HOST ASSOCIATIONS, PHYLOGENETICS, AND BIOGEOGRAPHY OF PARASITIC AVIAN CHEWING LICE (INSECTA: PHTHIRAPTERA) FROM SUB-SAHARAN AFRICA

A Thesis

by

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ABSTRACT

Parasitic chewing lice (Insecta: Phthiraptera) of birds are found everywhere their avian hosts are distributed, and their host relationships and taxonomy have been well studied in many regions. Lice have obligate parasitic relationships with their hosts (entire life cycle is carried out on the host body) and generally undergo vertical transmission across host generations. These biological traits of lice make them excellent model systems for exploring host-parasite co-evolution. Compared with Europe and the Americas, the ectoparasite fauna of Sub-Saharan African birds is poorly understood despite the avian fauna being relatively well-known. Recent field expeditions exploring the avian diversity in South Africa, Benin, and the Democratic Republic of the Congo allow an opportunity to obtain louse specimens from across Sub-Saharan Africa. The goal of this study was to investigate avian louse host associations and genetic diversity to increase our understanding of southern African parasite biodiversity, as well as to use molecular phylogenetic methods to examine potential broad biogeographic patterns in lice across Sub-Saharan Africa. From 1105 South African bird individuals and 170 species examined for lice, a total of 104 new louse-host associations were observed. Portions of the mitochondrial COI and nuclear EF-1α genes were amplified to observe phylogenetic relationships of southern African lice and investigate potential new species. The phylogenetic results gave strong support for multiple louse genera, and 26 genetically unique lineages were found, which may represent new louse species. Examining biogeographic patterns in parasitic lice across the entire region of Sub-

Saharan Africa indicated that lice tend to follow host distributions rather than grouping by geographic region. Several promising louse taxa were identified as candidates for future phylogenetic and biogeographic studies investigating Sub-Saharan African chewing lice.

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CHAPTER I

INTRODUCTION

Parasitic chewing lice (Insecta: Phthiraptera) of birds are found everywhere their avian hosts are distributed, and their host relationships and taxonomy have been well studied in many regions. Despite having relatively mild consequences for bird hosts compared to other parasites, lice have been shown to have negative effects on host metabolism and thermoregulation (Booth *et al.* 1993), with the ability to cause costly damage to animals of economic importance (DeVaney 1976, Girisgin *et al.* 2013). Lice have obligate parasitic relationships with their hosts (entire life cycle is carried out on the host body) and generally undergo vertical transmission across host generations (Marshall 1981). This can lead to high host specificity where a single parasitic species is found on only one host species (Stefka *et al.* 2011). These biological characteristics of lice make them excellent model systems for exploring host-parasite co-evolution. Previous studies have shown that certain louse parasites of birds as well as mammals co-evolve with, and can have a faster rate of molecular evolution than, their hosts (Hafner *et al*. 1994, Page *et al*. 1998, Whiteman *et al.* 2007, Demastes *et al*. 2012). The faster rate of parasite evolution can lead to parasite populations diverging prior to host populations, and can be used to gain insights into patterns of host biogeography when hosts have experienced cryptic speciation (Hafner *et al.* 1994, Nieberding *et al.* 2004, Voelker *et al.* 2013).

Avian chewing lice belong to two suborders: Amblycera and Ischnocera. Lice can also be divided into two main morphological groups (body and wing lice), which partition themselves into different microhabitats on the host as well as display different strategies for survival (Johnson *et al.* 2012). Amblyceran lice are primarily specialized body lice, while most ischnocerans are either exclusively wing lice or generalists (Price *et al.* 2003). Body lice are rounded in shape, are found in the downy body feathers of the host, and feed on feathers as well as skin debris and occasionally on blood, which can result in tight associations with hosts because of close interactions with the host immune system (Moller & Ròzsa 2005, Bueter *et al.* 2009). Overall, body lice tend to be more host-specific than wing lice (Johnson *et al.* 2002b). Wing lice, on the other hand, are elongate and thin and cling to the feather barbs of the flight feathers of the wings and in the tail, feeding exclusively on feathers. While wing lice can be highly host specific to the extent that a species of louse may only be found parasitizing a single species of host, morphological studies indicate that some species appear to be widespread (Clayton & Price 1999, Price *et al.* 2003, Johnson *et al.* 2005).

Although lice are typically transmitted vertically from mother to offspring, other modes of transmission also are occasionally possible among avian hosts. Transmission between individuals, as well as less frequently between species, occurs through close physical contact of other kinds, such as sharing of nest sites or copulation (Johnson *et al.* 2002a). Lice may thus have the ability to move between host species in mixed species flocks and be dispersed over extensive geographic areas along host migratory paths (Gustafsson & Olsson 2012, Escalante *et al.* 2016). Additionally, some wing lice

(moreso than body lice) are capable of phoresy, or dispersal by traveling to new hosts on the bodies of other organisms. Lice use ectoparasitic hippoboscid flies, clinging to the legs of the flies like they do to feather barbs (Johnson & Clayton 2003, Harbison *et al.* 2008). Wing louse species that regularly undergo phoresy tend to be host generalists and lack specificity (Johnson *et al.* 2002a, Harbison & Clayton 2011).

Compared with Europe and the Americas, the ectoparasite fauna of African birds is poorly understood (Gustafsson & Bush 2015). This is especially the case for Sub-Saharan Africa, despite the avian fauna being relatively well-known. Sub-Saharan Africa is defined as the region south of 20°N, which is biogeographically distinct from, and possesses much higher endemism and diversity of bird species than, the extremely arid Saharan Desert to the north (de Klerk *et al.* 2002a,b). In this area, there has been some recent work on avian lice in South Africa (focused on small geographic regions or a limited number of taxa; Kopij & Price 2009, Halajian *et al.* 2012, Halajian *et al.* 2014, Sychra *et al.* 2014), the Democratic Republic of the Congo (DRC; where many new host associations and several new louse species were found; Light *et al.* 2016), and Ghana (documenting a few new species of lice; Johnson & Price 2006, Meyer *et al.* 2008). In general, avian chewing lice from these regions are poorly known and there have been no studies on avian chewing lice in other countries such as Benin. In fact, very little is known about lice of wild birds in western Africa, including Benin, with studies primarily restricted to domestic host species of economic importance such as chickens, pigeons, and turkeys (Fabiyi 1996). Notably, recent field expeditions exploring the avian diversity in South Africa (e.g., Oatley *et al.* 2012, Voelker *et al.* 2012), Benin, and the Democratic

Republic of the Congo (DRC; e.g., Voelker *et al.* 2013) allow an opportunity to obtain louse specimens from across Sub-Saharan Africa.

This thesis will focus on assessing avian chewing louse diversity across Sub-Saharan Africa. In addition to assessing louse diversity, this study also will add to knowledge about host-parasite associations as well as geographic distributions of Sub-Saharan African birds, with potential conservation implications for parasites and hosts.

CHAPTER II

HOST ASSOCIATIONS AND GENETIC DIVERSITY OF AVIAN CHEWING LICE (INSECTA: PHTHIRAPTERA) FROM SOUTH AFRICA

Introduction

Recent biogeographic studies of birds in Africa have primarily focused on areas with high levels of endemism and species diversity, in particular the lowland forests of central Africa (e.g., Voelker *et al.* 2013, Huntley & Voelker 2016) and the Eastern Arc Mountains (e.g., Bowie *et al.* 2004a, b, Bowie *et al.* 2006, Voelker *et al.* 2010). Despite having lower overall avian species diversity than these regions, southern Africa (Botswana, Lesotho, Namibia, South Africa, Swaziland, and southern Mozambique and Zimbabwe; Chittenden 2007) also has areas with high numbers of endemic birds, although these are primarily restricted to the Cape Floristic Region (Fjeldså & Bowie 2008, Sinclair & Ryan 2011). Several recent studies have examined patterns of speciation in southern African vertebrate taxa (e.g., lizards, elephant-shrews, chameleons, and mice; Matthee & Flemming 2002, Smit *et al.* 2007, Tolley *et al.* 2008, du Toit *et al.* 2012). These taxa have shown consistent patterns of speciation across relatively small geographic barriers (as is the case in rock-dwelling species; Matthee & Flemming 2002, Smit *et al.* 2007), or across climate-related gradients (Tolley *et al.* 2008, du Toit *et al.* 2012). In contrast, the diversification processes of birds in this region are not well understood (Voelker *et al.* 2012, 2014). The difficulty in recognizing clear diversification patterns in birds may be explained by an absence of large geographic

barriers in the region, which reduces opportunities for allopatric speciation (Outlaw *et al.* 2007, Ribeiro *et al.* 2011). For example, Oatley *et al.* (2012) found that the diversification of *Zosterops* white-eyes in South Africa was driven by their association with distinct habitats, in particular speciation between birds of the fynbos (Mediterranean-like shrubland), Karoo (semi-desert), and coastal temperate forests. Outlaw *et al.* (2007) and Voelker *et al.* (2012) also found habitat relationships specifically in arid-adapted birds, which seem to have speciated in southern Africa as a result of isolation in fragmented ranges during wet and cold periods when forests expanded and dry grassland areas were reduced. Ultimately, our knowledge of avian speciation patterns in southern Africa is still rather poor, when compared to other regions in Africa.

Parasitic invertebrate taxa are often less well studied than their vertebrate hosts, and chewing lice (Insecta: Phthiraptera) of southern African birds are no exception. Chewing lice are ectoparasites of birds and mammals, and have global distributions and are known fairly well from Europe and North America (e.g., Emerson 1972, Price *et al.* 2003, Sychra *et al.* 2011, Girisgin *et al.* 2013, Tomás *et al.* 2016). Avian chewing lice belong to two suborders: Amblycera and Ischnocera, which have distinctive morphologies, and partition the host body according to feeding strategy and host preening avoidance behaviors (Johnson *et al.* 2012). Amblyceran lice are primarily specialized body lice, while most ischnocerans are either exclusively wing lice or generalists (Price *et al.* 2003). Lice can be highly host specific, to the extent that each parasitic species is found on only one host species (Stefka *et al.* 2011). Previous studies

have shown that certain louse parasites of birds as well as mammals co-evolve with, and can have a faster rate of molecular evolution than, their hosts (Hafner *et al*. 1994, Page *et al*. 1998, Whiteman *et al.* 2007, Demastes *et al*. 2012). The faster rate of parasite evolution can lead to parasite populations diverging prior to host populations, and can be used to gain insights into patterns of host biogeography when hosts have experienced cryptic speciation (Hafner *et al.* 1994, Nieberding *et al.* 2004, Voelker *et al.* 2013).

Studies of chewing lice parasitizing southern African birds have been restricted to small groups of taxa or limited geographic areas (Kopij & Price 2009, Halajian *et al.* 2012, Halajian *et al.* 2014), and studies using molecular phylogenetics to explore louse diversity are lacking (Sychra *et al.* 2014). These studies are necessary because lice have been shown to exhibit cryptic speciation, and it is often impossible to tell closely related species apart solely based on morphological traits (Escalante *et al.* 2016). The purpose of this study is to investigate avian louse diversity and host associations to increase our understanding of South African biodiversity, as well as assessing biogeographic patterns in South Africa using lice.

Materials and Methods

Ectoparasites were obtained by brushing ornithological museum research specimens housed at the Texas A&M University Biodiversity Research and Teaching Collections (BRTC). These avian specimens were collected over several field excursions from 2009-2014 across eleven localities in five South African provinces: Limpopo (localities 1-3), Mpumalanga (4), Northern Cape (5), Free State (6, 7), and Eastern Cape

(8-11; Fig. 1). Localities within 43 km of each other in the same habitat type were combined into a single locality on the map. The merged localities consisted of the following: three sites within Venetia Limpopo Nature Reserve, two sites near Munnik in Limpopo Province, three farms near Kimberley in the Northern Cape, and two farms in Graaff-Reinet in Eastern Cape Province (Localities 1, 3, 6, and 8, respectively; Fig. 1). During processing in the field, birds were kept in individual bags to avoid cross-contamination of lice between hosts. In the BRTC, each specimen was meticulously brushed and the collected material was examined for lice using an Olympus SZX10 microscope (other ectoparasites such as mites, ticks, and hippoboscid flies were saved and not further examined in this study). Lice were identified morphologically to genus or species when possible using published keys and host association checklists (Price *et al.* 2003, Najer *et al.* 2012, Halajian *et al.* 2014). Louse nymphs that could not be identified beyond family level were included in calculations of louse abundance but excluded from further analyses (Table A-1).

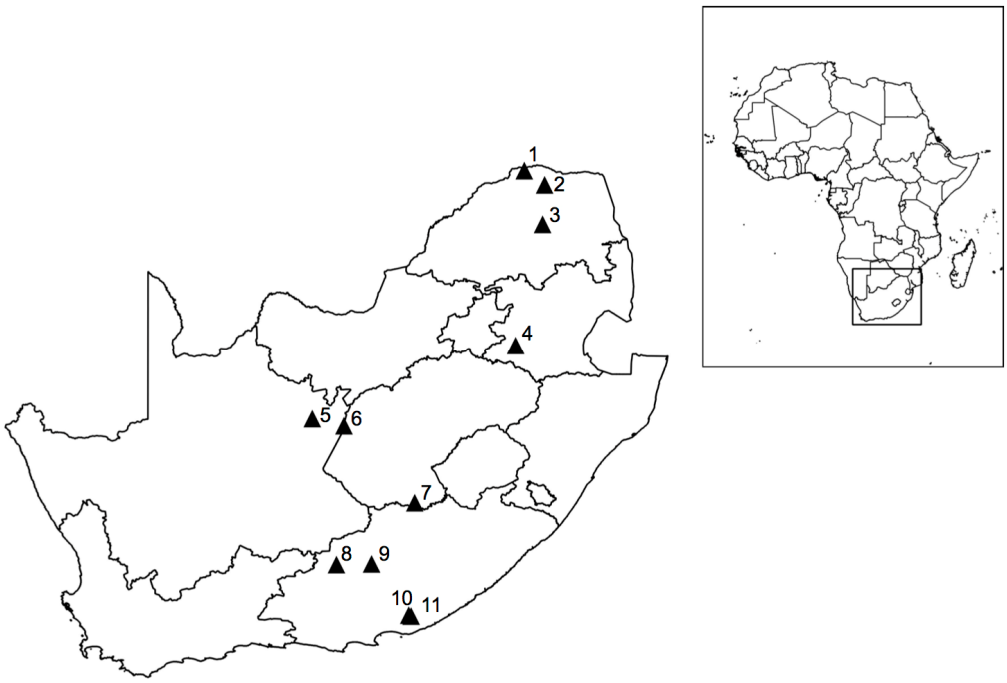

Figure 1. Map of South Africa showing louse collection localities (indicated by black triangles) from five provinces: Limpopo (localities 1-3), Mpumalanga (4), Northern Cape (5), Free State (6, 7), and Eastern Cape (8-11).

Phylogenetic analyses of molecular data were used to confirm morphological identifications and assess genetic diversity of lice. The Omega Bio-Tek E.Z.N.A. Tissue DNA Extraction Kit (Omega Bio-Tek Inc., Norcross, GA) was used to extract DNA from individual lice according to standard louse protocols (Cruickshank *et al.* 2001). Photographic vouchers and slide-mounted exoskeletons were retained for each louse specimen. Polymerase chain reactions (PCR) of segments of one mitochondrial (cytochrome *c* oxidase subunit I; COI) and one nuclear (elongation factor 1 alpha; EF-1α) gene were performed using the primers L6625 and H7005 (Hafner *et al.* 1994) and EF1-For3 and Cho10 (Danforth & Ji 1998), respectively. The PCR protocols followed

Light *et al.* (2016). Mitochondrial COI sequences were obtained for all lice, whereas EF-1α was obtained for a subset of lice representing one individual per unique lineage based on the COI phylogeny. Prior to sequencing, PCR results were visualized on an agarose gel using electrophoresis and all positive PCR products were purified using ExoSAP-IT (Affymetrix, Inc., Santa Clara, CA). Samples were sent to Beckman Coulter Genomics (Beckman Coulter, Inc., Fullerton, CA) for sequencing. Sequencher v. 4.5 (Gene Codes Corp., Ann Arbor, MI) was used to examine raw reads and manually edit base calls. In an effort to identify novel species genetically, each louse sequence was compared to published sequences in GenBank using the Basic Local Alignment Search Tool (BLAST), and top hits were included in subsequent phylogenetic analyses. In addition, all available South African louse sequences from GenBank were included in the analysis. All sequences were aligned by eye using the Se-Al alignment software v.2.0a11 (Rambaut 1996) and submitted to GenBank (pending manuscript acceptance).

All phylogenetic analyses were performed using MrBayes v.3.2 (Huelsenbeck & Ronquist 2001, Ronquist & Huelsenbeck 2003). Three separate Bayesian analyses were run: 1) Amblycera COI, 2) Ischnocera COI, and 3) Amblycera and Ischnocera COI + EF-1α for a subset of taxa based on unique lineages identified from the COI analyses. Prior to each analysis, PartitionFinder v.1.1.1 (Lanfear *et al.* 2012, Lanfear *et al.* 2014) was used with the Bayesian information criterion to select the best fitting partitions and models of evolution. For the Amblycera COI analysis, three optimal partitions (corresponding to each codon position) were selected with the following models of evolution: GTR+I+G for positions 1 and 2, and HKY+G for the third codon position.

The same partitioning scheme and models of evolution were identified for the Ischnocera COI dataset. For the COI + EF-1α analysis, four optimal partitions and models of evolution were identified: K80+I+G for all EF-1α codon positions, and GTR+I+G, GTR+G, and HKY+I+G for the COI first, second, and third codon positions, respectively. Two mammalian sucking louse species (Anoplura: *Fahrenholzia zacatecae* and *Haematopinus eurysternus*; GenBank HM171445 and HM171422 for COI and HM171477 and HM171457 for EF-1α, respectively) were included as outgroup taxa in all analyses. Phylogenetic analyses in MrBayes were performed using two independent runs with 4 incrementally heated chains (Metropolis-coupled Markov chain Monte Carlo; Ronquist & Huelsenbeck 2003), run for 10 million generations, and sampled every 1000 generations. The first 25% of trees from each run were discarded as burnin. The remaining trees were used to create a 50% majority consensus tree and calculate posterior probabilities. To examine genetic differentiation between and among taxa, average uncorrected *p*-distances were calculated using PAUP* v.4.0 (Swofford 2002).

Results

A total of 14 bird orders, representing 47 families (19 non-passerine and 28 passerine), 109 genera, and 170 species were examined for lice (Table A-1). Of 1105 host individuals examined, 248 birds (22%) were parasitized by lice, while 98 (58%) of the 170 host species were parasitized (Table A-1). Seven amblyceran and 14 ischnoceran genera were identified, with at least 10 and 38 species represented, respectively (taxa were not identified to species due to lack of reference material). In total, 138 host

associations were observed, with 104 new associations (Table 1). These new associations included both 70 first records of a louse parasitism for some bird species and 34 cases of parasitism by additional louse species for others (Table 1). Parasitism by a single species of louse per host was most common, however, co-infections of a single host parasitized by multiple louse species were also found: 35 bird species were host to 2 or more louse species. Co-infection by different suborders was most common, with 21 bird species parasitized by both amblyceran and ischnoceran lice. Additionally, 21 bird species were parasitized by more than 1 louse species of the same suborder (19 bird species with 2 or more ischnoceran species, 2 bird species with 2 amblyceran species). It should be noted that most of these co-infections were observed across multiple individuals of the same host species, as only 12 host individuals were actually parasitized by multiple louse species (Table 2).

Table 1. Bird-louse host associations from South Africa, including the first louse record for a particular bird species (*), as well as new host associations for bird hosts that were previously known to be parasitized by other louse species (†). The numbers of host individuals examined are indicated in parentheses following the host species.

Host Family	Host Species (number of individuals examined)	Louse Suborder	Louse Family	Louse Species
Order: Bucerotiformes				
Phoeniculidae	*Rhinopomastus cyanomelas* (5)	Amblycera	Menoponidae	*Odoriphila* sp.
		Ischnocera	Philopteridae	*Hopkinsiella* sp.
				Philopterus sp.
Upupidae	*Upupa africana* (6)	Ischnocera	Philopteridae	*Upupicola* sp.
Order: Caprimulgiformes				
Caprimulgidae	*Caprimulgus pectoralis* (3)	Ischnocera	Philopteridae	*Mulcticola* sp.
Order: Charadriiformes				
Charadriidae	*Charadrius tricollaris* (6)	Ischnocera	Philopteridae	*Quadraceps* sp.
Order: Coliiformes				
Coliidae	*Colius colius* (4)	Amblycera	Menoponidae	*Colimenopon* sp.
		Ischnocera	Philopteridae	*Colilipeurus* sp.
	Colius striatus (9)	Ischnocera	Philopteridae	*Colilipeurus* sp.
	Urocolius indicus (5)	Amblycera	Menoponidae	*Colimenopon* sp.
		Ischnocera	Philopteridae	*Colilipeurus* sp.
Order: Columbiformes				
Columbidae	*Streptopelia senegalensis* (1)	Ischnocera	Philopteridae	*Coloceras* sp.
Order: Coraciiformes				
Alcedinidae	*Halcyon albiventris* (12)	Ischnocera	Philopteridae	*Alcedoecus* sp.
Coraciidae	*Coracias naevius* (1)	Ischnocera	Philopteridae	*Capraiella* sp.*
Meropidae	*Merops pusillus* (2)	Amblycera	Menoponidae	*Meromenopon* sp.
Order: Gruiformes				
Rallidae	*Amaurornis flavirostra* (1)	Ischnocera	Philopteridae	*Fulicoffula* sp.*
				Rallicola sp.*

Table 1 Continued

Host Family	Host Species (number of individuals examined)	Louse Suborder	Louse Family	Louse Species
Order: Passeriformes				
Alaudidae	*Chersomanes albofasciata* (4)	Ischnocera	Philopteridae	*Penenirmus* sp.*
	Eremopterix verticalis (4)	Ischnocera	Philopteridae	*Penenirmus* sp.†
	Mirafra africana (1)	Ischnocera	Philopteridae	*Brueelia* sp.*
Cisticolidae	*Apalis flavida* (3)	Amblycera	Menoponidae	*Menacanthus* sp.*
		Ischnocera	Philopteridae	*Brueelia* sp.*
	Apalis thoracica (11)	Amblycera	Menoponidae	*Machaerilaemus* sp.*
				Menacanthus sp.*
	Calamonastes fasciolatus (5)	Amblycera	Menoponidae	*Menacanthus* sp.*
		Ischnocera	Philopteridae	*Penenirmus* sp.*
				Sturnidoecus sp.*
	Camaroptera brachyura (2)	Ischnocera	Philopteridae	*Brueelia* sp.†
	Cisticola fulvicapilla (6)	Ischnocera	Philopteridae	*Brueelia* sp.*
	Cisticola lais (16)	Amblycera	Menoponidae	*Menacanthus* sp.*
		Ischnocera	Philopteridae	*Brueelia* sp.*
	Prinia flavicans (3)	Amblycera	Menoponidae	*Menacanthus* sp.
	Prinia maculosa (4)	Ischnocera	Philopteridae	*Brueelia* sp.*
				Philopterus sp.*
Dicruridae	*Dicrurus adsimilis* (13)	Ischnocera	Philopteridae	*Brueelia sp.*
				Philopterus sp.†
Emberizidae	*Emberiza flaviventris* (15)	Amblycera	Ricinidae	*Ricinus* sp.*
		Ischnocera	Philopteridae	*Brueelia* sp.*
				Penenirmus sp.*
				Philopterus sp.*
	Emberiza tahapisi (5)	Amblycera	Ricinidae	*Ricinus* sp.†
		Ischnocera	Philopteridae	*Brueelia* sp.†
				Penenirmus sp.†
Estrildidae	*Estrilda erythronotus* (1)	Ischnocera	Philopteridae	*Brueelia* sp.*
	Granatina granatina (8)	Ischnocera	Philopteridae	*Brueelia* sp.*
	Lagonosticta rhodopareia (8)	Ischnocera	Philopteridae	*Brueelia* sp.*
	Lagonosticta rubricata (6)	Amblycera	Menoponidae	*Myrsidea* sp.*
	Pytilia melba (15)	Ischnocera	Philopteridae	*Brueelia* sp.†

Table 1 Continued

Host Family	Host Species (number of individuals examined)	Louse Suborder	Louse Family	Louse Species
Fringillidae	*Crithagra atrogularis* (5)	Ischnocera	Philopteridae	*Philopterus* sp.†
	Crithagra canicollis (1)	Ischnocera	Philopteridae	*Brueelia* sp.*
	Crithagra flaviventris (2)	Ischnocera	Philopteridae	*Penenirmus* sp.†
	Crithagra gularis (5)	Ischnocera	Philopteridae	*Brueelia* sp.*
				Philopterus sp.*
	Crithagra mozambica (8)	Ischnocera	Philopteridae	*Brueelia* sp.*
Laniidae	*Eurocephalus anguitimens* (3)	Amblycera	Menoponidae	*Menacanthus* sp.†
	Lanius collaris (3)	Amblycera	Menoponidae	*Menacanthus* sp.
		Ischnocera	Philopteridae	*Philopterus* sp.†
Leiothrichidae	*Turdoides bicolor* (2)	Amblycera	Menoponidae	*Myrsidea* sp.†
Macrosphenidae	*Sylvietta rufescens* (17)	Ischnocera	Philopteridae	*Brueelia* sp.*
Malaconotidae	*Dryoscopus cubla* (9)	Ischnocera	Philopteridae	*Philopterus* sp.†
	Laniarius atrococcineus (15)	Amblycera	Menoponidae	*Menacanthus* sp.*
		Ischnocera	Philopteridae	*Sturnidoecus* sp.*
	Laniarius ferrugineus (15)	Amblycera	Menoponidae	*Menacanthus* sp.*
		Ischnocera	Philopteridae	*Brueelia* sp.*
				Philopterus sp.*
	Nilaus afer (6)	Ischnocera	Philopteridae	*Brueelia* sp.*
				Philopterus sp.*
	Tchagra australis (3)	Ischnocera	Philopteridae	*Sturnidoecus* sp.*
Monarchidae	*Terpsiphone viridis* (8)	Ischnocera	Philopteridae	*Brueelia* sp.
				Sturnidoecus sp.†
Motacillidae	*Anthus* sp. (30)	Amblycera	Ricinidae	*Ricinus* sp.
		Ischnocera	Philopteridae	*Brueelia* sp.
	Macronyx capensis (3)	Ischnocera	Philopteridae	*Brueelia* sp.*
				Philopterus sp.*
	Motacilla capensis (17)	Ischnocera	Philopteridae	*Brueelia* sp.*
Muscicapidae	*Bradornis mariquensis* (3)	Ischnocera	Philopteridae	*Philopterus* sp.†
	Cercotrichas coryphaeus (5)	Ischnocera	Philopteridae	*Philopterus* sp.*
	Cercotrichas leucophrys (5)	Amblycera	Menoponidae	*Myrsidea* sp.†
			Ricinidae	*Ricinus* sp.
	Cercotrichas paena (12)	Ischnocera	Philopteridae	*Penenirmus* sp.†
	Cossypha caffra (39)	Ischnocera	Philopteridae	*Philopterus* sp.†

Table 1 Continued

Host Family	Host Species (number of individuals examined)	Louse Suborder	Louse Family	Louse Species
	Cossypha humeralis (7)	Amblycera	Menoponidae	*Menacanthus* sp.*
	Muscicapa striata (2)	Ischnocera	Philopteridae	*Brueelia* sp.†
	Myrmecocichla formicivora (16)	Ischnocera	Philopteridae	*Penenirmus* sp.*
				Philopterus sp.*
	Sigelus silens (28)	Amblycera	Menoponidae	*Menacanthus* sp.*
		Ischnocera	Philopteridae	*Brueelia* sp.*
	Stenostira scita (7)	Ischnocera	Philopteridae	*Philopterus* sp.*
Nectariniidae	*Chalcomitra amethystina* (14)	Ischnocera	Philopteridae	*Philopterus* sp.*
	Cinnyris chalybeus (5)	Amblycera	Menoponidae	*Menacanthus* sp.*
	Nectarinia famosa (3)	Ischnocera	Philopteridae	*Brueelia* sp.†
Oriolidae	*Oriolus larvatus* (7)	Ischnocera	Philopteridae	*Philopterus* sp.
Paridae	*Parus cinerascens* (4)	Ischnocera	Philopteridae	*Philopterus* sp.*
	Parus niger (5)	Ischnocera	Philopteridae	*Brueelia* sp.*
Passeridae	*Passer diffusus* (20)	Amblycera	Menoponidae	*Menacanthus* sp.*
		Ischnocera	Philopteridae	*Brueelia* sp.*
	Passer melanurus (14)	Ischnocera	Philopteridae	*Brueelia* sp.†
				Sturnidoecus sp.†
	Plocepasser mahali (9)	Amblycera	Menoponidae	*Menacanthus* sp.
		Ischnocera	Philopteridae	*Brueelia* sp.†
	Sporopipes squamifrons (4)	Ischnocera	Philopteridae	*Brueelia* sp.†
Platysteiridae	*Batis pririt* (9)	Ischnocera	Philopteridae	*Philopterus* sp.*
Ploceidae	*Anaplectes melanotis* (6)	Amblycera	Menoponidae	*Menacanthus* sp.*
	Bubalornis niger (2)	Amblycera	Menoponidae	*Myrsidea* sp.*
	Euplectes capensis (5)	Ischnocera	Philopteridae	*Philopterus* sp.*
	Ploceus capensis (11)	Ischnocera	Philopteridae	*Brueelia* sp.†
	Ploceus cucullatus (4)	Ischnocera	Philopteridae	*Brueelia* sp.†
	Ploceus ocularis (6)	Amblycera	Menoponidae	*Myrsidea* sp.*
	Ploceus velatus (27)	Ischnocera	Philopteridae	*Brueelia* sp.†
				Sturnidoecus sp.
	Quelea quelea (4)	Ischnocera	Philopteridae	*Brueelia* sp.†
Prionopidae	*Prionops plumatus* (4)	Ischnocera	Philopteridae	*Brueelia* sp.
Pycnonotidae	*Chlorocicla flaviventris* (5)	Ischnocera	Philopteridae	*Brueelia* sp.†

Table 1 Continued

Host Family	Host Species (number of individuals examined)	Louse Suborder	Louse Family	Louse Species
	Pycnonotus nigricans (28)	Amblycera	Menoponidae	*Menacanthus* sp.*
		Ischnocera	Philopteridae	*Brueelia* sp.*
				Philopterus sp.*
	Pycnonotus tricolor (21)	Amblycera	Menoponidae	*Menacanthus* sp.*
		Ischnocera	Philopteridae	*Brueelia* sp.*
Sturnidae	*Creatophora cinerea* (2)	Amblycera	Menoponidae	*Menacanthus* sp.
	Lamprotornis nitens (7)	Ischnocera	Philopteridae	*Brueelia* sp.
				Sturnidoecus sp.
	Onychognathus nabouroup (1)	Ischnocera	Philopteridae	*Philopterus* sp.*
Sylviidae	*Sylvia subcaerulea* (33)	Amblycera	Menoponidae	*Menacanthus* sp.
		Ischnocera	Philopteridae	*Brueelia* sp.†
Turdidae	*Turdus libonyanus* (8)	Amblycera	Menoponidae	*Menacanthus* sp.†
		Ischnocera	Philopteridae	*Philopterus* sp.
	Turdus smithi (9)	Ischnocera	Philopteridae	*Brueelia* sp.†
Viduidae	*Vidua macroura* (2)	Ischnocera	Philopteridae	*Brueelia* sp.†
Zosteropidae	*Zosterops capensis* (27)	Amblycera	Menoponidae	*Menacanthus* sp.*
		Ischnocera	Philopteridae	*Brueelia* sp.*
				Philopterus sp.*
	Zosterops pallidus (21)	Amblycera	Menoponidae	*Menacanthus* sp.
Order: Piciformes				
Lybiidae	*Lybius torquatus* (8)	Amblycera	Menoponidae	*Menacanthus* sp.
		Ischnocera	Philopteridae	*Penenirmus* sp.
	Pogoniulus chrysoconus (5)	Amblycera	Menoponidae	*Menacanthus* sp.*
	Trachyphonus vaillantii (8)	Ischnocera	Philopteridae	*Penenirmus* sp.*
	Tricholaema leucomelas (37)	Ischnocera	Philopteridae	*Brueelia* sp.†
				Penenirmus sp.

Table 2. South African lice identified in this study. All specimens have been accessioned into the Texas A&M University Biodiversity Research and Teaching Collections unless otherwise mentioned (MVZ= Museum of Vertebrate Zoology, University of California, Berkeley). Lice are organized by host taxonomy. Louse suborders are denoted by A= Amblycera and I= Ischnocera. Louse specimens not included in the phylogenetic analyses are indicated by an asterisk (*). Louse specimen collection localities correspond to locality numbers in Figure 1 and Table A-1.

