SYRAH RESOURCES GRAPHITE PROJECT, CABO DELGADO, MOZAMBIQUE

TERRESTRIAL FAUNAL IMPACT ASSESSMENT

Prepared for:	**Prepared by:**
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EXECUTIVE SUMMARY

Project Overview

Syrah Resources Limited plans to mine graphite in the project area using open pit mining to extract the ore. Conventional flotation processing will be used to extract the graphite using water from the Chipembe Dam located approximately 15 km north-west of the project site.

Syrah Resources Limited is an Australian resource company with its head office located in Melbourne, Australia. In December 2011 it acquired ownership of the Balama Graphite Project located in northern Mozambique, 7 km from the town of Balama, Cabo Delgado province, Mozambique. Syrah's local subsidiary, Twigg Exploration & Mining Ltd, has subsequently received a license for the prospecting and exploration of graphite, base and precious metals in the Balama district.

The Balama site is anticipated to have a large graphite deposit. It is anticipated that the mine couldhave a mine life of 50 years (minimum of 25 years with an option to extend with another 25 years). The plant will operate 365 days per year.

The ore will be processed at the processing plant located on the mine site and the final concentrate transported by road to Pemba, where a deep water port is located. The product will be exported internationally from Nacala Port.

Biophysical Environment

Cabo Delgado Province has a tropical climate with two distinct seasons. The wet season occurs from November to March and the dry season from April to November. Specific weather data for the project area is not available. Climate data for Montepuez, the nearest town to the project site (93km away), was therefore used. Montepuez has a tropical climate and is also a winter rainfall region. The average annual rainfall is approximately 942.3 mm. The driest month is August/September with 0 mm - 2 mm. Most precipitation falls in January, with an average of approximately 246.4 mm (http://www.weatherbase.com).

The average annual temperature in Montepuez is 24.2 °C. The warmest month of the year is November with an average temperature of 26.7 °C. In July, the average temperature is 21.1 °C making it the coolest month in the year. The average temperatures vary during the year by 5.6 °C. The highest recoded temperature was a maximum of 50 °C, recorded in November, while the lowest recoded temperature was a minimum of 5 °C, recorded in May (http://www.weatherbase.com).

Northeastern Mozambique is predominantly underlain by Proterozoic rocks that form a number of gneiss complexes that range from Palaeo to Neoproterozoic in age. The project site is underlain by metamorphic rocks of the Neoproterozoic Lurio Group that are included within the Xixano Complex.

The study area is relatively flat to gently undulating with sporadic inselbergs (Mount Nassilala and Mount Coronge) rising from the flat plains. The altitudinal range varies from 480 to 830 m above sea level (asl) with the highest point occurring on Mount Nassilala.

The Mehucua River flows through the southern section of the project site in a south-west to north-east direction. A few small wetlands occur in the project area, the most notable being a swampland located approximately 2 km south west of the proposed site and a wetland located approximately 7 km east south-east. The largest water body in the area, but outside of the project area, is the Chipembe Dam which is located 12 km northwest of the site.

Compared with other countries in the region, Mozambique has a rich natural resource base including untransformed indigenous forests, savannah woodlands and coastal habitats. About 25% of the land has commercial forestry potential, 12.5% constitutes state-protected areas and a further 22% comprises potential wildlife habitat.

The proposed mine area is covered predominantly by various forms of Miombo woodland, much of which has either been removed or degraded due to human land use impacts. The proposed mine site sits in the Chipembe River catchment, but without extensive riparian vegetation or wetlands.

Land use in the area is primarily for subsistence agriculture. Crops such as maize, cotton and cassava are grown on the flat areas which are cleared using slash and burn techniques. Some small livestock is reared in the area although these animals were only noted near the villages and are not abundant in the project site.

Almost all households are heavily reliant on the natural resources for their livelihoods. Natural resources are used for construction, medicinal consumption and to supplement their food. Charcoal production, for local and external use, was also evident in the project site.

Faunal Surveys

Two faunal surveys were undertaken in the wet (6-15 March 2013) and dry (16-21 August 2013) season. Lists of all terrestrial vertebrate species known of likely to occur in the region were compiled from the literature. From these lists, Species of Special Concern (SSC) were identified by reference to the IUCN Red Data List and CITES; and were highlighted during faunal surveys to confirm their presence.

Faunal diversity was historically high, but certain groups, i.e. large mammals and birds, have been depleted or locally extirpated. Thirty nine amphibian species may occur in Cabo Delgado Province, of which 20 were observed during the faunal surveys. No amphibian SSC or endemic species, or specimens of problematic taxonomic status, were recorded, and the amphibian fauna is not obviously impoverished from that expected to have historically occurred in the region.

During the faunal surveys only 22 reptiles were observed, and another seven were reported to occur in the region. This number is relatively low compared with the +60 species that can be expected for the region. No reptile SSC or endemic species or specimens of problematic taxonomic status, were recorded in the region, although a number of species do occur on CITES appendices, and their international trade is either banned or subject to strict control. It is probable that the low number of reptiles recorded during the survey reflects the shortness of the survey period and reduced reptile activity at the time. Due to persecution, the density of the larger, more conspicuous reptiles (e.g. pythons, cobras, mambas) may be impoverished from numbers expected to have historically occurred in the region. It is likely that the overall reptile diversity remains relatively intact.

Although the incidence of snakebite in the region is reported to be low, at least 12 venomous snakes occur in the region, bites from the majority of which have caused fatalities. In addition, three fatal attacks from crocodiles in Chipembe Dam were reported in 2012.

One hundred and thirty six (136) bird species were observed during the faunal surveys. Although the number of birds recorded is low relative to the possible 430+ bird species that may occur in the study area, it is a good reflection of the common bird fauna of Miombo woodlands. This number can be expected to increase with long-term observations, especially as many intra-African and Palaearctic migrant birds had already migrated northwards during the time of the field surveys.

No bird IUCN threatened bird species were recorded on site. However, several (11) CITES listed species were recorded. The recorded SSC include mainly the Falconiformes species (e.g. eagles, buzzards, goshawks, sparrowhawks etc), and Strigiformes species (owls). Of the *Tauraco* species that also fall under CITES, the purple-crested turaco was the only species observed on site.

Of the possible 145 mammal species which may occur in Cano Delgado Province; only 14 were recorded during the faunal survey. A further 20 mammal species are reported to occur in the area, while a further 96 could possibly also occur in the area. Most of these are small mammals, such as rodents, bats and shrews. Eighteen large to medium-sized herbivores and carnivores that historically occurred in the area are now either locally extnct or very rare vagrants.

Eight mammal SSC were identified for the study area: three of these occurred in the area during historical times but are highly unlikely to still occur; two mammal SSC (elephant and hippo) are still reported by local villagers to occur, at least seasonally, in the area.

Sensitive Faunal Habitats

The most sensitive habitats utilized by the surviving fauna include: 1) the Riparian zone and wetlands; 2) Steep slopes and rocky ridges. None of these habitats are specific to the project area and are well represented in the Balama Province. The Chipembe River and its associated drainage lines represent particularly sensitive habitats, especially from an amphibian and bird perspective. Similarly, the rocky ridges of Mts Nassilala and Coronge represent a sensitive habitat for the maintenance of reptile, bird and mammal diversity.

Assessment of Faunal Impacts

Most impacts could be mitigated to LOW significance with appropriate mitigation measures. Only six impacts (noted * below) were considered unlikely to be able to be significantly mitigated and remained of MODERATE significance.

Current impacts relating to the "NO-GO" or "Without project scenario"

1. Current land use	MODERATE
2. Habitat loss, fragmentation and degredation	HIGH

Impacts associated with the Construction phase of the Mining Option

1: Loss of Amphibian Diversity	MODERATE
2: Loss of Reptile Diversity	MODERATE
3: Loss of Bird Diversity	MODERATE
4: Loss of Mammal Diversity	MODERATE *
5: Loss of Species of Conservation Concern	MODERATE
6: habitat fragmentation and loss	MODERATE
7: Ecological impacts from dust	MODERATE
8: Disruption to fauna from increased noise levels	MODERATE *
9: Chemical Pollution	MODERATE

Impacts associated with the Operational phase of the Mining Option

10: Loss of faunal biodiversity	MODERATE
11: Loss of Species of Conservation Concern	MODERATE *
12: Introduction of Alien fauna	LOW
13: habitat fragmentation and loss	MODERATE
14: Increased Dust Levels	MODERATE *
15: Noise Pollution	MODERATE *
16: Chemical Pollution	LOW
17: Threats to Animal Movements	MODERATE *

Continued land use impacts were considered to have high negative impact, and their long term significance were assessed as MODERATE to HIGH.

Recommendations

Wetlands and river drainage areas should also be avoided as these are sensitive areas for amphibians and associated reptiles and birds.

Significant ecological corridors need to be maintained between all identified areas of High sensitivity, and this is particularly important in the case of the primary target habitat – Mature Miombo Woodland. This vegetation type, although previously widespread in the region, has been extensively cleared and fragmented for human agriculture. Ecological corridors between these fragmented habitats must be maintained. The corridors need to be of sufficient width to allow the potential natural movement.

Proposed conserved areas serve as small local refugia from existing land use impacts, and also those that will occur from the construction and operation of the proposed mine. In a regional context they are small, and their greater efficacy depends upon their integration into regional environmental planning.

An Environmental Management Plan (EMP) is essential. A qualified ecologist, familiar in both vegetation and fauna, should be on site during the contruction phase, and to monitor environmental impacts during the operational phase. For faunal SSC (threatened, endemic or cultural important species), the EMP should include guidelines for the safe capture and relocation of SSC to suitable, safe habits. During all phases of significant habitat loss trained observers should be present to identify, capture and relocate SSC.

Any form of disturbance to the natural habitats provides an opportunity for the invasion and colonization of alien species. The EMP should contain a strict monitoring plan that can be implemented to prevent the spread of alien species, and to identify and remove alien species when encountred.

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1. INTRODUCTION

1.1 Project Overview

Syrah Resources Limited is an Australian resource company with its head office located in Melbourne, Australia. In December 2011 it acquired ownership of the Balama Graphite Project located in northern Mozambique, 7 km from the town of Balama, Cabo Delgado province, Mozambique. Syrah's local subsidiary, Twigg Exploration & Mining Ltd, has subsequently received a license for the prospecting and exploration of graphite, base and precious metals in the Balama district.

The proposed mine is a greenfields project, and will extract outcropping graphitemineralization from the rocky range comprising Mts Nassilala amd Coronge. Syrah Resources Limited plans to mine graphite in the project area using open pit mining to extract the ore. Conventional flotation processing will be used to extract the graphite using water from the Chipembe dam located approximately 12 km north-west of the project site.

The ore will be processed at the processing plant located on the mine site and the final concentrate transported by road to Nacala, where a deep water port is located. The product will be exported internationally from Nacala Port.

The Balama site is anticipated to have a large graphite deposit. It is anticipated that the mine couldhave a mine life of 50 years (minimum of 25 years with an option to extend with another 25 years), although the site layout anticipates 100 years of operation. The plant will operate 365 days per year.

The only linear developments included in the development are construction of an 11km pipeline from Chipembe Dam with associated pump house and storage tank reservoirs, and transport links from the mine site to the existing main road to Balama.

1.2 Objectives

To provide a general description of the natural terrestrial fauna of the specific area to be mined, and adjacent areas that will be impacted by the associated mining infrastructure.

In addition, the objective of this terrestrial fauna survey is to determine the presence and distribution of species of special concern (SSC), as well as determine the likely habitat availability on site for these species.

1.3 Terms of reference

The following terms of reference were provided for the terrestrial faunal assessment:

- Identify and list all species of terrestrial vertebrates occurring in the mining area, based on the literature, published specimens or site records, and likely occurrences;
- Record species of fauna identified in the mining area list by: active searching, opportunistic siting and specimen collection;
- Provide details of any new species or occurrences;
- Assess the habitat preference of fauna and use these habitat preferences to assess the presence and abundance of faunal species;
- Note seasonal use of habitats by resident and migratory species, and identifiy any important corridors required for the maintenance of faunal diversity;
- Identify SSC using reference to the IUCN Red Data List;
- Define and map faunal habitats that are sensitive and require conservation. These may need to be defined as No-Go or Restricted Development areas;
- Describe current impacts on faunal groups and

- Identify any impacts that mining will have on the different faunal groups and specific species that would be significantly affected by the mining proposal.

1.4 Assumptions and Limitations

Study specific assumptions and limitations include:

- Mozambique has no national SSC lists. Assessment of SSC is thus difficult and must rely on list prepared in adjacent countries, or on international lists (e.g. IUCN Red Data lists and CITES appendices). As knowledge of the Mozambique fauna is relatively poor the species listed in this report may not be comprehensive, and it is likely that additional SSC will be found during construction and operation of the development.
- Time is a constraint in studies such as these and only a sample of the fauna of the area was taken.
- As this was a wet season survey, access to the entire site was limited due to the presence of surface water and inaccessible roads.

2. METHODS

2.1 Assessment

The aim of this report is to identify the terrestrial vertebrate fauna in the region and in the study area, and to evaluate the identified fauna in terms of its diversity, conservation importance, and habitat associations. In addition, the study also identified areas of high sensitivity and specific species that may be subject to significant impacts from the project. The extent and importance of existing impacts on the fauna were also identified, as well as those assoiated with the mining proposal.

Key onjectives were to identify:

- Presence of faunal species of special concern.
- Faunal habitats of conservation concern.
- Areas of high biodiversity.
- The presence of process areas:
    - Ecological corridors
    - Wetlands (including rivers)
    - Complex topographical features (especially steep and rocky slopes that provide niche habitats for both plants and animals)
- Identify and assess current impacts on faunal groups, and
- Identify any impacts that mining and its infrastructure will have on the different faunal groups, and specific species that would be significantly affected by the mining proposal

2.2 Faunal Diversity

The known diversity of the terrestrial fauna in the project area was determined by a literature review. Species known from the region, or from adjacent regions whose preferred habitat(s) were known to occur within the study area, were also included. Literature sources included:

- Amphibians – Channing (2001), Channing et al. (2012, 2013), Channing & Baptista (2013), Pickersgill (2007), Poynton & Broadley (1985-1991), Schiotz (1999), Frost (2012, Portik et al. (2013).
- Reptiles – Broadley (2000), Branch (1998, 2000, 2004), Branch & Bayliss (2009), Branch & Ryan (2001), Branch et al (2005a,b), Branch & Tolley (2010), Portik *et al*. 2013; Spawls & Branch (1995), Spawls *et al*. (2002).
- Birds – Sinclair & Ryan (2010), Parker (1999, 2001, 2005a,b), Lepage (2013), Ryan & Spottiswoode (2003).
- Mammals – Kingdon (2004), Smithers & Tello (1976), Monadjem *et al.* (2010a,b), Taylor *et al.* (2012).

2.3 Species of Special Concern

Species of Special Concern (SSC) in terms of the project area are defined as:

- **Threatened species**:
    - There is no Red Data Book (RDB) for threatened species of Mozambique. Reference is made to relevant RDBs for adjacent South Africa (e.g. amphibians, Minter et al. 2004; reptiles Bates et al. 2013; birds, Harrison et al. 1997; mammals, Freidman & Daly 2004) for species common to both countries, and to species included in other international lists (e.g., IUCN 2012 Red List of Threatened Animals).
        - Definitions include:
            - Critically Endangered (CR) - A taxon is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered, and it is therefore considered to be facing an extremely high risk of extinction in the wild.
            - Endangered (EN) - A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered, and it is therefore considered to be facing a very high risk of extinction in the wild.

  - Vulnerable (VU) - A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable, and it is therefore considered to be facing a high risk of extinction in the wild.
  - Near Threatened (NT) - A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.
- **Sensitive species**: Species not falling in the categories above but listed in:
  - Appendix I or II of the Convention of International Trade in Endangered Species (CITES[1]).
    - Appendix I lists species that are the most endangered among CITES-listed animals and plants
    - Appendix II lists species that are not necessarily now threatened with extinction but that may become so unless trade is closely controlled.
- **Endemic species**: Species endemic to Mozambique north of the Zambezi River.

2.4 Impact Assessment Methodology

Five factors need to be considered when assessing the significance of impacts (Table 2.1), namely:

1. Relationship of the impact to **temporal** scales - the temporal scale defines the significance of the impact at various time scales, as an indication of the duration of the impact.

2. Relationship of the impact to **spatial** scales - the spatial scale defines the physical extent of the impact.

3. The severity of the impact - the **severity/beneficial** scale is used in order to scientifically evaluate how severe negative impacts would be, or how beneficial positive impacts would be on a particular affected system (for ecological impacts) or a particular affected party.

   The severity of impacts can be evaluated with and without mitigation in order to demonstrate how serious the impact is when nothing is done about it. The word 'mitigation' means not just 'compensation', but includes concepts of containment and remedy. For beneficial impacts, optimization means anything that can enhance the benefits. However, mitigation or optimization must be practical, technically feasible and economically viable.

4. The **likelihood** of the impact occurring - the likelihood of impacts taking place as a result of project actions differs between potential impacts. There is no doubt that some impacts would occur (e.g. loss of vegetation), but other impacts are not as likely to occur (e.g. vehicle accident), and may or may not result from the proposed development. Although some impacts may have a severe effect, the likelihood of them occurring may affect their overall significance.

Each criterion is ranked with scores assigned as presented in Table 2.2 to determine the overall **significance** of an activity. The criterion is then considered in two categories, viz. effect of the activity and the likelihood of the impact. The total scores recorded for the effect and likelihood are then read off the matrix presented in Table 2.2, to determine the overall significance of the impact. The overall significance is either negative or positive.

[1] http://www.cites.org/

The ***environmental significance*** scale is an attempt to evaluate the importance of a particular impact. This evaluation needs to be undertaken in the relevant context, as an impact can either be ecological or social, or both. The evaluation of the significance of an impact relies heavily on the values of the person making the judgment. For this reason, impacts of especially a social nature need to reflect the values of the affected society.

Prioritising

The evaluation of the impacts, as described above is used to prioritise which impacts require mitigation measures.

Negative impacts that are ranked as being of "**VERY HIGH**" and "**HIGH**" significance will be investigated further to determine how the impact can be minimised or what alternative activities or mitigation measures can be implemented. These impacts may also assist decision makers i.e. numerous **HIGH** negative impacts may bring about a negative decision.

For impacts identified as having a negative impact of "**MODERATE**" significance, it is standard practice to investigate alternate activities and/or mitigation measures. The most effective and practical mitigations measures will then be proposed.

For impacts ranked as "**LOW**" significance, no investigations or alternatives will be considered. Possible management measures will be investigated to ensure that the impacts remain of low significance.

Table 2.1: Ranking of Evaluation Criteria

EFFECT	**Temporal Scale**		
	Short term	Less than 5 years	
	Medium term	Between 5-20 years	
	Long term	Between 20 and 40 years (a generation) and from a human perspective effectively permanent	
	Permanent	Over 40 years and resulting in a permanent and lasting change that will always be there	
	Localised	At localised scale and a few hectares in extent	
	Study Area	The proposed site and its immediate environs	
	Regional	District and Provincial level	
	National	Country	
	International	Internationally	
	Severity	**Severity**	**Benefit**
	Slight	Slight impacts on the affected system(s) or party(ies)	Slightly beneficial to the affected system(s) and party(ies)
	Moderate	Moderate impacts on the affected system(s) or party(ies)	Moderately beneficial to the affected system(s) and party(ies)
	Severe/ Beneficial	Severe impacts on the affected system(s) or party(ies)	A substantial benefit to the affected system(s) and party(ies)
	Very Severe/ Beneficial	Very severe change to the affected system(s) or party(ies)	A very substantial benefit to the affected system(s) and party(ies)
OD	**Likelihood**		
	Unlikely	The likelihood of these impacts occurring is slight	
	May Occur	The likelihood of these impacts occurring is possible	
	Probable	The likelihood of these impacts occurring is probable	
	Definite	The likelihood is that this impact will definitely occur	

** In certain cases it may not be possible to determine the severity of an impact thus it may be determined: Don't know/Can't know*

Table 2.2: Description of Environmental Significance Ratings and associated range of scores

Significance Rate	Description
Low	An acceptable impact for which mitigation is desirable but not essential. The impact by itself is insufficient even in combination with other low impacts to prevent the development being approved. These impacts will result in either positive or negative medium to short term effects on the social and/or natural environment.
Moderate	An important impact which requires mitigation. The impact is insufficient by itself to prevent the implementation of the project but which in conjunction with other impacts may prevent its implementation. These impacts will usually result in either a positive or negative medium to long-term effect on the social and/or natural environment.
High	A serious impact, if not mitigated, may prevent the implementation of the project (if it is a negative impact). These impacts would be considered by society as constituting a major and usually a long-term change to the (natural &/or social) environment and result in severe effects or beneficial effects.
Very High	A very serious impact which, if negative, may be sufficient by itself to prevent implementation of the project. The impact may result in permanent change. Very often these impacts cannot be mitigated and usually result in very severe effects, or very beneficial effects.

3. BIOPHYSICAL DESCRIPTION OF THE STUDY AREA

3.1 Biophysical Environment

A brief summary of the biophysical environment is given below. Fuller detail can be found in the Vegetation Specialist Report (CES 2013).

Cabo Delgado Province has a tropical climate with two distinct seasons. The wet season occurs from November to March and the dry season from April to November. Specific weather data for the project area is not available. Climate data for Montepuez, the nearest town to the project site (93km away), was therefore used. Montepuez has a tropical climate and is also a winter rainfall region. The average annual rainfall is approximately 942.3 mm. The driest month is August/September with 0 mm - 2 mm. Most precipitation falls in January, with an average of approximately 246.4 mm (http://www.weatherbase.com).

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North-eastern Mozambique is predominantly underlain by Proterozoic rocks that form a number of gneiss complexes that range from Palaeo to Neoproterozoic in age. The project site is underlain by metamorphic rocks of the Neoproterozoic Lurio Group that are included within the Xixano Complex.

The study area is relatively flat to gently undulating with sporadic inselbergs (Mount Nassilala and Mount Coronge) rising from the flat plains. The altitudinal range varies from 480 to 830 m above sea level (asl) with the highest point occurring on Mount Nassilala.

The Mehucua River flows through the southern section of the project site in a south-west to north-east direction. A few small wetlands occur in the project area, the most notable being a swampland located approximately 2 km south west of the proposed site and a wetland located approximately 7 km east south-east. The largest water body in the area, but outside of the project area, is the Chipembe Dam which is located 12 km northwest of the site.

Compared with other countries in the region, Mozambique has a rich natural resource base including untransformed indigenous forests, savannah woodlands and coastal habitats. About 25% of the land has commercial forestry potential, 12.5% constitutes state-protected areas and a further 22% comprises potential wildlife habitat.

Land use in the area is primarily for subsistence agriculture. Crops such as maize, cotton and cassava are grown on the flat areas which are cleared using slash and burn techniques. Some small livestock is reared in the area although these animals were only noted near the villages and are not abundant in the project site.

Almost all households are heavily reliant on the natural resources for their livelihoods. Natural resources are used for construction, medicinal consumption and to supplement their food. Charcoal production, for local and external use, was also evident in the project site.

3.2 Protected Area Network

The formal protected area network in Mozambique is relatively extensive (Table 3.1, Fig. 3.1). However, problems of declining infrastructure and protection during the extended civil war (Hatton et al. 2001) have led to poor formal wildlife protection in many isolated parts of the country.

Despite these problems, its components comprise areas that should not be impacted by project developments, and which may inform and incorporate impact mitigation. There have been extensive programmes to uplift and revitalize the protected area network and protect biodiversity in the country (see recent reviews: Anon 2009, USAid 2008).

