crocodiles (*Crocodylus niloticus*) with a particular concentration of them at the beach known as the 'Crocodile Market and abundant fish including Nile perch (Clark, 2010). Trends of wild animal population in Nechisar national park were more alarming and change their diversity. For example, the population of Swayne's hartebeest (*Alcelaphus buselaphus swaynei*) the park's flag - ship species which had been used to justify its establishment declined extremely from time to time (Table 2).

Table 2: Population size, trends and status of Swayne's hartebeest in Nechisar national park

S.no	Swayne's hartebeest ( <i>Alcelaphus buselaphus swaynei</i> )		Status
	Assessment year	Population size	
1	1972	100 <sup>1</sup>	Endangered (IUCNSSC, 2017)
2	2002-2003	67 <sup>2</sup>	
3	2007-2008	35 <sup>3</sup>	
4	2009-2010	12 <sup>4</sup>	
5	2011-2012	2 <sup>5</sup>	

Source: (<sup>1</sup> Bolton, 1973; <sup>2</sup> Befekadu, 2005; <sup>3</sup> Aramde *et al.*, 2011; <sup>4</sup> Demeke & Afework, 2011); <sup>5</sup> EWCA, 2012)

**Endemic species:** An 'Endemic Species' is one that is only found in that region and nowhere else in the world. As such they are of conservation concern because they are not widespread and may be confined to only one or two protected areas (IUCN, 2001). The following endemic mammals and birds are found in Nechisar national park.

**Mammals:** from the 90 endemic mammals of Nechisar national park Swayne's hartebeest (*Alcelaphus buselaphus swaynei*) is found as endangered status.

**Birds:** from the 24 endemic species of birds in Ethiopia the following three species of birds are endemic in NSNP. Wattled ibis (*Bostrychia carunculata*), Thick-billed raven (*Corvus crassirostris*), and NechSar Nightjar (*Caprimulgus solala*) (Weldemariam, 2016).

Table 3: Biodiversity comparison of Awash and Nechisar NPs with the whole country

I	The whole Country		ANP	NSNP	
	Category	No. of species			No. of Species
1	Mammals	320 <sup>1</sup>	42 <sup>2</sup>	78 <sup>6</sup>	37 <sup>7</sup>
2	Birds	924 <sup>3</sup>	24 <sup>3</sup>	472 <sup>6</sup>	330 <sup>8</sup>
3	Reptiles	240 <sup>4</sup>	16 <sup>7</sup>	43 <sup>5</sup>	-
4	Flora	>6000 <sup>10</sup>	625 <sup>7</sup>	400-600 <sup>5</sup>	800-1000 <sup>9</sup>

Source: (<sup>1</sup> Mutke and Barthlott, 2005; <sup>2</sup> Wilson & Reeder, 2005; <sup>3</sup> Weldemariam, 2016; <sup>4</sup> Largen & Spawls, 2010; <sup>5</sup> Jacobs & Schloeder, 1993; <sup>6</sup> Yirmed and Girum, 2013; <sup>7</sup> Vreugdenhil *et al.*, 2012; <sup>8</sup> BLI, 2011; <sup>9</sup> Evans *et al.*, 1992; <sup>10</sup> Hedberg *et al.*, 2009)

### 3. Conservation challenges & threats

Protected areas are currently increasingly facing numerous challenges. The root causes that destroys natural resources in parks are existence of communities engaged in agriculture and pastoralist and agro-pastoralist way of life (UNEP, 2013). For example Awash National Park from the beginning, was established in the home villages of indigenous local communities of Kereyu, and Afar (Ayalew, 2009; World Bank, 2006). Likewise in NSNP the Guji pastoral community lives inside the park and the Kore community agricultural practices and livestock grazing (Abiyot, 2009).