Host Family	Host Species	Host Specimen Number (louse voucher number and louse identification)	Locality Number
Order: Bucerotiformes			
Phoeniculidae	*Rhinopomastus cyanomelas*	16471 (3639.1*- A: *Odoriphila* sp.)	3
		16472 (3180.1- I: *Philopterus* sp.)	2
		(3130.2- I: *Philopterus* sp.)	
		15563 (3288.1*- I: *Hopkinsiella* sp.)	6
Upupidae	*Upupa africana*	17020 (3115.1*- I: *Upupicola* sp.)	3
Order: Caprimulgiformes			
Caprimulgidae	*Caprimulgus pectoralis*	17386 (3737.1- I: *Mulcticola* sp.)	3
Order: Charadriiformes			
Charadriidae	*Charadrius tricollaris*	17025 (3134.1- I: *Quadraceps* sp.)	3
		21642 (3962.1*- I: *Quadraceps* sp.)	1
Order: Coliiformes			
Coliidae	*Colius colius*	15567 (3347.1- I: *Colilipeurus* sp.)	6
		17400 (3775.1*- A: *Colimenopon* sp.)	7
		17401 (350.1*- I: *Colilipeurus* sp.)	7
		22381 (4132.1*- A: *Colimenopon* sp.)	8
		(4132.2*- I: *Colilipeurus* sp.)	
	Colius striatus	17021 (3080.1*- I: *Colilipeurus* sp.)	3
		17023 (3636.1*- I: *Colilipeurus* sp.)	3
		17403 (311.1- I: *Colilipeurus* sp.)	3
		17404 (330.1- I: *Colilipeurus* sp.)	3
		22452 (294.1*- I: *Colilipeurus* sp.)	8

Table 2 Continued

Host Family	Host Species	Host Specimen Number (louse voucher number and louse identification)	Locality Number
	Urocolius indicus	MVZ198661-659 (779.1*- A: *Colimenopon* sp.) (779.2*- I: *Colilipeurus* sp.)	5
		15569 (3303.1- I: *Colilipeurus* sp.)	6
		17399 (387.1*- I: *Colilipeurus* sp.)	5
Order: Columbiformes			
Columbidae			
	Streptopelia senegalensis	16999 (3146.1- I: *Coloceras* sp.)	2
Order: Coraciiformes			
Alcedinidae	*Halcyon albiventris*	MVZ198928-926 (704.1*- I: *Alcedoecus* sp.)	3
		16728 (3064.1- I: *Alcedoecus* sp.)	3
		16729 (3185.1*- I: *Alcedoecus* sp.)	3
		16732 (3249.1*- I: *Alcedoecus* sp.)	5
		17375 (308.1*- I: *Alcedoecus* sp.)	3
		22444 (264.1*- I: *Alcedoecus* sp.)	10
Coraciidae	*Coracias naevius*	17000 (3156.1- I: *Capraiella* sp.)	2
Meropidae	*Merops pusillus*	17560 (332.1- A: *Meromenopon* sp.)	3
Order: Gruiformes			
Rallidae	*Amaurornis flavirostra*	17379 (307.1- I: *Fulicoffula* sp.) (307.2- I: *Rallicola* sp.)	3
Order: Passeriformes			
Alaudidae	*Chersomanes albofasciata*	17623 (362.1- I: *Penenirmus* sp.)	7
	Eremopterix verticalis	15617 (3313.1*- I: *Penenirmus* sp.)	6
	Mirafra africana	14964 (3194.1- I: *Brueelia* sp.)	6
Cisticolidae	*Apalis flavida*	16859 (3553.1- I: *Brueelia* sp.)	3
		16860 (3187.1*- A: *Menacanthus* sp.)	3
		16861 (3564.1*- I: *Brueelia* sp.) (3564.2*- A: *Menacanthus* sp.)	3
	Apalis thoracica	22391 (4142.1*- A: *Menacanthus* sp.)	8
		22569 (5888.1*- A: *Machaerilaemus* sp.)	8

Table 2 Continued

Host Family	Host Species	Host Specimen Number (louse voucher number and louse identification)	Locality Number
	Calamonastes fasciolatus	16854 (3608.1*- I: *Penenirmus* sp.)	2
		16857 (3582.2- A: *Menacanthus* sp.) (3582.1- I: *Sturnidoecus* sp.)	2
	Camaroptera brachyura	16822 (3556.1- I: *Brueelia* sp.)	3
	Cisticola fulvicapilla	22582 (5901.1*- I: *Brueelia* sp.)	8
	Cisticola lais	16905 (3533.1*- A: *Menacanthus* sp.)	3
		16908 (3537.1*- A: *Menacanthus* sp.)	3
		16909 (3538.1*- A: *Menacanthus* sp.)	3
		16911 (3473.1*- A: *Menacanthus* sp.)	3
		16912 (3461.1*- A: *Menacanthus* sp.)	3
		17562 (313.1*- A: *Menacanthus* sp.)	3
		17564 (3741.1*- I: *Brueelia* sp.)	3
		17565 (3728.1*- A: *Menacanthus* sp.)	3
		17567 (3729.1- A: *Menacanthus* sp.)	3
	Prinia flavicans	16809 (3512.1- A: *Menacanthus* sp.)	3
	Prinia maculosa	22506 (5824.1*- I: *Brueelia* sp.) (5824.2*- I: *Philopterus* sp.)	9
Dicruridae	*Dicrurus adsimilis*	16958 (3617.1*- I: *Philopterus* sp.)	2
		16960 (3147.1- I: *Philopterus* sp.)	2
		16961 (3176.1- I: *Philopterus* sp.)	2
		21545 (3865.1- I: *Brueelia* sp.)	1
		22467 (356.1*- I: *Philopterus* sp.)	8
Emberizidae	*Emberiza flaviventris*	16862 (3620.2- I: *Brueelia* sp.)	2
		16865 (3583.1*- I: *Penenirmus* sp.)	2
		16868 (3616.1- I: *Penenirmus* sp.)	2
		17588 (393.1- A: *Ricinus* sp.)	5
		17589 (412.1*- I: *Brueelia* sp.)	5
		21618 (3938.1*- I: *Philopterus* sp.)	1
		21637 (3957.1*- I: *Brueelia* sp.)	1
	Emberiza tahapisi	MVZ198589-586 (800.1- A: *Ricinus* sp.)	5
		15624 (3268.1- I: *Penenirmus* sp.)	6
		17587 (384.1*- I: *Brueelia* sp.)	5
Estrildidae	*Estrilda erythronotus*	21624 (3944.1*- I: *Brueelia* sp.)	1

Table 2 Continued

Host Family	Host Species	Host Specimen Number (louse voucher number and louse identification)	Locality Number
	Granatina granatina	16871 (3475.1*- I: *Brueelia* sp.)	3
	Lagonosticta rhodopareia	16982 (3481.1*- I: *Brueelia* sp.)	3
	Lagonosticta rubricata	16972 (3485.1*- A: *Myrsidea* sp.)	3
	Pytilia melba	17007 (3466.1*- I: *Brueelia* sp.)	3
Fringillidae	*Crithagra atrogularis*	22578 (5879.1*- *Philopterus* sp.)	8
	Crithagra canicollis	22539 (5857.1*- I: *Brueelia* sp.)	11
	Crithagra flaviventris	17515 (323.1- I: *Penenirmus* sp.)	3
	Crithagra gularis	17559 (364.1*- I: *Philopterus* sp.)	7
		22379 (4130.1*- I: *Brueelia* sp.)	8
	Crithagra mozambica	21617 (3937.1*- I: *Brueelia* sp.)	1
Laniidae	*Eurocephalus anguitimens*	16714 (3179.1*- A: *Menacanthus* sp.)	2
	Lanius collaris	17644 (372.1- A: *Menacanthus* sp.)	7
		22508 (5826.1*- I: *Philopterus* sp.)	9
Leiothrichidae	*Turdoides bicolor*	17014 (3158.1*- A: *Myrsidea* sp.)	2
Macrosphenidae	*Sylvietta rufescens*	21531 (3851.1*- I: *Brueelia* sp.)	1
Malaconotidae	*Dryoscopus cubla*	16722 (3631.1*- I: *Philopterus* sp.)	3
		17649 (317.1- I: *Philopterus* sp.)	3
		17650 (3727.1*- I: *Philopterus* sp.)	3
	Laniarius atrococcineus	15579 (3280.1- I: *Sturnidoecus* sp.)	6
		16948 (3641.2- A: *Menacanthus* sp.)	3
	Laniarius ferrugineus	MVZ198934-932 (702.1- A: *Menacanthus* sp.)	3
		16943 (3062.1- I: *Philopterus* sp.)	3
		16944 (3120.1*- I: *Brueelia* sp.)	3
		17368 (3689.1*- A: *Menacanthus* sp.)	3
	Nilaus afer	15631 (3290.1*- I: *Philopterus* sp.)	6
		17646 (413.1- I: *Brueelia* sp.)	5
	Tchagra australis	16724 (3182.1- I: *Sturnidoecus* sp.)	3
Monarchidae	*Terpsiphone viridis*	22393 (4144.1*- I: *Brueelia* sp.)	8
		22420 (176.1*- I: *Sturnidoecus* sp.)	9

Table 2 Continued

Host Family	Host Species	Host Specimen Number (louse voucher number and louse identification)	Locality Number
Motacillidae	*Anthus* sp.	17284 (3829.1*- I: *Brueelia* sp.)	5
		17285 (3830.1*- I: *Brueelia* sp.)	5
		17287 (3831.1*- I: *Brueelia* sp.)	5
		17288 (3827.1*- I: *Brueelia* sp.)	5
		17291 (3837.1*- I: *Brueelia* sp.)	5
		17294 (3828.1*- I: *Brueelia* sp.)	5
		22314 (4065.1*- A: *Ricinus* sp.)	8
		22376 (4127.1*- A: *Ricinus* sp.) (4127.2*- I: *Brueelia* sp.)	8
	Macronyx capensis	17304 (3751.1*- I: *Philopterus* sp.)	4
		22544 (5862.1*- I: *Brueelia* sp.)	10
		22560 (5878.1*- I: *Philopterus* sp.)	10
	Motacilla capensis	22549 (5867.1*- I: *Brueelia* sp.)	10
Muscicapidae	*Bradornis mariquensis*	21543 (3863.1*- I: *Philopterus* sp.)	1
	Cercotrichas coryphaeus	22402 (87.1- I: *Philopterus* sp.)	8
	Cercotrichas leucophrys	16848 (3566.1*- A: *Myrsidea* sp.)	3
		17557 (293.1*- A: *Ricinus* sp.)	3
	Cercotrichas paena	21620 (3940.1- I: *Penenirmus* sp.)	1
	Cossypha caffra	17316 (339.1*- I: *Philopterus* sp.)	4
	Cossypha humeralis	16939 (3547.1*- A: *Menacanthus* sp.)	3
	Muscicapa striata	15609 (3264.1*- I: *Brueelia* sp.)	6
	Myrmecocichla formicivora	17611 (338.1*- I: *Philopterus* sp.)	4
		17612 (340.1- I: *Penenirmus* sp.)	4
		17613 (3752.1*- I: *Penenirmus* sp.)	4
		22466 (355.1*- I: *Philopterus* sp.)	8
	Sigelus silens	16995 (3642.1*- I: *Brueelia* sp.)	3
		17631 (3800.1- I: *Picicola* sp.)	7
		17640 (3822.1- A: *Menacanthus* sp.)	5
		22465 (349.1*- I: *Brueelia* sp.)	8
	Stenostira scita	22485 (5803.1*- I: *Philopterus* sp.)	8
Nectariniidae	*Chalcomitra amethystina*	22515 (5833.1*- I: *Philopterus* sp.)	9
		22523 (5841.1*- I: *Philopterus* sp.)	9

Table 2 Continued

Host Family	Host Species	Host Specimen Number (louse voucher number and louse identification)	Locality Number
	Cinnyris chalybeus	22333 (4084.1*- A: *Menacanthus* sp.)	9
		22514 (5832.1*- I: *Philopterus* sp.)	9
		22608 (5927.1*- I: *Sturnidoecus* sp.)	8
	Nectarinia famosa	22432 (200.1*- I: *Brueelia* sp.)	9
Oriolidae	*Oriolus larvatus*	17389 (288.1- I: *Philopterus* sp.)	3
		22561 (5879.1*- I: *Philopterus* sp.)	10
Paridae	*Parus cinerascens*	15022 (3224.1*- I: *Philopterus* sp.)	6
		16900 (3479.1*- I: *Philopterus* sp.)	3
	Parus niger	16899 (3585.1- I: *Brueelia* sp.)	2
Passeridae	*Passer diffusus*	15040 (3205.1*- A: *Menacanthus* sp.)	6
		16823 (3574.1- I: *Brueelia* sp.)	2
		21625 (3945.1*- I: *Brueelia* sp.)	1
		21640 (3960.1*- I: *Brueelia* sp.)	1
		22463 (343.1*- I: *Brueelia* sp.)	8
		22464 (346.1*- I: *Brueelia* sp.)	8
		22532 (5850.1*- I: *Brueelia* sp.)	9
		22599 (5918.1*- I: *Brueelia* sp.)	8
	Passer melanurus	17583 (3771.1- I: *Brueelia* sp.)	7
		22318 (4069.1*- I: *Sturnidoecus* sp.)	8
		22411 (124.1*- I: *Sturnidoecus* sp.)	8
		22480 (5798.1*- I: *Sturnidoecus* sp.)	8
		22495 (5813.1*- I: *Brueelia* sp.)	8
	Plocepasser mahali	15576 (3349.1*- A: *Menacanthus* sp.)	6
		15577 (3322.1- A: *Menacanthus* sp.)	6
		16963 (3581.1- I: *Brueelia* sp.)	2
		16964 (3580.1*- I: *Brueelia* sp.)	2
		16966 (3595.1*- I: *Brueelia* sp.)	2
	Sporopipes squamifrons	17511 (321.1*- I: *Brueelia* sp.)	3
		17512 (3721.1*- I: *Brueelia* sp.)	3
Platysteiridae	*Batis pririt*	15028 (3204.1- I: *Philopterus* sp.)	6
Ploceidae	*Anaplectes melanotis*	21586 (3906.1* A: *Menacanthus* sp.)	1
	Bubalornis niger	17016 (3621.1- A: *Myrsidea* sp.)	2
	Euplectes capensis	22555 (5873.1*- I: *Philopterus* sp.)	10

Table 2 Continued

Host Family	Host Species	Host Specimen Number (louse voucher number and louse identification)	Locality Number
	Ploceus capensis	16751 (3126.2*- I: *Brueelia* sp.)	3
		22361 (4112.1*- I: *Brueelia* sp.)	10
		22440 (241.1*- I: *Brueelia* sp.)	10
		22442 (260.1*- I: *Brueelia* sp.)	10
		22539 (5857.1*- I: *Brueelia* sp.)	10
		22548 (5866.1*- I: *Brueelia* sp.)	11
	Ploceus cucullatus	17606 (329.1- I: *Brueelia* sp.)	3
		22441 (255.1*- I: *Brueelia* sp.)	10
		22536 (5854.1*- I: *Brueelia* sp.)	11
	Ploceus ocularis	16953 (3107.1- A: *Myrsidea* sp.)	3
		17607 (314.1*- A: *Myrsidea* sp.)	3
	Ploceus velatus	15651 (3310.1*- I: *Brueelia* sp.)	6
		15653 (3300.1*- I: *Brueelia* sp.)	6
		15654 (3292.1*- I: *Brueelia* sp.)	6
		15655 (3299.1*- I: *Sturnidoecus* sp.)	6
		17600 (3774.1*- I: *Brueelia* sp.)	7
		17605 (3819.1*- I: *Brueelia* sp.)	5
		22543 (5861.1- I: *Brueelia* sp.)	10
		22597 (5916.1*- I: *Brueelia* sp.)	8
	Quelea quelea	15013 (3216.1*- I: *Brueelia* sp.)	6
Prionopidae	*Prionops plumatus*	16719 (3178.1*- I: *Brueelia* sp.)	2
Pycnonotidae	*Chlorocicla flaviventris*	17382 (3703.1*- I: *Brueelia* sp.)	3
	Pycnonotus nigricans	MVZ198652-650 (782.1*- A: *Menacanthus* sp.)	5
		MVZ198646-644 (784.1- I: *Brueelia* sp.) (784.2- A: *Menacanthus* sp.)	5
		16743 (3235.1*- I: *Brueelia* sp.)	5
		16748 (3236.1*- I: *Brueelia* sp.)	5
		17354 (377.1*- I: *Brueelia* sp.)	5
		17355 (3801.1*- I: *Brueelia* sp.)	7
		22403 (94.1*- I: *Philopterus* sp.)	8
		22405 (98.1*- I: *Brueelia* sp.)	8
		22491 (5809.1*- I: *Brueelia* sp.)	8

Table 2 Continued

Host Family	Host Species	Host Specimen Number (louse voucher number and louse identification)	Locality Number
	Pycnonotus tricolor	17345 (3736.1*- I: *Brueelia* sp.)	3
		17347 (326.1- A: *Menacanthus* sp.)	3
Sturnidae	*Creatophora cinerea*	21629 (3949.1*- A: *Menacanthus* sp.)	1
	Lamprotornis nitens	15559 (3296.1*- I: *Sturnidoecus* sp.)	6
		16737 (3644.1*- I: *Sturnidoecus* sp.)	3
		17271 (383.1*- I: *Brueelia* sp.)	5
	Onychognathus nabouroup	17270 (391.1*- I: *Philopterus* sp.)	5
Sylviidae	*Sylvia subcaerulea*	15599 (3281.1- I: *Brueelia* sp.)	6
		16889 (3499.1- A: *Menacanthus* sp.)	3
		16892 (3571.1*- A: *Menacanthus* sp.)	3
		16896 (3504.1*- A: *Menacanthus* sp.)	3
		17573 (3744.1*- A: *Menacanthus* sp.)	3
		17574 (3722.1*- A: *Menacanthus* sp.)	3
Turdidae	*Turdus libonyanus*	16989 (3572.1- A: *Menacanthus* sp.)	3
		17392 (3724.1*- A: *Menacanthus* sp.)	3
		17393 (3716.1- I: *Philopterus* sp.)	3
	Turdus smithi	17267 (3818.1- I: *Brueelia* sp.)	5
Viduidae	*Vidua macroura*	15015 (3215.1- I: *Brueelia* sp.)	6
Zosteropidae	*Zosterops capensis*	22329 (4080.1*- A: *Menacanthus* sp.)	8
		22389 (4140.1*- I: *Philopterus* sp.)	8
	Zosterops pallidus	16827 (3654.1*- A: *Menacanthus* sp.)	5
		16831 (3656.1*- A: *Menacanthus* sp.)	5
Order: Piciformes			
Lybiidae	*Lybius torquatus*	16933 (3129.1*- A: *Menacanthus* sp.)	3
		16936 (3544.1*- A: *Menacanthus* sp.)	3
		17405 (286.1- I: *Penenirmus* sp.)	3
	Pogoniulus chrysoconus	17544 (3726.1- A: *Menacanthus* sp.)	3
	Trachyphonus vaillantii	16915 (3065.1- I: *Penenirmus* sp.)	3
		16917 (3171.1- I: *Penenirmus* sp.)	2

Table 2 Continued

Host Family	Host Species	Host Specimen Number (louse voucher number and louse identification)	Locality Number
	Tricholaema leucomelas	MVZ198611-609 (794.1*- I: *Penenirmus* sp.)	5
		14982 (3219.1*- I: *Penenirmus* sp.)	6
		15646 (3265.1*- I: *Penenirmus* sp.)	6
		16920 (3067.1*- I: *Brueelia* sp.)	3
		(3067.2*- I: *Penenirmus* sp.)	
		16921 (3183.1*- I: *Penenirmus* sp.)	3
		16922 (3518.1*- I: *Penenirmus* sp.)	3
		16926 (3502.1*- I: *Penenirmus* sp.)	3
		16927 (3519.1*- I: *Penenirmus* sp.)	3
		17408 (3808.1*- I: *Penenirmus* sp.)	5
		17409 (3825.1- I: *Penenirmus* sp.)	5
		17410 (354.1*- I: *Penenirmus* sp.)	7
		17411 (365.1*- I: *Penenirmus* sp.)	7
		17412 (3797.1*- I: *Penenirmus* sp.)	7
		17413 (3793.1*- I: *Penenirmus* sp.)	7
		17414 (3772.1*- I: *Penenirmus* sp.)	7
		22394 (61.1*- I: *Penenirmus* sp.)	8
		22395 (62.1*- I: *Brueelia* sp.)	8
		(62.2*- I: *Brueelia* sp.)	
		(62.3*- A: *Menacanthus* sp.)	
		22412 (132.1*- I: *Penenirmus* sp.)	8

Mitochondrial COI phylogenetic analyses were performed using sequences from 44 and 100 amblyceran and ischnoceran specimens, respectively. Of these, 19 amblyceran and 48 ischnoceran sequences were obtained as part of this study; the rest were sequences from GenBank (Tables 2, 3; Figs. 2, 3). Within the amblyceran tree (Fig. 2), average uncorrected *p*-distances among genera were large: 20%. There was high support for monophyletic clades containing the genera *Ricinus*, *Myrsidea*, and *Colimenopon* (all with posterior probability [PP] of 1; Fig. 2). These same three clades were recovered with high support in the COI + EF-1α phylogeny, as well, although EF-1α could not be amplified for the South African *Myrsidea* samples and only GenBank *Myrsidea* were included in this analysis (Fig. 4). *Menacanthus* forms the largest clade of amblyceran lice, but without strong support for monophyly of the genus using only COI data (Fig. 2). Monophyly in the COI + EF-1α analysis, however, was supported (PP = 1; Fig. 4).

Within the ischnoceran COI tree (Fig. 3), diversity among the 25 genera was high (average 26% based on uncorrected *p*-distances). There was strong support for the clades comprising the genera *Alcedoecus* and *Colilipeurus* (PP = 1 in both cases). There was also strong support for the speciose *Brueelia*-complex (represented in this study by the genera *Brueelia* and *Sturnidoecus*; Smith 2001, Bush *et al.* 2016; PP =1; Fig. 3). The ischnoceran COI + EF-1α phylogeny provided high support for two additional genera, *Philopterus* and *Coloceras*, as well as recovering the same highly supported clades as mentioned previously for the COI analysis (Fig. 4). A large genus, *Penenirmus*, does not receive high support for monophyly in either of the COI or COI + EF-1α phylogenies,

but there is support for smaller groupings within the genus (Figs. 3, 4). In the combined COI + EF-1α analysis, the suborder Ischnocera was not monophyletic (Fig. 4).

The number of birds examined at each locality varied between 10 individuals (at locality 11) and 279 (locality 3; Table 4, Fig. 1). New host associations were found at all localities (Table 2). Across the geographic localities, the ischnocerans *Brueelia,* *Philopterus,* and *Penenirmus*, and the amblyceran *Menacanthus* were the most common genera encountered (35, 14, 12, and 14% prevalence rate, respectively; Table 2).

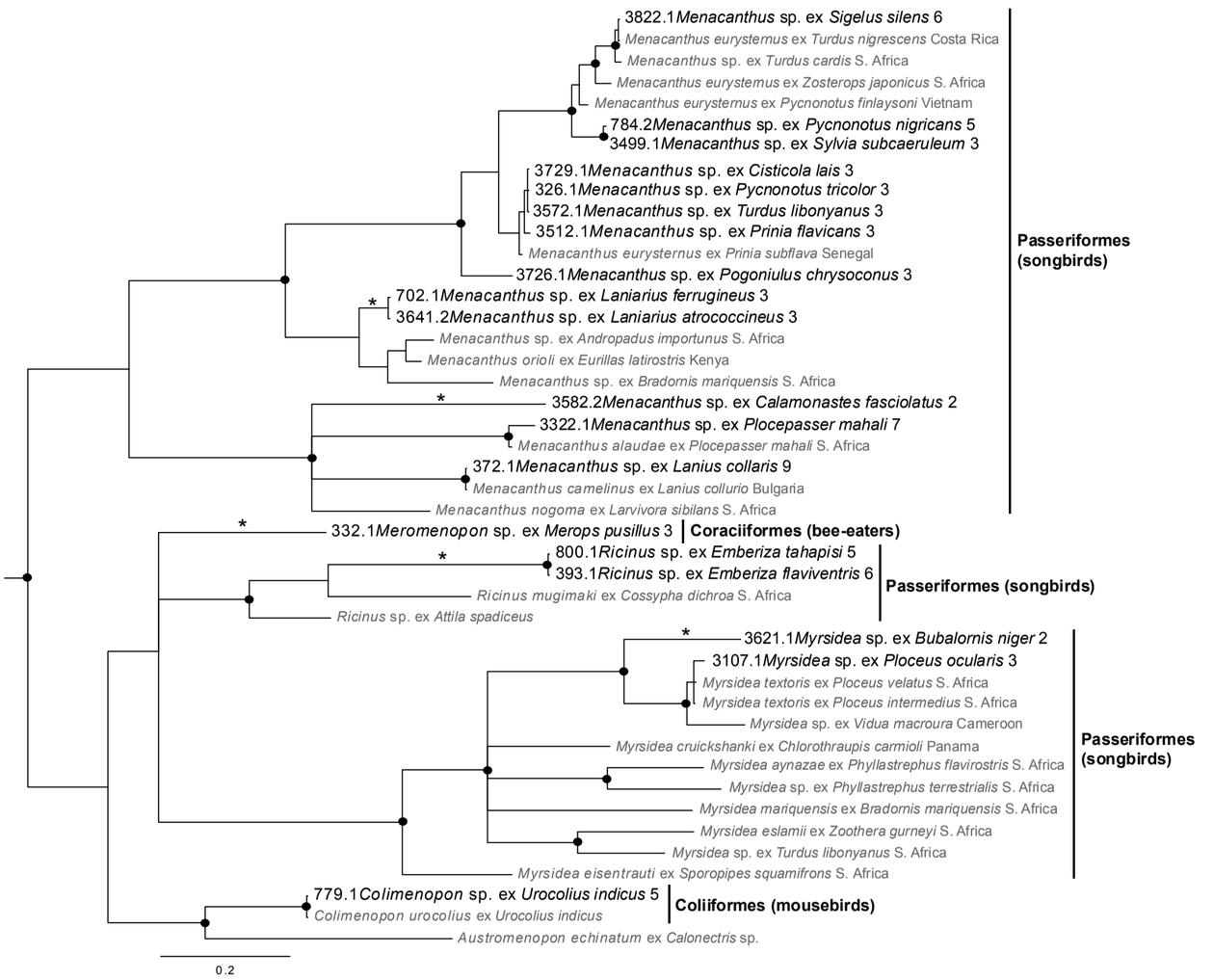

Figure 2. Bayesian phylogeny of South African amblyceran lice based on analysis of the mitochondrial COI gene. Newly collected specimens as part of this study are in black, with specimens identified by louse voucher number. Unique louse lineages identified in this study are indicated by an asterisk (*) on the branches. Grey indicates GenBank specimens. Posterior probabilities ≥ 0.95 are shown as filled circles at the nodes. Locality numbers (corresponding to Fig. 1) are indicated in the tip labels. Major clades of hosts are indicated. Outgroups are not shown.

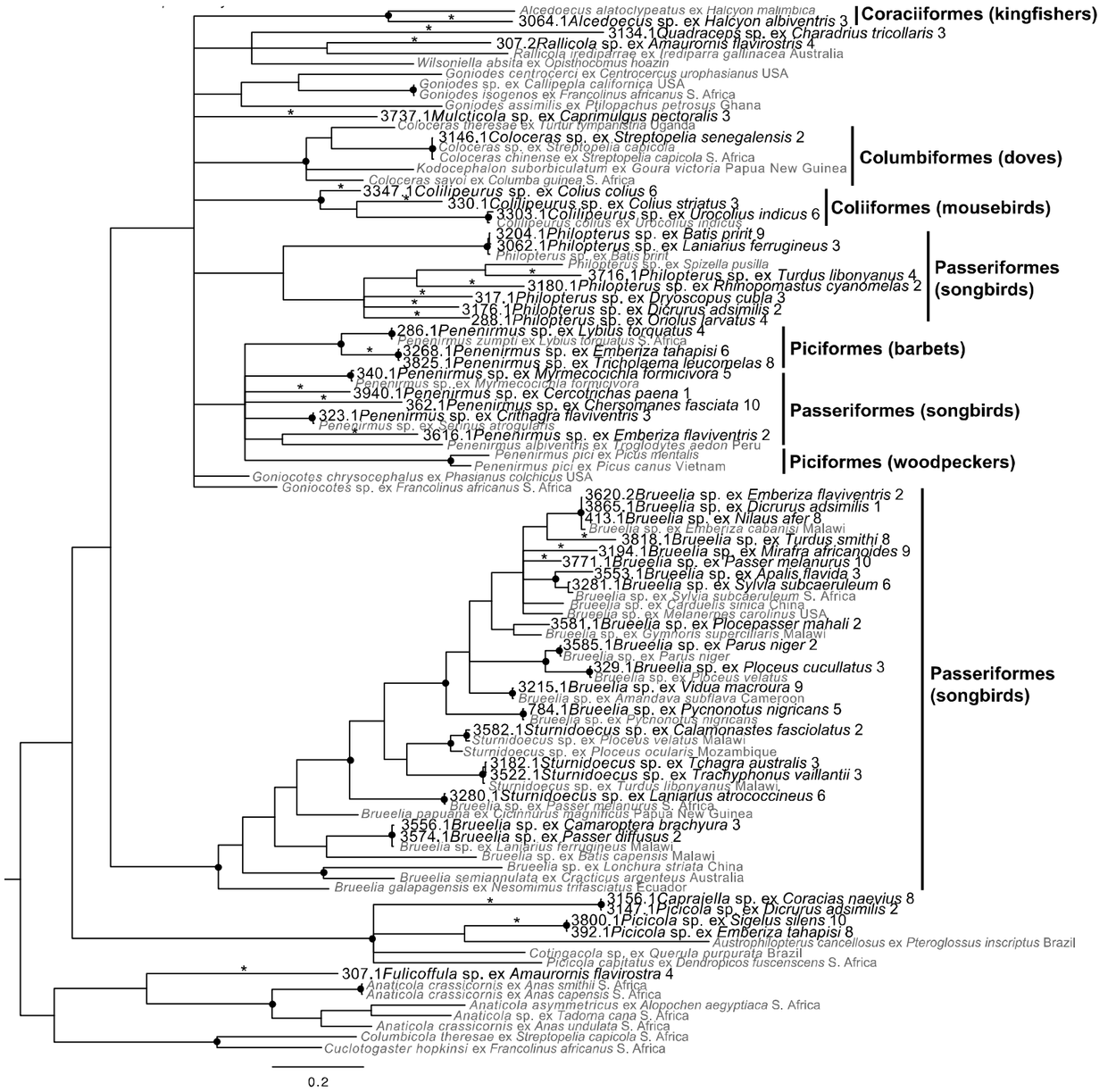

Figure 3. Bayesian phylogeny of South African ischnoceran lice based on analysis of the mitochondrial COI gene. Newly collected specimens as part of this study are in black, with specimens identified by louse voucher number. Unique louse lineages identified in this study are indicated by an asterisk (*) on the branches. Grey indicates GenBank specimens. Posterior probabilities ≥ 0.95 are shown as filled circles at the nodes. Locality numbers (corresponding to Fig. 1) are indicated in the tip labels. Major clades of hosts are indicated. Outgroups are not shown.

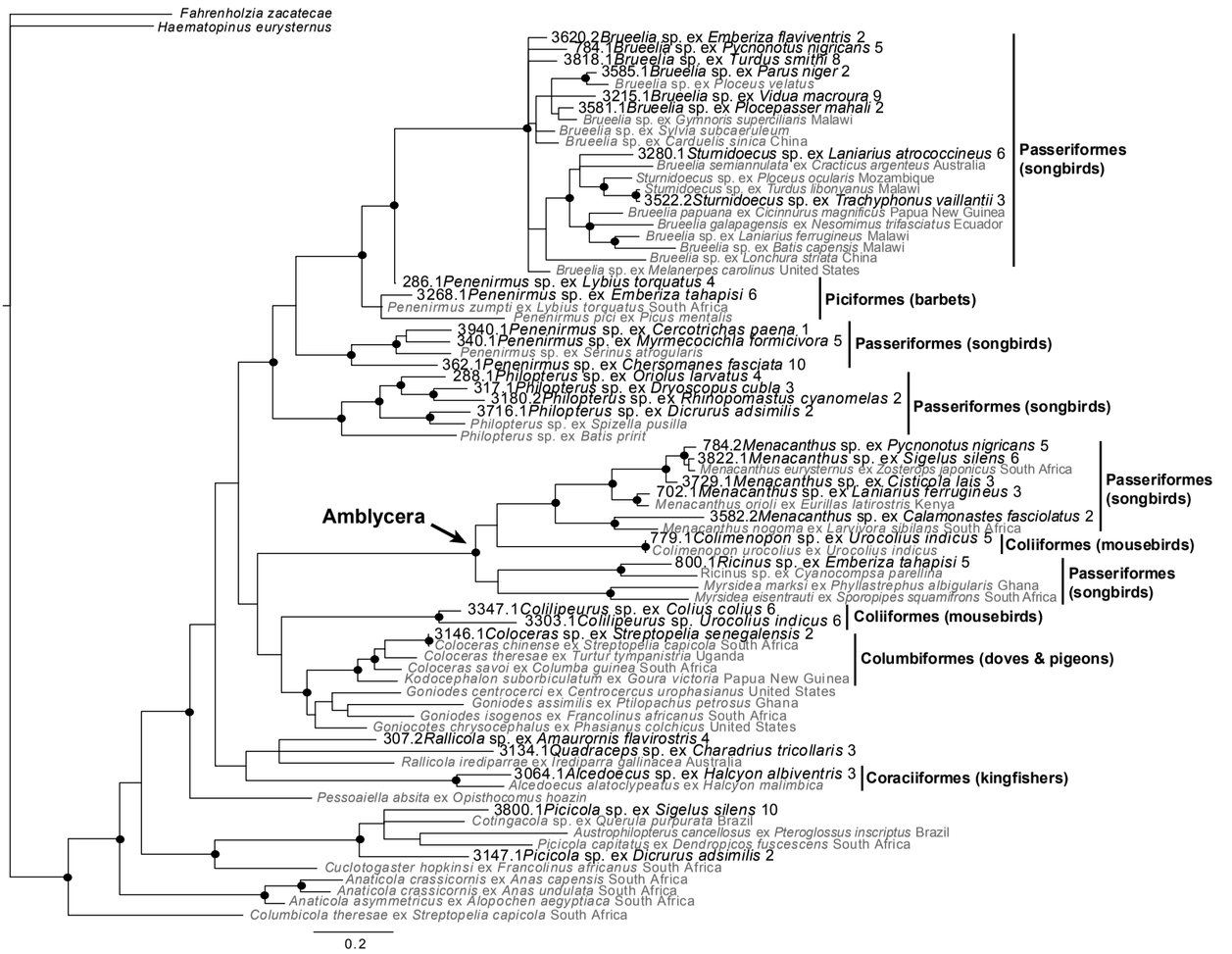

Figure 4. Bayesian phylogeny of South African amblyceran and ischnoceran lice based on analysis of the mitochondrial COI and nuclear EF-1α genes. The suborder Amblycera is indicated. Newly collected specimens as part of this study are in black, with specimens identified by louse voucher number. Unique louse lineages identified in this study are indicated by an asterisk (*) on the branches. Grey indicates GenBank specimens. Posterior probabilities ≥ 0.95 are indicated as filled circles at the nodes. Locality numbers (corresponding to Fig. 1) are indicated in the tip labels. Major clades of hosts are indicated.

Table 3. Louse GenBank sequences included in the South African phylogenetic analyses. Host species and collection locality are also given, if known.

Louse species	Host species	Collection Locality	COI GenBank Number	EF-1α GenBank Number
Suborder Amblycera				
Austromenopon echinatum	*Calonectris* sp.	--	EU088135	
Colimenopon urocolius	*Urocolius indicus*	--	AF385010	AF385029
Menacanthus alaudae	*Plocepasser mahali*	South Africa	KF768803	
Menacanthus camelinus	*Lanius collurio*	Bulgaria	KJ730543	
Menacanthus eurysternus	*Prinia subflava*	Senegal	KJ730624	
Menacanthus eurysternus	*Pycnonotus finlaysoni*	Vietnam	KJ385885	
Menacanthus eurysternus	*Turdus nigrescens*	Costa Rica	KJ730657	
Menacanthus eurysternus	*Zosterops japonicus*	South Africa	KF768817	KJ730720
Menacanthus nogoma	*Larvivora sibilans*	South Africa	KF768818	KJ730769
Menacanthus orioli	*Eurillas latirostris*	Kenya	KJ730607	KJ730701
Menacanthus orioli	*Andropadus importunus*	South Africa	KF768804	
Menacanthus sp.	*Bradornis mariquensis*	South Africa	KF768805	
Menacanthus sp.	*Turdus cardis*	South Africa	KF768819	
Myrsidea aynazae	*Phyllastrephus flavirostris*	South Africa	KF768806	
Myrsidea cruickshanki	*Chlorothraupis carmioli*	Panama	GQ454449	
Myrsidea eisentrauti	*Sporopipes squamifrons*	South Africa	KF768807	AF320428
Myrsidea eslamii	*Zoothera gurneyi*	South Africa	KF768809	
Myrsidea mariquensis	*Bradornis mariquensis*	South Africa	KF768810	
Myrsidea marksi	*Phyllastrephus albigularis*	Ghana	DQ366669	FJ171315
Myrsidea sp.	*Phyllastrephus terrestrialis*	South Africa	KF768812	
Myrsidea sp.	*Vidua macroura*	Cameroon	DQ887257	
Myrsidea textoris	*Ploceus intermedius*	South Africa	KF768813	
Myrsidea textoris	*Ploceus velatus*	South Africa	KF768814	

Table 3 Continued

Louse species	Host species	Collection Locality	COI GenBank Number	EF-1α GenBank Number
Ricinus mugimaki	*Cossypha dichroa*	South Africa	KF768816	
Ricinus sp.	*Attila spadiceus*	--	AF545762	
Ricinus sp.	*Cyanocompsa parellina*	--	AF385014	AF385033
Suborder Ischnocera				
Alcedoecus alatoclypeatus	*Halcyon malimbica*	--	AY314807	AY314825
Anaticola asymmetricus	*Alopochen aegyptiaca*	South Africa	KT587824	KT588011
Anaticola crassicornis	*Anas smithi*	South Africa	KT587842	
Anaticola crassicornis	*Anas capensis*	South Africa	KT587828	KT588013
Anaticola crassicornis	*Anas undulata*	South Africa	KT587846	KT588020
Anaticola sp.	*Tadorna cana*	South Africa	KT587870	
Austrophilopterus cancellosus	*Pteroglossus inscriptus*	Brazil	AY430443	AY430472
Brueelia galapagensis	*Nesomimus trifasciatus*	Ecuador	JF734040	JF734088
Brueelia papuana	*Cicinnurus magnificus*	Papua New Guinea	KT892286	KT892576
Brueelia semiannulata	*Cracticus argenteus*	Australia	KT892143	KT892435
Brueelia sp.	*Batis capensis*	Malawi	KT892105	KT892397
Brueelia sp.	*Carduelis sinica*	China	KT892117	KT892409
Brueelia sp.	*Emberiza cabanisi*	Malawi	KT892157	
Brueelia sp.	*Gymnoris superciliaris*	Malawi	KT892232	KT892522
Brueelia sp.	*Laniarius ferrugineus*	Malawi	KT892184	KT892476
Brueelia sp.	*Lonchura striata*	China	KT892191	KT892594
Brueelia sp.	*Melanerpes carolinus*	United States	KT892329	KT892619
Brueelia sp.	*Sylvia subcaeruleum*	--	AY149396	AF320375
Brueelia sp.	*Parus niger*	--	AF385000	
Brueelia sp.	*Passer melanurus*	South Africa	KT892224	
Brueelia sp.	*Ploceus velatus*	--	AY149392	AY149422

Table 3 Continued

Louse species	Host species	Collection Locality	COI GenBank Number	EF-1α GenBank Number
Brueelia sp.	*Pycnonotus nigricans*	--	AY149397	
Brueelia sp.	*Amandava subflava*	Cameroon	DQ887224	DQ887197
Colilipeurus colius	*Urocolius indicus*	--	AF384998	
Coloceras chinense	*Streptopelia capicola*	South Africa	AF278647	AF278665
Coloceras savoi	*Columba guinea*	South Africa	AF348845	AF278663
Coloceras sp.	*Streptopelia capicola*	--	AF545688	
Coloceras theresae	*Turtur tympanistria*	Uganda	HQ332822	HQ332884
Columbicola theresae	*Streptopelia capicola*	South Africa	EF678982	EF679117
Cotingacola sp.	*Querula purpurata*	Brazil	AF444863	AF447198
Cuclotogaster hopkinsi	*Francolinus africanus*	South Africa	AF444858	AF447195
Goniocotes chrysocephalus	*Phasianus colchicus*	United States	HQ332829	HQ332891
Goniocotes sp.	*Francolinus africanus*	South Africa	AF348852	
Goniodes assimilis	*Ptilopachus petrosus*	Ghana	HQ332828	HQ332890
Goniodes centrocerci	*Centrocercus urophasianus*	United States	HQ332825	HQ332887
Goniodes isogenos	*Francolinus africanus*	South Africa	AF348853	AF320404
Goniodes sp.	*Callipepla californica*	United States	AF545708	
Kodocephalon suborbiculatum	*Goura victoria*	Papua New Guinea	HQ332832	HQ332894
Penenirmus albiventris	*Troglodytes aedon*	Peru	KF614516	
Penenirmus pici	*Picus canus hessei*	Vietnam	KF385884	
Penenirmus pici	*Picus mentalis*	--	AF356706	AF356730
Penenirmus sp.	*Myrmecocichla formicivora*	--	AF356709	
Penenirmus sp.	*Serinus atrogularis*	--	AF356710	AF320447
Penenirmus zumpti	*Lybius torquatus*	South Africa	AF444865	AF447200
Pessoaiella absita	*Opisthocomus hoazin*	--	JX121681	JX121695
Philopterus sp.	*Batis pririt*	--	AF356715	AF320449
Philopterus sp.	*Spizella pusilla*	--	AY314820	AY314841

Table 3 Continued

Louse species	Host species	Collection Locality	COI GenBank Number	EF-1α GenBank Number
Picicola capitatus	*Dendropicos fuscescens*	South Africa	AF444866	AF447201
Rallicola irediparrae	*Irediparra gallinacea*	Australia	JQ717185	JQ717193
Sturnidoecus sp.	*Ploceus ocularis*	Mozambique	KT892350	KT892640
Sturnidoecus sp.	*Ploceus velatus*	Malawi	KT892352	
Sturnidoecus sp.	*Turdus libonyanus*	Malawi	KT892354	KT892633
Outgroups				
Fahrenholzia zacatecae	*Chaetodipus eremicus*	--	HM171445	DQ683190
Haematopinus eurysternus	*Bos* sp.	--	HM171422	HM171457

Table 4. Bird-louse associations found at localities in South Africa. Locality numbers correspond to Figure 1.

