Assessment of the biodiversity in terrestrial and marine landscapes of the proposed Lag Badana National Park and surrounding areas in Jubaland, Somalia

Osman Gedow Amir, Jan De Leeuw and Grace Koech

**World
Agroforestry
Centre**

**Assessment of the biodiversity in terrestrial and marine landscapes
of the proposed Lag Badana National Park and surrounding areas in
Jubaland, Somalia**

Osman Gedow Amir, Jan De Leeuw and Grace Koech

LIMITED CIRCULATION

Citation: Gedow AO, De Leeuw J, Koech G. 2017. Assessment of the biodiversity in terrestrial and marine landscapes of the proposed Lag Badana National Park and surrounding areas, Jubaland, Somalia. ICRAF Working Paper No 251. Nairobi, World Agroforestry Centre. DOI: <http://dx.doi.org/10.5716/WP16174.PDF>

Titles in the Working Paper Series aim to disseminate interim results on agroforestry research and practices and stimulate feedback from the scientific community. Other publication series from the World Agroforestry Centre include: Technical Manuals, Occasional Papers and the Trees for Change Series.

Published by the World Agroforestry Centre
United Nations Avenue
PO Box 30677, GPO 00100
Nairobi, Kenya
Tel: +254(0)20 722 4000, via USA +1 650 833 6645
Fax: +254(0)20 722 4001, via USA +1 650 833 6646
Email: worldagroforestry@cgiar.org
Website: www.worldagroforestry.org

©World Agroforestry Centre 2017

Working Paper No. 251

The views expressed in this publication are those of the authors and not necessarily those of the World Agroforestry Centre.

Articles appearing in the Working Paper Series may be quoted or reproduced without charge, provided their source is acknowledged.

TABLE OF CONTENTS

List of figures.....	iv
List of tables.....	iv
About the authors.....	v
Acknowledgements.....	vi
Abstract.....	vii
List of abbreviations and acronyms	ix
1. Context and rationale	1
2. Background on Somalia.....	2
3. Methodology	4
4. Biodiversity in Somalia.....	5
5. The proposed Lag Badana National Park and surrounding areas	7
5.1 Geography	7
5.2 Vegetation	8
5.3 Hydrology and tsetse	11
5.4 People	12
5.5 Past and current conservation efforts	12
6. Biodiversity of Lag Badana National Park and surrounding areas.....	15
6.1 Marine diversity	16
6.2 Terrestrial biodiversity	17
6.2.1 Plants	17
6.2.2 Birds	19
6.2.3 Mammals	20
6.2.4 Responses based on telephone survey	21
6.2.5 Herpetofauna	24
6.2.6 Fresh water fish	25
6.3 Threatened species	25
7. Biodiversity use, threats and opportunities.....	28
8. Conclusion	33
9. Recommendations.....	35
10. References.....	37

LIST OF FIGURES

Figure 1. Map of location of the Lag Badana National Park	7
Figure 2. Physiognomic vegetation map of the proposed Lag Badana National Park	9
Figure 3. Riparian forest fringed by grassland and wooded and bushed grassland.....	10
Figure 4. Coastal dune vegetation, beach and coral reef in the Lag Badana NP area	11

LIST OF TABLES

Table 1. Number of animal and plant species recorded in Somalia.....	6
Table 2. Diversity and conservation status of flora and fauna of Lag Badana National Park and surrounding areas.	16
Table 3. Families of higher plants, with number of genera and species in Lag Badana NP and Juba Valley	18
Table 4. Presence of larger mammal species in the Lag Badana NP area in 2016, 1970s and 1960....	22
Table 5. IUCN red listed and endemic animal species in Lag Badana National Park.....	26
Table 6. Drivers and pressures threatening biodiversity and social benefits in terrestrial and marine systems.....	30

ABOUT THE AUTHORS

Osman Gedow Amir works for the Somali Wildlife and Natural History Society (SWNHS).
E-mail: osmangedow10@gmail.com

Jan De Leeuw is a CIM Integrated Expert Biodiversity and Geo Information Science,
Faculty of Ecology and Soil Science at Baku State University. Email:
jan45leeuw@gmail.com

Grace Koech is a young scientist with specialization in genetic diversity, conservation biology,
biotechnology and biodiversity. She currently works as a researcher at the World Agroforestry
Centre. Email: gracekoech44@gmail.com

ACKNOWLEDGEMENTS

Assessment of the biodiversity of the region of the Lag Badana-Bushbushle National Park has benefited from the support of many people and publication of the report would not have been possible without the generous support of various institutions and individuals including the Somali Federal Government. We would like to express our profound appreciation to all those who provided us with valuable information in executing this exercise.

To begin with, we would like to extend our appreciation to Mr. Abdulkadir Abdi Farah, Director General of Ministry of Livestock, Forestry and Range and Dr. Mohamed Ahmed Ibrahim, Savanna Consultancy for their assistance during data collection and identification of stakeholders in the project area. We are extremely grateful to Hon. Mohamed Yusuf Omar, Minister of Water, Energy, Environment and Mineral Resources, Jubaland State of Somalia for his role in facilitating access to various stakeholders in Jubaland. Special thanks to the stakeholders, particularly key informants, who lent their precious time to provide feedback on our questionnaires. The success of this exercise could not have been possible without their willingness to participate during the data collection and stakeholder analysis exercises.

We would also like to thank ICRAF project team members for their continued support and guidance during data collection and preparation of the report. In addition, we are indebted to the staff of the Herbarium at the National Museums of Kenya for making it possible for the lead author of this report to access the flora of Somalia.

Finally, we are grateful to ICRAF's Communications Unit, Mr. Robert Muthami Kithuku and Mr. Jillo Katello for proof reading the manuscript.

ABSTRACT

This report describes an assessment of the terrestrial and marine biodiversity of the cross-border landscape in the Lag Badana Bushbushle National Park. The findings revealed that 1440 plant and animal species are recorded in the area of the proposed national park. There are 916 species belonging to 446 genera and 110 families that have been recorded in the area of the national park and the adjacent flood plain of the lower Juba valley. The highest number of species are recorded for the *Fabaceae* (121 species), *Poaceae* (116), the *Euphorbiaceae* (47) and the *Cyperaceae* (47). While 659 species of birds have been reported for the whole of Somalia, we report 293 bird species for the marine and terrestrial part of the cross-border area. The East African coastal forest is one of the endemic bird areas and is home to globally threatened species such as the Hooded Vulture, *Necrosyrtes monachus* (CR), White-backed Vulture, *Gyps africanus* (CR), Lappet-faced Vulture, *Torgos tracheliotos* (EN), Madagascar Pond Heron, *Ardeola idae* (EN), Madagascar Pratincole, *Glareola ocularis* (VU), Tana Cisticola, *Cisticola restrictus* (DD) and the endemic Somali Boubou, *Laniarius erlangeri* (VU). Ninety-six mammal species that have been recorded in the cross-border area namely Leopard, *Panthera pardus* (EN), African hunting dog, *Lycaon pictus* (EN), Savana Elephant, *Loxodonta african* (EN) and Hunter's Antelope *Beatragus hunteri* (CR) and several vulnerable species such as the Lion, *Panthera leo* (VU), the Cheetah, *Acinonyx jubatus* (VU) and the Hippopotamus, *Hippopotamus amphibious* (VU). Several East African forest restricted mammals such as the Oribi, *Ourebia aurebia haggard* (VU) are also recorded in the protected landscape. Three endemic reptile species (*Pristurus simonettai*, *Mabuya hildebrandti*, *Atractaspis engdahli*) and four endemic sub-species of reptiles (*Heliobolus spekiis sextaeniatus*, *Agamodon anguliceps*, *Ancylocranium somalicum somalicum*, *Brachyophis revoili revoili*) may occur in the protected area. Twenty-two out of the total number of 72 species of fresh water fish are endemic to Somalia. So far only two species have been reported for the Lag Badana National Park, the African catfish (*Clarias gariepinus*) and *Nothobranchius jubbi*. The Juba valley contains several endemic species such as *Barbus gananenis*, *Varicorhinus jubae*, *Pardiglanis tarabinii*, *Synodontis geledensis* and *Nothobranchius patrizii*. Major threats to the species include lack of security, an unstable government, lack of law enforcement in the management of national parks, illegal charcoal production, pressure on remnant wildlife as a result of hunting, illegal fishing, unsustainable mangrove harvesting and coastal mining. However, several opportunities were identified during the assessment, and key among them was the vision and roadmap for re-establishment of the Lag Badana National Park

and community-based conservation of biodiversity in the area. The park will offer several ecological services including non-destructive forest products, bioprospecting, eco-tourism and recreation for Somali communities returning from the diaspora.

Keywords: Flora, fauna, birds, mammals, herpetofauna, threats, opportunities, Lag Badana

LIST OF ABBREVIATIONS AND ACRONYMS

BMP	Biodiversity Management Programme
CBD	Convention on Biological Diversity
CR	Critically endangered, IUCN Red List category
DD	Data Deficient IUCN Red List category
DPSIR	Drivers, pressures, state, impact, response
EN	Endangered, IUCN Red List category
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
ICRAF	World Agroforestry Centre
IGAD	Intergovernmental Authority on Development
IUCN	International Union for Conservation of Nature
JESS	Juba Environmental and Socioeconomic Studies
NGO	Non-Governmental Organization
NP	National Park
NPA	National Park Agency
SWALIM	Somali Water and Land Information System
SWNHS	Somali Wildlife and Natural History Society
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
VU	Vulnerable, IUCN Red List category
WCMC	World Conservation Monitoring Centre

1. CONTEXT AND RATIONALE

The Biodiversity Management Programme (BMP) is an IGAD initiative supported by the European Union (EU). It aims to contribute to poverty reduction by improving the social and economic wellbeing of populations in the IGAD region, through better regional integration in the environmental sector. Its purpose is the conservation and sustainable management of ecosystems in the IGAD region, in order to contribute to lasting ecosystem goods and services.

