Scopus 36(2): 26–37, July 2016

Birds of Golden Pride Project area, Nzega District, central Tanzania: an evaluation of recolonization of rehabilitated areas

Chacha Werema, Kim M. Howell, Charles A. Msuya, Jackie Sinclair and Anael Macha

Summary

In Tanzania, the success of habitat restoration in mining areas to create suitable environmental conditions for wildlife is poorly understood. Between March 2010 and December 2014 bird species were recorded at the Golden Pride Project area, a gold mine in Nzega District, central Tanzania. The aims of this study were to document bird communities in the mine area, and to assess the extent to which rehabilitated areas have been recolonised. Mist netting, point counts, timed species counts and opportunistic observations were used to document 181 species of birds at the mine area. These included two species endemic to Tanzania, the Tanzanian Red-billed Hornbill *Tockus ruahae* (treated here as a species separate from *T. erythrorhynchus*, see Kemp & Delport 2002, Sinclair & Ryan 2010) and Ashy Starling *Cosmopsarus unicolor.* Rehabilitated areas had about half the number of species found in the unmined areas. Bird use of areas under rehabilitation suggests that habitat restoration can be used to create corridors linking fragmented landscapes. Results suggest that as the vegetation of the rehabilitated areas becomes more structurally complex, the number of bird species found there will be similar to those in unmined areas. This study provides a baseline for future monitoring, leading to a better understanding of the process of avian colonisation of rehabilitated areas. Furthermore, results imply that in mining areas it is useful to have an unmined area where vegetation is naturally allowed to regenerate, free of human activity. These unmined areas can later act as source habitats from which birds can disperse into rehabilitation areas once the vegetation structure is sufficiently complex.

Introduction

Tropical fauna and flora have suffered declines from a variety of destructive anthropogenic activities. The majority of habitat destruction, in terms of both impact and size, results from agriculture, forestry and urbanization (Hobbs 1993, Adams & Lindsey 2010). To a lesser extent, mining also results in land clearing and conversion, resulting in decreased habitat complexity that negatively affect flora and fauna (Wray *et al*. 1982). Impacts of mining activities range from vegetation clearance to development of mining infrastructure (Lloyd *et al.* 2002).

A number of studies have attempted to assess how birds use rehabilitated areas in different parts of the world. One general conclusion is that bird abundance and species richness of rehabilitated areas increases with rehabilitation age (van Aarde *et al.* 1996a, b; Kritzinger & van Aarde 1998; Amstrong & Nichols 2000; Nichols & Nichols 2003; Nichols & Grant 2007; Gould 2011). In some instances, particularly in older

rehabilitated areas, the composition of bird assemblages can become similar to those found in native forest or natural unmined areas (Brady & Noske 2010; Gould 2011).

The Golden Pride Project (GPP) is a mine owned by Resolute Tanzania Limited (RTL) located in Nzega District, Tabora Region in central Tanzania. Mineral extraction began in 1998 and in 1999 GPP started rehabilitating affected areas. Rehabilitation was a management task of GPP with the goal of rehabilitating the areas for different land uses. Moreover, within the lease area, some parts were not mined (these are termed unmined areas). Before the GPP took tenure, the area was occupied by traditional agriculturalists and cattle herders. After GPP was granted control of the area, all anthropogenic activities, such as cattle grazing and timber harvesting ceased. The unmined areas have undergone natural regeneration to the extent that they are currently closed woodlands owing to restricted human access and use since 1998.

One of the approaches used by the GPP management to restore areas was to reshape the waste rock dumps using heavy machinery. This was followed by deposition of topsoil with a seed bank and planting of native and/or exotic plants. The mine management initially started to replant such areas with over 50 species of plants, including local *Acacia* spp. and the exotic, *Leucaena leucocephala.* Overall, some 70 different species, including native and exotic trees, and vines, were planted in the rehabilitation areas. By the end of December 2014, all affected areas, including the Tailings Storage Facilities (TSFs) had been replanted. The mine area was officially turned over to the Minerals Resource Institute of Tanzania based in Dodoma to create its Nzega Campus on 14 December 2014.

While a number of gold mines in Tanzania exist (e.g., Geita, North Mara, Bulyanhulu and Buzwagi Gold Mines), published studies assessing how birds respond to rehabilitation of mined areas are generally lacking. Given the existing number of mines in Tanzania that may eventually be decommissioned, an understanding of the response of birds to rehabilitation is needed, and is compounded by the fact that no studies have addressed the effectiveness of post-mining management for recovery of bird communities. This is important because studies of this kind are a necessary step towards quantifying the extent to which rehabilitation can be considered to offset the impacts of development. Therefore, GPP's rehabilitation programme provides an opportunity to assess whether habitat restoration can create an environment suitable for birds.