Locality	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Number of Bird Hosts Examined for Lice	112	63	279	19	121	174	76	146	62	43	10
Number of Birds with Lice	13	22	79	5	31	24	14	35	10	12	3
Number of Louse Genera	5	8	17	2	8	7	6	9	4	3	1

Discussion

Compared to field studies on birds in Europe and South America, where the louse parasitism rates of individuals are often above 50% (Clayton *et al.* 1992, Sychra *et al.* 2011, Enout *et al.* 2012, Girisgin *et al.* 2013), the rates of parasitism in this study (22% of individuals and 58% of species) were relatively low. Since the lice in this study were obtained from museum specimens, it is possible that lice were lost at several stages of the bird specimen collection and preparation process. Regardless, based on the findings reported here, examining museum specimens is a useful way to investigate louse diversity, particularly when considering the large number of new host associations (104) and louse lineages (see below) resulting from this study. These new host associations included 70 louse records for bird species not previously known to be parasitized by lice (Table 1). The large number of novel host associations found in this study is perhaps not surprising given that the louse fauna of South African birds is not

well known, since previous studies have been limited to small geographic regions of the country or covered only certain louse taxa (Kopij & Price 2009, Halajian *et al.* 2014, Sychra *et al.* 2014).

Notably, the 104 new host associations is a minimum estimate based on the assumption that all lice belonging to the same genus and parasitizing the same host species represent the same species. It is possible that multiple congeneric species of lice may exist on a single host species (Price *et al.* 2003), especially given that previous studies have shown that different host populations can show high levels of genetic differentiation in their respective lice, resulting in the discovery of cryptic lineages (Voelker *et al.* 2013, Escalante *et al.* 2016). Additionally, more South African louse-host associations are likely; 16 instances of unidentified nymphal lice were found on the birds examined in this study and may represent novel host associations as well (nymphal lice that could only be identified to family level were excluded from the study; Table A-1).

The phylogenetic analysis of this study lends insight as to whether these new host associations represent new species. Many of the newly collected lice have COI and EF-1α sequences that are highly differentiated from louse sequences available on GenBank (Figs. 2-4). Genetically unique lineages were identified for 5 amblycerans and 21 ischnocerans; some of these unique lineages may represent species new to science. Further evidence for new louse species was obtained by examining the ranges of the corresponding hosts for these louse lineages. Because lice from southern Africa are poorly known, lice from hosts with restricted ranges, defined as southern African local endemic species or near-endemics (85% or more of the range within southern Africa;

Chittenden 2007), have most likely not been previously described. Lice from widespread hosts, on the other hand, could have been morphologically described from other geographic locations, even though genetic data is not available. An additional 13 amblyceran and 44 ischnoceran lice were identified morphologically as new host associations, but did not have associated molecular data (Table 2). These lice also may represent additional new species, for a total maximum number of 83 potential new louse species from this study.

Examining broader phylogenetic relationships based on the COI data, relationships among genera and species within each suborder are not always clear although there is strong support for several smaller groupings (Figs. 2, 3). The difficulty in resolving species relationships may be explained by the high variability in the COI gene (Johnson *et al.* 2002b, Smith *et al.* 2004). The dataset for Ischnocera was larger and more diverse than Amblycera overall, as is expected based on the species diversity of the two suborders (2737 and 1172 known ischnoceran and amblyceran species, respectively; Price *et al.* 2003). The combined COI + EF-1α analysis included both Amblycera and Ischnocera, and consistently supported the same clades as the COI only analysis, while yielding higher support values overall than the analyses of the COI gene alone (Fig. 4). Notably, monophyly of Ischnocera was not supported based on analysis of the COI + EF-1α dataset. However, this finding has been reported in previous studies (Cruickshank *et al.* 2001, Johnson & Whiting 2002, Yoshizawa & Johnson 2010, Light *et al.* 2016) and is likely the result of the inability of these molecular markers to fully resolve Phthirapteran relationships. Additionally, the hosts and lice examined were highly

diverse, making the phylogenetic results difficult to interpret for higher-level relationships of lice.

Amblycera

Although louse specimens from this study were not morphologically identified to species, host association lists (Price *et al.* 2003, Halajian *et al.* 2014) and low COI genetic divergence can indicate likely species identity. Within Amblycera, the majority of the unidentified *Menacanthus* species are likely *M. eurysternus* based on 0.3-10% average uncorrected *p*-distances and high support (PP = 1; Fig. 2). Additional *Menacanthus* specimens are likely known species (e.g., *M. alaudae* and *M. camelinus*) or are possibly new species based on high genetic divergence (3582.2 *Menacanthus* sp. ex *Calamonastes fasciolatus*; Fig. 2). The two South African *Ricinus* specimens (both found parasitizing the host genus *Emberiza*; Fig. 2) are genetically identical and represent a new genetic lineage, making this a likely candidate for a new species, especially given that both of these lice represent new host associations (Table 1). Only two *Myrsidea* specimens were genetically examined in this study, one of which is highly similar (average uncorrected *p*-distance = 1.7%) to the GenBank *M. textoris* sequences (the other *Myrsidea* specimen likely represents a new species; Fig. 2). *Myrsidea* is a widespread and speciose genus, found worldwide like *Menacanthus*, so it is somewhat surprising that there were so few *Myrsidea* found in this study, especially given that typical hosts for *Myrsidea* (primarily passerines; Price *et al.* 2003) were highly sampled. Halajian *et al.* (2012) also reported few *Myrsidea* known from South Africa. This may

simply indicate a need for further sampling, or that for some reason these lice are less common in southern Africa. The *Colimenopon* specimen is likely *C. urocolius* based on genetic divergence compared to the GenBank specimen parasitizing the same host species, *Urocolius indicus*. Lastly, the *Meromenopon* specimen included in this study likely represents a new species. In total, 26 new amblyceran host associations and as many as 18 new amblyceran species were found as part of this work (Table 1 and Fig. 2).

Ischnocera

In the ischnoceran phylogeny, similar methods were used to make inferences about species identifications. In total, 78 new ischnoceran host associations were discovered, in addition to as many as 65 new species. The South African *Coloceras* specimen is likely *Coloceras chinense*, based on host associations (genus *Streptopelia*) of both the South African specimen and closely related GenBank sequences (0.15% average uncorrected *p*-distance, PP = 1; Fig. 3). The genus *Colilipeurus*, which exclusively parasitizes mousebirds, is highly host-specific: each species of mousebird is parasitized by a particular species of *Colilipeurus* (Price *et al.* 2003). However, no GenBank sequences were available for comparison except for *Colilipeurus colius*, which parasitizes *Urocolius indicus*, and this sequence was genetically very similar to the *Colilipeurus* specimen from *Urocolius indicus* from this study (1.3% uncorrected *p*-distance). There is some signal for host association in the genus *Penenirmus*, which is found parasitizing the host orders Passeriformes (songbirds) and Piciformes

(woodpeckers, barbets, etc.; Price *et al.* 2003). In the ischnoceran COI phylogeny (Fig. 3), there is strong support for two clades (PP = 1 in both cases) of *Penenirmus* parasitizing Piciformes. The first of these clades is likely *Penenirmus pici* from *Picus* (woodpeckers), and the other clade consists of two lineages of *Penenirmus* from *Tricholaema* and *Lybius* (barbets; average uncorrected *p* distance= 12%). Although there is a lack of support for a monophyletic *Penenirmus* from passerine hosts with the COI data alone, inclusion of the EF-1α data provides strong support for a *Penenirmus* Passeriformes clade (PP = 1; Fig. 4). The *Philopterus* specimens included in this study were all from different passerine host families: Turdidae, Malaconotidae, Dicruridae, and Oriolidae, and were highly divergent from each other (average uncorrected *p*-distance= 24.8%). Two specimens (3204.1 and 3062.1) were nearly genetically identical (average uncorrected *p*-distance = 0.4%, PP = 1) to an unidentified *Philopterus* species from GenBank; these likely represent the same louse species. The *Philopterus* specimens in this clade were collected from different hosts from localities 3 and 9, which are geographically distant from each other, suggesting that this species is a widespread generalist (Fig. 1). It is also possible that the louse on *Laniarius ferrugineus* (3062.1) was a straggler (rare occurrence of a louse on an atypical host via horizontal transfer; Ròzsa 1993), since *Philopterus* species are usually restricted to a single host family (Price *et al.* 2003, Fig. 3). The *Brueelia*-complex (in this study containing the genera *Brueelia* and *Sturnidoecus*) received high support in the COI phylogeny. However, both genera are paraphyletic within this clade. *Brueelia*, as it is currently described, has a high amount of morphological diversity (including both wing and head louse morphotypes)

and is in need of taxonomic revision; thus the paraphyly of this genus is not of particular concern (Bush *et al.* 2016). Several likely species of *Brueelia* and *Sturnidoecus* were identified, although it is possible that some lice were stragglers and do not represent correct host associations since *Brueelia* species is highly host specific to a single host genus or species (Price *et al.* 2003). One example was a clade consisting of several genetically identical *Brueelia* (3620.2, 3865.1, 413.1, and a GenBank sequence; PP = 1; Fig. 3). This clade is geographically widespread, with the three South African lice collected from northeastern localities 1 and 2, southern locality 8 (Fig. 1), and the GenBank sequence from Malawi. Further supporting the possibility of straggling, *Brueelia* were found on *Dicrurus adsimilis* (3865.1), *Nilaus afer* (413.1), and *Emberiza*; these hosts represent three different avian families. All other ischnoceran lice likely represent new species based on high genetic divergence compared to other specimens included in this study (Fig. 3).

Geographic Patterns

Examination of the louse genera across the 11 localities showed that increased sampling effort yielded higher diversity as well as abundance of lice (Table 4). The localities with the most birds sampled had the most louse genera represented. The wing louse *Brueelia* was the most prevalent louse genus by far (35% total prevalence rate of all lice found across the localities) compared to the second most common genera *Menacanthus* and *Philopterus* (each with a prevalence rate of 14%). The high prevalence of *Brueelia* across sampling localities is unsurprising given that this ischnoceran genus is

cosmopolitan and common, particularly on passerine birds (Johnson *et al.* 2002a, Martinu *et al.* 2015), which comprise the majority (86%) of hosts sampled in this study.

The geographic localities examined in this study represented diverse habitats: localities 1-3 had the highest precipitation overall and consisted of mopane woodland (taller woodland with mopane trees) and bushveld (lower, shrubby woodland), localities 4 and 7 were grassland, 5 and 6 in central South Africa were the most arid localities in acacia thornveld (semi-arid savanna with acacia and other thorny trees and shrubs), and the southernmost localities 8-11 were in Nama Karoo (relatively dry shrubland) and coastal habitats (van Rensburg *et al.* 2004, du Toit *et al.* 2012, Barlow *et al.* 2013; Table 4). Some studies have indicated that in arid environments, birds have fewer lice than in humid regions (Chandra *et al.* 1990, Moyer *et al.* 2002). Ischnoceran lice are less affected by arid conditions than amblycerans due to physiological traits related to ability to uptake water vapor (Rudolph 1983, Carrillo *et al.* 2007, Bush *et al.* 2009). However, when considering the prevalence of louse infections, there do not appear to be patterns associated with humidity in southern Africa (note that louse abundance was not examined in this study since lice were obtained from museum specimens; examination of newly collected hosts that have not been processed as museum specimens would be necessary to provide an accurate estimate of louse load; Clayton & Drown 2001). Comparing the rate of louse parasitism across South Africa, there is little difference between regions, with 13-36% of the host individuals having lice across the localities (Table 4), and no clear geographic pattern to the rate of parasitism. There also was no difference in the proportion of Amblycera to Ischnocera found across the regions.

However, the relative proportions of the most prevalent genera of lice vary across the geographic regions of South Africa. Overall, *Brueelia* was typically the most common louse genus encountered (at 8 out of 11 localities). The genus *Penenirmus* was the second most common ischnoceran genus after *Brueelia* at most localities, except in the southern region, where *Philopterus* was more common. There is an apparent replacement of *Penenirmus* by *Philopterus* in the southern (Nama Karoo, localities 8-11; Fig. 1) region: these two ischnoceran genera are highly similar morphologically and are both considered generalist lice that are found inhabiting many parts of the host body. Both of these genera are found broadly across the Passeriformes, as well as in some of the Piciformes (Price *et al.* 2003). The reasons for *Philopterus* being more common than *Penenirmus* in the southern region are not clear, since these lice are found on many of the same hosts. The most common amblyceran genus across the localities was *Menacanthus*. This louse species is incredibly widespread across both geography and hosts, found on multiple continents and host orders (Price *et al.* 2003). *Menacanthus* specimens that were likely *M. eurysternus* were found from localities 3, 5, and 6, indicating that this species in particular has a broad distribution across South Africa (Figs. 1, 2), as well as globally. In general, louse distributions are primarily based on host distributions, which seem to be influenced by habitat.

The louse sampling in this study was limited by the availability of bird museum specimens. The set of avian hosts that provided lice were captured with mist nets, leading to a biased sampling of hosts consisting primarily of small and medium passerines (of 1105 individuals examined, 955 were passerines). Increased sampling in

both field studies and museum specimens would result in a better estimate of the diversity of lice from South African birds. Although this study helps to fill in the knowledge gap about diversity of parasitic chewing lice in South Africa, avian louse associations overall still remain underexplored in Sub-Saharan Africa. Additional sampling across southern Africa as well as examining additional host taxa will almost certainly lead to discovery of new host associations and species. This study forms a basis for future studies to investigate co-speciation of avian hosts and louse parasites in southern Africa, which may also be used to infer host biogeographic patterns.

CHAPTER III

AVIAN CHEWING LOUSE PHYLOGENETICS AND BIOGEOGRAPHY ACROSS SUB-SAHARAN AFRICA

Introduction

Sub-Saharan Africa encompasses the region south of 20°N, which is biogeographically distinct from, and possesses much higher endemism and diversity of species than, the extremely arid Saharan Desert to the north (de Klerk *et al.* 2002a, b). This large geographic area includes a broad range of habitats including semi-arid regions in the north, tropical forests in the central and western parts of the continent, and grasslands and shrublands in the south (Fig. 5). Phylogeographic studies of vertebrate taxa across Sub-Saharan Africa have revealed several significant geographic barriers that influence speciation patterns of many vertebrate groups, including birds. For example, between western and central Africa, barriers to species movements include the Dahomey Gap, a stretch of dry savanna that extends north to south across Benin and Ghana, cutting off the humid tropical rainforests of central Africa from those of western Africa (Crowe & Crowe 1982, Salzmann & Hoelzmann 2005, Linder *et al.* 2012), and the nearby Volta and Niger Rivers which act as similar large barriers (e.g., amphibians: Penner *et al.* 2011, birds: Fuchs & Bowie 2015, mammals: Nicolas *et al.* 2006, Harcourt & Wood 2012, Nesi *et al.* 2013). Possibly as a result of a combination of these geographic barriers, Benin in western Africa and the Democratic Republic of the Congo (DRC) in the central part of the continent have distinct vertebrate faunas (Linder *et al.*

2012). There are no large, apparent geographic barriers between central and southern Africa; instead, habitats transition more gradually from lowland forest to savanna towards the south (White 1983, Linder *et al.* 2012). Within biogeographic zones, regional barriers to gene flow further subdivide some regions. For example, in the DRC the presence of the Congo River explains at least some of the regional diversification patterns of bird species (Voelker *et al.* 2013). In southern Africa, however, similar large barriers do not exist and broad biogeographical patterns of birds remain less well understood (Oatley *et al.* 2012, Voelker *et al.* 2014). Rather, previous studies have indicated that habitat type, which is closely connected to rainfall and temperature, may instead explain bird distributions for southern Africa (e.g., Oatley *et al.* 2012). For example, birds often exhibit a lower overall species richness in arid regions of Africa (Williams *et al.* 1999, de Klerk *et al.* 2002b).

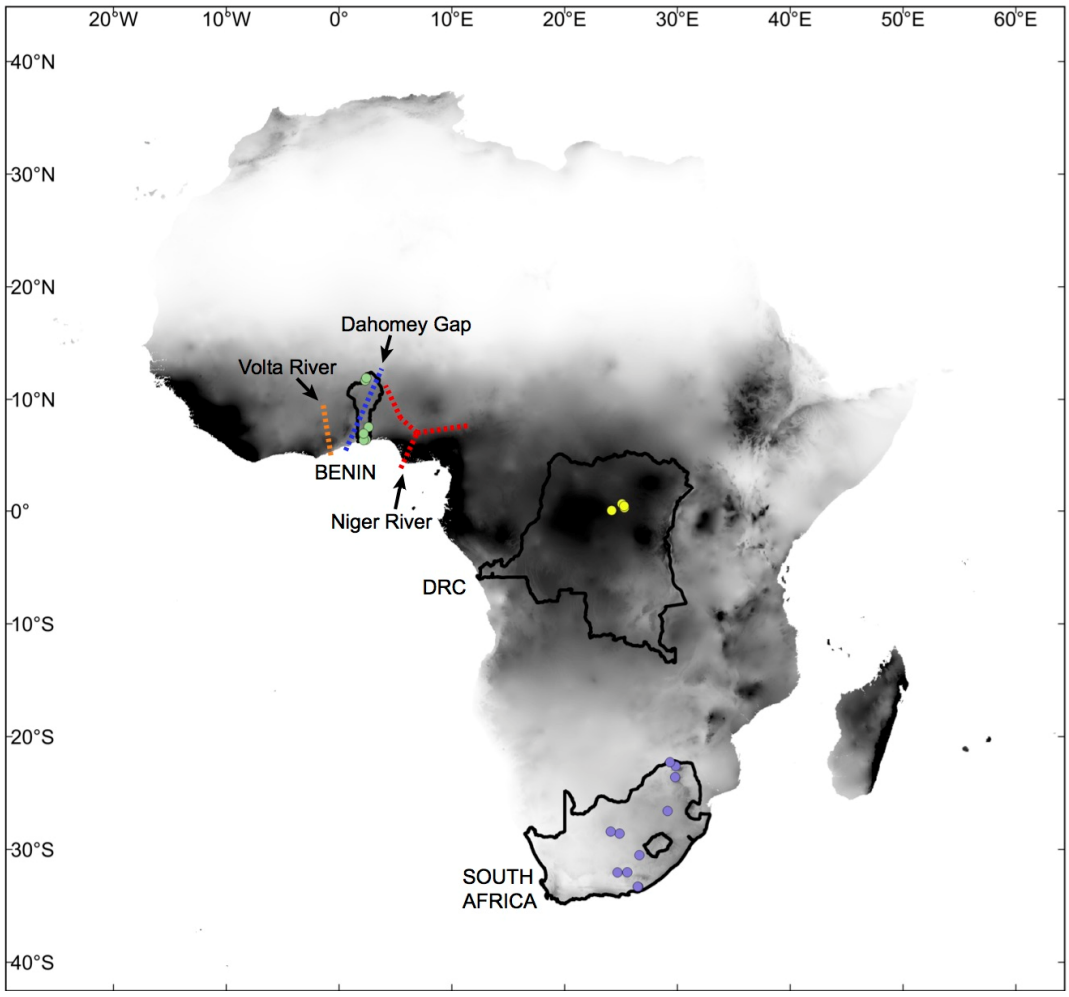

Figure 5. Map of Africa showing a gradient of bioclimatic variables (average annual temperature and rainfall) obtained from the WorldClim database (Hijmans *et al.* 2005). Darker shades indicate higher temperature and rainfall. The louse sampling localities are indicated for Benin (green circles), the Democratic Republic of the Congo (yellow circles), and South Africa (purple circles). Major geographic barriers are indicated.

Phylogeographic studies of birds across Sub-Saharan Africa to date have been few, and indicate that different bird taxa display different biogeographic patterns across the region, depending on life history traits. For instance, forest birds and grassland birds

show different patterns of speciation resulting from historical climatic cycling and consequent retraction and expansion of forest versus grassland habitats (Bowie *et al.* 2004a, Voelker *et al.* 2010, Fuchs *et al.* 2011). Bowie et al. (2004a) surprisingly did not find genetic structuring in a forest bird, *Nectarinia olivacea/obscura*, across all of northern Sub-Saharan Africa despite fragmentation of forests throughout climate cycles. The grassland species *Lanius collaris*, on the other hand, shows distinct divisions between the northwestern, central, and southern regions of the continent (Fuchs *et al.* 2011). Overall, it appears that there is more to be learned about phylogeography of birds across Sub-Saharan Africa. Examining additional bird species can help, but studying avian parasites can also provide valuable information about host and regional evolutionary history.

Parasitic chewing lice (Insecta: Phthiraptera) of birds are cosmopolitan, and known from practically all bird families (Price *et al.* 2003). Lice have obligate parasitic relationships with their hosts and are generally transmitted vertically across host generations (Marshall 1981). These characteristics can lead to lice having high host specificity where each parasitic species is found on only one host species, although this is also frequently not the case (Stefka *et al.* 2011). Avian chewing lice belong to two suborders: Amblycera (primarily specialized body lice) and Ischnocera (either specialist wing lice or generalists; Price *et al.* 2003). These two main groups (body and wing lice) partition the host into different microhabitats, such that both groups can co-exist on the same host individual (Johnson *et al.* 2012). Body lice have a rounded shape, are found in the downy body feathers of the host, and feed on feathers as well as occasionally on

blood, which can result in tight associations with hosts because of close interactions with the host immune system (Moller & Ròzsa 2005, Bueter *et al.* 2009). Wing lice have an elongate shape and fit tightly between the host flight feather barbs, feeding exclusively on feathers. Due to a faster rate of parasite evolution (which can lead to parasite populations diverging before host populations), studying the lice of birds can inform both parasite and host biogeographical relationships (Hafner *et al.* 1994, Nieberding *et al.* 2004, Voelker *et al.* 2013). Regional broad-scale phylogenetic studies of avian lice, particularly from Africa, have typically been lacking. Recent work on avian chewing lice from Benin (Mitchell *et al.* in prep), the DRC (Light *et al.* 2016), and South Africa (Chapter II; Takano *et al.* in prep) allows for a large-scale study of chewing louse phylogenetics across Sub-Saharan Africa.

The goal of this study was to use molecular phylogenetic methods to examine potential biogeographic patterns in parasitic lice across Sub-Saharan Africa, focusing on three regions: western (Benin), central (DRC), and southern Africa (South Africa; Fig. 5). On this broad geographic scale, lice may group taxonomically regardless of geographic region. Alternatively, lice could group by geographic region or, since lice have tight associations with their hosts, they may follow host phylogenetic patterns. This is the first study to explore broad geographic patterns of an invertebrate species across Sub-Saharan Africa.

Materials and Methods

Louse genetic data for the mitochondrial cytochrome *c* oxidase subunit I (COI) and nuclear elongation factor 1 alpha (EF-1α) genes were obtained from previous studies from Benin (Mitchell *et al.* in prep), the DRC (Light *et al.* 2016), and South Africa (Chapter II; Takano *et al.* in prep). All sequences are available on GenBank (COI KC349953–KC349958, KU187278–KU187342, XXXXX – XXXXX; EF-1α KU187354–KU197353, XXXXX – XXXXX; GenBank numbers currently pending for Benin and South Africa). A single louse sequence was analyzed for each louse lineage from each host species. In an effort to identify novel lineages, each louse COI and EF-1α sequence was compared to published sequences in GenBank using the Basic Local Alignment Search Tool (BLAST), and top hits were included in subsequent phylogenetic analysis. All sequences were aligned by eye using the Se-Al alignment software v.2.0a11 (Rambaut 1996).

All phylogenetic analyses were performed using MrBayes v.3.2 (Huelsenbeck & Ronquist 2001, Ronquist & Huelsenbeck 2003). Three separate Bayesian analyses were run: 1) Amblycera COI, 2) Ischnocera COI, and 3) Amblycera and Ischnocera COI + EF-1α for a subset of taxa based on unique lineages identified from the COI analyses. Prior to each analysis, PartitionFinder v.1.1.1 (Lanfear *et al.* 2012, Lanfear *et al.* 2014) was used with the Bayesian information criterion to select the best fitting partitions and models of evolution. For the Amblycera COI analysis, two optimal partitions (corresponding to codon position) were identified with the following models of evolution: GTR+I+G for positions 1 and 2, and HKY+G for the third codon position.

The same partitioning scheme and models of evolution were identified for the Ischnocera COI dataset. For the COI + EF-1α analysis, four optimal partitions and models of evolution were identified: K80+I+G for all EF-1α codon positions, and GTR+I+G, GTR+G, and HKY+I+G for the COI first, second, and third codon positions, respectively. Two mammalian sucking louse species (Anoplura: *Fahrenholzia zacatecae* and *Haematopinus eurysternus*; GenBank HM171445 and HM171422 for COI and HM171477 and HM171457 for EF-1α, respectively) were included as outgroup taxa in all analyses. Phylogenetic analyses in MrBayes were performed using two independent runs with 4 incrementally heated chains (Metropolis-coupled Markov chain Monte Carlo; Ronquist & Huelsenbeck 2003), run for 10 million generations, and sampled every 1000 generations. The first 25% of trees from each run were discarded as burnin. The remaining trees were used to create a 50% majority consensus tree and calculate posterior probabilities (the percentage of samples recovering any particular clade; Huelsenbeck & Ronquist 2001). To examine genetic differentiation between and among taxa, average uncorrected *p*-distances were calculated using PAUP* v.4.0 (Swofford 2002).

Results

The amblyceran COI phylogeny included a total of 71 specimens of which 21 were from South Africa, 3 from Benin, 15 from the DRC, and 32 from GenBank (Table 5, 6; Figs. 6, 7). The phylogenetic analysis provided high support for clades representing the amblyceran louse genera *Menacanthus* (except for one specimen from GenBank),

Ricinus, *Myrsidea*, and *Colimenopon* (posterior probability [PP]= 0.98, 1, 1, and 1, respectively; Figs. 6, 7). Across the suborder, lice grouped primarily by taxonomy and not geography (Figs. 6, 7). The ischnoceran COI phylogeny included a total of 140 specimens, of which 11 were from Benin, 20 from the DRC, 52 from South Africa, and 57 additional sequences from GenBank (Tables 5, 6; Figs. 8, 9). Similarly to Amblycera, ischnoceran lice grouped primarily by taxonomy and not geography. For example, high support was found for the genera *Alcedoecus*, *Alcedoffula*, *Penenirmus*, and the *Brueelia*-complex (*Brueelia* and *Sturnidoecus*; Figs. 8, 9). Within each suborder, the COI + EF-1α analysis produced similar results to the phylogenies based on the COI data alone, although support values were often higher (Fig. 10). Notably, Ischnocera was not supported as monophyletic.

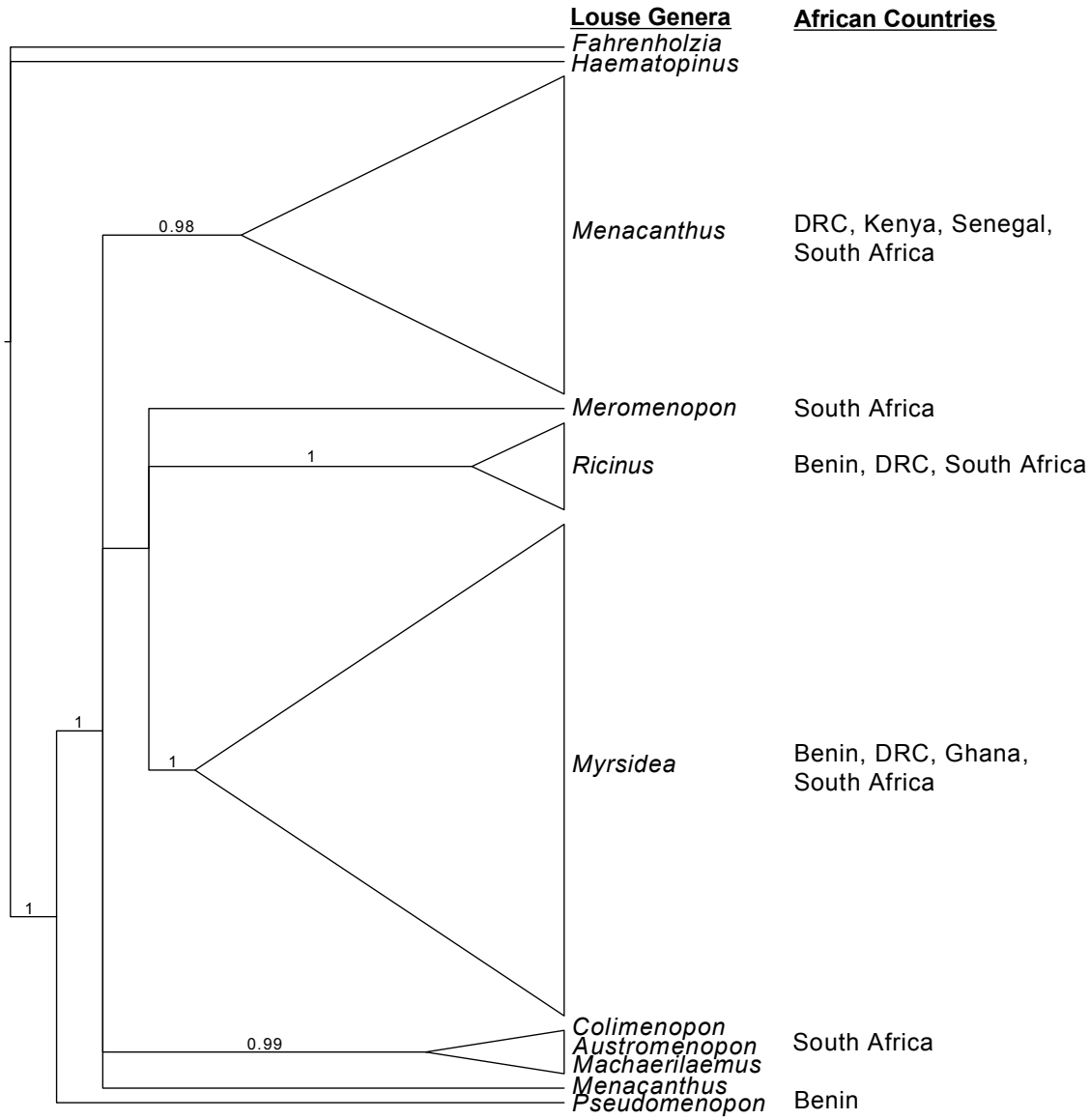

Figure 6. Bayesian phylogeny of African amblyceran lice based on analysis of the mitochondrial COI gene, with nodes collapsed for clades. Larger triangles represent a larger number of samples in the collapsed nodes. Geographic regions where lice were collected are indicated. Posterior probabilities ≥ 0.95 are shown above the nodes.

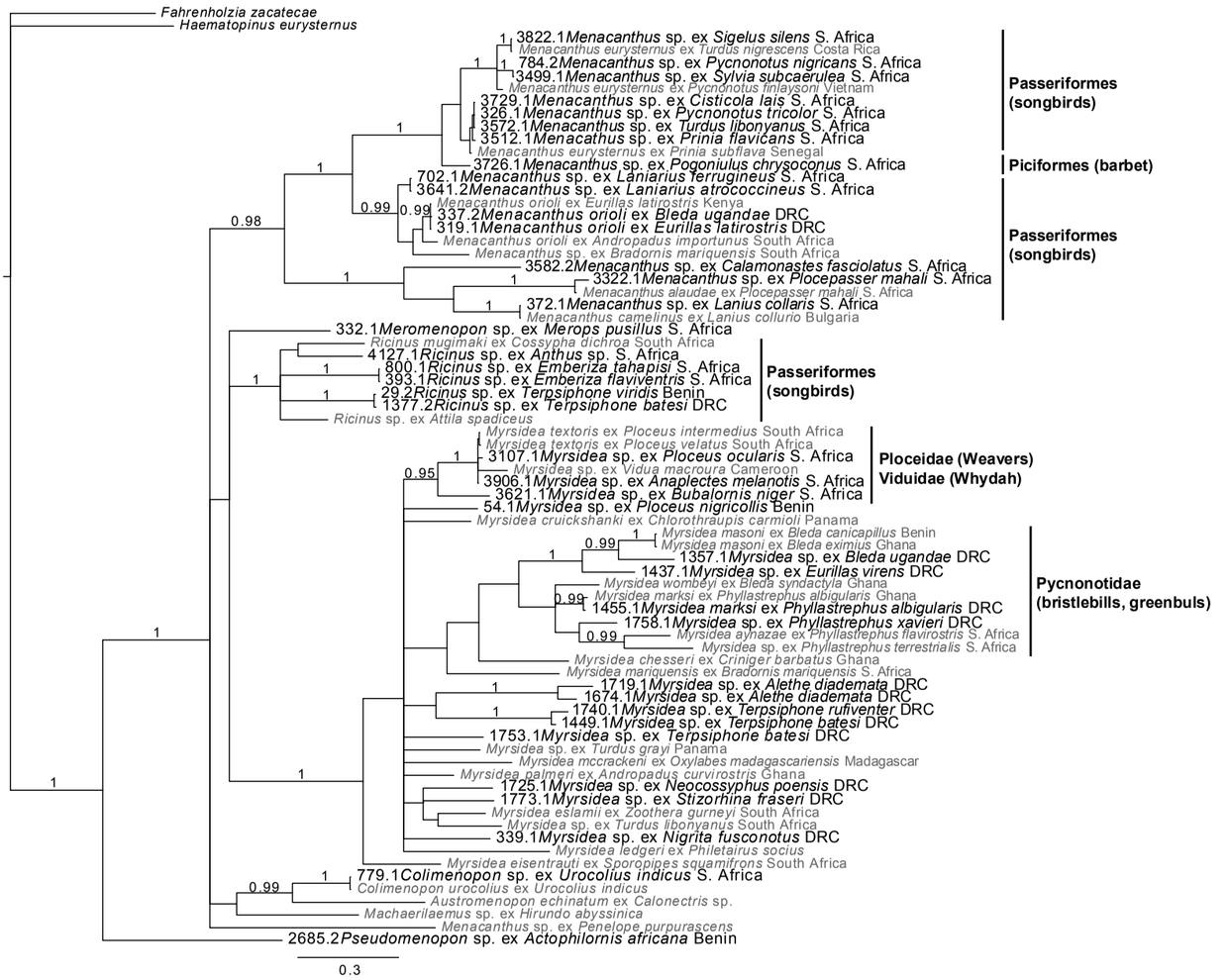

Figure 7. Bayesian phylogeny of African amblyceran lice based on analysis of the mitochondrial COI gene. Benin, DRC, and South Africa specimens are in black, with specimens identified by louse voucher number. Grey indicates additional specimens from GenBank. Posterior probabilities ≥ 0.95 are shown above the nodes. Major clades of hosts are indicated.

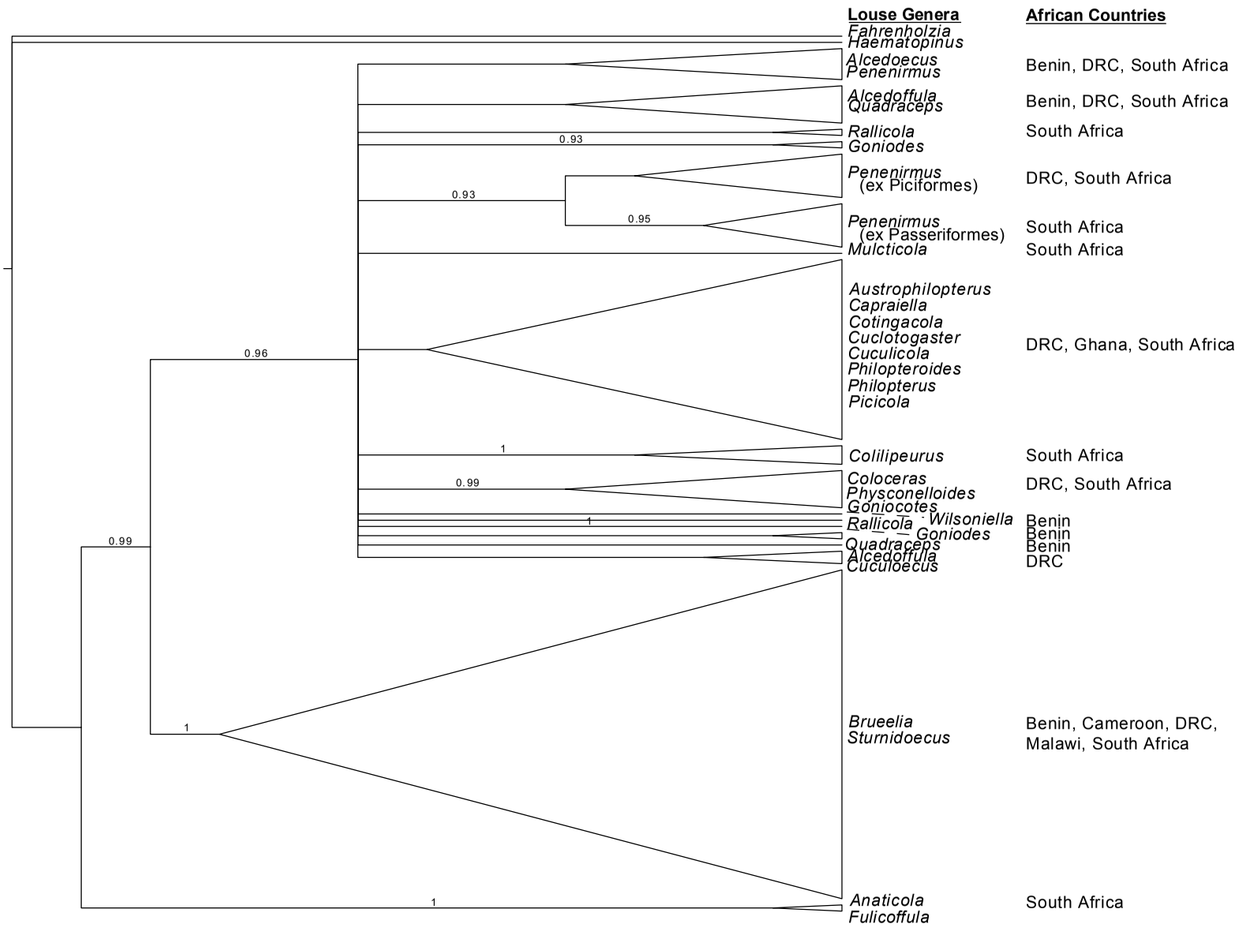

Figure 8. Bayesian phylogeny of African ischnoceran lice based on analysis of the mitochondrial COI gene, with nodes collapsed for clades. Larger triangles represent a larger number of samples in the collapsed nodes. Geographic regions where lice were collected are indicated. Posterior probabilities ≥ 0.90 are shown above the nodes.

