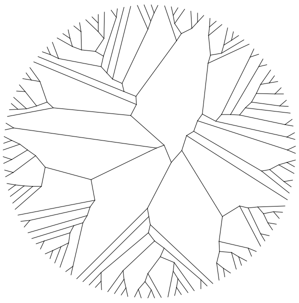
CLIMATE-LINKED TEMPORAL AND SPATIAL PATTERNS IN THE EVOLUTION OF AFRICAN BOVIDAE



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- To my family -

Der Leu und die Gazelle

Der Leu schreitet durch die Steppe - frisst.
Die Gazelle trabt zum Wasser - trinkt.

Dann ging der Löwe nach Norden.
keiner weiß, was aus ihm geworden.

Die Gazelle aber schwebte nach Westen.
Das war für sie auch am besten.

Heinz Erhardt

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Cover: Radial phylogeny of the Bovidae established in the present study

ABSTRACT

Climate and subsequent environmental changes are regarded as one driver of species evolution. Against this background the present study investigates the evolutionary history of the mammalian family Bovidae (Cetartiodactyla, Mammalia), today the most species-rich family of large herbivores on the African continent. Temporal and spatial patterns in that group's evolution are the focus of the present study and were investigated using methods and data deriving from multiple disciplines (palaeontology, genetics, climatology, conservation biology). The results serve as a validation of macroevolutionary hypotheses of species evolution.

A major proportion of African mammalian fossils can be assigned to that family. Due to their morphological adaptations, bovid species are highly indicative of their habitats. Hence, bovids are of great importance for paleontology. However, a strong taphonomic bias is present in the fossil record of bovids, favoring large and arid-adapted species. Molecular phylogenies of extant species and species distribution modelling combined with climate reconstructions can help to overcome these limitations.

A molecular phylogeny, based on the cytochrome b gene of 136 bovid species served as basis for analysis of temporal patterns. Divergence events were dated using the *relaxed molecular clock* approach. The tree was time calibrated at 30 nodes using information inferred from the fossil record. *Lineage-Through-Time* plots and the respective statistical analyses reveal detailed temporal patterns in the evolutionary history of tribes and groups combining arid- and humid-adapted tribes. The resulting pattern shows three distinct phases. Phase 1 (*P1*) is dominated by speciation events within the humid group, while the second phase (*P2*) is marked by a dominance of speciation within the arid group. The switch in diversification rates (*BDS*) from *P1* to *P2* is dated to 2.8 million years ago. The third phase (*P3*) shows low diversification rates for all groups, starting around 1.4 million year ago and culminates in a significantly reduced diversification rate for the complete family at 0.8 million years ago. Both transitions are contemporaneous with global climate changes and turnover events in fossil faunal communities.

To investigate the impact of climate changes onto the habitat availability within the last 3 million years and its putative influence on diversification rates, the species distribution modeling method was applied. For 85 African species and subspecies the climate niches were established and grouped into 5 climate-groups based on their climate preferences. For each group the available habitat for the period before and after the *BDS* was calculated on continental scale using reconstructed climate scenarios. To evaluate the modeled habitat distributions, regional analyses were performed in test areas surrounding well studied fossil sites (Laetoli, Olduvai, Chiwondo Beds, Lothagam, Koobi Fora, West Turkana, Swartkrans, Sterkfontain und Toros-Menalla). *Habitat profiles* (*HP*) permitted the comparison of the model based habitat reconstruction with the interpretations of classic paleontological reconstruction. The validity of the habitat modeling has been shown in particular for East African test areas. The reconstructions for the northern and southern fossil sites does not support the modeled habitats in these areas. Yet, the method of habitat-profiling may serve as suitable tool for environmental reconstruction of areas lacking sufficient paleontological material. A comparison of habitat availability before and after the *BDS* on continental scale identified a significant loss of habitat for humid adapted groups (7-22%) and habitat gain for arid adapted groups (19-173%). The climatically intermediate group experiences a tremendous gain of habitat (3366%). The greatest environmental change was modeled for East Africa, initiated by a progressive regional aridification.

In addition to the distribution modeling for past climate conditions, the geographical distribution was modeled for the future, i.e. for climate scenarios representing the years 2050 and 2080 under a putative climate change scenario (global surface warming). It was shown that in particular the arid groups have to expect a remarkable loss of habitat (41-76%), while a gain of available habitat can be expected for the humid adapted groups (114-577%). The climatically intermediate group suffers the strongest habitat loss (85%). Regions with locally stable climate conditions were detected and may serve as potential refugia and are already today known as Africa's hot spots of biodiversity.

The results show a positive correlation of high diversification rates and increasing habitat availability. None of the tested speciation hypotheses taken alone explains the observations (e.g., *Turnover-pulse Hypothesis*, *Relay Model*). A major element in these hypotheses is the passive fragmentation of populations induced by unfavorable climate changes. In contrast, the *Periodic Model* (Grubb 1999) considers natural, periodically recurring climate changes and moreover, the active dispersal of individuals and resulting founder events. I added the effect of a superimposed directed climate trend – like the progressive aridification since the late Pliocene in Africa – which leads to a bias in the proportion and probability towards *leading edge* effects. This *Directed Periodic Model* explains the patterns found in the evolution of Bovidae.

The combination of a molecular phylogeny and species distribution modeling, together with information inferred from the fossil record, reveals remarkable temporal and spatial patterns in the evolution of bovids, and helps overcome the limitations of the fossil record. The present study highlights the importance of active dispersal and founder populations in speciation processes. A point widely unattended in speciation hypotheses. The fully dated molecular phylogeny is the most densely sampled tree for the family Bovidae to date and may serve as a framework for a connection of present and future population studies, permitting the connection of medium-scale with long-term effects induced by climate and environmental changes.

ZUSAMMENFASSUNG

Klimaveränderungen und die damit verbundenen Veränderungen des Lebensraums gelten als treibende Kraft in der Evolution von Arten. Vor diesem Hintergrund untersucht die vorliegende Dissertation die evolutionsbiologische Entwicklung der Säugetierfamilie der Bovidae (Cetartiodactyla, Mammalia), heute die artenreichste Großsäugerfamile auf dem afrikanischen Kontinent. Die gewonnen Daten dienen der Validierung gängiger Theorien zur Entstehung neuer Arten, dem zentralen Thema im makroevolutionären Kontext. Im Fokus der Studie steht der Einfluss klimatischer Veränderungen auf Artbildungsprozesse innerhalb von Gruppierungen gleicher klimatischer Präferenzen, d.h. Gruppen angepasst an aride Lebensräume mit offener Vegetation oder humide Lebensräume mit geschlossener Vegetationsdecke. Hierzu kommen Methoden und Daten aus unterschiedlichen Forschungsfeldern (Paläontologie, Genetik, Klimatologie, Naturschutzbiologie) zur Anwendung.

Die morphologisch sehr vielfältigen Arten bewohnen unterschiedlichste Lebensräume und sind somit indikativ für die jeweiligen Habitate, was im speziellen für die Paläontologie von besonderer Relevanz ist. Ein großer, wenn nicht der größte Teil, der Säugetierfossilien lässt sich dieser Familie zuordnen. Somit sind Antilopen und ihre Verwandten wichtiger Bestandteil zur Rekonstruktion von Paläoökologie und vergangenen Lebensräumen. Anhand der Fossilien lassen sich die Entstehungszeitpunkte einzelner Arten und ihrer Vorfahren ermitteln und deren Evolutionsgeschichte nachvollziehen. Allerdings ist sowohl die Wahrscheinlichkeit, als auch der Prozess der Fossilwerdung, nicht für alle Arten gleich. So sind beispielsweise kleine Arten, sowie Arten aus feuchten und bewaldeten Lebensräumen meist in Fossilienansammlungen unterrepräsentiert. Eine wesentliche Anzahl der Bovidenarten sind allerdings kleine, waldbewohnende Formen und eine evolutionsgeschichtliche Rekonstruktionen für die Familie als Ganzes bislang nur mit starken Einschränkungen möglich. Des Weiteren ist die Zugänglichkeit von Fossilien sehr von lokalen, geologischen und topographischen Gegenebenheiten abhängig und in Afrika vorwiegend entlang des Ostafrikanischen Grabens gegeben. Die Verwendung von

datierten, molekularen Stammbäumen und Artverbreitungsmodelierungen unter paläoklimatischen Bedingungen ermöglichen es, diese Einschränkungen zu überwinden, und liefert empirische Daten zur Überprüfung gängiger Artentstehungshypothesen.

Unter Verwendungen von mitochondrialen DNS-Sequenzen (Cytochrome Oxidase b) wurde die genetische Geschichte der Boviden auf zeitliche Muster untersucht. Zunächst mussten die bereits in öffentlichen Datenbanken verfügbaren Sequenzen mit Sequenzen fehlender Arten, beziehungsweise Sequenzen unzureichender Länge durch neue vollständige Sequenzen ergänzt werden, um eine möglichst vollständigen Stammbaum der Bovidae zu erhalten. Dazu wurden Blutproben aus internationalen Tierhaltungen eingeholt, extrahiert, sequenziert und eine bayessche Phylogenie erstellt. Ein Schwerpunkt lag besonders auf der Datierung des Stammbaums. Hierfür wurde die Datierungsmethode der *entspannten molekularen Uhr* gewählt. Die zeitliche Kalibrierung erfolgte an 30 Punkten der Phylogenie unter Verwendung fossiler Belegstücke. Der resultierende Konsensusbaum aus 40.000 Einzelbäumen zeigt ein mittleres Alter von 18,2 Millionen Jahren für die Familie an. Eine auffällige Radiation, die letztlich zu den heutigen Triben (bspw. Antilopini, Alcelaphini, Cephalophini) führte, fand im späten Miozän vor 9,6 ±1,2 Millionen Jahren statt. Tiefgehende zeitliche Analysen unter der Verwendung der sogenannten *Lineage-Through-Time* (LTT) Grafiken und den zugehörigen statistischen Auswertungen gewähren genauere Erkenntnisse über zeitliche Muster der Artentstehung innerhalb der Triben. Die Gruppierung dieser nach vorwiegend arid bzw. humid angepassten Arten verstärkte die Ergebnisse der Einzelanalysen. Das resultierende Muster zeigt drei markante Phasen in Artentstehungsgeschichte der Gruppe. Die erste Phase (*P1*) ist durch gehäufte Artenentstehung der humiden Gruppe charakterisiert, gefolgt von einer Phase (*P2*) in der Artbildungen innerhalb der ariden Gruppe dominiert. Ein klarer Wechsel zwischen beiden Phasen konnte auf 2,8 Millionen Jahre vor heute datiert werden. Während eine Gruppe besonders viele Arten hervorbrachte, war die Artbildung innerhalb der jeweils anderen Gruppe signifikant geringer. Die dritte Phase (*P3*) begann etwa 1,4 Millionen Jahren vor Heute und ist durch eine niedrige Artbildungsrate beider Gruppen gekennzeichnet und kulminiert in einem signifikanten

Rückgang der Rate der gesamten Familie vor 0,8 Millionen Jahren. Der Phasenwechsel (*BDS – Bovid Diversifikation Switch*) bei 2,8 Millionen Jahren zeigt starke zeitliche Parallelität mit einem Wechsel der Periodizität der Milankovitchzyklen, sowie dem Beginn einer globalen Abkühlung und eines Aridifizierungstrends in Afrika. Ein ähnlicher Zusammenhang ist für den Beginn von *P3* zu erkennen. Dieser fällt ebenfalls in einen Zeitraum wechselnder Periodizität der Milankovitch-Zyklen, allerdings zeitlich nicht so scharf umrissen wie der vorherige Phasenwechsel *P1* zu *P2* und könnte im Zusammenhang mit einem langsameren Wechsel von extremeren Klimabedingungen stehen.

Um die Auswirkungen des Klimawandels der letzten 2,8 Millionen Jahre auf die Habitatverfügbarkeit und einen damit möglichen Einfluss auf die unterschiedlichen Artentstehungsraten zu untersuchen, kam die Methode der Artverbreitungsmodelierung (*Species Distribtution Modelling*) zur Anwendung. Diese Methode ist der Naturschutzbiologie entlehnt und findet heute zumeist Verwendung in Untersuchungen zur aktuellen Verbreitung von Arten bzw. auch einer möglichen Verbreitungsänderung in der Zukunft. Mittlerweile sind Klimaszenarien auch für die Vergangenheit verfügbar und somit ist die Möglichkeit der Verbreitungsmodellierung auch für die Phasen vor und nach dem *BDS* gegeben. Modelliert wurde die potentielle Habitatverfügbarkeit für fünf *Klimagruppen,* d.h. für Gruppen mit Arten gleicher Klimapräferenzen bezogen auf vier Klimavariablen (minimale Temperatur im kältesten Monat, maximale Temperatur im wärmsten Monat, Niederschlagsmenge in feuchtesten Monat und Niederschlagsmenge im trockensten Monat). Hierzu wurden für 85 afro-arabische Arten bzw. Unterarten Beobachtungspunkte (2529 Punkte mit Koordinaten) aus der Literatur und Datenbanken gesammelt und die Zentralwerte der vier Klimavariablen pro Art ermittelt. Anhand dieser Klimacharakteristika wurden alle berücksichtigten Arten in fünf Klimagruppen mit ähnlichen klimatischen Ansprüchen sortiert. Zusätzlich wurden die afrikanischen Hauptvegetationstypen nach White (1983), unter anderen *Desert, Grassland, Woodland und Forest,* in die Analyse mit eingebunden. Das ermöglichte eine direkte Zuordnung der ermittelten Klimagruppen an ihre Habitate. Die fünf Klimagruppen decken den gesamten von Boviden bewohnten Lebensraum ab und sind im wesentlichen entlang eines Niederschlagsgradienten wie folgt sortiert; von extrem arid nach extrem humid: *Desert*-Gruppe, *Grassland*-Gruppe, *Woodland*-Gruppe, *Forest*-Gruppe und *Lowland-Rainforest*-Gruppe. Ein Vergleich der verfügbaren Fläche bevorzugten Habitats vor und nach dem *BDS* zeigt auf kontinentaler Ebene einen deutlichen Rückgang des Lebensraums für beide humiden Gruppen (*Forest -7,0%*, *Lowland-Rainforest -22,2%*) und eine Zunahme für beide ariden Gruppen (*Desert* +19,1%, *Grassland* +173,9%). Die klimatisch in der Mitte befindliche *Woodland-Gruppe* erfährt die deutlichste Zunahme an Lebensraum (+3366,7%). Die stärksten Habitatveränderungen sind für den Osten Afrikas festzustellen und gehen auf eine zunehmende Aridifizierung zurück. Zur Prüfung der Funktionalität und Tauglichkeit der Klimaszenarien und damit der rekonstruierten Habitatverfügbarkeit wurden zusätzlich Analysen auf regionaler Ebene durchgeführt. Hierzu wurden Testgebiete definiert, die unter anderen folgende Fossilienlagestätten umfassen: Laetoli, Olduvai, Chiwondo Beds, Lothagam, Koobi Fora, West Turkana, Swartkrans, Sterkfontain und Toros-Menalla. Für die Testgebiete wurden *Habitatprofile* (*HP*) erstellt, basierend auf dem jeweils verfügbaren Anteil an Habitaten der fünf Klimagruppen. Das erlaubte das Einschätzen der vorherrschenden Vegetationsformen innerhalb der Testgebiete und den Vergleich mit klassischen paläoökologischen Rekonstruktionen. Die Habitatprofile für ostafrikanische Testgebiete zeigten große Übereinstimmungen mit den klassischen Rekonstruktionen. Die modellbasierten Rekonstruktionen für die süd- bzw. nordafrikanischen Testgebiete hingegen sind nur wenig kongruent mit klassischen paläoökologischen Interpretationen.

Zusätzlich zur Verbreitungsmodellierung für die Vergangenheit wurden Simulationen für die Zukunft, d.h. für die Jahre 2050 und 2080, durchgeführt und Veränderungen in der geografischen Verbreitung bei einem anstehenden Klimawandel (globale Oberflächenerwärmung) abgeschätzt. Hierbei zeigte sich, dass vor allem aride Lebensräume (-41-76%), und auch der Lebensraum der *Woodland*-Gruppe (-85%), zukünftig von einem starken klimawandelbedingten Lebensraumverlust bedroht sind. Der Lebensraum für humid-angepasste Arten könnte zukünftig hingegen deutlich zunehmen (113-577%). Als mögliche Refugien könnten Regionen mit relativ stabilen klimatischen Bedingungen dienen. Diese potentiellen Refugien sind bereits heute als Afrikas Zentren besonders hoher Artenvielfalt bekannt. Darunter das Horn von Afrika, die Kap Region Süd-Afrikas und die Bergregionen Ostafrikas.

Die Ergebnisse der zeitlichen Analyse der Artaufspaltungen, sowie die Verbreitungsmodellierung dienen der Validierung gängiger Artentstehungshypothesen (bspw. *Turnover-Hypothese*, *Relay-Model*). Ein wesentlicher Aspekt dieser ist die passive Fragmentierung von zunächst geografisch verbundenen Population durch ungünstige Klimaveränderungen. Die hier gewonnen Resultate zeigen jedoch eine positive Korrelation von hoher Artentstehungsrate und zunehmender Habitatverfügbarkeit. Keine der getesteten Hypothesen kann für sich alleingenommen diese Ergebnisse vollständig erklären. Das sogenannte *Periodic Model* (Grubb 1999) berücksichtigt neben natürlichen, zyklisch wiederkehrenden Klimaveränderung auch den Aspekt der aktiven Verbreitung von Individuen einer Art in neuverfügbare Areale und die daraus resultierenden Gründereffekte. Unter Berücksichtigung des seit dem späten Pliozän vorherrschenden Aridifizierungstrends in Afrika, gewinnen Gründerpopulationen als Ursprung neuer Arten an Bedeutung. Das vom *Periodic Model* abgeleitete *Directed Periodic Model* schließt diesen – den zyklisch wiederkehrenden Klimaveränderungen übergeordneten –Trend mit ein und erklärt die positive Korrelation von Habitatverfügbarkeit und erhöhter Artentstehungsrate.

Die Studie betont die Relevanz aktiver Verbreitung von Teilpopulationen und den resultierenden Gründereffekten für die Bildung neuer Arten. Dieser Punkt fand bislang in den gängigen Hypothesen zur Artentstehung unzureichende Beachtung. Darüber hinaus zeigte sich für die modelbasierten Habitatprofile, ursprünglich zur Validierung der Verbreitungs- und Klimamodelle in den Testarealen gedacht, das sie ein geeignetes Hilfsmittel zur Rekonstruktion der Paläoökologie von Gebieten sein können, speziell für solche, für die es sonst keine oder nur unzureichende paläontologische Belege gibt. Der dieser Studie zu Grunde liegende neue und vollständig datierte Stammbaum ist zur Zeit der umfassendste für die Bovidae auf Artniveau und gestattet Rückschlüsse auf langskalig wirkende Klimaeinflüsse. Er stellt einen Rahmen für eine mögliche

Vernetzung von Populationsstudien mit evolutionärer und biogeografischer Fragestellung dar. Solch eine Integration von Studien auf Unterartniveau erlaubt eine Verbindung von mittelskaligen und langskaligen Prozessen und wird helfen unser Verständnis von der Bedeutung sich ändernder Klimabedingungen auf die Artenvielfalt weiter zu verfeinern.

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ABBREVIATIONS

AIC	**A**kaike **I**nformation **C**riterion
AUC	**A**rea **U**nder the (ROC) **C**urve
BDS	**B**ovid-**D**iversification-**S**witch
bp	**b**ase **p**air
Cytb	**Cyt**ochrome **b**
EARS	**E**ast **A**frican **R**ift **S**ystem
FAD	**F**irst **A**ppearance **D**atum
Fm	**F**or**m**ation
GTR	**G**eneral **T**ime **R**eversible
HP	**H**abitat **P**rofile
HPD	**H**ighest **P**osterior **D**ensity (95% confidence interval)
HSI	**H**abitat **S**uitability **I**ndex
ITCZ	**I**nter **T**ropical **C**onvergence **Z**one
kyrs	thousand (kilo) years
LAD	**L**ast **A**ppearance **D**atum
LTT	**L**ineage-**T**hrough-**T**ime
Ma	Million years ago (**M**ega **a**nnum)
MRCA	**M**ost **R**ecent **C**ommon **A**ncestor
OBI	**O**lduvai **B**ed **I**
PCA	**P**rincipal **C**omponent **A**nalyses
pp	**p**osterior **p**robability
ROC	**R**eceiver **O**perating **C**haracteristic analysis
SDM	**S**pecies **D**istribution **M**odelling
ULD	**U**pper **L**aetoli **B**ed
UND	**U**pper **N**dolyana **B**ed
yrs	years

INTRODUCTION

Focus and Outline

This study investigates the evolution of the mammalian family Bovidae in relation to climate changes in the past and in the future. The time frame covers the range from the late Miocene to the year 2080 with a geographical focus on the African continent. I apply methods and data from multiple research fields (phylogenetics, palaeontology, climatology and conservation biology) to approach empirically the macroevolutionary question: "Do changing climate conditions affect the speciation process?" This dissertation is subdivided into two parts with two chapters each. The first part focuses on temporal evolutionary patterns, while in the second I investigate spatial evolutionary patterns of climate-groups in the past and the future. The respective results are discussed by chapter. In the section ***Closing Discussion*** I summarize, combine and discuss the chapter's findings in conclusion. Moreover, to set the findings into a macroevolutionary context I test the validity of established speciation hypotheses with the obtained results.

In ***Chapter 1*** I build a new Bayesian phylogenetic tree of the Bovidae and apply the molecular clock approach to it, based on fossil calibration points inferred from the fossil record. Besides the main goal of determining species divergence times, the first inclusion in molecular analyses of multiple species gives insight into their taxonomical position. The analyses of divergence times are performed in ***Chapter 2*** where the resulting diversification patterns are discussed and related to the fossil record. ***Chapter 3*** leads to the analyses of spatial patterns in bovid evolution. I group the African bovids into climate-groups based on climate preferences, and I model their distribution under three climate scenarios for the past on continental as well as on regional scale. I use paleoecological reconstructions of six reference areas, famous for bearing fossils of human ancestors, to validate the distribution projections. In ***Chapter 4*** I use the same methodical approach, yet the distribution of climate-communities is projected on climate scenarios for the near future. Here I evaluate the impact of the prospective climate change and the consequences for bovid species.

Chapter 1 and Chapter 2 are currently subject of the article "*A dense and dated Bayesian phylogeny shows response in diversity of Bovidae to climatic changes since the late Miocene in Africa"* Schikora, T. Bibi, F. and Schrenk, F. (in preparation), and I acknowledge and appreciate the cooperation and contribution of Faysal Bibi.

Background

Since the Miocene, Bovidae have played a dominant role in African environments. This is obvious when looking at present day faunal communities and the fossil record. A major proportion of mammalian fossil assemblages can be assigned to taxa of this family. This is particularly interesting, since bovids can be used to infer important information for paleoecological and paleoenvironmental reconstructions due to their habitat specific adaptations. Moreover, this may provide essential information for reconstructing human evolution, for which fossil remains are very scarce. Thus, it is not surprising that Bovidae are the focus of countless studies addressing macroevolutionary questions (Raia et al., 2005; Spencer, 1997; Vrba, 1984; Vrba, 1987; Vrba 1992). The fossil evidence permits a good interpretation of the evolutionary history. However, the information one can obtain from fossils is locally and chronologically restricted. Moreover, the fossil record has a strong spatial bias towards depositional basins of the East African Rift (Jacobs et al., 2010), where the geological setting permits access to fossiliferous layers. Further, a major factor affecting the fossil record is the taphonomic process that leads to an underrepresentation of small or forest dwelling species. The body size in bovids ranges from about 1.5 kg to more than 1000 kg (Kingdon, 1997). Most of the smaller species (e.g., duikers and dwarf-antelopes) live in forested habitats and, hence, are unlikely to be preserved as fossils. This demonstrates how unbalanced the fossil record for this family really is. Consequently, the interactions with the abiotic environment and therefore the evolutionary history for many species, and subsequently for the entire family, cannot be reconstructed without constraints.

When speaking of species I refer to the widely used "***Biological Species Concept***" (Dobzhansky, 1937; Mayr, 1942) and regard a species as a reproductively isolated population of individuals. Accordingly, subspecies are geographic divisions of a species, potentially able to interbreed. Yet, in few cases subspecies have been shown to be genetically very distinct from its congeners and I include them additionally to the present study, treating them as "species on the leap". Nevertheless, there are arguments against this, specifically a more "conservative" biological species concept (Groves, 2001; Groves & Grubb, 2011), and some advantages are discussed for using other concepts, e.g., the "***Phylogentic Species Concept***" (Eldredge & Cracraft, 1980). However, defining species always means squeezing a natural and continuous system into artificial categories. Hence, independent of concept choice, it cannot lead to a "right" or a "wrong" result. As long as it is clearly demonstrated which definition applies. Personally, I believe no argument should exist.

Molecular phylogenies of extant species and species distribution modelling combined with climate reconstructions can help to overcome limitations of the fossil record. As long as DNA containing tissue is available, there is no bias towards a certain group, species, body size or environment expected. Yet, shortcomings are present as well. For instance, introgressions or hybridization are typical pitfalls in phylogenetic analyses and interpretations. Nonetheless, the introduction of molecular clock approaches (Zuckerkandl & Pauling, 1965) was a step forward in the task to combine amenities of genetics and palaeontology. Information defining minimum and maximum ages of taxa obtained from the fossil record serve as temporal constraints for clock calibration. This method permits calculation of the divergence time between two lineages within molecular phylogenies. Such time-calibrated molecular phylogenies yield high potential for investigations of diversification patterns as well as speciation and extinction rate dynamics of extant species and their ancestral lineages. To avoid misunderstanding, I use the term "diversification" as following:

$$\text{diversification} = \text{speciation} - \text{extinction}.$$

Speciation is the divergence of two lineages from a single ancestral lineage and extinction is the terminal end of a lineage.

The prevailing climate at a given time drives the biotic environment, in particular plant communities. Bovids depend highly on plants as source of nutrition and shelter. Hence, an indirect top-down relation of climate and bovid distribution is apparent. A change in climate conditions must therefore affect the distribution of bovid species due to habitat conversion and availability. Vrba (1987) described this as "***species' habitat drift***" and "***species' distribution drift***", whereby initially species' habitats start drifting induced by climatic changes followed by drifting populations. As a consequence of drifting habitat in geographical space, the previously connected habitat as well as the population may be fragmented. Vrba (1992) portrayed three categories of possible species responses (Fig. 1) to "***vicariance***" (fragmentation of a geographically continuous distributed population into allopatric subpopulations due to environmental barriers) induced by physical environmental changes. Accordingly, species can reply with persistence, extinction or speciation. For the latter, conditions that keep the population separated must have persisted a sufficient time until two populations are sufficiently genetically distinct to prevent interbreeding.

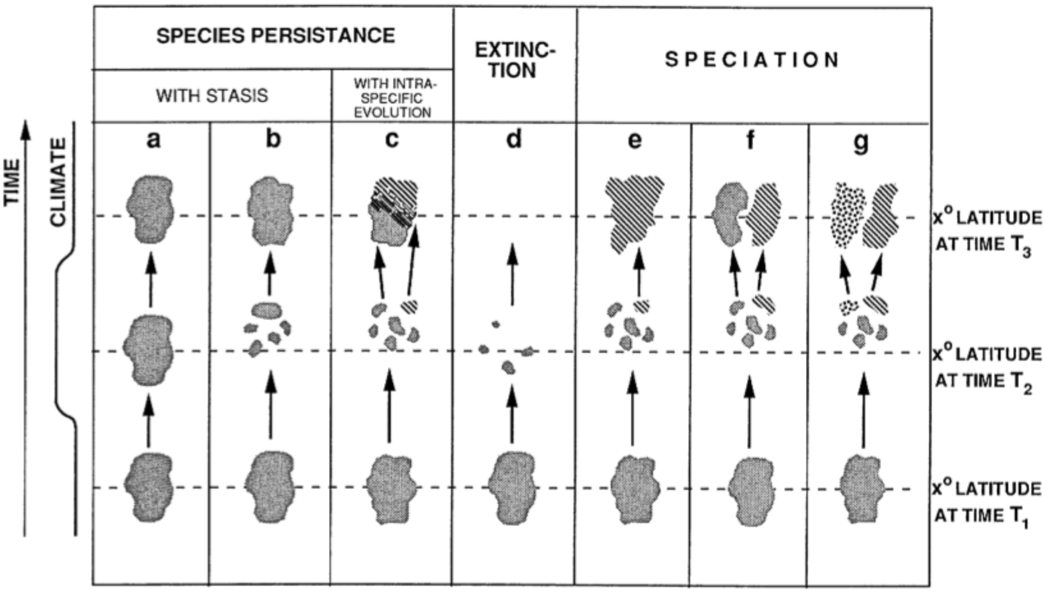


Fig. 1 **The Three Categories of Responses of Species and their Distribution to Environmental Change** are summarized in this hypothetical diagram: a, b, c: species persistence, with or without vicariance and latitudinal shifting of the distribution; d: extinction; e, f, g: speciation. The climatic excursions indicated can represent, for instance, cooling to the left and warming to the right (adapted from Vrba 1992).

Africa experienced a long-term cooling (see the "*African Climate and Environmental History*" section) associated with an overall aridification trend since the mid-Pliocene (ca. 3 million years ago), despite evidence that periods of extreme humidity punctuated that trend (Donges et al., 2011; Maslin & Trauth, 2009; Trauth et al., 2010). Multiple reasons are assumed to have induced that globally acting climate change at around 3 million years before present (Ma), e.g., plate tectonics and astronomical forces are main drivers of large-scale changes. In Africa, contemporaneously, the on-going rifting process of the "***East African Rift System***" (EARS) culminated in major faulting and significant uplifting of rift shoulders. They acted as a barrier for trade winds related to the "***Inter Tropic Convergence Zone***" (ITCZ), leading to a reduced moisture transport across the African continent from East to West. This must have affected the precipitation patterns in Central and East Africa. In particular, present East Africa is renowned for its bovid species richness due to its diverse biomes along the rainforest-savannah transition zone. In the same way the precipitation patterns changed here, the bovid species' habitats must have responded, either with geographical drift, shrinkage, vicariance, coalescence or expansion. As a consequence, the inhabiting species were forced to react as outlined by Vrba (1992, Fig. 1) Recent climate-modelling approaches made climate scenarios available, which simulate the impact of uplifting within the EARS on the African climate (Kaspar et al., 2010; Sepulchre et al., 2006). That is, climate maps for conditions with lowered topographic elevation in East and Southern Africa are obtainable. Combined with species distribution modelling approaches, it is now possible to predict and trace the extent and drift of the "***Fundamental Habitat***" (Vrba, 1992) of taxa or groups of interest in geological time. The fundamental habitat includes the geographical area suitable for a species to survive but not necessarily inhabited by it, in contrast to the "***Realized Habitat***" where a species does live. In my analyses I will refer to the fundamental habitat if not stated otherwise. The resulting habitat distribution maps for geological times probably differ from the truth since it does not include all relevant factors. Yet, it is a first approximation of how species might have dispersed under major environmental changes. Moreover, in combination with the established diversification times, this is a further step towards the understanding of how evolution, climate and biodiversity are linked to each other and permits empirical testing of macroevolutionary speciation hypothesis.

Based on several hypotheses Vrba (1992) postulated the "***Habitat Theory***" in which the key assumption is that climate and the respective species' habitat specificities play the preeminent role in the diversification processes. Eldredge and Gould (1972) laid the theoretical fundament for this hypothesis by introducing the idea of a "***Punctuated Equilibrium***" which assumes that species remain in (phenotypic) stasis between two temporally or locally restricted speciation events. The authors argued against the concept of a "***Phyletic Gradualism***" (Eldredge & Gould, 1972) which describes a gradual and continuous speciation process within a single lineage where the ancestral lineage is directly replaced by its daughter species (Fig. 2)

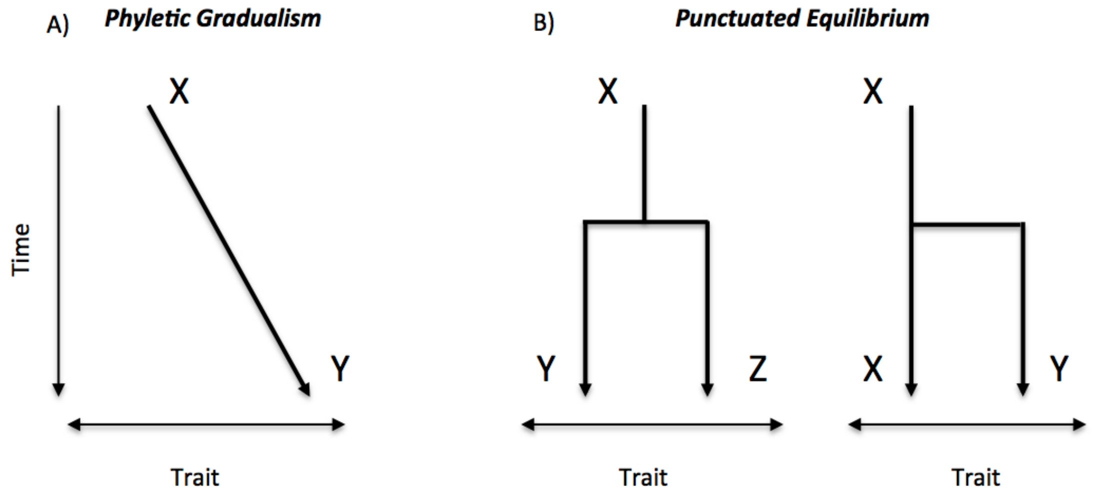


Fig. 2 **Simplified Speciation Process under the *Phyletic Gradualism* and *Punctuated Equilibrium* Concepts**. The *Phyletic Gradualism* (A) assumes a gradual speciation process over time. Species Y may replace its ancestor species X, basically driven by permanent biotic interaction (e.g., competition, sexual selection). In contrast the *Punctuated Equilibrium* concept assumes stasis (equilibrium) until a major extrinsic event (e.g., climate change) leads to a temporal restricted (punctuated) speciation, where either two descendant species Y and Z, replace the ancestral species X or species Y is budding of from the species X.

One theory in that context is the *Red Queen* model (Van Valen, 1973; Van Valen, 1977), which states that the competition between species is the major driver of speciation and extinction, eventually leading to a continuing evolutionary change. As mentioned before, the *Habitat Theory* is based on multiple hypotheses. One of them is the "***Turnover-Pulse Hypothesis***" (Vrba, 1992), which probably found the widest application in studies aiming to evaluate the evolutionary history of a clade of interest. According to this, major changes in the physical environment should lead to temporally synchronous speciation, extinction and migration events in a significant number of not related clades, so-called turnover-pulses. Biotic interactions, like predation or competition, occurring on their own in the absence of physical changes, are not sufficient to cause speciation or extinction (Vrba, 1992). A later addition to the complex of hypothesis within the *Habitat Theory* is the *“**Relay Model**”* (Vrba, et al. 1995) and can be regarded as a variation of the *Turnover-Pulse Hypothesis*. This model takes into account that species in contrasting habitat categories may differ in the timing of vicariance and speciation during reoccurring climate changes (Vrba, et al. 1995; Vrba, 1999). The model predicts a chronological sequence of speciation and extinction events under a hypothetical major warming trend as follows: 1) extinction of cool adapted species; 2) speciation of cool adapted species; 3) extinction of warm adapted species; 4) speciation of warm adapted species (Vrba, 1999). The key idea behind this hypothesis is the (passive) fragmentation of a previously continuously connected geographic population induced by physical environmental change. Grubb, (1989; 1999) admitted the active dispersal of roaming species to a newly available area an important role in the speciation processes. In addition to the aforementioned mechanism, he linked the dispersal mechanism to periodically reoccurring habitat availability due to cyclic climate changes described as the “***Periodic Model***” (Grubb, 1999).

Once the temporal and spatial evolutionary patterns are established for the Bovidae, I will discuss the aforementioned hypothesis (namely the *Turnover-Pulse Hypothesis*, *Relay Model* and *Periodic Model*) in more detail to evaluate to what extant they may apply to the (molecular) bovid evolutionary history in the “*Closing Discussion*” section. Additionally, with the knowledge of how environmental changes drove distribution and diversification of bovid species, consequences of a recent and future climate change can be inferred for the diversity of bovids. For this, again, I apply the distribution modelling technique for scenarios of the prospective climate change in the nearer future (i.e., in the years 2050 and 2080).

The Ecology and Evolutionary History of African Bovids

The mammalian family Bovidae (Gray, 1821) comprises cattle, sheep and goats, as well as a group commonly named antelopes. The latter group combines all bovids distributed in Africa, but does not reflect their taxonomical relationships. The prime trait of these herbivores is a pair of unbranched and non-deciduous horn cores and sheaths (Bubenik, 1990). Today, there are more than 150 extant species (Wilson, 2005) distributed in North America, Asia, Europe and about the half of all species in Africa. Despite the main occurrence in Africa, the evolution of Bovidae most probably had begun in Eurasia earlier than 18 Ma as is indicated by fossil remains of *Eotragus spp*. (e.g, Bibi, 2009) Since then, they underwent a rapid radiation unseen in any other family of large mammals (Gatesy, 1992). Until today, the impressive fossil record reveals more than 300 extinct species or ancestors of modern species (Savage & Russell, 1983). This permits palaeontologists to trace back species or taxonomic groups over millions of years. Phylogenetically, Bovidae can be subdivided into two sub-families: Bovinae and Antilopinae (following the nomenclature of Bibi et al., 2009; Bibi & Vrba, 2010; Hassanin & Douzery, 1999). The Bovinae comprises the tribes Bovini, Tragelaphini, Pseudorygini and Boselaphini while the sister clade Antilopinae groups the remaining tribes: Aepycerotini, Alcelaphini, Antilopini, Cephalophini, Caprini, Hippotragini, Reduncini and Neotragini.

Bovidae per se cannot be assigned to a particular habitat or climate conditions. The species occurring on the African continent today are inhabitants of almost all terrestrial environments, ranging from extremely arid (semi-deserts and deserts) to very humid (tropical rainforest and swamps) habitats. Correspondingly, they evolved physiological (Estes, 1992; Ferrell et al., 2001; Horowitz & Adler, 1983) and morphological adaptations (DeGusta & Vrba, 2005; Köhler, 1993; Plummer et al., 2008; Schellhorn, 2009) resulting in a variety of size, shape and behavioral characteristics. Nevertheless, the respective species are relatively restricted to their native environment, especially to the vegetation. The vegetation is important as food supply for these herbivorous animals and many species need a dense vegetation cover as shelter, for instance, against predators. Species adapted to densely covered habitats often are rather small, with short legs and compact bodies. These are very important for fast movements and sudden changes of direction with the aim to hide in the undergrowth. In contrast, species adapted to open and plain environments usually are very slender in shape with long legs and necks. This enables them to run quickly and sustain speed over long distances if threatened by predators or forced on long migrations following suitable habitat. Species-specific habitat adaptations can be inferred from shape and size of horns (Köhler, 1993) Typical forest dwellers (e.g., duikers) have short and spiky horns, while inhabitants of open habitats can afford remarkable frontal appendages, which would be problematic in forested environments. Thus, morphological adaptations are indicative of habitats and most suitable for reconstructing the paleoenvironments from fossils. Most tribes can be attributed to specific habitat types on the whole (Bobe et al., 2007; Greenacre & Vrba, 1984; Vrba, 1988), i.e., Antilopini, Alcelaphini and Hippotragini are typically adapted to open and rather arid environments, while Cephalophini, Reduncini and Tragelaphini roam in closed and humid environments. The main tribes involved in this study are described as follows (adapted from Kingdon, 1997; Kingdon, 1989a; Kingdon, 1989b):

Alcelaphini: The alcelaphines comprise seven species in four genera *Alcelaphus*, *Beatragus, Connochaetes* and *Damaliscus*. The species are medium to large in body weight (60–290 kg) with lyrate or double-curved horns in males and females. All kinds of grasses are in the dietary spectrum; however some alcelaphines are selective for grass species or part of the plant. They inhabit open bushland to wide grassy plains. Prominent members are the migrating wildebeests (*Connochaetes taurinus*).

Connochaetes taurinus

Antilopini: More than 20 species form the group of true antelopes and gazelles (*Antidorcas*, *Gazella*, *Eudorcas*, *Nanger, Litocranius, Antelope*). They are of a slender shape with long legs and of medium weight (15–60 kg). High heat tolerance enables them to inhabit very arid and usually open environments like deserts, grasslands and savannahs. They are predominantly grazers with a small proportion of herbs and shrubs within their diet. Yet, few species are highly adapted to browsing, e.g., the Dibatag (*Ammodorcas clarkei*). Probably the most prominent Antilopini species is the Thomson's gazelle (*Eudorcas thomsonii*).

Eudorcas thomsonii

Cephalophini: The common name Duikers for the cephalophines derives from the Afrikaans describing the behavior to dive/duck into thickets and understory. Described are 21 species in three genera: *Sylvicapra*, *Philantomba*, *Cephalophus*. They are of small to medium weight (5–80 kg), short-legged antelopes with compact body and head. Their typical habitat is dominated by dense covered forest or woodland. However, the Grey Duiker (*Sylvicapra grimmia*) is an exception and occupies more open environments like bushland. Duikers are browsers but feed on fruits and seeds as well.

Cephalophus zebra

Hippotragini: Hippotragines or commonly named horse antelopes comprise seven extant species in three genera (*Addax, Hippotragus and Oryx*) and the Bluebuck (*Hippotragus leucophaeus*), which became extinct in the early 19th century. They are large antelopes (100–200 kg) with long and well-annulated horns present in both sexes. The heavy torso and thick neck give the hippotragines its typical shape. The tribe is assigned to very arid and open environments, yet *Hippotragus spp.* occur in rather wooded environments, while *Addax spp.* and *Oryx spp.* are adapted to extreme desert-like landscapes. Hippotragines are grazers with high-crowned teeth for processing tough and dry grasses.

Oryx beisa

Neotragini: Neotragines are commonly named *Dwarf-Antelopes* due to their diminutive size and weight (1.5–12kg). The short and spike-like horns are found only in males. The taxonomically status is still debated. Several studies certified paraphyly within the 11 to 13 species in up to six genera (*Madoqua, Raphicerus, Dorcatragus; in dispute: Neotragus, Ourebia, Oreotragus*) assigned to the tribe (Allard et al., 1992; Hernández Fernández & Vrba, 2005a; Matthee & Robinson, 1999). Likewise the habitat preferences are very heterogeneous, ranging from dense undergrowth in moist forest (*Neotragus spp*.) to relatively arid environments (*Madoqua spp*.). The diet preferences are varied, yet most have a major proportion of browse and herbs in their spectra, but fruits, shoots and shrubs are eaten as well.

Madoqua piacentinii

Reduncini: The nine species of the genera *Kobus* and *Redunca* are medium to large sized antelopes with slender to stocky legs. Both sexes have horns that curl forward at the tips. Usually, the reedbucks and waterbucks are restricted to well-watered areas or permanent wetlands or even swamps. The preferred diet is dominated by fresh grass, if necessary leafs are consumed as well. The most widely distributed species is the Waterbuck (*Kobus ellipsiprymnus*) occurring from Senegal to Mozambique.

Kobus ellipsiprymnus

Tragelaphini: The spiral-horned antelopes unite nine species in the single genus *Tragelaphus*. They have a medium to large weight (50–900 kg) with stripped, reddish-brown to grey fur and twisted or spiralled horns. Tragelaphines are inhabitants of rather closed and humid environments, feeding on browse with minor proportions of soft grasses and fruits. Hence they have characteristic low-crowned teeth. The two Eland species, which are extraordinary large in size, *T. oryx* and *T. derbianus* are united into their own genus *Taurotragus* by some authors (Groves & Grubb, 2011).

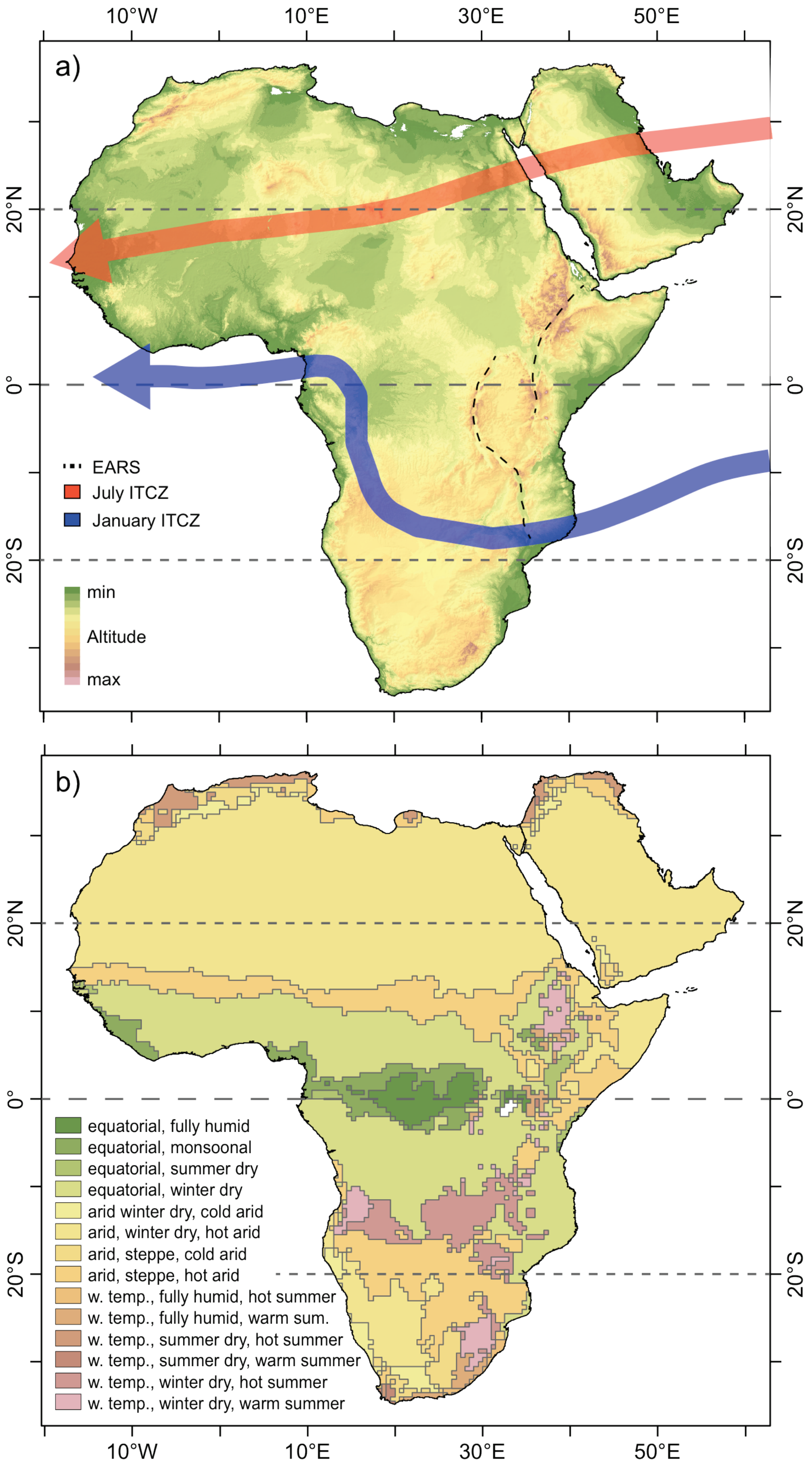
Tragelaphus strepsiceros

African Climate and Environmental History

Multiple factors have had, and still have, impact on global climate and hence, on the African climate. The timeframe of interest in this study covers approximately the last 18 million years, determined by the estimated offset of bovid evolution (Bibi et al., 2009). Over such a long timespan, tectonics and geomorphologic processes e.g., the uplifting of mountain ranges and subsequent erosion reach climate-relevant dimensions. Also, orbital forces must be considered, which led to several periodic climate changes, e.g., changes in the dominance of Milankovitch cycles from 41 kyrs (thousand years) to 100 kyrs at 1 Ma during the Mid-Pleistocene Revolution (Berger & Jansen, 1994). All these factors can interact with each other and might emphasize or even reduce the effect of climate change. Whatever the initial factor of climate change was at a certain time, it induced changed precipitation patterns followed by a change in vegetation cover. And that, in last consequence, is the most relevant factor for the survival and dispersal of bovid species. Hence the focus in this section is on the interaction between climate and vegetation cover. Generally spoken, the higher local precipitation is, the higher is the vegetation density (closed forests and rainforests); lower precipitation leads to decreased vegetation cover like the sparse plant cover growing in steppe and deserts in the extreme (Shorrocks, 2007).

The early Miocene was dominated by a relatively warm and humid climate that permitted forest vegetation to cover wide areas of the African continent (Bonnefille, 2010). Yet, fossils of grasses using the C_3 photosynthetic pathway at Fort Ternan, Kenya, indicate an opening of forested areas at latest around 14 Ma (Retallack, 1992). That fragmentation proceeded as shown by a major expansion of grasslands around 10 Ma in East Africa and about 3 million years later in West Africa (Bonnefille, 2010), accompanied by a gradual increase of C_4 biomass as indicated by isotopic data (Cerling, 1992; Cerling et al., 1993). A further reduced humidity is implied by a remarkable decrease in tree cover between 6.3 and 6 Ma that took place simultaneously in East and West Africa affecting the entire tropical region (Bonnefille, 2010). This arid phase was followed by a period of progressively increasing tree cover between 6 and 3.6 Ma indicating a reoccurrance of prevailing wet and warm climate supported by a relative high frequency of lake expansion (Trauth et al., 2007). This mid-Pliocene warming (about +3°C in global average) was estimated to have led to higher sea levels (+10–20 m) and reduced Antarctic ice cover (Ravelo et al. 2004). Furthermore, the closing of the Isthmus of Panama between 4.7 and 4.2 Ma (Haug & Tiedemann, 1998) might have caused a change of water circulations in the Atlantic and Pacific Oceans and consequently in tropical wind fields (Haug et al., 2001). These changes pushed the *Inter Tropical Convergence Zone* (ITCZ), a zone of high precipitation, further south (Billups et al., 1999) permitting forest expansion as indicated by pollen marine records from West and East Africa between 4.5 and 4 Ma (Bonnefille, 2010). Between 3 and 2.7 Ma a strong an abrupt environmental change took place. The proportions of grass pollen, especially of C_4 grasses increased significantly, while those of forest plants decreased. In northern Africa sub-desertic steppe overgrew savannah areas and savannah penetrated into rainforests in the West and East, which retreated to their present day distribution (Bonnefille, 2010; Cerling et al., 2011; Wynn, 2004). That is contemporary with a global climate change whose main feature was the glaciation of the Arctic (Haug et al., 2005). In Africa these global climate effects were superimposed by a major episode of rift shoulders uplift in the EARS (Fig. 3a), which culminated around 3 to 2.5 Ma (Partridge, 1998; Partridge & Maud, 1987) and enforced a climate change in Africa as well (see below). The effect of the uplifted rift shoulders was reduced moisture transport from the Indian Ocean to Central Africa, subsequently leading to increasing aridity with increasing elevation. However, the onset of an aridification trend after 3 Ma towards the present was also the beginning of increased climate variability (deMenocal, 2004; Trauth et al., 2007; Trauth et al., 2010), which occasionally permitted vegetation typical for humid climates to expand. Regionally, the climate is mainly influenced by seasonal shifts of the ITCZ, terrain complexity and large inland lakes (Kaspar et al., 2010). That is obvious in recent climate patterns, where the seasonal north-south shifting ITCZ promotes rainy seasons. Today, African climate zones are very diverse (Fig. 3b) ranging from equatorial moist climates (rainforests) via wet-dry temperate climates (savannahs) to arid climates (deserts) and further intermediate categories (Kottek et al., 2006; Rubel & Kottek, 2010). Since the Equator runs more or less through the middle of the continent these climate zones follow a succession from tropical rainforest at the equator to deserts in the north and south. The equable distribution of tropical rainforest in full extant of the tropical belt is altered in East Africa by the aforementioned EARS. The EARS is an intracontinental graben system (Fig. 3a), about 6000 km long and reaches from the Red Sea to the Mozambique Channel. It is the result of ongoing tectonic processes, eventually leading to the separation of an East African plate from the main continent (Chorowicz, 2005). The main topographic features, relevant for the present study, are the rift valleys harboring most of the major African lakes (e.g. Lake Albert, Lake Malawi, Lake Edward and Lake Kivu) bordered by rift shoulders. The rift shoulders today reach hights of several thousand meters and are therefore climatically relevant, acting as barriers for moisture transport (Fig. 3a).

Fig. 3 (right) **Topographic map, Inter Tropical Convergence Zone and Köppen-Geiger Climate Categories of Africa**. On the top the topographic map of Africa. The dashed line indicates roughly the East African Rift System. The course of the Inter Tropical Convergence Zone (ITCZ) is indicated by red (July) and blue (January) arrows, note the barrier effect of the East African Rift System (dashed line) pushing the eastern trade winds north and south culminating in seasonal shift of the ITCZ. Buttom: Keoppen-Geiger categories (Kottek et al., 2006) showing the distribution of equatorial humid climate zones (e.g., rainforest), warm temperate (w. temp.) seasonal dry-wet zones (savannahs) and arid zones (deserts).


a)
10°W
10°E
30°E
50°E
20°N
0°
20°S
EARS
July ITCZ
January ITCZ
min
Altitude
max
b)
equatorial, fully humid
equatorial, monsoonal
equatorial, summer dry
equatorial, winter dry
arid winter dry, cold arid
arid, winter dry, hot arid
arid, steppe, cold arid
arid, steppe, hot arid
w. temp., fully humid, hot summer
w. temp., fully humid, warm sum.
w. temp., summer dry, hot summer
w. temp., summer dry, warm summer
w. temp., winter dry, hot summer
w. temp., winter dry, warm summer

1. PHYLOGENY AND DIVERGENCE ESTIMATES

The intra-familial relationship within Bovidae is the focus of numerous publications, using a variety of morphological characters, behavioral patterns, and molecular data like enzyme activities, amino acid or DNA sequences (Allard et al., 1992; Gatesy et al. ,1997; Georgiadis et al., 1990; Matthee & Robinson, 1999). However, the completeness of species sampling within the family experienced little attention. Most studies performed tribe comparisons using only single species as representatives of tribes or genera. Other studies focused on single species or genera and their assumed sister taxa. Consequently, only a few phylogenies show high species densities (Agnarsson & May-Collado, 2008; Hernández, Fernández & Vrba, 2005a). The supertree approach of (Hernández, Fernández & Vrba, 2005a) combines multiple characters varying from molecular to morphological and ethological data. Yet, the quality and quantity of available information per character state is not equally distributed across all species. The highest species density in a bovid phylogeny is reached through the usage of cytochrome b *(cytb)* sequences (Agnarsson & May-Collado, 2008). In fact, this mitochondrial gene is an outstanding character in regard of availability due to its importance as a standard marker gene over decades of molecular phylogeny research. Here, I also use the cytochrome b sequence to establish a Bayesian phylogeny of Bovidae with a further increased species density compared to other studies. This is crucial for analyses of temporal evolutionary patterns from divergence times (see *Chapter 2*) within phylogenies. To obtain a dated phylogeny I used a relaxed molecular clock approach based on 29 calibration points inferred from fossil information.

METHODS

Sequence Sampling and Genetic Analyses

The mitochondrial gene *cytb* was and still is a preferred marker for phylogenetic analyses. Over the years, for a large proportion of bovid species *cytb* sequences became available. Yet, several species have never been investigated with molecular approaches, or only partial sequences of the complete gene or a different gene have been analysed before. Therefore, gaps in the species sampling were to be filled and short sequences needed improvement. Among the newly added species sequences of *Docratragus megalotis*, *Madoqua saltiana* and *Neotragus pygmaeus* were first included in such an approach. Sequences obtained from blood and tissue samples collected from captive animals, as well as from two species inhabiting a national park, and in one case from purified DNA were added to the sampling (SuppFig. 1). I excluded domesticated breeds variously defined as species from the sampling to avoid anthropogenic influenced speciation. In contrast, subspecies frequently assumed to be species of their own or for which distinct genetic lineages were found recently (Flagstad et al., 2001; Lerp et al., 2011; Moodley et al., 2009) were included, if available. Also, I included two extinct bovid species, *Myotragus balearicus* and *Hippotragus leucophaeus*. As out-group species I used representatives of the four next related pecoran families: *Antilocapra americana* (Antilocapridae)*, Giraffa camelopardalis* (Giraffidae), *Cervus elaphus* (Cervidae) and *Moschus leucogaster* (Moschidae). The final species sampling comprises 136 bovids and four out-group species based on 29 newly generated *cytb* sequences and 111 sequences downloaded from NCBI GenBank (SuppFig. 1)

DNA was isolated from either blood (n = 28) or skin (n = 1) samples (SuppFig. 1). Fresh full blood samples (1 vol.) were stored in ethanol 96% (2½ vol.) under cool conditions. The dried skin sample was stored on silica gel. DNA was extracted from blood and skin samples after washing with 500 µl CTAB-buffer and overnight incubation with 20 µl proteinase K (10 mg/ml) and 0.65 µl β-mercaptoethanol at 56°C, using standard phenol-chloroform extraction (Sambrook & Russell, 2001). For 27 species the complete *cytb* sequence (1140 bp) was amplified successfully with the following primer pair: *Cytb*H 5’CGGAATTCCATTTTTGGTTTACAAGAC3’ and *Cytb*L 5’AGGCGTCGAAGCTTGACATGAAAAGCCATCGTTG3’ (Arnason & Gullberg 1996). For two species only a shorter fragment could be amplified (SuppFig. 1). The PCR reactions were performed using 0.625 units peqGOLD Taq-DNA-Polymerase (PEQLAB Biotechnologie GMBH, Erlangen, Germany) according to the manufacturer’s recommendations. PCR was performed according to the following protocol: initial denaturation, 94°C, 3 min; followed by 30 cycles denaturation at 94°C, annealing at 45°C and extension at 72°C; each step 1 min. Followed by a final extension of 10 min at 72°C. Following the manufacturer’s instructions the PCR products were purified using Sephadex G50 (Sigma-Aldrich, Munich, Germany). The fragments were amplified in forward and in reverse direction in two separate sequencing-reactions using the primer *Cytb*H and *Cytb*L. After ethanol precipitation, sequencing was performed using BigDyeTerminator v.3 on an ABI 3730 DNA Analyzer (Applied Biosystems, Darmstadt, Germany). The sequences were edited and aligned with the Geneious Pro v5.0 software (Drummond et al., 2011). The sequences were checked manually for base pair ambiguities, nuclear copies of mitochondrial derived genes, stop codons, and high levels of divergence, as recommended by Buhay (2009). The combined forward and reverse *cytb* sequences of all 29 species are available in NCBI GenBank under accession numbers JF728761–JF728789. All 140 sequences were aligned using Geneious Pro v5.0. Due to shorter sequences in some cases and low sequence quality at the ends, the alignment was cropped to a final length of 960 bp (bases 91 to 1050 in the gene) reaching a uniform sequence length for 124 (86%) species. Missing bases were treated as neutral.

Phylogenetic Analysis and Divergence Time Estimation

For the DNA sequence alignment *Model testing* in *MEGA* v4 (Tamura et al. 2007) determined a general-time-reversible model (Lanave et al. 1984) with invariable sites and five classes of gamma rates (GTR+I+G) as the best fitting substitution model. I used *DAMBE* (Xia & Xie, 2001) to evaluate the pairwise genetic distances and substitution saturation. The molecular clock test implemented in *MEGA* v4 rejected a strict molecular clock for the tested data ($p < 0.001$). Thus, the relaxed molecular clock model of uncorrelated lognormal distribution was used to reconstruct a Bayesian phylogeny with the *BEAST* v1.6 software package (Drummond & Rambaut, 2007) as proposed by Nilsson et al. (2010). The calculation of divergence times and node support (posterior probability) was performed with the same software package. The Bayesian tree prior was set to a birth-death process, assuming a constant speciation and extinction rate (Nee et al., 1994). Data from the fossil record were used to calibrate the molecular clock at 29 nodes (Tab. 1). The parameters of 40 million Markov Chain Monte Carlo (MCMC) steps were sampled every 1000 generations. The results were examined using *Tracer* v1.5 (Rambaut & Drummond, 2009) to evaluate stationary. The first 10% of the trees (4000 generations) were discarded as burn-in and the remaining trees were summarized in a single consensus tree with *TreeAnnotator* v1.5.4 included in the *BEAST* software package.

Tab. 1 **Calibration Points used for Molecular Clock Calibration Inferred from the Fossil Record of Bovidae.** Crown clades are those defined by the descendants of the MRCA (most recent common ancestor) of a specified set of living species. Stem clade ages can be understood as the age of the node defined by the MRCA of the specified clade and its next sister clade. In many cases, the node being calibrated is referred to the stem because of uncertainty regarding the relationship of the fossil relative to the crown clade (thereby providing a conservative estimate). # Reference number indicating position in the consensus tree (Fig. 4).

#	**Clade**		**Age (Ma)***		**Prior Distribution**
			min	**max**	
1	Alcelaphini	stem	7.0		logNormal
2	Alcelaphini	crown	~5.0		logNormal
3	*Alcelaphus buselaphus* all ssp.	crown	0.3	0.6	logNormal
4	*Alcelaphus buselaphus lichtensteini*	stem	0.3	0.6	logNormal
5	*Beatragus*	stem	2.6		logNormal
6	Bovidae	stem	~18		logNormal
7	Bovina (= *Bos* spp incl. *Bison*)	stem	~3.2	~4	logNormal
8	Bovina (= *Bos* spp incl. *Bison*)	crown		~3.2	uniform
9	Bovini	stem	10.2		logNormal
10	Bovini	crown	3.6	8.9	logNormal
11	Bubalina (*Syncerus-Bubalus* MRCA)	crown	3.6	~7	logNormal
12	*Connochaetes taurinus – C. gnou*	crown	1.6	1.6	LaPlace
13	*Connochaetes taurinus –C. gnou*	stem	2.5		logNormal
14	*Damaliscus lunatus – D. pygargus*	crown	1.1	3.4	uniform
15	Hippotragini	stem	~7		logNormal
16	Hippotragini	crown	3.6	~7	uniform
17	*Hippotragus*	crown	2.5	2.8	uniform
18	*Kobus ellipsiprymnus*	stem	2.3		logNormal
19	*Kobus kob - K. vardoni*	stem	1.88		logNormal
20	*Redunca* spp.	stem	5.2		logNormal
21	Reduncini	stem	9.3		logNormal
22	Reduncini	crown	4.4	9.3	logNormal
23	Tragelaphini	stem	5.8		logNormal
24	Tragelaphini	crown	4.4		logNormal
25	*Tragelaphus derbianus - T. oryx*	stem	1.6		logNormal
26	*Tragelaphus eurycerus*	stem	3.6		logNormal
27	*Tragelaphus imberbis*	stem	2.85		logNormal
28	*Tragelaphus scriptus* (incl. T. s. *sylvaticus*)	stem	1.4		logNormal
29	*Tragelaphus strepsiceros*	stem	3.4		logNormal

* for detailed references and fossil information see SuppTab. 2

RESULTS

Phylogenetic Analysis

The consensus tree of the Bayesian analyses (Fig. 4) shows strong support (posterior probability (pp) = 1) for monophyly of Bovidae and the subfamilies Bovinae and Antilopinae as well as for most tribes. The basal placement of Pseudorygini (represented by it is only species the Saola, *Pseudoryx nghetinhenis*) basal of the sister clades Tragelaphini and Boselaphini is very low (pp < 0.50). Within the Tragelaphini the general node support is high (pp > 0.92), but for the species *Tragelaphus spekii* and *T. eurycerus* (pp < 0.50). Clear monophyly is found for two bovini clades (*Bubalus*+*Syncerus* and *Bos*+*Bison*). The two species of the genus *Bison* (*B. bison* and *B. bonasus*) are placed apart from each other, yet the respective taxonomic position is robust (pp > 0.96). Within the Antilopinae the Impala (*Aeypcerus melampus*) and the Suni (*Neotragus moschatus*) form a sister clade distinct from the remaining Antilopinae (pp = 1). Neotragini and Antilopini are highly supported as sister clades and them together are sister to the Reduncini (pp = 0.63). The node support within the Antilopini is very heterogeneous, especially within the genus *Gazella* it is partly very low. Neotragini is paraphyletic, since the two *Neotragus* species (*N. moschatus* and *N. pygmaeus*) do not cluster with the remaining neotragine genera. Yet, the genera *Madoqua* and *Raphicerus* are monophyletic sisters with the Beira antelope (*Dorcatragus megalotis*) basal of them. While *Neotragus moschatus* is placed next to *Aeypcerus* its putative sister *Neotragus pygmaeus* assembles with *Oreotragus oreotragus* (Klippspringer) at the base of the tribe Cephalophini. Yet, the support for the placement of *N. batesi* is not high (pp = 0.59). The genera *Cephalophus* and *Philantomba* are clearly distinct monophyletic clades (pp = 1), which together are sister to *Sylvicapra grimmia*. A complex of the tribes Hippotragini, Alcelaphini and Caprini is the sister clade of the extended Caphalophini group (Cephalophini+*Oreotragus*+*Neotragus batesi*). The node support within the Hippotragini and Alcelpahini is generally very high, except for the interspecific divergence of *Alcelaphus buselaphus major* and *A. b. lichtensteini* (pp > 0.50). The genus *Hippotragus* here appears to be paraphyletic. The recently extinct Bluebock (*H.*

leucophaeus) assembles basal of the remainder hippotragines, while the extant Sable and Roan antelope *(H. niger* and *H. equinus*) group together as a sister clade of *Addax+Oryx*. This is unexpected, yet highly supported by the posterior probability (pp = 1). Within Caprini the branching at the basal level is badly supported, apparently due to very short branch length, affecting the placement of all genera within the group. Towards the tips the support increases and is usually very high for species distinction. It is remarkable that *Capra* and *Ovis* are placed far apart from each other, i.e. *Ovis* rather basal, while *Capra* evolved more recently.

Divergence Time Estimation

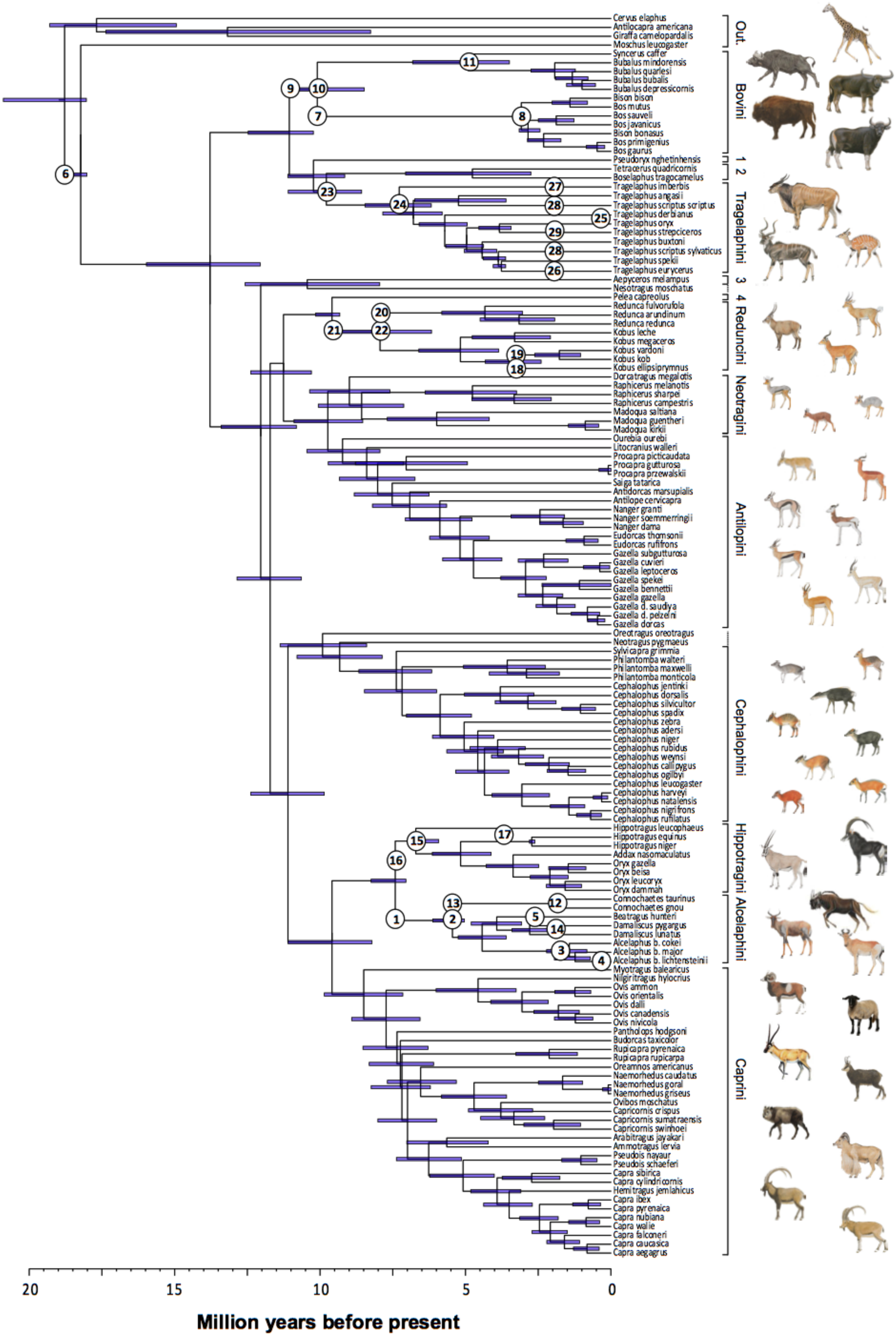
The estimation of divergence time based on 29 fossil calibration points indicates a stem age of 18.23 myrs (18.71–18.02 Ma 95% HPD, pp = 1) for the family Bovidae. The first linage split in the molecular phylogeny occurs at 13.78 Ma (15.97–12.06 Ma 95% HPD, pp = 1) and marks the divergence of Antilopinae and Bovinae. The radiation of tribes took place during a short interval around 9.6 Ma (± 1.2 myrs) with the exception of Alcelaphini and Hippotragini (7.41 Ma; Ma 95% HPD, pp = 0.99) who are the youngest tribes within the Bovidae (Tab. 2). Yet, the split of their common ancestor from the sister group is dated to 9.59 Ma (8.21–11.1 Ma 95% HPD, pp = 1) and fits right within the basic tribal radiation. The radiation of crown groups is less compact and scattered between 10.44 Ma (Aepycerotini) and 4.76 Ma (Boselaphini). The divergences of genera and species are distributed evenly across the full tree, yet variations between tribes are visible. For example, within the Tragelaphini, the diversification stops just after the split of *Tragelaphus eurycerus* and *T. spekeii* at 3.76 Ma (4.05–3.62 Ma 95% HPD, pp = 0.41). In contrast, speciation processes within the Bovini occur basically after 3.08 Ma (3.20–2.77 Ma 95% HPD, pp = 1), specifically, the divergence from the only extant African bovine *Syncerus caffer* who diverged from its sister group at 4.9 Ma (6.82–3.49 Ma 95% HDP, pp = 1). More detailed analyses of divergence times within the African tribes are performed in the chapter "*Temporal Patterns in Bovid Evolution*".

Tab. 2 **Crown and Stem Age Estimates of Bovid Clades**. Given are the estimated divergence times of stem (divergence from sister clade) and crown (first split within clade / most recent common ancestor) and the respective 95% HPD interval for the family Bovidae, its subfamilies and tribes.

Clade	**Stem Age (Ma)**			**Crown Age (Ma)**		
	mean	**Max**	**min**	**mean**	**max**	**min**
Bovidae	18.23	18.71	18.02	13.78	15.97	12.06
Antilopinae	13.78	15.97	12.06	12.04	13.40	10.82
Bovinae	13.78	15.97	12.06	11.06	12.47	10.23
Aepycerotini[3]	10.44	12.58	7.95	-	-	-
Alcelaphini	7.41	8.25	7.05	5.45	6.13	5.04
Antilopini	9.73	10.89	8.53	9.23	10.45	7.94
Bovini	11.06	12.47	10.23	10.09	11.04	8.48
Boselaphini	9.78	11.11	9.15	4.76	7.06	2.75
Caprini	9.59	11.10	8.21	8.50	9.86	7.15
Cephalophini[1]	11.1	12.38	9.86	9.91	11.37	8.40
Hippotragini	7.41	8.25	7.05	6.71	7.00	5.92
Neotragini[2]	9.73	10.89	8.53	8.90	10.36	7.60
Reduncini	9.59	10.15	9.32	7.94	9.33	6.17
Peleini[3]	9.59	10.15	9.32	-	-	-
Tragelaphini	9.78	11.09	8.57	7.28	8.45	6.18

[1] Cephalophini including *Oreotragus* oreotragus and *Neotragus pygmaeus*; [2] Neotragini excl. *Neotragus*); [3] stem group is identical with crown group

Fig. 4 (right) **Dated Bayesian Cytochrome b Phylogeny of the Bovidae**. The resulting consensus tree out of 40 thousand MCMC generations comprising 136 bovid species and four outgroup taxa (out.). Tribe names are given to the right, occasionally abbreviated as follows: (1) Pseudorygini, (2) Boselaphini and (3) Aepycerotini, (4) Peleini. Tree calibration was performed using 29 fossil calibration points (encircled numbers refer to the reference numbers in Tab. 2). Blue bars indicate 95% highest posterior density (HPD) of estimated divergence time, if not given, the posterior possibility (pp) is below 0.5.


Cervus elaphus
Antilocapra americana
Giraffa camelopardalis
Moschus leucogaster
Syncerus caffer
Bubalus mindorensis
Bubalus quarlesi
Bubalus bubalis
Bubalus depressicornis
Bison bison
Bos mutus
Bos sauveli
Bos javanicus
Bison bonasus
Bos primigenius
Bos gaurus
Pseudoryx nghetinhensis
Tetracerus quadricornis
Boselaphus tragocamelus
Tragelaphus imberbis
Tragelaphus angasii
Tragelaphus scriptus scriptus
Tragelaphus derbianus
Tragelaphus oryx
Tragelaphus strepciceros
Tragelaphus buxtoni
Tragelaphus scriptus sylvaticus
Tragelaphus spekii
Tragelaphus eurycerus
Aepyceros melampus
Nesotragus moschatus
Pelea capreolus
Redunca fulvorufola
Redunca arundinum
Redunca redunca
Kobus leche
Kobus megaceros
Kobus vardoni
Kobus kob
Kobus ellipsiprymnus
Dorcatragus megalotis
Raphicerus melanotis
Raphicerus sharpei
Raphicerus campestris
Madoqua saltiana
Madoqua guentheri
Madoqua kirkii
Ourebia ourebi
Litocranius walleri
Procapra picticaudata
Procapra gutturosa
Procapra przewalskii
Saiga tatarica
Antidorcas marsupialis
Antilope cervicapra
Nanger granti
Nanger soemmerringii
Nanger dama
Eudorcas thomsonii
Eudorcas rufifrons
Gazella subgutturosa
Gazella cuvieri
Gazella leptoceros
Gazella spekei
Gazella bennettii
Gazella gazella
Gazella d. saudiya
Gazella d. pelzelni
Gazella dorcas
Oreotragus oreotragus
Neotragus pygmaeus
Sylvicapra grimmia
Philantomba walteri
Philantomba maxwelli
Philantomba monticola
Cephalophus jentinki
Cephalophus dorsalis
Cephalophus silvicultor
Cephalophus spadix
Cephalophus zebra
Cephalophus adersi
Cephalophus niger
Cephalophus rubidus
Cephalophus weynsi
Cephalophus callipygus
Cephalophus ogilbyi
Cephalophus leucogaster
Cephalophus harveyi
Cephalophus natalensis
Cephalophus nigrifrons
Cephalophus rufilatus
Hippotragus leucophaeus
Hippotragus equinus
Hippotragus niger
Addax nasomaculatus
Oryx gazella
Oryx beisa
Oryx leucoryx
Oryx dammah
Connochaetes taurinus
Connochaetes gnou
Beatragus hunteri
Damaliscus pygargus
Damaliscus lunatus
Alcelaphus b. cokei
Alcelaphus b. major
Alcelaphus b. lichtensteinii
Myotragus balearicus
Nilgiritragus hylocrius
Ovis ammon
Ovis orientalis
Ovis dalli
Ovis canadensis
Ovis nivicola
Pantholops hodgsoni
Budorcas taxicolor
Rupicapra pyrenaica
Rupicapra rupicarpa
Oreamnos americanus
Naemorhedus caudatus
Naemorhedus goral
Naemorhedus griseus
Ovibos moschatus
Capricornis crispus
Capricornis sumatraensis
Capricornis swinhoei
Arabitragus jayakari
Ammotragus lervia
Pseudois nayaur
Pseudois schaeferi
Capra sibirica
Capra cylindricornis
Hemitragus jemlahicus
Capra ibex
Capra pyrenaica
Capra nubiana
Capra walie
Capra falconeri
Capra caucasica
Capra aegagrus
Out.
Bovini
1
2
Tragelaphini
3
4
Reduncini
Neotragini
Antilopini
Cephalophini
Hippotragini
Alcelaphini
Caprini
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①
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⑤
⑭
③
④
20
15
10
5
0
Million years before present

DISCUSSION

Phylogenetic Analyses

Although, single marker phylogenetic reconstructions have their limitations (Bromham, 2003; Kumar, 2005), it was recently shown, that the *cytb* gene is a reliable molecular marker to resolve the relationship within the Cetartiodactyla order (Agnarsson & May-Collado, 2008). A nearly complete set of *cytb* sequences of bovid species is available, thus avoiding artefacts, like long-branch-attraction (Alfaro et al. 2003). The circumstance that a comparable taxon density for nuclear gene markers is not given leaves the *cytb* gene as the best option despite possible shortcomings (Bromham, 2003; Kumar, 2005). Various phylogenies with varying amounts of bovid species and subclades were published over the last decades using various combinations of different mitochondrial or nuclear marker or morphological information. The relationships between tribes and single groups on a lower taxonomic level have been studied previously (Birungi & Arctander, 2001; Rezaei et al., 2010; Ricklefs, 2007; van Vuuren & Robinson, 2001), but were not densely sampled. The most comprehensive trees available today were published by Hernández, Fernández & Vrba (2005a) who used a super matrix of (not equally distributed across all species) morphologic, ethologic and molecular information to create a ruminant "supertree", and by Agnarsson & May-Collado (2008) using a pure *cytb* data set for a Cetartiodactyla tree. Compared to the latter study I added three species, which have not been analysed phylogenetically using molecular methods before, and replaced 47 *cytb* sequences by either complete or longer sequences. Moreover I excluded domesticated species from the dataset to avoid anthropogenic impact on speciation processes. Hence, the trees are not directly comparable with regard to pure species number. One issue in the "supertree approach" (Hernández, Fernández & Vrba, 2005a), fairly discussed by the authors, is the low node support due to conflicting results of the underlying source trees. Furthermore, the tree building algorithms vary between studies. Yet, the overall topology of the presented phylogeny is in strong accordance with two reference trees, especially in the placement of tribes. In the following I will discuss only findings achieved with the inclusion of new species or in conflict with previous molecular and/or morphological phylogenies.

