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ENVIRONMENTAL IMPACT ASSESSMENT FOR SASOL PSA AND LPG PROJECT

TERRESTRIAL FAUNA IMPACT ASSESSMENT

Specialist Report 10

PREPARED BY

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Submitted to:

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NON TECHNICAL SUMMARY

Introduction

Sasol Petroleum Mozambique (SPM) and Sasol Petroleum Temane (SPT) are proposing to develop the *PSA Development and Liquefied Petroleum Gas (LPG) Project*, situated near Inhassoro in the Inhambane Province of Mozambique. The project is an expansion of the existing Sasol Natural Gas Project in this area. Proposed new infrastructure includes 19 wells (oil and gas), associated flowlines and a new Manifold Station (8.8 ha), from which the oil flowlines will be combined into a single pipeline routed to the new Integrated PSA Liquids and LPG Plant (9.5 ha), constructed adjacent to the Central Processing Facility (CPF).

This Study

This study presents the findings of an assessment of the impact of the project on Terrestrial Fauna. It is one of a series of studies prepared for the Environmental Impact Assessment for the project.

The study takes into account Mozambique laws and regulations, regional conventions and protocols and importantly, the Performance Standards of the International Finance Corporation, in particular Performance Standard 6, *Biodiversity Conservation and Sustainable Management of Living Natural Resources,* as the underpinning of the assessment and the recommendations made in the report.

Methodology

The survey made use of habitat availability in the different vegetation types, while the presence of observed species was used as an indicator of habitat integrity. The habitat mapping was conducted in conjunction with the vegetation and wetland specialists (De Castro and Grobler, 2014), using satellite imagery with field verification. Habitat profiles were assessed, in conjunction with distribution data per species, to provide accurate information about the probability of species occuring in the relevant biotopes.

Regarding species presence, the survey was designed to determine the relative abundance and species richness of fauna in the proposed survey areas, with particular emphasis on CITES and International Union for the Conservation of Nature (IUCN) Red Data listed species. The study approach involved meticulous searches in all of the fixed transects in the representative biotopes to determine the presence/absence of amphibians, reptiles, birds and mammals species. Where necessary, methods were implemented to augment the chances of finding species, which included trapping, nocturnal spotlight searches and track and scat identification.

The Baseline Environment

The study considers the occurrence of fauna in each of the identified biotypes.

The **Mixed Woodland and Thicket** biotypes potentially support the most diverse range of terrestrial faunal (362 and 363 species respectively). In these biotypes, 7 frog, 51 reptile, 213 bird and 92 mammal species are likely to occur. Of these, thirteen could be Red Data species, including two vultures, the lappet-faced vulture (*Torgos tracheliotus*) and white-headed vulture (*Trigonoceps occipitalis*), the aerial raptors including bateleur (*Terathopius ecaudatus*), pallid harrier (*Circus macrourus*), martial eagle (*Polemaetus bellicosus*), crowned eagle (*Stephanoaetus coronatus*) and the sooty falcon (*Falco concolor*). Also the European roller (*Coracias garrulus*), plain-backed sunbird *(Anthreptes reichenowi)* and the secretary bird (*Sagittarius serpentarius*), striped leaf-nosed bat (*Hipposideros vittatus*), and the secretive leopard (*Panthera pardus*) most probably occurs in small numbers in the denser habitats.

The **Julbernardia-Brachystegia Woodland and Thicket** vegetation type in the study area contains available habitat for 7 frog, 51 reptile, 215 bird and 89 mammal species. The same thirteen Red Data species that occur in the Mixed Woodland and thicket vegetation type occur in the Julbernardia-Brachystegia Woodland, indicating a similar structure and function of the two woodland types.

The thicket types of both of the woodland types include pockets of dense foliage that are required by a number of retiring animal species as prime habitat. There are 28 species that require these dense habitat aspects for their survival, made up of 2 reptiles, 18 birds and 8 mammals.

The thicket fauna assemblage are also the animals that frequent the Coastal and Dune Forests, both habitats with dense woody vegetation and closed canopies. Although the forests are the favourite habitat of the Near–threatened crowned eagle (*Stephanoaetus coronatus*), it can range further away from the forest to hunt. The

Near-threatened plain-backed Sunbird *(Anthreptes reichenowi)* occurs in the deep cover of the vegetation and will move away should the thicket habitat be compromised.

The second highest faunal diversity is expected in the **Coastal Wetlands** with 156 species. These wetlands contain excellent habitat for 29 frog, 7 reptile, 92 birds and 28 mammal species. Five Red Data species could occur here. Expected Red Data fauna include the Zambezi flat-shelled terrapin (*Cycloderma frenatum*), as well as the Red Data raptors, pallid harrier (*Circus macrourus*) and sooty falcon (*Falco concolor*). There is the likelihood that the Near-threatened lesser flamingo (*Phoeniconaias minor*) might visit these wetlands, especially the Barrier Lakes. The status of the hippopotamus (*Hippopotamus amphibius*) in the area is unsure, but good habitat for hippos exists.

The **Govuro River and floodplain** is the largest wetland in the area and most of the fauna to be found in the other wetlands will occur there. The fauna species include 29 frog, 7 reptile, 74 birds and 33 mammal species. Four Red Data species possibly occur there. The only Red Data reptile, the Zambezi flat-shelled terrapin (*Cycloderma frenatum*), is expected to occur. Roving between habitats, the Red Data raptors, pallid harrier (*Circus macrourus*) and sooty falcon (*Falco concolor*), also utilize all the different wetland areas. The status of the hippopotamus (*Hippopotamus amphibius*) in the river is uncertain.

Although the **Mangrove Forests** were not included in the intensive surveys, it is clear that this biotope is linked to the Coastal Streams, which supply it with fresh water. Apart from the extensive mud flats with thousands of freshwater and marine wader birds feeding here, the deeper water of the Mangrove Forests is a favourable habitat for the Red Data marine mammal, the dugong (*Dugong dugong*).

Construction Phase Impacts

The study considered both the PSA Liquids Plant site, which is adjacent to the CPF and covers an area of 9.5 ha), and the sites of the access roads, flowlines and oil and gas wells for the project. The PSA Liquids Plant site is ideally situated for an expansion of the CPF, from the point of view of faunal impact, being immediately adjacent to the existing plant and within the area which is already affected by the activities at the CPF. No Red Data faunal species were found or are expected on the plant site nor are there any patches of high diversity habitat that will be lost that typically serve as refuges for fauna. Subject to appropriate management of construction- related pollution, and the prevention of hunting or persecution of any fauna found, the overall construction impact on fauna associated with the PSA Liquids and LPG plant is therefore considered to be of low significance.

A range of construction-related impacts potentially affecting terrestrial fauna were considered for the access roads, flowlines and well sites. These include the following:

- **Impact of Loss of Habitat:** A field assessment of existing Sasol access roads, flowlines and well pads in the study area has shown that the impacts of past construction have been tightly contained and do not extend significantly beyond the footprint of the facilities concerned. There is no evidence of erosion or pollution at any of the existing infrastructure and this provides a good indication of what may be expected with respect to the current project.
- Eighty percent of the new flowline infrastructure will be along existing roads. This increases to 96.5% if other existing corridors of disturbance such as old seismic lines are included. Since such good road access exists, the need to clear vegetation will be much reduced, with only a small area of additional clearing alongside existing roads being required for the flowlines. The total area of habitat disturbance will be in the order of 166.7 ha, which is a small fraction of similar available habitat in the study area and a minute proportion of this habitat in Mozambique, which extends over many million hectares. The overall direct effect of a reduction in habitat availability on the occurrence and diversity of fauna is therefore likely to be of low significance.
- **Impact of Faunal Disturbance (noise and dust):** Construction will involve a range of disturbing activities including earth moving, civil works, drilling, pipe-laying, welding and testing. Nuisance - related impacts will include dust, noise and vibration. These impacts may cause local impacts on species for a short period but none of these effects are likely to result in more than a temporary decline in populations of the more nuisance-sensitive species (small antelope, raptors and nesting bird species) close to the sites. Impact significance is negligible.
- **Impact of construction-related pollution:** The construction teams employ a range of materials that could result in pollution if released into the natural environment or result in the generation of wastes. These may be general, hazardous, or problem wastes. At the drilling sites, waste will include all three

categories - general domestic waste, used oil/diesel, rig wash and contaminated storm water, drill cuttings, drilling mud and mud additives, process water, used oil/diesel/hydraulic fluids, acids/surfactants/cleaning solvents, batteries, pesticides and paint. The completion of a well also involves the ignition of well fluids in a burn pit on the well pad. Along the flowlines wastes will include domestic waste, possibly some waste oils and lubricants, welding waste, off-cuts from pipe shimming and packaging waste (paper, cardboard, wood). During commissioning of the flowlines, hydrotest water will be produced which is likely to include corrosion inhibitors and biocides, both of which can be toxic and can result in mortality of aquatic fauna if released into the natural environment.

While many of these wastes are potentially hazardous for fauna if released into the environment, they can all be managed to reduce the risk of pollution to low levels of significance. The construction of wells and flowlines on Sasol's past projects has been controlled by means of Environmental Management Plan's which have been shown to be effective in managing the activities of construction contractors. Specialist Study 8, *Waste,* concludes that subject to the implementation of the requirements in the EMPs, the risks of pollution is low. No No residual pollution was observed anywhere within areas where Sasol has been actively engaged with exploration and production and the risk to fauna as a result of construction pollution is therefore considered to be of low significance.

- **Impact of Hunting and Persecution:** The presence of construction teams is a possible cause of wildlife mortality mainly to the extent that the teams are not appropriately managed and construction personnel either hunt wild animals for food or sale, or persecute them. The latter applies particularly to reptiles, which are killed by site personnel unless specific measures to prevent this are encouraged and enforced through the construction EMP. The current Sasol C-EMP prohibits hunting or persecution of wild animals. Subject to the enforcement of the requirements of the EMP and the ongoing education of personnel during the course of the contract about wildlife conservation, the potential impact on wildlife should be of negligible significance.
- **Impact of Road and Open Trench Kills**: Occasional wild animal deaths have been recorded in previous Sasol construction contracts as a result of collisions with vehicles. These are uncommon and in the Study Area are unlikely to be significant as long as speed limits are enforced. In the case of the flowlines, there is also a potential risk to small mammals, frogs and reptiles as a result of being trapped in the open trench. The current Sasol c-EMP does not mention trench kills and the requirement to conserve wildlife should be extended to make reference to the rescue of animals trapped in the flowline trenches.
- **Impact of Bush Fires:** There is an increased risk of bush fires as a result of construction personnel in the study area, the likelihood of which is mainly related to the management of smoking. The effect of bush fires may extend far beyond the boundaries of the site and at the wrong time of year may seriously impact on habitat availability for wild animal species, causing mortalities due to starvation. The risk to wildlife caused by bushfires is of moderate significance and can be reduced to low or negligible significance as long as contract teams are trained in this regard and a restriction is placed on areas in which smoking is permitted.
- **Impact on Red Data Species and Sensitive Habitats**: No terrestrial Red Data fauna were found in the field surveys for the project. While it is expected that Red Data fauna will occur within the Study Area, as described in Chapter 5, there are no known Red Data species localities in the Study Area that will be impacted by the project and that would warrant a change in the location of the wells, flowlines or access roads. Since much of the proposed road infrastructure already exists, the additional impact of adjacent flowlines and wells will be relatively minor and construction is very unlikely to impact directly on Red Data species.
- With regard to sensitive habitats, the direct impact of the proposed PSA roads, wells and flowlines will be of low significance, with the exception of a few localized areas, such as clusters of large trees around termite mounds and remaining patches of dense forest, which create micro environments that are species - rich faunal habitats. The significance of this impact on fauna is moderate and can be reduced to low if the recommendations made the Specialist Study 9, *Botanical Diversity and Habitats*, are implemented, which involve minor changes to the location of some of the wells and flowlines.

Operational Phase Impacts

Improved access encourages settlement. Roads provide a vital means of expanding agriculture into areas that were previously too remote to cultivate. This results in habitat loss, and a corresponding reduction in wildlife.

In addition, in areas where new access for the project penetrates more remote habitats (Figure 6-2), wildlife becomes more vulnerable to hunting, and the game favoured by local hunters diminishes.

While good access exists throughout most of the study area, there remain some areas which are relatively remote and where wildlife has escaped overexploitation. This is particularly true of the isolated area north east of Mapanzene, which includes Coastal Forest and Dune Forest communities, the largest of the Coastal Streams in the study area and Mangrove Swamps at the river mouth. According to Specialist Study 9, *Botanical Biodiversity and Habitat*, this area fulfils the criteria for definition as a Critical Habitat in terms of IFC Performance Standard 6. The presence of Chacma baboons (sighted) and leopard (reported) in this area between Mangarelane 1 and Mapanzene during the field studies, is indicative of the sensitivity of the area, since these species are only found in places which afford reasonable protection from humans.

It is expected that the new access to wells I-G6PX-1 and to I-G6PX-6 will significantly improve access into the Critical Habitat, resulting in an increased risk of habitat destruction and hunting and persecution of fauna. It is highly likely that the sensitive species such as the baboons and leopard, and many other species that find refuge in this isolated area, will be lost. The impact on fauna is considered to be of high significance.

Recommended Mitigation

The recommendations for the mitigation and monitoring of identified terrestrial faunal impacts are described below.

Impact of loss of habitat	▪ Comply with the requirements of the existing CPF to minimize habitat impacts beyond the footprint of the project
Disturbance (noise and dust) impacts	▪ Comply with the requirements of the existing CPF to minimize habitat noise and dust impacts.
Impact of construction – related pollution	▪ Comply with the requirements of the existing c-EMP to minimize the probability and consequences of any pollution related incident ▪ Amend the cEPM to include an additional requirement to conduct bioassay screening tests as a basis for the release of hydrotest water into the environment. The current c-EMP makes only a general statement regarding the management of pollution caused by hydrotest water. In screening tests conducted on fish (*Poecilia reticulata*) and water flee (*Daphnia pulex*) for the construction of the Sasol MSP pipeline, it was found that the water could not be directly released into the natural environment and that containment, followed by evaporation or dilution, was necessary in order to ensure that there was no lethality of aquatic organisms (South African CSIR, 2003). Furthermore, because the water affected by biocides and corrosion inhibitors is regarded as a 'complex industrial wastewater' which is one in which standard chemical analysis of the effluent quality inadequately describes the toxicity, bioassays are the appropriate testing methodology.
Impact of hunting and persecution	▪ Comply with requirements of the existing c-EMP to minimize the risk of hunting and persecution of wild animals.
Impact of road and open trench kills	▪ Comply with requirements of the existing c-EMP. ▪ Include requirements for a daily inspection to rescue fauna that may have fallen into the trench during the night.
Impact (direct) on Red Data Fauna and Sensitive Habitats	▪ Re-locate wells and flowlines that are situated in micro environments that are in species - rich faunal habitats, namely T-G8PX-2 (50 m), T-G8-PX5 (500 m), T-G8PX-3 (90 m), I-G6PX-5 (60 m). ▪ Amend the existing cEMP to manage impacts in the event of chance finds of Red Data species.
Impact of Nuisance and Persecution	▪ Sasol is in the process of preparing educational training courses spanning all environmental issues related to the operation of the CPF. These training courses are to include educational material about wildlife conservation so as to increase awareness of Sasol employees and contractors

Impact (indirect) of Improved Access	▪ Re-locate wells and flowlines that are situated in the critical habitat of the main coastal stream in the study area, namely I-G6PX-1 (relocate 750 m further west) and I-G6PX-6 (relocate 690 m further west on the existing I-6 well pad). Figure 6-2 indicates the location of the defined area of critical habitat and the relocation of wells G6PX-1 and I-G6PX-6. ▪ Consult with Government to determine how all parties could cooperate to encourage sustainable use of the critical habitat in the future.
Impact Monitoring	
	▪ Comply with requirements of the existing c-EMP and d-EMP ▪ Extend the baseline monitoring of the defined critical habitat to include more comprehensive seasonal fieldwork which can be used as a basis for detailed future planning of the sustainable use of the area. Sasol is to take responsibility for this initial monitoring, following which any further monitoring could be determined by discussion between the relevant parties. Monitoring is to include the Coastal and Dune Forests, the Coastal Stream and the Mangroves.

The authors acknowledge that there may be a number of factors that could influence the feasibility of moving wells and flowlines. Factors which are outside of the scope of this study are not taken into consideration, and the recommendations are based purely on the desirability of the change from the point of view of **terrestrial fauna**. Other factors which may need to be considered before finalizing the positions of wells and flowlines must be evaluated in the EIA."

Conclusions

The significance of construction phase impacts on terrestrial fauna will be low to negligible, subject to implementation of the requirements of the existing c-EMP and d-EMP, as amended. Construction phase impacts along the wells and flowlines consist mainly of clearing of areas, disturbance, minor pollution risks and the actions of people in the immediate area of construction. The period of construction is relatively short and the areas are small and contained. Much of the required road access to support construction of the flowlines already exists. The impacts can be mitigated successfully by implementing the existing EMP's with minor amendments, particularly if there is slight adjustment to some of the well locations to avoid micro environments of high biodiversity.

During the operational phase, disturbance–related impacts will be minor. The key concern will be the increased accessibility provided by the new access roads into an area of Critical Habitat near the coast, consisting of Coastal and Dune Forests, a Coastal Stream and a large Mangrove Swamp. Improved access into previously remote areas has been shown to have severe effects on habitat, which together with increasing pressure from hunters due to better accessibility, can have a severe effect on faunal populations. While most of the Study Area has good existing access, the area of Critical Habitat is relatively isolated and the access to two of the new wells will significantly increase the risk of secondary impacts in this area. The unmitigated impact is considered to be of high significance, but subject to relocation of the wells and other actions necessary to ensure that the habitat is protected, can be reduced to moderate significance.

Factors which are outside of the scope of this study are not taken into consideration, and the recommendations are based purely on the desirability of the change from the point of view of **aquatic fauna**. Other factors which may need to be considered before finalizing the positions of wells and flowlines must be evaluated in the EIA.

List of Acronymns

ADI	:	Area of Direct Influence
AII	:	Area of Indirect Influence
CITES	:	Convention on International Trade in Endangered Species
cm	:	centimeter
CMH	:	Companhia Moçambicana de Hidrocarbonetos
CPF	:	Central Processing Facility
E	:	East
EDM	:	Electricidade de Mocambique
EIA	:	Environmental impact assessment
EN	:	Endangered
EN-1	:	Highway in Mozambique
ENH	:	Empresa Nacional de Hidrocarbonetos
ESO	:	Environmental Site Officer
GPS	:	Global Positioning System
h	:	hour
IFC	:	International Finance Corporation
IUCN	:	Union for the Conservation of Nature
km	:	Kilometer
KNP	:	Kruger National Park
LPG	:	Liquefied Petroleum Gas
m	:	meter
MMscfd	:	Million standard cubic feet per day
MSP	:	Mozambique-Secunda Pipeline
NT	:	Near-threatened
pm	:	post meridiem (indicating the time period from midday to midnight)
PPA	:	Petroleum Production Agreement
PSA	:	Production Sharing Agreement
RR	:	Reporting Rate
S	:	South
SP	:	significance points
SPM	:	Sasol Petroleum Mozambique
SPT	:	Sasol Petroleum Temane
VU	:	Vulnerable

Definitions

Aestivate	Buried and domant
Haplic arenosols	Greyish-brown sandy soils associated with the marine dunes of the coastal areas
Diurnal	Active during daylight hours
Eulittoral	Marginal
Habitat Integrity Scores	How appropriate the habitat is for the species
Miombo	Broad leaved savanna
Montane	Mountain
Termitaria	Termite nests

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APPENDICES

1.0 INTRODUCTION

1.1 Project Overview

Sasol Petroleum Mozambique (SPM) has a Production Sharing Agreement (PSA) with the Government of Mozambique and ENH (Empresa Nacional de Hidrocarbonetos). In turn, a Petroleum Production Agreement (PPA) has been entered into between Sasol Petroleum Temane (SPT) and its partners (Companhia Moçambicana de Hidrocarbonetos (CMH) and IFC) and the Government of Mozambique which covers the currently- producing assets of the Temane and Pande fields.

The PPA and PSA licences overlap each other to a large extent in both the Pande and Temane areas. The PPA licence applies to specific hydrocarbon bearing formations within these areas. The PSA licence covers all other formations in the Temane and Pande geographical areas that are currently being considered for development, and also includes other fields and prospects where exploration and appraisal wells have been drilled but have not as yet been declared commercial.

Sasol's gas processing plant, known as the Central Processing Facility (CPF), is situated 40 km north-west of Vilanculos. Currently, all of Sasol's production is exported from the CPF as either pipeline gas, which is largely destined for use in South Africa, or as condensate which is trucked to Beira for onward shipment. An increasing proportion of the gas is being used in Mozambique, for both industrial purposes and power generation. In Inhambane Province, the gas is supplied to the EDM gas-fired power station, which generates the electricity supplying Inhassoro, Vilanculos and surrounding areas.

Sasol has expanded the CPF since the plant was first established in 2002, and has brought further gas wells on stream in the Temane and Pande gas fields. At present, the CPF consists of four gas processing trains, supplied by twenty four onshore production wells, twelve of which are in the Temane field and twelve of which are in the Pande field.

The PSA Development and LPG Project (hereafter referred to as 'the project') involves the expansion of the CPF to process additional gas, condensate and light oil from the area defined in the Production Sharing Agreement (PSA) with the Mozambique Government. The project will significantly increase Sasol's capability to process gas and liquids, and may include the facility to produce Liquefied Petroleum Gas (LPG), which would substitute much of the 15,000 to 20,000 tonnes/annum that is currently imported at significant cost to Mozambique.

The Project consists of two main components:

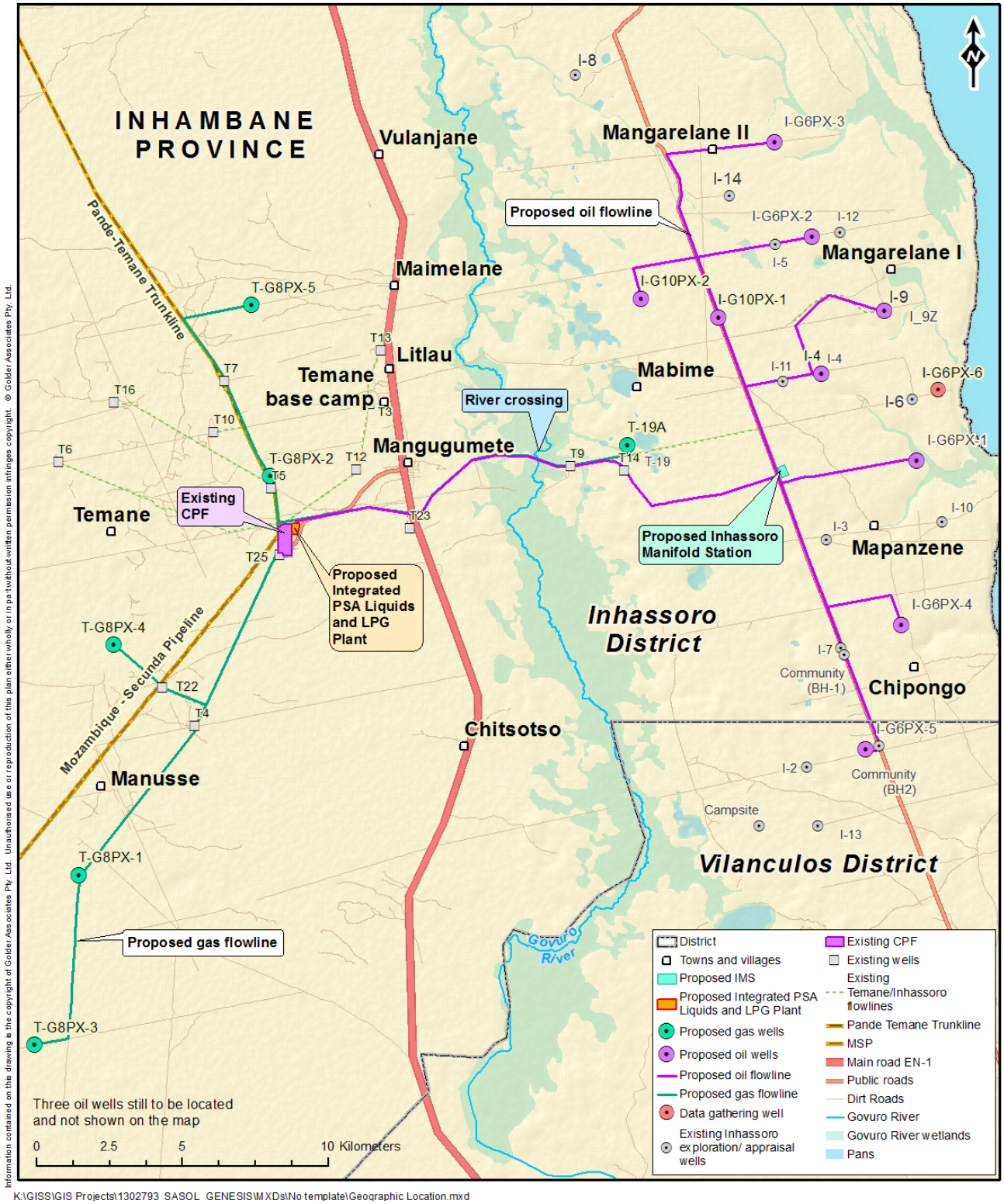
- The Phase 1 PSA Gas Development (the 'gas project'), involving six production wells in the Temane Field and an additional (5th) gas train at the CPF, designed to process the additional gas and condensate from the wells and situated within the existing plant boundaries;
- The Phase 1 PSA Liquids Development (the 'liquids project'), involving twelve oil production wells and one data gathering well in the Inhassoro field, and a new Liquids Processing plant and Liquefied Petroleum Gas (LPG) plant, situated adjacent to the north east side of the CPF. The plant is expected to produce 15,000 stock tank barrels of oil per day (stbopd[1]) and 20,000 tonnes per annum of LPG. As an alternative, the LPG plant may be developed as a standalone plant within the CPF fenceline, together with the PSA Gas Project.

All of the gas and oil wells will be connected to the CPF by buried pipelines known as 'flowlines', similar in design to those which currently supply the plant with gas. The new flowlines are intended to follow existing lines of access as far as possible, and in the section across the Govuro River, will be connected to existing pipes laid across the channel during the 2002 construction project, so as to avoid the disturbance caused by further crossings.

Figure 1-1 shows all of the elements of the proposed PSA Project, including the new gas and oil wells, flowlines and production facilities

[1] A stock tank barrel refers to the volume occupied by sales oil (i,e. after stabilisation to meet sales specification) and measured in barrels at standard conditions of 1.01325 bara (14.7 psia) and 15.56°C (60°F).

Figure 1-1: Elements of the Proposed PSA Development and LPG Project



1.1 Scope of the Specialist Study

The Terrestrial Faunal baseline study has had three main objectives:

- To determine the ecological integrity of the habitats and associated fauna of the study area (to include birds, mammals, insects, reptiles and amphibians) by desk top studies and field surveys;
- To establish a baseline against which future project impacts can be measured;
- To identify threatened species within the study area or the likelihood of occurrence of threatened species.
- To determine the potential impacts of the project during the construction and operational phases and to evaluate the effectiveness of any proposed mitigation.

The following detail defines the scope of the study:

- To characterise the terrestrial flora and fauna (to include birds, mammals, insects, reptiles, and amphibians) by desk top studies and field surveys. Field surveys shall take the form of direct observation, counting along a transect, humane trapping (animals) or deducing presence from sign (animals).
- To select the most appropriate assessment methods for the species concerned. To characterise any trends presently occurring that effect the environment (e.g. grazing, hunting). To assess the presence of any rare, endangered or protected species (IUCN, CITES or Mozambique national protected status).
- To use GPS tagged photographic evidence wherever possible to log species or habitats of interest.
- To characterise the terrestrial biodiversity pertinent to the development area.
- To repeat the ecological surveys across two seasons.
- To assess the probable construction and operational impacts of the project on terrestrial fauna, taking into consideration the nature of the activities and the sensitivity of the affected environment.

1.2 Details of the author(s)

Dr Andrew Deacon (PhD Zoology) has been involved in ecological work for the past 25 years, and well trained in Terrestrial and Freshwater Ecology. After an initial teaching (biology) and lecturing (zoology) profession, he became a Manager in Scientific Services of the South African National Parks and specialised in research aspects related to Aquatic systems and Biodiversity (between 1989 and 2011). He coordinated research in the Kruger National Park (KNP) as part of the multidisciplinary KNP Rivers Research Programme. As programme manager for the Savanna Unit he coordinated the monitoring and research programmes for aquatic ecosystems and small vertebrate (small mammals, birds, reptiles and frogs) ecology in 15 South African National Parks (including Addo-, Kalahari- and Kruger National Park).

Dr Deacon became involved in national programmes including the SA River Health Programme, Water Research Commission steering committees and the Department of Water Affairs environmental requirement studies. He also motivated and applied successfully for the Pafuri area to become the Makuleke Ramsar site in the north of the Kruger Park. He recently completed a Wetland Delineation Course.

Since 2012 he work as a specialist consultant regarding ecological studies and completed a number of projects related to aquatic ecosystems surveys and monitoring, Environmental Water Requirements, terrestrial faunal surveys, and biodiversity projects. Apart from projects in South Africa, he has worked on assignments in the Democratic Republic of the Congo, Zambia, Mozambique, Zimbabwe, Namibia and Swaziland.

2.0 DESCRIPTION OF THE PROJECT

2.1 The Wells

The location of the proposed gas and oil wells is shown in Figure 1-1. They will be similar to the pre-existing Temane and Pande wells, with the surface infrastructure consisting of a well head (or 'Christmas Tree') centred in a secured and cleared area of approximately 100 m x 100 m. There will be no release of fluids or gas into the atmosphere (venting) at the well heads during normal operations - all of the extracted fluids will be transferred via the flowlines to the CPF for processing.

The well positions have been determined on the basis of preliminary engineering studies and may be subject to some changes during the detailed design investigations. Three of the production wells to be situated in the Inhassoro field have not been located yet and are not shown in the figure.

2.2 The Flowlines

Fluids from the wells will be delivered to the Inhassoro Manifold Station (PSA Liquids Project) or the CPF (PSA Gas Project) by new flowlines, buried approximately 1 m underground, and mostly following existing cut lines, roads and other flowlines (Figure 1-1). A permanent all weather gravel access road will be constructed for maintenance access alongside flowlines in the few places where road access does not already exist. Figure 1-1 highlights where the lines will cross the Govuro River, tying into existing sections of spare pipe that were laid under the Govuro River in 2002, in order to avoid repeated construction works across the river channel. For the gas project, one well (T-19A) lies east of the Govuro River and will use a spare flowline across the river. For the liquids project, all of the oil wells lie east of the Govuro River. These will be combined at the Inhassoro Manifold Station, from which a single pipeline will transport the fluids, tying into another existing spare pipeline across the Govuro River, and then routing onward to the new plant adjacent to the CPF.

2.3 The 5th Gas Train (PSA Gas Project)

The CPF's existing gas/liquid separation provision and four gas processing trains will be supplemented by additional equipment added in parallel and tied into the same manifolding arrangements. The new equipment will be located within the boundaries of the existing CPF fenceline. One new production separator and one new liquid separator will be added, identical to the existing units. One new gas processing train will be added, this train will be the same capacity as the existing trains (150 MMscfd) and very similar equipment will be provided.

All stabilised condensate will be sent to the storage tanks at the CPF. No additional tanks are provided. The condensate will be exported by road tanker.

The CPF's LP and HP compression will be expanded with the addition of one new unit of each. The compression units and ancillaries will be identical to the existing units.

The increased water production at the CPF resulting from the PSA Gas development will be treated and disposed of by the existing systems at the CPF. Other utility systems, such as water, air and nitrogen, will be supplemented so that the new gas plant is not constrained by utility supply. No new power generation systems are required to support the PSA Gas plant. No new flare systems will be added.

2.4 The PSA Liquids and LPG Plant

The Integrated PSA Liquids and LPG Plant will be based on a throughput of 15,000 stbopd oil and 40MMscfd gas. This plant will be situated in a new area adjacent to the existing CPF to the north east. The new plant comprises two treatment trains operating in parallel, each processing approximately 50% of the liquids input; a 7,500 stbopd LPG train making a maximum of 20,000 tpa LPG (in addition to stabilised oil) and a 7,500 stbopd oil stabilisation train producing only stabilised oil and no LPG.

The PSA Liquids reception facilities will consist of connections for a temporary pipeline pig receiver followed by a slug catcher. The liquids from the slug catcher will be routed to an oil-water separator which separates the oil and water and removes residual gas as well.

The separated oil stream will be routed to two differently configured oil processing trains for stabilisation. The first is a 7,500 stbopd LPG train, producing 20,000 tpa LPG in addition to the stabilised oil. The second is a 7,500 stbopd oil stabilisation train, which produces only stabilised oil and no LPG.

LPG will be stored above ground in four earth mounded LPG storage bullets and exported from two LPG road tanker loading bays.

The gas from the slug catcher and separator will be combined with the off gas from the LPG train and stabiliser to be used as LP fuel gas and the balance routed to the CPF gas treatment system.

The stabilised oil will be sent to four new 15,000 bbl oil storage tanks. Four new road tanker loading bays are to be provided.

Produced water will be treated in a new produced water treatment system and sent to an existing disposal well.

2.5 The Standalone LPG Plant

The financial viability of the PSA Liquids Development is still being evaluated in Front End Engineering Design (FEED) studies. An alternative to be evaluated in the EIA is a standalone LPG plant, located with the 5th Gas Train inside the boundaries of the existing CPF. The LPG storage bullets and LPG loading bays would remain in the area identified for the full PSA Liquids and LPG Plant. In this case, the LPG plant would process, on average, 1,500 stbcpd of condensate to produce approximately 5,000 tpa of LPG.

The plant will process unstabilised condensate from the CPF. This will be routed to an LPG flash vessel designed to maximize the recovery of LPG. The unstabilised liquid will then be routed to the LPG production process which will separate the heavier and lighter components, producing condensate from the overhead stream and LPG from the bottoms stream.

The stabilized condensate will be sent to the existing storage tanks at the CPF where it will be stored for export by road tanker. The LPG will be stored in three above ground, earth mounded, LPG storage bullets located outside of the boundary of the existing CPF, in the same location as the proposed bullets for the PSA Liquids and LPG Plant. One of the bullets will be used to hold off-specification LPG.

A portion of the off-gas from the process will be used as LP fuel gas, while the balance will be routed to the CPF for treatment and export. The small volumes of water separated in the process will be returned to the produced water treatment system at the CPF.

Utilities will be supplied by the existing CPF systems.

3.0 LEGAL FRAMEWORK AND GUIDANCE

3.1 Mozambique legislation

The principal legislation pertaining to the protection of biodiversity and conservation areas is listed and briefly described in Table 2-1.

Table 3-1: Laws protecting Biodiversity and Conservation Areas

Laws Protecting Biodiversity and Conservation Areas	
Environment Law (Law 20/97 of 1 October).	Articles 12 and 13 cover a set of general norms to protect biodiversity and the establishment of environmental protection areas.
Land Law (Law 19/97 of 1 October) and Land Law Regulations (Decree 66/1998 of 8 December).	This law establishes total or partial protection zones. The former are designated as those reserved for nature conservation activities and the defence and security of the State, whereas partial protection zones include, among others, the beds of inland water courses, territorial waters, the exclusive economic zone, the continental shelf as well as the coastline, islands, bays and estuaries measured at the maximum high tide mark up to 100 m inside the country.
Law on Forest and Wildlife (Law 10/99 of 7 July).	Articles 11 and 13 of the law establish conservation areas such as national parks, nature reserves and areas of historical and cultural importance.
Law on Effluent Standards (Decree 18/2004 of 2 June).	The law prescribes standards for the discharge of treated domestic wastewater into the environment as well a standards for the release of industrial wastewater from petroleum refineries.

3.2 Conventions

Conventions pertaining to the protection of habitats and biological diversity are listed and briefly described in Table 2-2.

Table 3-2: Conventions on habitats and biological diversity

Habitats and Biological Diversity	
1968	African Convention on the Conservation of Nature and Natural Resources.
1971	Convention on Wetlands of International Importance especially the Water Fowl Habitat of Aquatic Birds (Ramsar Convention).
1979	Convention on Migratory Species of Wild Animals 1979 and its amendments.
1985	Convention for the Protection, Management and Development of the Marine and Coastal Environment of the Eastern Africa Region, 1985, and the Protocol concerning Protected Areas and Wild Life Fauna and Flora in the Eastern Africa Region; and the Protocol for Cooperation in Fighting Pollution in Emergency Region; and the Protocol for Cooperation in Fighting Pollution in Emergency Situations.
1992	United Nations Convention on Biological Diversity (CBD).
1999	SADC Protocol on Wildlife Conservation and Law Enforcement.
2001	SADC Protocol on Fisheries.
2002	SADC Protocol On Forestry Activities.
2003	African Convention on the Conservation of Nature and Natural Resources. Revised version.

3.3 IFC Performance Standards

The guidelines in IFC Performance Standard 6 (IFC, 2012), *Biodiversity Conservation and Sustainable Management of Living Natural Resources*, were used to identify Critical Habitat in the study area. The IFC criteria for determining Critical Habitats include:

- Criteria 1: habitat of significant importance to critically endangered and/or endangered species;
- Criteria 2: habitat of significant importance to endemic and/or restricted-range species;
- Criteria 3: habitat supporting globally significant concentrations or migratory species and/or congregatory species;
- Criteria 4: highly threatened and/or unique ecosystems; and/or
- Criteria 5: areas associated with key evolutionary processes.

IFC Performance Standard 6 also recommends that projects that are likely to have a significant impact on biodiversity should be subject to more detailed assessment. Such assessment must include consideration of the short term, long term and cumulative context of the impacts.

3.4 Sasol's existing commitments

Sasol's existing commitments are detailed in four separate EMP's dealing with various activities and infrastructure such as drilling activities the operation of the CPF and construction of infrastructure. Of relevance to the current study botanical biodiversity study is the Construction EMP (Revision 1, March 2006). The Construction EMP contains environmental management requirements for all activities related to the construction and installation of project components within the Sasol Exploration Block, including well-sites, flowlines and trunklines, access roads and all related infrastructure and construction requirements for the aforementioned components. The primary purpose of the Construction EMP is to ensure that negative environmental impacts of the project are effectively managed within acceptable limits and that the positive impacts are enhanced. The Construction EMP is also a means for Sasol and the Government of Mozambique to reach agreement about the project's environmental performance standards.

4.0 STUDY METHODOLOGY

4.1 Overview

The aim of the faunal baseline study was to characterize the habitats and fauna of the study area as a basis for predicting and monitoring impacts on faunal composition and abundance.

The rationale for sampling of fauna in the study area was as follows:

- Baseline sampling was undertaken in locations that were considered most likely to be impacted by the development on the basis of the preliminary planning.
- Transects were also selected in other similar areas in the study area so as to provide a representative baseline of faunal diversity and species richness throughout the area.

While concentrating on area directly affected by the project and some reference sites, the survey method was therefore designed to provide information about the possibility of significant impacts on fauna elsewhere in the study area.

The methodology of the study consisted of two main elements:

- the classification of biotopes as a basis for the selection of sampling areas; and
- linking of the occurrence of fauna to the defined biotopes.

For areas that were not sampled, the use of habitat as a surrogate for the occurrence of fauna was considered to be a defendable means of assessing the predicted faunal composition and abundance within the study area.

4.2 Survey of existing information

The study synthesised available information with emphasis on the following:

- sensitive habitats and areas of conservation importance;
- fauna (vertebrates: mammals, birds, reptiles and amphibians, emphasising species of conservation concern);
- fauna (invertebrates: insects, emphasising species of conservation concern).

The background study consolidated long-term distribution data about the fauna of the local area. An extensive literature study of all available information was prepared regarding faunal distribution, habitat preference and species status. The information was compiled in appendices (Appendices A to F), which show preferred habitat profiles for each relevant organism in the study area.

In addition to the habitat and distribution data, the following existing sources were reviewed for relevant information:

- available ecological survey data from other relevant consulting reports
- the Mozambique IUCN Red List of Threatened Species;

4.3 Survey sites

Survey sites were selected in areas potentially affected by construction in all prominent vegetation types identified in the study area. The sites were located:

- within 200m of the proposed wells;
- within 100 m on either side of the flowlines and access roads,
- within a 500m buffer zone.

Additional transects were added to expand the diversity and extent of habitats surveyed in the study area. Special habitats in and around the study area were also identified and surveyed.

In each vegetation type, extensive transects (400 m – 3,000 m) were surveyed for the different terrestrial faunal groups. GPS readings were taken of each transect so that they can be replicated in future monitoring (Table 4-1). The selection of survey sites within the areas defined above focused on:

a) sensitive habitats and areas of conservation importance;

b) areas of potential project disturbance in each of the identified habitat types;

c) minimally disturbed reference areas.

Initial site selection was based on literature review and satellite interpretation, taking into consideration the location of the project infrastructure. Final site location was adjusted in the field to ensure that the sites best reflected the site selection criteria.

Table 4-1 and Figures 4-1 to 4-3 provide more detailed information about the geographic location of each transect, its length and its position in each biotope.