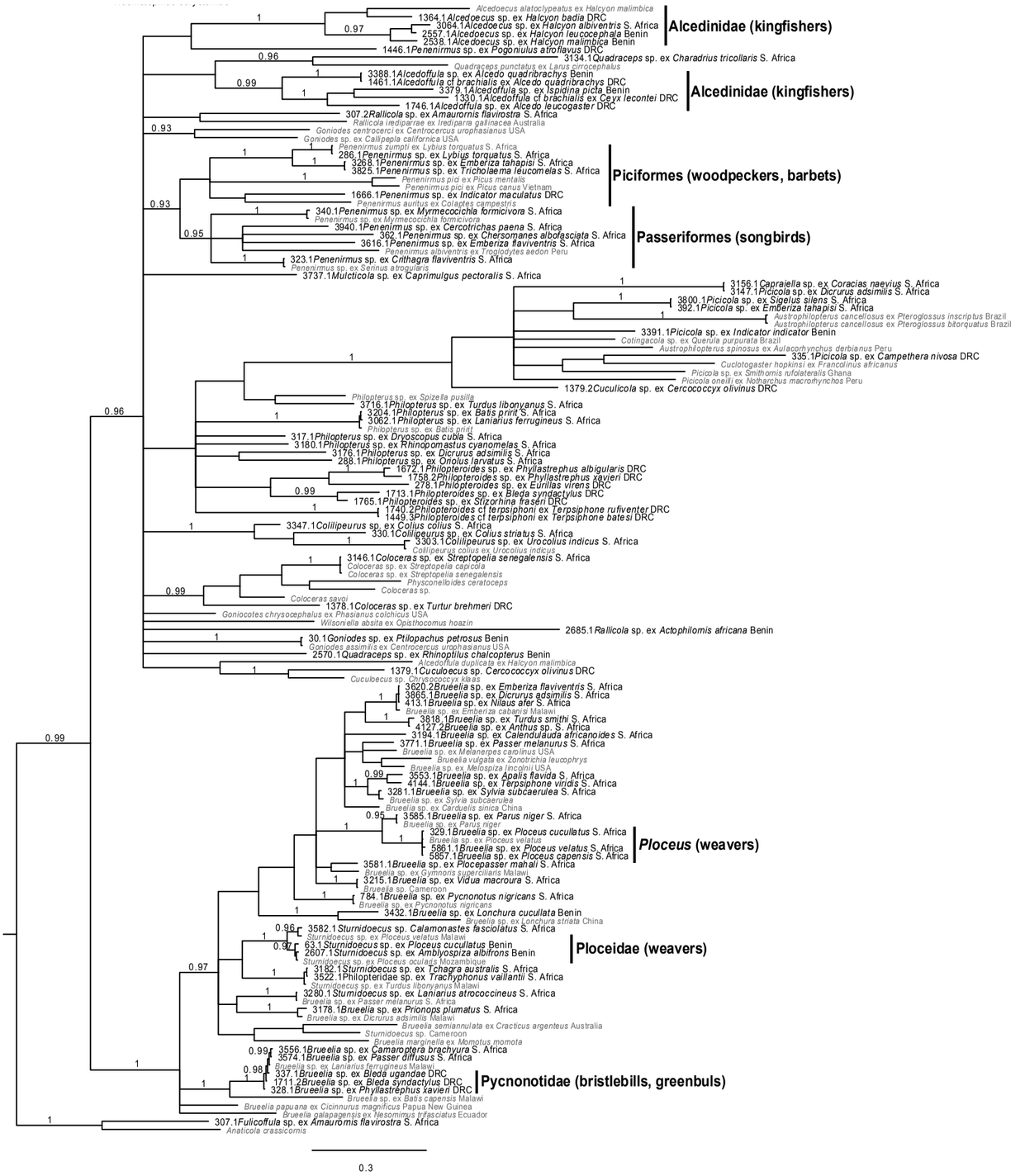

Figure 9. Bayesian phylogeny of African ischnoceran lice based on analysis of the mitochondrial COI gene. Benin, DRC, and South Africa specimens are in black, with specimens identified by louse voucher number. Grey indicates additional specimens from GenBank. Posterior probabilities ≥ 0.90 are shown above the nodes. Major clades of hosts are indicated. Outgroups are not shown.

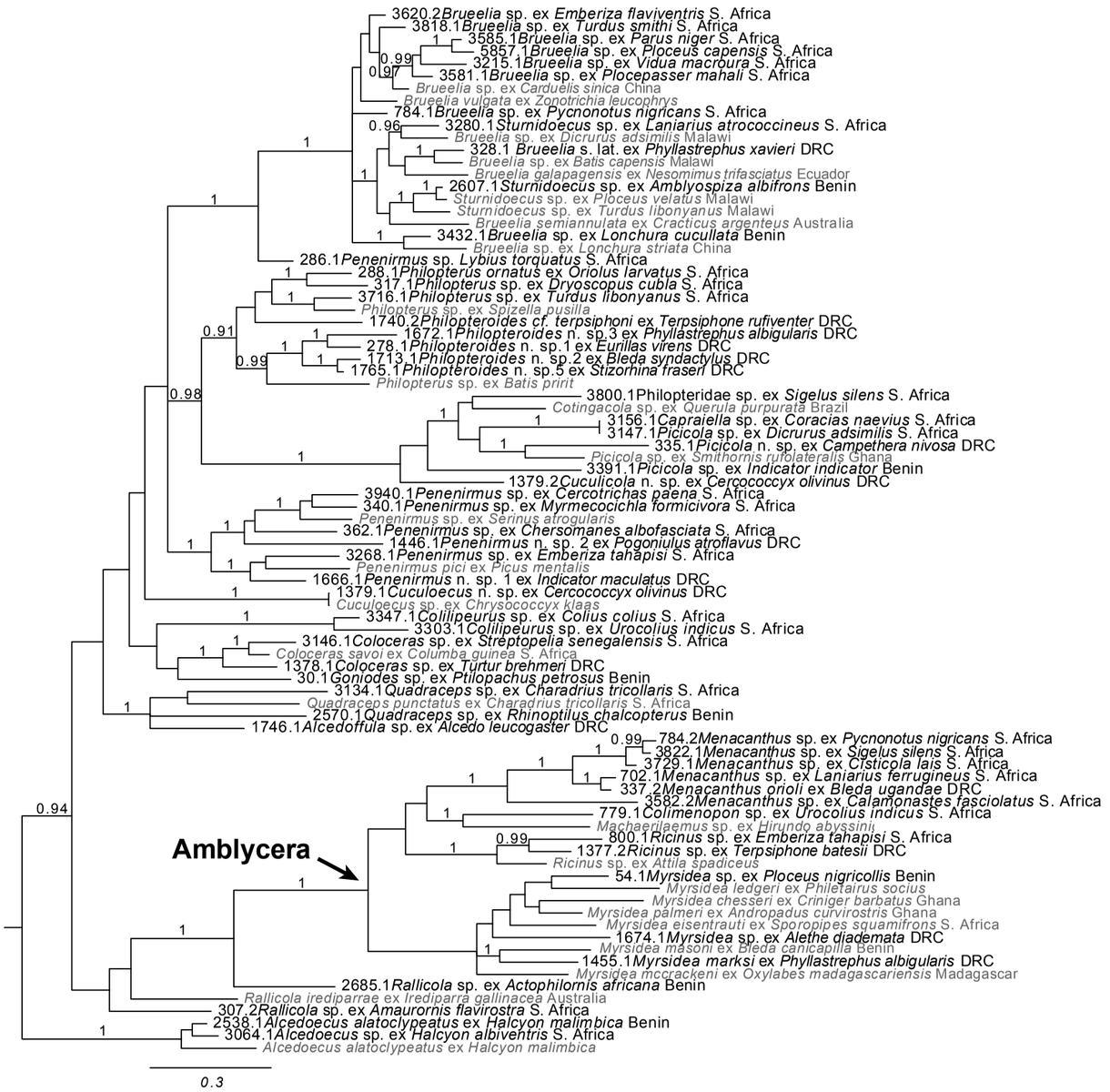

Figure 10. Bayesian phylogeny of African lice based on analysis of the mitochondrial COI and nuclear EF-1α genes. The suborder Amblycera is indicated. Benin, DRC, and South Africa specimens are in black, with specimens identified by louse voucher number. Grey indicates additional specimens from GenBank. Posterior probabilities ≥ 0.90 are shown above the nodes. Outgroups are not shown.

Table 5. Lice from Benin, the Democratic Republic of the Congo (DRC), and South Africa used in the phylogenetic analyses. Lice are organized by host taxonomy. All specimens have been accessioned into the Texas A&M University Biodiversity Research and Teaching Collections unless otherwise mentioned (MVZ= Museum of Vertebrate Zoology, University of California, Berkeley). Louse suborders are denoted by A= Amblycera and I= Ischnocera.

Host Family	Host Species	Host Specimen Number (Associated Louse Voucher and Louse Identification)	Locality
Order: Bucerotiformes			
Phoeniculidae	*Rhinopomastus cyanomelas*	16472 (3180.1- I: *Philopterus* sp.)	South Africa
Order: Caprimulgiformes			
Caprimulgidae	*Caprimulgus pectoralis*	17386 (3737.1- I: *Mulcticola* sp.)	South Africa
Order: Charadriiformes			
Charadriidae	*Charadrius tricollaris*	17021 (3134.1- I: *Quadraceps* sp.)	South Africa
Glareolidae	*Rhinoptilus chalcopterus*	15767 (2570.1- I: *Quadraceps schusteri*)	Benin
Jacanidae	*Actophilornis africana*	15763 (2685.1- I: *Rallicola africana*) (2685.2- A: *Pseudomenopon lanceolatum*)	Benin
Order: Coliiformes			
Coliidae	*Colius colius*	15567 (3347.1- I: *Colilipeurus* sp.)	South Africa
	Colius striatus	17403 (330.1- I: *Colilipeurus* sp.)	South Africa
	Urocolius indicus	MVZ198661-659 (779.1- A: *Colimenopon* sp.)	South Africa
		15569 (3303.1- I: *Colilipeurus* sp.)	South Africa
Order: Columbiformes	*Streptopelia senegalensis*	16999 (3146.1- I: *Coloceras* sp.)	South Africa
Columbidae			
	Turtur brehmeri	15172 (1378.1- I: *Coloceras* sp.)	DRC
Order: Coraciiformes			
Alcedinidae	*Alcedo leucogaster*	16116 (1746.1- I: *Alcedoffula* sp.)	DRC
	Alcedo quadribrachys	15089 (1461.1- I: *Alcedoffula cf. brachialis*)	DRC
		15665 (3388.1- *Alcedoffula brachialis*)	Benin
	Halcyon albiventris	16728 (3064.1- I: *Alcedoecus* sp.)	South Africa
	Halcyon badia	15085 (1364.1- I: *Alcedoecus* sp.)	DRC

Table 5 Continued

Host Family	Host Species	Host Specimen Number (Associated Louse Voucher and Louse Identification)	Locality
	Halcyon leucocephala	15663 (2557.1- I: *Alcedoecus cf. alatoclypeata*)	Benin
	Halcyon malimbica	15759 (2538.1- I: *Alcedoecus cf. capistratus*)	Benin
	Ispidina lecontei	15108 (1330.1- I: *Alcedoffula cf. brachialis*)	DRC
	Ispidina picta	15861 (3379.1- I: *Alcedoffula cf. carvalhoi*)	Benin
Coraciidae	*Coracias naevius*	16732 (3156.1- I: *Capraiella* sp.)	South Africa
Order: Cuculiformes			
Cuculidae	*Cercococcyx olivinus*	15173 (1379.1- I: *Cuculoecus* n. sp.) (1379.2- I: *Cuculicola* n. sp.)	DRC
Order: Galliformes			
Odontophoridae	*Ptilopachus petrosus*	16367 (30.1- I: *Goniodes* sp.)	Benin
Order: Gruiformes			
Rallidae	*Amaurornis flavirostra*	17379 (307.1- I: *Fulicoffula* sp.) (307.2- I: *Rallicola* sp.)	South Africa
Order: Passeriformes			
Alaudidae	*Calendulauda africanoides*	14964 (3194.1- I: *Brueelia* sp.)	South Africa
	Chersomanes albofasciata	17623 (362.1- I: *Penenirmus* sp.)	South Africa
Cisticolidae	*Apalis flavida*	16859 (3553.1- I: *Brueelia* sp.)	South Africa
	Calamonastes fasciolatus	16857 (3582.2- A: *Menacanthus* sp.)	South Africa
		(3582.1- I: *Sturnidoecus* sp.)	South Africa
	Camaroptera brachyura	16822 (3556.1- I: *Brueelia* sp.)	South Africa
	Cisticola lais	17567 (3729.1- A: *Menacanthus* sp.)	South Africa
	Prinia flavicans	16809 (3512.1- A: *Menacanthus* sp.)	South Africa
Dicruridae	*Dicrurus adsimilis*	16960 (3147.1- I: *Philopterus* sp.)	South Africa
		16961 (3176.1- I: *Philopterus* sp.)	South Africa
		21545 (3865.1- I: *Brueelia* sp.)	South Africa
Emberizidae	*Emberiza flaviventris*	16862 (3620.2- I: *Brueelia* sp.)	South Africa
		16868 (3616.1- I: *Penenirmus* sp.)	South Africa
		17588 (393.1- A: *Ricinus* sp.)	South Africa
	Emberiza tahapisi	MVZ198589-586 (800.1- A: *Ricinus* sp.)	South Africa
		15624 (3268.1- I: *Penenirmus* sp.)	South Africa
		17586 (392.1- I: Philopteridae sp.)	South Africa

Table 5 Continued

Host Family	Host Species	Host Specimen Number (Associated Louse Voucher and Louse Identification)	Locality
Estrildidae	*Lonchura cucullata*	15773 (3432.1- I: *Brueelia lonchurae*)	Benin
	Nigrita fusconotus	16064 (339.1- A: *Myrsidea* sp.)	DRC
Fringillidae	*Crithagra flaviventris*	17515 (323.1- I: *Penenirmus* sp.)	South Africa
Laniidae	*Lanius collaris*	17644 (372.1- A: *Menacanthus* sp.)	South Africa
Malaconotidae	*Dryoscopus cubla*	17649 (317.1- I: *Philopterus* sp.)	South Africa
	Laniarius atrococcineus	15579 (3280.1- I: *Sturnidoecus* sp.)	South Africa
		16948 (3641.2- A: *Menacanthus* sp.)	South Africa
	Laniarius ferrugineus	MVZ198934-932 (702.1- A: *Menacanthus* sp.)	South Africa
		16943 (3062.1- I: *Philopterus* sp.)	South Africa
	Nilaus afer	17646 (413.1- I: *Brueelia* sp.)	South Africa
	Tchagra australis	16724 (3182.1- I: *Sturnidoecus* sp.)	South Africa
Meropidae	*Merops pusillus*	17560 (332.1- A: *Meromenopon* sp.)	South Africa
Monarchidae	*Terpsiphone batesi*	16029 (1449.1- A: *Myrsidea* sp. 1) (1449.3- I: *Philopteroides cf. terpsiphoni*)	DRC
		16030 (1377.2- A: *Ricinus* sp.)	DRC
	Terpsiphone rufiventer	16038 (1740.1- A: *Myrsidea* sp. 1) (1740.2- I: *Philopteroides cf. terpsiphoni*)	DRC
	Terpsiphone viridis	22393 (4144.1- I: *Brueelia* sp.)	South Africa
		16385 (29.2- A: *Ricinus* sp.)	Benin
Motacillidae	*Anthus* sp.	22376 (4127.1- A: *Ricinus* sp.) (4127.2- I: *Brueelia* sp.)	South Africa
Muscicapidae	*Cercotrichas paena*	21620 (3940.1- I: *Penenirmus* sp.)	South Africa
	Myrmecocichla formicivora	17612 (340.1- I: *Penenirmus* sp.)	South Africa
	Sigelus silens	17631 (3800.1- I: *Brueelia* sp.)	South Africa
		17640 (3822.1- A: *Menacanthus* sp.)	South Africa
	Terpsiphone viridis	16385 (29.2- *Ricinus* sp.)	Benin
Oriolidae	*Oriolus larvatus*	17389 (288.1- I: *Philopterus* sp.)	South Africa
Paridae	*Parus niger*	16899 (3585.1- I: *Brueelia* sp.)	South Africa
Passeridae	*Passer diffusus*	16823 (3574.1- I: *Brueelia* sp.)	South Africa
	Passer melanurus	17583 (3771.1- I: *Brueelia* sp.)	South Africa
	Plocepasser mahali	15577 (3322.1- A: *Menacanthus* sp.)	South Africa
		16963 (3581.1- I: *Brueelia* sp.)	South Africa

Table 5 Continued

Host Family	Host Species	Host Specimen Number (Associated Louse Voucher and Louse Identification)	Locality
Platysteiridae	*Batis pririt*	15028 (3204.1- I: *Philopterus* sp.)	South Africa
Ploceidae	*Amblyospiza albifrons*	15789 (2607.1- *Sturnidoecus cf. basilewskyi*)	Benin
	Anaplectes melanotis	21586 (3906.1 A: *Menacanthus* sp.)	South Africa
	Bubalornis niger	17016 (3621.1- A: *Myrsidea* sp.)	South Africa
	Ploceus capensis	22539 (5857.1- I: *Brueelia* sp.)	South Africa
	Ploceus cucullatus	16421 (63.1- I: *Sturnidoecus* sp.)	Benin
		17606 (329.1- I: *Brueelia* sp.)	South Africa
	Ploceus nigricollis	16404 (54.1- A: *Myrsidea* sp.)	Benin
	Ploceus ocularis	16953 (3107.1- A: *Myrsidea* sp.)	South Africa
	Ploceus velatus	22543 (5861.1- I: *Brueelia* sp.)	South Africa
Prionopidae	*Prionops plumatus*	16719 (3178.1- I: *Brueelia* sp.)	South Africa
Pycnonotidae	*Bleda syndactylus*	15997 (1711.2- I: *Brueelia* s. lat. sp.)	DRC
		15998 (1713.1- *Philopteroides* sp. 2)	DRC
	Bleda ugandae	15135 (1357.1- A: *Myrsidea* sp.)	DRC
		15995 (337.1- I: *Brueelia* s. lat sp.) (337.2- A: *Menacanthus orioli*)	DRC
	Eurillas latirostris	15979 (319.1- A: *Menacanthus orioli*)	DRC
	Eurillas virens	15986 (1437.1- A: *Myrsidea* sp.)	DRC
		15990 (278.1- I: *Philopteroides* sp. 1)	DRC
	Phyllastrephus albigularis	15176 (1455.1- A: *Myrsidea marksi*)	DRC
		17462 (1672.1- I: *Philopteroides* sp. 3)	DRC
	Phyllastrephus xavieri	15962 (1758.1- A: *Myrsidea* sp.) (1758.2- I: *Philopteroides* sp. 4)	DRC
		16014 (328.1- *Brueelia* s. lat sp.)	DRC
	Pycnonotus tricolor	17347 (326.1- A: *Menacanthus* sp.)	South Africa
	Pycnonotus nigricans	MVZ198646-644 (784.1- I: *Brueelia* sp.) (784.2- A: *Menacanthus* sp.)	South Africa
Sylviidae	*Sylvia subcaerulea*	15599 (3281.1- I: *Brueelia* sp.)	South Africa
		16889 (3499.1- A: *Menacanthus* sp.)	South Africa
Turdidae	*Alethe diademata*	16040 (1719.1- A: *Myrsidea* sp.)	DRC
		17435 (1674.1- A: *Myrsidea* sp.)	DRC
	Neocossyphus poensis	16069 (1725.1- A: *Myrsidea* sp.)	DRC

Table 5 Continued

Host Family	Host Species	Host Specimen Number (Associated Louse Voucher and Louse Identification)	Locality
	Stizorhina fraseri	16065 (1765.1- I: *Philopteroides* sp. 5)	DRC
		16067 (1773.1- A: *Myrsidea* sp.)	DRC
	Turdus libonyanus	16989 (3572.1- A: *Menacanthus* sp.)	South Africa
		17393 (3716.1- I: *Philopterus* sp.)	South Africa
	Turdus smithi	17267 (3818.1- I: *Brueelia* sp.)	South Africa
Viduidae	*Vidua macroura*	15015 (3215.1- I: *Brueelia* sp.)	South Africa
Order: Piciformes			
Indicatoridae	*Indicator indicator*	15799 (3391.1- I: Philopteridae sp.)	Benin
	Indicator maculatus	17457 (1666.1- I: *Penenirmus* sp. 1)	DRC
Lybiidae	*Lybius torquatus*	17405 (286.1- I: *Penenirmus* sp.)	South Africa
	Pogoniulus atroflavus	15100 (1446.1- I: *Penenirmus* sp. 2)	DRC
	Pogoniulus chrysoconus	17544 (3726.1- A: *Menacanthus* sp.)	South Africa
	Trachyphonus vaillantii	16914 (3522.1- I: Philopteridae sp.)	South Africa
	Tricholaema leucomelas	17409 (3825.1- I: *Penenirmus* sp.)	South Africa
Picidae	*Campethera nivosa*	16123(335.1- I: *Picicola* new sp.)	DRC

Table 6. Additional louse GenBank sequences resulting from BLAST searches included in the African continent-wide phylogenetic analyses. Host species and collection locality are also given, if known.

Louse species	Host species	Collection Locality	COI GenBank No.	EF1 GenBank No.
Suborder Amblycera				
Austromenopon echinatum	*Calonectris* sp.	--	EU088135	
Colimenopon urocolius	*Urocolius indicus*	--	AF385010	AF385029
Machaerilaemus sp.	*Hirundo abyssinica*	--	AF385012	AF385031
Menacanthus alaudae	*Plocepasser mahali*	South Africa	KF768803	
Menacanthus camelinus	*Lanius collurio*	Bulgaria	KJ730543	
Menacanthus eurysternus	*Prinia subflava*	Senegal	KJ730624	
Menacanthus eurysternus	*Pycnonotus finlaysoni*	Vietnam	KJ385885	
Menacanthus eurysternus	*Turdus nigrescens*	Costa Rica	KJ730657	
Menacanthus orioli	*Eurillas latirostris*	Kenya	KJ730607	KJ730701
Menacanthus orioli	*Andropadus importunus*	South Africa	KF768804	
Menacanthus sp.	*Bradornis mariquensis*	South Africa	KF768805	
Menacanthus sp.	*Penelope purpurascens*	--	AF545727	
Myrsidea aynazae	*Phyllastrephus flavirostris*	South Africa	KF768806	
Myrsidea chesseri	*Criniger barbatus*	Ghana	DQ366672	FJ171308
Myrsidea cruickshanki	*Chlorothraupis carmioli*	Panama	GQ454449	
Myrsidea eisentrauti	*Sporopipes squamifrons*	South Africa	KF768807	AF320428
Myrsidea eslamii	*Zoothera gurneyi*	South Africa	KF768809	
Myrsidea ledgeri	*Philetairus socius*	--	AF545733	AF320429
Myrsidea mariquensis	*Bradornis mariquensis*	South Africa	KF768810	
Myrsidea marksi	*Phyllastrephus albigularis*	Ghana	DQ366669	
Myrsidea masoni	*Bleda canicapilla*	Benin	DQ366670	FJ171306
Myrsidea masoni	*Bleda eximius*	Ghana	DQ366671	
Myrsidea mccrackeni	*Oxylabes madagascariensis*	Madagascar	DQ860183	FJ171313

Table 6 Continued

Louse species	Host species	Collection Locality	COI GenBank No.	EF1 GenBank No.
Myrsidea palmeri	*Andropadus curvirostris*	Ghana	DQ366673	FJ171304
Myrsidea sp.	*Phyllastrephus terrestrialis*	South Africa	KF768812	
Myrsidea sp.	*Turdus grayi*	Panama	FJ171291	
Myrsidea sp.	*Turdus libonyanus*	South Africa	KF768811	
Myrsidea sp.	*Vidua macroura*	Cameroon	DQ887257	
Myrsidea textoris	*Ploceus intermedius*	South Africa	KF768813	
Myrsidea textoris	*Ploceus velatus*	South Africa	KF768814	
Myrsidea wombeyi	*Bleda syndactyla*	Ghana	DQ366667	
Ricinus mugimaki	*Cossypha dichroa*	South Africa	KF768816	
Ricinus sp.	*Attila spadiceus*	--	AF545762	AF545805
Suborder Ischnocera				
Alcedoecus alatoclypeatus	*Halcyon malimbica*	--	AY314807	AY314825
Alcedoffula duplicata	*Halcyon malimbica*	--	JX121669	
Anaticola crassicornis			AY314805	
Austrophilopterus cancellosus	*Pteroglossus inscriptus*	Brazil	AY430443	
Austrophilopterus cancellosus	*Pteroglossus bitorquatus*	Brazil	AY430444	
Austrophilopterus spinosus	*Aulacorhynchus derbianus*	Peru	AY430451	
Brueelia galapagensis	*Nesomimus trifasciatus*	Ecuador	JF734040	
Brueelia marginella	*Momotus momota*	--	AY149401	
Brueelia papuana	*Cicinnurus magnificus*	Papua New Guinea	KT892286	
Brueelia semiannulata	*Cracticus argenteus*	Australia	KT892143	
Brueelia sp.	*Batis capensis*	Malawi	KT892105	
Brueelia sp.	*Carduelis sinica*	China	KT892117	
Brueelia sp.	*Dicrurus adsimilis*	Malawi	KT892153	KT892445
Brueelia sp.	*Emberiza cabanisi*	Malawi	KT892157	

Table 6 Continued

Louse species	Host species	Collection Locality	COI GenBank No.	EF1 GenBank No.
Brueelia sp.	*Gymnoris superciliaris*	Malawi	KT892232	
Brueelia sp.	*Laniarius ferrugineus*	Malawi	KT892184	
Brueelia sp.	*Lonchura striata*	China	KT892191	KT892483
Brueelia sp.	*Melanerpes carolinus*	United States	KT892329	
Brueelia sp.	*Melaspiza lincolnii*	United States	KT892201	
Brueelia sp.	*Parisoma (Sylvia) subcaeruleum*	--	AY149396	
Brueelia sp.	*Parus niger*	--	AF385000	
Brueelia sp.	*Passer melanurus*	South Africa	KT892224	
Brueelia sp.	*Ploceus velatus*	--	AY149392	AY149422
Brueelia sp.	*Pycnonotus nigricans*	--	AY149397	
Brueelia sp.	*Amandava subflava*	Cameroon	DQ887224	DQ887197
Brueelia vulgata	*Zonotrichia leucophrys*	--	FJ171235	
Colilipeurus colius	*Urocolius indicus*	--	AF384998	AF385017
Coloceras savoi	*Columba guinea*	South Africa	AF348845	AF278663
Coloceras sp.	*Streptopelia capicola*	--	AF545688	
Coloceras sp.			AF348840	
Coloceras sp.	*Streptopelia senegalensis*	--	AF348843	
Cotingacola sp.	*Querula purpurata*	Brazil	AF444863	AF447198
Cuclotogaster hopkinsi	*Francolinus africanus*	--	AF348875	
Cuculoecus sp.	*Chrysococcyx klaas*	--	AF545692	KU187329
Goniocotes chrysocephalus	*Phasianus colchicus*	United States	HQ332829	
Goniodes assimilis	*Ptilopachus petrosus*	Ghana	HQ332828	
Goniodes centrocerci	*Centrocercus urophasianus*	United States	HQ332825	
Goniodes sp.	*Callipepla californica*	United States	AF545708	
Penenirmus albiventris	*Troglodytes aedon*	Peru	KF614516	
Penenirmus auritus	*Colaptes campestris*	--	AF356700	

Table 6 Continued

Louse species	Host species	Collection Locality	COI GenBank No.	EF1 GenBank No.
Penenirmus pici	*Picus canus hessei*	Vietnam	KF385884	
Penenirmus pici	*Picus mentalis*	--	AF356706	AF356730
Penenirmus sp.	*Myrmecocichla formicivora*	--	AF356709	AF320446
Penenirmus sp.	*Serinus atrogularis*	--	AF356710	AF320447
Philopterus sp.	*Batis pririt*	--	AF356715	AF320449
Philopterus sp.	*Spizella pusilla*	--	AY314820	AY314841
Physconelloides ceratoceps			AF278648	
Picicola sp.	*Smithornis rufolateralis*	Ghana	EU520585	EU520586
Quadraceps punctatus	*Charadrius tricollaris*	South Africa	AY149405	AF447209
Rallicola irediparrae	*Irediparra gallinacea*	Australia	JQ717185	JQ717193
Sturnidoecus sp.		Cameroon	DQ887262	
Sturnidoecus sp.	*Ploceus ocularis*	Mozambique	KT892350	
Sturnidoecus sp.	*Ploceus velatus*	Malawi	KT892352	KT892642
Sturnidoecus sp.	*Turdus libonyanus*	Malawi	KT892354	KT892644
Wilsoniella absita	*Opisthocomus hoazin*	--	JX121681	
Outgroups				
Fahrenholzia zacatecae	*Chaetodipus eremicus*	--	HM171445	HM171477
Haematopinus eurysternus	*Bos* sp.	--	HM171422	HM171457

Discussion

This study represents the first phylogenetic assessment of a highly diverse group of lice across a wide variety of hosts and habitats in Sub-Saharan Africa. Louse specimens from three distant regions (western, central, and southern Africa) were analyzed to examine potential biogeographic patterns in parasitic lice. Examining the resulting phylogenies (Figs. 6-10) on a broad scale, there are no evident biogeographic patterns in lice across Sub-Saharan Africa. This is almost certainly a reflection of the broad taxonomic sampling of both lice and hosts. Similarly, the lack of support for a monophyletic Ischnocera in the COI + EF-1α analysis (Fig. 10) is likely the result of the inability of these particular molecular markers to fully resolve louse relationships given the diverse taxonomic sampling in this study (similar to previous studies; Cruickshank *et al.* 2001, Johnson & Whiting 2002, Yoshizawa & Johnson 2010, Light *et al.* 2016, Chapter II). Despite the overall lack of broad biogeographic patterns, examination of specific louse clades reveals some interesting findings and provides insight and potential starting points for future studies.

Within the amblyceran phylogeny, the diverse genus *Menacanthus* is highly supported (with the exception of one GenBank specimen parasitizing *Penelope purpurascens* from the Neotropics) and has a relatively high level of genetic structuring (Fig. 7). All of the *Menacanthus* sp. examined in this study are likely *M. eurysternus* or *M. orioli*, except for three specimens, (two of these are likely *M. alaudae* or *M. camelinus* based on genetic similarity and the third is a unique lineage; Fig. 7). *Menacanthus eurysternus* is a generalist species found on a broad range of host families

(Price *et al.* 2003; for additional discussion of this species see Ch. II). In this study, *M. eurysternus* is incredibly widespread geographically, parasitizing hosts of the orders Passeriformes and Piciformes from South Africa, Costa Rica, Vietnam, and Senegal (Figs. 6, 7). Some of these hosts are migratory songbirds, and previous studies (Gustafsson & Olsson 2012, Martinu *et al.* 2015) have suggested that host movements between continents could explain the wide geographic ranges of some louse groups. Africa and Eurasia are connected by avian migratory routes, which could potentially explain the relationship between the Vietnam GenBank sequence and African *M. eurysternus*. It is possible that a migratory host with disjunct wintering ranges in Africa and Southeast Asia could have transported lice to those continents. Although the African and Southeast Asian hosts of *M. eurysternus* in this study are year-round residents of their respective continents (Chittenden 2007), it is also possible that other, migratory hosts exchanged lice on their breeding grounds in Europe, and then transported the lice to wintering grounds in Africa and Asia. However, migration between the New World (Costa Rica, GenBank sequence of *M. eurysternus* from *Turdus nigrescens*) and Old World (South Africa, specimen 3822.1 from *Sigelus silens*; Fig. 7) is much less likely. The host genus *Turdus* is cosmopolitan, and perhaps colonization by *Turdus* from the Old World to the New World resulted in lice being transported to Central America (Voelker *et al.* 2007). The two lice from these distant localities were genetically identical and additional studies will be necessary to test the validity of this relationship. Additionally, many of the lice in this clade have hosts that are local endemics with restricted ranges (i.e., southern Africa). Older studies noted the broad range of *M.*

eurysternus (Price 1975, 1977), and Galloway (2005) speculated about horizontal transfer of lice by introduced hosts to new regions. Martinu et al. (2015) suggested that if migratory and non-migratory hosts occur in sympatry, host transfer of generalist lice could occur. Besides *M. eurysternus*, *M. orioli* is also geographically widespread within Africa (DRC, Kenya, and South Africa). Overall, although no distinct geographic patterns were evident across the genus, different *Menacanthus* species could potentially serve as model organisms for exploring biogeography, host relationships and interactions, and population genetics across smaller geographic regions in Africa.

The amblyceran genus *Ricinus* was found in all three regions (Benin, DRC, and South Africa) across Sub-Saharan Africa (Figs. 6, 7). In general, the genus *Ricinus* is widespread across both hosts and geography (found parasitizing many passerine families, as well as on multiple continents; Price *et al.* 2003). Valan et al. (2016) reported that there is likely much undiscovered diversity of *Ricinus* based on a recent reexamination of museum specimens of the genus. In this study, *Ricinus* showed a decent amount of genetic diversity (5% average uncorrected *p*-distance across 5 lineages; Fig. 7) within a small clade, suggesting that this genus may be a candidate for taxonomic revision. With such a small sample size in this study, it is difficult to make any geographic conclusions about this genus. But given its widespread distribution, *Ricinus* is a likely candidate for more focused studies within a particular geographic region or across a single host group.

The *Myrsidea* sampled in this study represented a large group of lice from diverse hosts, primarily distributed across Africa (Fig. 7). Within this genus, lice group

by host taxonomy rather than geography. However, examination of smaller *Myrsidea* clades reveals some interesting geographic associations. One strongly supported *Myrsidea* clade consisted of lice parasitizing finches and weavers (Viduidae and Ploceidae) from South Africa and Cameroon (Fig. 7; PP = 0.95; average uncorrected *p*-distance = 5%). This *Myrsidea* lineage may therefore be geographically widespread and a good candidate for future studies, although additional sampling of *Myrsidea* from these host families will be necessary since all but one specimen were from South Africa. Another *Myrsidea* clade was found across Sub-Saharan Africa (Benin, DRC, Ghana, and South Africa), consisting of lice from hosts of the Pycnonotidae family, represented by bristlebills (*Bleda*) and greenbuls (*Eurillas* and *Phyllastrephus*). Although this large clade lacked support, several smaller internal clades received high support. The host family Pycnonotidae is restricted to the Old World, so it is unsurprising that all of these louse specimens were African. These *Myrsidea* likely represent multiple species, but do indicate that a more comprehensive examination of lice parasitizing Pycnonotidae may be useful for future biogeographic studies.

Within the suborder Ischnocera (Figs. 8, 9), the genera *Alcedoecus* and *Alcedoffula* are highly host specific, parasitizing only kingfishers (Alcedinidae). Both of these louse genera are genetically diverse for such small groups of lice (20 and 23% average uncorrected *p*-distances within *Alcedoecus* and *Alcedoffula*, respectively), and are geographically widespread across Sub-Saharan Africa (with *Alcedoecus* found on *Halcyon* hosts in Benin, DRC, and South Africa, and *Alcedoffula* parasitizing *Alcedo* and *Ceyx* hosts from Benin and DRC). Given these characteristics of both *Alcedoecus* and

Alcedoffula, examination of either genus may prove useful for future studies examining louse or host relationships, as well as geographical patterns across Sub-Saharan Africa.

The ischnoceran genus *Penenirmus* also shows promise for future studies. Two clades were recovered for this genus, one of which consists of parasites of Piciformes (and a possible straggler parasitizing *Emberiza tahapisi*, see Chapter II) and the other parasitizing Passeriformes. In this study, *Penenirmus* is genetically diverse and geographically widespread (DRC, South Africa, Vietnam, and Peru). Notably, there is low support grouping the Southeast Asian GenBank *P. pici* specimens with the rest of the piciform *Penenirmus*, and low support uniting the Peruvian specimen with the other passeriform *Penenirmus*. Johnson et al. (2001) also found a lack of monophyly in piciform *Penenirmus*, further indicating that future studies may reveal additional taxonomic and geographic separation within this genus. The African specimens appear to be restricted to central and southern Africa, although additional examination of passerine and piciform *Penenirmus* will be necessary to understand the full geographic distribution of this genus. The data presented here indicate the potential that *Penenirmus* from passeriform or piciform hosts may have for exploring biogeography in this region.