Table 3.1 Mozambique's Protected Area System (Serviços de Veterinaria and IIAM)

DESIGNATION	NUMBER	SURFACE AREA (sq. km)	% of COUNTRY
National Park	6	37, 476	4.69
National Reserves	6	47,700	5.95
Game Control Areas	2	2,700	0.34
Hunting Areas	12	50,017	6.24
Forest Reserves	26	9,452	1.8
TOTAL	52	147,345	17.32

3.2.1 Protected Areas

Current conservation legislation was drawn up by the colonial administration prior to 1977 and is in the process of being rewritten. The existing legislation makes provision for the creation of protected areas under six categories: National Park, Game Reserve, Partial Reserve, Faunal Reserve, Hunting and Photographic Safari Area and Forest Reserve. The closest protected area is the Quirimbas National Park that occurs 85 km north-east of the project site. The closest Game Reserve is the Niassa Reserve which is one of the largest protected Miombo forest ecosystems in the world, with a surface of 42,200 km². The Niassa Reserve is the largest conservation area of Mozambique and it contains by far the greatest concentration of wildlife in the country (USAid 2008).

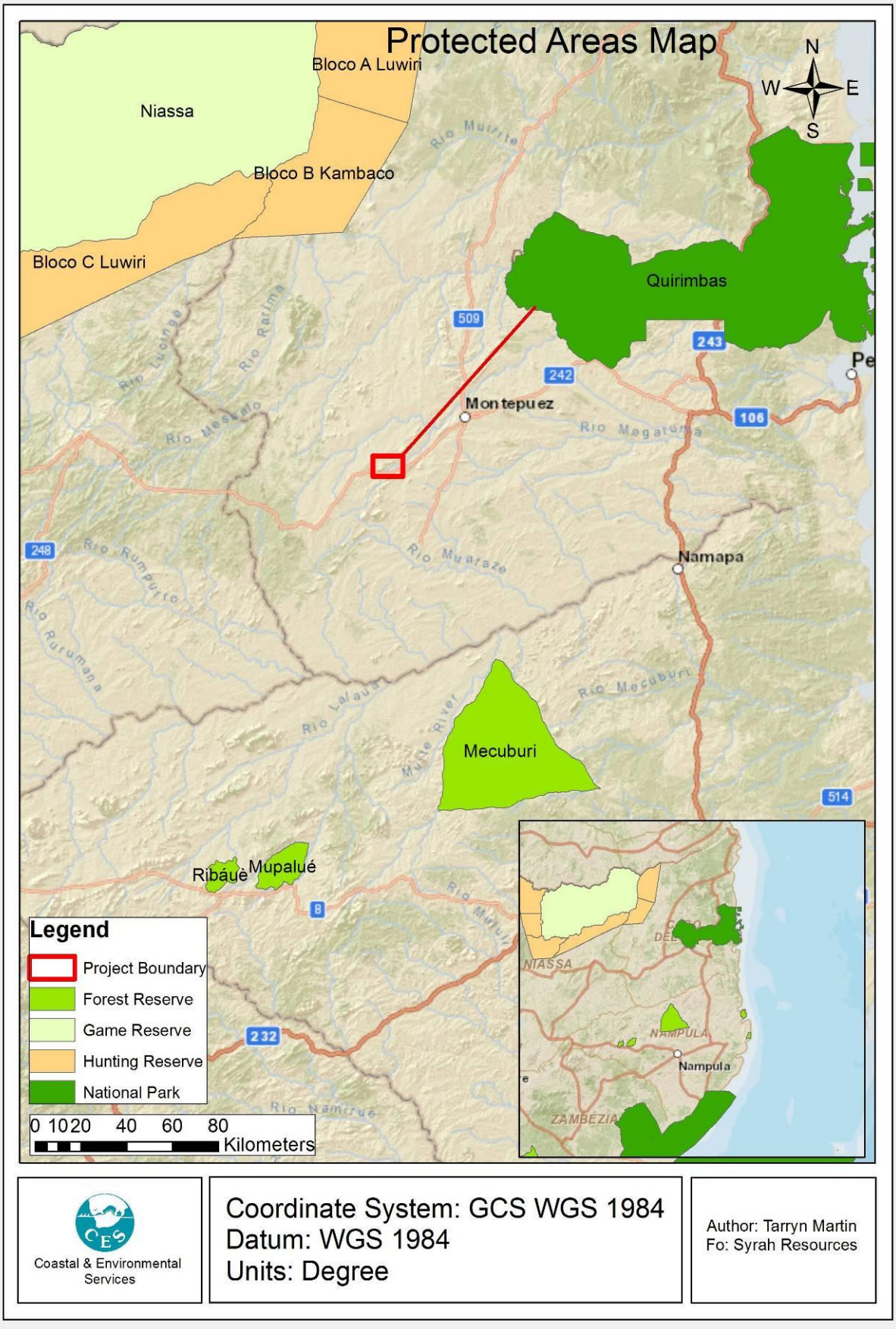

Figure 3.1: Protected areas surrounding the project site

3.2.2 Important Bird Areas

The Important Bird Area (IBA) project of Birdlife International has been developed to identify important areas for bird conservation. Four categories of internationally agreed, objective ornithological criteria are used to assess the suitability of IBAs, including:

Globally threatened species,
Restricted-range species,
Biome-restricted Assemblages,
Globally important congregations.

Currently there are 15 Important Bird Areas (IBAs) in Mozambique, covering approximately 13,890 km2 (Parker 2001). One site is fully protected, 5 are partly protected and the remaining 9 are unprotected. No IBA occurs on or in close proximity to the project area, with the closest being: Mt Namuli (Zambezia), Natia (Nampula), and Njesi Plateau (Niassa).

4. VERTEBRATE FAUNAL SURVEYS

Knowledge of the fauna of northern Mozambique remains one of the most poorly-known in Africa. This is a consequence of the inaccessibility of the region and also the protracted civil war which affected access to many areas (Hatton *et al.* 2001). The southern part of the country, i.e. south of the Zambezi River, has traditionally been incorporated into the southern African region and its fauna has been incorporated into numerous monographic reviews of the subcontinent. However, the region north of the Zambezi, including the provinces of Zambezia, Nampula, Niassa and Cabo Delgado, remains scientifically undocumented and many regions lack even preliminary surveys. Portik et al. (2013) noted that the unique herpetofaunal diversity present in northern Mozambique was a complex admixture of Afromontane species, East African lowland forms, and southern African species, but highlighted that there was a clear need for continued work in the poorly-studied region. This general ignorance is best shown in the figures accompanying the "Checklist and Centres of Vertebrate Diversity in Mozambique" (Schindler et al, 2005), which show massive gaps in analysis for northern Mozambique (Fig 4.1). These do not reflect lack of faunal diversity north of the Zambezi River, but simply the lack of modern data for analysis for all terrestrial vertebrate groups. It is evident from the overview, that the study area has experienced limited human influence, especially within the vicinity of the prospecting area. The deficit in distribution data for terrestrial vertebrates has led to confusion.

Mozambique has a diverse herpetofauna due to the variety of different habitat types available and the large area of the country. However, the lack of scientific study of northern Mozambique has led to widely disparate and inaccurate summaries for the country's herpetofaunal diversity. In an IUCN review of `Biodiversity in Sub-Saharan Africa and its Islands', Stuart and Adams (1990) listed 62 amphibian and 170 reptile species occurring in the country. This figure was later repeated (Anon, 1998), but without supporting documentation. An increased number of 79 species was reported in Hatton & Munguambe (1998), but this inflated figure probably resulted from a lack of careful screening of nomenclatural changes and synonyms may have been duplicated. Fuller details of more accurate regional estimates of herpetofaunal diversity are presented in the class discussions below, and summarized in Table 4.1.

4.1 Faunal Surveys

Two faunal surveys were under undertaken in the wet (6-15 March 2013) and dry (16-21 August 2013) seasons. Both comprised opportunistic collecting and observation of faunal groups, supplemented with interviews with local communities to assess their awareness of various faunal groups, the dependence upon terrestrial faunal resources, and the dangers various vertebrates posed to human welfare and livestock.

4.2 Amphibians

4.2.1 Regional overview of Amphibians

Amphibians are important in wetland systems, particularly where fish are excluded or of minor importance. In these habitats, frogs are dominant predators of invertebrates, many of which are disease vectors for malaria and bilharzia. Reports of declining amphibian populations continue to increase globally, even in pristine protected parks. These declines are not simple cyclic events; frogs, for example, are considered bio-indicator species that reflect the wellbeing of aquatic ecosystems (Poynton and Broadley 1991).

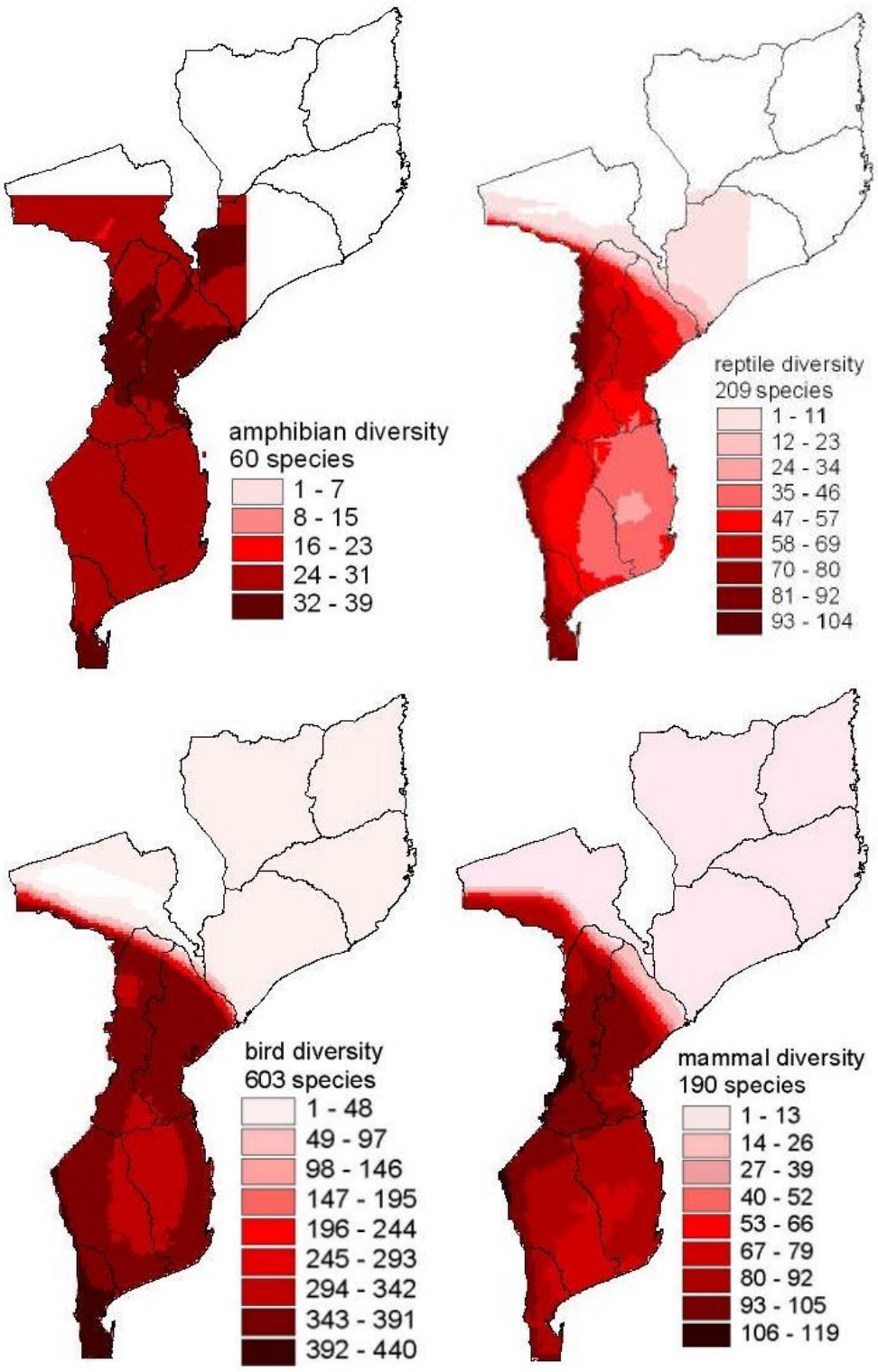

Figure 4.1: Faunal Diversity in Northern Mozambique (Schnieder et al 2005)

Poynton (1966) reviewed the amphibians of northern Mozambique and recorded 36 species from the region, but noted that his list "cannot be regarded as complete". He emphasized the absence of records from the northern regions (north of 14°S) of the country, and commented that "much more collecting needs to be done, particularly in the extreme north". Sadly this still remains a deficit. The lack of knowledge of amphibian diversity in the region is also reflected in Poynton and Broadley's review (1991) of the amphibians of the `Zambesiaca' area (the territories of Botswana, Zambia, Malawi, Mozambique, Zimbabwe, and eastern Caprivi Strip). These authors noted that large tracts of northern Mozambique were "… poorly or uncollected", and they listed only 23 quarter degree sites from which any amphibian has been collected in the area 14° to 18° S and 36° to 42° E (Fig. 4.2). This is less than 8% of the 298 quarter degree squares of land covered in extreme northern Mozambique. Poynton and Broadley (1991) and Channing (2001) listed 62 and 63 species, respectively, whilst Frost (2012) lists as many as 98 species. This is probably closer to the true diversity, although it does list a number of species (e.g. *Hoplobatrachus occipitalis* that have not been recorded from the country) and others of problematic occurrence (e.g. *Hyperolius parker,* which is considered by Pickersgill (2007) to be restricted to Zanzibar).

Channing (2001) mapped 40 amphibian species north of the Zambezi River and although it is probable that this is an underestimate of true diversity, it demonstrates that the Balama region can be expected to sustain a rich amphibian fauna. Branch (2004) reported 35 amphibians from the Niassa Game Reserve and noted that an additional 10 species may enter the northern provinces of country from adjacent southern Tanzania. Forest and isolated high altitude wetlands on inselbergs may also be centres for speciation, and diversity on the 'Great Inselberg Archipelago' is poorly documented and has been suggested to harbour taxonomic novelties (Schneider et al. 2005; Portik et al. 2013).

Table 4.1: Conflicting Assessments of Amphibian and Reptile diversity for Mozambique

Authors	Families	Genera	Species	Endemic & SSC
Amphibians				
Hatton & Munguambe 1998	3	18	39 (79)	5
Stuart & Adams, 1990	-	-	62	5
Poynton & Broadley, 1991	8	23	62	-
Channing 2002	8	24	63	4 (?)
USAID Mozambique 2008	-	-	79	28 Endemic
Frost 2012	13	24	98	?
Reptiles				
Hatton & Munguambe 1998	20	83	167	4
Stuart & Adams, 1990	-	-	170	3
USAID Mozambique 2008	-	-	167	3

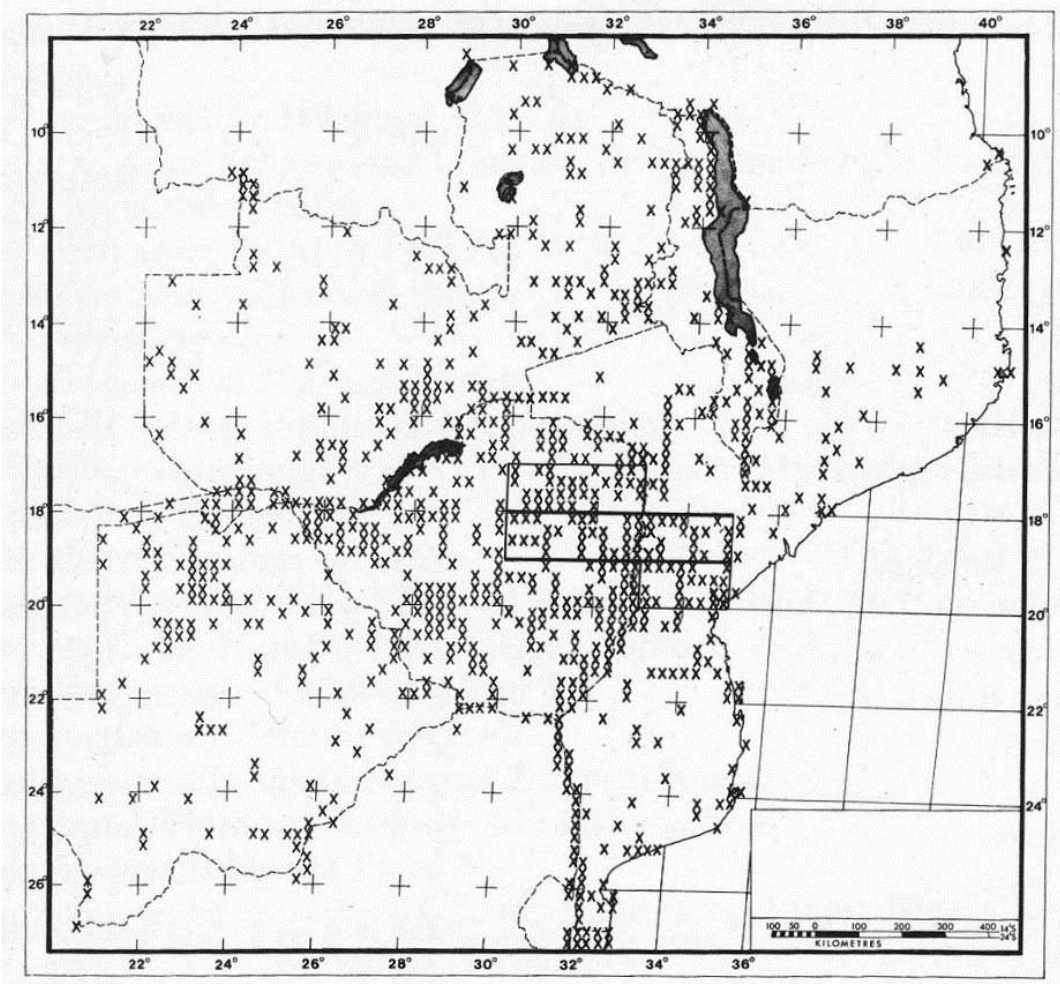

Figure 4.2: Map including all amphibian collections in Mozambique. Note the absence of any collections from northern Mozambique (from Poynton & Broadley, 1991)

4.2.2 Recorded Amphibians species from the project area

Although the faunal surveys did not occur at the beginning of the amphibian breeding season, many amphibians were still breeding and a good sampling of the known and possible amphibians occurring the region was obtained. Only two problematic amphibians were obtained. One small reed frog was assigned to *Hypeolius acuticeps* of the *Hyperolius nasutus* complex (Channing et al. 2013), although this is based on geographical location and was not confirmed by vocalisation of genetic analysis. The other was a small puddle frog, provisionally assigned to the *Prhynobtrachus* cf. *perpalmatus* complex.

Most of the observed amphibian fauna is characteristic species of wetlands in the lowlands of northern Mozambique, from which 25 species are recorded and a further 13 species are possible (Appendix 1).

Plate 4.1: An array of amphibians which were recorded during the site visit (Top: *Arthroleptis stenodactylus, Chiromantis xerampelina.* Bottom: *Amietophrynus gutturalis, Amietophrynus maculatus*)

4.3 Reptiles

4.3.1 Amphibian SSC

Two amphibians collected in the region, *Hyperolius acuticeps* (previously *H. nasutus*) and *Ameitia quecketti* (previously *A. angolensis*) remain of problematic status as both belong to groups that have recently undergone taxonomic revision (Channing et al. 2013 and Channing & Baptista 2013, respectively), and assignment of material from northern Mozambique is only provisional. No amphibians in the Balama region are endemic or of conservation concern. No amphibians are endemic to northern Mozambique.

4.3.2 Threats to Amphibians

There is no evidence of significant direct utilization of amphibians in the region, either for international trade or for food consumption. Amphibian threats are thus indirect, of which the most significant is habitat loss due to existing agricultural practises. This may be exacerbated by future industrial developments in the region, of which the proposed mine forms part. Increasing habitat fragmentation from land clearance or degradation resulting from agriculture or industry, can lead to secondary impacts, including road mortalities and exposure to predators as amphibians move to and from wetland breeding sites.

Plate 4.2: An array of amphibians which were recorded during the site visit (Top: *Afrixalus fornasini, Afrixalus delicatus.* Bottom: *Hyperolius tuberlinguis*, *Breviceps mossambicus*)

4.3.3 Regional overview of Reptiles

With the exception of land tortoises all terrestrial reptiles are carnivorous, although some larger lizards do supplement their diet with vegetable matter in certain seasons. Reptiles therefore play an important role in nutrient cycling within ecosystems and in the population control of their prey which often include common pest species.

The Mozambique reptile fauna has never been scientifically, and remains poorly known. Approximately 160-180 reptile species occur in Mozambique; endemicity is low (11-12 species) and mostly associated with offshore islands. According to Broadley and Howell (2000), the coastal forests of northern Mozambique between the Rovuma and Zambezi Rivers remain largely unexplored and urgently need investigation as there may be further species remaining to be discovered. MICOA (1998) provides a reptile list of possible species which may occur in Mozambique which are listed in the South African Red Data Book, but this list is dated, and many of the species mentioned occur only in Southern Mozambique. Compilation of published literature (see Table 4.1) indicates that at least 80 species occur in the Balama region, with 73 being recorded within the region and a further 14 species possibly present (Appendix 2).

4.3.4 Recorded Reptiles from the Project Area

Of the potential 87 reptiles that may occur in the Balama region, only 20 were recorded during the survey. A further eight large or conspicuous species, e.g. Southern Rock Python (*Python natalensis*), Spotted bush snake (*Philothamnus semivariegatus*), Mozambique spitting cobra (*Naja mossambica*), black mamba (*Dendroaspis polylepis*), green mamba (*Dendroaspis angusticeps*), tree agama (*Acanthocercus branchi*), and Eastern hinged tortoise (*Kinixys zombensis*), were reported by mine personnel and local villagers to be present on the mine site. Most reptiles documented on site were conspicuous diurnal lizards, with relatively few snakes observed or captured. Although snakes form the dominant component of reptile diversity in the region (48, 52%), they are mainly small, cryptic and nocturnal and therefore easily overlooked. Although only six snakes were collected during the survey, numerous additional snakes (15-20) are likely to be

present in the various habitats on site. Two of the snakes collected (Puff adder and southern burrowing asp) are venomous and are commonly responsible for snake bite in East and Southern Africa.

Plate 4.3: An array of reptiles recorded during the site visit (Top: *Trachylepis varia, Panaspis wahlbergii.* Bottom: *Trachylepis margaritifer, Hemidactylus platychephalus*)

4.3.5 Reptile SSC

One lizard of scientific interest was collected during the survey. A series of small, snake-eyed skinks (*Panaspis* cf *wahlbergii*) were collected beneath cashew trees near Ncuive village. Molecular analysis of similar material collected near Lishinga indicates that a new species occurs in northern Mozambique. It is unlikely that this new species, which already appears to have a relatively wide distribution, will be of conservation concern although it may be endemic to Mozambique.

Five Mozambican reptiles are listed as threatened in the IUCN Red List (2012); all are sea turtles found at the coast. Due to the position of the development area, these will not be impacted in any way due to the development. No other formally recognized threatened (IUCN 2012) reptiles were recorded in the region. Only one Mozambique reptile (the Zambezi soft-shelled terrapin, *Cycloderma frenatum*) is listed in the `Near Threatened' category of the Red List (2012), but no suitable habitat for the species occurs in region, although it is common in Lake Niassa and the Rovuma River. A number of non-threatened species in the region (e.g. the Flap-necked Chameleon (*Chamaeleo dilepis*), monitor lizards (*Varanus niloticus* and *V. albigularis*), a girdled lizard (*Cordylus* tropidosternum), tortoises (*Kinixys spekii, K. zombensis* and *Stigomochelys pardalis*) and Nile crocodile (*Crocodylus niloticus*), are involved in international trade and are listed on CITES Appendix 2 that controls and documents their numbers in international commerce.