Neotragini: All three new species (*Dorcatragus megalotis, Madoqua saltiana* and *Neotragus pygmaeus*) are conventionally assigned to the Neotragini (Gentry, 1992; Roberts, 1951; Ropiquet et al., 2009). The most common and prominent feature of the group Neotragini is their diminutive size (Gatesy et al., 1997). Thus, and for being a sister clade of Antilopini, they received their common name *Dwarf-Antelopes*. However, doubts about the monophyly of Neotragini were expressed before and supported by several molecular studies (Hassanin, 1999; Hassanin & Douzery, 1999; Hernández, Fernández & Vrba, 2005b; Matthee & Robinson, 1999; Rebholz & Harley, 1999), where *Neotragus moschatus* (synonymously *Nesotragus*) surprisingly, yet well supported, they cluster with the Impala (*Aepycerus melampus*). My results are in full agreement with these findings, moreover, the firstly included *Neotragus pygmaeus* (genotypic species) is placed between the Klipspringer (*Oreotragus oreotragus*) and the cephalophines, apart from the remainder Neotragini. This placement complicates the interpretation of the inner Neotragini relationship and evolution even more. Still, the last species *Neotragus batesi,* has to be included to complete the sample. The Beira (*Dorcatragus megalotis*) is morphologically sorted to the neotragines (Groves & Grubb, 2011). My result supports that and places the species basal of the tribe. The same is true for *Madoqua saltiana*, which found its place basal of the Dikdiks *M. guentheri* and *M. kirki*. Still, the Silver Dikdik (*M. piacentinii*) is lacking. The scattered placement of *Neotragus* indicates that a more detailed molecular investigation under the consideration of *N. batesi* (which I wasn’t able to sample during the period of the present study) is highly needed to infer further conclusions about dwarfing processes within the Bovidae. If the placement of *Neotragus* holds true, dwarfing processes had occurred independently several times at early stages of the bovid evolution, leading to morphological similarities that caused confusion and taxonomical misplacements. Consequently, the name *Neotragini* should be abandoned as previously suggested by Gentry (1992).

Hippotragini: The Bayesian tree of *cytb* sequences does not support monophyly of *Hippotragus* and places *Hippotragus leucophaeus* basal of all other hippotragines. Robinson et al. (1996) who extracted the only available and partial *cytb* sequence of that extinct species places it as sister of *H. niger* and *H. equinus*, yet, neither *Oryx* nor *Addax* were included in the investigation but *Damaliscus*. Unfortunately, Agnarson & May-Collado (2008) did not include the by then available sequence. The supertree approach (Hernández, Fernández & Vrba, 2005a), however supports the finding of Robinson et al (1996). Hence, I assume that the basal placement is an artifact due to short sequence length and a placement after the divergence from the *Addax*+*Oryx* clade with accordingly younger species age is more probable.

Tragelaphini: Within the Tragelaphini two conflicts result from the species sorting of the Bayesian phylogeny. The first concerns the differential placement of the two Eland species *Tragelaphus derbianus* and *T. oryx* (grouped under the genus *Taurotragus* due to morphological traits). Actually, that issue is known from several previous studies (Gatesy et al., 1997; Hassanin & Ropiquet, 2004; Moodley et al., 2009), but did not find much attention at all. A (infertile) male hybrid of *T. oryx* (male) and *T. strepsiceros* (female) was reported from the San Diego Zoo (Jorge et al. 1976) highlighting the general possibility of crossbreeding between these distinct species. In the presently highly fragmented environment both species have a still common distribution (distribution maps of the respective species can be found at: http://www.iucnredlist.org), theoretically enabling introgression of mitochondrial DNA from *T. strepsiceros* to *T. oryx* or vice versa due to hybridization. The inclusion of morphological data, like performed in the supertree, testifies sister status of both Eland species. The second issue was evoked by the inclusion of the Bushbuck subspecies *T. scriptus sylvaticus* that is placed as a sister of *T. eurycerus* while *T. scriptus scriptus* is sister to *T. angasi* and far apart. Actually, that is a very recent finding first noted by Moodley et al. (2007) who performed a comprehensive population study on the Bushbuck. The supertree places *T. scriptus* next to *T. strepsiceros* and *T. spekii*, like it is the case for the here used *cytb* sequence of *T.s. sylvaticus*. That raises the suspicion that *T. s. scriptus* (Hernández, Fernández & Vrba, 2005a) is affected by hybridization with *T. angasii* alike the example of the Eland showed, yet today the respective ranges are quite different.

Cephalophini: The Cephalophini show a clear separation of conservative dwarfs (*Philantomba*), giant and red duiker lineages (East and West Africa) as well as for a single grassland species (*Sylvicapra grimmia*) and is in that point identical to previous findings (Ntie et al., 2009; van Vuuren & Robinson, 2001). Yet, the placement of *Sylvicapra* basal to the remainder Cephalophini (p = 1), which are all forest dwelling, differs from the previous findings, where it was placed between *Philantomba* and *Cephalophini*, but with weak support (Ntie et al., 2009; van Vuuren & Robinson, 2001). The finding here, separates clearly the forest species from the grassland species and supports the result of Agnarsson & May-Collado (2008). The first inclusion of *Philantomba walteri* in a family wide Bayesian phylogeny places the species as sister of the remainder *Philantomba* species (p = 1). Colyn's analyses using a concatenated *COI* and *cytb* data set yield high support for a placement of *P. walteri* as a sister of *P. maxwelli* (Colyn et al., 2010), which actually is more plausible due to its distribution range.

Caprini: Recent studies indicate that *Pantholops* is the sister taxon to Caprini (Ropiquet & Hassanin, 2005; Vrba & Schaller, 2000), though this relationship is not revealed here. Many of the estimates within Caprini can thus be expected to change if the clade is returned to monophyly. The same is the case for *Capra* and *Bison*, which here are polyphyletic, as in other studies based on mtDNA, but which have been shown to be monophyletic on the basis of morphology and nuclear DNA (Nijman et al., 2008; Pidancier et al., 2006).

Divergence Time Estimation

Whenever inferring divergence times from gene trees, in particular from single marker genes, it must be considered that the estimated time only reflects in last consequence the evolution of that particular gene. Yet, it serves as an appropriate tool to overcome shortcomings basically invoked by taphonomic processes in the fossil record and biased fossil sampling. To my knowledge, it is not yet understood in which relation the divergence event of two “gene lineages” is to the divergence of two putative “morpho-species”, which actually can be distinguished in the fossil record. Moreover, I expect that this differs from gene to gene and organism to organism. The large and dated phylogeny presented here provides a huge wealth of information that can be compared to the fossil record. The phylogeny is itself a consensus of molecular (*cytb*) and paleontological (fossil calibration) approaches to systematics and should naturally be considered as representing a work in progress. As a result of the large number and wide coverage of the calibration points used, the divergence estimates in this phylogeny are, for the most part. in general agreement with the fossil record. The estimated divergence of Bovidae from its sister group to 18.7–18.0 Ma matches the estimated age of the oldest known putative member of Bovidae *Eotragus artensis* (Ginsburg & Heintz, 1968) dated to 18–17 Ma (Steininger, 1999) or *E. minus* from the early Miocene (Ginsburg & Morales, 2001). The divergence between the Bovinae and the Antilopinae at 13.78 Ma, may appear unexpectedly young compared to other studies but reflects the fact that the age of 18 Ma for *Eotragus noyei* (Solounias et al., 1995) was here used to calibrate a minimum age for the stem group (here the divergence between Bovidae and Moschidae) rather than a hard age for crown Bovidae, as many studies to date have done. The reality is that the exact phylogenetic position of early fossils such as *Eotragus* is not clear, and these may well be stem bovids (Bibi, 2009). In fact, there is little evidence in the fossil record to conclusively indicate the differentiation of Antilopinae from Bovinae (and hence the origin of crown Bovidae) before the middle Miocene. The ”young” date presented here is therefore a perfectly plausible hypothesis. It is also a sobering reminder of both the need for improved phylogenetic clarity in the early and middle Miocene bovid fossil records, and better calibration practices (Bibi & Vrba, 2010; Parham et al., 2012).

Analyses of tribe level estimates are subject of the following chapter “***Temporal Patterns in Bovid Evolution***” wherein I investigate patterns behind the estimated divergence times, in particular related to climate preferences of clades.

2. TEMPORAL PATTERNS IN BOVID EVOLUTION

Time-calibrated molecular phylogenies yield the potential to reveal diversification events in geological history within ancestral lineages of extant species. This second chapter deals with analyses of the previously obtained bovid phylogeny (*Chapter 1*). Elisabeth Vrba (1992) postulated that changes of the diversification rate within taxa are initiated by major environmental changes and should appear synchronous within lineages. If this holds true, the established phylogeny should show detectable patterns of rate shifts that can be related temporally to strong environmental changes. To test this I investigated the full bovid phylogeny on the family level. However, synchronous turnover pulses across all bovid lineages equally are not expected results. As mentioned earlier, bovids occupy an extremely wide ecological range in Africa from very humid to very arid environments (Kingdon, 1989a; Kingdon, 1989b). Environmental changes are assumed to work towards one direction, e.g., towards more arid or humid climate conditions compared to a previous time interval. Hence, the distribution of habitat types on one side of the climate spectrum should respond with expansion while, in contrast, habitat types of the contrary side of the spectrum contract. That would lead to an unequally distributed evolutionary pressure across bovid tribes and the respective species. Hence, contrasting diversification patterns are expected for clades adapted to oppositional environments. To test this assumption, I additionally analyse the diversification patterns on tribe level, which can be assigned to certain biomes. Moreover, pooling tribes that are either associated with arid/open habitats or with humid/closed habitats allows a comparison of the diversification history of arid and humid adapted species. Relating the resulting patterns to climate conditions at time may shed more light on the question of how environmental change affects speciation processes.

METHODS

Diversification and Lineage-Through-Time Plots

To identify and visualize events of changing net diversification rate I used "***Lineage Through Time***" (LTT) plots (Nee et al., 1992; Nee et al., 1994). I define here and further on diversification (***d***) as

.

Where ***s*** is the observed speciation rate (lineage splitting) of surviving lineages and their ancestors, while ***e*** is the reflected extinction of lineages over time. In LTT plots the logarithm of the lineage number is plotted against their divergence times obtained from a consensus tree of time-calibrated molecular phylogenies (chronograms). The resulting shape of the LTT curve reflects the diversification history of the respective clade using the estimated divergence times of a dated phylogeny. Under the assumption of pure-birth diversification model a curve rises linearly over time and implies that the net diversification has been constant through time (Fig. 5). A step-like increase of the curve implies a sudden increase of the net diversification rate compared to the period before. In contrast, a lowered slope stasis implies a reduced speciation or an increased extinction, resulting in a lowered net diversification. A plateau (i.e., the number of lineages remains the same) is a special case of reduced net diversification rate resulting from an extinction event that happened at the end of the plateau (Crisp & Cook, 2009). From the previously established consensus tree I extracted and analysed 10 "subtrees" (Fig. 6). Initially, I investigated the full Bovidae family under exclusion of the out-group species. Furthermore, I analysed the following tribes independently: Alcelaphini, Antilopini, Cephalophini, Hippotragini, Neotragini, Reduncini and Tragelaphini. For the Cephalophini the root was set after the divergence of *Sylvicapra grimmia* (Grey Duiker) from the remaining duikers, due to its preference for rather arid and less covered environments, which is atypical of duikers. For all other sets, the root was set to the moment when the group diverged from its sister clade. All manipulations within phylogenies were performed in *Dendroscope* v2.7.4 (Huson et al. 2007). Temporal analyses of diversification were not performed for the remaining tribes on the African continent (e.g., Bovini) due to low species numbers. In order to enhance possible weak signals of changing diversification rate in single tribes I established two artificial chronograms, based on tribe's climatic preferences. That permits the analyses of the impact of changing climate factors in dependency of habitat preferences. Firstly, the set ARID resembles Antilopini, Alcelaphini and Hippotragini, which are typical for open and arid environments. The tribe's distribution ranges from open grasslands to deserts. Secondly, Cephalophini, Reduncini and Tragelaphini are described as inhabitants of humid and covered habitats, and are therefore combined in the set HUMID. Since the basal nodes of the ARID and HUMID chronograms are artificial, they were excluded in all subsequent analyses.

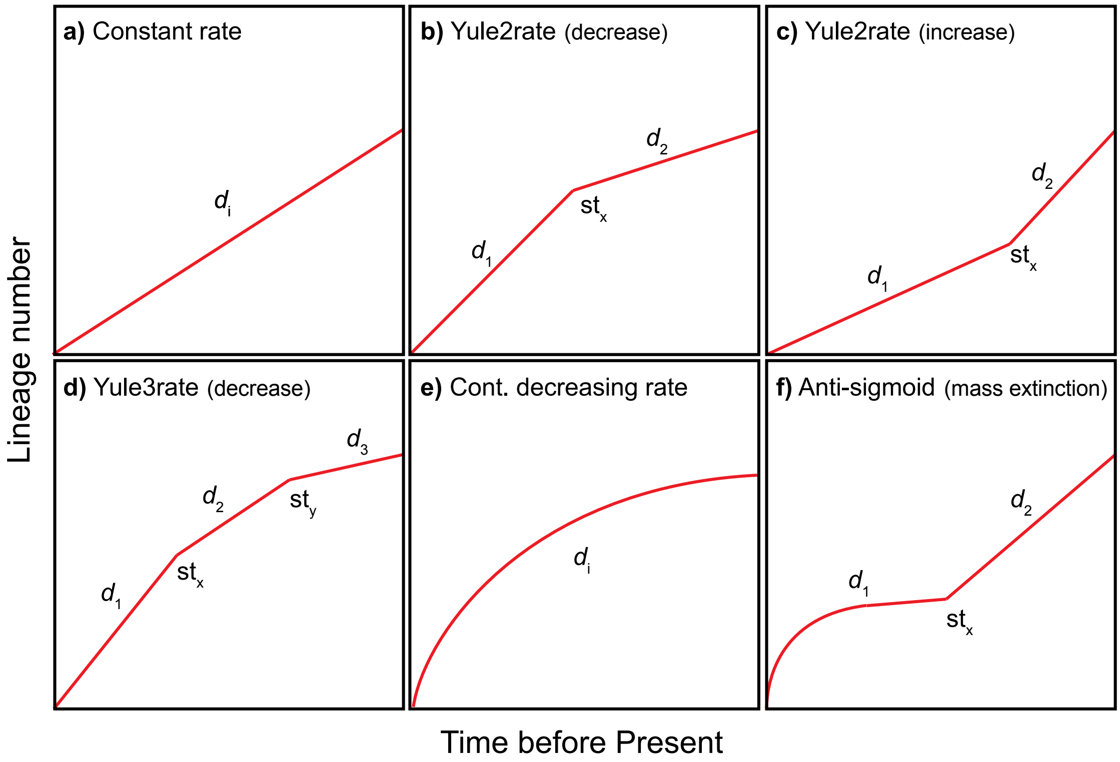
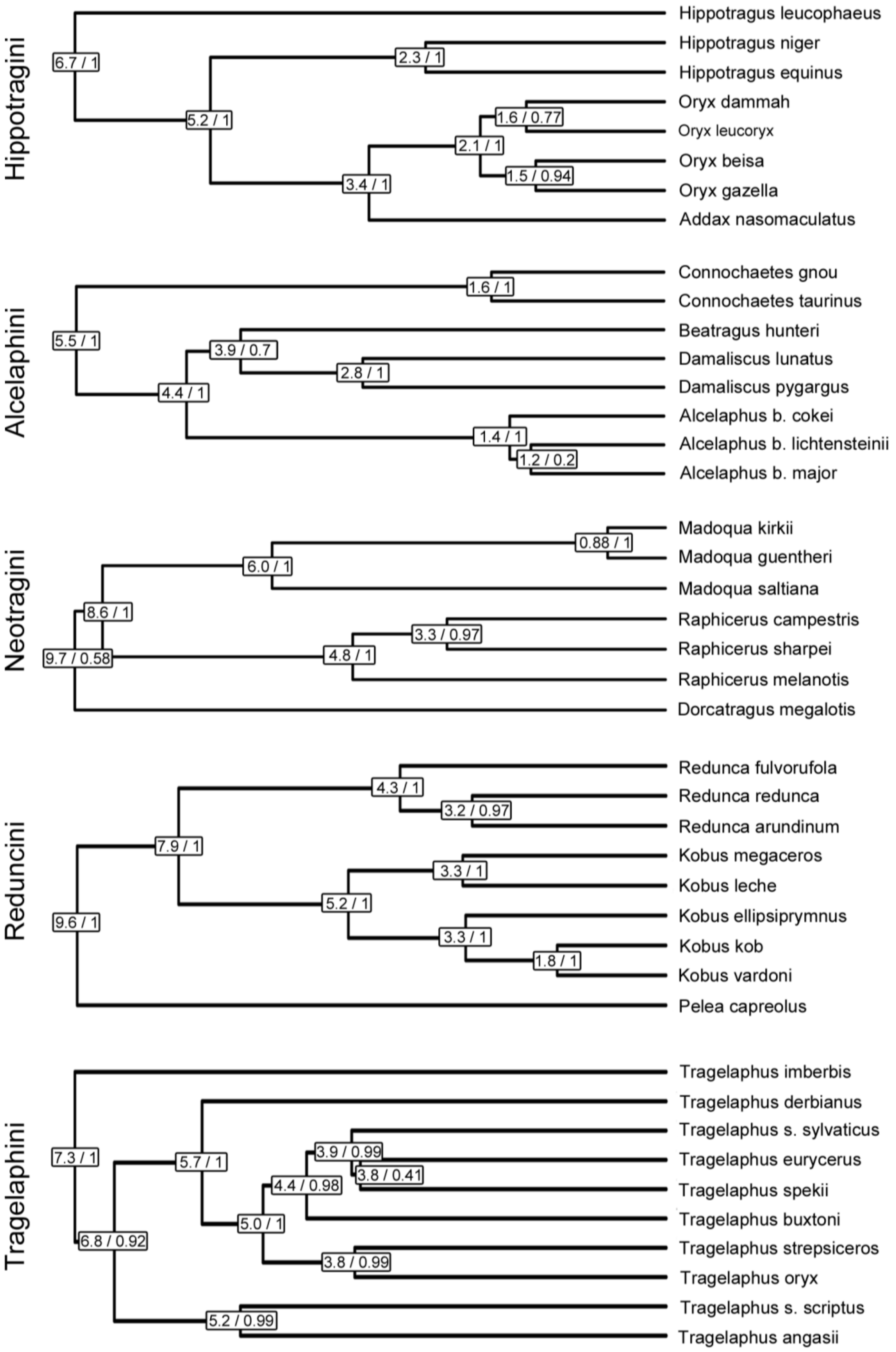


Fig. 5 **Idealized "Lineage Through Time" Plots.** In LTT plots the logarithmic number of lineages is plotted against the estimated time of their divergence. Shown are major categories of LTT shapes. **a**) assumed is a growth of species number under a constant rate d_i model; **b**) assumed is a single rate shift at the time st_x and otherwise constant net diversification rates (d_1 and d_2), **c**) like before but with increased rate d_2 after st_x; **d**) assumes two rate shifts at the time st_x and st_y otherwise constant net diversification rates ($d_1 - d_3$); **e**) assumes a continuously decreasing net diversification rate d_i towards the present leading to a convex curve shape; **f**) Antisigmoid curve from a mass extinction event—the plateau and subsequent sharp upturn in slope are caused entirely by the extinction and do not reflect any change in background diversification rate.

LTT plots provide a graphical mean for representing diversification rates over time. However, they do not permit any numerical interpretation (Rehan et al., 2010). Hence, I used the branching time information derived from the chronograms to assess the diversification rate and to apply model fitting using the *LASER* package (Rabosky & Lovette 2008) for *R* (R Development Core Team, 2008). I tested two constant-rate models of diversification (a pure-birth model (Yule, 1925) with constant speciation rate; a birth-death model (Kendall, 1948) with constant speciation and extinction rates) and multi-rate models, which allow for rate shifts at distinct times but with constant rates otherwise (yule2rate, youle3rate) (Rabosky, 2006b). The calculated AIC scores (Akaike-Information-Criterion), (Akaike, 1974) permit evaluation of which model fits best to the respective chronogram. It has to be mentioned that the applied method to test for best fitting models only discriminates between the models offered for comparison. In this study's context it is most interesting to see how groups behave compared to each other, i.e., how do arid species diversify while humid species increase their species number and vice versa. Therefore, I draw a comparative LTT plot for the ARID and HUMID groups. That may permit us to infer diversification patterns that are concealed in full family analyses and/or are not detectable in single clade approaches.


Hippotragini
6.7 / 1
5.2 / 1
2.3 / 1
3.4 / 1
2.1 / 1
1.6 / 0.77
1.5 / 0.94
Hippotragus leucophaeus
Hippotragus niger
Hippotragus equinus
Oryx dammah
Oryx leucoryx
Oryx beisa
Oryx gazella
Addax nasomaculatus
Alcelaphini
5.5 / 1
4.4 / 1
3.9 / 0.7
2.8 / 1
1.6 / 1
1.4 / 1
1.2 / 0.2
Connochaetes gnou
Connochaetes taurinus
Beatragus hunteri
Damaliscus lunatus
Damaliscus pygargus
Alcelaphus b. cokei
Alcelaphus b. lichtensteinii
Alcelaphus b. major
Neotragini
9.7 / 0.58
8.6 / 1
6.0 / 1
0.88 / 1
4.8 / 1
3.3 / 0.97
Madoqua kirkii
Madoqua guentheri
Madoqua saltiana
Raphicerus campestris
Raphicerus sharpei
Raphicerus melanotis
Dorcatragus megalotis
Reduncini
9.6 / 1
7.9 / 1
4.3 / 1
3.2 / 0.97
5.2 / 1
3.3 / 1
3.3 / 1
1.8 / 1
Redunca fulvorufola
Redunca redunca
Redunca arundinum
Kobus megaceros
Kobus leche
Kobus ellipsiprymnus
Kobus kob
Kobus vardoni
Pelea capreolus
Tragelaphini
7.3 / 1
6.8 / 0.92
5.7 / 1
5.0 / 1
4.4 / 0.98
3.9 / 0.99
3.8 / 0.41
3.8 / 0.99
5.2 / 0.99
Tragelaphus imberbis
Tragelaphus derbianus
Tragelaphus s. sylvaticus
Tragelaphus eurycerus
Tragelaphus spekii
Tragelaphus buxtoni
Tragelaphus strepsiceros
Tragelaphus oryx
Tragelaphus s. scriptus
Tragelaphus angasii

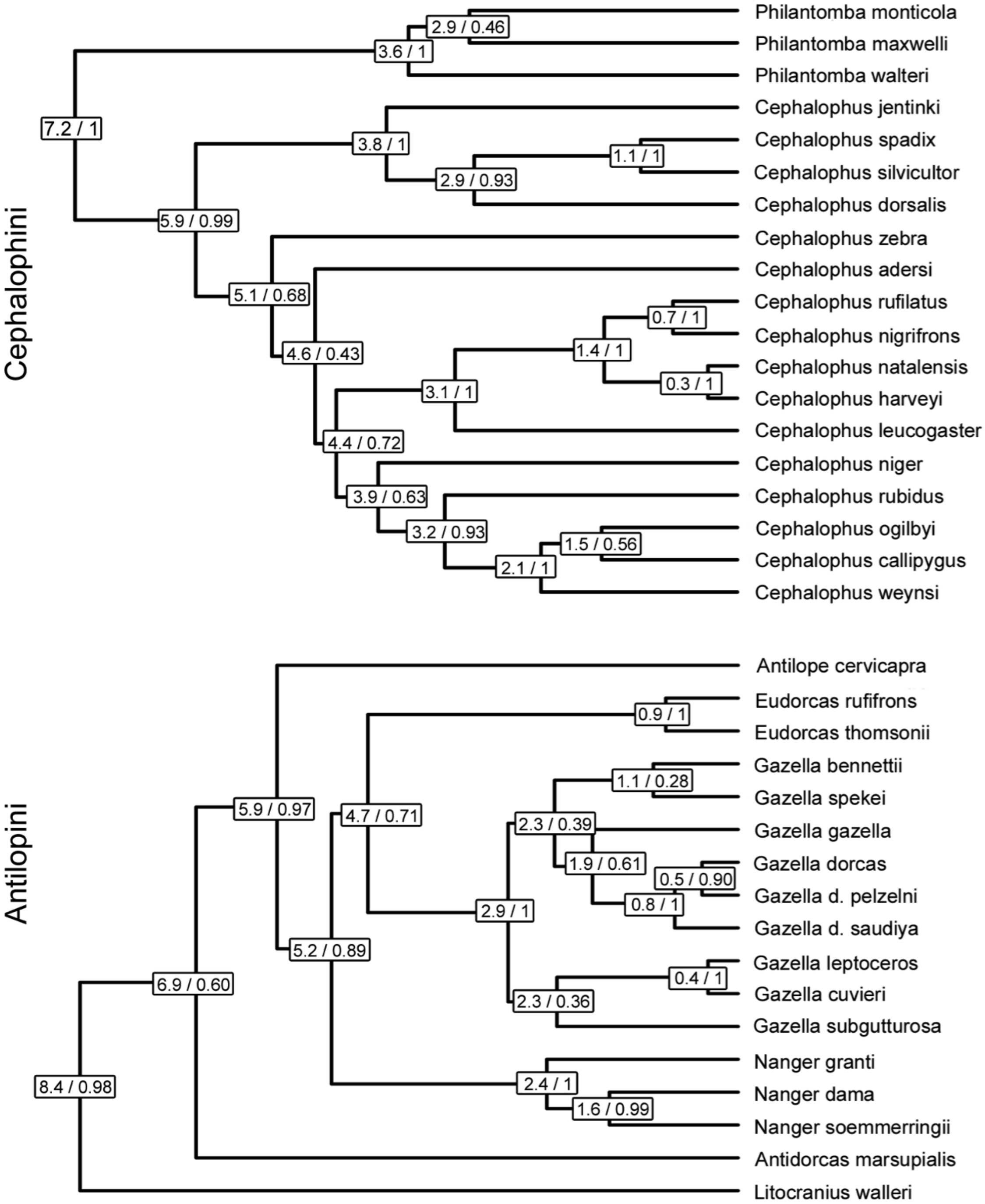


Fig. 6 **Chronograms of Tribes used for LTT Analyses**. Values at nodes give the estimate divergence age and posterior probability. The not shown chronograms for the artificial groups ARID and HUMID result from combining the chronograms of Antilopini, Alcelaphini, Hippotragini and Cephalophini, Reduncini and Tragelaphini, respectively.

RESULTS

Diversification and Lineage-Through-Time Plots

The LTT plots I established for the full family Bovidae, the seven major African tribes and the combined chronograms for arid and humid species permit an initial interpretation of the temporal diversification patterns of the respective clade (Fig. 7). I used the *LASER* package (Rabosky, 2006a) to test multiple diversification models with constant rates (pure birth, birth-death) and variable rates; i.e., the rates shifts at one or two points in time (Tab. 3). For the entire Bovidae family, a model with two rate shifts is proposed by the AIC values to be the best fitting one. A first rate shift is suggested to occur at 9.6 Ma (d_1 = 0.59, d_2 = 0.23), the second at 0.8 Ma (d_3 = 0.07). The LTT plot for the pooled humid tribes (HUMID) shows a remarkable downward bending, supported and dated to 2.8 Ma (d_1 = 0.36, d_2 = 0.07) by the model tests. A contemporaneous rate shift is found on tribe level for the Cephalophini (2.9 Ma, d_1 = 0.54, d_2 = 0.14). Furthermore an estimated shift in Reduncini occurs at 3.26 (d_1 = 0.5, d_2 = 0.07) and for Tragelaphini at 3.9 Ma (d_1 = 0.41, d_2 = 0.05). The course of the ARID LTT plot indicates a slight decrease at about 5.0 Ma followed by an increasing diversification rate at 3.0 Ma, however the model test suggests one single shift at 0.8 Ma (d_1 = 0.284, d_2 = 0.08) only. For the remaining clades (ALC, ANT, HIP, and NEO) a constant rate (pure birth) is preferred as best fitting model. The comparative LTT plot for the HUMID and ARID group (Fig. 8) shows an oppositional course of both curves that can be separated in three phases: ***P1*** separation of both LTTs at about 4.5 Ma; ***P2*** convergence of both LTTs at about 2.8 Ma; ***P3*** phasing of both LTTs at about 1.4 Ma. During *P1* the diversification rate of the HUMID species remains high while within the ARID group few new lineages evolve. In *P2* that patterns switches towards the development of more arid adapted species and less accumulation of new humid species. Around 1.4 Ma the net diversification rate of the arid group decreases like the HUMID group did previously and in *P3* both ARID and HUMID show similar diversification rates.

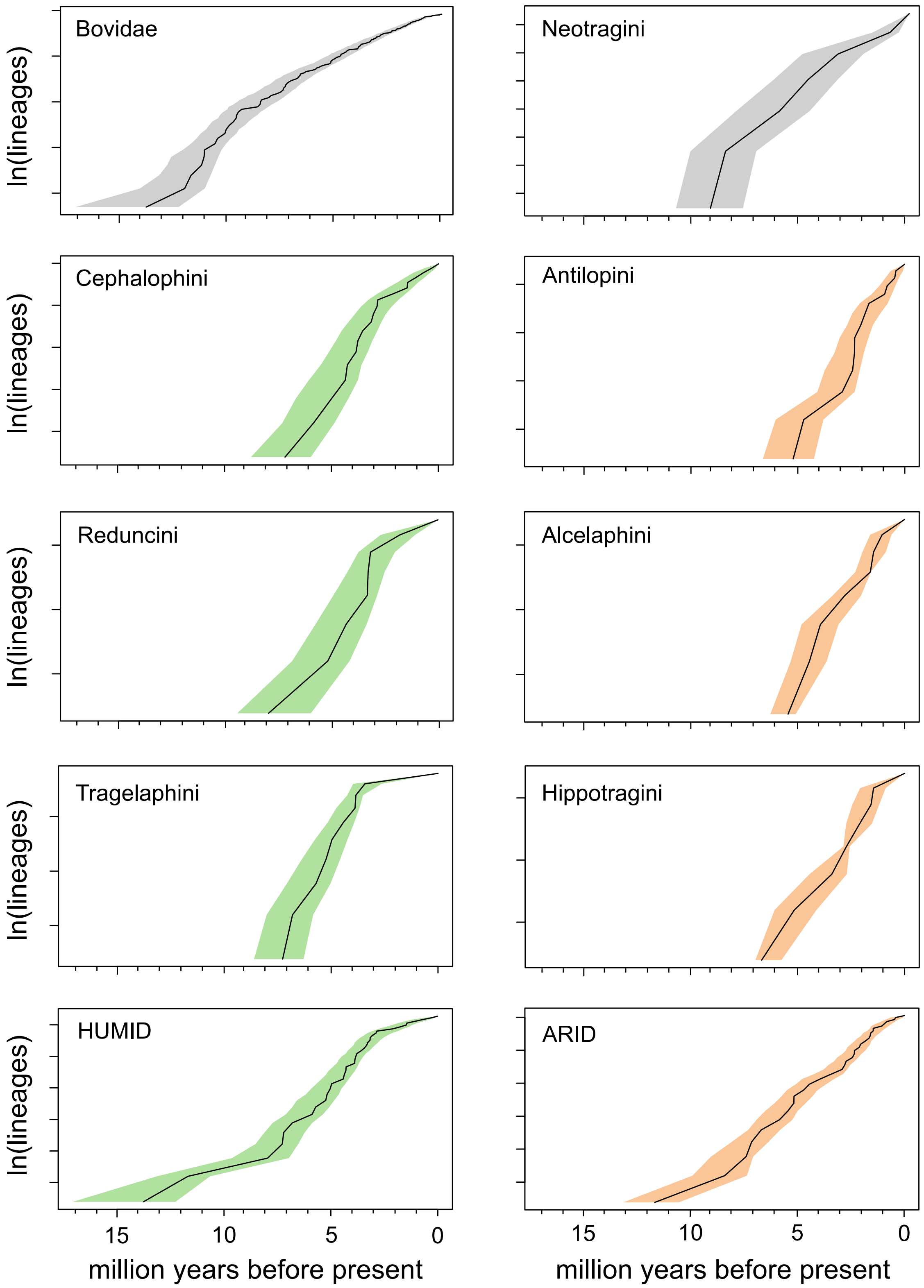


Fig. 7 “**Lineage Through Time” (LTT) plots for the Family Bovidae and seven African bovid tribes**. Black line represents the LTT of the consensus tree of the *BEAST* output. Shading is the 95% confidence interval based on 1000 random trees. Tribes with green shading are assigned to humid/closed habitats and are polled in the chronogram HUMID, orange shading indicates tribes assigned to arid/open habitats and are pooled in the ARID chronogram.

Tab. 3 **Model Testing using *LASER* for Estimated Divergence Times Visualized in the LTT Plots (**Fig. 7**).** For each chronogram two constant rate models (pure-birth, birth death) and two shifting rate models (yule2rate, yule3rate) were tested. The lowest AIC value indicates the best fitting of all tested models (bold).

Clade	**Model**	**Mean Diversification Rate**			**Rate Shift (Ma)**		**AIC**	**ΔAIC**
		d_1	d_2	d_3	st$_1$	st$_2$		
Bovidae	pure-birth	0.22					-380.24	24.12
	birth-death	0.22					-378.24	26.12
	yule2rate	0.25	0.07		0.78		-392.54	11.83
	yule3rate	**0.59**	**0.23**	**0.07**	**9.59**	**0.78**	**-404.37**	**0.00**
Humid	pure-birth	0.20					-8.19	14.14
	birth-death	0.20					-6.19	16.14
	yule2rate	**0.36**	**0.07**		**2.85**		**-22.33**	**0.00**
	yule3rate	0.13	0.42	0.07	7.94	2.85	-22.00	0.33
Arid	pure-birth	0.24					-13.26	0.97
	birth-death	0.24					-11.26	2.97
	yule2rate	**0.28**	**0.07**		**0.81**		**-14.23**	**0.00**
	yule3rate	0.27	0.73	0.13	1.64	1.43	-11.61	2.62
Alcelaphini	**pure-birth**	**0.23**					**14.69**	**0.00**
	birth-death	0.23					16.69	2.00
	yule2rate	0.56	0.18		3.93		17.15	2.47
	yule3rate	0.28	0.98	0.09	1.60	1.43	19.87	5.19
Antilopini	**pure-birth**	**0.26**					**10.54**	**0.00**
	birth-death	0.26					12.54	2.00
	yule2rate	0.30	0.15		0.81		13.67	3.12
	yule3rate	0.24	0.27	0.23	2.44	0.81	13.94	3.40
Cephalophini	pure-birth	0.26					8.58	3.85
	birth-death	0.26					10.58	5.85
	yule2rate	**0.54**	**0.14**		**2.85**		**4.72**	**0.00**
	yule3rate	0.51	1.61	0.14	2.90	2.85	7.83	3.10
Hippotragini	**pure-birth**	**0.20**					**16.19**	**0.00**
	birth-death	0.20					18.19	2.00
	yule2rate	0.28	0.13		2.10		19.30	3.11
	yule3rate	0.24	0.34	0.08	3.36	1.57	22.26	6.07
Neotragini	**pure-birth**	**0.12**					**20.01**	**0.00**
	birth-death	0.12					22.01	2.00
	yule2rate	0.22	0.07		4.76		22.42	2.42
	yule3rate	1.19	0.15	0.05	8.57	3.33	23.90	3.89
Reduncini	pure-birth	0.15					21.78	2.16
	birth-death	0.15					23.78	4.16
	yule2rate	0.25	0.07		3.26		23.35	3.73
	yule3rate	**0.20**	**1.95**	**0.04**	**3.31**	**3.16**	**19.62**	**0.00**
Tragelaphini	pure-birth	0.15					22.70	6.75
	birth-death	0.15					24.70	8.75
	yule2rate	0.41	0.05		3.87		18.90	2.95
	yule3rate	**0.41**	**3.32**	**0.03**	**3.87**	**3.83**	**15.95**	**0.00**

DISCUSSION

Diversification and Lineage-Through-Time Plots

The Bovidae per se show a fairly constant net diversification over time but shifts to slightly lower rates twice. The first shift is dated to 9.59 Ma, according to the consensus tree that is just after the ancestors of contemporary tribes diverged from their sister taxa and before the respective crown groups radiated. The breakpoint is followed by a plateau indicating very low diversification until about 8.5 Ma after which the rate spikes upwards again (antisigmoidal curve), (Crisp & Cook, 2009). An examination of the dated cladogram (Fig. 4) indicates that a lineage origination gap is present for this time period (9.5–8.5 Ma) in the histories of all the bovid tribes with the exception of the Antilopini+Neotragini. This gap suggests a major loss of stem lineages just prior to the origin of most of the modern bovid tribes. The fact that this gap is visible across the bovid tree suggests a concerted evolutionary event driven by extrinsic environmental factors. The time between 10 and 7 Ma experienced major faunal turnover both in Europe and Asia, the product of an increasingly seasonal and arid climate (Agusti et al., 2003; Nelson, 2007). Across Eurasia, this episode of faunal change saw disproportionate losses of forest, frugivorous and browsing species, and increases in the diversity of grazing clades (Barry et al., 2002), especially among ruminants and equids. The LTT diversification rate decrease, beginning at 9.59 Ma and plateauing until 8.5 Ma, might reflect the same episode of environmental and ecological change, through which many bovid lineages may not have survived. The second shift is estimated to 0.78 Ma ago. There are two methodical reasons explaining recent slow downs in LTTs. Firstly, it is possible that an incomplete sampling leads to a false rate slow down (Crisp & Cook, 2009). The Bovidae are a very well studied group and it is very unlikely that, alike other large mammals, unknown distinct "morpho-species" have not yet been discovered by the scientific community. However, just recently it has been shown by the "discovery" of *Philantomba walteri* (Colyn et al., 2010) that ***cryptic species*** (genetically but not phenotypically distinct species) can be found in even well investigated mammalian families. A further sampling bias may be introduced simply by the definition of species and their respective subspecies. More and more studies dealing with population structure and population genetics within single species shed light on the distinctiveness of intraspecies lineages (Flagstad et al., 2000; Moodley et al., 2009). Therefore I included several subspecies variously regarded as species into this study to address that issue. Yet, if this slowdown is reasoned by cryptic species or subspecies it raises the question why the respective candidates did not become morphologically distinct enough within the last 800,000 years to be visually distinguished? Secondly, population growth decreases after it reached a certain density of individuals due to limiting factors (e.g., food). That phenomenon can be applied to species diversification as well, were the limiting factor is the availability of niches. Once all niches are occupied, no new species evolve. Yet, this is highly speculative and progressive physical changes of the environment continuously alters the availability of niches and therefore a “sold-out” situation should not be possible. The two aforementioned arguments for a recent rate decrease are rather methodical and are reasonable for any clade and rate decrease at any time. The second breakpoint (0.78 Ma) is also recovered in the LTTs of the African ARID grouping (but none of its individual tribes) and in that of the Caprini (not shown). A circumstance that supports that an equal under-sampling in geographically and phylogenetically distinct clades leads to a shift for both at 0.8 Ma is very unlikely. This dating coincides with a shift to increased aridity especially well-documented in Africa (deMenocal, 2004), coincident with the dominance of 100 kyrs of eccentricity-modulated climatic Milankovitch cycles (“Ice Ages”) around 1 Ma. The “end-Villafranchian event” or “mid-Pleistocene transition” beginning around 0.9 Ma saw marked faunal turnover in Europe and probably in Asia as well (Azzaroli et al., 1988), but not so clearly in Africa (O'Regan et al., 2005). It is tempting to speculate that the Eurasian temperate to boreal Caprini might have been more strongly affected by the mid-Pleistocene transition than the remaining bovid tribes, the majority of which are restricted to lower latitudes. The other breakpoint found for Caprini at 6.34 Ma correlates roughly to a time of high faunal dispersal and turnover in the circum-Mediterranean region (Van Der Made et al., 2006), but with no obvious causal connection.

The tribes Antilopini, Hippotragini and Alcelaphini are rather inconspicuous; in contrast the humid assigned tribes show clear rate shifts. For the tragelaphines one shift is dated to 3.8 Ma and considering the tree topology and divergence estimates it is rather a speciation burst at that time after which no further completed speciation occurred. The fossil record of Tragelaphini is entirely African, and shows little morphological diversity from the tribe's first appearance around 6 Ma until just after 4 Ma when multiple lineages start to become evident (Bibi, 2009; Gentry, 2010). The LTT breakpoint at 3.87 Ma represents the time by which all the lineages that would give rise to the living species had differentiated. This date is itself a product of the fossil calibration points used in this study, specifically those identifying the origins of the greater Kudu and Bongo lineages (Bibi, 2011; Reed & Bibi, 2011). For Cephalophini it is slightly different. They too have a single rate shift but keep diversifying later on yet with a much lower rate. That is reflected in the pooled HUMID group with a breakpoint at 2.85 Ma. That is remarkably close to the onset of an overall global net aridification trend starting at 3.0–2.8 Ma (deMenocal, 2004). Moreover, the comparison of ARID and HUMID LTTs (Fig. 8) clearly shows an oppositional trend of net diversification for both LTTs, synchronously switching at 2.85 Ma.

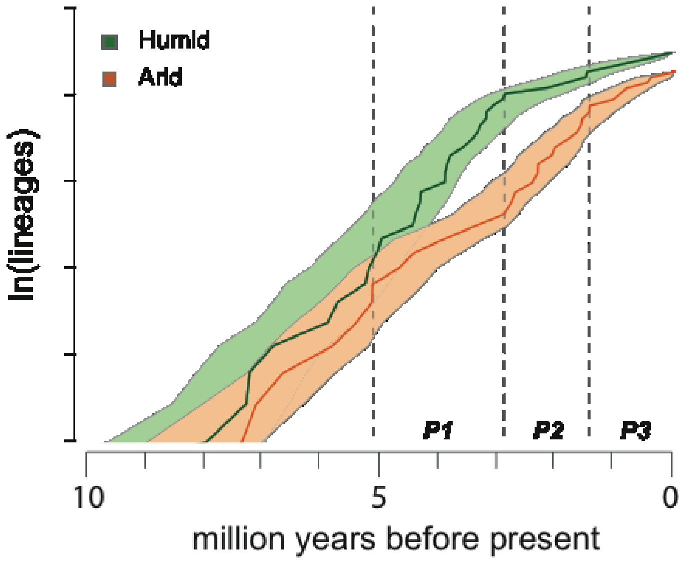


Fig. 8 Comparative LTT plots of the HUMID and ARID groups. Shown are the LTT plots based on the divergence estimates of the consensus tree (bold line) obtained from Bayesian analyses and the respective 95% confidence interval of 1000 random trees per group (shaded). *P1* separation phase; *P2* approachment phase; *P3* phasing of both diversification rates.

The period ***P1*** before this bovid diversification switch (*BDS*) was dominated by rather humid climates and a high proportion of forests and dense vegetation (Bonnefille, 2010) what led in sum to an accumulation of visibly more humid than arid lineages. The *BDS* marks the onset of increased arid lineage accumulation compared to strongly reduced diversification of humid lineages (***P2***) contemporaneous with vegetation opening (Bonnefille, 2010) and the beginning aridification trend. After 1.4 Ma both plots show similar low diversification (***P3***) what may be the initial decrease of diversification rate of all Bovidae cumulating in the rate shift at 0.78 Ma discussed above. The temporal pattern in the bovid evolution suggests that advantageous changing climate condition drove diversification processes within clades of common climate characteristics. In contrast, if the prevailing climate conditions deteriorate the diversification process appears to be hampered. In the next chapter "***Spatial Patterns of Bovid Evolution***" I investigate the impact of increasing aridity on habitat availability for groups with common climate preferences and how that could have effected changes in diversification rates.

3. SPATIAL PATTERNS IN BOVID EVOLUTION

The evolutionary temporal patterns described in Chapter 2 show a major diversification switch (*BDS*) within the bovid family at around 2.8 million years ago. Diversification processes within tribes adapted to humid habitats dominated the time before the *BDS*, while in the later time more species on the arid side of the climate spectrum evolved. Multiple indicators suggest a worldwide aridification trend from not later than 3 Ma onwards – interrupted by several humid periods. Yet, it is not clear how past climate changes affected habitats on a large scale and, consequently, its inhabitants.

In this chapter I link the species distribution modelling approach with climate scenarios, reconstructed for the *preBDS* and *postBDS* period. A set of climate scenarios basically driven by reduced elevation of Southern and Eastern Africa (Kaspar et al.. 2010; Sepulchre et al.. 2006) is used for habitat distribution projections. The resulting maps show the fundamental habitat distribution of bovids with common climate preferences (***climate-groups***). This addresses the question how changing climate affected bovid communities in the past. In particular, how has the habitat distribution changed over time? Aside from the reconstructed geographical habitat distribution for climate-groups at given times, its change in size and suitability over time can be investigated. I perform the analyses on a full continental scale as well as on a regional scale. For this I define six test areas around fossils sites known for hominid fossil-bearing layers. Additionally, for validation of the habitat projections I reconstruct the paleoecology of the test areas, inferred from bovid climate-group habitat suitability and test the results against classical paleoreconstructions.

METHODS

Climate-Group Building

The representativeness of occurrence information of investigated taxa is crucial for the distribution modelling applied here. For Bovidae, distribution maps such as from the IUCN webpage (http://www.iucnredlist.org/) or from literature, e.g., (Kingdon, 1989a) are available. However, they are much generalized and indicate occurrences even in areas with unsuitable environments and therefore overestimate the actual distribution. Today, the geographic range of most antelope species is negatively biased by anthropogenic factors (e.g., hunting, logging, cattle breeding) and is usually restricted to protected areas. Thus, one must assume that populations no longer reach their full possible geographic range. In contrast, single point observation data underrepresent the true range of climatic suitable environments. Nevertheless, I assume that the effect of underrepresentation is minor compared to an overrepresentation. Hence, I collected current data for 85 African bovid species and subspecies from several sources (SuppTab. 3) In total 2529 observation points (mean per species: 30 ± 28 points; minimum: 4 points for *Beatragus hunteri*; maximum: 182 points for *Gazella dorcas*) were included into the resulting database (SuppTab. 3) and prepared for further treatment in GIS applications (e.g., *ArcGIS* 10). No double locality entries per species were accepted. Since observation points do not yield any arial information, each point was buffered to a circular area with a radius of 1 km to enable climate niche modelling. All subsequent analyses (climate grouping, climate niche and distribution modelling) were performed using the following four *WorldClim* climate variables: maximum temperature of warmest month (Bio05); minimum temperature of coldest month (Bio06); precipitation of driest month (Bio13) and precipitation of wettest month (Bio14). The climate layers are available and were downloaded from the *WorldClim* homepage (http://www.worldclim.org/; (Hijmans et al., 2005) in a 30 arc-seconds resolution (~1 km^2 grid). In contrast to comparable studies (Kozak & Wiens, 2010), I decided to use only four out of 19 available climate variables. The selected variables, in particular the precipitation variables, are limiting factors for plant growth and dispersal (Bonnefille, 2010; Deshmukh, 1984). Thus, they are responsible for the structure of plant communities and are subsequently limiting factors for bovid distribution as well (Shorrocks, 2007). Moreover, many of the remainder variables are highly redundant and correlated. Also, I neglected the inclusion of a digital elevation model, since the elevation is reflected in the climate patterns. Moreover, the topography varied over the past million years, tremendously (Chorowicz, 2005; Partridge, 1997), and is not simulated in an appropriate resolution for past geological times to be included in species distribution modelling. The observation points, respectively the circular area around not necessarily matched the underlying grid cells, i.e., they may intersect multiple grid cells. To obtain a representative value per observation point and climate variable I calculated the median value of all grid cells (~1 km^2) intersecting with the circular area. With this data I calculated the median values per species and climate variable. I established five "***climate-groups***" using the k-means clustering method (MacQueen, 1967) to obtain groups representing different climate characteristics. To assign every climate group a vegetation type, I also calculated the median value per included climate variable for the main vegetation types of Africa after White (1983) and added them to the clustering procedure. White described the included major vegetation types as follows:

- *Desert* and *Semi-Desert*: Arid landscapes with a sparse plant cover dominated by sandy, stony or rocky substrate
- *Wooded grassland*: Land covered with grasses and other herbs, with woody plants covering between 10% and 40% of the ground.
- *Grassland*: Land covered with grasses and other herbs, either without woody plants or the latter not covering more than 10% of the ground.
- *Shrubland*: An open or closed stand of shrubs up to 2 m tall.
- *Thicket*: A closed stand of bushes and climbers usually between 3 and 8 m tall.
- *Bushland*: An open stand of bushes usually between 3 and 8 m tall with a canopy cover of more than 40%.
- *Woodland*: An open stand of trees at least 8 m tall with canopy cover of 40% or more. Grasses usually dominate the field layer.
- *Forest*: A continuous stand of trees at least 10 m tall with interlocking crowns.

The use of the tribes pooled in the artificial groups ARID and HUMID (*Chapter 2*) is unfeasible as preliminary tests showed (data not provided). The reason is most likely, that even within tribes that are typically classified to a certain habitat type, the climate preferences of the included species are very variable and therefore led to a blurred projection of suitable habitats.

Climate-Group Projection Using Species Distribution Modeling

The climate group distribution in Africa was performed with the species distribution modelling software *Maxent* version 3.1 (Phillips et al. 2004; Phillips et al. 2006). The software has shown remarkably good performance in a comparative study of presence-only niche modelling techniques (Elith et al., 2006). In short, based on presence-only data ecological variables are used to calculate the ecological niche as well as the habitat suitability on a defined geographic range. Furthermore, one can project the calculated niche onto different climate scenarios (e.g., increased temperature). The resulting projection maps show the habitat suitability, i.e., the potential distribution of a species or group of taxa, on a logarithmic scale between 0-100, here called ***Habitat Suitability Index*** (HSI). An HSI value of 100 indicates maximum suitability, 0 means the conditions are not suitable at all. The critical threshold value that is sufficient for species occurrence is at 20 HSI. For the habitat projections I used the same climate variables as before for the climate niche estimation of the climate-groups. As climate reference served a climate scenario that represents the climate conditions of a preindustrial scenario, i.e., reduced greenhouse gases and present day elevation, from Kaspar et al. (2010). The scenario used served as a basis for simulations of climate conditions under reduced elevation in East and Southern Africa (Kaspar et al., 2010). Using a preindustrial climate scenario instead of the actual present day climate avoids an anthropogenic bias. I refer to that preindustrial reference climate scenario henceforth when I use the term "***Present***" conditions. As I mentioned above, climate reconstructions were made for lowered elevation in Africa (Kaspar et al., 2010; Sepulchre et al., 2006), i.e., for a scenario assuming 75% and 50% of present day elevation. To project the climate-group habitat distribution I employed the 50% elevation scenario as representation for the time before the BDS (“***post BDS***”) and the 75% scenario as a representation of climate conditions just after the switch around 2.8 Ma (“***pre BDS***”). Kerstin Prömmel (pers. comm., Freie Universität Berlin, Germany) kindly provided the modelled climate data sets. I want to note that the on-going uplift processes of the EARS neither was, nor is, a continuous process and happened in different regions at different times. However, Partridge (1997) places major tectonic events of subsidence of rift floors and accompanying major uplifts (about 1000–1500 m) of the rift shoulders in the Afar and East African plateau at around 3 Ma. Today, the rift shoulders of the Afar plateau, for instance, have an elevation of > 2500 m. Therefore, the use of a 50% elevation model for the period before and an elevation of 75% after 2.8 Ma seems reasonable for a first approximation. The raw data grids have a resolution of approximately 3.75 arc-minutes and were downscaled to 1 km^2 grid cells using the neighbor joining interpolation tool in ArcGIS10. The *Maxent* algorithm was run 10 fold with a maximum number of 100,000 background points and adjusted linear, quadratic and product parameters. The models were tested using 75% of the observation points as a random test percentage. Otherwise the default setting was used. Statistical evaluation of the model performance was based on threshold-independent receiver operating characteristic (ROC) analysis. The most relevant information is the AUC value (area under the ROC curve), which indicates if the model performs better (> 0.5) or worse (< 0.5) than random. In Phillips (2006) a detailed explanation of the ROC and AUC functionality can be found, particularly for the special case of present-only data used with *Maxent*.

Once the projection maps for the reference climate conditions and the *pre*- and *postBDS* scenarios were established, they were further analyzed on continental and regional scales.

Climate-Group Habitat Projection – Continental Scale Analyses

To obtain a numerical representation of the projections, the available habitat per climate-group was determined on full continental range. For this, 1 km^2 grid cells with HSI values of ≥ 50 were counted and defined as ***"preferred habitat"***. To investigate the changing availability over time, the gain (higher number of grid cells) and loss (lower number of grid cells) of preferred habitat from one scenario to the next was calculated. Moreover, to trace variation of habitat quality over time, I subdivided the preferred habitat into two categories (***class 1:*** HSI ≥ 80; ***class 2***: 50 ≥ HSI < 80). This permits a numerical comparison of habitat quality and its availability over time.

Climate-Group Habitat Projection – Regional Scale Analyses

For more detailed analyses on a regional scale I created six test areas around fossil localities. All localities are very well examined in terms of paleoecology and paleoenvironment. Their paleoecological description is used to validate the reliability of projections maps (descriptions of the test areas and a broad overview of the paleoecology follow). Besides a visual interpretation of the projected habitat distribution maps, the mean HSI per test area, climate-group and climate scenario serves for further numerical comparisons. With those values, environmental shifts within test areas over time can be investigated and comparisons between test areas are possible. Moreover, this permits a direct assessment of similarities with White's phytochoria (Fig. 9), (White, 1983), which I call from here on ***ecozones***. For this I calculated the mean HSI for the geographical range of the ecozones as before for the test areas, using the *present* climate scenario. I then applied principal component analyses (PCA) using the mean HSI values per climate-group of all ecozones and all climate scenarios per test area. This facilitates a paleoenvironmental reconstruction of all test areas at times and a comparison with classical paleoenvironmental reconstructions inferred from fossils, pollen or other proxies.

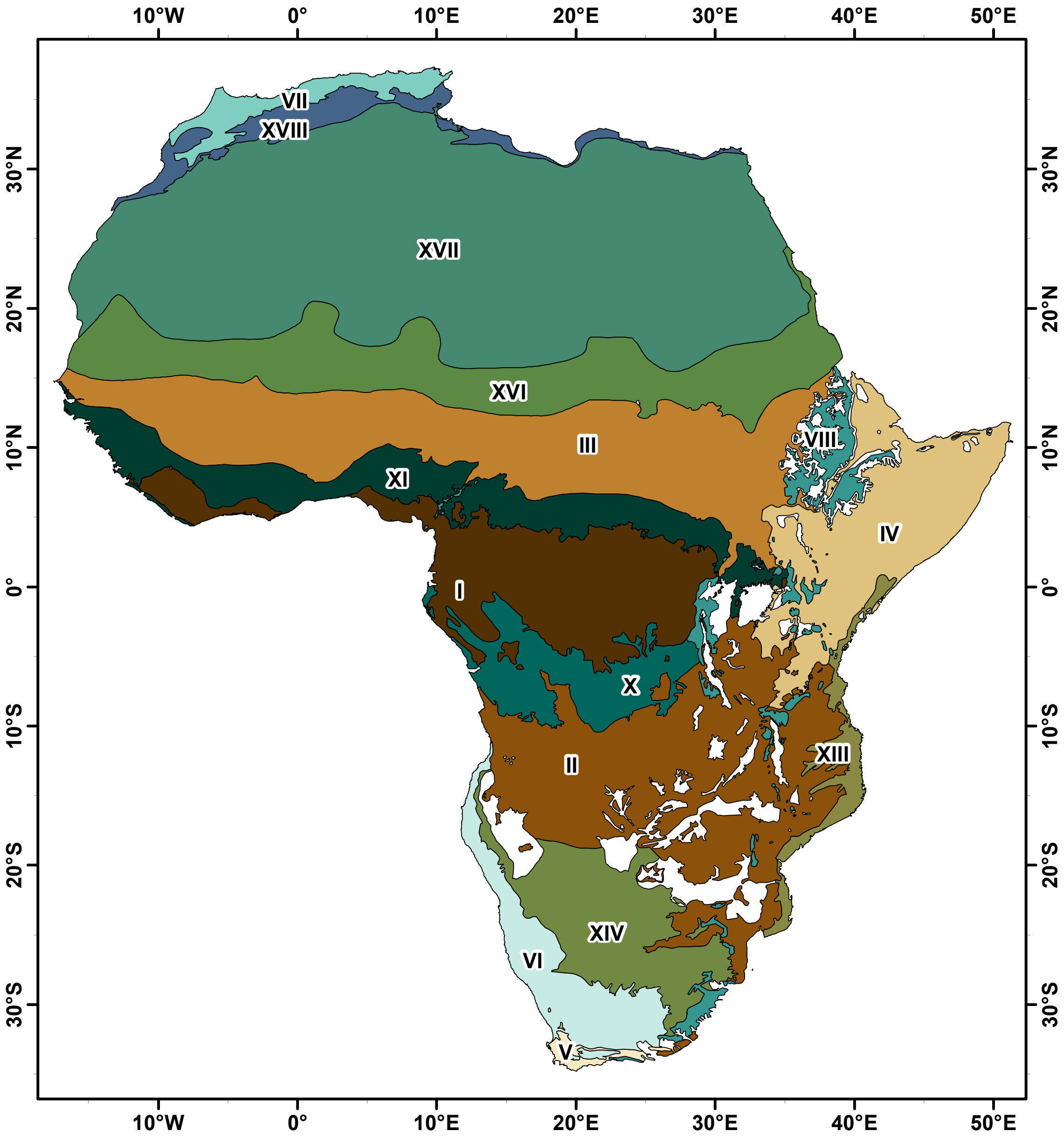


Fig. 9 **Main Ecozones adapted from White (1983).** I Guineo-Congolian Zone, II Zambesian Zone, III Sudanian Zone, IV Somali-Masai Zone, V Cape Zone, VI Karoo-Namib Zone, VII Mediterranean Zone, VIII Afromontane Zone, X Guineo-Congolian and Zambesian Transition Zone, XI Guineo-Congolian and Sudanian Transition Zone, XIII Zanzibar-Inhambane Zone, XIV Kalahari-Highveld Zone, XV Tongaland-Pondoland Zone, XVI Sahel Transition Zone, XVII Sahara Transition Zone, XVIII Mediterranean and Sahara Transition.

Description of Fossil Localities and Test Areas

Albertine Rift Area: Uganda/DR Congo; test area's geographical center: N 1.182894, E 30.401339, area: 41527 km^2. This test area's geological and paleoecological history is well studied and described (Pickford et al., 1993; Senut & Pickford, 1994), although it is the only one test area included in the present study not known for hominid bearing deposits. I used the same area as outlined in Pickford (1993). Today it comprises Lake Albert and Lake Edward, as well as parts of the Ruwenzori Mountains. Tropical lowland rainforest dominate the western part, while towards the east the environment becomes more open and arid. Nevertheless, the Albertine Rift area has the most humid environment among the six test areas. Here, the geological members Warwire (± 3.60 Ma), Kaiso Village Beds (1.50 Ma) and Hohwa (2.60–2.40 Ma) are of interest. Pickford et al. (1991) and Senut & Pickford (1994) described a more humid Pliocene environment as was prevailing in the eastern Rift in Tanzania and Kenya in that time. Following, the Plio-Pleistocene realized a transition towards increasing aridity. Eventually, the environment became similar to the eastern rift conditions during the Pleistocene (Senut & Pickford, 1994). This is supported by Geraads & Thomas (1994) who suggest more forested environments than open dry savannah for the Pliocene based on bovid communities. For the period between 2.60 and 2.40 Ma they describe the Albertine Rift area as an open dry savannah, as indicated by fossil pollens (Geraads & Thomas, 1994).

Chiwondo Area: Malawi; geographical center S 10.751485 E 33.954277, 24932 km^2; discovered hominids: *Homo rudolfensis*, *Paranthropus boisei*. This area, west from the Lake Malawi shore, is covered with vegetation referred to the Zambesian ecozone (White 1983). It comprises woodland and grassland in variable density, this permits a diversity of grazers and browsers typical of wooded grasslands, while open country grazers are distributed discontinuously (Bromage et al., 1995). The relevant stratigraphic layers are Unit 2 and Unit 3A. The first is dated to > 4.0–3.75 Ma. The second could be further subdivided and dated to 3.75–2.70 Ma (Unit 3A-1) and 2.70–1.80 Ma (Unit 3A-2) by Kullmer (2008). From the paleoecological point of view, the Chiwondo Beds appear to be similar to the Upper Ndolanya Beds (described earlier in this chapter) and Swartkrans 1 (Sandrock et al., 2007) and assembles a mixture of bovid species found in the Somali-Masai and Zambesian ecozones (Fig. 9), **(**White, 1983). Kullmer (2008) reconstructed an open forest to bushland environment along the northern shoreline of Lake Malawi throughout the sequence from early Pliocene to early Pleistocene.

Laetoli Area: Tanzania; test area's geographical center: S 3.598498 E 35.567734, area: 54717 km^2; discovered hominids: *Australopithecus afarensis*, *Paranthropus boisei*, *Homo habilis* and *H. erectus*. Besides the fossil localities Laetoli and Olduvai, the area comprises the Serengeti National Park. Around *Laetoli*, the composition of present day vegetation is highly diverse and complex, ranging from woodland to dense bushland and open grassland (Andrews et al., 2011). Various fossil localities were discovered in this region, yet for validation of the obtained *pre*- and *postBDS* distribution models the Upper Laetoli Beds (ULB) and Upper Ndolanyer Beds (UNB) are most useful. The layers are dated to 3.85–3.60 Ma and 3.60–2.66 Ma, respectively (Deino 2011). As today, the ecology was very complex and highly structured during the last 4 million years. For the ULB Reed (Reed, 1997) reconstructed a closed to medium dense woodland. Similarly, Andrews (Andrews, 1989) reconstructed a fairly wooded habitat. After the transition from ULB to UNB, several approaches and proxies indicate more open and arid conditions (Bishop et al., 2011; Kaiser, 2011; Kovarovic & Andrews, 2011), most likely dominated by semi-arid to arid grasslands (Su 2011). Nevertheless, a significant proportion of dense forest and woodland was present throughout the whole sequence (Kaiser, 2011; Su, 2011). The *Olduvai* Bed I (OBI, 1.99–1.75 Ma, Domínguez-Rodrigo et al., 2007) serves as additional reference for Pleistocene ecology. The levels within OBI indicate several ecological changes, yet the overall paleoecology is described as an arid environment with open grassland (Reed & Rector, 2007) and a proportion of wooded and forested areas (Reed, 2007).

Turkana Area: Kenya; test area's geographical center: N 3.662052 E 36.105553, 49677 km^2; discovered hominids: *Australopithecus anamensis*, *A. afarensis*, *Paranthropus boisei*, *Homo erectus*. The environment covered today by the test area refers to the Somali-Masai ecozone with a climate ranging from arid to very arid (White, 1983).

Three fossil localities are included in this study, namely Lothagam, West Turkana and Koobi Fora. The early ecological setting of *Lothagam* is described as a mosaic of wooded grasslands and grassy woodlands with a significant grass component. Pure C_3 ecosystems, such as riparian forests, were also represented (Leakey, 2003). Furthermore, a high percentage of tragelaphines and bovines signals closed habitats during Upper Nawata deposition (6.54–5.23 Ma). Considering the transition from Apak (4.90–4.20 Ma) to Kaiyumung (3.95–3.40 Ma), an increase of aepycerotines and alcelaphines in the fossil assemblage points to a trend towards more open and arid conditions (Harris, 2003). In *Koobi Fora*, Reed (1997) reconstructed scrub woodland and a riparian woodland or forest for Tulu Bor (3.40–2.68 Ma). During deposition of Burgi (2.68–1.88 Ma) it appears there was slightly more flooding or rainfall contributing to the presence of more herbaceous vegetation during this time period as compared to earlier Tulu Bor. Reed (1997) described the area as open woodland with edaphic grasslands and riparian woodland, while Harris (Harris 1991) reconstructed it as more closed woodland in the north and more open to the south. Based on various bovid tribes, Harris suggests dry open conditions for KBS (1.88–1.65 Ma). Pollen data indicate savannah or grassland/subdesertic steppe (Bonnefille, 1984). Reed (1997) reconstructed scrub woodland and arid shrubland based on multiple eco-variables, with a strong abundance of non-edaphic grasses. The ecological history of the *West Turkana* site starts with closed woodland conditions at the Lower Lomekwi (3.40–3.17 Ma). A first aridification phase is proposed for the Middle and Upper Lomekwi (3.12–2.52 Ma) with a shift towards more open ecozones between open grassland and closed woodland. A humid period led to closed woodland again during Lokalalai depositon (~2.52 Ma) and woodland during WT17000 (~2.50 Ma), respectively (Reed & Rector, 2007). That period is as well described as humid and highly variable (Trauth et al., 2005; Trauth et al., 2007; Trauth & Maslin, 2009). With the transition to Kalochoro (2.43–1.88 Ma) the reoccurring aridification eventually leads to grassland biomes (Reed & Rector, 2007). For the Turkana test area it can be concluded, that the localities experienced a generalized aridification accompanied with a vegetation shift from woodlands with some forest patches before 3 Ma towards more open and arid environments in the Pleistocene. However, the degree and timing of the aridification and vegetation opening varies between the localities, i.e., rather open grasslands at West Turkana and shrubland at Koobi Fora.

Swartkrans Area: South Africa, test area's geographical center: S 26.617132 E 28.307184, 41717 km^2; discovered hominids: *Australopithecus africanus, Paranthropus sp*. For the assessment of the area's paleoecological history, actually reconstructions for members from Makapansgat, Sterkfontain, Kromdraai and Swartkrans are taken into account. All sites are caves formed by extensive freshwater karstification and sedimentation processes that were used as shelters for hominids and probably functioned also as traps and scavenger caves (Kullmer, 2007). Presently, the area is dominated by tall grass savannah in the transition zone from afromontane scrub forest to Highveld grassland (White, 1983). *Makapansgat*: The Limeworks Cave members, younger than 3.2 Ma (Members 3–5) are assumed to be woodland and bushland habitats with intersecting water bodies, permitting riparian woodlands and edaphic grasslands. However, a trend towards more open and xeric environment in the Pleistocene (Reed, 1997) is present at this locality. This is supported by reconstructed scrub woodland with grasslands or perhaps wooded grasslands in *Kromdraai* between 1.5 and 1.0 Ma (Delson, 1984, Vrba, 1975). *Sterkfontain*: Member 4 in Sterkfontain is dated to 2.4–2.6 Ma (Delson, 1984) and its ecology is interpreted variously. While Vrba (1985b) suggested a moderately open savannah, Reed (1997) described it as open woodland with bushland and thicket areas similar to the more closed Member 3 in Makapansgat. McKee (1991) found open woodland to forest conditions. The overlaying Member 5 appears more opened, from open or wooded grassland or plains (Reed, 1997) to open savannah (Vrba, 1975; McKee, 1991). As Werdelin (2010) pointed out, the dating of Sterkofontain is highly discussed, controversial and uncertain to date. However, the discussed layers are younger than 3 Ma what is important in the present study. *Swartkrans*: The three focused members are dated between 1.8 and 1.2 Ma (Wenzel & Brain, 1993). The vegetation during Member 1 is described as savannah woodland with riparian woodland and reed beds (Reed, 1997; Watson, 1993). Sandrock (2007) described the Chiwondo Beds to be similar with Member 1 in regard to their ecology. Member 2 indicates a drier habitat than the previous member, perhaps wooded grassland with wetlands (Reed, 1997). Vrba (1975) reconstructed the habitat of Member 2 as a moderately open savanna. Faunal changes in the fossil assemblage of Member 3 point to slight moister environment again. Hence, open grassland with a nearby river supporting edaphic grasslands is assumed (Reed, 1975). Concluding, the reconstructed environment within the Swartkrans test area varies not only from locality to locality, but also within a single member depending on the proxies and indicators used for interpretation. The dominating vegetation type is between grassland and woodland, swinging towards more open and arid and more closed and humid conditions. However, the prevailing aridification in Africa is seen here as well, albeit slightly later and perhaps less extreme.

Toros-Menalla Area: Chad; geographical center: N 16.193224 E 17.550814, 97831 km^2; discovered hominids: *Sahelanthropus tchadensis*, *Australopithecus bahrelghazali*. The site is the most northern test areas and situated within the Chad depression, which occurs as a relatively static geological system with large lake transgression and regression cycles (Kullmer, 2007). Today, the fossiliferous areas TM266 and Kollé are situated in the transition between the Sahel and Sahara region dominated by highly arid environments like deserts and sand dunes. The site TM266 is dated to 7.2–6.8 Ma (Lebatard et al., 2008). Vignaud (2002) reconstructed the ecology during the disposition time as a mosaic of mainly open grassland, wooded savannah and some gallery forests, intersected by fresh water bodies. However a sand desert is assumed nearby. For the younger site Kollé (5.0–4.0 Ma), a mosaic of woodlands and grasslands is assumed (Brunet et al., 1988). Koro-Toro (KT12) is dated to about 3.6–3.0 Ma (Brunet et al., 1997) and described as much moister than present-day desert conditions. Open country grazers dominate the fossil assemblage, however the presence of reduncines indicate rather moist grasslands, while the lack of Aepycerotini and Tragelaphini point to poor tree cover (Geraads et al., 2001). This led to the assumption that more open and arid landscapes were present in Chad earlier than in eastern Africa. In summary, from about 7 Ma onwards a trend from wooded savannah with moist patches towards more arid and desert environments is observed.

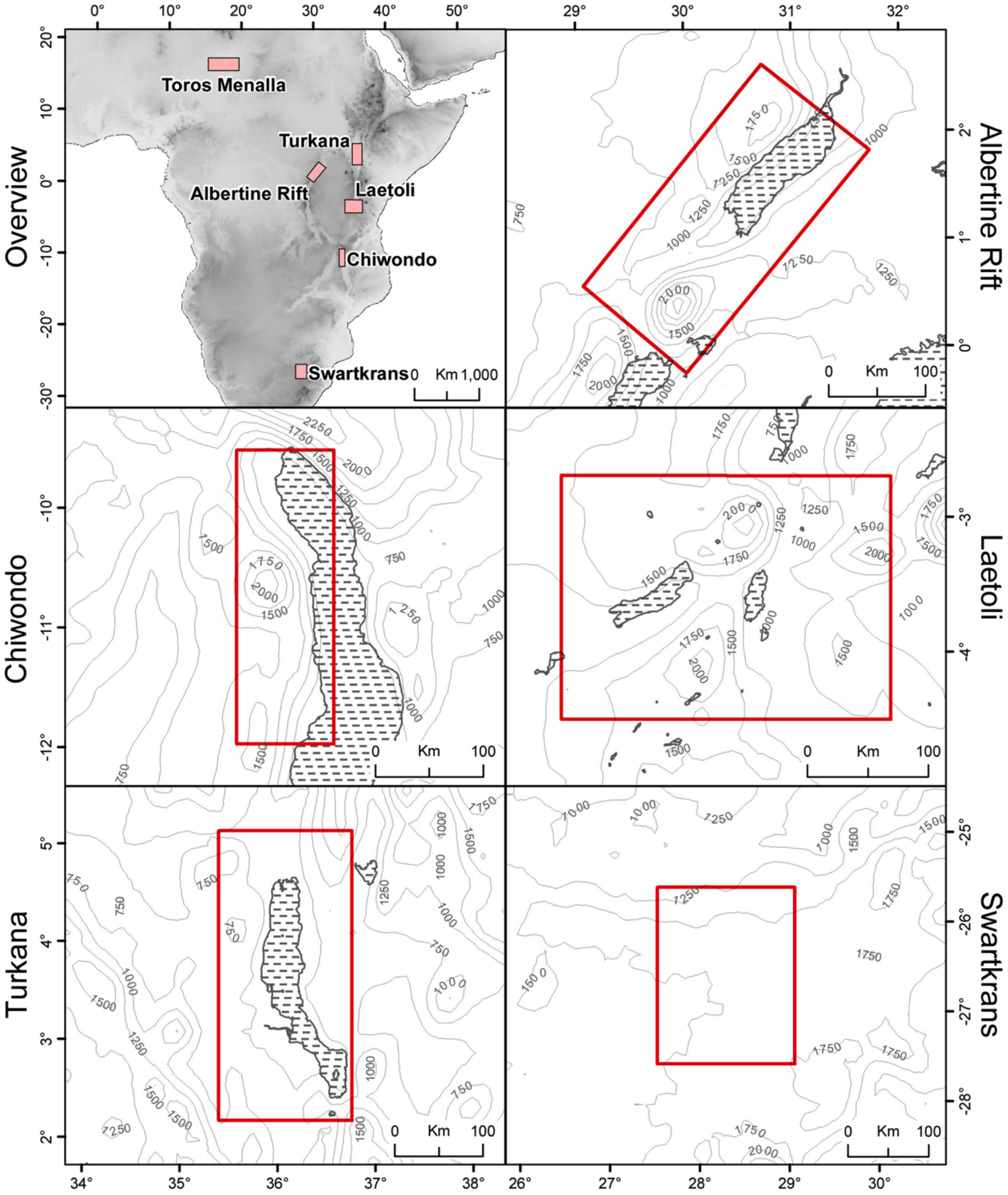


Fig. 10 **Test Areas Overview.** The test areas (red box) are chosen depending on availability of paleoecological reconstruction of fossil localities and can comprise multiple locations to cover the full time span of interest. The test areas Turkana, Albertine Rift, Chiwondo and Laetoli are situated within the East African Rift System. As reference from outside the rift serve Toros-Menalla (Chad) and Swartkrans (South Africa). Close ups of the test areas show lakes (dashed areas) and contour lines (250 m steps). None of such topographic features is given in the Toros-Menalla area, hence no close up is shown. Within the Albertine Rift area is Lake Albert, within the Chiwondo area is Lake Malawi, the two major lakes in the Laetoli area are Lake Eyasi to the west and Lake Manyara to the east. Furthermore, the elevated areas in the northern vicinity of the lakes belong to the Ngorogoro-Crate-Complex. Lake Turkana intersects the Turkana test area.

RESULTS

The resulting five climate-groups of 85 African antelope species (Tab. 4, Fig. 11) assorted along a precipitation gradient from arid (Group 1) to humid (Group 5), since the main discriminating climate variable herein is Bio13, describing the precipitation in the wettest month (Fig. 12). The species composition of each group can be found in the appendix (SuppTab. 5). Four groups could clearly be assigned to the main vegetation types (White, 1983),(Tab. 1). However, the assignment of the fifth and smallest group was not straightforward. The involved species (SuppTab. 5) are distributed in western Africa along the Gulf of Guinea in several very humid environments: lowland rain forest of the wet Guineo-Congolian type, mangroves, swamp forests, and mosaics of the drier and wetter types of Guineo-Congolian lowland rain forest (White, 1983). Therefore, this group is basically associated with wet lowland rainforest and is regarded as an extreme of climate-group four. For easier reading the climate-groups will be named after their associate vegetation type, as follows: ***Desert-Group***, ***Grassland-Group***, ***Woodland-Group***, ***Forest-Group*** and ***Lowland-Rainforest (RF)-Group***. The groups are not sharply defined from each other. Hence, a slight overlap of climate preference and distribution is apparent and has to be taken into account (Fig. 11, Fig. 12).