In this study, we compare bird communities between unmined and rehabilitated areas to determine whether rehabilitated areas have attracted avifauna that is similar in composition to unmined areas. Our paper is mainly descriptive and collates data on bird observations that have been recorded at the GPP mine area over five years (2010–2014). In addition, our study provides the first bird list for the Nzega area, even though Reynolds (1968) and Walton (1981) provided an annotated bird list for the Tabora region.

Materials and Methods

The present study was carried out at the GPP area, a gold mine located in the Lusu Ward, Nzega District, Tabora Region, Central Tanzania (Fig. 1). Average annual rainfall is between 700–800 mm per year and average temperatures range from 22° to 27°C (Sinclair & Laughton, 2013).

The study area (total area = 754 ha) consisted of unmined areas composed of naturally regenerated vegetation (296 ha), a one-year old rehabilitated area (45 ha), and

areas that were 4–15 years post-rehabilitation (413 ha) (Fig. 1). Unmined areas had been highly degraded due to timber harvesting and cattle grazing before RTL acquired tenure. They were composed of two woodlands that regenerated naturally after all destructive human activities ceased. One woodland was dominated by *Acacia* spp. and the other by *Brachystegia/Combretum* spp. (H.V. Lyaruu pers. comm.). These woodlands represented the original vegetation communities prior to mining and are thought to be the source habitats of most of the birds colonizing the rehabilitated areas.

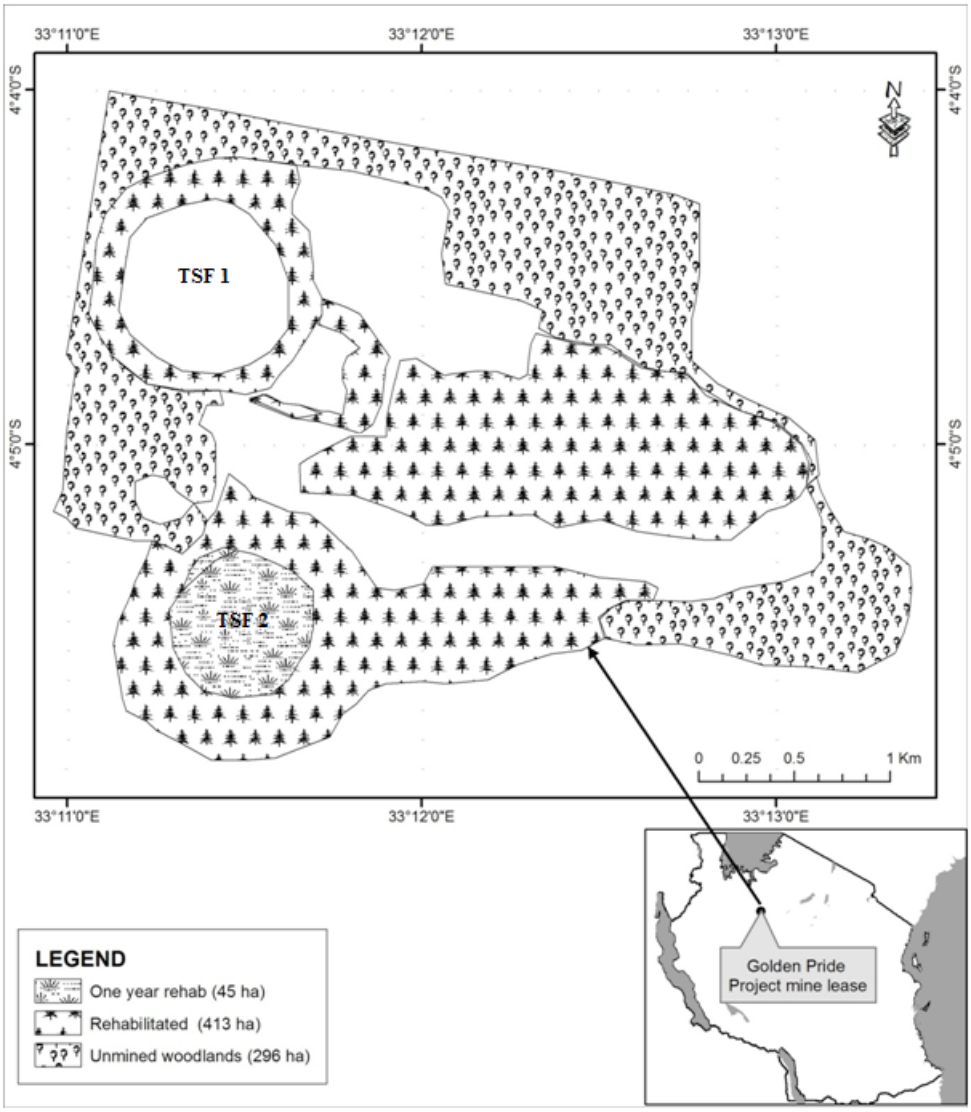


Figure 1. Location of GPP area, Nzega District, central Tanzania. The areas indicated are unmined, one-year rehabilitated area (one-year rehab), 4–15 year post-rehabilitated areas (post-rehab). Also, note that the one-year rehabilitated area was one of the TSFs.