Endemicity in Mozambique reptiles is surprisingly low, with only approximately 14 taxa endemic to the country, most being associated with isolated populations on the various offshore islands of the Bazaruto Archipelago. Two new species have also recently been described from isolated montane habitats in northern Mozambique (Branch & Bayliss 2009, Branch & Tolley 2010), with additional new species being described (Branch *et al*. in press). Although these taxonomic novelties are associated with montane isolates, a new burrowing skink has also been discovered north of Pemba in the coastal region of northern Mozambique (Verburgt & Broadley in press). The unusual

snake-eyed skink recorded during the faunal surveys indicates that additional new species may even occur in the Balama region.

4.3.6 Threats to Reptiles

As with amphibians, there is no evidence of significant direct utilization of reptiles in the region, either for international trade or for food consumption. However, all snakes are treated as dangerous and are usually killed when discovered by local inhabitants; this despite the majority of snakes in the region being non-venomous and thus harmless. Interviews with local inhabitants and mine personnel confirmed that snakebite in the region was rare, and usually non-fatal (albeit with pain and occasional morbidity). No tortoises were observed in the wild during the survey, although an adult leopard tortoise (*Stigmochelys pardalis*) was offered for sale by local villagers. It was refused, but was not released as it was retained by its captors for eating. Tortoises are known to be readily collected for food by local communities (Lindsey & Bento 2010), and their numbers may be very low or even locally extirpated due to local consumption.

Plate 4.4: An array of reptiles recorded during the site visit (Top: *Crotaphopeltis hotamboeia, Psammophis orientalis.* Bottom: *Atractaspis bibroni, Bitis arietans*)

The most significant threats to reptiles are indirect, and result mainly from habitat loss due to existing agricultural practises. Proposed industrial developments in the region will compound this threat, especially from the resulting habitat fragmentation that leads to elevated mortality from road traffic and exposure to predators as reptiles (particularly tortoises, snakes and monitors) move over the landscape.

4.3.7 Threats to humans from dangerous reptiles

Adult Nile crocodiles (*C. niloticus*) are the most important dangerous reptiles in the region. Crocodile encounters in the dam on the Chipembe River pose a serious threat, with three attacks (two fatal) reported in 2012 (pers. comm. Christian Nyaundi, Digby Wells).

There are numerous venomous snakes in the region, including black mamba (*Dendroaspis polylepis*), green mamba (*D. angusticeps*), several cobras (Mozambique spitting cobra, *Naja mossambica* and the forest cobra, *N. melanoleuca*), the Puff adder (*Bitis arietans*), the snouted night adder (*Causus rhombeatus*), the boomslang (*Dispholidus typus*), the twig snake (*Thelotornis*

mossambicanus), and the southern burrowing asp (*Atractaspis bibroni*). All, except the latter and the snouted night adder have venoms capable of causing death and therefore represent important clinical concerns. Despite this, only a few (about 3 a year) snakebites were reported locally, with no recent fatalities (pers. comm. Christian Nyaundi, Digby Wells).

4.4 Birds

4.4.1 Regional overview of Birds

A diverse avifauna occurs in Mozambique; more than 680 bird species have been recorded (Parker 1999, 2005a,b). Although a few birds are commensal, rapidly and successfully adapting to modified environments, the majority of birds are sensitive to disturbance and either migrate away from, or suffer greater mortality within, degraded habitats. However, because of their high mobility, birds are capable of rapidly recolonizing rehabilitated habitats. No recent review of Mozambique birds exists, but IUCN (2012) and Birdlife International (2008) cover Mozambique in their data base.

Although considered a rewarding "birding" destination, the avifauna of Mozambique remains relatively poorly known, particularly north of the Zambezi River. The country holds more than 680 bird species of which 530 species breed in Mozambique (Parker 2001). Lepage (2013) notes a much higher diversity, with 737 species (although this includes vagrants and "accidentals"). Parker undertook detailed ornithological surveys (1996-2005) for southern (Parker 1999) and central Mozambique (Parker 2005a), but his surveys of the northern regions were uncompleted and he published results only for the Niassa National Reserve (Parker 2005b), recording over 400 species.

From a conservation perspective, Mozambique contains a remarkable number of range-restricted species, in particular forest birds. Many of these species are near-endemic to the country and confined to three Endemic Bird Areas (EBA), which are shared with Zimbabwe, Malawi and South Africa. These EBAs are located on the: (1) South-east African coast with species such as Rudd's Apalis, Neergaard's Sunbird, Pink-throated Twinspot and Lemon-breasted Canary; (2) the Eastern Zimbabwean highlands which holds Swynnerton's Robin; and (3) the Tanzanian-Malawi mountains where one can find Thyolo Alethe, Dappled Mountain Robin and Long-billed Forest Warbler. Furthermore, the country has 30 species with Afro-temperate (highland) affinities and 25 species are found only along the East African coastal littoral. Another 26 species are restricted to the Zambezian woodlands (Parker, 2001), especially the tall Mopane and Brachystegia woodlands. Despite this diversity, and being a sizeable country, it is surprising that Mozambique only has one "true" endemic bird species, namely the Namuli Apalis (*Apalis lynesi*), which is restricted to isolated evergreen forest patches on Mt Namuli and Mt Mabu (Parker, 2001; Sinclair & Ryan, 2010).

4.4.2 Recorded Birds from the Project Area

Of the possible 300+ bird species which may occur in the study area, 133 were observed during the wet season survey (see Appendix 3). The number of birds recorded is to be expected for a short-term survey, especially as it is likely that many intra-African and Palaearctic migrant birds had already departed at the time of the field trip.

The majority of the recorded species were typical residents of Miombo woodland and secondary woodlands in agricultural landscapes, which are the dominant habitats on site (see Figure 5.1). Typical species included: black-headed oriole, black-backed puffback, black-crowned tchagra, spotted flycatcher, neddicky, tawny-flanked prinia, flappet lark, and broad-tailed paradise-whydah. Other species well represented in secondary clearings and grassy areas near rivers, included: black-winged bishop, yellow bishop, white-winged widowbird and Red-collared widowbird.

A number of waterbirds, including white-faced whistling duck, pygmy goose, Hottentot teal, black crake, common moorhen, African jacana, grey, rufous-bellied and green-backed herons, white-breasted cormorant, pied and malachite kingfisher, etc., occurred in the open water and surrounding reedbeds of the Chipembe River and associated dam, and also along the small water impoundment on the Malipe Stream associated with the embankment on the road to Balama.

Typical bird species found within the Riparian corridors (including riparian forest) included: pied kingfisher, little bee-eater, Klaas's cuckoo, Senegal coucal, Meyer's parrot, African green-pigeon, tropical boubou, orange-breasted bush-shrike and the ubiquitous dark-capped bulbul.

The hydrophilic grasslands and reed beds associated with the streams and depressions were inhabited by hamerkop, rattling cisticola, African pied wagtail, golden weaver, village weaver, red-billed firefinch, blue waxbill, bronze mannikin as well as yellow-fronted canary.

Numerous guilds of birds, common in uninhabited regions, were absent or very rare in the study area. These included: bustards and cranes, plovers and lapwings, francolin and spur fowl, ibis, and thrushes. These are large to medium-sized birds that are often eaten by rural people, and their absence is best explained by a long history of subsistence hunting targeting larger birds for food. In addition, increased fire regimes in floodplain habitats occur during cane rat hunts or when grazing is prepared for cattle. These fires can also lead to local extinctions of bird roosting and breeding sites. Many secretive birds of dense wetland vegetation, e.g. crakes, rails and fluff tails, were probably present but overlooked.

Domesticated and introduced birds included: chickens (*Gallus gallus domesticus*), feral pigeon (*Columba livia*) and house sparrow (*Passer domesticus*), all of which occur in villages in the region.

4.4.3 Bird SSC

No bird species which are considered threatened by the IUCN were recorded on site. However, several (11) CITES listed species were recorded, while a further 61 bird SSC may occur in very low numbers or as vagrants on site. The recorded SSC include mainly the Falconiformes species (e.g. eagles, buzzards, goshawks, sparrowhawks etc), and Strigiformes species (owls), of which 10 species were recorded in the area. Of the *Tauraco* (louries) species that also fall under CITES legislation, only the purple-crested turaco was observed on site.

Table 4.2 lists all possible and recorded bird SSC for the project area.

Table 4.2: All possible and recorded bird SSC for the project region.

Species	Common Name	Category	CITES	Possible	Recorded
Balearica regulorum	Grey Crowned-crane	EN	II	1	
Necrosyrtes monachus	Hooded Vulture	EN	II	1	
Gyps africanus	White-backed Vulture	EN	II	1	
Bugeranus carunculatus	Wattled Crane	VU	II	1	
Torgos tracheliotos	Lappet-faced Vulture	VU	II	1	
Trigonoceps occipitalis	White-headed Vulture	VU	II	1	
Sagittarius serpentarius	Secretarybird	VU	II	1	
Bucorvus leadbeateri	Southern Ground-hornbill	VU		1	
Terathopius ecaudatus	Bateleur	NT	II	1	1
Circus macrourus	Pallid Harrier	NT	II	1	
Polemaetus bellicosus	Martial Eagle	NT	II	1	
Stephanoaetus coronatus	African Crowned Eagle	NT	II	1	
Falco vespertinus	Red-footed Falcon	NT	II	1	
Falco concolor	Sooty Falcon	NT	II	1	
Coracias garrulus	European Roller	NT		1	
Gallinago media	Great Snipe	NT		1	
Falco peregrinus	Peregrine Falcon	LC	I	1	
Tauraco porphyreolophus	Purple-crested Turaco	LC	II		1
Tyto alba	Barn Owl	LC	II	1	
Tyto capensis	African Grass-owl	LC	II	1	
Otus leucotis	White-faced Scops-owl	LC	II	1	
Bubo africanus	Spotted Eagle-owl	LC	II		1
Otus senegalensis	African Scops-owl	LC	II		1
Bubo lacteus	Giant Eagle-owl	LC	II	1	
Scotopelia peli	Pel's Fishing-owl	LC	II	1	
Strix woodfordii	African Wood-owl	LC	II	1	
Glaucidium perlatum	Pearl-spotted Owlet	LC	II	1	
Glaucidium capense	African Barred Owlet	LC	II	1	
Asio capensis	Marsh Owl	LC	II	1	
Eupodotis melanogaster	Black-bellied Bustard	LC	II	1	
Pandion haliaetus	Osprey	LC	II	1	
Aviceda cuculoides	African Cuckoo-hawk	LC	II	1	
Pernis apivorus	European Honey-buzzard	LC	II	1	
Macheiramphus alcinus	Bat Hawk	LC	II	1	
Buteo augur	Augur Buzzard	LC	II	1	
Elanus caeruleus	Black-shouldered Kite	LC	II		1
Buteo buteo	Common Buzzard	LC	II		
Haliaeetus vocifer	African Fish-eagle	LC	II		1

Table 4.2: All possible and recorded bird SSC for the project region (cont.)

Species	Common Name	Category	CITES	Possible	Recorded
Milvus migrans	Black Kite	LC	II	1	
Milvus aegyptus	Yellow-billed Kite	LC	II	1	
Circaetus cinereus	Brown Snake-eagle	LC	II	1	
Circus aeruginosus	Western Marsh-harrier	LC	II	1	
Circaetus pectoralis	Black-chested Snake-eagle	LC	II	1	1
Circus ranivorus	African Marsh-harrier	LC	II	1	
Circaetus cinerascens	Banded Snake-eagle	LC	II		1
Polyboroides typus	African Harrier-hawk	LC	II	1	
Kaupifalco monogrammicus	Lizard Buzzard	LC	II		1
Melierax metabates	Dark Chanting-goshawk	LC	II		1
Melierax gabar	Gabar Goshawk	LC	II	1	
Accipiter tachiro	African Goshawk	LC	II	1	
Accipiter badius	Shikra	LC	II	1	
Accipiter minullus	Little Sparrowhawk	LC	II	1	
Accipiter ovampensis	Ovambo Sparrowhawk	LC	II	1	
Accipiter melanoleucus	Black Sparrowhawk	LC	II	1	
Aquila pomarina	Lesser Spotted Eagle	LC	II	1	
Aquila rapax	Tawny Eagle	LC	II	1	
Aquila wahlbergi	Wahlberg's Eagle	LC	II	1	
Aquila nipalensis	Steppe Eagle	LC	II	1	
Hieraaetus spilogaster	African Hawk-eagle	LC	II	1	
Hieraaetus pennatus	Booted Eagle	LC	II	1	
Hieraaetus ayresii	Ayres's Hawk-eagle	LC	II	1	
Lophaetus occipitalis	Long-crested Eagle	LC	II	1	
Falco naumanni	Lesser Kestrel	LC	II	1	
Falco rupicolus	Rock Kestrel	LC	II	1	
Falco dickinsoni	Dickinson's Kestrel	LC	II	1	
Falco amurensis	Amur Falcon	LC	II	1	
Falco subbuteo	Eurasian Hobby	LC	II	1	
Falco cuvierii	African Hobby	LC	II	1	
Falco biarmicus	Lanner Falcon	LC	II		1
Falco eleonorae	Eleonora's Falcon	LC	II	1	
Ciconia nigra	Black Stork	LC	II	1	
TOTALS				**61**	**11**

4.4.4 Threat to Birds

The woodlands in the project area are under anthropogenic pressures from population expansion, the long history of subsistence farming, and recent developments such as logging, charcoal production and coal mining operations in the region. The proposed mining operation will cause direct habitat loss at the footprints of the mining and infrastructure, but may also lead to secondary habitat degradation by facilitating access to wooded areas by loggers and charcoaling groups along new road networks.

4.5 Mammals

4.5.1 Regional overview of Mammals

The mammal fauna of Mozambique was last reviewed by Smithers and Tello (1976), and approximately 238 mammal species are reported to occur in Mozambique (MICOA 2009, IUCN 2012). However, many factors contribute to the difficulty in accurately predicting local remaining mammal diversity. Mozambique is a large country with highly variable population densities and localised environmental pressures. Therefore, the habitat integrity of a given area and subsequent mammalian diversity needs to be assessed on a site-specific basis. Human impact, due to habitat loss and over-hunting, is high. Nine of 21 species of antelope occurring in the country are considered threatened, and one has become nationally extinct. Other large herbivores, such as elephant, rhino and hippopotamus, have been extirpated from many areas due to the long history of local subsistence hunting and habitat destruction. The loss of woodland and thicket habitat, in particular, has reduced refugia for large mammals to avoid hunting. It has also been exasperated by the poor protection offered large mammals, even in protected areas.

Although mammal endemicity in southern Africa is high (42%), this is not considered to be the situation in Mozambique where endemicity is very low and the mammal fauna is mainly transitional between that of the East African coastal belt and the Cape temperate region.

4.5.2 Recorded Mammals from Project Area

Due to the brief faunal survey no detailed investigation of the mammal fauna could be undertaken. Of the possible 145 mammal species which may occur in the study area (including 13 large mammals now locally extinct), only 14 were recorded during the wet season survey (see Appendix 4). A further 21 species were reported to still occur in the region, although some are now acknowledged to be very rare. The reported species derived from two interviews undertaken with local people at Ncuite Village aimed to supplement field observations and to recorded dependence of the community on faunal resources. The interview group included the village headman and elders and local hunters. The group were shown pictures of mammals illustrated in Kingdon (1999) and further mammal images on a laptop. They were asked a series of general questions relating to mammals within the region and people's attitudes to them, i.e.:

- Was the illustrated species still known in the region, and how common was it?
- If considered very rare, when was it last seen?
- Was it historically present before the onset of the civil war?
- If present was it hunted or used for any other purpose?
- If hunted, how commonly was it caught?
- What hunting techniques were used?

The results of the interviews are summarised in Table 4.3. Hunting was still common and it was reported that all large villages had 1-2 specialist hunters. Young boys would also hunt opportunistically. Despite this effort, few medium-sized animals were collected (1 per week or month, depending on species). As insufficient animals were caught, all meat was sold or consumed locally, with no bushmeat traded in adjacent urban areas.

Scrub Hare (*Lepus saxatilis*) was said to be present, relatively common and snared or hunted with dogs to eat. Although Smithers & Tello (1976) do not show the species to occur in northern

Mozambique, it is recorded in the region by Kingdon (2004). A number of medium-sized to large mammals recorded by Smithers & Tello (1976) were considered local extinct by villagers, although were all known and some recorded seeing them still occasionally. They include: Greater Kudu (*Tragelaphus strepsiceros*), Impala (*Aepyceros melampus*), Reedbuck (*Redunca arundinum*), Waterbuck (*Kobus ellipsiprymnus*), Sable (*Hippotragus niger*), and Roan (*Hippotragus equinus*).

Table 4.3: Mammals present in the region and their use as a faunal resource

SPECIES	SCIENTIFIC NAME	COMMENTS
Rock Hyrax	*Procavia sp.*	Present but restricted to mountains. Hunted, but difficult to snare
Pangolin	*Smutsia temmincki*	Very rarely found. Always killed as they had high commercial value for local good luck charms and, especially for sale to Chinese businessmen.
Fruit Bats	*Eidolon*, etc.	Seasonal, but not common and not eaten
Scrub Hare	*Lepus saxatilis*	Present and hunted with dogs
Porcupine	*Hystrix africaeaustralis*	Present, relatively rare, and snared or dug out of burrows to eat
Cane Rat	*Thryonomys* sp.	Present in dambos and hunted with dogs in the dry season after fires
Vervet monkey	*Cercopithecus pygerythrus*	Mainly found along rivers. Not eaten, but may be problem in crops; hunted with dogs
Baboon	*Papio cynocephalus*	Mainly in hills. Not eaten, but a big problem in crop fields near hills; hunted with dogs, chased into trees and killed with bow and arrows (and probably guns).
Side-striped Jackal	*Canis adustus*	Still present, but restricted to less disturbed areas; no problem to livestock and not hunted
Slender Mongoose	*Herpestres sanguinea*	Common, seen almost daily
Spotted-neck Otter	*Lutra maculicollis*	Reported in Chipembe River, where it damages fish nets and steal fish from traps. Not hunted.
Honey Badger	*Mellivora capensis*	Very rare, not a problem (probably as few people collect honey in the region)
African Civet	*Civettictis civetta*	Present, not considered a problem
Genet	*Genetta sp.*	Present, not considered a problem
Spotted Hyena	*Hyaena hyaena*	Uncommon. Attacks livestock, but few recent records.
Lion	*Panthera leo*	No recent records.
Leopard	*Panthera pardus*	Still present in mountains, but not a problem with livestock
Hippopotamus	*Hippopotamus amphibious*	Recorded infrequently in Chipembe River
Elephant	*Loxodonta Africana*	Common before war, now rare. A small group comes to the dam on the Chipembe River each year. Three came to the village region 3 years ago and were chased off as they were damaging crops, and two were shot by agricultural services and all the villages remembered the feast.
Cape Buffalo	*Syncerus caffer*	Present before war, but no recent records
Bushbuck	*Tragelaphus scriptus*	Very rare now, but present in areas of thicker vegetation in riparian and hilly areas; hunted with dogs and snares
Suni & Common Duiker	*Neotragus moschatus & Sylvicapra grimmia*	Common in dambos; hunted with dogs and snares; one a month killed and sold in village (Sold at a cost of Me1800)
Bush Pig	*Potamochoerus larvatus*	Still present and hunted for food with dogs, snares and guns.

Domestic mammals observed on site included: cats (*Felis catus*), dogs (*Canis africanis*), zebu cattle (*Bos* sp.), pigs (*Sus scrofa*), and goats (*Capra aegagrus*).

A number of mammals not recorded during the survey are known by local people to still be present in the region. Hippo, were reported to occur infrequently in the Chipembe River, and spotted hyaena were also reported to still occur in the region to the north of the study area. Yellow baboon, ground pangolin, civet, cane rats, porcupine, etc. (see Table 4.3) were also all reported to still occur in the region.

Small mammals

Of the large number (96) species which could possibly occur in the study area, the majority are either rodents (Rodentia), bats (Chiroptera), or shrews (Eulipotyphla). These are all small mammals which can prove to be difficult to capture and identify: bat surveys require long-term trapping, using diverse arrays and in diverse habitats to achieve meaningful coverage of the species likely to be present. For bats these difficulties are increased by seasonal movements, usually associated with food availability.

The bat fauna of Mozambique has until recently been poorly documented. The most recent synopsis is 35 years old (Smithers & Tello 1976), in which only a single site (Ilha de Mozambique) had been surveyed north of the Zambezi River. Prior to 2000, a total of 56 bat species were known to occur in Mozambique, and 28 (50%) of these were known from two or fewer sites (Smithers &Tello, 1976), and at least three of these 56 species were based on misidentifications. To rectify this, Monadjem *et al*. (2010b) conducted a series of bat inventories across the country (2005 and 2009), including the first detailed surveys in northern Mozambique. They collected 50 species, including seven species new for the country, and increased the country total to 67 species. Subsequently, Taylor *et al*. (2012) described two new species, both endemic to Mozambique, bringing the country list (as of 2012) to 69 species. Monadjem *et al*. (2010b) modelled the distribution of bats across the country and recorded 38 bat species for northern Mozambique. Much of this diversity was restricted to montane isolates in the west, and the eastern coastal region of northern Mozambique had the lowest bat species diversity in the country. Two sites in the Balama region were surveyed and both had low diversity; i.e. Namapa and Balama Coutada where only four and two bat species were collected, respectively. However, *Taylor et al.* (2012) revised horseshoe bats of the *Rhinolophus hildebrandtii* complex, describing four new species of which two were endemic to Mozambique, including one species (*R. mossambicus*) from Namapa. The bat fauna for Mozambique thus includes 69 species, with 40 species recorded north of the Zambezi River.

Due to the cryptic nature and migratory movements, the conservation status of bats is generally poorly known. Of the 69 bats recorded from Mozambique (Monadjem *et al.* 2010b, Taylor et al. 2012), most were considered of Least Concern (54, 78.3%), six were Data Deficient (8.7%), six were Near Threatened (8.7%) and only three (4.3%) were considered Vulnerable (*Lissonycteris goliath* and *Myonycteris relicta*, Pteropodidae; *Cloeotis percivali*, Hipposideridae). None of these were recorded from the study site, and one of these (*Myonycteris relicta*) has only been recorded once for the country.

Many of the bat species which occur in the project area are wide-spread species of savannah and woodland. Many are associated with rivers and other water resources, and require either caves or buildings, or in some cases riparian forest, where they can roost during the day. While no large bat roosts in caves were observed or reported to occur in the study area, tall trees for fruit-eating bats do occur along the rivers systems in the region and can be expected to be used, at least seasonally.

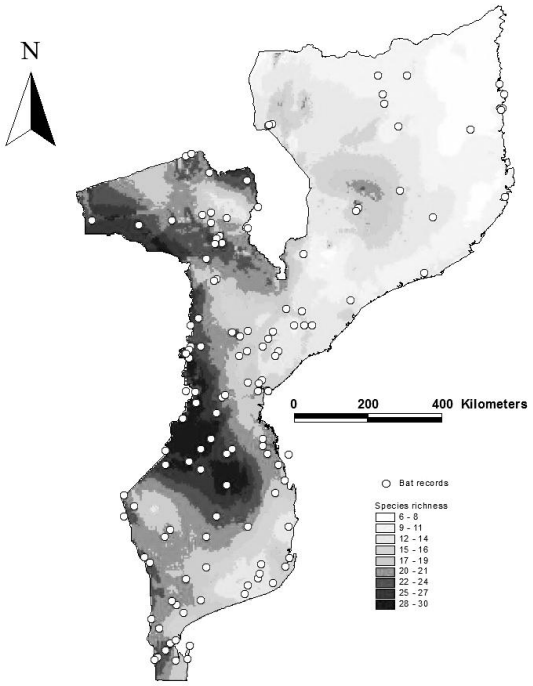

Figure 4.3: Map showing modelled distribution of bat species richness across Mozambique (from Monadjem *et al.* 2010b)

Although many large grazing mammals once occurred in the region, most have been extirpated from accessible regions. The large carnivores associated with the megafauna, such as lion, leopard, cheetah, and wild dog, have either been hunted to local extinction (e.g. lion, cheetah, and wild dog), or have simply moved away from the area due to disturbance or food shortages.