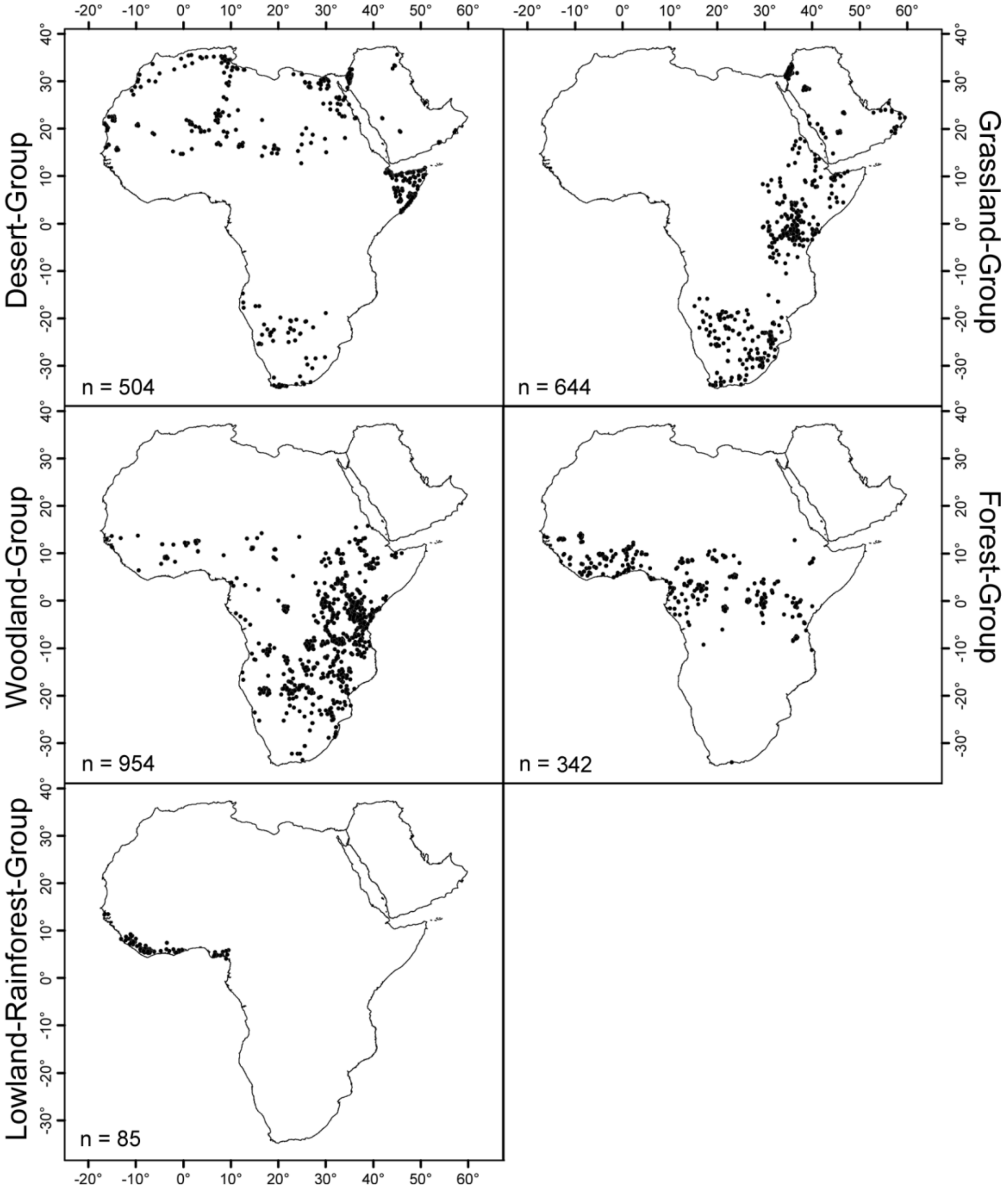


Fig. 11 **Observation points used for climate-group building**. A total number of 2529 observation points of 85 species were used to create five distinct climate-groups. Shown are the observation points of species assorted to the climate-groups Desert, Grassland, Woodland, Forest and Lowland-Rainforest.

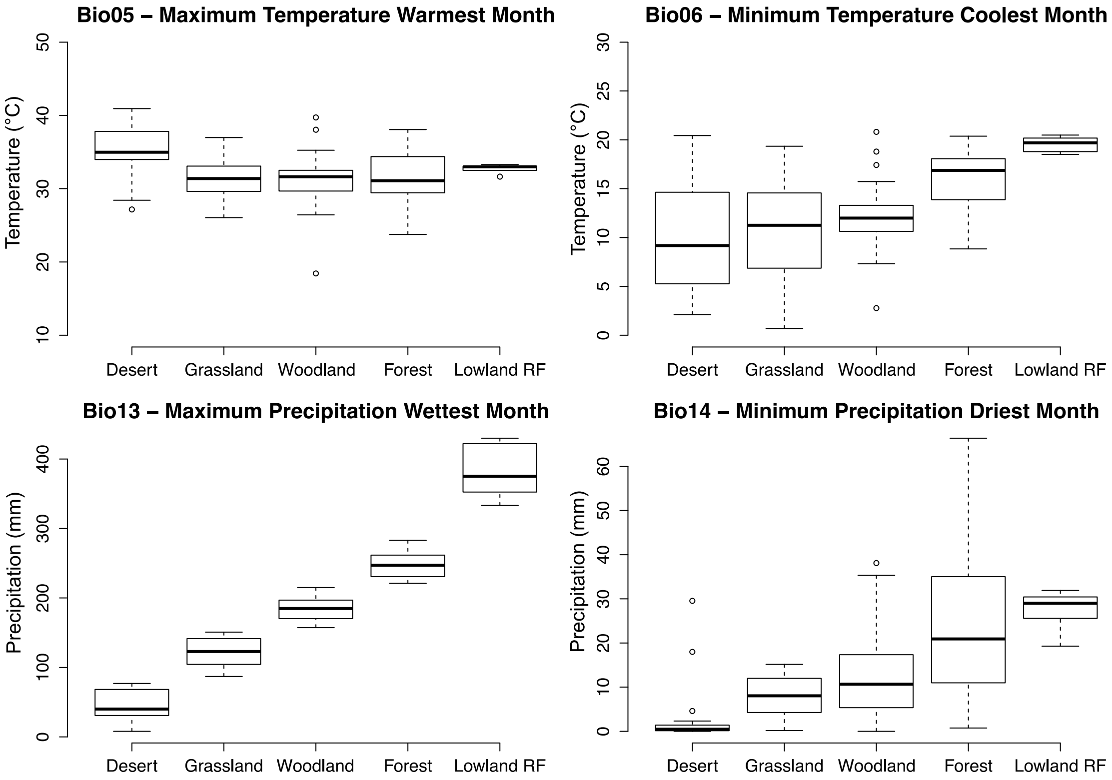


Fig. 12 **Boxplot Diagrams of Climate Variables and Resulting Climate-Groups.** The climate variable for precipitation of wettest month is the most discriminating one.

Tab. 4 **Clustering of Climate-Groups.** Given are the resulting climate-groups (#) and the associated main vegetation types after White (1983), the number of species and the median values with their standard error of Bio05 (maximum temperature of warmest month in °C), Bio06 (minimum temperature of coldest month in °C),Bio13 (precipitation of wettest month in mm) and Bio14 (precipitation of driest month in mm).

#	Vegetation Type	Species	Bio05	Bio06	Bio13	Bio14
1	Desert, Semi-Desert	18	35.0 ± 3.6	9.2 ± 5.6	40.1 ± 22.2	0.5 ± 7.8
2	Grassland	18	31.4 ± 2.7	11.3 ± 5.3	122.9 ± 21.4	8.0 ± 4.4
3	Woodland, Bushland, Thicket, Wooded Grassl.	28	31.6 ± 3.8	12.0 ± 3.5	184.9 ± 17.4	10.7 ± 9.5
4	Forest	16	31.1 ± 4.1	16.9 ± 3.3	247.0 ± 20.3	20.9 ± 17.3
5	Lowland Rainforest*	5	33.0 ± 0.7	19.7 ± 0.9	375.3 ± 42.5	29.0 ± 5.0

(*) No major vegetation type could be assigned to group 5. Detailed vegetation analyses suggest wet lowland rainforest of the Guineo-Congolian type.

Climate-Group Habitat Projection – Continental Scale Analyses

The climate niche was calculated for all five climate-groups and projected onto three climate scenarios representing *preBDS*, *postBDS* and *present* conditions (Fig. 13). The average AUC test of all projections is 0.8545 ± 0.006 for the test data. The high AUC values indicate that the most essential climate variables determining climate-group distributions are used and the models perform adequate or better than random, respectively. An increase of absolute coverage of preferred habitat (≥ 50 HSI) across Africa over time can be seen for the desert-, grassland- and woodland-group (Tab. 5). The strongest gain of preferred habitat was seen in the woodland-group with an increase of 1600% from *pre-* to *postBDS* conditions and a doubling in size towards the *present*. In contrast, the more humid forest- and rainforest-group suffer a loss of preferred habitat of about 10% from *pre-* to *postBDS*. While the forest-group can gain some habitat under *present* conditions, the total difference between *preBDS* and *present* is negative. A loss of 7.0% in the forest-group and 22.2% in the lowland-rainforest-group is evident (Tab. 5).

Tab. 5 **Percentage of Area covered with Preferred Habitat across Africa.** Shown is the area in percentage covered with preferred habitat (HIS ≥50) across the African continent at *pre* and *post bovid diversification switch* (BDS) and at *Present*. Furthermore gain and loss between the scenarios is given: Interval between the *preBDS* and *postBDS* (Int.1); Interval between *postBDS* and *Present* (Int.2) and from *preBDS* to *Present* (Total Δ).

Climate-Group	preBDS	postBDS	Present	Int.1	Int.2	Total Δ
Desert	16.2	16.6	19.3	2.5	16.3	19.1
Grassland	4.6	7.7	12.6	67.4	63.3	173.9
Woodland	0.3	5.1	10.4	1600.0	103.9	3366.7
Forest	11.5	10.3	10.7	-10.4	3.9	-7.0
Lowland RF	0.9	0.8	0.7	-11.1	-12.5	-22.2

Description of Fundamental Habitat Distribution

Under *present* climate conditions the niche projection for the ***desert-group*** (AUC = 0,986 ± 0,009) predicts suitable habitats in northern Africa, at the Horn of Africa, extending southwards along the East African coast and along the coastal areas of southwest Africa (Fig. 13a). The general pattern remains the same when applied for the pre- and *postBDS* scenarios, except for the areas in the east and at the Horn, which have lower values of suitable habitat during both past scenarios. A constant suitable climate over all epochs on the Arabian Peninsula is present in the Levant only. The overall increase of suitable habitat is due to a constantly increasing medium quality of habitat (class 2, Tab. 7), while the high quality habitats (class 1, Tab. 6) remain stable.

The projection for the ***grassland-group*** (AUC = 0,861 ± 0,003) shows suitable climate areas in southern Africa and partly along the southwest coast and in East Africa along the EARS, with high values for the Afar and East African plateau (Fig. 13b). The lowest suitable habitat available is under *preBDS* conditions, yet, with major patches in southern Africa and in the very north. The habitat suitability across Africa is constantly increasing towards the *present*, what is especially obvious for the East African area. Here almost no suitable habitat is available during *preBDS* times, but becomes a major element in the *present*.

Like the grassland-group, the ***woodland-group*** reaches high habitat suitability values along the EARS (AUC = 0,797 ± 0,005), with centers surrounding present day Lake Victoria and the Afar plateau in modern times. Roughly following the Zambesian ecozone a connection to another area of high suitability values at the southwest coast is present (Fig. 13c). All areas experience a tremendous and continuous increase of habitat suitability and size from the *preBDS* towards the *present* (> 3000%, Tab. XY). While the step from the *preBDS* to the *postBDS* is mainly due to a general increase of class 2 habitat (Tab. 7), areas previously covered with class 2 habitats experience an enhancement to high quality habitats of class 1 (Tab. 6).

The ***forest-group*** shows a broad and continuous habitat distribution (Fig. 13d) between N10°–15° to S15°–20° during *preBDS* times (AUC = 0.54 ± 0,004). Areas of class 1 habitats are at the coastal region along the Gulf of Guinea and some localities at the African east coast. There are stable high values over all scenarios along the Equator, however, approaching the *postBDS* period the connection between east and west starts to vanish in the EARS. Overall, a decrease of preferred habitat over the continent of ~10% (Tab. 5), mainly being a loss of class 2 habitats (Tab. 7) is found. A slight increase of the class 1 proportion (Tab. 6) is visible from the *postBDS* to the *present* scenario (Fig. 13d).

Tab. 6 **Percentage of Area Covered with Class 1 Habitat across Africa.** Shown is the area covered with class 1 habitat (HIS ≥80) across the African continent. Furthermore gain and loss between the scenarios is given: Interval between *preBDS* and *postBDS* (Int.1); Interval between *postBDS* and *Present* (Int.2) and from *preBDS* to *Present* (Total Δ).

Climate-group	**Area Covered with Class 1 Habitat (%)**			**Gain and Loss in Class 1 (%)**		
	preBDS	**postBDS**	**Present**	**Int. 1**	**Int. 2**	**Total Δ**
Desert	4.9	4.6	4.9	-6.1	6.5	0.0
Grassland	0.9	2.3	3.5	155.6	52.2	288.9
Woodland	0.0	0.1	3.1	900.0	3000.0	30900.0
Forest	2.2	2.1	2.7	-4.5	28.6	22.7
Lowland RF	0.6	0.4	0.2	-33.3	-50.0	-66.7

Tab. 7 **Percentage of Area covered with Class 2 Habitat across Africa.** Shown is the area covered with class 2 habitat (50≥ HIS <80) across the African continent. Furthermore gain and loss between the scenarios is given: Interval between *preBDS* and *postBDS* (Int.1); Interval between *postBDS* and *Present* (Int.2) and from *preBDS* to *Present* (Total Δ).

Climate-group	**Area Covered with Class 2 Habitat (%)**			**Gain and Loss in Class 2 (%)**		
	preBDS	**postBDS**	**Present**	**Int. 1**	**Int. 2**	**Total Δ**
Desert	11.3	12.0	14.4	6.2	20.0	27.4
Grassland	3.6	5.4	9.0	50.0	66.7	150.0
Woodland	0.3	5.0	7.2	1566.7	44.0	2300.0
Forest	9.3	8.1	8.0	-12.9	-1.2	-14.0
Lowland RF	0.3	0.4	0.5	33.3	25.0	66.7

The habitat suitability prediction for the lowland rainforest-group (AUC = 0,776 ± 0,011) has the smallest expansion of all groups in all three scenarios and is restricted to the coastal area of the Gulf of Guinea from Nigeria westward to Liberia (Fig. 13e). The greatest expansion of suitable habitat is estimated for the *preBDS* scenario. Towards the *present* a continuous decrease of quality and size leads to a total loss of ~22% (Tab. 1) of preferred habitat compared to the *preBDS* scenario. It is remarkable that despite the overall decrease in the proportion of area covered with class 2 habitats, preferred habitats are actually increasing (Tab. 7).

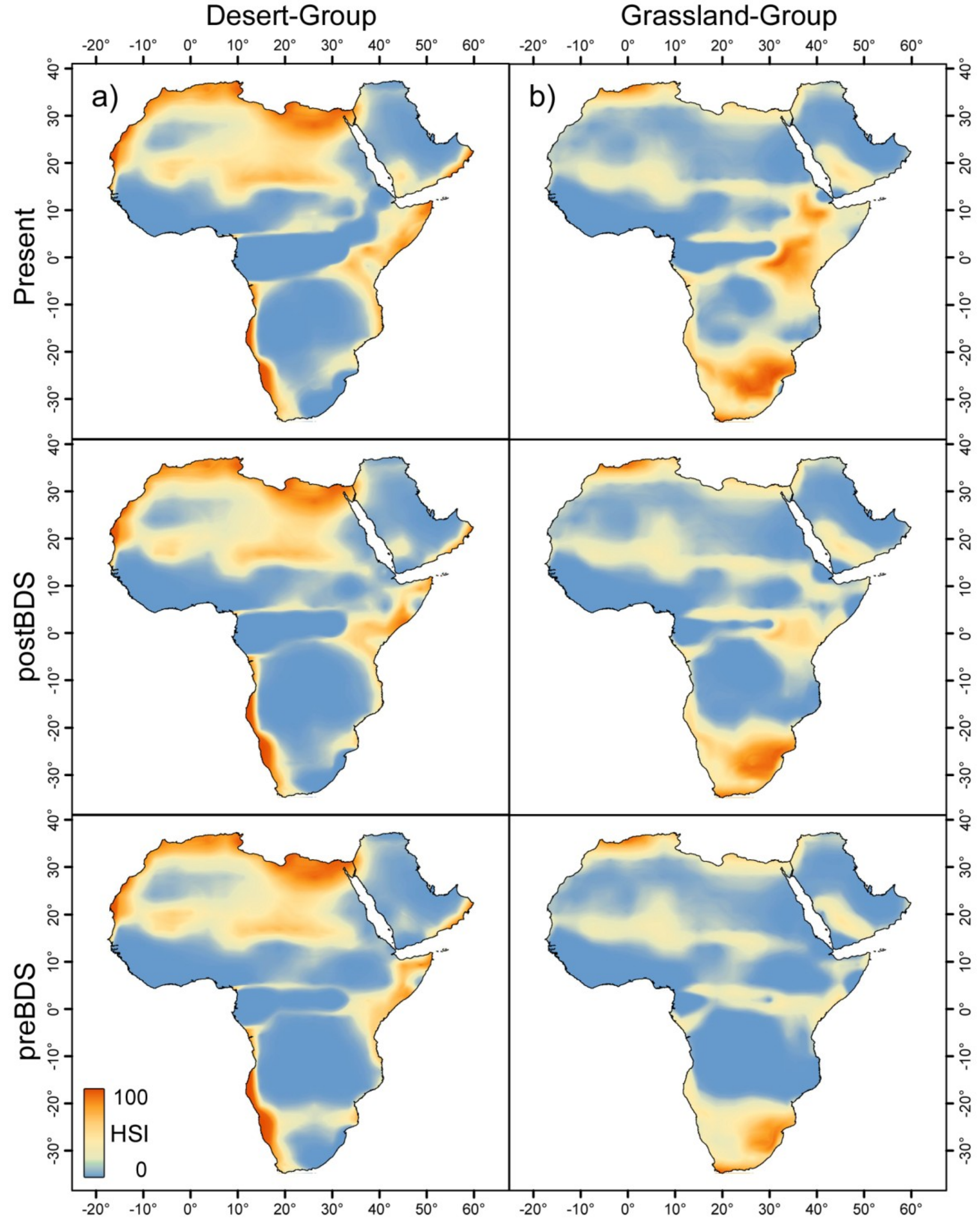


Fig. 13 **Continental Habitat Distribution Projection for the *preBDS*, *postBDS* and *present* scenario of Five Climate-Groups.** Habitat suitability was modelled desert-group (**a**) and grassland-group (**b**). From the top to bottom: *Present* (reference layer), *postBDS* and *preBDS*.

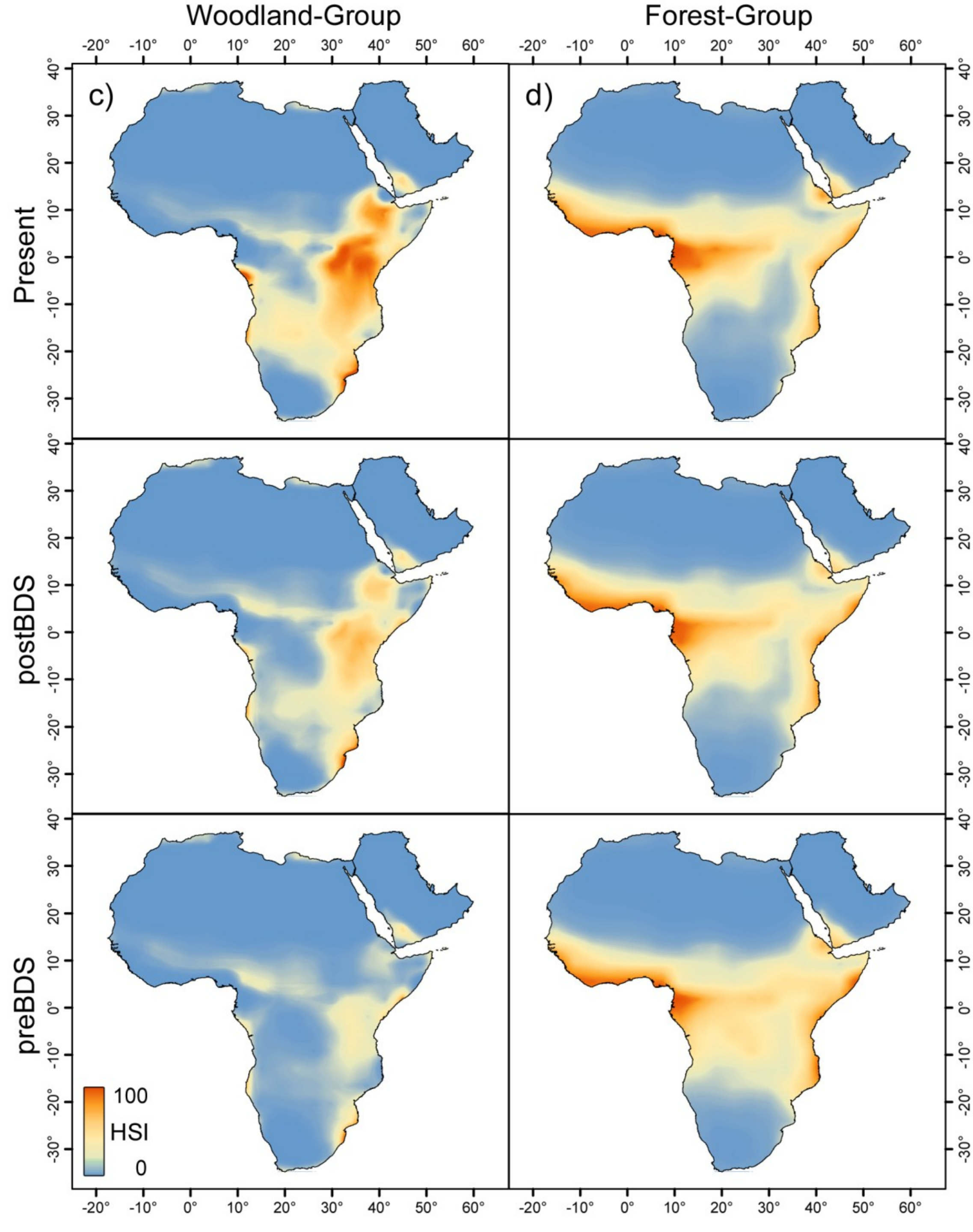


Fig. 13 continued **Continental Habitat Distribution Projection for the *preBDS*, *postBDS* and *Present* scenario of Five Climate-Groups.** Habitat suitability was modelled for the woodland-group (**b**) and forest-group (**c**). From the top to bottom: *Present* (reference layer), *postBDS* and *preBDS*

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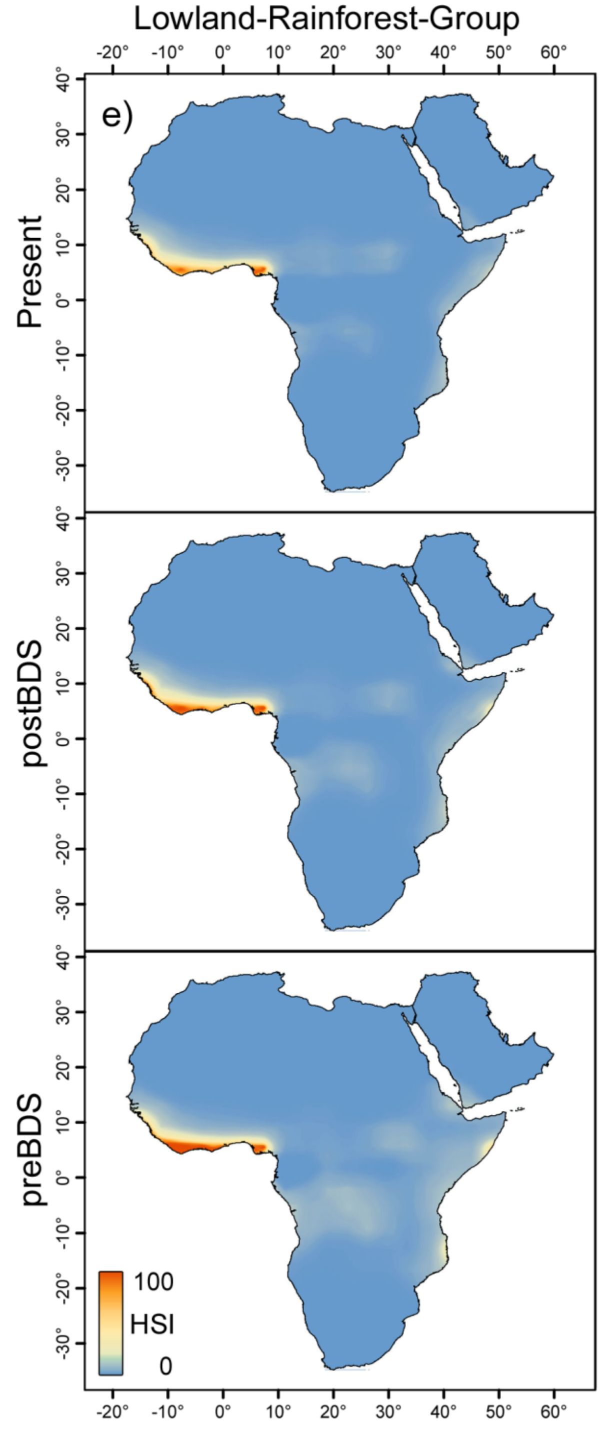


Fig. 13 continued **Continental Habitat Distribution Projection for the *preBDS*, *postBDS* and *Present* scenario of Five Climate-Groups.** Habitat suitability was modelled for the lowland-rainforest-group (**e**). From the top to bottom: *Present* (reference layer), *postBDS* and *preBDS*.

Climate-Group Habitat Projection – Regional Scale Analyses

In the ***East African test areas*** a change of habitat suitability is visible for all climate groups, except for the ***lowland-rainforest-group***, which did not reach any suitability in either of the scenarios at the site (Fig. 14a). Within the Laetoli test area an increase of ***desert-group*** habitat suitability from the *preBDS* to the *present* (Tab. 8) is observed. An increase of desert-group habitat suitability is visible in the Turkana-Area from *pre-* to *postBDS* as well (Fig. 14a). However, the gained suitability vanishes again during the transition to present day conditions and becomes even lower than before in the *preBDS* scenario. The test areas Chiwondo and Albertine Rift are out of range of suitable desert-group habitats. The strong expansion of the ***grassland-group's*** habitat in East Africa affects Laetoli and Turkana to the greatest extent (Fig. 14b), supported by an increase of mean habitat suitability values from 11.5 HSI in the *postBDS* scenario to > 72.5 HSI in the *present* (Tab. 8).

Tab. 8 **Mean Habitat Suitability at Test Areas**. Given is the mean habitat suitability value per climate group and test area except for the lowland-rainforest-group, which is not represented in the test areas. Decreasing suitability over time is indicated in **bold**.

Climate-Group		**Mean Habitat Suitability**					
		Albertine Rift	**Chiwondo**	**Laetoli**	**Turkana**	**Toros-Menalla**	**Swartkrans**
Desert	preBDS	0.2	0.6	20.1	13.4	54.3	8.7
	postBDS	**0.0**	0.6	41.8	28.0	58.0	11.1
	Present	**0.0**	3.3	56.1	6.5	60.8	11.8
Grassland	preBDS	22.2	0.8	11.5	7.3	18.5	76.6
	postBDS	**21.4**	13.7	38.2	35.8	19.5	88.7
	Present	**6.4**	29.5	72.3	71.0	**14.0**	93.6
Woodland	preBDS	13.0	25,8	31.3	11.9	0.1	6.4
	postBDS	37.5	53.2	67.8	39.7	0.1	16.2
	Present	53.0	70.5	90.1	77.1	0.1	**14.9**
Forest	preBDS	52.4	24.7	42.5	44.2		
	postBDS	**47.4**	**13.8**	**29.7**	**35.1**		
	Present	**45.6**	**9.4**	**20.9**	**27.8**		

The HSI for the ***woodland-group*** under *preBDS* conditions is below the critical value of 20 HSI at the Albertine Rift and in the Turkana areas. Sufficient values are found for the Chiwondo and Laetoli test areas, with 25.8 HSI and 31.3 HSI, respectively. With the upcoming *postBDS* period, preferred habitat becomes available for Laetoli (67.8 HSI) and Chiwondo (53.2 HSI). The remaining test areas are within a transition zone towards preferred habitat (Fig. 14c). *Present* climate conditions lead to an increase of the mean HSI in all areas. However, the Albertine Rift, still on the edge, reaches a suitability of 53.0 HSI. The increase is more pronounced for Laetoli and Turkana with mean values of 90.1 HSI and 77.1 HSI, respectively. The climate niche projections for the ***forest-group*** generally show decreasing mean HSI values for all test areas. The vanishing connection between West African and East African suitable habitats, mentioned in the previous section can be observed best at the Chiwondo test area (Fig. 14d). Even though the mean HSI is already low in the *preBDS* period it drops towards the *present* from 24.7 HSI to 9.4 HSI. In all three projections, the highest habitat suitability is reached in the Albertine Rift.

In ***Toros-Menalla*** the desert-group is the only one that reaches suitability values above the threshold of 20 HSI (Fig. 14f, Tab. 8). The median HSI for the region is continuously increasing from the *preBDS* period to the *present*, reaching a maximum mean of 60.8 HSI. At the South African test area ***Swartkrans*** (Fig. 14e) only for the grassland-group sufficient habitat suitability values were calculated. However, the values are very high in all three scenarios. Under *preBDS* conditions the grassland-group has a mean HSI of 76.6 and reaches its maximum value in the *present* with a mean of 93.6 HSI.

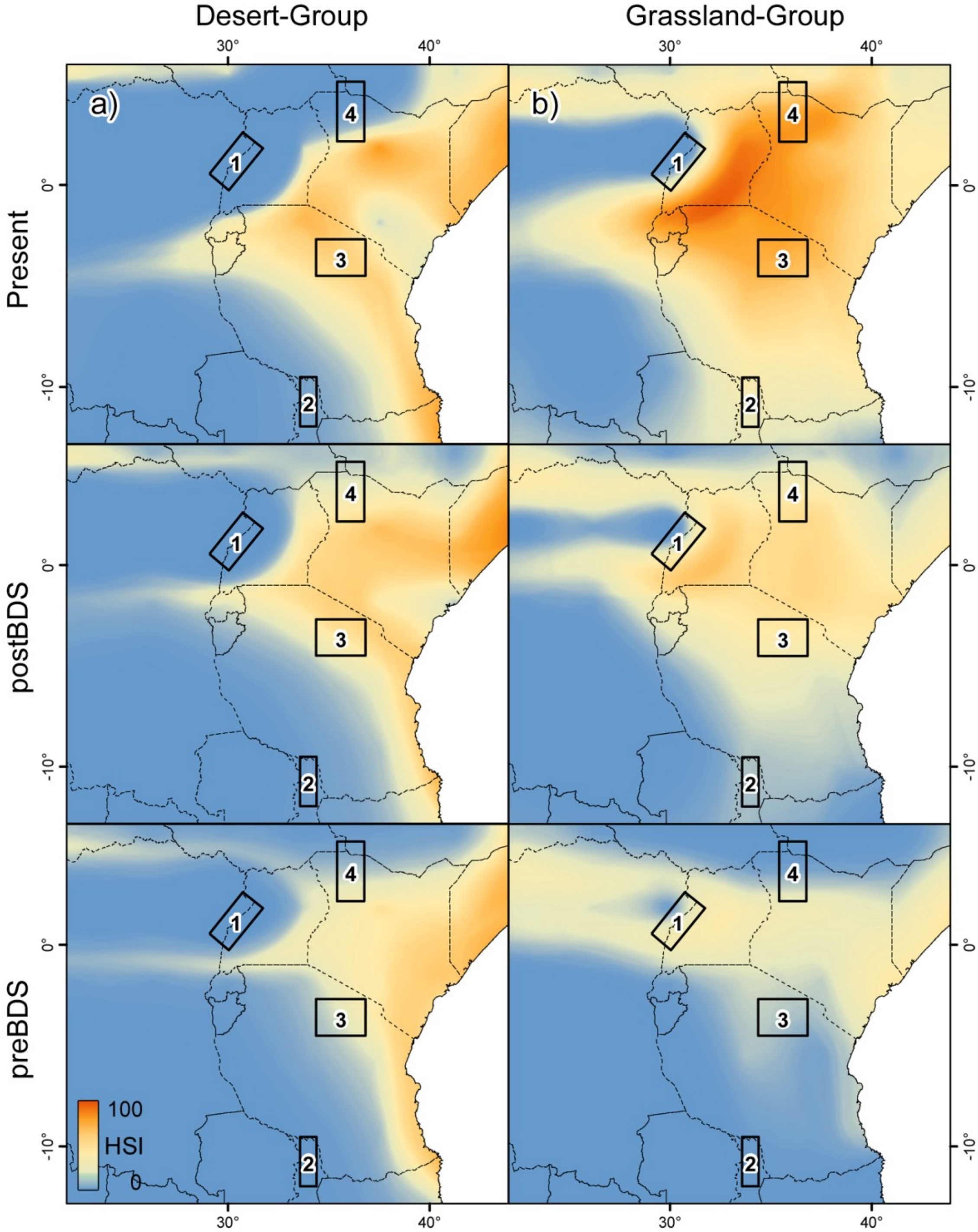


Fig. 14 **Habitat Distribution Projection for the East African Test Areas for the *preBDS*, *postBDS* and *Present*.** Habitat suitability was modelled for the desert-group (**a**) and grassland-group (**b**). The warmer the colour, the higher is the habitat suitability. From the top to bottom: *Present* (reference layer), *postBDS* and *preBDS*. **1**) Albertine Rift; **2**) Chiwondo; **3**) Laetoli and **4**) Turkana.

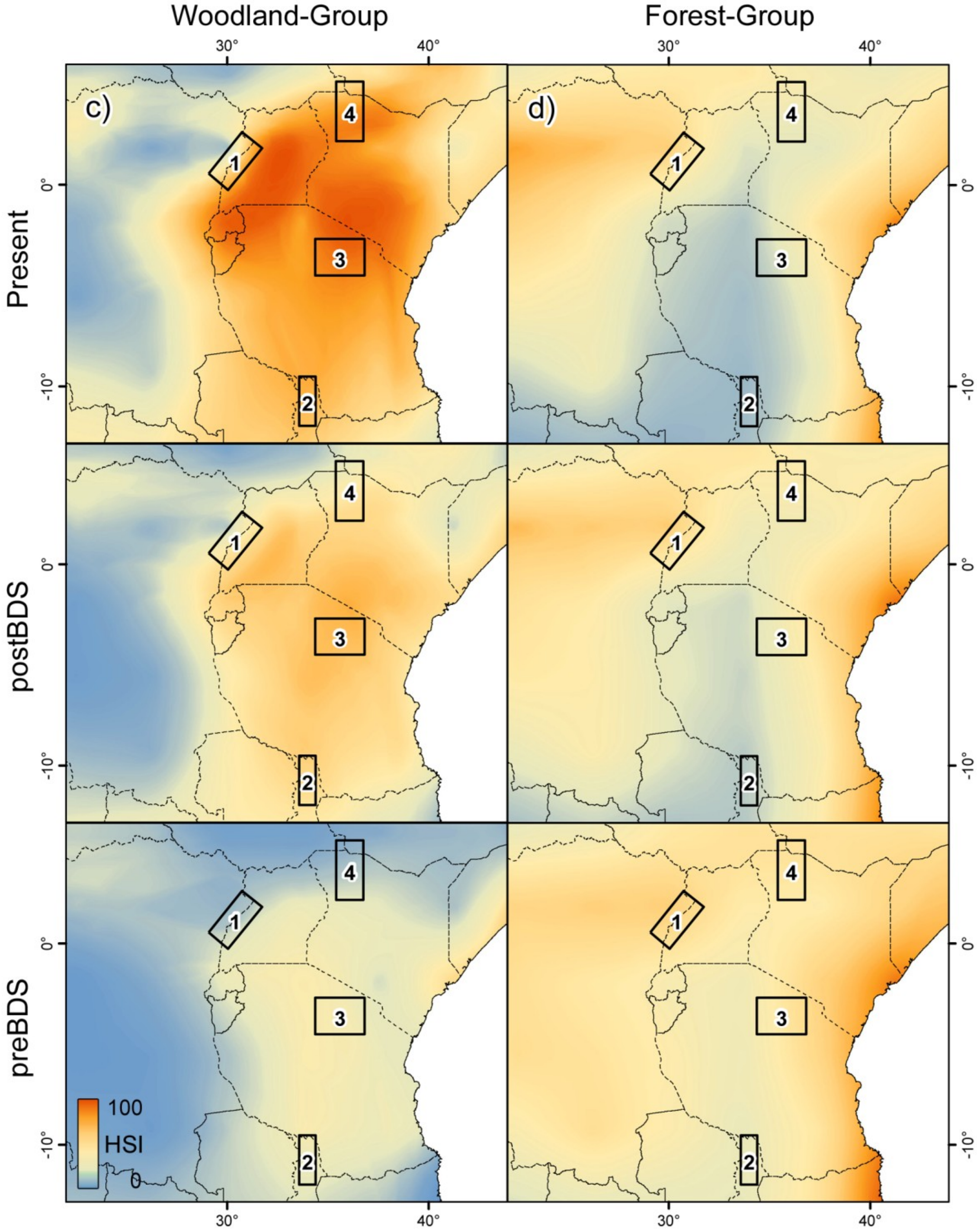


Fig. 14 Continued **Habitat Distribution Projection for the East African Test Areas for the *preBDS*, *postBDS* and *Present*.** Habitat suitability was modelled for the woodland-group (**c**) and forest-group (**d**). The warmer the colour, the higher is the habitat suitability. From the top to bottom: *Present* (reference layer), *postBDS* and *preBDS*. **1**) Albertine Rift; **2**) Chiwondo; **3**) Laetoli and **4**) Turkana.

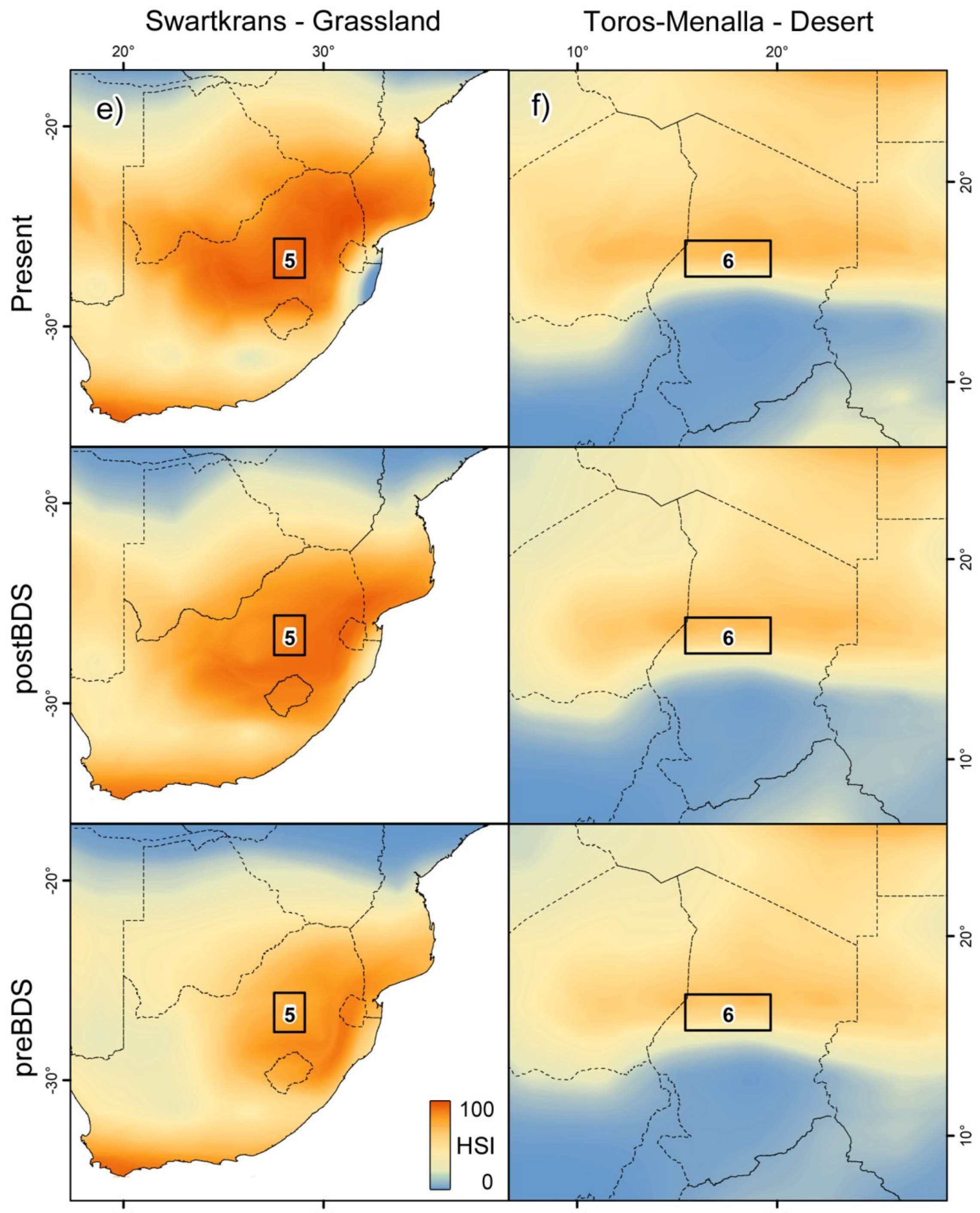


Fig. 14 continued **Habitat Distribution Projection for the Swartkrans and Toros-Menalla Test Area for the *preBDS*, *postBDS* and *Present*.** Habitat suitability was modelled grassland-group at **5**) Swartkrans (**e**) and desert-group at **6**) Toros-Menalla (**f**). The warmer the colour, the higher is the habitat suitability. From the top to bottom: *Present* (reference layer), *postBDS* and *preBDS*.

Comparison of Paleoenvironments and Modern Ecozones

Principal component analyses (PCA) were used to set paleoenvironments in relation with modern ecozones after White (1983; Fig. 9) in regard to the proportion of climate-group's mean habitat suitability (Fig. 14, Tab. 8). The resulting first two main factors (F1: 45.35%; F2: 25.64%) account for 70.7% of the total variability and were used for data visualization with a PCA scatterplot (Fig. 15).

Tab. 9 **Results of the Principal Component Analysis of Test Areas and Ecozones**. Shown is the contribution of the variables in percentage (i.e., the mean HSI of the climate-groups at the particular site) of the four most important factors describing 95% of the full data variability.

		Main Factors			
	Climate-Group	**F1**	**F2**	**F3**	**F4**
Contribution (%)	Desert	22.65	4.48	54.23	14.40
	Grassland	9.87	39.02	14.34	29.70
	Woodland	5.67	50.83	28.08	1.72
	Forest	35.92	0.48	3.35	0.02
	Lowland-Rainforest	25.89	5.19	0.01	54.16
PCA	Eigenvalue	2.27	1.28	0.62	0.57
	Variability (%)	45.35	25.64	12.40	11.36
	Cumulative variability (%)	45.35	70.99	83.38	94.74

The resulting scatterplot (Fig. 15) shows quadrants from which the lower left indicates high suitability for the desert-group Hence arid ecozones like the Sahel and Sahara Transition Zones (XVI and XVII) and Mediterranean Zones (VII and XVIII) are placed here. The upper left quadrant shows high suitability for the grassland-group. Both quadrants on the right hand side show more forested environments with woodland habitats in the upper quadrant and rather moist lowland-rainforest in the lower right quadrant. The latter quadrant comprises the Guineo-Congolian Zone (I) and the transition with the Sudanian Zone (XI). Overall a vegetation cover gradient along the F1 axis is observed with low cover on the left and high cover on the right. For the F2 axis a gradient of maximum temperature is indicated, were low values indicate high maximum temperatures and high values imply lower maximum temperatures. The strongest environmental change of all investigated test areas is observed for the

Turkana region. Prior to the BDS it is placed in between the Sudanian ecozone (III) and the transition to the Guineo-Congolian Zone (XI), while it is very close to the Somali-Masai Zone (IV) after the BDS and reaches the maximum F2 values under present day climate conditions. A similar change is calculated for the Laetoli test area. While equally in the proximity of the Guineo-Congolian/Zambesian Transition Zone (X) and the Zanzibar-Inhambane Zone (XIII) before the BDS, it shifts towards more wooded conditions (high F2 values) in modern times. A comparable trend is found for the Chiwondo area, yet not as strong as in aforementioned areas. Before the BDS it is placed next to the Guineo-Congolian/Zambesian Transition Zone (X) and shifts towards the upper left quadrant, being similar to the Zambesian (II) and Somali-Masai Zone (IV) after the BDS and close to Afromontane (VIII) conditions in the *present*. The Swartkrans area is assorted to the Kalahari-Highveld Zone (XIV) in all three scenarios, yet it shifts deeper into the grassland quadrant. The Toros-Menalla test area shows a slight shift in the opposite direction than observed for all other tested areas. Its closest ecozone counterpart is the Sahara Transition Zone (XVII).

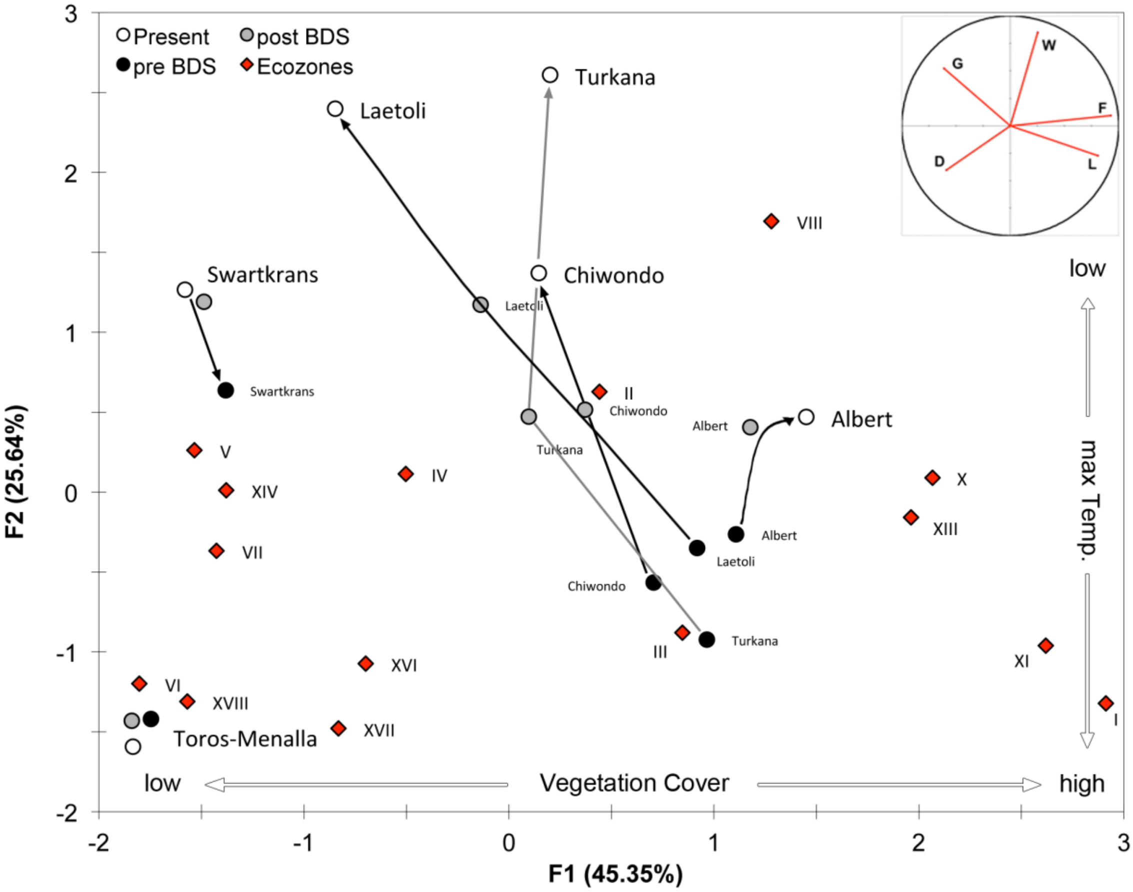


Fig. 15 **PCA Scatterplot of Modern Ecozones and Test Areas based on the Proportions of Climate-Group's mean HSI.** The arrows indicate the ecological shifts of test areas over time, i.e. before the BDS, after the BDS and in the *Present*. In the upper right corner a pictogram of the eigenvectors of the used climate-group is shown: (D) Desert, (G) Grassland, (W) Woodland, (F) Forest and (L) Lowland-Rainforest. Ecozones as follows: I Guineo-Congolian Zone, II Zambesian Zone, III Sudanian Zone, IV Somali-Masai Zone, V Cape Zone, VI Karoo-Namib Zone, VII Mediterranean Zone, VIII Afromontane Zone, X Guineo-Congolian and Zambesian Transition Zone, XI Guineo-Congolian and Sudanian Transition Zone, XIII Zanzibar-Inhambane Zone, XIV Kalahari-Highveld Zone, XV Tongaland-Pondoland Zone, XVI Sahel Transition Zone, XVII Sahara Transition Zone, XVIII Mediterranean and Sahara Transition

DISCUSSION

Climate-Groups

The resulting five climate-groups divide the included 85 bovid species and subspecies in dependency of the median climate conditions at their observation points. As intended by defining five classes, the groups assorted along a precipitation gradient with two groups on either side of the gradient and one group in the transition. This permits the investigation of climate change impacts on bovid communities with adaptations for very arid, arid, median, humid and very humid environments. The most arid group (desert-group) resembles species adapted to deserts and semi-deserts with highest maximum temperature in the warmest month (t_{max}) and lowest minimum temperatures in the coolest month (t_{min}) and lowest values of both precipitation variables (in the wettest month (p_{max}) and driest month (p_{min})). The grassland- and woodland-groups do not show differences in preference for climate conditions, except for the precipitation of the wettest month, where the woodland-group needs significantly more precipitation to allow for the growth of woodland vegetation. That is different to the grassland-group habitat as it yields a higher proportion of thickets, bushland and wooded grassland and is therefore ecologically between the forest and grassland groups. I assume complete tree cover for the forest-group habitat, which has a clear and restricted distribution within the tropical forests along the Equator. The group shares similar demands to the maximum temperature with the grassland- and woodland-group, but needs higher minimum temperatures during the coldest month and generally more precipitation. The lowland-rainforest-group can be regarded as an extreme of the forest group, with higher precipitation requirements and higher t_{min} compared to all other groups. Nevertheless, the climate groups are not distinct enough to avoid overlapping distributions. That is particularly obvious for the grassland- and woodland-group. The reason behind this is, of course, that the real habitat or climate tolerance of many, if not all, species is much broader as the climate-groups' mean value and individuals are able to penetrate into the neighboring biomes. That is most likely in areas of very heterogeneous environments (e.g., woodland-grassland mosaics) particularly within the EARS. An unequal number and distribution of observation points might have had further effect on the correct habitat interpretation. Nevertheless, working with occurrence data necessarily leads to an underestimation rather than to an overrepresentation of climate tolerance. A species obviously withstands the conditions where it was observed, while it may find suitable conditions elsewhere where it was not detected. A further issue of observation points is, that migrating species or individuals might be detected in times of suitable climate conditions but leave that area under unsuitable conditions (e.g., drought or low temperatures). Since the observed occurrence point is considered in all climate variables, even if it is an artifact, it may weaken the correct species placement into a group, or even worse, could affect a group on the whole. One solution would be to exclude migrating species, however, this would not be consistent with the presented approach as there is no clear line between migrating and stationary behavior, due to behavioral differences between sexes or within populations (Estes, 1992; Kingdon, 1997). However, using groups defined by shared climate niches instead of a comprehensive single species approach yields advantages to overcome the issues arising from low numbers of observation points per species.

Continental Scale Analyses

The projections of the fundamental habitat distribution of five climate-groups on a continental scale found the biggest proportion of preferred habitats (HSI ≥ 50) for the desert-group in all climate scenarios. The habitat range covers the northern Africa and the Sahara region, the Horn of Africa and extends to the South and southwestern Africa, especially the Namib and partly the Kalahari Desert. Interestingly, no observation points are present south of the Horn, despite higher habitat suitability values that would permit a broader distribution of individuals. Moreover, this vacant area is the only link to weak corridors connecting the North and East African habitats with the ones in southwest Africa. Hence, a restricting factor must have been or is still present that inhibits an expansion into that area. This factor may be given by the presence of grassland-group members, as the observation points indicate (Fig. 11).

That group occupies the same region in modern times and could have found suitable environments there, at latest after the climate conditions assumed for the *postBDS* period were reached. Indeed, the eastern African part of the grassland-group habitat is the area that experienced the most remarkable gain of habitat suitability over time. In the Mediterranean areas of North Africa suitable climate conditions are found as well, yet, due to the absence of modern species and the lack of connecting corridors this region can be neglected. Already during *preBDS* conditions the oldest area of broad availability of preferred habitat covers the southern tip of Africa. The overall increasing habitat suitability over time leads here to a northward expansion and connection to the eastern distribution under modern climate and topographic conditions. This, theoretically, permits group-members and the associated populations to move between these main areas of preferred habitats. A stripe of habitat with relative low suitability values is found along the Sahel Transition Zone, yet no group-member is recorded with observation points within this corridor. Actually, species with occurrence along that ecozone are assorted to either the desert-group or to the woodland-group (e.g., the Redfronted Gazelle, *Eudorcas rufifrons,* placed within the woodland-group*,* Fig. 11), despite the presence of pure grassland savannahs simultaneous with the uplifting of the rift shoulders in East Africa (Chorowicz, 2005) the habitat suitability for members of the woodland group increases strongly. Particularly, the uplifted region itself is affected. Since this habitat type is, so to speak, not present in terms of high suitability values previous to the event of diversification switch, its high values afterwards signal a sudden and wide development of a newly available habitat after 3 Ma. The maximum expansion is reached in modern times and is reflected in the highest species number of all climate-groups. Yet, here again, it is remarkable that the transition from the Sahara to the forested areas in West Africa is not part of the calculated fundamental habitat. The forest-group projection shows a distribution of fundamental habitat as it was expected, basically within the tropical belt along the Equator. The highest values are reached in the “core” of the total extent, associated with Guineo-Congolian Zone. The general pattern is already present in the geologically oldest scenario, yet with a continuous coverage between 10°S and 10°N.

With the progressive uplifting of rift shoulders in the EARS, the previously forest-generating conditions became replaced by woodland and grassland habitats. Furthermore, the development of more open environments separates the previously broad and continuous habitat into two patches in Central/West Africa and East Africa. That is the only detected large-scale habitat fragmentation that can be observed over time in this resolution. The lowland-rainforest-group appears very inconspicuous in terms of distribution shifts and size variation of the fundamental habitat. On a continental scale the proportion of area with preferred habitat is always below 1% and is slowly decreasing. However, one has to see this from the group-members perspective to recognize the evolutionary meaning. For the involved populations the actual change until the *present* is a habitat loss of more than one-fifth of the previously available habitat. A loss of available habitat is found, too, for the forest-group. While the loss between the *pre-* and *postBDS* scenario is similarly strong as for the lowland rainforest-group, the forest-group's habitat recovers slightly towards modern conditions, yet a total loss is apparent. In contrast, the remaining rather open and more arid adapted climate-groups gain habitat area and quality. From which the habitat expansion of the woodland-group outnumbers the others many times over. That gain and loss, respectively, must have had impacts on population structures and subsequently on diversification patterns (see *closing discussion*).

Regional Scale Analyses

The continental scale analyses showed that the overall changes in habitat availability for climate-groups corresponds to an overall aridification trend starting at the latest around 2.8 million years ago. And although habitat shifts are recognizable despite low resolution of the climate models, a comparison between classically reconstructed paleoenvironments and reconstructions inferred from combined climate and species distribution modelling is needed to test the validity of projections. For an ecological reconstruction of a test area's environments I plot the mean HSI values per climate-group and connect the points with a smoothed (spline interpolated) curve. The resulting "***habitat profile***" (*HP*) clearly shows if a test area yields suitable climate conditions for one single climate-group community (resulting curve has one single and pointed apex) or permits ***n*** climate-group habitats to exist in the test area contemporaneous (the curve is broad, spanning ***n*** climate groups and the apex is between climate-groups maxima). By plotting environmental profiles of all climate scenarios per site into one graph one easily can identify the strength and directions of environmental shifts over time. Additionally, I calculated the mean values of the four climate variables Bio05, Bio06, Bio13 and Bio14 in the test areas to get an impression of the temperature and precipitation range over time (SuppTab. 7).

Thereafter, the ***Albertine Rift*** area under *preBDS* conditions was dominated by forest (Fig. 16) with trees at least 10 m tall having interlocking crowns. A mean precipitation of 213 mm p_{max} and 40 mm p_{min} with temperature of 31°C t_{max} and 19°C t_{min} of the year is calculated (SuppTab. 7). Local opening of the otherwise closed tree cover may have permitted grassland to grow. The PCA indicates the Guineo-Congolian and Sudanian Transition Zone as the most similar ecozone. The climate conditions after the BDS allowed initially a further opening of the forest, as indicated by an increased proportion of the mean HSI value of the woodland group. That means, that open stands of woody plants not taller than 8 m and lower canopy cover replaced large parts of the forests, which still dominated the landscape. That was promoted by a lowered p_{max} of 196 mm. Local patches of grassland might be unaffected by that woodland intrusion. Under the *present* climate conditions the woodland-group habitats became dominant in the Albertine Rift area, yet the forests are an important part of the vegetation. It seems that the latest increase of woodland-group habitat was on the expanse of the local patches of grassland-group habitats, which disappear from the landscape. The p_{max} further decreased, yet must have remained sufficient to guarantee a persistence of forests. As I outlined previously in the test area description, the classic paleoecological reconstruction describes the environment of the Albertine Rift in Pleistocene times (i.e., in *preBDS*) as more humid as it was in the eastern rift in Tanzania and Kenya (Senut et al., 1994). The test areas Laetoli and Turkana serve here as eastern analogues, which are described below. Anticipating, my reconstructions for these test areas show forests as major habitat type in the Pliocene (i.e., *preBDS)*, yet not of that dominance as it is found for the Albertine Rift. Moreover, in Laetoli the curve testifies less humid conditions as in the Albertine Rift due to high proportions of woodland-group habitats. Senut et al. (1994) described a change to more arid environments in the Plio-Pleistocene (*postBDS*), leading to open dry savannahs (Geraads, 1993). I do not see such a strong shift in my results. Yet, an aridification from the *pre*- to *postBDS* is visible as well.

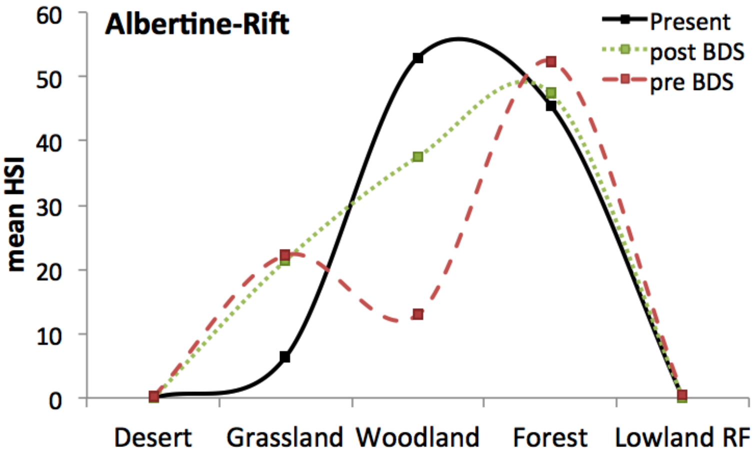


Fig. 16 **Habitat Profile of the Albertine Rift Test Area.** The mean habitat suitability indices (HSI) per climate-group are given per climate scenario (black/solid line: *Present*; green/pointed line: *postBDS*; red/dashed line: *preBDS*). Line smoothing was performed using a spline interpolation.

The environment within the ***Chiwondo*** test area in *preBDS* times was according to my reconstruction (Fig. 17) a mixture of closed forests and vegetation elements covered by the woodland-group, i.e., woodland, bushland, thickets and wooded grassland. A p_{max} of 236 mm (SuppTab.6) fulfilled the requirements of forest growth. As consequence of changed climate conditions induced by uplifting processes in the EARS (Sepulchre et al., 2006; Kaspar et al., 2010), the forest cover decreased to the favor of woodland vegetation, which becomes the dominating habitat in the *postBDS* scenario (Bonnefille 2010). The reconstruction for the reference scenario (*present*) documents a proceeding aridification that led to the additional occurrence of grasslands in the Malawi Rift. According to the PCA the environment within the Chiwondo area changed from being similar to the Guineo-Congolian and Zambesian Transition Zone, via the Somali-Masai ecozone towards similarities with the Afromontane vegetation. That is in a general agreement with the findings of Kullmer (2008) who reconstructed open forest to bushland vegetation for the period between the early Pliocene (*postBDS*) and Pleistocene (*preBDS*). Correspondence analyses performed by Sandrock et al. (2007) of bovid communities and White's ecozones placed the Chiwondo Beds between the Somali-Masai and Zambesian ecozones. That is affirmed by the placement of the test area under *preBDS* conditions next to aforementioned ecozones in the PCA. The Chiwondo area exhibits the highest mean pmax values of all test areas in all scenarios, nevertheless, it was less forested as the Albertine Rift area. The p_{min} values, however, are the second lowest of all areas in all scenarios after the Toros-Menalla area. This indicates to a strong seasonal change at all times, preferring the expansion of woodland, rather than the persistence of forested areas.

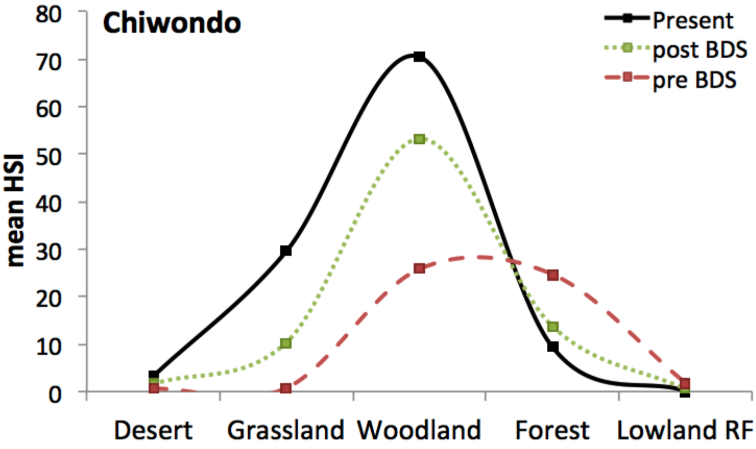


Fig. 17 **Habitat Profile of the Chiwondo Test Area.** The mean habitat suitability indices (HSI) per climate-group are given per climate scenario (black/solid line: *Present*; green/pointed line: *postBDS*; red/dashed line: *preBDS*). Line smoothing was performed using a spline interpolation.

The ***Laetoli*** area I here interpret as a mix of forest and true woodland (i.e. open stand of trees at least 8 m tall and interlocking canopy cover of 40% or more (White 1983) environment during the *postBDS* period (Fig. 17). A mean p_{max} of 210 mm and p_{min} of 7 mm at 20°C (t_{min}) to 30°C (t_{max}) was sufficient for forests and woodland to grow (SuppTab. 7). Again, the elevation of the East African topography led to an ecological shift in the favour of a dominance of woodland habitats. Furthermore, the vegetation elements assorted to the desert and grassland climate groups became an important part of the environment. I assume a lowered precipitation (p_{max} 186 mm) did not fulfil the requirements of forest growth anymore. The step towards *present* climate condition comes along with a further ecological shift towards more arid conditions.

The proportion of grassland and desert-group habitats is higher as during the *postBDS* conditions. I reconstruct an environment that is dominated by the low growing floral elements of the woodland category (i.e., shrubland and thicket) with a high proportion of pure grasslands. The p_{max} further decreased to 163 mm what is right between the median values of the grassland- and woodland-groups. Classical reconstruction methods of the Laetoli area described for the time of deposition of the Upper Laetoli Beds (3.85–3.60 Ma) a closed to medium dense woodland (Andrews, 1989; Reed & Rector, 2007). The superimposed Upper Ndolanya Beds (3.60–2.66 Ma) already show an aridification trend leading to an more open and arid conditions (Bishop et al., 2011; Kaiser, 2011; Kovarovic & Andrews, 2011) dominated by grasslands (Su, 2011) and presence of dense forests and woodland (Kaiser, 2011; Su, 2011). Both fossil layers were deposited between 3.85 Ma and 2.66 Ma (Deino, 2011) and are therefore representative for the *pre*- and *postBDS* event. The present reconstructed environment for the *preBDS* scenario suits more to the reconstruction for the older Upper Laetoli Beds, while the description of the Upper Ndolanya Beds fit more to the found vegetation composition of the *postBDS* period. This is not necessarily a contradiction. The presented scenarios represent a modelled snapshot in time and do not provide information of when an observed difference actually began. The reconstructions inferred from "*hard facts*", like pollen, fossils and/or isotopes etc. most likely present more accurate information. Hence, the ecological change certainly started during a much earlier phase of uplifting in this area.

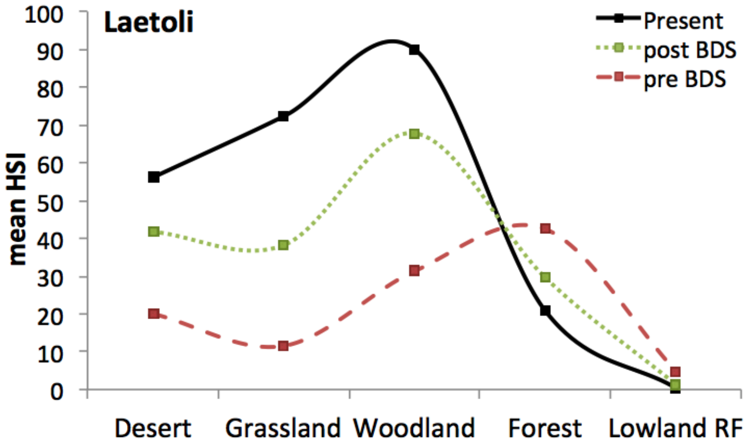


Fig. 18 **Habitat Profile of the Laetoli Test Area.** The mean habitat suitability indices (HSI) per climate-group are given per climate scenario (black/solid line: *Present*; green/pointed line: *postBDS*; red/dashed line: *preBDS*). Line smoothing was performed using a spline interpolation.

The reconstructions for a younger period, represented by the Olduvai Beds I 1.99–1.75 Ma (Domínguez-Rodrigo & Egido, 2007) point to an arid environment with open grassland and a proportion of wooded and forested areas (Reed & Rector, 2007; Reed 2007). That is more in line with the *postBDS* scenario, both in time and ecological interpretation. Yet, in my reconstruction the proportion of woodland habitat (probably the more open and shrub-like elements) is higher as for grassland. Nevertheless, the Laetoli test area yields the highest grassland proportion of all four East African test areas.

The last East African test area, ***Turkana***, experienced a tremendous environmental change over time (Fig. 19). It starts with a clear dominance of forest habitats under *preBDS* conditions and a p_{max} of 224 mm and not less precipitation than 10 mm in the driest month. The *postBDS* scenario shows a habitat composition that was not found in any other test area or climate scenario. All climate-groups except the lowland-rainforest-group were present with almost equal proportions. Hence, the environment appeared very heterogeneously structured. Except typical desert and semi-desert vegetation, all major vegetation types may have been present in that time. A closer look at the projection maps indicates a slight difference between the north and south of the area. The south has high HSI values for more arid habitats, whereas the north is more suitable for humid habitats (i.e., forest climate-group habitats). Hence a precipitation gradient is given, with high amounts in the north and lows in the south, permitting habitats for all climate groups within the test area. The overall mean for p_{max} of 200 mm supports a further aridification within the area. Yet the p_{min} increases from 11 to 15 mm, indicating a narrower range between the seasons. The *present* climate conditions lead to an easier interpretation. The *HP* shows a clear apex between the woodland and grassland group, what indicates a mixed environment of pure grassland and vegetation types summarized in the woodland group. Local forests are still present, in contrast, the habitat for the desert group is no longer available. A comparison with modern ecozones places the Turkana region in the *preBDS* scenario between the Sudanian Zone and its Transition Zone with the Guineo-Congolian Zone. The environment shifts towards the close vicinity of the Somali-Masai ecozone in the *preBDS* scenario. Under *present* climate conditions the PCA does not find any counterpart in the modern ecozones and places Turkana right between theoretically perfect woodland and grassland habitats, more wooded, as is Laetoli in that time. In the test area's description I pointed out how different the paleontological reconstructions for the Turkana area turned out depending on which data or proxies were used. Furthermore, the ecology varied considerably between the fossil localities (Lothagam, West Turkana and Koobi Fora) within the test area. However, the reconstruction of Reed & Rector (2007) for West Turkana is in accordance with my interpretation. Thereafter, closed woodland is found between 3.40 and 3.17 Ma, followed by an interval of more arid environments ranging from open grasslands to closed woodland (3.12–2.52 Ma, Reed & Rector 2007). I summarized the earlier multiple reconstruction (see "Fossil Localities and Test Areas" section and references herein) with the result that an aridification trend occurred in the Pleistocene (*postBDS*) with varying degrees of vegetation opening between the sites, in which Koobi Fora in the northeast of the test area was covered by shrubland and the site West Turkana by open grasslands. This suits the north-south precipitation gradient described above.

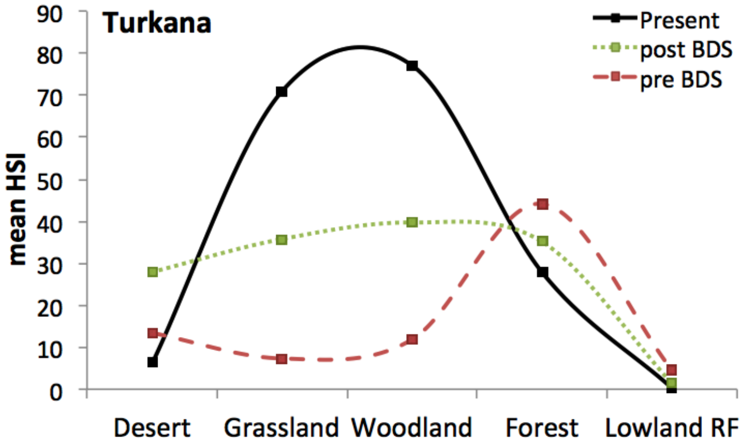


Fig. 19 **Habitat Profile of the Turkana Test Area.** The mean habitat suitability indices (HSI) per climate-group are given per climate scenario (black/solid line: *Present*; green/pointed line: *postBDS*; red/dashed line: *preBDS*). Line smoothing was performed using a spline interpolation.

The South African test area ***Swartkrans*** is in all climate scenarios a constant and clear grassland environment placing it next to the Kalahari-Highveld Zone (Fig. 15, Fig. 20). That is in sharp contrast to the classic reconstruction results. Those indicate an overall arid environment, yet with various environment changes over time including woodlands and even local forests (I refer to the "*Fossil Localities and Test Areas*" section and references therein). A similar discrepancy is found at the ***Toros-Menalla*** test area. Here, all reconstructions lead to a very arid environment most suitable for the desert climate-group inhabiting landscapes with sparse plant cover. The PCA places it next to the Sahara Transition Zone. For this area woodland, grassland and gallery forests were described during the past 7 million years (Geraads et al., 2001; Vignaud et al., 2002). Both test areas, Swartkrans and Toros-Menalla, do not show any changes in the ecology as response on enforced uplifting in the EARS and associated reduced moist transport. Yet, environmental changes are evident as shown by the fossil record and classic paleontological reconstructions. Several climate changes over time must have been present at either site, which were not detected by the applied climate model. Consequently, other factors than the uplifting process must have influenced the climate of North and Southern Africa and the climate scenarios are not sufficient to reconstruct paleoenvironments outside the EARS.

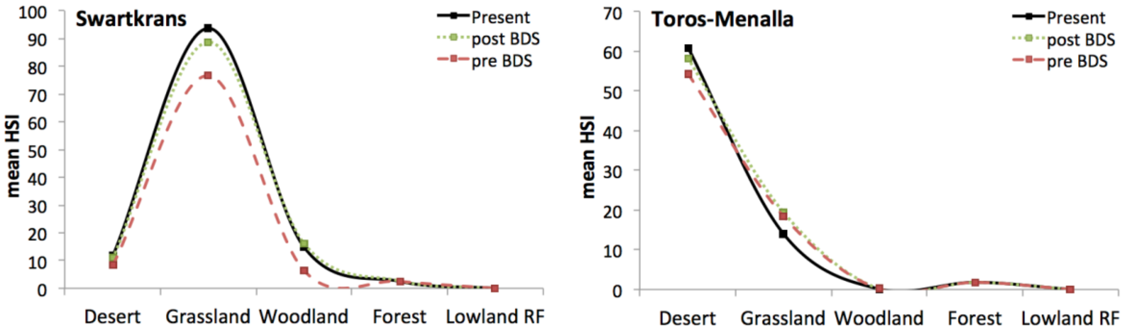


Fig. 20 **Habitat Profiles of Test Areas Swartkrans and Toros-Menalla.** The mean habitat suitability indices (HSI) per climate-group are given per climate scenario (black/solid line: *Present*; green/pointed line: *postBDS*; red/dashed line: *preBDS*). Line smoothing was performed using a spline interpolation.

Conclusion

The climate scenarios representing the time before and after the bovid diversification switch (*pre-* and *postBDS*) show an apparent change of the distribution and the extent of fundamental habitats over time for all bovid climate-groups. Generally spoken, a climate shift induced by the uplift of the East African rift shoulders benefited bovid communities adapted to more open and rather arid environments by expansion of their habitat. Conversely, habitats of species associated with dense tree cover and rather humid environments (i.e., forest and lowland-rainforest group) suffer a regression of habitat in extent and quality. That is in strong agreement with the findings of a reduced moist transport across the African continent induced by increased elevation of East and Southern African topography (Kaspar et al., 2010; Sepulchre et al., 2006). It is most apparent at test areas within the EARS, where the fundamental habitat of the forest-group is displaced by habitats suitable for woodland and grassland communities. That is in good accordance with classical reconstructions of paleoenvironments at the respective sites, which show an overall vegetation opening and a shift to more arid climate condition after approximately 3 Ma. Hence, the here first applied *Habitat Profile* reconstruction method, intended to test the projections validity, can be used as additional tool for paleoecological reconstruction, especially at sites lacking sufficient fossil proxies. However, a putative ecological stability found at test areas north and south of the EARS showed that the applied climate model is not operative for reconstructions remote from the rift system.

The resolution of the underlying climate model is relatively coarse, hence it does not permit detailed statements about habitat fragmentation on a regional scale from one scenario to the next. The projections show a rather broad expansion and regression in all directions. This might conceal the actual local situation, which is strongly affected by regional topographic and hydrologic features (e.g., river, lakes and mountains).

In the following chapter "***Future Spatial Development***" I will apply the same approach to climate scenarios of a prospective climate change. The available high-resolution climate layers allow a more detailed look on how changing climate conditions (in the future scenario it is a significant global surface warming) affect habitat distribution of climate-groups.

4. FUTURE SPATIAL DEVELOPMENT

In Chapter 3 I investigated how a past global long-term aridification process might have affected the distribution of African bovids and their habitat. This chapter shifts the focus to a near future climate change. As done for the past, here I model the distribution of climate-group habitats of climate scenarios for the years 2050 and 2080. Recent future climate prognoses predict a massive increase of industrial gases, associated with a continuing global warming. This would lead to significant shifts of present day biomes induced by changed precipitation patterns and an increased atmospheric carbon dioxide concentration. Again, antelopes would have to react to changing environmental conditions by migration, adaptation or extinction. Yet, the predicted change is probably far too fast for adaptation or speciation processes, leaving only a "run-or-die" option for climatically threatened species. In this chapter it will be analysed to what degree the climate-group's habitats are affected, and for what faunal community a risk of species loss is expected. Besides more detailed insights into climate-habitat interactions the outcomes are important for conservation actions, since many bovid species are already highly threatened with extinction due to overhunting and other anthropogenic impacts (East, 1988; 1989; 1990; Mallon & Kingswood, 2001).

METHODS

Methodically, the same approach was used to simulate future habitat distribution as it was used in the previous chapter to reconstruct the past. The identical point observations of the five climate-groups (i.e., desert-group, grassland-group, woodland-group, forest-group and lowland-rainforest-group) and climate variables Bio05, Bio06, Bio13 and Bio14 were used to establish the climate-niche. Yet, the present day reference layer was different. In the earlier chapter I used data from a preindustrial model with reduced greenhouse gases to reduce the anthropogenic impact on global climate. Here, I used the actual present day climate data downloaded from the *WorldClim* homepage (http://www.worldclim.org/; (Hijmans et al., 2005) in the highest available resolution (30 arc-seconds). I used the SRES A2a scenario based on the global general circulation climate model HADCM3 (Hadley Centre Coupled Model, version 3) for the years 2050 and 2080, published by the United Nations Intergovernmental Panel on Climate Change (IPCC) in the 4th Assessment Report (IPCC 2007). The datasets were downloaded in a 2.5 arc-minutes (http://www.ccafs-climate.org/). The here used scenario '… *describes a very heterogeneous world. The underlying theme is self-reliance and preservation of local identities. Fertility patterns across regions converge very slowly, which results in continuously increasing population. Economic development is primarily regionally oriented and per capita economic growth and technological change more fragmented and slower than (alternative) storylines.*' (IPCC, 2007; p.18). Hence it accounts for increasing greenhouse gas concentration and aerosol precursor emissions driven by the above-mentioned economic conditions. That would result in an increased average global surface temperature of +3.4°C and a rising sea water level of 0.23–0.51 m (relative to 1980–1999) at the end of the 21st century (IPCC, 2007) and is therefore a "worst case" scenario compared to the other available SRES scenarios (Fig. 21). *Maxent* was used for niche-calculation and habitat projections with the same setting as before (10 fold run, 100,000 background points; linear, quadratic and product features; random 75% of the observation points were used as test sample, otherwise the default setting applied). To evaluate the performance of the applied modelling the ROC analyses and

AUC values were calculated. The general change in habitat distribution was described visually using the generated habitat suitability maps created with *Maxent*. Furthermore, the available area of ***preferred habitat*** (HSI ≥ 50) was assessed on a continental scale for each scenario and a further subdivision into two categories (***class 1***: ≥ 80 HSI and ***class 2***: 50 ≥ HSI < 80) gave insights into the habitat quality change over time. To obtain a more regional impression, the previously described test areas were analyzed comparatively in regard to their median habitat suitability. For better comparison with ecozones after White (1983) and to investigate the ecological change over time I used the principal component analysis (PCA). In the graphical output I compare the proportions of the mean habitat suitability per climate-group and test-area with the same parameters calculated for the major ecozones (Fig. 9, see Chapter 3) defined by White (1983).