ICRAF is one of BMP's implementing partners. The organization is managing one of the three projects, whose specific aim is the development of collaborative management in the cross-boundary land and seascapes between Kenya and Somalia. The ICRAF project was launched in 2013 and will end in November 2017. It is being implemented in the cross-border area of north-eastern Kenya and southern Somalia in an area extending from Tana River in Kenya to Lag Badana area in Somalia. The Somali section of the cross-border area includes the proposed Lag Badana National Park and adjacent coastal and marine landscapes. The program comprises 12 activities.

One of these activities aims to compile and synthesize information on terrestrial and marine biodiversity for users involved in spatial planning and biodiversity conservation. In addition, these results will provide stakeholders in the cross-border area with information on the biodiversity and terrestrial and marine resources and the benefits derived from these.

This report presents a compilation of the biodiversity in the terrestrial and marine landscapes of the Somali part of the cross-border area. Since warfare and insecurity have made it impossible to access this area, the report presents an assessment based on existing publications, complemented with information on the current state of the biodiversity obtained from key informants living in the area.

2. BACKGROUND ON SOMALIA

Somalia is situated in the Horn of East Africa and is bordered by the Gulf of Aden and Djibouti to the north; the Indian Ocean to the east and south; Ethiopia to the west and Kenya to the southwest. The country covers an approximate area of land of 638,000km², and lies in the north-eastern corner of Africa between latitude 12° N in the north and 2°S at its southernmost point at the Kenyan border. With a length of 3300km Somalia has one of the longest and least spoilt coastlines on the African continent. Topographically, the country is fairly uniform with exception of the northern range mountains and associated escarpments facing the Gulf of Aden. There are five major topographic units. They include:

- The mountains in the north
- A broad limestone-sandstone basin covering the central and southern part
- The northern coastal plains
- The broad flood plains of the lower Shebelle and Jubba rivers
- The central coastal plains.

Climate and soil that determine the physiographic features of these lands influence the vegetation and its potential for biological productivity (Herlocker 1997). Climatologically, the country is dominated by the monsoon; rainfall is the most important meteorological element affecting life in Somalia. In the southern regions, the precipitation reaches 600mm and 400mm in the northwest, while the intervening area receives between 100-200mm annually (Hutchinson et al. 1988). The livelihood of the Somali people is closely intertwined and dependent on access to and use of the country's terrestrial and marine ecosystem. Livestock, agriculture and fisheries are the dominant agricultural production systems on which the Somali economy and culture are based. The country has an estimated population of 10.2 million people who share similar culture, religion and belong to one homogenous ethnic group, with the exception of several smaller minority groups such as the Boni, who used to live in the Lag Badana area (Laenderbricht 1991). The country harbours approximately 44.3 million heads of domestic animals (6.6 million camels, 19.7 million goats, 13.2 million sheep and 4.8 million cattle (Elmi 1991)) which exert an immense pressure on the vegetation and soils.

When the Central Government of Somalia collapsed in 1991 the country was plunged into a bloody civil war for more than two decades. In the absence of a central government, people reverted to their traditional customary and religious law to govern and resolve clan conflicts.

After a long search for a solution, the Somali people agreed to some sort of regional autonomous and federal system which established the first transitional government in 2004. The government was eventually recognized by the international community in 2012. One of the autonomous regions of the Federal State of Somalia is Jubaland, where the Lag Badana National Park is situated. The park is located in the southern tip of the Somali-Kenya border (Figure 1) and hosts lowland forest and bush lands with a rich biodiversity.

In addition to the above, the coastal forests of East Africa are a chain of relict forest stretching along the coastal area, extending from small patches of coastal riverine forest along the Juba and Shabelle rivers in southern Somalia to southern Mozambique. These forests are characterized by a mosaic of vegetation types including evergreen forest, *Brachystegia* woodland, scrub forest and dry forest. The biodiversity of the coastal forests is recognized as being of global importance due to high level of biodiversity and endemism found within the small, fragmented and highly threatened patches of [coastal forest](#). A total of 1356 vascular plant species were found to be endemic to the Zanzibar-Inhambane regional mosaic. Of these, 940 species (69%) are restricted to the northern part of the mosaic, while only 149 (11%) are confined to Mozambique's coastal line (Clarke 1998).

3. METHODOLOGY

An assessment of the terrestrial and marine biodiversity of the terrestrial and marine landscapes in and around the cross-border area and the proposed Lag Badana National Park was conducted over a period of 16 weeks (September-December 2015). In carrying out the assessment, existing literature on terrestrial and marine fauna was reviewed and additional information from the internet search gathered on biological resources in proposed protected area. Stakeholders from government institutions, universities, private sector actors, local NGOs and community elders in and around the national park were identified, and an interview schedule devised. One-on-one telephone interviews were conducted in January-February 2016 with national focal points, key-players from national institutions and agencies working in the sector.

While there have been earlier assessments for various species groups, this is the first assessment that brings together information on the terrestrial and marine biodiversity in the landscapes of the cross-border area. The availability of basic data for extracting biodiversity information on the present situation of the protected area was limited due to the prolonged civil war. In addition, the recently established regional and federal institutions responsible for management of natural resources are very weak and the data is not up-to-date. Moreover, there is no regional and/or federal-level government institution with clearly defined responsibilities for the collection of information on biodiversity, its conservation and protected area development and management. The absence of a responsible government institution hinders the collection of new information and access to existing information from those responsible, since no-one is sure about their mandates.

In 2016, a stakeholder interview to ascertain the presence of larger mammals in the national park was conducted with the aim of covering all settlements mentioned in the Abel report of 1976.

4. BIODIVERSITY IN SOMALIA

Somali became a signatory to the United Nations Convention on Biological Diversity (UNCBD or CBD) on 11 September 2009. It was the 193rd party to ratify the Convention on Biological Diversity (CBD); the notice of ratification was registered with the CBD secretariat on [10 December 2009](#). By ratifying the CBD, Somalia was committed to attain its objectives of “conservation of biological diversity; the sustainable use of its elements, and the fair and equitable sharing of the benefits arising from utilization of genetic resources”. The national focal point of the CBD is the State Ministry of Environment which falls directly under the Office of the Prime Minister.

Somalia has a rich and very interesting flora and fauna with many endemic species. In particular, it has an exceptionally rich assembly of species adapted to the arid and hyper-arid zones. The percentage of endemic species of its flora and fauna are very high. For example, 800 out of the 3165 plant species (25%) are endemics (Table 1). High percentages of endemism are also reported among its mammalian species (18%), reptiles (35%), amphibians (14%) and freshwater fish (31%).

However, while the biodiversity of Somalia is rich it has been under-studied. The last decent studies were published in the 1990s mainly due to rampant insecurity. In fact, no new biodiversity research has been undertaken in the last 25 years. Consequently, there is a significant knowledge gap on the current status of the country’s biodiversity and the distribution pattern of various species (Amir 1998). Scattered pieces of information revealed that the country has 1340 animal species and 3165 species of higher plants, which adapted to its unique ecological conditions (Amir 1998).

Given the richness of its biodiversity and the large number of endemic species, Somalia is part of two biodiversity hotspots. The first is the Horn of Africa [biodiversity hotspot](#) which includes the central and northern parts of Somalia. The second hotspot, more relevant to the current report, is the [East African Coastal Forest Biodiversity Hotspot](#). The coastal forests of southern Somalia form the northern tip of the East African Coastal Forest Biodiversity Hotspot, one of the 35 global biodiversity hotspots recognized by Conservation International¹. This

¹ [Conservation International, Coastal Forests of Eastern Africa](#)

biodiversity hotspot, which extends from southern Somalia to northern Mozambique, hosts 1750 endemic plant species. The dryland forests and savannas of this biodiversity hotspot host the entire world population of the Hirola or Hunter's Hartebeest (*Beatragus hunteri*). The Hirola is an endemic antelope species, which is the only remaining representative of the once more widespread and species rich genus of *Beatragus*².

Table 1. Number of animal and plant species recorded in Somalia³

No.	Type	Total no. of species	No. of endemic species	Percentage of the total (%)	No. of threatened species
1	Flora	3165	800	25	42
2	Mammals	176	32	18	15
3	Birds	659	10	1.5	15
4	Amphibian	29	4	14	0
5	Reptiles	230	80	35	10
6	Fresh water fish	71	22	31	4
7	Marine fish	276	-		22
8	Invertebrate	?	?	?	?
9	Microbes	?	?	?	?

This rich biodiversity is currently under threat. There are risks of losing the unique flora and fauna due to overexploitation, overgrazing and loss of the natural habitats. A decade of lawlessness and recurrent civil war have deepened inequalities and forced the local people to overexploit the natural environment and biodiversity indiscriminately for their survival. They have engaged in activities such as deforestation and overgrazing.

Prior to the State's collapse in 1991, Somalia developed the Mogadishu Manifesto which aimed at conserving the country's wildlife resources. The manifesto was signed by the then Head of State. This was a valuable document that reinvigorated the government's efforts to preserve wildlife and take the lead in ensuring sustainable natural resource development. About 32 National Parks (NP) and Game Reserves (GR) were created in Somalia, but none of them had effective protection mechanisms, thus the idea remained on paper (Amir 1998). One of these protected areas is Lag Badana-Bushbushle National Park, which lies in the southern tip of Somalia.

² Wikipedia, [Hirola](#), accessed 9 March 2016

³ Source: www.conservation.org and www.iucnredlist.org

5. THE PROPOSED LAG BADANA NATIONAL PARK AND SURROUNDING AREAS

5.1 Geography

The proposed national park is located in Badhadhe area, lower Juba region in Jubaland (Figure 1). The proposed park is mainly located within the Badhadhe district with its northern part extending into Kismayo District. The park area is roughly 3,340km².

Figure 1. Map of the Lag Badana National Park

Climatologically, the area experiences four distinct seasons namely; Jilal, the dry season experienced between December and March; Gu', the main rainy season that lasts from April to June; Haga, the dry spell which stretches from June to late September; Deyr season experienced from around October to mid-December when short rains fall. The annual average

rainfall is estimated between 400mm and 600mm with the north being the driest area while the southern part of the park is the wettest (Abel 1976, Abel and Kille 1976a).