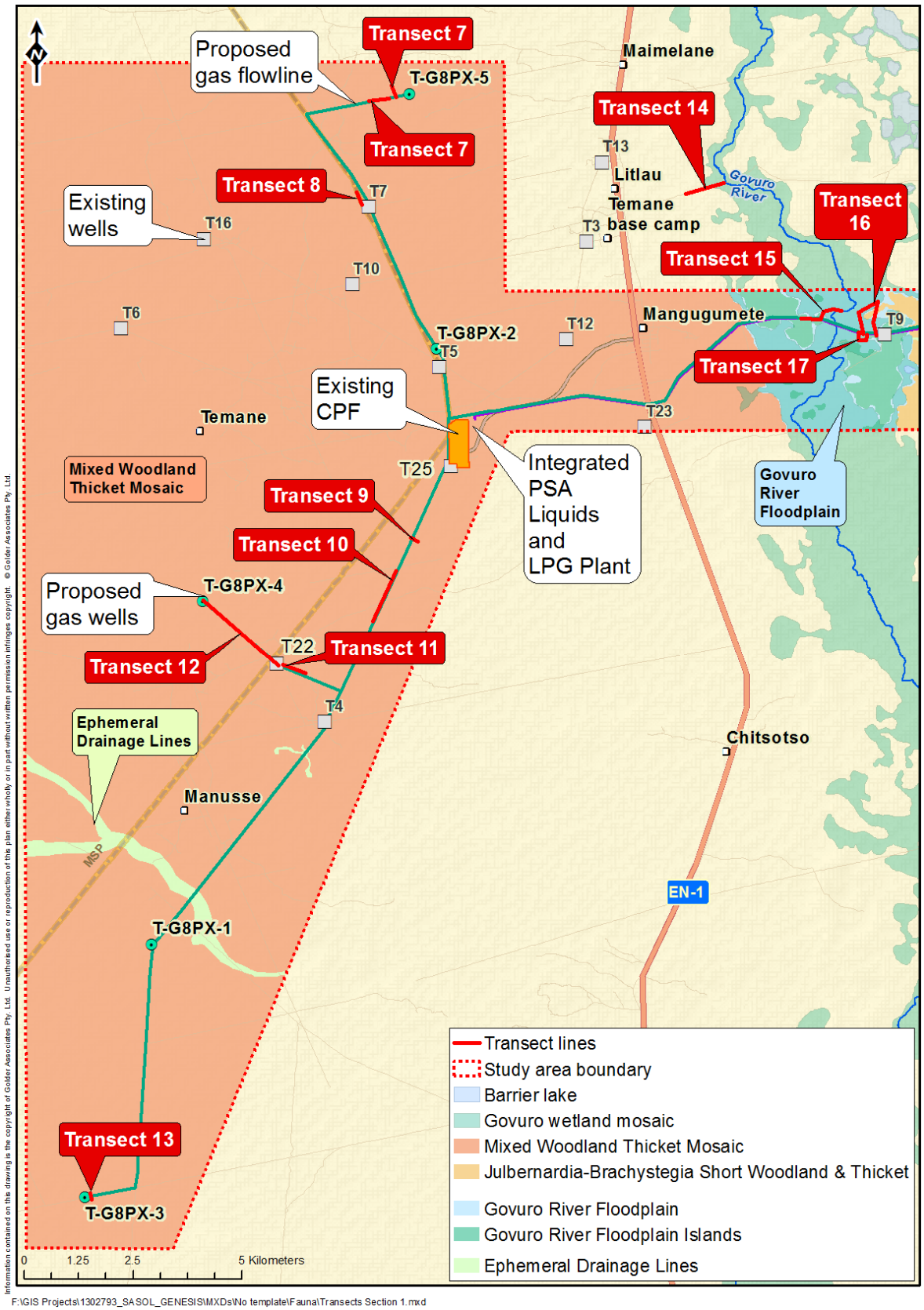


Figure 4-1: Faunal survey sites in the Mixed Woodland and Thicket vegetation type.

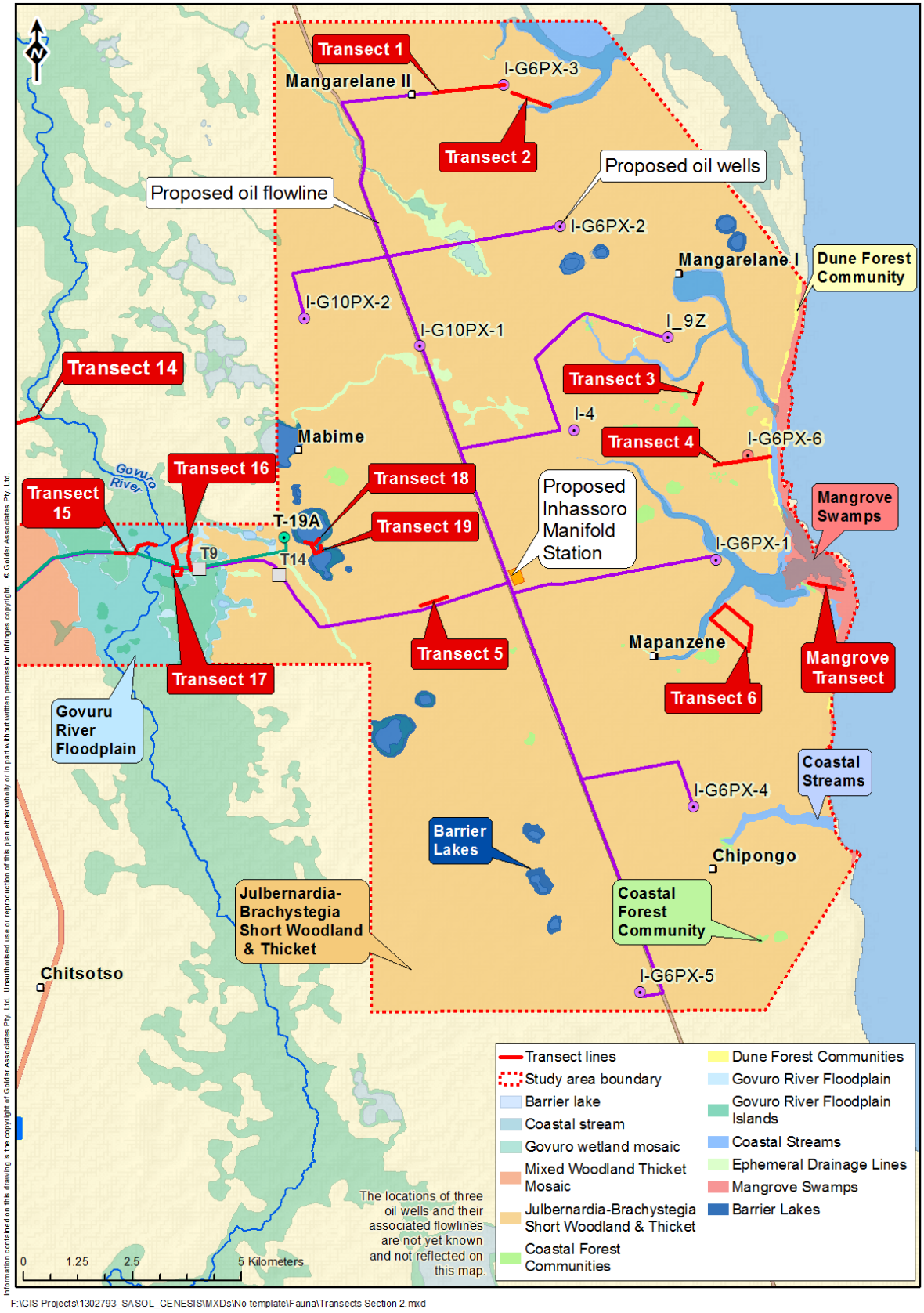


Figure 4-2: Faunal survey sites in the Julbernardia-Brachystegia Woodland vegetation type, the Govuro River and associated floodplain (Transects 14-17), and the Barrier Lakes (Transects 18-19).

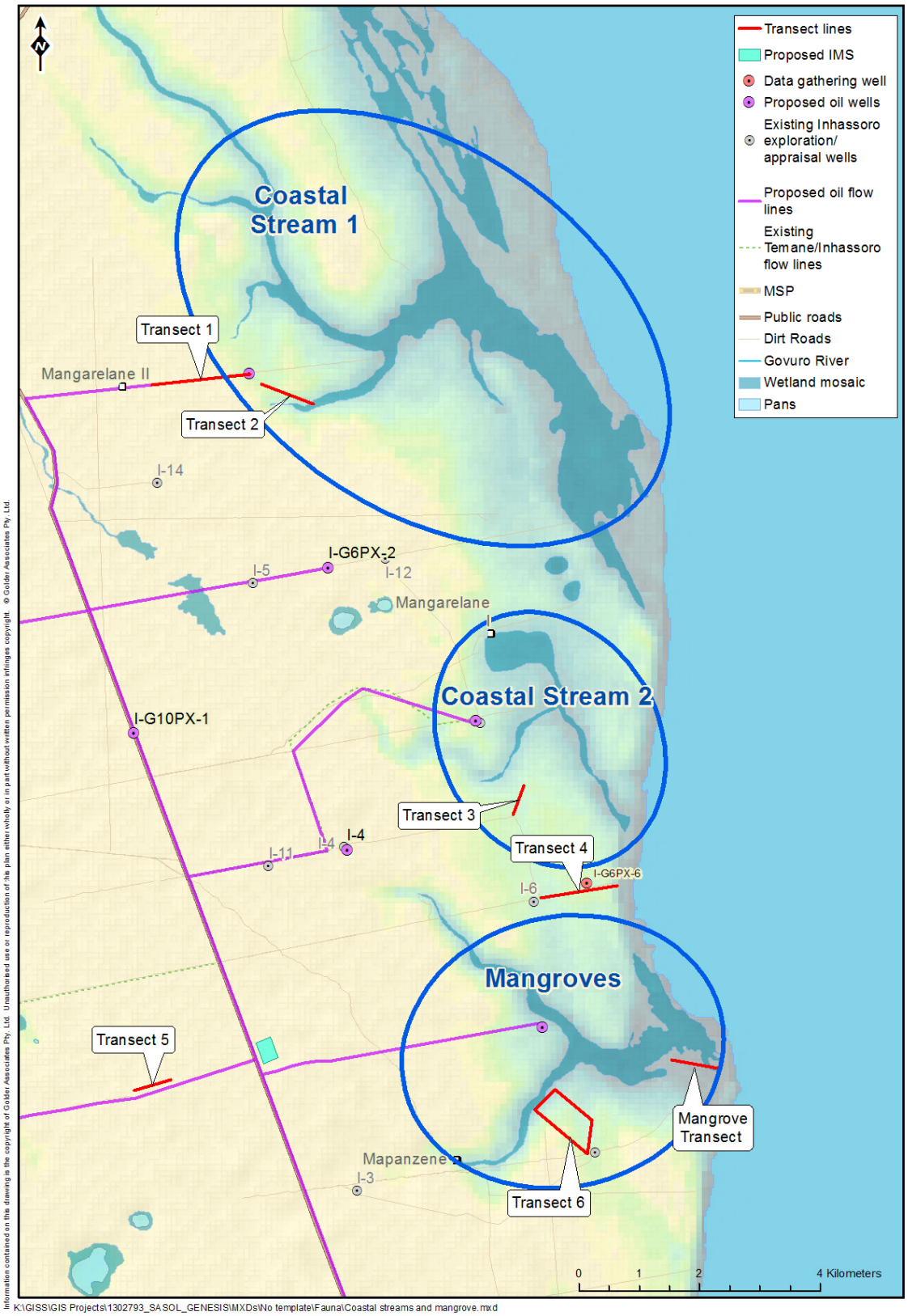


Figure 4-3: Faunal survey sites in the Coastal Streams and Mangrove.

Table 4-1: Survey transects used for the faunal studies (February 2014)

	Coordinates					
Habitat	**Start S**	**Start E**	**End S**	**End E**	**Length (m)**	**Total**
Mixed Woodland and Thicket						
Transect 12: Flowline to T-G8PX-4 including the well site	S 21^0 47'42.70"	E 35^0 01'23.23"	S 21^0 46'53.95"	E 35^0 00'27.39"	2190 m	
Transect 7: Flowline to T-G8PX-5 including the well site	S 21^0 40'39.48"	E 35^0 02'50.95"	S 21^0 40'30.79"	E 35^0 02'47.69"	280 m	
Transect 7: Flowline to T-G8PX-5	S 21^0 40'40.78"	E 35^0 02'45.81"	S 21^0 40'42.65"	E 35^0 02'30.56"	440 m	
Transect 11: Road towards T-G8PX-4	S 21^0 47'48.65"	E 35^0 01'43.58"	S 21^0 47'41.92"	E 35^0 01'26.93"	530 m	
Transect 8: Road between Well 5 (T-G8 PX-5) and well site (T-G8 PX-2);	S 21^0 41'50.49"	E 35^0 02'21.45"	S 21^0 41'59.85"	E 35^0 02'25.74"	310 m	
Transect 9: Road to T-G8 PX1 on termite mounds	S 21^0 46'07.38"	E 35^0 03'01.78"	S 21^0 46'10.02"	E 35^0 03'06.86"	160 m	
Transect 10: Woodland road transect towards T-G8 PX-1	S 21^0 46'31.75"	E 35^0 02'51.12"	S 21^0 47'09.56"	E 35^0 02'33.80"	1270 m	
Transect 13: Flowline to T-G8PX-3 including the well site	S 21^0 54'10.29"	E 35^0 59'04.01"	S 21^0 54'23.72"	E 35^0 59'07.80"	440 m	
Trap line 3 on road towards T-G8PX-5	S 21^0 41'55.08"	E 35^0 02'23.76"			Point	
Trap line 4 on road towards T-G8PX-4	S 21^0 47'48.09"	E 35^0 01'44.17"			Point	
					Total	**5620**
Julbernardia-Brachystegia Woodland						
Transect 3: Flowline between I-4 and I-G6PX-6	S 21^0 41'34.02"	E 35^0 15'01.94"	S 21^0 41'18.44"	E 35^0 15'07.56"	500 m	
Transect 4: Well site I-G6PX-6 to Coastal stream	S 21^0 42'19.31"	E 35^0 15'16.82"	S 21^0 42'13.05"	E 35^0 15'57.99"	1210 m	
Transect 1: Flowline to I-G6PX-3 (including the well site)	S 21^0 47'42.70"	E 35^0 01'23.23"	S 21^0 46'53.95"	E 35^0 00'27.39"	1340 m	
Transect 5: Flowline to Govuro River west towards T-14	S 21^0 44'03.29"	E 35^0 11'38.49"	S 21^0 43'57.15"	E 35^0 11'57.90"	465 m	
Transect 2: Well site at I-G6PX-3 to Coastal stream	S 21^0 44'37.36"	E 35^0 15'41.94"	S 21^0 44'13.21"	E 35^0 15'13.49"	2650 m	
Transect 6: Coastal stream transect near Mapanzene	S 21^0 37'39.49"	E 35^0 12'43.30"	S 21^0 37'53.34"	E 35^0 13'14.45"	2360 m	
Trap line 1 for I-G6PX-3 and well site	S 21^0 37'42.63"	E 35^0 12'46.47"			Point	
Trap line 2 for I-G6PX-6 and well site	S 21^0 42'21.16"	E 35^0 15'13.92"			Point	
					Total	**7365**

	Coordinates					
Habitat	**Start S**	**Start E**	**End S**	**End E**	**Length (m)**	**Total**
Govuro River (including floodplain)						
Transect 14: Govuro west floodplain road (northern point)	S 21^0 41'51.58"	E 35^0 06'26.10"	S 21^0 41'43.63"	E 35^0 06'54.65"	850 m	
Transect 15: Govuro west floodplain road (southern point)	S 21^0 43'24.42"	E 35^0 07'51.74"	S 21^0 43'18.33"	E 35^0 08'22.07"	1000 m	
Transect 17: Govuro west floodplain transect	S 21^0 43'33.66"	E 35^0 08'44.61"	S 21^0 43'11.03"	E 35^0 08'53.39"	1780 m	
Transect 16: Govuro floodplain transect	S 21^0 43'36.83"	E 35^0 08'48.14"	S 21^0 43'40.44"	E 35^0 08'38.13"	780 m	
Trap line 5	S 21^0 43'37.67"	E 35^0 08'46.71"			Point	
					Total	**4410**
Barrier Lakes						
Transect 18: Barrier lake 1	S 21^0 43'16.04"	E 35^0 10'12.55"	S 21^0 43'13.99"	E 35^0 10'22.84"	370 m	
Transect 19: Barrier lake 2	S 21^0 43'19.88"	E 35^0 10'17.84"	S 21^0 43'22.80"	E 35^0 10'25.59"	490 m	
Trap line 6	S 21^0 43'19.44"	E 35^0 10'19.49"		Point		
					Total	**860**
Mangrove Swamps						
Mangrove transect	S 21^0 43'51.21"	E 35^0 16'51.75"	S 21^0 43'46.61"	E 35^0 16'26.97"	740 m	
					Total	**740**
					Overall total	**18 995**

4.4 Field survey approach and reporting

The fieldwork for the summer survey was conducted from the 10th of February to the 1st of March 2014.

The survey made use of habitat availability in the different vegetation types, while the presence of observed species was used as an indicator of habitat integrity. The habitat mapping was conducted in conjunction with the vegetation and wetland specialists (De Castro and Grobler, 2014), using satellite imagery with field verification. Habitat profiles were assessed, in conjunction with distribution data per species, to provide accurate information about the probability of species occurring in the relevant biotopes.

Different habitat features were identified to provide an indication of available habitat for different animals (specifically medium-sized fauna across all vertebrate groups), favouring a specific biotope. Extensive use was made of fixed-point photography.

Regarding species presence, the survey was designed to determine the relative abundance and species richness of fauna in the proposed survey areas, with particular emphasis on CITES and International Union for the Conservation of Nature (IUCN) Red Data listed species. The study approach involved meticulous searches in all of the fixed transects in the representative biotopes to determine the presence/absence of amphibians, reptiles, birds and mammals species. Where necessary, methods were implemented to augment the chances of finding species, which included trapping, nocturnal spotlight searches and track and scat identification.

Macro- and micro-habitat surveys were undertaken to assess the quality of habitat and the associated potential for occurrence of faunal species. Information obtained from the micro-habitat surveys was used to improve the prediction capability of the habitat preference for the animals. This included:

- Quality and quantity of habitat aspects, which provide an indication of species abundance;
- Presence or absence of habitat aspects, which indicates the probability of species occurrence; and
- Habitat quality, which also provides an indication of utilisation (removing wood, chopping down trees, excavating soil, overgrazing, erosion).

The report and appendices describe the probability of occurrence of species with high conservation value; assess the availability of their habitats in the study area; describe the existing risks and threats to these species; provide a detailed overview of the current biodiversity status of the area, with respect to fauna; and describe the status of faunal habitat and species habitat preference in the study area. A detailed list of species encountered in the field survey and expected in the surveyed area is included in the Appendices.

4.5 Faunal survey methods

4.5.1 Relative abundance and density

Relative abundance and density of fauna in the different biotopes were estimated using the following method:

- the number of animals (or signs and sounds) surveyed per hour of observation or per trap night; and
- the number of animals (or signs and sounds) surveyed per linear distance (per kilometre) per biotope.

The timing of the survey was selected to coincide with the summer high rainfall season which provides optimal conditions for the faunal activity. Factors such as weather patterns (temperature, precipitation, topography, vegetation, and time of day) were recorded during each sampling period.

4.5.2 Detailed Methodology

The following internationally recognised survey methods were used to survey insects, amphibians, reptiles, birds and mammals.

4.5.2.1 Insects:

Due to the large number of insect families present in the study area, the study concentrated on two key families: the Lepidoptera (butterflies) and the Odonata (dragonflies and damselflies). The reasons for using these two families are:

- they have been assessed for IUCN Red Listed status in Mozambique
- they are relatively large in size and thus easily detectable,

- detailed field guides are available.

Surveys for these insects included active searches for butterflies and dragonflies, baited butterfly traps for certain butterflies, and insect sweep nets for dragonflies. Where possible, species encountered were photographed.

4.5.2.2 Amphibian surveys

Visual encounter surveys and audio monitoring are appropriate techniques for both inventory and monitoring studies. Visual and auditory surveys were conducted along selected transects, in plots, along streams, rivers and around the Barrier Lakes. Most amphibians that are visible and audible are detectable in this manner. To ensure a comprehensive inventory, all possible microhabitats were also searched, which included ground, water, tree trunks and beneath rocks, both during the day and at night.

Transects were generally related to wetland habitat present in the study area, as well as in the selected Barrier Lakes that were within 500 m of project infrastructure. The surveys included 500m transects per site/wetland habitat (250m in control/reference area, 250m in impacted area) if the habitat was large enough. Additionally, 30 minutes of nocturnal audio monitoring was done per wetland survey site to capture frog calls.

4.5.2.3 Reptile surveys

The most practical way to monitor reptiles, over large areas, is to sample along transects and systematically search encountered refuge areas. Transects were surveyed in different habitats and cover objects within a specified distance of the line were turned over and checked. One particular strength of such transect monitoring is that it can be used to relate reptile abundance to habitat variables, such as vegetation and cover.

The transect sampling was combined with systematic searches in refuge areas. This was done in 1km transects per survey site, surveying 500m in control/reference area, and 500m in impacted areas. Pitfall traps and drift fences were also used and 60 trap nights (=10 traps x 6 nights) per survey site (30 trap nights in control/reference area, 30 trap nights in impacted area) were implemented at the trapping sites.

The main objective of the survey was not to find as many reptiles as possible, but to develop a reliable evaluation of the habitat and quality of shelter available, and to compare the required habitat type with the expected reptiles.

4.5.2.4 Bird surveys

Transects are probably the most widely used method of estimating the numbers of bird species in terrestrial habitats. An observer moves along a fixed route undertaking recording the birds seen or heard on either side of the route. For small birds, which are usually relatively numerous, a transect width of 10m on either side of the route (or 20-50m in open habitats) was found to be suitable for this study. The transect length was 2km per survey site (1km in control/reference area, 1km in impacted area). Birds outside the transect band or flying over were noted for biodiversity reasons.

In denser areas point surveys were implemented using bird calls for identification. The point survey method was also used in open areas where the birds can be seen from a distance, such as pans and grassland flats. These surveys were done during the day and at night.

The surveys were done in combination with rapid visual surveys, which entail driving all the flowlines and cut lines and recording birds in relevant areas (in the control/reference area or in the impacted area.

4.5.2.5 Mammal surveys

Line-transect technique

The line-transect technique was also used to monitor diurnal (active during daylight hours) mammal species. The line-transects used to monitor birds were also used to survey diurnal mammal species. Visual sightings, as well as signs of mammal presence (tracks and scats) were used as indications of the presence and activities of particular species.

One kilometre transects per survey site (500m in control/reference area, 500m in impacted area) were conducted on foot. Each sighting as well as the related vegetation features were noted in order to establish habitat preferences. All major habitat types were assessed.

This method was not used for smaller mammals such as rodents and insectivores.

Live-trapping with Sherman traps

Small mammal trapping can be accomplished by three means: live-trapping, pitfall-trapping and, in some restricted cases, snap-trapping. Live-capture trapping (accomplished by both live- and pitfall-trapping) were used in this study. This is the most appropriate method for impact studies and provides the most reliable and informative data about population numbers and demography, as well as being the best method to determine differences between habitat types and for monitoring population changes following disturbance or over time. Because the Sherman traps are collapsible (approximately 8cm x 7cm x 23 cm), they could be carried over long distances.

One capture station (trap station) of 33 traps was set out per trap site. Each trap site consisted of 33 traps for each of the two trap lines (impacted and control areas). As a general guideline, a spacing of approximately 10 m between traps provides for adequate coverage and this guideline was used in the study. Trapping took place over a period of 5 nights per trap site, thus 300 trap nights per site (60 traps x 5 nights). Flagging tape was used to mark capture (trap) stations over the duration of the study.

Traps were baited in the evening (after 4 pm) and checked the following morning before 8 am. Thus traps were checked early in the morning for the entire capture session (trapping session). During the day time, traps were closed during the morning and early afternoon to minimise inadvertent capture and mortality due to heat stress.

Traps were baited with peanut butter mixed with rolled oats and golden syrup. All traps were set in shaded areas to prevent overheating. Animals caught in the traps were identified and later released at the original capture station. In some cases, measurements of external physical features, such as weight and length, and photographs were taken. Individuals that were not new or notable location records, or which were not needed for positive identification, were released.

Bat echolocation with the AnaBat SD2

All bats belonging to the suborder Microchiroptera (micro-bats) use echolocation to navigate and forage in conjunction with their eyesight. Due to differing ecological requirements among species, echolocation calls are often species-specific and also differ in relation to the bats' activities, such as commuting from A to B, feeding or drinking. Bat detectors identify the echolocation calls emitted by bats and make them audible and visible, revealing their presence at a given location. This then provides the opportunity to observe, identify and study the bats without catching them.

The AnaBat SD2 is equipped with a broad spectrum microphone and uses Frequency Division to make bat calls audible, and Zero-Crossings Analysis to make them visible as sonograms (time by frequency graphs). These techniques, in conjunction with a PDA mounted on the detector, make it possible to hear and see bat calls in the field as they are detected. In addition, the entire unit can be held comfortably in one hand.

Bat echolocation was done from 19h00 at pre-determined bat - sensitive habitats, with recordings being typically 30 minutes per station. These stations were close to the trapping sites, and also in areas deemed most suitable for bats. The recordings were downloaded on return to the base camp and evaluated with the programme software.

Fixed-point photographs

Fixed point photographs were taken as a basis for future comparison with monitoring results.

Photograph 4-1: The drift fence of the pitfall.

Photograph 4-2: The buckets that act as pitfall traps

Photograph 4-3: The pitfall traps filled with captured animals.

Photograph 4-4: A Sherman live rodent trap in place for a night of trapping.

Figure 4-4: A butterfly trap.

4.6 Impact Assessment Rating Criteria

Potential impacts are assessed according to the direction, intensity (or severity), duration, extent and probability of occurrence of the impact. These criteria are discussed in more detail below:

Direction of an impact may be positive, neutral or negative with respect to the particular impact. A positive impact is one which is considered to represent an improvement on the baseline or introduces a positive change. A negative impact is an impact that is considered to represent an adverse change from the baseline, or introduces a new undesirable factor.

Intensity / Severity is a measure of the degree of change in a measurement or analysis (e.g. the concentration of a metal in water compared to the water quality guideline value for the metal), and is classified as none, negligible, low, moderate or high. The categorization of the impact intensity may be based on a set of criteria (e.g. health risk levels, ecological concepts and/or professional judgment). The specialist study must attempt to quantify the intensity and outline the rationale used. Appropriate, widely-recognised standards are used as a measure of the level of impact.

Duration refers to the length of time over which an environmental impact may occur: i.e. transient (less than 1 year), short-term (0 to 5 years), medium term (5 to 15 years), long-term (greater than 15 years with impact ceasing after closure of the project) or permanent.

Scale/Geographic extent refers to the area that could be affected by the impact and is classified as site, local, regional, national, or international. The reference is not only to physical extent but may include extent in a more abstract sense, such as an impact with regional policy implications which occurs at local level.

Probability of occurrence is a description of the probability of the impact actually occurring as improbable (less than 5% chance), low probability (5% to 40% chance), medium probability (40 % to 60 % chance), highly probable (most likely, 60% to 90% chance) or definite (impact will definitely occur).

Impact significance will be rated using the scoring system shown in Table 4-2 below. The significance of impacts is assessed for the two main phases of the project: i) construction ii) operations. While a somewhat subjective term, it is generally accepted that significance is a function of the magnitude of the impact and the likelihood (probability) of the impact occurring. Impact magnitude is a function of the extent, duration and severity of the impact, as shown in Table 4-2.

Table 4-2: Scoring system for evaluating impacts

Severity	Duration	Extent	Probability
10 (Very high/ don't know)	5 (Permanent)	5 (International)	5 (Definite/don't know)
8 (High)	4 (Long-term - impact ceases after closure of activity)	4 (National)	4 (Highly probable)
6 (Moderate)	3 (Medium-term, 5 to 15 years)	3 (Regional)	3 (Medium probability)
4 (Low)	2 (Short-term. 0 to 5 years)	2 (Local)	2 (Low probability)
2 (Minor)	1 (Transient)	1 (Site)	1 (Improbable)
1 (None)			0 (None)

After ranking these criteria for each impact, a significance rating was calculated using the following formula:

SP (significance points) = (severity + duration + extent) x probability.

The maximum value is 100 significance points (SP). The potential environmental impacts were then rated as of High (SP >75), Moderate (SP 46 – 75), Low (SP ≤15 - 45) or Negligible (SP < 15) significance, both with and without mitigation measures in accordance with Table 4-3.

Table 4-3: Impact significance rating

Value	Significance	Comment
SP >75	Indicates **high** environmental significance	Where an accepted limit or standard may be exceeded, or large magnitude impacts occur to highly valued/sensitive resource/receptors. Impacts of high significance would typically influence the decision to proceed with the project.
SP 46 - 75	Indicates **moderate** environmental significance	Where an effect will be experienced, but the impact magnitude is sufficiently small and well within accepted standards, and/or the receptor is of low sensitivity/value. Such an impact is unlikely to have an influence on the decision. Impacts may justify significant modification of the project design or alternative mitigation.
SP 15 - 45	Indicates **low** environmental significance	Where an effect will be experienced, but the impact magnitude is small and is within accepted standards, and/or the receptor is of low sensitivity/value or the probability of impact is extremely low. Such an impact is unlikely to have an influence on the decision although impact should still be reduced as low as possible, particularly when approaching moderate significance.
SP < 15	Indicates **negligible** environmental significance	Where a resource or receptor will not be affected in any material way by a particular activity, or the predicted effect is deemed to be imperceptible or is indistinguishable from natural background levels. No mitigation is required.
+	**Positive impact**	Where positive consequences / effects are likely.

In addition to the above rating criteria, the terminology used in this assessment to describe impacts arising from the current project are outlined in Table 4-4. In order to fully examine the potential changes that the project might produce, the project area can be divided into Areas of Direct Influence (ADI) and Areas of Indirect Influence (AII).

- Direct impacts are defined as changes that are caused by activities related to the project and they occur at the same time and place where the activities are carried out i.e within the ADI.
- Indirect impacts are those changes that are caused by project-related activities, but are felt later in time and outside the ADI. The secondary indirect impacts are those which are as a result of activities outside of the ADI.

Table 4-4: Types of impact

Term for Impact Nature	Definition
Direct impact	Impacts that result from a direct interaction between a planned project activity and the receiving environment/receptors (i.e. between an effluent discharge and receiving water quality).
Indirect impact	Impacts that result from other activities that are encouraged to happen as a consequence of the Project (i.e., pollution of water placing a demand on additional water resources).
Cumulative impact	Impacts that act together with other impacts (including those from concurrent or planned activities) to affect the same resources and/or receptors as the Project.

The significance of the impact that is determined will be qualified, where necessary, with the degree of confidence in the assessment which is a function of uncertainties associated with the prediction. Degree of confidence can be expressed as low, medium or high

5.0 THE BASELINE ENVIRONMENT

5.1 Habitats

The Study Area is dominated by a mosaic of open woodland and denser thicket on sandy soils situated on both sides of the Govuro River. The vegetation types and wetlands are discussed in detail in the Specialist Study on vegetation and wetlands (De Castro and Grobler, 2014).

The ecoregion supports typical miombo (broad-leaved savanna) fauna. Long winter droughts and poor soils result in vegetation of low nutritional value. This greatly reduces the ecoregion's faunal carrying capacity, and large-bodied herbivores generally occur only in fairly low densities.

The structural differences in the woodland and thicket mosaic in the study area add to the diversity in habitat, and thus to the faunal diversity of the area. Together with the diverse wetland areas spread throughout the study area, this forms the habitat template for the fauna in the area.

The habitat types in the Study Area are described below, using the vegetation categories as the main classification. More detail can be found in Specialist Study 9 (de Castro and Grobler, 2014)

5.1.1 Mixed Woodland and Thicket

Structurally, the Mixed Woodland and Thicket vegetation type consists of a mosaic of open woodland with a herbaceous ground cover, and patches of dense thickets spread throughout the area. The soils that underlie this vegetation type are haplic lixisols, which are red limey soils derived from chalkstone that have a moderate organic content and are sensitive to erosion (Mark Wood Consultants, 2001).

The mixed woodland consists of low bushland with medium-sized trees and shrubs, with the herbaceous layer covering most of the sandy soil in between (Photograph 5-1). The thicket consists of a dense cover of low shrub, with larger protruding trees scattered in between (Photograph 5-2). Patches of dense woodland, verging on dry forest, are commonly associated with large termite (*Macrotermes*) mounds, up to 20 m across. These termite mounds on sandy soils provide "islands" of loamy fertile soils and are rich in nutrients. Parts of the area contain secondary succession plants which have established in previously de-forested agricultural areas.

Photograph 5-1: Mixed Woodland - open woodland with grassy patches.

Photograph 5-2: Thicket in Mixed Woodland - dense cover of low shrub, with lager protruding trees on old termite mound.

The different aspects of potential habitat and the structure of this vegetation type determines the presence of animal species and their abundance in the area. These aspects are summarised in Table 5-1.

Table 5-1: Important faunal habitat components of Mixed Woodland and Thicket vegetation types

	% cover of area
Mixed Woodland:	
Large trees	25%
Shrubs	5%
Herbaceous (herbs and grass)	60%
Termite mounds	3%
Dead trees (logs and wood rubble)	2%
Bare ground	5%
Thicket:	
Large trees	25%
Shrubs and woody climbers	45%
Herbaceous (herbs and grass)	3%
Termite mounds	10%
Dead trees (logs and wood rubble)	5%
Leaf litter	10%
Bare ground	2%

Both the open Mixed Woodland and denser Thicket components of this vegetation type, contain the same basic habitat components listed in Table 5-2. However, the thicket components are clumped and form a much denser vegetation cluster, which provide optimal habitat to retiring and secretive animals.

5.1.2 Julbernardia-Brachystegia Woodland and Thicket Mosaic

This vegetation type consists of a mosaic of open woodland with some grassy patches (Photograph 5-3), and patches of dense thicket distributed throughout the area (Photograph 5-4). The soils that underlie the vegetation type are arenosols with very low water-holding capacities, no salinity and a low superficial organic content, which presents some restrictions to agriculture.

The low woodland consists of a mosaic of medium sized trees and shrubs, and in some areas the herbaceous layer dominates the landscape. The thickets consist of canopy species and the dense under storey comprises many woody climbers and a well-developed shrub layer. In shaded areas, the sandy soils result in very poorly developed ground cover. Parts of the area contain secondary succession plants which have recolonised previously de-forested agricultural areas.

Photograph 5-3: Julbernardia-Brachystegia Woodland- open woodland with grassy patches.

Photograph 5-4: Thicket-pockets of low closed woodland with taller trees and shrubs.

The different aspects of potential habitat and the structure of Julbernardia-Brachystegia Woodland and Thicket Mosaic determine the presence of animal species and their abundance in the area. These aspects are summarised in Table 5-2.

Table 5-2: Important faunal habitat components of the Julbernardia-Brachystegia Woodland and Thicket vegetation type

Habitat aspect	% cover of area
Julbernardia-Brachystegia Woodland:	
Large trees	25%
Shrubs	10%
Herbaceous (herbs and grass)	50%
Termite mounds	1%
Dead trees (logs and wood rubble)	2%
Bare ground	12%
Thicket Mosaic:	
Large trees	35%
Shrubs and woody climbers	30%
Herbaceous (herbs and grass)	10%
Dead trees (logs and wood rubble)	2%
Leaf litter	20%
Bare ground	3%

Both the open Julbernardia-Brachystegia Woodland and denser Thicket components of this vegetation type contain the same basic habitat components listed in Table 5-2. However, the Thicket components are clumped and form a much denser vegetation cluster, which provide optimal habitat to retiring and secretive animals.

5.1.3 Coastal and Dune Forests

These forests lie mostly in the east of the Study Area. The coastal dunes normally include a pioneer zone of sand - binding species that eventually create conditions suitable for a dune thicket (Photograph 5-5). This in turn allows the gradual development of dune forest (Photograph 5-6).

These vegetation types consist of dense forests with closed canopies on haplic arenosols, which are greyish-brown sandy soils associated with the marine dunes of the coastal areas. The different aspects of potential

habitat and the structure of this vegetation type determines the presence of animal species and their abundance in the area. These aspects are summarized in Table 5-3.

Table 5-3: Important faunal habitat components of the Coastal and Dune Forests

Habitat aspect	% cover of area
Large trees	45%
Shrubs	30%
Herbaceous (herbs and grass)	8%
Dead trees (logs and wood rubble)	3%
Leaf litter	14%

Photograph 5-5: A dune thicket

Photograph 5-6: Coastal and Dune Forests - dense forests with closed canopies.

5.1.4 Wetlands

The Inhassoro Study Area is relatively flat and due to its low altitude it often floods during the rainy season. The most important wetland systems occur on the coastal plain. They comprise riverine floodplains with swamps and seasonal pans, and tidal or mangrove forests at the coast. A low ridge separates the coastline and the Goruvo River. Depressions in the broader landscape have resulted in the formation of lakes and wetland areas.

5.1.5 Govuro River (including floodplain)

The woodlands become more open towards the main drainage lines, thinning to wooded grasslands near the Govuro River valley. This valley is characterised by fertile soils and numerous wetlands and fresh and saltwater lakes.

The Govuro River system consists of the flowing river (aquatic) and the associate floodplain (riparian). The aquatic component of the system consists of a flowing channel (run) (Photograph 5-7) and backwaters towards the edges of the floodplain where inundated and emergent vegetation create favourable habitat (Photograph 5-8). The riparian zone consists mostly of inundated floodplain habitats, but riparian trees are scarce as the riverine zone rapidly merges into the terrestrial woodland system.

The soils underlying the Govuro River in the vicinity of the pipeline crossing are Gleyic Arenosols, which have very similar characteristics to the Arenosols, but with much better water-holding capacity. Downstream towards the high-level bridge the Arenosols change to Eutric Fluvisoils, which have imperfect to high water holding capacities and low to high superficial organic content.

Poorly drained, low lying areas in the Govuro River valley are characterised by more open woodland formations with an herbaceous layer comprising hygrophytic grassland and grass and sedge marshes. The vegetation on the banks of the river, and in the permanently or semi-permanently flooded parts of the floodplain, is

characterized by *Phragmites australis* and *Nymphaea*. *Hyphaene coriacea* and *Phoenix reclinata* are abundant with the latter species often associated with the fringes of small forest patches occurring on termite mounds.

Photograph 5-7: The main channel in the Govuro River during summer high flows.

Photograph 5-8: The backwaters of the river, inundating the marginal vegetation on the floodplain.

The different aspects of potential habitat and the structure of this biotope determine the presence of animal species and their abundance in the area. These aspects are summarised in Table 5-4.

Table 5-4: Important faunal habitat components of the Govuro River system

Habitat aspect	% cover of area
Emergent and inundated vegetation	42%
Herbaceous vegetation on floodplain	25%
Vegetated islands and reed beds	5%
Open water	25%
Mud flats	3%

5.1.6 Coastal Streams (Perennial to seasonal)

Coastal streams are found east of the low ridge that separates the coast line and the Goruvo River. Various very short coastal streams originate within this area (Photograph 5-9), being generally 8km or less in length. Seepage water from the areas of more elevated terrain create these features, where the water emerges on the surface to form fluvial wetlands and streams.

Peat soils were found in these coastal streams during the current study (De Castro and Grobler, 2014). Organic (peat) soils are in general very fertile and are continuously wet. They receive fresh water throughout the year as a result of seepage from the surrounding dune areas which have high infiltration and recharge rates. A major part of the wetland surface area is covered by emerging and inundated vegetation, with small areas of open surface water in the form of pools and backwaters (Photograph 5-10).

The different aspects of potential habitat and the structure of this biotope determine the presence of animal species and their abundance in the area. These aspects are summarised in Table 5-5.

Table 5-5: Important faunal habitat components of in the Coastal Streams system

Habitat aspect	% cover of area
Emergent and inundated vegetation	80%
Herbaceous vegetation on floodplain	10%
Open water	10%

Photograph 5-9: A coastal stream - small areas of open surface water form backwater habitat.

Photograph 5-10: A coastal stream, covered by emerging- and inundated vegetation.

5.1.7 Ephemeral Drainage Lines (including wetland flats)

The Ephemeral Drainage Line habitats are mostly dry drainage lines flanked by a narrow riparian zone, where the riparian zone acts as a corridor for fauna that utilise dense cover to move or migrate. Due to the flat sandy environment of the study area, there are not many drainage lines present, apart from those leading to the Govuro River.

5.1.8 Mangrove Swamps

Mangroves are a diverse group of trees, shrubs, palms, and ferns growing in the marine intertidal zone or estuarine margins where they form interdependent links between the inland terrestrial landscape and near-shore marine environment (Figure 5-1). Mangrove swamps in Mozambique serve as marine nurseries, and often adjoin similarly productive coral reefs and sea grass meadows.

Smaller patches of mangrove communities occur along the entire length of the coastline (Photograph 5-11), wherever freshwater seeps onto the beach from the dunes (Photograph 5-12). Mangrove Swamps are mostly associated with the coastline and are connected to the study area by the seeps and coastal streams described under Section 5.1.6 above. They are seldom very extensive between their landward and seaward faces and are semi-continuous along the coast.

The different aspects of potential habitat and the structure of this biotope determine the presence of animal species and their abundance in the area. The biotope was not surveyed in detail, although a short visit supplied some indication of the habitats available in the mangroves. These aspects are summarised in Table 5-6.