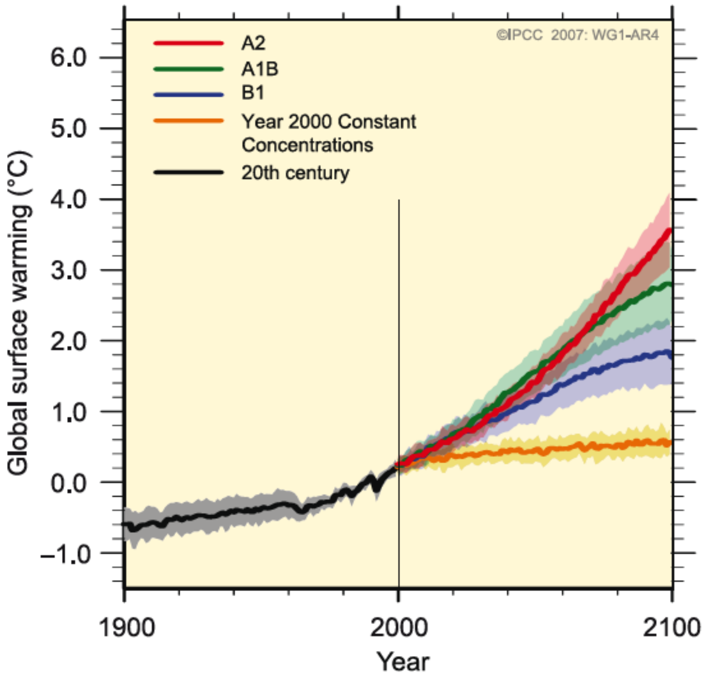


Fig. 21 **Multi-Model Averages and Assessed Ranges for Surface Warming from the 4th Assessment Report 2007 of the IPCC.** The graph shows the estimated global surface warming for three scenarios A2, A1B and B1 until the end of the 21st century. The scenario used in the present study belongs to the A2 family and can be regarded as a worst-case scenario (adapted from IPCC 2007).

RESULTS

Climate-Group Habitat Projection - Continental Scale Analyses

Habitat distributions for the years 2000 (reference layer), 2050 and 2080 were modelled for all five bovid climate-groups (Fig. 11). The average AUC of 0.871 ± 0.006 of all projections indicates adequate model performance and the usage of the most relevant climate variables to determine the climate niche. The here used reference climate layers (Year 2000) had a higher resolution than the reference layers used for the past climate reconstruction (Chapter 3). Hence, the projections for the *present* scenario and the year 2000 cannot be compared directly. Yet, the distribution patterns are broadly consistent. A continuous decrease of area covered with preferred habitat (i.e., ≥ 50 HSI) is found for the climate-groups desert (-41%), grassland (-76%) and woodland (-85%) between present day conditions and the year 2080 scenario (Tab. 10). The loss between the years 2050 and 2080 (Interval 2) is higher than from year 2000 conditions to the year 2050 (Interval 1). In contrast, the projection for the forest- and lowland-rainforest-group predicts a strong increase of +114% and +577%, respectively, from the year 2000 to 2080 (Total Δ). The latter group experiences its major habitat gain during the interval 1 (195%). For the forest-group the strongest increase (+51%) of preferred habitat is found for the second interval (Tab. 10). For an overview of East African Test Areas please see the figures in the appendix section (SuppFig. 2).

Tab. 10 **Area covered with Preferred Habitat across Africa.** Shown is the area covered with preferred habitat (HIS ≥ 50) across the African continent. Furthermore, percentile gain or loss between the scenarios is given: Interval between the year 2000 and 2050 (Int. 1); Interval between the year 2050 and 2080 (Int.2) and from the year 2000 to 2080 (Total Δ).

	Area Covered with HSI ≥ 50			**Gain and Loss**		
Climate-Group	**Year 2000**	**Year 2050**	**Year 2080**	**Int. 1**	**Int. 2**	**Total Δ**
Desert	11.47	8.64	6.78	-24.67	-21.58	-40.93
Grassland	9.78	4.99	2.31	-48.98	-53.69	-76.37
Woodland	12.64	5.19	1.95	-58.94	-62.36	-84.55
Forest	9.59	13.54	20.49	41.19	51.34	113.68
Lowland RF	2.43	7.15	16.44	194.24	129.92	576.52

The subdivision of the preferred habitat into two categories (Class 1: HSI ≥ 80; Class 2: 50 ≥ HSI < 80) clarifies that especially class 1 habitats are affected (Tab. 11) by the accelerated loss within the desert-, grassland- and woodland-group during interval 2. In the desert- and woodland-group class 2 values are continuously decreasing over time, whereas the loss of grassland-group class 2 habitats is stronger in the second interval as it is in the first (Tab. 12). The increase of the habitat size of the forest-group is basically due to a sudden expansion of class 1 habitats between the years 2050 and 2080 (+3% in Int.1; +83% in Int.2; Tab. 11), while class 2 keeps increasing over time, continuously (Tab. 12). In contrast, the lowland rainforest-group experiences its major increase of class 1 and 2 habitats between the years 2000 and 2050.

Tab. 11 **Area covered with Class 1 Habitat across Africa.** Shown is the area covered with class 1 habitat (HIS ≥ 80) across the African continent. Furthermore percentile gain or loss between the scenarios is given: Interval between the year 2000 and 2050 (Int. 1); Interval between the year 2050 and 2080 (Int. 2) and from the year 2000 to 2080 (Total Δ).

	Area Covered with ≥ 80 HSI			**Gain and Loss in Class 1**		
Climate-Group	**Year 2000**	**Year 2050**	**Year 2080**	**Int. 1**	**Int. 2**	**Total Δ**
Desert	2.73	2.38	2.10	-12.69	-11.74	-23.06
Grassland	2.64	1.47	0.47	-44.29	-67.87	-82.11
Woodland	2.31	1.14	0.45	-50.77	-60.18	-80.35
Forest	2.51	2.59	4.73	3.35	82.74	88.57
Lowland RF	0.20	0.50	1.95	151.04	289.90	874.75

Tab. 12 **Area covered with Class 2 Habitat across Africa.** Shown is the area covered with class 2 habitat (50 ≥ HSI < 80) across the African continent. Furthermore percentile gain or loss between the scenarios is given: Interval between the year 2000 and 2050 (Int. 1); Interval between the year 2050 and 2080 (Int.2) and from the year 2000 to 2080 (Total Δ).

	Area Covered with 50 ≥ HSI < 80			**Gain and Loss in Class 2**		
Climate-Group	**Year 2000**	**Year 2050**	**Year 2080**	**Int. 1**	**Int. 2**	**Total Δ**
Desert	8.74	6.26	4.68	-28.37	-25.31	-46.51
Grassland	7.14	3.52	1.84	-50.75	-47.77	-74.25
Woodland	10.33	4.05	1.50	-60.78	-62.98	-85.49
Forest	7.08	10.95	15.76	54.52	43.92	122.58
Lowland RF	2.23	6.65	14.49	198.77	117.90	549.78

Descriptive Distribution of Fundamental Habitat

The projection for reference scenario for Bovids within the ***desert-group*** (AUC 0.839 ± 0.005) predicts fundamental habitat in North Africa, including the Sahara desert, the Arabian Peninsula and the Horn of Africa (Fig. 22a). Furthermore, in southwestern Africa, especially along the coast and the Namib desert, climates are most suitable for the desert-group. Going forward in time towards the year 2080 one can see that the continuous reduction of preferred habitat over the continent (-41%, Tab. XY) is most apparent in the current Sahara-Transition Zone and the Arabian peninsula. The southern distribution experiences a visual decrease only in the second interval, leaving mainly the area of the current Karoo-Namib Zone covered with preferred habitat. The projection of the ***grassland-group***´s (AUC 0.853 ± 0.005) habitats currently shows its major distribution centers along the EARS, at the Horn of Africa, and in southern Africa but more towards the east coast than for the desert-group. A grassland stripe along the Sudanian Zone is suitable as well, however, it vanishes over time in accordance with the overall loss of available habitat in Africa until the year 2080 (-76%, Fig. 22b). The East African central region becomes more fragmented and the southern part splits into a western and eastern part, basically by a reduction of suitability for the grassland-group in the Kalahari-Highveld Zone. A very broad distribution is predicted for the ***woodland-group*** (AUC 0.815 ± 0.007). High suitability values are found along the EARS, in contrast to the grassland-group, it comprises the northern part as well (Fig. 22c). Furthermore, preferred habitat is found in the Zambesian Zone and its transitions with the Guineo-Congolian Zone. During the interval to the year 2050 most parts north of the Equator experience a significant loss of habitat suitability. Moreover, in 2080 only at the Afar-Plateau and in regions with high elevation along the EARS suitable climate is available for the woodland-group. South of the Equator, the presently closed distribution of suitable climate becomes more and more fragmented towards the year 2080. In 2080, remaining areas of higher habitat suitability are only found along the Rift shoulders of the EARS, along the east coast of South Africa and the coastal region in the west between the equator and 20°S. For the ***forest-group*** an expanding habitat distribution is predicted (AUC 0.876 ± 0.007). Today, this group’s fundamental habitat covers the Guineo-Congolian Zone and its adjacent ecozones Fig. 22d). Although, preferred habitat is distributed along the coast of East Africa as well, the EARS separates both areas from each other. Towards the year 2080 expansion associated with an overall suitability increase leads to a connection of forested area of the west and east part. Moreover, smaller gaps within the present day distribution are bridged in 2050 and 2080. In central Africa the HSI values increase, leading to a broad and continuous distribution of preferred habitat. The year 2000 projection (AUC 0.972 ± 0.008) for the lowland ***rainforest-group****'s* fundamental habitat exceeds the distribution predicted previously for the *present* reference scenario in *Chapter 3*. Still, highest values are reached along the coast of the Gulf of Guinea (Fig. 22e). Furthermore, the distribution covers the Guineo-Congolian Zone and areas along the East African coast. A major concentric habitat expansion until the year 2050 is obvious and a “filling” of areas with low elevation within the EARS is found. Towards 2080, the currently divided areas in the west and east become connected due to further expansion, especially in the eastern part of Africa. The areas with highest suitability values at the West African coast experience further intensification and expansion, particularly from 2050 to the year 2080.

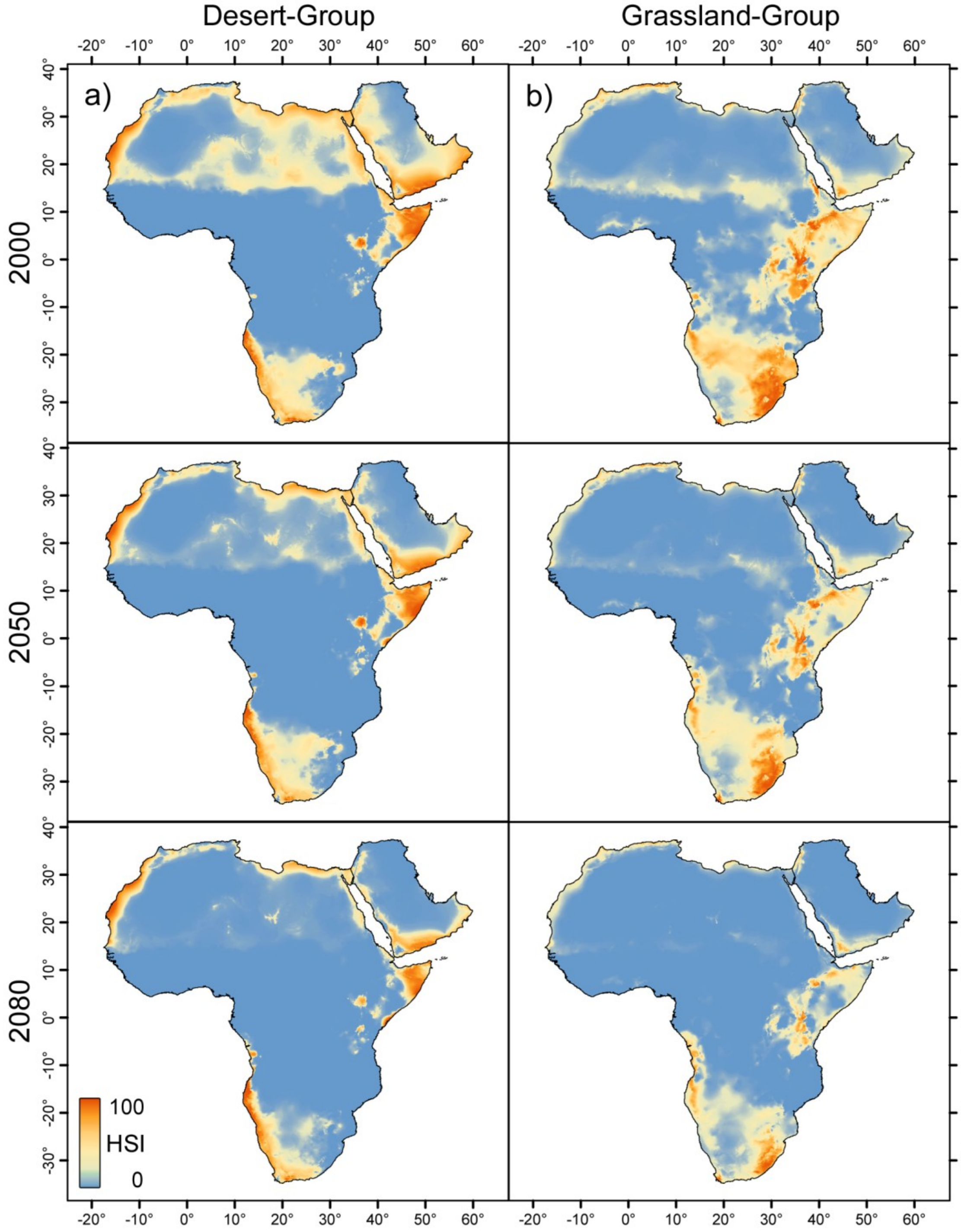


Fig. 22 **Habitat Distribution Projection for the Year 2000, 2050 and 2080 of Five Climate-Groups on Continental Scale.** Habitat suitability was modelled under the SRES A2 climate scenario (IPCC 2007) for the desert-group (a) and grassland-group (b). From the top to bottom: Year 2000 (reference layer), 2050 and 2080.

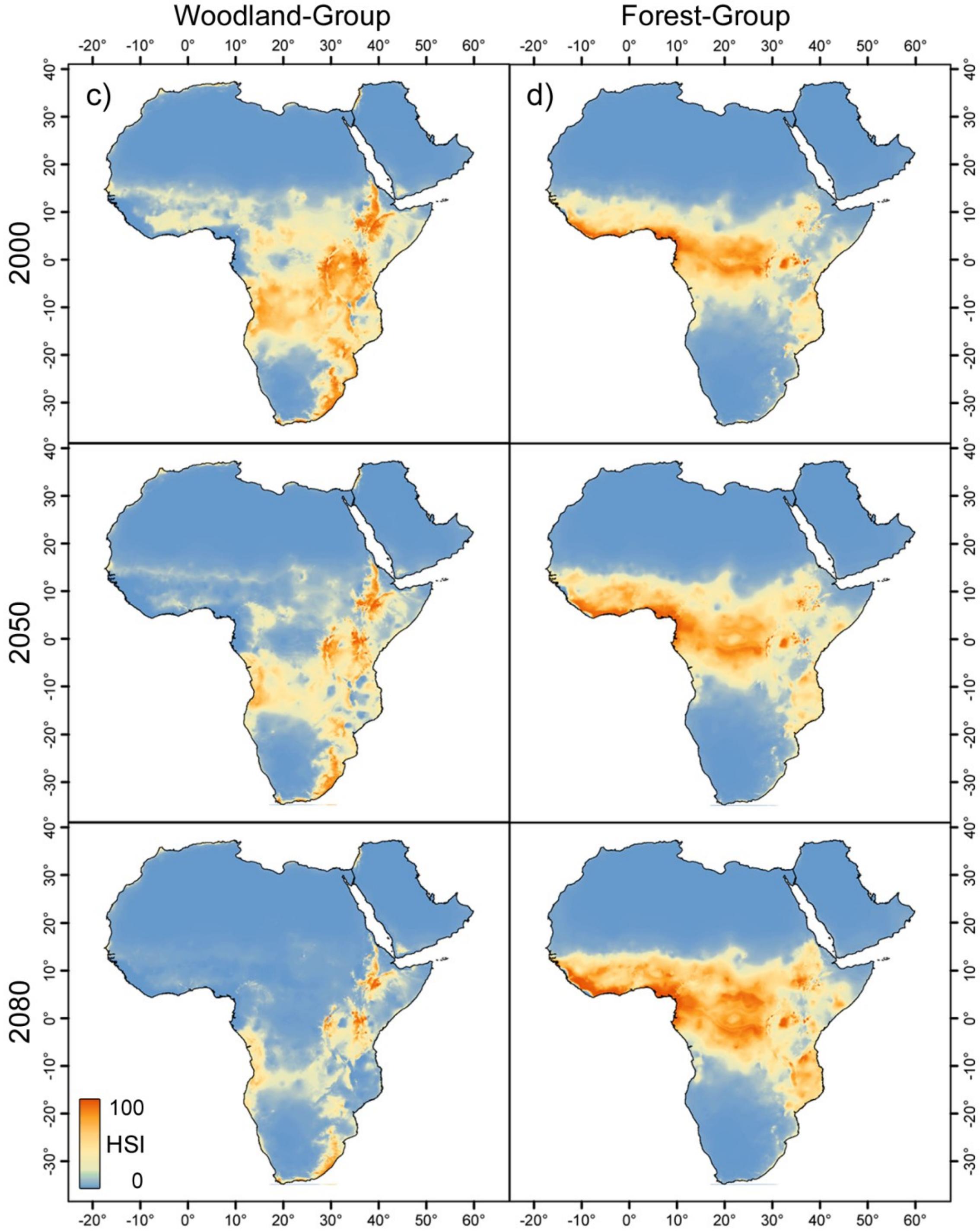


Fig. 22 continued **Habitat Distribution Projection for the Year 2000, 2050 and 2080 of Five Climate-Groups on Continental Scale.** Habitat suitability was modelled under the SRES A2 climate scenario (IPCC 2007) for the woodland-group (c) and forest-group (d). From the top to bottom: Year 2000 (reference layer), 2050 and 2080.

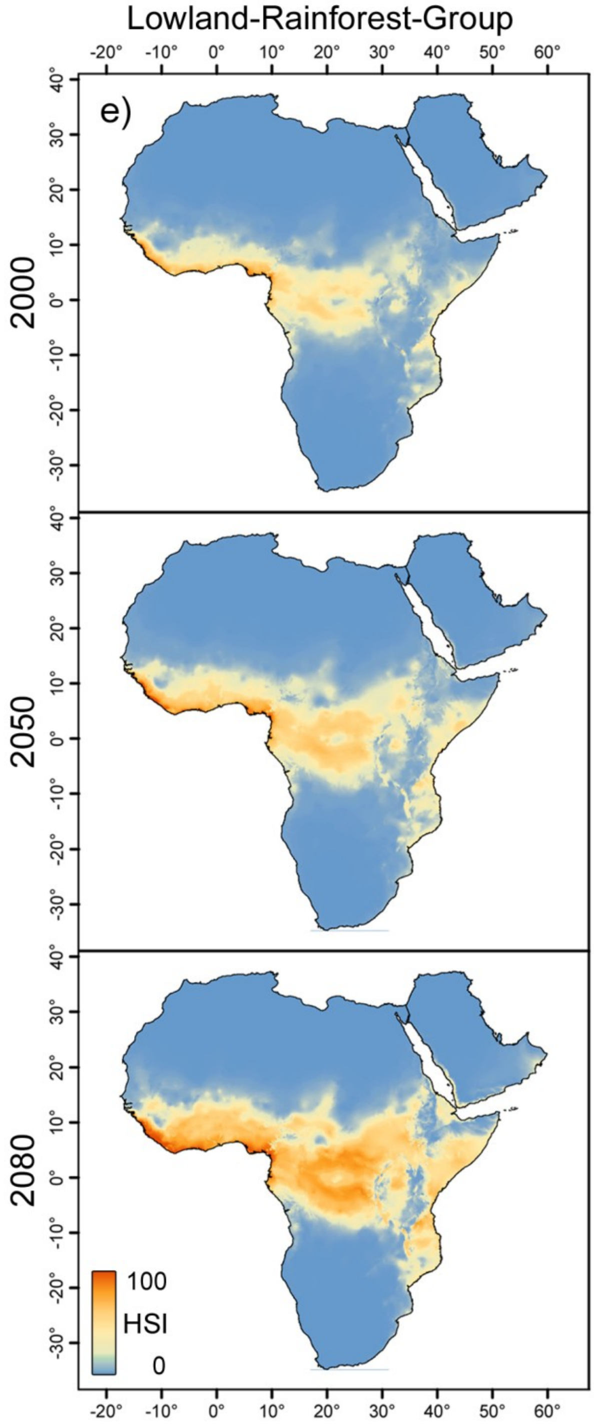


Fig. 22 continued **Habitat Distribution Projection for the Year 2000, 2050 and 2080 of Five Climate-Groups on Continental Scale.** Habitat suitability was modelled under the SRES A2 climate scenario (IPCC 2007) for the lowland-rainforest-group (e).

Climate-Group Habitat Projection - Regional Scale Analyses

To investigate the effects of a near future climate change scenario on bovid climate-groups more regionally, analyses were performed in six test areas. For this I calculated the mean HSI of all climate-groups per test areas and scenario (Tab. 13). The regional projection reflects the continental scale findings, where the desert-, grassland- and woodland-groups suffer a loss of habitat suitability and the forest- and lowland-rainforest-groups gain suitability.

Tab. 13 **Mean Habitat Suitability for the Years 2000, 2050 and 2080 per Test Area and Climate-Group.** Decreasing values over time are highlighted in bold. According projection maps are to be found in Fig. 23 to Fig. 28

		Mean HSI at Test Areas					
	Year	**Albertine Rift**	**Chiwondo**	**Laetoli**	**Torros-Menalla**	**Turkana**	**Swart-krans**
Desert	2000	0.1	0.0	3.5	27.8	57.4	2.4
	2050	**0.0**	0.0	6.9	**6.8**	57.7	5.8
	2080	**0.0**	0.0	**6.8**	**1.9**	**42.9**	**3.6**
Grassland	2000	36.0	10.9	58.2	5.5	39.7	87.6
	2050	**19.7**	**5.6**	**54.6**	**2.5**	**29.8**	**80.1**
	2080	6.9	1.1	34.0	0.6	27.1	63.1
Woodland	2000	67.3	49.1	77. 5	1.6	17.7	32.3
	2050	**45.3**	**31.1**	**68.1**	1.8	**14.0**	**23.8**
	2080	**25.2**	**15.2**	**56.3**	**0.9**	**7.0**	**13.8**
Forest	2000	50.9	29.5	20.3	1.2	17.4	3.2
	2050	**50.1**	34.1	20.2	2.0	24.3	**2.6**
	2080	**49.3**	52.8	23.8	2.8	**15.2**	**2.0**
Lowland RF	2000	13.4	11.0	5.4	1.4	19.9	0.3
	2050	22.9	16.7	7.7	2.1	29.5	0.5
	2080	40.7	28.0	11.9	5.6	47.7	**0.0**

In the ***Albertine Rift*** test area the strongest change of habitat suitability is found for the woodland-group. The mean habitat suitability shows a proceeding decrease from 67.3 HSI in the year 2000 to 25.2 HSI in 2080 (Tab. 13). That is basically due to a strong loss of suitability at lower elevations (< 1250 m), while high-elevated areas (> 1250 m) stay most suitable (Fig. 23b). That leads to the isolation of two distinct areas in the northern and southern part of the Albertine Rift in 2080, which is already implied in the year 2050. For the grassland-group a similar pattern is found. The generally lower mean HSI drops below the critical value of 20 HSI, from 36.0 HSI in the year 2000 to 6.9 HSI in 2080. Likewise before, only on high mountain ranges (> 2000 m) in the south and to a smaller extant in the north the area yields suitable habitats in the year 2080 (Fig. 23a). The median habitat suitability for the forest-groups is relatively constant around 50 HSI. Yet, the availability of areas of preferred habitat (> 50 HSI) decreases over time, especially at higher elevation at the western rift shoulders, in favour of a general suitability improvement across the whole test area (Fig. 23c). For the lowland-rainforest-group the median HSI is low in 2000 (13.4 HSI), but it gains continuously suitability towards the year 2080 (40.6 HSI). In contrast to the other groups, here areas below 1000 m change to more suitable conditions (Fig. 23d), whereas the mountains in the south and north remain unsuitable.

At the ***Chiwondo*** test area the woodland-group suffers the strongest reduction of median habitat suitability from 49.1 HSI in the year 2000 to 15.2 HSI in 2080 (Tab. 13). The decrease is continuous over time and suitable climate habitats remain only in the southwest on the Nyika plateau above 1250 m (Fig. 24c). In contrast, the forest-group emphasizes its habitat suitability between the years 2000 and 2080 (from 29.5 HSI to 52.8 HSI, Tab. 13) across the eastern half of the defined area (Fig. 24c). Since Lake Malawi covers the eastern test area, true habitat availability depends on the lake’s extension at time. Yet, suitable habitat is expected along the western shore and in areas below an elevation of 1250 m. For the lowland-rainforest-group a similar pattern like for the forest-group is found. In the year 2000 suitable habitat values can only be found in the very north and very south of the test area (Fig. 24d). The increasing mean habitat suitability leads to values above 20 HSI in 2080 (from 11.0 HSI in 2000 to 28.0 HSI in 2080) all along the eastern half and along the western shore of Lake Malawi, respectively. Suitable habitat for the grassland-group in the year 2000 can only be found in on the western mountain ranges and the Nyika plateau above 1250 m (Fig. 24a). Until the year 2080, almost no fundamental habitat can be found anymore in the

Chiwondo test area. Accordingly, the persistently low mean HSI decreases from 10.9 HSI in the year 2000 to 1.1 HSI in 2080.

Laetoli is topographically a very heterogeneous area due to the presence of two major lakes in the center (Lake Eyasi more to the west and Lake Manyara to the east) and volcanic mountain structures, like the Mt. Oldeani-Ngorongoro-Complex in the north. Correspondingly, the habitat distribution for the climate-groups is very diverse (Fig. 25). The woodland-group is dominating in the year 2000 (77.5 HSI) and the two future projections (68.1 HSI in 2050, 56.3 HSI in 2080), even though the suitability is decreasing over time. Areas of high suitability (> 50 HSI) are highly elevated regions (> 1500 m) like the Ngorongoro-Complex (Fig. 25c). This pattern remains the same until the year 2080, yet the necessary altitude rises to > 1750 m. In the year 2000 lower suitability values, but still above the critical value of 20 HSI are found at low altitude (< 1000 m) east and west of the Ngorongoro-Complex. These areas with lower values expand towards the south and include the shores of the Lake Manyara and Lake Eyasi in 2080. The second highest mean suitability in all projections is predicted for the grassland-group with 58.2 HSI in 2000, 54.6 HSI in 2050 and 34.0 HSI in 2080 (Tab. 13). Highest values for that group are found at the northwest inclination of the Ngorongoro-Complex and stay highest until the year 2080 (Fig. 25b). In contrast, south of that volcanic complex in between the lakes until the elevation rise again the climate appears unsuitable. Towards the year 2080 the HSI values of that very area increase, bridging the previous gap, despite an overall decreasing suitability. The mean habitat suitability of the desert-group in the Laetoli test area is very low in all projections. Yet, the projection maps clearly show that locally suitable habitats are available at the west and east inclination of the Ngorongoro-Complex (Fig. 25a). A slight increase of the mean HSI towards the year 2080 is predicted, as is basically the case for the eastern distribution, which further expands towards south until Lake Manyara at latest in the year 2050. For the lowland-rainforest-group, neither the calculated mean HSI, nor the projection maps (Fig. 25e) indicate any noteworthy habitat distribution within the test area for the years 2000 and 2050 (5.4 HSI, 7.7 HSI respectively). The projection for the year 2080 shows heightened suitability values along the sinks yielding the Lake

Manyara and Lake Eyasi, even though the mean HSI remains low for the Laetoli test area.

Today, the test area around ***Lake Turkana*** is clearly dominated by suitable habitat for members of the desert-group. This is shown by the estimated mean HSI (57.4 HSI) and visualized in a distribution map (Fig. 26a). A clear patch of preferred habitat can be found along the eastern shore of Lake Turkana. Despite the observation that the mean HSI remains relatively constant until the year 2050 (57.7 HSI), a shift of these high values to the east is predicted. The distribution and suitability values along the western coast remain unchanged during that interval. An overall loss of habitat suitability in the year 2080 is shown by the mean suitability (37.6 HSI) and on the projection map. It is remarkable that in all three projected scenarios a very sharp boundary between suitable and unsuitable climate conditions is visible. That is different in the remaining four climate-groups. The grassland-group has, over the entire test-area, equally distributed suitability values (mean HSI: 37.7) in the year 2000 (Fig. 26b). Some local spots with higher values are found in areas with elevation above 600 m, especially at the southern tip of Lake Turkana. The whole test area experiences a continuous decrease towards the year 2080 when only areas above 500 m show habitat of low suitability (mean HSI: 27.1). Under year 2000 conditions, the mean HSI of the woodland-group indicates low suitability for the Turkana test area (17.7 HSI). The projection map for that scenario supports this finding (Fig. 26c), showing habitat of good quality in elevated areas (> 750 m) only. Towards the future these higher elevated regions lose their suitability, accordingly the mean habitat suitability drops to a minimum of 7.0 HSI in 2080. For the forest- and lowland-rainforest-group the mean habitat suitability increases over time. For both groups the north-western part of the test area appears more suitable in the year 2000 (Fig. 26d, e). Advancing in time, the suitable habitat expands further south and gains suitability especially in elevated areas (> 750 m). For all projections the median HSI for the lowland-rain-forest group is always higher as it is for the forest-group. Moreover, the forest-group looses suitable habitat within the depression in the test area's center in 2080 and the overall mean decreases from 24.3 HSI in 2050 to 15.2 HSI in 2080.

In the ***Swartkrans*** test area only two climate groups find suitable habitats. The habitat suitability for the grassland-group dominates the environment in all three projections (Fig. 27a). Yet, a continuous decrease of mean habitat suitability from 87.6 HSI in the year 2080 to 63.1 HSI in 2080 is shown. Also, the woodland-group suffers a decrease of mean habitat suitability (32.3 HSI in 2000 to 13.1 HSI in 2080, Fig. 27b) most apparently due to a loss of suitability in the south and west. The northern area with high values in the year 2000 (> 50 HSI) remains available until 2080, yet, there suitability also decreases.

Today, the most northern test area ***Toros-Menalla*** yields suitable climate conditions for the desert-group only (Fig. 28). The mean suitability is calculated with 27.8 HSI in 2000. However, already in 2050 the value drops to a mean of 6.8 HSI and no noteworthy local high suitability can be found in the projections either for the year 2050 or for the year 2080. All other climate-groups have very low suitability values in all projections. A slight trend to increasing suitability for the forest- and lowland-rainforest groups is calculated between the year 2000 and 2080, however the maximum mean value of 5.6 HSI is still far below the critical value of 20 HSI.

Albertine Rift Test Area

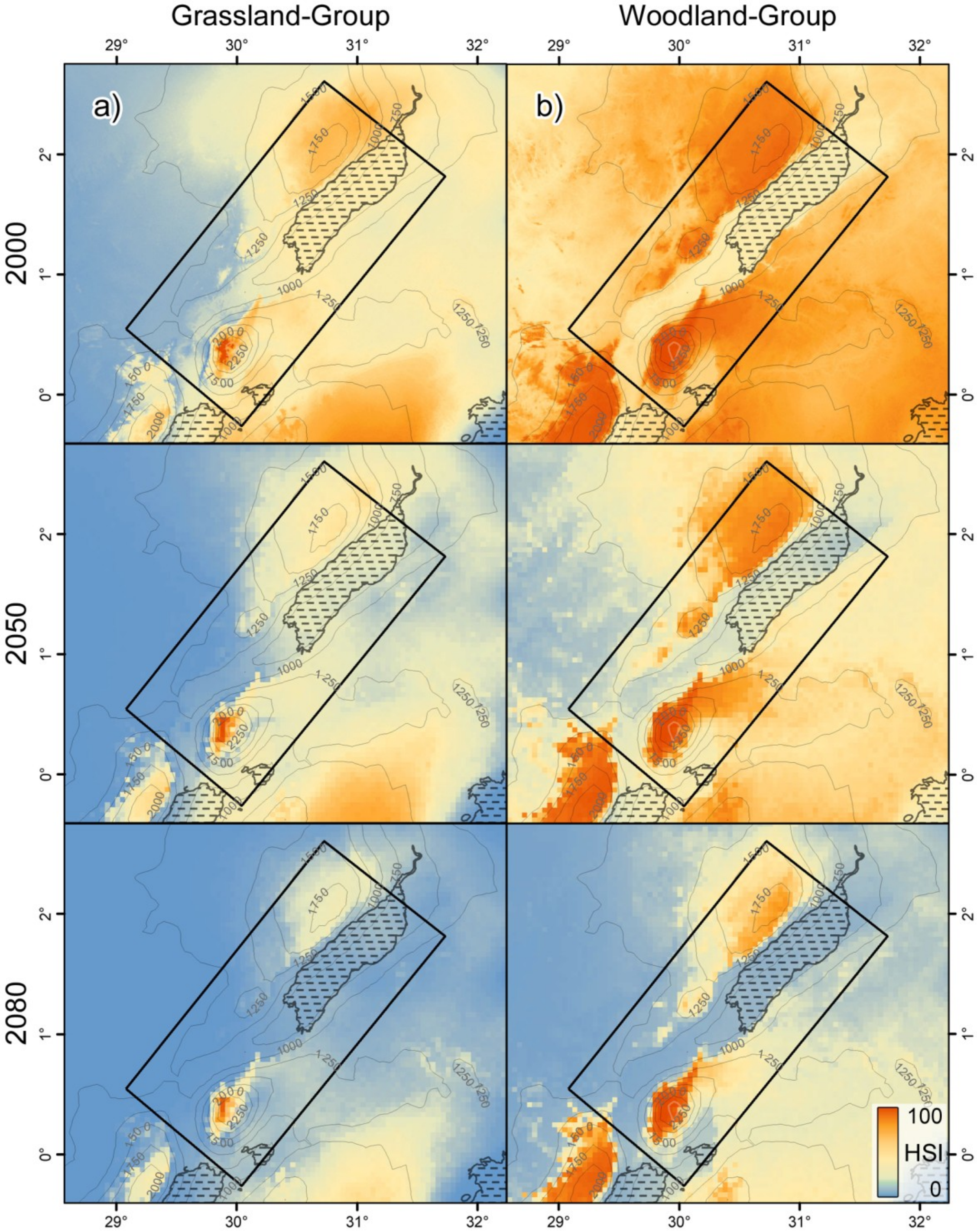


Fig. 23 **Habitat Distribution Projection for the Albertine Rift Test Area for the Years 2000, 2050 and 2080.** Habitat suitability was modelled under the SRES A2 climate scenario (IPCC 2007) for the grassland-group (a) and woodland-group (b). The warmer the colour, the higher is the habitat suitability. From the top to bottom: Year 2000 (reference layer), 2050 and 2080. The dashed area indicates Lake Albert.

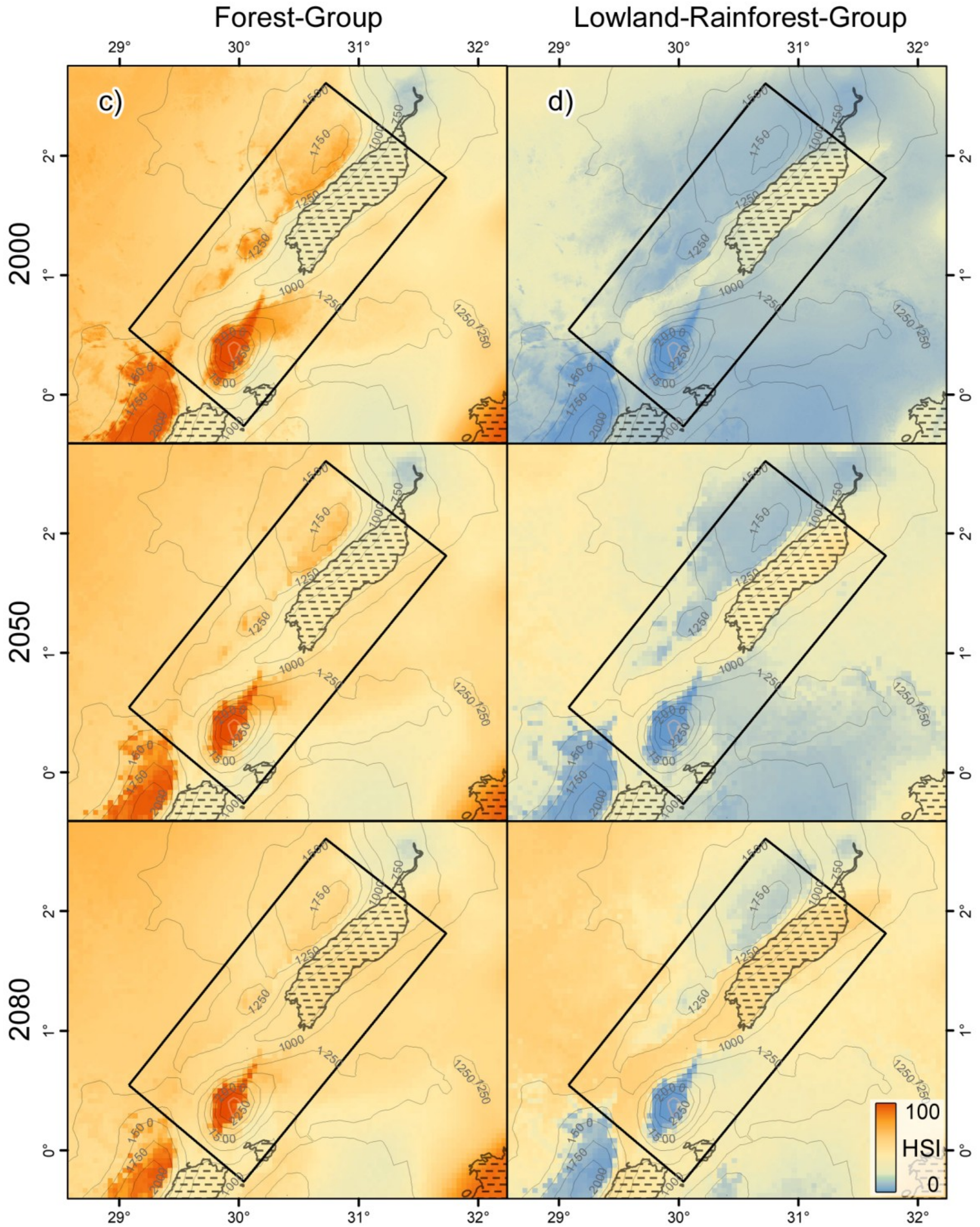


Fig. 23 (continued) **Habitat Distribution Projection for the Albertine Rift Test Area for the Years 2000, 2050 and 2080.** Habitat suitability was modelled under the SRES A2 climate scenario (IPCC 2007) for the forest-group (c) and lowland-rainforest-group (d). The warmer the colour, the higher is the habitat suitability. From the top to bottom: Year 2000 (reference layer), 2050 and 2080. The dashed area indicates Lake Albert.

Chiwondo Test Area

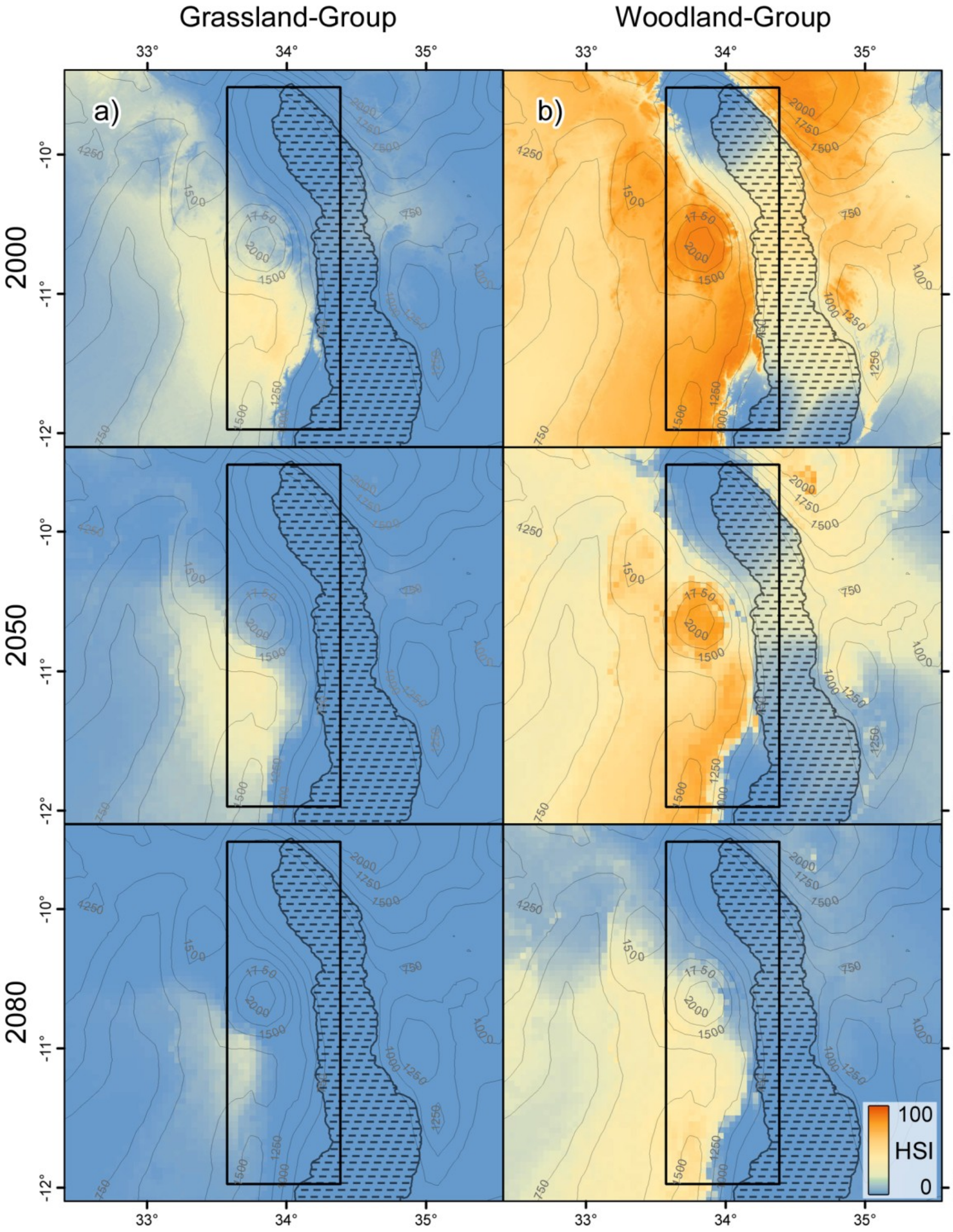


Fig. 24 **Habitat Distribution Projection for the Chiwondo Test Area for the Years 2000, 2050 and 2080.** Habitat suitability was modelled under the SRES A2 climate scenario (IPCC 2007) for the grassland-group (a) and woodland-group (b). The warmer the colour, the higher is the habitat suitability. From the top to bottom: Year 2000 (reference layer), 2050 and 2080. The dashed area indicates Lake Malawi.

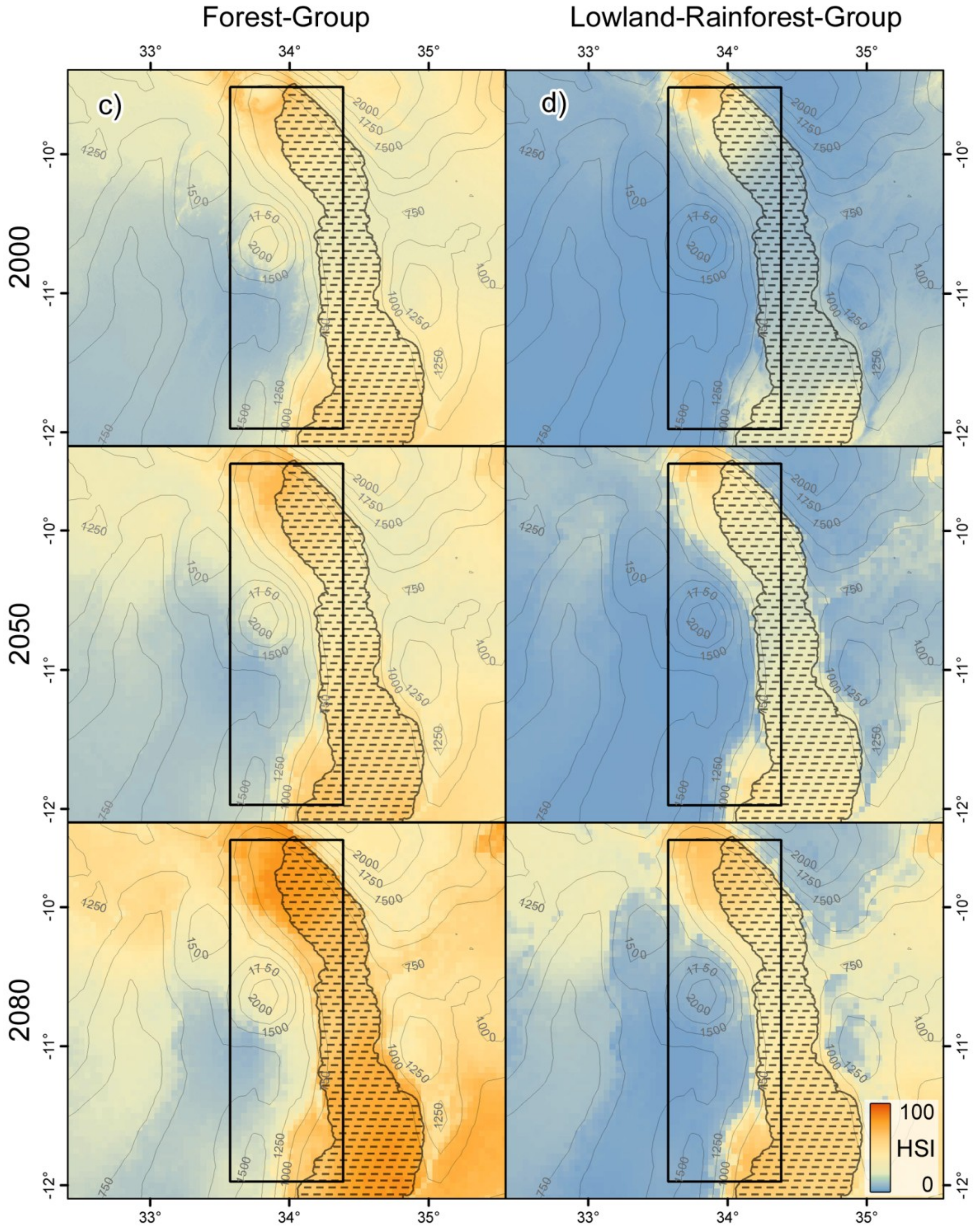


Fig. 24 (continued) **Habitat Distribution Projection for the Chiwondo Test Area for the Years 2000, 2050 and 2080.** Habitat suitability was modelled under the SRES A2 climate scenario (IPCC 2007) for the forest-group (c) and lowland-rainforest-group (d). The warmer the colour, the higher is the habitat suitability. From the top to bottom: Year 2000 (reference layer), 2050 and 2080. The dashed area indicates Lake Malawi.

Laetoli Test Area

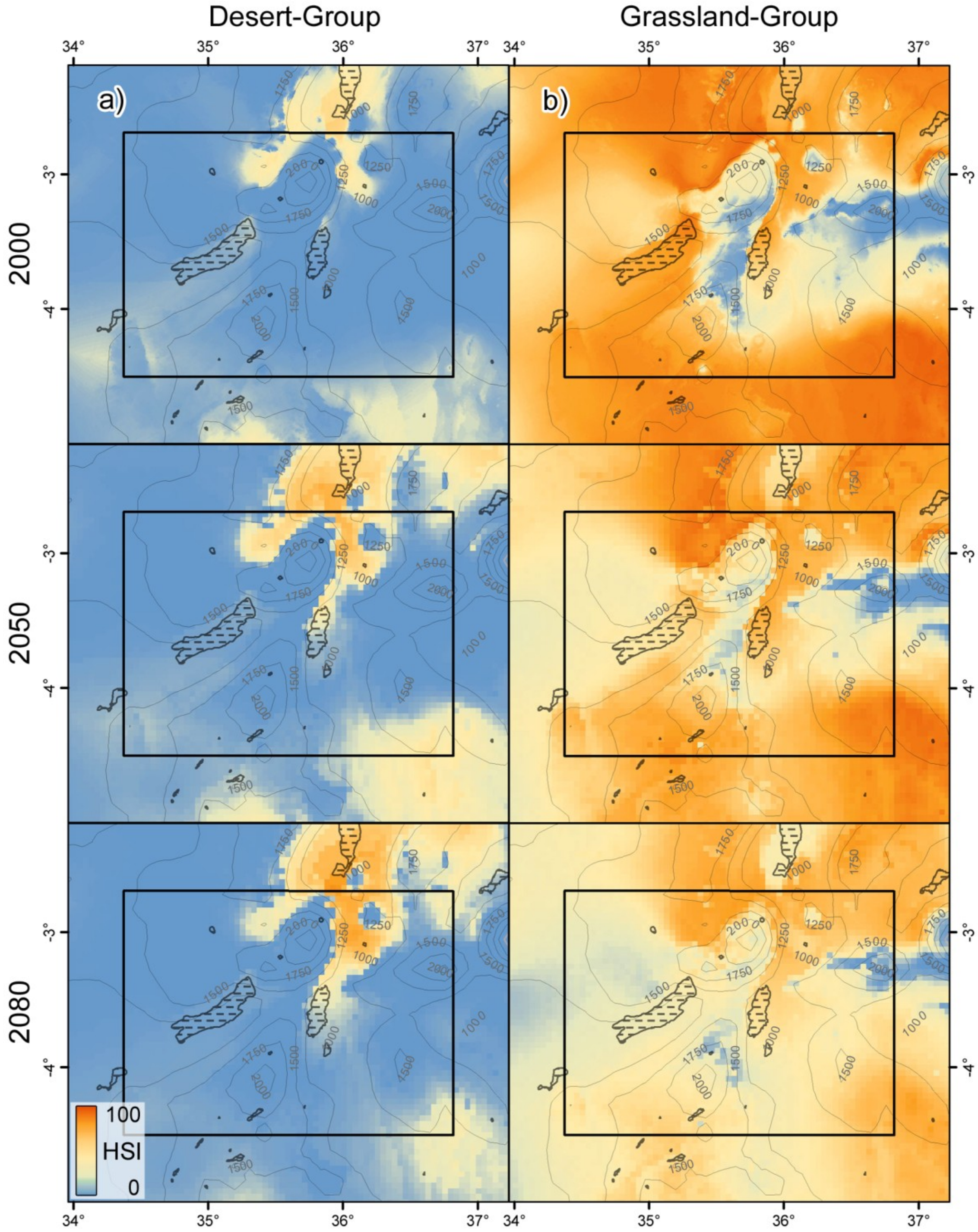


Fig. 25 **Habitat Distribution Projection for the Laetoli Test Area for the Years 2000, 2050 and 2080.** Habitat suitability was modelled under the SRES A2 climate scenario (IPCC 2007) for the desert-group (a) and grassland-group (b). The warmer the colour, the higher is the habitat suitability. From the top to bottom: Year 2000 (reference layer), 2050 and 2080. The dashed areas indicate Lake Eyasi (west) and Lake Manyara (east).

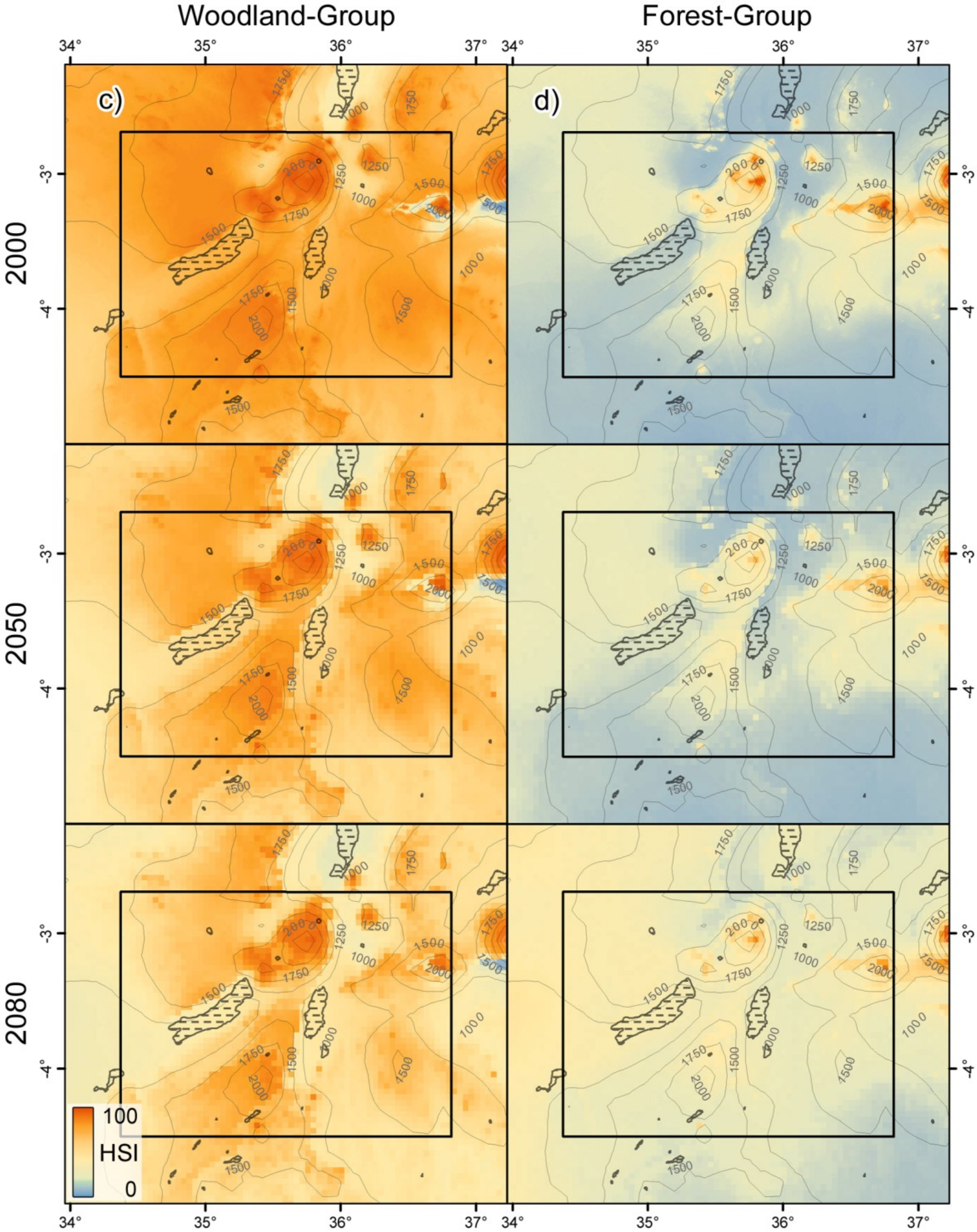


Fig. 25 (continued) **Habitat Distribution Projection for the Laetoli Test Area for the Years 2000, 2050 and 2080.** Habitat suitability was modelled under the SRES A2 climate scenario (IPCC 2007) for the woodland-group (c) and forest-group (d). The warmer the colour, the higher is the habitat suitability. From the top to bottom: Year 2000 (reference layer), 2050 and 2080. The dashed areas indicate Lake Eyasi (west) and Lake Manyara (east).

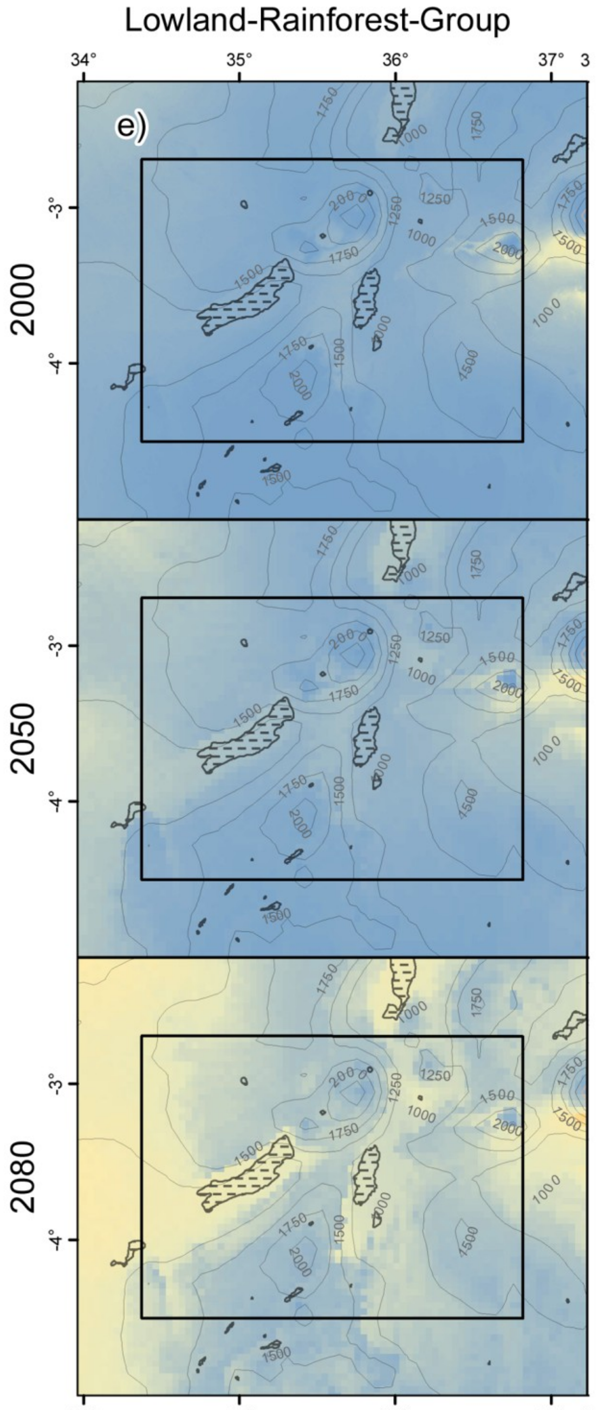


Fig 25 (continued) **Habitat Distribution Projection for the Laetoli Test Area for the Years 2000, 2050 and 2080.** Habitat suitability was modelled under the SRES A2 climate scenario (IPCC 2007) for the lowland-rainforest-group (e). The warmer the colour, the higher is the habitat suitability. From the top to bottom: Year 2000 (reference layer), 2050 and 2080. The dashed areas indicate Lake Eyasi (west) and Lake Manyara (east).

Turkana Test Area

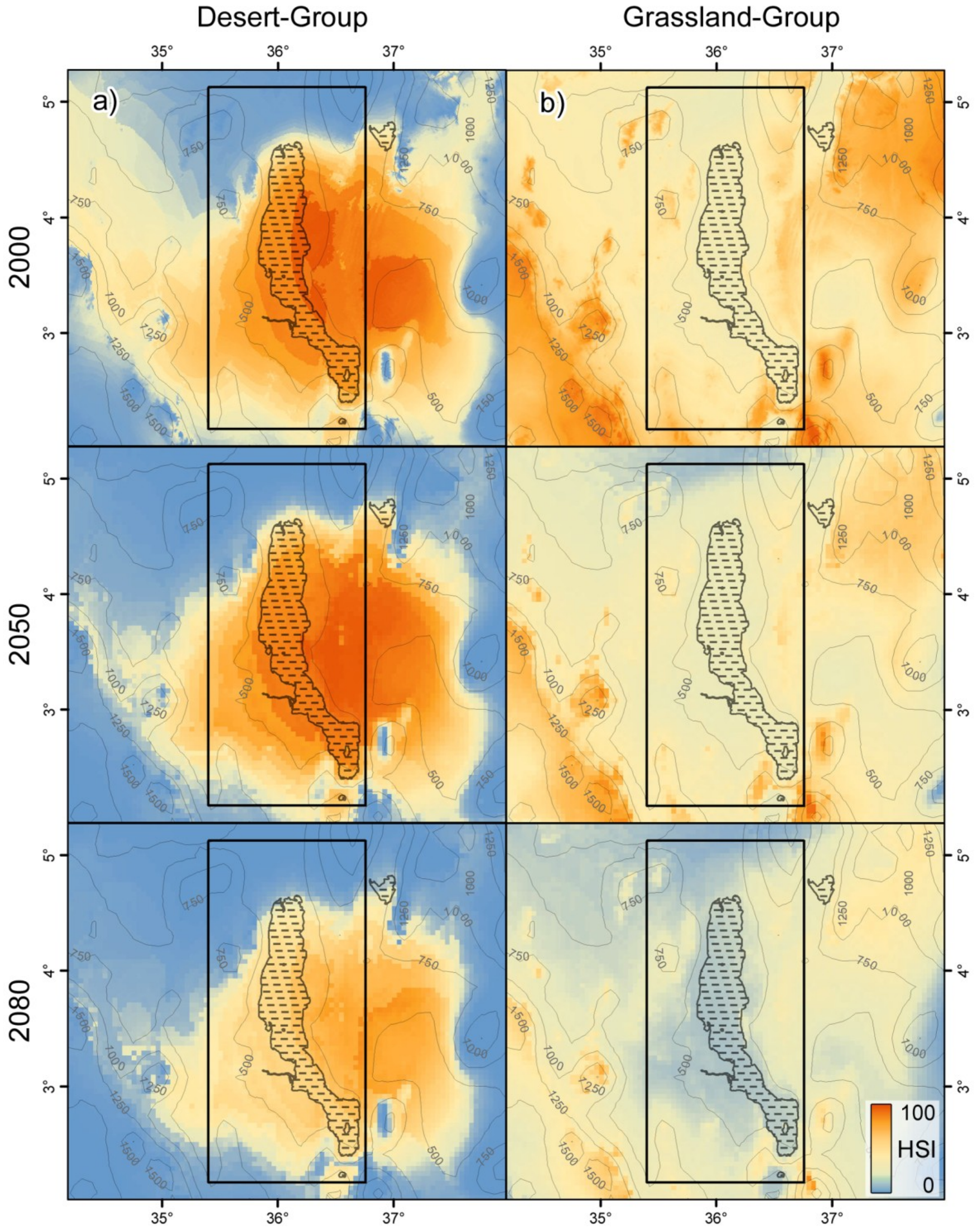


Fig. 26 **Habitat Distribution Projection for the Turkana Test Area for the Years 2000, 2050 and 2080.** Habitat suitability was modelled under the SRES A2 climate scenario (IPCC 2007) for the desert-group (a) and grassland-group (b). The warmer the colour, the higher is the habitat suitability. From the top to bottom: Year 2000 (reference layer), 2050 and 2080. The dashed area indicates Lake Turkana.

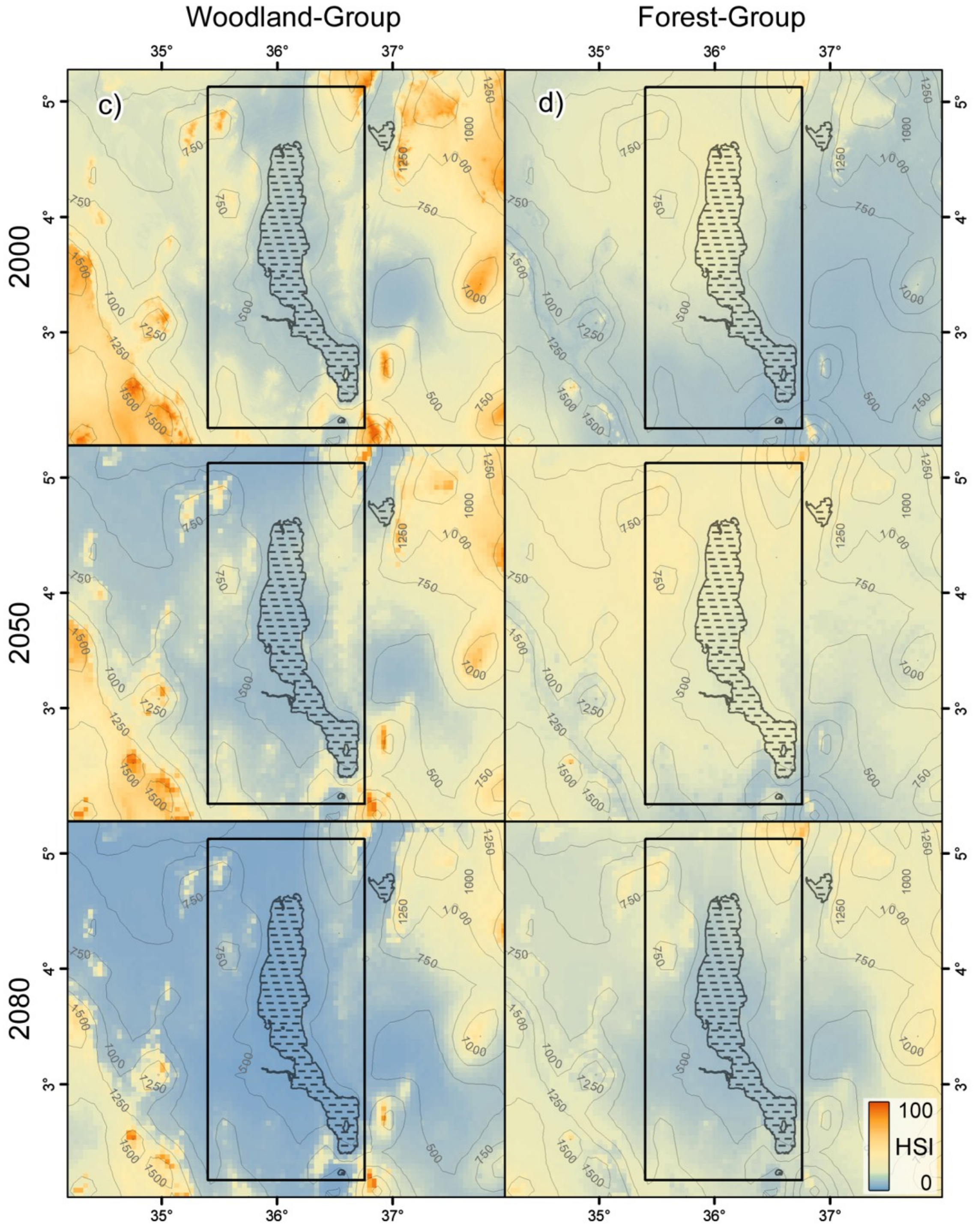


Fig. 26 (continued) **Habitat Distribution Projection for the Turkana Test Area for the Years 2000, 2050 and 2080.** Habitat suitability was modelled under the SRES A2 climate scenario (IPCC 2007) for the woodland-group (c) and forest-group (d). The warmer the colour, the higher is the habitat suitability. From the top to bottom: Year 2000 (reference layer), 2050 and 2080. The dashed area indicates Lake Turkana.

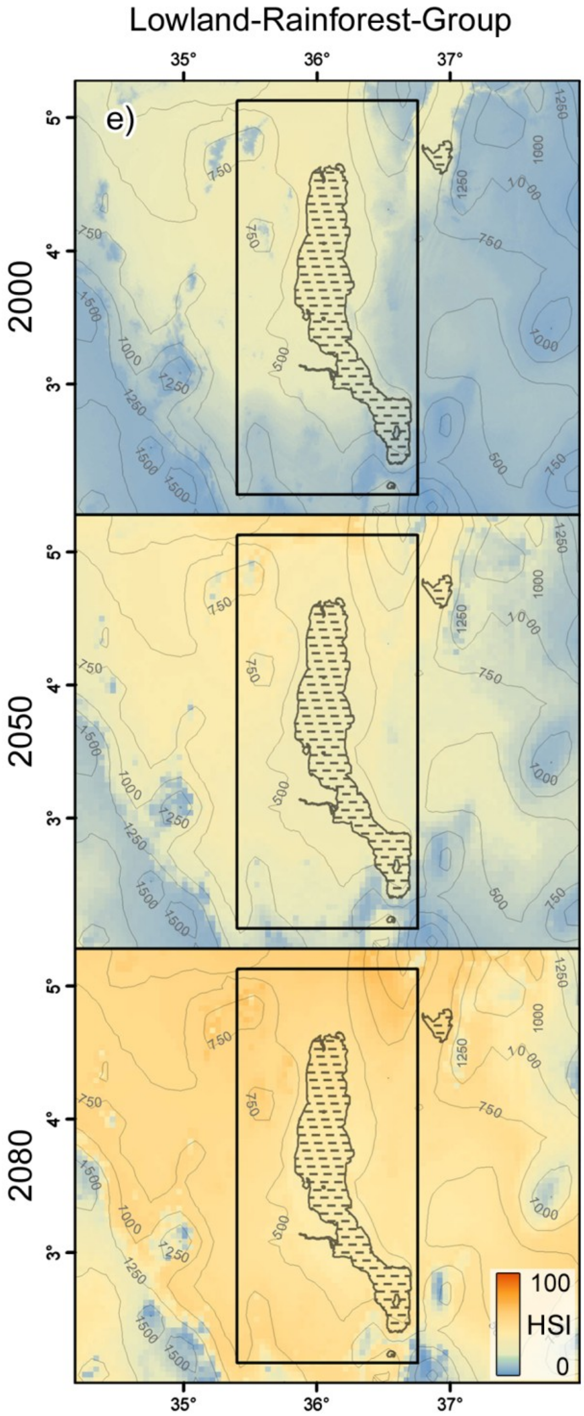


Fig. 26 (continued) **Habitat Distribution Projection for the Turkana Test Area for the Years 2000, 2050 and 2080.** Habitat suitability was modelled under the SRES A2 climate scenario (IPCC 2007) for the desert-group (e). The warmer the colour, the higher is the habitat suitability. From the top to bottom: Year 2000 (reference layer), 2050 and 2080. The dashed area indicates Lake Turkana.

Swartkrans Test Area

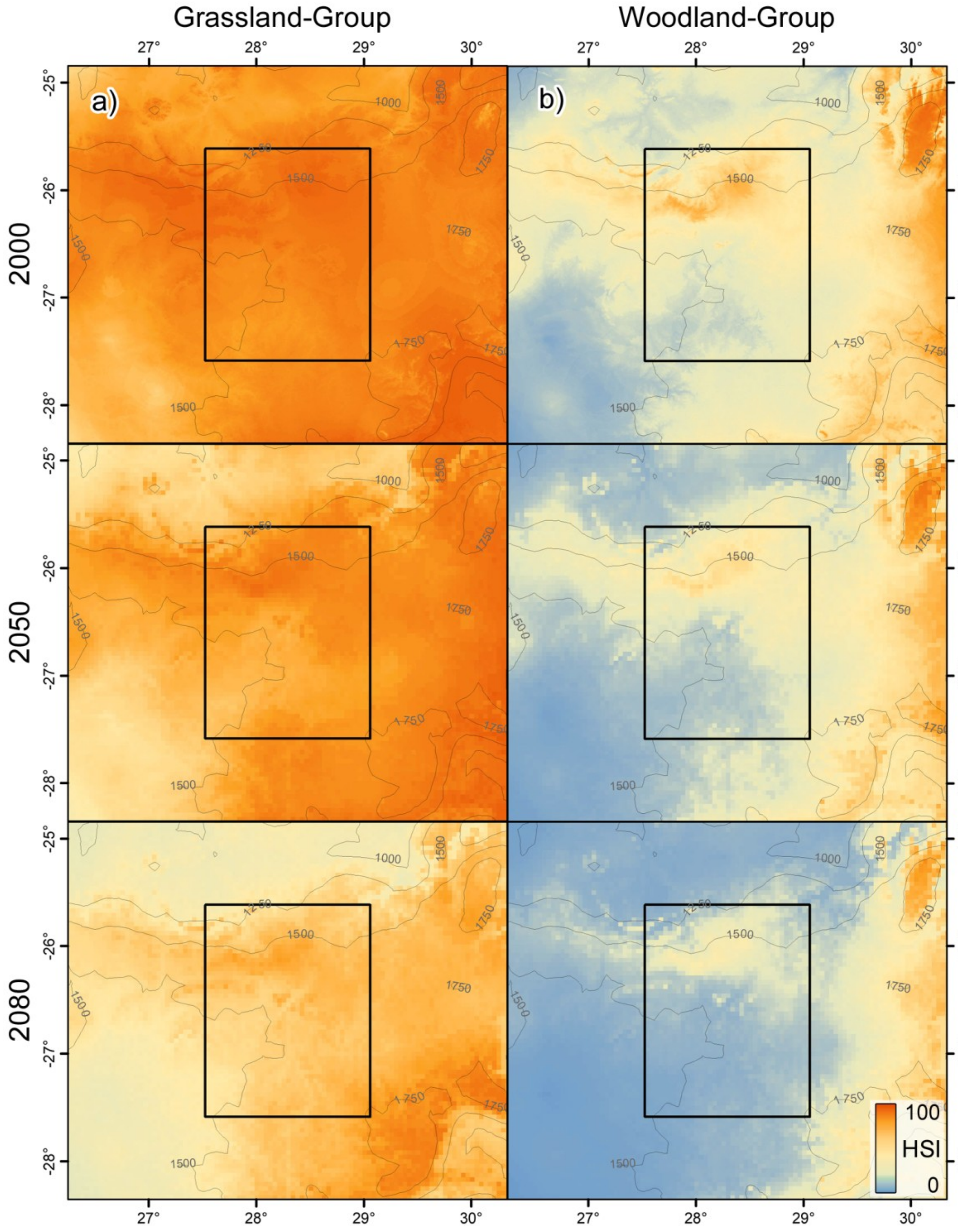


Fig. 27 **Habitat Distribution Projection for the Swartkrans Test Area for the Years 2000, 2050 and 2080.** Habitat suitability was modelled under the SRES A2 climate scenario (IPCC 2007) for the grassland-group (a) and woodland-group (b). The warmer the colour, the higher is the habitat suitability. From the top to bottom: Year 2000 (reference layer), 2050 and 2080.

Toros-Menalla Test Area

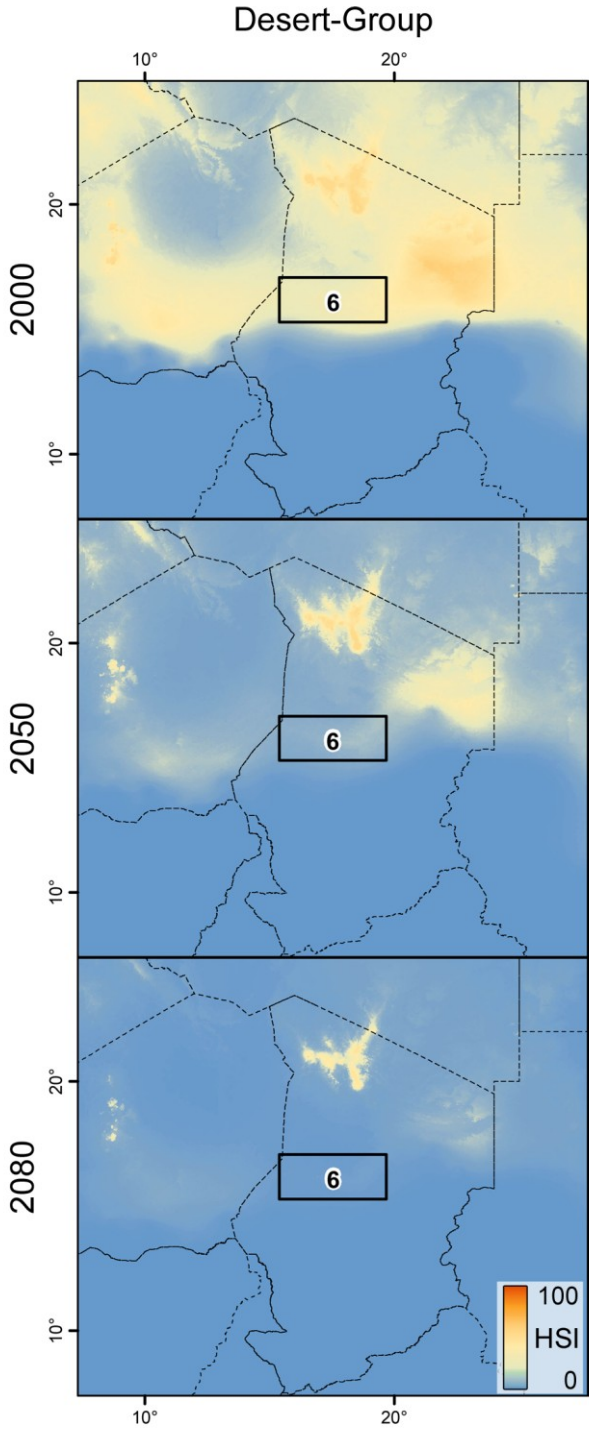


Fig. 28 **Habitat Distribution Projection for the Toros-Menalla Test Area for the Years 2000, 2050 and 2080.** Habitat suitability was modelled under the SRES A2 climate scenario (IPCC 2007) for the desert-group. The warmer the colour, the higher is the habitat suitability. From the top to bottom: Year 2000 (reference layer), 2050 and 2080.