4.5.3 Mammal SSC

Eight mammal SSC were identified for the study area: three of these occurred in the area during historical times, but local people report no recent records and they are highly unlikely to still occur locally; two mammal SSC (African Elephant and Hippopotamus) were reported by locals to still occur in the area (see Table 4.4).

Table 4.4: Mammals SSC which are likely to occur or have occurred within the project area.

Scientific Name	English Name	Red List status	Historical	Possible	Reported	Recorded
Lycaon pictus	African Wild Dog	EN	1			
Acinonyx jubatus	Cheetah	VU	1			
Panthera leo	African Lion	VU	1			
Loxodonta africana	African Elephant	VU			1	
Hippopotamus amphibius	Common Hippopotamus	VU			1	
Hipposideros vittatus	Striped Leaf-nosed bat	NT		1		
Eidolon helvum	Straw-coloured Fruit Bat	NT		1		
Panthera pardus	Leopard	NT		1		
Totals			**3**	**3**	**2**	

4.5.4 Threats to Mammals

Major threats to mammal biodiversity in the region is subsistence hunting and habitat destruction, as well as the impacts of uncontrolled burning, slash and burn agriculture, livestock overgrazing and uncontrolled settlements. With regards to larger mammals, many of the threatened species in Mozambique are either hunted for subsistence, are susceptible to habitat loss, or are key factors in human/wildlife conflict. Subsistence use and habitat degradation are key factors affecting the population dynamics of Red-Data small mammals in the region.

5. FAUNAL HABITAT ASSOCIATIONS

5.1 Vegetation habitats

The study area was previously dominated by various forms of Miombo woodland (see Vegetation Specialist Report (CES 2013). Much of this has now been cleared or degraded by resource extraction, and/or changes in water and fire regimes.

The main vegetation types include:

- Agricultural lands
- Riparian Woodland
- Miombo Woodland
    - Miombo Woodland: Graphite
    - Miombo Woodland: Granite
    - Miomdo Plains: intact
    - Miomdo Plains: degraded

These vegetation habitats are summarised in Fig. 5.1, and discussed in more detail in the Vegetation Specialist Report (CES 2013). Other abiotic habitats include wetlands and rocky outcrops.

The existing fauna still reflects that common in Miombo woodlands, but with an influx of open savannah and grassland species tolerant of the open habitats generated by the long history of human subsistence farming. Birds, due to their high mobility, form the main component of open habitat generalists that have opportunistically occupied these secondary habitats. They include common commensal species such as Cape Turtle Dove, Village Weaver, Yellow-eyed Canary and Black-eyed Bulbul, as well open savannah species such as Lilac-breasted Roller, Broad-tailed paradise whydah, Blue waxbill and Southern Red Bishop. Species dependent upon woodland habitats, particularly large mammal browsers such as Greater Kudu (*Tragelaphus strepsiceros*), Impala (*Aepyceros melampus*), Sable (*Hippotragus niger*), and Roan (*Hippotragus equinus*) are now locally extinct, or very rare vagrants, e.g. African Elephant (*Loxodonta* africana), due in part to hunting, but also habitat loss. Savannah amphibians, such as the toads *Amietophrynus gutturalis* and *A. maculates*, are common, and a transition from woodland/forest snakes to savannah relatives can be expected, with the black mamba (*Dendroaspis polylepis*) replacing the green mamba (*D. intermedius*), and the spitting cobra (*Naja mossambica*) replacing the forest cobra (*N. melanoleuca*).

5.2 Non-vegetation habitats

5.2.1 Rock outcrops

The only significant rock outcrops in the region are associated with Mts Nassilala and Coronge, with graphitic schists and graphitic sandstones comprising the former, and the latter forming an intrusion of granite. The granite is exposed as bedrock and sheer granites with the little vegetation usually associated with cracks and faults. (Fig. 5.2). It provides important habitat for rupiculous (rock loving) species such as certain birds and reptile species, and large rock cracks may also form important roosting sites for bats.

5.2.2 Wetlands

These are restricted to a few small drainage lines associated with run off from Mts Nassilala and Coronge, and with the Chipembe River and its associated dam and drainage lines.

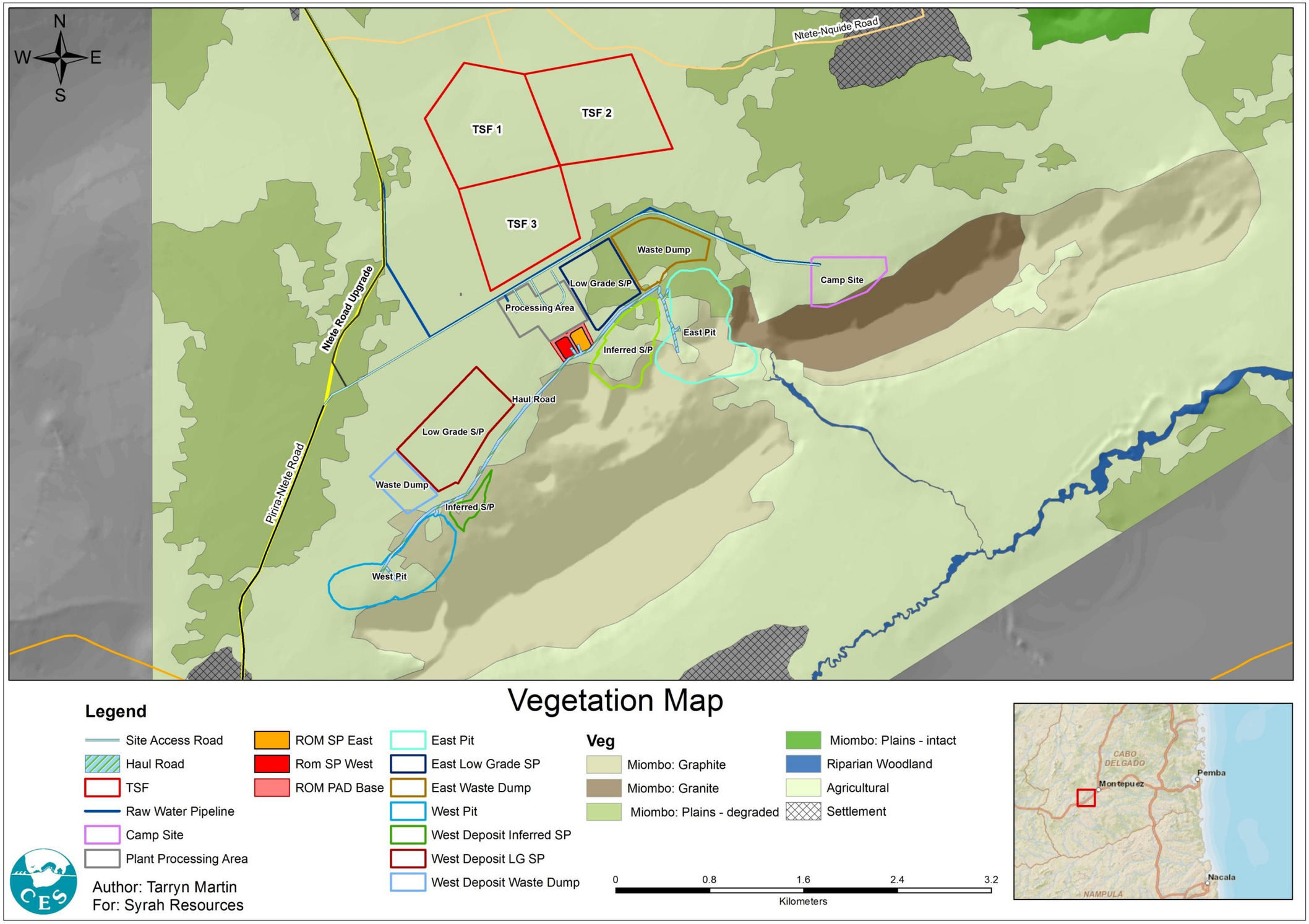

Figure 5.1: Vegetation map of the project area.

Figure 5.2: Exposed bedrock granite on the lower slopes of Mt Coronge.

Figure 5.3: Chipembe River just downstream from the dam. Note freshly repaired fish traps.

Figure 5.4: Small pond on Malipe Stream caused by road embankment on road to Balama.

These different wetland types form important habitats for most of the breeding amphibians in the region, as well as for aquatic reptiles (e.g. terrapins, water snakes and crocodiles) and numerous wetland and wading birds.

5.3 Sensitive areas

There are a number of sensitive habitats utilized by the surviving fauna. They include: riparian zones and wetlands; and steep slopes and rocky areas. None of these habitats are specific to the project area and are well represented in the region. The maintenance and protection of these sensitive habitats may help reduce the impact of the mining operations on the fauna. The Chipembe River and its associated drainage lines represent particularly sensitive habitats, especially from an amphibian and bird perspective. Many of these areas, however, do not fall directly in the area affected by the mine site and associated infrastructure, although secondary impacts to their hydrology may still occur. A small riparian zone drains south between the two main rocky ridges on the mine site, and the latter represent sensitive habitat for reptiles, birds and small mammals such as bats. Both form important corridors for faunal movement over the landscape. These sensitive areas were outlined in the Vegetation Survey (CES 2013) and are shown in Fig. 5.5.

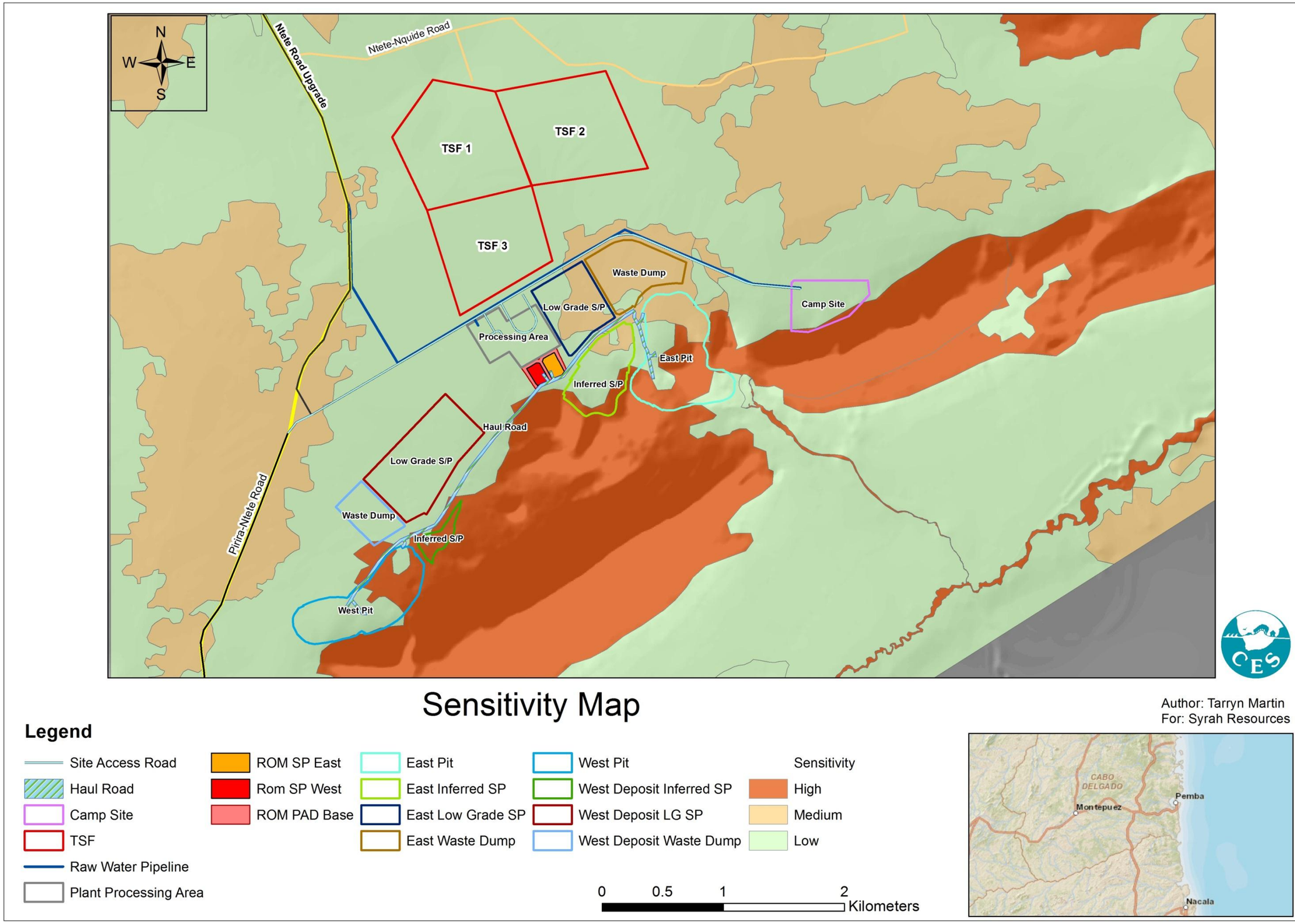

Figure 5.5: Sensitivity Map of the project area based on intact vegetation associated with rock outcrops and riparian zones bordering streams and rivers

5.3.1 Riparian zones and wetlands

Riparian zones and wetlands constitute features of conservation concern as they are process areas that are essential for ecosystem functioning, and provide niché habitats for a variety of plants and animals.

These areas are characterised by permanent, semi-permanent or seasonally inundated drainage lines and rivers, giving way to associated swampy wetlands (dambos) and riparian vegetation (forest/reeds). These wet areas show excellent grazing potential for small and larger hooved animals and may also provide excellent refugia and/or corridors for other mammal species. Where the drainage lines lead into permanent rivers and associated closed forests, the overall mammal sensitivity of this habitat type is considered to be high (Figure 5.5).

The vegetation of the riparian zones provide potential habitat for a unique bird composition not likely to be encountered in other habitats. Noteworthy species of open river and bankside habitats include Three-banded Plover (*Charadrius tricollaris*), African Pied Wagtail (*Motacilla aguimp*), Pied Kingfisher (*Ceryle rudis*), Giant Kingfisher (*Megaceryle maximus*), Malachite Kingfisher (*Alcedo cristata*), African Fish-eagle (*Haliaeetus vocifer*), Reed Cormorant (*Phalacrocorax africanus*) and various members of the Ardeidae (herons & egrets). Reed beds are the preferred habitat for a number of specialised species such as the Lesser Swamp Warbler (*Acrocephalus gracilirostris*), whilst also providing important nesting and roosting habitat for certain dryland foraging species (e.g. weavers, bishops, swallows).

Because the study area is situated within a previously well-wooded environment, most amphibian species were associated with rivers, drainage lines or flooded pools adjacent to the river, utilizing these areas for breeding in the wet season and for feeding year-round. Due to the hilly topography there are no large wetlands on the mine site. The presence of amphibians in the river/drainage lines also forms a major food resource for many reptilian, bird and mammalian predators. Due to moisture in the drainage lines plant growth is usually dense, often with large trees present. Vegetation types associated with rivers/drainage lines (e.g. riverine forest and riverine vegetation) are often restricted and scarce, giving the habitat a high conservation value. Fauna of conservation concern likely to occur in these habitats include the Southern rock python (*Python natalensis*) and various raptors and owls.

5.3.2 Steep slopes and rocky areas

Steep slopes and rocky areas also constitute important features for conservation concern as they constitute areas that are difficult to rehabilitate and are easily affected by changes in land use, with erosion being an important impact factor. They are also the most intact habitat types surviving in the region due to their low agricultural potential. As such they serve as refugia for many species driven from lost or degraded habitats of the valley bottoms.

Depending on their size and exposure, rock outcrops form specialised habitats for some reptiles and birds, and may also form important roosting and breeding sites for rock-sheltering bats. Rocky ridge habitats are a primary habitat type within the concession area and are considered to be of moderate sensitivity as these areas provide significant refugia for faunal species, especially reptiles and small mammals. Large rock formations are ecologically sensitive habitats for all vertebrate groups, due to the micro-habitat potential and structural complexity of the systems. They form the basis of the many food chains.

Many lizards (e.g. geckos, skinks, agamas) and invertebrates (e.g. scorpions) are rupiculous and therefore require habitat with exposed rocks usually only found on high-lying areas such as hills and ridges. The shelter provided by exposed rocks attracts other non-rupiculous species that utilize this habitat for the provision of refugia, e.g. bat roosts. This is especially important in areas where only a few rocky ridges exist as these are used as migratory "stepping stones" for rupiculous (and other) species between adjacent hilly areas. The presence of lizards and the availability of refugia on rocky ridges will also attract several species of snake. No caves suitable as shelters for large, communal roosting bats were located on the rock outcrops.

6. ASSESSMENT OF FAUNAL IMPACTS

6.1 Introduction

The faunal studies undertaken allow assessment of the existing impacts and those that can be predicted to occur due to the proposed mining project at various relevant spatial and temporal scales. The individual impacts can be grouped together as a series of key environmental issues.

6.2 The current impacts: the "NO-GO" or "Without project scenario"

6.2.1 Issue 1: Loss of faunal biodiversity

Historically, the Miombo woodlands of Mozambique supported a large diversity of animals as noted by early travellers (Smithers & Tello, 1976). A long list of small (e.g. bushbuck, duiker) and large ungulates (e.g. zebra, kudu, sable) as well as mega-herbivores (such as elephant, black rhinoceros and hippopotamus) and predators (e.g. lion, hyena) were found in the region. However, the density of animals, as well as the extent of seasonal fluctuations in their populations, prior to human settlement, particularly prior to the protracted civil war, is unknown. The disruption to rural life and agriculture during the civil war, as well as the wide-spread availability and uncontrolled use of firearms, put tremendous extra pressure on the surviving large mammal fauna.

Present land use is primarily focused on agriculture, with livestock grazing incidental and restricted to fallow and recently cleared land. Cultivation is also practiced along the major river courses, which have richer, better watered soils. Pastoralism is considered a major threat to the biodiversity of the region.

Existing Impact 1: Land use impacts on fauna

Cause and comment
While many of the larger mammals were extirpated in historical times, small herbivores such as Bushbuck (*Tragelaphus scriptus*), Suni (*Neotragus moschatus*) and Common Duiker (*Sylvicapra grimmia*), Bush Pig (*Potamochoerus larvatus*), Scrub Hare (*Lepus saxatilis*), Porcupine (*Hystrix africaeaustralis*) and Cane Rat (*Thryonomys* sp.) are all reported to be hunted, either by specialist hunters with snares or weapons, or opportunistically by young men and dog packs. The bushmeat forms a small, but significant addition to the diet of rural communities.

Another faunal impact comes from problem animal control, either from predation on livestock and chickens, and also on crops (e.g. Vervet monkey, *Cercopithecus pygerythrus*, and Baboon (*Papio cynocephalus*). Although side-striped jackal (*Canis adustus*) and leopard (*Panthera pardus*) are present, they occur in low numbers and are reported not to be serious predators on livestock. Spotted hyena (*Crocuta crocuta*) are uncommon, but are the major cause of predation. The use of poisoned carcasses by farmers to kill "problem" animals was considered rare, but this may occur when deemed necessary. Some large birds-of-prey, like the martial eagle (*Polemaetus bellicosus*), and Bateleur (*Terathopius ecaudatus*) were perceived to prey on domestic livestock and poultry, and therefore may be deliberately targeted. Due to the long history of subsistence hunting and habitat burning certain guilds of birds were also absent or very rare in the project area, including game birds (francolin, spurfowl, etc), storks, plovers and ibis, etc. Despite the loss of these large, conspicuous mammals and birds, the smaller minority such as reptiles, amphibians and small mammals are still represented in the region.

Significance Statement
Existing land use impacts on fauna in the project area results in a moderate negative impact in the medium to long-term in the Study Area. The environmental significance of this impact is MODERATE.

Existing Impact 1: Land use impacts on fauna					
	Effect			**Risk or Likelihood**	**Overall Significance**
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Medium term	Regional	Moderate	Definite	**MODERATE**
With Mitigation	N/A	N/A	N/A	N/A	**N/A**

Existing Impact 2: Habitat loss, fragmentation and degradation

Cause and comment
The study area is located within a mosaic of cleared, degraded and fragmented Miombo woodland. Fauna diversity remains high, however, except for large mammals and birds. The presence of species of concern is limited to those with nutritional, commercial and medicinal value to local communities. Unsustainable use of these resources has led to these species occurring on the IUCN Red List of threatened species.

Removal of natural vegetation for cultivation destroys the natural habitat of many animals. Where vegetation has been removed for cultivation, old fields take several years for the vegetation and thus faunal habitats to be restored. They may fail to revert to natural vegetation for several decades, long past the life spans of most faunal groups.

Significance Statement
Habitat loss through existing land use impacts in the project area has resulted in a moderate negative impact in the long-term in the Study Area. The environmental significance of this impact is HIGH.

Existing Impact 2: Habitat loss, fragmentation and degradation					
	Effect			**Risk or Likelihood**	**Overall Significance**
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Long term	Regional	Severe	Definite	**HIGH**
With Mitigation	N/A	N/A	N/A	N/A	**N/A**

In conclusion, it is evident that the natural vegetation of the study area has been degraded as a result of current land use, resulting in reduced biodiversity and low faunal populations. Mining related impacts need to be viewed in this context.

6.3 Impacts associated with the Construction phase of the Mining Option

Various activities are associated with the construction phase of the mining project. This section presents the issues that may impact terrestrial faunal systems arising from the construction and preparation of the mine, including its associated infrastructure such as accommodation (which is minimal during normal operations), the haul road and the associated infrastructure.

6.3.1 Issue 1: Loss of Biodiversity

All faunal groups will suffer a general loss of biodiversity due to varied impacts, such as increased mortality from vehicle movements, loss and fragmentation of suitable habitat due to the footprint of project structures, and various forms of pollution associated with traffic and development. This will be greatest for small, slow-moving species, e.g. amphibians, tortoises and snakes and terrestrial species will suffer higher mortalities than arboreal or burrowing species. Volant species (birds and bats) will suffer less mortality, except where important breeding or roosting sites are lost. For all

groups there will be increased mortality. The main impacts affecting biodiversity include:

- Long-term displacement of faunal groups leading to loss of diversity due to a loss of essential habitat, especially woodland habitat.
- Definite and permanent loss of daily movement corridors fauna dependent on closed-canopy vegetation or specialised (restricted) habitat along the drainage lines and rivers.
- Indirect, long-term impacts associated with increased anthropogenic encroachment and the non-sustainable use of natural resources (e.g., uncontrolled logging, charcoal extraction, and hunting).

Mining Impact 1: Loss of Amphibian Diversity

Cause and Comment
Amphibians are a specious group of terrestrial vertebrates in the concession area. Due to habitat loss and mortalities directly associated with specific project actions, a loss of amphibian diversity will probably occur. Amphibian mortalities will occur during all phases (construction and operational) but will be most significant in association with habitat loss, particularly of wetlands.

Applying a precautionary approach, a total of 39 amphibians may be expected to occur in the region of the study site.

The most sensitive habitats for amphibians are the riparian zone and associated wetlands, either on site or downstream from mining activities.

Mitigation measures

- Avoid clearing or damaging wetlands, and limit river and stream crossings as far as possible. Associated infrastructure, particularly transport linkages, should avoid these areas. Including a buffer distance of 30 m.
- Wetlands will be protected and/or rehabilitated if damaged.
- Maintenance of water quality and flow dynamics.

Significance statement
Impacts associated with construction of the proposed mine development in the project area will probably result in a moderate negative impact in the medium-term in the Study Area on amphibian diversity. The environmental significance of this impact is MODERATE and LOW after mitigation.