Table 5-6: Important faunal habitat components of the Mangrove Swamps system

Habitat aspect	% cover of area
Mangrove trees	20%
Emergent and inundated vegetation	10%
Herbaceous vegetation on floodplain	15%
Bottom cover: Organic litter, sea grass meadows, sand	Similar to open water
Muddy soils, mud flats	20%
Open water	35%

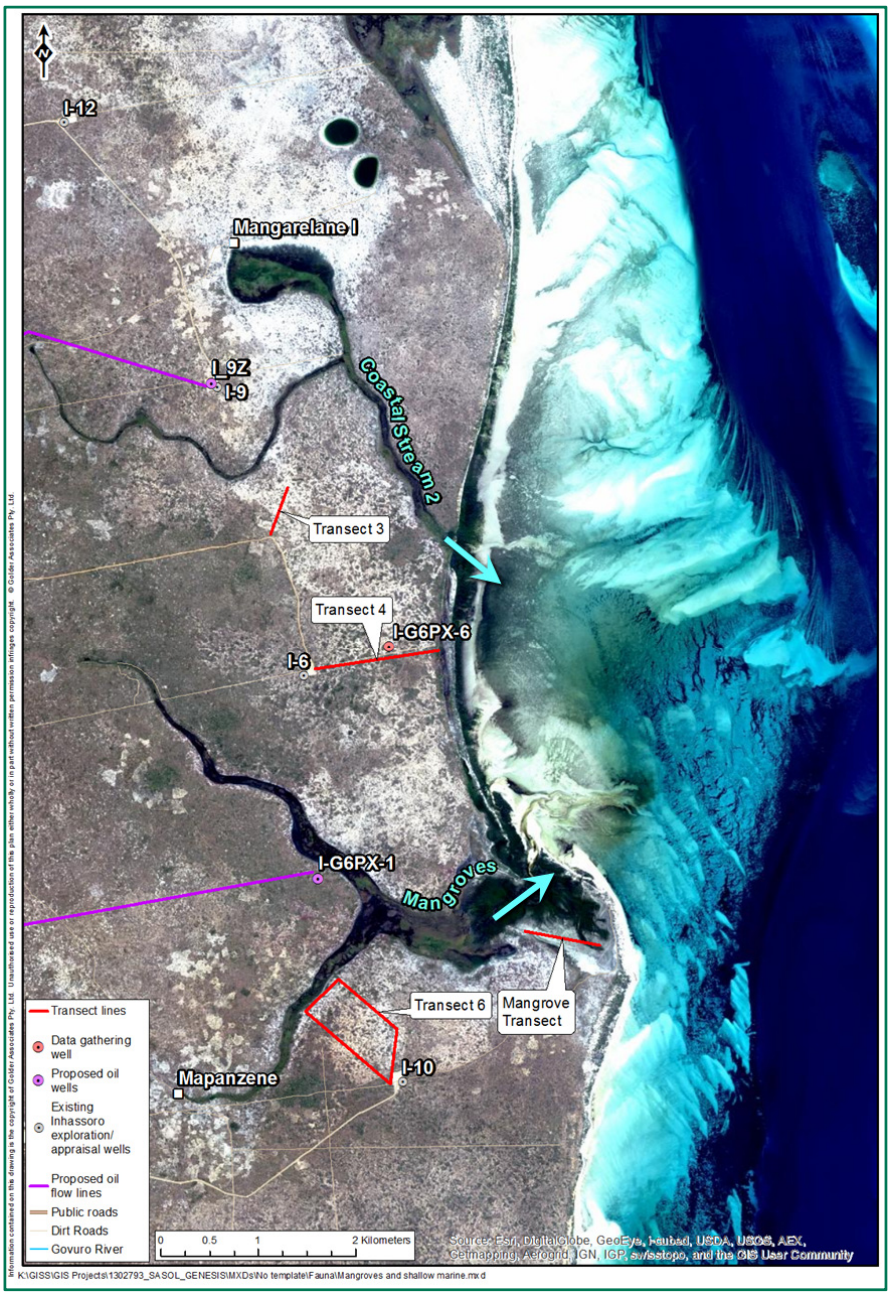


Figure 5-1: Mangrove Swamps and shallow marine areas with sea grass meadows at the mouth of a coastal stream downstream of I-G6PX-1.

Photograph 5-11: Mangrove Swamps downstream of I-G6PX-1.

Photograph 5-12: Mangrove Swamps close to the coast.

As shown in Figure 5-1, the largest area covered by shallow marine sediment is directly around the mouths of the two Coastal Streams. It is therefore evident that the Coastal Streams on land have an influence on the extent of the Mangroves in the area, having supplied sediment and nutrients to the coastal area for centuries. During a short visit to the Mangrove Swamp vicinity, hundreds of wading birds were observed on the extensive mud flats during low tide.

5.1.9 Barrier Lakes

Numerous barrier lakes are situated within the Study Area, located on a plain of low elevation. The prevalence of coastal lakes and lagoon systems is partly a consequence of the sandy lowland nature of the coastal plain and the pattern of sand deposition, and most are separated from the sea by a well-developed long-shore dune system. In the study area these lakes are uniformly small.

Changes in sea level have stranded old coastline, dune systems, and lagoons inland and parallel to the present coastline. Where coastal lagoons have become completely isolated, barrier lakes form (Photograph 5-13). Small perennial streams feed some of these lakes while others are seasonal, drying up completely during winter. Water quality within the lakes varies widely, but is generally sweet, with the lakes being situated on sandy beds with substantial organic deposits. The eulittoral zones (marginal) of the lakes are vegetated by marsh vegetation dominated by hygrophytic and hydrophytic grasses and sedges (Photograph 5-14).

Photograph 5-13: The larger of the two barrier lakes near T-19A.

Photograph 5-14: Marginal vegetation along the edges of the barrier lake.

The different aspects of potential habitat and the structure of this biotope determines the presence of animal species and their abundance in the area. These aspects are summarised in Table 5-7.

Table 5-7: Important faunal habitat components in the Barrier Lakes

Habitat aspect	% cover of area
Open water - muddy or sandy bottoms	60%
Emergent and inundated vegetation (sedges, grasses)	12%
Hydrophytic, herbaceous vegetation on floodplain	15%
Edge of lake - live trees and associated dead wood	5%
Mud flats	8%

5.1.10 Cultivated areas

Actively cultivated agricultural lands spread outward from Vilanculos and Inhassoro and along the EN-1 (main road, Figure 1-1). The most commonly cultivated species include maize, groundnuts, cassava, watermelons and beans. In areas with high levels of soil moisture, such as around barrier lakes and in the floodplain of the Govuro River, crops such as sugar cane, rice, bananas, paw-paw and sweet potatoes are grown. Indigenous plant and animal species do however still make an important contribution to the food, medicine, and construction requirements of local residents, and the knowledge base pertaining to the utilisation of natural resources is still very much intact.

5.2 Habitat viability

The importance of potential habitat and habitat combinations cannot be over-emphasized. Some aspects of habitat are more important or sensitive than others, and the distribution of animals can be greatly influenced by the presence or absence of these habitats. The goods and services supplied by the potential habitats can be summarized as follows:

Terrestrial systems

- Live trees and shrubs as:
  - shelter (dense leafy environment, holes and cracks in stem, loose bark, dense brushwood);
  - nesting and breeding (branches, holes, under roots);
  - feeding (leaves, fruit, seeds, pollen, nectar, etc.);
  - perching (vantage point for hunting, resting).
- Dead trees and shrubs as:
  - shelter, nesting and breeding (holes and cracks in dead logs, loose bark, inside rotten logs, toppled brushwood).
- Herbaceous ground cover as:
  - shelter, nesting and breeding (dense grass cover, patches of dense forbs).
- Leaf litter (especially in thicket habitats) as:
  - shelter;
  - feeding (finding prey underneath layers).
- Sandy soils as:
  - shelter, nesting and breeding (medium to tunnel and burrow in)
  - feeding (finding prey, eating roots – tunnelling and burrowing).
- Termitaria (termite nests) as:
  - shelter (holes in termitaria)

Aquatic systems

- Open water
  - shelter (escape into deeper water)
  - feeding (hunting for fish and other aquatic species)
- Emergent and inundated vegetation on floodplain
- shelter (between vegetation and in water)
  - feeding (hunting for aquatic species)
  - nesting and breeding (in vegetation and in water)
- Mud flats
  - feeding (in soft mud)

5.3 Faunal assemblages and habitat potential

The conservation status of Mozambique's biodiversity resources is mostly unknown, partly due to the lack of a national biodiversity inventory, the lack of systematic monitoring of species, and the fact that the little information that is available unconsolidated. There are a number of near-endemic and restricted range species recorded in Mozambique, mostly associated with isolated montane (mountain) habitats to the west, but none expected for the study area.

The great diversity of vegetation types and plant communities occurring in the study area provide a wide variety of animal habitats. The faunal accounts presented below are by no means comprehensive due to the short survey period (3 weeks), the size of the study area, and the limitations on movement due to the possibility of landmines in the area. However, the faunal accounts provide a good indication of the type of faunal communities and animal species diversity that can be expected to occur within the study area, and provides a suitable basis for the assessment of possible impacts and the recommendation of mitigation measures.

5.3.1 Frogs

The frog fauna of the study area are a product of the diversity of the region's topography, climate and habitats. Frogs have adapted to almost every type of environment and many species are highly specialised to suit conditions in a particular locality. This can, however, leave a species vulnerable when a habitat is degraded or irreversibly changed (Du Preez & Carruthers, 2009).

Amphibians are localised in their movement and habitat choices. Most frogs can occur in dry areas but need water for egg laying and the larval stage, and are thus absent if no standing water is available during this stage. They only emerge after good rains when there is water for them to feed and breed. During the rest of the year, they seek shelter in damp places in order to escape the dry or cold climate.

Recent research has shown that amphibian species are declining worldwide as a result of global habitat loss (Du Preez & Carruthers, 2009). Their small areas of occupancy make them more susceptible to extinction due to habitat loss and degradation compared with other vertebrates and habitat conservation is therefore a priority for amphibian preservation. Suitable environmental conditions, especially breeding sites, are critically important to frogs, and species are often very specific to those habitats.

For many reasons, frogs are important and useful indicators of environmental health. Factors that make frogs particularly sensitive to environmental deterioration include (Du Preez & Carruthers, 2009):

- Absorbent skin surface – absorbs water and any solvents and makes them susceptible to water and air pollution;
- Fragmented distribution – habitat losses may isolate surviving populations;
- Temperature – extreme environmental temperature fluxes affect their biology;
- Amphibious lifestyle – frogs are exposed to aquatic as well as terrestrial environment and are thus affected by changes to both; and
- Trophic level – important prey items to wide array of predators.

5.3.1.1 Surveys in primary habitats

The checklist by Schneider et al (2005) lists 60 species of frogs for all of Mozambique. The area which includes the Study Area has the potential to provide habitat for to 24 - 39 frog species.

In compiling the expected frog lists for the study, frog distribution records from Du Preez and Carruthers (2009) were used, along with habitat preference data, compiled from various sources. Sixteen frog species were encountered during the February 2014 survey (Table 5-8).

Table 5-8: Frogs encountered (12 species) in the available natural habitats of the Study Area during the 2014 survey (see Appendix A for detail). (Shaded cells = preferred habitat; number in cell = number of individuals detected during the different surveys).

Habitat / Frog	Julbernardia-Brachystegia Woodland and Thicket	Mixed Woodland and Thicket	Govuro River & floodplain	Coastal wetlands
Common Squeaker (*Arthroleptis stenodactylus)*		1		
Guttural toad (*Amietophrynus gutturalis*)	5			2
Painted reed frog (*Hyperolius marmoratus taeniatus)*			4	
Argus reed frog (*Hyperolius argus*)			2	
Bubbling kassina (*Kassina senegalensis*)			6	1
Common rain frog (*Breviceps adspersus*)	7	4	2	
Banded rubber frog (*Phrynomantis bifasciatus)*			3	
Dwarf Puddle Frog (*Phrynobatrachus mababiensis)*			1	4
Natal dwarf puddle frog (*Phrynobatrachus natalensis)*				2
Anchieta's ridged frog (*Ptychadena anchietae)*			1	1
Edible bullfrog (*Pyxicephalus edulis*)		1	1	
Common sand frog (*Tomopterna cryptotis*)	1	1		

All of the species that were not found are expected in the wetlands associated with the Govuro River and in the Coastal Wetlands. Although most of these frogs will move away from the wetlands in their life span, they will inevitably return to breed. Most of them aestivate in sheltering places and burrow into the soil, sometimes far removed from the wetlands during the dry cold winters. Frogs such as the bullfrog, rain frog and sand frog, are often found in the dryer areas due to their ability to dig into the sandy soils to aestivate (buried and dormant). Here they will remain throughout the dry period, emerging in the rains, when they make their way to areas of standing water to breed.

5.3.1.2 Species of concern

According to the IUCN Red List, three frogs in Mozambique have “threatened” status (Appendix E), however, none of these species occur in the study area (Channing, 2001).

5.3.1.3 Threats

The amphibian populations in Mozambique are faced with several environmental threats. Habitat destruction resulting in fragmentation of populations is cited as the most pervasive threat facing amphibians. Habitat loss most commonly results from subsistence agriculture, but is also due to localised urban development. Agricultural development affecting frogs include cultivation, overgrazing and trampling by domestic stock. Alien invasive plants and out-of-season fires caused by humans also impact on their habitat.

5.3.2 Reptiles

Current knowledge of reptiles within the study area is derived from information available in the publications of Branch (1998), Marais (2004) and Alexander and Marais (2007). Two-hundred and nine (209) reptile species have been recorded in Mozambique according to the checklist by Schneider et al (2005). Of these 209 reptile species, 24-34 species are expected to occur in the region of which the study area. Using updated data regarding distribution of reptiles in the region, this number of expected reptiles has increased to 62 species.

5.3.2.1 Surveys in primary habitats

In compiling the expected reptile lists for the study, reptile distribution records from Branch (1998) and Marais (2004) were used, along with habitat preference data, compiled from various sources. According to the reptile distribution maps, the Study Area is situated in the Lowland Forest vegetation type and an expected 62 reptile species could be present. However, given detailed knowledge of the available habitat in the study area, only 56 species are expected. The species with distribution records coinciding with the region, but not expected to be present in the study area, are the ocean-dwelling species such as turtles and sea snakes.

Twenty-three reptile species were encountered (also reported by the staff at the CPF) during the February 2014 survey (Table 5-9).

Table 5-9: Reptile species encountered or reported (23 species) in the available natural habitats of the Study Area during the 2014 survey (see Appendix B for detail). (Shaded cells = preferred habitat; number in cell = number of individuals detected during the diff

Habitat Reptile species	Julbernardia-Brachystegia Woodland and Thicket	Mixed Woodland and Thicket	Govuro River & floodplain	Coastal wetlands
Peter's thread snake (*Leptotyphlops scutifrons scutifrons)*	1			
Southern African python *(Python natalensis)*		1		
Cape file snake (*Mehelya capensis capensis)*		1		
Olive whip snake (*Psammophis mossambicus)*		1		
Spotted bush snake (*Philothamnus semivariegatus)*	1	2		
Rhombic egg-eater (*Dasypeltis scabra*)		1		
Eastern vine snake *(Thelotornis mossambicanus)*		1		
Snouted cobra *(Naja annulifera*)		1		
Mozambique spitting cobra (*Naja mossambica)*	1	2		
Black mamba *(Dendroaspis polylepis)*		1		
Puff adder (Bitis arietans arietans)		1		

Habitat Reptile species	Julbernardia-Brachystegia Woodland and Thicket	Mixed Woodland and Thicket	Govuro River & floodplain	Coastal wetlands
Eastern coastal skink *(Trachylepis depressa)*	1	1		
Striped skink (*Trachylepis striata*)	2	2		
Variable skink (*Trachylepis varia*)	1			
Greater writhing skink (*Mochlus afrum*)	1			
Common rough-scaled lizard (*Meroles squamulosa)*		1		
Cape rough-scaled lizard (*Ichnotropis capensis)*	5			
Water monitor (*Varanus niloticus niloticus)*				1
Mozambique agama *(Agama mossambica)*	1	7		
Peter's ground agama *(Agama armata)*	1			
Common flap-necked chameleon (*Chamaeleo dilepis dilepis)*	1			
Common dwarf gecko *(Lygodactylus capensis capensis)*	3	1		
Common tropical house gecko *(Hemidactylus mabouia)*		1		

The reason that relatively small numbers of reptiles are found can be attributed to the following factors, which apply to many species:

- Subterranean habits;
- Nocturnal habits;
- Secretive and retiring habits;
- Small size (of many species); and
- Cryptic colouring.

5.3.2.2 Species of concern

According to the IUCN Red List, 10 reptile species in Mozambique have “threatened” status (Appendix E), with five of these being sea turtles. Only one reptile species whose range and habitat matches the study area is considered threatened according to the IUCN Red List (IUCN= International Union for Conservation of Nature 2014): This is the Zambezi flat-shelled terrapin (*Cycloderma frenatum*) - Lower Risk/least concern.

5.3.2.3 Species of concern: Habitat availability

Comparing the habitat requirements of the threatened Zambezi flat-shelled terrapin with the habitat availability in the study area, the following vegetation types have habitat assemblages that correspond with the optimal requirements of the species:

Table 5-10: Habitat availability for reptile species of concern in the study area, indicating habitat requirement, and vegetation types with appropriate habitat.

Reptile species	Habitat requirements	Habitat availibility
Zambezi flat-shelled terrapin (*Cycloderma frenatum*) - **Lower Risk/least concern**	Rivers, lakes and stagnant pools. Burrow into soft mud. Fast swimming species. Prefer sandy rather than muddy substrates. Highly specialised fish-catcher, feeding on mussels only when fish are not available. Mussels are dug out from the substrate of rivers and lakes, using the powerful claws on the forefeet. Adult turtles may travel several kilometres from shore and, on days of dead calm, up to half a dozen can usually be seen floating on the surface basking in the sun. Female turtles come ashore at night to lay their eggs between the end of January and April. The nest site is in the shade under trees and bushes, usually within 200 m of the water. A clutch of 17–25 eggs is laid in a shallow excavated nest hole. Hatchlings are plentiful in January and may be found under loose stones and logs along the high-water mark.	**Govuro River & floodplain** Habitat Integrity score: 4*
		Coastal wetlands Habitat Integrity score: 4

*Habitat Integrity scores (how appropriate the habitat is for the species): Poor 1; Low 2; Medium 3; Good 4; Optimal 5

Table 5-10 suggests there is sufficient habitat available for the expected Zambezi flat-shelled terrapin to occur in the Study Area. The terrapin was not found during the 2014 survey.

5.3.3 Birds

Birds are an important component of many ecosystems, and of all the main wildlife groups, they are often the easiest to observe and count. Many studies have shown that bird counts can accurately detect environmental change (Pomeroy, 1992). A decline in species richness and diversity, as determined by routine monitoring, may serve as an early warning of environmental degradation (Ryder, 1986).

The conservation status of the birds of Mozambique is under review (Schneider et al, 2005), but a preliminary estimate indicates that at least 51 bird species are of conservation concern (IUCN, 2014). Out of 900 bird species recorded in southern Africa, 603 are found in Mozambique. According to the checklist by Schneider et al (2005), 294-342 species are expected to occur in the region of which the study area is a part. Although there are species considered near-endemic or with a restricted range, little conclusive information is available on endemism and conservation status.

The Bird Atlas prepared by Harrison et al (1997), Volumes 1 & 2, formed the basis of the distribution data used in this report, as it is currently the most updated printed information source about Southern African birds. The final atlas includes all additional data collected by birders in southern and central Mozambique after the publication of the interim atlases. The Roberts Birds of Southern Africa (Hockey, et al. 2005) was also consulted for habitat and bird data.

5.3.3.1 Surveys in primary habitats

During the February 2014 survey, a variety of biotopes and sites were surveyed for bird species, including both transformed and untransformed biotopes. The timing of the survey was optimal for birding, as it was during the summer high rainfall period when the migrant species were present.

Of the bird species expected to be found in the study area, certain birds are resident and will remain in the area throughout the year. Nomadic species will periodically move to other areas further away from the study area for feeding or breeding purposes. Of the expected migratory bird species, some birds are visitors from further north on the African continent, arriving in the southern African region to feed and often to breed. The

Palaearctic migrants are summer visitors to Southern Africa, spending our winters in Eurasia. Very few of these species breed in Southern Africa.

Excluding marine species, a total of 275 bird species were observed during the Bird Atlas project (Harrison *et al*, 1997) in this region. From an evaluation of bird distribution and local habitat, it is clear that all of these species of birds are likely to be present in the different biotopes of the study area (Appendix C). During the summer survey (February 2014), 129 bird species were observed in the transects that were surveyed (Appendix C).

Table 5-11: Summer survey (February 2014) bird species recorded in the study area (red = Special Species)

1. White-breasted cormorant (*Phalacrocorax carbo*)
2. Little egret (*Egretta garzetta*)
3. Western great egret (*Egretta alba*)
4. African openbill (*Anastomus lamelligerus*)
5. White-faced whistling duck (*Dendrocygna viduata*)
6. Spurwinged goose (*Plectopterus gambensis*)
7. African jacana *(Actophilornis africanus)*
8. Western osprey (*Pandion haliaetus*)
9. African cuckoo hawk (*Aviceda cuculoides*)
10. Black-winged kite *(Elanus caeruleus)*
11. Yellow-billed kite *(Milvus parasitus)*
12. African fish eagle (*Haliaeetus vocifer*)
13. African harrier-hawk (*Polyboroides typus*)
14. Lizard buzzard (*Kaupifalco monogrammicus*)
15. Dark chanting goshawk (*Melierax metabates)*
16. Little sparrowhawk (*Accipiter minullus*)
17. Black sparrowhawk (*Accipiter melanoleucus*)
18. African hawk-eagle *(Aquila spilogaster)*
19. Martial eagle *(Polemaetus bellicosus)*
20. Crested francolin (*Dendroperdix sephaena*)
21. Red-necked spurfowl (*Pternistes afer*)
22. Crested guineafowl (*Guttera pucherani*)
23. Black crake (*Amaurornis flavirostris*)
24. Black-bellied bustard (*Lissotis melanogaster*)
25. Common ringed plover (*Charadrius hiaticula)*
26. Three-banded plover (*Charadrius tricollaris*)
27. Little stint (*Calidris minuta*)
28. Spotted thick-knee (*Burhinus capensis*)
29. Black-winged stilt (*Himantopus himantopus*)
30. Ring-necked dove (*Streptopelia capicola*)
31. Redeyed dove (*Streptopelia semitorquata*)
32. Emerald-spotted wood dove (*Turtur chalcospilos*)
33. African green-pigeon (*Treron calva*)
34. Brown-necked parrot (*Poicephalus fuscicollis)*
35. Brown-headed parrot (*Poicephalus cryptoxanthus)*
36. Purple-crested turaco (*Tauraco porphyreolophus)*
37. Burchell's coucal (*Centropus burchellii*)
38. Red-chested cuckoo (*Cuculus solitarius*)
39. Klaas's cuckoo (*Chrysococcyx klaas*)
40. Diederik Cuckoo (*Chrysococcyx caprius*)
41. Black Cuckoo (*Cuculus clamosus*)
42. Spotted eagle-owl (*Bubo africanus*)
43. Fiery-necked nightjar (*Caprimulgus pectoralis)*
44. African palm-swift (*Cypsiurus parvus*)
45. Little swift *(Apus affinis)*
66. Cardinal woodpecker (*Dendropicos fuscescens*)
67. Rufousnaped lark (*Mirafra africana*)
68. Flappet lark (*Mirafra rufocinnamomea*)
69. Barn swallow (*Hirundo rustica*)
70. Wire-tailed swallow (*Hirundo smithii*)
71. Mosque swallow (*Cecropis senegalensis*)
72. Fork-tailed drongo (*Dicrurus adsimilis*)
73. Black-headed oriole (*Oriolus larvatus*)
74. Pied crow (*Corvus albus*)
75. Dark-capped bulbul (*Pycnonotus tricolor*)
76. Sombre Greenbul (*Andropadus importunus*)
77. Yellow-bellied greenbul (*Chlorocichla flaviventris)*
78. Terrestrial brownbul (*Phyllastrephus terrestris)*
79. Eastern nicator (*Nicator gularis)*
80. Southern black Tit (*Parus niger*)
81. Arrow-marked babbler (*Turdoides jardineii*)
82. Red-capped robin-chat (*Cossypha natalensis)*
83. White-browed scrub robin (*Erythropygia leucophrys)*
84. African reed-warbler (*Acrocephalus baeticatus)*
85. Marsh warbler (*Acrocephalus palustris*)
86. Yellow-breasted apalis (*Apalis flavida*)
87. Green-backed camaroptera *(Camaroptera brachyura)*
88. Long-billed crombec *(Sylvietta rufescens)*
89. Rattling cisticola (*Cisticola chiniana*)
90. Croaking cisticola (*Cisticola natalensis*)
91. Neddicky (*Cisticola fulvicapilla*)
92. Zitting cisticola *(Cisticola juncidis)*
93. Tawny-flanked prinia (*Prinia subflava*)
94. African paradise flycatcher (*Terpsiphone viridis)*
95. Pale flycatcher (*Bradornis pallidus*)
96. *Southern black flycatcher (Melaenornis pammelaina)*
97. Spotted flycatcher *(Muscicapa striata)*
98. Grey tit-flycatcher *(Myioparus plumbeus)*
99. Woodwards' batis (*Batis fratrum*)
100. Yellow-throated longclaw (*Macronyx croceus*)
101. Red-backed shrike *(Lanius collurio)*
102. Brubru (Nilaus afer)
103. Black-backed puffback (*Dryoscopus cubla*)
104. Blackcrowned tchagra *(Tchagra senegala)*
105. Brown-crowned tchagra *(Tchagra australis)*
106. Southern boubou (Laniarius ferrugineus)
107. Orange-breasted Bushshrike (*Chlorophoneus sulfureopectus*)
108. Gorgeous bushshrike *(Chlorophoneus quadricolor)*
109. Grey-headed bushshrike *(Malaconotus blanchoti)*
110. White-crested helmet-shrike *(Prionops plumatus)*
111. Retz's helmet-shrike *(Prionops retzii)*

46. Speckled mousebird *(Colius striatus)* 47. Common scimitarbill (*Rhinopomastus cyanomelas)* 48. Brown-hooded kingfisher (*Halcyon albiventris)* 49. Striped kingfisher (*Halcyon chelicuti*) 50. Pied kingfisher (*Ceryle rudis*) 51. Blue-cheeked bee-eater *(Merops persicus)* 52. European bee-eater (*Merops apiaster*) 53. Southern carmine bee-eater (*Merops nubicoides)* 54. Little bee-eater (*Merops pusillus*) 55. European roller (*Coracias garrulus*) 56. Lilac-breasted roller (*Coracias caudatus*) 57. Broad-billed roller (*Eurystomus glaucurus*) 58. Crowned hornbill (*Tockus alboterminatus*) 59. Trumpeter hornbill (*Bycanistes bucinator*) 60. Yellow-fronted tinkerbird (*Pogoniulus chrysoconus)* 61. Acacia pied barbet *(Tricholaema leucomelas)* 62. Blackcollared barbet (*Lybius torquatus*) 63. Greater honeyguide (*Indicator indicator*) 64. Lesser honeyguide (*Indicator minor*) 65. Golden-tailed woodpecker (*Campethera abingoni)*	112. Violet-backed starling (*Cinnyricinclus leucogaster)* 113. Amethyst sunbird (*Chalcomitra amethystina*) 114. Southern grey-headed sparrow *(Passer diffusus)* 115. Yellow-throated petronia *(Gymnoris superciliaris)* 116. Lesser masked weaver (*Ploceus intermedius)* 117. Spectacled weaver (*Ploceus ocularis*) 118. African golden weaver (*Ploceus xanthops*) 119. Southern masked weaver (*Ploceus velatus*) 120. Fan-tailed widowbird (*Euplectes axillaris*) 121. Yellow bishop (*Euplectes capensis*) 122. Pink-throated twinspot (*Hypargos margaritatus)* 123. Bronze mannikin (*Lonchura cucullata*) 124. Jameson's firefinch (*Lagonosticta rhodopareia)* 125. Common waxbill (*Estrilda astrild*) 126. Blue waxbill (*Uraeginthus angolensis*) 127. Pintailed whydah (*Vidua macroura*) 128. Long-tailed paradise-whydah *(Vidua paradisaea)* 129. Yellow-fronted canary *(Crithagra mozambicus*) 130. Golden-breasted bunting (*Emberiza flaviventris)*

Photograph 5-15: Lizard Buzzard (Kaupifalco monogrammicus)

Photograph 5-16: Little Bee-eater (Merops pusillus)

5.3.3.2 Species with Special Concern Habitat requirements

According to the IUCN Red List, 51 bird species in Mozambique have “threatened” status (Appendix E). Fifteen bird species that are expected to occur in the area (range and habitat) are considered threatened according to the IUCN Red List:

- Plain-backed Sunbird (*Anthreptes reichenowi*) - IUCN 2014 NT: Near-threatened.
- Malagasy Pond-Heron (*Ardeola idea*) - IUCN 2014 NT: Endangered.
- Chestnut-banded Plover (*Charadrius pallidus*) - IUCN 2014 NT: Near-threatened.
- Pallid Harrier (*Circus macrourus)* - IUCN 2014 NT: Near-threatened.
- European Roller (*Coracias garrulus*)- IUCN 2014 NT: Near-threatened.
- Sooty Falcon *(Falco concolor)* - IUCN 2014 NT: Near-threatened.
- Neergaard's Sunbird *(Cinnyris neergaardi)* - IUCN 2014 NT: Near-threatened.
- Eurasian Curlew (*Numenius arquata)* - IUCN 2014 NT: Near-threatened.
- Lesser flamingo (*Phoeniconaias minor*) - IUCN 2014 NT: Near-threatened.
- Martial Eagle *(Polemaetus bellicosus)* - IUCN 2014 NT: Vulnerable.
- Secretary bird (*Sagittarius serpentarius*) - IUCN 2014 NT: Vulnerable.
- Crowned Eagle (*Stephanoaetus coronatus*) - IUCN 2014 NT: Near-threatened.
- Bateleur (*Terathopius ecaudatus)* - IUCN 2014 NT: Near-threatened.
- Lappet-faced Vulture *(Torgos tracheliotus)* - IUCN 2014 NT: Vulnerable.
- White-headed Vulture *(Trigonoceps occipitalis)* - IUCN 2014 NT: Vulnerable.

5.3.3.3 Species of concern: Habitat availability

Comparing the habitat requirements of the IUCN Red List or Threatened Species with habitat availability in the study area, the following vegetation types have habitat qualities that correspond with the requirements of these birds:

Table 5-12: Habitat availability for bird species of concern in the study area, indicating habitat requirement, and vegetation types with appropriate habitat.

Bird species	Habitat requirements	Vegetation types
Plain-backed Sunbird (*Anthreptes reichenowi*) **IUCN 2014 NT: Near-threatened**	Coastal evergreen forest, mangrove and miombo woodland. Coastal forests, tall Lebombo ironwood. In vegetation, keeping to deep cover. This species is classed as Near Threatened because it is thought to have a moderately small population, which is suspected to be in decline owing to deforestation throughout its range (vegetation clearance along the coast, logging operations inland).	Julbernardia-Brachystegia Woodland and Thicket Habitat Integrity score: 4
		Mixed Woodland and Thicket Habitat Integrity score: 5
Malagasy Pond-Heron (*Ardeola idea*) **IUCN 2014 EN: Endangered**	Small grassy marshes, lakes and ponds, streams. This species is listed as Endangered because it has a very small population which is undergoing a continuing decline because many of its breeding colonies are heavily and increasingly exploited for eggs and young. This exploitation is exacerbated by pressures on its wetland habitats.	Govuro River & floodplain Habitat Integrity score: 4
		Coastal wetlands Habitat Integrity score: 5
Chestnut-banded Plover (*Charadrius pallidus*)	Saline lagoons, saline and brackish pans, salt works; occasionally estuaries and sandy lagoons. Rarely in freshwater habitats. This species has a large range, however, given the specific nature of its habitat requirements, the actual area it occupies is believed to be	Coastal wetlands Habitat Integrity score: 4

Bird species	Habitat requirements	Vegetation types
IUCN 2014 NT: Near-threatened	small, occurring at fewer than ten locations in the non-breeding season; at these sites habitat quality is declining. For these reasons it is evaluated as Near Threatened.	
Pallid Harrier (*Circus macrourus)* **IUCN 2014 NT: Near-threatened**	Open grassveld, cultivated fields, less commonly in open semi-arid savanna. Open pans or floodplains. This species is known to be undergoing steep population decline in Europe, although numbers in its Asiatic strongholds are thought to be more stable. Thus it is probably experiencing a moderately rapid population decline overall, and consequently it is categorised as Near Threatened.	Govuro River & floodplain Habitat Integrity score: 2
		Coastal wetlands Habitat Integrity score: 3
Neergaard's Sunbird *(Cinnyris neergaardi)* **IUCN 2014 NT: Near-threatened**	It is restricted to the coastal belt, mixed woodland away from the coast. Woodland, especially dry, dense forest on sandy soil. It also inhabits coastal scrubland. This species is listed as Near Threatened because it has a moderately small population, which may be in decline owing to the clearance of its native forest habitats. Confirmation of its population size and the severity of habitat loss may qualify the species for a higher threat category.	Julbernardia-Brachystegia Woodland and Thicket Habitat Integrity score: 4
		Mixed Woodland and Thicket Habitat Integrity score: 2
		Govuro River & floodplain Habitat Integrity score: 2
		Coastal wetlands Habitat Integrity score: 4
European Roller (*Coracias garrulus*) **IUCN 2014 NT: Near-threatened**	Woodlands, woodland and grasslands. Open woodland. This species has apparently undergone moderately rapid declines across its global range and it is consequently considered Near Threatened.	Julbernardia-Brachystegia Woodland and Thicket Habitat Integrity score: 4
		Mixed Woodland and Thicket Habitat Integrity score: 3
Sooty Falcon *(Falco concolor)* **IUCN 2014 NT: Near-threatened**	Tropical and subtropical coastal or marshy areas, moist savannas and forest edges. In the non-breeding season it forages for large insects over grassland and open country with trees. It breeds colonially in hot, arid environments; on cliffs, small rocky islands and rugged desert mountains where its breeding is timed to coincide with the autumn migration of small birds on which it feeds. This species has been classified as Near Threatened because it is suspected to have a moderately small, declining population. Detailed surveys and robust monitoring are much desired, and would lead to a clarification of its status.	Julbernardia-Brachystegia Woodland and Thicket Habitat Integrity score: 4
		Mixed Woodland and Thicket Habitat Integrity score: 3
		Govuro River & floodplain Habitat Integrity score: 2
		Coastal wetlands Habitat Integrity score: 4

Bird species	Habitat requirements	Vegetation types
Eurasian Curlew (*Numenius arquata)* **IUCN 2014 NT: Near-threatened**	Coastal wetlands; forages on intertidal mud- and sandflats and roosts on adjoining salt-marshes, sand-dunes, mangroves or rocks. This widespread species remains common in many parts of its range, and determining population trends is problematic. Nevertheless, declines have been recorded in several key populations and overall a moderately rapid global decline is estimated. As a result, the species has been uplisted to Near Threatened.	Coastal wetlands Habitat Integrity score: 5
Lesser flamingo (*Phoeniconaias minor*) **IUCN 2014 NT: Near-threatened**	Shallow eutrophic wetlands, saltpans and sheltered coastal lagoons. Larger brackish or saline inland and coastal waters. This species is classified as Near Threatened because populations appear to be undergoing a moderately rapid decline.	Coastal wetlands Habitat Integrity score: 2
Martial Eagle *(Polemaetus bellicosus)* **IUCN 2014 VU: Vulnerable**	Open grassland and scrub. Large trees for nests. Wide range of vegetation types: deserts, densely wooded and forested areas. This species has been uplisted to Vulnerable because it is suspected to have undergone rapid declines during the past three generations (56 years) owing to deliberate and incidental poisoning, habitat loss, reduction in available prey, pollution and collisions with power lines. Further information on trends across its large range may lead to its further uplisting to Endangered in the future.	Julbernardia-Brachystegia Woodland and Thicket Habitat Integrity score: 4
		Mixed Woodland and Thicket Habitat Integrity score: 4
Secretary bird (*Sagittarius serpentarius*) **IUCN 2014 VU: Vulnerable**	Open country: Savanna, open woodland, grassland and dwarf shrubland. This species is classified as Vulnerable because recent evidence from across its range suggests that its population is experiencing a rapid decline, probably owing to habitat degradation, disturbance, hunting and capture for trade.	Julbernardia-Brachystegia Woodland and Thicket Habitat Integrity score: 2
		Mixed Woodland and Thicket Habitat Integrity score: 2
Crowned Eagle (*Stephanoaetus coronatus*) **IUCN 2014 NT: Near-threatened**	Dense indigenous forest, including riverine gallery forest; may range far from forest to hunt. This species has been uplisted to Near Threatened because evidence of widespread threats suggests that its population is in moderately rapid decline.	Julbernardia-Brachystegia Woodland and Thicket Habitat Integrity score: 3
		Mixed Woodland and Thicket Habitat Integrity score: 3
Bateleur (*Terathopius ecaudatus)* **IUCN 2014 NT: Near-threatened**	Woodland and savanna on open plains, including Kalahari thornveld. Nests usually in canopy or on horizontal fork of large tree, 8-12-16m above ground. Roosts in trees. This species is classified as Near Threatened because it is suspected to have undergone moderately rapid declines during the past three generations (41 years) owing to habitat loss and incidental poisoning and pollution, and is consequently believed to approach the threshold for classification as Vulnerable.	Julbernardia-Brachystegia Woodland and Thicket Habitat Integrity score: 4
		Mixed Woodland and Thicket Habitat Integrity score: 4
Lappet-faced Vulture *(Torgos tracheliotus)*	Savannas, especially in more arid areas; nests and roosts on trees. This species is classified as Vulnerable since only a small, declining population remains, owing primarily	Julbernardia-Brachystegia Woodland and Thicket

Bird species	Habitat requirements	Vegetation types
IUCN 2014 VU: Vulnerable	to poisoning and persecution, as well as ecosystem alterations.	Habitat Integrity score: 2
		Mixed Woodland and Thicket Habitat Integrity score: 2
White-headed Vulture *(Trigonoceps occipitalis)* **IUCN 2014 VU: Vulnerable**	Open country: Savanna, open woodland, grassland and dwarf shrubland. This species has a small population which constitutes a single meta-population as there is presumed to be movement of individuals within its large range. It is listed as Vulnerable because information from across its range indicates that numbers are in decline owing to a variety of threats.	Julbernardia-Brachystegia Woodland and Thicket Habitat Integrity score: 2
		Mixed Woodland and Thicket Habitat Integrity score: 2

*Habitat Integrity scores (how appropriate is the habitat for the species): Poor 1; Low 2;Medium 3; Good 4; Optimal 5

5.3.4 Mammals

Although mammal species diversity is high in the Study Area, populations of these species, especially the larger mammals, have been significantly reduced, inside and outside of protected areas, due to lack of protection during the armed conflict (1981-1992) and subsequent uncontrolled hunting and trapping.

Healthy populations of smaller mammals are, however, present throughout the parts of the study area that are not heavily populated. According to the checklist by Schneider et al (2005), 190 mammal species occur in Mozambique, of which 80-92 species are expected to occur in the region surrounding the Study Area. With new mammal records (especially the bats) the number of expected species increased to 99 species.

5.3.4.1 Surveys on primary habitats

The publications of Skinner and Smithers, (1990), Mills and Hes (1997) and Monadjem *et al* (2010) formed the basis of the distribution data used in this report. Of the 99 mammal species that have distribution ranges in Mozambique that coincide with the Study Area, 98 species are expected to be present under natural conditions. While most of the bats need caves or similar roosting structures that do not necessarily occur in the Study Area, these nocturnal flying mammals are very mobile, flying long distances in search of food, and they are therefore likely to occur regardless of the local availability of roosting sites.

Due to persecution by humans and habitat loss, four of the expected larger game species are probably lost to the area. Thus, the 94 mammal species that survive human impacts more successfully are expected to occur in the study area.

During the February 2014 survey, the signs and/or actual occurrence of 21 mammal species were observed in the survey transects, or were reported in interviews with local inhabitants (See Appendix D for detail). The following mammal species were recorded:

1. Lesser red musk shrew (*Crocidura hirta*)
2. Yellow golden mole (*Calcochloris obtusirostris*)
3. Chacma baboon (*Papio ursinus*)
4. Vervet monkey (*Cercopithecus aethiops*)
5. Large-spotted genet (Genetta tigrina)
6. Slender mongoose (*Galerella sanguinea*)
7. Water mongoose (*Atilax paludinosus*)
8. Bushpig (*Potamochoerus porcus*)
9. Cape common duiker (*Sylvicapra grimmia grimmia*)

10. Suni (*Neotragus moschatus*)
11. Red duiker (*Cephalophus natalensis*)
12. Steenbok *(Raphicerus campestris)*
13. Springhare *(Pedetes capensis)*
14. Cape Porcupine *(Hystrix africaeaustralis)*
15. Common Molerat *(Cryptomys hottentotus)*
16. Red squirrel *(Paraxerus palliatus)*
17. Woodland gerbil *(Gerbilliscus leucogaster)*
18. Spiny mouse *(Acomys spinosissimus)*
19. Pouched mouse *(Saccostomus campestris)*
20. Veld Rat species *(Aethomys ineptus)*
21. Scrub hare (*Lepus saxatilis*)

Photograph 5-17: Lesser red musk shrew (Crocidura hirta)

Photograph 5-18: Chacma baboon (Papio ursinus)

5.3.4.2 Species of concern

According to the IUCN Red List, 19 mammal species in Mozambique have “threatened” status (Appendix E), four of which are marine mammals (dolphins or whales). Three mammal species that are expected to occur in the study area (range and habitat), are considered threatened, and one, the hippopotamus (*Hippopotamus amphibius*),is probably extinct in the study area:

- Dugong (*Dugong dugong*) - IUCN: VU Vulnerable;
- Hippopotamus (*Hippopotamus amphibius*) - IUCN: VU Vulnerable;
- Striped leaf-nosed bat (*Hipposideros vittatus*) - IUCN 2014: Near-threatened; and
- Leopard (*Panthera pardus*) - IUCN (2014): NT Near-threatened.

5.3.4.3 Species of concern: Habitat availability

During the evaluation of the suitability of habitats for the mammal species of concern, the habitat aspects of the biotopes were not evaluated in isolation, but the entire habitat assemblage per vegetation type was assessed. Table 5-13 compares the habitat requirements of the Red Data species with the habitat availability in the vegetation types, indicating which units have habitat assemblages that correspond with the habitat requirements of the threatened mammals:

Table 5-13: Habitat availability for mammal species of concern, indicating habitat requirements, and associated vegetation types with comparable habitats.

Mammal species	Habitat requirements	Vegetation types
Dugong (*Dugong dugong*) **IUCN: VU Vulnerable**	Coastal and Island waters between East Africa and Vanuatu between latitudes of about 27° North and South of Equator. Dugongs are primarily marine mammals. Inhabit shallow waters, depths of around 10 m, occasionally dive to depths of 39 m to feed. Shallow areas typically located in protected bays, wide mangrove channels and in sheltered areas of inshore islands. Seagrass beds consisting of phanerogamous seagrasses - primary source of nourishment, coincide with these optimal habitats. Tidal sandbanks and estuaries that are quite shallow, are potential areas suitable for calving. Because of the uncertainty associated with the assessment of the status of the dugong it is suggested that the classification should remain as Vulnerable.	Coastal wetlands Habitat Integrity score: 5
Hippopotamus (*Hippopotamus amphibius*) **IUCN: VU Vulnerable**	Suitable deep, open, permanent water (deep enough to allow it to submerge totally) with gently sloping sandbanks must be available and adjacent food supplies. Open stretches of permanent water. Temporary resting places during flooding in oxbows or up in tributaries of major rivers.	Govuro River & floodplain Habitat Integrity score: 4 Coastal wetlands Habitat Integrity score: 2
Striped leaf-nosed bat (*Hipposideros vittatus*) **IUCN 2014: Near-threatened**	Dependent on large caves for breeding. Variety of woodland and savanna habitats - arid to moist. Listed as Near Threatened because, although the species is still widely distributed, presumably a large proportion of the global population of this species is found as a few very large cave roosting colonies that are threatened by disturbance, habitat loss and over hunting. It is likely that the species is undergoing significant declines at these sites, however, the global population as a whole is probably declining at <30% over a ten year period.	Julbernardia-Brachystegia Woodland and Thicket Habitat Integrity score: 2 Mixed Woodland and Thicket Habitat Integrity score: 2
Leopard (*Panthera pardus*) **IUCN (2014): NT Near-threatened**	Widespread. Broken country or forests. Nocturnal & solitary. Leopards have a wide range and are locally common in some parts of Africa and tropical Asia. However, they are declining in large parts of their range due to habitat loss and fragmentation, and hunting for trade and pest control. These threats may be significant enough that the species could soon qualify for Vulnerable under criterion A.	Julbernardia-Brachystegia Woodland and Thicket Habitat Integrity score: 3 Mixed Woodland and Thicket Habitat Integrity score: 4

*Habitat Integrity scores (how appropriate is the habitat for the species): Poor 1; Low 2;Medium 3; Good 4; Optimal 5

5.3.5 Summary of all fauna

From the analysis of the faunal distribution data and habitat availability, it is concluded that 29 frog species, 56 reptile species, 275 bird species and 94 mammal species are expected to occur in the study area, a total of 454 animal species. The presence of different faunal groups is obviously dependent on availability of potential habitats in the distinct biotopes.