Lastly, *Brueelia* is a large, speciose ischnoceran genus that is widespread across the diverse songbird order Passeriformes and can be highly host specific (Johnson *et al.* 2002a, Price *et al.* 2003). However, despite having high host specificity, previous studies have shown that *Brueelia* do not necessarily co-speciate with hosts (Johnson *et al.* 2002a). The lack of co-speciation may be explained by the fact that many *Brueelia* species, like certain other ischnoceran wing lice, are capable of host switching by

phoresis, transferring horizontally to new hosts by hitchhiking on hippoboscid flies, which are host generalist ectoparasites (Johnson *et al.* 2002a, Bueter *et al.* 2009, Harbison & Clayton 2011, Bartlow *et al.* 2016). Although species identifications for many specimens are lacking in this study, the *Brueelia*-complex (which includes the genera *Brueelia* and *Sturnidoecus*) is in need of systematic revision and some of the difficulty identifying species and understanding relationships within *Brueelia* may be a result of the current lack of knowledge about this widespread and highly diverse group (Smith 2001, Bush *et al.* 2016). Regardless, there are still some interesting *Brueelia* host and geographic associations that can be seen as a result of this study. For example, there are several small, strongly supported clades of *Brueelia* consisting of louse specimens parasitizing the same host genus or species across South Africa (e.g., lice parasitizing *Parus niger* or *Ploceus* species; Fig. 9). There is also a strongly supported clade of genetically highly similar *Brueelia* from DRC, Malawi, and South Africa parasitizing mostly greenbuls and bristlebills (Pycnonotidae), but also the families Cisticolidae, Passeridae, and Malaconotidae (3556.1, 3574.1, 337.1, 1711.2, 328.1, and a GenBank louse; PP = 1; average uncorrected *p*-distance = 1%; Fig. 9). This lineage appears to consist of host generalist lice, at least based on the sampling from this study, but is potentially geographically restricted to central and southern Africa since no lice from western Africa were found in this clade. Finally, nested within *Brueelia* is a clade of *Sturnidoecus* primarily parasitizing weavers (Ploceidae; the louse parasitizing *Calamonastes fasciolatus* in the family Cisticolidae may be a straggler). This geographically widely distributed clade included lice collected from Benin, Malawi,

Mozambique, and South Africa (Fig. 9). Future examination of *Sturnidoecus* ploceid hosts may also provide informative biogeographic results across Sub-Saharan Africa.

This is the first study to examine invertebrate relationships across the large geographic scale of Sub-Saharan Africa. Perhaps not unexpectedly, it was difficult to tease apart any broad biogeographic conclusions with such diverse host and geographic sampling. To better understand the biogeography of Sub-Saharan African lice, it would perhaps be more useful to examine specific bird host and louse taxa at a finer scale. Using parasites to investigate biogeography is complicated by the fact that louse distributions often track the host distributions, resulting in complex geographic relationships between higher-level louse taxa. Restricting the phylogenetic analysis to lice from specific bird taxa would potentially better account for differing host life history traits such as migration of hosts across Africa or host species interactions (which can result in horizontal transfer of lice between hosts). Another option would be to study molecular phylogenetics of a single genus or even species of louse (e.g., *Alcedoecus*, *Alcedoffula*, etc.). However, despite its limitations, the information obtained from this study could be used to inform future studies to investigate biogeographic patterns of parasites and birds.

CHAPTER IV

SUMMARY

A large number of new South African louse-host associations (104) and louse lineages (26) were found from this study. These new host associations included 70 louse records for bird species not previously known to be parasitized by lice. The large number of novel host associations found in this study is perhaps not surprising given that the louse fauna of South African birds is not well known, since previous studies have been limited to small geographic regions of the country or covered only certain louse taxa (Kopij & Price 2009, Halajian *et al.* 2014, Sychra *et al.* 2014). Examining broader phylogenetic relationships of South African lice showed that relationships among genera and species within the louse suborders Amblycera and Ischnocera are not always clear although there was strong support for several smaller groupings. Notably, monophyly of Ischnocera was not supported based on analysis of the COI + EF-1α dataset. However, this finding has been reported in previous studies (Cruickshank *et al.* 2001, Johnson & Whiting 2002, Yoshizawa & Johnson 2010, Light *et al.* 2016) and is likely the result of the inability of these molecular markers to fully resolve louse relationships.

This study represents the first phylogenetic assessment of a highly diverse group of lice across a wide variety of hosts and habitats, and is likely the first study to examine invertebrate relationships across the large geographic scale of Sub-Saharan Africa. Louse specimens from three distant regions (western, central, and southern Africa) were analyzed to examine potential biogeographic patterns in parasitic lice. Examination of

the resulting phylogenies on a broad scale indicated no evident biogeographic patterns in lice across Sub-Saharan Africa. This is almost certainly a reflection of the broad taxonomic sampling of both lice and hosts. However, despite its limitations, the information obtained from this study can be used to inform future studies to investigate biogeographic patterns of parasites and birds.

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APPENDIX

Table A-1. South African bird specimens examined for lice in this study. All specimen numbers were accessioned in the Texas A&M University Biodiversity Research and Teaching Collections, unless specified otherwise (MVZ= Museum of Vertebrate Zoology, University of California, Berkeley). Asterisks (*) indicate specimens parasitized by lice and localities match those in Figure 1. Crosses (†) indicate unidentified nymphal specimens that were excluded from analyses.

SPECIMEN NUMBER	ORDER	FAMILY	GENUS	SPECIES	SEX	PROVINCE	LOCALITY NUMBER	LATITUDE	LONGITUDE
15572	Apodiformes	Apodidae	*Apus*	*bradfieldi*	F	Northern Cape	6	-28.596167	24.858500
16739	Bucerotiformes	Phoeniculidae	*Phoeniculus*	*purpureus*	F	Limpopo	2	-22.619444	29.834167
16472*	Bucerotiformes	Phoeniculidae	*Rhinopomastus*	*cyanomelas*	U	Limpopo	2	-22.619444	29.834167
16471*	Bucerotiformes	Phoeniculidae	*Rhinopomastus*	*cyanomelas*	F	Limpopo	3	-23.593055	29.783889
16740	Bucerotiformes	Phoeniculidae	*Rhinopomastus*	*cyanomelas*	M	Northern Cape	5	-28.418889	24.073330
15564	Bucerotiformes	Phoeniculidae	*Rhinopomastus*	*cyanomelas*	M	Northern Cape	6	-28.596167	24.858500
15563*	Bucerotiformes	Phoeniculidae	*Rhinopomastus*	*cyanomelas*	M	Northern Cape	6	-28.596167	24.858500
17019	Bucerotiformes	Upupidae	*Upupa*	*africana*	M	Limpopo	3	-23.593055	29.783889
17020*	Bucerotiformes	Upupidae	*Upupa*	*africana*	F	Limpopo	3	-23.593055	29.783889
17630	Bucerotiformes	Upupidae	*Upupa*	*africana*	M	Northern Cape	5	-28.418889	24.073330
14986	Bucerotiformes	Upupidae	*Upupa*	*africana*	F	Northern Cape	6	-28.596167	24.858500
15565	Bucerotiformes	Upupidae	*Upupa*	*africana*	M	Northern Cape	6	-28.596167	24.858500
22413	Bucerotiformes	Upupidae	*Upupa*	*africana*	F	Eastern Cape	8	-32.07803	24.67859
17385	Caprimulgiformes	Caprimulgidae	*Caprimulgus*	*pectoralis*	M	Limpopo	3	-23.593055	29.783889
17386	Caprimulgiformes	Caprimulgidae	*Caprimulgus*	*pectoralis*	M	Limpopo	3	-23.593055	29.783889
17386*	Caprimulgiformes	Caprimulgidae	*Caprimulgus*	*pectoralis*	M	Limpopo	3	-23.593055	29.783889
21598	Charadriiformes	Charadriidae	*Charadrius*	*tricollaris*	F	Limpopo	1	-22.29372	29.2955
21642*	Charadriiformes	Charadriidae	*Charadrius*	*tricollaris*	M	Limpopo	1	-22.29372	29.2955
17025*	Charadriiformes	Charadriidae	*Charadrius*	*tricollaris*	F	Limpopo	3	-23.593055	29.783889
17026	Charadriiformes	Charadriidae	*Charadrius*	*tricollaris*	U	Limpopo	3	-23.593055	29.783889
17377	Charadriiformes	Charadriidae	*Charadrius*	*tricollaris*	F	Limpopo	3	-23.674192	29.912025
17378	Charadriiformes	Charadriidae	*Charadrius*	*tricollaris*	F	Northern Cape	5	-28.418889	24.073330
15562	Charadriiformes	Glareolidae	*Rhinoptilus*	*africanus*	M	Northern Cape	6	-28.596167	24.858500
15558	Ciconiiformes	Burhinidae	*Burhinus*	*capensis*	M	Northern Cape	6	-28.596167	24.858500
15567*	Coliiformes	Coliidae	*Colius*	*Colius*	M	Northern Cape	6	-28.596167	24.858500
17400*	Coliiformes	Coliidae	*Colius*	*Colius*	F	Free State	7	-30.508611	26.613611
17401*	Coliiformes	Coliidae	*Colius*	*Colius*	F	Free State	7	-30.508611	26.613611
22381*	Coliiformes	Coliidae	*Colius*	*Colius*	F	Eastern Cape	8	-32.04423	24.6726
17022	Coliiformes	Coliidae	*Colius*	*striatus*	M	Limpopo	3	-23.593055	29.783889
17024	Coliiformes	Coliidae	*Colius*	*striatus*	F	Limpopo	3	-23.593055	29.783889
17402	Coliiformes	Coliidae	*Colius*	*striatus*	M	Limpopo	3	-23.593055	29.783889

17021*	Coliiformes	Coliidae	*Colius*	*striatus*	F	Limpopo	3	-23.593055	29.783889
17023*	Coliiformes	Coliidae	*Colius*	*striatus*	F	Limpopo	3	-23.593055	29.783889
17403*	Coliiformes	Coliidae	*Colius*	*striatus*	F	Limpopo	3	-23.593055	29.783889
17404*	Coliiformes	Coliidae	*Colius*	*striatus*	F	Limpopo	3	-23.593055	29.783889
22583	Coliiformes	Coliidae	*Colius*	*striatus*	M	Eastern Cape	8	-32.04423	24.6726
22452*	Coliiformes	Coliidae	*Colius*	*striatus*	F	Eastern Cape	8	-32.04423	24.6726
17398	Coliiformes	Coliidae	*Urocolius*	*indicus*	M	Northern Cape	5	-28.418889	24.073330
17399*	Coliiformes	Coliidae	*Urocolius*	*indicus*	M	Northern Cape	5	-28.418889	24.073330
MVZ198661 - 659*	Coliiformes	Coliidae	*Urocolius*	*indicus*	M	Northern Cape	5	-28.418889	24.07333
15568	Coliiformes	Coliidae	*Urocolius*	*indicus*	M	Northern Cape	6	-28.596167	24.858500
15569*	Coliiformes	Coliidae	*Urocolius*	*indicus*	M	Northern Cape	6	-28.596167	24.858500
17001	Columbiformes	Columbidae	*Oena*	*capensis*	M	Limpopo	2	-22.619444	29.834167
17545	Columbiformes	Columbidae	*Oena*	*capensis*	F	Northern Cape	5	-28.418889	24.073330
16999*	Columbiformes	Columbidae	*Streptopelia*	*senegalensis*	M	Limpopo	2	-22.619444	29.834167
16998	Columbiformes	Columbidae	*Turtur*	*chalcospilos*	M	Limpopo	3	-23.593055	29.783889
16727	Coraciiformes	Alcedinidae	*Alcedo*	*cristata*	F	Northern Cape	5	-28.418889	24.073330
22551	Coraciiformes	Alcedinidae	*Alcedo*	*cristata*	M	Eastern Cape	10	-33.29847	26.4641
22563	Coraciiformes	Alcedinidae	*Alcedo*	*cristata*	M	Eastern Cape	10	-33.29847	26.4641
17374	Coraciiformes	Alcedinidae	*Halcyon*	*albiventris*	F	Limpopo	3	-23.593055	29.783889
16728*	Coraciiformes	Alcedinidae	*Halcyon*	*albiventris*	M	Limpopo	3	-23.593055	29.783889
16729*	Coraciiformes	Alcedinidae	*Halcyon*	*albiventris*	M	Limpopo	3	-23.593055	29.783889
17375*	Coraciiformes	Alcedinidae	*Halcyon*	*albiventris*	F	Limpopo	3	-23.593055	29.783889
MVZ198928 - 926*	Coraciiformes	Alcedinidae	*Halcyon*	*albiventris*	M	Limpopo	3	-23.593055	29.783889
16730	Coraciiformes	Alcedinidae	*Halcyon*	*albiventris*	F	Northern Cape	5	-28.418889	24.073330
16731	Coraciiformes	Alcedinidae	*Halcyon*	*albiventris*	F	Northern Cape	5	-28.418889	24.073330
16732*	Coraciiformes	Alcedinidae	*Halcyon*	*albiventris*	M	Northern Cape	5	-28.418889	24.073330
14962	Coraciiformes	Alcedinidae	*Halcyon*	*albiventris*	F	Northern Cape	6	-28.596167	24.858500
14963	Coraciiformes	Alcedinidae	*Halcyon*	*albiventris*	M	Northern Cape	6	-28.596167	24.858500
22517	Coraciiformes	Alcedinidae	*Halcyon*	*albiventris*	M	Eastern Cape	9	-32.02632	25.54285
22444*	Coraciiformes	Alcedinidae	*Halcyon*	*albiventris*	F	Eastern Cape	10	-33.29847	26.4641
17000*	Coraciiformes	Coraciidae	*Coracias*	*naevius*	M	Limpopo	2	-22.619444	29.834167
21643	Coraciiformes	Meropidae	*Merops*	*hirundineus*	M	Limpopo	1	-22.2673	29.3307
17561	Coraciiformes	Meropidae	*Merops*	*hirundineus*	F	Northern Cape	5	-28.418889	24.073330
15642	Coraciiformes	Meropidae	*Merops*	*hirundineus*	F	Northern Cape	6	-28.596167	24.858500
15643	Coraciiformes	Meropidae	*Merops*	*hirundineus*	F	Northern Cape	6	-28.596167	24.858500
21596	Coraciiformes	Meropidae	*Merops*	*pusillus*	F	Limpopo	1	-22.34805	29.3258
17560*	Coraciiformes	Meropidae	*Merops*	*pusillus*	M	Limpopo	3	-23.593055	29.783889
15570	Cuculiformes	Cuculidae	*Chrysococcyx*	*caprius*	M	Northern Cape	6	-28.596167	24.858500
22573	Cuculiformes	Cuculidae	*Chrysococcyx*	*caprius*	M	Eastern Cape	8	-32.04423	24.6726
22501	Cuculiformes	Cuculidae	*Chrysococcyx*	*caprius*	M	Eastern Cape	8	-32.07803	24.67859

22524	Cuculiformes	Cuculidae	*Chrysococcyx*	*caprius*	M	Eastern Cape	9	-32.02632	25.54285
22527	Cuculiformes	Cuculidae	*Clamator*	*jacobinus*	F	Eastern Cape	9	-32.02632	25.54285
22581	Cuculiformes	Cuculidae	*Cuculus*	*solitarius*	M	Eastern Cape	8	-32.04423	24.6726
16969	Galliformes	Phasianidae	*Dendroperdix*	*sephaena*	M	Limpopo	2	-22.619444	29.834167
17379*	Gruiformes	Rallidae	*Amaurornis*	*flavirostra*	F	Limpopo	3	-23.674192	29.912025
17622	Passeriformes	Alaudidae	*Calandrella*	*cinerea*	M	Mpumalanga	4	-26.594167	29.116111
21577	Passeriformes	Alaudidae	*Calendulauda*	*sabota*	M	Limpopo	1	-22.34805	29.3258
16886	Passeriformes	Alaudidae	*Calendulauda*	*sabota*	M	Limpopo	3	-23.593055	29.783889
15636	Passeriformes	Alaudidae	*Chersomanes*	*albofasciata*	M	Northern Cape	6	-28.596167	24.858500
15637	Passeriformes	Alaudidae	*Chersomanes*	*albofasciata*	F	Northern Cape	6	-28.596167	24.858500
17624	Passeriformes	Alaudidae	*Chersomanes*	*albofasciata*	M	Free State	7	-30.508611	26.613611
17623*	Passeriformes	Alaudidae	*Chersomanes*	*albofasciata*	U	Free State	7	-30.508611	26.613611
15615	Passeriformes	Alaudidae	*Eremopterix*	*verticalis*	M	Northern Cape	6	-28.596167	24.858500
15616	Passeriformes	Alaudidae	*Eremopterix*	*verticalis*	M	Northern Cape	6	-28.596167	24.858500
15617*	Passeriformes	Alaudidae	*Eremopterix*	*verticalis*	F	Northern Cape	6	-28.596167	24.858500
15618	Passeriformes	Alaudidae	*Eremopterix*	*verticalis*	M	Northern Cape	6	-28.596167	24.858500
17621	Passeriformes	Alaudidae	*Galerida*	*magnirostris*	M	Free State	7	-30.508611	26.613611
14964*	Passeriformes	Alaudidae	*Mirafra*	*africana*	M	Free State	6	-28.596167	24.858500
15635	Passeriformes	Alaudidae	*Mirafra*	*apiata*	M	Northern Cape	6	-28.596167	24.858500
14965	Passeriformes	Alaudidae	*Mirafra*	*apiata*	F	Free State	6	-28.596167	24.858500
14966	Passeriformes	Alaudidae	*Mirafra*	*apiata*	M	Free State	6	-28.596167	24.858500
22607	Passeriformes	Alaudidae	*Mirafra*	*fasciolata*	M	Eastern Cape	8	-32.04423	24.6726
16859*	Passeriformes	Cisticolidae	*Apalis*	*flavida*	F	Limpopo	3	-23.593055	29.783889
16860*	Passeriformes	Cisticolidae	*Apalis*	*flavida*	M	Limpopo	3	-23.593055	29.783889
16861*	Passeriformes	Cisticolidae	*Apalis*	*flavida*	M	Limpopo	3	-23.593055	29.783889
16858	Passeriformes	Cisticolidae	*Apalis*	*thoracica*	F	Limpopo	3	-23.593055	29.783889
17548	Passeriformes	Cisticolidae	*Apalis*	*thoracica*	F	Limpopo	3	-23.593055	29.783889
17547	Passeriformes	Cisticolidae	*Apalis*	*thoracica*	M	Limpopo	3	-23.674192	29.912025
22392	Passeriformes	Cisticolidae	*Apalis*	*thoracica*	M	Eastern Cape	8	-32.04423	24.6726
22391*	Passeriformes	Cisticolidae	*Apalis*	*thoracica*	M	Eastern Cape	8	-32.04423	24.6726
22569*	Passeriformes	Cisticolidae	*Apalis*	*thoracica*	F	Eastern Cape	8	-32.04423	24.6726
22327	Passeriformes	Cisticolidae	*Apalis*	*thoracica*	M	Eastern Cape	8	-32.07803	24.67859
22475	Passeriformes	Cisticolidae	*Apalis*	*thoracica*	F	Eastern Cape	8	-32.07803	24.67859
22486	Passeriformes	Cisticolidae	*Apalis*	*thoracica*	M	Eastern Cape	8	-32.07803	24.67859
22502	Passeriformes	Cisticolidae	*Apalis*	*thoracica*	F	Eastern Cape	8	-32.07803	24.67859
22335	Passeriformes	Cisticolidae	*Apalis*	*thoracica*	M	Eastern Cape	9	-32.02632	25.54285
22337	Passeriformes	Cisticolidae	*Apalis*	*thoracica*	F	Eastern Cape	9	-32.02632	25.54285
21558	Passeriformes	Cisticolidae	*Calamonastes*	*fasciolatus*	F	Limpopo	1	-22.2673	29.3307
16855	Passeriformes	Cisticolidae	*Calamonastes*	*fasciolatus*	F	Limpopo	2	-22.619444	29.834167
16856	Passeriformes	Cisticolidae	*Calamonastes*	*fasciolatus*	F	Limpopo	2	-22.619444	29.834167

16854*	Passeriformes	Cisticolidae	*Calamonastes*	*fasciolatus*	F	Limpopo	2	-22.619444	29.834167
16857*	Passeriformes	Cisticolidae	*Calamonastes*	*fasciolatus*	F	Limpopo	2	-22.619444	29.834167
16821	Passeriformes	Cisticolidae	*Camaroptera*	*brachyura*	F	Limpopo	3	-23.593055	29.783889
16822*	Passeriformes	Cisticolidae	*Camaroptera*	*brachyura*	M	Limpopo	3	-23.593055	29.783889
21576	Passeriformes	Cisticolidae	*Camaroptera*	*brevicaudata*	M	Limpopo	1	-22.34805	29.3258
21540	Passeriformes	Cisticolidae	*Camaroptera*	*brevicaudata*	F	Limpopo	1	-22.2673	29.3307
21606	Passeriformes	Cisticolidae	*Cisticola*	*chiniana*	M	Limpopo	1	-22.2673	29.3307
22580	Passeriformes	Cisticolidae	*Cisticola*	*fulvicapilla*	M	Eastern Cape	8	-32.04423	24.6726
22582*	Passeriformes	Cisticolidae	*Cisticola*	*fulvicapilla*	M	Eastern Cape	8	-32.04423	24.6726
22468	Passeriformes	Cisticolidae	*Cisticola*	*fulvicapilla*	M	Eastern Cape	8	-32.07803	24.67859
22519	Passeriformes	Cisticolidae	*Cisticola*	*fulvicapilla*	M	Eastern Cape	9	-32.02632	25.54285
22364	Passeriformes	Cisticolidae	*Cisticola*	*fulvicapilla*	M	Eastern Cape	10	-33.29847	26.4641
22558	Passeriformes	Cisticolidae	*Cisticola*	*fulvicapilla*	F	Eastern Cape	11	-33.32144	26.52419
16902	Passeriformes	Cisticolidae	*Cisticola*	*lais*	F	Limpopo	3	-23.593055	29.783889
16903	Passeriformes	Cisticolidae	*Cisticola*	*lais*	F	Limpopo	3	-23.593055	29.783889
16904	Passeriformes	Cisticolidae	*Cisticola*	*lais*	F	Limpopo	3	-23.593055	29.783889
16907	Passeriformes	Cisticolidae	*Cisticola*	*lais*	M	Limpopo	3	-23.593055	29.783889
16910	Passeriformes	Cisticolidae	*Cisticola*	*lais*	F	Limpopo	3	-23.593055	29.783889
16913	Passeriformes	Cisticolidae	*Cisticola*	*lais*	M	Limpopo	3	-23.593055	29.783889
17563	Passeriformes	Cisticolidae	*Cisticola*	*lais*	F	Limpopo	3	-23.593055	29.783889
16905*	Passeriformes	Cisticolidae	*Cisticola*	*lais*	F	Limpopo	3	-23.593055	29.783889
16908*	Passeriformes	Cisticolidae	*Cisticola*	*lais*	M	Limpopo	3	-23.593055	29.783889
16909*	Passeriformes	Cisticolidae	*Cisticola*	*lais*	M	Limpopo	3	-23.593055	29.783889
16911*	Passeriformes	Cisticolidae	*Cisticola*	*lais*	M	Limpopo	3	-23.593055	29.783889
16912*	Passeriformes	Cisticolidae	*Cisticola*	*lais*	M	Limpopo	3	-23.593055	29.783889
17562*	Passeriformes	Cisticolidae	*Cisticola*	*lais*	M	Limpopo	3	-23.593055	29.783889
17564*	Passeriformes	Cisticolidae	*Cisticola*	*lais*	M	Limpopo	3	-23.593055	29.783889
17565*	Passeriformes	Cisticolidae	*Cisticola*	*lais*	M	Limpopo	3	-23.593055	29.783889
17567*	Passeriformes	Cisticolidae	*Cisticola*	*lais*	F	Limpopo	3	-23.593055	29.783889
17539	Passeriformes	Cisticolidae	*Eremomela*	*icteropygialis*	M	Free State	7	-30.508611	26.613611
21593	Passeriformes	Cisticolidae	*Eremomela*	*usticollis*	M	Limpopo	1	-22.34805	29.3258
21594	Passeriformes	Cisticolidae	*Eremomela*	*usticollis*	M	Limpopo	1	-22.34805	29.3258
16820	Passeriformes	Cisticolidae	*Eremomela*	*usticollis*	F	Limpopo	2	-22.619444	29.834167
16818	Passeriformes	Cisticolidae	*Eremomela*	*usticollis*	M	Limpopo	3	-23.593055	29.783889
16819	Passeriformes	Cisticolidae	*Eremomela*	*usticollis*	M	Limpopo	3	-23.593055	29.783889
16810	Passeriformes	Cisticolidae	*Prinia*	*flavicans*	M	Limpopo	3	-23.593055	29.783889
16809*	Passeriformes	Cisticolidae	*Prinia*	*flavicans*	M	Limpopo	3	-23.593055	29.783889
15632	Passeriformes	Cisticolidae	*Prinia*	*flavicans*	M	Northern Cape	6	-28.596167	24.858500
22603	Passeriformes	Cisticolidae	*Prinia*	*maculosa*	F	Eastern Cape	8	-32.04423	24.6726
22490	Passeriformes	Cisticolidae	*Prinia*	*maculosa*	F	Eastern Cape	8	-32.07803	24.67859

22474*†	Passeriformes	Cisticolidae	*Prinia*	*maculosa*	M	Eastern Cape	8	-32.07803	24.67859
22506*	Passeriformes	Cisticolidae	*Prinia*	*maculosa*	M	Eastern Cape	9	-32.02632	25.54285
16807	Passeriformes	Cisticolidae	*Prinia*	*subflava*	F	Limpopo	3	-23.593055	29.783889
16808	Passeriformes	Cisticolidae	*Prinia*	*subflava*	M	Limpopo	3	-23.593055	29.783889
21602	Passeriformes	Dicruridae	*Dicrurus*	*adsimilis*	M	Limpopo	1	-22.34805	29.3258
21544	Passeriformes	Dicruridae	*Dicrurus*	*adsimilis*	M	Limpopo	1	-22.2673	29.3307
21545*	Passeriformes	Dicruridae	*Dicrurus*	*adsimilis*	M	Limpopo	1	-22.2673	29.3307
16957	Passeriformes	Dicruridae	*Dicrurus*	*adsimilis*	F	Limpopo	2	-22.619444	29.834167
16959	Passeriformes	Dicruridae	*Dicrurus*	*adsimilis*	M	Limpopo	2	-22.619444	29.834167
16958*	Passeriformes	Dicruridae	*Dicrurus*	*adsimilis*	F	Limpopo	2	-22.619444	29.834167
16960*	Passeriformes	Dicruridae	*Dicrurus*	*adsimilis*	U	Limpopo	2	-22.619444	29.834167
16961*	Passeriformes	Dicruridae	*Dicrurus*	*adsimilis*	U	Limpopo	2	-22.619444	29.834167
16962*†	Passeriformes	Dicruridae	*Dicrurus*	*adsimilis*	F	Limpopo	3	-23.593055	29.783889
17642*†	Passeriformes	Dicruridae	*Dicrurus*	*adsimilis*	F	Limpopo	3	-23.593055	29.783889
15573	Passeriformes	Dicruridae	*Dicrurus*	*adsimilis*	M	Northern Cape	6	-28.596167	24.858500
22467*	Passeriformes	Dicruridae	*Dicrurus*	*adsimilis*	F	Eastern Cape	8	-32.04423	24.6726
22434	Passeriformes	Dicruridae	*Dicrurus*	*adsimilis*	F	Eastern Cape	9	-32.02632	25.54285
17585	Passeriformes	Emberizidae	*Emberiza*	*capensis*	M	Northern Cape	5	-28.418889	24.073330
21621	Passeriformes	Emberizidae	*Emberiza*	*flaviventris*	F	Limpopo	1	-22.2673	29.3307
21618*	Passeriformes	Emberizidae	*Emberiza*	*flaviventris*	M	Limpopo	1	-22.2673	29.3307
21637*	Passeriformes	Emberizidae	*Emberiza*	*flaviventris*	M	Limpopo	1	-22.2673	29.3307
16864	Passeriformes	Emberizidae	*Emberiza*	*flaviventris*	M	Limpopo	2	-22.619444	29.834167
16866	Passeriformes	Emberizidae	*Emberiza*	*flaviventris*	M	Limpopo	2	-22.619444	29.834167
16867	Passeriformes	Emberizidae	*Emberiza*	*flaviventris*	M	Limpopo	2	-22.619444	29.834167
16862*	Passeriformes	Emberizidae	*Emberiza*	*flaviventris*	M	Limpopo	2	-22.619444	29.834167
16865*	Passeriformes	Emberizidae	*Emberiza*	*flaviventris*	F	Limpopo	2	-22.619444	29.834167
16868*	Passeriformes	Emberizidae	*Emberiza*	*flaviventris*	M	Limpopo	2	-22.619444	29.834167
17588*	Passeriformes	Emberizidae	*Emberiza*	*flaviventris*	F	Northern Cape	5	-28.418889	24.073330
17589*	Passeriformes	Emberizidae	*Emberiza*	*flaviventris*	M	Northern Cape	5	-28.418889	24.073330
15621	Passeriformes	Emberizidae	*Emberiza*	*flaviventris*	M	Northern Cape	6	-28.596167	24.858500
15622	Passeriformes	Emberizidae	*Emberiza*	*flaviventris*	M	Northern Cape	6	-28.596167	24.858500
15623	Passeriformes	Emberizidae	*Emberiza*	*flaviventris*	F	Northern Cape	6	-28.596167	24.858500
22386	Passeriformes	Emberizidae	*Emberiza*	*flaviventris*	M	Eastern Cape	8	-32.04423	24.6726
21532	Passeriformes	Emberizidae	*Emberiza*	*impetuani*	F	Limpopo	1	-22.2673	29.3307
21533	Passeriformes	Emberizidae	*Emberiza*	*impetuani*	F	Limpopo	1	-22.2673	29.3307
21583	Passeriformes	Emberizidae	*Emberiza*	*impetuani*	F	Limpopo	1	-22.2673	29.3307
21584	Passeriformes	Emberizidae	*Emberiza*	*impetuani*	M	Limpopo	1	-22.2673	29.3307
21585	Passeriformes	Emberizidae	*Emberiza*	*impetuani*	F	Limpopo	1	-22.2673	29.3307
15619	Passeriformes	Emberizidae	*Emberiza*	*impetuani*	M	Northern Cape	6	-28.596167	24.858500
15620	Passeriformes	Emberizidae	*Emberiza*	*impetuani*	M	Northern Cape	6	-28.596167	24.858500

17586*†	Passeriformes	Emberizidae	*Emberiza*	*tahapisi*	F	Northern Cape	5	-28.418889	24.073330
17587*	Passeriformes	Emberizidae	*Emberiza*	*tahapisi*	F	Northern Cape	5	-28.418889	24.073330
MVZ198589 - 586*	Passeriformes	Emberizidae	*Emberiza*	*tahapisi*	M	Northern Cape	5	-28.418889	24.07333
15625	Passeriformes	Emberizidae	*Emberiza*	*tahapisi*	M	Northern Cape	6	-28.596167	24.858500
15624*	Passeriformes	Emberizidae	*Emberiza*	*tahapisi*	M	Northern Cape	6	-28.596167	24.858500
17551	Passeriformes	Estrildidae	*Amadina*	*erythrocephala*	M	Northern Cape	5	-28.418889	24.073330
17011	Passeriformes	Estrildidae	*Amadina*	*fasciata*	F	Limpopo	2	-22.619444	29.834167
17012	Passeriformes	Estrildidae	*Amadina*	*fasciata*	F	Limpopo	2	-22.619444	29.834167
22309	Passeriformes	Estrildidae	*Estrilda*	*astrild*	M	Eastern Cape	8	-32.07803	24.67859
22310	Passeriformes	Estrildidae	*Estrilda*	*astrild*	M	Eastern Cape	8	-32.07803	24.67859
22325	Passeriformes	Estrildidae	*Estrilda*	*astrild*	F	Eastern Cape	8	-32.07803	24.67859
22477	Passeriformes	Estrildidae	*Estrilda*	*astrild*	M	Eastern Cape	8	-32.07803	24.67859
22498	Passeriformes	Estrildidae	*Estrilda*	*astrild*	M	Eastern Cape	8	-32.07803	24.67859
22499	Passeriformes	Estrildidae	*Estrilda*	*astrild*	M	Eastern Cape	8	-32.07803	24.67859
22500	Passeriformes	Estrildidae	*Estrilda*	*astrild*	F	Eastern Cape	8	-32.07803	24.67859
22347	Passeriformes	Estrildidae	*Estrilda*	*astrild*	M	Eastern Cape	9	-32.02632	25.54285
22349	Passeriformes	Estrildidae	*Estrilda*	*astrild*	M	Eastern Cape	9	-32.02632	25.54285
22522	Passeriformes	Estrildidae	*Estrilda*	*astrild*	M	Eastern Cape	9	-32.02632	25.54285
22553	Passeriformes	Estrildidae	*Estrilda*	*astrild*	F	Eastern Cape	10	-33.29847	26.4641
21624*	Passeriformes	Estrildidae	*Estrilda*	*erythronotus*	M	Limpopo	1	-22.2673	29.3307
16872	Passeriformes	Estrildidae	*Estrilda*	*erythronotus*	F	Limpopo	2	-22.619444	29.834167
16873	Passeriformes	Estrildidae	*Estrilda*	*erythronotus*	M	Limpopo	2	-22.619444	29.834167
16874	Passeriformes	Estrildidae	*Estrilda*	*erythronotus*	M	Limpopo	2	-22.619444	29.834167
16875	Passeriformes	Estrildidae	*Estrilda*	*erythronotus*	M	Limpopo	3	-23.593055	29.783889
17549	Passeriformes	Estrildidae	*Estrilda*	*erythronotus*	M	Northern Cape	5	-28.418889	24.073330
15001	Passeriformes	Estrildidae	*Estrilda*	*erythronotus*	M	Northern Cape	6	-28.596167	24.858500
15002	Passeriformes	Estrildidae	*Estrilda*	*erythronotus*	M	Northern Cape	6	-28.596167	24.858500
15003	Passeriformes	Estrildidae	*Estrilda*	*erythronotus*	M	Northern Cape	6	-28.596167	24.858500
16869	Passeriformes	Estrildidae	*Granatina*	*granatina*	M	Limpopo	2	-22.619444	29.834167
16870	Passeriformes	Estrildidae	*Granatina*	*granatina*	M	Limpopo	2	-22.619444	29.834167
16871*	Passeriformes	Estrildidae	*Granatina*	*granatina*	M	Limpopo	3	-23.593055	29.783889
17550	Passeriformes	Estrildidae	*Granatina*	*granatina*	F	Northern Cape	5	-28.418889	24.073330
14994	Passeriformes	Estrildidae	*Granatina*	*granatina*	F	Northern Cape	6	-28.596167	24.858500
14995	Passeriformes	Estrildidae	*Granatina*	*granatina*	M	Northern Cape	6	-28.596167	24.858500
14996	Passeriformes	Estrildidae	*Granatina*	*granatina*	F	Northern Cape	6	-28.596167	24.858500
14997	Passeriformes	Estrildidae	*Granatina*	*granatina*	F	Northern Cape	6	-28.596167	24.858500
16986	Passeriformes	Estrildidae	*Lagonosticta*	*rhodopareia*	M	Limpopo	2	-22.619444	29.834167
16979	Passeriformes	Estrildidae	*Lagonosticta*	*rhodopareia*	F	Limpopo	3	-23.593055	29.783889
16981	Passeriformes	Estrildidae	*Lagonosticta*	*rhodopareia*	M	Limpopo	3	-23.593055	29.783889
16983	Passeriformes	Estrildidae	*Lagonosticta*	*rhodopareia*	F	Limpopo	3	-23.593055	29.783889