#### Habitat/land cover conversion

Land use conversion due to increasing human and livestock population is quite common in protected areas of most Eastern African countries (Pomeroy *et al.*, 2003). Such a conversion of natural vegetation cover to other use types such as farmlands, grazing lands, human settlements and urban center has been shown a root cause to loss of biodiversity (Maitima *et al.*, 2009).

For example, Awash national park found that scattered bush land was drastically reduced by 29.4% between 1972 and 2006, grass land expanded rapidly by 14.2% between 1972 and 1986 and by 10.5% between 1986 and 2006. Moreover, in addition to ever increase in demand for farm and grazing land in and around ANP, bare land expanded rapidly. For example portion of Mount Fentale, 4.9% of the area became barren land between 1972 and 2006 (Solomon *et al.*, 2014).

Furthermore, on the eastern side of the park where the Afar ethnic group resides, recently 20,000 ha of land were allocated for sugar plantation (AFWADO, 2010). The expansion of commercial farming and land alienation by the Ittu migrants, losses pasture land of Kereyu community outside the park (Ayalew, 2009). Permanent settlements in and around the park are other an important contributing factor to continued human pressure on park resources (Fig.5). For example four sub-districts in the Oromiya side of the park: Gelcha, Benti, Kobo and Debiti were reported to have permanent settlements (Solomon, *et al.*, 2013). Another indication of settlement in the park has constructed various public service facilities (schools, clinic, millhouse, store house, water works, etc) inside the western part of the park by Gudina Tumsa foundation, a NGO which the Kereyu community settled (Molla *et al.*, 2010). The major drivers of land cover change in ANP (Fig.3).

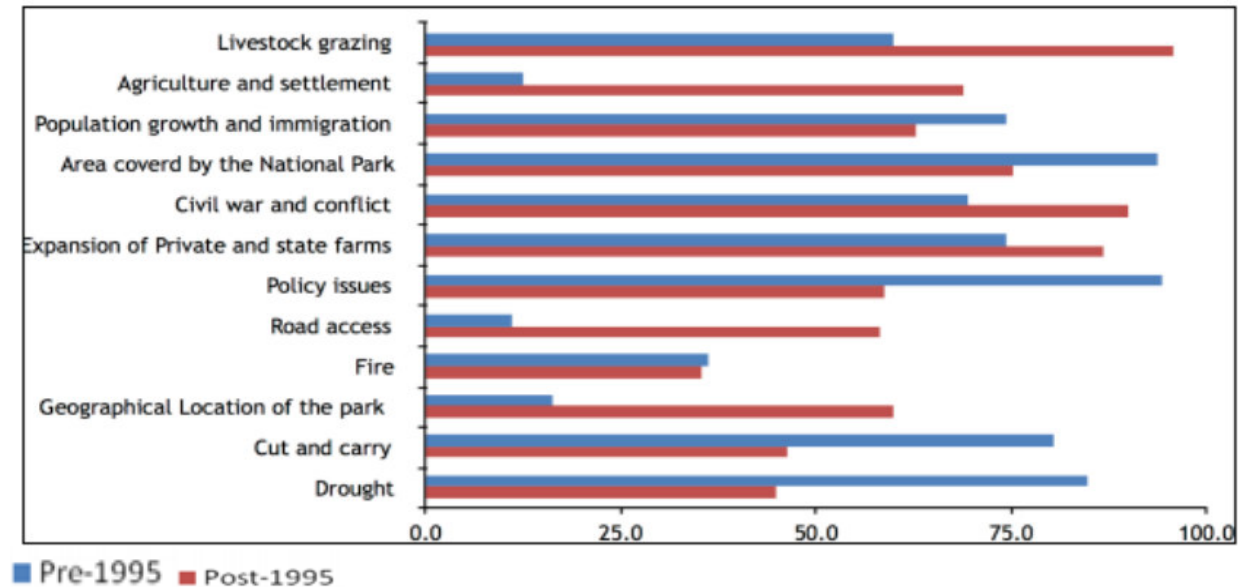


Fig.3 Key drivers of Land use land cover change in ANP (Solomon *et al.*, 2014)