In order to establish the biodiversity importance of the biotopes in the study area, Table 5-14 was prepared as an estimate the preference of the faunal species for particular habitats. On the basis of Table 5-14, both the Woodland and Thicket biotypes potentially support the most diverse range of terrestrial faunal assemblages (362 and 363 species). The second highest ranking occurs in the Coastal Wetlands with 156 species, followed by the Govuro River and Floodplain (143 species).

Table 5-14: Summary of the faunal groups per habitat.

Biotope	Julbernardia-Brachystegia Woodland and Thicket Mosaic	Mixed Woodland and Thicket	Govuro River & floodplain	Coastal wetlands
Frogs	7	7	29	29
Reptiles	51	51	7	7
Birds	215	213	74	92
Mammals	89	92	33	28
Totals	362	363	143	156
% of total	79%	79%	31%	34%
Red Data species	13	13	4	5

5.3.6 Discussion

5.3.6.1 The vegetation types and associated faunal assemblages

Woodland and Thicket Mosaic

Most of the study area consists of woodland and thicket mosaic (Mixed Woodland and Thicket; Julbernardia-Brachystegia Woodland and Thicket), with the Govuro River flowing through the area, practically separating the two woodland types. The Julbernardia-Brachystegia Woodland and Thicket to the east of the Govuro River share many common features with the Mixed Woodland and Thicket regarding the structure and function of their fundamental habitats.

Figure 5-2: Julbernardia-Brachystegia Woodland-open woodland with patches of denser thickets.

Figure 5-3: Mixed Woodland with the denser thicket on termite mounds.

The more open woodland areas of both these vegetation types will attract woodland fauna that prefer scattered shrubs and medium tall trees, with grass and forbs (herbaceous layer) on sandy soils in between them. There is very little difference between the fauna assemblages that utilise this component in the two different woodland vegetation types (compare Appendices A to D).

The Mixed Woodland and Thicket has potential habitat for 7 frog, 51 reptile, 213 birds and 92 mammal species, of which thirteen are Red Data species. Similarly the Julbernardia-Brachystegia Woodland and Thicket has potential habitat for 7 frog, 51 reptile, 215 birds and 89 mammals, of which thirteen are Red Data species.

The thickets in the two woodland vegetation types differ from each other to some extent. In the Mixed Woodland vegetation type a large percentage of the thickets occur on termite mounds. These termitaria form the base for the thicket, as the soil is rich in nutrients, creating a favourable growth medium for the large trees, woody climbers and a dense shrub layer. Apart from the dense “forest” that the thickets on termite mounds provide, the termitaria themselves provide habitat in the form of a mound in which there are holes and tunnels, especially when no longer occupied by the termites.

Other thickets also occur in the Mixed Woodland vegetation type. These are similar in structure to the thickets that are found in the Julbernardia-Brachystegia Woodland but typically cover larger areas than the termite mound thickets, some of them quite extensive and more than 100 m x 100m. Although they resemble termite mound thickets, they are found on sandy soils, and have an open under-storey and closed canopy, whereas the under-storey of the termite mound thicket is typically cluttered with shrubs and forbs, and the soil is more clayey due to the presence of the termite mound.

While there are slight differences between the faunal assemblages making use of the two thicket types mainly due to the preference of some species for particular soil and vegetation density, both provide pockets of dense foliage that are required by a number of retiring animal species as prime habitat.

There are 28 species that have these dense habitat preferences (refer to Appendices A to D). Although other woodland species may also occur in these sub-habitats, a particular assemblage of animals specifically choose the woodland biotopes due to the presence of the thickets as habitat for sheltering, feeding and breeding. These thicket species are listed in Table 5-15.

Table 5-15: Fauna that requires thicket habitat for their survival (Red Data species in red).

Group	Species
Reptiles	Forest cobra (*Naja melanoleuca*) Green mamba (*Dendroaspis angusticeps*)
Birds	African Broadbill *(Smithornis capensis)* Knysna Turaco *(Tauraco corythaix)*

Group	Species
	Purple-crested Turaco (*Tauraco porphyreolophus*) African Wood Owl *(Strix woodfordii)* Narina Trogon *(Apaloderma narina)* Square-tailed Drongo (*Dicrurus ludwigii)* Red-capped robin-chat (*Cossypha natalensis*) Bearded Scrub Robin *(Erythropygia quadrivirgata)* Red-capped robin-chat (*Cossypha natalensis*) Marsh Warbler *(Acrocephalus palustris)* Rudd's Apalis *(Apalis ruddi)* Green-backed Camaroptera *(Camaroptera brachyura)* Grey-backed Camaroptera *(Camaroptera brevicaudata)* AfricanParadise Flycatcher (*Terpsiphone viridis*) Grey Tit-Flycatcher *(Myioparus plumbeus)* Gorgeous Bushshrike *(Chlorophoneus quadricolor*) Pink-throated Twinspot *(Hypargos margaritatus)* Plain-backed Sunbird *(Anthreptes reichenowi)*
Mammals	Thick-tailed bush baby (*Otolemur crassicaudatus*) Grant's bushbaby (*Galagoides granti)* Suni (*Neotragus moschatus*) Red duiker (*Cephalophus natalensis)* Sun squirrel (*Heliosciurus mutabilis)* Red squirrel (*Paraxerus palliatus*) Mozambique woodland mouse (*Grammomys cometes)* Four-toed elephant-shrew (*Petrodromus tetradactylus tetradactylus*)

The thicket fauna assemblage is also the group that frequents the Coastal and Dune Forests, both being habitats with dense woody vegetation and closed canopies. Although the forests are the favoured habitat of the Near–threatened Crowned Eagle (*Stephanoaetus coronatus*), it ranges far from these areas to hunt. The Near-threatened Plain-backed Sunbird *(Anthreptes reichenowi)* occurs in the deep cover of the vegetation and will move away should the thicket habitat be compromised.

Woodland and Mixed Woodland

The Julbernardia-Brachystegia Woodland and Mixed Woodland (excluding the thickets) provide habitat for typical woodland species on a sandy substrate. The two woodland vegetation types are very similar in structure and function, with the main difference being that the Julbernardia-Brachystegia Woodland tends to be a more open.

Most of the Red Data species (Appendix E) favour the open savanna-like woodland habitat, which is enhanced by pockets of thicket (shelter prey, provide perches, provide shade). The savanna Red Data fauna include two vultures, the Lappet-faced Vulture (*Torgos tracheliotus*) and the White-headed Vulture (*Trigonoceps occipitalis*), and the aerial raptors, which include the Bateleur (*Terathopius ecaudatus*), Pallid Harrier (*Circus macrourus*), Martial Eagle (*Polemaetus bellicosus*), Crowned Eagle (*Stephanoaetus coronatus*) and Sooty Falcon (*Falco concolor*). The European Roller (*Coracias garrulus*) also prefers the more open areas with perching trees while the Secretary bird (*Sagittarius serpentarius*) hunts in the grassy areas between the trees.

Not many Red Data mammal species are found in the woodlands of the area, and it is only the Striped leaf-nosed bat (*Hipposideros vittatus*) and the secretive Leopard (*Panthera pardus*) that probably occur in small numbers in the denser, more isolated parts of the study area. A troop of baboons was observed in the study area in a dense, isolated patch of untransformed woodland in the Julbernardia-Brachystegia Woodland close to the coast, which is a rare sighting for the Inhassoro region. It is also apparent that the density of small game species is higher in the eastern part of the Study Area towards the coast than in the remainder of this particular vegetation type.

Govuro River Wetlands and Floodplain

The Govuro River and floodplain is the largest wetland in the area and most of the fauna to be found in the other wetlands will also occur here, except certain Mangrove species. The fauna species include 29 frog, 7 reptile, 74 birds and 33 mammal species which will be able to survive in this wetland habitat.

Four Red Data species probably occur here. The only Red Data reptile, the Zambezi flat-shelled terrapin (*Cycloderma frenatum*), is expected to occur. Moving between habitats, the Red Data raptors, the Pallid Harrier (*Circus macrourus*) and Sooty Falcon (*Falco concolor*), also utilize all the different wetland areas. The status of the Hippopotamus (*Hippopotamus amphibius*) in the river is uncertain, but a recent update of its status reads (IUCN, 2014): "Despite the civil strife in the 1980s and 1990s, a surprising number of hippopotamus appear to have survived in Mozambique. The species is still widely distributed and present on most river systems. Threats to the species exist through human-wildlife conflict due to crop raiding."

Barrier Lakes, Ephemeral Drainage Line and Coastal Streams

Barrier Lakes, Ephemeral Drainage Line and Coastal Streams are all wetlands with different aspects of habitat. These sensitive habitats were combined under 'wetlands' due to the fact that they were not all considered initially when the project was proposed. The summer survey has shown that there may be reason to separate them with respect to faunal habitats, but this will be confirmed in the winter survey.

On the basis of the summer season analysis, the wetland biotopes contained suitable habitat for 29 frog, 7 reptile, 92 birds and 28 mammal species. Five Red Data species are expected to occur. Expected Red Data fauna include the Zambezi flat-shelled terrapin (*Cycloderma frenatum*), as well as the Red Data raptors, the Pallid Harrier (*Circus macrourus*) and Sooty Falcon (*Falco concolor*). There is a moderate possibility that the Near-threatened Lesser flamingo (*Phoeniconaias minor*) visits these wetlands, especially the Barrier Lakes (Harrison, et al, 1997). The status of the Hippopotamus (*Hippopotamus amphibius*) in the area is uncertain, although good habitat for the species exists in the wetlands.

Although the mangroves were not included in the intensive surveys, it is clear that this biotope is functionally linked with the study area. Figure 5-4 shows the main mangrove area and the Coastal Streams on land.

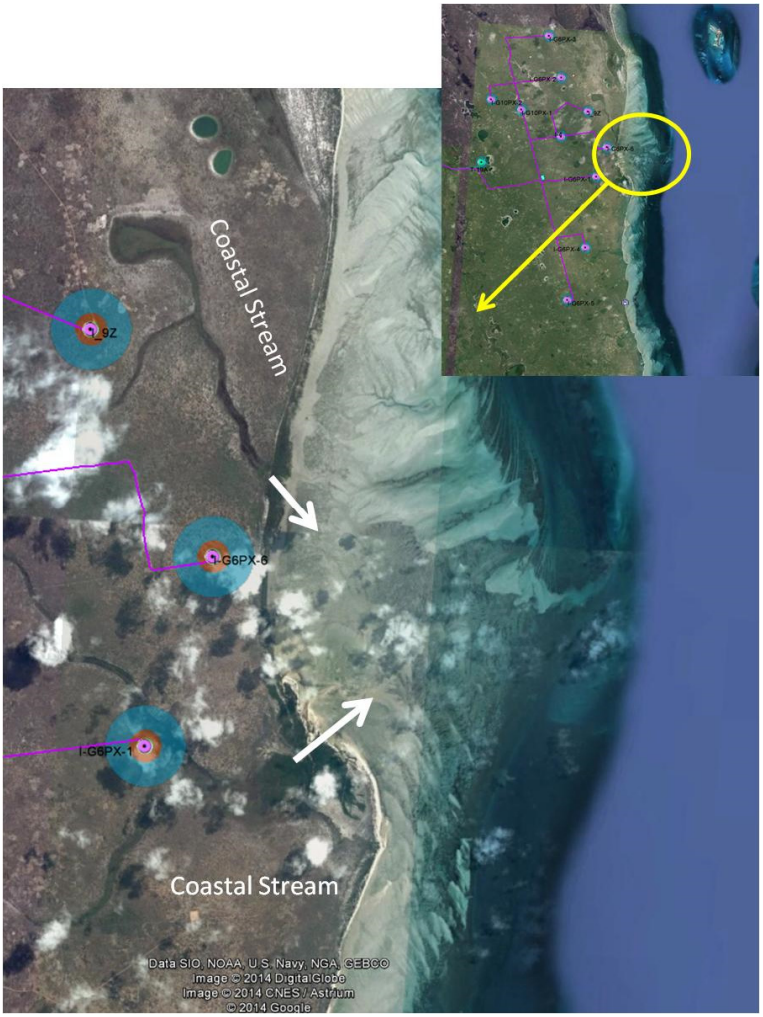


Figure 5-4: The main mangrove area and the Coastal Streams on land.

It is evident that the Coastal Streams on land have had an influence on the extent of the main Mangrove in the area by supplying sediment and nutrients to the coastal area for centuries. Most of the coastal streams in the study area are in pristine or near pristine condition and their ecological status is likely to have a direct influence on the the ecological integrity of the downstream Mangrove swamps. Thus the coastal streams also have a high functional status as they play a crucial role in maintaining the large and species rich Mangrove forest communities within their estuaries, which represent the largest remaining Mangrove forests along an approximately 90km stretch of coastline (De Castro and Retief, 2014).

Apart from the extensive mud flats with thousands of freshwater and marine wader birds feeding here, the deeper water of the Mangrove Swamps is a favourable habitat for the Red Data marine mammal, the Dugong (*Dugong dugong*). This mammal inhabits shallow waters at depths of around 10 metres. The shallow areas that are located in the protected bays, wide mangrove channels and sheltered areas along the coast adjacent to the study area, are prime habitat for these threatened species.

5.3.7 Human Impact on the local ecology

The woodland areas are utilised by the local inhabitants living in the district. Large areas have been influenced by these inhabitants and their survival strategies. Most of them rely on natural resources for their livelihoods. Subsistence agriculture is widely practiced, with the sale of products only taking place when households have surplus production. Slash-and-burn activities are common, involving the removal of indigenous vegetation to make way for cultivation, to maintain pastures for livestock, or to drive game to positions where they can easily be hunted.

The secondary vegetation of previously cultivated areas is characterised by pioneer species and other species indicative of disturbance. In the more advanced stages of secondary succession, trees and shrubs gradually replace the herbaceous vegetation and the secondary vegetation begins to resemble the surrounding climax vegetation.

Figure 5-5: The clearing of Julbernardia-Brachystegia Woodland for the establishment of agricultural fields.

Figure 5-6: The clearing of Mixed Woodland and thicket for the establishment of agricultural fields

In order to survive, the local inhabitants make use of all of the services provided by the natural environment, and hunting and trapping is widespread across the entire area (Photograph 5-19 to 5-21). Plant products are also used extensively, and trees that are cut down as fuel and sold as fire wood (Photograph 5-22), together with the production of charcoal, take a heavy toll on the environment, especially around the villages and towns.

Photograph 5-19: A hunter with his rifle returning home with an African hawk eagle and a Crested guineafowl.

Photograph 5-20: A log trap for smaller animals such as duiker, cane rats and game birds.

Photograph 5-21: Another hunter with a rifle returns to home with five steenbuck on his bicycle.

Photograph 5-22: Wood collected in the Miombo for selling.

5.3.8 Areas with lower impact - "Untransformed habitats"

Land can become less suitable as habitat even if it is not directly converted to other uses. When actions such as urban development, rural development, industry and infrastructural development carve large sectors of land into fragments, the undeveloped parcels may be too small or isolated to support viable populations of species

that thrived in the larger ecosystems. This process, which is called habitat fragmentation, reduces biodiversity by:

- Splitting populations into smaller groups, which may be less viable because it is harder for the isolated individuals within the groups to defend themselves or find mates
- Increasing crowding and competition within the fragments
- Reducing species' foraging ranges and access to prey and water sources
- Increasing friction between animals and humans as animals range into developed areas.

To establish zones of intact habitats for the fauna identified in the study area, a Google Earth aerial image was used to plot polygons of areas with a) high population density and extensive vegetation clearing for lands, and b) moderate population density and moderate vegetation clearing for lands. The areas not demarcated were then categorised as “Untransformed habitats” 1 to 4 (Figure 5-7).

In the areas considered to be untransformed, varying levels of utilisation by the local people probably occurs but adequate suitable habitat is available for most of the expected animal species. These areas can be listed as follows:

- *Untransformed Habitat 1*: Govuro River and floodplain, Barrier Lakes
- *Untransformed Habitat 2*: Mixed Woodland and thicket
- *Untransformed Habitat 3:* Julbernardia-Brachystegia Woodland and thicket, as well as Coastal and Dune Forests, Coastal Streams and Mangroves
- *Untransformed Habitat 4*: Coastal Stream.

The *Untransformed Habitat 1* which incorporates the Govuro River, is heavily utilized along the fringes where the land is not inundated, but the extensive floodplain and large instream area prevent settlement and the area is therefore to a large extent un-impacted, apart from subsistence fishermen and reed gatherers. This area also includes some Barrier Lakes to the east of the river, and is intact enough to provide habitat for all the fauna expected in the wetland type.

The *Untransformed Habitat 2* covers roughly half of the Mixed Woodland and thicket vegetation type in the Study Area containing this vegetation type (Figure 5-7). This area is large enough and sufficiently intact to provide habitat for all of the fauna expected in this vegetation type.

The *Untransformed Habitat 3*, which incorporates roughly a third of the Julbernardia-Brachystegia Woodland and Thicket Mosaic in the study area, also includes Coastal and Dune Forests, Coastal streams and a large Mangrove Swamp at the coast. The area is able to serve as adequate habitat for all the animal species that are expected for the Julbernardia-Brachystegia Woodland and Thicket vegetation type. Certain woodland areas are still so intact that larger mammals are abundant here, including the only baboon troop in the region.

The wetlands in this *Untransformed Habitat 3* offer excellent habitat for 29 frog, 7 reptile, 92 birds and 28 mammal species. Five Red Data species could occur here, including the vulnerable Dugong (*Dugong dugong*) in the mangrove areas.

The smaller *Untransformed Habitat 4* includes a Coastal stream with pristine, intact, habitats.

The combination of Julbernardia-Brachystegia Woodland and Thicket and the different wetland types to the east increases the number of animal species, as woodland and wetland species occur in the same *Untransformed Habitat* section. The favourable combination of untransformed woodland and thicket and various wetland types results in a high expected fauna assemblage of 29 frog, 56 reptile, 275 bird and 99 mammal species, practically all of the species expected in the entire study area.

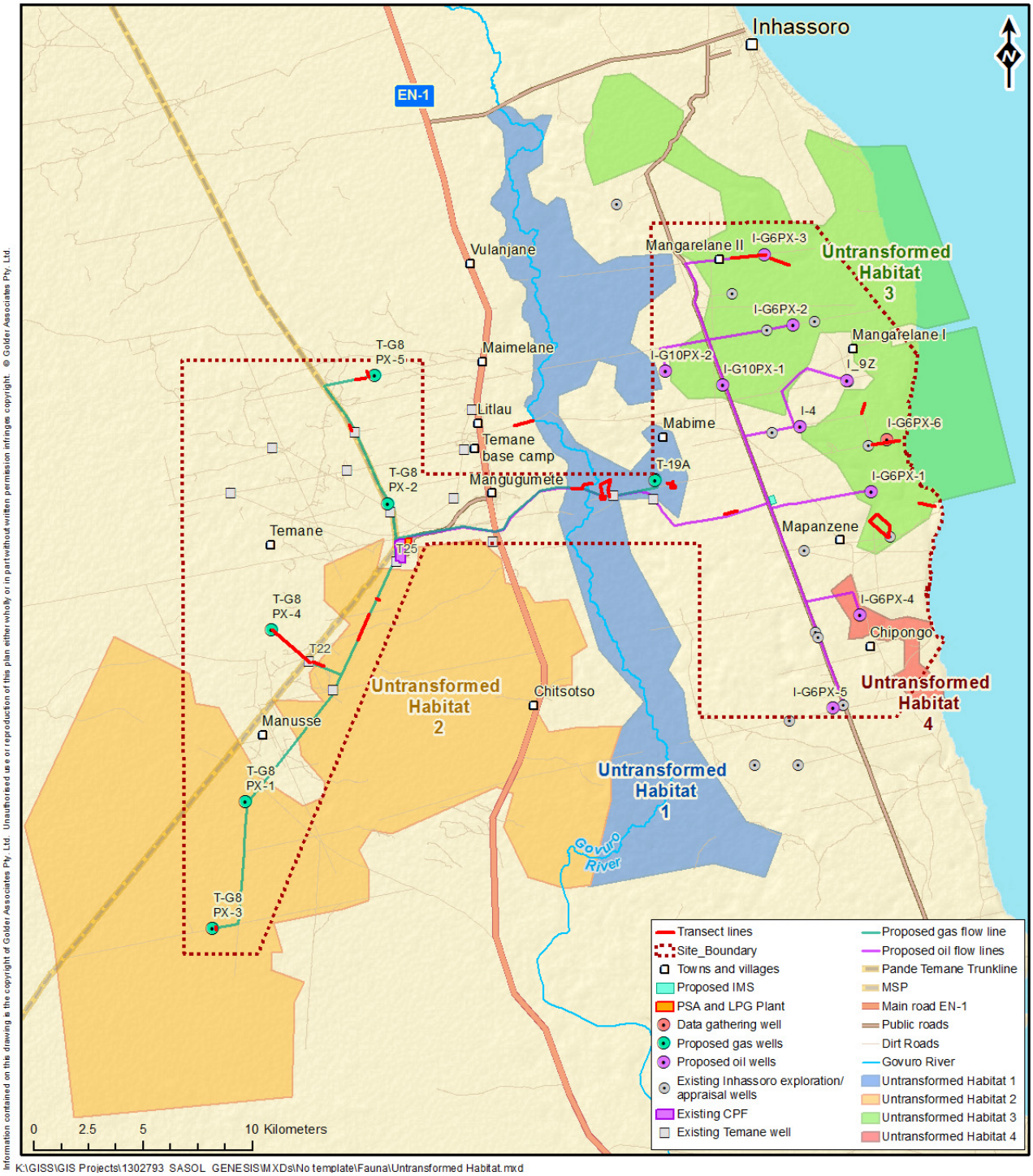


Figure 5-7: Areas with lower population density that are not extensively utilized, demarcated into four zones of "Untransformed Habitats".

6.0 PROJECT IMPACTS

6.1 Construction Phase Impacts

The construction phase is regarded as a specific period of time rather than the consequences of actions relating to construction. Hence, construction impacts end when the construction phase is over and even if there are residual effects later, these are considered to be operational phase impacts.

6.1.1 Impact of the wells and flowlines

6.1.1.1 Impact of Loss of Habitat

Of the 19 oil and gas wells, fifteen will be on new well pads, each covering an area of 1 ha. For the construction of the flowlines, 88.8 km of the total of 111.1 km will be constructed adjacent to existing access roads (Figure 6-1). Along these roads, the amount of bush clearing that will be necessary will be limited to a narrow additional strip to accommodate the flowline, probably not in excess of 10 m wide.

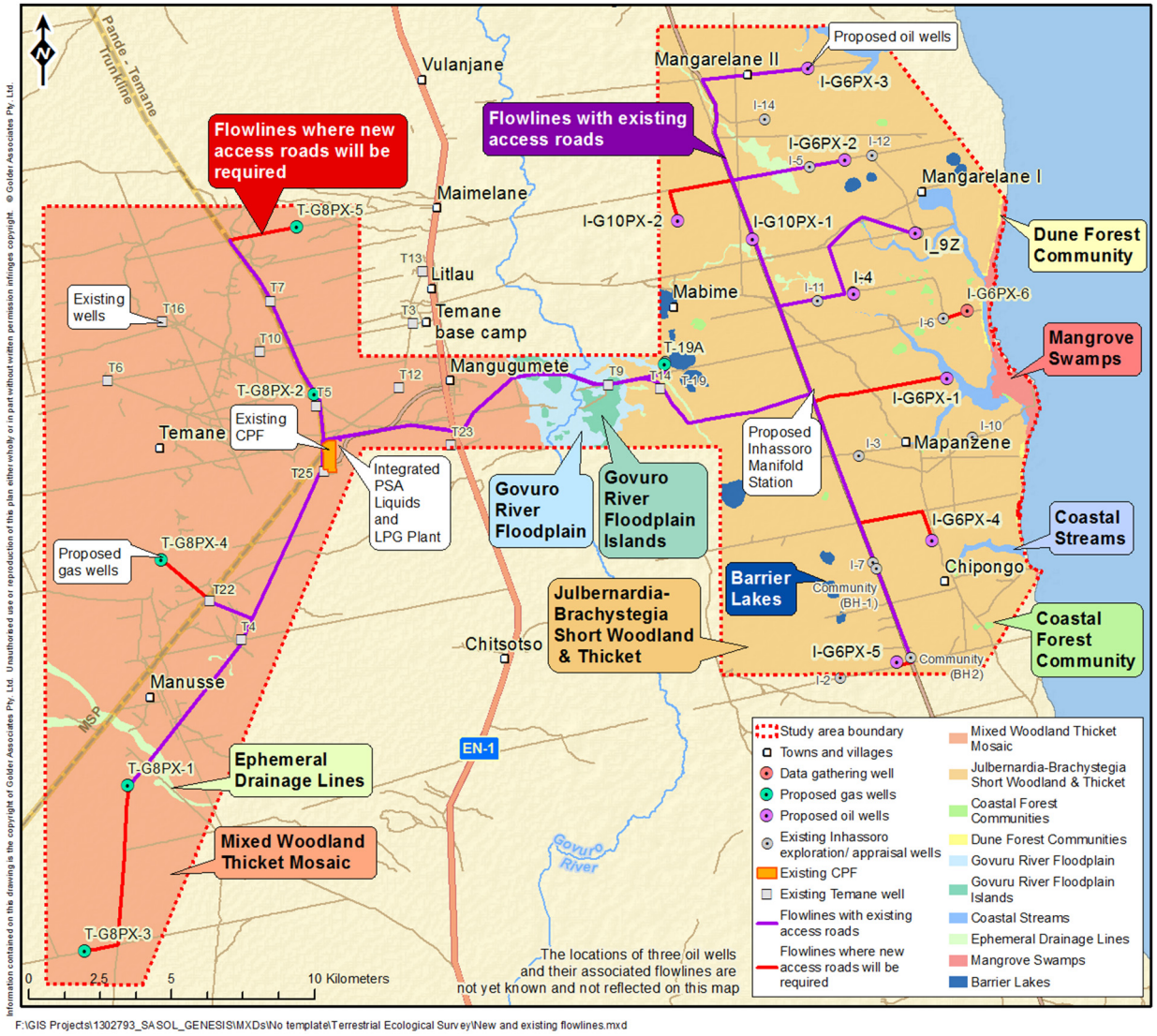


Figure 6-1: Flowlines where new access roads will be required

Taking the above into account, it is estimated that a total area of approximately 133.4 ha will be disturbed by construction of the well pads and flowlines, of which approximately 98 ha will be untransformed vegetation. The remainder will be areas of existing or recent cultivation.

The assessment of habitat impact (removal of vegetation) relates to the value of the structural component of the vegetation as habitat for fauna, and does not consider the species composition of the vegetation removed. The species composition and threatened status of the vegetation is addressed in Specialist Study 9, *Botanical Diversity and Habitat*. The loss of habitat is minimal in relation to the total area of similar habitat within the study area and in the region, representing a small fraction of one percent of such habitats available to fauna. It is also evident from the field survey that the narrow band of lost habitat will easily be bridged by fauna and will not create a barrier that influences the distribution of species. While the area of habitat under the new roads (22.3 ha) will be permanently lost, or at least lost for the lifetime of the project, the habitat affected by the new flowlines will recover to a condition which is suitable for use by fauna.

The severity of the direct impact of wells and flowlines on fauna is therefore low and the overall direct effect of a reduction in habitat availability on the occurrence and diversity of fauna is likely to be of low significance.

6.1.1.2 Impact of Faunal Disturbance (Noise and Dust)

Construction will involve a range of disturbing activities including earth moving, civil works, drilling, pipe-laying, welding and testing. Nuisance - related impacts will include dust, noise and vibration. These impacts may cause local impacts on species for a short period but none of these effects are likely to result in more than a temporary decline in populations of the more nuisance - sensitive species (small antelope, raptors and nesting bird species) close to the sites. It is expected that these animals will re-establish in the area once the construction teams have finished work.

On the basis of the field survey, no sites were identified that are particularly sensitive to nuisance, such as breeding colonies of bats, habitat providing limited roosting sites for birds, caves or other habitats which are highly restricted and which if unavailable to wildlife due to construction nuisance could result in breeding failures. Most of the construction will take place in areas where access has already been created and where wildlife is accustomed to the presence of humans. Given the short term nature of the activities (1-2 months per well and a similar period along sections of flowline), the unmitigated significance of this impact is considered to be low. Careful management of construction activities, such as dust suppression on the roads, directional lighting at camp sites and other standard construction management measures to minimize unnecessary nuisance will further reduce the impact to negligible levels of significance.

6.1.1.3 Impact of Construction-related Pollution

The construction teams employ a range of materials that could result in pollution if released into the natural environment or result in the generation of wastes. These may be general, hazardous, or problem wastes. Hazardous waste is defined as waste that has potential, even in low concentrations, to have significant adverse effects on public health and/or the environment on account of its inherent chemical and physical characteristics, such as toxic, ignitable, corrosive, carcinogenic and other properties (*DWAF, 1994*). Problem wastes have been classified for the purpose of this assessment as those that are not necessarily hazardous, but which require special management and disposal. The general wastes are primarily dry, and are suitable for incineration on site. This type of waste is not considered to be a threat to fauna.

At the drilling sites, waste will include all three categories - general domestic waste, used oil/diesel, rig wash and contaminated storm water, drill cuttings, drilling mud and mud additives, process water, used oil/diesel/hydraulic fluids, acids/surfactants/cleaning solvents, batteries, pesticides and paint. The completion of a well also involves the ignition of well fluids in a burn pit on the well pad. Along the flowlines wastes will include domestic waste, possibly some waste oils and lubricants, welding waste, off-cuts from pipe shimming and packaging waste (paper, cardboard, wood). During commissioning of the flowlines, hydrotest water will be produced which is likely to include corrosion inhibitors and biocides, both of which can be toxic and can result in mortality of aquatic fauna if released into the natural environment.

All hazardous substances and waste used during construction will be managed according to Sasol's standard construction management requirements for new facilities, which are contained in the Construction EMP's for the wells and flowlines (SPT, 2006: SPT, 2006a) The hazardous materials and waste management requirements in these EMP's are designed to minimize the impact of construction to levels of low significance. They have also been thoroughly reviewed for the purposes of the current EIA, information about which is contained in Specialist Study 8, *Waste*.

Sasol has been extensively involved in the construction of access roads, exploration wells and flowlines over the last 10 years, both inside and outside of the Area of Direct Influence of the current project. The evidence along this infrastructure supports the conclusion that the Construction EMPs have provided appropriate

management tools for minimizing pollution risks - no evidence was found of significant, medium or long term pollution impact on faunal populations that has resulted from pollution caused by past construction or drilling campaigns. No residual pollution was observed anywhere within areas where Sasol has been actively engaged with exploration and production.

Thus, subject to the implementation of the requirements of the construction EMP's, as amended by the current study, the risk of pollution-related impact of construction on surrounding faunal populations is considered to be of low significance (moderate significance assumed in the absence of mitigation, which consists of the measures set out in the construction EMP's as amended by the present study).

It is noted that this assessment does not include for the potential impacts associated with a major accident, where large quantities of oil are lost due to a blowout during construction of a well. This potential impact is considered elsewhere in the oil spill risk assessments (Specialist Studies 7 and 8).

6.1.1.4 Impact of Hunting and Persecution

The presence of construction teams is a possible cause of wildlife mortality mainly to the extent that the teams are not appropriately managed and construction personnel either hunt wild animals for food or sale, or persecute them. The latter applies particularly to reptiles, which are killed by site personnel unless specific measures to prevent this are encouraged and enforced through the construction EMP. At all sites, bush clearing may expose those wild animals that tend to hide rather than flee, in which case the animals are often killed, either by the bulldozers or, if dangerous, by the construction teams themselves. Of these animals, the most significant and likely loss would probably be the African Python *(Python natalensis)*, which is a Protected species. Instances of both the death and rescue of African Pythons were recorded during the construction of the Mozambique Secunda Pipeline (MSP), together with other reptile species such as the Mozambique Spitting Cobra (*Naja mossambica*) and Forest cobra (*Naja melanoleuca)* (personal communication, Mark Wood, March 2014).

Hunting, snaring or trapping of wildlife is usually closely related to the presence of construction camps. It is less likely when personnel are brought to site each day. In the present case, no new construction camps will be established since Sasol plans to house most of the construction personnel at the CPF. This camp is very tightly controlled and the decision to use if for construction purposes will minimise the risk to wildlife. Sasol has also encouraged its staff not to kill snakes, which are a common occurrence at the CPF, and a number of staff members are trained to capture them, and later release them back into the wild. These staff members could be used to assist in the rescue of any wildlife caught in the trenches or exposed as a result of bush clearing, or could assist in the training of contract staff to do the same.

From a population point of view, these impacts have little significance if unmitigated, since Red Data species are unlikely to be involved (none found during the field surveys), but they nevertheless warrant management to minimise mortality of all species as far as reasonably possible. The unmitigated impact is considered to be of moderate significance. The current Sasol C-EMP prohibits hunting or persecution of wild animals. Subject to the enforcement of the requirements of the EMP and the ongoing education of personnel during the course of the contract about wildlife conservation, the potential impact on wildlife should be of negligible significance. It is noted, in particular, that efforts to create a culture of understanding and interest in wildlife conservation among project personnel proved highly effective on the MSP project, resulting in the rescue of many animals that would otherwise have been killed.

Photograph 6-1: African python killed by construction workers along the Mozambique Secunda Pipeline

Photograph 6-2: Hunter with two Red Duiker

6.1.1.5 Impact of Road and Open Trench Kills

Occasional wild animal deaths have been recorded in previous Sasol construction contracts as a result of collisions with vehicles. These are uncommon and in the Study Area are unlikely to be significant as long as speed limits are enforced. In the case of the flowlines, there is also a potential risk to small mammals, frogs and reptiles as a result of being trapped in the open trench – many instances of animals caught in the flowline trenches have been recorded in Sasol's previous pipeline projects in Mozambique. At a population level, these impacts are of low significance but they warrant mitigation since unnecessary mortality is caused that can easily be circumvented. The current Sasol c-EMP does not mention trench kills and the requirement to conserve wildlife should be extended to make reference to the rescue of animals trapped in the flowline trenches.

6.1.1.6 Impact of Bush Fires

There is an increased risk of bush fires as a result of construction personnel in the study area, the likelihood of which is mainly related to the management of smoking. The effect of bush fires may extend far beyond the boundaries of the site and at the wrong time of year may seriously impact on habitat availability for wild animal species, causing mortalities due to starvation. Most species are attuned to natural fires and populations are not significantly affected by individual deaths, but repeated burns and at the wrong time of the year can have an impact on slow moving animals (tortoises, chameleons, snakes, etc.) and grazing capacity of the field cover, impacting on herbivores.

The risk to wildlife caused by bushfires is of moderate significance and can be reduced to low or negligible significance as long as contract teams are trained in this regard and a restriction is placed on areas in which smoking is permitted. These requirements are already included in the existing Sasol Construction EMP. Personal communication with the Environmental Manager responsible for much of the past construction work east of the Govuro River indicates that the C-EMP has been effective in this regard and that no bush fires as a result of actions by construction employees were recorded during any of the construction contracts in this area (personal communication Ms M Cosijn, February 2014).

6.1.1.7 Impact on Red Data Fauna and Sensitive Habitats

No terrestrial Red Data fauna were found in the field surveys for the project. While it is expected that Red Data fauna will occur within the Study Area, as described in Chapter 5, there are no known Red Data species localities in the Study Area that will be impacted by the project and that would warrant a change in the location of the wells, flowlines or access roads. Since much of the proposed road infrastructure already exists, the additional impact of adjacent flowlines and wells will be relatively minor and construction is very unlikely to impact directly on Red Data species.

With regard to sensitive habitats, the direct impact of the proposed PSA roads, wells and flowlines will be of low significance, with the exception of a few localized areas, such as clusters of large trees around termite mounds and remaining patches of dense forest, which create micro environments that are species - rich faunal habitats. Table 6-4 defines the areas (refer also to Specialist Study 9). While the direct construction - related impacts on fauna within these areas will involve a fairly small footprint, it will result in impacts of moderate significance (refer to indirect impacts in Section 6.3.2.)

Table 6-1: Proximity of proposed Wells and Flowlines to Sensitive Habitats

Project Infrastructure	Sensitive Habitat
T-G8PX-2	Well footprint within untransformed short closed woodland
T-G8-PX5	Well located in untransformed short thicket and forest patches
T-G8PX-3	Well located in dense Short Thicket and a patch of Tall Forest on a termite mound
I-G6PX-5	Well located in untransformed closed woodland and short thicket
I-G6PX-6	Located in primary Short Closed Woodland and dense Short Thicket within 630 m of the coast
I-G6PX-1	Located in untransformed Short Thicket within 150 m of a short coastal stream
IMS	Located in primary thicket.

6.1.2 The PSA Liquids and LPG Plant and the 5th Gas Train

6.1.2.1 Impact of Loss of Habitat on Faunal Populations and Red Data Species

Although the CPF's facilities will be expanded to provide the required additional processing capacity, the new equipment for the 5th gas train (and 'standalone' LPG Plant, if built) will be located within the boundaries of the existing CPF fence line and no habitat loss will result. The PSA Liquids plant is proposed immediately adjacent to the CPF, on the eastern boundary, and will result in the loss of approximately 9.5 Ha of Mixed Woodland Thicket. There are no sensitive habitats within this area, which is directly adjacent to the existing CPF and is sandwiched between the CPF boundary, the EDM power generation facility and two access roads. No threatened species were identified or are expected to occur. Regarding the more reclusive species, the area is impacted by its proximity to the existing industrial facilities and dense rural settlement to the east. The location of the new plant is therefore ideal from the point of view of minimizing impact on fauna.

The severity of faunal losses that are likely to result from the clearing of this habitat will be low and the impact is considered to be of low significance.

6.1.2.2 Impact of Faunal Disturbance, Hunting and Persecution

The large construction teams working on site and accommodated at the CPF will increase human presence in the local area. This may result in the more sensitive species moving away until construction is complete. In the absence of risk to breeding success of Red Data species, this issue is of negligible significance. Construction activities will be well contained, being within the fenced area of the new plant footprint. Personnel accommodation will be within the existing fenced area of the contractor's. Assuming induction of construction workers regarding the preservation of fauna and control over activities such as setting of snares, the construction teams are unlikely to significantly impact on fauna around the CPF and the mitigated impact will be of negligible significance.

6.1.2.3 Impact of Construction-related Pollution

Reference is made to the assessment in Section 6.2.1.3. Construction at the CPF is managed by a separate c-EMP which is similar in purpose and content to the Environmental Management Plans that control impacts at drilling sites and along access roads and flowlines. Subject to appropriate management of hazardous materials and wastes, as set out in the existing c-EMP, pollution risks to surrounding faunal populations are

likely to be negligible. Subject to implementation of the c-EMP, the pollution-related impact of the construction of the new plant on surrounding fauna is therefore expected to be of negligible significance.

6.2 Operational Phase Impacts

6.2.1 Impact of the Wells and Flowlines

6.2.1.1 Impact of Ongoing Operations

The wells and flowlines operate from day to day with little maintenance required. Each operating well is surrounded by a security fence and is occupied by a guard (Photograph 6-3). The operating wells do not generate significant noise and have no material impact on fauna in the surrounding area.

Evidence along the existing flowlines shows that they rehabilitate well, leaving only the gravel access road as a permanent disturbance (Photograph 6-4). The infrequent traffic along these roads means that the risk of animal mortality is extremely low, and the roads do not act as a deterrent to animal movement, even for small invertebrates. The occasional presence of a vehicle and a small maintenance team along the flowlines and at well sites is unlikely to have any significant direct impact on the occurrence of fauna.

No impacts on fauna has been recorded in the ESO reports for the CPF over the past 10 years and this situation is unlikely to change as a result of the production facilities.

Photograph 6-3: Guards at the T-9 well pad

Photograph 6-4: Rehabilitation along a buried flowline from a Temane well to the CPF

6.2.1.2 Indirect Impact caused by Improved Access

Improved access encourages settlement. Roads provide a vital means of expanding agriculture into areas that were previously too remote to cultivate. The typical pattern of clearing for agriculture is to burn the vegetation, with the ash providing a short term nutrient boost in the soils. This results in habitat loss, and a corresponding reduction in wildlife. In addition, in areas where new access for the project penetrates more remote habitats (Figure 6-2), wildlife becomes more vulnerable to hunting, and the game favoured by local hunters diminishes. A list of species that are most intensively hunted is provided in Table 6-5, but almost any animals that can provide protein are killed, as evidenced by the African Hawk Eagle shot by a local Inhassoro hunter in Photograph 5-19.

This is not a significant issue where good roads exist. Much of the Study Area is already accessible, taking into consideration the EN-1, the extensive network of roads to Sasol's production and exploration wells east and west of the Govuro River and the road along the Mozambique Secunda Pipeline. Only 21 % of the 105.5km of road required by the project will need to be newly constructed (refer to Figure 6-1), which is indicative of the generally good existing access. This will reduce the indirect impact of project access on fauna to low levels of significance for most of the study area.