Comparison of Future Environments and Today’s Ecozones

I used principal component analyses to investigate the similarities between test areas and modern ecozones (White, 1983) at different times in regard to the proportion of climate-group’s mean habitat suitability. The resulting two main factors (F1: 44.72%; F2 30.25%) account for 74.97% of the total variance (Tab. 14) and were used for visualisation in the corresponding scatterplot (Fig. 29).

Tab. 14 **Results of the Principal Component Analysis of Test Areas and Ecozones**. Shown is the contribution of the variables in percentage (i.e., the mean HSI of the climate-groups at the particular site) of the four most important factors describing 95% of the full data variability.

		Main Factors			
	Climate-Group	**F1**	**F2**	**F3**	**F4**
Contribution (%)	Desert	16.70	11.69	45.29	24.33
	Grassland	7.86	34.68	23.80	29.80
	Woodland	9.79	41.56	3.28	31.83
	Forest	41.16	0.00	2.89	0.68
	Lowland-Rainforest	24.50	12.06	24.74	13.36
PCA	Eigenvalue	2.24	1.51	0.80	0.36
	Variability (%)	44.72	30.25	15.96	7.11
	Cumulative variability (%)	44.72	74.97	90.93	98.04

The four quadrants within the PCA scatterplot visualizing the PCA results (Fig. 29), can be described as follows. The lower left quadrant represents conditions most suitable for the desert-group and yields ecozones assorted to the Sahara and Sahel ecozones (XVI and XVII), as well as the Mediterranean zones (VII and XVIII) and Karoo-Namib Zone (VI). The upper left quadrant comprises areas dominated by high proportion of grassland groups. The southern African Cape Zone (V) and Kalahari-Highveld Zone (XIV) fall within this category. In the upper right quadrant the woodland-group is the dominating faunal community in the environment. The two groups typically representing humid and densely covered landscapes, namely the forest- and lowland-rainforest-group are placed along positive values of the x-axis and within the lower right quadrant. Overall an increasing vegetation cover gradient along the x-axis, from the left towards the right, can be recognized. Furthermore, a temperature gradient along the y-axis can be assumed, where high values indicate lower maximum temperatures and negative values higher maximum temperatures.

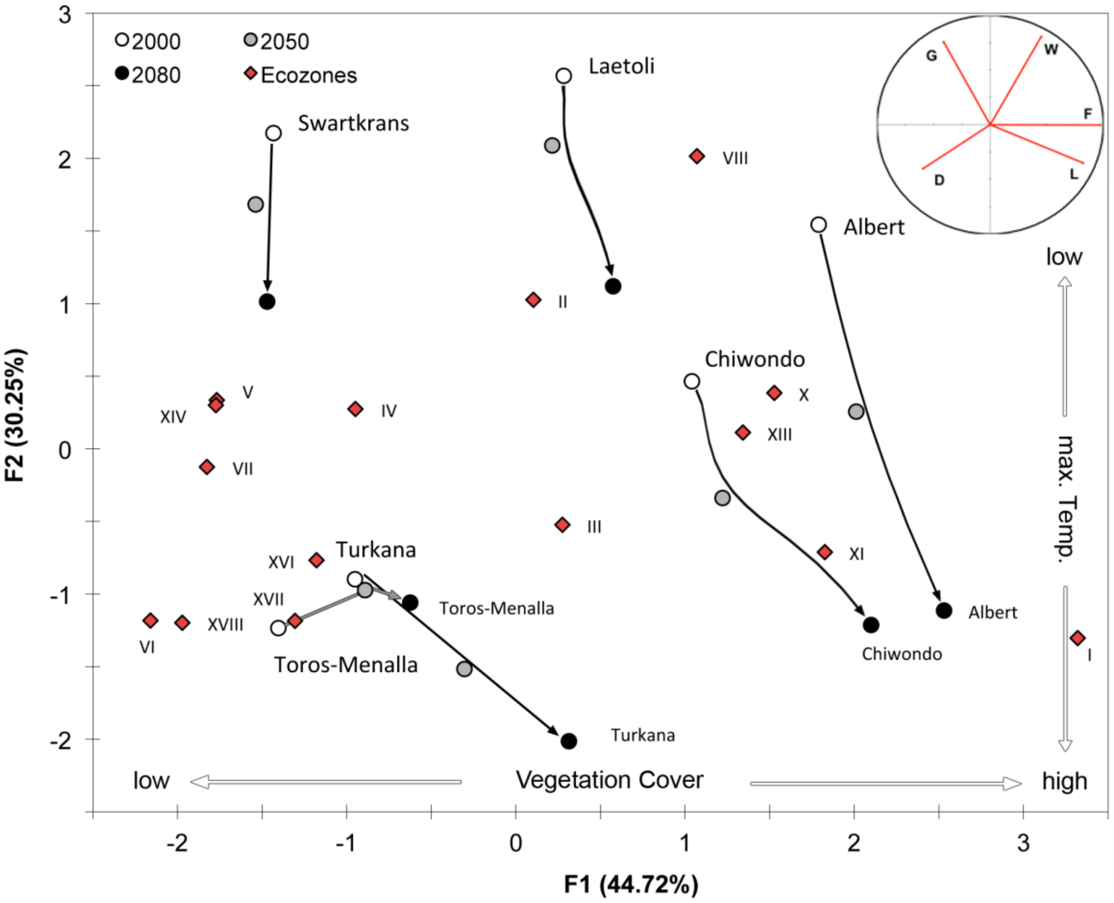


Fig. 29 **PCA Scatterplot of Modern Ecozones and Test Areas based on the Proportions of Climate-Group's mean HSI.** The arrows indicate the ecological shifts of test areas over time from the year 2000 to 2080. In the upper right corner a pictogram of the eigenvectors of the used climate-group is shown: (D) Desert, (G) Grassland, (W) Woodland, (F) Forest and (L) Lowland-Rainforest. Ecozones as follows: I Guineo-Congolian Zone, II Zambesian Zone, III Sudanian Zone, IV Somali-Masai Zone, V Cape Zone, VI Karoo-Namib Zone, VII Mediterranean Zone, VIII Afromontane Zone, X Guineo-Congolian and Zambesian Transition Zone, XI Guineo-Congolian and Sudanian Transition Zone, XIII Zanzibar-Inhambane Zone, XIV Kalahari-Highveld Zone, XV Tongaland-Pondoland Zone, XVI Sahel Transition Zone, XVII Sahara Transition Zone, XVIII Mediterranean and Sahara Transition

The Albertine Rift test area experiences the strongest shift of all areas (Fig. 29). While placed right in the middle of the woodland quadrant without direct ecozone comparison in the year 2000, it continuously shifts towards forested conditions in the year 2080. The closed corresponding ecozones in 2080 is the Guineo-Congolian ecozone (I). Chiwondo is in 2000 most similar to the Zanzibar-Inhambane ecozone (XIII). Alike before, a shift towards a more forested environment is projected for the future. That leads to a placement between the Guineo-Congolian/Sudanian Transition Zone (XI) in 2050 and Guineo-Congolian Zone (I) in 2080. The Laetoli test area appears under present day climate between optimal grassland and woodland conditions, shifting towards more wooded environments in 2080. The Turkana test area is close to the Sahel-Transition Zone (XVI) in 2000. Yet, a shift towards more vegetation cover within the test area is seen approaching the year 2080. Swartkrans is placed deep in the grassland quadrant today. A shift is present here, too, yet it is basically due to lowered values of F2, leading to a final placement closer to mean values of the Kalahari-Highveld (XIV) and Cape Zone (V). The least environmental change is expected in Toros-Menalla, which is in proximity to the Sahara and Sahel Transition Zone (XVI and XVII) in the year 2000. In the future the values for F1 and F2 increase, yet its associations with the mentioned zones remains.

DISCUSSION

Continental Scale Analyses

The projected climate-group habitats are under present day conditions (reference layer year 2000) in broad agreement with the estimated distribution in the reference layer (*present*) of the paleoenvironment reconstructions (*Chapter 2*). Yet, the undelaying climate models have very different resolution. Hence, the modelled climate-group distributions cannot be compared to each other straightforwardly. In this approach where I am modelling future habitat distributions, the higher resolution of the underlying climate models permits more detailed insights. Hence, local differences in climate suitability can be seen even on a continental scale. In the year 2000 scenario, the woodland climate group is the one with largest area of preferred habitat (≥ 50HSI). Yet, the assumed global surface warming leads to a tremendous loss of preferred habitat for that group. In the year 2080 the woodland-group has the smallest extent of climate-groups (i.e., species grouped to that community lose more than 80% of their habitat). This, especially in southern and western Africa leads to high fragmentation and disconnected habitat patches. A similar effect is found for the grassland group. Even though the total loss is slightly less, the fragmentation appears more significant. Of the wide distribution in the year 2000, covering the Sahel Zone, East Africa and a major proportion of southern Africa, only the higher elevated areas in the EARS and fragmented areas in South Africa remain suitable. The desert-group adapted to most arid environments suffers a habitat loss as well. It is the only groups whose members are able to persist in the area covered by the Sahara Desert nowadays. Yet, the climatic conditions change towards the year 2080 in a way that does not permit the survival of the regarded species. Also, that is the case in large parts of Arabia and in the Kalahari region. In contrast, the habitat of the two forest groups actually expands with increasing global warming. Both groups have a similar distributed fundamental habitat, though the forest group yields higher suitability values and the lowland-rainforest group's extent is tighter. In the year 2080 the expansion of the later reaches more than fourfold the size of present availability. The forest-groups still doubles the extant of preferred habitat and expands to the north and south and - as is the major change – to the east leading to a reconnection with habitats in East Africa. Again, that happens as well with the lowland-rainforest-group but to a lower degree. Summarized it appears that the assumed global warming changes the environment of the western, central and eastern regions towards more humid habitats at the cost of the grassland and woodland species. Northern and southern Africa suffer a loss of the present prevailing habitats, due to a change of climate conditions to a combination not covered by any of the climate-group communities.

Regional Scale Analyses

In the previous chapter I introduced the *habitat profile* (HP) technique to study environmental shifts within the test areas over time. The approach is used to investigate changes in the habitat composition under a prospective climate change. Additionally, I calculated the mean values of the four used precipitation and temperature variables (Bio05, Bio06, Bio13, Bio14, SuppTab. 9).

Today, the ***Albertine Rift*** test area is dominated by woodland vegetation with a large proportion of grassland and forests (Fig. 30). The PCA places it near the Afromontane ecozone (Fig. 29). A look at the close-up of the test area (Fig. 23), shows that indeed high mountains are within the area, but it is not a typical Afromontane ecozone sensu White (1983). The broad habitat suitability is rather due to the heterogeneity given by the mentioned two mountains and the lake-filled depression. The *HP* of the years 2050 and 2080 indicate an environmental shift towards more forested and closed habitats. That is accompanied by a slight increase of the precipitation in the wettest month (p_{max}) and a strong increase of the temperature variables maximum temperature in the warmest month (t_{max}) and minimum temperature in coolest month (t_{min}), respectively, from 29°C to 35°C (t_{max}) and 15°C to 20°C (t_{min}) (SuppTab.9). The PCA found the present Guineo-Congolian/Zambesian Transition Zone as analogous in 2050. In 2080 forest habitats will dominate the test-area, which is than climatically between the Guineo-Congolian ecozone and its transition with the Sudanian ecozone.

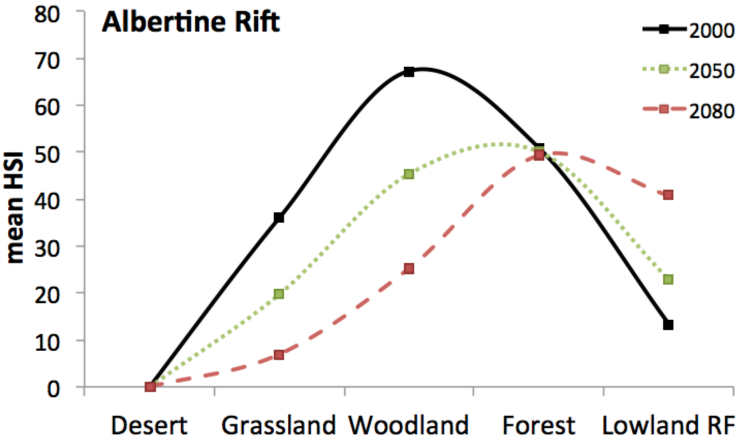


Fig. 30 **Habitat Profile of the Albertine Test Area.** The mean habitat suitability indices (HSI) per climate-group are given per climate scenario (black/solid line: year 2000; green/pointed line: year 2050; red/dashed line: year 2080). Line smoothing was performed using a spline interpolation.

The environmental development in the ***Chiwondo*** area resembles to the situation in the Albertine Rift. Yet, here the proportion of grassland is lower in all climate scenarios than it is in the Albertine Rift. The PCA places the area in the year 2000 projection next to the Guineo-Congolian/Zambesian Transition Zone, yet a little bit more towards open and more arid conditions. In the year 2050 the area is predicted to show a mixture of woodland and forest habitats and shifts further towards a forest dominated environment in 2080, placing it near the Guineo-Congolian/Sudanian Transition Zone. That is due to clearly increased values of both temperatures variables (+5°C) and increased precipitation in the wettest month. Regarding the distribution of habitats within the test areas, it is clear that forest habitats will become dominant in the lower elevated areas close to Lake Malawi, while the high elevated areas (e.g., Nyika Plateau) stay more suitable for open habitats such as the woodland-group and grassland-group. Yet, the decreasing HSI values for the latter groups indicate a change of climate conditions in a way that is not suitable for any other climate-group.

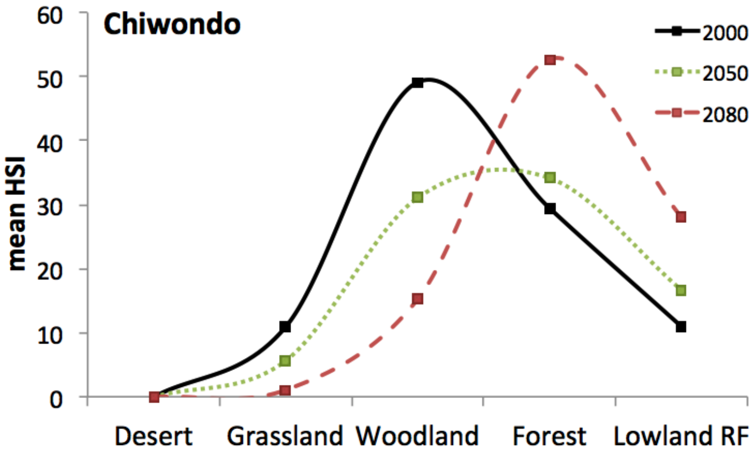


Fig. 31 **Habitat Profile of the Chiwondo Test Area.** The mean habitat suitability indices (HSI) per climate-group are given per climate scenario (black/solid line: year 2000; green/pointed line: year 2050; red/dashed line: year 2080). Line smoothing was performed using a spline interpolation

The *HP* for the ***Laetoli*** test area indicates only few changes of the climate-group proportions over time (Fig. 32). All climate scenarios are dominated by woodland-group habitats, followed by a high proportion of grassland. The mean HSI per climate-group decreases, except for the forest- and lowland-rainforest-group, whose values actually increase slightly after 2050. This may point to slight expansion of humid vegetation like forests. That is supported by the finding that the PCA places Laetoli first near the Afromontane ecozone and in 2080 between the Afromontane and Zambesian Zone. Topographically, Laetoli is the most heterogeneous of all test areas permitting all habitats to exist in parallel. It is remarkable that the suitability in Ngorongoro-Complex remains very stable for all climate-groups and might serve as climatic refuge area, particularly for the woodland- and forest-group.

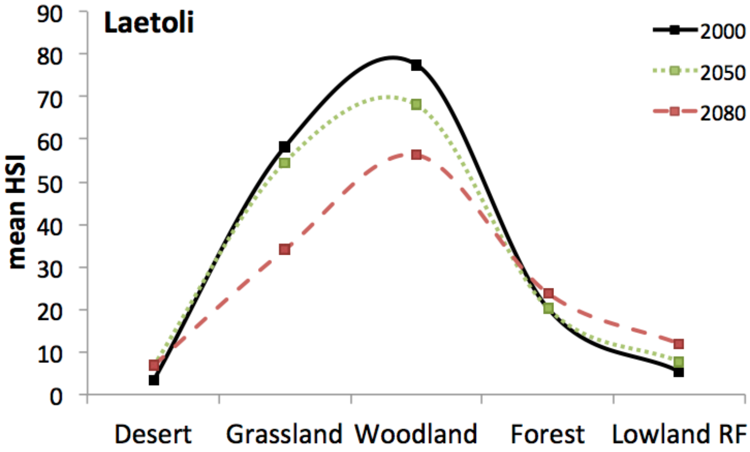


Fig. 32 **Habitat Profile of the Laetoli Test Area.** The mean habitat suitability indices (HSI) per climate-group are given per climate scenario (black/solid line: year 2000; green/pointed line: year 2050; red/dashed line: year 2080). Line smoothing was performed using a spline interpolation

The fourth East African test Area placed around Lake ***Turkana*** is today an arid environment dominated by habitats of desert-group (Fig. 33). That is particularly the case on the eastern side of the lake members and grouped by the PCA to the Sahel Transition Zone. Yet, in the future the proportion of suitable habitats of the forest- and lowland-rainforest-group increases at costs of the desert- and grassland-group, from which the desert-group still is dominating the area. Although its mean HSI value is decreasing, the extant of the habitat is constant over time and a structural change of the environment in that patch is not expected. For the grassland- and woodland group it looks different in the test area. For them the climate conditions become more and more unsuitable and are leading to strong habitat fragmentation. In contrast, the habitat for the forest and lowland-rainforest-group expands from the north. The shape of the *HP* suggests for the year 2080 a sharp boundary from forested to grassland habitats, shown by the low values for the woodland-group. Here, as in aforementioned East African test areas, the temperatures are rising accompanied by an increase of the precipitation in respect to the year 2000. That benefits the growth of more and dense vegetation cover, yet the low values for the woodland group remain a curious result. In all other test areas a shift from one side of the climate spectrum towards the opposite led to a relative strong proportion of the vegetation type in the transition.

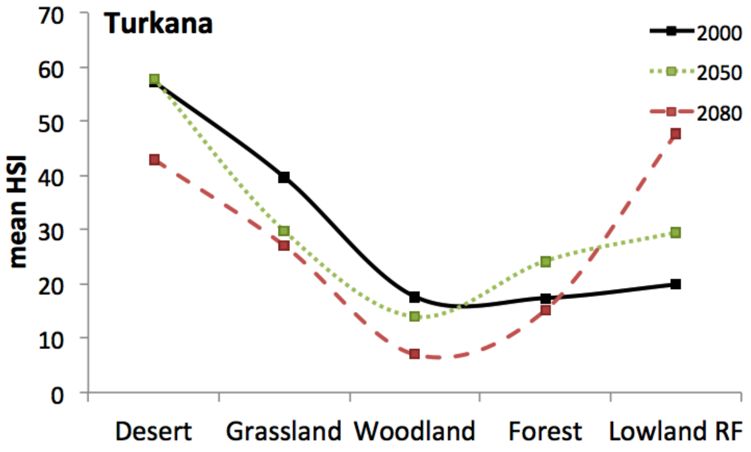


Fig. 33 **Habitat Profile of the Turkana Test Area.** The mean habitat suitability indices (HSI) per climate-group are given per climate scenario (black/solid line: year 2000; green/pointed line: year 2050; red/dashed line: year 2080). Line smoothing was performed using a spline interpolation

Swartkrans is clearly dominated by habitats represented by the grassland-group (Fig. 34). That does not change even though the temperature increases (Bio05: from 27°C in 2000 to 34°C in 2080). Initially, the woodland-group habitats are a major element especially in the northern part of the environment, but become successively less important what is most probably due to a lowered amount of precipitation in the driest month of the year. As the PCA shows, that leads to more similarities with the averaged values of the South African Cape and Kalahari-Highveld ecozones.

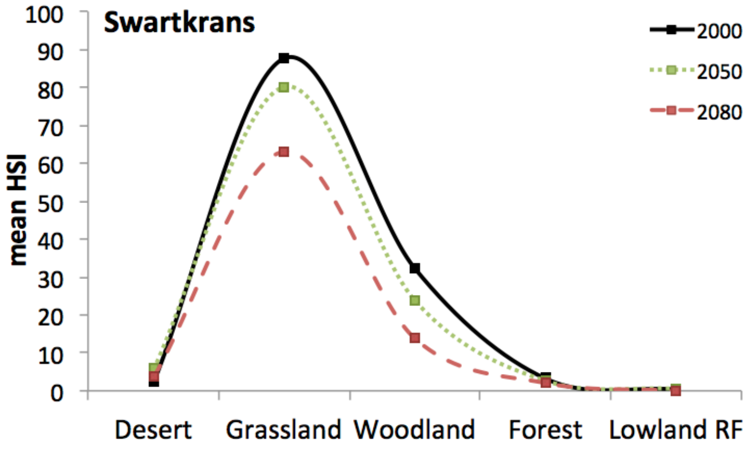


Fig. 34 **Habitat Profile of the Swartkrans Test Area.** The mean habitat suitability indices (HSI) per climate-group are given per climate scenario (black/solid line: year 2000; green/pointed line: year 2050; red/dashed line: year 2080). Line smoothing was performed using a spline interpolation

Under present climate condition, the PCA places ***Toros-Menalla*** into the cluster of North African ecozones (Fig. 29). Yet, towards the future the area undergoes a clear climatically and, consequently, environmental change. Increasing temperatures up to 48°C in the warmest month and 20°C in the coolest month leads to strong decreased habitat suitability for desert-group members. That is clearly seen in the close-up of the test area, where no local patches of good habitat quality remain. The PCA indicates an environmental shift towards more vegetation cover, as does the *HP* (Fig. 35). The HSI values however are extremely low, so that the climate condition in the Sahara region can be assumed unsuitable to harbor the established climate-group as such.

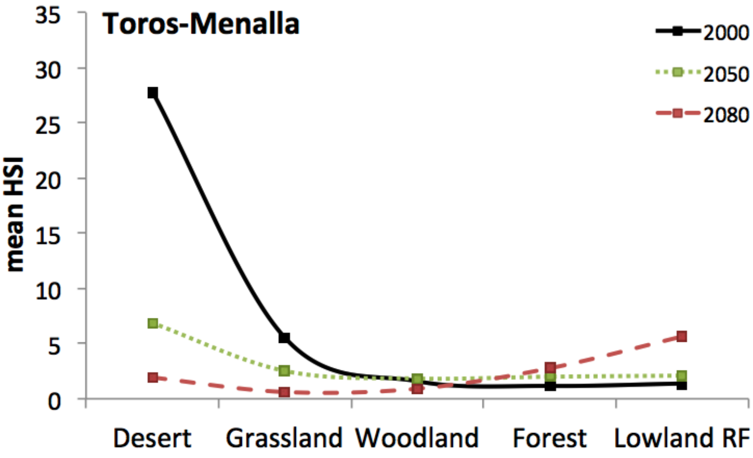


Fig. 35 **Habitat Profile of the Toros-Menalla Test Area.** The mean habitat suitability indices (HSI) per climate-group are given per climate scenario (black/solid line: year 2000; green/pointed line: year 2050; red/dashed line: year 2080). Line smoothing was performed using a spline interpolation

Conclusion

All climate scenarios for the prospective climate development assume an increasing global surface temperature. As a consequence, the precipitation in Africa will increase equatorially with increased aridification in southern and northern Africa expected. Correspondingly, the climate-group habitats respond with concentric expansion and contraction. The species assigned to the forest- and lowland-rainforest-groups experience massive expansion of habitat range, particularly at the Equator where it disperses from the west to the east. In strong contrast, the woodland-, grassland- and desert-groups suffer a dramatic habitat loss. Moreover, three-quaters of all living African bovid species are confronted with a considerable habitat loss until the year 2080. That is particularly concerning, since most species assorted to these groups are at least endangered or classified even higher in the IUCN ranking (*IUCN Red List of Threatened Species. Version 2011.2*) Yet, in the here used “worst case” scenario relatively stable regions in terms of habitat suitability remain, which may serve as retreat areas. For species in the desert-group such areas are the Horn of Africa and coastal regions in north-western and south-western Africa. Refugia for the grassland- and woodland-species will persist in southern Africa and locally in elevated areas in East Africa and to a minor extant along the south-western coast. These potential bovid refugia are already recognized as today’s African biodiversity hotspots (Cape Floristic Region (Cowling & Pressey, 2003; Picker & Samways, 1996), Eastern Afromontane (Brooks et al. 2001), Horn of Africa (Friis & Balslev, 2005), Maputaland-Pondoland-Albany (Matthews et al., 1999), Succulent Karoo (Lombard et al., 1999) what may be a result of relative climate stability in the past and underlines the importance of conservation actions in these particular regions.

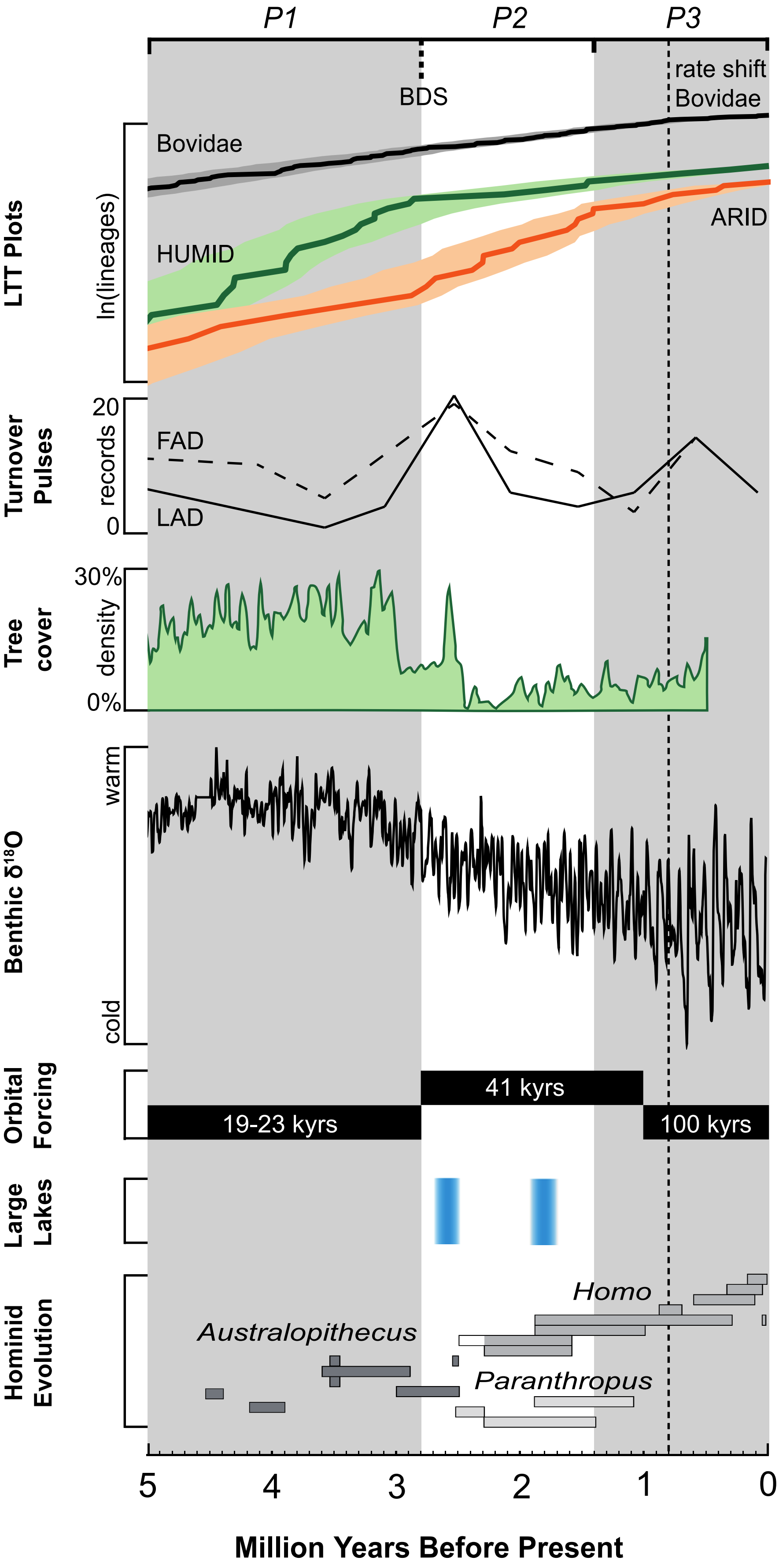
Yet, even if those refugia may harbor populations of endangered species, a severe loss of intraspecific genetic diversity must be expected due to the loss of locally adapted subspecies or genetic variants (Bálint et al., 2011). Forest species seem to be on the winning side of a global warming. Yet, these analyses use climate variables as proxies of potential habitat distribution. It has to be pointed out, that the actual present vegetation defines the true and realizable habitat of bovid species. The expansion of forests itself is restricted by the growing rates and seed dispersal of the respective plant species, and therefore, will be much slower than the climate conditions may permit and as it is indicated in the present study. This is further complicated as logging and agriculture act as an opponent of forest expansion. The chance of a broad dispersal both of bovid forest species and forests across Africa is relatively low. Nevertheless, the affected forest-dwelling bovid species are not threatened by climatically induced habitat loss in the near future. The fact that vegetation growth and seed dispersal are not considered in such a species distribution modelling approach underlines its limitations. Hence, interpretations are strictly hypothetical. If forests will not be able to colonize the newly available areas the question arises, which vegetation types will capture this niche? Presumably, thickets, bush- and shrubland vegetation types, which are able to persist under their respective climatic conditions. That is in strong contrast to the predicted habitat loss of the woodland group but may lead to a compensation of the estimated habitat loss of the woodland climate-group. However the affected species, both plant and bovid species will have to cope with higher temperatures.

CLOSING DISCUSSION

Temporal and Spatial Evolutionary Patterns

The present study differs from other studies investigating the impact of past and future climate change onto species persistence. Herein, I compare members of one family in regard to their climate preferences yet with strong contrasting climate requirements. Methodically comparable studies usually focus on single species or taxa inhabiting a rather confined environment. My results were generated on the basis of 85 bovid species and show the dynamics of habitat distribution from the past until the near future. The timeframe contains three changes in the prevailing climate conditions from a humid period to a long-term cooling and aridification trend starting at about 2.8 Ma and a rapid global surface warming between the present and the year 2080. It is clearly shown how habitat distribution swings back and forth, challenging species persistence in one moment and easing them in the next. The resulting paleoenvironmental reconstructions are in general agreement with the classical paleontological reconstructions, despite some minor differences. Hence, the suitability of habitat projections is approved. Yet, the approach is very restricted due to the model set up (e.g., resolution of available climate data). But with increasing climate model resolution and more relevant factors included in the paleoclimate reconstruction, the accuracy will improve correspondingly. However, for areas or temporal sequences within fossil localities lacking sufficient paleoecological proxies like fossils or pollen it may serve as a helpful tool.

The temporal patterns of the molecular diversification processes within the Bovidae show first of all a remarkably pronounced switch between lineage accumulation of humid and arid species at 2.85 Ma, whereas arid species benefit afterwards. That is in strong temporal concordance with: i) a drop of forest density in Africa at 2.7 Ma (Bonnefille, 2010), ii) the strongest fossil turnover pulse of bovids between 2.8 and 2.5 Ma (Vrba, 1985a; Vrba, 1995), iii) the switch of the periodicity of large lakes occurrences from 400 kyrs to 800 kyrs at 2.7 Ma (Trauth et al., 2007), iv) the onset of a global cooling and aridification trend as indicated by the benthic oxygen isotope curve and coupled with the onset of northern hemisphere at 2.7 Ma (Haug & Tiedemann, 1998; deMenocal, 2004); and v) the probably superimposed change of orbital forcing as indicated by the change of the Milankovitch cycles to 41 kyrs periodicity at 2.7 Ma. All the mentioned data point to a prevailing humid climate before 2.7 Ma and more arid conditions afterwards. It is evident that the aridification process was rather a trend than a continuous process, intersected by multiple extreme variable climate condition (Donges et al., 2011; Maslin & Trauth, 2009; Trauth et al., 2007; Trauth et al., 2010). Temporal analyses of the bovid divergences do not show any correlation with those periods, either for humid or for arid species or for Bovidae per se. Hence, periods of increased environmental variability do not seem to be causal for speciation processes, at least not for Bovidae. Climate variability was claimed to be a major driver in the hominid evolution based on the "*Variability Selection Hypothesis*" (Potts, 1998b). Trauth et al. (2007; 2010) related alternating extreme "wet-dry" periods to the first appearance of *Australopithecus*, *Paranthropus* and *Homo* species. A second change in the diversification process of Bovidae is rather a period than a distinct moment, starting at 1.4 Ma (ARID and HUMID show reduced rate) and eventually end at 0.8 Ma, when the latest rate decrease is observed on family level. It is tempting to relate the last rate shift to the *Mid-Pleistocene Revolution* (Berger & Jansen, 1994) between 1.1 and 0.9 Ma and change from dominating 41 kyrs Milankovitch cycles to 100 kyrs at about 1 Ma. Yet, as mentioned earlier, the more recent a rate shift is found, the more attention has to be given due to methodological biases. Nevertheless, the period after 0.8 Ma experienced several faunal turnovers in Eurasia (Azzaroli et al., 1988) and to a lesser extent in Africa (O'Regan et al., 2005) and detected by a turnover pulse as well (Vrba 1985a; Vrba 1995). Comparing the LTT plots generated from analyses of living bovids to the diversification rates indicated by the fossil record is not straightforward. However, the temporal similarities are striking although it is not clear in which way these indeed very different data sets (fossils versus *cytb* phylogeny) correlate. Nevertheless, I test if and how established speciation theories, originally inferred from fossil record, explain the molecular evidence in the following.


P1
P2
P3
BDS
rate shift
Bovidae
LTT Plots
ln(lineages)
Bovidae
HUMID
ARID
Turnover Pulses
records
20
0
FAD
LAD
Tree cover
density
30%
0%
Benthic δ18O
warm
cold
Orbital Forcing
19-23 kyrs
41 kyrs
100 kyrs
Large Lakes
Hominid Evolution
Homo
Australopithecus
Paranthropus
5
4
3
2
1
0
Million Years Before Present

*Evaluation of Evolutionary Hypothesis and the "*Directed Periodic Model*"*

The mammalian family Bovidae due to the diverse habitat specificities of its comprised species is a prime model group to analyse evolutionary patterns. As the dated phylogeny, based on the *cytb* gene, indicates the evolutionary history seems to have acted on the species and their ancestors differently. That is obvious if one compares the varying branch length of extant species. The Impala, *Aepyceros melampus,* or the African Buffalo, *Syncerus caffer,* for example, have very long branches since their last divergence event. Both are widely distributed and are very abundant across the Sub-Saharan Africa and are commonly regarded as biome generalists. In contrast, in other clades frequent divergences occur within short times, leading to relatively scattered and restricted geographical distributions often, but not always, associated with biome specialisation. Already these preliminary findings strongly imply that no ultimate evolutionary model can explain these heterogeneous strategies. The question of how speciation works is discussed controversially (e.g., Potts, 1998a; Grubb, 1999; Van Valen, 1977; Vrba, 1992). Various hypotheses were conceived, tested, confirmed and rejected, depending to which organism, taxonomical level, time frame or parameter in question was applied. Two basic concepts, *Phyletic Gradualism* and *Punctuated Equilibrium* (Fig. 2), serve as framework for more detailed hypothesis. Reduced to its bare assumptions, the former concept describes speciation as a gradual process, driven by competition and sexual selection without need of an external factor. The concept of *Punctuated Equilibrium* describes speciation as a temporal restricted event, induced basically by extrinsic events (e.g., habitat fragmentation, tectonics), framed by long periods of relative stasis.

Fig. 36 (previous page) **Comparative LTT Plots in the Paleoclimatological and Ecological Context.** From top to bottom: a) LTT Plots of the family Bovidae and the clades ARID and HUMID; b) Turnover Pulses showing the first appearance (FAD) and last appearance datum (FAD) of bovid species in the fossil record (adapted from Vrba 1985a); c) Tree Cover Density in West Africa based on pollen record adapted from Bonnefille (2010); d) Oxygen Isotope Curve ($\delta^{18}O$) inferred from benthic foraminifers from multiple drilling localities (adapted from Lisiecki & Raymo 2007); e) Orbital Forcing simplified by indicated dominating Milankovitch cycles; f) Large Lakes as indicator for intensified climate variability and extreme humid periods (adapted from Donges et al. (2011), g) Hominid Evolution of three putative lineages (adapted from Trauth et al. (2007) and references herein); *P1 – P3* refer to the recognized phases of diversification rate patterns in the comparative LTT plot of HUMID and ARID.

Gradualistic speciation processes cannot be investigated with the presented approach. Hence, I will not discuss related theories in detail, although I want to mention that I do not exclude the validity of that concept.

In the following I test prominent speciation hypothesis, which follow in principle the *Punctuated Equilibrium* concept, assuming physical change of the environment as driving factor in relation to my results. My basic and condensed results of the analyses of temporal and spatial evolutionary patterns are as follows:

> (i) With the onset of an overall long-term aridification process and coherent expansion of arid habitats, more arid species emerged. In contrast, (ii) humid habitats contracted and fewer humid species evolved. (iii) Within the newly evolved humid species a higher proportion was adapted to a more arid habitat compared to their ancestral lineages. (iv) Most of the newly-formed arid species stay in an arid habitat type.

Vrba postulated several hypotheses relating speciation to changes in the environment and tested them with the fossil record of African bovids (Vrba, 1992; Vrba, 1995). The *turnover-pulse* hypothesis is the one with the most direct link between environmental change and speciation, extinction and migration events. The hypothesis states that the mentioned effects occur very restricted temporally and across a wide number of not closely related lineages contemporaneous with major physical change in the environment. Indeed, Vrba, (1985) found turnover-pulses in the fossil record of various taxonomically different clades, particularly within African bovid species. Thereafter a strong pulse is found between 2.8 and 2.5 Ma, and smaller pulses between 1.9–1.8 Ma and 0.9–0.6 Ma. If this is reflected in the molecular evolutionary history of the extant species, such turnover pulses lead to peculiar deviations from an otherwise rather flat curve. In general, the LTT plots do not support a pulsed speciation or extinction, but a gradual increase of lineage numbers. Yet, it is remarkable that the pulses found in the fossil record match very well with rate shifts indicated by the LTT plot. That is, the pulse in the time frame 2.8–2.5 Ma matches the *BDS* (transition from *P1* to *P2*) and the pulse between 0.9 and 0.6 Ma meets the latest rate shift in the full family LTT plot at 0.8 Ma (Fig. 36).

A further model proposed by Vrba, the relay model, predicts for species with differing climate requirements, highest speciation rates to be out of phase to each other (Vrba, 1995; Vrba, 1999). She applied that hypothesis onto two species that reach their respective climatic optimum at different but consecutive times in a climate cycle, resulting in a fixed sequence of speciation and extinction. During overall cooling conditions, warm-adapted species become extinct due to habitat fragmentation (long-term vicariance) and survivors speciate afterwards but with adaptation to cooler conditions as their ancestors. Under proceeding cooling below the optimum of the rather cool adapted species, they respond with extinction and afterwards with speciation and adaptation to cooler conditions (for more detailed explanation see the original publications (Vrba, 1995; Vrba, 1999). As Vrba (1999) stated the Late Neogene cooling trend would have led to unequal relay succession, favoring diversification within cooler adapted lineages and adaptations to cooler environments within warmer species. Indeed, that is exactly what is found in the comparative LTT plot (Fig. 8, Fig. 36), yet not as a result of pulsed diversification but of a punctuated shift in the net diversification rate at 5 and 2.8 Ma. My results, as well, suggest more speciation within arid habitats with constant habitat preference. In contrast, changes in the habitat preference towards more arid/open habitats within the few new humid species are evident. In this regard my data supports the *Relay Model*. Yet, Vrba's theories are strongly influenced by the idea of speciation due to long-term vicariance induced by habitat fragmentation. That is extensively reasoned (Vrba, 1985a; Vrba, 1985b; Vrba, 1987; Vrba, 1992; Vrba, 1999; Vrba et al., 1995), yet one point - active dispersal - did not find much attention in her hypothesis and related ideas (Eldredge & Cracraft, 1980; Cracraft, 1986; Cracraft, 1988). The late Peter Grubb highlighted the role of ***dispersal*** and its effect on speciation and described this in the "***Periodic Model***", which aims to combine the established idea of habitat fragmentation during habitat contraction and the chances of dispersal into new areas during habitat expansion (Grubb, 1989; Grubb, 1999). The model he proposed for the distribution pattern of

Afro-tropical primates '… suggests that environmental pulsation interrupted spatio-temporal anagenesis (phyletic gradualism) of populations thereby initiating cladogenesis' (Grubb, 1989, p. 206). With this summary, he already combines the two basic concepts of *Phyletic Gradualism* and *Punctuated Equilibrium*. Grubb names the possibility of achieving vicariance due to long-distance dispersal of a founder population (Grubb, 1999), which than would become a peripheral isolate (Bush, 1975). It is surprising that the effect of founder events finds only little attention in macro evolutionary theories, particularly as this an evident factor in human evolution (Relethford, 2007). Distribution drift of species (Vrba, 1992) within the available habitat may be the predominant form of population dispersal (Myers & Gillers, 1988) for nonvolant mammals (Grubb, 1999). With the tendency of populations and individuals to roam within their available habitat they may enter previously unoccupied habitat islands (Grubb, 1989) in the surrounding of the "stem area" crossing temporally passable corridors. The invading population may increase rapidly released from regulatory factors (e.g. competition) and become established in the area, leading to heightened geographic variations (Grubb, 1999). Of course, within the periodic cycle the climate conditions of the biome in question deteriorate what, again, leads to habitat fragmentation and local extinctions of sub populations. At that point I want to add a further aspect of the climate variability, in particular for the special case of the overall cooling trend during the last 3 million years, not explicitly mentioned by Grubb (1989, 1999). As he stated: '…as climatic cycles were repeated, opportunities to reach more and more distant unoccupied territories continued to be created, … so that successive dispersals, colonisations, and breakup of populations could create chains and branchings of morphoclinally related taxa' (Grubb, 1999, p. 163). Certainly, that is only the case if climate cycles have an overall trend towards one direction, colder or warmer, drier or wetter. Such a trend would lead to a shift of the respective maxima and minima in the cycles. Under constant climate cycles (i.e. alternating around the same mean) the gained area of available habitat during the way up the curve would just be lost when going all the way down to the same minima as before. As a result the distribution of a population (and putative new species) would not vary after a full climate cycle. Hence, an overall directed trend is essential to archive the effect described above with the *Periodic Model*. Moreover, the manner of how a habitat drifts, and respectively expands is crucial for the proportion of vicariance due to habitat fragmentation or dispersal and founder events. Vrba (1992) compared the "*species' habitat drift*" with the drifting continental plates (Fig. 1). The habitat projections for the five climate groups (*Chapter 3* and *Chapter 4*), however, do not show that behavior. According to the projections, a rather concentric expansion and contraction, respectively, around a relative stable core is given. If this holds true the proportion of "***leading edge***" and "***rear edge***" effects varies remarkable between the two habitat "movements" (Fig. 37a,b). On the first view both sides, i.e., the *leading* and the *rear edge*, show the same effect: isolation of subpopulations. At the rear edge the habitat becomes concentrated and lineages within a population admix.

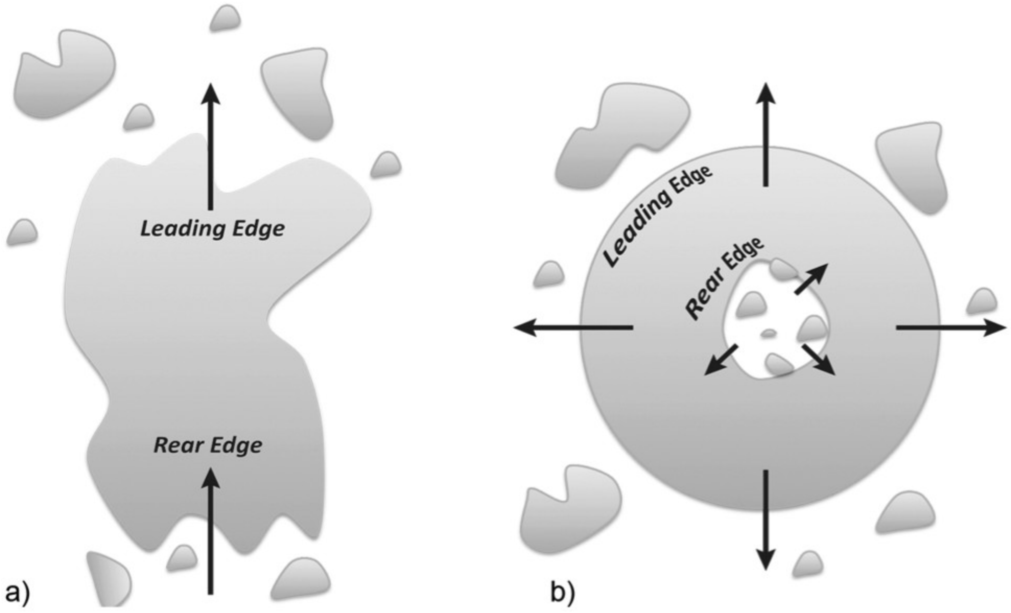


Fig. 37 **The "*Habitat Drift*" and "*Habitat Pulse*" Models as Response to Climate Changes.** The "*Habitat Drift*" model (**a**) has an equal proportion of the leading and rear edge, due to a directed movement of the entire habitat. In contrast, in the "*Habitat Pulse*" model (**b**) the *leading edge* is dominating under habitat expansion in all directions. It may be possible that changing conditions lead to habitat fragmentation within the inhabited area and gives way for *rear edge* effects, yet they remain minor compared to the *leading edge*. Note that at a later state of a climatic cycle the movements reverse leading to dominating *rear edge* effects in b) while in a) no change in the rear to leading edge proportion is expected.

Then vicariance due to habitat fragmentation occurs. At the leading edge population growth is expected due to dispersal into the expanding biome. Occasionally, founder populations may migrate to newly available habitat islands and become separated from the ancestral population. Eventually, at both sides of the isolated populations experience a loss in genetic diversity due to bottleneck effects and with their ability to cope with changing environments, but with different consequences. The isolated subpopulations at the rear edge suffer an increasing selection pressure due to proceeding climate deterioration and the extinction risk is rising, accordantly. In the end, the respective species will respond as outlined by Vrba (1992) either with extinction, persistence in the same habitat, or became adapted to the conditions surrounding the stem habitat island.

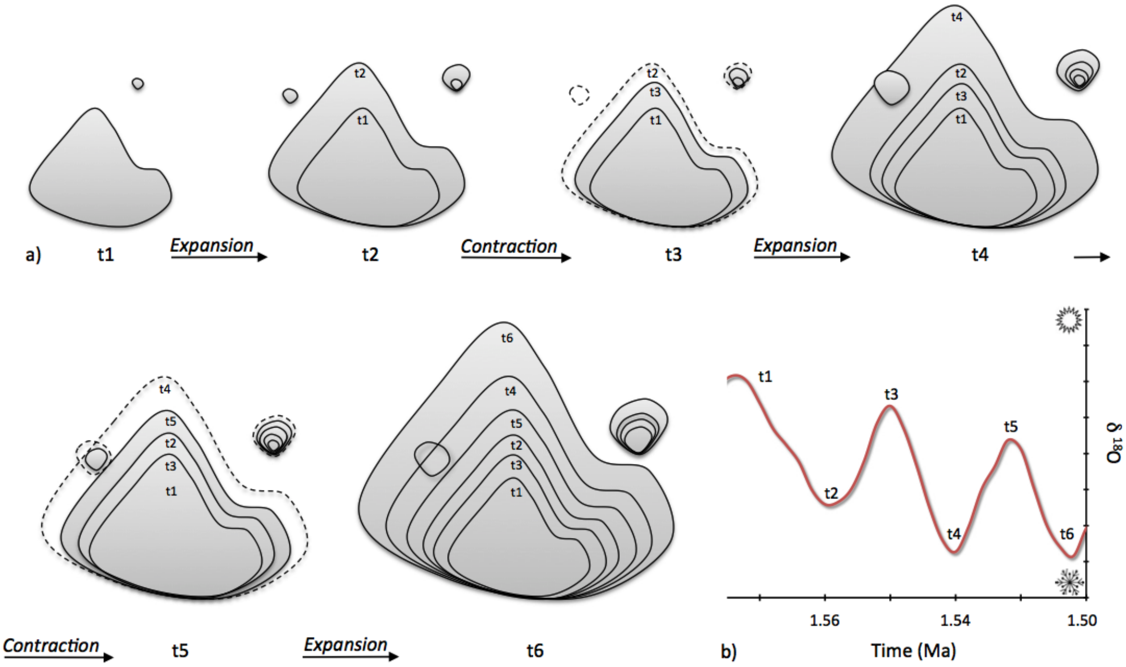


Fig. 38 **Principle of the "*Directed Periodic Model*".** Shown is the respective available habitat (**a**) at six different stages (t1-t6) of the climatic cycle superimposed by an overall aridification trend indicated by the benthic oxygen isotope curve (**b**) adapted from (Lisiecki & Raymo 2007). t1: the available habitat before the climate condition start to ameliorate; t2: the habitat expands to its maximum before the climate cycle leads to deteriorating conditions; t3: the habitat is contracted, yet it keeps a larger extent than during the previous minimum t1; t4: expansion of the habitat, yet exceeding t2; t5: a second habitat contraction, yet the remaining habitat extant is still larger than after the contraction in t3; t6: a last habitat expansion pulse. Note the emergence and expansion-contraction pulses of the habitat island in the vicinity of the major habitat, which may give opportunity for dispersing individuals to found subpopulations. The chance of persistence in isolation over multiple climate cycles is in strong dependency of the initial distance, what is in turn a basic necessity to evolve to a distinct species.

The isolated populations at the leading edge can grow and become established in the newly reached area of similar habitat, relaxed from selective pressure since the climate conditions are most suitable for the regarded species. With a superimposed climate trend the chances of persistence of peripheric isolated subpopulations during a full climatic cycle is very high (Fig. 38). In contrast, even if the rear edge population survive without adapting to the new conditions the risk of extinction in the next turn is even higher. Overall, under the edited *Periodic Model* (i.e., directed climate trend and concentric habitat pulsing) arid species would produce more species due to dispersal as due to habitat fragmentation under a superimposed aridification trend. Additionally, the newly emerging species within the arid lineages are expected to inhabit similar habitats as their ancestors. For humid species, relatively low speciation is expected due to the high extinction risk caused by the overall dominance of the rear edge. If speciation occurs, adaptations to new habitats are expected.

Indeed this **"*Directed Periodic Model*"** (Fig. 38) can explain the basic results of the temporal and spatial analysis (higher diversification under habitat expansion with new species in the same habitat; low diversification under habitat contraction with new species adapted to differing habitats). As mentioned earlier, other models in particular the *Relay Model* do lead to the same result or at least indicate similarities in timing (*Turnover-Pulse Hypothesis*). These results show that a combination of those models mentioned lead to a higher degree of probability than single ones.

Conclusions and Future Research

This study is a first attempt to combine data and methods from the fields of genetics, paleontology, paleoclimate simulation and species distribution modeling to gain insights into long-term climate-species-interaction within the diverse mammalian family Bovidae. Moreover, it provides an empirical basis for testing current hypotheses on macroevolutionary evolution of species.

The radiation of Bovidae in Africa was triggered by prevailing climatic conditions as revealed by analyses of arid and humid species. While the overall species diversity on the family level is constantly increasing, humid and arid species reacted differently to particular climate conditions. During climatically favorable conditions lineages diversify, while lineages experiencing unfavorable climate changes react with a lowered diversification rate. This effect is positively correlated with modeled habitat expansion and contraction, respectively. The timing of diversification rate shifts coincides remarkable with the timing of major climatic changes and faunal turnover events inferred from the fossil record. However, the relations of molecular and fossil data are still unclear. None of the tested evolutionary speciation hypothesis fully explains the empirical results. Thus, a combination of different models seems to be more appropriate to explain the molecular results of bovid evolution. The *Periodic Model* (Grubb 1999) adds active dispersal of individuals to the main idea of climate-induced (passive) population fragmentation. I have extended the model by superimposing a directed climatic trend on climate cycles. That results in a change in the proportion of *leading edge* and *rear edge* effects and explains the temporal and spatial evolutionary patterns. With the *Directed Periodic Model* I demonstrate that active dispersal, a factor often dismissed, needs strong consideration in macroevolutionary speciation theories.

In a multidisciplinary approach, such as presented in this study, the scope for future research is manifold and this will lead to an optimisation of the methods and results presented.

i) Although the underlying species sampling is the densest to date, the missing species (in particular *Ammodorcas clarkei*, *Madoqua piacentini*, *Neotragus batesi*) need to be included to finally resolve taxonomical questions. Moreover, the drive to obtain more and longer sequences in genetics is high. ii) Likewise is the necessity of more and better preserved fossil samples. For this study only fossils with highest reliability of accurate temporal and taxonomical assignment were chosen as calibration points. Future fossil calibration points may alter the molecular dating and evolutionary patterns. In particular for some clades (e.g. Antilopini, Cephalophini) accurate calibration points are required, since no fossil available to date fulfills all the requirements for reliable calibration. iii) The resolution of the climate layer for paleoecological climate reconstructions is very coarse, but the availability of models with higher resolution is most probably a matter of time and computational improvement. However, all climate models are simulations and must be regarded as approximations to the reality of a dynamic and chaotic system. iv) Population studies of Bovid species are numerous in conservation biology, and their number continues to grow. This will offer the opportunity to extend the LTT plot analyses to the subspecies level to gain a better insight into the evolution of Bovidae, particularly during the last 0.8 million years.

BIBLIOGRAPHY

AGNARSSON, I. **&** **MAY-COLLADO**, L.J., 2008. The phylogeny of Cetartiodactyla: the importance of dense taxon sampling, missing data, and the remarkable promise of cytochrome b to provide reliable species-level phylogenies. *Molecular Phylogenetics and Evolution*, 48(3), pp.964–985.

AKAIKE, H., 1974. A new look at the statistical model identification. *IEEE Transactions on Automatic Control*, 19(6), pp. 716– 723.

ALLARD, M.W. et al., 1992. DNA Systematics and Evolution of the Artiodactyl Family Bovidae. *Proceedings of the National Academy of Sciences*, 89(9), pp.3972–3976.

ANDREWS, P. et al., 2011. The Ecology and Biogeography of the Endulen-Laetoli Area in Northern Tanzania. In T. Harrison, ed. *Paleontology and Geology of Laetoli: Human Evolution in Context*. Springer Netherlands, pp. 167–200.

ANDREWS, P.J., 1989. Palaeoecology of Laetoli. *Journal of Human Evolution*, 18(2), pp.173–181.

AZZAROLI, A. et al., 1988. Late Pliocene to Early Mid-Pleistocene Mammals in Eurasia - Faunal Succession and Dispersal Events. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 66, pp.77–100.

BADGLEY, C. et al., 2008. Ecological changes in Miocene mammalian record show impact of prolonged climatic forcing. *Proceedings of the National Academy of Sciences*, 105(34), pp.12145–12149.

BÁLINT, M. et al., 2011. Cryptic biodiversity loss linked to global climate change. *Nature Climate Change*, 1(6), pp.313–318.

BARRY, J.C. et al., 2002. Faunal and environmental change in the late Miocene Siwaliks of northern Pakistan. *Paleobiology*, 28(3), pp.1–71.

BERGER, W. **&** **JANSEN**, E., 1994. *Mid-Pleistocene climate shift - The Nansen connection*, Geophysical Monograph Series.

BIBI, F., 2009. *Evolution, Systematics, and Paleoecology of Bovinae (Mammalia: Artiodactyla) from the Late Miocene to the Recent.*, New Haven: Yale University.

BIBI, F., 2011. Mio-Pliocene Faunal Exchanges and African Biogeography: The Record of Fossil Bovids. *PLoS ONE*, 6(2), p.e16688.

BIBI, F. et al., 2009. The Fossil Record and Evolution of Bovidae: State of the Field. *Palaeontologia Electronica*, 12(3).

BIBI, F. **&** VRBA, E.S., 2010. Unraveling bovin phylogeny: accomplishments and challenges. *BMC Biology*, 8(1), p.50.

BILLUPS, K. et al., 1999. Link between oceanic heat transport, thermohaline circulation, and the Intertropical Convergence Zone in the early Pliocene Atlantic. *Geology*, 27(4), pp.319–322.

BIRUNGI, J. **&** **ROY**, M., 1998. DMSO-preserved samples as a source of mRNA for RT-PCR. *Molecular Ecology*.

BIRUNGI, J. **& ARCTANDER**, P., 2001. Molecular systematics and phylogeny of the Reduncini (Artiodactyla: Bovidae) inferred from the analysis of mitochondrial cytochrome b gene sequences. *Journal of Mammalian Evolution*, 8(2), pp.125–147.

BISHOP, L.C. et al., 2011. Paleoenvironments of Laetoli, Tanzania as Determined by Antelope Habitat Preferences. In T. Harrison, ed. *Paleontology and Geology of Laetoli: Human Evolution in Context*. Springer Netherlands, pp. 355–366.

BOBE, R. et al., 2007. Patterns of abundance and diversity in late Cenozoic bovids from the Turkana and Hadar Basins, Kenya and Ethiopia. In R. Bobe, Z. Alemseged, & A. K. Behrensmeyer, eds. *Hominin environments in the East African Pliocene: an assessment of the faunal evidence*. Springer Netherlands, pp. 129–157.

BONNEFILLE, R., 1984. *Cenozoic vegetation and environments of early hominids in East Africa* Palaeobotany, Palaeozoology, and Palaeonathropology. R. Whyte, ed. Hong Kong: The Evolution of the East Asian Environment.

BONNEFILLE, R., 2010. Cenozoic vegetation, climate changes and hominid evolution in tropical Africa. *Global and Planetary Change*, 72(4), pp.390–411.

BROMAGE, T. et al., 1995. Paleoanthropology of the Malawi Rift: an early hominid mandible from the Chiwondo Beds, northern Malawi. *Journal of Human Evolution*, 28(1), pp.71–108.

BROMHAM, L., 2003. Molecular Clocks and Explosive Radiations. *Journal of Molecular Evolution*, 57(0), pp.S13–S20.

BRUNET, M. et al., 1988. Tchad: découverte d'une faune de mammifères du Pliocène inférieur*Comptes Rendus de l'Académie des Sciences - Series IIA - Earth and Planetary Science*, 326(2), pp.153–158.

BRUNET, M. et al., 1997. Tchad: Un nouveau site à Hominidés Pliocène. *Comptes rendus de l'Académie des sciences. Série 2. Sciences de la terre et des planètes*, 324(4), pp.341–345.

BUBENIK, A., 1990. *Epigenetical, morphological, physiological, and behavioral aspects of evolution of horns, pronghorns, and antlers* G. A. Bubenik & A. B. Bubenik, eds. New York: Horns, Pronghorns and Antlers Springer Verlag, New York.

BUHAY, J.E., 2009. “Coi-Like” Sequences Are Becoming Problematic in Molecular Systematic and Dna Barcoding Studies. *Journal of Crustacean Biology*, 29(1), pp.96–110.

BUNCH, T.D. et al., 2006. Phylogenetic analysis of snow sheep (Ovis nivicola) and closely related taxa. *Journal of Heredity*, 97(1), pp.21–30.

BUSH, G.L., 1975. Modes of animal speciation. *Annual Review of Ecology and Systematics*, 6, pp.339–364.

CAO, L.-R., 2003. A molecular phylogeny of Bharal and dwarf blue sheep based on mitochondrial cytochrome b gene sequences. *Acta Zoologica Sinica*, 49(2), pp.198–204.

CERLING, T., 1992. Development of grasslands and savannas in East Africa during the Neogene. *Global and Planetary Change*, 5(3), pp.241–247.

CERLING, T. et al. 1993. Expansion of C4 ecosystems as an indicator of global ecological change in the late Miocene. *Nature*, 361(6410), pp.344–345.

CERLING, T. et al., 2011. Woody cover and hominin environments in the past 6 million years. *Nature*, 476(7358), pp.51–56.

CHIKUNI, K. et al., 1995. Molecular phylogeny based on the κ-casein and cytochrome b sequences in the mammalian suborder Ruminantia. *Journal of Molecular Evolution*, 41(6), pp.859–866.

CHOROWICZ, J., 2005. The East African rift system. *Journal of African Earth Sciences*, 43(1-3), pp.379–410.

COLYN, M. et al., 2010. Discovery of a new duiker species (Bovidae: Cephalophinae) from the Dahomey Gap, West Africa. *Zootaxa*, pp.1–30.

CRISP, M.D. **& COOK**, L.G., 2009. Explosive radiation or cryptic mass extinction? Interpreting signatures in molecular phylogenies. *Evolution*, 63(9), pp.2257–2265.

DEGUSTA, D. **& VRBA**, E.S., 2005. Methods for inferring paleohabitats from discrete traits of the bovid postcranial skeleton. *Journal of Archaeological Science*, 32(7), pp.1099–1113.

DEINO, A.L., 2011. 40 Ar/39 Ar Dating of Laetoli, Tanzania. In T. Harrison, ed. *Paleontology and Geology of Laetoli: Human Evolution in Context*. Springer Netherlands, pp. 77–97.

DELSON, E., 1984. *Cercopithecid biochronology of the African Plio-Pleistocene: correlation among eastern and southern hominid-bearing localities*, Courier Forschungsinstitut Senckenberg.

DEMENOCAL, P., 2004. African climate change and faunal evolution during the Pliocene–Pleistocene. *Earth and Planetary Science Letters*, 220(1-2), pp.3–24.

DOBZHANSKY, T., 1937. *Genetics and the Origin of Species*, Columbia University Press.

DOMÍNGUEZ-RODRIGO, M. **& EGIDO**, R., 2007. *Deconstructing Olduvai: a taphonomic study of the Bed 1 sites*, Springer Verlag.

DOMÍNGUEZ-RODRIGO, M. et al., 2007. Geological and paleoecological overview of Olduvai Gorge. In *Deconstructing Olduvai: A Taphonomic Study of the Bed I Sites*. Springer Netherlands, pp. 33–38.

DONGES, J.F. et al., 2011. Nonlinear detection of paleoclimate-variability transitions possibly related to human evolution. *Proceedings of the National Academy of Sciences*, 108(51), pp.20422–20427.

DRUMMOND, A. **& RAMBAUT**, A., 2007. BEAST: Bayesian evolutionary analysis by sampling trees. *BMC Evolutionary Biology*, 7(1), p.214.

DRUMMOND, A. et al., 2011. *Geneious Pro v 5.0*, http://www.geneious.com.

EAST, R., 1988. *Antelopes Part 1: East and Northeast Africa*, Gland: SSC Antelope Specialist Group, IUCN.

EAST, R., 1989. *Antelopes Part 2: South and South-Central Africa*, Gland: SSC Antelope Specialist Group, IUCN.

EAST, R., 1990. *Antelopes Part 3: West and Central Africa*, Gland: SSC Antelope Specialist Group, IUCN.

EDWARDS, C.J. et al., 2010. A complete mitochondrial genome sequence from a mesolithic wild aurochs (*Bos primigenius*). *PLoS ONE*, 5(2), p.e9255.

ELDREDGE, N. **& CRACRAFT**, J., 1980. *Phylogenetic patterns and the evolutionary process*, New York: Columbia University Press.

ELITH, J. et al., 2006. Novel methods improve prediction of species' distributions from occurrence data. *Ecography*, 29(2), pp.129–151.

ESTES, R., 1992. *The behavior guide to African mammals*, Berkley: University of California Press.

FERRELL, S. et al., 2001. Comparisons among selected neonatal biomedical parameters of four species of semi-free ranging hippotragini: Addax (Addax nasomaculatus), scimitar-horned oryx (Oryx dammah), Arabian oryx (Oryx leucoryx), and sable antelope (Hippotragus niger). *Zoo Biology*, 20(1), pp.47–54.

FLAGSTAD, O. et al., 2001. Environmental change and rates of evolution: the phylogeographic pattern within the hartebeest complex as related to climatic variation. *Proceedings of the Royal Society B: Biological Sciences*, 268(1468), pp.667–677.

GATESY, J., 1992. Phylogeny of the Bovidae (Artiodactyla, Mammalia), based on mitochondrial ribosomal DNA sequences. *Molecular Biology and Evolution*, 9(3), pp.433–446.

GATESY, J. et al., 1997. A Cladistic Analysis of Mitochondrial Ribosomal DNA from the Bovidae. *Molecular Phylogenetics and Evolution*, 7(3), pp.303–319.

GEBREMEDHIN, B. et al., 2009. Combining genetic and ecological data to assess the conservation status of the endangered Ethiopian walia ibex. *Animal Conservation*, 12(2), pp.89–100.

GENTRY, A., 1985. The Bovidae of the Omo group deposits, Ethiopia (French and American, collections). In *Les faunes plio-pléistocènes de la Basse vallée de l'Omo (Ethiopie)*. Paris: CNRS, pp. 119–191.

GENTRY, A., 1990. The Semliki Fossil Bovids. In *Evolution of Environments and Hominidae in the African Western Rift Valley*. Martinsville: Virginia Museum of Natural History, pp. 225–234.

GENTRY, A., 1992. The subfamilies and tribes of the family Bovidae. *Mammal Review*, 22(1), pp.1–32.

GENTRY, A., 2006. A new bovine (Bovidae, Artiodactyla) from the Hadar Formation, Ethiopia. *Transactions of the Royal Society of South Africa*, 61(2), pp.41–50.

GENTRY, A., 2010. Bovidae. In L. Werdelin & W. J. Sanders, eds. *Cenozoic mammals of Africa*. University of California Press.

GENTRY, A., 2011. Bovidae. In T. Harrison, ed. *Paleontology and Geology of Laetoli: Human Evolution in Context*. Springer Netherlands, pp. 363–465.

GERAADS, D. et al., 2001. Pliocene Bovidae (Mammalia) from the Koro Toro Australopithecine sites, Chad. *Journal of Vertebrate Paleontology*, 21(2), pp.335–346.

GERAADS, D. et al., 2008. New Hippotragini (Bovidae, Mammalia) from the late Miocene of Toros-Menalla (Chad). *Journal of Vertebrate Paleontology*, 28(1), pp.231–242.

GERAADS, D. **& THOMAS**, H., 1994. Bovidés du plio-pléistocène d'Ouganda. In B. Senut & T. Pickford, eds. Geology and palaeobiology of the Albertine Rift Valley, Uganda-Zaïre, p. 383.

GERAADS, D., 2009. Middle Pliocene Bovidae from Hominid-bearing sites in the Woranso-Mille area, Afar region, Ethiopia. *Palaeontologia Africana*, 44, pp.59–70.

GINSBURG, L. **& HEINTZ**, E., 1968. *La plus ancienne antilope d"Europe, Eotragus artenensis du Burdigalien d"Artenay*, Bulletin du Museum national d'Histoire naturelle.

GINSBURG, L. **& MORALES**, J., 2001. Les ruminantia (Artiodactyla, Mammalia) du miocene des bugti (Balouchistan, Pakistan). *Estudios Geologicos*, 57, pp.155–170.

GRAY, J., 1821. *On the natural arrangement of vertebrose animals*, London Medical Repository.

GREENACRE, M. **& VRBA**, E.S., 1984. Graphical display and interpretation of antelope census data in African wildlife areas, using correspondence analysis. *Ecology(Durham)*, 65(3), pp.984–997.

GROVES, C., 2001. Why taxonomic stability is a bad idea, or why are there so few species of primates (or are there?). *Evolutionary Anthropology Issues News and Reviews*, 10(6), pp.192–198.

GROVES, C. **& GRUBB**, P., 2011. *Ungulate Taxonomy*, Johns Hopkins University Press.

GROVES, P. **& SHIELDS**, G., 1996. Phylogenetics of the Caprinae Based on Cytochrome b Sequence. *Molecular Phylogenetics and Evolution*, 5(3), pp.467–476.

GRUBB, P., 1989. Primate geography in the Afro-tropical forest biome. In G. Peters & R. Hutterer, eds. *Vertebrates in the Tropics*. Bonn: Alexander Koenig Zoological Research Institute and Zoological Museum.

GRUBB, P., 1999. Evolutionary processes implicit in distribution patterns of modern African mammals. In *African Biogeography Climate Change, & Human Evolution*. New York: Oxford University Press.

HAILE-SELASSIE, Y. et al., 2009. Bovidae. In *Ardipithecus kadabba: late miocene evidence from the Middle Awash, Ethiopia*. University of California Press, pp. 277–330.

HARRIS, J., 1991. *The Fossil Ungulates: Geology, Fossil Artiodactyls and Palaeoenvironments*, Oxford University Press.

HARRIS, J.M., 2003. Bovidae from the Lothagam succession. In *Lothagam: The dawn of humanity in eastern Africa*. New York: Columbia University Press.

HASSANIN, A., 1999. Evolutionary affinities of the enigmatic saola (Pseudoryx nghetinhensis) in the context of the molecular phylogeny of Bovidae. *Proceedings of the Royal Society B: Biological Sciences*, 266(1422), pp.893–900.

HASSANIN, A. **& DOUZERY**, E., 1999. The Tribal Radiation of the Family Bovidae (Artiodactyla) and the Evolution of the Mitochondrial Cytochrome b Gene. *Molecular Phylogenetics and Evolution*, 13(2), pp.227–243.

HASSANIN, A. **& DOUZERY**, E., 2000. Is the Newly Described Vietnamese Bovid *Pseudonovibos* spiralis a Chamois (Genus *Rupicapra*)? *Naturwissenschaften*, 87(3), pp.122–124.

HASSANIN, A. **& DOUZERY**, E., 2003. Molecular and morphological phylogenies of ruminantia and the alternative position of the moschidae. *Systematic Biology*, 52(2), pp.206–228.

HASSANIN, A. **& ROPIQUET**, A., 2004. Molecular phylogeny of the tribe Bovini (Bovidae, Bovinae) and the taxonomic status of the Kouprey, *Bos sauveli* Urbain 1937. *Molecular Phylogenetics and Evolution*, 33(3), pp.896–907.

HASSANIN, A. et al., 1998. Molecular Systematics of the Subfamily Caprinae (Artiodactyla, Bovidae) as Determined from Cytochrome b Sequences. *Journal of Mammalian Evolution*, 5(3), pp.217–236.

HASSANIN, A. et al., 2009. Evolution of the Mitochondrial Genome in Mammals Living at High Altitude: New Insights from a Study of the Tribe Caprini (Bovidae, Antilopinae). *Journal of Molecular Evolution*, 68(4), pp.293–310.

HAUG, G.H. **& TIEDEMANN**, R., 1998. Effect of the formation of the Isthmus of Panama on Atlantic Ocean thermohaline circulation. *Nature*, 393(6686), pp.673–676.

HAUG, G.H. et al., 2001. Role of Panama uplift on oceanic freshwater balance. *Geology*, 29(3), pp.207–210.

HAUG, G.H. et al., 2005. North Pacific seasonality and the glaciation of North America 2.7 million years ago. *Nature*, 433(7028), pp.821–825.

HERNÁNDEZ FERNÁNDEZ, M. **& VRBA**, E.S., 2005a. A complete estimate of the phylogenetic relationships in Ruminantia: a dated species-level supertree of the extant ruminants. 80(2), pp.269–302.

HERNÁNDEZ FERNÁNDEZ, M. **& VRBA**, E.S., 2005b. Macroevolutionary Processes and Biomic Specialization: Testing the Resource-use Hypothesis. *Evolutionary Ecology*, 19(3), pp.199–219.

HIJMANS, R.J. et al., 2005. Very high resolution interpolated climate surfaces for global land areas. *International Journal of Climatology*, 25(15), pp.1965–1978.

HOROWITZ, M. **& ADLER**, J.H., 1983. Plasma volume regulation during heat stress: albumin synthesis vs capillary permeability. A comparison between desert and non-desert species. *Comperativ Biochemistry and Physiology A: Physiology*, 75(1), pp.105–110.

IPCC, 2007. Summary for Policymakers. *IPCC, 2007: Summary for Policymakers. In: Climate Change 2007: The Physical Science Basis*, pp.1–18.

IRWIN, D.M. et al., 1991. Evolution of the cytochrome b gene of mammals. *Journal of Molecular Evolution*, 32(2), pp.128–144.

JORGE, W. et al., 1976. Studies on a male eland X kudu hybrid. *Journal of reproduction and fertility*, 46(1), pp.13–16.

KAISER, T.M., 2011. Feeding Ecology and Niche Partitioning of the Laetoli Ungulate Faunas. In T. Harrison, ed. *Paleontology and Geology of Laetoli: Human Evolution in Context*. Springer Netherlands, pp. 329–354.

KASPAR, F et al., 2010. Impacts of tectonic and orbital forcing on East African climate: a comparison based on global climate model simulations. *International Journal of Earth Sciences*, 99(7), pp.1677–1686.

KENDALL, D.G., 1948. On the generalized“ birth-and-death” process. *The annals of mathematical statistics*, 19(1), pp.1–15.

KINGDON, J., 1989a. , Chicago: The University of Chicago Press.

KINGDON, J., 1989b. , Chicago: University of Chicago Press.

KINGDON, J., 1997. *The Kingdon Field Guide to African Mammals*, London: Academic Press.

KÖHLER, M., 1993. *Skeleton and Habitat of recent and fossil Ruminants*, Münchner Geowissenschaftliche Abhandlungen

KOTTEK, M. et al., 2006. World Map of the Köppen-Geiger climate classification updated. *Meteorologische Zeitschrift*, 15(3), pp.259–263.

KOVAROVIC, K. **& ANDREWS**, P., 2011. Environmental Change within the Laetoli Fossiliferous Sequence: Vegetation Catenas and Bovid Ecomorphology. In T. Harrison, ed. *Paleontology and Geology of Laetoli: Human Evolution in Context*. Springer Netherlands, pp. 367–380.

KOZAK, K.H. **& WIENS**, J.J., 2010. Accelerated rates of climatic-niche evolution underlie rapid species diversification. *Ecology Letters*, 13(11), pp.1378–1389.

KULLMER, O., 2007. Geological Background of Early Hominid Sites in Africa. In *Handbook of Paleoanthropology*. Springer Verlag.

KULLMER, O., 2008. The fossil suidae from the Plio-Pleistocene Chiwondo Beds of northern Malawi, Africa. *Journal of Vertebrate Paleontology*, 28(1), pp.208–216.

KUMAR, S., 2005. Molecular clocks: four decades of evolution. *Nature Reviews Genetics*, 6(8), pp.654–662.

LALUEZA-FOX, C. et al., 2005. Molecular dating of caprines using ancient DNA sequences of Myotragus balearicus, an extinct endemic Balearic mammal. *BMC Evolutionary Biology*, 5(1), p.70.

LANAVE, C. et al., 1984. A new method for calculating evolutionary substitution rates. *Journal of Molecular Evolution*, 20(1), pp.86–93.

LEAKEY, M.G., 2003. Lothagam: Its significance and contributions. In *Lothagam: The dawn of humanity in eastern Africa*. New York: Columbia University Press.

LEBATARD, A.-E. et al., 2008. Cosmogenic nuclide dating of Sahelanthropus tchadensis and Australopithecus bahrelghazali: Mio-Pliocene hominids from Chad. *PNAS*, 105(9), pp.3226–3231.

LERP, H. et al., 2011. A phylogeographic framework for the conservation of Saharan and Arabian Dorcas gazelles (Artiodactyla: Bovidae). *Organisms Diversity & Evolution*, 11(4), pp.317–329.

LOMBARD, A. et al., 1999. Reserve selection in the Succulent Karoo, South Africa: coping with high compositional turnover. *Plant Ecology*, 142, pp.35–55.

LUDT, C. et al., 2004. Mitochondrial DNA phylogeography of red deer (*Cervus elaphus*). *Molecular Phylogenetics and Evolution*, 31(3), pp.1064–1083.

MACQUEEN, J., 1967. Some methods for classification and analysis of multivariate observations. *University of California Press*, pp.281–297.

MALLON, D.P. **&** Kingswood, S.C., 2001. *Antelopes Part 4: North Africa, the Middle East, and Asia*, Gland, Switzerland: SSC Antelope Specialist Group, IUCN.

MASEMBE, C. et al., 2006. Three genetically divergent lineages of the Oryx in eastern Africa: Evidence for an ancient introgressive hybridization. *Conservation Genetics*, 7(4), pp.551–562.

MASLIN, M.A. **& TRAUTH**, M.H., 2009. Plio-Pleistocene East African Pulsed Climate Variability and Its Influence on Early Human Evolution F. Grine, J. G. Fleagle, & R. E. Leakey, eds. *The First Humans: Origin and Early Evolution of the Genus Homo*, p.151.

MATTHEE, C.A. **& DAVIS**, S.K., 2001. Molecular Insights into the Evolution of the Family Bovidae: A Nuclear DNA Perspective. *Molecular Biology and Evolution*, 18(7), pp.1220–1230.

MATTHEE, C.A. **& ROBINSON**, T.J., 1999. Cytochrome b Phylogeny of the Family Bovidae: Resolution within the Alcelaphini, Antilopini, Neotragini, and Tragelaphini. *Molecular Phylogenetics and Evolution*, 12(1), pp.31–46.

MATTHEWS, W. et al., 1999. Vegetation of the Sileza Nature Reserve and neighbouring areas, South Africa, and its importance in conserving the woody grasslands of the Maputaland Centre of Endemism. *Bothalia*, 29(1), pp.151–167.

MAYR, E., 1942. *Systematics and the origin of species*, New York: Columbia University Press.

MCKEE, J., 1991. *Palaeo-Ecology of the Sterkfontein Hominids: a Review and Synthesis*, Palaeontologia Africana.