Similarly, the landscape in Nechisar national park underwent major changes between 1985 to 2013 with the forest and grass land are the most threatened habitats with the mean patch size of forest has decreased from 46.33ha in 1985 to 13.88ha in 2013 and the mean patch size of grass land has decreased from 76.52 ha to 9.81 ha in the same period respectively. The changes were from forest to crop land mean patch of 32.45 ha and from open grassland to land cover of undesirable non-native species as well as extensive shrub encroachment mean patch of 66.71 ha in the grassland areas (Aramde *et al.*, 2014). Remote sensing data showed that open grassland in the park decreased from 6300 ha in 2000, to 5400 ha in 2011(Marsboom, 2014). The main drivers of change and threat in Nechisar national park are the following (Fig.4).

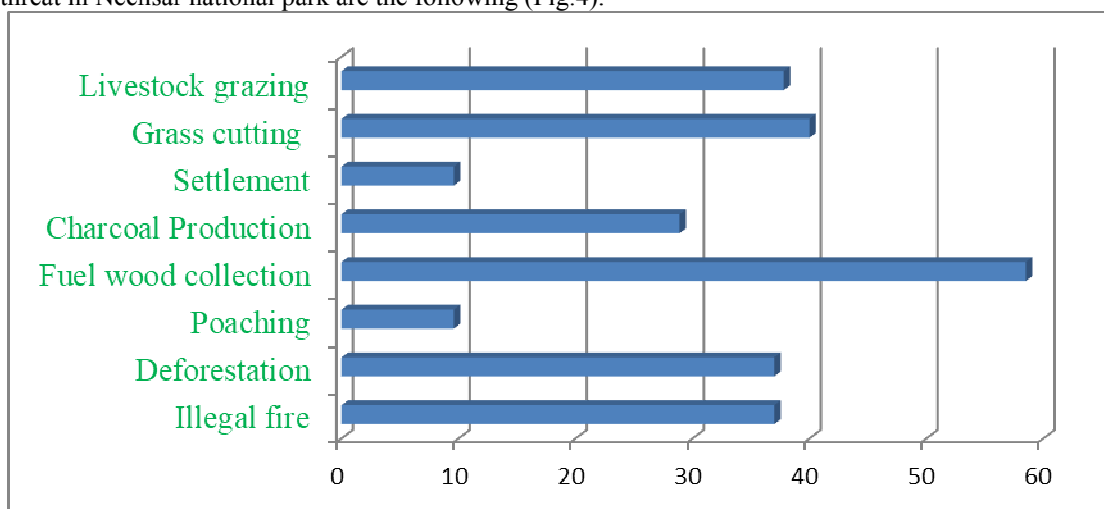


Fig.4 Main drivers of land cover change & illegal activities in NSNP (Solomon & Dereje, 2015)



Fig.5 Local community settlements in side Awash national park (Tamene *et al.*, 2011)

### **Livestock grazing & pastoralists**

The management issues of protected areas are influenced by livestock grazing globally. Overgrazing by domestic livestock of an area is an important cause of land degradation in arid (Perveen *et al.*, 2008) and semi-arid ecosystems (Huang *et al.*, 2007). Similarly grazing by livestock has been an important issue for the management of national parks and generally protected areas of Ethiopia. As grazing opportunities outside the park have been reduced, pastoralists are putting greater pressure on parks, causing damage to fragile habitats, competition with native wildlife, and potential for disease transfer (Alers *et al.*, 2007).