However, there remain some areas which are relatively remote and where wildlife has escaped overexploitation. This is particularly true of the isolated eastern section of the critical habitat shown in Figure 6-2, which includes Coastal Forest and Dune Forest communities, the largest of the Coastal Streams in the study area and Mangrove Swamps at the river mouth. The presence of Chacma baboons (sighted) and leopard (reported) in this area between Mangarelane 1 and Mapanzene during the field studies, is indicative of the sensitivity of this area, since these species are only found in places which afford reasonable protection from humans. Table 6-5 describes these and other species that are particularly vulnerable to hunting and persecution.

In this section of the study area, the new access shown in Figure 6-1 will cause long term indirect impact on terrestrial and aquatic fauna that is likely to be of high significance. Table 6-6 describes the type of activities that better access into this area will promote.

Table 6-2: Wildlife vulnerable to hunting

Expected Fauna in the Study Area	Reason for Threat
Freshwater Crustacea	Hunted for food (crabs and prawns).
Fish (all types)	Used as food, dried, smoked or fresh; smaller species are used as bait to catch larger fish.
Edible bullfrog (*Pyxicephalus edulis*)	Hunted for food. Probably the only frog species to be locally utilized as food.
Sea turtles (visit the coast to breed)	Hunted for food. Eggs are dug up and eaten. Turtle shells may be sold.
Nile crocodile (*Crocodylus niloticus*) and Southern African python (*Python natalensis*)	Persecuted as vermin. The skins and meat are sometimes used.
Snakes (in general)	Persecuted out of fear.
Tortoises	Hunted for food, easily caught.
Birds (especially ducks, guineafowl, francolin, doves)	Hunted for food. Virtually all bird species are hunted (large and small), mostly by trapping and shooting.
Vultures	Used as muti (medicine).
Baboons, monkeys and bush babies	Hunted for food. Baboons and monkeys are persecuted for raiding crops and stealing food.
Leopard (*Panthera pardus*) and serval (*Felis serval*)	Persecuted as vermin for catching livestock. The skins are sometimes used.
Jackal	Persecuted as vermin for catching livestock.
Genet, civet and mongoose	Persecuted as vermin for catching livestock. The skins are sometimes used.
Bushpig (*Potamochoerus porcus*) and warthog (*Phacochoerus aethiopicus*)	Hunted for food.
Hippopotamus (*Hippopotamus amphibius*)	Hunted for food and due to their habit of raiding crops
Dugong (*Dugong dugong*)	Hunted for food. They often drown in fishing nets.
Small game (eg: duiker, steenbuck)	Hunted and snared for food.
Larger game (eg: antelope such as nyala, impala, kudu, bushbuck and reedbuck).	Hunted and snared for food.

Expected Fauna in the Study Area	Reason for Threat
Pangolin (*Manis temminckii*) and antbear (*Orycteropus afer*)	Hunted for food and as muti.
Cape Porcupine *(Hystrix africaeaustralis) and* Greater cane rat *(Thryonomys swinderianus)*	Hunted for food.
Small rodents	Hunted for food in times of need.
Scrub hare (*Lepus saxatilis*) and Giant rat (*Cricetomys gambiensis*)	Hunted for food.

Table 6-3: Human related actions promoted by access that may impact on faunal populations

Issue	Specific Actions
Animal mortality	▪ Hunting of game species; ▪ Hunting of other food species (rodents, birds and their eggs, small mammals); ▪ Persecution of perceived vermin; ▪ Persecution of disliked animals (snakes, scorpions, spiders);
Removal or change of habitat	▪ Clearing for agricultural lands; ▪ Collecting dead wood (fire wood); ▪ Chopping down trees (building material, fire wood, charcoal); ▪ Opening up thickets and removing needed cover; ▪ Burning large areas of natural habitat (untimely out of season); ▪ Using termite mounds as building material (clay); ▪ Disrupting soil surface (ploughing, sand mining); ▪ Overgrazing by cattle and goats
Animal disturbance	▪ Vehicle and human movement; ▪ Permanent occupation by villages; ▪ Lights at night (insects) ▪ Noise

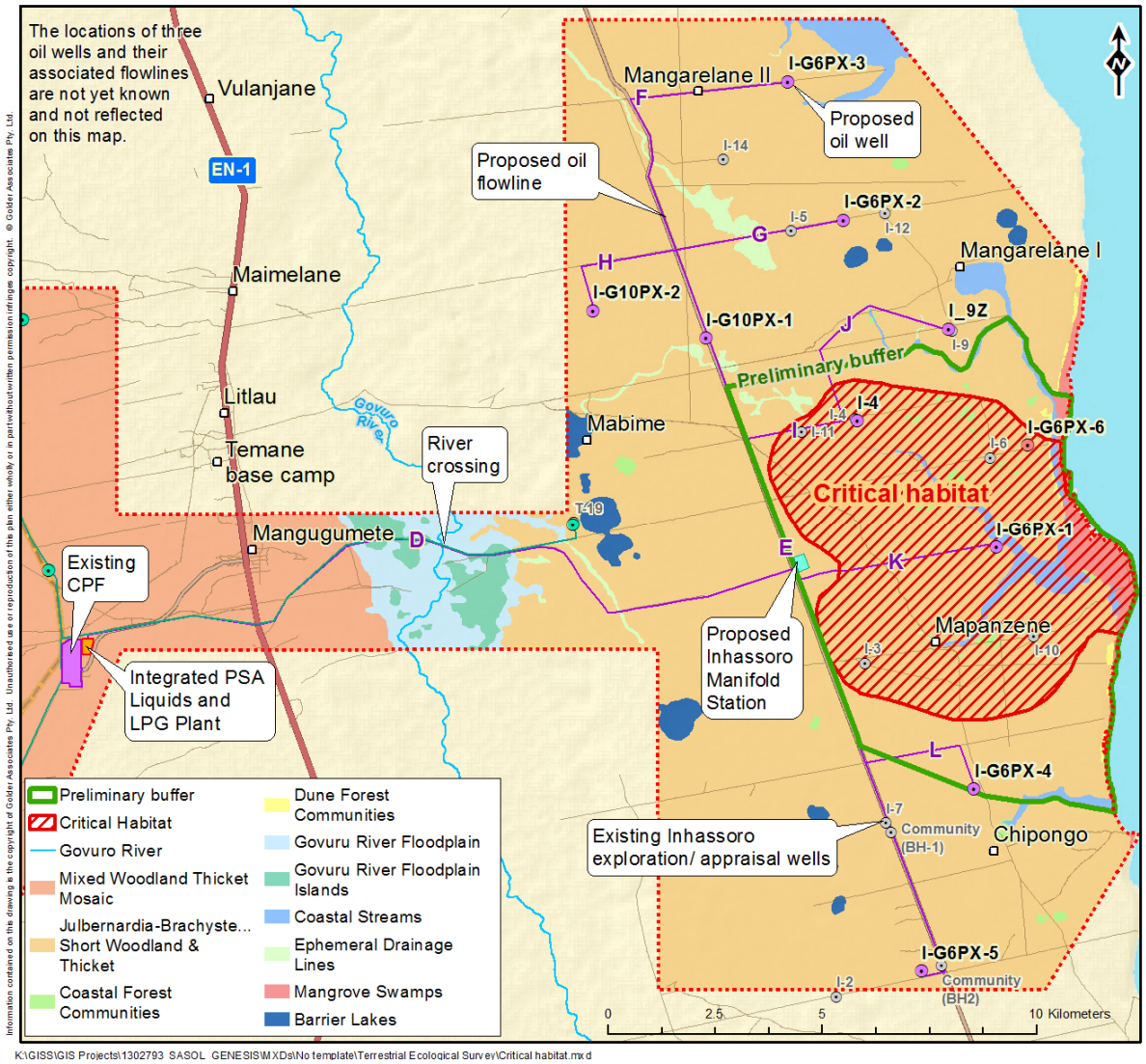


Figure 6-2: Critical habitat supporting the Mapanzene Coastal Stream

6.2.2 Impacts of the PSA Liquids and LPG Plant and the 5th Gas Train

6.2.2.1 Nuisance, Pollution and other Risks

The impact of the existing plant on surrounding fauna is an accurate template for what can be expected as a result of the combined operating plant. The existing plant has little effect on fauna in the surrounding area and the addition of the PSA Liquids and LPG Plant is not expected to alter this. While noticeable in the areas around the plant, noise is not considered to be an impact that is materially affecting the occurrence of fauna around the plant perimeter. While the more reclusive species may stay away from the immediate environs around the plant where the activities associated with the plant are noticeable, overall, the plant's direct impact on surrounding faunal populations is expected to be negligible.

Neither air nor water pollution impacts are likely to have an impact on surrounding fauna. Air quality will continue to meet the required standards for the protection of human health outside of the plant boundaries and negative effects on fauna are therefore unlikely. There are presently no offsite treated wastewater emissions from the CPF and this will continue to be the case for the combined plant.

The operating impact of the plant on fauna is therefore expected to be of low significance subject to the continued implementation of the o-EMP, as amended.

7.0 RECOMMENDED MITIGATION AND MONITORING

The recommendations for the mitigation and monitoring of identified terrestrial faunal impacts are described below.

Impact of loss of habitat	▪ Comply with the requirements of the existing CPF to minimize habitat impacts beyond the footprint of the project
Disturbance (noise and dust) impacts	▪ Comply with the requirements of the existing CPF to minimize habitat noise and dust impacts.
Impact of construction – related pollution	▪ Comply with the requirements of the existing cEMP to minimize the probability and consequences of any pollution related incident ▪ Amend the cEPM to include an additional requirement to conduct bioassay screening tests as a basis for the release of hydrotest water into the environment. The current cEMP makes only a general statement regarding the management of pollution caused by hydrotest water. In screening tests conducted on fish (*Poecilia reticulata*) and water flee (*Daphnia pulex*) for the construction of the Sasol MSP pipeline, it was found that the water could not be directly released into the natural environment and that containment, followed by evaporation or dilution, was necessary in order to ensure that there was no lethality of aquatic organisms (South African CSIR, 2003). Furthermore, because the water affected by biocides and corrosion inhibitors is regarded as a 'complex industrial wastewater' which is one in which standard chemical analysis of the effluent quality inadequately describes the toxicity, bioassays are the appropriate testing methodology.
Impact of hunting and persecution	▪ Comply with requirements of the existing cEMP to minimize the risk of hunting and persecution of wild animals
Impact of road and open trench kills	▪ Comply with requirements of the existing cEMP. ▪ Include requirements for a daily inspection to rescue fauna that may have fallen into the trench during the night.
Impact (direct) on Red Data Fauna and Sensitive Habitats	▪ Re-locate wells and flowlines that are situated in micro environments that are in species - rich faunal habitats, namely T-G8PX-2 (50 m), T-G8-PX5 (500 m), T-G8PX-3 (90 m), I-G6PX-5 (60 m). Refer to Specialist Study 9, *Botanical Biodiversity and Habitat* for details. ▪ Amend the existing c-EMP to manage impacts in the event of chance finds of Red Data species.
Impact of Nuisance and Persecution	▪ Sasol is in the process of preparing educational training courses spanning all environmental issues related to the operation of the CPF. These training courses are to include educational material about wildlife conservation so as to increase awareness of Sasol employees and contractors
Impact (indirect) of Improved Access	▪ Re-locate wells and flowlines that are situated in the critical habitat of the main coastal stream in the study area, namely I-G6PX-1 (relocate 750 m further west) and I-G6PX-6 (relocate 690 m further west on the existing I-6 well pad). Figure 6-2 indicates the location of the defined area of critical habitat and the relocation of wells G6PX-1 and I-G6PX-6. ▪ Consult with Government to determine how all parties could cooperate to encourage sustainable use of the critical habitat in the future.
Impact Monitoring	
	▪ Comply with requirements of the existing cEMP and d-EMP ▪ Sasol to facilitate the extension of the baseline monitoring of the defined critical habitat to include more comprehensive seasonal fieldwork which can be used as a basis for detailed future planning of the sustainable use of the area. Sasol is to take responsibility for facilitating this initial monitoring, following which any further monitoring could be determined by discussion between the relevant parties. Monitoring is to include the Coastal and Dune Forests, the Coastal Stream and the Mangroves.

8.0 IMPACT SIGNIFICANCE RATING

Tables 8-1 to 8-4 include rate the terrestrial faunal impacts of the project, with and without mitigation, for both the construction and operational phases.

Table 8-1: Environmental impact assessment matrix for the access roads, flowlines and well pads – construction phase

Potential Impact	Environmental Significance											
	Before mitigation						After mitigation					
	Severity	Duration	Extent	Probability	SP	Significance	Severity	Duration	Extent	Probability	SP	Significance
Loss of Habitat	3	2	2	5	35	L	3	2	2	5	30	L
Faunal Disturbance	3	2	2	3	21	L	2	2	2	2	12	N
Construction - related pollution	4	2	2	4	32	L	2	2	2	2	12	N
Hunting and persecution	4	2	2	5	40	L	2	2	2	2	12	N
Road and other accidents	7	2	2	5	55	M	7	2	2	2	22	L
Bush Fires	8	2	2	4	48	M	8	2	2	2	24	L
Red Data Fauna and Sensitive Habitats	8	2	2	4	48	M	8	2	2	2	24	L

Table 8-2: Environmental impact assessment matrix for the PSA Liquids and LPG plant and 5th Gas Train – construction phase

Potential Impact	Environmental Significance											
	Before mitigation						After mitigation					
	Severity	Duration	Extent	Probability	SP	Significance	Severity	Duration	Extent	Probability	SP	Significance
Loss of Habitat and Red Data Species	4	2	2	5	40	L	3	2	2	5	35	L
Construction - related pollution	4	2	2	3	24	L	2	2	2	2	12	N

Table 8-3: Environmental impact assessment matrix for the access roads, flowlines and well pads – operational phase

Potential Impact	Environmental Significance											
	Before mitigation						After mitigation					
	Severity	Duration	Extent	Probability	SP	Significance	Severity	Duration	Extent	Probability	SP	Significance
Pollution hazard (minor spills)	2	2	2	2	12	L	2	2	2	1	6	L
Increased accessibility (cultivation, hunting)	10	5	3	5	90	H	5	4	2	3	33	L

Table 8-4: Environmental impact assessment matrix for the PSA Liquids and LPG plant and 5th Gas Train – operational phase

Potential Impact	Environmental Significance											
	Before mitigation						After mitigation					
	Severity	Duration	Extent	Probability	SP	Significance	Severity	Duration	Extent	Probability	SP	Significance
Nuisance, pollution and other risks	5	4	2	3	33	L	3	4	2	1	9	N

9.0 CONCLUSIONS

The significance of construction phase impacts on terrestrial fauna will be low to negligible, subject to implementation of the requirements of the existing c-EMP and d-EMP, as amended. Construction phase impacts along the wells and flowlines consist mainly of clearing of areas, disturbance, minor pollution risks and the actions of people in the immediate area of construction. The period of construction is relatively short and the areas are small and contained. Much of the required road access to support construction of the flowlines already exists. The impacts can be mitigated successfully by implementing the existing EMP's with minor amendments, particularly if there is slight adjustment to some of the well locations to avoid micro environments of high biodiversity.

During the operational phase, disturbance–related impacts will be minor. The key concern will be the increased accessibility provided by the new access roads into an area of Critical Habitat near the coast, consisting of Coastal and Dune Forests, a Coastal Stream and a large Mangrove Swamp. Improved access into previously remote areas has been shown to have severe effects on habitat, which together with increasing pressure from hunters due to better accessibility, can have a severe effect on faunal populations. While most of the Study Area has good existing access, the area of critical habitat is relatively isolated and the access to two of the new wells will significantly increase the risk of secondary impacts in this area. The unmitigated impact is considered to be of high significance, but subject to relocation of the wells and other actions necessary to ensure that the habitat is protected, can be reduced to low significance. The author acknowledges that there may be a number of factors that could influence the feasibility of moving wells and flowlines. Factors which are outside of the scope of this study are not taken into consideration, and the recommendations are based purely on the desirability of the change from the point of view of **terrestrial fauna**. Other factors which may need to be considered before finalizing the positions of wells and flowlines must be evaluated in the EIA.

10.0 BIBLIOGRAPHY

Alexander, G., Marais, J. 2007. A guide to the reptiles of southern Africa. Struik Publishers, Cape Town. 408 pp.

BRANCH, B. 1998.Field guide to the snakes and other reptiles of Southern Africa. Struik Publishers, Cape Town.399 pp.

Channing, A. 2001.Amphibians of central and southern Africa. Protea Bookhouse, Pretoria. Pp 470.

De Castro & Brits. 2014. Sasol Petroleum Mozambique & Sasol Petroleum Temane Limitada. PSA Development and LPG Project. Environmental Impact Assessment. Specialist Study 9. Terrestrial Flora and Wetlands. Authors De Castro. T. & Grobler. R.

Du Preez, L. &Carruthers, V. 2009. A complete guide to the frogs of Southern Africa. Struik Nature, Cape Town.

Harrison, J.A., Allan, D.G., Underhill, M., Herremans, M., Tree, A.J., Parker, V. & Brown, C.J. 1997. The atlas of Southern African Birds. Volume 1: Non-passerines. Avian Demography Unit. Birdlife SA. Pp 786.

Harrison, J.A., Allan, D.G., Underhill, M., Herremans, M., Tree, A.J., Parker, V. & Brown, C.J. 1997. The atlas of Southern African Birds. Volume 2: Passerines. Avian Demography Unit. Birdlife SA. Pp 786.

IUCN, 2010.IUCN Red List of Threatened Species. Website: www.iucn.org/redlist.

Marais, J. 2004. A complete guide to the snakes of southern Africa. Struik Publishers, Cape Town.312 pp.

Mark Wood Consultants. 2001. Sasol Natural Gas Project – Mozambique to South Africa: Environmental Impact study of a proposed natural gas field at Temane and Pande in Mozambique.

Mark Wood Consultants. 2002. EIA 2002 - Seismic Exploration, Exploratory and Development drilling Temane and Pande.

Mills, G,.Hes, L. 1997.The complete book of southern African mammals. Struik Publishers, Cape Town.356 pp.

Monadjem, A., Taylor, PJ., Cotterill F.P.D., Schoeman, M.C. 2010. Bats of southern and central Africa: A biogeographic and taxonomic synthesis. Wits University Press. Pp. 596.

Pomeroy, D. 1992. Counting birds: A guide to assessing numbers, biomass and diversity of Afrotropical birds. AWF technical Handbook Series: 6. Nairobi, Kenya. Pp 1-48.

Ryder, R. A. 1986. Songbirds. In: Cooperrider, A.Y., Boyd, R.J. & Stuart, H.R., eds. 1986.*Inventory and monitoring of wildlife habitat*.U.S. Dept. Inter., Bur. Land. Manage. Service Center.Denver, Co. xviii, 858 pp.

Schneider M.F., Buramuge, V.A., Aliasse L., Serfontein F. (2005) Checklist and centres of vertebrate diversity in Mozambique. Internet: *www.fzi.uni-freiburg.de/VertebratesMOC/maps/diversity.pdf.*

SKINNER, J. D., SMITHERS, H. N. 1990. The mammals of the southern African subregion. University of Pretoria.771 pp.

GOLDER ASSOCIADOS MOÇAMBIQUE LIMITADA

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APPENDIX A

Frogs

FROGS: Available habitat, expected occurrence and observed presence of frogs during the survey (Du Preez & Carruthers, 2009).

Different biotopes surveyed:

Vegetation/Habitat Types:

1. Julbernardia-Brachystegia Woodland and Thicket Mosaic
2. Mixed Woodland and Thicket
3. Govuro River and floodplain
4. Coastal wetlands

Listed below are the frogs expected to occur in the available natural habitats of the study area (see table above). The words in **bold font** illustrate the qualifying habitat (preferred habitat) for each species, and the *underlined italics* indicate the disqualifying habitat (the reason why it is unlikely to find the frog in the surveyed biotopes). The shaded cells indicate the biotope that incorporates the preferred habitat, and the number inside a cell gives the number of individuals or definite signs detected during surveys.

Frog species	Habitat Preference	Julbernardia-Brachystegia Woodland and Thicket Mosaic	Mixed Woodland and Thicket	Govuro River & floodplain	Coastal wetlands
Family: Arthroleptidae					
Common Squeaker (*Arthroleptis stenodactylus)*	**Forest patches, leaf litter of riverine woodland. Wooded areas with abundant leaf litter and sandy soils. Dry coastal dune forest and acacia woodland.**		**1**		
Brown-backed Tree Frog(*Leptopelis mossambicus)*	Breeds in **wooded savanna, sand forest and mangrove swamps in the vicinity of streams and pans**. Burrows underground during dry periods.				
Family: Bufonidae					
Eastern Olive toad *(Amietophrynusgarmani*)	Various woodland vegetation types in the Savanna biome. Prefer **well-wooded low-lying areas** where there is relatively high rainfall (above 600mm/annum). **Breeds in vleis, pans** and dams in **open or wooded savanna. Occasionally in quiet backwaters of rivers and pools along small, slow-flowing streams**. Tadpole metamorphosis complete after 64-91 days.			**1**	
Guttural toad *(Amietophrynus gutturalis*)	Savanna, Grassland & Thicket biome**: Breeds in open shallow pools, vleis,** dams, **rivers, streams or other more or less permanent water.** Common in suburban gardens and farmland. Excavate burrows in soft ground. Tadpole metamorphosis complete after 5-6 weeks.			**3**	**2**
Family: Hemisotidae					

Frog species	Habitat Preference	Julbernardia-Brachystegia Woodland and Thicket Mosaic	Mixed Woodland and Thicket	Govuro River & floodplain	Coastal wetlands
Marbled snout-burrower(*Hemisus marmoratus)*	Savannas: Semi-arid environments. **Marshy ground and in sandy riverbanks in woodland savanna** throughout sub-Saharan Africa. Breeds at the **margins of pans, waterholes and isolated pools that form in riverbeds where there are exposed mud banks. Shallow, temporary water bodies.**				
Family: Hyperoliidae. Subfamily: Hyperoliinae					
Painted reed frog (*Hyperolius marmoratus taeniatus)*	Aestivates under stones and logs. Canopy of surrounding trees or emergent vegetation. Call sites: **emergent reeds and sedges, trees, grasses, bushes, floating vegetation.**			**4**	
Argus reed frog (*Hyperolius argus)*	Coastal woodland grassland, at or close to sea level. Breeds in **temporary, shallow water-filled depressions or coastal pans, favouring those with emergent or floating vegetation.**			**2**	
Waterlily Frog (*Hyperolius pusillus)*	**Open grassy pans, ponds, vleis** and dams in **open savanna and grassland; often found sitting on floating vegetation, such as water lily leaves.Breeds in pans and vleis especially where there are water lilies and other floating plants**. Eggs are laid in clutches in a single layer between overlapping lily leaves on the water's surface or in clusters around aquatic vegetation.				
Tinker Reed Frog(*Hyperolius tuberilinguis)*	Breeds in reed beds on the periphery of **swamps or rivers, or dense vegetation surrounding inundated pans.** Breeds in moderately deep waters with dense vegetation along rivers or in pans, pools and dams in low-lying areas of savanna; especially in **coastal woodland or grassveld**. Eggs laid loosely attached to reeds or grass stems above the water line.				
Family: Hyperoliidae Subfamily: Kassininae					
Bubbling kassina (*Kassina senegalensis*)	**Wide variety of vegetation types in Savanna and Grassland biomes.**			**6**	**1**
Red-legged kassina (*Kassina maculata*)	Wide variety of woodland vegetation types. Breeding – **well-vegetated pans, vleis, marshes, and dams.**				
Delicate leaf-folding frog (*Afrixalus delicatus)*	Tropical and **subtropical coastal bus**h and grassland, including **marshes and swamp forests.**				
Greater leaf-folding frog (*Afrixalus fornasinii)*	**Wide variety of densely vegetated habitats in coastal swamps, streams and dams in woodland and grassland.**				
Family: Breviceptidae					
Common rain frog (*Breviceps adspersus*)	Savanna biome: Semi-arid habitats with **sandy to sandy-loam soils. Woodland vegetation with a grassy ground layer and distinct upper layer of woody plants.**	**7**	**4**	**2**	
Mozambique rain frog (*Breviceps mossambicus*)	Found in a variety of habitats, including **open woodland or grassland. Shallow, well-drained, humus-rich rocky soils.** No standing water needed.				
Family: Microhylidae					

Frog species	Habitat Preference	Julbernardia-Brachystegia Woodland and Thicket Mosaic	Mixed Woodland and Thicket	Govuro River & floodplain	Coastal wetlands
Banded rubber frog (*Phrynomantis bifasciatus*)	Variety of woodland vegetation types in Savanna biome. Hot semi-arid environments (50-1450m). Breeds in **shallow temporary pans and pools, or inundated grass in savanna and Acacia.** Also small shallow dams.			**3**	
Family: Pipidae					
Muller's platanna*(Xenopus muelleri)*	Breeding = non-breeding habitat. Wide variety of **permanent bodies of water, including pans, lagoons and quiet regions of lowland rivers**. Tolerant to high temperatures. Burrow into dry mud to aestivate when pools dry up.				
Family: Phrynoatrachidae					
Dwarf Puddle Frog(*Phrynobatrachus mababiensis)*	**Open to wooded savanna;** less frequently grassland; high & low altitudes. Summer rainfall: 500-1000mm p.a. Calls from **water's edge well concealed by vegetation.**			**1**	**4**
East African Puddle Frog(*Phrynobatrachus acridoides)*	Dry and humid savannas, shrubland, grassland and coastal habitats; tolerates altered habitats. Opportunistic species that breeds in pans, roadside ditches, **flooded grassy depressions, puddles, pools, swamps and vleis.** Eggs are laid in clumps attached to vegetation just below the water surface.				
Natal dwarf puddle frog (*Phrynobatrachus natalensis*)	**A variety of vegetation types in the Savanna and Grassland biome.** Shelter under rocks near breeding sites.				**2**
Family: Ptychadenidae					
Southern ornate frog(*Hildebrandtia ornata)*	Variety of woodland vegetation types. **Deep sandy soils. Breed – shallow temporary pans in dry open woodland, often with emergent grass.**				
Anchieta's ridged frog (*Ptychadena anchietae*)	Savanna biome. Found sheltering amongst **grass and plant and plant debris on edges of breeding sites. Adults occur in the grassy edges of rivers and streams, escape into the wate**r.			**1**	**1**
Sharp-nosed GrassFrog(*Ptychadena oxyrhynchus)*	Moist open savanna and woodland. Breeds in sedge **pans, vleis, inundated grassland**s, pools in rock outcrops and other temporary pools.				**2**
Mascarene grassland frog(*Ptychadena mascareniensis)*	Along streams and in **temporary and permanent standing water. Swamps, marshes and pans in open, lowland savanna**. Semi- and permanent pans and pools. Also brackish coastal pools.				**1**
Mozambique ridged frog(*Ptychadena mossambica)*	Savanna species; woodland vegetation types, open grassland. Conceal themselves in grass tussocks near vleis, seepage areas and pans. **Floodplains of rivers and inundated grassland**. Dry season: deep cracks in dry mud of pans. Call from vegetation from water edge.				**1**
Family: Pyxicephalidae					
Edible bullfrog (*Pyxicephalus edulis*)	Several woodland vegetation types. **Flat, low-lying areas in open grassy woodland that become flooded after heavy rain or contain shallow seasonal pans.** Breeds in rain-filled pools.		**1**	**1**	
Knocking sand frog (*Tomopterna krugerensis)*	Occupies a variety of habitats in savanna areas. **Breeds in temporary rain pools and pans.**				

Frog species	Habitat Preference	Julbernardia-Brachystegia Woodland and Thicket Mosaic	Mixed Woodland and Thicket	Govuro River & floodplain	Coastal wetlands
Common sand frog (*Tomopterna cryptotis*)	Variety of habitats in open savanna and grassland, including arid areas. Open arid landscapes with sandy soils form the habitat of this species. The frogs spend most of the year buried in the soil; hibernate half a meter or more beneath the soil surface. Males call from exposed sites at the **banks of streams, pools and puddles**. They call at least partially from subterranean refuges, too.	**1**	**1**		
Family: Rhacophoridae					
Grey foam-net treefrog (*Chiromantis xerampelina)*	Savanna biome. Breeds over **temporary pans, vleis and rivers in constructing foam nests.** Found around seasonal or permanent bodies of open water in a variety of woodland vegetation types in the savanna biome.				

APPENDIX B

Reptiles

REPTILES: Available habitat, expected occurrence and observed presence of reptiles during the survey (Branch, 1998 and Marais, 2004).

Different biotopes surveyed:

Vegetation/Habitat Types:

1. Julbernardia-Brachystegia Woodland and Thicket Mosaic
2. Mixed Woodland and Thicket
3. Govuro River and floodplain
4. Coastal wetlands

Listed below are the reptiles expected to occur in the available natural habitats of the study area (see table above). The words in**bold font** illustrate the qualifying habitat (preferred habitat) for each species, and the *underlined italics* indicate the disqualifying habitat (the reason why it is unlikely to find the reptiles in the surveyed biotopes). The shaded cells indicate the biotope that incorporates the preferred habitat, and the number inside a cell gives the number of individuals or definite signs detected during surveys.

Species	Total habitat	Status: Mozambique,	Julbernardia-Brachystegia Woodland and Thicket Mosaic	Mixed Woodland and Thicket	Govuro River & floodplain	Coastal wetlands
Family Testudinidae (Land tortoises)						
Bell's hinged tortoise (*Kinixys belliana belliana*)	**Savanna, coastal plain and dune forest, entering thornveld.** Old termitaria or small burrows in earth embankments	**Least concern**				
Family Cheloniidae						
Green Turtle (*Chelonia mydas*)	*Ocean*	**IUCN 2010: Endangered**				
Hawksbill Sea Turtle (*Eretmochelys imbricate*)	*Ocean*	**IUCN 2010: Critically Endangered**				
Olive ridley (*Lepidochelys olivacea*)	*Ocean*	**IUCN 2010: Vulnerable**				
Loggerhead turtle (*Caretta caretta*)	*Ocean*	**IUCN 2010: Endangered**				
Family Trionychidae						

Species	Total habitat	Status: Mozambique,	Julbernardia-Brachystegia Woodland and Thicket Mosaic	Mixed Woodland and Thicket	Govuro River & floodplain	Coastal wetlands
Zambezi flat-shelled terrapin *(Cycloderma frenatum)*	**Rivers, lakes and stagnant pools. Burrow into soft mud.** Fast swimming species. Prefer sandy rather than muddy substrates. highly specialized fish-catcher, feeding on mussels only when fish are not available. Mussels are dug out from the substrate of rivers and lakes, using the powerful claws on the forefeet. adult turtles may travel several kilometers from shore and, on days of dead calm, up to half a dozen can usually be seen floating on the surface basking in the sun. Female turtles come ashore at night to lay their eggs between the end of January and April. The nest site is in the shade under trees and bushes, usually within 200 m of the water. A clutch of 17–25 eggs is laid in a shallow excavated nest hole. Hatchlings are plentiful in January and may be found under loose stones and logs along the high-water mark.	**Mozambique - Lower Risk/least concern**				
Family Pelomedusidae						
Yellow-bellied Hinged Terrapin *(Pelusios castanoides)*	**Still lakes and swamps at low altitudes. Shallow water; buries into mud when pools dry up.**	**Least concern**				
Pan hinged terrapin (*Pelusios subniger*)	**Ephemeral pans of the northern sandy terrain regions.** Seasonal or temporary pans with relatively shallow temporary water covered with dense mass of floating water grass and plants in woodland and scrub. Dry periods – leave pans & bury themselves on land in surrounding areas till favorable conditions return.	**Least concern**				
Family: Crocodylidae						
Nile crocodile (*Crocodylus niloticus*)	**Larger rivers, lakes and swamps.** River mouths, estuaries and mangrove swamps. Young - dig burrow to shelter; spend lot of time out of water and eat small prey. Sub-adults prefer swamps and backwaters, eating fish, terrapins, birds and small mammals. Nest on sunny sand bank above floodwater level with good drainage and cover nearby.	**Least concern**				
Family Typhlopidae						
Zambezi blind snake *(Rhinotyphlops schlegelii mucruso)*	**Varied, coastal bush to sandy terrain. Deep underground.** Variety of veld types, mostly sandy soil. Large adults deeper underground than smaller specimens, come to surface only after heavy rains have flooded them out.	**Least concern**				
Family Leptotyphlopidae						
Peter's thread snake *(Leptotyphlops scutifrons scutifrons)*	**Varied; grassland, coastal bushland, mesic and arid savanna. Burrow underground.** Usually taken under stones, under rocks on soil, under rotting logs, among grass roots.	**Least concern**	1			
Family Boidae						

Species	Total habitat	Status: Mozambique,	Julbernardia-Brachystegia Woodland and Thicket Mosaic	Mixed Woodland and Thicket	Govuro River & floodplain	Coastal wetlands
Southern African python (*Python natalensis*)	**Open savanna regions**, particularly rocky areas and **riverine scrub.** Moist, rocky, well-wooded valleys, **reed-beds or even bush country, seldom venture far from permanent water.** Eggs are laid in hollow tree trunks, antbear holes, caves or old termite hills. Fond of water in which they may lie and hunt. Dive into deep pools, remain submerged for long periods.	**Least concern**		1		
Family Colubridae						
Brown house snake *(Boaedon capensis)*	Wide distribution: Highveld grassland and arid karroid regions. Terrestrial Nocturnal. Eggs being laid in **decaying vegetable matter, termite hills or other suitable location. Variety of habitats: Moribund termitaria** or any form of shelter. Tolerant of urban sprawl.	**Least concern**				
Cape file snake (*Mehelya capensis capensis*)	**Open woodland, mainly savanna; entering coastal forest and arid regions**. Shelters under large rocks, logs or other debris.	**Least concern**		1		
Eastern bark snake (*Hemirhagerrhis nototaenia)*	**Savanna or woodland-savanna areas** up to 1550m. Under rough bark of trees, often associated with **Mopane bush.**	**Least concern**				
East-African shovel-snout (*Prosymna stuhlmannii*)	**Savanna,** extending into wooded hills. **Fossorial:** Under stones, logs, or heaps of decaying vegetable matter. In **termitaria** and other similar locations.	**Least concern**				
Rufous beaked snake (*Rhamphiophis rostratus*)	**Thorn- or woodland country** - rocky surroundings.	**Least concern**				
Western yellow-bellied sand snake (*Psammophis subtaeniatus*)	Open woodland and scrub in arid areas, **open dry savanna, thorn- or woodland.** Dry rocky hillsides in crevices between rocks, **large termitaria,** under loose bark or dead logs.	**Least concern**				
Olive whip snake (*Psammophis mossambicus*)	**Coastal plains and upland savanna.** Bush along streams and rivers rather than the more open dry area. **Mainly ground-living** – in grass; may resort climbing on tops of bushes and shrubs in order to bask in sun. Pursued: quick moving, dash into thick cover where it lies still. Eggs are laid in piles of dead leaves or other similar location.	**Least concern**		1		
Eastern stripe-bellied sand snake *(Psammophis orientalis)*	**Lowland forests and moist savanna**. Diurnal; often found **near water.** A ground dweller but ventures into shrubs and low bushes either to bask or seek out food.	**Least concern**				
Atractaspididae						
Bibron's stiletto snake(*Atractaspis bibronii*)	Variable: grassland, scrub and **open woodland to coastal forest** in semi-arid to quite moist climates (sea level to 1700m), highveld grassland to semi desert. Occasionally found on surface on warm rainy nights in summer. **Moribund termitaria. Rotting logs, under**	**Least concern**				

Species	Total habitat	Status: Mozambique,	Julbernardia-Brachystegia Woodland and Thicket Mosaic	Mixed Woodland and Thicket	Govuro River & floodplain	Coastal wetlands
	logs on soil, under stones, and crevices at ground level or under debris.					
Black-headed centipede-eater *(Aparallactus capensis)*	Varied: Highveld and montane grassland, **open woodland,** open scrub veld, grassland and coastal bush. Open bush or savanna country. Found in **moribund termitaria,** which offer shelter, warm and food. Under stones, under logs, among roots of shrubs and grasses.	**Least concern**				
Common purple-glossed snake (*Amblyodipsas polylepis polylepis*)	**Open woodland and scrub to coastal forest** at altitudes from sea level to 1300m, savannah, **and entering dry forest.** Fossorial (burrowing snake) and slow moving. In burrows or piles of vegetation, not found under rocks or logs. Seen abroad after heavy rains have fallen and soil becomes water-logged.	**Least concern**				
Striped quill-snouted snake *(Xenocalamus lineatus)*	**Deep sand, alluvial sands**: moist savanna, arid savanna and Karoo scrub. Nocturnal burrower deep down in alluvial sands; also under rotting logs, deserted termite mounds.	**Least concern**				
Spotted bush snake *(Philothamnus semivariegatus)*	**Open woodland, scrub and coastal forest, open forest or savanna**: **Open forest or bush, even dry and far removed from water**, however more frequently where water is – swims with ease. Coastal plain, along streams and rivers or along river courses. On rocky hillsides and mountains, shrubs and bushes on rocky ridges. Holes in trees or under loose bark. In crevices between or under rocks. In holes in large termitaria of Macrotermes. Take refuge to trees if disturbed.	**Least concern**		3		
South-eastern green snake *(Philothamnus hoplogaster)*	Varied: Coastal plains (bush), higher inland savanna (Arid and mesic savanna) and even montane forest. **Home near water bodies where it hunts for frogs, frequenting marshes, ponds, rivers, reedbeds, pans, vleis and streams.** Under logs, stones and under debris. Favours damp localities such as reed swamps, riverine thickets and flood plains of lakes and rivers.	**Least concern**				
Eastern Natal green snake *(Philothamnus natalensis natalensis)*	Wet montane and dry forest. **Reedbeds, vleis and streams.** Home near water bodies where it hunts for frogs, frequenting marshes, ponds, rivers, reedbeds, pans, vleis and streams. Under logs, stones and under debris. Favours damp localities such as reed swamps, **riverine thickets and flood plains of lakes and rivers.**	**Least concern**				
Marbled tree snake (*Dipsadoboa aulica*)	**Riparian and coastal forest.** Under some debris under large shady trees; hollow logs, under bark, piles of vegetation.	**Least concern**				
Rhombic egg-eater *(Dasypeltis scabra)*	Widespread in most veld types: from sea level to an altitude of 2300m. Common in grassveld and woodland. Absent only from true desert and closed-canopy forest. **Mainly terrestrial, but climb trees** in search of birds' eggs. Any place where it can find shelter:	**Least concern**		1		

Species	Total habitat	Status: Mozambique,	Julbernardia-Brachystegia Woodland and Thicket Mosaic	Mixed Woodland and Thicket	Govuro River & floodplain	Coastal wetlands
	Moribund termitaria, rock crevices, rock faces, heaps of rubble, rotting logs.					
Red-lipped snake *(Crotaphopeltis hotamboeia)*	**Most habitats: Savannah and open woodland;** Grassland to coastal forest but not in desert. Preference for damp localities. Marshy areas. Under virtually any available cover: Under rocks, in termitaria. Eggs laid in vegetable matter.	**Least concern**				
Eastern tiger snake (*Telescopus semiannulatus semiannulatus*)	Savanna and sandy terrain: **Well-wooded areas** from sea level to 1600m. May be found in grassland. Terrestrial, old dead trees, under rocks, in crevices, in small shrubs and weavers' nests.	**Least concern**				
Eastern vine snake (*Thelotornis mossambicanus*)	**Savanna woodland: Open or closed woodland or coastal forest** from sea level to 1200m. Almost exclusively arboreal: Live amongst the branches of trees. **Entering holes in evergreen trees** on slope during cold periods. May hibernate in hole in tree and even hole in ground.	**Least concern**		1		
Boomslang (*Dispholidus typus typus*)	**Common in most wooded regions** outside actual rainforests. From closed woodland through more open areas to scrub, from sea level to 1700m. Diurnal, mostly arboreal; move through branches of trees, shrubs and bushes. Mating takes place in trees and eggs are deposited in holes or hollows of trees, woodpeckers' nests or leaf litter on ground wherever suitable conditions exist. Take shelter in holes in trees and large termitaria and hibernate in holes in trees.	**Least concern**				
Family: Elapidae						
Long-tailed garter snake *(Elapsoidea sundervallii longicaudata)*	Varied: **coastal forest,** highveld grassland, arid and mesic savanna. Kwa-Zulu Natal to SE Mpumalanga. **Old termitaria** and under stones.	**Least concern**				
Eastern Shield Cobra (*Aspidelaps scutatus fulafula*)	**Sandy and loamy regions, moist and arid savanna.** Forage for food at night, push through sandy soil.	**Least concern**				
Snouted cobra (*Naja annulifera*)	Savanna: Usually in drier regions – **bush- and lowveld.** Permanent or semi-permanent home or retreat. Animal or other hole in the ground or in a tree, in **termite hills** or under outcrops of rocks or boulders. Eggs laid in some suitable, sheltered hole or cavity in the ground or in trees.	**Least concern**		1		
Mozambique spitting cobra (*Naja mossambica*)	**Savanna:** Rocky outcrops and hillsides in **fairly closed woodland** at altitudes from sea-level to 1750m along rivers or localities near water. Cleared areas in former forests. Holes in termitaria and other small animal burrows.	**Least concern**		2		
Forest cobra (*Naja melanoleuca)*	**Tropical and sub-tropical rain forest and coastal thicket.**	**Least concern**				
Green mamba (*Dendroaspis angusticeps*)	**Coastal bush and dune and escarpment forest. Arboreal.**	**Least concern**				