The one-year rehabilitated area was located on one of the former TSFs. TSFs are

embankments constructed from waste rocks which create ponds where tailings are stored. When active, TSFs contain slurry (fine ore particles and cyanide in various forms). The ore particles may settle out and undergo sedimentation creating temporary standing water on TSFs, which may attract wildlife such as birds (see Hadson & Bouwman 2008). The TSFs are now capped with topsoil and during the rainy season there are some small water ponds. The one-year rehabilitated area had young seedlings of *Acacia* spp., *Brachystegia* spp. and some grasses. It is surrounded by the 4–15 years post-rehabilitation area (Fig. 1). We considered the one-year rehabilitated area separately since it had newly planted seedlings of native species, such as *Acacia* spp. and *Brachystegia* spp., and a few water pools and areas with grass cover.

Post-rehabilitation areas had different stages of rehabilitation. The oldest areas (11–15 yrs) were dominated by the exotic *Leucaena leucocephala* and a few *Acacia* spp. The younger areas (4–10 yrs) were dominated by native *Acacia* tree species. All these areas had a few individuals of *Grewia* sp., *Pterocarpus* sp. *Albizia* sp. and the exotic *Azadirachta indica*. The areas under rehabilitation for more than 1 yr differed in their species composition and complexity of vegetation.

Bird surveys at GPP area were conducted during two separate periods, May 2010 and December 2014. We used mist nets (total 720 metre-net-hour), timed species counts (total 15 hr) and point counts (total 21 hr). Mist nets were set both in the unmined and post-rehabilitation areas but not in one-year old rehabilitation. Prior to our first survey in May 2010, a reconnaissance visit was made in March 2010 by two of the authors of this paper (i.e., KMH and CAM). Between these two periods, birds that were seen opportunistically were recorded by JS and AM who were resident at the study site.

In response to queries from interested individuals, CW returned to the study area in December 2015 to confirm the presence of Tanzania Red-billed Hornbill *Tockus ruahae*.

Sorensen's Similarity Index was used to calculate similarity between unmined and two categories of rehabilitated areas (Magurran 1988). Species order, taxonomy and common names follow Sinclair & Ryan (2010).

Results

One hundred and eighty-one species were recorded within the GPP area (Appendix 1). These included all species recorded during field surveys, as well as species recorded during opportunistic observations. The list excludes species that were recorded in the TSFs (i.e., TSF 1 and TSF 2), which will be presented elsewhere (Werema *in prep*.). A total of 40 species were recorded using mist nets, 98 from timed species ounts, 92 from point counts and 83 during opportunistic observations. Most species were recorded in unmined areas (n = 178), followed by post-rehabilitation areas (n = 82), and 13 were found in the one-year-old rehabilitated area (Appendix 1). The Sorensen's similarity index comparing unmined and two categories of rehabilitated areas showed unmined and post-rehabilitation areas shared the most bird species, as compared to the one-year rehabilitated area that was not similar to the other areas (Table 1). Of the bird species observed, 92 occurred exclusively in the unmined area, 3 occurred exclusively in the one-year rehabilitated area; none occurred solely in the post-rehabilitation areas (Appendix 1).

Table 1. Sorensen's similarity indices comparing bird species composition between unmined and rehabilitated areas.

	Unmined	Post-rehabilitation	One-year rehabilitation
Unmined	-		
Post-rehabilitation	0.633	-	
One-year rehabilitation	0.105	0.147	-

Discussion

Our results suggest that the GPP area currently supports a rich avifauna as evidenced by this survey and that of Howell *et al*. (2010). This may be due to a wide range of both naturally regenerated and man-made habitats in the study area. The rich avifauna could also be due partly to the commitment made by staff and management of RTL in conserving the available habitats, in comparison with the surrounding land. Based on satellite maps, the study area has become an "island" of both bushland and woodland in a sea of agricultural lands and villages. As a result, the area appears to have attracted a number of bird species. In addition, the number of species recorded may also be accounted for by the amount of time spent on both field surveys and long-term opportunistic observations. Of particular interest is the presence of Fischer's Lovebird *Agapornis fischeri*, an East African endemic categorised as Near Threatened (BirdLife International 2016). Furthermore, two species endemic to Tanzania, the Tanzanian Red-billed Hornbill (Kemp & Delport 2002, Sinclair & Ryan 2010) and Ashy Starling *Cosmopsarus unicolor* were recorded in the study area. Another species, Ashy Flycatcher *Muscicapa caerulescens* was recorded in the unmined woodland and is a range extension for the GPP area (see Stevenson & Fanshawe 2002; Sinclair & Ryan 2010).