The consequences of overgrazing increases soil erosion, decreased quality and productivity of range resources, reduction or elimination of the natural regeneration of preferred forage species, favor aggressive bush encroachment and loss of biodiversity (EBTF, 2008). For example soil erosion in the Nechisar Plain is a great problem arising from livestock overgrazing by the pastoralist. Parallel to degradation, overgrazing a large area of the grass-land habitat of Nechisar is threatened by 41 species of shrub encroachment (Hasan *et al.*, 2011). Consequently, grazing in NSNP is a challenging problem, diminishing the abundance of wild life forage “nechisar grass” there by threatening the grazers biodiversity such as the Burchel's zebra (*Equus burchellii*), and Grant's gazelle (*Gazella granti*) (Solomon & Dereje, 2015).

Furthermore, common use of the grassland plains by wildlife and domestic animals increase the risk of disease transmission to and from wildlife (Desalegn, 2008). Bolton (1973) and Kirubel (1985) have pointed out that overgrazing severely deteriorated the Nechisar open grassy plain area and enhanced invasion of ticks during the dry season. As a result livestock are a major ecological competitor in the plains zebra range. There is high competition by both the livestock and plains zebra for the major palatable grass species of *Themeda triandra*, *Carduus nutans L.*, *Setaria sphacelata* and *Cenchrus ciliaris*.

Similarly, grazing is also a big challenge in **Awash national park**. Extensive pastoral herding based on communal grazing system is the main lifestyle of the pastoral communities around Awash National Park (Abule *et al.*, 2005; Tessema *et al.*, 2011). Livestock of the pastoral and agro-pastoral communities share resources with wildlife in and around ANP as commonly observed in other conservation areas of Africa and elsewhere in the world. The pastoralist communities, who largely depend on communal natural resource management systems, inhabit the area and live off the natural resources found within and around ANP. The extensive presence of the community within the park's boundary has influenced the management and the development of the park's natural resources (Melaku, 2011).

Population of camels, cattle, sheep and goats of the pastoralist are flooding in Awash national park. As a result the wildlife's are stressed by disturbance, and shortage food (Mengistu *et al.*, 2017). The local community of Kereyu, Ittu and Afar are the principal livestock owners of surrounding awash park. The aerial survey was estimated that between these three groups there were 106,301 livestock found in the area. Most of them dependant up on the natural forage found on Awash National Park lands, either seasonally or permanently which will have a direct devastating impact on lowering down the density and diversity of floras (Jacobs, & Schroeder, 1993). Moreover the park area suffered from overgrazing by the cattle emphasizing that the cattle population is well beyond the carrying capacity of the area (Bolton, 1973). ANP biodiversity loss is also due to expansion of private commercial farm and state supported settlement programs in the nearby areas of the park aggravated the



scarcity of grazing land and forced the park adjacent pastoral and semi pastoral communities to use the grasslands of ANP natural resources for grazing. Competition from grazing for large flock of domestic animals forced wild mammalians either to migrate or to conflict with domestic animals. Moreover, over grazing in the park's grassland brought scarcity of pasture and water which in turn become a major cause for loss of wildlife either in death or migration (Habtamu, 2014; Tezera, 2015).



Fig.6 The impact of domestic animals on Awash NP biodiversity (Solomon, 2014)

#### **Invasive species**

Biological invasive alien species (IAS) are non native species of plant and animal origin, and widely recognized among the greatest threats to ecosystem biodiversity and productivity (CBD, 2005). Non-native or alien species pose a significant threat to protected areas by their direct and indirect impacts to native species, and by their effects on broader scale ecological patterns and processes (Cole and Landres, 1996).

Invasive species cause biodiversity loss by competing native species for feed and habitat and altering the physical environment in a way that excludes native species. So far, close to 35 invasive weed species are identified in Ethiopia, and they are posing negative impacts on native species (EBI, 2014). The introduction of invasive alien species, particularly in the eastern and southern lowlands of Ethiopia, is a major cause of loss of biodiversity. Currently there are many invasive species that are flourishing around ANP such as *Prosopis juliflora*, *Lantana camara*, *Calotropis procera*, *Parkinsonia aculata*, *Parthenium hysteropholus*, *Cryptostegia grandiflora* (Ayana *et al.*, 2011, Tamene *et al.*, 2011; Ayana *et al.*, 2013; Mengistu *et al.*, 2017).