5.2 Vegetation

The Lag Badana area supports various vegetation types. In the sections below, we present a classification of physiognomic vegetation types used by Abel (1975), which was based on the physiognomic classification proposed by Pratt et al (1966). While ecological classification is broad categorization according to the climate of the area within which the vegetation is located, physiognomy narrows down to growth forms of the plants, and relative amounts of woody and non-woody species. Figure 2 presents the vegetation map developed by Abel (1975). The map was based on aerial photographs of 1950 and hence represents the state of the vegetation 66 years ago. The report of Abel (1975) also provided a detailed description of the various vegetation types.

Bush land – This vegetation type consists of woody plants, mainly shrubs less than 6m high with trees grown sporadically here and there. This is substantiated further to Bush land B found in the Lag Dera Plain Region and unclassified area between Lag Garebey and Coastal Dune Region (Pratt et al. 1966). The canopy cover ranges from dense to fairly open in this area. Bush land on sand over limestone covers a large part of the park, growing on Dudumali Plain Region on ‘Chisimaio’ soil. Another type of bush land is found on the coastal dunes and hills located near the coast with human settlements. Plant species including *Acacia tortilis* and annual grasses such as *Chloris* and *Dactyloctenium* are common in this area (Abel 1976). Apart from bush land, woodland is similarly prevalent in this area standing to about 18m high with either open or continuous canopy, but not interlaced. Most of these vegetation types have been turned into secondary bush through shifting cultivation that is practised by hunter-cultivators (Abel 1976).

Source: Abel (1976)

Figure 2. Physiognomic vegetation map of the proposed Lag Badana National Park

Grassland – The grassland vegetation type is dominated by grasses, scattered trees and shrubs. It is further classified on the basis of height, species composition, degree of swampiness and dominance by annual grasses or other herbs into bushed grassland, dwarf shrub grassland and mixed types. This classification is based on the maximum height attained by the grasses when they are fully grown.

Woodland plus bush land – This is a mixed vegetation type with trees including *Terminalia*, *Delonix* and *Adansonia digitata* (baobab). The shrub layer is made of *Combretum* and *Acacia*. The woodland is vulnerable to conversion into cropland and pasture by pastoralists. It is home to many wildlife species.

Wooded and bushed grassland – Is the medium height *sporobolus* – *Terminalia* where grass is perennial, and the soil is free draining sand. Past human activities might have led to openness of the vegetation in the area. Wooded Grassland plus Bushed Grassland is a composite type that is similar to the wooded and bushed grassland type with which it is contiguous (Abel 1976).

Riparian forest – In addition to this, there is what is known Riparian forest (Figure 3), which is a strip of forests growing along the banks and in the beds of the streams – ‘Lagaag’ (where the name of the protected area originated) with *Diospyros*, *Garcinia* and *Ficus* species of trees. The vegetation around permanent watering places had been altered greatly owing to grazing by cattle, elephants and human activities. The riparian vegetation was described to be in good condition with little soil erosion at the time of surveys in the 1970s. The Google Earth imagery reveals a rather closed canopy of the riparian forest, suggesting that these systems are still intact. This observation contradicts the assumption that the often-mentioned export-oriented charcoal production could have destroyed all forests in the area.

Source: Google Earth

Figure 3. Riparian forest fringed by grassland and wooded and bushed grassland

Coastal Dune Region – The natural regions identified then included coastal dune region consisting of coastal hills and dunes (Figure 4). Though not found within the park, sand had been blown to the hinterland and deposits of white eolian sand were common between the coastal dune region, and Lag Bush Bush and Lag Garabey. Just like other areas of Somalia’s coast, a combination of unlimited off-road driving and livestock grazing denude the dunes, thus exposing the sand to wind erosion. The sand blown into the park could affect the vegetation and wildlife habitats, but its impact remains to be assessed. Moreover, Dudumali Plain Region is a landform type classified by FAO as ‘mantled plain limestone’, meaning a plain having a mantle of residual materials derived by weather from underlying bedrock (FAO 1968). The area was classified as flood plain meander. The soils are not suitable for agriculture and the area is home to a large animal population. Since it contains good grasslands it could be considered as a rangeland or incorporated into a natural reserve (Abel and Killeh 1976a).

Source: Google Earth

Figure 4. Coastal dune vegetation, beach and coral reef in the Lag Badana NP area

5.3 Hydrology and tsetse

Previously, the park enjoyed a good supply of surface water when compared to other areas of Lower Juba and Somalia as a whole. Most water holes are filled up during the rainy season with most of them drying up before the end of the dry season. However, a few of them hold

water throughout the dry season. The park was highly infested with tsetse fly making it unsuitable for livestock rearing. This problem presented a clash between the artificial and the natural; artificial signifying man, his livestock and agricultural activities while natural is the wildlife, the parasites and natural vegetation. Wild animals can tolerate trypanosomes as the two evolved together, but domestic animals are not their natural hosts and untreated livestock usually die instantly in the area (Ford 1971). However, Abel and Killeh (1976) predicted that cattle ranches, holding grounds and disease-free zones, as well as forest reserve in the acacia woodland, supplemented by irrigated plantations would be established in the proposed protected area to supply the fuel wood requirements for a population estimated at 2,000,000 by the year 2010. Unfortunately, their prediction did not come true as the country was plunged into civil war in 1991.

5.4 People

In the 1970s, there were three general groups of communities using the area that had been proposed for the national park. The first was a small community of Boni or Awer, hunters and gatherers who resided permanently in the interior of the proposed area. The population of this group of hunters was estimated at about 200 people and they lived in the forest relying on wild products collected from nature and practising shifting agriculture along streams. Their source of proteins was wild animals. Their main village was Wayore, but the community also inhabited the areas of Sher and Saddeh Lagaod. It is thought that they fled into neighbouring Kenya where they have joined the other members of their tribe. A second group of 3000 people lived along the coast at the perimeter of the proposed park in the villages of Yeman, Kudha, Stamboul, Yasini, Tosha Sheya, Kidivani, Navava, Burgabo, Oda, Kamboni and Manarani. This community was composed of fishermen, traders and farmers who stocked cattle, sheep and goats. The third group consisted of nomadic pastoralists who used the park during the Jilal; they would use the watering points at Malka Robi, Malka Jira, Malka Ari, Lag Kudut, Hola Wajir, Dera Bon, Shamku and Gisile (Abel 1976, Law and Fauna 1969).

5.5 Past and current conservation efforts

The proposed protected area, known as the Lag Badana-Bushbushle area, is located in the extreme southern tip of Somalia. It borders Kenya and currently belongs to the newly formed administration of Jubaland, one of the states in the Federal State of Somalia. The park is

bordered to the east by the Indian Ocean that also encompasses the Banajuni Island archipelago. To the west it is bordered by *Acacia-Commiphora* bushland and thickets.

The Lag Badana-Bushbushle landscape is part of the East African Coastal Forest Biodiversity Hotspot. These coastal forests are home to a high level of endemism among its plant species and fauna. They are one of the 35 global biodiversity hotspots recognized by [Conservation International](#) which identifies global biodiversity hotspots based on their high level of endemism. A recent assessment reveals that a total of 1356 vascular plant species were found to be endemic in the Zanzibar-Inhambane coastal forest mosaic. Around 940 species are restricted to the northern part of the mosaic, along the coastal of southern Somalia, Kenya and Tanzania and it has been dubbed the Swahilian Regional Centre of Endemism. The southern part of the coastal forest supports 140 endemic species in the areas in Tanzania and Mozambique (Clarke 1998). The landscape supports a considerable population of threatened African mammals such as the African Elephant, *Loxodonta africana*, the African Wild Dog, *Lycaon pictus*, Hunter's Antelope, *Beatragus hunteri* and many near-threatened species of birds, mammals and reptiles.

The Italian colonial rulers recognized the rich and unique biodiversity and the pristine nature of the Lag Badana area. Because of this, they made it a game reserve in the early 1950s when they established the Bubashi Absolute Reserve under Ordinaza no. 26 (Funaioli and Simonnetta 1966). This absolute reserve was to include a National Faunistic Park of Lak Badana. After Somalia gained independence, the government promulgated a new conservation law referred to as "The Law No. 15 of January 25, 1969 on Fauna (Hunting) and Forest Conservation". This law changed the conservation status of the area to the Bush Bush Game Reserve (FAOLEX 1969, Abel and Killeh 1976a). In 1971, the National Parks Agency (NPA) was created as a self-governing body reporting to the Office of the President. A few years later, the NPA was transformed into the Wildlife Department which was placed under the Ministry of Livestock, Forestry and Range. By that time, it was the intention of the Somali government to establish the first national park in this extreme tip of southern Somalia and consequently, sought assistance from UNDP and FAO. These two bodies conducted several studies from 1975 to 1977. The project produced a series of policy and management reports to assist the government establish the national park. The government planned to develop the tourism industry around the park, adjoining coastal areas and the Bajuni Archipelago. However, establishment of the park never materialized due to political instability in the country. Hence, legally speaking, the

conservation of the area is still supported by the Bush Bush Game Reserve which was established in 1969.

In 1989 the former president of Somalia, Mr. Mohamed Said Barre, issued guidelines, popularly known as the Mogadishu Manifesto on the Conservation of Wildlife, 1989. The document embodies government policy which forms the basis of all future development projects and activities in various fields pertaining to Somali wildlife. Some of the key policy statements include:

- i) With immediate effect, wildlife projects shall be considered among those receiving first priority in the country.
- ii) Henceforth, any feasibility studies involving intervention in nature should collaborate with the wildlife authorities to ensure that due consideration is given to the local fauna.
- iii) In the interest of wildlife preservation, immediate action shall be taken to set up faunal and floral protected areas and to complete those already in progress such as Bush Bush and Alifunto. To this end, studies shall be undertaken to identify suitable locations for establishment of wildlife protected areas from which all other projects shall be excluded.

The document also pointed out that, in order to defend wildlife against its enemies, the poachers, the Anti-Poaching Unit would be strengthened by increasing its numbers and improving its skills. Unfortunately, the Mogadishu Manifesto became nothing more than a piece of paper.