There were more species in unmined areas compared to those observed in rehabilitated areas. These findings are similar to those reported by van Aarde *et al.* (1996a & b) and Kritzinger & van Aarde (1998) in South Africa, as well as those of Becker *et al*. (2013) in Brazil. This could be due to the complexity of the vegetation in the unmined areas compared to that in rehabilitated areas, affecting availability of food resources, nesting sites and provision of favourable habitat. Our results are in contrast to those of Nichols & Nichols (2003) who found that after eight years the bird community composition of a rehabilitated area in southwest Australia was similar to that of unmined forest. They suggested that the similarity in bird community composition in their study was due to the indistinguishable difference in vegetation composition of rehabilitated and mined areas, which was not the case in our study. Our findings suggest that as vegetation in rehabilitated areas becomes more structurally complex to levels, more similar to that of the unmined areas, both areas may be used by similar bird species (see Nichols & Nichols 2003). It is possible that delayed influx of species into rehabilitated areas is due to factors inhibiting vegetation growth.

Similar to the findings of Gould (2011), our results suggest that at the GPP area, 15 years of rehabilitation have not been sufficient for the number of species of birds to reach a level similar to that of unmined areas. Gould (2011) found that 23 years after rehabilitation commenced, the composition of bird assemblages in post-mining rehabilitations remained significantly different from that of native forest bird assemblages. Our study and that of Gould (2011) imply that under some conditions rehabilitation is a long-term process requiring the commitment of the developer and

government agencies responsible for rehabilitation.

The low similarity indices of the one-year old rehabilitated areas compared to those of the unmined and the 5–15 years post-rehabilitated areas reflect the lower species richness of this habitat. The differences between the three broad habitats in our study presumably account for these observations. Bird species richness in rehabilitated areas is explained by within-site vegetation (Gould & Mackey 2015). Loyn (1985) and Gould & Mackey (2015) found that the vegetation stage at which a bird species enters a revegetated area is related to the development of key vegetation-based habitat resources such as food plants, tree hollows, canopy gaps and leaf litter.

While about half of the species observed in unmined areas were also recorded in rehabilitated areas, all species found in the latter areas were also observed in unmined areas, suggesting that these were the source of the species found in rehabilitated areas. The exclusive presence of three species, the Saddle-billed Stork *Ephippiorhynchus senegalensis*, White Stork *Ciconia ciconia* and Spotted Thick-knee *Burhinus capensis* in the one-year rehabilitated area was probably due to the openness of the area and the presence of some small water ponds. It is possible that these birds occurred in the unmined and post-rehabilitation areas, but they were not recorded during our fieldwork.

Conclusions and implications for bird conservation

Our results provide baseline information that can be used in future long-term monitoring studies to better understand how birds re-establish themselves in rehabilitated areas. Rehabilitated areas at the GPP site have attracted bird species from the surrounding environment, presumably from the nearby unmined areas, the source habitats. Our results suggest that in rehabilitated areas, full habitat diversity and the dependent avian community do not develop within 15 years.

Our study focused on recolonization of mined areas that had undergone or are undergoing rehabilitation. The results do not tell us the time period required for completion of bird recolonization. One of the aspects which we could not address, but which needs to be considered when planning rehabilitation is the impact of climate change. Climatic factors such as total rainfall, and its annual distribution and intensity may vary over time. What effect will these variables have on rehabilitation? Will general climate change make rehabilitated areas more attractive than the surrounding areas and thus "attract" birds to them?

Another observation is that in rehabilitated areas there is a need to replant a variety of indigenous plant species, rather than planting these areas with monocultures of exotic ornative tree species. These should include fruit-bearing species such as fig trees *Ficus* spp., which are important for frugivorous birds. A recommendation for future rehabilitation programs is to plant a mix of native species to increase species diversity.

The use of rehabilitated areas by birds suggests that restoration can be useful to link isolated patches of natural habitat. Our results suggest that in mining areas it is useful to have some portion of land where natural vegetation is allowed to flourish free of human activities. This may later provide source habitats from which birds can disperse into sufficiently mature rehabilitated areas.