Parthenium weed has the potential to decline adversely the herbaceous components of ANP vegetation; up to 90% by its aggressive competition and allelopathic effect (Mahadevappa *et al.*, 2001). This weed can create a great challenge on herbaceous plant diversity of the ANP, the precious wild lives inhabiting the Park depending on the vegetation and values the country gain from the sector (Ayana *et al.*, 2011). Similarly, *Prosopis juliflora*, which is widely spread in the adjoining Afar plains, was slowly penetrating to the ANP from the NE and Eastern part. The species is known for its aggressive expansion and invading characteristics (Tezera, 2015). *Prosopis* reduced rangeland and free movements of wildlife (Mengistu *et al.*, 2017) and suppress the growth of grasses under its canopy and the biodiversity (Niguse and Amare, 2016) by delaying seed germination and reducing plant growth in terms of roots, shoots, leaf area, stem diameter, and plant height (Mangla *et al.*, 2008).

#### **Deforestation & land degradation**

Conversion of natural vegetation cover to various land use types, in East Africa, including Ethiopia, were ranked as the highest in Africa at a rate of 0.94% (1990-2000) and 0.97% per year (2000-2005) (FAO, 2007). Deforestation in Ethiopia occurs when locals clear forests for their personal needs, like fuel, hunting, agriculture, housing development, etc.

Deforestation resulting land degradation is the global threats for many wild animals with its natural habitat and affects the wild animal's life style in their preferred habitats. The forest cover of Ethiopia has been approximately 40 % of its land a century ago but now has declined to only 3% (Badege, 2001). The extensive deforestation has also led to the extinction of various biotas as resulting in significant biodiversity loss. However, more than 17.1% of the country's land is protected area much of this is forest land that is now widely used for

cultivation, grazing, fuel wood and construction (Masanja, 2014). As a result uncontrolled logging, illegal charcoal production and fuel wood collection are some of the major causes of deforestation that directly influence large mammal's habitat (Alemneh, 2015).

High consumption for fire and construction wood as well as illegal charcoal production that focused on big trees, in addition to aggravating deforestation, endangered the survival of the varieties wild life in ANP. Big trees are very essential for shade provision to mammals during strong sun radiation and bird species for nesting (Tezera, 2015). Similarly reported that production of charcoal and fuel wood is the primary driver of deforestation and subsequent land degradation due to extensive agriculture were the major threats observed in NSNP. Because the forests and woodlands just next to Arba Minch town (Figure 2) are an important source of firewood and timber (Aregu and Demeke, 2006).

Consequently, extensive woodland has to be cleared in Awash national park to meet the high charcoal demand of the community (Silayo *et al.*, 2008). The indigenous people mainly depend on fuel wood species for their house hold consumptions and income generation. The dominant fuel wood (charcoal and/or firewood) species used by the Afar and Oromo (Kereyu and Ittu) in ANP are 156 plant species like *Acacia tortilis*, *Acacia nilotica*, *Acacia prasinata* and *Acacia negrii* as a source of deforestation (Tinsae *et al.*, 2012). Moreover, charcoal making causes many accidental fires on forests. Thus, both charcoal harvesting and accidental fire contribute to deforestation and land degradation and finally result global warming (Silayo *et al.*, 2008).

Due to the above mentioned factors deforestation and land degradation in the whole country particularly in protected areas has been aggravated in an alarming rate. For example the annual deforestation rate based on satellite image quantification in Awash national park (ANP) savanna wood land to be estimated that 677.7 hectare. According to this estimation if deforestation continued in the same rate, the remaining wood land in the park will be lost in 71.5 years (Habtamu, 2014).