16984	Passeriformes	Estrildidae	*Lagonosticta*	*rhodopareia*	M	Limpopo	3	-23.593055	29.783889
16985	Passeriformes	Estrildidae	*Lagonosticta*	*rhodopareia*	M	Limpopo	3	-23.593055	29.783889
16980	Passeriformes	Estrildidae	*Lagonosticta*	*rhodopareia*	M	Limpopo	3	-23.593055	29.783889
16982*	Passeriformes	Estrildidae	*Lagonosticta*	*rhodopareia*	M	Limpopo	3	-23.593055	29.783889
16970	Passeriformes	Estrildidae	*Lagonosticta*	*rubricata*	F	Limpopo	3	-23.593055	29.783889
16971	Passeriformes	Estrildidae	*Lagonosticta*	*rubricata*	M	Limpopo	3	-23.593055	29.783889
16972*	Passeriformes	Estrildidae	*Lagonosticta*	*rubricata*	M	Limpopo	3	-23.593055	29.783889
22577	Passeriformes	Estrildidae	*Lagonosticta*	*rubricata*	M	Eastern Cape	8	-32.04423	24.6726
22319	Passeriformes	Estrildidae	*Lagonosticta*	*rubricata*	M	Eastern Cape	8	-32.07803	24.67859
22489	Passeriformes	Estrildidae	*Lagonosticta*	*rubricata*	F	Eastern Cape	8	-32.07803	24.67859
16973	Passeriformes	Estrildidae	*Lagonosticta*	*senegala*	M	Limpopo	3	-23.593055	29.783889
16974	Passeriformes	Estrildidae	*Lagonosticta*	*senegala*	F	Limpopo	3	-23.593055	29.783889
16975	Passeriformes	Estrildidae	*Lagonosticta*	*senegala*	M	Northern Cape	5	-28.418889	24.073330
16976	Passeriformes	Estrildidae	*Lagonosticta*	*senegala*	M	Northern Cape	5	-28.418889	24.073330
16977	Passeriformes	Estrildidae	*Lagonosticta*	*senegala*	M	Northern Cape	5	-28.418889	24.073330
16978	Passeriformes	Estrildidae	*Lagonosticta*	*senegala*	F	Northern Cape	5	-28.418889	24.073330
22609	Passeriformes	Estrildidae	*Lagonosticta*	*senegala*	M	Eastern Cape	8	-32.04423	24.6726
22610	Passeriformes	Estrildidae	*Lagonosticta*	*senegala*	F	Eastern Cape	8	-32.04423	24.6726
22330	Passeriformes	Estrildidae	*Lagonosticta*	*senegala*	M	Eastern Cape	8	-32.07803	24.67859
22478	Passeriformes	Estrildidae	*Lagonosticta*	*senegala*	M	Eastern Cape	8	-32.07803	24.67859
21626	Passeriformes	Estrildidae	*Pytilia*	*melba*	F	Limpopo	1	-22.2673	29.3307
17002	Passeriformes	Estrildidae	*Pytilia*	*melba*	F	Limpopo	2	-22.619444	29.834167
17003	Passeriformes	Estrildidae	*Pytilia*	*melba*	M	Limpopo	2	-22.619444	29.834167
17004	Passeriformes	Estrildidae	*Pytilia*	*melba*	M	Limpopo	2	-22.619444	29.834167
17005	Passeriformes	Estrildidae	*Pytilia*	*melba*	M	Limpopo	2	-22.619444	29.834167
17006	Passeriformes	Estrildidae	*Pytilia*	*melba*	M	Limpopo	3	-23.593055	29.783889
17008	Passeriformes	Estrildidae	*Pytilia*	*melba*	F	Limpopo	3	-23.593055	29.783889
17009	Passeriformes	Estrildidae	*Pytilia*	*melba*	M	Limpopo	3	-23.593055	29.783889
17553	Passeriformes	Estrildidae	*Pytilia*	*melba*	F	Limpopo	3	-23.593055	29.783889
17007*	Passeriformes	Estrildidae	*Pytilia*	*melba*	M	Limpopo	3	-23.593055	29.783889
17010	Passeriformes	Estrildidae	*Pytilia*	*melba*	F	Northern Cape	5	-28.418889	24.073330
17552	Passeriformes	Estrildidae	*Pytilia*	*melba*	M	Northern Cape	5	-28.418889	24.073330
17554	Passeriformes	Estrildidae	*Pytilia*	*melba*	M	Northern Cape	5	-28.418889	24.073330
15014	Passeriformes	Estrildidae	*Pytilia*	*melba*	M	Northern Cape	6	-28.596167	24.858500
15633	Passeriformes	Estrildidae	*Pytilia*	*melba*	F	Northern Cape	6	-28.596167	24.858500
21581	Passeriformes	Estrildidae	*Uraeginthus*	*angolensis*	M	Limpopo	1	-22.2673	29.3307
21582	Passeriformes	Estrildidae	*Uraeginthus*	*angolensis*	F	Limpopo	1	-22.2673	29.3307
21623	Passeriformes	Estrildidae	*Uraeginthus*	*angolensis*	F	Limpopo	1	-22.2673	29.3307
21631	Passeriformes	Estrildidae	*Uraeginthus*	*angolensis*	M	Limpopo	1	-22.2673	29.3307
21632	Passeriformes	Estrildidae	*Uraeginthus*	*angolensis*	F	Limpopo	1	-22.2673	29.3307

16876	Passeriformes	Estrildidae	*Uraeginthus*	*angolensis*	M	Limpopo	2	-22.619444	29.834167
16877	Passeriformes	Estrildidae	*Uraeginthus*	*angolensis*	F	Limpopo	2	-22.619444	29.834167
16878	Passeriformes	Estrildidae	*Uraeginthus*	*angolensis*	M	Limpopo	3	-23.593055	29.783889
16879	Passeriformes	Estrildidae	*Uraeginthus*	*angolensis*	M	Limpopo	3	-23.593055	29.783889
16880	Passeriformes	Estrildidae	*Uraeginthus*	*angolensis*	F	Limpopo	3	-23.593055	29.783889
16881	Passeriformes	Estrildidae	*Uraeginthus*	*angolensis*	M	Limpopo	3	-23.593055	29.783889
17538	Passeriformes	Estrildidae	*Uraeginthus*	*angolensis*	F	Limpopo	3	-23.593055	29.783889
15601	Passeriformes	Estrildidae	*Uraeginthus*	*granatinus*	M	Northern Cape	6	-28.596167	24.858500
15602	Passeriformes	Estrildidae	*Uraeginthus*	*granatinus*	M	Northern Cape	6	-28.596167	24.858500
15603	Passeriformes	Estrildidae	*Uraeginthus*	*granatinus*	M	Northern Cape	6	-28.596167	24.858500
15604	Passeriformes	Estrildidae	*Uraeginthus*	*granatinus*	F	Northern Cape	6	-28.596167	24.858500
17516	Passeriformes	Fringillidae	*Crithagra*	*atrogularis*	F	Free State	7	-30.508611	26.613611
17517	Passeriformes	Fringillidae	*Crithagra*	*atrogularis*	M	Free State	7	-30.508611	26.613611
17518	Passeriformes	Fringillidae	*Crithagra*	*atrogularis*	M	Free State	7	-30.508611	26.613611
22579	Passeriformes	Fringillidae	*Crithagra*	*atrogularis*	F	Eastern Cape	8	-32.04423	24.6726
22578*	Passeriformes	Fringillidae	*Crithagra*	*atrogularis*	M	Eastern Cape	8	-32.04423	24.6726
22538	Passeriformes	Fringillidae	*Crithagra*	*canicollis*	M	Eastern Cape	11	-33.32144	26.52419
17515*	Passeriformes	Fringillidae	*Crithagra*	*flaviventris*	M	Limpopo	3	-23.593055	29.783889
17514	Passeriformes	Fringillidae	*Crithagra*	*flaviventris*	M	Northern Cape	5	-28.418889	24.073330
17591	Passeriformes	Fringillidae	*Crithagra*	*gularis*	M	Northern Cape	5	-28.418889	24.073330
17558	Passeriformes	Fringillidae	*Crithagra*	*gularis*	F	Free State	7	-30.508611	26.613611
17559*	Passeriformes	Fringillidae	*Crithagra*	*gularis*	F	Free State	7	-30.508611	26.613611
22601	Passeriformes	Fringillidae	*Crithagra*	*gularis*	M	Eastern Cape	8	-32.04423	24.6726
22379*	Passeriformes	Fringillidae	*Crithagra*	*gularis*	M	Eastern Cape	8	-32.04423	24.6726
21566	Passeriformes	Fringillidae	*Crithagra*	*mozambica*	M	Limpopo	1	-22.2673	29.3307
21567	Passeriformes	Fringillidae	*Crithagra*	*mozambica*	F	Limpopo	1	-22.2673	29.3307
21630	Passeriformes	Fringillidae	*Crithagra*	*mozambica*	F	Limpopo	1	-22.2673	29.3307
21617*	Passeriformes	Fringillidae	*Crithagra*	*mozambica*	F	Limpopo	1	-22.2673	29.3307
16882	Passeriformes	Fringillidae	*Crithagra*	*mozambica*	F	Limpopo	2	-22.619444	29.834167
16883	Passeriformes	Fringillidae	*Crithagra*	*mozambica*	M	Limpopo	2	-22.619444	29.834167
16884	Passeriformes	Fringillidae	*Crithagra*	*mozambica*	U	Limpopo	2	-22.619444	29.834167
22354	Passeriformes	Fringillidae	*Crithagra*	*mozambica*	M	Eastern Cape	9	-32.02632	25.54285
16885	Passeriformes	Fringillidae	*Crithagra*	*sulphuratus*	F	Limpopo	3	-23.593055	29.783889
22494	Passeriformes	Hirundinidae	*Hirundo*	*dimidiata*	M	Eastern Cape	8	-32.07803	24.67859
22378	Passeriformes	Hirundinidae	*Ptyonoprogne*	*fuligula*	F	Eastern Cape	8	-32.04423	24.6726
16716	Passeriformes	Laniidae	*Eurocephalus*	*anguitimens*	F	Limpopo	2	-22.619444	29.834167
16714*	Passeriformes	Laniidae	*Eurocephalus*	*anguitimens*	F	Limpopo	2	-22.619444	29.834167
16715*†	Passeriformes	Laniidae	*Eurocephalus*	*anguitimens*	F	Limpopo	2	-22.619444	29.834167
16718	Passeriformes	Laniidae	*Lanius*	*collaris*	M	Limpopo	3	-23.593055	29.783889
17643	Passeriformes	Laniidae	*Lanius*	*collaris*	F	Mpumalanga	4	-26.594167	29.116111

17645	Passeriformes	Laniidae	*Lanius*	*collaris*	F	Mpumalanga	4	-26.594167	29.116111
17644*	Passeriformes	Laniidae	*Lanius*	*collaris*	F	Free State	7	-30.508611	26.613611
22419	Passeriformes	Laniidae	*Lanius*	*collaris*	F	Eastern Cape	9	-32.02632	25.54285
22508*	Passeriformes	Laniidae	*Lanius*	*collaris*	M	Eastern Cape	9	-32.02632	25.54285
21599	Passeriformes	Laniidae	*Urolestes*	*melanoleucus*	F	Limpopo	1	-22.29372	29.2955
21600*†	Passeriformes	Laniidae	*Urolestes*	*melanoleucus*	F	Limpopo	1	-22.29372	29.2955
17014*	Passeriformes	Leiothrichidae	*Turdoides*	*bicolor*	M	Limpopo	2	-22.619444	29.834167
17015*†	Passeriformes	Leiothrichidae	*Turdoides*	*bicolor*	M	Limpopo	2	-22.619444	29.834167
21546	Passeriformes	Leiothrichidae	*Turdoides*	*jardineii*	M	Limpopo	1	-22.2673	29.3307
21547	Passeriformes	Leiothrichidae	*Turdoides*	*jardineii*	M	Limpopo	1	-22.2673	29.3307
21635	Passeriformes	Leiothrichidae	*Turdoides*	*jardineii*	M	Limpopo	1	-22.2673	29.3307
21636	Passeriformes	Leiothrichidae	*Turdoides*	*jardineii*	F	Limpopo	1	-22.2673	29.3307
21595	Passeriformes	Macrosphenidae	*Sylvietta*	*rufescens*	F	Limpopo	1	-22.34805	29.3258
21615	Passeriformes	Macrosphenidae	*Sylvietta*	*rufescens*	F	Limpopo	1	-22.2673	29.3307
21616	Passeriformes	Macrosphenidae	*Sylvietta*	*rufescens*	M	Limpopo	1	-22.2673	29.3307
21531*	Passeriformes	Macrosphenidae	*Sylvietta*	*rufescens*	F	Limpopo	1	-22.2673	29.3307
16817	Passeriformes	Macrosphenidae	*Sylvietta*	*rufescens*	M	Limpopo	2	-22.619444	29.834167
16812	Passeriformes	Macrosphenidae	*Sylvietta*	*rufescens*	M	Limpopo	3	-23.593055	29.783889
16813	Passeriformes	Macrosphenidae	*Sylvietta*	*rufescens*	F	Limpopo	3	-23.593055	29.783889
16814	Passeriformes	Macrosphenidae	*Sylvietta*	*rufescens*	F	Limpopo	3	-23.593055	29.783889
16815	Passeriformes	Macrosphenidae	*Sylvietta*	*rufescens*	M	Limpopo	3	-23.593055	29.783889
16816	Passeriformes	Macrosphenidae	*Sylvietta*	*rufescens*	F	Limpopo	3	-23.593055	29.783889
17535	Passeriformes	Macrosphenidae	*Sylvietta*	*rufescens*	M	Limpopo	3	-23.593055	29.783889
17536	Passeriformes	Macrosphenidae	*Sylvietta*	*rufescens*	F	Limpopo	3	-23.593055	29.783889
15607	Passeriformes	Macrosphenidae	*Sylvietta*	*rufescens*	F	Northern Cape	6	-28.596167	24.858500
15608	Passeriformes	Macrosphenidae	*Sylvietta*	*rufescens*	M	Northern Cape	6	-28.596167	24.858500
15024	Passeriformes	Macrosphenidae	*Sylvietta*	*rufescens*	F	Free State	6	-28.596167	24.858500
15025	Passeriformes	Macrosphenidae	*Sylvietta*	*rufescens*	M	Free State	6	-28.596167	24.858500
17537	Passeriformes	Macrosphenidae	*Sylvietta*	*rufescens*	M	Free State	7	-30.508611	26.613611
21578	Passeriformes	Malaconotidae	*Dryoscopus*	*cubla*	M	Limpopo	1	-22.34805	29.3258
21530	Passeriformes	Malaconotidae	*Dryoscopus*	*cubla*	M	Limpopo	1	-22.2673	29.3307
21560	Passeriformes	Malaconotidae	*Dryoscopus*	*cubla*	F	Limpopo	1	-22.2673	29.3307
16721	Passeriformes	Malaconotidae	*Dryoscopus*	*cubla*	F	Limpopo	3	-23.593055	29.783889
16723	Passeriformes	Malaconotidae	*Dryoscopus*	*cubla*	M	Limpopo	3	-23.593055	29.783889
16722*	Passeriformes	Malaconotidae	*Dryoscopus*	*cubla*	M	Limpopo	3	-23.593055	29.783889
17649*	Passeriformes	Malaconotidae	*Dryoscopus*	*cubla*	F	Limpopo	3	-23.593055	29.783889
17650*	Passeriformes	Malaconotidae	*Dryoscopus*	*cubla*	M	Limpopo	3	-23.593055	29.783889
17648	Passeriformes	Malaconotidae	*Dryoscopus*	*cubla*	F	Limpopo	3	-23.674192	29.912025
21574	Passeriformes	Malaconotidae	*Laniarius*	*atrococcineus*	M	Limpopo	1	-22.34805	29.3258
21575	Passeriformes	Malaconotidae	*Laniarius*	*atrococcineus*	F	Limpopo	1	-22.34805	29.3258

21591	Passeriformes	Malaconotidae	*Laniarius*	*atrococcineus*	M	Limpopo	1	-22.34805	29.3258
21601	Passeriformes	Malaconotidae	*Laniarius*	*atrococcineus*	U	Limpopo	1	-22.34805	29.3258
16950	Passeriformes	Malaconotidae	*Laniarius*	*atrococcineus*	M	Limpopo	2	-22.619444	29.834167
16951	Passeriformes	Malaconotidae	*Laniarius*	*atrococcineus*	M	Limpopo	2	-22.619444	29.834167
16947	Passeriformes	Malaconotidae	*Laniarius*	*atrococcineus*	M	Limpopo	3	-23.593055	29.783889
16949	Passeriformes	Malaconotidae	*Laniarius*	*atrococcineus*	M	Limpopo	3	-23.593055	29.783889
17359	Passeriformes	Malaconotidae	*Laniarius*	*atrococcineus*	F	Limpopo	3	-23.593055	29.783889
16948*	Passeriformes	Malaconotidae	*Laniarius*	*atrococcineus*	F	Limpopo	3	-23.593055	29.783889
17360	Passeriformes	Malaconotidae	*Laniarius*	*atrococcineus*	M	Northern Cape	5	-28.418889	24.073330
17361	Passeriformes	Malaconotidae	*Laniarius*	*atrococcineus*	M	Northern Cape	5	-28.418889	24.073330
15578	Passeriformes	Malaconotidae	*Laniarius*	*atrococcineus*	F	Northern Cape	6	-28.596167	24.858500
15580	Passeriformes	Malaconotidae	*Laniarius*	*atrococcineus*	M	Northern Cape	6	-28.596167	24.858500
15579*	Passeriformes	Malaconotidae	*Laniarius*	*atrococcineus*	F	Northern Cape	6	-28.596167	24.858500
16942	Passeriformes	Malaconotidae	*Laniarius*	*ferrugineus*	F	Limpopo	3	-23.593055	29.783889
16945	Passeriformes	Malaconotidae	*Laniarius*	*ferrugineus*	M	Limpopo	3	-23.593055	29.783889
16946	Passeriformes	Malaconotidae	*Laniarius*	*ferrugineus*	F	Limpopo	3	-23.593055	29.783889
17366	Passeriformes	Malaconotidae	*Laniarius*	*ferrugineus*	M	Limpopo	3	-23.593055	29.783889
17367	Passeriformes	Malaconotidae	*Laniarius*	*ferrugineus*	F	Limpopo	3	-23.593055	29.783889
16943*	Passeriformes	Malaconotidae	*Laniarius*	*ferrugineus*	M	Limpopo	3	-23.593055	29.783889
16944*	Passeriformes	Malaconotidae	*Laniarius*	*ferrugineus*	F	Limpopo	3	-23.593055	29.783889
MVZ198934 - 932*	Passeriformes	Malaconotidae	*Laniarius*	*ferrugineus*	F	Limpopo	3	-23.593055	29.783889
17369	Passeriformes	Malaconotidae	*Laniarius*	*ferrugineus*	M	Limpopo	3	-23.674192	29.912025
17368*	Passeriformes	Malaconotidae	*Laniarius*	*ferrugineus*	F	Limpopo	3	-23.674192	29.912025
22487	Passeriformes	Malaconotidae	*Laniarius*	*ferrugineus*	M	Eastern Cape	8	-32.07803	24.67859
22493	Passeriformes	Malaconotidae	*Laniarius*	*ferrugineus*	M	Eastern Cape	8	-32.07803	24.67859
22351	Passeriformes	Malaconotidae	*Laniarius*	*ferrugineus*	F	Eastern Cape	9	-32.02632	25.54285
22529	Passeriformes	Malaconotidae	*Laniarius*	*ferrugineus*	M	Eastern Cape	9	-32.02632	25.54285
22565	Passeriformes	Malaconotidae	*Laniarius*	*ferrugineus*	F	Eastern Cape	10	-33.29847	26.4641
17646*	Passeriformes	Malaconotidae	*Nilaus*	*afer*	M	Northern Cape	5	-28.418889	24.073330
15039	Passeriformes	Malaconotidae	*Nilaus*	*afer*	M	Northern Cape	6	-28.596167	24.858500
15629	Passeriformes	Malaconotidae	*Nilaus*	*afer*	F	Northern Cape	6	-28.596167	24.858500
15630	Passeriformes	Malaconotidae	*Nilaus*	*afer*	F	Northern Cape	6	-28.596167	24.858500
15631*	Passeriformes	Malaconotidae	*Nilaus*	*afer*	F	Northern Cape	6	-28.596167	24.858500
15038	Passeriformes	Malaconotidae	*Nilaus*	*afer*	M	Northern Cape	6	-28.954167	24.731111
21588	Passeriformes	Malaconotidae	*Tchagra*	*australis*	F	Limpopo	1	-22.2673	29.3307
16724*	Passeriformes	Malaconotidae	*Tchagra*	*australis*	M	Limpopo	3	-23.593055	29.783889
17647	Passeriformes	Malaconotidae	*Tchagra*	*australis*	F	Northern Cape	5	-28.418889	24.073330
22407	Passeriformes	Malaconotidae	*Tchagra*	*tchagra*	M	Eastern Cape	8	-32.07803	24.67859
16725	Passeriformes	Malaconotidae	*Telophorus*	*sulfureopectus*	M	Limpopo	3	-23.593055	29.783889
16726	Passeriformes	Malaconotidae	*Telophorus*	*sulfureopectus*	M	Limpopo	3	-23.593055	29.783889

17365*†	Passeriformes	Malaconotidae	*Telophorus*	*sulfureopectus*	F	Limpopo	3	-23.593055	29.783889
17362	Passeriformes	Malaconotidae	*Telophorus*	*viridis*	U	Limpopo	3	-23.593055	29.783889
17363	Passeriformes	Malaconotidae	*Telophorus*	*zeylonus*	M	Free State	7	-30.508611	26.613611
22368	Passeriformes	Malaconotidae	*Telophorus*	*zeylonus*	M	Eastern Cape	10	-33.29847	26.4641
21555	Passeriformes	Monarchidae	*Terpsiphone*	*viridis*	F	Limpopo	1	-22.2673	29.3307
22447	Passeriformes	Monarchidae	*Terpsiphone*	*viridis*	M	Eastern Cape	8	-32.04423	24.6726
22448	Passeriformes	Monarchidae	*Terpsiphone*	*viridis*	F	Eastern Cape	8	-32.04423	24.6726
22393*	Passeriformes	Monarchidae	*Terpsiphone*	*viridis*	M	Eastern Cape	8	-32.04423	24.6726
22473	Passeriformes	Monarchidae	*Terpsiphone*	*viridis*	M	Eastern Cape	8	-32.07803	24.67859
22430	Passeriformes	Monarchidae	*Terpsiphone*	*viridis*	M	Eastern Cape	9	-32.02632	25.54285
22436	Passeriformes	Monarchidae	*Terpsiphone*	*viridis*	M	Eastern Cape	9	-32.02632	25.54285
22420*	Passeriformes	Monarchidae	*Terpsiphone*	*viridis*	F	Eastern Cape	9	-32.02632	25.54285
17275	Passeriformes	Motacillidae	*Anthus*	sp.	M	Mpumalanga	4	-26.594167	29.116111
17276	Passeriformes	Motacillidae	*Anthus*	sp.	M	Mpumalanga	4	-26.594167	29.116111
17277	Passeriformes	Motacillidae	*Anthus*	sp.	M	Mpumalanga	4	-26.594167	29.116111
17278	Passeriformes	Motacillidae	*Anthus*	sp.	M	Mpumalanga	4	-26.594167	29.116111
17283	Passeriformes	Motacillidae	*Anthus*	sp.	M	Northern Cape	5	-28.418889	24.073330
17289	Passeriformes	Motacillidae	*Anthus*	sp.	M	Northern Cape	5	-28.418889	24.073330
17290	Passeriformes	Motacillidae	*Anthus*	sp.	F	Northern Cape	5	-28.418889	24.073330
17292	Passeriformes	Motacillidae	*Anthus*	sp.	M	Northern Cape	5	-28.418889	24.073330
17293	Passeriformes	Motacillidae	*Anthus*	sp.	M	Northern Cape	5	-28.418889	24.073330
17284*	Passeriformes	Motacillidae	*Anthus*	sp.	M	Northern Cape	5	-28.418889	24.073330
17285*	Passeriformes	Motacillidae	*Anthus*	sp.	M	Northern Cape	5	-28.418889	24.073330
17286*†	Passeriformes	Motacillidae	*Anthus*	sp.	F	Northern Cape	5	-28.418889	24.073330
17287*	Passeriformes	Motacillidae	*Anthus*	sp.	M	Northern Cape	5	-28.418889	24.073330
17288*	Passeriformes	Motacillidae	*Anthus*	sp.	M	Northern Cape	5	-28.418889	24.073330
17291*	Passeriformes	Motacillidae	*Anthus*	sp.	M	Northern Cape	5	-28.418889	24.073330
17294*	Passeriformes	Motacillidae	*Anthus*	sp.	M	Northern Cape	5	-28.418889	24.073330
15626	Passeriformes	Motacillidae	*Anthus*	sp.	F	Northern Cape	6	-28.596167	24.858500
15627	Passeriformes	Motacillidae	*Anthus*	sp.	M	Northern Cape	6	-28.596167	24.858500
15628	Passeriformes	Motacillidae	*Anthus*	sp.	F	Northern Cape	6	-28.596167	24.858500
17279	Passeriformes	Motacillidae	*Anthus*	sp.	M	Free State	7	-30.508611	26.613611
17280	Passeriformes	Motacillidae	*Anthus*	sp.	M	Free State	7	-30.508611	26.613611
17281	Passeriformes	Motacillidae	*Anthus*	sp.	F	Free State	7	-30.508611	26.613611
17282	Passeriformes	Motacillidae	*Anthus*	sp.	M	Free State	7	-30.508611	26.613611
22322	Passeriformes	Motacillidae	*Anthus*	sp.	M	Eastern Cape	8	-32.04423	24.6726
22374	Passeriformes	Motacillidae	*Anthus*	sp.	M	Eastern Cape	8	-32.04423	24.6726
22375	Passeriformes	Motacillidae	*Anthus*	sp.	M	Eastern Cape	8	-32.04423	24.6726
22571	Passeriformes	Motacillidae	*Anthus*	sp.	F	Eastern Cape	8	-32.04423	24.6726
22376*	Passeriformes	Motacillidae	*Anthus*	sp.	F	Eastern Cape	8	-32.04423	24.6726

22323	Passeriformes	Motacillidae	*Anthus*	sp.	M	Eastern Cape	8	-32.07803	24.67859
22314*	Passeriformes	Motacillidae	*Anthus*	sp.	M	Eastern Cape	8	-32.07803	24.67859
15031	Passeriformes	Motacillidae	*Anthus*	*vaalensis*	F	Free State	6	-28.596167	24.858500
15032	Passeriformes	Motacillidae	*Anthus*	*vaalensis*	F	Free State	6	-28.596167	24.858500
17304*	Passeriformes	Motacillidae	*Macronyx*	*capensis*	M	Mpumalanga	4	-26.594167	29.116111
22544*	Passeriformes	Motacillidae	*Macronyx*	*capensis*	M	Eastern Cape	10	-33.29847	26.4641
22560*	Passeriformes	Motacillidae	*Macronyx*	*capensis*	M	Eastern Cape	10	-33.29847	26.4641
17013	Passeriformes	Motacillidae	*Macronyx*	*croceus*	M	Limpopo	3	-23.593055	29.783889
16733	Passeriformes	Motacillidae	*Motacilla*	*capensis*	F	Northern Cape	5	-28.418889	24.073330
16734	Passeriformes	Motacillidae	*Motacilla*	*capensis*	F	Northern Cape	5	-28.418889	24.073330
16735	Passeriformes	Motacillidae	*Motacilla*	*capensis*	M	Northern Cape	5	-28.418889	24.073330
17295	Passeriformes	Motacillidae	*Motacilla*	*capensis*	M	Northern Cape	5	-28.418889	24.073330
17296	Passeriformes	Motacillidae	*Motacilla*	*capensis*	M	Northern Cape	5	-28.418889	24.073330
17297	Passeriformes	Motacillidae	*Motacilla*	*capensis*	M	Northern Cape	5	-28.418889	24.073330
15639	Passeriformes	Motacillidae	*Motacilla*	*capensis*	M	Northern Cape	6	-28.596167	24.858500
15640	Passeriformes	Motacillidae	*Motacilla*	*capensis*	M	Northern Cape	6	-28.596167	24.858500
15641	Passeriformes	Motacillidae	*Motacilla*	*capensis*	F	Northern Cape	6	-28.596167	24.858500
14998	Passeriformes	Motacillidae	*Motacilla*	*capensis*	M	Free State	6	-28.596167	24.858500
17298	Passeriformes	Motacillidae	*Motacilla*	*capensis*	M	Free State	7	-30.508611	26.613611
17299	Passeriformes	Motacillidae	*Motacilla*	*capensis*	F	Free State	7	-30.508611	26.613611
17300	Passeriformes	Motacillidae	*Motacilla*	*capensis*	F	Free State	7	-30.508611	26.613611
17301	Passeriformes	Motacillidae	*Motacilla*	*capensis*	M	Free State	7	-30.508611	26.613611
22371	Passeriformes	Motacillidae	*Motacilla*	*capensis*	F	Eastern Cape	10	-33.29847	26.4641
22549*	Passeriformes	Motacillidae	*Motacilla*	*capensis*	M	Eastern Cape	10	-33.29847	26.4641
22550	Passeriformes	Motacillidae	*Motacilla*	*capensis*	M	Eastern Cape	10	-33.29847	26.4641
14984	Passeriformes	Muscicapidae	*Bradornis*	*infuscatus*	M	Free State	6	-28.596167	24.858500
21528	Passeriformes	Muscicapidae	*Bradornis*	*mariquensis*	M	Limpopo	1	-22.2673	29.3307
21542	Passeriformes	Muscicapidae	*Bradornis*	*mariquensis*	M	Limpopo	1	-22.2673	29.3307
21543*	Passeriformes	Muscicapidae	*Bradornis*	*mariquensis*	F	Limpopo	1	-22.2673	29.3307
16806	Passeriformes	Muscicapidae	*Bradornis*	*pallidus*	M	Limpopo	3	-23.593055	29.783889
21572	Passeriformes	Muscicapidae	*Cercomela*	*familiaris*	M	Limpopo	1	-22.34805	29.3258
21573	Passeriformes	Muscicapidae	*Cercomela*	*familiaris*	F	Limpopo	1	-22.34805	29.3258
15634	Passeriformes	Muscicapidae	*Cercomela*	*familiaris*	M	Northern Cape	6	-28.596167	24.858500
15017	Passeriformes	Muscicapidae	*Cercomela*	*familiaris*	F	Northern Cape	6	-28.954167	24.731111
15018	Passeriformes	Muscicapidae	*Cercomela*	*familiaris*	F	Northern Cape	6	-28.954167	24.731111
15019	Passeriformes	Muscicapidae	*Cercomela*	*familiaris*	U	Northern Cape	6	-28.954167	24.731111
15020	Passeriformes	Muscicapidae	*Cercomela*	*familiaris*	M	Northern Cape	6	-28.954167	24.731111
17609	Passeriformes	Muscicapidae	*Cercomela*	*familiaris*	M	Free State	7	-30.508611	26.613611
22302	Passeriformes	Muscicapidae	*Cercomela*	*familiaris*	F	Eastern Cape	8	-32.07803	24.67859
22307	Passeriformes	Muscicapidae	*Cercomela*	*familiaris*	F	Eastern Cape	8	-32.07803	24.67859

22308	Passeriformes	Muscicapidae	*Cercomela*	*familiaris*	F	Eastern Cape	8	-32.07803	24.67859
22311	Passeriformes	Muscicapidae	*Cercomela*	*familiaris*	M	Eastern Cape	8	-32.07803	24.67859
22317	Passeriformes	Muscicapidae	*Cercomela*	*familiaris*	M	Eastern Cape	8	-32.07803	24.67859
22338	Passeriformes	Muscicapidae	*Cercomela*	*familiaris*	M	Eastern Cape	9	-32.02632	25.54285
22528	Passeriformes	Muscicapidae	*Cercomela*	*familiaris*	F	Eastern Cape	9	-32.02632	25.54285
22385	Passeriformes	Muscicapidae	*Cercotrichas*	*coryphaeus*	M	Eastern Cape	8	-32.04423	24.6726
22305	Passeriformes	Muscicapidae	*Cercotrichas*	*coryphaeus*	M	Eastern Cape	8	-32.07803	24.67859
22397	Passeriformes	Muscicapidae	*Cercotrichas*	*coryphaeus*	M	Eastern Cape	8	-32.07803	24.67859
22399	Passeriformes	Muscicapidae	*Cercotrichas*	*coryphaeus*	M	Eastern Cape	8	-32.07803	24.67859
22402*	Passeriformes	Muscicapidae	*Cercotrichas*	*coryphaeus*	M	Eastern Cape	8	-32.07803	24.67859
21537	Passeriformes	Muscicapidae	*Cercotrichas*	*leucophrys*	M	Limpopo	1	-22.2673	29.3307
17555	Passeriformes	Muscicapidae	*Cercotrichas*	*leucophrys*	F	Limpopo	3	-23.593055	29.783889
17556	Passeriformes	Muscicapidae	*Cercotrichas*	*leucophrys*	M	Limpopo	3	-23.593055	29.783889
16848*	Passeriformes	Muscicapidae	*Cercotrichas*	*leucophrys*	F	Limpopo	3	-23.593055	29.783889
17557*	Passeriformes	Muscicapidae	*Cercotrichas*	*leucophrys*	F	Limpopo	3	-23.674192	29.912025
21620*	Passeriformes	Muscicapidae	*Cercotrichas*	*paena*	M	Limpopo	1	-22.2673	29.3307
16847	Passeriformes	Muscicapidae	*Cercotrichas*	*paena*	M	Limpopo	3	-23.593055	29.783889
17302	Passeriformes	Muscicapidae	*Cercotrichas*	*paena*	M	Northern Cape	5	-28.418889	24.073330
15648	Passeriformes	Muscicapidae	*Cercotrichas*	*paena*	M	Northern Cape	6	-28.596167	24.858500
15649	Passeriformes	Muscicapidae	*Cercotrichas*	*paena*	F	Northern Cape	6	-28.596167	24.858500
15650	Passeriformes	Muscicapidae	*Cercotrichas*	*paena*	M	Northern Cape	6	-28.596167	24.858500
15007	Passeriformes	Muscicapidae	*Cercotrichas*	*paena*	M	Free State	6	-28.596167	24.858500
15008	Passeriformes	Muscicapidae	*Cercotrichas*	*paena*	M	Free State	6	-28.596167	24.858500
15009	Passeriformes	Muscicapidae	*Cercotrichas*	*paena*	M	Free State	6	-28.596167	24.858500
15010	Passeriformes	Muscicapidae	*Cercotrichas*	*paena*	F	Free State	6	-28.596167	24.858500
15011	Passeriformes	Muscicapidae	*Cercotrichas*	*paena*	F	Free State	6	-28.596167	24.858500
15012	Passeriformes	Muscicapidae	*Cercotrichas*	*paena*	F	Free State	6	-28.596167	24.858500
17272	Passeriformes	Muscicapidae	*Cercotrichas*	*quadrivirgata*	F	Limpopo	3	-23.674192	29.912025
17273	Passeriformes	Muscicapidae	*Cercotrichas*	*quadrivirgata*	M	Limpopo	3	-23.674192	29.912025
17312	Passeriformes	Muscicapidae	*Cossypha*	*caffra*	M	Mpumalanga	4	-26.594167	29.116111
17313	Passeriformes	Muscicapidae	*Cossypha*	*caffra*	M	Mpumalanga	4	-26.594167	29.116111
17314	Passeriformes	Muscicapidae	*Cossypha*	*caffra*	M	Mpumalanga	4	-26.594167	29.116111
17315	Passeriformes	Muscicapidae	*Cossypha*	*caffra*	M	Mpumalanga	4	-26.594167	29.116111
17316*	Passeriformes	Muscicapidae	*Cossypha*	*caffra*	F	Mpumalanga	4	-26.594167	29.116111
16991	Passeriformes	Muscicapidae	*Cossypha*	*caffra*	M	Northern Cape	5	-28.418889	24.073330
16992	Passeriformes	Muscicapidae	*Cossypha*	*caffra*	M	Northern Cape	5	-28.418889	24.073330
16993	Passeriformes	Muscicapidae	*Cossypha*	*caffra*	F	Northern Cape	5	-28.418889	24.073330
17317	Passeriformes	Muscicapidae	*Cossypha*	*caffra*	M	Northern Cape	5	-28.418889	24.073330
17318	Passeriformes	Muscicapidae	*Cossypha*	*caffra*	M	Northern Cape	5	-28.418889	24.073330
17319	Passeriformes	Muscicapidae	*Cossypha*	*caffra*	M	Northern Cape	5	-28.418889	24.073330