The results of this study show the ability of some avian communities to use rehabilitated areas. It is possible that the patterns presented here and the conclusions obtained reflect what might be expected in other faunal groups such as invertebrates,

amphibians, reptiles and mammals. Therefore, this study calls for further research in order to have a better understanding of the role of rehabilitation on fauna as a whole.

Acknowledgments

We gratefully acknowledge the assistance of all staff of the Environmental Department at GPP, whose cooperation, enthusiasm and persistence ensured that the field work was completed. We thank David Moyer and two anonymous reviewers for constructive comments that greatly improved the manuscript.

References

Adams, C.E. & Lindsey, K.J. 2010. *Urban Wildlife Management*. Second Edition. Boca Raton, FL: CRC Press.

Armstrong, K.N. & Nichols, O.G. 2000. Long-term trends in avifaunal recolonization of rehabilitated bauxite mines in the Jarrah forest of south-western Australia. *Forest Ecology and Management* 126: 213–225.

Becker, R.G., Paise, G. & Pizo, M.A. 2013. The structure of bird communities in areas re-vegetated after mining in southern Brazil. *Ravista Brasileira de Ornitologia* 21: 221–234.

BirdLife International (2016) Species factsheet: *Agapornis fischeri*. Downloaded from http://www.birdlife.org on 09 June 2016

Brady, C.J. & Noske, R.A. 2010. Succession in bird and plant communities over a 24-year chronosequence of mine rehabilitation in the Australian monsoon tropics. *Restoration Ecology* 18: 855–864.

Gould, S.F. 2011. Does post-mining rehabilitation restore habitat equivalent to that removed by mining? A case study from the monsoonal tropics of northern Australia. *Wildlife Research* 38: 482–490.

Gould, S.F. & Mackey, B.G. 2015. Vegetation characteristics are more important than landscape context in determining bird assemblages in revegetation. *Restoration Ecology* 23: 670–680.

Hobbs, R.J. 1993. Can revegetation assist in the conservation of biodiversity in agricultural areas? *Pacific Conservation Biology* 1: 29–38.

Hudson, A. & Bouwman, H. 2008. Birds associated with a tailings storage facility and surrounding areas from a South African gold mine. *African Journal of Ecology* 46: 276–281.

Howell, K.M., Msuya, C.A., Ngalason W., Werema C. & Kihaule, P.M. 2010. *Faunal Survey of the Golden Pride Project, Nzega, Tanzania*. A Consultancy Report of the Department of Zoology & Wildlife Conservation, University of Dar es Salaam. Submitted to Resolute Tanzania Ltd.

Kemp, A.C. & Delport, W. 2002. Comments on the status of subspecies in the red-billed hornbill (*Tockus erythrorhynchus*) complex (Aves: Bucerotidae), with the description of a new taxon endemic to Tanzania. *Annals of the Transvaal Museum* 39: 1–8.

Kritzinger, J.J. & Van Aarde, R.J. 1998. The bird communities of rehabilitating coastal dunes at Richards Bay, KwaZulu-Natal. *South African Journal of Science* 94: 71–78.

Lloyd, M.V., Barnett, G., Doherty, M.D., Jeffree, R.A., John, J., Majer, J.D., Osborne, J.M. & Nichols, O.G. 2002. *Managing the impacts of the Australian minerals industry on biodiversity.* Australian Centre for Mining Environmental Research.

Loyn, R.H. 1985. Bird populations in successional forests of mountain ash *Eucalyptus regnans* in central Victoria. *Emu* 85: 213–231.

Magurran, A.E. 1988. *Ecological diversity and its measurement*. Princeton, NJ: Princeton University Press.

Nichols, O.G. & Grant, C.D. 2007. Vertebrate fauna recolonization of restored bauxite mines—key findings from almost 30 years of monitoring and research. *Restoration Ecology* 15: 116–126.

Nichols, O.G. & Nichols, F.M. 2003. Long term trends in faunal recolonization after bauxite mining in the Jarrah forest of southwestern *Australia. Restoration* Ecology 11: 261–272.

Reynolds, J.F. 1969. Notes on birds observed in the vicinity of Tabora, Tanzania with special reference to breeding data. *Journal of the East African Natural History Society* 27: 117–139.

Sinclair, I. & Ryan, P. 2010. *Birds of Africa South of the Sahara. A comprehensive field guide.* Second Edition. Cape Town: Struik Publishers.

Sinclair, J. & Laughton, J. 2013. *Golden Pride Project, Resolute (Tanzania) Limited: Annual Environmental Report*. Submitted to the National Environmental Management Council and Ministry Of Energy and Minerals, Tanzania.