Fig.6 Illegal charcoal production and mass cutting of trees in ANP (Tamene *et al.*, 2011)

#### Illegal fire

Illegal fire has effects on biological diversities and ecosystem function by damaging habitats, breeding site and food causing loss of wildlife and the territorial birds and mammals from their natural homes (Bowman and Murphy, 2010; CBD, 2010). All the above practices can destroy tree and grasses at the early stages of their growth. However, fire is a basic part of the ecology of semi-arid rangeland ecosystems; it often encourages bush encroachment, greatly reduced forage production and major changes to the structure and species composition of the vegetation. Fire bans result from well-meaning initiatives taken by politicians and technicians who lack a good understanding of the role of fire in the ecology of dry land ecosystems (EBTF, 2008).

An occurrence of fire hazard within protected areas including ANP is of anthropogenic origin. Because most fire prone areas are located in or adjoining areas of the Awash park where such activities are permitted. For example, from time series record of fire estimation, between 2001 and 2013 there had been 26 fire incidences at

ANP. While the seasonal distribution of fire incidence at ANP showed that most fire incidences had occurred between early October and end of December (Tezera, 2015).

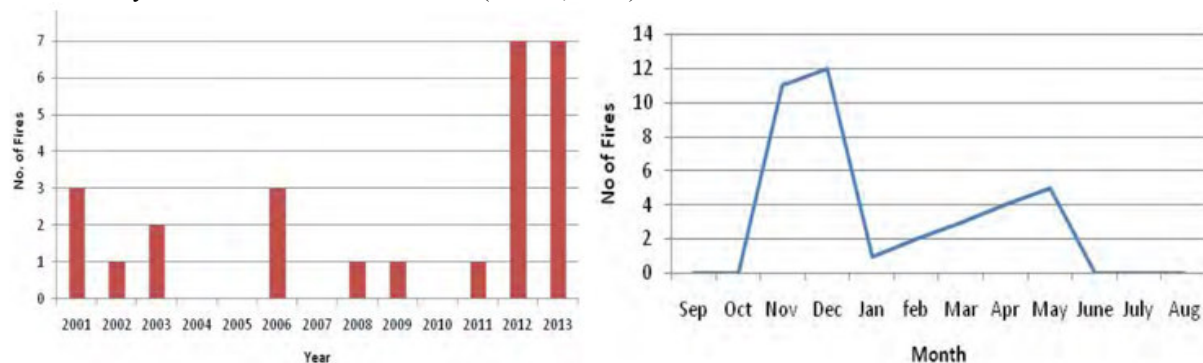


Fig.7 Number of fires observed by year & month at Awash National Park (Tezera, 2015)

### Conflicts among local communities & with park administrator

Ethiopia protected areas may have many challenges some of which are results of border conflicts among local communities and community with park management (Ashenafi and Leader, 2005). Such factors have threatened the existence of many parks in the country (Solomon *et al.*, 2012). Conflicts continue among communities surrounding the ANP such as the Kereyu/Ittu against the Afar and between the local communities and the park administration (Mulugeta & Hagmann, 2008). As a result the conflict between the Afar and the Kereyu/Ittu tribes is long standing in eastern part of the country (Ayalew, 2009).

The sources of conflicts are scarcity of natural resources and border conflicts between the neighboring communities are recognized sources of enmity between communities (Gleditsch, 1998). Furthermore, shortage of pasture and water sources, and sharing of border are causes of conflicts between the Kereyu/Ittu and Afar and conflicts between these tribes often involves looting of livestock (Eyasu Elias, 2008).

Similar conflict between park staff (scouts) and local communities surrounding the Nechisar National Park were also reported (Demeke & Afework, 2011). The increasing livestock population and illicit exploitation of resources have impacted resources in Nechisar National Park and establish conflict (Demeke, 2011).