Species	Total habitat	Status: Mozambique,	Julbernardia-Brachystegia Woodland and Thicket Mosaic	Mixed Woodland and Thicket	Govuro River & floodplain	Coastal wetlands
Black mamba (*Dendroaspis polylepis*)	**Savanna & open coastal bush** below 1500m: Lower lying, drier more open woodland and scrub to wooded grassland, moist savanna and lowland forest (900-1200m). Ground living snake, also at home in bush, shrubs or trees - in thickets, commonly on hillsides and outcrops, granite hillocks, termite mounds, hollow tree trunks. Female will find a good place to lay eggs, burrow must be damp but not wet, and warm, but not too hot (termite nests).	**Least concern**		1		
Sub-Family: Hydropphiinae						
Yellow-bellied sea snake *(Pelamis platurus)*	*Indian and Pacific oceans.* Truly pelagic sea snake and is largely a surface dwelling species and tends to float motionlessly.	**Least concern**				
Family: Viperidae						
Puff adder *(Bitis arietans arietans)*	Widespread: grassland, **scrub and woody savannas,** from sea level to 1800m. Absent only from desert, dense forest and mountain tops. Any sort: rock on rock, rock on soil, logs, moribund grass.	**Least concern**		1		
Family: Amphisbaenidae						
Van Dam's dwarf worm lizard *(Zygaspis vandami vandami)*	Alluvial sands with **mesic savannah.** Usually found under stones on sandy or **humic soils.**	**Least concern**				
Slender worm lizard (*Monopeltis sphenorhynchus)*	Deep Kalahari sand or **coastal alluvium.**	**Least concern**				
Family:Scincidae						
Golden Legless Skink (*Acontias aurantiacus aurantiacus*)	**Coastal sands and sandy terrain.** Under logs.	**Least concern**				
Eastern coastal skink *(Trachylepis depressa*)	**Coastal thicket on sandy soils**. Terrestrial; sandy soils around base of thicket; climbs onto trunks and into foliage.	**Least concern**		2		
Striped skink (*Trachylepis striata*)	**Variety of woodland and savanna types,** and a wide range of ecological conditions from sea level to high mountain tops, desert to tropical bush. Although mainly arboreal, they also inhabit rocky koppies and will cross open ground readily. Among rocks and boulders, on the ground and in trees.	**Least concern**		3		
Variable skink(*Trachylepis varia)*	Varied: Very adaptive, wide variety of habitats: from sea level to high mountain slopes: Woodland, open woodland and scrubby grasslands without rocks and grassland. Desert, karroid veld, montane grassland, savanna, coastal bush, mesic thicket. Terrestrial and diurnal: Amongst rocks and stones at rocky or stony localities, but avoids extensive rocky areas. Broken ground, rocks and tree bases. Also running on ground surface. Uses boles of trees, rocks or logs as vantage points to survey surroundings for prey. Forage among leaf litter under trees or shrubs or amongst grass tussocks, under grass tufts, tree trunks or in any convenient	**Least concern**	1			

Species	Total habitat	Status: Mozambique,	Julbernardia-Brachystegia Woodland and Thicket Mosaic	Mixed Woodland and Thicket	Govuro River & floodplain	Coastal wetlands
	hole in the ground. At night: among stones, beneath bark of fallen logs, in holes in the ground or buried in leaf-litter. Small rocky outcrops, sheltering in burrows under rocks and logs, soil-filled rock cracks.					
Greater writhing skink (Mochlus *afrum*)	**Eastern coastal plain.** Sandy soil under logs and piles of vegetable debris.	**Least concern**	1			
Wahlberg's snake-eyed skink *(Afroblepharus wahlbergii*)	Arid & mesic savanna. From highveld grasslands and mountain tops through the woodland and into the lowveld. Forage among grass and **leaf-litter,** seeking prey under fallen leaves. Shelter among grass tussocks, Grass roots, under stones and rotting logs, in moribund termitaria and among leaf-litter in shady places under shrubs, in termite hills, and on broken ground. Eggs laid under a stone or log or sheltered, under stones and rotting logs or among fallen leaves and brushwood lying in shady places, lying on moist ground or among the roots of a tree or shrub, **grassy spots, shrubs and trees.** Rocky outcrops and rocky hillsides.	**Least concern**				
African Coral Rag Skink (*Cryptoblepharus africanus*)	*Coastal rock outcrops*	**Least concern**				
Family:Lacertidae						
Common rough-scaled lizard *(Meroles squamulosa)*	Arid and mesic savannah, found in both **sand- and woodland country**. Open woodland, scrub and grassland, at altitudes of 250-1400. More common in areas with **sandy substrates, sandy flat clearings. Particularly on sandy soils where there it shelters in holes in the ground or where it can burrow itself.** Forage among grass tufts or edge of bushes.	**Least concern**		**1**		
Cape rough-scaled lizard *(Ichnotropis capensis)*	**Arid and mesic savanna**	**Least concern**	5			
Family: Gerrhosauridae						
Rough-scaled plated lizard (*Gerrhosaurus major major*)	Arid and mesic savanna. Lowveld in open to fairly dense woodland – **around rocky outcrops or isolated koppies** in woodland country. Rocky outcrops –crevices or hollows between rocks and boulders. Disused warrens of animals such as antbears, warthogs, **small animal burrow - spring-hares, etc. old termitaria**. Seldom found far from burrow – retreat at sign of danger. Cracks in small, well-vegetated rock outcrops and also in old termitaria. Lays eggs under log in moist soil, or in rock crack.	**Least concern**				
Family:Varanidae						
Rock monitor *(Varanus albigularis albigularis)*	**Savanna and open bush or forest country**, open woodland, rocky hillsides, ridges and outcrops. Moister Karroid areas. Terrestrial. Dig	**Least concern**				

Species	Total habitat	Status: Mozambique,	Julbernardia-Brachystegia Woodland and Thicket Mosaic	Mixed Woodland and Thicket	Govuro River & floodplain	Coastal wetlands
	tunnel under rock overhangs. Cracks and fissures between or under rocks, or in disused animal burrows or in hollow trees or holes in trees. Expert climbers: tree and rocks. Great wanderers – even far from water. Eggs deposited in holes in suitable soil dug to 150-230 mm - cover and camouflage nest. Eggs in live termite nest, hollow tree, usually hole in soft moist sand.					
Water monitor *(Varanus niloticus niloticus)*	Near water: rivers, dams, pans and major lakes. **Major river valleys.** Shelter in holes in banks, in animal burrows or in crevices between rocks or under rocks, marginal vegetation. Basking in sun on rocks, outcrops, tree stumps, branches of overhanging trees or amongst vegetation on banks - never far from water. Escape into water – swim swiftly. Forage in marginal vegetation. Hibernate in large rock crag on rocky cliff or koppie bordering river. Young – marginal reed beds. Eggs deposited in hole dug deep into a living termite nest or sandbank by female, roughly covered over – termites seal up securely.	**Least concern**				1
Family:Agamidae						
Mozambique agama (*Agama mossambica)*	**Lowland savanna and forest fringe. Equally at home in trees and on the ground, climb nearest tree when disturbed.**	**Least concern**	1	7		
Peter's ground agama (*Agama armata)*	Semi-desert and savannah: **Open woodland in sandy Acacia woodland** and calcrete areas where there are rodent and other **suitable burrows for shelter.** Shelters in burrows and under flat rocks, lying half-buried in the soil. **Live in holes in ground; mainly those of burrowing animals**: gerbils, ground squirrels and spring hares. Also found in deserted termite hills. Hibernate in holes underground or under stones and in rock crevices. savanna: Terrestrial, loose soil.	**Least concern**	1			
Family:Chamaeleonidae						
Common flap-necked chameleon (*Chamaeleo dilepis dilepis*)	**Various kinds of woodland**: Savanna woodland; and wooded grassland, along streams. Wooded areas; branches of trees; branches of shrubs; Open forest and bush country, savanna woodland. Lays eggs in tunnel in damp soft soil at a sheltered spot. Diurnal, arboreal species, common in suitable habitat.	**Least concern**	1			
Family:Gekkonidae						
Common dwarf gecko *(Lygodactylus capensis capensis)*	**Well-wooded dry savanna:** Open woodland and well-wooded dry savanna country. Diurnal and arboreal gecko. Inhabiting trees with holes or loose bark, which provides shelter. Also shelters among rocks and dead vegetation. Marked preference for Baobab, Acacia and Mopane – plenty suitable rough bark as cover. Eggs are laid in	**Least concern**	3	1		

Species	Total habitat	Status: Mozambique,	Julbernardia-Brachystegia Woodland and Thicket Mosaic	Mixed Woodland and Thicket	Govuro River & floodplain	Coastal wetlands
	rock cracks, crevices, under stones or under loose bark. Forage in low scrub and on dead trees. Observed clinging, head down, near base of tree waiting for prey.					
Common tropical house gecko (*Hemidactylus mabouia*)	**Varied; arid and mesic savanna, and coastal bush. Arboreal** in wild and very territorial. Common under loose tree bark and in the hollows of trees (particularly baobab), in the crowns of palms, and in rock cracks and crevices. In fact, in any dark convenient place on or above the ground (also piles of rubble). In the wild the eggs are laid under a rock or in a crevice and sometimes in a communal depository. Mainly nocturnal.	**Least concern**		1		
Flat-headed tropical house gecko (*Hemidactylus platycephalus)*	High rainfall areas - **mopani and miombo woodlands** at low altitudes. Trunks of baobab trees. Crevices of rocks, houses.	**Least concern**				

APPENDIX C

Birds

BIRDS: Available habitat, expected occurrence and observed presence of birds during the survey (Gibbons, 1997; Harrison et al, 1997; Hockey et al, 2005 – latest name changes).

Different biotopes surveyed:

Vegetation/Habitat Types:

1. Julbernardia-Brachystegia Woodland and Thicket Mosaic
2. Mixed Woodland and Thicket
3. Govuro River and floodplain
4. Coastal wetlands

Listed below are birds expected to occur in the available natural habitats of the proposed study area (see table above). The words in **bold font** illustrate the qualifying habitat (preferred habitat) for each species, and the *underlined italics* indicate the disqualifying habitat (the reason why it is unlikely to find the bird in the surveyed biotopes). The shaded cells indicate the biotope that incorporates the preferred habitat, and the number inside a cell gives the number of individuals or definite signs detected during surveys. The sub-headings in the "Woodland and Thicket Mosaic" column, emphasize the importance of the Woodland and Thicket aspects as prominent habitat entities in theJulbernardia-Brachystegia- and Mixed Woodlandand Thicket biotopes.

RR* supplies the reporting rate according to the Atlas of South African birds (Harrison, et al, 1997)

BIRD	Biotope (Geographical area)	Status in Africa	Reporting rates	Woodland and Thicket Mosaic		Julbernardia-Brachystegia Woodland and Thicket Mosaic	Mixed Woodland and Thicket	Govuro River & floodplain	Coastal wetlands
				Woodlands	Thickets				
Flamingos									
Lesser flamingo (*Phoeniconaias minor*)	**Shallow eutrophic wetlands**, saltpans and **sheltered coastal lagoons**. Larger brackish or saline inland and coastal waters.	**IUCN 2014 NT: Near-threatened.**							
Pelicans									
Great white pelican *(Pelecanus onocrotalus)*	**Shallow warm, fresh or moderately alkaline water bodies with adequate supplies of fish**. Shallow lakes, flood plain pans, estuaries, sheltered coastal bays, lagoons. Roost on dry land.	Locally common	0.35-0.51						

BIRD	Biotope (Geographical area)	Status in Africa	Reporting rates	Woodland and Thicket Mosaic		Julbernardia-Brachystegia Woodland and Thicket Mosaic	Mixed Woodland and Thicket	Govuro River & floodplain	Coastal wetlands
				Woodlands	Thickets				
Pink-backed pelican *(Pelecanus rufescens)*	**Permanent wetlands** for foraging and trees for breeding. Large freshwater or alkaline lakes. Wide range of wetlands, including lakes**, slow-flowing rivers,** saline pools, lagoons, estuaries, sheltered bays.	Locally common	0.25-0.36						
Cormorants									
White-breasted cormorant (*Phalacrocorax lucidus)*	**Coastal and fresh waters:** Dams and impoundments, streams and rivers. Mainly aquatic, in both salt and freshwater. Interior - streams and rivers.	Locally common	0.25-0.63						2
Reed cormorant (*Microcarbo africanus*)	**Virtually all freshwater habitats** except fast flowing streams. Prefers gently sloping shores. Also estuaries, lagoons and **sheltered coastal waters.** Freshwater wetlands (any size) and water bodies: ephemeral habitats, major rivers and fast-flowing streams with pools, artificial wetlands: dams, sewage works.	Common	0.25-0.82						
Darters									
African Darter (*Anhinga rufa*)	**Freshwater wetlands, rivers and streams**; avoids fast-flowing and turbulent water; adapted to artificial wetlands. Still and slow-moving freshwater bodies with open water. Scarce on fast flowing rivers and in areas with dense floating vegetation. Prefers areas with dead trees, rocks or banks where it can rest after feeding.	Common	0.25-0.65						
Egrets, herons and bitterns									
Grey heron (*Ardea cinerea*)	**Bodies of shallow open water. Wetlands – rivers,** dams, **pans, marshes and estuaries – provided there is sufficient shallow water to feed in.** Mountainous areas: keep to valleys. Tall trees, reed beds and cliffs for roosting. Also marine intertidal zone, estuaries, lagoons. Rarely in dry grasslands.	Common	0.25-0.90						
Little egret (*Egretta garzetta*)	**Open areas of shallow water: margins of lakes**, dams, **rivers, marshes**, saltpans, **estuaries and mangrove swamps**. Breeds near water in trees or bushes. Edges of rivers and lakes, estuaries, pans, marshes, and saltpans. Also mangroves, open coastal.	Common	0.44-1.18						2
Intermediate egret (*Egretta intermedia*)	**Shallow water** or wet grasslands. **Margins of lakes, rivers,** saltpans and estuaries; especially seasonal waterbodies, marshes and flooded grasslands. Prefers	Common resident and nomad	0.25-0.44						

BIRD	Biotope (Geographical area)	Status in Africa	Reporting rates	Woodland and Thicket Mosaic		Julbernardia-Brachystegia Woodland and Thicket Mosaic	Mixed Woodland and Thicket	Govuro River & floodplain	Coastal wetlands
				Woodlands	Thickets				
	shallow water, but also forages in dry grassland close to water.								
Western Great Egret (*Egretta alba*)	**Shallow open water at lakes, rivers, floodplains, flooded grasslands, marshes,** saltpans and estuaries.	Common	0.25-0.52					2	
Black-headed heron (*Ardea melanocephala*)	Open habitats, preferring grasslands. Pastures and field of **stubble near wetlands**. Tall trees for breeding and roosting.	Common	0.25-0.71						
Purple heron (*Ardea purperea*)	**Larger water bodies and wetlands: Reedbeds, marshes, reed-fringed rivers and lakes**; flooded areas with tall grasses, rushes and sedges. Dense emergent vegetation, especially reed beds fringing shallow wetlands; also mangroves.	Common	0.43-1.1						
Western Cattle egret (*Bubulcus ibis*)	**Terrestrial; open short grassland**. Nests in trees and reedbeds.	Common	0.25-0.9						
Squacco heron (*Ardeola ralloides*)	**Freshwater habitats: dense emerging/fringing vegetation in the quiet backwaters of ponds and the edges of slow-flowing rivers** and streams. Adequate reed cover and a few bushes or trees are prerequisites. Flooded grasslands and ephemeral pans with emergent vegetation.	Common	0.25-0.43						
Malagasy Pond-Heron *(Ardeola idea)*	**Small grassy marshes, lakes and ponds, streams.**	IUCN (2014): Endangered. Breeds on Madagascar; it has a large non-breeding range.							
Rufous-bellied Heron *(Ardeola rufiventris)*	**Dense marshes and flooded grasslands.**	Uncommon resident and local migrant	0.37-0.58						
Straited heron (*Butorides striata*)	**Densely vegetated rivers**, estuaries, streams, lakes, ponds, **swamps** and mangroves. Wooded areas around margins of rivers, streams, lakes, estuaries, mangroves reedbeds, and swamps where vegetation overhangs water. Occasional - mudflats, temporarily flooded grassland and seashore.	Fairly common	0.25-0.49						
Black-crowned night heron	**Dense vegetation along the edges of shallow, still or slow-moving water such as rivers, lakes, pans,**	Common resident and	0.39-0.72						

BIRD	Biotope (Geographical area)	Status in Africa	Reporting rates	Woodland and Thicket Mosaic		Julbernardia-Brachystegia Woodland and Thicket Mosaic	Mixed Woodland and Thicket	Govuro River & floodplain	Coastal wetlands
				Woodlands	Thickets				
(*Nycticorax nycticorax*)	marshes or **seasonal floodplains**. Well-vegetated and slow-moving water - estuaries, mangroves. Roosts in trees and reedbeds.	Palaearctic migrant							
Storks									
African Openbill *(Anastomus lamelligerus)*	**Various open aquatic habitats – swamps, floodplains, ephemeral pans**, rice fields, **river shallows and lake edges**. Wetlands, including flood plains, temporarily flooded pans, marshes, swamps, ponds, river shallows, streams, lake edges, lagoons, intertidal flats.	Locally common Intra-African migrant	0.41-0.82					8	
Saddle-billed stork (*Ephippiorhynchus senegalensis*)	**Larger inland waters: large rivers in open savannas, freshwater wetlands and marshes:** dams, pans, floodplains, swamps; usually in open or lightly wooded country. Freshwater and alkaline lake shores. Absent from forests.	Uncommon; seasonal movements	0.42-0.95						
Spoonbills									
African spoonbill (*Platalea alba*)	Shallow aquatic habitats: **freshwater wetlands, marshes, pans, temporary flooded grasslands, floodplains, rivers**, dams. Almost exclusively shallow aquatic habitats, favouring lake and river margins, seasonally and permanent pans, coastal lagoons and estuaries.	Common resident and local migrant.	0.25-0.6						
Ibis									
Glossy ibis (*Plegadis falcinellus*)	Grassland habitats, associated with **freshwater habitats: shallow inland waters,** lake and **river-edge marshes, seasonal pans, flooded grassland.** Riparian marshes, shallow rivers.	Locally common	0.25-0.39						
Hadeda Ibis (*Bostrychia hagedash*)	Open moist grasslands & **savanna, along well-vegetated river courses; also marshes, flooded grasslands, edges of large wetlands,** gardens.	Common	11.86-29.2						
African Sacred ibis (*Threskiornis aethiopicus*)	Grassland habitats, associated with **freshwater habitats: marshes, estuaries** and dams.	Common	0.25-0.65						
Hamerkop									
Hamerkop (*Scopus umbretta*)	**Large perennial waterbodies** (lakes, dams and rivers), vleis and ephemeral wetlands, perennial and seasonal rivers with pools. **Edges and shallow waters of lakes, pans, swamps and marshes, rivers**, streams and	Common	0.25-0.8						

BIRD	Biotope (Geographical area)	Status in Africa	Reporting rates	Woodland and Thicket Mosaic		Julbernardia-Brachystegia Woodland and Thicket Mosaic	Mixed Woodland and Thicket	Govuro River & floodplain	Coastal wetlands
				Woodlands	Thickets				
	seasonally flooded ponds, including relatively small puddles.								
Ducks & geese									
Fulvous whistling duck (*Dendrocygna bicolor*)	**Larger inland waters: floodplains, plentiful aquatic vegetation.** Shallow water bodies. Thickly vegetated with aquatic grasses and other plants. Feed in partly flooded / marshy wetland.	Locally common	0.25-0.34						
White-faced whistling duck (*Dendrocygna viduata*)	**Inland waters, mainly in savanna** and grassland. **Expanses of shallow water with emergent vegetation: backwaters of larger rivers, grassy floodplains, small ephemeral pans.** Feeds in water - usually in shallows of permanent or seasonal wetlands, or flooded grasslands; on land - natural grasslands.	Common	0.25-0.74					4	
Spur-winged goose (*Plectopterus gambensis*)	**Inland waters / wetland: larger bodies of water, floating vegetation**; croplands. Flightless moult: Dams and dense swamp. Breeding: smaller system or secluded bay, emerging fringing vegetation. Rivers - shallow areas in open.	Common	0.25-0.7						1
Knob-billed duck (*Sarkidiornis melanotos)*	**Inland waters: seasonal flooded pans and vleis. Rivers - shallow areas in open.**	Locally common nomad and Intra-African migrant	0.25-0.53						
African Pygmy Goose *(Nettapus auritus)*	**Freshwater lakes with floating vegetation, especially Nymphaea lilies; nests in hole in tree. River pools.**	Locally common	0.25-0.38						
Red-billed teal (*Anas erythrorhyncha*)	**Shallow, permanent or temporary eutrophic fresh water with grassy surroundings.**	Common	0.25-0.61						
Hottentot teal (*Anas hottentota*)	**Inland waters with emergent vegetation such as floodplains, vleis, marshes with bulrushes.**	Locally common	0.36-0.63						

BIRD	Biotope (Geographical area)	Status in Africa	Reporting rates	Woodland and Thicket Mosaic		Julbernardia-Brachystegia Woodland and Thicket Mosaic	Mixed Woodland and Thicket	Govuro River & floodplain	Coastal wetlands
				Woodlands	Thickets				
Jacanas									
African Jacana *(Actophilornis africanus)*	**Aquatic habitats: seasonal pans and floodplains; along fringes of slow-flowing, meandering rivers – emergent, floating hydrophytes to forage**. Permanent, seasonal and ephemeral shallow, freshwater wetlands and margins of slow-flowing rivers with low emergent vegetation. Favours areas dominated by water lilies and pondweed. Walks on floating plants or swim when hydrophytes provide insufficient support.	Common	0.48-1.36					1	1
Vultures									
Lappet-faced Vulture *(Torgos tracheliotus)*	**Savannas, especially in more arid areas; nests and roosts on trees.**	**IUCN status (2014): Vulnerable.**							
White-headed Vulture *(Trigonoceps occipitalis)*	**Open savannas; roosts and nests on trees.**	**IUCN status (2014): Vulnerable.** Uncommon to locally common	0.25-0.44						
Secretary bird									
Secretary bird (*Sagittarius serpentarius*)	**Open country: Savanna, open woodland,** grassland and dwarf shrubland.	**IUCN status (2014): Vulnerable.** Uncommon to locally common							
Hawks and eagles									
Western Osprey *(Pandion haliaetus)*	**Inland and coastal waters. Widespread.** Coastal along the sea shore, and at estuaries and lagoons; **inland on lakes and large rivers.**	Fairly common	0.33-0.46						2
African Cuckoo Hawk *(Aviceda cuculoides)*	**Forest and dense woodland, indigenous** or exotic.	Uncommon to locally fairly common	3.17+			6			
Black-winged Kite *(Elanus caeruleus)*	**Wide distribution:** Most abundant in grassland with cultivated areas.	Common	5.82-13.0				1		
Yellow-billed Kite (*Milvus parasitus*)	**Great variety of habitats: especially woodlands (higher rainfall areas)**	Common intra-African migrant	3.76-11.41			1	3		

BIRD	Biotope (Geographical area)	Status in Africa	Reporting rates	Woodland and Thicket Mosaic		Julbernardia-Brachystegia Woodland and Thicket Mosaic	Mixed Woodland and Thicket	Govuro River & floodplain	Coastal wetlands
				Woodlands	Thickets				
African fish eagle (*Haliaeetus vocifer*)	Widespread. **Coastal along the sea shore, and at estuaries and lagoons; inland on lakes and large rivers.** Usually associated with large water bodies, either flowing or still, including estuaries. Sometimes along open coastline. May remain on seasonally dry rivers once last pools dry up, subsisting on birds and scavenging carcasses. Absent from rivers that flow for only a few weeks a year.	Common	0.25-0.56					1	
Black-chested Snake-Eagle *(Circaetus pectoralis)*	**Open country; savanna woodlands,** dwarf shrublands, semi-desert.	Uncommon to Locally common nomad and possible intra-African migrant							
Brown Snake Eagle (*Circaetus cinereus*)	**Arid woodland.** Breeds and roosts in trees.	Locally common; nomad	2.49-5.94						
Bateleur *(Terathopius ecaudatus)*	**Woodland and savanna on open plains**, including Kalahari Acacia woodland. Nests usually in canopy or on horizontal fork of large tree, 8-12-16m above ground. **Roosts in trees**.	**IUCN 2014 NT: Near-threatened.** Common	18.7-32.21						
African marsh harrier (*Circus ranivorus*)	**Nests in extensive reedbeds; forage over reeds, lake margins, floodplains** and woodland.	Locally common to scarce	0.41-0.78						
Pallid Harrier *(Circus macrourus)*	**Open grassveld, cultivated fields, less commonly in open semi-arid savanna. Open pans or floodplains.**	**IUCN 2014 NT: Near-threatened.** Uncommon Palearctic migrant.							
African Harrier-Hawk *(Polyboroides typus)*	**Mainly in forests. Dense woodland, tall riparian vegetation** and well-wooded ravines. Partial to stands of alien trees.	Fairly common	0.61-2.12			2			
Lizard Buzzard *(Kaupifalco monogrammicus)*	**Savanna and woodland, especially mature broadleaved deciduous woodland.**	Locally common resident	24.99+			1	2		
Dark Chanting Goshawk	**Woodland and savanna:** avoids forests and arid savanna. Nest: Platform of sticks 4.5-9.0m above ground	Uncommon	3.12-7.77			4			

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				Woodlands	Thickets				
(Melierax metabates)	in vertical fork of tree within canopy. Usually perch on top of tree, scanning ground for prey.								
African Goshawk *(Accipiter tachiro)*	**Mainly indigenous forest; also dense riverine woodland** and exotic plantations.	Common	0.57-1.39						
Shikra *(Accipiter badius)*	**All woodland types – nests in open woodland.**	Common resident and local nomad	1.42-4.24						
Little Sparrowhawk *(Accipiter minullus)*	**Forest and woodland types: Dense vegetation forests, riparian bush and thickets.**	Locally common					1		
Black Sparrowhawk *(Accipiter melanoleucus)*	**Forest,** wooded kloofs and gorges, exotic plantations (especially Eucalyptus) in grassveld.	Locally fairly common					1		
Common Buzzard *(Buteo buteo)*	Open country: dwarf shrubland, grassland, **savanna, open woodland and Acacia woodland**. Also found in dense woodland.	Abundant Palearctic migrant	6.38-11.73						
Wahlberg's Eagle *(Hieraaetus wahlbergi)*	**Woodland – flat areas: river lines** and riparian woodlands. Breeding in tall riparian trees in grassland and woodland	Common intra-African migrant	0.74-3.63						
African Hawk-Eagle *(Aquila spilogaster)*	**Woodlands**: breeds on hill slopes or along river courses in tall trees.	Uncommon	0.25-0.51				1		
Booted Eagle *(Hieraaetus pennatus)*	Breeding birds occur in semi-arid hilly country and edges of karoo; nonbreeding birds occur in wide variety of habitats from **woodland** to semi-desert.	Uncommon Palearctic migrant	0.36-0.55						
Ayres's Hawk-Eagle *(Hieraaetus ayresii)*	**Dense woodland, forest edge**, Eucalyptus groves in towns; avoids arid towns.	Uncommon resident and Intra-African migrant	0.25-0.32						
Martial Eagle *(Polemaetus bellicosus)*	Open grassland and scrub. Large trees for nests. **Wide range of vegetation types**: deserts, **densely wooded** and forested areas.	**IUCN 2014 Status: Vulnerable.** Locally common	0.55-1.2			1			
Crowned Eagle *(Stephanoaetus coronatus)*	**Dense indigenous forest, including riverine gallery forest; may range far from forest to hunt.**	**IUCN 2014 Status: Near-threatened.**	0.42-0.88						

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				Woodlands	Thickets				
		Locally fairly common							
Falcons, hobbies and kestrels									
Dickinson's Kestrel *(Falco dickinsoni)*	**Palm savanna and open woodland, often near baobab trees.**	Uncommon	1.83-4.79						
Sooty Falcon *(Falco concolor)*	**Tropical and subtropical coastal or marshy areas, moist savannas and forest edges**. In the non-breeding season it forages for large insects over grassland and open country with trees. It breeds colonially in hot, arid environments; on cliffs, small rocky islands and rugged desert mountains where its breeding is timed to coincide with the autumn migration of small birds on which it feeds.	**IUCN 2014 NT: Near-threatened.** A small but unknown proportion winters in coastal Mozambique.							
Peregrine Falcon *(Falco peregrinus)*	Cliffs, mountains, steep gorges; may hunt over open grassland, farmland and **forests;** rarely enters cities to hunt pigeons.	Uncommon resident and Palearctic migrant	0.33-0.44						
Francolins and spurfowl									
Coqui Francolin *(Peliperdix coqui)*	**Savanna or well-grassed woodland, sandy areas with good bush cover: grassy clearings and along edges of woodland.**	Common to locally common	1.61-4.54						
Crested Francolin *(Dendroperdix sephaena)*	**Woodlands with dense scrub component.** Favors areas with bush encroachment in savannas and tolerates poor grass cover.		29.32-47.94			2	15		
Shelley's Francolin *(Scleroptila shelleyi)*	**Acacia savanna with good grass cover,** edges of cultivated lands, often on stony ground.	Locally common	0.25-0.48						
Red-necked Spurfowl *(Pternistes afer)*	Wooded gorges, **edges of upland evergreen forests, riverine scrub**; feeds in clearings and cultivated lands.	Common	29.3+				6		
Guineafowl									
Crested Guineafowl	**Forest edge, thickets and dense woodland.**	Locally common	7.76-16.58				1		

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				Woodlands	Thickets				
(Guttera pucherani)									
Helmeted Guineafowl (*Numida meleagris*)	**Savanna** mixed with cultivation. Inhabiting most agricultural regions	Common	2.51-15.89						
Quails									
Kurrichane Buttonquail *(Turnix sylvatica)*	Open grassveld: neither very tall or very dense. **Savanna.** Fallow lands.	Locally common	0.79-1.83						
Crake and rails									
Black crake (*Amaurornis flavirostris*)	**Rank grass, sedges, reedbeds, bulrushes, papyrus, swampy thickets, bushes and other vegetation beside flowing, still or open fresh and estuarine waters. Occurs in tangled growth in which birds climb, roost and nest. In thin cover along very small streams in arid regions.**	Common	0.25-0.47					1	
Flufftails									
Red-chested flufftail (*Sarothrura rufa)*	**Wide range of freshwater, marshy habitats, from seasonally wet grassland and sedge meadow to permanently flooded reedbeds.** Wetland vegetation types, dense cover, firm ground or short vegetation. Marshy, boggy areas, reed-fringed pools, swamps, vleis, dambos, marshy vegetation fringing rivers, streams, lakes. Isolated wetland patches in grassland, woodland and forest.	Common resident	0.25-0.34						
Coot, moorhens and gallinules									
African Swamphen *(Porphyrio madagascariensis)*	Fresh to brackish, **sheltered, still to slow-flowing rivers and still waters fringed or overgrown by reeds, rushes, bulrushes, sedges,** etc. All marshes and swamps with permanent water, and ephemeral and seasonal flooded wetlands.	Common	0.38-0.65						
Korhaans and bustards									
Black-bellied Bustard *(Lissotis melanogaster)*	**Woodland, savanna, grassland, vleis,** cultivated lands.	Fairly common	0.43-0.94			2			

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				Woodlands	Thickets				
Plovers and lapwings									
Common Ringed Plover *(Charadrius hiaticula)*	**Estuaries and inland wetlands: Muddy, sandy and gritty substrate**. Gently sloping shorelines and eutrophic water conditions – vegetation no influence. Inland on mud- and sandbanks along rivers and at wetlands, favouring **wide, bare shorelines with little emergent vegetation**. Roosts on bare, open shoreline.	Common Palearctic migrant	0.33-0.46						8
Kittlitz's plover (*Charadrius pecuarius*)	Open dry mud and short grass, usually close to water. **Natural pans – dry mud and short grass. Also estuaries, salt-marshes and flood plains.**	Uncommon resident and local nomad	0.46-1.04						
Three-banded plover (*Charadrius tricollaris*)	**Any freshwater habitat with an open shoreline**. Open shores of any freshwater habitat, favouring pools, streams and seeps. Also at tidal pools, estuaries and lagoons.	Common							2
Chestnut-banded Plover *(Charadrius pallidus)*	**Saline lagoons, saline and brackish pans,** saltworks; occasionally estuaries and sandy lagoons. Rarely in freshwater habitats.	**IUCN 2010: NT Near-threatened.**							
White-fronted Plover *(Charadrius marginatus)*	**Sandy shores of marine and larger inland waters (lakes, pans, rivers).** Mainly sandy shores and coastal dunes, estuaries along large rivers and lakes; also on rocky coasts and intertidal mudflats. Roosts mainly away from water on broad, open shorelines.		0.25-0.38						
Senegal Lapwing *(Vanellus lugubris)*	**Open, short-grass savanna, often in recently burned areas.**	Uncommon resident and local migrant	0.42-0.82						
Crowned Lapwing *(Vanellus coronatus)*	Dry, short and over-grazed or burnt grassveld. Widespread in a number of grassland and **woodland types**. Absent from mountainous and desert areas.		0.25-3.98						
Sandpipers & other waders									
Common Greenshank (*Tringa nebularia*)	**Aquatic habitats: coastal sites and inland wetlands with shallow margins. Vleis, pans, and rivers.**	Common Palearctic migrant	0.25-0.61						
Wood sandpiper (*Tringa glareola*)	**Marshy shorelines: ephemeral pans, vleis, marshes, streams, floodplains and upper reaches of estuaries.** Muddy, sandy or gravel borders of dams and ponds, inundated short grassland, sandy and muddy riverbeds, natural pans, mixed rocky and sandy beaches, salt	Common Palearctic migrant	0.25-0.57						

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				Woodlands	Thickets				
	marshes, estuaries, tidal and non-tidal lagoons and mangroves. Marsh-like conditions favoured over open shore-lines.								
Common sandpiper (*Actitis hypoleucos*)	**Any aquatic habitat, but favours streams and rivers shores with sandy, gravelly, stony or rocky substrata, estuaries, tidal creeks in salt marsh, mangroves**. Open water edges: streams, rivers, marshes, vleis, coastal lagoons and upper reaches of tidal estuaries. Prefer wet conditions adjacent to water rather than wading in water.	Common Palearctic migrant	0.25-0.53						
Curlew sandpiper (*Calidris ferruginea*)	**Wetlands: pans and wetlands with muddy edges.**	Abundant Palearctic migrant	0.38-0.62						
Little stint (*Calidris minuta*)	**Muddy edges of wetlands.**	Common Palearctic migrant							1
Whimbrels and Curlews									
Whimbrel *(Numenius phaeopus)*	**Almost exclusively open coast and at coastal lagoons and estuaries.** Favours sandy and rocky intertidal habitats, salt marshes and mangroves; on rocky shores.		0.25-0.39						
Eurasian Curlew *(Numenius arquata)*	**Coastal wetlands; forages on intertidal mud- and sandflats** and roosts on adjoining salt-marshes, sand-dunes, mangroves or rocks.								
Dikkops or thick-knees									
Water Thick-knee *(Burhinus vermiculatus)*	**Primarily freshwater wetlands, especially large rivers**, lakes and dams. Also mangrove swamps, estuaries and open beaches. Favours site with open sand banks; also rocky areas, but avoids heavily vegetated wetland margins.	Common resident	0.25-0.57						
Spotted Thick-knee *(Burhinus capensis)*	Various types of grasslands; whole of SA highveld. Open grassland and **savanna, edges of woodland**, semi-desert with scrub, stony slopes of low hills, cultivated land. Sparse ground cover where stony.	Common resident	0.25-0.88				1		
Stilts									

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				Woodlands	Thickets				
Black-winged stilt (*Himantopus himantopus*)	**Extensive open, shallow waters: coastal lagoons** and saltpans. **Inland and coastal wetlands,** ranging from flooded fields, flood plains and papyrus swamps. Typically roosts communally in open areas.	Common nomadic resident	0.25-0.52					2	
Pratincole									
Collared Pratincole *(Glareola pratincola)*	**Wetland margins and open areas near water**	Locally common Intra-African migrant and Palearctic migrant	0.4-0.67						
Doves and pigeons									
Laughing dove (Spilopelia *senegalensis*)	**Open savanna**, Acacia Acacia woodland and grassland; avoids natural high altitude grasslands.	Abundant	0.25-19.55						
Ring-necked Dove (*Streptopelia capicola*)	**Catholic choice of habitats: all vegetation types, except forests.**	Abundant	43.58-61.41			11	10		
Red-eyed Dove (*Streptopelia semitorquata*)	**Tall trees in the vicinity of water. Riparian woodland, forest verges and other well-wooded country.**	Common	59.66+			2	4		
Emerald-spotted Wood Dove (*Turtur chalcospilos*)	**Various deciduous woodland types & moister Acacia woodland; thickets** or drainage lines and in valleys – taller denser growth.	Common	84.74+			37	58		
Namaqua Dove *(Oena capensis)*	**Dry to semi-arid open woodlands and savannas.** More open habitat.	Common resident and local migrant	0.25-5.79						
AfricanGreen-Pigeon (*Treron calva*)	Well-wooded areas, along permanent rivers. Fig trees for food. Nests in drier woodlands.	Common, local movements	0.89-4.0				2		
Parrots, lovebirds and parakeets									
Brown-necked Parrot *(Poicephalus fuscicollis)*	**Broadleaved woodland with large, emergent trees** and riverine forests.	Locally common	0.86-2.27				2		

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				Woodlands	Thickets				
Brown-headed Parrot (*Poicephalus cryptoxanthus*)	**Woodland and riverine forest.** Nests In hole in tree; up to 10m above ground. Gregarious in small groups in dead or leafy trees.		33.68-44.04			3	4		
Pittas & broadbills									
African Broadbill *(Smithornis capensis)*	**Forests and thickets;** common; easily overlooked when not displaying.	Uncommon to locally common	0.25-0.37						
Louries									
Knysna Turaco *(Tauraco corythaix)*	**Evergreen and riverine forest, dense thickets.**		0.26-2.56						
Purple-crested Turaco (*Tauraco porphyreolophus*)	**Closed woodland, particularly riverine woodland, secondary forest, patches where woodland intergrades with forest, coastal forest, dense scrub and thickets on termitaria**.Riverine forest, evergreen thickets, woodland, dense Acacia woodland, savanna, parks and gardens.		56.97+			4	12		1
Grey go-away-bird (*Corythaixoides concolor*)	**Open woodland,** *Acacia* woodlands, near water.	Common	0.25-3.07						
Coucals									
Black Coucal *(Centropus grillii)*	Moist grassland with **rank vegetation.**	Uncommon to locally common resident and intra-African migrant	0.37-0.56						
White-browed Coucal *(Centropus superciliosus)*	**Reedbeds and thickets, usually close to water.**	Common	46.35+						
Burchell's Coucal (*Centropus burchellii*)	**Rank and tangled growth. Reedbeds, marshes, and thickets, coastal bush. Along drainage lines, edges of wetlands.**		27.08-46.35			4	4		1
Cuckoos									
Thick-billed Cuckoo	**Riparian forests and woodland.**	Uncommon resident	0.38-0.5						

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				Woodlands	Thickets				
(Pachycoccyx audeberti)									
Red-chested Cuckoo (*Cuculus solitarius*)	**Forest and well-wooded habitats: riparian growth, thickets and evergreen forests**. Trees around habitation.	Common resident and intra-African migrant	9.79-15.74			1	1		
Klaas's Cuckoo (*Chrysococcyx klaas*)	**Forest, moist woodland and savanna.** Trees around habitation.	Common resident and intra-African migrant	5.83-10.33				3		
Diederik Cuckoo (*Chrysococcyx caprius*)	**Variety of habitats: from forest edge t**o semi desert. Not in forests and uncommon in mopane.	Common resident and intra-African migrant	0.81-3.42			2			
Black Cuckoo *(Cuculus clamosus)*	**Forest edges,** woodland riverine bush exotic plantations farmland, suburban areas. Acacia woodland, riparian thickets and **mixed Acacia woodland**.	Common resident and intra-African migrant	1.39-3.8			3	5		
Owls									
Western Barn owl (*Tyto alba*)	**Wide range of vegetation types. Northern woodlands. Needs large trees to roost. Nomadic owls moving in response to rodent population explosion.**	Common	3.46-6.63						
Southern White-faced Owl *(Ptilopsus granti)*	**Woodland, savanna, arid Acacia woodland, riverine bush.**	Common	0.72-1.6						
Spotted eagle-owl (Bubo africanus)	Broad range of habitats. Man-made structures. Rocky areas, **woodland, forest edge savanna,** semi desert. Towns.	Common	2.42-5.33			1			
African Wood Owl *(Strix woodfordii)*	**Evergreen and riverine forest, dense woodland, coastal bush,** pine plantations; **seldom in savanna.**	Common	10.74+						
African Barred Owlet *(Glaucidium capense)*	**Mature woodland, thickets, forest and forest edge.**	Locally common	0.85-2.17						
Nightjars									
Fiery-necked nightjar (*Caprimulgus pectoralis*)	**Dense broadleaved woodland, savanna, coastal bush** and alien plantations. **Ground, preferring areas where there is dense leaf litter.**	Common	2.68-7.7			1			

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				Woodlands	Thickets				
Square-tailed Nightjar *(Caprimulgus fossii)*	**Scrub with open sandy ground in savanna and riverine bush.** Eggs laid on bare ground among plant debris. Often under thorn bush.	Common	0.92-2.36						
Swifts and spinetails									
Mottled Spinetail *(Telacanthura ussheri)*	**Aerial, over savanna and woodland;** often along forested rivers. Breeds in hollow trees or vertical shafts; often **associated with baobabs**.		4.77+						
Bohm's Spinetail *(Neafrapus boehmi)*	**Aerial, over savanna and woodland; often near baobab trees**. Breeds in hollow trees or vertical shafts.	Locally common	0.59-1.25						
African Palm-Swift (*Cypsiurus parvus*)	**Governed by the distribution of the flabelliform palms,** nests underside dead leaves.	Common resident and local migrant	2.01-6.41				3		
Common Swift *(Apus apus)*	Aerial and wide ranging; often in large flocks; roosts on the wing. **Mostly open country,** but occurs almost anywhere.	Common Palearctic migrant	0.75-1.51						
Little Swift *(Apus affinis)*	**Over all vegetation types**: prefers open grasslands and Karoo, not high-altitude alpine grasslands. Occur over water and nests under dry overhangs.	Common resident	0.25-0.9					20	
White-rumped Swift (*Apus caffer*)	**Forage over open ground.** Cliffs. Anywhere: common in more humid south and east.	Common resident and intra-African migrant	3.79-8.1						
Mousebirds									
Speckled mousebird *(Colius striatus)*	**Forest, subtropical thicket and mesic woodland.** Ecotones: **Edges of forests and closed woodland, wooded drainage lines** and gardens.	Common	39.22-56.02			6	1		
Red-faced Mousebird *(Urocolius indicus)*	**Savanna woodlands, moist woodlands, shrubland. Avoiding forest and open grassland.**	Common resident	7.03-16.25						
Trogons									
Narina Trogon *(Apaloderma narina)*	Evergreen and riverine forests, **dense woodland,** moist Acacia woodland, **coastal bush**, valley woodland, wattle plantations. Nests in natural hole in tree or dead stump. Forages by sallying from perch, catching prey of leaves, branches or from air.	Fairly common resident	5.26-10.57						