Mining Impact 1: Loss of Amphibian Diversity					
	Effect			**Risk or Likelihood**	**Overall Significance**
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Medium term	Study Area	Moderate	Probable	**MODERATE**
With Mitigation	Medium term	Study Area	Slight	Probable	**LOW**

Mining Impact 2: Loss of Reptile Diversity

Cause and Comment
The Project Area probably contains a greater diversity of reptiles than discovered during the survey. Reptile populations, particularly snakes, are difficult to study. Increased human numbers associated with the development of the project will lead to increased mortality of snakes directly from road mortalities and human attitudes, as well as the loss of other reptiles from habitat loss and fragmentation. Applying a precautionary approach, a total of 40+ reptiles may be expected to occur in the region of the study site.

The most sensitive habitats for reptiles are the rocky outcrops and wetlands, either on site or downstream from mining activities.

Mitigation measures

- Protect abiotic habitats, such as rock outcrops, which shelter many reptile species.
- Prohibit exploitation of sensitive reptiles, e.g. chameleons.
- Educate mine staff about the necessity of protecting snakes.

Significance statement

Impacts associated with construction of the proposed mine development in the project area will probably result in a moderate negative impact in the medium-term in the Study Area on reptile diversity. The environmental significance of this impact is MODERATE, and LOW after mitigation.

Mining Impact 2: Loss of Reptile Diversity					
	Effect			**Risk or Likelihood**	**Overall Significance**
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Medium term	Study Area	Moderate	Probable	**MODERATE**
With Mitigation	Medium term	Study Area	Slight	Probable	**LOW**

Mining Impact 3: Loss of Bird Diversity

Cause and Comment

Birds are by far the most speciose vertebrate component in the region. Birds play important and diverse roles in ecosystem functioning (e.g. seed dispersal and trophic transfer) and maintenance of bird diversity is important to maintain viable habitats. Although a few birds are commensal, and can rapidly and successfully adapt to disturbed environments, the majority of birds are sensitive to disturbance and either migrate away from, or suffer greater mortality within, degraded habitats. However, because of their high mobility, birds are capable of rapidly re-colonising rehabilitated habitats, provided suitable microhabitats are available. Applying a precautionary approach, a total of nearly 300 birds may be expected to occur in general region of the study site.

The most sensitive habitats for birds are mature Miombo woodland, the riparian zone and associated wetlands.

Mitigation measures

- Maintain habitat connectivity, particularly to protected areas, via habitat corridors.
- Undertake habitat clearance during winter when birds are not breeding.

Significance statement

Impacts associated with construction of the proposed mine development in the project area will probably result in a moderate negative impact in the medium-term in the Study Area on bird diversity. The environmental significance of this impact is MODERATE, and LOW after mitigation..

Mining Impact 3: Loss of Bird Diversity					
	Effect			**Risk or Likelihood**	**Overall Significance**
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Medium term	Study Area	Moderate	Probable	**MODERATE**
With Mitigation	Medium term	Study Area	Slight	Probable	**LOW**

Mining Impact 4: Loss of Mammal Diversity

Cause and Comment
The long history of human settlement, associated with subsistence and later commercial farming, has greatly reduced the presence of large mammals in the region. The maintenance of the small mammal diversity depends on the maintenance of habitat corridors and diversity.

Despite the largely undisturbed nature of the habitat, the study area appears to have very limited mammalian activity due to a series of existing impacts. These include vegetation clearing and logging, subsistence hunting, the effect of feral dogs and the effects of livestock agriculture. These impacts on mammals could be intensified by activities associated with the mine, particularly accidental road kills and increased hunting associated with increased human numbers in the region. Applying a precautionary approach, a total of 50+ mammals may occur in the region of the study site, although a significant proportion of these will be small mammals, particularly bats, whose use of the area may be seasonal. The most sensitive habitats for mammals are mature Miombo woodland and rocky ridges.

Mitigation measures
- Maintain habitat connectivity, particularly to intact habitats, via habitat corridors.
- Protect abiotic habitats, such as rock outcrops, which shelter many small mammals, particularly bat roosts.

Significance statement
Impacts associated with construction of the proposed mine development in the project area will probably result in a moderate negative impact in the medium-term in the Study Area on mammal diversity. The environmental significance of this impact is MODERATE.

Mining Impact 4: Loss of Mammal Diversity					
	Effect			**Risk or Likelihood**	**Overall Significance**
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Medium term	Study Area	Severe	Probable	**MODERATE**
With Mitigation	Medium term	Study Area	Moderate	Probable	**MODERATE**

Mining Impact 5: Loss of Species of Conservation Concern

Cause and Comment
No amphibian SSC occur in the region, although eight reptiles are listed on CITES appendices. Many large birds (particularly owls and raptors) and large mammal species are either of conservation concern, or are listed on international trade controls (CITES). Although no reptile species in the region are listed on the IUCN Red List, a number are listed on CITES. Trade in the African rock python (*Python natalensis*), two species of monitor lizard (*Varanus niloticus* and *V. albigularis*), two tortoises (*Stigmochelys pardalis* and *Kinixys zombensis*), and a chameleon (*Chamaeleo dilepis*) are regulated, all being listed on CITES App 2. One lizard (*Afroblepharus* cf. *wahlbergi*) is of problematic taxonomic status.

Among birds within the study area, three are endangered, five vulnerable and nine near-threatened species. Based on its geographical position, the study area is expected to provide habitat for bird species that are prominent in Miombo woodlands, although there are no regional endemic species for this habitat in the region. Specifically, the riparian woodland, rock outcrops and intact Miombo woodland were identified as important bird habitats, as these facilitate bird dispersal and provide specialised habitat for habitat-restricted species. Parker (2005a) noted an increased utilization of birds for food and for the cage-bird trade that can be expected to increase with increasing access to Asian markets.

There are no IUCN Red Listed mammal SSC in the area that will be impacted by direct project activities.

Mitigation measures

- Maintain habitat connectivity, particularly to intact habitats, via habitat corridors.
- Protect abiotic habitats, such as rock outcrops, which shelter many small faunal species, including reptiles and bats.
- Design project structures and transport linkages will avoid where possible sensitive habitat corridors, e.g. drainage lines and wetlands.
- Where possible the road traffic should be limited after dark, as much of the surviving fauna is nocturnal, e.g. bats, most snakes, small rodents, amphibians, etc.
- Vehicle speeds will be limited, and should not exceed 50km/h on the mine site.
- Drivers will be educated regarding their role in impacting on animals and the need to minimize collisions with animals at all times.

Significance statement

Impacts associated with construction of the proposed mine development in the project area will probably result in a moderate negative impact in the medium-term in the Study Area on Species of Special Concern. The environmental significance of this impact is MODERATE, and LOW after mitigation.

Mining Impact 5: Loss of Species of Conservation Concern					
	Effect			**Risk or Likelihood**	**Overall Significance**
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Medium term	Study Area	Moderate	Probable	**MODERATE**
With Mitigation	Medium term	Study Area	Slight	Probable	**LOW**

Mining Impact 6: Faunal impact of habitat fragmentation and loss

Cause and Comment

Various components of the development will cause biodiversity loss directly or indirectly through fragmentation of viable habitats for the various faunal groups. This is usually a loss of vegetation (plant communities) that supply food or shelter, but may include abiotic features such as the loss of temporary wetlands, caves or rock outcrop.

Impacts to sensitive habitats are highly probable and will be local and negative in nature, and occur over the long-term. The significance of these impacts may vary from low to high depending upon the local importance of the habitat and the particular fauna that it harbours.

The proposed transport linkages and associated infrastructure will all cause additional habitat loss and fragmentation, over and above the mining area. The greatest impact on habitat loss and fragmentation will be associated with the waste and tailings areas, as well as the mine site, dwellings and the haul road. The negative impact of habitat loss associated with the development of the mine cannot be fully mitigated. But the following mitigation measures can assist in reducing the severity of the impact.

Mitigation measures

The negative impact of habitat loss associated with the development of the mine cannot be fully mitigated. But the following can assist in reducing the severity of the impact:

- All specific project actions associated with construction, access roads, borrow pits and cut-and-fill construction will avoid sensitive habitats as far as is practicable.
- Natural drainage will be maintained and the silt loads into rivers, streams and wetlands

must stay within normal limits.
- Maintain habitat connectivity, particularly to intact habitats, via habitat corridors.
- Protect abiotic habitats, such as rock outcrops, which shelter many small faunal species, including reptiles and bats.
- Where possible, design project structures and transport linkages to avoid sensitive habitat corridors, e.g. drainage lines and wetlands.

Significance statement
Impacts associated with construction of the proposed mine development in the project area will probably result in a moderate negative impact on the fauna in the medium term in the Study Area due to habitat loss and fragmentation. The environmental significance of this impact is MODERATE, and LOW after mitigation.

Mining Impact 6: Faunal impact of habitat fragmentation and loss					
	Effect			**Risk or Likelihood**	**Overall Significance**
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Medium term	Study Area	Moderate	Probable	**MODERATE**
With Mitigation	Medium term	Study Area	Slight	May Occur	**LOW**

6.3.2 Issue 2: Additional Construction Impacts on Fauna

A variety of impacts are likely to result from the construction of the various components of the mine, both during the construction and operational phases.

However, a significant and widespread impact results from increased transport in the region. Roads are known to alter physical characteristics of the environment and through these impacts roads affect ecosystems, biological communities and species in numerous and different ways.

Mining Impact 7: Ecological impacts from dust

Cause and Comment
Increased dust levels are common during construction especially from veld clearance and increased vehicular traffic. Short-term increased dust levels will accompany all land preparation associated with construction of mine infrastructure.

Mitigation measures
- The unpaved haul is to be watered down during high wind and dry weather conditions.
- Road speeds in sensitive regions e.g. near wetlands, across drainage lines, and during extreme dry climatic conditions, should be limited to curtail dust production.
- Vehicle speed should not exceed 50km/h.
- Where feasible, any construction material is to be transported by covered trucks or containers to avoid contamination to the surrounding area.

Significance statement
The impact of increased dust associated with the construction of the proposed mine development in the project area will definitely result in a moderate negative impact in the medium-term in the Study Area on the fauna. The environmental significance of this impact is MODERATE, and LOW after mitigation.

Mining Impact 7: Ecological impacts from dust					
	Effect			**Risk or Likelihood**	**Overall Significance**
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Short term	Study Area	Moderate	Definite	**MODERATE**
With Mitigation	Short term	Study Area	Slight	May Occur	**LOW**

Mining Impact 8: Disruption to fauna from increased noise levels

Cause and Comment
Mining construction and associated vehicle traffic will create noise pollution that can depress local populations of sensitive faunal groups. Animals differ in the degree to which they tolerate such disturbance, and can be expected to have potentially negative and positive impacts on various faunal groups. Large breeding birds do not usually tolerate continuous disturbance. Increased noise and motor vibrations in wetlands may also impact amphibian breeding choruses, but these impacts will be localised and many amphibian species are surprisingly tolerant of vehicle noise. Noise pollution will occur during all phases (construction, operational, and de-commissioning/closure). Little mitigation is possible.

Mitigation measures
- Mitigation of this impact is difficult, but noise reduction measures should be implemented in all sensitive areas (e.g. adjacent to wetlands) at sensitive times (e.g. at night).
- Construction activities after dark will only be considered in special highly managed circumstances.

Significance statement
Impacts associated with increased noise levels during the construction of the proposed mine development in the project area will definitely result in a moderate negative impact in the medium-term in the Study Area on the fauna. The environmental significance of this impact is MODERATE.

Mining Impact 8: Disruption to fauna from increased noise levels					
	Effect			**Risk or Likelihood**	**Overall Significance**
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Short term	Study Area	Moderate	Definite	**MODERATE**
With Mitigation	Short term	Study Area	Slight	May Occur	**MODERATE**

Mining Impact 9: Chemical Pollution

Cause and Comment
Many faunal groups are sensitive to pollutants. Lead concentrations are higher in small terrestrial mammals collected alongside roads than in bats caught in the same areas. Frog diversity in ponds affected by pollution from road run-off is depressed, and the accumulation of herbicides and their residues in adjacent wetlands can lead to developmental abnormalities in tadpoles and metamorphosing froglets as well as masculinization of female frogs. Pollution may result from periodic accidents, or from a slow, on-going contamination. Operation of the mine particularly in relation to the use of inflammable liquids such as diesel will probably result in periodic accidents. Heavy vehicle traffic is also associated with increased local pollution resulting from exhaust fumes, oil spillage and accumulation of rubber compounds from tyre wear. These pollutants can cause localised impacts. Sensitive wetlands or patches of threatened vegetation may need protection from road surface water run-off containing such pollutants and the application of herbicides to control plant growth alongside roads and around buildings should be monitored.

Mitigation measures

- Storage facilities for chemicals, particularly diesel, will not be situated in regions subject to flooding.
- Design chemical storage facilities so that in the event of spillage their contents are contained within the bunds for decontamination.
- The use of insecticides and herbicides should be closely monitored and dosages and application detailed in the EMP.

Significance statement

Unmitigated chemical pollution resulting from impacts associated with construction of the proposed mine development in the project area will probably result in a moderate negative impact in the medium-term in the Study Area on the fauna. The environmental significance of this impact is MODERATE, and LOW after mitigation.

Mining Impact 9: Chemical Pollution					
	Effect			**Risk or Likelihood**	**Overall Significance**
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Short Term	Study Area	Moderate	Probable	**MODERATE**
With Mitigation	Short Term	Study Area	Slight	May Occur	**LOW**

6.4 Impacts associated with the Operational phase of the Mining Option

This section presents the issues that may impact terrestrial faunal systems arising from the operation of the mine, the haul road and the mineral concentration plant and associated infrastructure.

6.4.1 Issue 1: Loss of Biodiversity

Mining Impact 10: Loss of faunal biodiversity

Cause and Comment

Impacts of the proposed developments on the surviving fauna will vary for the different groups. Amphibian diversity may be impacted by possible small scale, localized changes in water flow dynamics in the region of the mine path, particularly where it crosses drainage lines and wetlands. However, most frogs in the region are widespread and have rapid colonizing abilities. The reptile fauna comprises some species relatively tolerant of agricultural development. Birds are by far the most speciose vertebrate component in the region, but many species are tolerant of low to medium disturbance. The remaining mammal diversity in the region consists of small mammals. With the exception of introduced rodents and bats, most mammals in the region are poor colonizers and require protected habitats to maintain viable population levels. Due to disturbance resulting from habitat loss there will also be an increase in animal mortality as animals move away from the region.

Mitigation measures

- Mitigation of the impact entails protection and where necessary, rehabilitation of adjacent habitats as an environmental off-set, particularly wetland and riparian habitats.
- Avoid clearing or damaging wetlands, and limit river and stream crossings as far as possible. Associated infrastructure, particularly transport linkages, should avoid these areas. Including a buffer distance of 30 m.
- Mainten of water quality and flow dynamics.
- Protect abiotic habitats, such as rock outcrops, which shelter many reptile and mammal species.

- Prohibit exploitation of sensitive species e.g. chameleons and birds within the project area and by project staff.
- Educate mine staff about the necessity of faunal groups such as crocodiles and snakes.

Significance statement
Impacts associated with the operation of the proposed mine development in the project area will definitely result in a moderate negative impact in the medium-term in the Study Area on faunal biodiversity. The environmental significance of this impact is MODERATE.

Mining Impact 10: Loss of faunal biodiversity					
	Effect			**Risk or Likelihood**	**Overall Significance**
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Medium term	Study Area	Moderate	Definite	**MODERATE**
With Mitigation	Medium term	Study Area	Slight	May Occur	**LOW**

Mining Impact 11: Loss of Species of Conservation Concern

Refer to Mining Impact 5: Loss of Species of Conservation Concern

Significance statement
Impacts associated with the operation of the proposed mine development in the project area will definitely result in a moderate negative impact in the medium-term in the Study Area on Species of Special Concern. The environmental significance of this impact is MODERATE.

Mining Impact 11: Loss of Species of Conservation Concern					
	Effect			**Risk or Likelihood**	**Overall Significance**
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Medium term	Study Area	Moderate	Definite	**MODERATE**
With Mitigation	Medium term	Study Area	Slight	Probable	**MODERATE**

Mining Impact 12: Introduction of Alien fauna

Cause and Comment
Developments such as mines and their associated roads create suitable corridors for the introduction of alien species. Introduced urban rodent pests such as the house mouse (*Mus musculus*), house rat (*Rattus rattus*) and the Norwegian rat (*Rattus norvegicus*) are likely to occur in populated areas such as mining villages. These species generally tend to survive alongside human habitation, and don't spread in natural areas.

The most widespread and common alien bird is the House Sparrow (*Passer domesticus*) which is now distributed almost worldwide and was recorded on site.

Mitigation measures
- Eradication programs of problem animals should be undertaken in consultation with conservation authorities.

Significance statement
Impacts associated with the operation of the proposed mine development in the project area will probably result in a moderate negative impact in the medium-term in the Study Area from the introduction of alien species. The environmental significance of this impact is LOW.

Mining Impact 12: Introduction of Alien fauna					
	Effect			**Risk or Likelihood**	**Overall Significance**
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Medium term	Study Area	Slight	May Occur	**LOW**
With Mitigation	Medium term	Study Area	Slight	May Occur	**LOW**

6.4.2 Issue 2: Habitat impacts

Mining Impact 13: Faunal Impact of habitat fragmentation and loss

Cause and Comment
Habitat fragmentation can have diverse consequences for ecosystems and their fauna and flora. Habitat loss is rarely uniform and usually occurs piecemeal, leaving a mosaic of habitat fragments that may serve as refugia for the surviving fauna. Intervening unsuitable habitat, however, creates artificial barriers to normal migration and prevents or inhibits genetic interchange between the isolated populations. Tolerance of habitat fragmentation depends on numerous factors and will thus affect different faunal groups differently.

Mitigation measures
- Where possible the planning of the mine path, roads and the location of buildings should ensure minimal fragmentation of sensitive habitats.

Significance statement
Impacts associated with the operation of the proposed mine development in the project area will definitely result in habitat fragmentation and habitat loss resulting in a moderate negative impact in the medium-term in the Study Area on the fauna. The environmental significance of this impact is MODERATE.

Mining Impact 13: Faunal Impact of habitat fragmentation and loss					
	Effect			**Risk or Likelihood**	**Overall Significance**
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Medium term	Study Area	Moderate	Definite	**MODERATE**
With Mitigation	Medium term	Study Area	Slight	Probable	**LOW**

Mining Impact 14: Increased Dust Levels

Cause and Comment
Increased dust levels during the operational phase will be mainly related to digging activities, crushing and increased vehicular traffic on unpaved surfaces. Dust settling on adjacent vegetation can block plant photosynthesis, respiration and transpiration, in addition to causing physical injuries of plants. Its presence may also make plants unpalatable, thus acting as a possible deterrent to grazing. Dust from road surfaces can also transport chemical pollutants to adjacent regions, thus affecting riparian ecosystems via impacts on water quality.

Mitigation measures

- Water down the haul road to inhibit dust production.
- Limit road speeds especially in sensitive regions e.g. near wetlands, across drainage lines, and during extreme dry climatic conditions, to curtail dust generation.
- In areas of high dust production road surfaces should be dampened.

Significance statement

Impacts associated with the operation of the proposed mine development in the project area will definitely result in increased dust levels resulting in a moderate negative impact in the medium-term in the Study Area on the fauna. The environmental significance of this impact is MODERATE.

Mining Impact 14: Increased Dust Levels					
	Effect			**Risk or Likelihood**	**Overall Significance**
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Medium term	Study Area	Moderate	Definite	**MODERATE**
With Mitigation	Medium term	Study Area	Slight	Probable	**MODERATE**

Mining Impact 15: Noise Pollution

Cause and Comment

Mining activities, associated housing developments and greater vehicle traffic will increase noise levels in the study area. This will reduce the abundance of sensitive bird species. Increased noise and motor vibrations in the vicinity of wetlands will also impact amphibian breeding choruses, but these will be localised and many amphibian species are surprisingly tolerant of urban noise.

Mitigation measures

- Mitigation of this impact is difficult and unlikely to be effected, but could involve noise reduction measures in sensitive areas (e.g. adjacent to wetlands) at sensitive times (e.g. at night).

Significance statement

Impacts associated with the operation of the proposed mine development in the project area will definitely result in increased noise levels resulting in a moderate negative impact in the medium-term in the Study Area on the fauna. The environmental significance of this impact is MODERATE.

Mining Impact 15: Noise Pollution					
	Effect			**Risk or Likelihood**	**Overall Significance**
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Medium term	Study Area	Moderate	Definite	**MODERATE**
With Mitigation	Medium term	Study Area	Slight	Probable	**MODERATE**

Mining Impact 16: Chemical Pollution

Many faunal groups are sensitive to pollutants. Lead concentrations are higher in small terrestrial mammals collected alongside roads than in bats caught in the same areas. Frog diversity in ponds affected by pollution from road run-off is depressed, and the accumulation of herbicides and their residues in adjacent wetlands can lead to developmental abnormalities in tadpoles and metamorphosing froglets as well as masculinization of female frogs. Pollution may result from periodic accidents, or from a slow, on-going contamination. Operation of the mine particularly in relation to the use of inflammable liquids such as diesel will probably result in periodic accidents. Heavy vehicle traffic is also associated with increased local pollution resulting from exhaust fumes, oil spillage and accumulation of rubber compounds from tyre wear. These pollutants can cause localised impacts. Sensitive wetlands or patches of threatened vegetation may need protection from road surface water run-off containing such pollutants and the application of herbicides to control plant growth alongside roads and around buildings will be monitored.

Mitigation Measures:

Mitigation measures is the same as what is listed for the construction phase, thus refer to Section 6.3.6, Issue 2, Impact 2.3.

Significance statement
Impacts associated with the operation of the proposed mine development in the project area will probably result in chemical pollution resulting in a moderate negative impact in the medium-term in the Study Area on the fauna. The environmental significance of this impact is MODERATE. With mitigation measures in place the significance is reduced to LOW.

Mining Impact 16: Chemical Pollution					
	Effect			**Risk or Likelihood**	**Overall Significance**
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Medium term	Study Area	Moderate	Probable	**MODERATE**
With Mitigation	Medium term	Localized	Slight	May Occur	**LOW**

6.4.3 Issue 3: Impacts from Product Transport

Mining Impact 17: Threats to Animal Movements

Cause and Comment
Linear developments, such as haul roads and above-surface pipelines, disrupt the movement of species within their normal home ranges or the seasonal movements of migratory species. Habitat fragmentation may require species to make long movements between patches of suitable habitat in search of mates, breeding sites or food. At such times they may suffer increased mortality, either directly by road vehicles, or from their natural predators due to increased exposure.

Reptiles and amphibians do not undertake long distance migrations, but both groups may undertake short seasonal movements. Many snakes undertake movements between winter hibernation sites and their summer foraging areas. Amphibians are known to experience the highest levels of mortalities associated with the presence of roads among vertebrates. This is mainly attributed to en masse seasonal migrations to and from their breeding sites. Some amphibians, particularly toads, are explosive breeders, and move en masse to the breeding ponds. At such times they may suffer heavy casualties whilst crossing roads.

Impacts on animal movements will be significant for all faunal groups. For amphibians this impact will be greatest where the road runs adjacent to wetlands suitable for breeding. It is an impact of

high probability that will be negative due to increased mortality. It will be localised and occur over the long-term.

Mitigation measures

- Mitigation depends firstly on on-going assessment of the significance of animal road mortalities, levels of which will be monitored during the construction and operational phases.
- The design of project structures and transport linkages should avoid where possible sensitive habitat corridors, e.g. drainage lines and wetlands.
- Road designs will incorporate, where possible, underpasses and culverts that allow the movement of animals. This is of particular importance along drainage lines, which form natural corridors for faunal movements.
- Where possible the road traffic should be limited after dark, as much of the surviving fauna is nocturnal, e.g. bats, most snakes, small rodents, amphibians, etc. In addition to this dipped headlights to reduce light pollution into adjacent habitat are required, and lower speeds must be enforced. These recommendations will help reduce night driving impacts, although the most effective option would be to prohibit driving at night.
- Limit vehicle speed will not exceed 50km/h.
- Drivers should be educated regarding their role in impacting on animals and the need to minimize collisions with animals at all times.