17320	Passeriformes	Muscicapidae	*Cossypha*	*caffra*	F	Northern Cape	5	-28.418889	24.073330
15575	Passeriformes	Muscicapidae	*Cossypha*	*caffra*	F	Northern Cape	6	-28.596167	24.858500
17334	Passeriformes	Muscicapidae	*Cossypha*	*caffra*	M	Free State	7	-30.508611	26.613611
17335	Passeriformes	Muscicapidae	*Cossypha*	*caffra*	F	Free State	7	-30.508611	26.613611
17336	Passeriformes	Muscicapidae	*Cossypha*	*caffra*	M	Free State	7	-30.508611	26.613611
17337	Passeriformes	Muscicapidae	*Cossypha*	*caffra*	M	Free State	7	-30.508611	26.613611
17338	Passeriformes	Muscicapidae	*Cossypha*	*caffra*	M	Free State	7	-30.508611	26.613611
17339	Passeriformes	Muscicapidae	*Cossypha*	*caffra*	M	Free State	7	-30.508611	26.613611
17340	Passeriformes	Muscicapidae	*Cossypha*	*caffra*	F	Free State	7	-30.508611	26.613611
17341	Passeriformes	Muscicapidae	*Cossypha*	*caffra*	M	Free State	7	-30.508611	26.613611
22320	Passeriformes	Muscicapidae	*Cossypha*	*caffra*	F	Eastern Cape	8	-32.04423	24.6726
22382	Passeriformes	Muscicapidae	*Cossypha*	*caffra*	M	Eastern Cape	8	-32.04423	24.6726
22383	Passeriformes	Muscicapidae	*Cossypha*	*caffra*	M	Eastern Cape	8	-32.04423	24.6726
22384	Passeriformes	Muscicapidae	*Cossypha*	*caffra*	M	Eastern Cape	8	-32.04423	24.6726
22449	Passeriformes	Muscicapidae	*Cossypha*	*caffra*	F	Eastern Cape	8	-32.04423	24.6726
22450	Passeriformes	Muscicapidae	*Cossypha*	*caffra*	F	Eastern Cape	8	-32.04423	24.6726
22451	Passeriformes	Muscicapidae	*Cossypha*	*caffra*	F	Eastern Cape	8	-32.04423	24.6726
22312	Passeriformes	Muscicapidae	*Cossypha*	*caffra*	M	Eastern Cape	8	-32.07803	24.67859
22326	Passeriformes	Muscicapidae	*Cossypha*	*caffra*	F	Eastern Cape	8	-32.07803	24.67859
22332	Passeriformes	Muscicapidae	*Cossypha*	*caffra*	F	Eastern Cape	9	-32.02632	25.54285
22345	Passeriformes	Muscicapidae	*Cossypha*	*caffra*	M	Eastern Cape	9	-32.02632	25.54285
22418	Passeriformes	Muscicapidae	*Cossypha*	*caffra*	M	Eastern Cape	9	-32.02632	25.54285
22505	Passeriformes	Muscicapidae	*Cossypha*	*caffra*	F	Eastern Cape	9	-32.02632	25.54285
22510	Passeriformes	Muscicapidae	*Cossypha*	*caffra*	M	Eastern Cape	9	-32.02632	25.54285
22362	Passeriformes	Muscicapidae	*Cossypha*	*caffra*	M	Eastern Cape	10	-33.29847	26.4641
22366	Passeriformes	Muscicapidae	*Cossypha*	*caffra*	F	Eastern Cape	10	-33.29847	26.4641
22367	Passeriformes	Muscicapidae	*Cossypha*	*caffra*	M	Eastern Cape	10	-33.29847	26.4641
22557	Passeriformes	Muscicapidae	*Cossypha*	*caffra*	F	Eastern Cape	10	-33.29847	26.4641
16937	Passeriformes	Muscicapidae	*Cossypha*	*humeralis*	M	Limpopo	3	-23.593055	29.783889
16938	Passeriformes	Muscicapidae	*Cossypha*	*humeralis*	M	Limpopo	3	-23.593055	29.783889
16941	Passeriformes	Muscicapidae	*Cossypha*	*humeralis*	F	Limpopo	3	-23.593055	29.783889
17310	Passeriformes	Muscicapidae	*Cossypha*	*humeralis*	F	Limpopo	3	-23.593055	29.783889
17311	Passeriformes	Muscicapidae	*Cossypha*	*humeralis*	M	Limpopo	3	-23.593055	29.783889
16939*	Passeriformes	Muscicapidae	*Cossypha*	*humeralis*	F	Limpopo	3	-23.593055	29.783889
17309	Passeriformes	Muscicapidae	*Cossypha*	*humeralis*	M	Limpopo	3	-23.674192	29.912025
22559	Passeriformes	Muscicapidae	*Monticola*	*rupestris*	F	Eastern Cape	11	-33.32144	26.52419
17274	Passeriformes	Muscicapidae	*Muscicapa*	*caerulescens*	M	Limpopo	3	-23.674192	29.912025
15610	Passeriformes	Muscicapidae	*Muscicapa*	*striata*	M	Northern Cape	6	-28.596167	24.858500
15609*	Passeriformes	Muscicapidae	*Muscicapa*	*striata*	F	Northern Cape	6	-28.596167	24.858500
17614	Passeriformes	Muscicapidae	*Myrmecocichla*	*formicivora*	F	Mpumalanga	4	-26.594167	29.116111

17611*	Passeriformes	Muscicapidae	*Myrmecocichla*	*formicivora*	F	Mpumalanga	4	-26.594167	29.116111
17612*	Passeriformes	Muscicapidae	*Myrmecocichla*	*formicivora*	F	Mpumalanga	4	-26.594167	29.116111
17613*	Passeriformes	Muscicapidae	*Myrmecocichla*	*formicivora*	M	Mpumalanga	4	-26.594167	29.116111
15581	Passeriformes	Muscicapidae	*Myrmecocichla*	*formicivora*	M	Northern Cape	6	-28.596167	24.858500
15582	Passeriformes	Muscicapidae	*Myrmecocichla*	*formicivora*	F	Northern Cape	6	-28.596167	24.858500
15583	Passeriformes	Muscicapidae	*Myrmecocichla*	*formicivora*	F	Northern Cape	6	-28.596167	24.858500
15585	Passeriformes	Muscicapidae	*Myrmecocichla*	*formicivora*	M	Northern Cape	6	-28.596167	24.858500
14968	Passeriformes	Muscicapidae	*Myrmecocichla*	*formicivora*	M	Free State	6	-28.596167	24.858500
14969	Passeriformes	Muscicapidae	*Myrmecocichla*	*formicivora*	M	Free State	6	-28.596167	24.858500
14970	Passeriformes	Muscicapidae	*Myrmecocichla*	*formicivora*	M	Free State	6	-28.596167	24.858500
17615	Passeriformes	Muscicapidae	*Myrmecocichla*	*formicivora*	M	Free State	7	-30.508611	26.613611
17616	Passeriformes	Muscicapidae	*Myrmecocichla*	*formicivora*	M	Free State	7	-30.508611	26.613611
17617	Passeriformes	Muscicapidae	*Myrmecocichla*	*formicivora*	M	Free State	7	-30.508611	26.613611
22466*	Passeriformes	Muscicapidae	*Myrmecocichla*	*formicivora*	M	Eastern Cape	8	-32.04423	24.6726
22321	Passeriformes	Muscicapidae	*Myrmecocichla*	*formicivora*	M	Eastern Cape	8	-32.07803	24.67859
15605	Passeriformes	Muscicapidae	*Oenanthe*	*pileata*	M	Northern Cape	6	-28.596167	24.858500
15606	Passeriformes	Muscicapidae	*Oenanthe*	*pileata*	F	Northern Cape	6	-28.596167	24.858500
17610	Passeriformes	Muscicapidae	*Saxicola*	*torquatus*	M	Free State	7	-30.508611	26.613611
16995*	Passeriformes	Muscicapidae	*Sigelus*	*silens*	F	Limpopo	3	-23.593055	29.783889
16994	Passeriformes	Muscicapidae	*Sigelus*	*silens*	M	Northern Cape	5	-28.418889	24.073330
17639	Passeriformes	Muscicapidae	*Sigelus*	*silens*	F	Northern Cape	5	-28.418889	24.073330
17641	Passeriformes	Muscicapidae	*Sigelus*	*silens*	M	Northern Cape	5	-28.418889	24.073330
17640*	Passeriformes	Muscicapidae	*Sigelus*	*silens*	M	Northern Cape	5	-28.418889	24.073330
15586	Passeriformes	Muscicapidae	*Sigelus*	*silens*	F	Northern Cape	6	-28.596167	24.858500
15587	Passeriformes	Muscicapidae	*Sigelus*	*silens*	F	Northern Cape	6	-28.596167	24.858500
15588	Passeriformes	Muscicapidae	*Sigelus*	*silens*	F	Northern Cape	6	-28.596167	24.858500
15589	Passeriformes	Muscicapidae	*Sigelus*	*silens*	M	Northern Cape	6	-28.596167	24.858500
15590	Passeriformes	Muscicapidae	*Sigelus*	*silens*	F	Northern Cape	6	-28.596167	24.858500
14971	Passeriformes	Muscicapidae	*Sigelus*	*silens*	M	Free State	6	-28.596167	24.858500
14973	Passeriformes	Muscicapidae	*Sigelus*	*silens*	F	Free State	6	-28.596167	24.858500
14975	Passeriformes	Muscicapidae	*Sigelus*	*silens*	M	Free State	6	-28.596167	24.858500
14976	Passeriformes	Muscicapidae	*Sigelus*	*silens*	M	Free State	6	-28.596167	24.858500
14972	Passeriformes	Muscicapidae	*Sigelus*	*silens*	M	Northern Cape	6	-28.954167	24.731111
17632	Passeriformes	Muscicapidae	*Sigelus*	*silens*	F	Free State	7	-30.508611	26.613611
17633	Passeriformes	Muscicapidae	*Sigelus*	*silens*	F	Free State	7	-30.508611	26.613611
17634	Passeriformes	Muscicapidae	*Sigelus*	*silens*	M	Free State	7	-30.508611	26.613611
17635	Passeriformes	Muscicapidae	*Sigelus*	*silens*	M	Free State	7	-30.508611	26.613611
17636	Passeriformes	Muscicapidae	*Sigelus*	*silens*	F	Free State	7	-30.508611	26.613611
17631*	Passeriformes	Muscicapidae	*Sigelus*	*silens*	M	Free State	7	-30.508611	26.613611
22465*	Passeriformes	Muscicapidae	*Sigelus*	*silens*	M	Eastern Cape	8	-32.04423	24.6726

22315	Passeriformes	Muscicapidae	*Sigelus*	*silens*	M	Eastern Cape	8	-32.07803	24.67859
22396	Passeriformes	Muscicapidae	*Sigelus*	*silens*	F	Eastern Cape	8	-32.07803	24.67859
22404	Passeriformes	Muscicapidae	*Sigelus*	*silens*	F	Eastern Cape	8	-32.07803	24.67859
22341	Passeriformes	Muscicapidae	*Sigelus*	*silens*	M	Eastern Cape	9	-32.02632	25.54285
22427	Passeriformes	Muscicapidae	*Sigelus*	*silens*	M	Eastern Cape	9	-32.02632	25.54285
22521	Passeriformes	Muscicapidae	*Sigelus*	*silens*	M	Eastern Cape	9	-32.02632	25.54285
15591	Passeriformes	Muscicapidae	*Stenostira*	*scita*	F	Northern Cape	6	-28.596167	24.858500
15592	Passeriformes	Muscicapidae	*Stenostira*	*scita*	M	Northern Cape	6	-28.596167	24.858500
15593	Passeriformes	Muscicapidae	*Stenostira*	*scita*	F	Northern Cape	6	-28.596167	24.858500
14999	Passeriformes	Muscicapidae	*Stenostira*	*scita*	M	Northern Cape	6	-28.954167	24.731111
15000	Passeriformes	Muscicapidae	*Stenostira*	*scita*	M	Northern Cape	6	-28.954167	24.731111
22574	Passeriformes	Muscicapidae	*Stenostira*	*scita*	M	Eastern Cape	8	-32.04423	24.6726
22485*	Passeriformes	Muscicapidae	*Stenostira*	*scita*	M	Eastern Cape	8	-32.07803	24.67859
17522	Passeriformes	Nectariniidae	*Chalcomitra*	*amethystina*	F	Limpopo	3	-23.593055	29.783889
17523	Passeriformes	Nectariniidae	*Chalcomitra*	*amethystina*	F	Limpopo	3	-23.674192	29.912025
17524	Passeriformes	Nectariniidae	*Chalcomitra*	*amethystina*	M	Limpopo	3	-23.674192	29.912025
17525	Passeriformes	Nectariniidae	*Chalcomitra*	*amethystina*	M	Limpopo	3	-23.674192	29.912025
17526	Passeriformes	Nectariniidae	*Chalcomitra*	*amethystina*	M	Limpopo	3	-23.674192	29.912025
17527	Passeriformes	Nectariniidae	*Chalcomitra*	*amethystina*	M	Limpopo	3	-23.674192	29.912025
17652	Passeriformes	Nectariniidae	*Chalcomitra*	*amethystina*	U	Limpopo	3	-23.674192	29.912025
22476	Passeriformes	Nectariniidae	*Chalcomitra*	*amethystina*	F	Eastern Cape	8	-32.07803	24.67859
22488	Passeriformes	Nectariniidae	*Chalcomitra*	*amethystina*	M	Eastern Cape	8	-32.07803	24.67859
22339	Passeriformes	Nectariniidae	*Chalcomitra*	*amethystina*	M	Eastern Cape	9	-32.02632	25.54285
22340	Passeriformes	Nectariniidae	*Chalcomitra*	*amethystina*	M	Eastern Cape	9	-32.02632	25.54285
22353	Passeriformes	Nectariniidae	*Chalcomitra*	*amethystina*	M	Eastern Cape	9	-32.02632	25.54285
22515*	Passeriformes	Nectariniidae	*Chalcomitra*	*amethystina*	F	Eastern Cape	9	-32.02632	25.54285
22523*	Passeriformes	Nectariniidae	*Chalcomitra*	*amethystina*	F	Eastern Cape	9	-32.02632	25.54285
17528	Passeriformes	Nectariniidae	*Chalcomitra*	*senegalensis*	M	Limpopo	3	-23.674192	29.912025
17529	Passeriformes	Nectariniidae	*Chalcomitra*	*senegalensis*	M	Limpopo	3	-23.674192	29.912025
17530	Passeriformes	Nectariniidae	*Chalcomitra*	*senegalensis*	M	Limpopo	3	-23.674192	29.912025
17531	Passeriformes	Nectariniidae	*Cinnyris*	*afer*	M	Limpopo	3	-23.674192	29.912025
17532	Passeriformes	Nectariniidae	*Cinnyris*	*afer*	M	Limpopo	3	-23.674192	29.912025
17533	Passeriformes	Nectariniidae	*Cinnyris*	*afer*	M	Limpopo	3	-23.674192	29.912025
17651	Passeriformes	Nectariniidae	*Cinnyris*	*afer*	U	Limpopo	3	-23.674192	29.912025
22357	Passeriformes	Nectariniidae	*Cinnyris*	*afer*	M	Eastern Cape	10	-33.29847	26.4641
22370	Passeriformes	Nectariniidae	*Cinnyris*	*afer*	M	Eastern Cape	10	-33.29847	26.4641
22608*	Passeriformes	Nectariniidae	*Cinnyris*	*chalybeus*	M	Eastern Cape	8	-32.04423	24.6726
22530	Passeriformes	Nectariniidae	*Cinnyris*	*chalybeus*	M	Eastern Cape	9	-32.02632	25.54285
22534	Passeriformes	Nectariniidae	*Cinnyris*	*chalybeus*	F	Eastern Cape	9	-32.02632	25.54285
22333*	Passeriformes	Nectariniidae	*Cinnyris*	*chalybeus*	M	Eastern Cape	9	-32.02632	25.54285

22514*	Passeriformes	Nectariniidae	*Cinnyris*	*chalybeus*	M	Eastern Cape	9	-32.02632	25.54285
21536	Passeriformes	Nectariniidae	*Cinnyris*	*mariquensis*	M	Limpopo	1	-22.2673	29.3307
21569	Passeriformes	Nectariniidae	*Cinnyris*	*mariquensis*	M	Limpopo	1	-22.2673	29.3307
21604	Passeriformes	Nectariniidae	*Cinnyris*	*mariquensis*	M	Limpopo	1	-22.2673	29.3307
21605	Passeriformes	Nectariniidae	*Cinnyris*	*mariquensis*	M	Limpopo	1	-22.2673	29.3307
21633	Passeriformes	Nectariniidae	*Cinnyris*	*mariquensis*	M	Limpopo	1	-22.2673	29.3307
16797	Passeriformes	Nectariniidae	*Cinnyris*	*mariquensis*	M	Limpopo	3	-23.593055	29.783889
16798	Passeriformes	Nectariniidae	*Cinnyris*	*mariquensis*	M	Limpopo	3	-23.593055	29.783889
16799	Passeriformes	Nectariniidae	*Cinnyris*	*mariquensis*	M	Limpopo	3	-23.593055	29.783889
16800	Passeriformes	Nectariniidae	*Cinnyris*	*mariquensis*	M	Limpopo	3	-23.593055	29.783889
16801	Passeriformes	Nectariniidae	*Cinnyris*	*mariquensis*	M	Limpopo	3	-23.593055	29.783889
16802	Passeriformes	Nectariniidae	*Cinnyris*	*mariquensis*	F	Limpopo	3	-23.593055	29.783889
16803	Passeriformes	Nectariniidae	*Cinnyris*	*mariquensis*	F	Limpopo	3	-23.593055	29.783889
16804	Passeriformes	Nectariniidae	*Cinnyris*	*mariquensis*	F	Limpopo	3	-23.593055	29.783889
21534	Passeriformes	Nectariniidae	*Cinnyris*	*talatala*	M	Limpopo	1	-22.2673	29.3307
21535	Passeriformes	Nectariniidae	*Cinnyris*	*talatala*	M	Limpopo	1	-22.2673	29.3307
21556	Passeriformes	Nectariniidae	*Cinnyris*	*talatala*	M	Limpopo	1	-22.2673	29.3307
21562	Passeriformes	Nectariniidae	*Cinnyris*	*talatala*	M	Limpopo	1	-22.2673	29.3307
21563	Passeriformes	Nectariniidae	*Cinnyris*	*talatala*	M	Limpopo	1	-22.2673	29.3307
21634	Passeriformes	Nectariniidae	*Cinnyris*	*talatala*	F	Limpopo	1	-22.2673	29.3307
16781	Passeriformes	Nectariniidae	*Cinnyris*	*talatala*	M	Limpopo	3	-23.593055	29.783889
16782	Passeriformes	Nectariniidae	*Cinnyris*	*talatala*	M	Limpopo	3	-23.593055	29.783889
16783	Passeriformes	Nectariniidae	*Cinnyris*	*talatala*	M	Limpopo	3	-23.593055	29.783889
16784	Passeriformes	Nectariniidae	*Cinnyris*	*talatala*	M	Limpopo	3	-23.593055	29.783889
16785	Passeriformes	Nectariniidae	*Cinnyris*	*talatala*	M	Limpopo	3	-23.593055	29.783889
16786	Passeriformes	Nectariniidae	*Cinnyris*	*talatala*	M	Limpopo	3	-23.593055	29.783889
16787	Passeriformes	Nectariniidae	*Cinnyris*	*talatala*	M	Limpopo	3	-23.593055	29.783889
16788	Passeriformes	Nectariniidae	*Cinnyris*	*talatala*	M	Limpopo	3	-23.593055	29.783889
16789	Passeriformes	Nectariniidae	*Cinnyris*	*talatala*	M	Limpopo	3	-23.593055	29.783889
16790	Passeriformes	Nectariniidae	*Cinnyris*	*talatala*	F	Limpopo	3	-23.593055	29.783889
16791	Passeriformes	Nectariniidae	*Cinnyris*	*talatala*	F	Limpopo	3	-23.593055	29.783889
16792	Passeriformes	Nectariniidae	*Cinnyris*	*talatala*	F	Limpopo	3	-23.593055	29.783889
16793	Passeriformes	Nectariniidae	*Cinnyris*	*talatala*	F	Limpopo	3	-23.593055	29.783889
16794	Passeriformes	Nectariniidae	*Cinnyris*	*talatala*	F	Limpopo	3	-23.593055	29.783889
16795	Passeriformes	Nectariniidae	*Cinnyris*	*talatala*	F	Limpopo	3	-23.593055	29.783889
16796	Passeriformes	Nectariniidae	*Cinnyris*	*talatala*	F	Limpopo	3	-23.593055	29.783889
17534	Passeriformes	Nectariniidae	*Cinnyris*	*talatala*	M	Limpopo	3	-23.674192	29.912025
22518	Passeriformes	Nectariniidae	*Nectarinia*	*famosa*	F	Eastern Cape	9	-32.02632	25.54285
22533	Passeriformes	Nectariniidae	*Nectarinia*	*famosa*	M	Eastern Cape	9	-32.02632	25.54285
22432*	Passeriformes	Nectariniidae	*Nectarinia*	*famosa*	M	Eastern Cape	9	-32.02632	25.54285

16956	Passeriformes	Oriolidae	*Oriolus*	*larvatus*	M	Limpopo	3	-23.593055	29.783889
17387	Passeriformes	Oriolidae	*Oriolus*	*larvatus*	F	Limpopo	3	-23.593055	29.783889
17388	Passeriformes	Oriolidae	*Oriolus*	*larvatus*	M	Limpopo	3	-23.674192	29.912025
17389*	Passeriformes	Oriolidae	*Oriolus*	*larvatus*	F	Limpopo	3	-23.674192	29.912025
22562	Passeriformes	Oriolidae	*Oriolus*	*larvatus*	M	Eastern Cape	10	-33.29847	26.4641
22561*	Passeriformes	Oriolidae	*Oriolus*	*larvatus*	M	Eastern Cape	10	-33.29847	26.4641
15571	Passeriformes	Oriolidae	*Oriolus*	*oriolus*	F	Northern Cape	6	-28.596167	24.858500
16900*	Passeriformes	Paridae	*Parus*	*cinerascens*	F	Limpopo	3	-23.593055	29.783889
15022*	Passeriformes	Paridae	*Parus*	*cinerascens*	F	Free State	6	-28.596167	24.858500
15021	Passeriformes	Paridae	*Parus*	*cinerascens*	M	Northern Cape	6	-28.954167	24.731111
15023	Passeriformes	Paridae	*Parus*	*cinerascens*	F	Northern Cape	6	-28.954167	24.731111
21561*†	Passeriformes	Paridae	*Parus*	*niger*	M	Limpopo	1	-22.2673	29.3307
16897	Passeriformes	Paridae	*Parus*	*niger*	U	Limpopo	2	-22.619444	29.834167
16898	Passeriformes	Paridae	*Parus*	*niger*	M	Limpopo	2	-22.619444	29.834167
16899*	Passeriformes	Paridae	*Parus*	*niger*	F	Limpopo	2	-22.619444	29.834167
17579	Passeriformes	Paridae	*Parus*	*niger*	M	Limpopo	3	-23.593055	29.783889
21622	Passeriformes	Passeridae	*Passer*	*diffusus*	M	Limpopo	1	-22.2673	29.3307
21639	Passeriformes	Passeridae	*Passer*	*diffusus*	F	Limpopo	1	-22.2673	29.3307
21625*	Passeriformes	Passeridae	*Passer*	*diffusus*	M	Limpopo	1	-22.2673	29.3307
21640*	Passeriformes	Passeridae	*Passer*	*diffusus*	M	Limpopo	1	-22.2673	29.3307
16823*	Passeriformes	Passeridae	*Passer*	*diffusus*	F	Limpopo	2	-22.619444	29.834167
17580	Passeriformes	Passeridae	*Passer*	*diffusus*	M	Limpopo	3	-23.593055	29.783889
17581	Passeriformes	Passeridae	*Passer*	*diffusus*	M	Northern Cape	5	-28.418889	24.073330
15574	Passeriformes	Passeridae	*Passer*	*diffusus*	F	Northern Cape	6	-28.596167	24.858500
15041	Passeriformes	Passeridae	*Passer*	*diffusus*	F	Free State	6	-28.596167	24.858500
15042	Passeriformes	Passeridae	*Passer*	*diffusus*	M	Free State	6	-28.596167	24.858500
15043	Passeriformes	Passeridae	*Passer*	*diffusus*	F	Free State	6	-28.596167	24.858500
15044	Passeriformes	Passeridae	*Passer*	*diffusus*	M	Free State	6	-28.596167	24.858500
15040*	Passeriformes	Passeridae	*Passer*	*diffusus*	F	Free State	6	-28.596167	24.858500
17582	Passeriformes	Passeridae	*Passer*	*diffusus*	M	Free State	7	-30.508611	26.613611
22714	Passeriformes	Passeridae	*Passer*	*diffusus*	M	Eastern Cape	8	-32.04423	24.6726
22463*	Passeriformes	Passeridae	*Passer*	*diffusus*	M	Eastern Cape	8	-32.04423	24.6726
22464*	Passeriformes	Passeridae	*Passer*	*diffusus*	M	Eastern Cape	8	-32.04423	24.6726
22599*	Passeriformes	Passeridae	*Passer*	*diffusus*	F	Eastern Cape	8	-32.04423	24.6726
22421	Passeriformes	Passeridae	*Passer*	*diffusus*	F	Eastern Cape	9	-32.02632	25.54285
22532*	Passeriformes	Passeridae	*Passer*	*diffusus*	F	Eastern Cape	9	-32.02632	25.54285
15611	Passeriformes	Passeridae	*Passer*	*melanurus*	F	Northern Cape	6	-28.596167	24.858500
15613	Passeriformes	Passeridae	*Passer*	*melanurus*	M	Northern Cape	6	-28.596167	24.858500
15614	Passeriformes	Passeridae	*Passer*	*melanurus*	M	Northern Cape	6	-28.596167	24.858500
15612*†	Passeriformes	Passeridae	*Passer*	*melanurus*	F	Northern Cape	6	-28.596167	24.858500

17584	Passeriformes	Passeridae	*Passer*	*melanurus*	F	Free State	7	-30.508611	26.613611
17583*	Passeriformes	Passeridae	*Passer*	*melanurus*	M	Free State	7	-30.508611	26.613611
22387	Passeriformes	Passeridae	*Passer*	*melanurus*	M	Eastern Cape	8	-32.04423	24.6726
22388	Passeriformes	Passeridae	*Passer*	*melanurus*	F	Eastern Cape	8	-32.04423	24.6726
22572	Passeriformes	Passeridae	*Passer*	*melanurus*	F	Eastern Cape	8	-32.04423	24.6726
22380	Passeriformes	Passeridae	*Passer*	*melanurus*	M	Eastern Cape	8	-32.04423	24.6726
22318*	Passeriformes	Passeridae	*Passer*	*melanurus*	M	Eastern Cape	8	-32.07803	24.67859
22411*	Passeriformes	Passeridae	*Passer*	*melanurus*	M	Eastern Cape	8	-32.07803	24.67859
22480*	Passeriformes	Passeridae	*Passer*	*melanurus*	M	Eastern Cape	8	-32.07803	24.67859
22495*	Passeriformes	Passeridae	*Passer*	*melanurus*	F	Eastern Cape	8	-32.07803	24.67859
15034	Passeriformes	Passeridae	*Philetairus*	*socius*	M	Free State	6	-28.596167	24.858500
15035	Passeriformes	Passeridae	*Philetairus*	*socius*	F	Free State	6	-28.596167	24.858500
15036	Passeriformes	Passeridae	*Philetairus*	*socius*	M	Free State	6	-28.596167	24.858500
15037	Passeriformes	Passeridae	*Philetairus*	*socius*	M	Free State	6	-28.596167	24.858500
21592	Passeriformes	Passeridae	*Plocepasser*	*mahali*	F	Limpopo	1	-22.34805	29.3258
16965	Passeriformes	Passeridae	*Plocepasser*	*mahali*	F	Limpopo	2	-22.619444	29.834167
16967	Passeriformes	Passeridae	*Plocepasser*	*mahali*	F	Limpopo	2	-22.619444	29.834167
16963*	Passeriformes	Passeridae	*Plocepasser*	*mahali*	M	Limpopo	2	-22.619444	29.834167
16964*	Passeriformes	Passeridae	*Plocepasser*	*mahali*	F	Limpopo	2	-22.619444	29.834167
16966*	Passeriformes	Passeridae	*Plocepasser*	*mahali*	M	Limpopo	2	-22.619444	29.834167
16968	Passeriformes	Passeridae	*Plocepasser*	*mahali*	M	Limpopo	3	-23.593055	29.783889
15576*	Passeriformes	Passeridae	*Plocepasser*	*mahali*	U	Northern Cape	6	-28.596167	24.858500
15577*	Passeriformes	Passeridae	*Plocepasser*	*mahali*	M	Northern Cape	6	-28.596167	24.858500
17510	Passeriformes	Passeridae	*Sporopipes*	*squamifrons*	F	Limpopo	3	-23.593055	29.783889
17511*	Passeriformes	Passeridae	*Sporopipes*	*squamifrons*	M	Limpopo	3	-23.593055	29.783889
17512*	Passeriformes	Passeridae	*Sporopipes*	*squamifrons*	F	Limpopo	3	-23.593055	29.783889
15595	Passeriformes	Passeridae	*Sporopipes*	*squamifrons*	F	Northern Cape	6	-28.596167	24.858500
21590	Passeriformes	Platysteiridae	*Batis*	*molitor*	M	Limpopo	1	-22.2673	29.3307
16850	Passeriformes	Platysteiridae	*Batis*	*molitor*	F	Limpopo	3	-23.593055	29.783889
16851	Passeriformes	Platysteiridae	*Batis*	*molitor*	F	Limpopo	3	-23.593055	29.783889
16852	Passeriformes	Platysteiridae	*Batis*	*molitor*	M	Limpopo	3	-23.593055	29.783889
17521	Passeriformes	Platysteiridae	*Batis*	*molitor*	F	Limpopo	3	-23.593055	29.783889
16853*†	Passeriformes	Platysteiridae	*Batis*	*molitor*	M	Limpopo	3	-23.593055	29.783889
17519	Passeriformes	Platysteiridae	*Batis*	*pririt*	M	Northern Cape	5	-28.418889	24.073330
17520	Passeriformes	Platysteiridae	*Batis*	*pririt*	M	Northern Cape	5	-28.418889	24.073330
15594	Passeriformes	Platysteiridae	*Batis*	*pririt*	M	Northern Cape	6	-28.596167	24.858500
15026	Passeriformes	Platysteiridae	*Batis*	*pririt*	M	Free State	6	-28.596167	24.858500
15029	Passeriformes	Platysteiridae	*Batis*	*pririt*	F	Free State	6	-28.596167	24.858500
15030	Passeriformes	Platysteiridae	*Batis*	*pririt*	M	Free State	6	-28.596167	24.858500
15028*	Passeriformes	Platysteiridae	*Batis*	*pririt*	M	Free State	6	-28.596167	24.858500

15027	Passeriformes	Platysteiridae	*Batis*	*pririt*	M	Northern Cape	6	-28.954167	24.731111
22482	Passeriformes	Platysteiridae	*Batis*	*pririt*	M	Eastern Cape	8	-32.07803	24.67859
21541	Passeriformes	Ploceidae	*Anaplectes*	*melanotis*	M	Limpopo	1	-22.2673	29.3307
21553	Passeriformes	Ploceidae	*Anaplectes*	*melanotis*	F	Limpopo	1	-22.2673	29.3307
21554	Passeriformes	Ploceidae	*Anaplectes*	*melanotis*	F	Limpopo	1	-22.2673	29.3307
21641	Passeriformes	Ploceidae	*Anaplectes*	*melanotis*	M	Limpopo	1	-22.2673	29.3307
21586*	Passeriformes	Ploceidae	*Anaplectes*	*melanotis*	M	Limpopo	1	-22.2673	29.3307
16849	Passeriformes	Ploceidae	*Anaplectes*	*melanotis*	M	Limpopo	2	-22.619444	29.834167
17017	Passeriformes	Ploceidae	*Bubalornis*	*niger*	F	Limpopo	2	-22.619444	29.834167
17016*	Passeriformes	Ploceidae	*Bubalornis*	*niger*	M	Limpopo	2	-22.619444	29.834167
16887	Passeriformes	Ploceidae	*Euplectes*	*albonotatus*	F	Limpopo	3	-23.593055	29.783889
16888	Passeriformes	Ploceidae	*Euplectes*	*albonotatus*	M	Limpopo	3	-23.593055	29.783889
17546	Passeriformes	Ploceidae	*Euplectes*	*capensis*	F	Limpopo	3	-23.593055	29.783889
22445	Passeriformes	Ploceidae	*Euplectes*	*capensis*	M	Eastern Cape	10	-33.29847	26.4641
22446	Passeriformes	Ploceidae	*Euplectes*	*capensis*	M	Eastern Cape	10	-33.29847	26.4641
22556	Passeriformes	Ploceidae	*Euplectes*	*capensis*	F	Eastern Cape	10	-33.29847	26.4641
22555*	Passeriformes	Ploceidae	*Euplectes*	*capensis*	M	Eastern Cape	10	-33.29847	26.4641
22454	Passeriformes	Ploceidae	*Euplectes*	*orix*	M	Eastern Cape	8	-32.04423	24.6726
22459	Passeriformes	Ploceidae	*Euplectes*	*orix*	M	Eastern Cape	8	-32.04423	24.6726
16751*	Passeriformes	Ploceidae	*Ploceus*	*capensis*	F	Limpopo	3	-23.593055	29.783889
17608	Passeriformes	Ploceidae	*Ploceus*	*capensis*	M	Mpumalanga	4	-26.594167	29.116111
22360	Passeriformes	Ploceidae	*Ploceus*	*capensis*	M	Eastern Cape	10	-33.29847	26.4641
22540	Passeriformes	Ploceidae	*Ploceus*	*capensis*	M	Eastern Cape	10	-33.29847	26.4641
22545	Passeriformes	Ploceidae	*Ploceus*	*capensis*	M	Eastern Cape	10	-33.29847	26.4641
22361*	Passeriformes	Ploceidae	*Ploceus*	*capensis*	M	Eastern Cape	10	-33.29847	26.4641
22440*	Passeriformes	Ploceidae	*Ploceus*	*capensis*	F	Eastern Cape	10	-33.29847	26.4641
22442*	Passeriformes	Ploceidae	*Ploceus*	*capensis*	M	Eastern Cape	10	-33.29847	26.4641
22539*	Passeriformes	Ploceidae	*Ploceus*	*capensis*	M	Eastern Cape	10	-33.29847	26.4641
22537	Passeriformes	Ploceidae	*Ploceus*	*capensis*	F	Eastern Cape	11	-33.32144	26.52419
22548*	Passeriformes	Ploceidae	*Ploceus*	*capensis*	M	Eastern Cape	11	-33.32144	26.52419
17606*	Passeriformes	Ploceidae	*Ploceus*	*cucullatus*	F	Limpopo	3	-23.593055	29.783889
22541	Passeriformes	Ploceidae	*Ploceus*	*cucullatus*	F	Eastern Cape	10	-33.29847	26.4641
22441*	Passeriformes	Ploceidae	*Ploceus*	*cucullatus*	F	Eastern Cape	10	-33.29847	26.4641
22536*	Passeriformes	Ploceidae	*Ploceus*	*cucullatus*	M	Eastern Cape	11	-33.32144	26.52419
21557	Passeriformes	Ploceidae	*Ploceus*	*intermedius*	F	Limpopo	1	-22.2673	29.3307
21570	Passeriformes	Ploceidae	*Ploceus*	*intermedius*	M	Limpopo	1	-22.2673	29.3307
21610	Passeriformes	Ploceidae	*Ploceus*	*intermedius*	F	Limpopo	1	-22.2673	29.3307
21638	Passeriformes	Ploceidae	*Ploceus*	*intermedius*	F	Limpopo	1	-22.2673	29.3307
16952	Passeriformes	Ploceidae	*Ploceus*	*ocularis*	M	Limpopo	3	-23.593055	29.783889
16953	Passeriformes	Ploceidae	*Ploceus*	*ocularis*	M	Limpopo	3	-23.593055	29.783889

16954	Passeriformes	Ploceidae	*Ploceus*	*ocularis*	F	Limpopo	3	-23.593055	29.783889
17607	Passeriformes	Ploceidae	*Ploceus*	*ocularis*	F	Limpopo	3	-23.593055	29.783889
16953*	Passeriformes	Ploceidae	*Ploceus*	*ocularis*	M	Limpopo	3	-23.593055	29.783889
17607*	Passeriformes	Ploceidae	*Ploceus*	*ocularis*	F	Limpopo	3	-23.593055	29.783889
21579	Passeriformes	Ploceidae	*Ploceus*	sp.	M	Limpopo	1	-22.2673	29.3307
21580	Passeriformes	Ploceidae	*Ploceus*	sp.	M	Limpopo	1	-22.2673	29.3307
21611	Passeriformes	Ploceidae	*Ploceus*	*velatus*	M	Limpopo	1	-22.2673	29.3307
21612	Passeriformes	Ploceidae	*Ploceus*	*velatus*	M	Limpopo	1	-22.2673	29.3307
21613	Passeriformes	Ploceidae	*Ploceus*	*velatus*	M	Limpopo	1	-22.2673	29.3307
21614	Passeriformes	Ploceidae	*Ploceus*	*velatus*	M	Limpopo	1	-22.2673	29.3307
16752	Passeriformes	Ploceidae	*Ploceus*	*velatus*	F	Northern Cape	5	-28.418889	24.073330
16753	Passeriformes	Ploceidae	*Ploceus*	*velatus*	M	Northern Cape	5	-28.418889	24.073330
16754	Passeriformes	Ploceidae	*Ploceus*	*velatus*	M	Northern Cape	5	-28.418889	24.073330
17604	Passeriformes	Ploceidae	*Ploceus*	*velatus*	M	Northern Cape	5	-28.418889	24.073330
17605*	Passeriformes	Ploceidae	*Ploceus*	*velatus*	M	Northern Cape	5	-28.418889	24.073330
15652	Passeriformes	Ploceidae	*Ploceus*	*velatus*	M	Northern Cape	6	-28.596167	24.858500
15656	Passeriformes	Ploceidae	*Ploceus*	*velatus*	F	Northern Cape	6	-28.596167	24.858500
15657	Passeriformes	Ploceidae	*Ploceus*	*velatus*	F	Northern Cape	6	-28.596167	24.858500
15651*	Passeriformes	Ploceidae	*Ploceus*	*velatus*	M	Northern Cape	6	-28.596167	24.858500
15653*	Passeriformes	Ploceidae	*Ploceus*	*velatus*	M	Northern Cape	6	-28.596167	24.858500
15654*	Passeriformes	Ploceidae	*Ploceus*	*velatus*	M	Northern Cape	6	-28.596167	24.858500
15655*	Passeriformes	Ploceidae	*Ploceus*	*velatus*	M	Northern Cape	6	-28.596167	24.858500
17601	Passeriformes	Ploceidae	*Ploceus*	*velatus*	F	Free State	7	-30.508611	26.613611
17602	Passeriformes	Ploceidae	*Ploceus*	*velatus*	M	Free State	7	-30.508611	26.613611
17603	Passeriformes	Ploceidae	*Ploceus*	*velatus*	M	Free State	7	-30.508611	26.613611
17600*	Passeriformes	Ploceidae	*Ploceus*	*velatus*	M	Free State	7	-30.508611	26.613611
22596	Passeriformes	Ploceidae	*Ploceus*	*velatus*	M	Eastern Cape	8	-32.04423	24.6726
22597*	Passeriformes	Ploceidae	*Ploceus*	*velatus*	M	Eastern Cape	8	-32.04423	24.6726
22598	Passeriformes	Ploceidae	*Ploceus*	*velatus*	M	Eastern Cape	8	-32.04423	24.6726
22546	Passeriformes	Ploceidae	*Ploceus*	*velatus*	M	Eastern Cape	10	-33.29847	26.4641
22547	Passeriformes	Ploceidae	*Ploceus*	*velatus*	M	Eastern Cape	10	-33.29847	26.4641
22554	Passeriformes	Ploceidae	*Ploceus*	*velatus*	M	Eastern Cape	10	-33.29847	26.4641
22543*	Passeriformes	Ploceidae	*Ploceus*	*velatus*	M	Eastern Cape	10	-33.29847	26.4641
15013*	Passeriformes	Ploceidae	*Quelea*	*quelea*	M	Northern Cape	6	-28.596167	24.858500
22414	Passeriformes	Ploceidae	*Quelea*	*quelea*	F	Eastern Cape	8	-32.07803	24.67859
22415	Passeriformes	Ploceidae	*Quelea*	*quelea*	F	Eastern Cape	9	-32.02632	25.54285
22428	Passeriformes	Ploceidae	*Quelea*	*quelea*	M	Eastern Cape	9	-32.02632	25.54285
21551	Passeriformes	Prionopidae	*Prionops*	*plumatus*	F	Limpopo	1	-22.2673	29.3307
21552	Passeriformes	Prionopidae	*Prionops*	*plumatus*	F	Limpopo	1	-22.2673	29.3307
16720	Passeriformes	Prionopidae	*Prionops*	*plumatus*	F	Limpopo	2	-22.619444	29.834167