IGAD then launched a project in November 2013 on conservation of cross-border biodiversity land/seascapes dubbed the Biodiversity Management Programme. Activities aimed to contribute to poverty reduction by improving the social and economic wellbeing of the populations in the region, through a better regional integration in the environmental sector. One of BMP's activities is to support the Government of Somalia in the development of a plan to establish and manage a protected area in the Lag Badana-Bushbushle area, develop a vision on what the protected area would look like, and describe what needs to be done to legally establish and manage the protected area.

6. BIODIVERSITY OF LAG BADANA NATIONAL PARK AND SURROUNDING AREAS

The biodiversity assessment of the BMP cross-border area was based on existing literature and reports relating to the flora and fauna of Somalia. Specifically, reports of Funaioli & Simonetta 1966 (mammals), Abel & Kille 1975-77 (mammals and birds), Ash and Miskell 1983 & 1998 (birds), Lanza 1990 (reptiles and amphibians), Kingdom 2012 (mammals), Sommer et al 1996 (marine species) and Iman 2010 (fish) were studied. They describe various aspects of the terrestrial and marine flora and fauna of the area where the proposed Lag Badana-Bushbushle National Park is to be established.

The assessment of flora in Lag Badana National Park and its surrounding area revealed that 916 species belonging to 446 genera and 110 families have been recorded in the national park and the adjacent floodplain of the lower Juba Valley (Table 2). The highest number of species are recorded for the *Fabaceae* (121 species), *Poaceae* (116), *Euphorbiaceae* (47) and *Cyperaceae* (47). The number of species reported account for 28.9% of the total flora recorded in Somalia. The number of endemic species was not as high as expected. Most of them occur in central and northern regions. However, there are quite number of plant species restricted to Juba Valley and the coastal lowland forest of southern Somalia. About 32 species are endemic to protected areas and adjacent flood plains of Juba Valley (Thulin 1993-2006).

The assessment revealed that the area of the proposed national park and its surroundings holds 524 species of vertebrates and 915 plant species (Table 2). Out of these, 25 vertebrate species are highly threatened such as Vultures (*Necrosyrtes monochus*, *Gyps africanus* and *Torgos tracheliotos*), mammals (*Lycaon pictus*, *Loxodonta Africana*, *Beatragus hunteri* and *Panther pardus*) and reptiles (*Chelonia mydas*, *Eretmochelys imbricata* and *Dermochelys coriacea*) (www.iucnredlist.org) while 11 animal species are endemic to the area.

Lists of the mammals, birds, reptiles, amphibians and freshwater fish species occurring in Lag Badana-Bushbushle area are presented in the appendices. These lists are likely to be incomplete because of the lack of effort to inventory biodiversity and collect specimens.

Table 2. Diversity and conservation status of flora and fauna of Lag Badana National Park and surrounding areas

S/N	Taxonomic group	No species	Endemic species		IUCN Red List species	
			No	%	No	%
1	Flora	915	32	3.5	?	
2	Birds	293	1	0.4	7	
3	Mammals	100	2	2.2	10	10
4	Amphibians & reptiles	93	3	3.3	8	
5	Fresh water fish	37	5	13.5	?	
6	Marine fish	?			?	
7	Molluscs	1			1	

6.1 Marine diversity

Somalia has the longest coastline (3300km) in Africa with an estimated shelf area of 32,500km² (Carbone 2000). The coastal environment adjacent to Lag Badana-Bushbushle National Park is a very important coastal environment in the southern part of the country. The southern coastal environment encompasses diverse habitats such as coral reefs, mangroves and a chain of small islands. These diverse habitats support various biological diversities such as Finfish and shell fishes. It is also well known that coral reef fish form the basis for major parts of the fisheries production in southern Somalia. However, there are no definitive surveys of coral reef ecosystem and associated fauna has been conducted; despite this, 276 marine fish have been recorded in Somalia marine water (Sommer 1996; Iman 2010).

There were reports of reef lobster and sea turtle exploitation in Bajuni Island, but the annual off-take is still unknown. The coastal environment of Lag Badana-Bushbushle National Park supports six endangered marine species namely; Dugong (*Dugong dugon*), Green Turtle (*Chelonia mydas*), Hawksbill Turtle (*Eretmochelys imbricata*) Loggerhead Turtle (*Caretta caretta*) (VU), Olive-ridley Turtle (*Lepidochelys olivacea*) (VU), and the Leather-backed Turtle (*Dermochelys coriacea*) (VU). They are caught and used as traditional medicine. Their fats are used to enhance the sexual libido. The sea turtles in southern Somalia may be overexploited and there is urgent need to assess the harvesting pressure upon the sea turtles and lobsters in the proposed national park, as well as the species range.

Six species of mangrove trees have been described in the southern coastal area of Somalia – *Avicennia marina*, *Bruguiera gymnorrhiza*, *Ceriops tagal*, *Rhizophora mucronata*, *Sonneratia*

alba, and *Xylocarpus granatum*. Mangrove harvesting is a common practice among the inhabitants in the proposed national park. They are used as building poles. The threat to mangroves also include inland topsoil erosion and excessive nutrient load from agriculture and grazing land, oil spills from passing tankers and mismanagement of harbours close to the sites (Taylor et al. 2003). Increased urbanization may also exacerbate the demand for building materials. Climate change will most certainly have an impact on the mangroves due to increasing temperatures, rise in sea level and change of rainfall pattern in the region.

6.2 Terrestrial biodiversity

6.2.1 Plants

The terrestrial landscapes of the Lag Badana-Bushbushle are situated in the southern tip of Somalia. Floristically speaking, these bushlands forms the northern tip of the Northern Zanzibar-Inhambane coastal forest mosaic that extends south to Mozambique. The analysis of flora in Lag Badana-Bushbushle is based on the work of Mats Thulin from 1988-2006 who produced four volumes of the Flora of Somalia. The distribution of plant species was analysed based on the holotypes and records from Juba Valley to the border of Kenya since both areas are within the same ecosystem.

Overall, flora in Somalia comprises 3165 species; out of these, 800 species are endemic to the country. The most diverse families are the *Fabaceae* (121 species), followed by the *Poaceae* (116 species), the *Euphorbiaceae* (47 species) and the *Cyperaceae* (47 species) (Table 3). This high rate of species richness is due to climate conditions prevailing in Juba Valley and the diversity of habitats existing in the coastal zones. Some of the 32 plant species are endemic to the study area. The status of biological diversity in the southern tip of Somalia is not well known due to recurrent civil war.

Table 3. Families of higher plants, with number of genera and species in Lag Badana NP and Juba Valley

S/N	Family	Genera	Species	S/N	Family	Genera	Species
10	<i>Annonaceae</i>	4	8	93	<i>Rhamnaceae</i>	1	2
11	<i>Lauraceae</i>	1	1	94	<i>Vitaceae</i>	4	8
14	<i>Nymphaeaceae</i>	1	2	95	<i>Balanitaceae</i>	1	3
16	<i>Menispermaceae</i>	3	3	96	<i>Rutaceae</i>	4	7
17	<i>Aristolochiaceae</i>	1	2	98	<i>Burseraceae</i>	1	6
19	<i>Piperaceae</i>	1	1	99	<i>Meliaceae</i>	3	5
22	<i>Turneraceae</i>	1	1	100	<i>Sapindaceae</i>	7	8
24	<i>Capparaceae</i>	5	20	102	<i>Anacardiaceae</i>	3	5
25	<i>Moringaceae</i>	1	3	104	<i>Apiaceae</i>	1	1
26	<i>Brassicaceae</i>	1	1	106	<i>Ebenaceae</i>	2	6
27	<i>Violaceae</i>	2	2	107	<i>Sapotaceae</i>	3	4
29	<i>Polygalaceae</i>	1	4	111	<i>Boraginaceae</i>	5	19
31	<i>Elatinaceae</i>	1	1	112	<i>Rubiaceae</i>	20	31
33	<i>Molluginaceae</i>	1	1	113	<i>Loganiaceae</i>	2	3
34	<i>Aizoaceae</i>	2	3	115	<i>Apocynaceae</i>	17	17
35	<i>Gisekiaceae</i>	1	1	116	<i>Solanaceae</i>	4	9
36	<i>Portulacaceae</i>	1	1	117	<i>Convolvulaceae</i>	11	25
37	<i>Phytolaccaceae</i>	1	1	118	<i>Sphenocleaceae</i>	1	1
38	<i>Chenopodiaceae</i>	5	6	119	<i>Oleaceae</i>	1	2
39	<i>Amaranthaceae</i>	11	16	120	<i>Scrophulariaceae</i>	3	3
41	<i>Nyctaginaceae</i>	2	2	123	<i>Orobanchaceae</i>	1	1
42	<i>Polygonaceae</i>	2	3	125	<i>Lentibulariaceae</i>	1	2
43	<i>Zygophyllaceae</i>	1	1	126	<i>Bignoniaceae</i>	3	3
47	<i>Lythraceae</i>	3	4	127	<i>Lamiaceae (Labiatae)</i>	11	23
48	<i>Sonneratiaceae</i>	1	1	128	<i>Verbenaceae</i>	2	2
50	<i>Onagraceae</i>	1	3	129	<i>Pedaliaceae</i>	3	4
51	<i>Thymelaeaceae</i>	1	1	130	<i>Acanthaceae</i>	19	38
53	<i>Flacourtiaceae</i>	4	4	131	<i>Avicenniaceae</i>	1	1
56	<i>Passifloraceae</i>	2	8	134	<i>Lobeliaceae</i>	1	1
57	<i>Cucurbitaceae</i>	11	18	135	<i>Menyanthaceae</i>	1	1
58	<i>Caricaceae</i>	1	1	136	<i>Goodeniaceae</i>	1	1
59	<i>Ochnaceae</i>	1	3	137	<i>Asteraceae</i> (<i>Compositae</i>)	18	34
60	<i>Myrtaceae</i>	4	5	138	<i>Hydrocharitaceae</i>	5	6
61	<i>Lecythidaceae</i>	1	1	139	<i>Apongetonaceae</i>	1	1
62	<i>Melastomaceae</i>	1	1	140	<i>Alismataceae</i>	1	1