Significance statement

Impacts associated with the operation of the proposed mine development in the project area will definitely result in threats to animal movements resulting in a moderate negative impact in the medium-term in the Study Area on the fauna. The environmental significance of this impact is MODERATE.

Mining Impact 17: Threats to Animal Movements					
	Effect			**Risk or Likelihood**	**Overall Significance**
	Temporal Scale	Spatial Scale	Severity of Impact		
Without Mitigation	Medium term	Study Area	Moderate	Definite	**MODERATE**
With Mitigation	Medium term	Study Area	Slight	Probable	**MODERATE**

7. CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

Syrah Resources Limited plans to mine graphite in the project area using open pit mining to extract the ore. This proposed development is the focus of this report.

This terrestrial fauna baseline report has identified and listed all species of terrestrial vertebrates occurring in the mining area; identified SSC using reference to the IUCN Red Data List and CITES; defined and mapped faunal habitats that are sensitive and require conservation; described current impacts on faunal groups and identified any impacts that mining will have on the different faunal groups and specific species that would be significantly affected by the mining proposal.

The area is predominantly covered by various forms of Miombo woodland, much of which has either been removed or degraded due to human land use impacts. The proposed mine site sits in the Chipembe River catchment, but without extensive riparian vegetation or wetlands.

Faunal diversity was historically high, but certain groups, i.e. large mammals and birds, have been depleted or locally extirpated. Thirty nine amphibian species may occur in Cabo Delgado Province, of which 20 were observed during the faunal surveys. No amphibian SSC or endemic species, or specimens of problematic taxonomic status, were recorded, and the amphibian fauna is not obviously impoverished from that expected to have historically occurred in the region.

During the faunal surveys only 22 reptiles were observed, and another seven were reported to occur in the region. This number is relatively low compared with the +60 species that can be expected for the region. No reptile SSC or endemic species or specimens of problematic taxonomic status, were recorded in the region, although a number of species do occur on CITES appendices, and their international trade is either banned or subject to strict control. It is probable that the low number of reptiles recorded during the survey reflects the shortness of the survey period and reduced reptile activity at the time. Due to persecution, the density of the larger, more conspicuous reptiles (e.g. pythons, cobras, mambas) may be impoverished from numbers expected to have historically occurred in the region. It is likely that the overall reptile diversity remains relatively intact.

Although the incidence of snakebite in the region is reported to be low, at least 12 venomous snakes occur in the region, bites from the majority of which have caused fatalities. In addition, three fatal attacks from crocodiles in Chipembe Dam were reported in 2012.

One hundred and thirty six (136) bird species were observed during the faunal surveys. Although the number of birds recorded is low relative to the possible 430+ bird species that may occur in the study area, it is a good reflection of the common bird fauna of Miombo woodlands. This number can be expected to increase with long-term observations, especially as many intra-African and Palaearctic migrant birds had already migrated northwards during the time of the field surveys.

No bird IUCN threatened bird species were recorded on site. However, several (11) CITES listed species were recorded. The recorded SSC include mainly the Falconiformes species (e.g. eagles, buzzards, goshawks, sparrowhawks etc), and Strigiformes species (owls). Of the *Tauraco* species that also fall under CITES, the purple-crested turaco was the only species observed on site.

Of the possible 145 mammal species which may occur in Cabo Delgado Province; only 14 were recorded during the wet season survey. A further 20 mammal species are reported to occur in the area, while a further 96 could possibly also occur in the area. Most of these are small mammals, such as rodents, bats and shrews. Eighteen large to medium-sized herbivores and carnivores that historically occurred in the area are now either locally extinct or very rare vagrants.

Eight mammal SSC were identified for the study area: three of these occurred in the area during historical times but are highly unlikely to still occur; two mammal SSC (elephant and hippo) are still reported by local villagers to occur, at least seasonally, in the area.

The most sensitive habitats utilized by the surviving fauna include: 1) the Riparian zone and wetlands; 2) Steep slopes and rocky ridges. None of these habitats are specific to the project area and are well represented in the Balama Province. The Chipembe River and its associated drainage lines represent particularly sensitive habitats, especially from an amphibian and bird perspective. Similarly, the rocky ridges of Mts Nassilala and Coronge represent a sensitive habitat for the maintenance of reptile, bird and mammal diversity.

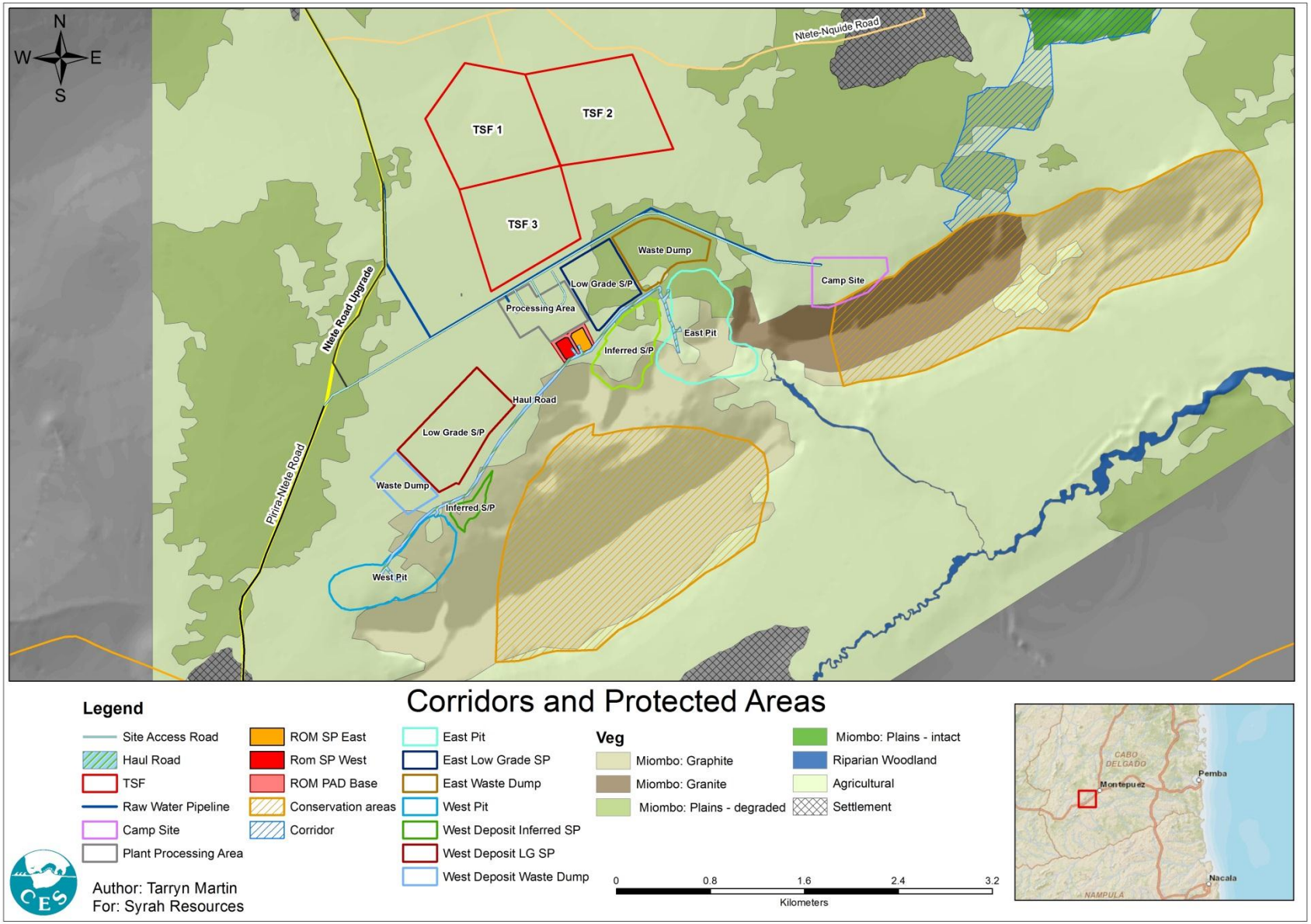

Figure 7.1: Proposed corridors (blue stripes) and conservation areas (orange stripes).

7.2 Recommendations

1. River drainage and small associated wetland areas should be avoided as these are sensitive area for amphibians and associated reptiles and birds.
2. Ecological corridors need to be maintained between all identified areas of High sensitivity. For birds and some reptiles and small mammals the primary target habitat is Mature (Intact) Miombo Woodland. Complete severance of this currently largely intact habitat by means of transport links, tailings and waste sites, and the mine pits, will further exacerbate existing impacts. Thus an ecological corridor between the major fragments on the mine site needs to be developed and protected (blue stripes, Fig. 9.1). The riparian zone draining south from the East Pit, and between the two major rock areas of the mine site (Fig. 9.1), also forms an important corridor for natural faunal movement. Due to its proximity to the mine area and activities it has increased susceptibility to hydrological impacts, and its condition needs careful monitoring to maintain its functionality.
3. The recommended conservation areas serve as small local refugia from existing land use impacts, and also those that will occur from the construction and operation of the proposed mine. In a regional context they are small, and their greater efficacy depends upon their incorporation into regional planning for conservation and ecosystem services. These currently have low priority as the country and province recover from past conflict. However, with burgeoning provincial growth local developments such as the proposed mine must be integrated into regional environmental planning.
4. An Environmental Management Plan (EMP) is essential. A qualified ecologist, familiar in both vegetation and fauna, should be on site during the construction phase, and to monitor environmental impacts during the operational phase. For faunal SSC (threatened, endemic or cultural important species), the EMP should include guidelines for the safe capture and relocation of SSC to suitable, safe habits. During all phases of significant habitat loss trained observers should be present to identify, capture and relocate SSC.
5. Any form of disturbance to the natural habitats provides an opportunity for the invasion and colonization of alien species. The EMP should contain a strict monitoring plan that can be implemented to prevent the spread of alien species, and to identify and remove alien species when encountered.

8. REFERENCES

Anon, 2009. 4th National Report on Implementation of the Convention on Biological Diversity in Mozambique, Maputo. June 2009.

Bates, M.F., Branch, W.R., Bauer, A.M., Burger, M., Marais, J., Alexander, G.J. & De Villiers, M.S. (eds). 2013. *Atlas and Red Data Book of the Reptiles of South Africa, Lesotho and Swaziland*. South African National Biodiversity Institute, Pretoria.

BirdLife International (2008). BirdLife's online World Bird Database: the site for bird conservation. Version 2.1. Cambridge, UK: BirdLife International. Available: http://www.birdlife.org (accessed 30/3/2009)

Branch, W. R. (1998). *Field Guide to the Snakes and other Reptiles of Southern Africa*. rev. ed. Struik Publ., Cape Town, 399 pp, 112 col. pls.

Branch, W.R. (2000). Appendix 3. Survey of the Reptiles and amphibians of the Zambezi Delta. Zambezi Basin Wetlands Biodiversity Project, pp377-392. In: Zambezi Basin Wetlands. Vol. 2: Chapters 3-6. The Zambezi Society.

Branch, W. R. (2004). Herpetological survey of the Niassa Game Reserve, Northern Mozambique, Sociedade para a Gestão e Desenvolvimento da Reserva do Niassa, March 2004.

Branch, W.R. & Bayliss, J. 2009. A new species of *Atheris* (Serpentes: Viperidae) from northern Mozambique. Zootaxa 2113: 41-54.

Branch, W.R., Bayliss, J. & Tolley, K.A. 2014. Pygmy chameleons of the *Rhampholeon platyceps complex*: Description of four new species from isolated 'sky islands' of northern Mozambique. Zootaxa *in press*

Branch, W. R. & Ryan, P. G. 2001. Additions to the Mozambique Herpetofauna: Two new lizards from the Namuli Massif, Mozambique. Herpetology. Rev. 32(4): 281-282.

Branch, W.R. & K. A. Tolley 2010. A new chameleon (Sauria: Chamaeleonidae: *Nadzikambia*) from Mount Mabu, Northern Mozambique. Afr. J. Herpetology. 59(2): 157-172.

Branch, W.R., M.-O. Rödel & J. Marais 2005a. Herpetological survey of the Niassa Game Reserve, northern Mozambique - Part I: Reptiles. – Salamandra, Rheinbach, 41: 195-214.

Branch, W. R., Rödel, M-O. & Marais, J. 2005b. A new species of rupiculous *Cordylus* Laurenti 1768 (Sauria: Cordylidae), from Northern Mozambique. Afr. J. Herpetology. 54(2): 131-138.

Broadley, D.G. (2000). The Herpetofauna of the Zambezi Basin Wetlands. In: Biodiversity of the Zambezi Basin Wetlands (edited by J.R. Timberlake), pp. 145-199. Consultancy report for IUCN ROSA. Biodiversity Foundation for Africa, Bulawayo/The Zambezi Society, Harare.

Broadley, D.G. & Howell, K.M. 1991. A checklist of the reptiles of Tanzania, with synoptic keys. Syntarsus 1: 1-70.

Coastal & Environmental Services, June 2013: Syrah Resources Limited Project: Botanical Specialist Report, CES, Grahamstown

Channing, A. (2001). *Amphibians of Central and Southern Africa*, Protea Books, Pretoria, 470p.

Channing, A., Rödel, M.-O. & Channing, J. (2012) *Tadpoles of Africa*. Edition Chimaira, Frankfurt am Main, 402 pp.

Channing, A. & Baptista, N. (2013). *Amietia angolensis* and *A. fuscigula* (Anura: Pyxicephalidae) in southern Africa: A cold case reheated. Zootaxa 3640 (4): 501-520.

Channing, A., Hillers, A., Lotters, S., Rodel, M-O., Conradie, W., Rodder, D., Mercurio, V., Wagner, P., Dehling, J.M., Du Preez, L.H., Kielgast, J. & Burger, M. (2013). Taxonomy of the super-cryptic *Hyperolius nasutus* group of long reed frogs of Africa (Anura: Hyperoliidae), with descriptions of six new species. Zootaxa, 3620(3): 301-350.

Friedmann, Y. & Daly, B. (eds.) 2004. Red Data Book of the Mammals of South Africa: A Conservation Assessment. CBSG Southern Africa, Conservation Breeding Specialist Group (SSG/IUCN), Endangered Wildlife Trust, South Africa. 722p.

Frost, D. (2012) Amphibian Species of the World, on-line data base American Museum of Natural History (http://research.amnh.org/herpetology/amphibia/ - accessed 5 May 2013).

Harrison, J.A., D.G. Allan, L.G. Underhill, M. Herremans, A.J. Tree, V. Parker & C.J. Brown, 1997. *The Atlas of southern African birds, including Botswana, Lesotho, Namibia, South Africa, Swaziland and Zimbabwe*. Vol. 1 Non-passerines, 785 pp; Vol. 2 Passerines, 732 pp. BirdLife South Africa, Johannesburg.

Hatton J. E & Munguambe F. 1998. The Biological Biodiversity of Mozambique. Maputo: Impacto Lda, 78p.

Hatton, J, Couto, M., Oglethorpe, J. 2001. Biodiversity and War: A Case Study of Mozambique. Washington, D.C.: Biodiversity Support Program. (http://www.worldwildlife. org/bsp/ publications/africa/146/Mozambique.pdf)

IUCN 2012. IUCN Red List of Threatened Species. Version 2012.2. <www.iucnredlist.org>. Downloaded on 01 May 2013.

Kingdon, J. 2004 The Kingdon Pocket Guide to African Mammals. Princeton University Press. 272 pp.

Lepage, D. 2013. Checklist of the birds of Mozambique. Avibase, the world database. Retrieved from http://avibase.bsc-eoc.org.

Lindsey, P. & Bento, C. 2010. Illegal Hunting and the Bushmeat Trade in Central Mozambique: A Case Study from Coutada 9, Manica Province. TRAFFIC, Cambridge, UK.

Ministry of Coordination and Environmental Affairs (MICOA). 2009. National Report on Implementation of the Convention on Biological Diversity in Mozambique. Republic of Mozambique.

Minter, L.R., Burger, M., Harrison, J.A., Braack, H.H., Bishop, P.J & Kloepfer, D. (eds.) 2004. Atlas and Red Data Book of the Frogs of South Africa, Lesotho and Swaziland, SI/MAB Series 9. Smithsonian Institute, Washington D.C., 360p.

Monadjem A, Taylor PJ, Cotterill FPD, Schoeman M.C. 2010a. *Bats of Southern and Central Africa: A Biogeographic and Taxonomic Synthesis*. Johannesburg: Wits University Press.

Monadjem A, Schoeman MC, Reside A, Pio DV, Stoffberg S, Bayliss, J., Cotterill, F.P.D., Curran, M., Kopp, M. & Taylor, P.J. 2010b. A recent inventory of the bats of Mozambique with documentation of seven new species to the country. Acta Chiropterologica 12: 371–391.

Parker, V. (1999). The Atlas of the Birds of Sul do Save, Southern Mozambique. Avian Demography Unit and Endangered Wildlife Trust, Cape Town and Johannesburg.

Parker, V. (2001). Mozambique pp 627–638. In: FISHPOOL, L.D.C. and EVANS M.I. (eds.), *Important Bird Areas in Africa and Associated Islands: Priority sites for conservation*. Newbury and Cambridge, UK. Pisces Publications and BirdLife International (BirdLife Conservation Series No.11).

Parker, V. (2005a). *The Atlas of the Birds of Central Mozambique.* Endangered Wildlife Trust & Avian Demography Unit, Johannesburg and Cape Town, 321p.

Parker, V. (2005b). *The Birds of the Niassa Reserve, Mozam*bique. Bright Continent Guide 4. Cape Town: ADU. 30pp.

Pickersgill, M. (2007). *Frog Search. Results of expeditions to Southern and Eastern Africa*. Edition Chimaira, Frankfurt am Main, 574p.

Portik, D.M., Mulungu, E., Sequeira, D. & McEntee, J.P. (2103) Herpetological surveys of the Serra Jeci and Namuli massifs, Mozambique, and an annotated checklist of the southern Afromontane archipelago. *Herpetological Review*, 44(3): 394–406.

Poynton, J.C. 1966. Amphibia of northern Mozambique. Mems. Inst. Invest. client. Mocam. 8 Ser. A: 13-34.

Poynton, J.C. & Broadley, D.G. (1985). Amphibia Zambesiaca 1. Scolecomorphidae, Pipidae, Microhylidae, Hemisidae, Arthroleptidae. Ann. Natal Mus., 26: 503-553.

Poynton, J.C. & Broadley, D.G. (1986). Amphibia Zambesiaca 2. Ranidae. Ann. Natal Mus., 27: 115-181.

Poynton, J.C. & Broadley, D.G. (1987). Amphibia Zambesiaca 3. Rhacophoridae and Hyperoliidae. Ann. Natal Mus., 28: 161-229.

Poynton, J.C. & Broadley, D.G. (1988). Amphibia Zambesiaca 4. Bufonidae. Ann. Natal Mus., 29: 447-490.

Poynton, J.C. and Broadley, D.G. (1991). Amphibia Zambesiaca 5. Zoogeography. Ann. Natal Mus., 32: 221-277.

Ryan, P. G., and C. N. Spottiswoode. 2003. Long-billed Tailorbirds (*Orthotomus moreaui*) rediscovered at Serra Jeci, northern Mozambique. Ostrich. 74:141–145.

Schiotz, A. (1999). *Treefrogs of Africa*, Edition Chimaira, Frankfurt am Main, 350p.

Schneider, M.F., Buramuge, V.A., Aliasse, L. & Serfontein, F. 2005. Checklist and Centres of Vertebrate Diversity in Mozambique. Forestry Department report, Maputo, 19p.

Sinclair, I. & Ryan, P. 2010. Birds of Africa south of the Sahara: a comprehensive illustrative guide. 2nd edition. Struik Publishers, Cape Town.

Smithers, R.H.N. and Tello, J.L.T.L. 1976. Checklist and atlas of the mammals of Mozambique, Mus. Mem. Natl. Mus. Monum. Rhod. 9: 1-147.

Spawls, S. & Branch, W.R. 1995. *Dangerous Snakes of Africa. Natural History, species directory, venoms and snakebite*. 192 p. Southern Book Publ., Johannesburg.

Spawls, S., Howell, K., Drewes, R. & Ashe, J. 2002. *A Field Guide to the Reptiles of East Africa.* Academic press, San Diego, 543p.

Stuart, S., R. Adams, and M. Jenkins. 1990. Biodiversity in sub-saharan Africa and its islands: conservation, management and sustainable use. Occasional Papers of the IUCN Species Survival Commission. No. 6. IUCN, Gland, Switzerland.

Taylor PJ, Stoffberg S, Monadjem A, Schoeman MC, Bayliss J, et al. 2012. Four New Bat Species (*Rhinolophus hildebrandtii* Complex) Reflect Plio- Pleistocene Divergence of Dwarfs and Giants across an Afromontane Archipelago. PLoS ONE 7(9): e41744. doi:10.1371/journal.pone.0041744

USAid, 2008. Mozambique Biodiversity and Tropical Forests. 118/119 Assessment.

Verbrugt, L. & Broadley, D.G. 2013. A new species of *Scolecoseps* (Reptilia: Scincidae) from north-eastern Mozambique. Arnoldia. Zim. *In press*.