MICHAUX, J. et al., 1991. *Alephis tigneres*i nov. sp., un bovidé nouveau du pliocène du Roussillon (France). *Géobios*, 24, pp.735–745.

MOODLEY, Y. **& BRUFORD**, M.W., 2007. Molecular Biogeography: Towards an Integrated Framework for Conserving Pan-African Biodiversity. *PLoS ONE*, 2(5), p.454.

MOODLEY, Y. et al., 2009. Analysis of mitochondrial DNA data reveals non-monophyly in the bushbuck (Tragelaphus scriptus) complex. *Mammalian Biology*, 74(5), pp.418–422.

MYERS, A. **& GILLERS**, P., 1988. *Analytical Biogeography : an Integrated Approach to the Study of Animal and Plant Distributions*, London: Chapman and Hall.

NEE, S. et al., 1992. Tempo and Mode of Evolution Revealed From Molecular Phylogenies. *Proceedings of the National Academy of Sciences of the United States of America*, 89(17), pp.8322–8326.

NEE, S. et al., 1994. The reconstructed evolutionary process. *Philosophical Transactions: Biological Sciences*, pp.305–311.

NIJMAN, I.J. et al., 2008. Phylogeny of Y chromosomes from bovine species. *Cladistics*, 24(5), pp.723–726.

NILSSON, M.A. et al., 2010. The impact of fossil calibrations, codon positions and relaxed clocks on the divergence time estimates of the native Australian rodents (Conilurini). *Gene*, 455(1-2), pp.22–31.

NTIE, S. et al., 2009. A molecular diagnostic for identifying central African forest artiodactyls from faecal pellets. *Animal Conservation*, pp.1–14.

O'REGAN, H.J. et al., 2005. Large mammal turnover in Africa and the Levant between 1.0 and 0.5 Ma. *Geological Society, London, Special Publications*, 247(1), pp.231–249.

PARHAM, J.F. et al., 2012. Best practices for justifying fossil calibrations. *Systematic Biology*, 61(2), pp.346–359.

PARTRIDGE, T., 1997. Late Neogene Uplift in Eastern and Southern Africa and Its Paleoclimatic Implications. In *Tectonic uplift and climate change*. Springer US.

PARTRIDGE, T., 1998. Of Diamonds, Dinosaurs and Diastrophism; 150 Million Years of Landscape Evolution in Southern Africa. *South African journal of geology*, 101(3), pp.67–184.

PARTRIDGE, T. **&** Maud, R.R., 1987. Geomorphic Evolution of Southern Africa Since the Mesozoic. *South African journal of geology*, 90(2), pp.179–205.

PHILLIPS, S.J. et al., 2006. Maximum entropy modeling of species geographic distributions. *Ecological Modelling*, 190(3-4), pp.231–259.

PHILLIPS, S.J et al., 2004. A maximum entropy approach to species distribution modeling. *Proceedings of the twenty-first international conference on Machine learning*, p.83.

PICKFORD, M. et al., 1991. Nouvelle Biostratigraphie du Néogène et du Quaternaire de la Région de Nkondo (Bassin du Lac Albert, Rift Occidental Ougandais). *Comptes rendus de l"Académie des sciences. Série 2, Mécanique, Physique, Chimie, Sciences de l"univers, Sciences de la Terre*, 312(3), pp.1667–1672.

PIDANCIER, N. et al., 2006. Evolutionary history of the genus Capra (Mammalia, Artiodactyla): discordance between mitochondrial DNA and Y-chromosome phylogenies. *Molecular Phylogenetics and Evolution*, 40(3), pp.739–749.

PLUMMER, T.W. et al., 2008. Habitat preference of extant African bovids based on astragalus morphology: operationalizing ecomorphology for palaeoenvironmental reconstruction. *Journal of Archaeological Science*, 35(11), pp.3016–3027.

POTTS, R., 1998a. Environmental hypotheses of hominin evolution. *American Journal of Physical Anthropology*, 107(s 27), pp.93–136.

POTTS, R., 1998b. Variability selection in hominid evolution. *Evolutionary Anthropology Issues News and Reviews*, 7(3), pp.81–96.

RABOSKY, D.L., 2006a. LASER: a maximum likelihood toolkit for detecting temporal shifts in diversification rates from molecular phylogenies. *Evolutionary Bioinformatics Online*, 2, pp.273–276.

RABOSKY, D.L., 2006b. Likelihood methods for detecting temporal shifts in diversification rates. *Evolution*, 60(6), pp.1152–1164.

RABOSKY, D.L. **& LOVETTE**, I.J., 2008. Explosive evolutionary radiations: decreasing speciation or increasing extinction through time? *Evolution*, 62(8), pp.1866–1875.

RAMBAUT, A. **& DRUMMOND**, A., 2009. *Tracer: v1.5*, [http://beast.bio.ed.ac.uk/Tracer].

RAVELO, A.C. et al., 2004. Regional climate shifts caused by gradual global cooling in the Pliocene epoch. *Nature*, 429(6989), pp.263–267.

REBHOLZ, W. **& HARLEY**, E.H., 1999. Phylogenetic Relationships in the Bovid Subfamily Antilopinae Based on Mitochondrial DNA Sequences. *Molecular Phylogenetics and Evolution*, 12(2), pp.87–94.

REED, D.N., 2007. Serengeti micromammals and their implications for Olduvai paleoenvironments. In R. Bobe, Z. Alemseged, & A. K. Behrensmeyer, eds. *Hominin environments in the East African Pliocene: an assessment of the faunal evidence*. Springer Netherlands, pp. 217–255.

REED, K.E., 1997. Early hominid evolution and ecological change through the African Plio-Pleistocene. *Journal of Human Evolution*, 32(2-3), pp.289–322.

REED, K.E. **& BIBI**, F., 2011. Fossil Tragelaphini (Artiodactyla: Bovidae) from the Late Pliocene Hadar Formation, Afar Regional State, Ethiopia. *Journal of Mammalian Evolution*, 18(1), pp.57–69.

REED, K.E. **& RECTOR**, A., 2007. African Pliocene Paleoecology: Hominin Habitats, Resources, and Diets. In *Evolution of the human diet: the known, the unknown, and the unknowable*. Oxford University Press, p. 331.

RELETHFORD, J., 2007. Population Genetics and Paleoanthropology. In *Handbook of Paleoanthropology*. Springer Verlag.

RETALLACK, G., 1992. Middle Miocene Fossil Plants From Fort Ternan (Kenya) and Evolution of African Grasslands. *Paleobiology*, 18(4), pp.383–400.

REZAEI, H.R. et al., 2010. Evolution and taxonomy of the wild species of the genus Ovis (Mammalia, Artiodactyla, Bovidae). *Molecular Phylogenetics and Evolution*, 54(2), pp.315–326.

RICKLEFS, R.E., 2007. Estimating diversification rates from phylogenetic information. *Trends in Ecology & Evolution*, 22(11), pp.601–610.

ROBERTS, A., 1951. *The mammals of South Africa*, Published by the Trustees of "The Mammals of South Africa" Book Fund.

ROBINSON, T.J. et al., 1996. Mitochondrial DNA sequence relationships of the extinct blue antelopeHippotragus leucophaeus. *Naturwissenschaften*, 83(4), pp.178–182.

ROPIQUET, A. **& HASSANIN**, A., 2005. Molecular phylogeny of caprines (Bovidae, Antilopinae): the question of their origin and diversification during the Miocene. *Journal of Zoological Systematics and Evolutionary Research*, 43(1), pp.49–60.

ROPIQUET, A., et al., 2009. SuperTRI: A new approach based on branch support analyses of multiple independent data sets for assessing reliability of phylogenetic inferences. *Comptes Rendus Biologies*, 332(9), pp.832–847.

RUBEL, F. **& KOTTEK**, M., 2010. Observed and projected climate shifts 1901–2100 depicted by world maps of the Köppen-Geiger climate classification. *Meteorologische Zeitschrift*, 19(2), pp.135–141.

SAMBROOK, J. **& RUSSELL**, D.W., 2001. *Molecular Cloning: a Laboratory Manual*, Cold Spring Harbor Laboratory Press.

SANDROCK, O. et al., 2007. Fauna, taphonomy, and ecology of the Plio-Pleistocene Chiwondo Beds, Northern Malawi. In R. Bobe, Z. Alemseged, & A. K. Behrensmeyer, eds. *Hominin environments in the East African Pliocene: an assessment of the faunal evidence*. Dordrecht: Springer Netherlands, pp. 315–332.

SAVAGE, D.E. **&** Russell, D.E., 1983. *Mammalian paleofaunas of the world*, Addison-Wesley.

SCHELLHORN, R., 2009. *Eine Methode zur Bestimmung fossiler Habitate mittels Huftierlangknochen*, Eberhard Karls Universität Tübingen.

SEPULCHRE, P. et al., 2006. Tectonic Uplift and Eastern Africa Aridification. *Science*, 313(5792), pp.1419–1423.

SHORROCKS, B., 2007. *The biology of African savannahs*, New York: Oxford University Press.

SOLOUNIAS, N. et al., 1995. The oldest bovid from the Siwaliks, Pakistan. *Journal of Vertebrate Paleontology*, 15(4), pp.806–814.

STEININGER, F., 1999. *Chronostratigraphy, Geochronology and Biochro-no-logy of the Miocene "European Land Mammal Mega-Zones" (ELMMZ) and the Miocene "Mammal-Zones MN-Zones)"* G. Rössner & K. Heissig, eds. München: The Miocene Mammals of Europe.

SU, D.F., 2011. Large Mammal Evidence for the Paleoenvironment of the Upper Laetolil and Upper Ndolanya Beds of Laetoli, Tanzania. In T. Harrison, ed. *Paleontology and Geology of Laetoli: Human Evolution in Context*. Springer Netherlands, pp. 381–392.

SUWA, G. et al., 2003. Plio-Pleistocene terrestrial mammal assemblage from Konso, southern Ethiopia. *Journal of Vertebrate Paleontology*, 23(4), pp.901–916.

TANAKA, K. et al., 1996. Phylogenetic relationship among all living species of the genusBubalus based on DNA sequences of the cytochromeb gene. *Biochemical genetics*, 34(11), pp.443–452.

THOMAS, H., 1980. Les bovidés du Miocène supérieur des couches de Mpesida et de la formation de Lukeino (district de Baringo, Kenya. In *Proceedings of the 8th Panafrican Congress of Prehistory and Quaternary Studies: Nairobi, 5 to 10 September, 1977*. International Louis Leakey Memorial Institute for African Prehistory, pp. 82–91.

TRAUTH, M.H. et al., 2005. Late Cenozoic Moisture History of East Africa. *Science*, 309(5743), pp.2051–2053.

TRAUTH, M.H. et al., 2007. High- and low-latitude forcing of Plio-Pleistocene East African climate and human evolution. *Journal of Human Evolution*, 53(5), pp.475–486.

TRAUTH, M.H. et al., 2010. Human evolution in a variable environment: the amplifier lakes of Eastern Africa. *Quaternary Science Reviews*, 29, pp.2981–2988.

TRAUTH, M.H. **& MASLIN**, M.A., 2009. Comment on "Diatomaceous sediments and environmental change in the Pleistocene Olorgesailie Formation, southern Kenya Rift" by RB Owen, R. Potts, AK Behrensmeyer and P. Ditchfield [Palaeogeography, Palaeoclimatology, Palaeoecology 269 (2008) 17-37]. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 282, pp.145–146.

VAN DER MADE, J. et al., 2006. Late Miocene turnover in the Spanish mammal record in relation to palaeoclimate and the Messinian Salinity Crisis. In *Palaeogeography Palaeoclimatology Palaeoecology*. Palaeogeography Palaeoclimatology Palaeoecology. pp. 228–246.

VAN VALEN, L., 1973. A new evolutionary law. *Evolutionary theory*, 1(1), pp.1–30.

VAN VALEN, L., 1977. The red queen. *The American Naturalist*, 111(980), pp.809–810.

VAN VUUREN, B.J. **& ROBINSON**, T.J., 2001. Retrieval of four adaptive lineages in duiker antelope: evidence from mitochondrial DNA sequences and fluorescence in situ hybridization. *Molecular Phylogenetics and Evolution*, 20(3), pp.409–425.

VIGNAUD, P. et al., 2002. Geology and palaeontology of the Upper Miocene Toros-Menalla hominid locality, Chad. *Nature*, 418(6894), pp.152–155.

VRBA, E.S., 1975. Some evidence of chronology and palaeoecology of Sterkfontein, Swartkrans and Kromdraai from the fossil Bovidae. *Nature*, 254(5498), pp.301–304.

VRBA, E.S., 1985a. African Bovidae: evolutionary events since the Miocene. *South African Journal of Science*, 81(5), pp.263–266.

VRBA, E.S., 1985b. Environment and Evolution: Alternative Causes of the Temporal Distribution of Evolutionary Events. *South African Journal of Science*, 81, pp.229–236.

VRBA, E.S., 1987. Ecology in relation to speciation rates: some case histories of Miocene-Recent mammal clades. *Evolutionary Ecology*, 1(4), pp.283–300.

VRBA, E.S., 1988. The Significance of Bovid Remains as Indicators of Environment and Predation Patterns. In *Fossils in the Making: Vertebrate Taphonomy and Paleoecology*. University of Chicago Press.

VRBA, E.S., 1992. Mammals as a key to evolutionary theory. *Journal of Mammalogy*, 73(1), pp.1–28.

VRBA, E.S., 1995. The Fossil Record of African Antelopes Relative to Human Evolution. In *Paleoclimate and Evolution, with Emphasis on Human Origins*. New Haven: Yale University Press, pp. 385–385424.

VRBA, E.S., 1997. New fossils of Alcelaphini and Caprinae (Bovidae: Mammalia) from Awash, Ethiopia, and phylogenetic analysis of Alcelaphini. *Palaeontologia Africana*, 34, pp.127–198.

VRBA, E.S., 1999. Habitat theory in relation to the evolution in African Neogene biota and hominids. In *African Biogeography Climate Change, & Human Evolution*. New York: Oxford University Press.

VRBA, E.S., 2006. A possible ancestor of the living waterbuck and lechwes: Kobus basilcookeisp. nov. (Reduncini, Bovidae, Artiodactyla) from the Early Pliocene of the Middle Awash, Ethiopia. *Transactions of the Royal Society of South Africa*, 61(2), pp.63–74.

VRBA, E.S. et al., 1995. On the Connections Between Paleoclimate and Evolution. In *Paleoclimate and Evolution, with Emphasis on Human Origins*. New Haven: Yale University Press, pp. 24–45.

VRBA, E.S. **& GATESY**, JE, 1994. New antelope fossils from Awash, Ethiopia, and phylogenetic analysis of Hippotragini. *Palaeontologia Africana*, 31, pp.55–72.

VRBA, E.S. **& SCHALLER**, G., 2000. Phylogeny of Bovidae Based on Behavior, Glands, Skulls, and Postcrania. In *Antelopes, Deer, and Relatives*. New Haven: Yale University Press, pp. 203–222

WATSON, V., 1993. Composition of the Swartkrans bone accumulations, in terms of skeletal parts and animals represented. In *Swartkrans: a cave's chronicle of early man*. Transvaal Museum, pp. 35–73.

WENZEL, S. **& BRAIN**, C.K., 1993. Swartkrans. A Cave's Chronicle of Early Man. In *Swartkrans: a cave's chronicle of early man*. Transvaal Museum.

WERDELIN, L., 2010. *Chronology of Neogene mammal localities*, Cenozoic mammals of Africa. Berkeley: University of ….

WHITE, F., 1983. *The vegetation of Africa*, Unesco, Paris.

WILLOWS-MUNRO, S. et al., 2005. Utility of nuclear DNA intron markers at lower taxonomic levels: Phylogenetic resolution among nine *Tragelaphus spp*. *Molecular Phylogenetics and Evolution*, 35(3), pp.624–636.

WILSON, D.E., 2005. *Mammal Species of the World* 3rd ed. JHU Press.

WYNN, J.G., 2004. Influence of Plio-Pleistocene aridification on human evolution! Evidence from paleosols of the Turkana Basin, Kenya. *American Journal of Physical Anthropology*, 123(2), pp.106–118.

XIA, X. **& XIE**, Z., 2001. DAMBE: software package for data analysis in molecular biology and evolution. *Journal of Heredity*, 92(4), pp.371–373.

YULE, G., 1925. A mathematical theory of evolution, based on the conclusions of Dr. JC Willis, FRS. *Philosophical Transactions of the Royal Society of London. Series B*, 213, pp.21–87.

ZIMMERMANN, S. et al., 1998. Cytochrom b-Sequenz-Vergleiche zwischen Wisent (*Bison bison bonasus*) und Hausrind (*Bos primigenius f. taurus*). *Zeitschrift für Jagdwissenschaft*, 44(1), pp.26–32.

ZUCKERKANDL, E. **& PAULING**, L., 1965. Molecules as documents of evolutionary history. *Journal of theoretical biology*, 8(2), pp.357–366.

APPENDIX

SuppFig. 1 **Cytochrome b Sequences of Newly Added Species**

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                                              1       10         20         30         40         50         60         70         80         90        100        110        120
                                              |        |          |          |          |          |          |          |          |          |          |          |          |
                                              ATGACCAACA TTCGAAAAAC CCACCCACTA ATAAAAATTG TAAACAACGC ATTCATTGAC CTCCCAGCCC CATCAAACAT CTCATCATGA TGAAACTTYG GCTCCCTCCT AGGCATCTGC
1. JF728761 (Antidorcas marsupialis)          ....T...T. .A......CG T........C .......... ....T..... .......... ..T....... .......... .......... ........C. .....T.A.. ...T......
2. JF728762 (Connochaetes gnou)               .......... .......... T......... .........A .T........ .......... .......... .......... .......... .....T..T. ....T..T.. G.........
3. JF728763 (Dorcatragus megalotis)                                                                                                                   .T. ....A..... ....G.T...
4. JF728764 (Eudorcas rufifrons)              ....T...T. C......... .........T .......... .......... .......... .......... .......... .......... ........T. .......... ..........
5. JF728765 (Eudorcas thomsonii)              ....T..... CC........ .........T .......... .......... .......... ......A... .......... .......... ........T. .......... ..........
6. JF728766 (Gazella gazella)                                                                                                                           . .......... ..........
7. JF728767 (Gazella leptoceros)              ....A...AT .C....N..G .........T .......... .......... .......... ..T.....T. .......T.. .......... ........T. .......... ...T......
8. JF728768 (Gazella dorcas pelzelni)         ....T...AT .C.....G.. S........T ........C. .......... .......... .......... .......T.. .......... ..G.....T. .......... ...T......
9. JF728769 (Hippotragus equinus)             ....T...YT .C........ T.....G..G .......... .......... ...T...... ........T. .......T.. T......... ........T. .......... ..........
10. JF728770 (Hippotragus niger)              ....T...T. .C........ T........G .......... .......... .......... ......A... ..C....T.. ......G... ........C. .......... ...T......
11. JF728771 (Kobus ellipsiprymnus)           ....T.C... .A........ A......... .......... .......... .........T .......... .......... .......... ........T. .......... ...T......
12. JF728772 (Kobus leche)                    ....TTCC.. .A........ A......... .......... .......... .........T ..T....... .......... .......... .....T..C. .T........ .........T
13. JF728773 (Kobus megaceros)                .......... .A........ A.....CT.. .......... .......... .........T ..T....... .......... .......... .....T..C. .......... ..........
14. JF728774 (Madoqua saltiana)               .......... .......... A........C .......... .......... .......... ..T.....T. .......... .......... .....T..C. .......AT. ...TG.....
15. JF728775 (Nanger dama)                    ....TTCCA. CC........ ...T.....T .......... .......... ..A....... .......... .......... .......... ........C. .T.....T.. G.........
16. JF728776 (Nanger soemmerringii)           ....T...T. CC........ .........T .......... .......... .......... .......... .......... .......... ........C. .T.....T.. ..........
17. JF728777 (Neotragus pygmaeus)             ........T. .C........ .........G .......... .C........ .........T .......... .......... .......... ........T. .......T.. ..........
18. JF728778 (Oryx dammah)                    .......... .......... T........G ..G....... .......... ......C... .......... .......... .......... ........T. .......A.. ..........
19. JF728779 (Oryx gazella)                   .......... .......... T......... .......... .......... C.....C... ......A... .......... .......... ........T. .......G.. ...TG.....
20. JF728780 (Philantomba maxwellii)          .......... .C........ T......... .......... ....T..... ....G.C... ........T. .......T.. .......... ........T. ....T..T.. ...T.....T
21. JF728781 (Philantomba monticola)          .....T.... .......... T......... .......... .......... ....G.C... .......... .......T.. T........G ........T. .T..T..... ..........
22. JF728782 (Redunca fulvorufula)            .....T.... .......... ......G... .......... .......... ......Y... ........T. .......T.. .......... ........T. ....T..A.. ...T......
23. JF728783 (Tragelaphus angasii)            .......... .C......T. .........G .......... .......... ......C... .......... .......... ...T...... ........C. .A......T. ...AG.....
24. JF728784  (Tragelaphus eurycerus)         .......... ........T. .........G .......... .......... ...T...... .......... .......T.. .......... ........C. .A.....T.. ...A......
25. JF728785 (Tragelaphus imberbis )          ....T..... ........T. T.....GT.. ........C. .......... .......... ......A... ..C....... .......... .....T..C. .A..A..T.. ...G......
26. JF728786 (Tragelaphus oryx)               .......... ........T. .......... .......... .......... ......C... ......A... .......... .......... ........C. .A........ ...A......
27. JF728787 (Tragelaphus scriptus scriptus)  .......... .......GT. .......... .......... ....T..... .......... ..T....... .......... .........G ........C. .A........ ...G......
28. JF728788 (Tragelaphus spekii)             .......... ........T. .........G .......... .......... ......C... .......... .......... .......... ........C. .A.....T.. ...A......
29. JF728789 (Tragelaphus strepsiceros )       .......... ........T. .......... .......... .......... ......C... .......... .......T.. .......... ........C. .A.....T.. ...A......
                                                     130        140        150        160        170        180        190        200        210        220        230        240
                                                       |          |          |          |          |          |          |          |          |          |          |          |
                                              CTAATTCTAC AAATCCTAAC AGGCCTATTC CTAGCAATAC ACTACACATC CGACACAACA ACAGCATTCT CCTCCGTCAC CCACATCTGC CGAGACGTCA ACTATGGCTG AATCATCCGA
1. JF728761 (Antidorcas marsupialis)          T....C.... ....TT.... .......... ..G.....G. ........G. ...T...G.. .......... ....T..... G......... .......... ....C..T.. ...T..T...
2. JF728762 (Connochaetes gnou)               ..G..C.... .......... ...GT....T .......... .......... ...T...... ........T. .......... ......T... .....T..T. .......... ..........
3. JF728763 (Dorcatragus megalotis)           G....A.... .......... .........T T......... ....T...G. T......... .......... ....T..... .......... ........T. .......T.. ......T...
4. JF728764 (Eudorcas rufifrons)              T......... .......... ....T..... .......... .T......G. .......G.. ........T. .......T.. .......... .......... .......... .G.T......
5. JF728765 (Eudorcas thomsonii)              T......... .......... .......... .......... .T......G. .......G.. ........T. .......T.. .......... .......... .......... .G.T......
6. JF728766 (Gazella gazella)                 T......... .......... .......... .......... ........G. ...T...G.. .......... .......T.. ...T...... .......... ....C..... ...T......
7. JF728767 (Gazella leptoceros)              T......... .......... ...T...... ........G. ........G. ...T...G.. .......... .T........ ...T...... .....T.... ....C..... ..........
8. JF728768 (Gazella dorcas pelzelni)         T....C.... ....T..... .......... .......... ........G. ...T...G.. .......... .......... ...T...... .....T.... .T........ ...T......
9. JF728769 (Hippotragus equinus)             .......... .......... .......... ..G....... .......... T........G .......... ....T..... ......T... .....T.... .......... ...T......
10. JF728770 (Hippotragus niger)              T......... .......G.. G......... .......... .......... ......G.T. .......... ....T..... T..T..T... .....T.... ....C..... ......T...
11. JF728771 (Kobus ellipsiprymnus)           T..G....T. ....TT.... .......... .......... .......... .........C ........T. .T.....T.. T......... .....T.... .......... .G........
12. JF728772 (Kobus leche)                    .....C..T. .....T.... .......... .......... .T..T..... T........T .......... .T........ ......T... .......... ....C..... ..........
13. JF728773 (Kobus megaceros)                T.......T. ....TT.... .......... .......... .......... .........T .......... .T..T..... .......... ........T. .......... ......T...
14. JF728774 (Madoqua saltiana)               ...G.C.... .......... G......... ........G. ........G. .......G.. .......... .......... ......T... .......... .......A.. ...T......
15. JF728775 (Nanger dama)                    T......... .......... .......... T......... ....T...G. .......G.. .......... .......... ...T...... .......... .......... ...T......
16. JF728776 (Nanger soemmerringii)           .......... .......... .......... T......... ....T...G. ...T...G.. .......... .......... ...T...... .......... .......... ...T......
17. JF728777 (Neotragus pygmaeus)             .....C.... .......G.. .......... .....T.... ....T...G. .......... .......... ....A..... .......... ........A. .......... ..........
18. JF728778 (Oryx dammah)                    ........G. ....TT.... ...T...... .......... .T........ .......... .......... ....T..... ......T... .......... .......... ..........
19. JF728779 (Oryx gazella)                   ........G. ....T..... ...T...... .......... ....T..... T......... ........T. ....T..... ......T... .......... .......... ..........
20. JF728780 (Philantomba maxwellii)          T....CT... ....T..... G..T...... .......... .T......G. ...T...... .......... .......T.. ......T..T ..G....... ....C..... ..........
21. JF728781 (Philantomba monticola)          .....CT... .......... .......... .......... ........G. ...T...... .....T.... .......T.. ......T..T .......... ....C..... .G....T...
22. JF728782 (Redunca fulvorufula)            T....A.... ....T..... ...A...... .......... .......... .......G.T .......... .T........ .......... .......... ....C..... ..........
23. JF728783 (Tragelaphus angasii)            .......... .......T.. ....T..... ..G..C.... .......... A.....C.T. ........T. .......... .........T .....T..A. ....C..... ...T......
24. JF728784  (Tragelaphus eurycerus)         ........C. .......C.. ....T....T .....T.... .......G.. A......... .......... ....T..... ...T...... ........A. ....C..... ...T......
25. JF728785 (Tragelaphus imberbis )          ...G....G. .......T.. ....TT...T .......... .......... A.......T. ........T. .......... .........T ........A. ....C..... .........G
26. JF728786 (Tragelaphus oryx)               .......... .......C.. G...T..... .....T.... .......... A......... .......... ....T..... T......... ........A. ....C..... ..........
27. JF728787 (Tragelaphus scriptus scriptus)  ....CC.... ....T..T.. ....T..... .....C.... .......... A..T...... .......... ....T...G. ...T.....T .....T..G. .......... ...T......
28. JF728788 (Tragelaphus spekii)             .......... .......C.. ....T..... .....T.... .......G.. A......... .......... ....T..T.. ...T...... ........A. .T..C..... ......T...
29. JF728789 (Tragelaphus strepsiceros )       .....C.... .......C.. ....T....T .......... .......GC. A......... .......... .T..T..... T..T...... ........A. ....C..... ..........
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                                                     250        260        270        280        290        300        310        320        330        340        350        360
                                              TACATACATG CAAACGGAGC ATCAATATTC TTCATCTGCC TATTCATACA CGTAGGACGA GGCCTCTACT ACGGATCATA CACCTTCCTA GAAACATGAA ACATCGGAGT AATTCTCCTA
1. JF728761 (Antidorcas marsupialis)          .......... .G........ ...T...... .......... .C....C... .......... .......... .T........ ...A...... .......... .TG.T..... ......TT..
2. JF728762 (Connochaetes gnou)               ..T.....C. .......G.. .........T .......... .....T.G.. .......... .......... .......... T......... .......... ..G.T..G.. ...C...T..
3. JF728763 (Dorcatragus megalotis)           ..T.....C. .......... .......... ..T....... ....T..... .......... ..A.....T. .T........ .......... .......... ........A. T.........
4. JF728764 (Eudorcas rufifrons)              ..T....... .......... ...T.....T ..T....... .C........ T......... .......... .T........ T..A..TA.. .......... .......... G..C......
5. JF728765 (Eudorcas thomsonii)              .......... .......... ...C.....T .......... .C........ T......... .......... .......... T..A..T... .......... ....T..... G..C......
6. JF728766 (Gazella gazella)                 ..T....... ....T..... ...C.....T ..T....... .C..T..... .......... .......... .T........ T..A...... ........G. .T........ ......T...
7. JF728767 (Gazella leptoceros)              ..T....... ....T..... ...C...... ..T....... .T..T..... T......... .......... .T........ ...A...T.. .......... .T........ ......T...
8. JF728768 (Gazella dorcas pelzelni)         .......... ....T..... ...C...... ..T....... .C..T..... .......... .......... .T........ ...A...... .......... .T..T..G.. ......T...
9. JF728769 (Hippotragus equinus)             .......... .......... .........T .......... .......... .......... .......... .......... .......... .......... .......... ...C......
10. JF728770 (Hippotragus niger)              .......... .......G.. .......... .......... .......G.. T......... ........T. .......... .......... A......... .......... .......T..
11. JF728771 (Kobus ellipsiprymnus)           ..T.....C. ....T..... .......... .......... .C.....G.. .........G .....A.... .......... ..TT...... .......... .T..T..... .G....TT..
12. JF728772 (Kobus leche)                    ........C. ....T..... .......... ........T. .C.....G.. .......... .....A.... .......... T.TT...... .......... .T..T..... ..........
13. JF728773 (Kobus megaceros)                .....G..C. .......... ......G... .......... .C.....G.. T......... .....A.... .T........ T.T....... .......... .T..T..... ..........
14. JF728774 (Madoqua saltiana)               ..T.....C. .......... .......... ..T....... .......G.. .......... ..A.....T. .......... .......... .......... ....T..... T......T..
15. JF728775 (Nanger dama)                    ..T....... ....T..... ...C..G... ..T....... .T........ T.....G... .......... .......C.. ...A..T... ........G. .T..T..... ..........
16. JF728776 (Nanger soemmerringii)           .......... ....T..... ...C..G... ..T....... .T........ T.....G... .......... .......... ...A..T... .....G.... .T.....G.. ..........
17. JF728777 (Neotragus pygmaeus)             ...GC...C. .......... C......... ..T....... .C........ T..T...... .....G.... .T........ T......... .......... .T........ C..C.....G
18. JF728778 (Oryx dammah)                    ........C. .......... .........T .......... .......... T......... .......... ....G..... T..T...T.. ..G....... .TG....... ...C...T..
19. JF728779 (Oryx gazella)                   ........C. .......... .........T .......... .G........ .......... .......... .T..G..... T..T...T.. .......... .......... ...C..TT..
20. JF728780 (Philantomba maxwellii)          ........C. .......... ...C...... .......... .......... .......... .......... .......T.. TG....TA.. .......... .......... ...C...T..
21. JF728781 (Philantomba monticola)          ........C. .......... ...C..G... .......... .......... T......... .......... .......C.. .G....TA.. .......... ....T..... ..........
22. JF728782 (Redunca fulvorufula)            ........C. ....T..... .......... ..T....... .T.....G.. T......... .....A.... .......T.. T.TA..T... .......... ....T..... .C....T...
23. JF728783 (Tragelaphus angasii)            .......... .......... C........T ..T....... ...AT..... .......... ..GT.A..T. .T..G..T.. ...T...... ..G....... ..G....G.. ......T...
24. JF728784  (Tragelaphus eurycerus)        ..T....... ....T..... C......... .......... ...AT..... T......... ..AA.A.... .......C.. .......... .......... .......... ..........
25. JF728785 (Tragelaphus imberbis )          ..T..G.... ....T..... T........T .....T...T ...AT..G.. .......... ..A..G.... ....G..... ...T...... .......... .T........ ......TA..
26. JF728786 (Tragelaphus oryx)               ..T....... .......... C......... .......... .G.A...... ...G...... ..AA.A..T. .......... T..T..T... .......... ....T..... .......T..
27. JF728787 (Tragelaphus scriptus scriptus)  ..T....... .......... T........T ..T..T...T ...AT..... .......... ..A..A.... .......... ...T...... .......... ..G.A..... ......T...
28. JF728788 (Tragelaphus spekii)             .......... ....T..... C......... .......... .G.A...... T......... ..AA.A.... .......C.. .......... .......... .......... ..........
29. JF728789 (Tragelaphus strepsiceros )       ..T....... .......... C......... .....T.... .G.A...... T........G ..GA.A..T. .......... ...T..T... ..G....... .......... .......T..
                                                     370        380        390        400        410        420        430        440        450        460        470        480
                                              TTTGCAACAA TAGCCACAGC ATTCATAGGA TACGTCCTAC CATGAGGACA AATATCATTC TGAGGAGCAA CAGTCATCAC TAACCTCCTC TCAGCAATCC CATATATCGG CACAAACCTA
1. JF728761 (Antidorcas marsupialis)          ...A...... .G..T..... .......... .......... .......... ......C... .......... .......... .......... ........T. .......... T.....TT..
2. JF728762 (Connochaetes gnou)               ..C....... .......... ......G..C ..T..A.... .......... .......... .......... .......... C......... .......... ....C..T.. ...T......
3. JF728763 (Dorcatragus megalotis)           .......... .......... ...T...... ........G. .......... ......C... .....G.... ....T..T.. C..T..T... ........T. .......T.. ..........
4. JF728764 (Eudorcas rufifrons)              .......... .......... .......... .......... .G........ ......T... .......... ....T..T.. ......T... ........T. .......T.. ..........
5. JF728765 (Eudorcas thomsonii)              .......... .......... .......... .......... .......... ......T... .......... ....T..T.. ......T... ........T. .......T.. ..........
6. JF728766 (Gazella gazella)                 .......... ....T..... ...T...... .......... .......... ......T... .......... ....T..... G......... .......... ....C..... ..........
7. JF728767 (Gazella leptoceros)              .......... ....T..... .C.T.....T .......... .......... ......C..T .......... ....T..... A......... .......... .......... ..........
8. JF728768 (Gazella dorcas pelzelni)         .......... ....T..... ...T...... .......... .......... ......T... .......... ....T..... G......... .......... .......... .....G...G
9. JF728769 (Hippotragus equinus)             ..C....... .......... ...T.....T ..T..T.... .......... .......... .......... .......... C......... .......... .......T.. ..........
10. JF728770 (Hippotragus niger)              ..CA...... ....T..... .........C ..T.....G. .......... .......... .......... .......... ...T...... .......... .......... ..........
11. JF728771 (Kobus ellipsiprymnus)           ...A....T. .......... .......... ..T....... .......... .......... .......... .......... C..T.....T ........T. ....C..T.. ..........
12. JF728772 (Kobus leche)                    ...A....C. .......... ...T...... ..T....... .......... ......C... .......... .......... ...T...... .......... .......T.. ..........
13. JF728773 (Kobus megaceros)                ...A....T. .......... .......... ..T....... .......... ......C... ........G. .......... ...T.....T .......... .......... ..........
14. JF728774 (Madoqua saltiana)               ..C....... .......... ......G... ..T..T.... .......... ......C... .....G.... .G.....T.. ...T...... ........T. .......T.. T.........
15. JF728775 (Nanger dama)                    .......... .......... .......... ..T....... .......... ......T..T .....G.... ....T..... .......... .......... ....C..... ....G.....
16. JF728776 (Nanger soemmerringii)           ........G. .......... ...T...... ..T....... .......... ......T..T .....G.... .......... .......... .......... ....C..... .......T..
17. JF728777 (Neotragus pygmaeus)             ..C....... .......... .........C ........T. .......... .......... ..G.....C. .......... C......... .......... .T........ ..........
18. JF728778 (Oryx dammah)                    ..C....... ....T..... ...T.....C .......... .......... .........T .....G.... ....T..... ......T... .......... ....C..... ......T...
19. JF728779 (Oryx gazella)                   ..C....... ....T..... ...T.....C .......... .......... .........T .....G.... .......... ......T... .......... ....C..... ..........
20. JF728780 (Philantomba maxwellii)          ..C.....G. .......... .........T ........T. .......... ...G.....T ........T. .......... C..T...... .......... ....C..... .......T..
21. JF728781 (Philantomba monticola)          ..C.....G. .......... .........C ..T..T..T. .......... .........T .....G..T. .......... C..T...... ........T. ....C..T.. ..........
22. JF728782 (Redunca fulvorufula)            .......... .......... .......... ........G. ....G..... ......C... .......... ....T..... ......T... .......... ....C..... ..........
23. JF728783 (Tragelaphus angasii)            ...AT.GT.. .......... .......... .....G..G. .......... .......... .......... .G........ A........A .......... .......T.. ...C......
24. JF728784  (Tragelaphus eurycerus)        ...A..GT.. .......... ......G..C .....A.... .......... .........T .......... .......... A.....T..A .....T.... .T........ ...C.G....
25. JF728785 (Tragelaphus imberbis )          ..CA..GT.. .......... G......... .....A.... .......G.. ...G...... .......... ....T..... G........A .......... ....C..T.. ...C......
26. JF728786 (Tragelaphus oryx)               ..CA..GT.. .......... ......G..C ..T..A.... .......... .......... .......... ....T..... A.....T..A .......... .T........ ...C.G....
27. JF728787 (Tragelaphus scriptus scriptus)  ...A..GT.. ....T..... .......... ..T..A..G. .......... .......... .....G.... ....T..... A..T..TT.A .......... .......... ...C.G....
28. JF728788 (Tragelaphus spekii)             ...A..GT.. .......... ......G..C .....A.... .......... .........T .......... .......... A.....T..A .......... .T.....T.. ...C.G....
29. JF728789 (Tragelaphus strepsiceros )       ..CA.GGT.. .......... .........C .....G.... .......... .......... .......... ....A..T.. A.....TT.A .......... .T.....T.. ...C......
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                                                     490        500        510        520        530        540        550        560        570        580        590        600
                                              GTCGAATGAA TCTGAGGAGG ATTCTCAGTA GACAAAGCAA CCCTCACCCG ATTCTTCGCC TTCCACTTTA TCCTCCCATT TATCATTGCA GCCCTCGCCA TAGTCCACCT ACTATTCCTC
1. JF728761 (Antidorcas marsupialis)          .......... .......... C..T..G... .......... ....T..... ...T..T... .......... ....T..... C......... ..T..T..T. .......... ...C.....T
2. JF728762 (Connochaetes gnou)               .......... .......G.. ......G... .......... .......... ...T...... ........C. .......... ......CA.. .....T..T. .......T.. C.........
3. JF728763 (Dorcatragus megalotis)           ..T....... .......G.. C..T...... .....G..C. ....T..T.. ...T...... .....T.... .T..T..... ...T...... .......... .......T.. C..T......
4. JF728764 (Eudorcas rufifrons)              ..A....... .T.....C.. G......... ..T....... .A........ ......T... ..T....... .T........ C......... .......... ....T..... CT.......T
5. JF728765 (Eudorcas thomsonii)              ..A....... .T.....T.. G......... ..T....... .A........ ......T... ..T....... .T........ C......... .......... ....T..... CT.......T
6. JF728766 (Gazella gazella)                 ..A....... .......... G......... ..T....... .A........ ......T..T ..T....... .T........ C......... ........T. ........T. .T.......T
7. JF728767 (Gazella leptoceros)              ..A....... .......... .......... ..T....... .A..T..... ...T..T... .......... .T..T..... C........G .......... ....T...T. .T.......T
8. JF728768 (Gazella dorcas pelzelni)         ..A....... .......... .......... ..T....... .A..T..... ......T..T ..T....... .T........ C......... ........T. ........T. .T....T..T
9. JF728769 (Hippotragus equinus)             .......... .......G.. ......C... .......... .......... .......... .......... .T..T..C.. ......CA.T .....T.... ....A..... ...C..T...
10. JF728770 (Hippotragus niger)              .......... .......G.. ......C... .......... .......... ......T..T .......... .T.....T.. .......A.T .......... ....A..... ...C..T..T
11. JF728771 (Kobus ellipsiprymnus)           .......... .......... ...T...... ..T..G.... ....T..... C.....T... .......... .T........ C.....C... ..TA.TA... .......T.. T..G..T...
12. JF728772 (Kobus leche)                    .......... .......... .......... .......... ....T..... C......... .......... .......... ......C... ..TA..A.T. ....T..... G.....T..T
13. JF728773 (Kobus megaceros)                .......... .......... .......... .......... ....T..... C......... .......... .......... ......C... ..TA....T. ....T..... .........T
14. JF728774 (Madoqua saltiana)               .......... .......... T......... ..T....... .......T.. ......T... .......... .......... ......C... .......... .......... T..T..T...
15. JF728775 (Nanger dama)                    ..A....... .......... .......... ..T..G.... .A........ ......T... .....T..C. ..T....... C......... .....T.... ....T..T.. .T....T..T
16. JF728776 (Nanger soemmerringii)           ..A....... .......... G......... .......... .A........ ......T... .....T.... ..T.T..... C......... .....T.... .......T.. .T....T..T
17. JF728777 (Neotragus pygmaeus)             ..T....... .......G.. G......... ..T..G.... ....A..T.. .........T ........C. .T..T..C.. ...T.....G .....A.... .G........ .T........
18. JF728778 (Oryx dammah)                    .......... .T.....G.. ......C... .......... .......... ...T...... .......... .T.....T.. ...T..C..T .....T.... .......... ...C..T...
19. JF728779 (Oryx gazella)                   ........G. .T.....G.. ......C... .......... .......... .......... .......... .T.....C.. ...T..C..T .....T.... .......T.. ...C..T...
20. JF728780 (Philantomba maxwellii)          ..T....... .......... ...T...... ..T....... ....T..... .......... ........C. ..T.T..... ......C... .....T.... ....T..... ...C......
21. JF728781 (Philantomba monticola)          .......... .......G.. T..T...... .......... ....T..... .......... ........C. ..T.T..... ......C... .....T.... ....T..... ...C......
22. JF728782 (Redunca fulvorufula)            ..T....... .......... G........G ..T....... .......T.. .......... .......... .......... ......CAT. ........T. .......... ..........
23. JF728783 (Tragelaphus angasii)            ..T....... .......... C.....G... .....G.... ....A..... ...T...... ........C. .......G.. ...T...A.. ..G..G.TT. .G........ .T........
24. JF728784  (Tragelaphus eurycerus)         ..T..G..G. .......... C..T...... .......... ....G..... .........T .......... .TT....... ...T...... ..A..A.... .G..A..... ......T...
25. JF728785 (Tragelaphus imberbis )          .......... .......... G..T.....G .......... ....A..... ...T...... ........C. ....T..... ...T..C... ..A..A...C .T........ T.........
26. JF728786 (Tragelaphus oryx)               ..T..G.... .......... C..T...... .......... ..T.A..... .......... ........C. .......... ...T...... ..A..A.... .G........ ..........
27. JF728787 (Tragelaphus scriptus scriptus)  .......... .......T.. T.....G..T .......... ..T.A..T.. .......... .......... .......... ...T..CA.. ..A..G.... .......... ...T.....G
28. JF728788 (Tragelaphus spekii)             .......... .......G.. C..T...... .......... ..T.A..... .......... .......... ....T..... ...T...A.. ..A..A.... .G..A..... ..........
29. JF728789 (Tragelaphus strepsiceros )      ..T....... .......G.. C..T.....G .......... ..T.A..... .......... ........C. .......G.. C..T...... ..A..A.... .......... ......T...
                                                     610        620        630        640        650        660        670        680        690        700        710        720
                                              CACGAAACAG GATCCAACAA CCCCACAGGA ATCTCATCAG ACACAGACAA AATCCCATTC CACCCCTACT ACACCATCAA AGACATCCTA GGCGCCCTAC TACTAATCCT AGCCCTAATA
1. JF728761 (Antidorcas marsupialis)          ..T....... ....A..... ...T...... .......... ..G....... G..T.....T .......... .T.....T.. .........G ..A....... ..T....TT. .A....C..G
2. JF728762 (Connochaetes gnou)               .....G.... ....T..... T......... ..T.....C. ....C..T.. .......... ........T. .......... .......... .....T...T .......T.. ......C...
3. JF728763 (Dorcatragus megalotis)           .....G.... ....T..... ...T.....C .......... ..G....... ...T...... .......... .......T.. ......T... ......T... ..T....TA. ..T...T...
4. JF728764 (Eudorcas rufifrons)              ..T....... .......T.. ...T...... .......... .......... ...T...... .......... .T..T..... ...T...... ..A..A..G. .......TA. ......C...
5. JF728765 (Eudorcas thomsonii)              .......... .......T.. ...T...... .......... ..G....... ...T...... ..T..A.... .T..T..... ...T...... ..A..A.... .......TA. ......T...
6. JF728766 (Gazella gazella)                 .......... .......... .......... ..T....... ..G....... .........T .......... .......... G......... ..A..A.... .......... ..TT..T...
7. JF728767 (Gazella leptoceros)              ..T....... .......... .......... .......... ..G....... ...T.....T ..T....... .T........ G.....T... ..A..A.... .......T.. ..TT..T.C.
8. JF728768 (Gazella dorcas pelzelni)         .......... ....T..... T..T...... ..T....... ..G....... ...T.....T .......... .......... G.....T... ..A..A.... .......... ..TT..C.C.
9. JF728769 (Hippotragus equinus)             ..T..G.... .C........ .......... ..T....... ..G....... G......... ..T..T.... .......T.. ......T... .......... .......T.. ......C...
10. JF728770 (Hippotragus niger)              .......... .C........ .......... ..T....... ..G....... ......G... ..T..T.... .T..T..T.. .......... ..T....... ........T. ......C...
11. JF728771 (Kobus ellipsiprymnus)           ..T....... .......T.. T......... .......... ...T...T.. ...T.....T .....A.... .......... ......T... .......... .......... ..T.T.....
12. JF728772 (Kobus leche)                    ..T....... ....T..... .........G .......... .T.T...... .......... .....A..T. .......T.. ......T... ..T....... .....G..TC .A........
13. JF728773 (Kobus megaceros)                ..T....... ....T..... ...T.....G ..T....... .......... .......... .....A..T. .T........ ...T..T... ..T.....C. ..T....... .ATA......
14. JF728774 (Madoqua saltiana)               .......... .......... T..A.....C ..T....... ..G....... .........T .......... .T..T..T.. ...T..T... ..TAT..... .......TA. ..G...C...
15. JF728775 (Nanger dama)                    .......... .......... .......... ..T....... .TG....... ...T..G... .......... .......... ......T... ..A..A.... ..T....T.. ......C...
16. JF728776 (Nanger soemmerringii)           .......... ....T..... .......... ..T....... .TG....... ...T...... .......... .......... ......T... ..A..A.... ..T..G.T.. ......C...
17. JF728777 (Neotragus pygmaeus)             .......... ....T..... .......... .......... ..G....T.. .........T .......... .......T.. .......T.. ....TT.... ....T...T. ......T...
18. JF728778 (Oryx dammah)                    .......... .C........ ...T...... ...A.C.... .......... ...T..G... .....T..T. .T.....T.. ...T...T.. .......... .......... ......T..G
19. JF728779 (Oryx gazella)                   .......... .C........ ...T...... ...A.C.... .......... G......... ........T. .T.....T.. .......T.. .........T .......... ......C..G
20. JF728780 (Philantomba maxwellii)          .......... .......... .......... .......... ..G....T.. ...T.....T ........T. .T........ .........G .........T ....T..T.. ..........
21. JF728781 (Philantomba monticola)          .......... ....T..T.. .......... .......... ..G....... .........T .......... ....T..... .......... .........T ....T..T.. ..........
22. JF728782 (Redunca fulvorufula)            ..T....... .......... .........G ..T....... .Y.TR..... .........T ..T..A.... .......... ...T..T... ..T....... .......... G.......C.
23. JF728783 (Tragelaphus angasii)            ..T....... .......... ...A...... .......... ...T...... ...T...... ........T. ....T..... G......... .......... ..T....... ..........
24. JF728784  (Tragelaphus eurycerus)         .....G.... .......... ...A...... .......... ...T...... .........T .....T.... ....T..... G......T.. ..T.T..... .GT....... .A.T......
25. JF728785 (Tragelaphus imberbis )          .......... .......... ...A...... .....G.... .......... .......... .......... .T..A..T.. ......T... ..T......T .......T.. ...T......
26. JF728786 (Tragelaphus oryx)               .......... .......... ...A...... .......... ...T...... .......... .....T...C ....T..... G......... .......... .....G.... .A.T......
27. JF728787 (Tragelaphus scriptus scriptus)  .......... .......... ...A...... ...C...... .......... .......... .......... .......... G.....T... ....T....A .......... .A....G...
28. JF728788 (Tragelaphus spekii)             .......... .......... ...A...... ..T......A ...T...... ...T.....T .....T.... ....T..T.. N......... N.T....... .G........ .A.T......
29. JF728789 (Tragelaphus strepsiceros )      .......... ....T..... ...A...... .......... ...T...... .......... .....T.... ....T..... ...T...T.. .......... .GT..G.... ...T......
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                                                     730        740        750        760        770        780        790        800        810        820        830        840
                                              CTCCTAGTAC TATTCGCACC CGACCTACTY GGAGACCCAG ACAACTACAC CCCAGCAAAC CCACTCAACA CACCCCCTCA CATCAAACCC GAATGATATT TCCTATTCGC ATACGCAATC
1. JF728761 (Antidorcas marsupialis)          ..A.....C. ....TT.... A........T .......... .T........ A......... .....T..T. .......A.. .......... .......... .......... ..........
2. JF728762 (Connochaetes gnou)               ..A....... .......G.. ...TT....T .......... .......... ...C.....T .......... .......... ......G... .......... .......T.. ...T......
3. JF728763 (Dorcatragus megalotis)           ........TT .G...T.... A.....G..A .......... .......... A......... .....T..T. .......A.. T......... .......... .T........ ..........
4. JF728764 (Eudorcas rufifrons)              .....T.... .....T.... G.....G..T .......... .......... A........T .......... .......A.. .........T .......... ..T....... .........T
5. JF728765 (Eudorcas thomsonii)              .......... .......... G.....G..T .....T.... .......... A........T .......... .......A.. .........T .......... ..T....... .........T
6. JF728766 (Gazella gazella)                 ........T. .....T.... G........C .......... .......T.. A........T .......... .......A.. .........T .....G..C. ..T....... ...T.....T
7. JF728767 (Gazella leptoceros)              ........T. .....T.... G........C .......... ....T..... A........T .......... .......A.. .........T ........C. .......... ..........
8. JF728768 (Gazella dorcas pelzelni)         ........T. .....T.... A........C .......... .......... A........T .......... .......A.. .........T ........C. ..T....... ...T.....T
9. JF728769 (Hippotragus equinus)            ..A....... .......... .........T .......... .......T.. .......... .......... .......... .......... .......... .TT....... G........T
10. JF728770 (Hippotragus niger)              T.A....... .G........ .........T .......... .T........ .......... ........T. .......... ......G... .......... ..T....T.. ..........
11. JF728771 (Kobus ellipsiprymnus)           ........T. .......C.. .........C .....T..T. .......T.. .......... .....T.... .......... ...T.....T ........C. ..T....... ...T.....T
12. JF728772 (Kobus leche)                    .......... ....T..C.. .........C ........T. ....T..T.. .......... .......... .......... T......... .......... ..T....T.. ..........
13. JF728773 (Kobus megaceros)                .......... ....T..C.. .........T ........T. ....T..T.. .......... .....T..T. ....T..C.. T..T...... .......... ..T....... .........T
14. JF728774 (Madoqua saltiana)               ........C. ....TT.... A.....G..C .......... .......... A......... ..C....... .......... T..T..G... ..G....... .......T.. ..........
15. JF728775 (Nanger dama)                    ........T. .....A.... A..T..G..T .......... .......T.. A........T .....T..T. .......A.. T.....G..T ..G....... .......T.. .........T
16. JF728776 (Nanger soemmerringii)           ........C. .....A.... G.....G..T .......... .......... A......... ........T. .......A.. T.....G..T ..G....... .......T.. .........T
17. JF728777 (Neotragus pygmaeus)             .....T..GT .G...AT... T.....G..T ........G. .......... .......... .....A.... .......... T..T...... .....G..C. .......... ...T..T...
18. JF728778 (Oryx dammah)                    T.G......T .......... .........T .......... .T..T..T.. A........T .....T.... .......... .......... .......... .......T.. ...T..G...
19. JF728779 (Oryx gazella)                   ..A......T .......... .........T .......... ....T..T.. .........T .....T.... .......... .......... ........C. .......T.. ..........
20. JF728780 (Philantomba maxwellii)          A......... .....T.... ....T....C .....T.... .T..T..T.. T......... .....T.... ....T..C.. ......G... .......... .......... G........T
21. JF728781 (Philantomba monticola)          A.T....... .G...T.... ...TT....C .......... ....T..... T........T .....T.... .......... .......... ........C. .......... .........T
22. JF728782 (Redunca fulvorufula)            ..AT...... ....TA.C.. T........C ........C. ....T..... .......... .......... ....T..... .........A ........C. ..T....T.. ..........
23. JF728783 (Tragelaphus angasii)            G.A....... .....A.... T.....C..C ........C. .......... ......G... ..C.....T. ....T..C.. T........T .......... ....G..... ...T......
24. JF728784  (Tragelaphus eurycerus)         .......... .....S.... ....Y.C..C ........CR .......T.. .......... .......... .M..A..... ......G... .....G.... .......T.. ...T......
25. JF728785 (Tragelaphus imberbis )          ..T.....G. .G..T..... T..T..C..T ........C. .......T.. .......... .......... .......... ...T...... .....G..C. .......... .........T
26. JF728786 (Tragelaphus oryx)               ..T....... .......... ......C..C ........T. .......... .......... .......... ....T..C.. T..T...... .......... .......T.. ...T......
27. JF728787 (Tragelaphus scriptus scriptus)  ..A..GAC.T .......... ......C..T ........C. .......... .......... .......... ....T..... ...T.....T .......... ....G..... C.........
28. JF728788 (Tragelaphus spekii)             .......... .......... ......T..C ........C. .......... .......... ......N... ..N.A.T... .........T ........C. .......... ...T......
29. JF728789 (Tragelaphus strepsiceros )      ..A....... ....TA.... ......C..C ........T. .......... .......... .....T.... ....T..C.. T..T...... ........C. .......... ..........
                                                     850        860        870        880        890        900        910        920        930        940        950        960
                                              CTACGATCAA TCCCCAATAA ACTAGGAGGA GTCCTAGCCC TAGTCCTCTC AATCCTAATC CTAGTCCTTA TACCCCTACT CCACACATCC AAACAACGAA GCATAATATT CCGACCAATC
1. JF728761 (Antidorcas marsupialis)          ..T....... .T..T..C.. .......... ..A....... ..A.TA.A.. .........T .......... .....T.... ...T...... .......... .......... ..........
2. JF728762 (Connochaetes gnou)               .......... ....T..C.. .......... ...T...... .......A.. .......... .....A..C. ....A..G.. .......... .......... ....G..... T.........
3. JF728763 (Dorcatragus megalotis)           ..C....... .T.....C.. .......... ...T...... ....GT.... G..T...... T..A...... .......... T......... .......... ....G..... .........T
4. JF728764 (Eudorcas rufifrons)              ..T....... ....T..... .........G ...T...... .......G.. ...T...... ........G. .......... A......... .......... .......... T.........
5. JF728765 (Eudorcas thomsonii)              ..T....... ....T..... .........G ...T...... .......A.. ...T...... ........G. .......... A......... .......... .......... T.........
6. JF728766 (Gazella gazella)                 ..C....... .T........ .........G ..T......T .......A.. ...T...... ...A...... .......... A......... .......... .......... T.........
7. JF728767 (Gazella leptoceros)              ..C....... .T.....C.. G......... .......... .......A.. ...T...... T..A...... .......... A..T.....T .......... .......... T.........
8. JF728768 (Gazella dorcas pelzelni)         ..C....... .T........ .......... .........T .......A.. ...T...... T......... .G........ ...T.....T .......... .......... T..G......
9. JF728769 (Hippotragus equinus)            .......... .......... ...G...... .......... .......... .......... T....AT.A. .....GC... .......... .......... .......... ..........
10. JF728770 (Hippotragus niger)              ..C....... .T........ .......... ..T....... ..A..T.... ...T.....T .....A.... ....TGC... ...T...... .......... ....G..... ...G......
11. JF728771 (Kobus ellipsiprymnus)           .......... .......C.. .........G .......... ....T..... C......... .....T..C. .......... .......... .......... .T........ T........T
12. JF728772 (Kobus leche)                    T....G.... .T........ .......... .......... .......... C..T...... .......... .......... .......... .......... .T........ ..........
13. JF728773 (Kobus megaceros)                T....G.... .T..T..... ...G...... ..T....... ..A....... T..TT....T .......... .....T.... ...T...... .......... .T........ ..........
14. JF728774 (Madoqua saltiana)               ..T....... .T..T..C.. .......... ...T...... .......... .......... .....T..C. ....T..G.. .......... .......... .T........ .........T
15. JF728775 (Nanger dama)                    ..C....... .T........ .......... .....G.... .......A.. .......... ........C. ....T..... T..T...... .......... .T..G..G.. T........T
16. JF728776 (Nanger soemmerringii)           ..C....... .T........ .......... .....G.... .......A.. G......... .......... .G..T..... ...T.....T .......... .......... T.........
17. JF728777 (Neotragus pygmaeus)             .......... ....A..C.. .......... .......... ....T..T.. .......... ..CA...... .......... .......... ..G....... .......... .........T
18. JF728778 (Oryx dammah)                    T......... .......C.. .........C .......... .......... .......... ..G..A..CG .....AC... .......... .......... ....G..... T.........
19. JF728779 (Oryx gazella)                   T......... .......C.. .........T .......... .......... .......... ..G..A..CG .....AC... .......... .......... ....G..... ..........
20. JF728780 (Philantomba maxwellii)          .......... ....A..... .T.......G .......... .......... .......... ...A.T..C. ....AT.T.. .......... .......... .......G.. ..........
21. JF728781 (Philantomba monticola)          .......... ....A..... .........G .......... .......... .......... ..TA.T.... ....A..T.. .......... .......... .......... ......G...
22. JF728782 (Redunca fulvorufula)            .......... .......... .......... ..A.....TT ....TT.A.. C........T .....T..C. .....T.... ...T...... .....G.... .......... ..........
23. JF728783 (Tragelaphus angasii)            ........T. .......C.. G........T .......... ....A..... .........T ...A....A. ....T..... A....T...A .......... .T........ .......T.A
24. JF728784  (Tragelaphus eurycerus)         .......... .......... .......... ..T....... ....A..... ......T... ..CA..T.A. .G........ A..TGT.... .......... .......... T......T.A
25. JF728785 (Tragelaphus imberbis )          ..G....... ....A..... .........G .......... ....A..... .......... ..TA..T.A. ....T..... G......... .......... .......... .......T.G
26. JF728786 (Tragelaphus oryx)               .......... .......C.. .......... ..T.....T. ....A..... ...T...... ..TA..T.A. .......... A......... .......... .......G.. .......T.A
27. JF728787 (Tragelaphus scriptus scriptus)  ........C. .......... .......... .......... .G..A..... .......... ..CA....A. .......... G..T...... .......... .......... T......C.A
28. JF728788 (Tragelaphus spekii)             .......... ....T..... .........G ..T....... ....A..... .......... ..CA.T..A. ........T. A..TGT.... .......... .......... .......T.A
29. JF728789 (Tragelaphus strepsiceros )      ........G. .......C.. G..C.....G ..T.....T. ....A..A.. ...T..T..T ..TA..T... ........T. A......... .......... .......... .......T.A
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                                                 970        980        990      1,000      1,010      1,020      1,030      1,040      1,050      1,060      1,070      1,080
                                                   |          |          |          |          |          |          |          |          |          |          |          |
                                          AGCCAATGCC TATTCTGAAT CCTAGTAGCA GACCTACTAA CACTCACATG AATCGGAGGA CAACCAGTCG AACACCCATA CATTATTATC GGACAACTAG CATCTATCAT ATATTTCCTA
1. JF728761 (Antidorcas marsupialis)      .........A .......... T......... ...T.G.... ..T.A..... ...T...... .....G..T. .........T .......... .....G.... ....A...C. .......T..
2. JF728762 (Connochaetes gnou)           .........A .......... .......... ........G. ....T..... .......... ..G....... .......... ......C... .......... ....C..T.. .........G
3. JF728763 (Dorcatragus megalotis)       .......... .G........ TT........ .......... ....T..... ......G... .......... .......... ...C..C..T .......... ........T. ...C...AC
4. JF728764 (Eudorcas rufifrons)          .....G.... .T........ ......C... .....G.... .......... ...T...... .......... .......... ......C..T .......... ....A..T.. G..C......
5. JF728765 (Eudorcas thomsonii)          .....G.... .C........ ......C... .....GT... .......... ...T...... .......... .......... .........T .......... ....A..... G..C......
6. JF728766 (Gazella gazella)             .......... .......... ...T...... ...T.G.... .......... .......... .......... .......... ...C...... .......... ....A..... .........G
7. JF728767 (Gazella leptoceros)          .......... .......... .......... .....G.... ....T..... .........G ........T. .......... ...C...... .......... ....A..... ......T...
8. JF728768 (Gazella dorcas pelzelni)     .......... .......... T......... .....G.... ....T..... .......... .......... .......... .......... .......... ....A..T.. ..........
9. JF728769 (Hippotragus equinus)         .........A .T........ .T........ ......T... .......... .......... ........T. .......... T..C..C... ......T... .......... ..........
10. JF728770 (Hippotragus niger)          ........TA .C........ .T....G... ...T...... .......... ...T...... ........T. .......... T......... ......T... .......... ...C......
11. JF728771 (Kobus ellipsiprymnus)       ..T.....T. .G........ T......... .......... .......... .......... .....G.... ....T..... T.....C..T .......... .......... ...C.....T
12. JF728772 (Kobus leche)                ..T....... .G........ T......... .......... .......G.. .......... ..G....... .......... ......C..T .......... ....C..T.. .........T
13. JF728773 (Kobus megaceros)            ..T....... .G........ T......... ..TT...... .......... .......... ........T. .......... T..C.....T .......... .......T.. .........T
14. JF728774 (Madoqua saltiana)           ........TT ........G. .......... .......... ....T..... ...T.....C ........T. .......... ...C...... .......... ....C...C. G.....TAC.
15. JF728775 (Nanger dama)                ........T. .......... T......... .....GT... .......... G......... .....G..T. .......... .........T .......... ....A..... G..C.....G
16. JF728776 (Nanger soemmerringii)       .......... .......... .......... .....GT... .......... G......... ........T. .......... .........T .......... ....A....C G..C......
17. JF728777 (Neotragus pygmaeus)         .........T .G......G. A........G ......T... .......... ...T...... .......... .......... .......... .......... .......T.. ...C......
18. JF728778 (Oryx dammah)                .........A .T........ .T........ ...T...... .G........ ......T... ..G.....T. .......... ..C...C... ......T... .......... ..........
19. JF728779 (Oryx gazella)               ........TG .T........ .T........ ...T..T... ....T..... ......T... ........T. .......... ......C... ......T... .......... ..........
20. JF728780 (Philantomba maxwellii)      ..T....... .G........ T......... ......T... .......... ...T...... .....G.... .......... .........T ......T... .......T.. .........C
21. JF728781 (Philantomba monticola)      ..T.....T. .......... T......... .......... .......... .......... .......... .......... T........T ......T... .......T.. .........C
22. JF728782 (Redunca fulvorufula)        .......... ....T..... .......... ..TT...... .......... ...T.....G .......... .......... T..C..C... .......... ....C..... ..........
23. JF728783 (Tragelaphus angasii)        .........T ........C. .T....G... .......... .C..T..... ...T...... ..G.....T. .......... T......... .......... ....C..... T..C.....C
24. JF728784  (Tragelaphus eurycerus)     .......... .C........ .T...C.... .......... .......... ...T...... .....G..T. .......... T........T .......... ....C..... ...C.....C
25. JF728785 (Tragelaphus imberbis )      .......... .......... .T........ ........C. .......... ...T.....G .......... .......... T..C..C... .......... .......T.. ...C.....C
26. JF728786 (Tragelaphus oryx)           ..T....... .C......G. .T...C.... .......... .......... .......... ........T. .......... ...C..C... .......... ....C..... ...C.....C
27. JF728787 (Tragelaphus scriptus scriptus) ..T.....TT ........C. TT........ .......... .......... ...T.....G ........T. .......... T.....C... .......... ....C....C C..C.....C
28. JF728788 (Tragelaphus spekii)         .......... .C........ .T...C.... .......... .....MN... .......... .......... .........C T.....C..T .......... ...NC..... .CTC...T.C
29. JF728789 (Tragelaphus strepsiceros )  .......... .C........ .T........ .......... ....A..... G......... .......... .......... T..A..C... .......... ....C..... G.....T..C

                                               1,090      1,100      1,110      1,120      1,130      1,140
                                                   |          |          |          |          |          |
                                          CTTATCCTAG TACTAATACC AGTAGCCAGC ACCATTGAAA ATAACCTCCT AAAATGAAGA
1. JF728761 (Antidorcas marsupialis)      .......... .G........ ...G...... .....C.... .......... ........A.
2. JF728762 (Connochaetes gnou)           ..A....... ....G..... ..C....G.. ..T....... .C...T..T. ..........
3. JF728763 (Dorcatragus megalotis)
4. JF728764 (Eudorcas rufifrons)          ..C..T.... .GT.G..... .......... ........G. .......... ..........
5. JF728765 (Eudorcas thomsonii)          ..C..T.... .GT.G..... .......... ........G. .......... ..........
6. JF728766 (Gazella gazella)
7. JF728767 (Gazella leptoceros)          .....T.... ....G..... ..C......T .......... ...G..C.T. ..........
8. JF728768 (Gazella dorcas pelzelni)     ..C....... ....G..... ..C......T .......... ...GT..... ..........
9. JF728769 (Hippotragus equinus)         ..C......A .T........ .A....T... .......... ........T. ..........
10. JF728770 (Hippotragus niger)          ..C....... .G........ .A.G...G.T T.T..C.... ....A..... ..........
11. JF728771 (Kobus ellipsiprymnus)       ..C...T... .TT....... .AC....... ..T..C.... .C..T..... ..........
12. JF728772 (Kobus leche)                ..A..T.... .C........ .AC....... .....C.... .C......T. ..........
13. JF728773 (Kobus megaceros)            ..A...T.G. .C........ .AC....... .......... .....TCT.. ..........
14. JF728774 (Madoqua saltiana)           ..C....... .G........ ......T... ..A....... .C...TCT.. ..........
15. JF728775 (Nanger dama)                .......... .......G.. ......TG.. .......... .......... ..........
16. JF728776 (Nanger soemmerringii)       .......... ....G..... ......T... .......... .......... ...G......
17. JF728777 (Neotragus pygmaeus)         ..C..T.... .G........ ......TG.T ..T..C.... .C........ ........A.
18. JF728778 (Oryx dammah)                ......T... ....T..... .........T ..T....... .......T.. ..........
19. JF728779 (Oryx gazella)               .....T.... ....C..... ......T..T G......... .C.....T.. ..........
20. JF728780 (Philantomba maxwellii)      ..A....... ..T....... ......T... .....C.... .C.....T.. ..........
21. JF728781 (Philantomba monticola)      ..A....... ..T....... ......T... .....C.... .......T.. ..........
22. JF728782 (Redunca fulvorufula)        ..A......A .C..R..... .AC...T... .......... .......... ..........
23. JF728783 (Tragelaphus angasii)        .....T..T. .......... ...TAT...T ..A..C.... .C........ ..........
24. JF728784  (Tragelaphus eurycerus)     .....T.... .......... ..C.A..... .TA....... .....T.TT. ..........
25. JF728785 (Tragelaphus imberbis )      .....TT... ..T....G.. ..C.ATT... .TA..C.... ....TT.AT. ...G......
26. JF728786 (Tragelaphus oryx)           ..C....... .G........ ....A.T... .TA..C.... .....T.... ..........
27. JF728787 (Tragelaphus scriptus scriptus) .....T..C. .......... ....A.T..T ..A..C.... ....T..... ..........
28. JF728788 (Tragelaphus spekii)         .A...T.... ..T....... ....A....T .TA....... .....T.TT. ..........
29. JF728789 (Tragelaphus strepsiceros )  ......T... .......... ....A....T .TA..C.... .C...T.... ..........
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SuppTab. 1 **Sequence List and References used for Phylogeny Reconstruction**. Given are GenBank accession numbers of 140 *cytb* sequences used for the reconstruction of the dated bayesian bovid phylogeny (Fig.4). Sequences obtained from own tissue samples are referred to its origin. Sequence length is given if not achieving full 960 bp length; *) outgroup species, AWWP) Al Wabra Wildlife Preservation.

Species	Accession Numbers	References, Origin	Sequence length
Addax nasomaculatus	AF034722	Hassanin et al. 1998	-
Aepyceros melampus	AF022056	Matthee & Robinson 1999	-
Alcelaphus b. cokei	AF300939	Flagstad et al. 2001	327
Alcelaphus b. lichtensteinii	AF016636	Matthee & Robinson 1999	-
Alcelaphus b. major	AF300942	Flagstad et al. 2001	327
Ammotragus lervia	AF034731	Hassanin et al. 1998	-
Antidorcas marsupialis	JF728761	Hannover Zoo, Germany	-
*Antilocapra americana**	AF091629	Hassanin & Douzery 1999	-
Antilope cervicapra	AF022058	Matthee & Robinson 1999	-
Arabitragus jayakari	AY846791	Ropiquet & Hassanin 2005	-
Beatragus hunteri	AF034968	Hassanin & Douzery 1999	-
Bison bison	AF036273	Hassanin & Douzery 1999	-
Bison bonasus	Y15005	Zimmermann et al. 1998	-
Bos gaurus	DQ459331	Hassanin & Douzery 1999	-
Bos javanicus	AY689188	Hassanin & Ropiquet 2004	-
Bos mutus	AY955226	Liu, 2005 (unpublished)	-
Bos primigenius	NC013996	Edwards et al. 2010	-
Bos sauveli	AY689189	Hassanin & Ropiquet 2004	-
Boselaphus tragocamelus	AJ222679	Hassanin & Douzery 1999	-
Bubalus bubalis	EU807964	Geng, 2009 (unpublished)	-
Bubalus depressicornis	AF091632	Hassanin & Douzery 1999	-
Bubalus mindorensis	D82895	Tanaka et al. 1996	-
Bubalus quarlesi	D82891	Tanaka et al. 1996	-
Budorcas taxicolor	AY669320	Ropiquet & Hassanin 2005	-
Capra aegagrus	FJ936175	Hassanin 2003	-
Capra caucasica	DQ246801	Kazanskaya 2005 (unpublished)	-
Capra cylindricornis	DQ246778	Kazanskaya 2005 (unpublished)	-
Capra falconeri	AF034736	Hassanin et al. 1998	-
Capra ibex	AF034735	Hassanin et al. 1998	-
Capra nubiana	AF034740	Hassanin et al. 1998	-
Capra pyrenaica	FJ207528	Hassanin 2003	-
Capra sibirica	AF034734	Hassanin et al. 1998	-
Caupra walie	EU368863	Gebremedhin et al. 2009	509
Capricornis crispus	FJ207533	Hassanin et al. 2009	-
Capricornis sumatraensis	FJ207534	Hassanin et al. 2009	-
Capricornis swinhoei	D32194	Chikuni et al. 1995	646
Cephalophus adersi	AF153883	van Vuuren & Robinson 2001	-
Cephalophus callipygus	AF153885	van Vuuren & Robinson 2001	-
Cephalophus dorsalis	AF153884	van Vuuren & Robinson 2001	-
Cephalophus harveyi	AF153887	van Vuuren & Robinson 2001	-
Cephalophus jentinki	AF153888	van Vuuren & Robinson 2001	-
Cephalophus leucogaster	AF153889	van Vuuren & Robinson 2001	-
Cephalophus natalensis	AF153890	van Vuuren & Robinson 2001	-
Cephalophus niger	AF153895	van Vuuren & Robinson 2001	-
Cephalophus nigrifrons	AF153896	van Vuuren & Robinson 2001	-
Cephalophus ogilbyi	AF153897	van Vuuren & Robinson 2001	-

Species	Accession Numbers	References, Origin	Sequence length
Cephalophus rubidus	AF153900	van Vuuren & Robinson 2001	-
Cephalophus rufilatus	AF153901	van Vuuren & Robinson 2001	-
Cephalophus silvicultor	AF153898	van Vuuren & Robinson 2001	-
Cephalophus spadix	AF153899	van Vuuren & Robinson 2001	-
Cephalophus weynsi	AF153902	van Vuuren & Robinson 2001	-
Cephalophus zebra	AF153903	van Vuuren & Robinson 2001	-
*Cervus elaphus**	AY035875	Ludt et al. 2004	-
Connochaetes gnou	JF728762	Zoo Dvůr Králové, Czech Rep.	-
Connochaetes taurinus	AF016638	Matthee & Robinson 1999	-
Damaliscus lunatus	AF016635	Matthee & Robinson 1999	-
Damaliscus pygargus	AF036287	Hassanin & Douzery 1999	-
Dorcatragus megalotis	JF728763	AWWP, Quatar	-
Eudorcas rufifrons	JF728764	AWWP, Quatar	-
Eudorcas thomsonii	JF728765	Hannover Zoo, Germany	-
Gazella bennettii	DQ919166	Sahajpal 2006 (unpublished)	314
Gazella cuvieri	AF030609	Rebholz & Harley 1999	300
Gazella d. pelzelni	JF728768	AWWP, Quatar	-
Gazella d. saudiya	JN410323	Lerp et al. 2011	-
Gazella dorcas dorcas	JN410338	Lerp et al. 2011	-
Gazella gazella	JF728766	AWWP, Quatar	-
Gazella leptoceros	JF728767	Zoo Dvůr Králové, Czech Rep.	-
Nanger soemmerringii	JF728776	AWWP, Quatar	-
Gazella spekei	AF030608	Rebholz & Harley 1999	300
Gazella subgutturosa	AF036282	Hassanin & Douzery 1999	-
*Giraffa camelopardalis**	X56287	Irwin et al. 1991	-
Hemitragus jemlahicus	AF034733	Hassanin et al. 1998	-
Hippotragus equinus	JF728769	Rostock Zoo, Germany	-
Hippotragus leucophaeus	AH006574	Robinson et al. 1996	484
Hippotragus niger	JF728770	Zoo Dvůr Králové, Czech Rep.	-
Kobus ellipsiprymnus	JF728771	Berlin Zoo, Germany	-
Kobus kob		Birungi & Roy 1998	-
Kobus leche	JF728772	Rostock Zoo, Germany	-
Kobus megaceros	JF728773	Zoo Dvůr Králové, Czech Rep.	-
Kobus vardoni	AF096619	Birungi & Arctander 2001	-
Litocranius walleri	AF249974	Matthee & Davis 2001	-
Madoqua guentheri	AF022071	Matthee & Robinson 1999	-
Madoqua kirkii	AF022070	Zoo Dvůr Králové, Czech Rep.	-
Madoqua saltiana	JF728774	AWWP, Quatar	-
*Moschus leucogaster**	AF026889	Su 1997, (unpublished)	-
Myotragus balearicus	AY380560	Lalueza-Fox et al. 2005	-
Naemorhedus caudatus	AY356357	Min 2003, (unpublished)	-
Naemorhedus goral	D32196	Chikuni et al. 1995	646
Naemorhedus griseus	FJ207532	Hassanin et al. 2009	-
Nanger dama	JF728775	Frankfurt Zoo, Germany	-
Nanger granti	AF034723	Hassanin et al. 1998	-
Neotragus pygmaeus	JF728777	Central Region, Ghana	-
Neotragus moschatus	AF022069	Matthee & Robinson 1999	-
Nilgiritragus hylocrius	AY846792	Ropiquet & Hassanin 2005	-
Oreamnos americanus	AF190632	Hassanin & E. Douzery 2000	-
Oreotragus oreotragus	AF036288	Hassanin & Douzery 1999	-
Oryx beisa	DQ138199	Masembe et al. 2006	-
Oryx dammah	JF728778	Karlsruhe Zoo, Germany	-

Species	Accession Numbers	References, Origin	Sequence length
Oryx gazella	JF728779	Zoo Dvůr Králové, Czech Rep.	-
Oryx leucoryx	AF036286	Hassanin & Douzery 1999	-
Ourebia ourebi	AF320574	Birungi & Roy 1998	-
Ovibos moschatus	U90302	Groves & Shields 1996	-
Ovis ammon	AF242349	Hiendleder, 2002, unp.	-
Ovis canadensis	EU365985	Rezaei et al. 2010	-
Ovis dalli	U17860	Groves & Shields 1996	-
Ovis nivicola	AJ867264	Bunch et al. 2006	-
Ovis orientalis	FJ936207	Rezaei et al. 2010	-
Pantholops hodgsoni	AF034724	Hassanin et al. 1998	-
Pelea capreolus	AF022055	Matthee & Robinson 1999	-
Philantomba maxwelli	JF728780	Central Region, Ghana	-
Philantomba monticola	JF728781	Krefeld Zoo, Germany	-
Philantomba walteri	HM144012	Colyn et al. 2010	312
Procapra gutturosa	DQ001162	Zhang 2005 (unpublished)	326
Procapra picticaudata	DQ423513	Zhang 2006 (unpublished).	321
Procapra przewalskii	DQ001160	Zhang 2005 (unpublished).	-
Pseudois nayaur	FJ207537	Hassanin et al. 2009	-
Pseudois schaeferi	AF473605	Cao 2003	-
Pseudoryx nghetinhensis	AF091635	Hassanin & Douzery 1999	-
Raphicerus campestris	AF022068	Matthee & Robinson 1999	-
Raphicerus melanotis	AF022053	Matthee & Robinson 1999	-
Raphicerus sharpei	AF022050	Matthee & Robinson 1999	-
Redunca arundinum	AF096628	Birungi and Arctander 1999	-
Redunca fulvorufula	JF728782	Zoo Dvûr Králové, Czech Rep.	-
Redunca redunca	AF096626	Birungi and Arctander 1999	-
Rupicapra pyrenaica	AF034726	Hassanin et al. 1998	-
Rupicapra rupicarpa	AF034725	Hassanin et al. 1998	-
Saiga tatarica	AF064487	Hassanin et al. 1998	-
Sylvicapra grimmia	AF153905	van Vuuren & Robinson 2001	-
Syncerus caffer	AF036275	Hassanin & Douzery 1999	-
Tetracerus quadricornis	AF036274	Hassanin & Douzery 1999	-
Tragelaphus angasii	JF728783	Zoo Dvůr Králové, Czech Rep.	-
Tragelaphus buxtoni	AY667216	Willows-Munro et al. 2005	-
Tragelaphus derbianus	AF022062	Matthee & Robinson 1999	-
Tragelaphus eurycerus	JF728784	Lund University, Sweden	-
Tragelaphus imberbis	JF728785	Hannover Zoo, Germany	-
Tragelaphus oryx	JF728786	Cottbus Zoo, Germany	-
Tragelaphus scri. sylvaticus	EF138112	Moodley & Bruford 2007	556
Tragelaphus scri scriptus.	JF728787	Central Region, Ghana	-
Tragelaphus spekii	JF728788	Lund University, Sweden	-
Tragelaphus strepsiceros	JF728789	Zoo Dvůr Králové, Czech Rep.	-

SuppTab. 2 **Extended Reference List for Tree Calibration**. Given are minimum and maximum ages for node calibration of clades defined by the fossil evidence. Data provided by F. Bibi. # refers to numbered nodes in the bayesian consensus tree (Fig. 4).