Stevenson, T. & Fanshawe, J. 2002. *Field guide to the birds of East Africa*. Christopher Helm, London.

van Aarde, R.J., Coe, M. & Niering, W.A. 1996a. On the rehabilitation of the coastal dunes of Kwazulu Natal. *South African Journal of Science* 92: 122–124.

van Aarde, R.J., Ferreira, S.M. & Kritzinger, J.J. 1996b. Successional changes in rehabilitating coastal dune communities in northern Kwazul/Natal, South Africa. *Landscape and Urban Planning* 34: 277–286.

Walton, R.K. 1981. Bird observations from Tabora Region, Tanzania. *Scopus* 5: 116–120

Wray, T., Strait, K.A. & Whitmore, R.C. 1982. Reproductive success of grassland sparrows on a reclaimed surface mine in West Virginia. *Auk*. 99: 157–164.

Chacha Werema, Kim M. Howell and Charles A. Msuya
Department of Zoology and Wildlife Conservation, University of Dar es Salaam, P.O. Box 35064, Dar es Salaam, Tanzania

Jackie Sinclair and Anael Macha
Resolute Tanzania Limited, P.O. Box 78486, Dar es Salaam, Tanzania

Scopus 36(2): 26–36, July 2016
Received 31 March 2015

Appendix 1. A list of species recorded at GPP lease area, Nzega District, Tabora Region, central Tanzania. Key: Unmined = unmined areas, Post-rehab = rehabilitated areas of varying age between 4–15 years, 1-year rehab = 1-year old rehabilitated area, x = species present.

Common Name	Species	Unmined	Post-Rehab	One-year Rehab
Hamerkop	*Scopus umbretta*	x		
Black-headed Heron	*Ardea melanocephala*	x		
Hadeda Ibis	*Bostrichia hagedash*	x	x	
Marabou Stork	*Leptoptilos crumeniferus*	x		
Saddle-billed Stork	*Ephippiorhynchus senegalensis*			x
African Openbill	*Anastomus lamelligerus*	x		
Abdim's Stork	*Ciconia abdimii*	x		
White Stork	*Ciconia ciconia*			x
Black-shouldered Kite	*Elanus caeruleus*	x		
Black Kite	*Milvus migrans*	x	x	
Osprey	*Pandion haliaetus*	x		
Palm-nut Vulture	*Gypohierax angolensis*	x		
Hooded Vulture	*Necrosyrtes monachus*	x		
Black-chested Snake-Eagle	*Circaetus pectoralis*	x		
Bateleur	*Terathopius ecaudatus*	x		
African Harrier Hawk	*Polyboroides typus*	x		
Lizard Buzzard	*Kaupifalco mongrammicus*	x		
African Goshawk	*Accipiter tachiro*	x	x	
Little Sparrowhawk	*Accipiter minullus*	x	x	
Tawny Eagle	*Aquila rapax*	x		
Verreaux's Eagle	*Aquila verreauxii*	x		
Long-crested Eagle	*Lophaetus occipitalis*	x		
Martial Eagle	*Polemaetus bellicosus*	x		
Lanner Falcon	*Falco biarmicus*	x		
Peregrine Falcon	*Falco peregrinus*	x		
Helmeted Guineafowl	*Numida meleagris*	x	x	
Coqui Francolin	*Peliperdix coqui*	x	x	
Crested Francolin	*Dendroperdix sephaena*	x	x	
Hildebrandt's Spurfowl	*Pternistis hildebrandti*	x	x	
Red-necked Spurfowl	*Pternistis afer*	x		
Small Button-quail	*Turnix sylvaticus*	x	x	
African Crake	*Crecopsis egregia*	x	x	
Water Thick-knee	*Burhinus vermiculatus*	x		
Spotted Thick-knee	*Burhinus capensis*			x
Crowned Plover	*Vanellus coronatus*	x		x
Speckled Pigeon	*Columba guinea*	x		
Red-eyed Dove	*Streptopelia semitorquata*	x	x	
African Mourning Dove	*Streptopelia decipiens*	x	x	x
Ring-necked Dove	*Streptopelia capicola*	x	x	
Laughing Dove	*Streptopelia senegalensis*	x	x	
African Green Pigeon	*Treron calvus*	x		
Emerald-spotted Wood-Dove	*Turtur chalcospilos*	x	x	
Namaqua Dove	*Oena capensis*	x	x	
Fischer's Lovebird	*Agapornis fischeri*	x	x	
Yellow-collared Lovebird	*Agapornis personatus*	x		
Purple-crested Turaco	*Tauraco porphyreolopha*	x		
Bare-faced Go-away-bird	*Corythaixoides personatus*	x		
Eastern Grey Plantain-eater	*Crinifer zonurus*	x		
Diderick Cuckoo	*Chrysococcyx caprius*	x	x	
Klaas's Cuckoo	*Chrysococcyx klaas*	x		
Jacobin Cuckoo	*Clamator jacobinus*	x	x	
Red-chested Cuckoo	*Cuculus solitarius*	x	x	
White-browed Coucal	*Centropus superciliosus*	x	x	
Barn Owl	*Tyto alba*	x		
Verreaux's Eagle-Owl	*Bubo lacteus*	x		
Square-tailed Nightjar	*Caprimulgus fossii*	x	x	
Slender-tailed Nightjar	*Caprimulgus clarus*	x		
Pennant-winged Nightjar	*Macrodipteryx vexillarius*	x		