APPENDIX 1: LIST OF AMPHIBIAN SPECIES

Species	Common Name	Red List Status	Possible	Recorded
ARTHROLEPTIDAE				
Common Squeaker	*Arthroleptis stenodactylus*	LC		Y
Dwarf Squeaker	*Arthroleptis xenodactyloides*	LC		Y
Yellow-spotted tree frog	*Leptopelis flavomaculatus*	LC	?	
Silvery tree frog	*Leptopelis argentus/broadleyi*	LC	?	
Cryptic tree frog	*Leptopelis parabocagii*	LC	Y	
BUFONIDAE				
Guttural toad	*Amietophryne gutturalis*	LC		Y
Flat-backed toad	*Amietophryne maculatus*	LC		Y
Lidner's dwarf toad	*Mertensophryne lidneri*	LC	?	
Red toad	*Schismaderma carens*	LC	?	
BREVICIPIDAE				
Mozambique rain frog	*Breviceps mossambicus*	LC	Y	
MICROHYLIDAE				
Striped rubber frog	*Phrynomantis bifasciatus*	LC	Y	
HEMISOTIDAE				
Marbled snout-burrower	*Hemisus marmoratus*	LC	Y	
Guinea snout-burrower	*Hemisus guineensis*	LC	?	
PIPIDAE				
XENOPODINAE				
Tropical platanna	*Xenopus muelleri*	LC		Y
HYPEROLIIDAE				
Snoring leaf-folding frog	*Afrixalus delicatus*	LC		Y
Short-legged leaf-folding frog	*Afrixalus brachycnemis*	LC	?	
Giant leaf-folding frog	*Afrixalus fornasinii*	LC		Y
Argus reed frog	*Hyperolius argus*	LC	Y	
Painted Reed Frog	*Hyperolius marmoratus*	LC	?	
Long Reed Frog	*Hyperolius acuticeps*	LC		Y
Variable Reed Frog	*Hyperolius pusillus*	LC	Y	
Tinker Reed Frog	*Hyperolius tuberlinguis*	LC		Y
Red-legged Kassina	*Kassina maculata*	LC		Y
Senegal Kassina	*Kassina senegalensis*	LC		Y
PHRYNOBATRACHIDAE				
Eastern Puddle Frog	*Phrynobatrachus acridoides*	LC		Y
Mababe Puddle Frog	*Phrynobatrachus mababiensis*	LC		Y
Natal Puddle Frog	*Phrynobatrachus natalensis*	LC		Y
Puddle Frog	*Phrynobatrachus* cf. *perpalmatus*	LC		Y
PTYCHADENIDAE				
Anchieta's Ridged Frog	*Ptychadena anchietae*	LC		Y
Mascarene Ridged Frog	*Ptychadena mascareniensis*	LC	Y	
Mozambique Ridged Frog	*Ptychadena mossambica*	LC		Y
Sharp-nosed Ridged Frog	*Ptychadena oxyrhynchus*	LC		Y

Species	Common Name	Red List Status	Possible	Recorded
Upemba Ridged Frog	*Ptychadena upembae*	LC	Y	
Ornate frog	*Hildebrandti o. ornata*	LC	?	
PYXICEPHALIDAE				
Common river frog	*Ameitia quecketti* (previously *angolensis*)	LC		Y
Galem white-lipped frog	*Amnirana galamensis*	LC	?	
Dwarf Bullfrog	*Pyxicephalus edulis*	LC	?	
Beaded sand frog	*Tomopterna tuberculosa*	LC	?	
RHACOPHORIDAE				
Grey Foam Nest Frog	*Chiromantis xerampelina*	LC		Y
	TOTALS	**39**	**8 (? = 11)**	**20**

APPENDIX 2: LIST OF REPTILE SPECIES

Species	Common Name	Red List Status	CITES	Possible	Recorded
LIZARDS					
GEKKONIDAE					
Tropical house gecko	*Hemidactylus mabouia*	LC			Y
Flat-headed house gecko	*Hemidactylus platycephalus*	LC			Y
Cape dwarf day gecko	*Lygodactylus capensis*	LC			Y
Speckled Dwarf Day Gecko	*Pachydactylus punctatus*	LC		?	
Turner's Thick-toed Gecko	*Chondrodactylus turneri*	LC			Y
VARANIDAE					
Rock monitor	*Varanus albigularis*	LC	2	Y	
Water monitor	*Varanus niloticus*	LC	2		Y
CHAMAELEONIDAE					
Flap-necked chameleon	*Chamaeleo dilepis*	LC	2		Y
AGAMIDAE					
Tree agama	*Acanthocercus atricollis* (*branchi*)	LC			R
Ground Agama	*Agama armata*	LC		?	
Kirk's Rock Agama	*Agama kirkii*	LC		?	
Mozambique Agama	*Agama mossambica*	LC			Y
LACERTIDAE					
Blue-tailed Gliding Lizard	*Holaspis laevis*	LC		Y	
Ornate sandveld lizard	*Nucras ornata*	LC		Y	
Rough-scaled desert lizard	*Meroles squamulosus*	LC		?	
SCINCIDAE					
Mozambique Writhing Skink	*Lygosoma afrum*	LC		Y	
Sundevall's Writhing Skink	*Lygosoma sundevallii*	LC		Y	
Spotted snake-eyed skink	*Panaspis maculicollis*	LC		?	
Snake-eyed skink	*Panaspis* cf *wahlbergii*	LC			Y
Boulenger's Skink	*Trachylepis boulengeri*	LC		Y	
Rainbow Skink	*Trachylepis margaritifer*	LC			Y
Striped Skink	*Trachylepis striata*	LC			Y
Varied Skink	*Trachylepis varia*	LC			Y
GERRHOSAURIDAE					
Giant plated lizard	*Gerrhosaurus validus*	LC		?	
Rough-scaled plated lizard	*Gerrhosaurus major*	LC		Y	
Yellow-throated plated lizard	*Gerrhosaurus flavigularis*	LC		Y	
Black-lined plated lizard	*Gerrhosaurus nigrolineatus*	LC			Y
CORDYLIDAE					
Tropical Girdled Lizard	*Cordylus tropidosternum*	LC	2	Y	
Spotted Flat Lizard	*Platysaurus maculatus*	LC		Y	
AMPHISBAENIDAE					

Species	Common Name	Red List Status	CITES	Possible	Recorded
Swnnerton's Worm Lizard	*Chirindia swynnertoni*	LC		?	
SERPENTES					
TYPHLOPIDAE					
Zambezi Beaked Blind Snake	*Megatyphlops mucruso*	LC		Y	
Blunt Blind Snake	*Lethiobia obtusus*	LC		Y	
LEPTOTYPHLOPIDAE					
Long-tailed Thread Snake	*Myriapholis longicaudus*	LC		Y	
Peter's Thread Snake	*Leptotyphlops scutifrons*	LC		Y	
Cryptic Thread Snake	*Leptotyphlops incognitus*	LC		Y	
BOIDAE					
Southern African Python	*Python natalensis*	LC	2		R
ATRACTASPIDIDAE					
Purple-glossed Snake	*Amblyodipsas p. polylepis*	LC		Y	
Cape Centipede-Eater	*Aparallactus capensis*	LC		Y	
Plumbeous Centipede-Eater	*Aparallactus lunulatus lunulatus*	LC		Y	
Günther's Centipede Eater	*Aparallactus guentheri*	LC		?	
Bicoloured Quill-snout	*Xenocalamus bicolor*	LC		Y	
Bibron's Burrowing Asp	*Atractaspis bibronii*	LC			Y
LAMPROPHIIDAE					
Cape House Snake	*Boaedon capensis*	LC			Y
Cape Wolf Snake	*Lycophidion capense capense*	LC		Y	
Flat-snouted Wolf Snake	*Lycophidion nanum*	LC		?	
Cape File Snake	*Gonionotrophis capensis capensis*	LC		Y	
Nyassa File Snake	*Gonionotrophis nyassae*	LC		Y	
PSEUDOXYRHOPIIDAE					
Mole Snake	*Pseudaspis cana*	LC		?	
PSAMMOPHIIDAE					
Spotted Bark Snake	*Hemirhagerrhis nototaenia*	LC		?	
Angola Dwarf Sand Snake	*Psammophis angolensis*	LC		Y	
Mozambique Sand Snake	*Psammophis mossambicus*	LC			Y
Eastern Striped-bellied Snake	*Psammophis orientalis*	LC			Y
Beaked Snake	*Rhamphiophis rostratus*	LC		Y	
Striped Skaapsteker	*Psammophylax tritaeniatus*	LC		Y	
PROSYMNIDAE					
Stulmann's Shovel-snout	*Prosymna stuhlmannii*	LC		Y	
Lined Shovel-snout	*Prosymna lineata*	LC		Y	
COLUBRIDAE					
Red-lipped Snake	*Crotaphopeltis hotamboeia*	LC			Y
Broadley's Tree Snake	*Dipsadoboa flavida broadleyi*	LC		Y	
Angola Green Snake	*Philothamnus angolensis*	LC		Y	
Common Green Snake	*Philothamnus hoplogaster*	LC		Y	

Species	Common Name	Red List Status	CITES	Possible	Recorded
Spotted Buch Snake	*Philothamnus semivariegatus*	LC			R
Tiger Snake	*Telescopus semiannulatus*	LC		Y	
Boomslang	*Dispholidus typus viridus*	LC		Y	
Mozambique Twig Snake	*Thelotornis mossambicanus*	LC		Y	
Semiornate Snake	*Meizodon s. semiornatus*	LC		Y	
East African Egg-eater	*Dasypeltis medici medici*	LC		Y	
Common Egg-eater	*Dasypeltis scabra*	LC		Y	
NATRICIDAE					
Olive Swamp Snake	*Natriciteres olivacea*	LC		?	
Forest Swamp Snake	*Natriciteres sylvatica*	LC		Y	
ELAPIDAE					
Boulenger's Garter Snake	*Elapsoidea boulengeri*	LC			Y
Snouted Cobra	*Naja annulifera*	LC		Y	
Forest Cobra	*Naja melanoleuca*	LC		Y	
Mozambique Spitting Cobra	*Naja mossambica*	LC			R
Black Mamba	*Dendroaspis polylepis*	LC			R
Green Mamba	*Dendroaspis angusticeps*	LC			R
VIPERIDAE					
Snouted Night Adder	*Causus defilippii*	LC		Y	
Rhombic Night Adder	*Causus rhombeatus*	LC		Y	
Puff Adder	*Bitis arietans arietans*	LC			Y
ORDER: CHELONIA					
TESTUDINIDAE					
Leopard Tortoise	*Stigmochelys pardalis*	LC	2		Y
Southern Hingeback Tortoise	*Kinixys zombensis*	LC	2		R
Spek's Hingeback Tortoise	*Kinixys spekii*	LC	2	?	
TRIONYCHIDAE					
Zambezi Soft-shelled Terrapin	*Cycloderma frenatum*	NT		?	
PELOMEDUSIDAE					
Marsh Terrapin	*Pelomedusa subrufa*	LC		Y	
Yellow-bellied Hinged Terrapin	*Pelusios castanoides*	LC		Y	
Serrated Hinged Terrapin	*Pelusois sinuatus*	LC			Y
Black-bellied Hinged Terrapin	*Pelusios subniger*	LC		?	
ORDER: CROCODYLIA					
CROCODYLIDAE					
Nile Crocodile	*Crocodylus niloticus*	LC	2		Y
	TOTALS		**8**	**44 (? = 14)**	**22 (R* = 7)**

***** Reported to still be in the area

APPENDIX 3: LIST OF BIRD SPECIES

Species	Common Name	Red List Status	CITES	Possible	Recorded
Francolinus coqui	Coqui Francolin	LC		1	
Francolinus sephaena	Crested Francolin	LC		1	
Francolinus afer	Red-necked Spurfowl	LC			1
Coturnix coturnix	Common Quail	LC			1
Coturnix delegorguei	Harlequin Quail	LC		1	
Numida meleagris	Helmeted Guineafowl	LC			1
Dendrocygna bicolor	Fulvous Whistling-duck	LC		1	
Dendrocygna viduata	White-faced Whistling-duck	LC			1
Thalassornis leuconotus	White-backed Duck	LC		1	
Alopochen aegyptiaca	Egyptian Goose	LC		1	
Plectropterus gambensis	Spur-winged Goose	LC		1	
Sarkidiornis melanotos	Comb Duck	LC		1	
Nettapus auritus	African Pygmy-goose	LC			1
Anas sparsa	African Black Duck	LC		1	
Anas erythrorhyncha	Red-billed Teal	LC		1	
Anas hottentota	Hottentot Teal	LC			1
Netta erythrophthalma	Southern Pochard	LC		1	
Turnix sylvaticus	Small Buttonquail	LC		1	
Indicator variegatus	Scaly-throated Honeyguide	LC		1	
Turnix nanus	Black-rumped Buttonquail	LC		1	
Indicator indicator	Greater Honeyguide	LC		1	
Indicator minor	Lesser Honeyguide	LC		1	
Indicator meliphilus	Pallid Honeyguide	LC		1	
Prodotiscus zambesiae	Green-backed Honeyguide	LC		1	
Prodotiscus regulus	Brown-backed Honeyguide	LC		1	
Campethera bennettii	Bennett's Woodpecker	LC		1	
Campethera abingoni	Golden-tailed Woodpecker	LC		1	
Campethera elachus	Little Spotted Woodpecker	LC			1
Dendropicos fuscescens	Cardinal Woodpecker	LC			1
Thripias namaquus	Bearded Woodpecker	LC			1
Stactolaema whytii	Whyte's Barbet	LC		1	
Pogoniulus chrysoconus	Yellow-fronted Tinkerbird	LC			1
Lybius torquatus	Black-collared Barbet	LC			1
Trachyphonus vaillantii	Crested Barbet	LC		1	
Tockus erythrorhynchus	Red-billed Hornbill	LC		1	
Tockus alboterminatus	Crowned Hornbill	LC			1
Tockus nasutus	African Grey Hornbill	LC			1
Tockus pallidirostris	Pale-billed Hornbill	LC		1	
Bycanistes bucinator	Trumpeter Hornbill	LC			1
Bucorvus leadbeateri	Southern Ground Hornbill	VU		1	
Upupa epops	African Hoopoe	LC		1	
Phoeniculus purpureus	Green Wood-hoopoe	LC			1
Rhinopomastus cyanomelas	Common Scimitarbill	LC			1

Species	Common Name	Red List Status	CITES	Possible	Recorded
Apaloderma narina	Narina Trogon	LC		1	
Coracias garrulus	European Roller	NT		1	
Coracias caudatus	Lilac-breasted Roller	LC			1
Coracias spatulatus	Racket-tailed Roller	LC		1	
Coracias naevia	Purple Roller	LC		1	
Eurystomus glaucurus	Broad-billed Roller	LC		1	
Alcedo semitorquata	Half-collared Kingfisher	LC		1	
Ceyx pictus	African Pygmy-kingfisher	LC		1	
Halcyon leucocephala	Grey-headed Kingfisher	LC		1	
Alcedo cristata	Malachite Kingfisher	LC			1
Halcyon senegalensis	Woodland Kingfisher	LC			1
Halcyon albiventris	Brown-hooded Kingfisher	LC			1
Halcyon chelicuti	Striped Kingfisher	LC			1
Megaceryle maxima	Giant Kingfisher	LC		1	
Ceryle rudis	Pied Kingfisher	LC			1
Merops bullockoides	White-fronted Bee-eater	LC		1	
Merops pusillus	Little Bee-eater	LC			1
Merops hirundineus	Swallow-tailed Bee-eater	LC			1
Merops boehmi	Boehm's Bee-eater	LC		1	
Merops persicus	Blue-cheeked Bee-eater	LC		1	
Merops superciliosus	Madagascar Bee-eater	LC			1
Merops apiaster	European Bee-eater	LC			1
Merops nubicoides	Southern Carmine Bee-eater	LC		1	
Colius striatus	Speckled Mousebird	LC		1	
Urocolius indicus	Red-faced Mousebird	LC			1
Clamator jacobinus	Jacobin Cuckoo	LC		1	
Clamator levaillantii	Levaillant's Cuckoo	LC		1	
Clamator glandarius	Great Spotted Cuckoo	LC		1	
Pachycoccyx audeberti	Thick-billed Cuckoo	LC		1	
Cuculus solitarius	Red-chested Cuckoo	LC		1	
Cuculus clamosus	Black Cuckoo	LC		1	
Cuculus poliocephalus	Lesser Cuckoo	LC		1	
Cuculus canorus	Common Cuckoo	LC		1	
Cuculus gularis	African Cuckoo	LC		1	
Cuculus rochii	Madagascar Cuckoo	LC		1	
Chrysococcyx klaas	Klaas's Cuckoo	LC			1
Chrysococcyx cupreus	African Emerald Cuckoo	LC			1
Chrysococcyx caprius	Didric Cuckoo	LC		1	
Centropus grillii	Black Coucal	LC		1	
Centropus senegalensis	Senegal Coucal	LC			1
Centropus superciliosus	White-browed Coucal	LC		1	
Poicephalus cryptoxanthus	Brown-necked Parrot	LC		1	
Poicephalus meyeri	Meyer's Parrot	LC			1
Telacanthura ussheri	Mottled Spinetail	LC		1	
Poicephalus suahelicus	Grey-headed Parrot	?		1	

Species	Common Name	Red List Status	CITES	Possible	Recorded
Neafrapus boehmi	Boehm's Spinetail	LC		1	
Cypsiurus parvus	African Palm-swift	LC			1
Tachymarptis aequatorialis	Mottled Swift	LC		1	
Apus apus	Common Swift	LC		1	
Apus barbatus	African Black Swift	LC		1	
Apus affinis	Little Swift	LC		1	
Apus caffer	White-rumped Swift	LC		1	
Apus horus	Horus Swift	LC		1	
Tauraco porphyreolophus	Purple-crested Turaco	LC	ii		1
Corythaixoides concolor	Grey Go-away-bird	LC		1	
Tyto alba	Barn Owl	LC	ii	1	
Tyto capensis	African Grass-owl	LC	ii	1	
Otus leucotis	White-faced Scops-owl	LC	ii	1	
Bubo africanus	Spotted Eagle-owl	LC	ii		1
Otus senegalensis	African Scops-owl	LC	ii		1
Bubo lacteus	Giant Eagle-owl	LC	ii	1	
Scotopelia peli	Pel's Fishing-owl	LC	ii	1	
Strix woodfordii	African Wood-owl	LC	ii	1	
Glaucidium perlatum	Pearl-spotted Owlet	LC	ii	1	
Glaucidium capense	African Barred Owlet	LC	ii	1	
Asio capensis	Marsh Owl	LC	ii	1	
Caprimulgus europaeus	Eurasian Nightjar	LC		1	
Caprimulgus pectoralis	Fiery-necked Nightjar	LC		1	
Caprimulgus tristigma	Freckled Nightjar	LC		1	
Caprimulgus fossii	Square-tailed Nightjar	LC			1
Macrodipteryx vexillarius	Pennant-winged Nightjar	LC		1	
Stigmatopelia senegalensis	Laughing Dove	LC			1
Streptopelia decipiens	African Mourning Dove	LC		1	
Streptopelia capicola	Cape Turtle-dove	LC			1
Streptopelia semitorquata	Red-eyed Dove	LC			1
Turtur chalcospilos	Emerald-spotted Wood-dove	LC			1
Turtur afer	Blue-spotted Wood-dove	LC		1	
Turtur tympanistria	Tambourine Dove	LC			1
Oena capensis	Namaqua Dove	LC		1	
Treron calvus	African Green-pigeon	LC			1
Eupodotis melanogaster	Black-bellied Bustard	LC	ii	1	
Balearica regulorum	Grey Crowned-crane	EN	ii	1	
Bugeranus carunculatus	Wattled Crane	VU	ii	1	
Podica senegalensis	African Finfoot	LC		1	
Sarothrura elegans	Buff-spotted Flufftail	LC		1	
Rallus caerulescens	African Rail	LC		1	
Sarothrura boehmi	Streaky-breasted Flufftail	LC		1	
Crecopsis egregia	African Crake	LC		1	
Crex crex	Corncrake	LC		1	
Amaurornis flavirostra	Black Crake	LC			1

Species	Common Name	Red List Status	CITES	Possible	Recorded
Porzana pusilla	Baillon's Crake	LC		1	
Porzana porzana	Spotted Crake	LC		1	
Aenigmatolimnas marginalis	Striped Crake	LC		1	
Porphyrio porphyrio	Purple Swamphen	LC		1	
Porphyrio alleni	Allen's Gallinule	LC		1	
Gallinula chloropus	Common Moorhen	LC			1
Gallinula angulata	Lesser Moorhen	LC		1	
Pterocles bicinctus	Double-banded Sandgrouse	LC		1	
Gallinago media	Great Snipe	NT		1	
Gallinago nigripennis	African Snipe	LC		1	
Rostratula benghalensis	Greater Painted-snipe	LC		1	
Tringa stagnatilis	Marsh Sandpiper	LC			1
Tringa nebularia	Common Greenshank	LC		1	
Tringa ochropus	Green Sandpiper	LC		1	
Tringa glareola	Wood Sandpiper	LC		1	
Actitis hypoleucos	Common Sandpiper	LC		1	
Calidris minuta	Little Stint	LC		1	
Calidris ferruginea	Curlew Sandpiper	LC		1	
Philomachus pugnax	Ruff	LC		1	
Actophilornis africanus	African Jacana	LC			1
Microparra capensis	Lesser Jacana	LC		1	
Burhinus vermiculatus	Water Thick-knee	LC			1
Larus fuscus	Lesser Black-backed Gull	LC		1	
Burhinus capensis	Spotted Thick-knee	LC		1	
Himantopus himantopus	Black-winged Stilt	LC		1	
Chlidonias hybrida	Whiskered Tern	LC		1	
Recurvirostra avosetta	Pied Avocet	LC		1	
Chlidonias leucopterus	White-winged Tern	LC		1	
Charadrius hiaticula	Common Ringed Plover	LC		1	
Charadrius pecuarius	Kittlitz's Plover	LC		1	
Charadrius tricollaris	Three-banded Plover	LC			1
Charadrius marginatus	White-fronted Plover	LC		1	
Charadrius asiaticus	Caspian Plover	LC		1	
Vanellus crassirostris	Long-toed Lapwing	LC		1	
Vanellus armatus	Blacksmith Lapwing	LC		1	
Vanellus senegallus	Wattled Lapwing	LC		1	
Vanellus lugubris	Senegal Lapwing	LC		1	
Vanellus coronatus	Crowned Lapwing	LC		1	
Rhinoptilus chalcopterus	Bronze-winged Courser	LC			1
Cursorius temminckii	Temminck's Courser	LC		1	
Glareola pratincola	Collared Pratincole	LC		1	
Rynchops flavirostris	African Skimmer	NT		1	
Pandion haliaetus	Osprey	LC	ii	1	
Aviceda cuculoides	African Cuckoo-hawk	LC	ii	1	
Pernis apivorus	European Honey-buzzard	LC	ii	1	

Species	Common Name	Red List Status	CITES	Possible	Recorded
Macheiramphus alcinus	Bat Hawk	LC	ii	1	
Buteo augur	Augur Buzzard	LC	ii	1	
Elanus caeruleus	Black-shouldered Kite	LC	ii		1
Buteo buteo	Common Buzzard	LC	ii	1	
Haliaeetus vocifer	African Fish Eagle	LC	ii		1
Milvus migrans	Black Kite	LC	ii	1	
Necrosyrtes monachus	Hooded Vulture	EN	ii	1	
Milvus aegyptus	Yellow-billed Kite	LC	ii	1	
Gyps africanus	White-backed Vulture	EN	ii	1	
Torgos tracheliotos	Lappet-faced Vulture	VU	ii	1	
Trigonoceps occipitalis	White-headed Vulture	VU	ii	1	
Circaetus cinereus	Brown Snake-eagle	LC	ii	1	
Terathopius ecaudatus	Bateleur	NT	ii	1	1
Circus aeruginosus	Western Marsh-harrier	LC	ii	1	
Circaetus pectoralis	Black-chested Snake-eagle	LC	ii		1
Circus ranivorus	African Marsh-harrier	LC	ii	1	
Circaetus cinerascens	Western Banded Snake-eagle	LC	ii	1	
Circus macrourus	Pallid Harrier	NT	ii	1	
Polyboroides typus	African Harrier-hawk	LC	ii	1	
Kaupifalco monogrammicus	Lizard Buzzard	LC	ii		1
Melierax metabates	Dark Chanting-goshawk	LC	ii	1	
Melierax gabar	Gabar Goshawk	LC	ii	1	
Accipiter tachiro	African Goshawk	LC	ii	1	
Accipiter badius	Shikra	LC	ii	1	
Accipiter minullus	Little Sparrowhawk	LC	ii	1	
Accipiter ovampensis	Ovampo Sparrowhawk	LC	ii	1	
Accipiter melanoleucus	Black Sparrowhawk	LC	ii	1	
Aquila pomarina	Lesser Spotted Eagle	LC	ii	1	
Aquila rapax	Tawny Eagle	LC	ii	1	
Aquila wahlbergi	Wahlberg's Eagle	LC	ii	1	
Aquila nipalensis	Steppe Eagle	LC	ii	1	
Hieraaetus spilogaster	African Hawk-eagle	LC	ii	1	
Hieraaetus pennatus	Booted Eagle	LC	ii	1	
Hieraaetus ayresii	Ayres's Hawk-eagle	LC	ii	1	
Polemaetus bellicosus	Martial Eagle	NT	ii	1	
Lophaetus occipitalis	Long-crested Eagle	LC	ii	1	
Stephanoaetus coronatus	African Crowned Eagle	NT	ii	1	
Sagittarius serpentarius	Secretarybird	VU	ii	1	
Falco naumanni	Lesser Kestrel	LC	ii	1	
Falco rupicolus	Rock Kestrel	?	ii	1	
Falco dickinsoni	Dickinson's Kestrel	LC	ii	1	
Falco vespertinus	Red-footed Falcon	NT	ii	1	
Falco amurensis	Amur Falcon	LC	ii	1	
Falco concolor	Sooty Falcon	NT	ii	1	
Falco subbuteo	Eurasian Hobby	LC	ii	1	