#	**Clade**		**Min Age**	**Max Age**	**Reference for minimum age**	**Reference for maximum age**
1	Alcelaphini	stem	7 Ma		Lower Nawata & Toros Menalla alcelaphins (Harris 2003; Vignaud et al. 2002)	
2	Alcelaphini	crown	~5 Ma		(Vrba 1997)	
3	*Alcelaphus buselaphus* ssp.	crown	0.3 Ma	0.6 Ma	Minimum age of *A. lichtensteini* from Semliki (Gentry 1990; Vrba 1997)	Youngest *Rabaticerus arambourgi* fossil and oldest *A. buselaphus* fossil (Vrba 1997)
4	*Alcelaphus b. lichtensteini*	stem	0.3 Ma	0.6 Ma	Minimum age of *A. lichtensteini* from Semliki (Gentry 1990; Vrba 1997)	Oldest *A. buselaphus* fossil (Vrba 1997)
5	*Beatragus*	stem	2.6 Ma		Age of *Beatragus whitei* (Vrba 1997)	
6	Bovidae	stem	~18 Ma		*Eotragus noyei* (Solounias et al. 1995)	
7	Bovina (= *Bos* spp incl. *Bison*)	stem	~3.2 Ma	~4 Ma	Age of oldest *Leptobos* spp. assuming these are stem Bovina (Michaux et al. 1991)	Oldest age for *Alephis*, assuming it is an early stem Bovina (Michaux et al. 1991)
8	Bovina (= *Bos* spp incl. *Bison*)	crown		~3.2 Ma		Age of oldest *Leptobos* spp. assuming these are stem Bovina (Duvernois 1990)
9	Bovini	stem	10.2 Ma		Earliest *Selenoportax vexillarius* (Badgley et al. 2008), a stem bovin (Bibi 2009)	
10	Bovini	crown	3.6 Ma	8.9 Ma	*Ugandax coryndonae* (A. W. Gentry 2006; Geraads et al. 2009) is in the crown clade.	If specimens described by Bibi (2007) are stem bovins.
11	Bubalina (*Syncerus-Bubalus* MRCA)	crown	3.6 Ma	~7 Ma	*Ugandax coryndonae* is already on the line to *Syncerus* (Gentry 2006)	Oldest African bovin (Vignaud et al. 2002)
12	*Connochaetes taurinus – C. gnou*	crown	1.6 Ma	1.6 Ma	Oldest *Connochaetes taurinus* and *C. africanus* (Vrba 1997)	Youngest age of *Connochaetes gentryi* (Vrba 1997)
13	*Connochaetes taurinus – C. gnou*	stem	2.5 Ma		Oldest *Connochaetes gentryi* (Vrba 1997)	
14	*Damaliscus lunatus– D. pygargus*	crown	1.1 Ma	3.4 Ma	Oldest *Damaliscus dorcas* (Vrba 1997)	Age of *Damaliscus “hadari”*, supposed ancestor to all later *Damaliscus* (Vrba 1997)

#	Clade		Min Age	Max Age	Reference for minimum age	Reference for maximum age
15	Hippotragini	stem	~7 Ma		Age of stem hippotragins from Toros-Menalla (Geraads et al. 2008)	
16	Hippotragini	crown	3.6 Ma	~7 Ma	*Hippotragus* and *Oryx* at Laetoli (Gentry 2011)	Age of stem hippotragins from Toros-Menalla (Geraads et al. 2008)
17	*Hippotragus*	crown	2.5 Ma	2.8 Ma	Oldest *Hippotragus equinus* (Vrba & Gatesy 1994)	Age of *Hippotragus cookei*, supposedly basal to crown *Hippotragus* (Vrba & Gatesy 1994)
18	*Kobus ellipsiprymnus*	stem	2.3 Ma		Oldest *K. ellipsiprymnus* (Gentry 2010)	
19	*Kobus kob - K. vardoni*	stem	1.88 Ma		Oldest *Kobus kob* (Gentry 2010)	
20	Redunca spp.	stem	5.2 Ma		Age of *Redunca ambae* (Haile-Selassie et al. 2009)	
21	Reduncini	stem	9.3 Ma		Earliest Reduncini from the Siwaliks (Badgley et al. 2008)	
22	Reduncini	crown	4.4 Ma	9.3 Ma	Age of *Kobus basilcookei,* a possible ancestor of lechwes and waterbucks (Vrba 2006)	Earliest Reduncini from the Siwaliks (Badgley et al. 2008)
23	Tragelaphini	stem	5.8 Ma		T. moroitu (Haile-Selassie et al. 2009) and Lukeino tragelaphin (Thomas 1980)	
24	Tragelaphini	crown	4.4 Ma		The tragelaphin from Aramis is derived enough to belong to the crown clade (Bibi pers. comment)	
25	*Tragelaphus derbianus – T. oryx*	stem	1.6 Ma		Minimum age of *Taurotragus* sp. from Chemeron (Bibi 2009)	
26	*Tragelaphus eurycerus*	stem	3.6 Ma		Oldest *T. rastafari* and *T. saraitu*. (Bibi 2011; Geraads et al. 2009)	
27	*Tragelaphus imberbis*	stem	2.85 Ma		Oldest *Tragelaphus gaudryi* (Gentry 1985)	
28	*Tragelaphus scriptus* (incl. T. s. *sylvaticus*)	stem	1.4 Ma		*T. scriptus* from Konso-Gardula (Suwa et al. 2003)	
29	*Tragelaphus strepsiceros*	stem	3.4 Ma		Oldest *T. lockwoodi* (Reed & Bibi 2011)	

SuppTab. 3 **Observation Points Used for Climate-Group Building and Respective Climate Variable Value**. Points not obtained from the Global Biodiversity Information Facility (GBIF) database (http://data.gbif.org) were georeferenced by hand on the base of geographic range maps or precise geographic information inferred from the respective references. Climate Variables: **Bio05** maximum temperature (°C) in warmest month, **Bio06** minimum temperature (°C) in coolest month, **Bio13** precipitation (mm) in wettest month; **Bio14** precipitation (mm)in driest month. Note that the observation points for subspecies of *Alcelaphus buselaphus* refer to the distinct clades comprising sister subspecies as well found by Flagstadt et al., 2001. Occurrence data for *Philantomba maxwellii* were assigned to *P. walterii* if within the population range of *P. walterii* (Colyn et al., 2010). Data obtained from GBIF is a subset of a total count of 52,000 records for "Bovidae", reduced by following criteria: 1) occurrence in Africa or Arabia, 2) non fossil, 3) binomial nomenclature, 4) observed in the wild (i.e. not in a zoo). Species and tribe names were corrected/changed if necessary to fit the taxonomical system.

ID	Species	Genus	Tribe	Coord. X	Coord. Y	Reference	Bio05	Bio06	Bio13	Bio14
A0001	Addax nasomaculatus	Addax	Hippotragini	24.81670000	12.70000000	http://data.gbif.org/ws/rest/occurrence/get?key=42071903	37.1	9.4	159	0
A0002	Addax nasomaculatus	Addax	Hippotragini	19.55704000	15.80000000	http://data.gbif.org/ws/rest/occurrence/get?key=79787223	41.4	15.4	47	0
A0003	Addax nasomaculatus	Addax	Hippotragini	19.10566000	16.08333000	http://data.gbif.org/ws/rest/occurrence/get?key=79821811	41.4	15.0	33	0
A0004	Addax nasomaculatus	Addax	Hippotragini	19.11667000	16.45298000	http://data.gbif.org/ws/rest/occurrence/get?key=79785551	41.3	14.8	26	0
A0005	Addax nasomaculatus	Addax	Hippotragini	35.04380000	29.86800000	http://data.gbif.org/ws/rest/occurrence/get?key=42237690	38.9	8.9	8	0
A0006	Addax nasomaculatus	Addax	Hippotragini	-9.93934334	20.64243997	http://www.iucnredlist.org	43.6	11.9	15	0
A0007	Addax nasomaculatus	Addax	Hippotragini	-9.62215917	20.91997612	http://www.iucnredlist.org	44.0	11.7	13	0
A0008	Addax nasomaculatus	Addax	Hippotragini	11.62918015	16.08291754	http://www.iucnredlist.org	40.3	11.5	29	0
A0009	Addax nasomaculatus	Addax	Hippotragini	11.78777223	16.59834182	http://www.iucnredlist.org	40.6	11.1	23	0
A0010	Addax nasomaculatus	Addax	Hippotragini	12.34284453	16.32080567	http://www.iucnredlist.org	40.5	11.1	26	0
A0011	Addax nasomaculatus	Addax	Hippotragini	12.50143661	16.99482203	http://www.iucnredlist.org	40.8	10.4	19	0
A0012	Addax nasomaculatus	Addax	Hippotragini	16.90236696	16.12256556	http://www.iucnredlist.org	41.7	13.8	38	0
A0013	Addax nasomaculatus	Addax	Hippotragini	17.14025508	16.04326952	http://www.iucnredlist.org	41.8	14.0	37	0
A0014	Addax nasomaculatus	Addax	Hippotragini	-9.58251115	20.60279195	http://www.iucnredlist.org	43.6	11.8	14	0
A0015	Addax nasomaculatus	Addax	Hippotragini	-9.75599035	29.87220941	http://www.iucnredlist.org	28.5	9.0	35	0
A0016	Addax nasomaculatus	Addax	Hippotragini	-9.66853551	29.92184594	http://www.iucnredlist.org	28.9	9.0	36	0
A0017	Addax nasomaculatus	Addax	Hippotragini	-9.61417169	30.07548283	http://www.iucnredlist.org	28.4	8.1	41	0
A0018	Addax nasomaculatus	Addax	Hippotragini	-9.54562600	30.31657457	http://www.iucnredlist.org	27.8	7.8	49	0

A0019	Addax nasomaculatus	Addax	Hippotragini	-9.59998982	30.17711955	http://www.iucnredlist.org	28.0	8.1	44	0
A0020	Aepyceros melampus	Aepyceros	Aepycerotini	32.16700000	-26.66700000	http://data.gbif.org/ws/rest/occurrence/get?key=239939439	31.1	9.5	114	9
A0021	Aepyceros melampus	Aepyceros	Aepycerotini	31.52207000	-25.09963000	http://data.gbif.org/ws/rest/occurrence/get?key=49926816	31.1	8.3	121	9
A0022	Aepyceros melampus	Aepyceros	Aepycerotini	31.77973000	-24.39478000	http://data.gbif.org/ws/rest/occurrence/get?key=49926821	33.3	7.8	103	8
A0023	Aepyceros melampus	Aepyceros	Aepycerotini	31.26482000	-24.36363000	http://data.gbif.org/ws/rest/occurrence/get?key=49926832	31.5	8.9	109	6
A0024	Aepyceros melampus	Aepyceros	Aepycerotini	22.28300000	-24.20000000	http://data.gbif.org/ws/rest/occurrence/get?key=239939842	33.6	3.1	71	1
A0025	Aepyceros melampus	Aepyceros	Aepycerotini	27.26700000	-21.68300000	http://data.gbif.org/ws/rest/occurrence/get?key=239940406	31.6	4.8	82	0
A0026	Aepyceros melampus	Aepyceros	Aepycerotini	17.00000000	-20.50000000	http://data.gbif.org/ws/rest/occurrence/get?key=224339111	30.9	4.1	103	0
A0027	Aepyceros melampus	Aepyceros	Aepycerotini	22.99440000	-19.57500000	http://data.gbif.org/ws/rest/occurrence/get?key=153238375	34.7	6.6	108	0
A0028	Aepyceros melampus	Aepyceros	Aepycerotini	17.85000000	-15.83330000	http://data.gbif.org/ws/rest/occurrence/get?key=79770791	33.6	5.6	169	0
A0029	Aepyceros melampus	Aepyceros	Aepycerotini	35.83330000	-3.58333000	http://data.gbif.org/ws/rest/occurrence/get?key=42072133	30.3	13.9	153	1
A0030	Aepyceros melampus	Aepyceros	Aepycerotini	37.75000000	-3.56000000	http://data.gbif.org/ws/rest/occurrence/get?key=49602259	32.7	15.7	120	6
A0031	Aepyceros melampus	Aepyceros	Aepycerotini	38.13330000	-3.40000000	http://data.gbif.org/ws/rest/occurrence/get?key=42071910	29.7	13.9	135	10
A0032	Aepyceros melampus	Aepyceros	Aepycerotini	35.81000000	-3.37000000	http://data.gbif.org/ws/rest/occurrence/get?key=175773966	28.5	12.6	207	2
A0033	Aepyceros melampus	Aepyceros	Aepycerotini	37.35000000	-3.06667000	http://data.gbif.org/ws/rest/occurrence/get?key=48220287	1.6	-10.4	335	68
A0034	Aepyceros melampus	Aepyceros	Aepycerotini	36.04000000	-2.90000000	http://data.gbif.org/ws/rest/occurrence/get?key=175774662	31.4	14.8	115	0
A0035	Aepyceros melampus	Aepyceros	Aepycerotini	33.41670000	-2.53333000	http://data.gbif.org/ws/rest/occurrence/get?key=42071911	29.9	15.5	182	2
A0036	Aepyceros melampus	Aepyceros	Aepycerotini	36.00000000	-2.25000000	http://data.gbif.org/ws/rest/occurrence/get?key=175774808	33.8	17.0	101	3
A0037	Aepyceros melampus	Aepyceros	Aepycerotini	34.61667000	-2.08333000	http://data.gbif.org/ws/rest/occurrence/get?key=79787302	28.7	14.2	153	17
A0038	Aepyceros melampus	Aepyceros	Aepycerotini	36.83330000	-1.36667000	http://data.gbif.org/ws/rest/occurrence/get?key=91212361	27.7	11.0	167	11
A0039	Aepyceros melampus	Aepyceros	Aepycerotini	36.35000000	-1.18333000	http://data.gbif.org/ws/rest/occurrence/get?key=79787365	24.5	7.9	190	18
A0040	Aepyceros melampus	Aepyceros	Aepycerotini	35.38333000	-1.10000000	http://data.gbif.org/ws/rest/occurrence/get?key=79787679	26.2	9.1	188	34
A0041	Aepyceros melampus	Aepyceros	Aepycerotini	36.36700000	0.06700000	http://data.gbif.org/ws/rest/occurrence/get?key=86873427	23.1	5.4	141	32
A0042	Aepyceros melampus	Aepyceros	Aepycerotini	32.58330000	0.31666700	http://data.gbif.org/ws/rest/occurrence/get?key=42238271	28.5	15.6	182	62
A0043	Aepyceros melampus	Aepyceros	Aepycerotini	36.08330000	0.63333000	http://data.gbif.org/ws/rest/occurrence/get?key=201217602	33.4	15.0	90	21
A0044	Aepyceros melampus	Aepyceros	Aepycerotini	37.68330000	0.65000000	http://data.gbif.org/ws/rest/occurrence/get?key=91204056	33.7	14.8	124	3
A0045	Aepyceros melampus	Aepyceros	Aepycerotini	35.56667000	1.40000000	http://data.gbif.org/ws/rest/occurrence/get?key=79785543	32.0	14.3	129	18
A0046	Aepyceros melampus	Aepyceros	Aepycerotini	37.06670000	1.90874000	http://data.gbif.org/ws/rest/occurrence/get?key=91210878	33.0	14.2	123	7

A0047	Alcelaphus b. lichtensteinii	Alcelaphus	Alcelaphini	28.86670000	-30.06670000	http://data.gbif.org/ws/rest/occurrence/get?key=224263237	23.2	-0.5	161	11
A0048	Alcelaphus b. lichtensteinii	Alcelaphus	Alcelaphini	26.61670000	-27.36670000	http://data.gbif.org/ws/rest/occurrence/get?key=61809529	29.6	-3.6	100	8
A0049	Alcelaphus b. lichtensteinii	Alcelaphus	Alcelaphini	18.19990000	-23.61330000	http://data.gbif.org/ws/rest/occurrence/get?key=49614292	33.6	2.2	57	0
A0050	Alcelaphus b. lichtensteinii	Alcelaphus	Alcelaphini	24.45000000	-23.31670000	http://data.gbif.org/ws/rest/occurrence/get?key=61808415	32.3	4.0	80	1
A0051	Alcelaphus b. lichtensteinii	Alcelaphus	Alcelaphini	24.61670000	-23.18330000	http://data.gbif.org/ws/rest/occurrence/get?key=61808412	32.3	4.0	80	1
A0052	Alcelaphus b. lichtensteinii	Alcelaphus	Alcelaphini	23.25000000	-22.55000000	http://data.gbif.org/ws/rest/occurrence/get?key=61808413	33.0	4.5	86	0
A0053	Alcelaphus b. lichtensteinii	Alcelaphus	Alcelaphini	17.66667000	-22.31667000	http://data.gbif.org/ws/rest/occurrence/get?key=79793569	31.3	2.9	85	0
A0054	Alcelaphus b. lichtensteinii	Alcelaphus	Alcelaphini	21.78300000	-22.15000000	http://data.gbif.org/ws/rest/occurrence/get?key=239942681	33.1	3.9	93	0
A0055	Alcelaphus b. lichtensteinii	Alcelaphus	Alcelaphini	21.80000000	-22.10000000	http://data.gbif.org/ws/rest/occurrence/get?key=151527150	33.1	4.0	94	0
A0056	Alcelaphus b. lichtensteinii	Alcelaphus	Alcelaphini	16.21540000	-21.98330000	http://data.gbif.org/ws/rest/occurrence/get?key=49615448	33.3	6.2	80	0
A0057	Alcelaphus b. lichtensteinii	Alcelaphus	Alcelaphini	27.30000000	-21.90000000	http://data.gbif.org/ws/rest/occurrence/get?key=151527082	31.4	4.4	82	0
A0058	Alcelaphus b. lichtensteinii	Alcelaphus	Alcelaphini	27.26700000	-21.88300000	http://data.gbif.org/ws/rest/occurrence/get?key=239942588	31.4	4.5	82	0
A0059	Alcelaphus b. lichtensteinii	Alcelaphus	Alcelaphini	25.79970000	-20.57880000	http://data.gbif.org/ws/rest/occurrence/get?key=61808409	33.5	5.8	81	0
A0060	Alcelaphus b. lichtensteinii	Alcelaphus	Alcelaphini	22.26670000	-19.66670000	http://data.gbif.org/ws/rest/occurrence/get?key=49619504	34.6	6.2	104	0
A0061	Alcelaphus b. lichtensteinii	Alcelaphus	Alcelaphini	20.50000000	-19.50000000	http://data.gbif.org/ws/rest/occurrence/get?key=151527101	33.5	5.6	133	0
A0062	Alcelaphus b. lichtensteinii	Alcelaphus	Alcelaphini	15.13570000	-17.39450000	http://data.gbif.org/ws/rest/occurrence/get?key=201219283	34.4	7.3	120	0
A0063	Alcelaphus b. lichtensteinii	Alcelaphus	Alcelaphini	19.67424111	-33.49283431	http://www.iucnredlist.org	29.3	3.3	62	10
A0064	Alcelaphus b. lichtensteinii	Alcelaphus	Alcelaphini	21.35112081	-33.34039070	http://www.iucnredlist.org	26.1	-0.2	36	22
A0065	Alcelaphus b. lichtensteinii	Alcelaphus	Alcelaphini	26.12768725	-31.96839821	http://www.iucnredlist.org	28.4	0.8	64	13
A0066	Alcelaphus b. lichtensteinii	Alcelaphus	Alcelaphini	25.31465467	-29.63092953	http://www.iucnredlist.org	31.5	0.3	67	10
A0067	Alcelaphus b. lichtensteinii	Alcelaphus	Alcelaphini	22.31659701	-26.83613002	http://www.iucnredlist.org	34.6	1.5	51	1
A0068	Alcelaphus b. lichtensteinii	Alcelaphus	Alcelaphini	19.57261204	-24.14295958	http://www.iucnredlist.org	33.5	1.5	51	0
A0069	Alcelaphus b. lichtensteinii	Alcelaphus	Alcelaphini	29.73551935	-28.30975158	http://www.iucnredlist.org	28.8	1.4	138	8
A0070	Alcelaphus b. lichtensteinii	Alcelaphus	Alcelaphini	30.80262461	-27.85242075	http://www.iucnredlist.org	27.4	5.5	141	11
A0071	Alcelaphus b. lichtensteinii	Alcelaphus	Alcelaphini	29.43063213	-30.29151851	http://www.iucnredlist.org	24.8	-0.7	157	11
A0072	Alcelaphus b. lichtensteinii	Alcelaphus	Alcelaphini	31.31076998	-23.07585432	http://www.iucnredlist.org	33.2	8.6	90	4
A0073	Alcelaphus b. lichtensteinii	Alcelaphus	Alcelaphini	16.21885262	-15.86019013	http://www.iucnredlist.org	34.4	6.5	156	0
A0074	Alcelaphus b. lichtensteinii	Alcelaphus	Alcelaphini	33.54660959	-19.82372398	http://www.iucnredlist.org	32.9	11.3	190	9

A0075	Alcelaphus b. lichtensteinii	Alcelaphus	Alcelaphini	31.71728627	-24.75273402	http://www.iucnredlist.org	31.9	8.1	111	9
A0076	Alcelaphus b. lichtensteinii	Alcelaphus	Alcelaphini	31.76810081	-20.89082925	http://www.iucnredlist.org	32.3	8.1	130	4
A0077	Alcelaphus b. lichtensteinii	Alcelaphus	Alcelaphini	31.86972988	-24.65110495	http://www.iucnredlist.org	32.3	8.2	110	10
A0078	Alcelaphus b. lichtensteinii	Alcelaphus	Alcelaphini	31.25995544	-23.07585432	http://www.iucnredlist.org	33.1	8.8	94	4
A0079	Alcelaphus b. lichtensteinii	Alcelaphus	Alcelaphini	33.54660959	-19.82372398	http://www.iucnredlist.org	32.9	11.3	190	9
A0080	Alcelaphus b. lichtensteinii	Alcelaphus	Alcelaphini	28.61759954	-23.83807237	http://www.iucnredlist.org	30.8	4.5	91	2
A0081	Alcelaphus b. lichtensteinii	Alcelaphus	Alcelaphini	29.98959203	-27.29346085	http://www.iucnredlist.org	24.7	0.0	131	8
A0082	Alcelaphus b. lichtensteinii	Alcelaphus	Alcelaphini	29.58307574	-29.98663129	http://www.iucnredlist.org	23.6	-1.7	186	12
A0083	Alcelaphus b. lichtensteinii	Alcelaphus	Alcelaphini	31.97135895	-21.19571646	http://www.iucnredlist.org	32.4	9.2	121	3
A0084	Alcelaphus b. lichtensteinii	Alcelaphus	Alcelaphini	19.67424111	-34.10260875	http://www.iucnredlist.org	28.0	5.5	59	20
A0085	Alcelaphus b. lichtensteinii	Alcelaphus	Alcelaphini	20.69053184	-33.44201977	http://www.iucnredlist.org	28.6	1.1	27	13
A0086	Alcelaphus b. lichtensteinii	Alcelaphus	Alcelaphini	22.87555691	-33.13713255	http://www.iucnredlist.org	29.0	3.5	44	18
A0087	Alcelaphus b. lichtensteinii	Alcelaphus	Alcelaphini	25.87361457	-32.98468894	http://www.iucnredlist.org	29.8	4.8	59	17
A0088	Alcelaphus b. lichtensteinii	Alcelaphus	Alcelaphini	24.55243662	-32.78143080	http://www.iucnredlist.org	31.7	4.4	47	9
A0089	Alcelaphus b. lelwel	Alcelaphus	Alcelaphini	35.83330000	-3.58333000	http://data.gbif.org/ws/rest/occurrence/get?key=42072132	30.3	13.9	153	1
A0090	Alcelaphus b. lelwel	Alcelaphus	Alcelaphini	37.75000000	-3.56000000	http://data.gbif.org/ws/rest/occurrence/get?key=49611012	32.7	15.7	120	6
A0091	Alcelaphus b. lelwel	Alcelaphus	Alcelaphini	38.13330000	-3.40000000	http://data.gbif.org/ws/rest/occurrence/get?key=42071907	29.7	13.9	135	10
A0092	Alcelaphus b. lelwel	Alcelaphus	Alcelaphini	39.95000000	-3.40000000	http://data.gbif.org/ws/rest/occurrence/get?key=61808252	32.2	20.5	266	12
A0093	Alcelaphus b. lelwel	Alcelaphus	Alcelaphini	35.81000000	-3.37000000	http://data.gbif.org/ws/rest/occurrence/get?key=175773968	28.6	12.7	207	2
A0094	Alcelaphus b. lelwel	Alcelaphus	Alcelaphini	35.85000000	-3.36000000	http://data.gbif.org/ws/rest/occurrence/get?key=175774661	30.4	14.0	128	1
A0095	Alcelaphus b. lelwel	Alcelaphus	Alcelaphini	34.82500000	-2.44167000	http://data.gbif.org/ws/rest/occurrence/get?key=61809300	27.5	13.0	130	13
A0096	Alcelaphus b. lelwel	Alcelaphus	Alcelaphini	36.00000000	-2.25000000	http://data.gbif.org/ws/rest/occurrence/get?key=175774810	33.8	17.0	101	3
A0097	Alcelaphus b. lelwel	Alcelaphus	Alcelaphini	37.05000000	-1.46667000	http://data.gbif.org/ws/rest/occurrence/get?key=61808373	27.8	10.7	140	5
A0098	Alcelaphus b. lelwel	Alcelaphus	Alcelaphini	36.86670000	-1.38333000	http://data.gbif.org/ws/rest/occurrence/get?key=91212319	27.9	11.0	158	10
A0099	Alcelaphus b. lelwel	Alcelaphus	Alcelaphini	35.46700000	-1.21700000	http://data.gbif.org/ws/rest/occurrence/get?key=86873411	26.3	9.1	175	27
A0100	Alcelaphus b. lelwel	Alcelaphus	Alcelaphini	36.56670000	-1.05000000	http://data.gbif.org/ws/rest/occurrence/get?key=42071906	27.7	10.3	205	20
A0101	Alcelaphus b. lelwel	Alcelaphus	Alcelaphini	36.56670000	-0.93333000	http://data.gbif.org/ws/rest/occurrence/get?key=61808391	25.6	8.2	236	29
A0102	Alcelaphus b. lelwel	Alcelaphus	Alcelaphini	36.00000000	-0.60000000	http://data.gbif.org/ws/rest/occurrence/get?key=61808268	22.0	5.7	151	36

A0103	Alcelaphus b. lelwel	Alcelaphus	Alcelaphini	36.25000000	-0.45000000	http://data.gbif.org/ws/rest/occurrence/get?key=61808386	28.1	8.3	131	29
A0104	Alcelaphus b. lelwel	Alcelaphus	Alcelaphini	35.73330000	-0.25000000	http://data.gbif.org/ws/rest/occurrence/get?key=61808376	23.0	6.5	174	35
A0105	Alcelaphus b. lelwel	Alcelaphus	Alcelaphini	36.81700000	-0.23300000	http://data.gbif.org/ws/rest/occurrence/get?key=86873418	24.9	5.9	144	34
A0106	Alcelaphus b. lelwel	Alcelaphus	Alcelaphini	35.28330000	0.22558000	http://data.gbif.org/ws/rest/occurrence/get?key=61809311	26.4	8.2	191	39
A0107	Alcelaphus b. lelwel	Alcelaphus	Alcelaphini	37.60000000	0.33300000	http://data.gbif.org/ws/rest/occurrence/get?key=86873413	33.1	13.8	200	6
A0108	Alcelaphus b. lelwel	Alcelaphus	Alcelaphini	35.45000000	1.25000000	http://data.gbif.org/ws/rest/occurrence/get?key=61809308	19.3	4.6	208	34
A0109	Alcelaphus b. lelwel	Alcelaphus	Alcelaphini	37.06670000	1.90874000	http://data.gbif.org/ws/rest/occurrence/get?key=91210872	33.0	14.3	123	7
A0110	Alcelaphus b. lelwel	Alcelaphus	Alcelaphini	31.40000000	2.96667000	http://data.gbif.org/ws/rest/occurrence/get?key=61808393	34.9	14.3	154	11
A0111	Alcelaphus b. lelwel	Alcelaphus	Alcelaphini	29.71670000	3.73330000	http://data.gbif.org/ws/rest/occurrence/get?key=213088318	33.1	18.0	224	24
A0112	Alcelaphus b. lelwel	Alcelaphus	Alcelaphini	32.46670000	4.03333000	http://data.gbif.org/ws/rest/occurrence/get?key=61808679	34.6	17.6	192	9
A0113	Alcelaphus b. lelwel	Alcelaphus	Alcelaphini	32.56670000	4.41667000	http://data.gbif.org/ws/rest/occurrence/get?key=61808678	37.6	18.7	153	6
A0114	Alcelaphus b. lelwel	Alcelaphus	Alcelaphini	34.16670000	5.95000000	http://data.gbif.org/ws/rest/occurrence/get?key=61808752	35.6	19.5	139	9
A0115	Alcelaphus b. lelwel	Alcelaphus	Alcelaphini	38.41670000	7.48333000	http://data.gbif.org/ws/rest/occurrence/get?key=61808355	29.2	10.3	122	10
A0116	Alcelaphus b. lelwel	Alcelaphus	Alcelaphini	38.41670000	7.53333000	http://data.gbif.org/ws/rest/occurrence/get?key=61808364	29.1	10.3	124	9
A0117	Alcelaphus b. lelwel	Alcelaphus	Alcelaphini	40.06670000	8.83333000	http://data.gbif.org/ws/rest/occurrence/get?key=61808359	35.3	13.0	137	7
A0118	Alcelaphus b. lelwel	Alcelaphus	Alcelaphini	44.80000000	9.16667000	http://data.gbif.org/ws/rest/occurrence/get?key=61808253	32.6	12.9	57	1
A0119	Alcelaphus b. lelwel	Alcelaphus	Alcelaphini	44.50000000	9.21667000	http://data.gbif.org/ws/rest/occurrence/get?key=61808296	32.2	12.5	61	1
A0120	Alcelaphus b. lelwel	Alcelaphus	Alcelaphini	36.20000000	12.96670000	http://data.gbif.org/ws/rest/occurrence/get?key=61808360	40.3	18.7	231	0
A0121	Alcelaphus b. major	Alcelaphus	Alcelaphini	18.99370000	8.84460000	http://www.iucnredlist.org	38.2	15.5	238	0
A0122	Alcelaphus b. major	Alcelaphus	Alcelaphini	18.99370000	9.15530000	http://www.iucnredlist.org	38.8	16.0	239	0
A0123	Alcelaphus b. major	Alcelaphus	Alcelaphini	3.01700000	10.41700000	http://data.gbif.org/ws/rest/occurrence/get?key=239942591	37.2	16.7	257	0
A0124	Alcelaphus b. major	Alcelaphus	Alcelaphini	1.32150360	11.16666209	http://www.iucnredlist.org	39.1	18.9	228	0
A0125	Alcelaphus b. major	Alcelaphus	Alcelaphini	1.60870860	11.11777613	http://www.iucnredlist.org	38.9	18.5	236	0
A0126	Alcelaphus b. major	Alcelaphus	Alcelaphini	1.80425244	11.34998443	http://www.iucnredlist.org	39.1	18.0	240	0
A0127	Alcelaphus b. major	Alcelaphus	Alcelaphini	1.49871520	11.34998443	http://www.iucnredlist.org	39.1	18.4	231	0
A0128	Alcelaphus b. major	Alcelaphus	Alcelaphini	-3.40105318	8.79328902	http://www.iucnredlist.org	34.6	18.3	213	6
A0129	Alcelaphus b. major	Alcelaphus	Alcelaphini	-3.85790969	8.98364590	http://www.iucnredlist.org	36.0	19.3	210	5
A0130	Alcelaphus b. major	Alcelaphus	Alcelaphini	-3.61044575	9.28821691	http://www.iucnredlist.org	36.1	19.0	215	4

A0131	Alcelaphus b. major	Alcelaphus	Alcelaphini	-4.06730226	9.36435966	http://www.iucnredlist.org	35.8	18.7	212	4
A0132	Alcelaphus b. major	Alcelaphus	Alcelaphini	-9.24117877	13.80570208	Happold, 1973	40.0	14.5	244	0
A0133	Alcelaphus b. major	Alcelaphus	Alcelaphini	-8.89139801	14.19831315	Happold, 1973	39.9	13.6	229	0
A0134	Alcelaphus b. major	Alcelaphus	Alcelaphini	-8.91995154	13.78071774	Happold, 1973	39.7	13.7	248	0
A0135	Alcelaphus b. major	Alcelaphus	Alcelaphini	-8.51663290	13.86280915	Happold, 1973	40.0	13.2	243	0
A0136	Alcelaphus b. major	Alcelaphus	Alcelaphini	-8.73078439	13.25247740	Happold, 1973	39.0	13.0	287	0
A0137	Alcelaphus b. major	Alcelaphus	Alcelaphini	-8.61300107	13.42022940	Happold, 1973	39.4	12.7	276	0
A0138	Alcelaphus b. major	Alcelaphus	Alcelaphini	-13.50065192	12.92411178	Happold, 1973	39.2	15.0	299	0
A0139	Alcelaphus b. major	Alcelaphus	Alcelaphini	-13.26270582	13.14302219	Happold, 1973	39.5	15.7	247	0
A0140	Alcelaphus b. major	Alcelaphus	Alcelaphini	-12.49592000	13.19943000	Happold, 1973	39.9	17.0	268	0
A0141	Alcelaphus b. major	Alcelaphus	Alcelaphini	-12.61073350	12.89555825	Happold, 1973	39.4	16.6	296	0
A0142	Alcelaphus b. major	Alcelaphus	Alcelaphini	-1.99096109	9.43582194	Happold, 1973	36.6	19.6	203	1
A0143	Alcelaphus b. major	Alcelaphus	Alcelaphini	-1.46801000	9.87425000	Happold, 1973	36.7	19.2	212	1
A0144	Alcelaphus b. major	Alcelaphus	Alcelaphini	0.58480545	10.11396833	Happold, 1973	38.2	18.4	244	1
A0145	Alcelaphus b. major	Alcelaphus	Alcelaphini	4.10212471	10.24900274	Happold, 1973	37.3	16.0	242	0
A0146	Alcelaphus b. major	Alcelaphus	Alcelaphini	3.99504896	9.93491389	Happold, 1973	36.9	16.4	232	1
A0147	Alcelaphus b. major	Alcelaphus	Alcelaphini	4.81596301	9.82783815	Happold, 1973	36.8	16.3	245	1
A0148	Alcelaphus b. major	Alcelaphus	Alcelaphini	5.13719025	9.84211491	Happold, 1973	37.1	16.7	254	0
A0149	Alcelaphus b. major	Alcelaphus	Alcelaphini	14.59983077	8.56910327	Happold, 1973	38.0	16.6	259	0
A0150	Alcelaphus b. major	Alcelaphus	Alcelaphini	14.68073245	8.72614770	Happold, 1973	38.0	16.5	254	0
A0151	Alcelaphus b. major	Alcelaphus	Alcelaphini	13.83364433	8.46916591	Happold, 1973	37.1	16.0	267	0
A0152	Alcelaphus b. major	Alcelaphus	Alcelaphini	13.87647463	8.21694304	Happold, 1973	36.3	15.6	276	0
A0153	Ammodorcas clarkei	Ammodorcas	Antilopini	44.80000000	9.16667000	http://data.gbif.org/ws/rest/occurrence/get?key=61809609	32.6	12.9	57	1
A0154	Ammodorcas clarkei	Ammodorcas	Antilopini	45.41861986	4.76840668	http://www.iucnredlist.org	36.1	20.6	72	0
A0155	Ammodorcas clarkei	Ammodorcas	Antilopini	45.71082671	4.56386189	http://www.iucnredlist.org	35.9	19.8	74	1
A0156	Ammodorcas clarkei	Ammodorcas	Antilopini	45.82770945	4.88528942	http://www.iucnredlist.org	36.2	20.0	67	1
A0157	Ammodorcas clarkei	Ammodorcas	Antilopini	45.65238534	5.17749627	http://www.iucnredlist.org	35.7	19.6	69	0
A0158	Ammodorcas clarkei	Ammodorcas	Antilopini	44.77576480	5.67424792	http://www.iucnredlist.org	36.7	20.1	88	0

A0159	Ammodorcas clarkei	Ammodorcas	Antilopini	44.68810274	6.40476504	http://www.iucnredlist.org	35.1	17.8	112	0
A0160	Ammodorcas clarkei	Ammodorcas	Antilopini	44.36667521	7.13528216	http://www.iucnredlist.org	33.5	14.6	107	3
A0161	Ammodorcas clarkei	Ammodorcas	Antilopini	44.30823384	7.51515107	http://www.iucnredlist.org	33.7	13.8	97	2
A0162	Ammodorcas clarkei	Ammodorcas	Antilopini	45.09719233	7.54437175	http://www.iucnredlist.org	33.7	15.1	79	1
A0163	Ammodorcas clarkei	Ammodorcas	Antilopini	46.06147493	7.36904764	http://www.iucnredlist.org	34.4	16.3	58	0
A0164	Ammodorcas clarkei	Ammodorcas	Antilopini	46.14913699	6.93073737	http://www.iucnredlist.org	35.0	17.3	58	0
A0165	Ammodorcas clarkei	Ammodorcas	Antilopini	45.59394397	6.05411682	http://www.iucnredlist.org	35.6	18.8	73	0
A0166	Ammodorcas clarkei	Ammodorcas	Antilopini	45.30173713	6.84307531	http://www.iucnredlist.org	34.8	17.2	83	1
A0167	Ammodorcas clarkei	Ammodorcas	Antilopini	47.63939192	6.40476504	http://www.iucnredlist.org	35.6	18.7	55	0
A0168	Ammodorcas clarkei	Ammodorcas	Antilopini	48.01926082	6.20022024	http://www.iucnredlist.org	35.1	19.6	55	0
A0169	Ammodorcas clarkei	Ammodorcas	Antilopini	48.57445384	6.25866161	http://www.iucnredlist.org	34.7	20.3	54	0
A0170	Ammodorcas clarkei	Ammodorcas	Antilopini	48.39912973	5.79113066	http://www.iucnredlist.org	34.1	20.8	54	0
A0171	Ammodorcas clarkei	Ammodorcas	Antilopini	48.04848151	5.32359970	http://www.iucnredlist.org	34.1	20.6	55	0
A0172	Ammodorcas clarkei	Ammodorcas	Antilopini	47.69783329	5.46970312	http://www.iucnredlist.org	35.2	20.5	53	0
A0173	Ammodorcas clarkei	Ammodorcas	Antilopini	47.55172987	5.96645476	http://www.iucnredlist.org	35.6	19.5	54	0
A0174	Ammodorcas clarkei	Ammodorcas	Antilopini	47.34718507	5.67424792	http://www.iucnredlist.org	35.7	19.8	53	0
A0175	Ammodorcas clarkei	Ammodorcas	Antilopini	47.93159877	5.76190997	http://www.iucnredlist.org	35.0	20.4	53	0
A0176	Ammodorcas clarkei	Ammodorcas	Antilopini	47.93159877	4.94373079	http://www.iucnredlist.org	33.3	19.4	61	1
A0177	Antidorcas marsupialis	Antidorcas	Antilopini	24.55000000	-32.25000000	http://data.gbif.org/ws/rest/occurrence/get?key=61811597	31.2	5.0	49	12
A0178	Antidorcas marsupialis	Antidorcas	Antilopini	16.36000000	-25.46000000	http://data.gbif.org/ws/rest/occurrence/get?key=79775452	26.5	2.9	37	2
A0179	Antidorcas marsupialis	Antidorcas	Antilopini	16.06670000	-25.38330000	http://data.gbif.org/ws/rest/occurrence/get?key=49628743	26.3	5.0	26	1
A0180	Antidorcas marsupialis	Antidorcas	Antilopini	23.51160000	-24.64640000	http://data.gbif.org/ws/rest/occurrence/get?key=49628431	33.2	2.9	68	2
A0181	Antidorcas marsupialis	Antidorcas	Antilopini	18.19990000	-23.61330000	http://data.gbif.org/ws/rest/occurrence/get?key=49629936	33.6	2.2	57	0
A0182	Antidorcas marsupialis	Antidorcas	Antilopini	16.51667000	-23.43333000	http://data.gbif.org/ws/rest/occurrence/get?key=79787189	29.6	2.0	64	0
A0183	Antidorcas marsupialis	Antidorcas	Antilopini	24.61670000	-23.18330000	http://data.gbif.org/ws/rest/occurrence/get?key=61810833	32.3	4.0	80	1
A0184	Antidorcas marsupialis	Antidorcas	Antilopini	18.21670000	-23.13330000	http://data.gbif.org/ws/rest/occurrence/get?key=49628373	32.6	2.7	61	0
A0185	Antidorcas marsupialis	Antidorcas	Antilopini	22.00000000	-23.00000000	http://data.gbif.org/ws/rest/occurrence/get?key=202058772	33.0	3.4	84	1
A0186	Antidorcas marsupialis	Antidorcas	Antilopini	18.48000000	-22.96000000	http://data.gbif.org/ws/rest/occurrence/get?key=175774807	32.8	2.6	60	0

A0187	Antidorcas marsupialis	Antidorcas	Antilopini	19.00000000	-22.40000000	http://data.gbif.org/ws/rest/occurrence/get?key=213093325	32.3	2.1	81	0
A0188	Antidorcas marsupialis	Antidorcas	Antilopini	17.66667000	-22.31667000	http://data.gbif.org/ws/rest/occurrence/get?key=79793567	31.3	2.9	85	0
A0189	Antidorcas marsupialis	Antidorcas	Antilopini	22.53430000	-22.26910000	http://data.gbif.org/ws/rest/occurrence/get?key=61811570	33.2	4.4	90	0
A0190	Antidorcas marsupialis	Antidorcas	Antilopini	27.30000000	-21.90000000	http://data.gbif.org/ws/rest/occurrence/get?key=151531913	31.4	4.4	82	0
A0191	Antidorcas marsupialis	Antidorcas	Antilopini	27.26700000	-21.88300000	http://data.gbif.org/ws/rest/occurrence/get?key=239946618	31.4	4.5	82	0
A0192	Antidorcas marsupialis	Antidorcas	Antilopini	16.92130000	-21.33350000	http://data.gbif.org/ws/rest/occurrence/get?key=201220134	32.2	4.5	102	0
A0193	Antidorcas marsupialis	Antidorcas	Antilopini	25.66670000	-20.66670000	http://data.gbif.org/ws/rest/occurrence/get?key=61810837	33.6	5.8	82	0
A0194	Antidorcas marsupialis	Antidorcas	Antilopini	22.60000000	-20.60000000	http://data.gbif.org/ws/rest/occurrence/get?key=151531912	34.6	6.0	102	0
A0195	Antidorcas marsupialis	Antidorcas	Antilopini	25.79970000	-20.57880000	http://data.gbif.org/ws/rest/occurrence/get?key=61810829	33.5	5.8	81	0
A0196	Antidorcas marsupialis	Antidorcas	Antilopini	22.58300000	-20.56700000	http://data.gbif.org/ws/rest/occurrence/get?key=239946632	34.7	6.1	101	0
A0197	Antidorcas marsupialis	Antidorcas	Antilopini	22.45000000	-20.44270000	http://data.gbif.org/ws/rest/occurrence/get?key=49628571	34.7	6.1	102	0
A0198	Antidorcas marsupialis	Antidorcas	Antilopini	29.90000000	-18.90000000	http://data.gbif.org/ws/rest/occurrence/get?key=175774617	30.9	5.7	166	0
A0199	Antidorcas marsupialis	Antidorcas	Antilopini	12.61670000	-17.75000000	http://data.gbif.org/ws/rest/occurrence/get?key=79793564	24.8	10.5	36	0
A0200	Antidorcas marsupialis	Antidorcas	Antilopini	15.89300000	-17.39600000	http://data.gbif.org/ws/rest/occurrence/get?key=201220128	34.9	6.3	136	0
A0201	Antidorcas marsupialis	Antidorcas	Antilopini	15.13570000	-17.39450000	http://data.gbif.org/ws/rest/occurrence/get?key=201220132	34.4	7.3	119	0
A0202	Antidorcas marsupialis	Antidorcas	Antilopini	12.58330000	-16.66670000	http://data.gbif.org/ws/rest/occurrence/get?key=79770800	26.4	11.6	39	0
A0203	Antidorcas marsupialis	Antidorcas	Antilopini	12.50000000	-14.78330000	http://data.gbif.org/ws/rest/occurrence/get?key=61811572	29.3	14.2	70	0
A0204	Antidorcas marsupialis	Antidorcas	Antilopini	23.13330000	31.41670000	http://data.gbif.org/ws/rest/occurrence/get?key=42238702	31.9	6.4	12	0
A0205	Beatragus hunteri	Beatragus	Alcelaphini	41.22001673	-0.17580017	East, 1988	36.3	21.0	80	4
A0206	Beatragus hunteri	Beatragus	Alcelaphini	40.24048325	-1.75467856	East, 1988	34.0	20.1	88	12
A0207	Beatragus hunteri	Beatragus	Alcelaphini	38.92978021	-3.40311525	East, 1988	32.6	18.1	114	14
A0208	Beatragus hunteri	Beatragus	Alcelaphini	39.03141792	-3.42005487	East, 1988	32.3	18.2	114	18
A0209	Cephalophus adersi	Cephalophus	Cephalophini	39.94248316	-3.24467634	http://www.iucnredlist.org	31.8	19.8	214	13
A0210	Cephalophus adersi	Cephalophus	Cephalophini	39.88860082	-3.29257175	http://www.iucnredlist.org	32.0	20.1	208	14
A0211	Cephalophus adersi	Cephalophus	Cephalophini	39.84669234	-3.38237564	http://www.iucnredlist.org	31.4	19.3	204	16
A0212	Cephalophus adersi	Cephalophus	Cephalophini	39.84669234	-3.46619261	http://www.iucnredlist.org	31.9	19.9	234	15
A0213	Cephalophus adersi	Cephalophus	Cephalophini	40.93631290	-1.79584021	http://www.iucnredlist.org	32.2	21.3	191	3
A0214	Cephalophus adersi	Cephalophus	Cephalophini	40.99618216	-1.79584021	http://www.iucnredlist.org	32.2	21.4	195	2

A0215	Cephalophus adersi	Cephalophus	Cephalophini	40.99618216	-1.85570947	http://www.iucnredlist.org	31.9	21.4	210	2
A0216	Cephalophus adersi	Cephalophus	Cephalophini	41.12789454	-1.84373561	http://www.iucnredlist.org	31.8	21.6	212	2
A0217	Cephalophus adersi	Cephalophus	Cephalophini	41.35539773	-1.79584021	http://www.iucnredlist.org	31.5	21.7	196	1
A0218	Cephalophus adersi	Cephalophus	Cephalophini	41.25960691	-1.81380098	http://www.iucnredlist.org	31.6	21.7	204	1
A0219	Cephalophus brookei	Cephalophus	Cephalophini	-11.00000000	7.90000000	http://data.gbif.org/ws/rest/occurrence/get?key=151596873	33.6	19.3	429	14
A0220	Cephalophus brookei	Cephalophus	Cephalophini	-10.96700000	7.90000000	http://data.gbif.org/ws/rest/occurrence/get?key=240009338	33.6	19.3	416	13
A0221	Cephalophus brookei	Cephalophus	Cephalophini	-1.78512784	5.48387807	http://www.iucnredlist.org	31.9	21.4	261	39
A0222	Cephalophus brookei	Cephalophus	Cephalophini	-2.96656582	5.75065439	http://www.iucnredlist.org	32.2	20.7	322	37
A0223	Cephalophus brookei	Cephalophus	Cephalophini	-4.75777823	5.71254348	http://www.iucnredlist.org	33.2	21.7	296	18
A0224	Cephalophus brookei	Cephalophus	Cephalophini	-6.16788162	5.63632168	http://www.iucnredlist.org	31.8	21.1	279	29
A0225	Cephalophus brookei	Cephalophus	Cephalophini	-7.50176320	5.52198897	http://www.iucnredlist.org	32.6	20.8	287	46
A0226	Cephalophus brookei	Cephalophus	Cephalophini	-8.64509028	5.86498709	http://www.iucnredlist.org	33.3	19.6	409	47
A0227	Cephalophus brookei	Cephalophus	Cephalophini	-9.78841735	6.70342695	http://www.iucnredlist.org	32.6	18.8	428	25
A0228	Cephalophus brookei	Cephalophus	Cephalophini	-10.16952637	7.57997770	http://www.iucnredlist.org	34.7	19.5	404	19
A0229	Cephalophus brookei	Cephalophus	Cephalophini	-11.23663164	8.38030665	http://www.iucnredlist.org	33.6	16.9	475	10
A0230	Cephalophus brookei	Cephalophus	Cephalophini	-8.18775945	5.36954536	http://www.iucnredlist.org	32.5	19.9	384	94
A0231	Cephalophus brookei	Cephalophus	Cephalophini	-3.53822935	6.05554160	http://www.iucnredlist.org	32.9	20.9	271	24
A0232	Cephalophus brookei	Cephalophus	Cephalophini	-2.12812596	6.05554160	http://www.iucnredlist.org	32.9	20.7	234	19
A0233	Cephalophus brookei	Cephalophus	Cephalophini	-1.02290979	5.52198897	http://www.iucnredlist.org	31.8	21.7	242	34
A0234	Cephalophus brookei	Cephalophus	Cephalophini	-10.05519366	8.26597394	http://www.iucnredlist.org	33.9	14.5	449	17
A0235	Cephalophus brookei	Cephalophus	Cephalophini	-10.58874630	7.04642507	http://www.iucnredlist.org	32.2	19.4	499	24
A0236	Cephalophus brookei	Cephalophus	Cephalophini	-9.17864291	7.08453597	http://www.iucnredlist.org	34.3	17.0	395	18
A0237	Cephalophus brookei	Cephalophus	Cephalophini	-0.29880265	5.94120890	http://www.iucnredlist.org	33.2	21.0	217	24
A0238	Cephalophus callipygus	Cephalophus	Cephalophini	14.25000000	3.75000000	http://data.gbif.org/ws/rest/occurrence/get?key=311502241	30.0	17.0	251	34
A0239	Cephalophus callipygus	Cephalophus	Cephalophini	10.13330000	3.80000000	http://data.gbif.org/ws/rest/occurrence/get?key=61832282	32.5	21.9	462	33
A0240	Cephalophus callipygus	Cephalophus	Cephalophini	14.50000000	4.25000000	http://data.gbif.org/ws/rest/occurrence/get?key=311502356	31.0	17.2	233	30
A0241	Cephalophus callipygus	Cephalophus	Cephalophini	10.44726738	1.96680505	http://www.iucnredlist.org	28.9	18.0	369	32
A0242	Cephalophus callipygus	Cephalophus	Cephalophini	12.46324213	1.45364784	http://www.iucnredlist.org	30.4	18.1	299	26

A0243	Cephalophus callipygus	Cephalophus	Cephalophini	14.77244956	1.23372333	http://www.iucnredlist.org	30.7	17.8	250	46
A0244	Cephalophus callipygus	Cephalophus	Cephalophini	15.87207214	0.35402526	http://www.iucnredlist.org	31.9	19.7	226	41
A0245	Cephalophus callipygus	Cephalophus	Cephalophini	16.97169473	3.17638990	http://www.iucnredlist.org	31.1	17.2	218	30
A0246	Cephalophus callipygus	Cephalophus	Cephalophini	17.74143054	3.83616345	http://www.iucnredlist.org	30.9	16.3	236	24
A0247	Cephalophus callipygus	Cephalophus	Cephalophini	17.70477645	2.55327043	http://www.iucnredlist.org	31.8	18.7	210	38
A0248	Cephalophus callipygus	Cephalophus	Cephalophini	17.66812237	1.08710698	http://www.iucnredlist.org	31.7	19.8	197	70
A0249	Cephalophus callipygus	Cephalophus	Cephalophini	15.94538032	-0.70894324	http://www.iucnredlist.org	31.4	19.9	231	24
A0250	Cephalophus callipygus	Cephalophus	Cephalophini	17.30158150	0.13410074	http://www.iucnredlist.org	31.2	20.3	199	63
A0251	Cephalophus callipygus	Cephalophus	Cephalophini	13.67282697	-1.36871679	http://www.iucnredlist.org	30.3	18.8	267	11
A0252	Cephalophus callipygus	Cephalophus	Cephalophini	12.09670126	-2.94484250	http://www.iucnredlist.org	31.0	17.1	291	0
A0253	Cephalophus callipygus	Cephalophus	Cephalophini	11.07038685	-2.83488024	http://www.iucnredlist.org	31.2	17.2	304	0
A0254	Cephalophus callipygus	Cephalophus	Cephalophini	10.96042459	-1.66194948	http://www.iucnredlist.org	34.5	17.0	381	4
A0255	Cephalophus callipygus	Cephalophus	Cephalophini	10.04407244	-1.58864131	http://www.iucnredlist.org	32.7	18.9	375	3
A0256	Cephalophus callipygus	Cephalophus	Cephalophini	11.84012266	-0.23244012	http://www.iucnredlist.org	31.3	18.5	287	2
A0257	Cephalophus callipygus	Cephalophus	Cephalophini	13.30628611	0.17075483	http://www.iucnredlist.org	29.7	17.8	287	13
A0258	Cephalophus callipygus	Cephalophus	Cephalophini	11.07038685	0.68391203	http://www.iucnredlist.org	30.2	17.5	348	6
A0259	Cephalophus callipygus	Cephalophus	Cephalophini	13.45290245	-2.57830164	http://www.iucnredlist.org	29.3	16.5	305	2
A0260	Cephalophus dorsalis	Cephalophus	Cephalophini	14.04000000	-5.07000000	http://data.gbif.org/ws/rest/occurrence/get?key=142329073	31.3	17.5	216	0
A0261	Cephalophus dorsalis	Cephalophus	Cephalophini	29.46000000	0.49000000	http://data.gbif.org/ws/rest/occurrence/get?key=142328973	29.1	16.9	185	65
A0262	Cephalophus dorsalis	Cephalophus	Cephalophini	28.35000000	1.25000000	http://data.gbif.org/ws/rest/occurrence/get?key=49681075	31.8	18.6	196	66
A0263	Cephalophus dorsalis	Cephalophus	Cephalophini	10.13330000	3.80000000	http://data.gbif.org/ws/rest/occurrence/get?key=61832282	32.5	21.9	462	33
A0264	Cephalophus dorsalis	Cephalophus	Cephalophini	14.00000000	4.00000000	http://data.gbif.org/ws/rest/occurrence/get?key=311502256	30.4	17.3	263	29
A0265	Cephalophus dorsalis	Cephalophus	Cephalophini	14.25000000	4.25000000	http://data.gbif.org/ws/rest/occurrence/get?key=311502257	30.7	17.2	251	26
A0266	Cephalophus dorsalis	Cephalophus	Cephalophini	-0.98333000	5.91667000	http://data.gbif.org/ws/rest/occurrence/get?key=61832607	32.4	20.9	241	27
A0267	Cephalophus dorsalis	Cephalophus	Cephalophini	-8.10000000	6.20000000	http://data.gbif.org/ws/rest/occurrence/get?key=151596887	34.1	19.1	344	20
A0268	Cephalophus dorsalis	Cephalophus	Cephalophini	-8.13300000	6.21700000	http://data.gbif.org/ws/rest/occurrence/get?key=240009255	34.3	19.2	345	20
A0269	Cephalophus dorsalis	Cephalophus	Cephalophini	21.30915409	-1.94693977	Salong, National Park, DR Congo - http://www.iucnredlist.org	30.2	18.9	238	83
A0270	Cephalophus dorsalis	Cephalophus	Cephalophini	21.60818932	-2.20325568	Salong, National Park, DR Congo - http://www.iucnredlist.org	30.3	18.7	238	72

A0271	Cephalophus dorsalis	Cephalophus	Cephalophini	21.99266318	-1.56246591	Salong, National Park, DR Congo - http://www.iucnredlist.org	30.5	18.8	230	92
A0272	Cephalophus dorsalis	Cephalophus	Cephalophini	21.60818932	-1.13527273	Salong, National Park, DR Congo - http://www.iucnredlist.org	30.7	18.9	230	114
A0273	Cephalophus dorsalis	Cephalophus	Cephalophini	21.22371545	-1.30615000	Salong, National Park, DR Congo - http://www.iucnredlist.org	30.5	19.1	233	110
A0274	Cephalophus dorsalis	Cephalophus	Cephalophini	21.60818932	-1.69062386	Salong, National Park, DR Congo - http://www.iucnredlist.org	30.5	18.9	232	92
A0275	Cephalophus dorsalis	Cephalophus	Cephalophini	29.19809212	-0.75318948	Virunga National Park; DR Congo - http://www.iucnredlist.org	24.3	11.7	160	63
A0276	Cephalophus dorsalis	Cephalophus	Cephalophini	29.12730902	-0.48185425	Virunga National Park; DR Congo - http://www.iucnredlist.org	22.2	10.1	165	66
A0277	Cephalophus dorsalis	Cephalophus	Cephalophini	29.29246959	-0.30489649	Virunga National Park; DR Congo - http://www.iucnredlist.org	19.8	8.0	180	62
A0278	Cephalophus dorsalis	Cephalophus	Cephalophini	29.43403580	-0.13973592	Virunga National Park; DR Congo - http://www.iucnredlist.org	17.8	6.1	198	69
A0279	Cephalophus dorsalis	Cephalophus	Cephalophini	29.51661609	0.04901903	Virunga National Park; DR Congo - http://www.iucnredlist.org	28.9	16.3	142	56
A0280	Cephalophus dorsalis	Cephalophus	Cephalophini	29.58739919	0.24957116	Virunga National Park; DR Congo - http://www.iucnredlist.org	30.4	17.6	143	47
A0281	Cephalophus dorsalis	Cephalophus	Cephalophini	29.30426678	0.49731202	Virunga National Park; DR Congo - http://www.iucnredlist.org	29.6	17.1	172	61
A0282	Cephalophus dorsalis	Cephalophus	Cephalophini	29.42223862	0.63887823	Virunga National Park; DR Congo - http://www.iucnredlist.org	29.8	17.0	176	62
A0283	Cephalophus dorsalis	Cephalophus	Cephalophini	29.26887523	0.28496271	Virunga National Park; DR Congo - http://www.iucnredlist.org	26.1	12.7	176	74
A0284	Cephalophus dorsalis	Cephalophus	Cephalophini	26.49653699	-0.24591057	Maiko National Park; DR Congo - http://www.iucnredlist.org	29.3	17.8	219	102
A0285	Cephalophus dorsalis	Cephalophus	Cephalophini	26.50833418	0.06081621	Maiko National Park; DR Congo - http://www.iucnredlist.org	30.5	18.9	217	91
A0286	Cephalophus dorsalis	Cephalophus	Cephalophini	26.28418768	0.28496271	Maiko National Park; DR Congo - http://www.iucnredlist.org	30.6	19.0	223	85
A0287	Cephalophus dorsalis	Cephalophus	Cephalophini	26.60271165	0.35574581	Maiko National Park; DR Congo - http://www.iucnredlist.org	30.2	18.6	221	87
A0288	Cephalophus dorsalis	Cephalophus	Cephalophini	26.82685814	0.14339650	Maiko National Park; DR Congo - http://www.iucnredlist.org	29.9	18.3	216	93
A0289	Cephalophus dorsalis	Cephalophus	Cephalophini	26.68529194	-0.04535844	Maiko National Park; DR Congo - http://www.iucnredlist.org	29.8	18.2	218	98
A0290	Cephalophus dorsalis	Cephalophus	Cephalophini	26.23699894	-0.10434436	Maiko National Park; DR Congo - http://www.iucnredlist.org	30.7	19.1	217	93
A0291	Cephalophus harveyi	Cephalophus	Cephalophini	36.00000000	-1.00000000	http://data.gbif.org/ws/rest/occurrence/get?key=142328813	24.9	7.4	156	28
A0292	Cephalophus harveyi	Cephalophus	Cephalophini	36.43330000	-0.71667000	http://data.gbif.org/ws/rest/occurrence/get?key=61833337	27.4	8.4	126	34
A0293	Cephalophus harveyi	Cephalophus	Cephalophini	38.47148569	-3.47766514	http://www.iucnredlist.org	32.2	16.7	122	7
A0294	Cephalophus harveyi	Cephalophus	Cephalophini	42.11739296	0.44398302	http://www.iucnredlist.org	38.4	20.0	102	4
A0295	Cephalophus harveyi	Cephalophus	Cephalophini	35.49961170	-3.53894089	Kingdon,1989	27.6	12.2	200	2
A0296	Cephalophus harveyi	Cephalophus	Cephalophini	35.56088745	-3.81468178	Kingdon,1989	25.0	10.0	241	3
A0297	Cephalophus harveyi	Cephalophus	Cephalophini	36.60257524	-2.80363186	Kingdon,1989	28.8	12.5	159	1
A0298	Cephalophus harveyi	Cephalophus	Cephalophini	36.72512675	-3.04873487	Kingdon,1989	28.5	12.3	186	4

A0299	Cephalophus harveyi	Cephalophus	Cephalophini	42.60759898	0.10696638	Kingdon,1989	34.0	21.4	119	1
A0300	Cephalophus harveyi	Cephalophus	Cephalophini	42.69951261	0.87291329	Kingdon,1989	36.5	20.3	123	2
A0301	Cephalophus harveyi	Cephalophus	Cephalophini	37.55234941	-0.16877451	Kingdon,1989	24.7	8.2	374	54
A0302	Cephalophus harveyi	Cephalophus	Cephalophini	36.66385100	-0.26068814	Kingdon,1989	17.8	2.3	207	48
A0303	Cephalophus harveyi	Cephalophus	Cephalophini	36.84767825	-0.68961840	Kingdon,1989	23.4	6.1	458	63
A0304	Cephalophus harveyi	Cephalophus	Cephalophini	37.55234941	-0.23005026	Kingdon,1989	25.7	8.6	408	54
A0305	Cephalophus harveyi	Cephalophus	Cephalophini	36.20428285	-6.90910727	Kingdon,1989	31.3	14.1	131	1
A0306	Cephalophus harveyi	Cephalophus	Cephalophini	38.56339932	-4.76445594	Kingdon,1989	29.6	14.1	174	35
A0307	Cephalophus harveyi	Cephalophus	Cephalophini	39.42125986	-4.15169841	Kingdon,1989	32.3	19.3	199	22
A0308	Cephalophus harveyi	Cephalophus	Cephalophini	37.30724640	-2.80363186	Kingdon,1989	29.2	12.9	181	9
A0309	Cephalophus harveyi	Cephalophus	Cephalophini	37.06214339	-2.92618337	Kingdon,1989	26.2	10.2	179	5
A0310	Cephalophus harveyi	Cephalophus	Cephalophini	36.81704038	-5.71423010	Kingdon,1989	28.8	10.5	134	3
A0311	Cephalophus harveyi	Cephalophus	Cephalophini	36.41874799	-6.20443612	Kingdon,1989	32.2	11.1	124	1
A0312	Cephalophus harveyi	Cephalophus	Cephalophini	36.08173135	-7.30739967	Kingdon,1989	30.2	13.9	145	1
A0313	Cephalophus harveyi	Cephalophus	Cephalophini	35.53024958	-7.79760568	Kingdon,1989	26.3	9.5	159	0
A0314	Cephalophus harveyi	Cephalophus	Cephalophini	35.00940568	-8.31844958	Kingdon,1989	26.9	10.1	184	1
A0315	Cephalophus harveyi	Cephalophus	Cephalophini	38.16510693	-5.07083470	Kingdon,1989	32.8	15.6	157	21
A0316	Cephalophus harveyi	Cephalophus	Cephalophini	38.59403720	-5.25466196	Kingdon,1989	33.0	17.3	241	49
A0317	Cephalophus harveyi	Cephalophus	Cephalophini	38.53276145	-4.91764532	Kingdon,1989	28.9	13.8	227	48
A0318	Cephalophus harveyi	Cephalophus	Cephalophini	37.98127967	-4.88700744	Kingdon,1989	31.8	14.3	118	12
A0319	Cephalophus harveyi	Cephalophus	Cephalophini	40.00337950	-2.74235611	Kingdon,1989	31.6	19.5	132	12
A0320	Cephalophus harveyi	Cephalophus	Cephalophini	41.29017031	-1.54747894	Kingdon,1989	32.3	21.5	154	1
A0321	Cephalophus harveyi	Cephalophus	Cephalophini	40.27912039	-2.09896071	Kingdon,1989	33.2	20.8	134	10
A0322	Cephalophus harveyi	Cephalophus	Cephalophini	39.23743260	-2.98745912	Kingdon,1989	33.0	19.1	138	22
A0323	Cephalophus harveyi	Cephalophus	Cephalophini	38.47148569	-3.41638939	Kingdon,1989	32.0	16.4	137	10
A0324	Cephalophus harveyi	Cephalophus	Cephalophini	36.75576462	-0.90408354	Kingdon,1989	24.2	7.2	367	48
A0325	Cephalophus harveyi	Cephalophus	Cephalophini	37.27660852	-0.26068814	Kingdon,1989	15.8	1.1	304	59
A0326	Cephalophus harveyi	Cephalophus	Cephalophini	33.84516638	-8.99248286	Kingdon,1989	20.3	4.2	398	4

A0327	Cephalophus harveyi	Cephalophus	Cephalophini	33.44687399	-9.14567224	Kingdon,1989	24.1	7.1	325	8
A0328	Cephalophus jentinki	Cephalophus	Cephalophini	-13.11370701	8.31434561	East, 1990	29.8	21.7	1025	9
A0329	Cephalophus jentinki	Cephalophus	Cephalophini	-13.11370701	8.23985331	East, 1990	28.5	20.0	940	9
A0330	Cephalophus jentinki	Cephalophus	Cephalophini	-12.21979950	7.97913029	East, 1990	33.4	20.5	550	4
A0331	Cephalophus jentinki	Cephalophus	Cephalophini	-11.12724588	9.19583773	East, 1990	29.1	9.7	433	13
A0332	Cephalophus jentinki	Cephalophus	Cephalophini	-10.79203056	8.92269933	East, 1990	30.8	10.1	424	13
A0333	Cephalophus jentinki	Cephalophus	Cephalophini	-10.63063060	7.58183806	East, 1990	33.0	19.0	441	19
A0334	Cephalophus jentinki	Cephalophus	Cephalophini	-10.45681525	7.48251501	East, 1990	33.8	20.0	433	19
A0335	Cephalophus jentinki	Cephalophus	Cephalophini	-8.95455402	6.27822295	East, 1990	33.9	18.7	380	27
A0336	Cephalophus jentinki	Cephalophus	Cephalophini	-8.95455402	5.74436152	East, 1990	32.8	19.8	463	61
A0337	Cephalophus jentinki	Cephalophus	Cephalophini	-8.58209256	6.01749992	East, 1990	33.8	19.4	386	36
A0338	Cephalophus jentinki	Cephalophus	Cephalophini	-8.55726179	5.78160767	East, 1990	33.3	19.7	409	53
A0339	Cephalophus jentinki	Cephalophus	Cephalophini	-7.96132346	6.17889989	East, 1990	33.9	19.3	337	21
A0340	Cephalophus jentinki	Cephalophus	Cephalophini	-7.86200040	5.93059225	East, 1990	33.8	18.8	327	31
A0341	Cephalophus jentinki	Cephalophus	Cephalophini	-8.12272342	5.76919228	East, 1990	33.8	19.1	352	46
A0342	Cephalophus jentinki	Cephalophus	Cephalophini	-7.81233887	6.32788448	East, 1990	33.8	19.0	331	19
A0343	Cephalophus jentinki	Cephalophus	Cephalophini	-7.58886199	6.02991531	East, 1990	33.2	19.7	318	22
A0344	Cephalophus jentinki	Cephalophus	Cephalophini	-7.98615422	6.84933052	East, 1990	33.8	17.3	345	16
A0345	Cephalophus jentinki	Cephalophus	Cephalophini	-7.09224671	5.64503846	East, 1990	32.1	20.6	254	30
A0346	Cephalophus jentinki	Cephalophus	Cephalophini	-7.12949286	6.10440760	East, 1990	32.7	19.9	278	20
A0347	Cephalophus jentinki	Cephalophus	Cephalophini	-7.10466209	5.26016162	East, 1990	31.2	20.6	291	43
A0348	Cephalophus jentinki	Cephalophus	Cephalophini	-6.17350844	5.52088464	East, 1990	32.1	21.6	313	26
A0349	Cephalophus leucogaster	Cephalophus	Cephalophini	29.46000000	0.49000000	http://data.gbif.org/ws/rest/occurrence/get?key=142328973	29.1	16.9	185	65
A0350	Cephalophus leucogaster	Cephalophus	Cephalophini	28.35000000	1.25000000	http://data.gbif.org/ws/rest/occurrence/get?key=49681075	31.8	18.6	196	66
A0351	Cephalophus leucogaster	Cephalophus	Cephalophini	27.86670000	3.70000000	http://data.gbif.org/ws/rest/occurrence/get?key=213128203	33.3	17.3	248	18
A0352	Cephalophus leucogaster	Cephalophus	Cephalophini	10.13330000	3.80000000	http://data.gbif.org/ws/rest/occurrence/get?key=61832282	32.5	21.8	462	33
A0353	Cephalophus leucogaster	Cephalophus	Cephalophini	16.54625045	2.05715136	Nouabale-Ndoki National Park, Congo - http://www.iucnredlist.org	31.6	18.6	219	43
A0354	Cephalophus leucogaster	Cephalophus	Cephalophini	16.89764500	2.29873511	Nouabale-Ndoki National Park, Congo - http://www.iucnredlist.org	31.5	18.4	215	40

A0355	Cephalophus leucogaster	Cephalophus	Cephalophini	16.54625045	2.56228102	Nouabale-Ndoki National Park, Congo - http://www.iucnredlist.org	31.2	17.9	219	38
A0356	Cephalophus leucogaster	Cephalophus	Cephalophini	16.32662886	3.39684307	Nouabale-Ndoki National Park, Congo - http://www.iucnredlist.org	31.4	17.3	214	29
A0357	Cephalophus leucogaster	Cephalophus	Cephalophini	29.89924318	0.78334614	Semuliki National Park, Uganda - http://www.iucnredlist.org	31.7	17.6	141	46
A0358	Cephalophus leucogaster	Cephalophus	Cephalophini	15.90934784	3.41880523	Nouabale-Ndoki National Park, Congo - http://www.iucnredlist.org	30.9	17.0	203	33
A0359	Cephalophus leucogaster	Cephalophus	Cephalophini	29.67962159	0.69549750	Semuliki National Park, Uganda - http://www.iucnredlist.org	31.5	17.9	148	49
A0360	Cephalophus leucogaster	Cephalophus	Cephalophini	29.83335670	0.56372455	Semuliki National Park, Uganda - http://www.iucnredlist.org	30.8	17.2	145	49
A0361	Cephalophus leucogaster	Cephalophus	Cephalophini	16.26074239	2.95759989	Nouabale-Ndoki National Park, Congo - http://www.iucnredlist.org	32.0	18.4	216	32
A0362	Cephalophus leucogaster	Cephalophus	Cephalophini	16.32662886	2.62816750	Nouabale-Ndoki National Park, Congo - http://www.iucnredlist.org	31.4	18.1	219	37
A0363	Cephalophus leucogaster	Cephalophus	Cephalophini	22.58584420	5.08792932	http://www.iucnredlist.org	33.7	15.9	231	14
A0364	Cephalophus leucogaster	Cephalophus	Cephalophini	23.35451977	5.02204284	http://www.iucnredlist.org	32.7	17.1	237	25
A0365	Cephalophus leucogaster	Cephalophus	Cephalophini	23.61806568	5.61502114	http://www.iucnredlist.org	33.0	16.2	241	13
A0366	Cephalophus leucogaster	Cephalophus	Cephalophini	23.92553591	5.37343739	http://www.iucnredlist.org	32.5	16.8	239	14
A0367	Cephalophus leucogaster	Cephalophus	Cephalophini	23.35451977	5.35147523	http://www.iucnredlist.org	33.0	16.4	233	17
A0368	Cephalophus leucogaster	Cephalophus	Cephalophini	23.06901170	5.26362659	http://www.iucnredlist.org	33.4	16.4	230	17
A0369	Cephalophus natalensis	Cephalophus	Cephalophini	28.86670000	-30.06670000	http://data.gbif.org/ws/rest/occurrence/get?key=224268058	23.2	-0.5	157	11
A0370	Cephalophus natalensis	Cephalophus	Cephalophini	30.61000000	-28.90000000	http://data.gbif.org/ws/rest/occurrence/get?key=175788263	25.5	3.9	129	12
A0371	Cephalophus natalensis	Cephalophus	Cephalophini	32.08330000	-28.08330000	http://data.gbif.org/ws/rest/occurrence/get?key=70136263	28.5	10.6	123	28
A0372	Cephalophus natalensis	Cephalophus	Cephalophini	29.53947859	-22.97199080	http://www.iucnredlist.org	26.3	4.2	166	7
A0373	Cephalophus natalensis	Cephalophus	Cephalophini	30.08934533	-22.97199080	http://www.iucnredlist.org	24.8	5.0	305	23
A0374	Cephalophus natalensis	Cephalophus	Cephalophini	30.84261690	-24.52555070	Kruger Nationalpark, South Africa - http://www.iucnredlist.org	28.6	7.8	149	8
A0375	Cephalophus natalensis	Cephalophus	Cephalophini	30.88131972	-24.78356950	Kruger Nationalpark, South Africa - http://www.iucnredlist.org	23.4	4.8	179	12
A0376	Cephalophus natalensis	Cephalophus	Cephalophini	31.28124886	-25.11899395	Kruger Nationalpark, South Africa - http://www.iucnredlist.org	30.9	8.8	122	11
A0377	Cephalophus natalensis	Cephalophus	Cephalophini	31.71988083	-25.33830993	Kruger Nationalpark, South Africa - http://www.iucnredlist.org	31.4	8.4	123	9
A0378	Cephalophus natalensis	Cephalophus	Cephalophini	31.30705075	-25.46731933	Kruger Nationalpark, South Africa - http://www.iucnredlist.org	29.3	8.3	138	12
A0379	Cephalophus natalensis	Cephalophus	Cephalophini	31.43606015	-23.94500838	Kruger Nationalpark, South Africa - http://www.iucnredlist.org	32.7	8.7	95	5
A0380	Cephalophus natalensis	Cephalophus	Cephalophini	31.07483382	-22.82262658	Kruger Nationalpark, South Africa - http://www.iucnredlist.org	32.9	10.2	107	4
A0381	Cephalophus natalensis	Cephalophus	Cephalophini	31.30705075	-22.87423034	Kruger Nationalpark, South Africa - http://www.iucnredlist.org	33.1	9.3	93	3
A0382	Cephalophus natalensis	Cephalophus	Cephalophini	31.34575357	-23.62248488	Kruger Nationalpark, South Africa - http://www.iucnredlist.org	32.6	8.7	90	4