S/N	Family	Genera	Species	S/N	Family	Genera	Species
63	<i>Combretaceae</i>	3	16	142	<i>Cymodoceaceae</i>	4	4
64	<i>Rhizophoraceae</i>	3	3	143	<i>Araceae</i>	2	3
65	<i>Clusiaceae</i>	1	1	145	<i>Asparagaceae</i>	1	3
66	<i>Malpighiaceae</i>	3	4	146	<i>Dracaenaceae</i>		
67	<i>Erythoxylaceae</i>	1	1	150	<i>Aloaceae</i>	1	6
69	<i>Euphorbiaceae</i>	20	47	151	<i>Anthericaceae</i>	1	5
72	<i>Fabaceae</i>	49	121	152	<i>Hyacinthaceae</i>	5	7
73	<i>Tiliaceae</i>	3	21	154	<i>Amaryllidaceae</i>	3	3
74	<i>Sterculiaceae</i>	4	5	155	<i>Iridaceae</i>	2	2
75	<i>Bombacaceae</i>	2	2	156	<i>Colchicaceae</i>	1	1
76	<i>Malvaceae</i>	7	25	157	<i>Orchidaceae</i>	4	4
80	<i>Ulmaceae</i>	2	2	158	<i>Velloziaceae</i>	1	1
81	<i>Moraceae</i>	1	1	160	<i>Zingiberaceae</i>	1	1
83	<i>Celastraceae</i>	4	9	162	<i>Commelinaceae</i>	3	7
84	<i>Icacinaceae</i>	1	1	163	<i>Typhaceae</i>	1	1
85	<i>Salvadoraceae</i>	3	4	165	<i>Cyperaceae</i>	5	47
86	<i>Olacaceae</i>	2	2	166	<i>Amaryllidaceae</i>	1	1
87	<i>Opiliaceae</i>	1	1	167	<i>Poaceae</i>	44	116
88	<i>Loranthaceae</i>	7	14	168	<i>Arecaceae</i>	3	4
91	<i>Balanophoraceae</i>	1	1	169	<i>Pandanaceae</i>	1	1
					Total	446	916

6.2.2 Birds

The avifauna of Lag Badana is very diverse, comprising resident and migratory species. About 293 species have been recorded in the Lag Badana-Bushbushle National Park and adjacent flood plain below the Juba Valley. Distribution data was analysed in order to extract the species dependent on the ecosystems in Lag Badana (Ash and Miskell 1998). Ninety-three Euro-African migratory species were recorded in the protected area, while 143 species were presumed to be resident. The coastal and marine environment of the national park support 57 species, predominantly waders and pelagic species. The reserve is the last post of the Zanzibar-Inhambane forest in Eastern Africa and plays an important role in facilitating the movement of fauna in the region.

Globally threatened species include the Madagascar Squacco Heron (*Ardeola idae*) (EN), Madagascar pratincole, (*Glareola ocularis*) (VU), Hooded Vulture (*Necrosyrtes monachus*)

(CR), White-backed Vulture (*Gyps africanus*) (CR), and the Lappet-faced Vulture (*Torgos tracheliotos*) (EN). Further research on off-shore islands may reveal sea bird breeding, Tana Cisticola (*Cisticola restrictus*) and Somali boubou (*Laniarius erlangeri*).

The destruction of forest, grassland and wetland in the national park means no food or shelter for the avifauna in the region. Poaching is also rampant. Respondents of the telephone surveys reported eating vulture Guinea fowl (section 6.2.4). The pastoralists sometimes poison predators and advertently affect birds of prey in the park area. The coastal forests support Palearctic species, which overwinter in parks and along the coastal stretches between Kismayo and Kimaboni. The bird families that are dependent on the forest include; Accipitridae, Strigidae, Indicatoridae, Picidae, Pycnotidae, Turnidae, Muscicapidae, Laniidae and Nactrinidae, among others.

6.2.3 Mammals

The southern tip of Somalia has been known for a long time as being rich in mammal species. Historic information on larger mammal species and their distribution is available through the work of Funaiole et al. (1966) who provided maps of the distribution of 36 larger mammal species and of Abel (1975) who gave information on distribution and population estimates for larger mammal species. Funaiole et al. (1966) also listed a number of small mammals without giving distribution data. This historic information reveals that at least 96 species of mammals have been recorded in the Lag Badana Bushbushle landscape. The most diverse mammal groups are bats (22 species), rodents (14 species), carnivores (23 species), primates (3 species) and herbivores (23 species) (Table 4).

There are various globally red listed species among the mammals that were reported by the above authors. Four highly threatened species, namely the Leopard, *Panthera pardus* (EN), the African Hunting Dog (*Lycaon pictus*, EN), the Savanna Elephant (*Loxodonta Africana*, EN) and Hunter's Hartebeest or the Hirola (*Beatragus hunteri*, CR). Further, there are several vulnerable species such as Hamilton's Tombat (*Taphozous hamiltoni*, VU), the Lion (*Panthera leo*, VU), the Cheetah (*Acinonyx jubatus*, VU), the Hippopotamus (*Hippopotamus amphibious*, VU) and the forest-restricted sub-species of Haggard's Oribi (*Ourebia ourebia haggard*, VU). Juba Environmental and Socioeconomic Studies (JESS) reported that the team encountered the Dibatag (*Ammodorca clarkei*) in the floodplain below Juba Valley but there is no mention of exact location (Deshmukh 1987). In the coastal area of the protected area, threatened marine

mammals such as Sea Cow (*Dugong dugon*, VU) have been recorded in the Bajuni Archipelago. The Hunter's Hartebeest and Haggard's Oribi are endemic to the coastal areas of northern Kenya and southern Somalia.

The information on mammal species in the area of the proposed national park is more than 40 years old. Since then the area has been plagued with poaching, resulting in local extinction or possible loss of several species that were known to be present. The effects of poaching probably had a higher impact on mammal species than on other taxonomic groups. Therefore, a survey was carried out to assess the current distribution of mammal species in the area. Given the level of insecurity it was impossible to visit the area and thus a telephone survey was conducted. Nine key informants living in nine settlements under control of the Jubaland State administration were identified. The respondents were male, aged between 40 and 70 years. They mainly comprised agro-pastoralists, pastoralists, livestock traders, honey traders and fishermen.

6.2.4 Responses based on telephone survey

The responses received were divided into two groups – carnivores and herbivores:

- A. Carnivores:** Respondents were knowledgeable on larger carnivores, because they predate on the livestock in the area. Most respondents agreed that they had seen different types of Foxes (Dawaco), Hyenas, Lions, Leopards, Cheetahs and Caracals. The most abundant carnivores reported were Hyenas, Leopards and Caracals. All respondents complained that these animals attacked young calves of cattle and goats. The Leopard population has been increasing in the national park since the collapse of the state in 1991. This is due to reduced hunting activities as a result of reduced market prices of the skins in Somalia. The respondents mentioned the Cheetah (Haramcad) a few times since it is very rare in the target area. It is interesting to note that the reports were made on the African Wild Dog (Uuley) in Istanbul-Kudaayo and Manaranni-Odow, where a group of 10-50 individuals noted that they had encountered the animal about 3-4 times in a month. According to one respondent, attacks on livestock were recorded and the frequency was five times more from August 2015 to February 2016. In Kudaayo Village, the respondent confirmed the presence of 10-15 packs of African Wild Dogs in January 2016. Some respondents said that the Wild dogs appear during the rainy season in Hala, Wajir, Istanbul and Yamani and Manarani.

Table 4. Presence of larger mammal species in Lag Badana NP area in 2016, 1970s and 1960

English and Somali Names	Buulo Xaali	Caanoole	Istanbuul	Kudaayo	Buurgaabo	Holawajeer	Manaaraani	Odaw	Kiamboni	Abel (1975)	Data (1960)
Yellow Baboobi (Daayeer)	x	x	x	x	x	x	x	x	x	X	
Vervet Monkey										X	
White-Throated Monkey										X	
Gentle Monkey											
Somali Galagao										X	
Red-bellied coat squirrel (Dabagaalo)	x	x	x	x	x	x	x	x	x		
Crested Porcupine (Kashiito)	x	x	x	x	x	x	x	x	x	x	
Common Jackal (Dawaco)	x	x	x	x	x	x	x	x	x		
Side-striped Jackal (Dawaco)	x	x	x	x	x	x	x	x	x	x	
Black-backed jackal (Dawaco)	x	x	x	x	x	x	x	x	x		
Bat-eared fox	x	x	x	x	x	x	x	x	x		
African wild dog (Yey)		x	x	x		x	x	x		x	
Striped hyena	x	x	x	x	x	x	x	x	x		X
Spotted hyena (Waraabe)	x	x	x	x	x	x	x	x	x		X
Aardwolf (<i>Proteles cristata</i>)											X
Common genet (<i>Genetta geneta</i>)										X	X
Wild cat (Bisad duur)										X	X
Serval cat (Muqshabeelle)										X	X
Caracal (Gaduudane)	x	x	x	x	x	x	x	x	x	X	X
Leopard (Shabeel)	x	x	x	x	x	x	x	x	x	X	X
Lion (Libaax)	x	x	x	x	x	x	x	x	x	X	X
Cheetah (Harimcad)							x			X	X
Aardvark (Seddex suuley)				x				x		X	X
Savanna Elephant (Maroodi)				x	x	x	x	x		X	X
Common Zebra (Dameer Farow)				x	x			x		X	X
Grevy's zebra (Dameer Farow)											X
Browse rhinoceros (Wiyil)										X	X
Hippopotamus (Jeer)				x			x			X	X
Bush big (Goome)	x	x	x	x	x	x	x	x	x	X	X
Desert warthog (Doofaar)	x	x	x	x	x	x	x	x	x	X	X
Giraffe (Geri)				x						X	X
African buffalo (Gisi)	x	x	x	x	x	x	x	x	x	X	X
Bushbuck (Dhool)										X	X
Lesser Kudu (Goodir)	x	x	x	x	x	x	x	x	x	X	X
Bush duiker (Sagaaro Furdug)										X	X
Harvey's duiker (Sagaaro Gaduud)										X	X