Common Name	Species	Unmined	Post-Rehab	One-year Rehab
Speckled Mousebird	*Colius striatus*	x	x	
Blue-naped Mousebird	*Urocolius macrourus*	x	x	
Green Wood Hoopoe	*Phoeniculus purpureus*	x		
Malachite Kingfisher	*Alcedo cristata*	x		
African Pygmy-Kingfisher	*Ispidina picta*	x	x	
Grey-headed Kingfisher	*Halcyon leucocephala*	x	x	
Woodland Kingfisher	*Halcyon senegalensis*	x		
Brown-hooded Kingfisher	*Halcyon albiventris*	x		
Rufous-crowned Roller	*Coracias naevius*	x	x	
Lilac-breasted Roller	*Coracias caudatus*	x		
Little Bee-eater	*Merops pusillus*	x		x
Madagascar Bee-eater	*Merops superciliosus*	x		
European Bee-eater	*Merops apiaster*	x		
Southern Ground-Hornbill	*Bucorvus leadbeateri*	x		
Tanzania Red-billed Hornbill	*Tockus ruahae*	x		
Von der Decken's Hornbill	*Tockus deckeni*	x		
Crowned Hornbill	*Tockus alboterminatus*	x		
Red-fronted Tinkerbird	*Pogoniulus pusillus*	x	x	
Spot-flanked Barbet	*Tricholaema lacrymosa*	x		
Black-collared Barbet	*Lybius torquatus*	x		
d'Arnaud's Barbet	*Trachyphonus darnaudii*	x		
Greater Honeyguide	*Indicator indicator*	x		
Lesser Honeyguide	*Indicator minor*	x		
Nubian Woodpecker	*Campethera nubica*	x	x	
Cardinal Woodpecker	*Dendropicos fuscescens*	x		
Fischer's Sparrow-Lark	*Eremopterix leucopareia*	x	x	x
Lesser Striped Swallow	*Cercropsis abyssinica*	x	x	
African Pied Wagtail	*Motacilla aguimp*	x		
Yellow Wagtail	*Motacilla flava*	x		
Black Cuckooshrike	*Campephaga flava*	x		
Fork-tailed Drongo	*Dicrurus adsimilis*	x	x	
African Golden Oriole	*Oriolus auratus*	x		
Black-headed Oriole	*Oriolus larvatus*	x		
Pied Crow	*Corvus albus*	x		
Arrow-marked Babbler	*Turdoides jardineii*	x	x	
Rufous Chatterer	*Turdoides rubiginosa*	x		
Dark-capped Bulbul	*Pycnonotus tricolor*	x	x	
Yellow-bellied Greenbul	*Chlorocichla flaviventris*	x	x	
Eastern Nicator	*Nicator gularis*	x		
Kurrichane Thrush	*Turdus libonyanus*	x		
White-browed Robin-Chat	*Cossypha heuglini*	x	x	
Spotted Palm Thrush	*Cichladusa guttata*	x	x	
White-browed Scrub Robin	*Erythropygia leucophrys*	x	x	
Familiar Chat	*Cercomela familiaris*	x		
White-headed Black Chat	*Myrmecocichla arnotti*	x		
Northern Wheatear	*Oenanthe oenanthe*	x		x
Pied Wheatear	*Oenanthe pleschanka*	x		
Capped Wheatear	*Oenanthe pileata*	x		
Willow Warbler	*Phylloscopus trochilus*	x	x	
Rattling Cisticola	*Cisticola chiniana*	x	x	
Winding Cisticola	*Cisticola marginatus*	x	x	x
Zitting Cisticola	*Cisticola juncidis*	x		
Yellow-breasted Apalis	*Apalis flavida*	x	x	
Tawny-flanked Prinia	*Prinia subflava*	x	x	x
Grey-capped Warbler	*Eminia lepida*	x		
Red-faced Crombec	*Sylvietta whytii*	x	x	
Grey-backed Camaroptera	*Camaroptera brevicaudata*	x	x	
African Grey Flycatcher	*Bradornis microrhynchus*	x	x	
Silverbird	*Empidornis semipartitus*	x		
Ashy Flycatcher	*Muscicapa caerulescens*	x		
African Paradise Flycatcher	*Terpsiphone viridis*	x	x	
Chinspot Batis	*Batis molitor*	x	x	