### Institutional instability & poor enforcement of existing legislation

Series of institutional change in the protected areas governance is underlined as one of the main challenges for the conservation enforcement of many protected areas in Ethiopia. For instance, NSNP since its foundation, it has been subjected to several institutional changes (Table 4) and instability of the organizational structure has had a strong impact on the park's protection and its enforcement (Abiyot, 2009; Debelo, 2011, 2012; Kelboro and Stellmacher, 2012). These changes and institutional instability at national level have had negative effect on NSNP and other protected areas (PAs) in Ethiopia and subsequently have led to decline of flora and fauna population (Vymyslicka, *et al.*, 2010; Aramde *et al.*, 2011; Yosef *et al.*, 2012).

Table 4: Nechisar national park management and enforcement periods for protection

S.no	Management period	Responsible body
1	1974–1980	Ethiopian wildlife conservation organization
2	1980–1994	Forest and wildlife conservation and development authority
3	1995–2004	Southern nation nationalities and peoples regional state
4	2004–2008	African parks foundation (private–public management)
5	2008–present	Ethiopian wildlife conservation authority

Source: (Abiyot, 2009; Debelo, 2011, 2012; Kelboro and Stellmacher, 2012)

In Ethiopia there are various stakeholders involving in protected areas, including local communities, regional government, Ethiopian Wildlife Authority, Ethiopian Biodiversity Institute, and NGOs. However, these various stakeholders from state government to project implementers lack work cohesion. Consequently, they design and plan to achieve different objectives. Such differences are common when conservation activities are linked to donor funding for development. Thus, these all differences finally complicate management of the park resources (Alers *et al.*, 2007).

As some investigators noted law enforcement is the best way to prevent further biodiversity erosion, and is necessary to achieve proper management of protected areas as a common good (Gibson *et al.*, 2005; Fischer, 2008). Based on the IUCN definition of protected areas, activities like settlements, agriculture, poaching and others are illegal inside protected areas; but no adequate law enforcement has been done to stop such activities in Ethiopia protected areas. For instance, in Yangudi-Rassa and awash national park, conflict in resources use between Issa (Somali) and Afar tribes resulted in the scrambling the park areas for grazing and settlement by chasing out the scouts (Mengistu *et al.*, 2017). Moreover, conservation Awash national park practically failed however at the time of establishment it was given a classification of “strict conservation area” and defined as

excluding all kinds of human use in the area like settlement, exploitation of natural resources, & grazing (Moore, 1982).

### The existence of infrastructure crossing protected areas

The longest road which is extended from Awash to Djubti port is biggest economic corridor of the country. However, within the highway there are three protected areas, including Awash National Park, Yangudi Rasa National Park and Allideghi Wildlife Reserve set aside for wildlife conservation (Habtamu, 2014; Tezera, 2015). The road is passing in the fragmented landscape of the protected areas exclusive of wildlife crossing structures. Besides, ecological safety management of wildlife vehicle collision is poorly designed so that, it is causing mortality of wildlife of conservation interest (Getachew & Weldemariam, 2016). During incidental survey, considerable road kill of wild animals (a large number of wild life and big birds are lost in a road kill) as well as the road is also too crowded with heavy vehicles of the whole day (Tezera, 2015; Molla, *et al.*, 2010). The arid climatic condition of the highway makes the drivers to frequently travel during active hour of the wild animals. Such kind of traffic concordance may aggravate the rate of wildlife road kill in the park. On the other hand, conservation efforts on road ecology are not practically feasible due to weak law enforcement and lack of multi sector involvement before and after construction plan. Thus, such threats are leading the conservation efforts of biodiversity problematic and will take the predominant role for the decline of the wild mammal resource base of Awash National Park for the future (Getachew & Weldemariam, 2016).

Further, on top of the above factors the state sugarcane farm around Sabure Camp site of ANP is expanding its territory at the north eastern edge of the park and is currently cultivating the lands of the park by crossing the beacon, corner stones, of the park. Similarly, irrigation project works are also crossing the park's territory which needs a special attention. The other destructive agent of the vegetation of the park is the huge hydropower lines (to Dire Dawa, Djibouti) which are constructed with a minimum of 14 meters diagonal destruction/ through clearance of the vegetation (Molla *et al.*, 2010).