English and Somali Names	Bulo Xaali	Caanoole	Istanbuul	Kudaayo	Buurgaabo	Holawajeer	Manaaraani	Odaw	Kiamboni	Abel (1975)	Data (1960)
Oribi (Muri)										X	X
Kirki's dik dik (Sagaaro)	x	x	x	x	x	x	x	x	x	X	X
Guenther's dik dik (Sagaaro)	x	x	x	x	x	x	x	x	x	X	X
Water buck (Balanqo)		x		x	x					X	X
Grant's gazelle (Deero)										X	X
Gerenuk (Gerinuug)	x		x	x	x			x		X	X
Hirola (Carowle)										X	X
Topi (Siig)				x	x			x	x	X	X
Beisa oryx (Biciid)				x	x			x	x	X	x

Note: X= present; blank= not determined

B. Herbivores: All respondents agreed that herbivore species encountered daily were Lesser Kudu, Buffalo and two big species Bush big (*Potamochoerus larvatus somalinensis*) and Desert warthog (*Phacochoerus aethiopicus delamerei*), which is not hunted by local people for religious reasons. The drought of 2011 had a great impact on the Buffalo population in the national park because surface water dried up. However, the population has been slowly recovering over the last three years. The second group observed frequently in the protected area were small antelopes such Dik diks and Duikers (*Sylvicapra grammia* and *Cerphalopus harveyi*). The Bushbuck, Common Zebra, Topi and Beisa Oryx were uncommon and the few observed were found in the open grassland and abandoned farmland. Waterbucks were reported close to the lakes and watercourses in the national park and one of the interviewees confirmed the presence of waterbucks near Lake Malkajir.

There were also a number of species that were common in the 1970s that were not reported. Examples include the elephant and the giraffe, which are now extinct. Interviewees reported that resident populations are absent in the national park, but noted that they were occasionally seen close to the Kenyan border. Similarly, there are no longer resident populations of Hunter's Hartebeest. The Hirola was however, mentioned by two respondents who indicated that the species is occasionally found near the Kenyan border area, around Kiamboni and Kolbiyo. A species rarely mentioned is the bushbuck *Tragelaphus scriptus* (Dool), which was possibly missed because of its nocturnal and solitary behaviour.

The mammalian fauna of the Lag Badana NR and its surroundings faces a number of threats from human activities such as poaching. As already reported, the resident populations of the Elephant, Giraffe and Hunter's Hartebeest have gone extinct because of excessive hunting. In the absence of these bigger mammal species, poaching has now focused on smaller sized species. Our respondents indicated that the commonly hunted species are the Lesser Kudu, Waterbuck and Buffalo. Six of the respondents reported that apart from meat from the Lesser Kudu and Buffalo they had also eaten wild meat from Dik diks, Vultures and Guinea fowls. The Dugong is threatened by human activities for different reasons such as an incidental killing or entanglement in fishing gears. The seismic and drilling action planned by both the Somali and Kenyan governments may affect the population in southern Somalia.

6.2.5 Herpetofauna

Somali Herpetofauna is one of the least known in Africa. The specimens collected date back to 1881 when French naturalist, G. Revoil, visited the country. Around 203 species of reptiles and amphibians are known to occur in Somalia. However, their distribution data is very scanty. Benedetto Lanza (1983) compiled distribution information which formed the basis of our analysis of the herpetofauna in the Bushbushle National Park. Ninety (90) species are presumed to be present in the national park and adjacent floodplain below the Juba River. Future research in the national park may reveal more species and accurate distribution of herpetofauna in the Lag Badana landscape.

There are three endemic reptile species (*Pristurus simonettai*, *Mabuya hildebrandti*, *Atractaspis engdahli*) and four endemic sub-species of reptiles (*Heliobolus spekiis sextaeniatus*, *Agamodon anguliceps*, *Ancylocranium somalicum somalicum*, *Brachyophis revoili revoili*) in the target area. Furthermore, five highly threatened marine reptiles are enlisted in the IUCN Red Data list: the Green turtle, *Chelonia mydas* (EN), the Hawksbill turtle, *Eretmochelys imbricata* (CR), the Loggerhead turtle *Caretta caretta* (VU), the Olive-ridley turtle *Lepidochelys olivacea* (VU), and the Leather backed turtle *Dermochelys coriacea* (VU).

People along the coastal area poach the eggs of Green and Hawksbill turtles when they come to nest on the beaches, and sometimes the meat and fat of the sea turtle are sold in fish markets along the coastal towns of Mogadishu, Marka, Brava, Kismayo and Bajuni islands. Illegal harvesting of sea turtles may jeopardize conservation efforts at the global level.

6.2.6 Fresh water fish

The Somali society is primarily a pastoral community with their protein demands extracted from domesticated animals. However, many non-stock owning residents of the riverine and coastal zones rely on fresh and salt water fish as their main source of animal protein. The fish fauna in Somalia are far less researched and information is difficult to access, despite 72 species of fresh water fish recorded in the country (Douthwaite 1985, Iman 2010, Sommer et al. 1996). Two species of fresh water fish in the national park were identified: African Catfish (*Clarias gariepinus*) in the report of N. Abel (1976) and *Nothobranchius jubbi*, in the report of Wildekamp (1987). Further research may reveal more interesting species.

There is seasonal flooding of Juba River into the floodplains adjacent to the national park and it is presumed that some of the fish overflow into the park's wetland system during heavy rains. Juba River contains several endemic species such as *Barbus gananensis*, *Varicorhinus jubae*, *Pardiglanis tarabinii*, *Synodontis geledensis* and *Nothobranchius patrizii*.

6.3 Threatened species

The primary threats to fauna in Lag Badana include illegal harvesting, charcoal production, agriculture, human-wildlife conflict and predator poisoning due to livestock attacks, among others.

Twenty-three species occurring in the Lag Badana National Park and adjacent floodplain below the Juba Valley are listed in the [IUCN Red List](#). Five of them are critically endangered, six are endangered, 10 are vulnerable and two Data Deficient (Table 5). The Hunter's Antelope (*Beatragus hunteri*) and Haggard's Orib (*Ourebia ourebia haggard*) are restricted to the cross-border ecosystem. The long-term species survival depends on effective protection of the area such as the Boni-Dodori National Park Reserve and Carwale Conservancy Area. Until the cross-border side managers set up an effective management measures and ensure appropriate security, survival of species is not guaranteed. There are 32 plants species restricted to this area and the threat they face is not clear due to scanty information. Further research and conservation programmes are needed to clarify and gather actual information for sound decision-making.

Table 5. IUCN red listed and endemic animal species in Lag Badana National Park and its surroundings

Group	Family	Species Name	English Name	Red List	Endemics
Birds	<i>Ardeidae</i>	<i>Ardeola idae</i>	Madagascar Pond Heron	EN	
	<i>Glareolidae</i>	<i>Glareola ocularis</i>	Madagascar Pranticole	VU	
	<i>Acciptridae</i>	<i>Necrosyrtes monachus</i>	Hooded Vulture	CR	
	<i>Acciptridae</i>	<i>Gyps africanus</i>	White-backed Vulture	CR	
	<i>Acciptridae</i>	<i>Torgos tracheliotos</i>	Lappet-faced Vulture	EN	
	<i>Malaconotidae</i>	<i>Laniarius erlangeri</i>	Somali Boubou	VU	
	<i>Cisticolidae</i>	<i>Cisticla restrictus</i>	Tana River Cisticola	DD	
Mammals	<i>Emballonuridae</i>	<i>Taphozous hamiltoni</i>	Hamilton's Tomb bat	VU	
	<i>Canidae</i>	<i>Lycaon pictus</i>	African Hunting Dog	EN	
	<i>Elephantidae</i>	<i>Loxodonta african</i>	Savanna Elephant	EN	
	<i>Bovidae</i>	<i>Beatragus hunteri</i>	Hunter's Antelope	CR	Coast area Kenya, Somalia
	<i>Bovidae</i>	<i>Ourebia ourebia haggard</i>	Haggard's Oribi	VU	Coastal area Kenya, Somalia
	<i>Felidae</i>	<i>Panthera pardus</i>	Leopard	EN	
	<i>Felidae</i>	<i>Panthera leo</i>	Lion	VU	
	<i>Felidae</i>	<i>Acinonyx jubatus</i>	Cheetah	VU	
	<i>Hippopotamidae</i>	<i>Hippopotamus amphibius</i>	Hippopotamus	VU	
	<i>Dugonidae</i>	<i>Dugong dugon</i>	Sea cow	VU	
	<i>Cheloniidae</i>	<i>Chelonia mydas</i>	Green turtle	EN	
	<i>Cheloniidae</i>	<i>Eretmochelys imbricata</i>	Hawksbill turtle	CR	
	<i>Cheloniidae</i>	<i>Caretta caretta</i>	Loggerhear turtle	VU	

Group	Family	Species Name	English Name	Red List	Endemics
	<i>Cheloniidae</i>	<i>Lepidochelys olivacea</i>	Olive ridley turtle	VU	
	<i>Cheloniidae</i>	<i>Dermochelys coriacea</i>	Leather backed turtle	CR	
	<i>Sphaerodactylidae</i>	<i>Pristurus simonettai</i>			Coastal dunes
	<i>Scincidae</i>	<i>Mabuya hildebrandti</i>			Somalia/Ethiopia
	<i>Atractaspidae</i>	<i>Atractaspis engdahli</i>	Mole viper		Somalia/Kenya
Molluscs	<i>Ampullaridae</i>	<i>Pila speciosa</i>	Fresh water snail	DD	

7. BIODIVERSITY USE, THREATS AND OPPORTUNITIES

Biodiversity use: Biological diversity in the Lag Badana-Bushbushle landscape has supported man's needs for over 1000 years. This diversity of living plant and animal species formed a support system, which has been used and benefited different groups that lived in the proposed national park for several years. Three different groups of people who use or used the biodiversity in the area, and how they benefited are described below.

The first group are the Awer who were hunters and gatherers with an estimated population of about 200 by the end of the 20th Century. The Awer lived in the forest and relied on non-destructive collection of products such as wild fruits, honey, gum, resin, dye and medicinal plants for their traditional healers. Given their low numbers it is assumed that they utilized the resources in a sustainable manner. This group is no longer living in the area. They relocated to neighbouring Kenya due to conflicts.