16719*	Passeriformes	Prionopidae	*Prionops*	*plumatus*	M	Limpopo	2	-22.619444	29.834167
17305	Passeriformes	Pycnonotidae	*Andropadus*	*importunus*	M	Limpopo	3	-23.593055	29.783889
17306	Passeriformes	Pycnonotidae	*Andropadus*	*importunus*	F	Limpopo	3	-23.593055	29.783889
17307	Passeriformes	Pycnonotidae	*Andropadus*	*importunus*	F	Limpopo	3	-23.593055	29.783889
17376	Passeriformes	Pycnonotidae	*Andropadus*	*importunus*	F	Limpopo	3	-23.593055	29.783889
22503	Passeriformes	Pycnonotidae	*Andropadus*	*importunus*	F	Eastern Cape	9	-32.02632	25.54285
17383	Passeriformes	Pycnonotidae	*Chlorocicla*	*flaviventris*	M	Limpopo	3	-23.593055	29.783889
17382*	Passeriformes	Pycnonotidae	*Chlorocicla*	*flaviventris*	F	Limpopo	3	-23.593055	29.783889
17380	Passeriformes	Pycnonotidae	*Chlorocicla*	*flaviventris*	M	Limpopo	3	-23.674192	29.912025
17381	Passeriformes	Pycnonotidae	*Chlorocicla*	*flaviventris*	M	Limpopo	3	-23.674192	29.912025
17595	Passeriformes	Pycnonotidae	*Chlorocicla*	*flaviventris*	F	Limpopo	3	-23.674192	29.912025
17619	Passeriformes	Pycnonotidae	*Phyllastrephus*	*terrestris*	F	Limpopo	3	-23.674192	29.912025
17620	Passeriformes	Pycnonotidae	*Phyllastrephus*	*terrestris*	M	Limpopo	3	-23.674192	29.912025
16744	Passeriformes	Pycnonotidae	*Pycnonotus*	*nigricans*	F	Northern Cape	5	-28.418889	24.073330
16745	Passeriformes	Pycnonotidae	*Pycnonotus*	*nigricans*	M	Northern Cape	5	-28.418889	24.073330
16746	Passeriformes	Pycnonotidae	*Pycnonotus*	*nigricans*	F	Northern Cape	5	-28.418889	24.073330
16747	Passeriformes	Pycnonotidae	*Pycnonotus*	*nigricans*	F	Northern Cape	5	-28.418889	24.073330
16750	Passeriformes	Pycnonotidae	*Pycnonotus*	*nigricans*	M	Northern Cape	5	-28.418889	24.073330
17353	Passeriformes	Pycnonotidae	*Pycnonotus*	*nigricans*	M	Northern Cape	5	-28.418889	24.073330
16743*	Passeriformes	Pycnonotidae	*Pycnonotus*	*nigricans*	F	Northern Cape	5	-28.418889	24.073330
16748*	Passeriformes	Pycnonotidae	*Pycnonotus*	*nigricans*	F	Northern Cape	5	-28.418889	24.073330
17354*	Passeriformes	Pycnonotidae	*Pycnonotus*	*nigricans*	M	Northern Cape	5	-28.418889	24.073330
MVZ198646 - 644*	Passeriformes	Pycnonotidae	*Pycnonotus*	*nigricans*	F	Northern Cape	5	-28.418889	24.07333
MVZ198652 - 650*	Passeriformes	Pycnonotidae	*Pycnonotus*	*nigricans*	F	Northern Cape	5	-28.418889	24.07333
17357	Passeriformes	Pycnonotidae	*Pycnonotus*	*nigricans*	F	Free State	7	-30.508611	26.613611
17358	Passeriformes	Pycnonotidae	*Pycnonotus*	*nigricans*	M	Free State	7	-30.508611	26.613611
17592	Passeriformes	Pycnonotidae	*Pycnonotus*	*nigricans*	F	Free State	7	-30.508611	26.613611
17355*	Passeriformes	Pycnonotidae	*Pycnonotus*	*nigricans*	M	Free State	7	-30.508611	26.613611
22456	Passeriformes	Pycnonotidae	*Pycnonotus*	*nigricans*	M	Eastern Cape	8	-32.04423	24.6726
22457	Passeriformes	Pycnonotidae	*Pycnonotus*	*nigricans*	M	Eastern Cape	8	-32.04423	24.6726
22458	Passeriformes	Pycnonotidae	*Pycnonotus*	*nigricans*	F	Eastern Cape	8	-32.04423	24.6726
22400	Passeriformes	Pycnonotidae	*Pycnonotus*	*nigricans*	M	Eastern Cape	8	-32.07803	24.67859
22401	Passeriformes	Pycnonotidae	*Pycnonotus*	*nigricans*	M	Eastern Cape	8	-32.07803	24.67859
22504	Passeriformes	Pycnonotidae	*Pycnonotus*	*nigricans*	M	Eastern Cape	8	-32.07803	24.67859
22403*	Passeriformes	Pycnonotidae	*Pycnonotus*	*nigricans*	F	Eastern Cape	8	-32.07803	24.67859
22405*	Passeriformes	Pycnonotidae	*Pycnonotus*	*nigricans*	M	Eastern Cape	8	-32.07803	24.67859
22491*	Passeriformes	Pycnonotidae	*Pycnonotus*	*nigricans*	F	Eastern Cape	8	-32.07803	24.67859
22417	Passeriformes	Pycnonotidae	*Pycnonotus*	*nigricans*	F	Eastern Cape	9	-32.02632	25.54285
22425	Passeriformes	Pycnonotidae	*Pycnonotus*	*nigricans*	F	Eastern Cape	9	-32.02632	25.54285
22433	Passeriformes	Pycnonotidae	*Pycnonotus*	*nigricans*	F	Eastern Cape	9	-32.02632	25.54285

22516	Passeriformes	Pycnonotidae	*Pycnonotus*	*nigricans*	M	Eastern Cape	9	-32.02632	25.54285
21559	Passeriformes	Pycnonotidae	*Pycnonotus*	*tricolor*	F	Limpopo	1	-22.2673	29.3307
21564	Passeriformes	Pycnonotidae	*Pycnonotus*	*tricolor*	M	Limpopo	1	-22.2673	29.3307
21565	Passeriformes	Pycnonotidae	*Pycnonotus*	*tricolor*	M	Limpopo	1	-22.2673	29.3307
21568	Passeriformes	Pycnonotidae	*Pycnonotus*	*tricolor*	F	Limpopo	1	-22.2673	29.3307
21571	Passeriformes	Pycnonotidae	*Pycnonotus*	*tricolor*	F	Limpopo	1	-22.2673	29.3307
21587	Passeriformes	Pycnonotidae	*Pycnonotus*	*tricolor*	M	Limpopo	1	-22.2673	29.3307
16749	Passeriformes	Pycnonotidae	*Pycnonotus*	*tricolor*	F	Limpopo	3	-23.593055	29.783889
17342	Passeriformes	Pycnonotidae	*Pycnonotus*	*tricolor*	M	Limpopo	3	-23.593055	29.783889
17343	Passeriformes	Pycnonotidae	*Pycnonotus*	*tricolor*	M	Limpopo	3	-23.593055	29.783889
17344	Passeriformes	Pycnonotidae	*Pycnonotus*	*tricolor*	M	Limpopo	3	-23.593055	29.783889
17346	Passeriformes	Pycnonotidae	*Pycnonotus*	*tricolor*	F	Limpopo	3	-23.593055	29.783889
17345*	Passeriformes	Pycnonotidae	*Pycnonotus*	*tricolor*	M	Limpopo	3	-23.593055	29.783889
17347*	Passeriformes	Pycnonotidae	*Pycnonotus*	*tricolor*	F	Limpopo	3	-23.593055	29.783889
17348	Passeriformes	Pycnonotidae	*Pycnonotus*	*tricolor*	M	Limpopo	3	-23.674192	29.912025
17349	Passeriformes	Pycnonotidae	*Pycnonotus*	*tricolor*	F	Limpopo	3	-23.674192	29.912025
17350	Passeriformes	Pycnonotidae	*Pycnonotus*	*tricolor*	M	Limpopo	3	-23.674192	29.912025
17351	Passeriformes	Pycnonotidae	*Pycnonotus*	*tricolor*	F	Limpopo	3	-23.674192	29.912025
17352	Passeriformes	Pycnonotidae	*Pycnonotus*	*tricolor*	F	Limpopo	3	-23.674192	29.912025
22438	Passeriformes	Pycnonotidae	*Pycnonotus*	*tricolor*	M	Eastern Cape	11	-33.32144	26.52419
22439	Passeriformes	Pycnonotidae	*Pycnonotus*	*tricolor*	F	Eastern Cape	11	-33.32144	26.52419
22713	Passeriformes	Pycnonotidae	*Pycnonotus*	*tricolor*	F	Eastern Cape	11	-33.32144	26.52419
21607	Passeriformes	Remizidae	*Anthoscopus*	*minutus*	M	Limpopo	1	-22.2673	29.3307
21608	Passeriformes	Remizidae	*Anthoscopus*	*minutus*	F	Limpopo	1	-22.2673	29.3307
16805	Passeriformes	Remizidae	*Anthoscopus*	*minutus*	M	Limpopo	3	-23.593055	29.783889
21549	Passeriformes	Sturnidae	*Buphagus*	*erythrorhynchus*	M	Limpopo	1	-22.2673	29.3307
21550	Passeriformes	Sturnidae	*Buphagus*	*erythrorhynchus*	M	Limpopo	1	-22.2673	29.3307
21619	Passeriformes	Sturnidae	*Cinnyricinclus*	*leucogaster*	M	Limpopo	1	-22.2673	29.3307
21628	Passeriformes	Sturnidae	*Creatophora*	*cinerea*	F	Limpopo	1	-22.2673	29.3307
21629*	Passeriformes	Sturnidae	*Creatophora*	*cinerea*	F	Limpopo	1	-22.2673	29.3307
21597	Passeriformes	Sturnidae	*Lamprotornis*	*nitens*	F	Limpopo	1	-22.34805	29.3258
16736	Passeriformes	Sturnidae	*Lamprotornis*	*nitens*	F	Limpopo	3	-23.593055	29.783889
16738	Passeriformes	Sturnidae	*Lamprotornis*	*nitens*	M	Limpopo	3	-23.593055	29.783889
16737*	Passeriformes	Sturnidae	*Lamprotornis*	*nitens*	M	Limpopo	3	-23.593055	29.783889
17271*	Passeriformes	Sturnidae	*Lamprotornis*	*nitens*	M	Northern Cape	5	-28.418889	24.073330
15560	Passeriformes	Sturnidae	*Lamprotornis*	*nitens*	M	Northern Cape	6	-28.596167	24.858500
15559*	Passeriformes	Sturnidae	*Lamprotornis*	*nitens*	M	Northern Cape	6	-28.596167	24.858500
22453	Passeriformes	Sturnidae	*Onychognathus*	*morio*	F	Eastern Cape	8	-32.04423	24.6726
22575	Passeriformes	Sturnidae	*Onychognathus*	*morio*	M	Eastern Cape	8	-32.04423	24.6726
17270*	Passeriformes	Sturnidae	*Onychognathus*	*nabouroup*	M	Northern Cape	5	-28.418889	24.073330

17568	Passeriformes	Sylviidae	*Sylvia*	*layardi*	F	Free State	7	-30.508611	26.613611
16890	Passeriformes	Sylviidae	*Sylvia*	*subcaerulea*	F	Limpopo	3	-23.593055	29.783889
16893	Passeriformes	Sylviidae	*Sylvia*	*subcaerulea*	M	Limpopo	3	-23.593055	29.783889
16894	Passeriformes	Sylviidae	*Sylvia*	*subcaerulea*	F	Limpopo	3	-23.593055	29.783889
16895	Passeriformes	Sylviidae	*Sylvia*	*subcaerulea*	F	Limpopo	3	-23.593055	29.783889
17571	Passeriformes	Sylviidae	*Sylvia*	*subcaerulea*	M	Limpopo	3	-23.593055	29.783889
17572	Passeriformes	Sylviidae	*Sylvia*	*subcaerulea*	F	Limpopo	3	-23.593055	29.783889
16889*	Passeriformes	Sylviidae	*Sylvia*	*subcaerulea*	F	Limpopo	3	-23.593055	29.783889
16892*	Passeriformes	Sylviidae	*Sylvia*	*subcaerulea*	M	Limpopo	3	-23.593055	29.783889
16896*	Passeriformes	Sylviidae	*Sylvia*	*subcaerulea*	F	Limpopo	3	-23.593055	29.783889
17573*	Passeriformes	Sylviidae	*Sylvia*	*subcaerulea*	F	Limpopo	3	-23.593055	29.783889
17574*	Passeriformes	Sylviidae	*Sylvia*	*subcaerulea*	M	Limpopo	3	-23.593055	29.783889
17575	Passeriformes	Sylviidae	*Sylvia*	*subcaerulea*	M	Northern Cape	5	-28.418889	24.073330
17576	Passeriformes	Sylviidae	*Sylvia*	*subcaerulea*	M	Northern Cape	5	-28.418889	24.073330
17577	Passeriformes	Sylviidae	*Sylvia*	*subcaerulea*	M	Northern Cape	5	-28.418889	24.073330
17578	Passeriformes	Sylviidae	*Sylvia*	*subcaerulea*	M	Northern Cape	5	-28.418889	24.073330
15596	Passeriformes	Sylviidae	*Sylvia*	*subcaerulea*	M	Northern Cape	6	-28.596167	24.858500
15597	Passeriformes	Sylviidae	*Sylvia*	*subcaerulea*	F	Northern Cape	6	-28.596167	24.858500
15598	Passeriformes	Sylviidae	*Sylvia*	*subcaerulea*	F	Northern Cape	6	-28.596167	24.858500
15600	Passeriformes	Sylviidae	*Sylvia*	*subcaerulea*	F	Northern Cape	6	-28.596167	24.858500
15599*	Passeriformes	Sylviidae	*Sylvia*	*subcaerulea*	M	Northern Cape	6	-28.596167	24.858500
14988	Passeriformes	Sylviidae	*Sylvia*	*subcaerulea*	F	Free State	6	-28.596167	24.858500
14989	Passeriformes	Sylviidae	*Sylvia*	*subcaerulea*	M	Free State	6	-28.596167	24.858500
14993	Passeriformes	Sylviidae	*Sylvia*	*subcaerulea*	M	Free State	6	-28.596167	24.858500
14987	Passeriformes	Sylviidae	*Sylvia*	*subcaerulea*	M	Northern Cape	6	-28.954167	24.731111
14991	Passeriformes	Sylviidae	*Sylvia*	*subcaerulea*	M	Northern Cape	6	-28.954167	24.731111
22304	Passeriformes	Sylviidae	*Sylvia*	*subcaerulea*	M	Eastern Cape	8	-32.07803	24.67859
22469	Passeriformes	Sylviidae	*Sylvia*	*subcaerulea*	F	Eastern Cape	8	-32.07803	24.67859
22470	Passeriformes	Sylviidae	*Sylvia*	*subcaerulea*	M	Eastern Cape	8	-32.07803	24.67859
22483	Passeriformes	Sylviidae	*Sylvia*	*subcaerulea*	M	Eastern Cape	8	-32.07803	24.67859
22497	Passeriformes	Sylviidae	*Sylvia*	*subcaerulea*	M	Eastern Cape	8	-32.07803	24.67859
22343	Passeriformes	Sylviidae	*Sylvia*	*subcaerulea*	M	Eastern Cape	9	-32.02632	25.54285
22352	Passeriformes	Sylviidae	*Sylvia*	*subcaerulea*	M	Eastern Cape	9	-32.02632	25.54285
22355	Passeriformes	Sylviidae	*Sylvia*	*subcaerulea*	M	Eastern Cape	9	-32.02632	25.54285
22511	Passeriformes	Sylviidae	*Sylvietta*	*rufescens*	M	Eastern Cape	9	-32.02632	25.54285
16990	Passeriformes	Turdidae	*Turdus*	*libonyanus*	M	Limpopo	3	-23.593055	29.783889
17391	Passeriformes	Turdidae	*Turdus*	*libonyanus*	M	Limpopo	3	-23.593055	29.783889
16988*†	Passeriformes	Turdidae	*Turdus*	*libonyanus*	F	Limpopo	3	-23.593055	29.783889
16989*	Passeriformes	Turdidae	*Turdus*	*libonyanus*	F	Limpopo	3	-23.593055	29.783889
17392*	Passeriformes	Turdidae	*Turdus*	*libonyanus*	M	Limpopo	3	-23.593055	29.783889

17394	Passeriformes	Turdidae	*Turdus*	*libonyanus*	F	Limpopo	3	-23.674192	29.912025
17393*	Passeriformes	Turdidae	*Turdus*	*libonyanus*	M	Limpopo	3	-23.674192	29.912025
17395	Passeriformes	Turdidae	*Turdus*	*libonyanus*	M	Mpumalanga	4	-26.594167	29.116111
17396	Passeriformes	Turdidae	*Turdus*	*litsitsirupa*	F	Northern Cape	5	-28.418889	24.073330
17397	Passeriformes	Turdidae	*Turdus*	*litsitsirupa*	F	Northern Cape	5	-28.418889	24.073330
17266	Passeriformes	Turdidae	*Turdus*	*smithi*	M	Northern Cape	5	-28.418889	24.073330
17268	Passeriformes	Turdidae	*Turdus*	*smithi*	M	Northern Cape	5	-28.418889	24.073330
17269	Passeriformes	Turdidae	*Turdus*	*smithi*	F	Northern Cape	5	-28.418889	24.073330
17267*	Passeriformes	Turdidae	*Turdus*	*smithi*	M	Northern Cape	5	-28.418889	24.073330
14961	Passeriformes	Turdidae	*Turdus*	*smithi*	M	Free State	6	-28.596167	24.858500
17262	Passeriformes	Turdidae	*Turdus*	*smithi*	F	Free State	7	-30.508611	26.613611
17263	Passeriformes	Turdidae	*Turdus*	*smithi*	F	Free State	7	-30.508611	26.613611
17264	Passeriformes	Turdidae	*Turdus*	*smithi*	F	Free State	7	-30.508611	26.613611
17265	Passeriformes	Turdidae	*Turdus*	*smithi*	M	Free State	7	-30.508611	26.613611
15015*	Passeriformes	Viduidae	*Vidua*	*macroura*	F	Free State	6	-28.596167	24.858500
22564	Passeriformes	Viduidae	*Vidua*	*macroura*	M	Eastern Cape	10	-33.29847	26.4641
17417	Passeriformes	Zosteropidae	*Zosterops*	*capensis*	M	Limpopo	3	-23.674192	29.912025
17418	Passeriformes	Zosteropidae	*Zosterops*	*capensis*	F	Limpopo	3	-23.674192	29.912025
22372	Passeriformes	Zosteropidae	*Zosterops*	*capensis*	M	Eastern Cape	8	-32.04423	24.6726
22373	Passeriformes	Zosteropidae	*Zosterops*	*capensis*	F	Eastern Cape	8	-32.04423	24.6726
22377	Passeriformes	Zosteropidae	*Zosterops*	*capensis*	F	Eastern Cape	8	-32.04423	24.6726
22390	Passeriformes	Zosteropidae	*Zosterops*	*capensis*	F	Eastern Cape	8	-32.04423	24.6726
22566	Passeriformes	Zosteropidae	*Zosterops*	*capensis*	F	Eastern Cape	8	-32.04423	24.6726
22567	Passeriformes	Zosteropidae	*Zosterops*	*capensis*	M	Eastern Cape	8	-32.04423	24.6726
22570	Passeriformes	Zosteropidae	*Zosterops*	*capensis*	M	Eastern Cape	8	-32.04423	24.6726
22389*	Passeriformes	Zosteropidae	*Zosterops*	*capensis*	M	Eastern Cape	8	-32.04423	24.6726
22299	Passeriformes	Zosteropidae	*Zosterops*	*capensis*	F	Eastern Cape	8	-32.07803	24.67859
22300	Passeriformes	Zosteropidae	*Zosterops*	*capensis*	F	Eastern Cape	8	-32.07803	24.67859
22301	Passeriformes	Zosteropidae	*Zosterops*	*capensis*	M	Eastern Cape	8	-32.07803	24.67859
22306	Passeriformes	Zosteropidae	*Zosterops*	*capensis*	F	Eastern Cape	8	-32.07803	24.67859
22324	Passeriformes	Zosteropidae	*Zosterops*	*capensis*	F	Eastern Cape	8	-32.07803	24.67859
22471	Passeriformes	Zosteropidae	*Zosterops*	*capensis*	M	Eastern Cape	8	-32.07803	24.67859
22329*	Passeriformes	Zosteropidae	*Zosterops*	*capensis*	F	Eastern Cape	8	-32.07803	24.67859
22344	Passeriformes	Zosteropidae	*Zosterops*	*capensis*	F	Eastern Cape	9	-32.02632	25.54285
22346	Passeriformes	Zosteropidae	*Zosterops*	*capensis*	M	Eastern Cape	9	-32.02632	25.54285
22520	Passeriformes	Zosteropidae	*Zosterops*	*capensis*	M	Eastern Cape	9	-32.02632	25.54285
22525	Passeriformes	Zosteropidae	*Zosterops*	*capensis*	M	Eastern Cape	9	-32.02632	25.54285
22526	Passeriformes	Zosteropidae	*Zosterops*	*capensis*	F	Eastern Cape	9	-32.02632	25.54285
22358	Passeriformes	Zosteropidae	*Zosterops*	*capensis*	F	Eastern Cape	10	-33.29847	26.4641
22359	Passeriformes	Zosteropidae	*Zosterops*	*capensis*	M	Eastern Cape	10	-33.29847	26.4641

22363	Passeriformes	Zosteropidae	*Zosterops*	*capensis*	F	Eastern Cape	10	-33.29847	26.4641
22365	Passeriformes	Zosteropidae	*Zosterops*	*capensis*	M	Eastern Cape	10	-33.29847	26.4641
22535	Passeriformes	Zosteropidae	*Zosterops*	*capensis*	M	Eastern Cape	11	-33.32144	26.52419
16824	Passeriformes	Zosteropidae	*Zosterops*	*pallidus*	F	Northern Cape	5	-28.418889	24.073330
16825	Passeriformes	Zosteropidae	*Zosterops*	*pallidus*	M	Northern Cape	5	-28.418889	24.073330
16826	Passeriformes	Zosteropidae	*Zosterops*	*pallidus*	M	Northern Cape	5	-28.418889	24.073330
16828	Passeriformes	Zosteropidae	*Zosterops*	*pallidus*	M	Northern Cape	5	-28.418889	24.073330
16829	Passeriformes	Zosteropidae	*Zosterops*	*pallidus*	M	Northern Cape	5	-28.418889	24.073330
16830	Passeriformes	Zosteropidae	*Zosterops*	*pallidus*	F	Northern Cape	5	-28.418889	24.073330
16832	Passeriformes	Zosteropidae	*Zosterops*	*pallidus*	F	Northern Cape	5	-28.418889	24.073330
16833	Passeriformes	Zosteropidae	*Zosterops*	*pallidus*	M	Northern Cape	5	-28.418889	24.073330
16834	Passeriformes	Zosteropidae	*Zosterops*	*pallidus*	M	Northern Cape	5	-28.418889	24.073330
16835	Passeriformes	Zosteropidae	*Zosterops*	*pallidus*	M	Northern Cape	5	-28.418889	24.073330
16836	Passeriformes	Zosteropidae	*Zosterops*	*pallidus*	F	Northern Cape	5	-28.418889	24.073330
17424	Passeriformes	Zosteropidae	*Zosterops*	*pallidus*	F	Northern Cape	5	-28.418889	24.073330
17425	Passeriformes	Zosteropidae	*Zosterops*	*pallidus*	F	Northern Cape	5	-28.418889	24.073330
17427	Passeriformes	Zosteropidae	*Zosterops*	*pallidus*	M	Northern Cape	5	-28.418889	24.073330
17428	Passeriformes	Zosteropidae	*Zosterops*	*pallidus*	M	Northern Cape	5	-28.418889	24.073330
16827*	Passeriformes	Zosteropidae	*Zosterops*	*pallidus*	M	Northern Cape	5	-28.418889	24.073330
16831*	Passeriformes	Zosteropidae	*Zosterops*	*pallidus*	M	Northern Cape	5	-28.418889	24.073330
15004	Passeriformes	Zosteropidae	*Zosterops*	*pallidus*	M	Free State	6	-28.596167	24.858500
15005	Passeriformes	Zosteropidae	*Zosterops*	*pallidus*	F	Free State	6	-28.596167	24.858500
17423	Passeriformes	Zosteropidae	*Zosterops*	*pallidus*	M	Free State	7	-30.508611	26.613611
17426	Passeriformes	Zosteropidae	*Zosterops*	*pallidus*	M	Free State	7	-30.508611	26.613611
16838	Passeriformes	Zosteropidae	*Zosterops*	*virens*	F	Limpopo	3	-23.593055	29.783889
16839	Passeriformes	Zosteropidae	*Zosterops*	*virens*	M	Limpopo	3	-23.593055	29.783889
17419	Passeriformes	Zosteropidae	*Zosterops*	*virens*	F	Limpopo	3	-23.674192	29.912025
17420	Passeriformes	Zosteropidae	*Zosterops*	*virens*	M	Limpopo	3	-23.674192	29.912025
16837	Passeriformes	Zosteropidae	*Zosterops*	*virens*	M	Northern Cape	5	-28.418889	24.073330
17421	Passeriformes	Zosteropidae	*Zosterops*	*virens*	M	Free State	7	-30.508611	26.613611
17422	Passeriformes	Zosteropidae	*Zosterops*	*virens*	M	Free State	7	-30.508611	26.613611
17429	Passeriformes	Zosteropidae	*Zosterops*	*virens*	M	Free State	7	-30.508611	26.613611
17430	Passeriformes	Zosteropidae	*Zosterops*	*virens*	F	Free State	7	-30.508611	26.613611
17431	Passeriformes	Zosteropidae	*Zosterops*	*virens*	F	Free State	7	-30.508611	26.613611
17432	Passeriformes	Zosteropidae	*Zosterops*	*virens*	F	Free State	7	-30.508611	26.613611
17434	Passeriformes	Zosteropidae	*Zosterops*	*virens*	M	Free State	7	-30.508611	26.613611
17433*†	Passeriformes	Zosteropidae	*Zosterops*	*virens*	F	Free State	7	-30.508611	26.613611
16929	Piciformes	Indicatoridae	*Indicator*	*indicator*	F	Limpopo	3	-23.593055	29.783889
17625	Piciformes	Indicatoridae	*Indicator*	*indicator*	F	Northern Cape	5	-28.418889	24.073330
14985	Piciformes	Indicatoridae	*Indicator*	*indicator*	F	Northern Cape	6	-28.596167	24.858500

17626	Piciformes	Indicatoridae	*Indicator*	*indicator*	U	Free State	7	-30.508611	26.613611
17628	Piciformes	Indicatoridae	*Indicator*	*minor*	M	Northern Cape	5	-28.418889	24.073330
17629	Piciformes	Indicatoridae	*Indicator*	*minor*	M	Northern Cape	5	-28.418889	24.073330
17627	Piciformes	Indicatoridae	*Indicator*	*minor*	F	Free State	7	-30.508611	26.613611
22507	Piciformes	Indicatoridae	*Indicator*	*minor*	F	Eastern Cape	9	-32.02632	25.54285
16930	Piciformes	Lybiidae	*Lybius*	*torquatus*	F	Limpopo	3	-23.593055	29.783889
16931	Piciformes	Lybiidae	*Lybius*	*torquatus*	M	Limpopo	3	-23.593055	29.783889
16932	Piciformes	Lybiidae	*Lybius*	*torquatus*	M	Limpopo	3	-23.593055	29.783889
16934	Piciformes	Lybiidae	*Lybius*	*torquatus*	M	Limpopo	3	-23.593055	29.783889
16935	Piciformes	Lybiidae	*Lybius*	*torquatus*	M	Limpopo	3	-23.593055	29.783889
16933*	Piciformes	Lybiidae	*Lybius*	*torquatus*	M	Limpopo	3	-23.593055	29.783889
16936*	Piciformes	Lybiidae	*Lybius*	*torquatus*	M	Limpopo	3	-23.593055	29.783889
17405*	Piciformes	Lybiidae	*Lybius*	*torquatus*	M	Limpopo	3	-23.674192	29.912025
16928	Piciformes	Lybiidae	*Pogoniulus*	*chrysoconus*	M	Limpopo	3	-23.593055	29.783889
17541	Piciformes	Lybiidae	*Pogoniulus*	*chrysoconus*	M	Limpopo	3	-23.593055	29.783889
17542	Piciformes	Lybiidae	*Pogoniulus*	*chrysoconus*	F	Limpopo	3	-23.593055	29.783889
17544*	Piciformes	Lybiidae	*Pogoniulus*	*chrysoconus*	M	Limpopo	3	-23.593055	29.783889
17543	Piciformes	Lybiidae	*Pogoniulus*	*chrysoconus*	M	Limpopo	3	-23.674192	29.912025
16917*	Piciformes	Lybiidae	*Trachyphonus*	*vaillantii*	M	Limpopo	2	-22.619444	29.834167
16916	Piciformes	Lybiidae	*Trachyphonus*	*vaillantii*	F	Limpopo	3	-23.593055	29.783889
16914*†	Piciformes	Lybiidae	*Trachyphonus*	*vaillantii*	M	Limpopo	3	-23.593055	29.783889
16915*	Piciformes	Lybiidae	*Trachyphonus*	*vaillantii*	M	Limpopo	3	-23.593055	29.783889
15566*†	Piciformes	Lybiidae	*Trachyphonus*	*vaillantii*	M	Northern Cape	6	-28.596167	24.858500
14983	Piciformes	Lybiidae	*Trachyphonus*	*vaillantii*	F	Free State	6	-28.596167	24.858500
17415	Piciformes	Lybiidae	*Trachyphonus*	*vaillantii*	M	Free State	7	-30.508611	26.613611
17416	Piciformes	Lybiidae	*Trachyphonus*	*vaillantii*	F	Free State	7	-30.508611	26.613611
21529	Piciformes	Lybiidae	*Tricholaema*	*leucomelas*	M	Limpopo	1	-22.2673	29.3307
21539	Piciformes	Lybiidae	*Tricholaema*	*leucomelas*	F	Limpopo	1	-22.2673	29.3307
21609	Piciformes	Lybiidae	*Tricholaema*	*leucomelas*	F	Limpopo	1	-22.2673	29.3307
16919	Piciformes	Lybiidae	*Tricholaema*	*leucomelas*	M	Limpopo	2	-22.619444	29.834167
16923	Piciformes	Lybiidae	*Tricholaema*	*leucomelas*	U	Limpopo	3	-23.593055	29.783889
16924	Piciformes	Lybiidae	*Tricholaema*	*leucomelas*	F	Limpopo	3	-23.593055	29.783889
16925	Piciformes	Lybiidae	*Tricholaema*	*leucomelas*	F	Limpopo	3	-23.593055	29.783889
17406	Piciformes	Lybiidae	*Tricholaema*	*leucomelas*	M	Limpopo	3	-23.593055	29.783889
16920*	Piciformes	Lybiidae	*Tricholaema*	*leucomelas*	F	Limpopo	3	-23.593055	29.783889
16921*	Piciformes	Lybiidae	*Tricholaema*	*leucomelas*	M	Limpopo	3	-23.593055	29.783889
16922*	Piciformes	Lybiidae	*Tricholaema*	*leucomelas*	F	Limpopo	3	-23.593055	29.783889
16926*	Piciformes	Lybiidae	*Tricholaema*	*leucomelas*	M	Limpopo	3	-23.593055	29.783889
16927*	Piciformes	Lybiidae	*Tricholaema*	*leucomelas*	F	Limpopo	3	-23.593055	29.783889
17407	Piciformes	Lybiidae	*Tricholaema*	*leucomelas*	F	Northern Cape	5	-28.418889	24.073330

17408*	Piciformes	Lybiidae	*Tricholaema*	*leucomelas*	M	Northern Cape	5	-28.418889	24.073330
17409*	Piciformes	Lybiidae	*Tricholaema*	*leucomelas*	M	Northern Cape	5	-28.418889	24.073330
MVZ198611 - 609*	Piciformes	Lybiidae	*Tricholaema*	*leucomelas*	F	Northern Cape	5	-28.418889	24.07333
14979	Piciformes	Lybiidae	*Tricholaema*	*leucomelas*	M	Northern Cape	6	-28.596167	24.858500
14980	Piciformes	Lybiidae	*Tricholaema*	*leucomelas*	M	Northern Cape	6	-28.596167	24.858500
14981	Piciformes	Lybiidae	*Tricholaema*	*leucomelas*	M	Northern Cape	6	-28.596167	24.858500
15644	Piciformes	Lybiidae	*Tricholaema*	*leucomelas*	M	Northern Cape	6	-28.596167	24.858500
15645	Piciformes	Lybiidae	*Tricholaema*	*leucomelas*	M	Northern Cape	6	-28.596167	24.858500
15647	Piciformes	Lybiidae	*Tricholaema*	*leucomelas*	F	Northern Cape	6	-28.596167	24.858500
14982*	Piciformes	Lybiidae	*Tricholaema*	*leucomelas*	F	Northern Cape	6	-28.596167	24.858500
15646*	Piciformes	Lybiidae	*Tricholaema*	*leucomelas*	F	Northern Cape	6	-28.596167	24.858500
17410*	Piciformes	Lybiidae	*Tricholaema*	*leucomelas*	F	Free State	7	-30.508611	26.613611
17411*	Piciformes	Lybiidae	*Tricholaema*	*leucomelas*	F	Free State	7	-30.508611	26.613611
17412*	Piciformes	Lybiidae	*Tricholaema*	*leucomelas*	F	Free State	7	-30.508611	26.613611
17413*	Piciformes	Lybiidae	*Tricholaema*	*leucomelas*	F	Free State	7	-30.508611	26.613611
17414*	Piciformes	Lybiidae	*Tricholaema*	*leucomelas*	F	Free State	7	-30.508611	26.613611
22461	Piciformes	Lybiidae	*Tricholaema*	*leucomelas*	F	Eastern Cape	8	-32.04423	24.6726
22462	Piciformes	Lybiidae	*Tricholaema*	*leucomelas*	M	Eastern Cape	8	-32.04423	24.6726
22406	Piciformes	Lybiidae	*Tricholaema*	*leucomelas*	F	Eastern Cape	8	-32.07803	24.67859
22496	Piciformes	Lybiidae	*Tricholaema*	*leucomelas*	F	Eastern Cape	8	-32.07803	24.67859
22394*	Piciformes	Lybiidae	*Tricholaema*	*leucomelas*	F	Eastern Cape	8	-32.07803	24.67859
22395*	Piciformes	Lybiidae	*Tricholaema*	*leucomelas*	M	Eastern Cape	8	-32.07803	24.67859
22412*	Piciformes	Lybiidae	*Tricholaema*	*leucomelas*	M	Eastern Cape	8	-32.07803	24.67859
17598	Piciformes	Picidae	*Campethera*	*abingoni*	M	Limpopo	3	-23.593055	29.783889
14978	Piciformes	Picidae	*Campethera*	*abingoni*	M	Free State	6	-28.596167	24.858500
17596	Piciformes	Picidae	*Dendropicos*	*fuscescens*	F	Limpopo	3	-23.674192	29.912025
17597	Piciformes	Picidae	*Dendropicos*	*fuscescens*	M	Northern Cape	5	-28.418889	24.073330
14977	Piciformes	Picidae	*Dendropicos*	*fuscescens*	M	Free State	6	-28.596167	24.858500
22600	Piciformes	Picidae	*Dendropicos*	*fuscescens*	M	Eastern Cape	8	-32.04423	24.6726
22492	Piciformes	Picidae	*Dendropicos*	*fuscescens*	F	Eastern Cape	8	-32.07803	24.67859
22336	Piciformes	Picidae	*Dendropicos*	*fuscescens*	F	Eastern Cape	9	-32.02632	25.54285
22350	Piciformes	Picidae	*Dendropicos*	*fuscescens*	M	Eastern Cape	9	-32.02632	25.54285
22369	Piciformes	Picidae	*Dendropicos*	*fuscescens*	M	Eastern Cape	10	-33.29847	26.4641
21603	Pterocliformes	Pteroclididae	*Pterocles*	*bicinctus*	F	Limpopo	1	-22.29372	29.2955