Species	Common Name	Red List Status	CITES	Possible	Recorded
Falco cuvierii	African Hobby	LC	ii	1	
Falco biarmicus	Lanner Falcon	LC	ii		1
Falco peregrinus	Peregrine Falcon	LC	i	1	
Falco eleonorae	Eleonora's Falcon	LC	ii	1	
Tachybaptus ruficollis	Little Grebe	LC			1
Anhinga rufa	African Darter	LC		1	
Phalacrocorax africanus	Reed Cormorant	LC		1	
Egretta ardesiaca	Black Heron	LC		1	
Phalacrocorax carbo	White-breasted Cormorant	LC			1
Ardea cinerea	Grey Heron	LC			1
Ardea melanocephala	Black-headed Heron	LC			1
Ardea goliath	Goliath Heron	LC		1	
Ardea purpurea	Purple Heron	LC			1
Bubulcus ibis	Cattle Egret	LC			1
Ardeola ralloides	Squacco Heron	LC			1
Egretta garzetta	Little Egret	LC			1
Ardeola rufiventris	Rufous-bellied Heron	LC			1
Ardea alba	Great White Egret	LC			1
Mesophoyx intermedia	Intermediate Egret	LC			1
Butorides striata	Green-backed Heron	LC			1
Nycticorax nycticorax	Black-crowned Night-heron	LC		1	
Gorsachius leuconotus	White-backed Night-heron	LC		1	
Ixobrychus minutus	Little Bittern	LC		1	
Ixobrychus sturmii	Dwarf Bittern	LC		1	
Botaurus stellaris	Eurasian Bittern	LC		1	
Scopus umbretta	Hamerkop	LC			1
Plegadis falcinellus	Glossy Ibis	LC		1	
Bostrychia hagedash	Hadada Ibis	LC		1	
Threskiornis aethiopicus	African Sacred Ibis	LC		1	
Platalea alba	African Spoonbill	LC		1	
Pelecanus onocrotalus	Great White Pelican	LC		1	
Pelecanus rufescens	Pink-backed Pelican	LC		1	
Mycteria ibis	Yellow-billed Stork	LC		1	
Anastomus lamelligerus	African Openbill	LC			1
Ciconia nigra	Black Stork	LC	ii	1	
Ciconia abdimii	Abdim's Stork	LC		1	
Ciconia episcopus	Woolly-necked Stork	LC		1	
Ciconia ciconia	White Stork	LC		1	
Ephippiorhynchus senegalensis	Saddle-billed Stork	LC		1	
Leptoptilos crumeniferus	Marabou Stork	LC		1	
Pitta angolensis	African Pitta	LC		1	
Smithornis capensis	African Broadbill	LC		1	
Lanius collurio	Red-backed Shrike	LC			1
Lanius souzae	Souza's Shrike	LC		1	
Lanius minor	Lesser Grey Shrike	LC		1	

Species	Common Name	Red List Status	CITES	Possible	Recorded
Lanius collaris	Common Fiscal	LC			1
Corvus albicollis	White-necked Raven	LC		1	
Oriolus oriolus	Eurasian Golden Oriole	LC		1	
Corvus albus	Pied Crow	LC			1
Oriolus auratus	African Golden Oriole	LC		1	
Oriolus larvatus	African Black-headed Oriole	LC			1
Coracina pectoralis	White-breasted Cuckooshrike	LC		1	
Campephaga flava	Black Cuckooshrike	LC		1	
Erythrocercus livingstonei	Livingstone's Flycatcher	LC		1	
Dicrurus adsimilis	Fork-tailed Drongo	LC			1
Elminia albonotata	White-tailed Crested-flycatcher	LC		1	
Terpsiphone viridis	African Paradise-flycatcher	LC			1
Nilaus afer	Brubru	LC		1	
Dryoscopus cubla	Black-backed Puffback	LC			1
Tchagra senegalus	Black-crowned Tchagra	LC			1
Tchagra australis	Brown-crowned Tchagra	LC		1	
Laniarius major	Tropical Boubou	LC			1
Telophorus sulfureopectus	Orange-breasted Bush-shrike	LC			1
Malaconotus blanchoti	Grey-headed Bush-shrike	LC			1
Prionops plumatus	White Helmet-shrike	LC			1
Prionops retzii	Retz's Helmet-shrike	LC			1
Batis soror	Mozambique Batis	LC			1
Platysteira peltata	Black-throated Wattle-eye	LC		1	
Monticola angolensis	~~Miombo~~Miombo Rock-thrush	LC		1	
Psophocichla litsitsirupa	Groundscraper Thrush	LC		1	
Turdus libonyanus	Kurrichane Thrush	LC		1	
Bradornis pallidus	Pale Flycatcher	LC			1
Melaenornis pammelaina	Southern Black Flycatcher	LC			1
Muscicapa striata	Spotted Flycatcher	LC			1
Muscicapa adusta	African Dusky Flycatcher	LC		1	
Muscicapa caerulescens	Ashy Flycatcher	LC			1
Myioparus plumbeus	Grey Tit-flycatcher	LC		1	
Ficedula albicollis	Collared Flycatcher	LC		1	
Luscinia luscinia	Thrush Nightingale	LC		1	
Cossypha heuglini	White-browed Robin-chat	LC			1
Cossypha natalensis	Red-capped Robin-chat	LC		1	
Cichladusa arquata	Collared Palm-thrush	LC		1	
Erythropygia quadrivirgata	Bearded Scrub-robin	LC		1	
Erythropygia leucophrys	White-browed Scrub-robin	LC		1	
Oenanthe pileata	Capped Wheatear	LC		1	
Cercomela familiaris	Familiar Chat	LC		1	
Myrmecocichla arnoti	Arnott's Chat	LC		1	
Thamnolaea cinnamomeiventris	Mocking Cliff-chat	LC		1	

Species	Common Name	Red List Status	CITES	Possible	Recorded
Onychognathus morio	Red-winged Starling	LC		1	
Lamprotornis chalybaeus	Greater Blue-eared Glossy-starling	LC		1	
Cinnyricinclus leucogaster	Violet-backed Starling	LC		1	
Creatophora cinerea	Wattled Starling	LC		1	
Anthoscopus caroli	African Penduline-tit	LC		1	
Parus niger	Black Tit	LC			1
Riparia riparia	Sand Martin	LC			1
Riparia paludicola	Plain Martin	LC		1	
Pseudhirundo griseopyga	Grey-rumped Swallow	LC		1	
Hirundo fuligula	Rock Martin	LC		1	
Hirundo rustica	Barn Swallow	LC			1
Hirundo albigularis	White-throated Swallow	LC		1	
Hirundo smithii	Wire-tailed Swallow	LC			1
Hirundo dimidiata	Pearl-breasted Swallow	LC		1	
Hirundo abyssinica	Lesser Striped-swallow	LC			1
Hirundo semirufa	Rufous-chested Swallow	LC		1	
Hirundo senegalensis	Mosque Swallow	LC		1	
Delichon urbicum	Common House-martin	LC		1	
Psalidoprocne orientalis	Eastern Saw-wing	?		1	
Pycnonotus tricolor	Dark-capped Bulbul	LC			1
Andropadus importunus	Sombre Greenbul	LC		1	
Chlorocichla flaviventris	Yellow-bellied Greenbul	LC		1	
Phyllastrephus terrestris	Terrestrial Brownbul	LC			1
Phyllastrephus cerviniventris	Grey-olive Greenbul	LC		1	
Nicator gularis	Eastern Nicator	LC			1
Cisticola erythrops	Red-faced Cisticola	LC			1
Cisticola cantans	Singing Cisticola	LC		1	
Cisticola aberrans	Lazy Cisticola	LC		1	
Cisticola chiniana	Rattling Cisticola	LC			1
Cisticola lais	Wailing Cisticola	LC			1
Cisticola natalensis	Croaking Cisticola	LC		1	
Cisticola fulvicapilla	Neddicky	LC			1
Cisticola brachypterus	Siffling Cisticola	LC		1	
Cisticola juncidis	Zitting Cisticola	LC		1	
Prinia subflava	Tawny-flanked Prinia	LC			1
Apalis thoracica	Bar-throated Apalis	LC		1	
Apalis flavida	Yellow-breasted Apalis	LC			1
Zosterops senegalensis	African Yellow White-eye	LC		1	
Bradypterus baboecala	Little Rush Warbler	LC		1	
Melocichla mentalis	Moustached Grass-warbler	LC		1	
Acrocephalus schoenobaenus	Sedge Warbler	LC			1
Acrocephalus palustris	Marsh Warbler	LC		1	
Acrocephalus arundinaceus	Great Reed-warbler	LC		1	
Acrocephalus gracilirostris	Lesser Swamp-warbler	LC		1	
Hippolais icterina	Icterine Warbler	LC			1

Species	Common Name	Red List Status	CITES	Possible	Recorded
Eremomela icteropygialis	Yellow-bellied Eremomela	LC		1	
Locustella fluviatilis	River Warbler	LC		1	
Eremomela scotops	Greencap Eremomela	LC		1	
Hippolais olivetorum	Olive Tree Warbler	LC		1	
Eremomela usticollis	Burnt-neck Eremomela	LC		1	
Sylvia communis	Common Whitethroat	LC		1	
Sylvietta whytii	Red-faced Crombec	LC		1	
Sylvietta rufescens	Cape Crombec	LC		1	
Phylloscopus trochilus	Willow Warbler	LC			1
Camaroptera brachyura	Green-backed Camaroptera	LC			1
Hyliota flavigaster	Yellow-bellied Hyliota	LC		1	
Camaroptera stierlingi	Stierling's Wren-warbler	LC		1	
Turdoides jardineii	Arrow-marked Babbler	LC			1
Sylvia borin	Garden Warbler	LC		1	
Mirafra rufocinnamomea	Flappet Lark	LC			1
Pinarocorys nigricans	Dusky Lark	LC		1	
Eremopterix leucotis	Chestnut-backed Sparrow-lark	LC		1	
Calandrella cinerea	Red-capped Lark	LC		1	
Anthreptes anchietae	Anchieta's Sunbird	LC		1	
Anthreptes longuemarei	Western Violet-backed Sunbird	LC		1	
Anthreptes collaris	Collared Sunbird	LC		1	
Nectarinia amethystina	Amethyst Sunbird	LC		1	
Nectarinia senegalensis	Scarlet-chested Sunbird	LC			1
Nectarinia venusta	Variable Sunbird	LC		1	
Nectarinia talatala	White-breasted Sunbird	LC			1
Nectarinia cuprea	Copper Sunbird	LC		1	
Nectarinia shelleyi	Shelley's Sunbird	LC		1	
Passer diffusus	Southern Grey-headed Sparrow	LC			1
Passer domesticus	House Sparrow	LC			1
Petronia superciliaris	Yellow-throated Petronia	LC		1	
Passer griseus	Northern Grey-headed Sparrow	?		1	
Motacilla aguimp	African Pied Wagtail	LC			1
Motacilla flava	Yellow Wagtail	LC		1	
Motacilla clara	Mountain Wagtail	LC		1	
Macronyx croceus	Yellow-throated Longclaw	LC		1	
Anthus vaalensis	Buffy Pipit	LC		1	
Anthus trivialis	Tree Pipit	LC		1	
Plocepasser mahali	White-browed Sparrow-weaver	LC		1	
Anthus cinnamomeus	African Pipit	?		1	
Anthus nyassae	Woodland Pipit	?		1	
Ploceus intermedius	Lesser Masked Weaver	LC		1	
Ploceus ocularis	Spectacled Weaver	LC			1
Ploceus xanthops	Holub's Golden Weaver	LC			1

Species	Common Name	Red List Status	CITES	Possible	Recorded
Ploceus xanthopterus	Southern Brown-throated Weaver	LC			1
Ploceus velatus	Southern Masked-weaver	LC		1	
Ploceus cucullatus	Village Weaver	LC			1
Anaplectes rubriceps	Red-headed Weaver	LC			1
Quelea erythrops	Red-headed Quelea	LC		1	
Quelea quelea	Red-billed Quelea	LC		1	
Euplectes hordeaceus	Black-winged Bishop	LC			1
Euplectes orix	Red Bishop	LC		1	
Euplectes capensis	Yellow Bishop	LC			1
Euplectes albonotatus	White-winged Widowbird	LC			1
Euplectes ardens	Red-collared Widowbird	LC			1
Amblyospiza albifrons	Thick-billed Weaver	LC		1	
Pytilia afra	Orange-winged Pytilia	LC			1
Pytilia melba	Green-winged Pytilia	LC			1
Pyrenestes minor	Lesser Seedcracker	LC			
Hypargos niveoguttatus	Red-throated Twinspot	LC		1	
Lagonosticta senegala	Red-billed Firefinch	LC			1
Lagonosticta rhodopareia	Jameson's Firefinch	LC			1
Uraeginthus angolensis	Blue Waxbill	LC			1
Estrilda astrild	Common Waxbill	LC			1
Amandava subflava	Zebra Waxbill	LC		1	
Ortygospiza locustella	Locust Finch	LC		1	
Spermestes cucullatus	Bronze Mannikin	LC			1
Spermestes nigriceps	Red-backed Mannakin	LC		1	
Spermestes fringilloides	Magpie Mannikin	LC			1
Amadina fasciata	Cut-throat Finch	LC		1	
Vidua chalybeata	Village Indigobird	LC			1
Vidua purpurascens	Purple Indigobird	LC		1	
Vidua macroura	Pin-tailed Whydah	LC			1
Vidua paradisaea	Eastern Paradise-whydah	LC		1	
Vidua obtusa	Broad-tailed Paradise-whydah	LC			1
Serinus mozambicus	Yellow-fronted Canary	LC			1
Serinus sulphuratus	Brimstone Canary	LC			1
Serinus reichardi	Reichard's Seedeater	LC		1	
Serinus mennelli	Black-eared Seedeater	LC		1	
Emberiza tahapisi	Cinnamon-breasted Bunting	LC		1	
Emberiza flaviventris	African Golden-breasted Bunting	LC			1
Emberiza cabanisi	Cabanis's Bunting	LC		1	
Totals	**437**			**301**	**136**

APPENDIX 4: LIST OF MAMMAL SPECIES

Scientific Name	English Name	Red List status	Historical	Possible	Reported	Recorded
Atelerix albiventris	Four-toed Hedgehog	LC			1	
Elephantulus fuscus	Dusky Elephant Shrew	DD		1		
Elephantulus myurus	Eastern Rock Elephant Shrew	LC		1		
Petrodromus tetradactylus	Four-toed Elephant-shrew	LC				1
Crocidura cyanea	Reddish-gray Musk Shrew	LC		1		
Crocidura fuscomurina	Bicolored Musk Shrew	LC		1		
Crocidura hirta	Lesser Red Musk Shrew	LC		1		
Crocidura luna	Greater Gray-brown Musk Shrew	LC		1		
Crocidura olivieri	African Giant Shrew	LC		1		
Suncus lixus	Greater Dwarf Shrew	LC		1		
Suncus megalura	Climbing Shrew	LC		1		
Coleura afra	African Sheath-tailed Bat	LC		1		
Taphozous mauritianus	Mauritian Tomb Bat	LC		1		
Hipposideros caffer	Sundevall's Roundleaf Bat	LC		1		
Triaenops persicus	Persian Trident Bat	LC		1		
Hipposideros vittatus	Striped Leaf-nosed bat	NT		1		
Tadarida bivittata	Spotted Free-tailed Bat	LC		1		
Tadarida pumila	Little Free-tailed Bat	LC		1		
Tadarida condylura	Angolan Free-tailed Bat	LC		1		
Tadarida midas	Midas Free-tailed Bat	LC		1		
Tadarida ventralis	African Giant Free-tailed Bat	DD		1		
Nycteris grandis	Large Slit-faced Bat	LC		1		
Nycteris hispida	Hairy Slit-faced Bat	LC		1		
Nycteris macrotis	Large-eared Slit-faced Bat	LC		1		
Nycteris thebaica	Egyptian Slit-faced Bat	LC		1		
Nycteris woodi	Wood's Slit-faced Bat	LC		1		
Eidolon helvum	Straw-coloured Fruit Bat	NT		1		
Epomophorus wahlbergi	Wahlberg's Epauletted Fruit Bat	LC		1		

Scientific Name	English Name	Red List status	Historical	Possible	Reported	Recorded
Rousettus aegyptiacus	Egyptian Fruit Bat	LC		1		
Epomophorus crypturus	Peters's Epauletted Fruit Bat	LC		1		
Lissonycteris angolensis	Angolan Fruit Bat	LC		1		
Rhinolophus blasii	Blasius' Horseshoe Bat	LC		1		
Rhinolophus clivosus	Geoffroy's Horseshoe Bat	LC		1		
Rhinolophus fumigatus	Rüppell's Horseshoe Bat	LC		1		
Rhinolophus hildebrandti	Hildebrandt's Horseshoe Bat	LC		1		
Rhinolophus landeri	Lander's Horseshoe Bat	LC		1		
Rhinolophus simulator	Bushveld Horseshoe Bat	LC		1		
Rhinolophus swinnyi	Swinny's Horseshoe Bat	LC		1		
Eptesicus hottentotus	Long-tailed House Bat	LC		1		
Kerivoula argentata	Damara Woolly Bat	LC		1		
Miniopterus fraterculus	Lesser Long-fingered Bat	LC		1		
Myotis bocagii	Rufous Mouse-eared Bat	LC		1		
Myotis tricolor	Cape Hairy Bat	LC		1		
Myotis welwitschii	Welwitch's Bat	LC		1		
Pipistrellus rueppellii	Rüppel's Pipistrelle	LC		1		
Scotoecus hirundo	Dark-winged Lesser House Bat	LC		1		
Scotophilus dinganii	African Yellow Bat	LC		1		
Scotophilus nigrita	Giant House Bat	LC		1		
Scotophilus viridis	Greenish Yellow Bat	LC		1		
Nycticeinops schlieffeni	Schlieffen's Bat	LC		1		
Glauconycteris variegata	Butterfly Bat	LC		1		
Miniopterus natalensis	Natal Long-fingered Bat	LC		1		
Pipistrellus capensis	Cape Serotine	LC		1		
Pipistrellus flavescens	Yellow Serotine	DD		1		
Pipistrellus melckorum	Melck's House Bat	DD		1		
Pipistrellus nanus	Banana Bat	LC		1		
Pipistrellus rendalli	Rendall's Serotine Bat	LC		1		
Pipistrellus hesperidus	Dusky pipistrelle Bat	LC		1		

Scientific Name	English Name	Red List status	Historical	Possible	Reported	Recorded
Papio cynocephalus	Yellow Baboon	LC				1
Chlorocebus pygerythrus	Vervet monkey	LC				1
Galago moholi	South African Galago	LC		1	1	
Otolemur crassicaudatus	Thick-tailed Bushbaby	LC		1		
Smutsia temminckii	Ground Pangolin	LC				1
Lepus saxatilis	Scrub Hare	LC				1
Heliophobius argenteocinereus	Silvery Mole Rat	LC		1		
Cryptomys darlingi	Mashona Mole-rat	LC		1		
Graphiurus kelleni	Kellen's Dormouse	LC		1		
Graphiurus microtis	Small-eared Dormouse	LC		1		
Graphiurus murinus	Woodland Dormouse	LC			1	
Graphiurus platyops	Rock Dormouse	LC		1		
Hystrix africaeaustralis	Cape Porcupine	LC				1
Acomys spinosissimus	Spiny Mouse	LC		1		
Aethomys chrysophilus	Red Rock Rat	LC		1		
Dasymys incomtus	African Marsh Rat	LC		1		
Grammomys dolichurus	Woodland Thicket Rat	LC		1		
Lemniscomys rosalia	Single-striped Grass Mouse	LC		1		
Mastomys natalensis	Natal Mastomys	LC		1		
Mus minutoides	Pygmy Mouse	LC		1		
Mus triton	Gray-bellied Mouse	LC		1		
Otomys angoniensis	Angoni Vlei Rat	LC		1		
Pelomys fallax	Creek Groove-toothed Swamp Rat	LC		1		
Rhabdomys pumilio	Four-striped Grass Mouse	LC		1		
Gerbilliscus boehmi	Boehm's Gerbil	LC		1		
Gerbilliscus leucogaster	Bushveld Gerbil	LC		1		
Thallomys paedulcus	Acacia Rat	LC		1		
Uranomys ruddi	Rudds Bristle-furred Rat	LC		1		
Cricetomys gambianus	Gambian Rat	LC		1		
Dendromus melanotis	Gray African Climbing Mouse	LC		1		

Scientific Name	English Name	Red List status	Historical	Possible	Reported	Recorded
Dendromus mystacalis	Chestnut Climbing Mouse	LC		1		
Dendromus nyikae	Nyika Climbing Mouse	LC		1		
Saccostomus campestris	Pouched Mouse	LC		1		
Steatomys pratensis	Fat Mouse	LC		1		
Heliosciurus mutabilis	Mutable Sun Squirrel	LC		1		
Paraxerus cepapi	Smith's Bush Squirrel	LC				1
Paraxerus flavovittis	Striped Bush Squirrel	LC		1		
Paraxerus palliatus	Red Bush Squirrel	LC		1		
Lepus saxatilis	Scrub Hare	LC			1	
Thryonomys swinderianus	Greater Cane Rat	LC			1	
Canis adustus	Side-striped Jackal	LC			1	
Lycaon pictus	African Wild Dog	EN	1			
Acinonyx jubatus	Cheetah	VU	1			
Caracal caracal	African Caracal	LC	1			
Felis silvestris	Wildcat	LC	1			
Leptailurus serval	Serval	LC			1	
Panthera leo	African Lion	VU	1			
Panthera pardus	Leopard	NT		1	1	
Atilax paludinosus	Marsh Mongoose	LC				1
Bdeogale crassicauda	Bushy-tailed Mongoose	LC		1		
Herpestes sanguineus	Slender Mongoose	LC				1
Helogale parvula	Common Dwarf Mongoose	LC			1	
Herpestes ichneumon	Large Grey Mongoose	LC			1	
Ichneumia albicauda	White-tailed Mongoose	LC			1	
Mungos mungo	Banded Mongoose	LC				1
Rhynchogale melleri	Meller's Mongoose	LC		1		
Crocuta crocuta	Spotted Hyaena	LC			1	
Aonyx capensis	African Clawless Otter	LC		1	1	
Lutra maculicollis	Speckle-throated Otter	LC		1		
Mellivora capensis	Honey Badger	LC		1	1	

Scientific Name	English Name	Red List status	Historical	Possible	Reported	Recorded
Ictonyx striatus	Striped Polecat	LC		1		
Poecilogale albinucha	African Striped Weasel	LC		1		
Nandinia binotata	African Palm Civet	LC		1		
Civettictis civetta	African Civet	LC			1	
Genetta angolensis	Angolan Genet	LC				
Genetta maculata	Large-spotted Genet	LC			1	
Orycteropus afer	Aardvark	LC				1
Loxodonta africana	African Elephant	VU				1
Heterohyrax brucei	Bush Hyrax	LC		1		
Procavia capensis	Rock Dassie	LC		1	1	
Equus quagga	Burchell's Zebra	LC	1			
Phacochoerus africanus	Common Warthog	LC				
Potamochoerus larvatus	Bushpig	LC				1
Hippopotamus amphibius	Common Hippopotamus	VU			1	
Aepyceros melampus	Impala	LC				
Hippotragus equinus	Roan Antelope	LC	1			
Hippotragus niger	Sable Antelope	LC	1			
Kobus ellipsiprymnus	Waterbuck	LC	1			
Nesotragus moschatus	Suni	LC			1	
Oreotragus oreotragus	Klipspringer	LC	1			
Ourebia ourebi	Oribi	LC				
Raphicerus sharpei	Sharpe's Grysbok	LC				
Redunca arundinum	Common Reedbuck	LC	1			
Sylvicapra grimmia	Common Duiker	LC			1	
Syncerus caffer	African Buffalo	LC	1			
Tragelaphus scriptus	Bushbuck	LC				1
Tragelaphus strepsiceros	Greater Kudu	LC				
Tragelaphus oryx	Common Eland	LC	1			
Totals	**145**	**12**	**13**	**96**	**20**	**14**