BIRD	Biotope (Geographical area)	Status in Africa	Reporting rates	Woodland and Thicket Mosaic		Julbernardia-Brachystegia Woodland and Thicket Mosaic	Mixed Woodland and Thicket	Govuro River & floodplain	Coastal wetlands
				Woodlands	Thickets				
Hoopoe and woodhoopoes									
African Hoopoe *(Upupa africana)*	**Catholic use of habitats. Tall savanna Acacia woodland. Woodland.** Bare ground and short grass.	Common	3.18-14.3						
Green Wood-Hoopoe (*Phoeniculus purpureus*)	**Arboreal. Most woodland types. Edges of evergreen forests.**	Common	7-19.4						
Common Scimitarbill (*Rhinopomastus cyanomelas*)	**Tropical and subtropical arid woodland. Absent from closed canopy woodland.**	Common	26.51-38.06			4	3		
Kingfishers									
Malachite kingfisher (*Alcedo cristata*)	**Strictly aquatic environments – availability of fish. River and stream banks** – hung by trees, shrubs and recumbent riverine grasses and weedy vegetation. **Prefer well-vegetated, slow-flowing rivers and streams, but not with canopy closed over river. Sheltered shores, coastal lagoons, tidal estuaries, mangrove swamps.**	Common	0.25-0.6						
Woodland Kingfisher (*Halcyon senegalensis*)	**Well-developed woodland;** tall riverine *Acacia* stands & mopane; grass under-storey heavily grazed.	Common resident and intra-African migrant	0.52-1.22						
Brown-hooded Kingfisher (*Halcyon albiventris*)	**Edges of evergreen forests, woodland and riverine woodland.**	Common	37.67-50.56				2		
Striped Kingfisher (*Halcyon chelicuti*)	**Open woodlands, broadleaved**& *Acacia* mesic and arid conditions.	Common	23.93-37.63			4	2		
Pied kingfisher (*Ceryle rudis*)	**Aquatic environments – availability of fish.** Any water body with small fish, including **large rivers** and perennial streams, estuaries, lakes, temporarily flooded areas, rocky coasts and intertidal zone of coast. Less common along well-wooded, fast flowing streams.	Common	3.8-11.59					2	
Bee-eaters									
Little Bee-eater *(Merops pusillus)*	Semi-arid to high rainfall areas. **Open spaces to forage – low bushes or reeds. Savanna and light woodland.**	Common	24.89-35.12			2		1	2

BIRD	Biotope (Geographical area)	Status in Africa	Reporting rates	Woodland and Thicket Mosaic		Julbernardia-Brachystegia Woodland and Thicket Mosaic	Mixed Woodland and Thicket	Govuro River & floodplain	Coastal wetlands
				Woodlands	Thickets				
Swallow-tailed Bee-eater *(Merops hirundineus)*	Wide range: from semi-desert scrub to forest margins. Arid Acacia savanna, riverine trees and scrub, clearings and **edges of woodland.**	Common resident with local movements	3.99-12.36						
Blue-cheeked Bee-eater *(Merops persicus)*	Desert edge, near water. **Arid woodland areas.**	Locally fairly common Palaearctic migrant	0.41-0.8			4			
European Bee-eater (*Merops apiaster*)	**Variety of woodland and shrubby habitats**, avoids relatively mesic and arid conditions.	Common Palaearctic migrant	6.66-13.18			10	12		
Southern Carmine Bee-eater *(Merops nubicoides)*	**Open woodland & savannas**; floodplains & arid *Acacia* steppe; nests in freshly cut sand cliffs. Disperses to open grassy places in variety of woodland types.	Common resident and local migrant	0.52-1.42			15	1		
Rollers									
European Roller (*Coracias garrulus*)	**Woodlands, woodland** and grasslands. **Open woodland.**	**IUCN 2014 NT: Near-threatened;** Common Palaearctic migrant	0.25-0.45			6		1	
Lilac-breasted Roller *(Coracias caudatus)*	**Ecotone between light woodland and open grassy areas. Savanna and open woodland (broadleaved &*Acacia*)**	Common resident and local migrant	50.17-64.1			2	2		
Racket-tailed Roller *(Coracias spatulatus)*	**Tall woodland, especially miombo.**	Uncommon	0.41-0.85						
Purple roller *(Coracias naevius)*	**Uniform woodland and woodland (broadleaved &*Acacia*).**	Scarce to common resident and intra-African migrant	4.65-14.03						
Broad-billed Roller (*Eurystomus glaucurus*)	**Riverine forest and adjacent savanna.**	Locally common resident and intra-African migrant	11.88-18.79				1		

BIRD	Biotope (Geographical area)	Status in Africa	Reporting rates	Woodland and Thicket Mosaic		Julbernardia-Brachystegia Woodland and Thicket Mosaic	Mixed Woodland and Thicket	Govuro River & floodplain	Coastal wetlands
				Woodlands	Thickets				
Hornbills									
Southern Yellow-billed Hornbill *(Tockus leucomelas)*	**Variety of dry, open savanna woodlands (broadleaved &*Acacia*)**		0.25-4.43						
Crowned Hornbill *(Tockus alboterminatus)*	**Dense dry thorn thicket in lowland savanna, dense woodland, forest edge**. Primary and secondary forest and tall dense woodland; from patches of montane and coastal forests to linear strips of riverine and escarpment forests. Forages mainly in trees. Roosts communally on slender branches exposed from above; sheltered sites below canopy.	Common resident and local nomad	48.86+			5	12		
African Grey Hornbill (*Tockus nasutus*)	**Taller woodland (broadleaved &*Acacia*) in dry and humid savannas. Woodland.**	Common	0.25-3.07						
Trumpeter Hornbill *(Bycanistes bucinator)*	Forest, **dense woodland with tall trees**, riverine woodland. **Patches of warm, coastal, lowland forests,** especially along rivers. Lower altitudes - montane forests, in moist woodlands and mangroves, and along riparian forest strips in arid savanna. Mobile in search of fruit.	Common resident and local nomad	3.79-9.71			1	4		
Southern Ground-Hornbill *(Bucorvus leadbeateri)*	**Any woodland, savanna,** open grassveld, agricultural lands.	Scarce; maily confined to large reserves	0.25-0.71						
Barbets & tinker barbets									
Yellow-rumped Tinkerbird *(Pogoniulus bilineatus)*	**Woodland: broad-leaved.** Forages like warbler in vegetation. Nests in hole excavated in dead trunk or underside of sloping branch of tree. Perches in high tree while calling.	Common	18.5-39.23						
Yellow-fronted Tinkerbird (*Pogoniulus chrysoconus*)	**Broad-leaved woodland, moist woodland – mixed woodland** and rocky hills.	Common	5.62-13.54			12	12		
Acacia Pied Barbet *(Tricholaema leucomelas)*	Arid savannas, soft-wooded trees (*Acacia*) present, wooded drainage lines in grassland.		0.25-4.11						

BIRD	Biotope (Geographical area)	Status in Africa	Reporting rates	Woodland and Thicket Mosaic		Julbernardia-Brachystegia Woodland and Thicket Mosaic	Mixed Woodland and Thicket	Govuro River & floodplain	Coastal wetlands
				Woodlands	Thickets				
Black-collared Barbet (*Lybius torquatus*)	**Miombo, moist wooded areas**, along east facing slopes of the escarpment, **eastern coastal areas**. Drier savannas: restricted to riverine vegetation. **Coastal bush, woodland,** forest edge, riverine forest, parks, gardens.	Common	22.51-38.57			7	9		
Crested Barbet (*Trachyphonus vaillantii*)	**Savanna, woodland and thickets – broadleaved woodlands. Mixed woodland** and *Acacia* habitats. Acacia woodland, **thickets in woodland,** riverine woodland, exotic plantations, parks, gardens.	Common	2.08-13.65						
Honeyguides & honeybirds									
Scaly-throated Honeyguide *(Indicator variegatus)*	**Canopy of evergreen and taller riverine forest, woodland**, thickly wooded valleys, exotic plantations.	Scarce to locally common	0.77-1.6						
Greater Honeyguide (*Indicator indicator*)	**Arid and moist woodland: Wide range of woodland types.**	Scarce to locally common	1.68-3.84				4		
Lesser honeyguide *(Indicator minor)*	**Wide range of wooded habitats: savannas with scattered trees to forest fringes**, riverine woodland; exotic plantations, gardens.	Common	0.25-0.45			1			
Woodpeckers									
Golden-tailed Woodpecker (*Campethera abingoni*)	**Wide spectrum of woodland and savanna types.**	Common	21.82+			2	1		
Cardinal Woodpecker (*Dendropicos fuscescens*)	**Wide variety of woodland and savanna.**	Common	18.05-27.65			2			
Bearded Woodpecker *(Dendropicos namaquus)*	**More arid savanna types. Savanna and woodland, tall trees in open park-like settings.** Broadleaved woodland with tall trees and dead ones.	Common	2.89-7.71						
Larks									

BIRD	Biotope (Geographical area)	Status in Africa	Reporting rates	Woodland and Thicket Mosaic		Julbernardia-Brachystegia Woodland and Thicket Mosaic	Mixed Woodland and Thicket	Govuro River & floodplain	Coastal wetlands
				Woodlands	Thickets				
Rufous-naped Lark (*Mirafra africana*)	Variety of habitats: bare patches, sparse grass cover, suitable perches. Open grassland with termitaria or scattered bushes and bare patches, **open savanna woodland with sparse grass cover between trees**, bare patches in fallow fields and cultivated lands.	Common and widespread	0.97-4.98			3			
Flappet Lark (*Mirafra rufocinnamomea*)	**Woodlands: clearings or drainage lines.**	Common	19.58+			3	18		
Fawn-coloured Lark *(Calendulauda africanoides)*	**Scrub and savanna, usually with sandy soils.**		0.25-0.78						
Dusky Lark *(Pinarocorys nigricans)*	**Open woodland and savanna;** often in recently burnt areas.	Fairly common intra-African migrant	0.37-0.61						
Swallows & martins									
Sand Martin *(Riparia riparia)*	Moist open grassveld, **inland waters, reedbeds**, irrigated pastures and crops.	Locally common Palearctic migrant	0.33-0.49						
Grey-rumped Swallow *(Pseudhirundo griseopyga)*	Dry or burnt grassland, bare ground at edges of vleis, **clearings in woodland**, fallow lands, polo fields, golf courses.	Locally common resident and Intra-African migrant	0.48-1.08						
Barn Swallow (*Hirundo rustica*)	All habitats: more common in higher-rainfall eastern half: moister grassland, and **woodlands**.	Abundant Palearctic migrant	25.6-33.01			29	24		
Wire-tailed Swallow *(Hirundo smithii)*	**Always associated with water bodies, including large rivers, streams, flood plains**, adjacent open grassland, **open miombo,** mopane woodlands, Acacia woodland and forest edges. Rivers, streams and dams, usually in woodland and around buildings. Breeds widely in lower-lying mesic savannas but is confined to the vicinity of permanent water, especially larger rivers.	Common resident and intra-African migrant	0.25-0.84					2	
Lesser Striped Swallow *(Cecropis abyssinica*)	**Variety of woodland and savanna habitats.**	Common resident and intra-African migrant	0.25-1.44						

BIRD	Biotope (Geographical area)	Status in Africa	Reporting rates	Woodland and Thicket Mosaic		Julbernardia-Brachystegia Woodland and Thicket Mosaic	Mixed Woodland and Thicket	Govuro River & floodplain	Coastal wetlands
				Woodlands	Thickets				
Mosque Swallow *(Cecropis senegalensis)*	**Open woodland, often near rivers and especially near baobabs.**	Locally common	5.69-12.71				2		
Common House-Martin *(Delichon urbicum)*	Wide variety of habitats: grassland, **savanna woodland** and cultivated areas. Hilly open country.	Common Palearctic migrant	0.25-0.46						
Black Saw-wing (*Psalidoprocne pristoptera)*	**Streams, vleis and clearings in forest, dense woodland** and exotic plantations.	Locally common	2.17-7.16						
Cuckooshrikes									
White-breasted Cuckooshrike *(Coracina pectoralis)*	**Tall woodlands, especially miombo and riverine forests.**	Uncommon to locally common	0.25-0.5						
Black Cuckooshrike (*Campephaga flava*)	**Canopy of moist woodlands, both broadleaved** and *Acacia* woodland. Moist, arid and riparian woodlands.	Locally common resident and local migrant	9.86-16.15						
Drongos									
Square-tailed Drongo (*Dicrurus ludwigii)*	**Mid-stratum of evergreen forest.**	Locally common	0.45-1.08						
Fork-tailed Drongo (*Dicrurus adsimilis*)	**Wide range of vegetation types: Open bush and woodland; edges of forest patches;** Highveld – alien trees.	Common	15.05-49.45			4	2		
Orioles									
Eurasian Golden Oriole *(Oriolus oriolus)*	**Lush foliage in shady tree canopies. Broadleaved trees.** Riverine strips.	Fairly common Palearctic migrant	0.37-0.56						
Black-headed Oriole (*Oriolus larvatus*)	**Moist woodland; evergreen** or lightly deciduous. Afro-montane Forests. Overfly extensive unsuitable habitat – grassveld.	Common	38.41-50.87			1	9		
Crows and ravens									
Pied Crow (*Corvus albus*)	**Wide variety of biomes: unrelated to vegetation,** not in southern Kalahari.	Common	59.72				1		
Bulbuls									

BIRD	Biotope (Geographical area)	Status in Africa	Reporting rates	Woodland and Thicket Mosaic		Julbernardia-Brachystegia Woodland and Thicket Mosaic	Mixed Woodland and Thicket	Govuro River & floodplain	Coastal wetlands
				Woodlands	Thickets				
Dark-capped Bulbul (*Pycnonotus tricolor)*	**Wide range of habitats: moister woodland and savanna,** riverine bush, **forest edge & regenerating forest (not inside)** dense montane scrub, scrubby vegetation, alien plantations. Not in open grassland.	Abundant	95.84+			16	10		1
Sombre Greenbul *(Andropadus importunus)*	**Forest, coastal and riverine bush, dense thicket.**		70.08+			10	19		3
Yellow-bellied Greenbul *(Chlorocichla flaviventris)*	**Thickets, dense woodland and forest edge.**	Common	46.68+			1	3		
Terrestrial Brownbul *(Phyllastrephus terrestris)*	**Evergreen forest, mainly in lowlands, riverine bush and forest, dense thickets.**		26.27+				13		
Nicator									
Eastern Nicator *(Nicator gularis)*	Riverine forests, **thickets in woodland. Skulks in tangled and dense vegetation, forages in low vegetation**, on ground among leaf litter. Nest well-concealed, low-down in fork of dense bush. Sing from concealed perch in upper branches of trees.		30.41+			2	13		
Tits									
Grey Penduline Tit *(Anthoscopus caroli)*	**Well-developed broadleaved woodland.**	Common	0.52-1.14						
Southern Black Tit (*Parus niger*)	**Broadleaved woodlands.**		38.74-50.01			7	2		
Babblers									
Arrow-marked Babbler (*Turdoides jardineii*)	**Thickets or strips of denser vegetation** along seasonal drainage lines. **Broadleaved and mixed woodlands.**	Common	0.25-3.96			3	4		
Thrushes									
Kurrichane Thrush (*Turdus libonyana*)	**Woodland and thickets. Moist broadleaved and mixed woodland habitat.**	Common	13.23-23.51						
Robins									

BIRD	Biotope (Geographical area)	Status in Africa	Reporting rates	Woodland and Thicket Mosaic		Julbernardia-Brachystegia Woodland and Thicket Mosaic	Mixed Woodland and Thicket	Govuro River & floodplain	Coastal wetlands
				Woodlands	Thickets				
White-throated Robin-Chat *(Cossypha humeralis)*	**Thickets that lines dry water courses in the woodland and Acacia woodland. Open woodland – closed thickets under large shade trees.** Termite mounds & fire-free places on rocky hills.		0.25-1.0						
Red-capped robin-chat (*Cossypha natalensis*)	**Evergreen forests and woodland, riparian growth, deciduous thickets, riverine forests**. Keeps to undergrowth of forests, forages on ground (dusk), moves seasonally to higher forest strata when fruit ripen. Sing from low perch. In general, favours linear habitats (eg along wet and dry watercourses).	Common	0.43-1.1				1		
Scrub-Robin									
Bearded Scrub Robin *(Erythropygia quadrivirgata)*	Lowveld and riverine mixed **woodland.Forests and thickets,** especially with thorny and grassy tangles along streams and dongas. Forages in low bushes or by hopping on ground scratching among leaf litter. Nests in crevice or cavity in tree or behind loose bark, 1-3m above ground. Inactive in heat of day, keeping to dense cover.		0.38-0.63						
Red-capped robin-chat (*Cossypha natalensis*)	**Evergreen forests and woodland, riparian growth, deciduous thickets, riverine forests. Keeps to undergrowth of forests, forages on ground (dusk),** moves seasonally to higher forest strata when fruit ripen. Sing from low perch. In general, favours linear habitats (e.g. along wet and dry watercourses).						1		
White-browed Scrub Robin *(Erythropygia leucophrys)*	**Woodland and woodland habitats. Patches of dense undergrowth in Acacia woodland and broadleaved woodland.**	Common	53.17+				2		
Warblers									
African reed-warbler (*Acrocephalus baeticatus*)	Usually in **moist or wet areas, including edges of reeds, bulrushes, sedges, tall herbs and forbs, and tall grass and shrubs along river banks**. Marshland: Outskirts of reed-beds where there is a mixture of grass, sedges, rushes and tall willow herbs.	Common Intra-African migrant						1	
Marsh Warbler *(Acrocephalus palustris)*	**Thickets and marshland: Fringes of reedbeds, waterside weeds, woody thickets** on anthills and leafy vegetation along rivers. Dense lush thickets with rank herbaceous undergrowth, usually away from water.	Common Palaearctic migrant	3+					1	

BIRD	Biotope (Geographical area)	Status in Africa	Reporting rates	Woodland and Thicket Mosaic		Julbernardia-Brachystegia Woodland and Thicket Mosaic	Mixed Woodland and Thicket	Govuro River & floodplain	Coastal wetlands
				Woodlands	Thickets				
Lesser swamp warbler (*Acrocephalus gracilirostris*)	**Marshland: Phragmites over water. Reeds and bulrushes in standing water in estuaries, lagoons, rivers, marshes.**	Common	0.25-0.48						
Willow Warbler *(Phylloscopus trochilus)*	**Any woodland: edges of evergreen forests**, savannas, gardens, parks, exotic plantations. Anywhere with trees and bushes ie adequate tree cover; Adequate tree cover.	Abundant Palearctic migrant	0.25-0.66						
Apalis									
Yellow-breasted Apalis *(Apalis flavida)*	**Riverine forest, moist woodland, mixed woodland, mature Acacia woodland, thickets, middle to lowland evergreen forest, regenerating scrub.**	Common	43.22+			1	7		
Rudd's Apalis *(Apalis ruddi)*	Dense Acacia thicket and mixed woodland. Tangled riparian cover. Dense dry sandy terrain woodland. Sand and riverine forests. **Well-developed undergrowth.**		1.89-6.69						
Camaroptera									
Green-backed Camaroptera *(Camaroptera brachyura)*	**Evergreen forests:** lowland, riparian, montane and temperate forest. Small patches of forest or **dense secondary growth and thickets.**		41.31+			1	8		
Grey-backed Camaroptera *(Camaroptera brevicaudata)*	**Thickets and dense cover in drier deciduous woodlands.**	Common	26.03-41.31						
Wren-Warbler									
Stierling's Barred Warbler (*Calamonastes stierlingi*)	**Large-leaved woodland; thickets on termite mounds.** Forages mostly on or near ground, disturbed, ascend to canopy. Nests of spider webs in drooping leaves.		11.38-21.58						
Crombec									
Red-faced Crombec *(Sylvietta whytii)*	**Miombo woodland**, edges of lowland evergreen and riverine forests.		0.94-2.16						
Long-billed Crombec (*Sylvietta rufescens*)	**Woodland; scrubland. Catholic in use of different woodland** – not found in unwooded grassland and forest interiors.	Common	6.68-13.28			2			
Cisticolas									

BIRD	Biotope (Geographical area)	Status in Africa	Reporting rates	Woodland and Thicket Mosaic		Julbernardia-Brachystegia Woodland and Thicket Mosaic	Mixed Woodland and Thicket	Govuro River & floodplain	Coastal wetlands
				Woodlands	Thickets				
Rattling Cisticola (*Cisticola chiniana*)	**Tree savanna** – Acacia woodland where grassland interspersed with trees & thickets or shrub. **Fringes of dense woodland and in coastal scrub patches.**	Common to abundant	63.25+			13	20		2
Rufous-winged Cisticola *(Cisticola galactotes)*	**Acacia savanna. patches of bush** in open grassland and karroid shrublands, regenerating woodland on old cultivated lands and in gardens.		0.86-3.13						
Croaking Cisticola (*Cisticola natalensis*)	**Rank open moist grassland, edges of vleis, usually with scattered bushes or trees; also in clearings and edges of forest** and regenerating secondary growth.	Common	0.25-0.42					1	
Neddicky (*Cisticola fulvicapilla*)	Dune scrub, in scrub and rank grass on hill slopes, **on the edges of woodlands** and plantations, in secondary growth and in Acacia woodland savanna. **Under-storey of woodlands.** Tolerant of alien vegetation. Avoid dense grassland – cannot feed on ground level. Especially Valley Woodland.	Common	39.93+			15	10		2
Zitting Cisticola *(Cisticola juncidis)*	Natural grasslands and weedy areas, **edges of vleis, dams, pans,** and salt marshes. *Eragrostis* grass pastures, cereal cropland, edges of cultivation, fallow lands, and any open areas with rank grass. **Associated with wetlands.**	Common						2	1
Prinias									
Tawny-flanked prinia (*Prinia subflava*)	Marshland: **In reeds and sedges in vleis. Relatively tall and dense patches of vegetation:** rank grass on edges of roads or farmlands, drainage lines and edges of dams and rivers, scrubby patches within woodland savannas, secondary thickets, reeds and sedges in wetlands, ecotones between grassland and dense, tall woodlands and forests. Suburban and rural gardens.	Common	60.95+			8	8		
Flycatchers									
African Paradise Flycatcher (*Terpsiphone viridis*)	**Woodlands: evergreen forests and broadleaved woodlands. Riverine strips, riparian vegetation.**	Common resident and intra-African migrant	7.58-15.24				1		
Pale Flycatcher *(Bradornis pallidus*)	**Mainly broad-leaved woodland and savanna with well-developed understory.** Less often Acacia savanna. In fork of densely foliaged tree, near trunk or far out on branch, 1.5-4m above ground. Perches on lower outer	Locally common	15.29+			5			

BIRD	Biotope (Geographical area)	Status in Africa	Reporting rates	Woodland and Thicket Mosaic		Julbernardia-Brachystegia Woodland and Thicket Mosaic	Mixed Woodland and Thicket	Govuro River & floodplain	Coastal wetlands
				Woodlands	Thickets				
	branch at edge of clearing, dropping to ground to catch prey.								
Southern Black Flycatcher (*Melaenornis pammelaina*)	**Woodlands near surface water; taller vegetation,** not necessarily clumped, open space at ground level.	Common	20.15-32.01				1		
Spotted Flycatcher *(Muscicapa striata)*	**Open woodland;** habitat where bare branches alternate with open space. Open habitat with less well-structured middle and lower stratum.	Common Palearctic migrant	9.41-16.5			1	1		
Ashy flycatcher *(Muscicapa caerulescens)*	**Edges of lowland evergreen forests,** upper strata of riverine woodland, **thickets in drier woodland, moister savanna**, wooded gorges.	Common	1.97-5.07						
Grey Tit-Flycatcher *(Myioparus plumbeus)*	**Dense vegetation, upper strata.** Riverine strips. Holes in trees for nests.	Locally common	0.44-0.94			1	1		
Batis									
Woodwards' Batis *(Batis fratrum)*	**Mature forests** with ironwood trees		0.25-0.38				1		
Longclaws									
Yellow-throated Longclaw (*Macronyx croceus*)	**Rank grass, edges of vleis, swampy drainage lines, with scattered trees and bushes or in savanna or light woodland.**		2.73-10.65			4			
Pipits									
African Pipit *(Anthus cinnamomeus)*	Grasslands: open stretches fringing pans, lightly wooded savanna, dry floodplains with short vegetation and recently burnt open veld. Avoids dense rank growth. Fallow fields.	Common	0.99-5.35						
Shrikes									
Red-backed Shrike *(Lanius collurio)*	**Medium dense Acacia woodland. Open habitats with fewer smaller trees for males; females – skulk in taller woodland.** Fallow land with coppicing Acacia bushes, pockets of scrub.	Common Palearctic migrant	10.86-19.41			4	6		
Brubru *(Nilaus afer)*	**Savanna woodlands**. Acacia and **broadleaved woodland. From tall, well-developed, mixed woodlands, forest edges, scattered scrubby areas.**	Common	13.89-22.11			2	2		2

BIRD	Biotope (Geographical area)	Status in Africa	Reporting rates	Woodland and Thicket Mosaic		Julbernardia-Brachystegia Woodland and Thicket Mosaic	Mixed Woodland and Thicket	Govuro River & floodplain	Coastal wetlands
				Woodlands	Thickets				
Black-backed puffback (*Dryoscopus cubla*)	**Indigenous woodland and forest. Dense woodland.**	Common	69.8+			12	9		2
Blackcrowned Tchagra (*Tchagra senegala*)	**Scrub and woodland habitats. Mesic broadleaved woodlands.**	Common	56.94+			12	5		2
Brown-crowned Tchagra *(Tchagra australis)*	**Woodland and scrub – restricted to undergrowth. Acacia-, mopane- and broadleaved woodland.**	Common	40.9+			5	5		
Southern Boubou *(Laniarius ferrugineus)*	**Dense tangled undergrowth, thickets along watercourses in wide range of woodland types; all woodlands** and forest types. Forests and exotic plantations. Grasslands - thickets along watercourses.		62.68+			27	22		1
Orange-breasted Bushshrike *(Chlorophoneus sulfureopectus)*	**Woodland. Mixed riparian woodland.**	Common	8.89-16.46			2	11		
Gorgeous Bushshrike *(Chlorophoneus quadricolor*)	**Dense thickets at edges of lowland** to mid-altitude evergreen forest and fairly dry woodland; dune forest; riverine bush, **tangles of secondary growth**. Forages low down in undergrowth and on ground, creeps into densest vegetation when disturbed. Nest 0.6-1.5m (usually 1m) above ground in tangled creeper or dense bush, well hidden.		32+			3	12		
Grey-headed Bushshrike *(Malaconotus blanchoti)*	**Woodland of medium density.**	Common	21.69-30.86			1	2		
White-crested Helmet-Shrike *(Prionops plumatus)*	**Deciduous broadleaved woodland – breeding. Otherwise – Acacia savanna.**	Common resident local movements	10.79-20.62			4			
Retz's Helmet-Shrike *(Prionops retzii)*	**Deciduous woodlands** when breeding. Non-breeding: disperses into **Acacia savanna and other dry woodland types.** Forages mainly on larger branches and on trunks of trees. Nests 3-20m above ground on stout horizontal branch of large tree (especially *Pterocarpus rotundifolia*).	Common	2.39-5.68				4		

BIRD	Biotope (Geographical area)	Status in Africa	Reporting rates	Woodland and Thicket Mosaic		Julbernardia-Brachystegia Woodland and Thicket Mosaic	Mixed Woodland and Thicket	Govuro River & floodplain	Coastal wetlands
				Woodlands	Thickets				
Starlings									
Black-bellied Starling *(Notopholia corruscus)*	**Canopy of lowland evergreen forest and adjacent dense woodland.** Forages mainly in canopy of trees, seldom comes to ground. In natural hole or old nest hole of barbet or woodpecker in tree, fairly high above ground.		3.44-9.03						
Greater Blue-eared Starling *(Lamprotornis chalybaeus)*	**Open woodland, savanna,** riverine forest, woodland. Usually with fairly tall dense ground cover. Forages mostly by running about on the ground. Nests in natural hole in tree. Roosts communally in trees or reedbeds.	Common	1.03-7.14						
Violet-backed Starling (*Cinnyricinclus leucogaster*)	**Open woodlands; mixed broadleaved woodlands.**	Common resident and intra-African migrant	0.94-5				1		
Wattled Starling *(Creatophora cinerea)*	Dry grasslands and **dry open country;** nests in thorn trees.	Common resident and nomad	0.25-0.72						
Sunbirds									
Plain-backed Sunbird *(Anthreptes reichenowi)*	**Coastal evergreen forest, mangrove and miombo woodland.** Coastal forests, tall Lebombo ironwood. In vegetation, **keeping to deep cover.**	**IUCN (2014): Near Threatened.** In southern Mozambique, it is uncommon (total population fewer than 500 birds) and declining.	0.42-0.58						
Grey Sunbird *(Cyanomitra veroxii)*	**Mainly canopy and sub-canopy of coastal evergreen forests** and well-developed valley woodland, inland to patches of Afro-montane forests. Open woodland.		1.73-5.53						
Amethyst Sunbird *(Chalcomitra amethystina)*	**Broadleaved woodland types.** Gardens and stands of alien trees.	Common	0.25-0.91			1			
Scarlet-chested Sunbird *(Chalcomitra senegalensis)*	**Woodland, savanna,** riverine bush, gardens.	Common	43.25+						

BIRD	Biotope (Geographical area)	Status in Africa	Reporting rates	Woodland and Thicket Mosaic		Julbernardia-Brachystegia Woodland and Thicket Mosaic	Mixed Woodland and Thicket	Govuro River & floodplain	Coastal wetlands
				Woodlands	Thickets				
Collared Sunbird *(Hedydipna collaris*)	**Riverine and lowland evergreen forest; coastal bush, especially with tangled creepers**. Nest suspended to drooping branch of leafy tree or shrub at edge of forest.	Common	25.62+						
Neergaard's Sunbird *(Cinnyris neergaardi)*	**It is restricted to the coastal belt, mixed woodland away from the coast. Woodland, especially dry, dense forest on sandy soil. It also inhabits coastal scrubland.**	**IUCN 2014 NT: Near-threatened.** In southern Mozambique, the species's coastal forest habitat is highly threatened, particularly by commercial logging and afforestation with non-native tree species.	0.46-0.97						
White-bellied Sunbird *(Cinnyris talatala*)	**Wide range of woodland and bush types – moist woodlands. Open savanna.**	Common	27.01-42.26						
Marico Sunbird *(Cinnyris mariquensis)*	**Acacia Acacia woodland. Woodlands** dominated by Acacia. Aloe.		0.25-0.79						
Purple-banded Sunbird *(Cinnyris bifasciata)*	**Woodland, moist savanna and coastal shrub.**	Common	28.57+						
White-eyes									
African Yellow White-eye *(Zosterops senegalensis)*	**Woodland, scrub, forest** and gardens.	Common	0.25-0.62						
Sparrows									
Southern Grey-headed Sparrow *(Passer diffusus)*	**Various woodland types: broadleaved** and *Acacia*. Alien tree populations.		14.39-23.09				3		

BIRD	Biotope (Geographical area)	Status in Africa	Reporting rates	Woodland and Thicket Mosaic		Julbernardia-Brachystegia Woodland and Thicket Mosaic	Mixed Woodland and Thicket	Govuro River & floodplain	Coastal wetlands
				Woodlands	Thickets				
Northern Grey-headed Sparrow *(Passer griseus)*	**Diversity of fairly open habitats** up to 2500m; commensal with man.	Common	14.39-23.09						
Yellow-throated petronia*(Gymnoris superciliaris*)	**Broadleaved woodland and savanna.**	Locally common				2			
Weavers									
Lesser Masked Weaver *(Ploceus intermedius)*	**Acacia savanna, woodland, dry woodland, riverine trees, usually near water.** Forages mostly in canopies of trees and by probing flowers. Nests suspended from branch on inside or outside of tree, often over water up to 18m above ground. Sometimes also in reeds or low bushes. In small colonies of 10-20 nests.		0.43-0.82				1		
Spectacled Weaver (*Ploceus ocularis*)	**Tall woodland or other tall vegetation, edge of forest patches and in riverine woodland and thickets.**	Fairly common resident.	12.37-22			1	2		
African Golden Weaver *(Ploceus xanthops)*	**Rank vegetation, reeds and bushes along streams and rivers,** forest edge.	Locally common	0.25-0.46					2	
Southern Masked weaver (*Ploceus velatus*)	**Nests in reeds, bushes and trees along watercourses. Also in trees near homesteads and in other vegetation away from water.**	Common and widespread	0.25-5.04			1	1	1	
Village weaver *(Ploceus cucullatus)*	**Near water; different woodland vegetation types** along river valleys. Open Acacia woodland, but not in forests and treeless grasslands. **Edges of riverine forests, usually near water. Wide range of woodland types along river valleys.**	Uncommon	8.2-14.45						
Dark-backed Weaver *(Ploceus bicolor)*	**Forest and dense woodland.**	Locally common	10.81-23.45						
Red-headed Weaver *(Anaplectes melanotis)*	**Woodland, woodland, savanna, usually not far from water.** Forages off foliage. Nest attached to branch of tree, usually several meters from the ground.	Locally common	0.79-3.24						
Thick-billed weaver *(Amblyospiza albifrons)*	Forest types: riparian forest**, reeds or bulrushes near forests**. In breeding season at **marshes, rivers, with rank grass, reedbeds and papyrus.**	Common	0.25-5.2						

BIRD	Biotope (Geographical area)	Status in Africa	Reporting rates	Woodland and Thicket Mosaic		Julbernardia-Brachystegia Woodland and Thicket Mosaic	Mixed Woodland and Thicket	Govuro River & floodplain	Coastal wetlands
				Woodlands	Thickets				
Quelea									
Red-billed Quelea (*Quelea quelea*)	**Most vegetation types. Woodlands and grasslands.** Annual grasses and surface water.	Common nomad	1.32-5.72						
Widows									
Fan-tailed Widowbird *(Euplectes axillaris)*	**Open moist grassland, edges of vleis, rank grassy hillsides, marshes,** edges of sugarcane fields.	Common	0.25-0.99			1		1	2
White-winged Widowbird *(Euplectes albonotatus)*	**Woodland and grassland: rank growth on the margins of open grassy areas, usually near water.** Overgrown edges of cultivated areas. Seasonally inundated floodplains and tall grasslands.	Common	0.25-0.72						
Bishops									
Yellow bishop (*Euplectes capensis)*	Alpine Grassland: scrubby fringes of Afro-montane forest. Rank grass or marshy places on steep slopes or in valley bottoms in mountainous or hilly country, usually with scattered trees and bushes, often at **edge of woodland** or patch of forest; also edges of sugarcane and cotton. Damp grassy areas and heathlands.		0.25-0.6				3		
Pytilia									
Green-winged Pytilia *(Pytilia melba)*	Acacia savanna; open grassland close to cover; mixed thorn and **broadleaved savanna with thickets**. Broadleaved woodland with grassy patches and thickets or thorny shrubs.	Common	4.68-11.3						
Twinspots									
Pink-throated Twinspot *(Hypargos margaritatus)*	Arid woodland and grassland. **Dry thick scrub, thorny tangles and thickets in woodland. Palm savanna and edges of evergreen forest, including sand forests**. Dense thickets of Acacia.		0.48-1.25				3		
Mannikin									
Bronze Mannikin *(Lonchura cucullata)*	**Edge habitats; dependent on water. Moist wooded areas.**	Abundant	29.37-45.31			8			
Red-backed Mannikin *(Lonchura nigriceps)*	Riverine forest, **moist thickets, edges of coastal, lowland to midland evergreen forest**, sometimes with tall grass.		0.45-0.97						

BIRD	Biotope (Geographical area)	Status in Africa	Reporting rates	Woodland and Thicket Mosaic		Julbernardia-Brachystegia Woodland and Thicket Mosaic	Mixed Woodland and Thicket	Govuro River & floodplain	Coastal wetlands
				Woodlands	Thickets				
Firefinches & bluebills									
Red-billed Firefinch *(Lagonosticta senegala)*	**Woodland, savanna, riverine and thicket vegetation – near water.**	Common	0.25-0.62						
Jameson's Firefinch *(Lagonosticta rhodopareia)*	**Broadleaved woodlands** – open grassy areas with thickets; watercourses. Rank grass, **edges of thickets,** secondary growth, cultivated lands, edges of riverine forest, bushy gullies and rocky hillsides.	Common	1.11-5.36				2		
Waxbills									
Common Waxbill (*Estrilda astrild*)	**Rank grasslands, reedbeds**, croplands, coastal estuaries, **inland wetlands** and dams, **along ephemeral and permanent rivers.**	Common	5.13-11.54				24		8
Blue Waxbill (*Uraeginthus angolensis*)	**Arid thorn savannas**. Reliable on availability of surface water.	Common	69.63-81.26			4	5		
Whydahs									
Pin-tailed Whydah (*Vidua macroura*)	**Wide range of open mesic habitats**. Edge habitats with man. Wetlands.	Common	0.84-4.36			2	3		
Long-tailed Paradise-Whydah *(Vidua paradisaea)*	**Semi-arid woodlands and savannas** – thorn savanna. Open Acacia savanna with large grassy areas. Prominent trees.	Common with local movements	4.01-8.91			1	4		
Canaries									
Lemon-breasted Canary *(Crithagra citrinipectus)*	**Arid woodland and palm savanna**		0.43-0.63						
Yellow-fronted Canary*(Crithagra mozambicus*)	**Wide variety of woodland habitats**: lightly wooded Acacia woodland, **moist broadleaved woodlands, along river courses.** Avoid *Acacia* woodlands. Alien plantations.	Common to abundant	6.05-21.66			6	7		
Streaky-headed Seedeater *(Crithagra gularis)*	Vegetation associated with mountains and hilly topography: wooded valleys. **Well-wooded areas; drier deciduous woodland and miombo.** Avoids open grassland, arid *Acacia* woodland. Edges of evergreen forests and scrub on mountain slopes.		0.25-0.96						
Buntings									

BIRD	Biotope (Geographical area)	Status in Africa	Reporting rates	Woodland and Thicket Mosaic		Julbernardia-Brachystegia Woodland and Thicket Mosaic	Mixed Woodland and Thicket	Govuro River & floodplain	Coastal wetlands
				Woodlands	Thickets				
Golden-breasted Bunting (*Emberiza flaviventris*)	**Open broadleaved and mixed woodlands and savanna.**	Common	16.67-29.41			5			
Cabanis's Bunting *(Emberiza cabanisi)*	**Woodland and moist savanna.**	Locally common	0.38-0.61						

APPENDIX D

Mammals

MAMMALS: Available habitat, expected occurrence and observed presence of mammals during the survey (Monadjem, et al, 2010; Skinner, & Smithers, 1990. Mills, & Hes, 1997).

Different biotopes surveyed:

Vegetation/Habitat Types:

1. Julbernardia-Brachystegia Woodland and Thicket Mosaic
2. Mixed Woodland and Thicket
3. Govuro River and floodplain
4. Coastal wetlands

Listed below are mammal expected to occur in the available natural habitats of the study area (see table above). The words in**bold font** illustrates the qualifying habitat (preferred habitat) for each species, and the *underlined italics* indicate the disqualifying habitat (the reason why it is unlikely to find the mammal in the surveyed biotopes). The shaded cells indicate the biotope that incorporates the preferred habitat, and the number inside a cell gives the number of individuals or definite signs detected during surveys.

Mammal	Habitat	Status (Mozambique IUCN)	Woodland and Thicket Mosaic		Julbernardia-Brachystegia Woodland and Thicket Mosaic	Mixed Woodland and Thicket	Govuro River & floodplain	Coastal wetlands
			Woodlands	Thicket				
Order: Insectivora								
Family: Soricidae								
Tiny musk shrew (*Crocidura fuscomurina*)	**All latitudes, wide tolerance. Terrestrial. Cover such as debris, fallen trees, wood piles or dense grass clumps.**	**Data deficient**						
Lesser red musk shrew (*Crocidura hirta*)	**In damp situations along rivers and streams. Low bushes, dense undergrowth, piles of debris and fallen logs.**	**Data deficient**			**1**		**1**	
Family: Chrysochloridae								
Yellow golden mole (*Calcochloris obtusirostris*)	**Sandy soils in woodland savanna and coastal sand dunes. Makes subsurface foraging runs that connects with deeper burrows, containing nesting chambers, usually located under the bases of trees.**	**Least concern. A widespread species in a region**			**8**	**3**		
Family: Pteropodidae								

Mammal	Habitat	Status (Mozambique IUCN)	Woodland and Thicket Mosaic		Julbernardia-Brachystegia Woodland and Thicket Mosaic	Mixed Woodland and Thicket	Govuro River & floodplain	Coastal wetlands
			Woodlands	Thicket				
Wahlberg'sepauletted fruit bat (*Epomophorus wahlbergi*)	Tropical forests and evergreen riverine forests; forests and forest edges in dryer savanna areas, thickets where there are fruit-bearing trees. Penetrate up river valleys carrying evergreen forests. Hang during day in dense canopy of large evergreen trees. Travel several kilometres each night to reach fruiting trees.	Least concern.						
Egyptian rousette (*Rousettus aegyptiacus*)	Almost all habitats. Totally dependent on the presence of caves. Roosts gregariously in caves. Distribution is influenced more by the availability of suitable roosting sites than vegetation associations. Rely on fruiting trees. Nomadic.	Least concern.						
Family: Emballonuridae								
Mauritian tomb bat (*Taphozous mauritianus)*	Savanna woodlands: open habitats, avoiding closed forests. Vertical surfaces of tree trunks, rock faces - in shade.	Least concern.						
Family: Molossidae								
Little free-tailed bat *(Chaerephon pumilus)*	*Rocky environment with an abundance of crevices. Narrow cracks in rocks and trees.*	Least concern.						
Ansorge's free-tailed bat (*Chaerephon ansorgei)*	Dry woodland savanna, vicinity of rugged hills and mountain ranges with rocky cliffs and precipices. Natural roosts - narrow cracks in rocks, especially on cliff faces. Buildings; high level bridges.	Least concern.						
Angola free-tailed bat *(Mops condylurus*)	Catholic in habitat requirements. Narrow crevices in rock faces and caves; hollows in trees.	Least concern.						
Family: Vespertilionidae								
Natal long-fingered bat (*Miniopterus natalensis*)	Temperate of sub-tropical. Savannas and grassland. Cave dependent. Migrate between caves.	Least concern.						
Variegated butterfly bat (*Glauconycteris variegata*)	Savanna woodland. Open woodland and not forests. Open bush country. Riverine and coastal woodland. Heavily wooded or forested areas. Roosting singly/pairs in dense foliage.	Least concern.						
Anchieta's pipistrelle *(Hypsugo anchietae)*	Widely but sparsely. Savanna and woodland. Well-wooded , such as riparian vegetation.	Least concern.						