Common Name	Species	Unmined	Post-Rehab	One-year Rehab
Red-backed Shrike	*Lanius collurio*	x		
Common Fiscal	*Lanius collaris*	x		
Magpie Shrike	*Urolestes melanoleucus*	x		
Northern White-crowned Shrike	*Eurocephalus rueppelli*	x		
Black-backed Puffback	*Dryoscopus cubla*	x	x	
Brubru	*Nilaus afer*	x		
Tropical Boubou	*Laniarius major*	x		
Slate-colored Boubou	*Laniarius funebris*	x	x	
Orange-breasted Bush-Shrike	*Chlorophoneus sulfureopectus*	x	x	
Grey-headed Bush-Shrike	*Malaconotus blanchoti*	x		
Brown-crowned Tchagra	*Tchagra australis*	x	x	
Black-crowned Tchagra	*Tchagra senegalus*	x	x	
White-crested Helmet Shrike	*Prionops plumatus*	x	x	
Greater Blue-eared Starling	*Lamprotornis chalybaeus*	x		
Ashy Starling	*Lamprotornis unicolor*	x		
Superb Starling	*Lamprotornis superbus*	x		
Violet-backed Starling	*Cinnyricinclus leucogaster*	x		
Yellow-billed Oxpecker	*Buphagus africanus*	x		
Red-billed Oxpecker	*Buphagus erythrorhynchus*	x		
Amethyst Sunbird	*Chalcomitra amethystina*	x		
Scarlet-chested Sunbird	*Chalcomitra senegalensis*	x	x	
Western Violet-backed Sunbird	*Anthreptes longuemarei*	x	x	
Collared Sunbird	*Hedydipna collaris*	x	x	
Variable Sunbird	*Cinnyris venustus*	x	x	
Beautiful Sunbird	*Cynnyris pulchellus*	x	x	
Swahili Sparrow	*Passer suahelicus*	x	x	x
Chestnut Sparrow	*Passer eminibey*	x		
Cut-throat Finch	*Amadina fasciata*	x	x	
Red-billed Buffalo Weaver	*Bubalornis niger*	x		
Speckle-fronted Weaver	*Sporopipes frontalis*	x		
Grey-capped Social-Weaver	*Pseudonigrita arnaudi*	x		
Holub's Golden Weaver	*Ploceus xanthops*	x		
Vitelline Masked Weaver	*Ploceus vitellinus*	x	x	
Lesser Masked Weaver	*Ploceus intermedius*	x		
Golden-backed Weaver	*Ploceus jacksoni*	x	x	
Red-headed Weaver	*Anaplectes melanotis*	x		
Red-billed Quelea	*Quelea quelea*	x	x	
Southern Red Bishop	*Euplectes orix*	x	x	
Black-winged Bishop	*Euplectes hordeaceus*	x	x	x
Black Bishop	*Euplectes gierowii*	x		
White-winged Widowbird	*Euplectes albonotatus*	x	x	
Green-winged Pytilia	*Pytilia melba*	x	x	
Red-billed Firefinch	*Lagonosticta senegala*	x	x	
Jameson's Firefinch	*Lagonosticta rhodopareia*	x	x	
Bronze Mannikin	*Spermestes cucullatus*	x	x	
Red-cheeked Cordonbleu	*Uraeginthus bengalus*	x	x	
Blue-capped Cordonbleu	*Uraeginthus cyanocephalus*	x	x	x
Purple Grenadier	*Granatina ianthinogaster*	x	x	
Black-faced Waxbill	*Estrilda erythronotos*	x		
Crimson-rumped Waxbill	*Estrilda rhodopyga*	x	x	
Pin-tailed Whydah	*Vidua macroura*	x		
Straw-tailed Whydah	*Viuda fischeri*	x		
Steel-blue Whydah	*Vidua hypocherina*	x		
Long-tailed Paradise-Whydah	*Vidua paradisaea*	x	x	
Broad-tailed Paradise-Whydah	*Vidua obtusa*	x		
Yellow-fronted Canary	*Crithagra mozambica*	x	x	
White-bellied Canary	*Crithagra dorsostriata*	x	x	
Brimstone Canary	*Crithagra sulphurata*	x	x	
Reichenow's Seed-eater	*Crithagra reichenowi*	x	x	
Cinnamon-breasted Rock Bunting	*Emberiza tahapisi*	x	x	
Golden breasted Bunting	*Emberiza flaviventris*	x	x	
Total number of species per site		178	82	13