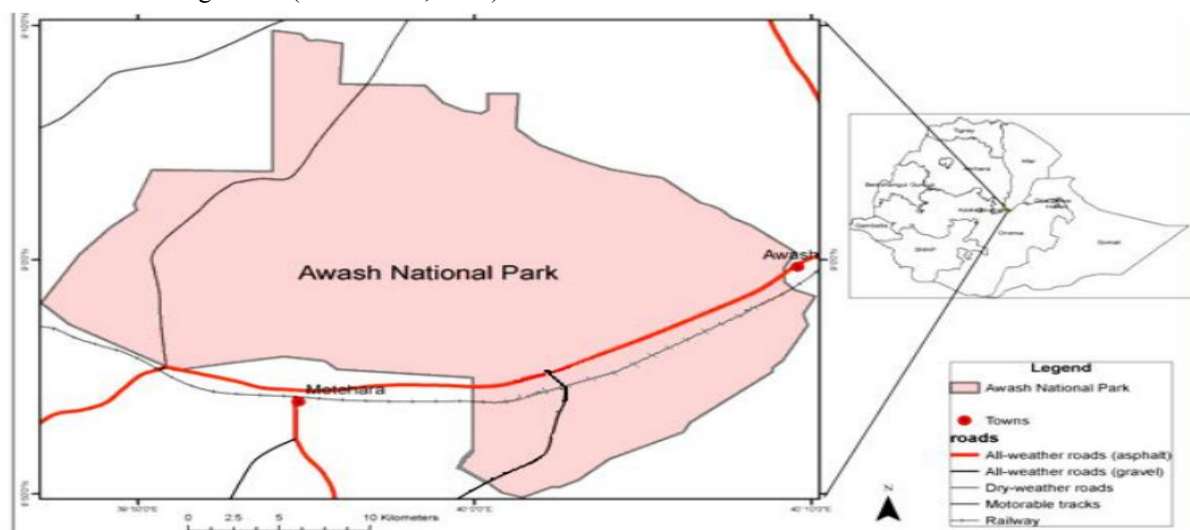


Fig.8 Different types of roads and rail way crossing ANP (Ayana, *et al.*, 2011)

### Conclusion

Protected areas of Ethiopia particularly national parks have a key role in conserving the life of flora and fauna. However, protected area resources are usually misleading of understanding and have a great threat from increasing and development of human interest. Awash and Nechsar National Parks are among the protected areas and they are not escaped from conservation challenges. Consequently, despite its ecological and socio-economic importance, these parks are exposed to sever pressure by pastoral and agro-pastoral community in the area. Livestock grazing, deforestation (due to fire, charcoal production) expansion of invasive species, habitat conversion, conflict between settler and park manager and other are the major threats of the parks biodiversity. Due to the less emphasis given to our protected areas some of the national parks are paper parks; devoid of the intended schemes of conservation and management practices. Moreover, the unique and endemic wild mammal species richness and diversity of the parks is gradually declining from time to time. These all changes and challenges cannot be stopped and will continue because it is a question of survival in relation to the livelihood of the communities in and surrounding the protected areas.

### Recommendation

Develop awareness creation and Strengthen capacity building on protected areas sustainability by formulating

chains from local people to higher governmental organizations. The local community living in and around protected areas livelihood specifically pastoralists and agro-pastoralists depend on them and consequently, permanent resettlements and alternative life sport activity should be arranged. The legislation which were developed for protected area should be implemented on ground and the responsible organ should recognized the sustainability of local community livelihood and the biodiversity resources .Most protected areas has no clear demarcation at the ground level and re-demarcation is important. In most protected areas there is lack of enough & continuous recorded information on biodiversity & their changes. Thus annual assessment of PAs biodiversity is mandatory.

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