Mammal	Habitat	Status (Mozambique IUCN)	Woodland and Thicket Mosaic		Julbernardia-Brachystegia Woodland and Thicket Mosaic	Mixed Woodland and Thicket	Govuro River & floodplain	Coastal wetlands
			Woodlands	Thicket				
Dusky pipistrelle (*Pipistrellus hesperidus*)	Well-wooded locations such as riparian vegetation and forest patches especially in the proximity of water. Roosts in trees and man-made structures; narrow cracks in exfoliating granitic rock; loose bark of dead trees.	Least concern.						
Long-tailed serotine bat *(Eptesicus hottentotus)*	Occurs widely but sparsely. - roosting in rocky outcrops - caves and crevices.	Least concern.						
Yellow-bellied house bat (*Scotophilus dinganii*)	Savanna & mixed bushland: Narrow crevices, holes and in hollow trees. Tied to presence of trees. Avoid open habitat - grassland and karoo scrub.	Least concern.						
Green house bat (*Scotophilus viridis*)	Low-lying, hot savannas and woodland. Avoid open habitats (grassland). Riverine conditions - tall riparian woodland. Various shelters - holes in trees, roofs of houses.	Least concern.						
Lesser woolly bat (*Kerivoula lanosa*)	Riparian forests and patchy afro-montane habitat. Riverine conditions and with well-watered terrain.	Least concern.						
Damara woolly bat (*Kerivoula argentata*)	Savanna woodland. Riverine conditions and with well-watered terrain. Roost in foliage amongst leaves or in bird's nests.	Least concern.						
Zulu serotine (*Neoromicia zuluensis*)	Woodland savanna - associated with riparian habitats.Roosts among dead leaves of aloes.	Least concern.						
Banana bat *(Neoromicianana*)	Forest and woodland savanna; well-wooded habitats - riparian vegetation; forest patches in proximity of water: Near bananas or Strelitzia trees, rolled-up terminal leaves of banana plants; Also other leaves.	Least concern.						
Schlieffen's twilight bat (*Nycticeinops schlieffeni*)	Low-lying savannah woodland: well-wooded places such as riparian vegetation along rivers and drainage lines; not in forests. Roosts in crevices in trees.	Least concern.						
Family: Nycteridae								
Hairy slit-faced bat (*Nycteris hispida*)	Catholic in habitat requirements. Dry savanna woodland and high forest.	Least concern.						
Large-eared slit-faced bat (*Nycteris macrotis*)	Forests and moist savanna woodland. Shelters: caves, trunks of large trees.	Least concern.						
Large slit-faced bat (*Nycteris grandis*)	Well-developed riparian (in woodlands) and evergreen forests. Hollows of large trees, shallow caverns in rock.	Least concern.						

Mammal	Habitat	Status (Mozambique IUCN)	Woodland and Thicket Mosaic		Julbernardia-Brachystegia Woodland and Thicket Mosaic	Mixed Woodland and Thicket	Govuro River & floodplain	Coastal wetlands
			Woodlands	Thicket				
Egyptian slit-faced bat (*Nycteris thebaica*)	Open savannah woodland; karoo; avoids open grassland: caves, hollow large trees or holes in the ground. Caves (not deep) and subterranean habitats (aardvark burrows); temperate savanna and shrubland. Man-made structures. Need tree cover.	Least concern.						
Family: Rhinolophidae								
Hildebrandt's horseshoe bat (*Rhinolophus hildebrandti*)	Savanna woodland; roost in caves, mines, disused buildings, cavities in rocks or large hollow trees	Least concern.						
Darling's horseshoe bat (*Rhinolophus darlingi*)	Woodland savanna: Caves, and amongst piles of loose boulders. It roosts in caves and subterranean habitats (mines) in medium-sized colonies.	Least concern.						
Ruppels horseshoe bat (*Rhinolophus fumigatus*)	Open savanna woodland; fringes of forests. Absent fro forests, desert and semi-deserts. Roosts in caves, mines road culverts.	Least concern.						
Lander's horseshoe bat (*Rhinolophus landeri*)	Forests and savanna woodlands. Riverine conditions and with well-watered terrain. Cave dweller. Roost in caves, mines, and large hollow trees. Roost in small groups.	Least concern.						
Blasius horseshoe bat (*Rhinolophus blasii*)	Woodland; savanna: It roosts in caves and subterranean habitats (mines) in small groups.	Least concern.						
Woodland horseshoe bat (*Rhinolophus simulator*)	Savanna woodland; riparian forest and along wooded drainage lines. Dependent on substantial shelter in form of caves, small caverns in rocky outcrops, road culverts and mines. Roost in large groups.	Least concern.						
Family: Hipposideridae								
Percival's short-eared trident bat *(Cloeotis percivali)*	Savanna woodland. Rest in caves. Sufficient cover in the form of caves and mine tunnels for day roosting. Roost in narrow crevices. A clutter forages (in vegetation).	Least concern.						
Striped leaf-nosed bat *(Hipposideros vittatus)*	Dependent on large caves for breeding. Variety of woodland and savanna habitats - arid to moist.	IUCN 2014: Near-threatened						
Giant leave-nosed bat *(Hipposideros gigas)*	Mesic savanna and forest.	Least concern.						

Mammal	Habitat	Status (Mozambique IUCN)	Woodland and Thicket Mosaic		Julbernardia-Brachystegia Woodland and Thicket Mosaic	Mixed Woodland and Thicket	Govuro River & floodplain	Coastal wetlands
			Woodlands	Thicket				
Sundevall's leaf-nosed bat (*Hipposideros caffer*)	Savanna woodland: Wide range of caves, sink holes and subterranean habitats (cavities); athropogenic roosts: mines and culverts. Colonies - dozen to hundreds. Riparian locations. Forage in and around thickets and well-developed undergrowth vegetation, avoiding open areas. Fly slowly through cluttered environment.	Least concern.						
Family: Lorisidae								
Thick-tailed bush baby (*Otolemur crassicaudatus*)	Forests, thickets and well developed woodland.Penetrate into dry terrain in riverine forests and woodland. During the day - in the thick foliage of trees.	Least concern.						
Grant's bushbaby (*Galagoides granti)*	Evergreen forests at low altitudes and prefers dense parts of the habitat, 6-20m high.	Least concern.						
Southern lesser bushbaby (*Galago moholi*)	Woodland: Nocturnal; arboreal – holes in trees, thick foliage, disused bird nests. Degraded open forest	Least concern.						
Family: Cercopithecidae								
Chacma baboon (*Papio ursinus*)	Widespread, diurnal: At night - Cliffs & high trees	Least concern.			5			
Samango monkey (*Cercopithecus mitis*)	Open forest	Least concern.						
Vervet monkey (*Cercopithecus aethiops*)	Woodland, diurnal: At night – Heavy foliage in high trees, rocky cliffs	Least concern.			4	1		
Family: Felidae								
Leopard (*Panthera pardus*)	Widespread. Broken country or forests. Nocturnal & solitary.	IUCN (2014): NT Near-threatened.						
African wild cat (*Felis lybica*)	Widespread – Wide habitat tolerance. Rocky hillsides, underbush, reedbeds, stands of tall grass. Litters born dense underbrush or other substantial cover.	Least concern.						
Serval (*Felis serval*)	Proximity to water essential requirement, coupled with availability of adequate cover; tall grass, underbrush or reed beds - during day. Wet grassland, vleis and reed beds.	Least concern.						

Mammal	Habitat	Status (Mozambique IUCN)	Woodland and Thicket Mosaic		Julbernardia-Brachystegia Woodland and Thicket Mosaic	Mixed Woodland and Thicket	Govuro River & floodplain	Coastal wetlands
			Woodlands	Thicket				
Family: Canidae								
Side-striped jackal (*Canis adustus*)	Savanna and well-watered conditions; tall grass. Open forest; savanna.	Least concern.						
Black-backed jackal (*Canis mesomelas*)	Widespread. Wide habitat tolerance. Open terrain. Litters born in holes in ground.	Least concern.						
Family: Mustelidae								
Cape clawless otter (*Aonyx capensis*)	Predominantly aquatic; freshwater an essential requirement: Rivers, lakes, swamps and dams. Widespread. Tributaries of rivers into small streams - habitat with food. Litters born in holes in banks of rivers. Estuarine and sea water.	Least concern.						
Striped polecat (*Ictonyx striatus*)	Widespread. Wide habitat tolerance. Scrub cover, open grassland, and savannah woodland. Holes in the ground.	Least concern.						
Honey badger (*Mellivora capensis*)	Widespread. Not in desert. Use crevices in rocky areas, will also dig refuges. Rocky koppies, scrub sandy terrain, open grassland, open woodland, riverine woodland and floodplain grassland.	Least concern.						
Family: Viverridae								
Large-spotted genet (*Genetta tigrina*)	Better watered parts: Woodland, open scrub and dry grassland or dry vlei areas. Trees. Nocturnal – nests in holes in the ground or in hollow trees.	Least concern			1			
African civet (*Civettictis civetta*)	Widely distributed – forest and woodland where water is available. Nocturnal & solitary. Litters born in holes or dense underbrush.	Least concern						
Slender mongoose (*Galerella sanguinea*)	Widespread. Open areas. Underbrush or holes in the ground, holes in termitaria.	Least concern				2		
White-tailed mongoose (*Ichneumia albicauda*)	Savannah woodland: Well watered areas. Not in desert, semi-desert or forest.	Least concern						
Water mongoose (*Atilax paludinosus*)	Well-watered terrain: Rivers, streams, marshes, swamps, wet vleis, dams and tidal estuaries - adequate cover of reed beds or dense stands of semi-aquatic grasses. Coastally in mangrove swamps in brackish water.	Least concern					1	1

Mammal	Habitat	Status (Mozambique IUCN)	Woodland and Thicket Mosaic		Julbernardia-Brachystegia Woodland and Thicket Mosaic	Mixed Woodland and Thicket	Govuro River & floodplain	Coastal wetlands
			Woodlands	Thicket				
Large grey mongoose (Herpestes ichneumon)	On fringes of rivers, swamps, lakes and dams. Riverine underbush or reed beds.	Least concern						
Banded mongoose (*Mungos mungo*)	Wide habitat tolerance. Essential habitat requirement: woodland, underbush, substrate detritus such as fallen logs and other vegetable debris. Acacia woodland.	Least concern						
Dwarf mongoose (*Helogale parvula*)	Widespread. Dry open woodland and on grassland where there is substrate litter and termitaria. Lives in permanent holes – termitaria, burrows deeply.	Least concern						
Family: Equidae								
Burchell's (Plains) zebra (*Equus burchellii*)	Open plains to heavily wooded savannas	Least concern						
Family: Orycteropodidae								
Aardvark / Antbear (*Orycteropus afer*)	Widespread. Wide habitat tolerance. Open woodland, scrub and grassland. Nocturnal. Lives in extensive burrows.	Least concern						
Family: Suidae								
Bushpig (*Potamochoerus porcus*)	Forests, thickets, riparian underbrush, reed beds or stands of tall grass where there is water. Nests of grass in secluded places.	Least concern			1	2		
Warthog (*Phacochoerus aethiopicus*)	Open areas of grassland, floodplain, vleis and around waterholes and pans. Deserted antbear holes. Linear forest.	Least concern						
Family: Hippopotamidae								
Hippopotamus (*Hippopotamus amphibius*)	Suitable deep, open, permanent water (deep enough to allow it to submerge totally) with gently sloping sandbanks must be available and adjacent food supplies. Open stretches of permanent water. Temporary resting places during flooding in oxbows or up in tributaries of major rivers.	IUCN (2012): VU Vulnerable.						

Mammal	Habitat	Status (Mozambique IUCN)	Woodland and Thicket Mosaic		Julbernardia-Brachystegia Woodland and Thicket Mosaic	Mixed Woodland and Thicket	Govuro River & floodplain	Coastal wetlands
			Woodlands	Thicket				
Family: Dugongidae								
Dugong (*Dugong dugong*)	Coastal and Island waters between East Africa and Vanuatu between latitudes of about 27° North and South of Equator. Dugongs are primarily marine mammals. Inhabit shallow waters, depths of around 10 m, occasionally dive to depths of 39 m to feed. Shallow areas typically located in protected bays, wide mangrove channels and in sheltered areas of inshore islands. Seagrass beds consisting of phanerogamous seagrasses - primary source of nourishment, coincide with these optimal habitats.*Also observed in deeper water where the continental shelf is broad, neritic and sheltered.* Tidal sandbanks and estuaries that are quite shallow, are potential areas suitable for calving.	IUCN (2014): VU Vulnerable.						
Family: Bovidae								
Cape common duiker (*Sylvicapra grimmia grimmia*)	Widespread. Presence of bush. Woodland with ample underbush, grassland of medium and tall grass. Rest in bushes or tall grass.	Least concern			4	6	1	
Suni (*Neotragus moschatus*)	Close canopy forest with a high stem density and low ground cover.	Least concern.			1	3		
Red duiker (*Cephalophus natalensis)*	Forest, dense thickets, thickly wooded ravines and dense coastal bush where there is surface water.	Least concern.				1		
Steenbok (*Raphicerus campestris)*	Widespread. Open country: Open grassland with stands of tall grass, scattered bushes or scrub and forbs. Avoid densely wooded areas.	Least concern.				1		
Sharpe's grysbok (*Raphicerus shapei)*	Open forest. Thick woodland, riverine forest, thick bush and broken country with bush cover.	Least concern.						
Sable (*Hippotragus niger*)	Open woodland. Areas with a well developed field layer. Dependent on the availability of water.	Least concern.						
Kudu (T*ragelaphus strepsiceros*)	Widespread in savanna woodland. Areas of broken, rocky terrain with woodland cover & open water.	Least concern.						
Bushbuck (T*ragelaphus scriptus*)	Riverine and thickets near water.	Least concern.						
Reedbuck (*Redunca arundinum*)	Open water with cover; stands of tall grass or reed beds	Least concern.						

Mammal	Habitat	Status (Mozambique IUCN)	Woodland and Thicket Mosaic		Julbernardia-Brachystegia Woodland and Thicket Mosaic	Mixed Woodland and Thicket	Govuro River & floodplain	Coastal wetlands
			Woodlands	Thicket				
Waterbuck (*Kobus ellipsiprymnus*)	Savanna habitats with medium and tall grass in the close proximity of water.	Least concern						
Order: Manidae Family: Pholidota								
Pangolin (*Manis temminckii*)	Wide habitat tolerance, absent from forests. Day – piles of leaves or other vegetable debris, holes in the ground	Least concern.						
Order: Rodentia								
Family: Hystricidae								
Cape Porcupine *(Hystrix africaeaustralis)*	Widespread: All types of country apart from swampy areas, very moist forests and barren desert areas. Nocturnal. Shelter - resting in caves, rock cavities, holes in ground. Absent from forest. Use abandoned antbear and other types of holes in the ground or lie up under the roots of trees exposed by erosion.	Least concern				2		
Family: Pedetidae								
Springhare (*Pedetes capensis*)	Widespread on sandy soils: Nocturnal – resting in burrows. Avoid hard ground or heavy clay soils. Savanna.	Least concern						1
Family: Sciuridae								
Sun squirrel (*Heliosciurus mutabilis)*	Lowland or montane evergreen forest, but also occurs in riverine forest and woodland thicket. Uses holes in trees or sheltered places among dense clumps of creepers high in the forest trees to rest.	Least concern.						
Red squirrel (*Paraxerus palliatus*)	Varies from montane, evergreen, moist relic forest along western edge of coastal plain, to denser and drier coastal forests and thickets. Flee along branches to hiding places in dense foliage. Nests in holes in trees.	Least concern.			1	1		
Tree squirrel (*Paraxerus cepapi*)	Widespread in woodland: Savanna woodland including a wide variety of woodland types. Trees with suitable nest holes are favoured. Diurnal – resting in holes in trees.	Least concern						

Mammal	Habitat	Status (Mozambique IUCN)	Woodland and Thicket Mosaic		Julbernardia-Brachystegia Woodland and Thicket Mosaic	Mixed Woodland and Thicket	Govuro River & floodplain	Coastal wetlands
			Woodlands	Thicket				
Family: Thryonomyidae								
Greater Canerat *(Thryonomys swinderianus)*	**Forest belts and open woodland wherever there is tall and matted grass or reeds growing in damp or wet places. Reedbeds or areas of dense tall grass with thick reed or cane-like stems. In vicinity of rivers, lakes and swamps - never found far from water. Resting place densest part of reed bed. Cover - matted tussock grasses, holes in stream banks, under root systems of trees adjacent to grass and reeds. Use existing holes ore simply use matted vegetation.**	**Least concern**						
Family: Bathyergidae								
Common Molerat *(Cryptomys hottentotus)*	**Loose sandy soils to stony soils and hills to montane and escarpment conditions. Tendency to loose sandy soil - especially alluvial soils along major rivers and streams. Karroid veldtypes, coastal rhenosterwoodland, coastal forests, Acacia woodland, mopaneveld, savanna and pure grassveld, as well as temperate and transitional forests, scrub and woodland. Savanna, cultivated fields.**	**Least concern**			**1**	**4**		
Family: Cricrtidae								
Giant rat (*Cricetomys gambiensis*)	**Evergreen forests and woodland. Urban areas. Linear forest, termite mounds.**	**Least concern.**						
Woodland gerbil (Gerbilliscus leucogaster)	**Widespread – Survives regardless of vegetation type or degree of cover present, having been recorded in open grasslands, Acacia woodland or scrub, and mopane woodland. Commonly encountered on old cultivated lands. Occur on hard ground, but prefer light sandy soils or sandy alluvium. Nocturnal and terrestrial. Does not usually excavate its own burrows but uses holes in termitaria or under tree roots, however, can excavate burrows in sandy soils. These burrows are usually found at the base of small shrubs, but also in the open, and they have resting chambers floored with vegetable debris. A fresh ramp of sand is left at the entrances to the burrows in the morning, following night-time activity.**	**Data deficient**			**1**			

Mammal	Habitat	Status (Mozambique IUCN)	Woodland and Thicket Mosaic		Julbernardia-Brachystegia Woodland and Thicket Mosaic	Mixed Woodland and Thicket	Govuro River & floodplain	Coastal wetlands
			Woodlands	Thicket				
	Independant of water, but does not tolerate waterless conditions.							
Family: Muridae								
Spiny mouse (*Acomys spinosissimus*)	Widespread – associated with rocky areas/terrain: Nocturnal and terrestrial (single or groups) – rests in rock crevices, under tree roots. More common habitat: among boulders in rocky habitat. Sheltered overhanging rocks, under exfoliated slabs and in other sheltered crannies. Also sandy alluvium along rivers, dry woodland and in thickets; use cover of roots of trees exposed by erosion; or holes in termite mounds. Nests made of grass and other debris in crannies or under foliated slabs of rock.	Least concern				1		
Pouched mouse (*Saccostomus campestris*)	Widespread and catholic, wide habitat tolerance: In burrows, sandy soil or sandy alluvium, open short grass fringes of pans, rocky koppies, fringes of lowland forests. Exclusively terrestrial, predominantly solitary and nocturnal.	Least concern				6		
Veld Rat species *(Aethomys ineptus)*	Widespread – Grassland with open shrub association, open woodland, fringes of pans. Sandy ground or sandy alluvium, or hard ground – holes or rock crevices and piles of boulders. Associated with cover: rocky crevices, piles of debris, clumps of grass or fallen trees. Dry Acacia scrub, as well as in the fringe vegetation of evergreen forests. Sheltering in burrows under bush on the plains. Lives in burrows with interconnecting runways; may frequent old termite mounds. High reproductive potential under favourable conditions. Not gregarious; shelters are used at most by a pair or a family party.	Least concern				3		
Tree Rat/mouse *(Thallomys paedulcus)*	Acacia woodland: Living in crevices in the trunks, under loose strips of bark or in holes in the ground between the roots of the tree (Especially Acacia). Nocturnal.	Least concern						
Single-striped Mouse *(Lemniscomys rosalia)*	Savanna woodland to dry open scrub. Common factor: Grassland - excavates burrows under the cover of matted grass.	Data deficient						
Multimammate mouse *(Mastomys natalensis)*	Wide habitat tolerance (pioneer species - drought, burn, ploughing), from sea level to high-lying ground,	Least concern.						

Mammal	Habitat	Status (Mozambique IUCN)	Woodland and Thicket Mosaic		Julbernardia-Brachystegia Woodland and Thicket Mosaic	Mixed Woodland and Thicket	Govuro River & floodplain	Coastal wetlands
			Woodlands	Thicket				
	absent from arid areas: Fond of grassland where there is some cover of low scrub.Households; fringes of agricultural land; In riverine associations running westwards into arid country. Degraded forests, fields. Often occurs in high numbers. Communal, terrestrial and nocturnal. Constructs its own burrows but often uses existing burrows of other rodents.							
Groove-toothed mouse (*Pelomys fallax*)	Rivers, vleis, swamps and wet places – damp places. Ecotone wet- and dry land. Savanna, cultivated fields	Least concern.						
Woodland mouse (*Grammomys dolichurus*)	Predominantly arboreal: in forests and thickets, usually in damp places; constructs nests of grass or leaves in dense underbrush	Least concern						
Mozambique woodland mouse (*Grammomys cometes)*	Thick, well-developed woodland. Eastern high rainfall region.	Least concern.						
Pygmy Mouse *(Mus minutoides)*	In all types of vegetation. Wide variety of habitats. Nocturnal and terrestrial, not communal. Fairly damp country where there is high grass, bush or other cover. Makes its own burrows in soft ground. Normally finds shelter under piles of debris, fallen tree trunks/logs and similar type of cover, also boulders or holes in termite mounds.	Least concern						
Thomas' pygmy mouse *(Mus sorella)*	Subtropical or tropical moist lowland forests, subtropical or tropical moist montane forests, and dry savanna. Associated with open clearings in lowland and montane forest, and also within savanna areas.	Least concern.						
Rudd's mouse (*Uranomys ruddi*)	Seasonally inundated and dry grassland on alluvial soil in the vicinity of rivers and streams.	Least concern.						
Family: Gliridae								
Woodland Dormouse *(Graphiurus murinus)*	Widespread in woodland. Wooded areas. Large trees provide holes for shelter. Live in holes in trees or under loose bark.	Least concern						
Lesser Savanna Dormouse *(Graphiurus parvus)*	Wooded areas. Large trees provide holes for shelter.	Least concern.						
Family: Leporidae								

Mammal	Habitat	Status (Mozambique IUCN)	Woodland and Thicket Mosaic		Julbernardia-Brachystegia Woodland and Thicket Mosaic	Mixed Woodland and Thicket	Govuro River & floodplain	Coastal wetlands
			Woodlands	Thicket				
Scrub hare (*Lepus saxatilis*)	Savannah woodland and in scrub, tall grass. Absent from forest, desert and open grass. Open forest, savanna.	Least concern			2	6	2	
Family: Macroscelididae								
Four-toed elephant-shrew (*Petrodromus tetradactylus tetradactylus*)	Well-developed riparian and evergreen forests with dense underbush.	Least concern.						

APPENDIX E

Red Data Animals

Red Data animals (vertebrates) for Mozambique according to the IUCN Red List of Threatened Species (IUCN, 2014)

Species	Common name	Status	Population trend
FISH			
Amarginops hildae	Buzi Grunter	Data Deficient	Unknown
Aplocheilichthys sp. nov. 'Rovuma'	Rovuma Topminnow	Vulnerable	Unknown
Barbus sp. nov. 'Banhine'	Banhine Barb	Critically Endangered	Unknown
Barbus sp. nov. 'Chimanimani'	Chimanimani Chubbyhead	Vulnerable	Unknown
Chetia brevis	Orange-fringed River Bream	Endangered	Unknown
Copadichromis geertsi		Vulnerable	Unknown
Copadichromis trewavasae		Vulnerable	Unknown
Haplochromis tweddlei		Vulnerable	Unknown
Iodotropheus stuartgranti		Vulnerable	Unknown
Maylandia phaeos		Vulnerable	Unknown
Opsaridium microcephalum		Vulnerable	Decreasing
Oreochromis karongae		Endangered	Decreasing
Oreochromis lidole		Endangered	Decreasing
Oreochromis mortimeri	Kariba Tilapia	Critically Endangered	Decreasing
Oreochromis mossambicus	Mozambique Tilapia	Near Threatened	Unknown
Oreochromis squamipinnis		Endangered	Decreasing
Serranochromis meridianus	Lowveld Largemouth	Endangered	Unknown
FROGS			
Stephodaedes anotis	Chirinda Toad	Endangered	Decreasing
Nothophryne broadleyi	Mongrel frog	Endangered	Decreasing
Strongylopus rhodesianus	Chimanimani Stream Frog	Vulnerable	Decreasing

Species	Common name	Status	Population trend
REPTILES			
Caretta caretta	Loggerhead	Endangered	Needs updating
Chelonia mydas	Green Turtle	Endangered	Decreasing
Cordylus meculae	Mecula Girdled Lizard	Endangered http://www.iucnredlist.org/static/categories_criteria_2_3	Unknown
Cycloderma frenatum	Zambezi flat-shelled terrapin	Lower Risk/near threatened http://www.iucnredlist.org/static/categories_criteria_2_3	Needs updating
Dermochelys coriacea	Trunkback Turtle	Vulnerable	Decreasing
Eretmochelys imbricata	Hawksbill Turtle	Endangered	Decreasing
Kinixys natalensis	Natal Hinge-backed Tortoise	Lower Risk/near threatened http://www.iucnredlist.org/static/categories_criteria_2_3	Needs updating
Lepidochelys olivacea	Olive Ridley	Vulnerable	Decreasing
Lycophidion nanus	Dwarf Wolf Snake	Vulnerable http://www.iucnredlist.org/static/categories_criteria_2_3	Unknown
Platysaurus imperator	Imperial Flat Lizard	Vulnerable http://www.iucnredlist.org/static/categories_criteria_2_3	Unknown
BIRDS			
Acrocephalus griseldis	Basra Reed-warbler	Endangered	Decreasing
Agapornis lilianae	Lilian's Lovebird	Near Threatened	Decreasing
Alethe choloensis	Thyolo Alethe	Endangered	Decreasing
Anthreptes reichenowi	Plain-backed Sunbird	Near Threatened	Decreasing
Apalis chariessa	White-winged Apalis	Vulnerable	Decreasing
Apalis lynesi	Namuli Apalis	Near Threatened	Decreasing
Ardeola idae	Madagascar Pond-heron	Endangered	Decreasing
Ardeotis kori	Kori Bustard	Near Threatened	Decreasing
Artisornis moreaui	Long-billed Tailorbird	Critically Endangered	Decreasing
Balearica regulorum	Grey Crowned-crane	Endangered	Decreasing

Species	Common name	Status	Population trend
Bucorvus leadbeateri	Southern Ground-hornbill	Vulnerable	Decreasing
Bugeranus carunculatus	Wattled Crane	Vulnerable	Decreasing
Charadrius pallidus	Chestnut-banded Plover	Near Threatened http://www.iucnredlist.org/static/categories_criteria_3_1	Stable
Circaetus fasciolatus	Southern Banded Snake-eagle	Near Threatened	Decreasing
Circus macrourus	Pallid Harrier	Near Threatened http://www.iucnredlist.org/static/categories_criteria_3_1	Decreasing
Cinnyris neergaardi	Neergaard's Sunbird	Near Threatened	Decreasing
Coracias garrulus	European Roller	Near Threatened http://www.iucnredlist.org/static/categories_criteria_3_1	Decreasing
Dendropicos stierlingi	Stierling's Woodpecker	Near Threatened	Stable
Diomedea exulans	Wandering Albatross	Vulnerable	Decreasing
Egretta vinaceigula	Slaty Egret	Vulnerable	Decreasing
Falco concolor	Sooty Falcon	Near Threatened http://www.iucnredlist.org/static/categories_criteria_3_1	Decreasing
Falco fasciinucha	Taita Falcon	Near Threatened	Stable
Falco vespertinus	Red-footed Falcon	Near Threatened http://www.iucnredlist.org/static/categories_criteria_3_1	Decreasing
Gallinago media	Great Snipe	Near Threatened	Decreasing
Glareola ocularis	Madagascar Pratincole	Vulnerable	Decreasing
Gyps africanus	White-backed Vulture	Near Threatened http://www.iucnredlist.org/static/categories_criteria_3_1	Decreasing
Gyps coprotheres	Cape Vulture	Vulnerable	Decreasing
Hirundo atrocaerulea	Blue Swallow	Vulnerable	Decreasing
Limosa limosa	Black-tailed Godwit	Near Threatened http://www.iucnredlist.org/static/categories_criteria_3_1	Decreasing
Modulatrix orostruthus	Dapple-throat	Vulnerable	Decreasing

Species	Common name	Status	Population trend
Morus capensis	Cape Gannet	Vulnerable	Decreasing
Necrosyrtes monachus	Hooded Vulture	Endangered	Decreasing
Neotis denhami	Denham's Bustard	Near Threatened http://www.iucnredlist.org/static/categories_criteria_3_1	Decreasing
Numenius arquata	Eurasian Curlew	Near Threatened http://www.iucnredlist.org/static/categories_criteria_3_1	Decreasing
Phalacrocorax capensis	Cape Cormorant	Near Threatened	Decreasing
Phoeniconaias minor	Lesser Flamingo	Near Threatened http://www.iucnredlist.org/static/categories_criteria_3_1	Decreasing
Ploceus olivaceiceps	Olive-headed Weaver	Near Threatened	Decreasing
Polemaetus bellicosus	Martial Eagle	Vulnerable	Decreasing
Procellaria aequinoctialis	White-chinned Petrel	Vulnerable	Decreasing
Rynchops flavirostris	African Skimmer	Near Threatened	Decreasing
Sagittarius serpentarius	Secretary bird	Vulnerable	Decreasing
Sheppardia gunningi	East Coast Akalat	Near Threatened	Decreasing
Spheniscus demersus	African Penguin	Endangered	Decreasing
Stephanoaetus coronatus	Crowned Hawk-eagle	Near Threatened	Decreasing
Swynnertonia swynnertoni	Swynnerton's Robin	Vulnerable	Decreasing
Terathopius ecaudatus	Bateleur	Near Threatened	Decreasing
Thalassarche carteri	Indian Yellow-nosed Albatross	Endangered	Decreasing
Thalassarche chlororhynchos	Atlantic Yellow-nosed Albatross	Endangered	Decreasing
Torgos tracheliotos	Lappet-faced Vulture	Vulnerable	Decreasing
Trigonoceps occipitalis	White-headed Vulture	Vulnerable	Decreasing
Zoothera guttata	Spotted Ground-thrush	Endangered	Decreasing

Species	Common name	Status	Population trend
MAMMALS (Excluding marine species – dolphins and whales)			
Acinonyx jubatus	Cheetah	Vulnerable	Decreasing
Carpitalpa arendsi	Arend's Golden Mole	Vulnerable	Unknown
Ceratotherium simum	White Rhinoceros	Near Threatened http://www.iucnredlist.org/static/categories_criteria_3_1	Increasing
Diceros bicornis	Black Rhinoceros	Critically Endangered	Increasing
Dugong dugon	Dugong	Vulnerable	Unknown
Eidolon helvum	Straw-coloured Fruit Bat	Near Threatened http://www.iucnredlist.org/static/categories_criteria_3_1	Decreasing
Hippopotamus amphibius	Common Hippopotamus	Vulnerable	Decreasing
Hipposideros vittatus	Striped leaf-nosed bat	Near Threatened http://www.iucnredlist.org/static/categories_criteria_3_1	Decreasing
Hyaena brunnea	Brown Hyaena	Near Threatened http://www.iucnredlist.org/static/categories_criteria_3_1	Decreasing
Loxodonta africana	African Elephant	Vulnerable http://www.iucnredlist.org/static/categories_criteria_3_1	Increasing
Lycaon pictus	African Wild Dog	Endangered	Decreasing
Panthera pardus	Leopard	Near Threatened http://www.iucnredlist.org/static/categories_criteria_3_1	Decreasing
Panthera leo	Lion	Vulnerable	Decreasing
Paraxerus vincenti	Vincent's Bush Squirrel	Endangered	Decreasing
Praomys delectorum	Delectable Soft-furred Mouse	Near Threatened http://www.iucnredlist.org/static/categories_criteria_3_1	Stable
Rhynchocyon cirnei	Checkered Sengi	Near Threatened http://www.iucnredlist.org/static/categories_criteria_3_1	Unknown

APPENDIX F

The Forest and Wildlife Law (Decree No. 12/2002, 6 June 2002)

The Forest and Wildlife Law (Decree No. 12/2002, 6 June 2002) includes a list of animal species in Mozambique that are protected and illegal to hunt including certain species of coastal/marine avifauna. This would include:

- **Birds**
  - Flamingos - Greater flamingo (*Phoenicopterus ruber*) and Lesser flamingo (*Phoeniconaias minor*)
  - Seagulls
  - Herons
  - Marabou Stork (*Leptoptilos crumeniferus*)
  - Pelicans - Great White Pelican *(Pelecanus onocrotalus)* andPink-backed Pelican *(Pelecanus rufescens)*
  - *Secretary bird (Sagittarius serpentarius)*
  - *Kori Bustard (Ardeotis kori)*
  - *Struthio australis*
  - *Bucorvus cafer*
- **Reptiles**
  - Marine turtles
- **Mammals**
  - Klipspringer (Oreotragus oreotragus)
  - Caracal (Felis caracal)
  - Side-striped jackal (Canis adustus)
  - Black-backed jackal (Canis mesomelas)
  - Reedbuck (Redunca arundinum)
  - Cheetah (Acinonyx jubatus)
  - African civet (Civettictis civetta)
  - Dugong (Dugong dogon)
  - African weasel (Poecilogale albinucha)
  - African wild cat (Felis lybica)
  - Serval (Felis serval)
  - Giraffe (Giraffa camelopardalis)
  - Brown hyaena (Hyaena brunnea)
  - Wild dog (Lycaon pictus)
  - (Cercopithecus pygerythrus)
  - Samango monkey (Cercopithecus mitis)
  - Striped polecat (Ictonyx striatus)
  - Roan antelope (Hippotragus equinus)
  - Tsessebe (Damaliscus lunatus)
  - Pangolin (Manis temminckii)
  - Aardwolf (Proteles cristatus)
  - Bat-eared fox (Otocyon megalotis)
  - Honey badger (Mellivora capensis)
  - Black rhino (Diceos bicornis)
  - White rhino (Ceratotherium simum)
  - Sitatunga (Tragelaphus spekei)

APPENDIX G

Curricula Vitae

CURRICULUM VITAE

DR ANDREW RICHARD DEACON

CONTACT DETAILS

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Personal:

Born in Klerksdorp, South Africa in 10/08/1951.
Matriculated at the Goudveld High School in 1969.
Male South African citizen.
Married to Jacqueline, one child, Allison.
Language: English and Afrikaans: good written and oral skills
Identity number: 5108105091082

FORMAL EDUCATION

Ph.D., Zoology (RAU 1987) Thesis: "The nutritional ecology and physiology of *Tilapia rendalli* and *Oreochromis mossambicus* in a warm, sewage-enriched habitat".
M.Sc., Zoology (RAU 1983) Thesis: "The occurrence and feeding habits of *Anguilla*-species in selected rivers of the Transkei".
B.Sc., Hons. - Zoology (RAU 1980)
B.Sc., majors Zoology and Botany (PU for CHE 1974)

PROFESSIONAL EXPERIENCE

2012-2013 Full-time Environmental Consultant

1989-2011 Scientific Services, Kruger National Park, SANParks

2000-2011 Programme Manager: Small vertebrates – in 15 Savanna National Parks (Kalahari, Kruger, Addo, Richtersveld, Mapungubwe, etc.)

Responsible for the co-ordination of small vertebrate (fish, amphibian, reptile, bird & small mammal) research programs in the parks:

- Devise monitoring protocols for the small vertebrate bio-monitoring and propose management actions
- Test and administer monitoring program in order to establish anthropological-related influences on the small vertebrates in the Savanna parks
- Co-ordinate all small vertebrate monitoring and research in the Savanna parks
- Co-ordinate and assist in Reserve Determination of the Savanna parks rivers
- Conduct management related research concerning the National Parks (pest control; fish kills; silt releases; EIA's and scoping; etc).

1989-2000 Senior Scientist: **Freshwater Ecologist**.

Responsible for the co-ordination of river management and research in the KNP:

- Co-ordinate and manage logistic support for the participants of the KNP River Research Programme.

- Involved in the catchment management of the Lowveld rivers (until September 1997).
- Champion or the Rivers Health Programme in the Greater Kruger region.

Responsible for the co-ordination of river research in the KNP

1988 Consulting - Technikon of RSA; Berghoek Nature Reserve; Klaserie Nature Reserve.
1985-1987 Lecturer (Part-time) - Witwatersrand Technikon. Biology for the Food Technologists.
1984-1986 Lecturer - Department of Zoology at RAU. Biology and Taxonomy.
1983 Lecturer - Goudstad College of Education. Zoology.
1979-1982 Research assistant - Department of Zoology at RAU. Supervisor: Freshwater aquarium, student practical classes, field excursions and museum.
1978 Research technician - Onderstepoort Veterinary Institute. Helminthology - Taxonomy and physiology of South African helminths.
1975 – 1977 Teacher - Biology and Science

CONSULTING PROJECTS

- **Terrestrial fauna survey projects: 68 projects in Africa**

- **Aquatic ecology survey projects: 38 projects in Africa**

Projects relevant to the SASOL proposal:

- Mark Wood Consultants: Sasol pipeline crossings over the major rivers in Mpumalanga – Impacts on the aquatic environment (2003-2007).
- Mark Wood Consultants: Sasol Gas Pipeline (Mozambique): Survey and monitoring with regard to the recovery of the herbaceous field layer on the Temane - Resano Garcia pipeline (500km) (2005-2011).
- Mark Wood Consultants: Fungurume-Tenke copper mining, DRC. The potential impacts of the mining development on the faunal component and associated habitat (2006).
- Golder Associates Africa: Tenke Fungurume Mining (DRC): Biodiversity Monitoring - Fauna (2008).
- Golder Associates Africa: Transnet Pipeline, Durban to Heidelberg. – River crossing evaluation (2009).
- ERM Southern Africa: Inhassoro Gas Development Project: Environmental Impact Study Phase. Terrestrial and Aquatic Ecosystem Assessment (2009).
- Environmental Resources Management Ltd (ERM): An aquatic ecology specialist study for the ROMPCO Loop Line (the SASOL Project), Mozambique (2012).

OTHER

Completed the Environmental Impact Assessment short course at the University of Cape Town.
Accredited for SASS4 Macro-invertebrate Biomonitoring Methods.
Completed: Wetland Introduction and Delineation – Centre for Environmental Management: University of the Free State

SCIENTIFIC PAPERS IN REFEREED JOURNALS

Deacon, A.R. December 1994. The River Systems of the Kruger National Park. In: Endangered Species and Habitats in the SARCCUS Region. Southern African Regional Commission for the Conservation and Utilisation of the Soil (SARCCUS). Edited by dr G. de Graaff.

Seymore, T., H.H. du Preez, J.H.J. van Vuren, A. Deacon and G. Strydom. 1994. Variations in selected water quality variables and metal concentrations in the sediment of the lower Olifants and Selati rivers, South Africa. KOEDOE 37/2, 1-18.

Van Vuren, J.H.J., H.H. du Preez and A.R. Deacon. 1994. Effect of pollution on the physiology of fish in the Olifants River (Eastern Transvaal). Final Report, Project K5/350.

Buermann, Y., H.H. du Preez, G.J. Steyn, J.T. Harmse and A.R. Deacon. 1995. Suspended silt concentrations in the lower Olifants River (Mpumalanga) and impacts of silt releases from the Phalaborwa Barrage on water quality and fish survival. KOEDOE 38/2, 11-34.

Venter, F.J. and A.R. Deacon. 1995. Managing rivers for conservation and ecotourism in the Kruger National Park. Wat. Sci. Tech. Vol. 32, No. 5-6, pp. 227-233.

Steyn J.G., C.L.Gagiano, A.R. Deacon & H.H. du Preez. 1996. Notes on the induced reproduction and development of the tigerfish, *Hydrocynus vittatus* (Characidae), embryos and larvae. Environmental Biology of Fishes. 47: 387-398.

Roux, D.J., Kleynhans, C.J., Thirion, C., Hill, L., Engelbrecht, J.S., Deacon, A.R., Kemper, N.P. 1999. Adaptive assessment and management of riverine ecosystems: The Crocodile/Elands river case study. Water SA, 25:4.

Huchzermeyer, KDA., Govender, D., Pienaar, DJ., Deacon, AR. 2011. Staetitis in wild sharptooth catfish, Clarias gariepinus (Burchell), in the Olifants and Lower Letaba Rivers in the Kruger National Park, South Africa. Journal of Fish Diseases, 34, 489-498.

McLoughlin, CA., Deacon, AR., Sithole, H., Gyendu-Ababio, T. 2011. History, rationale, and lessons learned: Thresholds of potential concern in Kruger National Park river adaptive management. Koedoe, Vol. 53, No 2.

Ferreira, S., Deacon, AR., Sithole, H., Bezuidenhout, H. Daemane, M., Herbst, M. 2011. From numbers to ecosystems and biodiversity: A mechanism approach to monitoring. Koedoe, Vol. 53, No 2.

APPENDIX H

Document Limitations

DOCUMENT LIMITATIONS

This Document has been provided by Golder Associados Mozambique Lda (Golder) subject to the following limitations:

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ii) The transition from conceptual design to detailed design, and the resultant limitations on available information is well recognised in the EIA process. Indeed, EIA practitioners will directly target information that is crucial to the EIA, but is typically only available during detailed design. For example, the details of all environmental aspects must be available for the EIA, and these include atmospheric emissions, waste water discharge, solid waste types and quantities and other like information. Where this information is not directly available, the EIA practitioner will use conservative 'worst case' assumptions to ensure that negative impacts are exaggerated rather than underestimated in the EIA.

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vi) As a result of what has been described above, detailed site specific information only becomes available as the pipeline is progressively established and this understandably limits the information that is available at the time of the completing the EIA. This should not be seen to undermine the comprehensiveness of the EIA, but simply to understand what certain information is not directly available at the time of completing the EIA. It is important to emphasise at this point that the principal purpose of an EIA is *decision-making*. It is thus incumbent on EIA practitioners to ensure that they have identified and assessed in the EIA, all issues that are relevant to decision making. Significant effort has gone into sourcing for the purposes of this EIA, not all information, but certainly all information required for effective decision-making.

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