The second group of people lived along coastal area adjacent to the national park. They were farmers, fishers, traders, and kept small livestock (cattle, sheep and goats). The historic use of biological resources in the area of the proposed national park by these populations is not well documented.

The third group of people who used the national park were pastoralists who used the park during periods of droughts to allow their livestock access pasture and water. The pastoralists followed the farmers who opened the forest and removed the hazards of tsetse fly for the livestock (Abel and Kille 1976). The traditional method of reducing the incidence of tsetse is by opening up the bush. The tsetse fly thrives in bushland and other vegetation with closed tree canopy. There are no detailed reports or information of how these communities managed the land and used biological resources. However, reports by Abel suggested that the degradation of bushland vegetation in the area was the result of grazing and use of fire by pastoralists. So it could be assumed that they did have a significant impact on the vegetation in the park.

After the collapse of the Somali state, people started to trade in charcoal within the country and neighbouring Gulf States. Charcoal is principally produced from trees, and specifically *Acacia bussei*, which is of high quality. The charcoal trade became a very lucrative business and

attracted warlords and local militia. This triggered felling of trees in the woodland and coastal forests. Huge piles of charcoal sacks are reported in Kismayu and Barawe districts, areas controlled by the Al Shabab militia. They took control of and exported charcoal for quite a long period until the UN banned charcoal trade in Somalia. It is still not clear what impact this destructive business has had on the Lag Badana National Park. It would be worthwhile to conduct ground investigation when the situation permits. The coastal mangroves are also reported to be affected by felling of illegal trees by local people to be used as construction poles along the coastal areas. Information on the extraction of marine resources in the national park is very scanty and outdated and therefore, it would be a key priority to conduct ground survey to ascertain the impact of charcoal on the lowland forest and adjacent woodland in southern Somalia.

The other destructive harvest was illegal hunting of wildlife species such as Rhinoceros, Elephants, Grévy's Zebra and the Cheetah. There is evidence of enormous pressure on wildlife during the period of insecurity and proliferation of automatic weapons. The population of herbivore antelopes in the national park has practically been decimated. All that are left are a few Dik diks, Lesser Kudu and Buffalo.

While consumptive use had little impact on biodiversity in the past, everything changed with the war. The Awer emigrated from the area and were replaced by the Al Shabab. To support themselves, the militia group ventured into unsustainable harvesting and sale of resources such as charcoal production, wildlife poaching, and cutting down of mangroves for building poles.

Local honey traders complained that the removal of old trees for charcoal production had had a negative impact on the honey bee population. Consequently, harvest per tree declined. One stakeholder interviewed mentioned that he used to harvest 40 litres of pure honey/tree before the civil war. FAO/SWALIM estimated a tree cover loss of up to 10% from 2006 to 2012 in the lower and middle Juba regions, including the proposed Lag Badana National Park.

Threats: Based on the available literature and discussions with various stakeholders, a number of current threats on biodiversity were identified. Table 6 provides a summary of these and the impacts they have had.

Table 6. Drivers and pressures threatening biodiversity and social benefits in terrestrial and marine systems

	Threats		Impacts	
	Drivers of change	Pressure and degradation	State biodiversity	Social impacts
Terrestrial	Warfare and insecurity Lack of governance Lack of market regulations	Overuse woody biomass for charcoal and mangrove poles Overgrazing Poaching of wildlife Use of fire	Degraded forests Decimated wildlife populations	Reduced availability of biodiversity resources Reduced access to biodiversity resources Opportunity cost of not developing tourism Failure to comply with CBD
Marine	Piracy Market demand for fish, e.g., from Kenya and internationally Lack of governance	Overfishing by local and foreign fishermen Destructive fishing practices of foreign trawlers destroying coral reefs	Reduced fish stocks and marine resources Destruction of coral reefs	Reduced social benefits Poverty

The table shows three major drivers of change that had an impact on the biodiversity of the terrestrial part of the cross-border area. A combination of warfare and insecurity resulted in a breakdown of institutions and governance. The effects of this are worsened by a widespread belief that a free market and lack of market regulation will solve all problems. An example is the degradation of the woody vegetation to support export of charcoal to the Middle East. These drivers of change have put a lot of pressure on the region's natural resources, resulting in widespread degradation of vegetation and wildlife.

The Somali people are traditionally pastoralist nomads who are constantly moving in search of pasture and water. Lag Badana-Bushbushle National Park is located below the equator and it lies within good moisture areas and has different grazing and browsing habitats with abundant service water. Abel (1976) reported the presence of livestock in the national park and buffer zones of the reserve. He envisaged that if the park were to be established, there would be human-wildlife conflict, particularly on water points and predator species that attack livestock.

Based on a recent report on the movement of elephants and giraffes in the park, there is need for ground thrusting to ascertain the population of these species and viability of the species in the long term in southern Somalia. In the park there are rare animals such as Hirola or Hunter's Antelope (*Beatragus hunteri*) and Cheetah (*Acinonyx jubatus*), and if they are not put under a conservation programme they may soon become extinct. It is worth mentioning here that the 25 years of civil unrest in Somalia has had a severe impact on the flora and fauna, and many species are still in decline, while others have had their population decimated. This necessitates the need to conduct detailed field studies in order to account for all the threatened flora and fauna in the country.

The analysis of existing literature reveals that the following are the major threats facing biodiversity of the national park:

1. Lack of security and stable government
2. Lack of legislation and institutions to support conservation of the environment and biodiversity
3. Ravages created by charcoal production for export
4. Hunting/poaching of remnant wildlife in the landscape
5. Agricultural expansion (shifting cultivation)
6. Overgrazing by livestock
7. Destruction of old forest which is crucial for breeding birds
8. Illegal, unregulated and unreported overfishing in marine area
9. Uncontrolled harvest of mangroves and other coastal habitats
10. Egg harvesting of sea turtle and breeding birds
11. Invasive species
12. Coral bleaching
13. Potential mining as the area is thought to have oil deposits
14. Sea floor damage and destruction of coral reefs by foreign trawlers
15. Climate change effects on sea level rise, temperature and oceanic circulation pattern

Opportunities: Economic activities are divided into use and non-use. The use value include non-destructive products such as wild fruits, honey, resins, dynes, medicinal plants, construction poles and eco-tourism, while non-use value involve conservation of the ecosystem for future generations.

Lag Badana-Bushbushle National Park provides both opportunities of use and non-use, and literature reveal that indigenous people use nature to harvest honey, resin, medicinal plants, wild fruits and meat for their daily livelihoods. The commercial harvest and sale of trees for the production of charcoal and increasing demand of black gold in foreign countries are the major driving factors degrading the landscape.

There is need for field assessment and identification of the plants used for traditional medicine. Once identified, the medicinal plants should then be linked with a bioprospecting agency for value addition. Targeted honey value chain may increase the livelihood opportunities of forest dependent people and increase the understanding and appreciation of biological diversity of Lag Badana-Bushbushle. The effort of IGAD-BMP to protect the cross-border land/seascape is an opportunity to support the federal government and Jubaland state of Somalia to achieve its goal of re-establishment of the national park and put in place long-term biodiversity management plan. All of these activities will only be possible when the security has improved and access to the protected area is enhanced.

8. CONCLUSION

- a) **Status of the biodiversity.** The area of the proposed national park and its surroundings hosts a rich and unique biodiversity.
- i. Vertebrate fauna: It is home to 524 vertebrate species, among them 11 species that are endemic to the area and 26 that are threatened. The area hosts an assemblage of big mammals typical of East African tropical savannas and interestingly, a significant population of Leopards and African Hunting Wild dog. The Lag Badana area also provides a seasonal habitat to a large number of afro-tropical and palearctic migratory bird species.
 - ii. Invertebrate fauna: Little is known about the invertebrate fauna of the area, a knowledge gap that should be addressed.
 - iii. Flora: The area has a unique flora of 916 species belonging to 446 genera and 110 families. The region is the northern tip of the Swahili endemic plant centre and to avoid fragmentation and destruction of important habitats, it is recommended that apart from establishing a protected area, to also seek to develop value chains based on the areas plant species. This would require bioprospecting and identification of species of potential value chain development in view of local and regional markets.
 - iv. Marine diversity: There is very little information on the marine fauna and flora and associated habitats such as coral reefs, mangroves, sea grass beds and estuaries. There could be need to consider setting up a marine protected area, because the coastal area is relatively pristine and hosts the northernmost mangrove and coral reef habitats along the coast of East Africa. Given this, it is important to conduct further investigations on marine fauna and the status of coral reefs and mangroves of southern Somalia in order to support initiatives to conserve these marine habitats.
- b) **Threats.** The biggest threat to the biodiversity in Lag Badana-Bushbushle is the degradation of wildlife and forest resources, due to poaching and tree felling for charcoal production. This continues because of insecurity, which results in lack of law enforcement, a situation that has been prevailing for more than two decades. If this

issue is not resolved, any attempts to conserve the biodiversity of the area may not be successful.

- c) **Opportunities.** The area of the proposed national park holds great opportunity for restoration of the environment and its biodiversity resources, as well as potential socio-economic benefits for the local communities. Once security is established and proper institutions for park management are in place, it should be relatively simple to restore the vegetation and wildlife.

9. RECOMMENDATIONS

Undertake biodiversity surveys

The information on biodiversity in the area where the Lag Badana National Park is to be developed is incomplete and outdated. For example, there is no list of plant species, nothing is known about freshwater fish species and invertebrates, and extremely little information exists on marine life. For other taxa, such as mammals, birds and herpetofauna, information is severely outdated. It is therefore recommended that biodiversity surveys be conducted to collect field data on distribution of plant and animal species to address these knowledge gaps and update existing information.

Carry out problem analysis

There was very little information on the state of the biodiversity, the benefits that people derive from this and the various drivers and pressures that have resulted in the reported environmental degradation. A detailed problem analysis that attempts to quantify the various processes at stake and stakeholders involved should be carried out. This will help clarify what options exist to respond to the undesirable developments. Restoration of security is a prerequisite in this case.

Support the vision for the Lag Badana area

The IGAD BMP project has supported the development of a vision and road map for establishment of the Lag Badana National Park that will be submitted to both the National and State governments. Follow-up is required to ensure that the vision is implemented.

Establish a marine national park

The proposed Lag Badana National Park aims to secure the conservation status of the rich and unique terrestrial biodiversity in southern Somalia. The neighbouring coastline and coastal marine systems are unique and in a rather pristine state. The government of Somalia should consider establishing a marine protected area to secure the biodiversity and develop the tourism potential of this area.

Land use planning

Most land in the area is public land. This may rapidly change when restoration begins because the Lag Badana area has potential for multiple land uses, including dryland agriculture, real estate development along the coast and public road infrastructure development to connect southern Somalia to the rest of the country and neighbouring Kenya. The area of the national park could benefit from proper land use planning that would establish the land tenure and conservation status of the area.

Awareness raising

This report aims to support the raising of awareness on the biodiversity of the proposed National Park. The information is intended to support stakeholders including NGOs, civil society and local and regional authorities in conserving the rich biodiversity of the Lag Badana land and seascape as well as to attract investment from conservation agencies to support the development of an effective protected area system.

10. REFERENCES

- Arnold Z. 2001. Agribusiness strategy development and entrepreneurship. *Journal of Soil Science* 55:222–234.
- Abel NOJ. 1976. Management Plan for Proposed National Park. Badhadhe District. UNDP/FAO Field Document No. 3. Pp. 1-118.
- Abel NOJ, Kille ME. 1976. Conservation and Exploitation of Wildlife of South-Eastern Somalia. UNDP/FAO Field Document No. 5. Pp. 1-51.
- Agnelli P, Azzaroli ML, Simonetta AM. 1990. Some remarks on the mammals of Somalia. *Biogeographia*, 14, 499–513.
- Amir OG. 1998. The silent victim: the wildlife of Somalia and its rate of extinction. Proceeding of EASS/SSIA-international congress of Somali studies, Turku, Finland. Pp. 189-195.
- Ash J, Miskell E. 1998. Bird of Somalia, Pica press.
- Clarke GP. 1998. A new regional centre of endemism in Africa. In: Huxley, CR et al. Chronology, Taxonomy and Ecology of floras of Africa and Madagascar. Pp. 53-65.
- Deshmukh I. 1990. Terrestrial ecology baseline studies, *Jess environmental studies* Volume 11.
- Douthwaite RJ. 1985. Final Report of Environmental aspect of tsetse fly eradication in Somalia; Tropical development and research institute, ODA, London, UK.
- Elmi Ahmed A. 1991. Livestock production with special emphasis on camel, *Nomad People* 29: 87-103.
- Nigel R, Terry S, John F. 2011. Second ed. London, UK: Christopher Helm. 512 pp, 213 colour plates, colour distribution and other maps. Softback. ISBN 978-1-4081-5735-0. [ABC Bulletin 16.2 September 2009](#), pages 243 - 244
- FAO/SWALIM 2013. SWALIM locates source of Kismayo charcoal piles. Swalim update, Issue 2; May-July 2013.
- Funaioli U, Simonetta AM. 1966. The mammals' fauna of the Somali Republic: Status and Conservation problems. *Italian Journal of Zoology*, 285-347.
- Herlocker D. 1997. Renewable natural resources and production systems, IUCN-Somali Natural resources management programme.
- Huchinson P, Polishchouk O. 1988. The agroclimatology of Somalia; Food early warning department, Ministry of Agriculture, Mogadishu, Somalia.
- Iman AM. 2010. Fishery development plan, Ministry of Fishery and Marine Resources.

- Kingdom J. 2012. The Kingdom Field Guide to African Mammals. Bloomsbury press.
- Lanza B. 1990. Amphibians and reptiles of the Somali Democratic Republic: checklist and biogeography. *Biogeographia* Vol XIV: 407-466.
- Lanza B. 1983. A list of the Somali Amphibians and reptiles. *Italian Journal of Zoology*, 193-247.
- Simonetta MA, Simonetta J. 1983. An outline of the status of the Somali fauna and of its conservation and management problems. *Rivista di Agricoltura subtropicale e tropicale*. Anno LXXVII, Pp. 457-483.
- Sommer C, Schneider W, Poutiers JM. 1996. The living marine resources of Somalia. FAO species identification field guide for fishery purposes. Rome, FAO. Pp. 376 pp.
- Taylor M, Ravilious C, Green EP. 2003. Mangroves of East Africa. UNEP-WCMC Biodiversity Series, 13. UNEP/WCMC: Cambridge. Pp 24.
- Thulin M. 1993. Flora of Somalia. Volume one, 493 pages, Royal Botanic Gardens, KEW.
- Thulin M. 1995. Flora of Somalia. Volume four, 298 pages, Royal Botanic Gardens, KEW.
- Thulin M. 1999. Flora of Somalia. Volume two, 303 pages, Royal Botanic Gardens, KEW.
- Thulin M. 2006. Flora of Somalia. Volume three, 626 pages, Royal Botanic Gardens, KEW.
- Wildekamp RH. 1983. Preliminary study of the Somalia *Nothobranchius* species of larvivorous fish. World Health Organization Som/mpd/001/RB.
- Wildekamp RH. 1987. Notes sur le poisson annuel *Nothobranchius jubbi* Wildekamp & Berkenkamp, 1979 (Cyprinodontiformes; Nothobranchiinae) du North-eas du Kenya et del Somalie du sud. *Revue fr. Aquariol*, 13 (1986) 4, 25 fevrier 1987.

Working Paper series

231. Seri Agroforestri dan Kehutanan di Sulawesi: Kebutuhan Penyuluhan Agroforestri untuk Rehabilitasi Lahan di Sumba Timur, Nusa Tenggara Timur, Indonesia. <http://dx.doi.org/10.5716/WP16077.PDF>
232. Agroforestry and Forestry in Sulawesi series: Agroforestry extension needs for land rehabilitation in East Sumba, East Nusa Tenggara, Indonesia. <http://dx.doi.org/10.5716/WP16078.PDF>
233. Central hypotheses for the third agroforestry paradigm within a common definition. <http://dx.doi.org/10.5716/WP16079.PDF>
234. Assessing smallholder farmers' interest in shade coffee trees: The Farming Systems of Smallholder Coffee Producers in the Gisenyi Area, Rwanda: a participatory diagnostic study. <http://dx.doi.org/10.5716/WP16104.PDF>
235. Review of agricultural market information systems in sub-Saharan Africa. <http://dx.doi.org/10.5716/WP16110.PDF>
236. Vision and road map for establishment of a protected area in Lag Badana, Lower Jubba, Somalia. <http://dx.doi.org/10.5716/WP16127.PDF>
237. Replicable tools and frameworks for Bio-Carbon Development in West Africa. <http://dx.doi.org/10.5716/WP16138.PDF>
238. Existing Conditions, Challenges and Needs in the Implementation of Forestry and Agroforestry Extension in Indonesia. <http://dx.doi.org/10.5716/WP16141.PDF>
239. Situasi Terkini, Tantangan dan Kebutuhan Pelaksanaan Penyuluhan Kehutanan dan Agroforestri di Indonesia. <http://dx.doi.org/10.5716/WP16142.PDF>
240. The national agroforestry policy of India: experiential learning in development and delivery phases. <http://dx.doi.org/10.5716/WP16143.PDF>
241. Agroforestry and Forestry in Sulawesi series: Livelihood strategies and land-use system dynamics in Gorontalo. <http://dx.doi.org/10.5716/WP16157.PDF>
242. Seri Agroforestri dan Kehutanan di Sulawesi: Strategi mata pencaharian dan dinamika sistem penggunaan lahan di Gorontalo. <http://dx.doi.org/10.5716/WP16158.PDF>
243. Ruang, Gender dan Kualitas Hidup Manusia: Sebuah studi Gender pada komunitas perantau dan pengelola kebun di Jawa Barat. <http://dx.doi.org/10.5716/WP16159.PDF>
244. Gendered Knowledge and perception in managing grassland areas in East Sumba, Indonesia. <http://dx.doi.org/10.5716/WP16160.PDF>
245. Pengetahuan dan persepsi masyarakat pengelola padang aavana, Sebuah Kajian Gender di Sumba Timur. <http://dx.doi.org/10.5716/WP16161.PDF>
246. Dinamika Pengambilan Keputusan pada komunitas perantau dan pengelola kebun di Jawa Barat. <http://dx.doi.org/10.5716/WP16162.PDF>
247. Gaharu (eaglewood) domestication: Biotechnology, markets and agroforestry options. <http://dx.doi.org/10.5716/WP16163.PDF>
248. Marine habitats of the Lamu-Kiunga coast: an assessment of biodiversity value, threats and opportunities. <http://dx.doi.org/10.5716/WP16167.PDF>
249. Assessment of the biodiversity in terrestrial landscapes of the Witu protected area and surroundings, Lamu County Kenya. <http://dx.doi.org/10.5716/WP16172.PDF>
250. An ecosystem services perspective on benefits that people derive from biodiversity of Coastal forests in Lamu County, Kenya <http://dx.doi.org/10.5716/WP16173.PDF>

The World Agroforestry Centre is an autonomous, non-profit research organization whose vision is a rural transformation in the developing world as smallholder households increase their use of trees in agricultural landscapes to improve food security, nutrition, income, health, shelter, social cohesion, energy resources and environmental sustainability. The Centre generates science-based knowledge about the diverse roles that trees play in agricultural landscapes, and uses its research to advance policies and practices, and their implementation that benefit the poor and the environment. It aims to ensure that all this is achieved by enhancing the quality of its science work, increasing operational efficiency, building and maintaining strong partnerships, accelerating the use and impact of its research, and promoting greater cohesion, interdependence and alignment within the organization.

United Nations Avenue, Gigiri • PO Box 30677 • Nairobi, 00100 • Kenya

Telephone: +254 20 7224000 or via USA +1 650 833 6645

Fax: +254 20 7224001 or via USA +1 650 833 6646

Email: worldagroforestry@cgiar.org • www.worldagroforestry.org