A0383	Cephalophus natalensis	Cephalophus	Cephalophini	31.04903194	-23.42897077	Kruger Nationalpark, South Africa - http://www.iucnredlist.org	32.3	8.9	103	4
A0384	Cephalophus natalensis	Cephalophus	Cephalophini	30.26173166	-23.02267581	http://www.iucnredlist.org	27.2	7.9	223	17
A0385	Cephalophus natalensis	Cephalophus	Cephalophini	29.91274710	-23.09053392	http://www.iucnredlist.org	27.8	6.4	143	8
A0386	Cephalophus natalensis	Cephalophus	Cephalophini	29.92244112	-22.96451172	http://www.iucnredlist.org	25.9	5.3	176	10
A0387	Cephalophus natalensis	Cephalophus	Cephalophini	29.49590443	-22.99359377	http://www.iucnredlist.org	25.6	3.8	161	7
A0388	Cephalophus niger	Cephalophus	Cephalophini	-7.40000000	5.30000000	http://data.gbif.org/ws/rest/occurrence/get?key=151596913	32.1	21.0	302	57
A0389	Cephalophus niger	Cephalophus	Cephalophini	-7.36700000	5.35000000	http://data.gbif.org/ws/rest/occurrence/get?key=240009205	32.1	21.1	295	51
A0390	Cephalophus niger	Cephalophus	Cephalophini	-6.80000000	5.80000000	http://data.gbif.org/ws/rest/occurrence/get?key=151596920	32.2	20.6	228	28
A0391	Cephalophus niger	Cephalophus	Cephalophini	-6.75000000	5.81700000	http://data.gbif.org/ws/rest/occurrence/get?key=240009230	32.1	20.6	224	28
A0392	Cephalophus niger	Cephalophus	Cephalophini	-0.98333000	5.91667000	http://data.gbif.org/ws/rest/occurrence/get?key=61832607	32.4	20.9	241	27
A0393	Cephalophus niger	Cephalophus	Cephalophini	-9.06917000	6.06056000	http://data.gbif.org/ws/rest/occurrence/get?key=49680195	33.3	19.3	426	39
A0394	Cephalophus niger	Cephalophus	Cephalophini	-8.10000000	6.20000000	http://data.gbif.org/ws/rest/occurrence/get?key=151596887	34.1	19.1	344	20
A0395	Cephalophus niger	Cephalophus	Cephalophini	-8.13300000	6.21700000	http://data.gbif.org/ws/rest/occurrence/get?key=240009255	34.3	19.2	345	20
A0396	Cephalophus niger	Cephalophus	Cephalophini	-7.60000000	6.90000000	http://data.gbif.org/ws/rest/occurrence/get?key=151596914	33.6	17.7	310	14
A0397	Cephalophus niger	Cephalophus	Cephalophini	-7.61700000	6.91700000	http://data.gbif.org/ws/rest/occurrence/get?key=240009265	33.8	17.6	311	14
A0398	Cephalophus niger	Cephalophus	Cephalophini	-7.05000000	7.00000000	http://data.gbif.org/ws/rest/occurrence/get?key=240009263	33.5	18.2	266	13
A0399	Cephalophus niger	Cephalophus	Cephalophini	-7.00000000	7.00000000	http://data.gbif.org/ws/rest/occurrence/get?key=151596908	33.4	18.2	263	14
A0400	Cephalophus niger	Cephalophus	Cephalophini	-3.50000000	7.40000000	http://data.gbif.org/ws/rest/occurrence/get?key=151596915	35.4	20.7	178	5
A0401	Cephalophus niger	Cephalophus	Cephalophini	-3.46700000	7.43300000	http://data.gbif.org/ws/rest/occurrence/get?key=240009191	35.3	20.6	177	5
A0402	Cephalophus niger	Cephalophus	Cephalophini	3.00000000	10.40000000	http://data.gbif.org/ws/rest/occurrence/get?key=151596906	37.2	16.8	256	0
A0403	Cephalophus niger	Cephalophus	Cephalophini	3.01700000	10.41700000	http://data.gbif.org/ws/rest/occurrence/get?key=240009166	37.2	16.7	257	0
A0404	Cephalophus niger	Cephalophus	Cephalophini	-0.49897673	5.67474883	own observation (TS)	32.1	21.2	231	26
A0405	Cephalophus niger	Cephalophus	Cephalophini	-8.46486150	7.72115716	http://www.iucnredlist.org	33.9	14.1	350	15
A0406	Cephalophus niger	Cephalophus	Cephalophini	-8.67087576	7.78982858	http://www.iucnredlist.org	34.6	13.3	348	13
A0407	Cephalophus nigrifrons	Cephalophus	Cephalophini	21.00000000	-6.00000000	http://data.gbif.org/ws/rest/occurrence/get?key=151596921	31.2	16.3	226	5
A0408	Cephalophus nigrifrons	Cephalophus	Cephalophini	13.78330000	-4.48330000	http://data.gbif.org/ws/rest/occurrence/get?key=142328879	28.7	15.4	247	1
A0409	Cephalophus nigrifrons	Cephalophus	Cephalophini	36.76670000	-1.40000000	http://data.gbif.org/ws/rest/occurrence/get?key=142329021	26.8	10.6	181	12
A0410	Cephalophus nigrifrons	Cephalophus	Cephalophini	29.64190000	-1.38806000	http://data.gbif.org/ws/rest/occurrence/get?key=61832204	16.4	5.9	242	39

A0411	Cephalophus nigrifrons	Cephalophus	Cephalophini	29.86670000	-1.30000000	http://data.gbif.org/ws/rest/occurrence/get?key=61832203	22.2	8.9	165	16
A0412	Cephalophus nigrifrons	Cephalophus	Cephalophini	36.66670000	-0.50000000	http://data.gbif.org/ws/rest/occurrence/get?key=142328985	18.0	2.5	280	49
A0413	Cephalophus nigrifrons	Cephalophus	Cephalophini	36.83333000	-0.45000000	http://data.gbif.org/ws/rest/occurrence/get?key=79803031	23.8	5.8	293	55
A0414	Cephalophus nigrifrons	Cephalophus	Cephalophini	36.63333000	-0.41667000	http://data.gbif.org/ws/rest/occurrence/get?key=79785211	14.9	0.7	243	57
A0415	Cephalophus nigrifrons	Cephalophus	Cephalophini	37.33000000	-0.17000000	http://data.gbif.org/ws/rest/occurrence/get?key=142328986	9.7	-3.6	295	77
A0416	Cephalophus nigrifrons	Cephalophus	Cephalophini	29.48330000	0.48330000	http://data.gbif.org/ws/rest/occurrence/get?key=142329645	28.9	16.7	187	66
A0417	Cephalophus nigrifrons	Cephalophus	Cephalophini	34.55000000	1.13333000	http://data.gbif.org/ws/rest/occurrence/get?key=201228998	15.2	2.0	253	57
A0418	Cephalophus nigrifrons	Cephalophus	Cephalophini	28.35000000	1.25000000	http://data.gbif.org/ws/rest/occurrence/get?key=49681075	31.8	18.5	196	66
A0419	Cephalophus nigrifrons	Cephalophus	Cephalophini	29.96670000	1.25000000	http://data.gbif.org/ws/rest/occurrence/get?key=142328841	29.6	15.4	150	62
A0420	Cephalophus nigrifrons	Cephalophus	Cephalophini	10.53330000	2.78333000	http://data.gbif.org/ws/rest/occurrence/get?key=91155449	29.4	19.1	386	51
A0421	Cephalophus nigrifrons	Cephalophus	Cephalophini	29.26053920	-2.49140807	http://www.iucnredlist.org	20.6	9.5	252	15
A0422	Cephalophus nigrifrons	Cephalophus	Cephalophini	9.20564532	4.20776693	http://www.iucnredlist.org	16.6	5.0	409	45
A0423	Cephalophus nigrifrons	Cephalophus	Cephalophini	6.49552452	4.75588125	http://www.iucnredlist.org	32.2	22.0	454	42
A0424	Cephalophus nigrifrons	Cephalophus	Cephalophini	29.44324398	-2.94817000	http://www.iucnredlist.org	26.1	12.8	220	9
A0425	Cephalophus nigrifrons	Cephalophus	Cephalophini	5.85605782	4.87768443	http://www.iucnredlist.org	32.1	22.0	502	47
A0426	Cephalophus ogilbyi	Cephalophus	Cephalophini	9.01670000	4.10000000	http://data.gbif.org/ws/rest/occurrence/get?key=142329511	29.9	19.9	490	84
A0427	Cephalophus ogilbyi	Cephalophus	Cephalophini	9.25697341	4.94567578	http://www.iucnredlist.org	25.0	13.3	431	21
A0428	Cephalophus ogilbyi	Cephalophus	Cephalophini	9.47315648	5.90305794	http://www.iucnredlist.org	33.3	19.7	410	15
A0429	Cephalophus ogilbyi	Cephalophus	Cephalophini	8.94814045	5.71775816	http://www.iucnredlist.org	33.3	20.6	398	20
A0430	Cephalophus ogilbyi	Cephalophus	Cephalophini	8.26870795	5.53245839	http://www.iucnredlist.org	32.5	21.3	355	18
A0431	Cephalophus ogilbyi	Cephalophus	Cephalophini	6.66277659	5.47069180	http://www.iucnredlist.org	32.7	21.8	379	19
A0432	Cephalophus ogilbyi	Cephalophus	Cephalophini	8.14517477	4.97655907	http://www.iucnredlist.org	32.4	21.9	405	31
A0433	Cephalophus ogilbyi	Cephalophus	Cephalophini	7.77457523	4.76037600	http://www.iucnredlist.org	32.3	21.6	453	29
A0434	Cephalophus ogilbyi	Cephalophus	Cephalophini	7.12602602	4.85302589	http://www.iucnredlist.org	32.3	21.5	405	31
A0435	Cephalophus ogilbyi	Cephalophus	Cephalophini	6.44659352	4.60595953	http://www.iucnredlist.org	32.2	22.0	469	50
A0436	Cephalophus ogilbyi	Cephalophus	Cephalophini	6.53924341	4.94567578	http://www.iucnredlist.org	32.3	21.8	448	33
A0437	Cephalophus rufilatus	Cephalophus	Cephalophini	29.71670000	3.73330000	http://data.gbif.org/ws/rest/occurrence/get?key=213128171	33.1	18.0	224	24
A0438	Cephalophus rufilatus	Cephalophus	Cephalophini	-3.50000000	7.40000000	http://data.gbif.org/ws/rest/occurrence/get?key=151596915	35.4	20.7	178	5

A0439	Cephalophus rufilatus	Cephalophus	Cephalophini	-3.46700000	7.43300000	http://data.gbif.org/ws/rest/occurrence/get?key=240009191	35.3	20.6	177	5
A0440	Cephalophus rufilatus	Cephalophus	Cephalophini	-11.16670000	8.88333000	http://data.gbif.org/ws/rest/occurrence/get?key=49681433	35.0	15.2	438	10
A0441	Cephalophus rufilatus	Cephalophus	Cephalophini	-12.95621650	8.33770223	http://www.iucnredlist.org	31.3	22.2	764	9
A0442	Cephalophus rufilatus	Cephalophus	Cephalophini	31.49151225	2.21392614	http://www.iucnredlist.org	33.4	17.3	139	21
A0443	Cephalophus rufilatus	Cephalophus	Cephalophini	31.41841159	2.03117449	http://www.iucnredlist.org	33.0	18.8	126	22
A0444	Cephalophus rufilatus	Cephalophus	Cephalophini	31.54633775	1.92152349	http://www.iucnredlist.org	32.7	18.9	138	26
A0445	Cephalophus rufilatus	Cephalophus	Cephalophini	31.56461291	2.04944965	http://www.iucnredlist.org	33.1	18.5	141	25
A0446	Cephalophus rufilatus	Cephalophus	Cephalophini	-8.92054843	13.63535402	East, 1990	39.8	13.9	255	0
A0447	Cephalophus rufilatus	Cephalophus	Cephalophini	-8.73768240	12.41015162	East, 1990	38.2	14.5	298	0
A0448	Cephalophus rufilatus	Cephalophus	Cephalophini	2.27085259	12.31871861	East, 1990	39.7	16.7	205	0
A0449	Cephalophus rufilatus	Cephalophus	Cephalophini	-16.52991519	13.56827072	East, 1990	34.5	16.7	302	0
A0450	Cephalophus rufilatus	Cephalophus	Cephalophini	-15.89974069	13.39973568	East, 1990	38.2	15.1	288	0
A0451	Cephalophus rufilatus	Cephalophus	Cephalophini	-12.45977802	9.72905134	East, 1990	37.3	19.7	527	3
A0452	Cephalophus rufilatus	Cephalophus	Cephalophini	-12.28458092	9.87139898	East, 1990	33.0	16.6	460	5
A0453	Cephalophus rufilatus	Cephalophus	Cephalophini	-11.03630153	9.23630947	East, 1990	34.4	12.5	394	9
A0454	Cephalophus rufilatus	Cephalophus	Cephalophini	-6.05413383	7.18869330	East, 1990	34.1	19.8	225	15
A0455	Cephalophus rufilatus	Cephalophus	Cephalophini	-6.60162478	8.00992973	East, 1990	34.2	18.1	235	12
A0456	Cephalophus rufilatus	Cephalophus	Cephalophini	-4.78395481	7.82378281	East, 1990	35.2	20.3	191	9
A0457	Cephalophus rufilatus	Cephalophus	Cephalophini	-5.04675047	9.93709790	East, 1990	35.9	17.6	282	3
A0458	Cephalophus rufilatus	Cephalophus	Cephalophini	-4.80585444	9.64145278	East, 1990	35.7	17.8	242	3
A0459	Cephalophus rufilatus	Cephalophus	Cephalophini	-7.03961755	8.85306580	East, 1990	34.6	16.3	262	5
A0460	Cephalophus rufilatus	Cephalophus	Cephalophini	-4.83870390	9.95899754	East, 1990	36.1	18.1	260	3
A0461	Cephalophus rufilatus	Cephalophus	Cephalophini	-4.21456421	9.88234880	East, 1990	36.6	18.6	236	2
A0462	Cephalophus rufilatus	Cephalophus	Cephalophini	2.25677890	11.88616571	East, 1990	38.9	16.7	228	0
A0463	Cephalophus rufilatus	Cephalophus	Cephalophini	1.26034536	11.44817294	East, 1990	38.8	18.1	229	0
A0464	Cephalophus rufilatus	Cephalophus	Cephalophini	0.27486164	6.04991211	East, 1990	33.9	21.6	189	15
A0465	Cephalophus rufilatus	Cephalophus	Cephalophini	0.60335621	6.42220596	East, 1990	34.2	21.7	176	24
A0466	Cephalophus rufilatus	Cephalophus	Cephalophini	0.01206598	7.48433841	East, 1990	35.7	20.1	199	13

A0467	Cephalophus rufilatus	Cephalophus	Cephalophini	-2.41441394	8.40412322	East, 1990	35.8	20.0	192	4
A0468	Cephalophus rufilatus	Cephalophus	Cephalophini	-2.03117027	9.21440984	East, 1990	35.9	19.0	206	1
A0469	Cephalophus rufilatus	Cephalophus	Cephalophini	-2.42536376	10.59408705	East, 1990	37.2	18.8	250	1
A0470	Cephalophus rufilatus	Cephalophus	Cephalophini	0.79388306	10.88973216	East, 1990	39.2	19.4	247	1
A0471	Cephalophus rufilatus	Cephalophus	Cephalophini	0.78293324	10.59408705	East, 1990	39.0	19.0	242	0
A0472	Cephalophus rufilatus	Cephalophus	Cephalophini	0.83768234	9.98089718	East, 1990	37.8	18.9	249	2
A0473	Cephalophus rufilatus	Cephalophus	Cephalophini	0.22449247	10.69263542	East, 1990	38.1	18.2	258	0
A0474	Cephalophus rufilatus	Cephalophus	Cephalophini	0.77198342	8.65596906	East, 1990	34.1	17.4	234	10
A0475	Cephalophus rufilatus	Cephalophus	Cephalophini	2.08596172	8.11942792	East, 1990	36.4	20.8	169	5
A0476	Cephalophus rufilatus	Cephalophus	Cephalophini	1.45087221	7.11204456	East, 1990	35.2	21.4	151	9
A0477	Cephalophus rufilatus	Cephalophus	Cephalophini	1.38517330	11.05397945	East, 1990	38.9	18.9	230	0
A0478	Cephalophus rufilatus	Cephalophus	Cephalophini	13.70371983	8.45522238	East, 1990	36.7	15.6	271	0
A0479	Cephalophus rufilatus	Cephalophus	Cephalophini	12.68173671	8.06102889	East, 1990	35.5	14.9	268	0
A0480	Cephalophus rufilatus	Cephalophus	Cephalophini	14.68190367	8.64501924	East, 1990	38.1	16.6	257	0
A0481	Cephalophus rufilatus	Cephalophus	Cephalophini	13.55772224	5.84186554	East, 1990	31.5	16.5	264	4
A0482	Cephalophus rufilatus	Cephalophus	Cephalophini	19.82101878	8.51362141	East, 1990	37.7	16.1	239	0
A0483	Cephalophus rufilatus	Cephalophus	Cephalophini	19.13483012	8.83481611	East, 1990	38.2	15.6	239	0
A0484	Cephalophus rufilatus	Cephalophus	Cephalophini	21.33939370	9.52100477	East, 1990	39.2	15.0	242	0
A0485	Cephalophus rufilatus	Cephalophus	Cephalophini	21.49999105	9.24360935	East, 1990	38.7	15.0	239	0
A0486	Cephalophus rufilatus	Cephalophus	Cephalophini	29.74885480	4.52788724	East, 1990	33.0	16.9	237	15
A0487	Cephalophus silvicultor	Cephalophus	Cephalophini	13.00000000	-4.00000000	http://data.gbif.org/ws/rest/occurrence/get?key=142329075	31.9	18.5	220	0
A0488	Cephalophus silvicultor	Cephalophus	Cephalophini	29.50280000	-3.46444000	http://data.gbif.org/ws/rest/occurrence/get?key=61832229	21.4	8.1	282	5
A0489	Cephalophus silvicultor	Cephalophus	Cephalophini	29.96670000	1.25000000	http://data.gbif.org/ws/rest/occurrence/get?key=142328841	29.6	15.4	150	62
A0490	Cephalophus silvicultor	Cephalophus	Cephalophini	10.50000000	3.10000000	http://data.gbif.org/ws/rest/occurrence/get?key=142328864	30.3	20.2	395	48
A0491	Cephalophus silvicultor	Cephalophus	Cephalophini	27.86670000	3.70000000	http://data.gbif.org/ws/rest/occurrence/get?key=213128203	33.3	17.3	248	18
A0492	Cephalophus silvicultor	Cephalophus	Cephalophini	29.71670000	3.73330000	http://data.gbif.org/ws/rest/occurrence/get?key=213128171	33.1	18.0	224	24
A0493	Cephalophus silvicultor	Cephalophus	Cephalophini	10.13330000	3.80000000	http://data.gbif.org/ws/rest/occurrence/get?key=61832282	32.5	21.8	462	33
A0494	Cephalophus silvicultor	Cephalophus	Cephalophini	31.83298049	0.26312237	Kingdon,1989	28.5	15.2	140	41

A0495	Cephalophus silvicultor	Cephalophus	Cephalophini	34.65563007	1.27254673	http://www.iucnredlist.org	25.0	9.0	190	31
A0496	Cephalophus silvicultor	Cephalophus	Cephalophini	34.50608572	1.30993281	http://www.iucnredlist.org	22.4	7.5	223	39
A0497	Cephalophus silvicultor	Cephalophus	Cephalophini	34.46869963	1.16038846	http://www.iucnredlist.org	18.5	4.6	248	48
A0498	Cephalophus silvicultor	Cephalophus	Cephalophini	34.46869963	0.97345803	http://www.iucnredlist.org	21.5	6.8	236	47
A0499	Cephalophus silvicultor	Cephalophus	Cephalophini	35.46877746	-0.64349024	http://www.iucnredlist.org	25.0	7.8	207	59
A0500	Cephalophus silvicultor	Cephalophus	Cephalophini	35.42204485	-0.48459937	http://www.iucnredlist.org	24.9	7.7	216	57
A0501	Cephalophus silvicultor	Cephalophus	Cephalophini	35.58093572	-0.77434155	http://www.iucnredlist.org	24.6	7.5	186	58
A0502	Cephalophus silvicultor	Cephalophus	Cephalophini	35.89871746	-0.83976720	http://www.iucnredlist.org	23.2	6.5	156	45
A0503	Cephalophus silvicultor	Cephalophus	Cephalophini	35.91741051	-0.69956937	http://www.iucnredlist.org	21.2	5.3	140	36
A0504	Cephalophus silvicultor	Cephalophus	Cephalophini	35.89871746	-0.46590633	http://www.iucnredlist.org	21.7	5.7	171	38
A0505	Cephalophus silvicultor	Cephalophus	Cephalophini	35.73048007	-0.42852024	http://www.iucnredlist.org	20.4	5.5	181	41
A0506	Cephalophus silvicultor	Cephalophus	Cephalophini	35.71178703	-0.53133198	http://www.iucnredlist.org	22.2	6.2	165	40
A0507	Cephalophus silvicultor	Cephalophus	Cephalophini	35.40335181	-0.33505502	http://www.iucnredlist.org	25.8	8.1	228	56
A0508	Cephalophus silvicultor	Cephalophus	Cephalophini	35.64636138	-0.24158980	http://www.iucnredlist.org	22.4	6.6	170	36
A0509	Cephalophus silvicultor	Cephalophus	Cephalophini	34.71170920	1.02953716	http://www.iucnredlist.org	23.0	7.5	215	37
A0510	Cephalophus silvicultor	Cephalophus	Cephalophini	34.62759050	0.93607194	http://www.iucnredlist.org	22.0	6.9	229	43
A0511	Cephalophus silvicultor	Cephalophus	Cephalophini	29.52438960	-0.93323242	Kingdon,1989	29.0	15.6	130	38
A0512	Cephalophus silvicultor	Cephalophus	Cephalophini	29.84217135	-1.12950937	Kingdon,1989	23.4	9.8	173	24
A0513	Cephalophus silvicultor	Cephalophus	Cephalophini	29.67393395	-1.10146981	Kingdon,1989	21.2	8.8	190	32
A0514	Cephalophus silvicultor	Cephalophus	Cephalophini	29.77674569	-1.21362807	Kingdon,1989	21.9	8.9	171	23
A0515	Cephalophus silvicultor	Cephalophus	Cephalophini	26.02892021	-14.33892178	Kafue National Park, Zambia - http://www.iucnredlist.org	32.7	6.4	233	0
A0516	Cephalophus silvicultor	Cephalophus	Cephalophini	26.02892021	-14.67433155	Kafue National Park, Zambia - http://www.iucnredlist.org	32.7	6.1	231	0
A0517	Cephalophus silvicultor	Cephalophus	Cephalophini	25.69351043	-14.76580694	Kafue National Park, Zambia - http://www.iucnredlist.org	32.8	5.9	225	0
A0518	Cephalophus silvicultor	Cephalophus	Cephalophini	25.35810066	-14.06449560	Kafue National Park, Zambia - http://www.iucnredlist.org	32.6	6.0	236	0
A0519	Cephalophus silvicultor	Cephalophus	Cephalophini	26.02892021	-14.03400380	Kafue National Park, Zambia - http://www.iucnredlist.org	32.3	6.4	239	0
A0520	Cephalophus silvicultor	Cephalophus	Cephalophini	26.27285459	-14.49138077	Kafue National Park, Zambia - http://www.iucnredlist.org	32.5	6.4	235	0
A0521	Cephalophus silvicultor	Cephalophus	Cephalophini	27.52301829	-7.81367710	Upemba National Park, DR Congo - http://www.iucnredlist.org	30.9	13.4	184	1
A0522	Cephalophus silvicultor	Cephalophus	Cephalophini	27.24859211	-8.48449665	Upemba National Park, DR Congo - http://www.iucnredlist.org	27.9	11.3	244	0

A0523	Cephalophus silvicultor	Cephalophus	Cephalophini	26.51678897	-9.12482439	Upemba National Park, DR Congo - http://www.iucnredlist.org	32.0	12.0	171	0
A0524	Cephalophus silvicultor	Cephalophus	Cephalophini	26.08990380	-9.85662754	Upemba National Park, DR Congo - http://www.iucnredlist.org	29.1	8.7	208	0
A0525	Cephalophus silvicultor	Cephalophus	Cephalophini	26.33383818	-10.31400450	Upemba National Park, DR Congo - http://www.iucnredlist.org	31.4	8.8	188	0
A0526	Cephalophus silvicultor	Cephalophus	Cephalophini	27.15711671	-10.07007012	Upemba National Park, DR Congo - http://www.iucnredlist.org	33.2	9.4	169	0
A0527	Cephalophus silvicultor	Cephalophus	Cephalophini	27.24859211	-9.39925057	Upemba National Park, DR Congo - http://www.iucnredlist.org	33.0	11.0	146	0
A0528	Cephalophus silvicultor	Cephalophus	Cephalophini	27.64498548	-8.42351305	Upemba National Park, DR Congo - http://www.iucnredlist.org	29.5	12.2	204	0
A0529	Cephalophus silvicultor	Cephalophus	Cephalophini	26.79121514	-8.48449665	Upemba National Park, DR Congo - http://www.iucnredlist.org	33.3	14.2	152	3
A0530	Cephalophus silvicultor	Cephalophus	Cephalophini	26.54728076	-9.70416855	Upemba National Park, DR Congo - http://www.iucnredlist.org	31.2	9.6	177	0
A0531	Cephalophus silvicultor	Cephalophus	Cephalophini	21.08924900	-1.86777657	Salonga National Park, DR Congo - http://www.iucnredlist.org	30.3	19.0	238	87
A0532	Cephalophus silvicultor	Cephalophus	Cephalophini	21.45515057	-1.47138321	Salonga National Park, DR Congo - http://www.iucnredlist.org	30.6	18.9	232	102
A0533	Cephalophus silvicultor	Cephalophus	Cephalophini	21.45515057	-1.13597343	Salonga National Park, DR Congo - http://www.iucnredlist.org	30.6	18.9	231	116
A0534	Cephalophus silvicultor	Cephalophus	Cephalophini	21.08924900	-1.13597343	Salonga National Park, DR Congo - http://www.iucnredlist.org	30.9	19.4	231	117
A0535	Cephalophus silvicultor	Cephalophus	Cephalophini	21.39416698	-1.71531759	Salonga National Park, DR Congo - http://www.iucnredlist.org	30.2	18.7	234	91
A0536	Cephalophus silvicultor	Cephalophus	Cephalophini	21.88203574	-1.89826837	Salonga National Park, DR Congo - http://www.iucnredlist.org	30.3	18.6	235	80
A0537	Cephalophus silvicultor	Cephalophus	Cephalophini	21.63810136	-2.41662893	Salonga National Park, DR Congo - http://www.iucnredlist.org	30.2	18.6	240	65
A0538	Cephalophus silvicultor	Cephalophus	Cephalophini	21.27219979	-2.14220275	Salonga National Park, DR Congo - http://www.iucnredlist.org	30.3	18.9	239	75
A0539	Cephalophus silvicultor	Cephalophus	Cephalophini	21.97351113	-1.22744883	Salonga National Park, DR Congo - http://www.iucnredlist.org	30.8	19.0	224	106
A0540	Cephalophus silvicultor	Cephalophus	Cephalophini	29.32203434	-0.06876052	Virunga National Park; DR Congo - http://www.iucnredlist.org	19.9	7.7	173	70
A0541	Cephalophus silvicultor	Cephalophus	Cephalophini	29.10859176	-0.37367849	Virunga National Park; DR Congo - http://www.iucnredlist.org	21.1	9.2	173	65
A0542	Cephalophus silvicultor	Cephalophus	Cephalophini	29.10859176	-0.83105546	Virunga National Park; DR Congo - http://www.iucnredlist.org	25.0	12.3	163	66
A0543	Cephalophus silvicultor	Cephalophus	Cephalophini	29.35252614	-0.95302265	Virunga National Park; DR Congo - http://www.iucnredlist.org	30.2	16.8	118	42
A0544	Cephalophus silvicultor	Cephalophus	Cephalophini	29.50498513	0.26664926	Virunga National Park; DR Congo - http://www.iucnredlist.org	30.0	17.5	149	52
A0545	Cephalophus silvicultor	Cephalophus	Cephalophini	29.68793591	0.41910824	Virunga National Park; DR Congo - http://www.iucnredlist.org	30.1	17.3	152	52
A0546	Cephalophus spadix	Cephalophus	Cephalophini	36.38330000	-7.81667000	http://data.gbif.org/ws/rest/occurrence/get?key=61833950	25.4	9.6	235	2
A0547	Cephalophus spadix	Cephalophus	Cephalophini	38.25000000	-4.66667000	http://data.gbif.org/ws/rest/occurrence/get?key=61832220	23.9	8.2	151	9
A0548	Cephalophus spadix	Cephalophus	Cephalophini	37.43560000	-3.14889000	http://data.gbif.org/ws/rest/occurrence/get?key=61834014	14.2	0.3	281	25
A0549	Cephalophus spadix	Cephalophus	Cephalophini	37.42670000	-3.12611000	http://data.gbif.org/ws/rest/occurrence/get?key=61834015	11.1	-2.1	297	37
A0550	Cephalophus spadix	Cephalophus	Cephalophini	37.20994261	-2.93552034	http://www.iucnredlist.org	19.1	4.3	257	13

A0551	Cephalophus spadix	Cephalophus	Cephalophini	37.14717356	-3.07988915	http://www.iucnredlist.org	22.4	7.1	252	9
A0552	Cephalophus spadix	Cephalophus	Cephalophini	37.36058834	-3.00456629	http://www.iucnredlist.org	14.3	0.4	286	27
A0553	Cephalophus spadix	Cephalophus	Cephalophini	37.46729572	-2.98573558	http://www.iucnredlist.org	21.3	6.1	246	9
A0554	Cephalophus spadix	Cephalophus	Cephalophini	38.27073958	-4.51102352	http://www.iucnredlist.org	23.5	8.1	156	8
A0555	Cephalophus spadix	Cephalophus	Cephalophini	38.37117006	-4.56751566	http://www.iucnredlist.org	27.7	11.8	147	21
A0556	Cephalophus spadix	Cephalophus	Cephalophini	38.42766220	-4.78093044	http://www.iucnredlist.org	25.0	9.7	240	48
A0557	Cephalophus spadix	Cephalophus	Cephalophini	36.58852901	-7.45489201	http://www.iucnredlist.org	29.2	13.9	234	4
A0558	Cephalophus spadix	Cephalophus	Cephalophini	36.82705140	-7.86289085	http://www.iucnredlist.org	28.2	14.0	320	6
A0559	Cephalophus spadix	Cephalophus	Cephalophini	36.85843593	-7.67458369	http://www.iucnredlist.org	27.0	11.8	274	3
A0560	Cephalophus spadix	Cephalophus	Cephalophini	36.34372971	-7.99470585	http://www.iucnredlist.org	31.1	17.2	349	6
A0561	Cephalophus spadix	Cephalophus	Cephalophini	35.92317707	-8.28661557	http://www.iucnredlist.org	25.3	9.2	246	3
A0562	Cephalophus spadix	Cephalophus	Cephalophini	35.89806945	-8.42470748	http://www.iucnredlist.org	26.6	10.6	270	5
A0563	Cephalophus spadix	Cephalophus	Cephalophini	36.62619044	-7.91310609	http://www.iucnredlist.org	28.9	14.6	329	6
A0564	Cephalophus spadix	Cephalophus	Cephalophini	29.65115677	-4.68304057	Kingdon,1989	27.2	13.2	223	2
A0565	Cephalophus weynsi	Cephalophus	Cephalophini	29.20000000	-2.50000000	http://data.gbif.org/ws/rest/occurrence/get?key=151596984	22.6	10.5	228	15
A0566	Cephalophus weynsi	Cephalophus	Cephalophini	29.16700000	-2.48300000	http://data.gbif.org/ws/rest/occurrence/get?key=240009354	21.7	10.2	227	16
A0567	Cephalophus weynsi	Cephalophus	Cephalophini	29.45010000	-1.18290000	http://data.gbif.org/ws/rest/occurrence/get?key=142329598	27.9	14.5	139	41
A0568	Cephalophus weynsi	Cephalophus	Cephalophini	29.46000000	0.49000000	http://data.gbif.org/ws/rest/occurrence/get?key=142328973	29.1	16.8	184	65
A0569	Cephalophus weynsi	Cephalophus	Cephalophini	29.46000000	0.49000000	http://data.gbif.org/ws/rest/occurrence/get?key=142328973	29.1	16.8	184	65
A0570	Cephalophus weynsi	Cephalophus	Cephalophini	28.35000000	1.25000000	http://data.gbif.org/ws/rest/occurrence/get?key=49681075	31.8	18.5	196	66
A0571	Cephalophus weynsi	Cephalophus	Cephalophini	32.88617549	3.89346738	http://www.iucnredlist.org	25.8	11.6	223	17
A0572	Cephalophus weynsi	Cephalophus	Cephalophini	32.65730048	4.00790488	http://www.iucnredlist.org	26.7	12.1	225	17
A0573	Cephalophus weynsi	Cephalophus	Cephalophini	32.51997548	4.14522989	http://www.iucnredlist.org	34.2	17.5	189	9
A0574	Cephalophus weynsi	Cephalophus	Cephalophini	33.13793799	4.14522989	http://www.iucnredlist.org	25.5	11.8	208	14
A0575	Cephalophus weynsi	Cephalophus	Cephalophini	34.41963803	1.12407980	http://www.iucnredlist.org	26.4	10.5	239	46
A0576	Cephalophus weynsi	Cephalophus	Cephalophini	34.62562554	0.87231729	http://www.iucnredlist.org	25.6	9.0	219	40
A0577	Cephalophus weynsi	Cephalophus	Cephalophini	34.67140054	1.23851730	http://www.iucnredlist.org	24.3	8.6	191	31
A0578	Cephalophus weynsi	Cephalophus	Cephalophini	34.94605055	0.27724227	http://www.iucnredlist.org	29.4	10.5	243	61

A0579	Cephalophus weynsi	Cephalophus	Cephalophini	35.12915055	0.13991727	http://www.iucnredlist.org	27.4	8.7	203	53
A0580	Cephalophus weynsi	Cephalophus	Cephalophini	35.58690057	-0.52382025	http://www.iucnredlist.org	23.5	6.9	175	43
A0581	Cephalophus weynsi	Cephalophus	Cephalophini	35.70133807	-0.61537025	http://www.iucnredlist.org	22.9	6.5	165	42
A0582	Cephalophus weynsi	Cephalophus	Cephalophini	35.99887558	-0.89002026	http://www.iucnredlist.org	22.7	6.2	154	44
A0583	Cephalophus weynsi	Cephalophus	Cephalophini	36.29641309	-0.95868276	http://www.iucnredlist.org	28.2	9.9	157	22
A0584	Cephalophus weynsi	Cephalophus	Cephalophini	36.13620058	-0.66114525	http://www.iucnredlist.org	24.0	6.5	159	34
A0585	Cephalophus weynsi	Cephalophus	Cephalophini	29.88791290	-6.17703291	http://www.iucnredlist.org	26.0	11.0	212	1
A0586	Cephalophus zebra	Cephalophus	Cephalophini	-6.80000000	5.80000000	http://data.gbif.org/ws/rest/occurrence/get?key=151596920	32.2	20.6	228	28
A0587	Cephalophus zebra	Cephalophus	Cephalophini	-6.75000000	5.81700000	http://data.gbif.org/ws/rest/occurrence/get?key=240009230	32.3	20.7	224	28
A0588	Cephalophus zebra	Cephalophus	Cephalophini	-9.06917000	6.06056000	http://data.gbif.org/ws/rest/occurrence/get?key=49680195	33.3	19.3	426	39
A0589	Cephalophus zebra	Cephalophus	Cephalophini	-11.31440000	7.21000000	http://data.gbif.org/ws/rest/occurrence/get?key=49681684	33.2	21.2	611	20
A0590	Cephalophus zebra	Cephalophus	Cephalophini	-3.50000000	7.40000000	http://data.gbif.org/ws/rest/occurrence/get?key=151596915	35.3	20.7	178	5
A0591	Cephalophus zebra	Cephalophus	Cephalophini	-3.46700000	7.43300000	http://data.gbif.org/ws/rest/occurrence/get?key=240009191	35.3	20.5	177	5
A0592	Cephalophus zebra	Cephalophus	Cephalophini	-10.64140388	7.78746830	East, 1990	33.8	19.0	416	16
A0593	Cephalophus zebra	Cephalophus	Cephalophini	-10.90132309	7.62925660	East, 1990	32.6	19.1	447	17
A0594	Cephalophus zebra	Cephalophus	Cephalophini	-10.65082124	7.51436478	East, 1990	32.9	19.4	447	19
A0595	Cephalophus zebra	Cephalophus	Cephalophini	-7.45645184	5.28433331	East, 1990	32.1	21.0	308	62
A0596	Cephalophus zebra	Cephalophus	Cephalophini	-7.47905351	5.61582447	East, 1990	32.6	20.6	295	38
A0597	Cephalophus zebra	Cephalophus	Cephalophini	-8.49612867	5.65349392	East, 1990	33.0	19.8	412	64
A0598	Cephalophus zebra	Cephalophus	Cephalophini	-7.81054467	5.48774834	East, 1990	32.8	19.8	319	68
A0599	Cephalophus zebra	Cephalophus	Cephalophini	-7.52425685	5.96238342	East, 1990	33.2	20.1	316	21
A0600	Cephalophus zebra	Cephalophus	Cephalophini	-7.01948621	5.93224786	East, 1990	32.3	20.2	259	24
A0601	Cephalophus zebra	Cephalophus	Cephalophini	-7.01948621	5.47268056	East, 1990	31.7	20.9	268	33
A0602	Connochaetes gnou	Connochaetes	Alcelaphini	18.46700000	-33.93300000	http://data.gbif.org/ws/rest/occurrence/get?key=86875202	26.8	8.1	122	19
A0603	Connochaetes gnou	Connochaetes	Alcelaphini	25.03470000	-33.90610000	http://data.gbif.org/ws/rest/occurrence/get?key=158799302	25.4	7.2	59	33
A0604	Connochaetes gnou	Connochaetes	Alcelaphini	29.06281736	-28.75499166	Estes, 1992	23.7	1.2	171	10
A0605	Connochaetes gnou	Connochaetes	Alcelaphini	29.42154232	-28.79983228	Estes, 1992	27.0	1.1	164	10
A0606	Connochaetes gnou	Connochaetes	Alcelaphini	29.42154232	-28.95677445	Estes, 1992	27.0	1.1	161	10

A0607	Connochaetes gnou	Connochaetes	Alcelaphini	29.51122356	-29.24823848	Estes, 1992	22.9	-2.1	181	8
A0608	Connochaetes gnou	Connochaetes	Alcelaphini	29.33186108	-28.53078856	Estes, 1992	28.4	0.9	155	11
A0609	Connochaetes gnou	Connochaetes	Alcelaphini	28.83861426	-28.39626670	Estes, 1992	25.3	-0.8	127	10
A0610	Connochaetes gnou	Connochaetes	Alcelaphini	28.90587519	-28.62046980	Estes, 1992	24.1	0.1	144	10
A0611	Connochaetes gnou	Connochaetes	Alcelaphini	29.17491891	-28.44110732	Estes, 1992	24.3	-0.4	140	9
A0612	Connochaetes gnou	Connochaetes	Alcelaphini	26.17169303	-28.81049086	East, 1989	31.2	-1.7	82	8
A0613	Connochaetes gnou	Connochaetes	Alcelaphini	26.92687865	-28.27556771	East, 1989	29.5	-0.6	92	9
A0614	Connochaetes gnou	Connochaetes	Alcelaphini	26.07729482	-30.60405672	East, 1989	30.7	-0.7	78	13
A0615	Connochaetes gnou	Connochaetes	Alcelaphini	25.88849842	-26.41906971	East, 1989	29.5	1.2	113	3
A0616	Connochaetes gnou	Connochaetes	Alcelaphini	28.31138564	-26.48200185	East, 1989	26.5	-0.5	119	7
A0617	Connochaetes gnou	Connochaetes	Alcelaphini	27.43033574	-30.32086211	East, 1989	28.9	-0.3	106	12
A0618	Connochaetes taurinus	Connochaetes	Alcelaphini	31.26670000	-25.16670000	http://data.gbif.org/ws/rest/occurrence/get?key=201242213	30.6	9.0	124	12
A0619	Connochaetes taurinus	Connochaetes	Alcelaphini	31.54000000	-24.39000000	http://data.gbif.org/ws/rest/occurrence/get?key=232037216	32.1	8.5	107	7
A0620	Connochaetes taurinus	Connochaetes	Alcelaphini	31.26482000	-24.36363000	http://data.gbif.org/ws/rest/occurrence/get?key=49926837	31.5	8.9	109	6
A0621	Connochaetes taurinus	Connochaetes	Alcelaphini	31.11670000	-23.95000000	http://data.gbif.org/ws/rest/occurrence/get?key=61838993	31.8	9.4	103	4
A0622	Connochaetes taurinus	Connochaetes	Alcelaphini	21.71700000	-23.73300000	http://data.gbif.org/ws/rest/occurrence/get?key=240022376	33.3	3.1	75	1
A0623	Connochaetes taurinus	Connochaetes	Alcelaphini	21.70000000	-23.70000000	http://data.gbif.org/ws/rest/occurrence/get?key=151629388	33.4	3.0	75	1
A0624	Connochaetes taurinus	Connochaetes	Alcelaphini	23.25000000	-22.55000000	http://data.gbif.org/ws/rest/occurrence/get?key=61838475	33.0	4.5	86	0
A0625	Connochaetes taurinus	Connochaetes	Alcelaphini	22.45000000	-22.10000000	http://data.gbif.org/ws/rest/occurrence/get?key=61838476	33.3	4.4	92	0
A0626	Connochaetes taurinus	Connochaetes	Alcelaphini	25.79970000	-20.57880000	http://data.gbif.org/ws/rest/occurrence/get?key=61838479	33.5	5.8	81	0
A0627	Connochaetes taurinus	Connochaetes	Alcelaphini	23.74500000	-20.29380000	http://data.gbif.org/ws/rest/occurrence/get?key=49707882	34.6	6.5	103	0
A0628	Connochaetes taurinus	Connochaetes	Alcelaphini	22.26670000	-19.66670000	http://data.gbif.org/ws/rest/occurrence/get?key=49710336	34.6	6.2	104	0
A0629	Connochaetes taurinus	Connochaetes	Alcelaphini	22.94370000	-19.53620000	http://data.gbif.org/ws/rest/occurrence/get?key=61838970	34.7	6.5	108	0
A0630	Connochaetes taurinus	Connochaetes	Alcelaphini	23.41670000	-18.81260000	http://data.gbif.org/ws/rest/occurrence/get?key=49708562	34.7	6.2	118	0
A0631	Connochaetes taurinus	Connochaetes	Alcelaphini	34.31360000	-18.69030000	http://data.gbif.org/ws/rest/occurrence/get?key=49710461	35.0	13.1	224	15
A0632	Connochaetes taurinus	Connochaetes	Alcelaphini	17.85000000	-15.83330000	http://data.gbif.org/ws/rest/occurrence/get?key=79770773	33.6	5.6	169	0
A0633	Connochaetes taurinus	Connochaetes	Alcelaphini	31.50000000	-13.16670000	http://data.gbif.org/ws/rest/occurrence/get?key=61838972	35.8	10.8	220	0
A0634	Connochaetes taurinus	Connochaetes	Alcelaphini	31.50000000	-13.16667000	http://data.gbif.org/ws/rest/occurrence/get?key=52123181	35.8	10.8	220	0

A0635	Connochaetes taurinus	Connochaetes	Alcelaphini	35.83330000	-3.58333000	http://data.gbif.org/ws/rest/occurrence/get?key=42075202	30.2	13.9	153	1
A0636	Connochaetes taurinus	Connochaetes	Alcelaphini	35.81000000	-3.37000000	http://data.gbif.org/ws/rest/occurrence/get?key=175791377	28.6	12.7	207	2
A0637	Connochaetes taurinus	Connochaetes	Alcelaphini	34.82500000	-2.44167000	http://data.gbif.org/ws/rest/occurrence/get?key=61838950	27.5	13.0	130	13
A0638	Connochaetes taurinus	Connochaetes	Alcelaphini	34.83330000	-2.33333000	http://data.gbif.org/ws/rest/occurrence/get?key=61838521	27.6	13.1	132	15
A0639	Connochaetes taurinus	Connochaetes	Alcelaphini	36.00000000	-2.25000000	http://data.gbif.org/ws/rest/occurrence/get?key=175792667	33.8	16.9	101	3
A0640	Connochaetes taurinus	Connochaetes	Alcelaphini	36.01670000	-1.86667000	http://data.gbif.org/ws/rest/occurrence/get?key=42074923	31.0	14.1	137	6
A0641	Connochaetes taurinus	Connochaetes	Alcelaphini	37.05000000	-1.46667000	http://data.gbif.org/ws/rest/occurrence/get?key=61838400	27.8	10.7	140	5
A0642	Connochaetes taurinus	Connochaetes	Alcelaphini	36.86670000	-1.38333000	http://data.gbif.org/ws/rest/occurrence/get?key=91212344	27.9	11.0	158	10
A0643	Connochaetes taurinus	Connochaetes	Alcelaphini	35.46700000	-1.21700000	http://data.gbif.org/ws/rest/occurrence/get?key=86875386	26.3	9.1	175	27
A0644	Connochaetes taurinus	Connochaetes	Alcelaphini	36.03000000	-0.36000000	http://data.gbif.org/ws/rest/occurrence/get?key=175792603	27.6	7.9	134	26
A0645	Connochaetes taurinus	Connochaetes	Alcelaphini	31.86522975	-12.73720226	Luangwa National Park, Zambia - http://www.iucnredlist.org	35.4	11.0	213	0
A0646	Connochaetes taurinus	Connochaetes	Alcelaphini	26.54688734	-18.79854839	Hwange National Park, Zimbabw - http://www.iucnredlist.org	33.7	5.8	154	0
A0647	Connochaetes taurinus	Connochaetes	Alcelaphini	26.42957097	-19.30691935	Hwange National Park, Zimbabw - http://www.iucnredlist.org	33.8	5.7	126	0
A0648	Connochaetes taurinus	Connochaetes	Alcelaphini	27.40720744	-19.42423573	Hwange National Park, Zimbabw - http://www.iucnredlist.org	34.0	4.5	134	0
A0649	Connochaetes taurinus	Connochaetes	Alcelaphini	26.97704739	-19.50244665	Hwange National Park, Zimbabw - http://www.iucnredlist.org	33.7	5.4	125	0
A0650	Connochaetes taurinus	Connochaetes	Alcelaphini	26.97704739	-18.87675931	Hwange National Park, Zimbabw - http://www.iucnredlist.org	33.3	4.5	156	0
A0651	Connochaetes taurinus	Connochaetes	Alcelaphini	16.41857349	-19.15049752	Etosha National Park, Namibia - http://www.iucnredlist.org	34.4	6.5	115	0
A0652	Connochaetes taurinus	Connochaetes	Alcelaphini	16.06662436	-18.56391563	Etosha National Park, Namibia - http://www.iucnredlist.org	34.6	6.4	109	0
A0653	Connochaetes taurinus	Connochaetes	Alcelaphini	16.96604992	-18.40749380	Etosha National Park, Namibia - http://www.iucnredlist.org	34.5	7.0	122	0
A0654	Connochaetes taurinus	Connochaetes	Alcelaphini	17.47442088	-18.44659926	Etosha National Park, Namibia - http://www.iucnredlist.org	34.4	7.6	126	0
A0655	Connochaetes taurinus	Connochaetes	Alcelaphini	17.90458093	-18.79854839	Etosha National Park, Namibia - http://www.iucnredlist.org	34.0	8.0	124	0
A0656	Connochaetes taurinus	Connochaetes	Alcelaphini	17.82637001	-19.34602481	Etosha National Park, Namibia - http://www.iucnredlist.org	32.7	7.5	136	0
A0657	Connochaetes taurinus	Connochaetes	Alcelaphini	16.88783900	-19.30691935	Etosha National Park, Namibia - http://www.iucnredlist.org	33.7	6.7	125	0
A0658	Connochaetes taurinus	Connochaetes	Alcelaphini	16.96604992	-18.83765385	Etosha National Park, Namibia - http://www.iucnredlist.org	34.3	7.3	118	0
A0659	Connochaetes taurinus	Connochaetes	Alcelaphini	16.49678441	-18.83765385	Etosha National Park, Namibia - http://www.iucnredlist.org	34.5	6.7	114	0
A0660	Connochaetes taurinus	Connochaetes	Alcelaphini	32.25628434	-12.03330400	Luangwa National Park, Zambia - http://www.iucnredlist.org	34.3	11.3	218	0
A0661	Connochaetes taurinus	Connochaetes	Alcelaphini	32.53002255	-12.03330400	Luangwa National Park, Zambia - http://www.iucnredlist.org	33.8	11.0	219	0
A0662	Connochaetes taurinus	Connochaetes	Alcelaphini	38.09440727	-11.91503812	Selous Game Reserve, Tanzania - http://www.iucnredlist.org	34.2	17.2	253	2

A0663	Connochaetes taurinus	Connochaetes	Alcelaphini	37.46052020	-11.63943505	Selous Game Reserve, Tanzania - http://www.iucnredlist.org	33.3	17.3	252	1
A0664	Connochaetes taurinus	Connochaetes	Alcelaphini	37.04711559	-10.75750521	Selous Game Reserve, Tanzania - http://www.iucnredlist.org	30.4	15.5	241	1
A0665	Connochaetes taurinus	Connochaetes	Alcelaphini	36.63371099	-10.34410060	Selous Game Reserve, Tanzania - http://www.iucnredlist.org	30.0	14.7	253	1
A0666	Connochaetes taurinus	Connochaetes	Alcelaphini	37.10223621	-9.37948985	Selous Game Reserve, Tanzania - http://www.iucnredlist.org	30.7	16.5	241	2
A0667	Connochaetes taurinus	Connochaetes	Alcelaphini	37.01955529	-8.58024094	Selous Game Reserve, Tanzania - http://www.iucnredlist.org	30.9	17.8	308	7
A0668	Connochaetes taurinus	Connochaetes	Alcelaphini	37.62588205	-7.89123326	Selous Game Reserve, Tanzania - http://www.iucnredlist.org	31.5	18.8	264	8
A0669	Connochaetes taurinus	Connochaetes	Alcelaphini	38.25976912	-8.77316309	Selous Game Reserve, Tanzania - http://www.iucnredlist.org	29.8	17.2	218	3
A0670	Connochaetes taurinus	Connochaetes	Alcelaphini	37.59832174	-8.44243940	Selous Game Reserve, Tanzania - http://www.iucnredlist.org	30.7	18.1	248	6
A0671	Connochaetes taurinus	Connochaetes	Alcelaphini	35.44861777	-1.41456104	http://www.iucnredlist.org	27.2	10.3	163	21
A0672	Connochaetes taurinus	Connochaetes	Alcelaphini	35.61397962	-2.18624965	http://www.iucnredlist.org	23.9	9.1	184	11
A0673	Connochaetes taurinus	Connochaetes	Alcelaphini	34.62180855	-2.54453364	http://www.iucnredlist.org	27.8	13.4	140	9
A0674	Connochaetes taurinus	Connochaetes	Alcelaphini	34.95253224	-1.82796565	http://www.iucnredlist.org	27.4	12.3	161	22
A0675	Connochaetes taurinus	Connochaetes	Alcelaphini	35.33837654	-2.51697334	http://www.iucnredlist.org	24.8	10.3	140	10
A0676	Connochaetes taurinus	Connochaetes	Alcelaphini	37.29515836	-2.07600842	http://www.iucnredlist.org	29.6	12.8	159	2
A0677	Connochaetes taurinus	Connochaetes	Alcelaphini	38.17708819	-1.93820688	http://www.iucnredlist.org	32.2	15.3	209	2
A0678	Connochaetes taurinus	Connochaetes	Alcelaphini	37.95660574	-2.70989549	http://www.iucnredlist.org	29.2	13.1	209	3
A0679	Connochaetes taurinus	Connochaetes	Alcelaphini	36.85419344	-3.48158409	http://www.iucnredlist.org	30.6	13.8	215	8
A0680	Connochaetes taurinus	Connochaetes	Alcelaphini	36.57859037	-4.22571239	http://www.iucnredlist.org	28.0	11.4	143	3
A0681	Connochaetes taurinus	Connochaetes	Alcelaphini	37.18491713	-4.88715976	http://www.iucnredlist.org	30.1	12.6	119	7
A0682	Connochaetes taurinus	Connochaetes	Alcelaphini	37.68100266	-4.63911700	http://www.iucnredlist.org	31.3	13.8	117	10
A0683	Connochaetes taurinus	Connochaetes	Alcelaphini	37.62588205	-4.00522993	http://www.iucnredlist.org	31.9	14.6	122	6
A0684	Connochaetes taurinus	Connochaetes	Alcelaphini	37.12979652	-3.97766962	http://www.iucnredlist.org	30.3	13.4	162	8
A0685	Damaliscus lunatus	Damaliscus	Alcelaphini	23.00000000	-19.50000000	http://data.gbif.org/ws/rest/occurrence/get?key=42075183	34.7	6.5	108	0
A0686	Damaliscus lunatus	Damaliscus	Alcelaphini	21.00000000	-18.80000000	http://data.gbif.org/ws/rest/occurrence/get?key=151653929	34.0	6.0	134	0
A0687	Damaliscus lunatus	Damaliscus	Alcelaphini	21.03300000	-18.76700000	http://data.gbif.org/ws/rest/occurrence/get?key=240033895	34.0	6.0	134	0
A0688	Damaliscus lunatus	Damaliscus	Alcelaphini	17.85000000	-15.83330000	http://data.gbif.org/ws/rest/occurrence/get?key=79770784	33.6	5.5	169	0
A0689	Damaliscus lunatus	Damaliscus	Alcelaphini	34.50000000	-10.50000000	http://data.gbif.org/ws/rest/occurrence/get?key=224281433	32.2	15.3	223	1
A0690	Damaliscus lunatus	Damaliscus	Alcelaphini	37.75000000	-3.56000000	http://data.gbif.org/ws/rest/occurrence/get?key=49721287	32.7	15.7	120	6

A0691	Damaliscus lunatus	Damaliscus	Alcelaphini	36.00000000	-2.25000000	http://data.gbif.org/ws/rest/occurrence/get?key=175796912	33.8	16.9	101	3
A0692	Damaliscus lunatus	Damaliscus	Alcelaphini	35.61000000	-2.05000000	http://data.gbif.org/ws/rest/occurrence/get?key=175796911	22.7	7.9	199	15
A0693	Damaliscus lunatus	Damaliscus	Alcelaphini	36.01670000	-1.86667000	http://data.gbif.org/ws/rest/occurrence/get?key=42074916	31.0	14.1	137	6
A0694	Damaliscus lunatus	Damaliscus	Alcelaphini	35.46700000	-1.21700000	http://data.gbif.org/ws/rest/occurrence/get?key=86875385	26.3	9.1	175	27
A0695	Damaliscus lunatus	Damaliscus	Alcelaphini	36.03000000	-0.36000000	http://data.gbif.org/ws/rest/occurrence/get?key=175796837	27.6	7.9	134	26
A0696	Damaliscus lunatus	Damaliscus	Alcelaphini	36.08330000	0.63333000	http://data.gbif.org/ws/rest/occurrence/get?key=201244305	33.4	15.0	90	21
A0697	Damaliscus lunatus	Damaliscus	Alcelaphini	35.00000000	12.33330000	http://data.gbif.org/ws/rest/occurrence/get?key=42357405	40.6	17.1	215	0
A0698	Damaliscus lunatus	Damaliscus	Alcelaphini	41.33725932	-1.71218203	Kingdon,1989	31.8	21.7	180	1
A0699	Damaliscus lunatus	Damaliscus	Alcelaphini	40.90427785	-1.18298246	Kingdon,1989	33.8	20.8	94	4
A0700	Damaliscus lunatus	Damaliscus	Alcelaphini	40.54345996	-1.47163677	Kingdon,1989	33.9	20.4	89	7
A0701	Damaliscus lunatus	Damaliscus	Alcelaphini	40.13453302	-1.78434561	Kingdon,1989	34.3	20.2	91	12
A0702	Damaliscus lunatus	Damaliscus	Alcelaphini	40.06236944	-2.16921802	Kingdon,1989	33.5	20.6	104	11
A0703	Damaliscus lunatus	Damaliscus	Alcelaphini	40.27886018	-2.36165423	Kingdon,1989	33.0	21.1	180	9
A0704	Damaliscus lunatus	Damaliscus	Alcelaphini	40.68778712	-2.02489087	Kingdon,1989	32.2	21.2	219	6
A0705	Damaliscus lunatus	Damaliscus	Alcelaphini	36.30986339	4.37361304	Kingdon,1989	36.6	21.9	62	1
A0706	Damaliscus lunatus	Damaliscus	Alcelaphini	36.43013602	3.86846799	Kingdon,1989	36.7	21.8	50	0
A0707	Damaliscus lunatus	Damaliscus	Alcelaphini	36.67068128	4.37361304	Kingdon,1989	35.8	20.9	61	2
A0708	Damaliscus lunatus	Damaliscus	Alcelaphini	35.58822761	4.46983114	Kingdon,1989	36.0	21.7	90	10
A0709	Damaliscus lunatus	Damaliscus	Alcelaphini	35.66039119	4.13306778	Kingdon,1989	35.7	21.5	84	6
A0710	Damaliscus lunatus	Damaliscus	Alcelaphini	35.63633667	3.91657705	Kingdon,1989	35.2	21.1	80	5
A0711	Damaliscus lunatus	Damaliscus	Alcelaphini	35.99715456	2.93034148	Kingdon,1989	36.8	21.5	50	2
A0712	Damaliscus lunatus	Damaliscus	Alcelaphini	35.70850024	3.21899579	Kingdon,1989	36.4	21.8	53	2
A0713	Damaliscus lunatus	Damaliscus	Alcelaphini	34.26522869	-2.02489087	Kingdon,1989	29.4	15.4	154	13
A0714	Damaliscus lunatus	Damaliscus	Alcelaphini	34.96280994	-1.78434561	Kingdon,1989	27.3	12.1	164	23
A0715	Damaliscus lunatus	Damaliscus	Alcelaphini	35.25146425	-2.09705445	Kingdon,1989	25.8	10.9	153	15
A0716	Damaliscus lunatus	Damaliscus	Alcelaphini	35.51606404	-1.39947319	Kingdon,1989	26.8	9.7	164	21
A0717	Damaliscus lunatus	Damaliscus	Alcelaphini	34.69821015	-2.48192686	Kingdon,1989	27.4	13.1	137	11
A0718	Damaliscus lunatus	Damaliscus	Alcelaphini	35.15524615	-2.24138160	Kingdon,1989	26.6	11.8	134	14

A0719	Damaliscus lunatus	Damaliscus	Alcelaphini	34.19306511	-1.30325509	Kingdon,1989	29.5	15.1	204	30
A0720	Damaliscus lunatus	Damaliscus	Alcelaphini	34.36144679	-0.89432815	Kingdon,1989	29.7	13.7	220	38
A0721	Damaliscus lunatus	Damaliscus	Alcelaphini	34.74631921	-0.55756478	Kingdon,1989	29.4	11.6	242	73
A0722	Damaliscus lunatus	Damaliscus	Alcelaphini	34.28928321	1.94410592	Kingdon,1989	31.7	16.3	152	22
A0723	Damaliscus lunatus	Damaliscus	Alcelaphini	34.65010110	1.63139708	Kingdon,1989	30.9	15.2	158	27
A0724	Damaliscus lunatus	Damaliscus	Alcelaphini	34.91470089	1.03003393	Kingdon,1989	28.5	9.6	148	20
A0725	Damaliscus lunatus	Damaliscus	Alcelaphini	33.54359291	1.43896087	Kingdon,1989	33.1	17.2	211	25
A0726	Damaliscus lunatus	Damaliscus	Alcelaphini	30.84948600	-1.01460078	Kingdon,1989	27.6	13.1	181	8
A0727	Damaliscus lunatus	Damaliscus	Alcelaphini	30.94570410	-0.48540121	Kingdon,1989	27.7	13.3	125	17
A0728	Damaliscus lunatus	Damaliscus	Alcelaphini	31.04192221	-1.35136414	Kingdon,1989	25.7	12.5	192	5
A0729	Damaliscus lunatus	Damaliscus	Alcelaphini	31.25841294	-2.36165423	Kingdon,1989	28.2	15.6	203	2
A0730	Damaliscus lunatus	Damaliscus	Alcelaphini	30.75326789	-1.56785487	Kingdon,1989	27.9	14.3	171	5
A0731	Damaliscus lunatus	Damaliscus	Alcelaphini	31.54706725	-2.40976328	Kingdon,1989	27.4	15.0	212	2
A0732	Damaliscus lunatus	Damaliscus	Alcelaphini	31.71544893	-7.26877753	Kingdon,1989	33.2	15.1	188	0
A0733	Damaliscus lunatus	Damaliscus	Alcelaphini	31.13814031	-7.05228680	Kingdon,1989	33.9	17.0	203	0
A0734	Damaliscus lunatus	Damaliscus	Alcelaphini	31.81166704	-6.25848744	Kingdon,1989	32.7	15.2	201	0
A0735	Damaliscus lunatus	Damaliscus	Alcelaphini	32.94222976	-6.59525080	Kingdon,1989	32.1	14.3	184	0
A0736	Damaliscus lunatus	Damaliscus	Alcelaphini	32.46113924	-5.70523334	Kingdon,1989	32.6	14.5	203	0
A0737	Damaliscus lunatus	Damaliscus	Alcelaphini	30.89759505	-4.79116135	Kingdon,1989	30.2	13.6	178	0
A0738	Damaliscus lunatus	Damaliscus	Alcelaphini	31.54706725	-4.98359756	Kingdon,1989	31.2	13.4	181	0
A0739	Damaliscus lunatus	Damaliscus	Alcelaphini	31.54706725	-4.04547105	Kingdon,1989	30.6	13.8	169	0
A0740	Damaliscus lunatus	Damaliscus	Alcelaphini	34.31333774	-8.37528572	Kingdon,1989	31.4	13.5	162	0
A0741	Damaliscus lunatus	Damaliscus	Alcelaphini	32.02815777	-3.87708937	Kingdon,1989	30.7	14.2	154	0
A0742	Damaliscus lunatus	Damaliscus	Alcelaphini	32.53330282	-3.32383527	Kingdon,1989	30.5	14.9	145	1
A0743	Damaliscus lunatus	Damaliscus	Alcelaphini	31.88383062	-3.13139906	Kingdon,1989	28.8	14.5	190	3
A0744	Damaliscus lunatus	Damaliscus	Alcelaphini	33.54359291	-2.98707191	Kingdon,1989	30.3	15.0	149	2
A0745	Damaliscus lunatus	Damaliscus	Alcelaphini	33.85630174	-2.57814497	Kingdon,1989	29.8	15.3	175	2
A0746	Damaliscus lunatus	Damaliscus	Alcelaphini	33.20682954	-2.67436307	Kingdon,1989	30.1	15.0	164	4

A0747	Damaliscus lunatus	Damaliscus	Alcelaphini	29.52648707	-0.82216457	Kingdon,1989	29.4	16.0	126	38
A0748	Damaliscus lunatus	Damaliscus	Alcelaphini	29.69486875	-0.62972836	Kingdon,1989	29.4	15.9	125	32
A0749	Damaliscus pygargus	Damaliscus	Alcelaphini	24.55000000	-32.25000000	http://data.gbif.org/ws/rest/occurrence/get?key=61847106	31.2	5.0	49	12
A0750	Damaliscus pygargus	Damaliscus	Alcelaphini	27.06670000	-30.53330000	http://data.gbif.org/ws/rest/occurrence/get?key=42074921	29.1	-1.2	99	13
A0751	Damaliscus pygargus	Damaliscus	Alcelaphini	19.50971514	-34.37671122	http://www.iucnredlist.org	24.8	6.7	74	24
A0752	Damaliscus pygargus	Damaliscus	Alcelaphini	20.14520327	-34.40115307	http://www.iucnredlist.org	27.0	7.0	61	24
A0753	Damaliscus pygargus	Damaliscus	Alcelaphini	20.16964512	-33.93675790	http://www.iucnredlist.org	30.4	4.6	50	21
A0754	Damaliscus pygargus	Damaliscus	Alcelaphini	20.73180770	-34.20561826	http://www.iucnredlist.org	28.3	5.5	66	34
A0755	Damaliscus pygargus	Damaliscus	Alcelaphini	21.22064472	-34.18117641	http://www.iucnredlist.org	28.1	5.1	60	25
A0756	Damaliscus pygargus	Damaliscus	Alcelaphini	21.70948175	-34.25450196	http://www.iucnredlist.org	26.3	7.0	49	28
A0757	Damaliscus pygargus	Damaliscus	Alcelaphini	26.08457312	-29.70831763	http://www.iucnredlist.org	30.1	-2.0	82	9
A0758	Damaliscus pygargus	Damaliscus	Alcelaphini	25.79127091	-28.33957396	http://www.iucnredlist.org	31.0	-2.3	81	6
A0759	Damaliscus pygargus	Damaliscus	Alcelaphini	27.81994456	-28.43734137	http://www.iucnredlist.org	27.2	-1.3	113	11
A0760	Damaliscus pygargus	Damaliscus	Alcelaphini	29.72640896	-28.21736471	http://www.iucnredlist.org	27.5	0.8	137	9
A0761	Dorcatragus megalotis	Dorcatragus	Neotragini	43.91910000	9.61263000	http://data.gbif.org/ws/rest/occurrence/get?key=61854682	29.9	10.2	84	2
A0762	Dorcatragus megalotis	Dorcatragus	Neotragini	42.74855708	11.16224234	Giotto et al., 2008	37.6	16.6	30	4
A0763	Dorcatragus megalotis	Dorcatragus	Neotragini	42.72434438	11.04117887	Giotto et al., 2008	36.7	15.8	40	5
A0764	Dorcatragus megalotis	Dorcatragus	Neotragini	42.79698246	10.99759603	Giotto et al., 2008	36.6	15.8	38	5
A0765	Dorcatragus megalotis	Dorcatragus	Neotragini	42.80666754	10.92495795	Giotto et al., 2008	37.6	17.0	34	4
A0766	Dorcatragus megalotis	Dorcatragus	Neotragini	42.86962054	11.07023410	Giotto et al., 2008	36.8	16.0	30	4
A0767	Dorcatragus megalotis	Dorcatragus	Neotragini	42.58875330	10.77483925	Giotto et al., 2008	37.2	16.4	49	3
A0768	Dorcatragus megalotis	Dorcatragus	Neotragini	42.53548538	10.69251610	Giotto et al., 2008	37.3	16.5	53	3
A0769	Dorcatragus megalotis	Dorcatragus	Neotragini	42.67107646	10.59566533	Giotto et al., 2008	37.0	16.5	51	3
A0770	Dorcatragus megalotis	Dorcatragus	Neotragini	42.68560407	10.73125641	Giotto et al., 2008	37.5	16.9	44	3
A0771	Dorcatragus megalotis	Dorcatragus	Neotragini	50.80468393	11.70037193	http://www.iucnredlist.org	34.9	18.7	12	0
A0772	Dorcatragus megalotis	Dorcatragus	Neotragini	50.68224542	11.49630775	http://www.iucnredlist.org	31.9	14.0	16	1
A0773	Dorcatragus megalotis	Dorcatragus	Neotragini	50.62102617	11.41468208	http://www.iucnredlist.org	31.7	13.3	17	1
A0774	Dorcatragus megalotis	Dorcatragus	Neotragini	50.00883364	11.00655373	http://www.iucnredlist.org	31.3	11.5	24	2

A0775	Dorcatragus megalotis	Dorcatragus	Neotragini	49.70273738	11.00655373	http://www.iucnredlist.org	29.2	9.3	29	3
A0776	Dorcatragus megalotis	Dorcatragus	Neotragini	49.43745395	11.08817940	http://www.iucnredlist.org	33.4	13.1	18	1
A0777	Dorcatragus megalotis	Dorcatragus	Neotragini	48.00900471	10.78208313	http://www.iucnredlist.org	27.5	8.7	55	1
A0778	Dorcatragus megalotis	Dorcatragus	Neotragini	48.39672665	10.78208313	http://www.iucnredlist.org	31.6	12.0	28	0
A0779	Dorcatragus megalotis	Dorcatragus	Neotragini	47.72331487	10.78208313	http://www.iucnredlist.org	27.1	8.7	65	1
A0780	Dorcatragus megalotis	Dorcatragus	Neotragini	43.94812761	10.06785852	http://www.iucnredlist.org	36.1	15.7	37	2
A0781	Dorcatragus megalotis	Dorcatragus	Neotragini	43.74406343	10.08826493	http://www.iucnredlist.org	34.9	14.6	51	2
A0782	Dorcatragus megalotis	Dorcatragus	Neotragini	43.74406343	10.31273553	http://www.iucnredlist.org	38.5	18.4	22	2
A0783	Dorcatragus megalotis	Dorcatragus	Neotragini	43.58081209	10.51679970	http://www.iucnredlist.org	39.7	19.6	16	2
A0784	Dorcatragus megalotis	Dorcatragus	Neotragini	44.47869447	7.14974080	http://www.iucnredlist.org	33.4	14.5	106	3
A0785	Dorcatragus megalotis	Dorcatragus	Neotragini	44.76438431	6.92527020	http://www.iucnredlist.org	34.2	16.3	104	1
A0786	Eudorcas rufifrons	Eudorcas	Antilopini	32.53330000	10.32020000	http://www.iucnredlist.org	38.8	19.0	153	0
A0787	Eudorcas rufifrons	Eudorcas	Antilopini	32.43330000	10.45000000	http://www.iucnredlist.org	38.8	18.9	146	0
A0788	Eudorcas rufifrons	Eudorcas	Antilopini	32.50000000	10.46670000	http://www.iucnredlist.org	38.8	18.9	146	0
A0789	Eudorcas rufifrons	Eudorcas	Antilopini	32.50000000	10.46670000	http://www.iucnredlist.org	38.8	18.9	146	0
A0790	Eudorcas rufifrons	Eudorcas	Antilopini	32.51670000	10.46670000	http://www.iucnredlist.org	38.8	18.9	146	0
A0791	Eudorcas rufifrons	Eudorcas	Antilopini	32.48330000	10.53330000	http://www.iucnredlist.org	38.8	18.8	144	0
A0792	Eudorcas rufifrons	Eudorcas	Antilopini	32.48330000	10.53330000	http://www.iucnredlist.org	38.8	18.8	144	0
A0793	Eudorcas rufifrons	Eudorcas	Antilopini	32.53330000	10.64240000	http://www.iucnredlist.org	38.9	18.6	142	0
A0794	Eudorcas rufifrons	Eudorcas	Antilopini	32.53330000	10.75960000	http://www.iucnredlist.org	38.9	18.5	140	0
A0795	Eudorcas rufifrons	Eudorcas	Antilopini	32.53330000	10.75960000	http://www.iucnredlist.org	38.9	18.4	140	0
A0796	Eudorcas rufifrons	Eudorcas	Antilopini	16.48333000	14.23570000	http://www.iucnredlist.org	42.0	15.0	109	0
A0797	Eudorcas rufifrons	Eudorcas	Antilopini	36.39890000	15.45580000	http://www.iucnredlist.org	41.7	16.3	90	0
A0798	Eudorcas rufifrons	Eudorcas	Antilopini	36.39890000	15.45580000	http://www.iucnredlist.org	41.7	16.3	90	0
A0799	Eudorcas rufifrons	Eudorcas	Antilopini	3.22777727	12.63375703	W National Park, Benin - http://www.iucnredlist.org	40.2	17.0	191	0
A0800	Eudorcas rufifrons	Eudorcas	Antilopini	2.86679408	12.69392089	W National Park, Benin - http://www.iucnredlist.org	40.7	17.1	196	0
A0801	Eudorcas rufifrons	Eudorcas	Antilopini	2.50581089	12.57359316	W National Park, Benin - http://www.iucnredlist.org	40.6	16.9	193	0
A0802	Eudorcas rufifrons	Eudorcas	Antilopini	14.40915734	11.22167026	Waza National Park, Cameroon - http://www.iucnredlist.org	40.0	16.4	228	0

A0803	Eudorcas rufifrons	Eudorcas	Antilopini	14.31891155	10.86068707	Waza National Park, Cameroon - http://www.iucnredlist.org	39.8	17.5	242	0
A0804	Eudorcas rufifrons	Eudorcas	Antilopini	14.54452604	10.95093287	Waza National Park, Cameroon - http://www.iucnredlist.org	40.2	17.3	232	0
A0805	Eudorcas rufifrons	Eudorcas	Antilopini	14.67989474	11.22167026	Waza National Park, Cameroon - http://www.iucnredlist.org	40.2	16.4	219	0
A0806	Eudorcas rufifrons	Eudorcas	Antilopini	19.38894459	10.76543297	Zakouma National Park, Chad - http://www.iucnredlist.org	39.3	15.6	251	0
A0807	Eudorcas rufifrons	Eudorcas	Antilopini	19.13512829	10.76543297	Zakouma National Park, Chad - http://www.iucnredlist.org	39.5	16.0	245	0
A0808	Eudorcas rufifrons	Eudorcas	Antilopini	2.68630248	12.09228224	Waza National Park, Cameroon - http://www.iucnredlist.org	39.8	17.0	212	0
A0809	Eudorcas rufifrons	Eudorcas	Antilopini	19.33818133	10.91772276	Zakouma National Park, Chad - http://www.iucnredlist.org	39.4	15.7	251	0
A0810	Eudorcas thomsoni	Eudorcas	Antilopini	35.83330000	-3.58333000	http://data.gbif.org/ws/rest/occurrence/get?key=42077990	30.2	13.9	153	1
A0811	Eudorcas thomsoni	Eudorcas	Antilopini	37.75000000	-3.56000000	http://data.gbif.org/ws/rest/occurrence/get?key=49767231	32.7	15.7	120	6
A0812	Eudorcas thomsoni	Eudorcas	Antilopini	35.81000000	-3.37000000	http://data.gbif.org/ws/rest/occurrence/get?key=175806878	28.6	12.7	207	2
A0813	Eudorcas thomsoni	Eudorcas	Antilopini	34.82500000	-2.44167000	http://data.gbif.org/ws/rest/occurrence/get?key=61865554	27.5	13.0	130	13
A0814	Eudorcas thomsoni	Eudorcas	Antilopini	34.83330000	-2.33333000	http://data.gbif.org/ws/rest/occurrence/get?key=147517569	27.6	13.1	132	15
A0815	Eudorcas thomsoni	Eudorcas	Antilopini	36.00000000	-2.25000000	http://data.gbif.org/ws/rest/occurrence/get?key=175807772	33.8	16.9	101	3
A0816	Eudorcas thomsoni	Eudorcas	Antilopini	34.61670000	-2.08333000	http://data.gbif.org/ws/rest/occurrence/get?key=42077942	28.7	14.2	153	17
A0817	Eudorcas thomsoni	Eudorcas	Antilopini	33.80000000	-1.50000000	http://data.gbif.org/ws/rest/occurrence/get?key=49768099	28.8	16.8	185	18
A0818	Eudorcas thomsoni	Eudorcas	Antilopini	37.05000000	-1.46667000	http://data.gbif.org/ws/rest/occurrence/get?key=61864082	27.8	10.7	136	5
A0819	Eudorcas thomsoni	Eudorcas	Antilopini	36.98330000	-1.45000000	http://data.gbif.org/ws/rest/occurrence/get?key=61864088	28.7	11.4	139	6
A0820	Eudorcas thomsoni	Eudorcas	Antilopini	36.83330000	-1.28333000	http://data.gbif.org/ws/rest/occurrence/get?key=42438978	27.8	11.3	186	14
A0821	Eudorcas thomsoni	Eudorcas	Antilopini	35.38333000	-1.10000000	http://data.gbif.org/ws/rest/occurrence/get?key=79787364	26.2	9.1	188	34
A0822	Eudorcas thomsoni	Eudorcas	Antilopini	36.56670000	-1.05000000	http://data.gbif.org/ws/rest/occurrence/get?key=42077752	27.7	10.3	205	20
A0823	Eudorcas thomsoni	Eudorcas	Antilopini	36.35000000	-0.76667000	http://data.gbif.org/ws/rest/occurrence/get?key=61863963	27.4	8.5	126	31
A0824	Eudorcas thomsoni	Eudorcas	Antilopini	36.36700000	0.06700000	http://data.gbif.org/ws/rest/occurrence/get?key=86876563	23.3	5.5	141	32
A0825	Eudorcas thomsoni	Eudorcas	Antilopini	37.06670000	1.90874000	http://data.gbif.org/ws/rest/occurrence/get?key=91210892	32.9	14.1	124	7
A0826	Eudorcas thomsoni	Eudorcas	Antilopini	36.62000000	2.39000000	http://data.gbif.org/ws/rest/occurrence/get?key=175807640	36.5	19.7	64	2
A0827	Gazella arabica	Gazella	Antilopini	35.02320000	29.82290000	http://data.gbif.org/ws/rest/occurrence/get?key=84157809	38.8	8.9	8	0
A0828	Gazella arabica	Gazella	Antilopini	35.06240000	29.89960000	http://data.gbif.org/ws/rest/occurrence/get?key=84058860	38.7	8.8	8	0
A0829	Gazella arabica	Gazella	Antilopini	35.04370000	29.90410000	http://data.gbif.org/ws/rest/occurrence/get?key=84059487	38.3	8.5	8	0
A0830	Gazella arabica	Gazella	Antilopini	35.08190000	30.00970000	http://data.gbif.org/ws/rest/occurrence/get?key=84037962	37.8	8.2	9	0

A0831	Gazella arabica	Gazella	Antilopini	35.09530000	30.03410000	http://data.gbif.org/ws/rest/occurrence/get?key=84058039	37.5	8.0	9	0
A0832	Gazella arabica	Gazella	Antilopini	35.11600000	30.08910000	http://data.gbif.org/ws/rest/occurrence/get?key=48481358	36.4	7.2	10	0
A0833	Gazella arabica	Gazella	Antilopini	35.27210000	30.75210000	http://data.gbif.org/ws/rest/occurrence/get?key=84034587	37.5	8.9	13	0
A0834	Gazella arabica	Gazella	Antilopini	35.09050000	31.52320000	http://data.gbif.org/ws/rest/occurrence/get?key=84028145	29.8	4.4	120	0
A0835	Gazella arabica	Gazella	Antilopini	35.03380000	32.58730000	http://data.gbif.org/ws/rest/occurrence/get?key=84050730	31.3	8.3	157	0
A0836	Gazella cuvieri	Gazella	Antilopini	-10.56089286	27.16485104	http://www.iucnredlist.org	35.2	7.8	13	0
A0837	Gazella cuvieri	Gazella	Antilopini	-9.31673987	31.36923011	http://www.iucnredlist.org	26.5	4.6	51	1
A0838	Gazella cuvieri	Gazella	Antilopini	-9.05932890	28.79512048	http://www.iucnredlist.org	36.2	6.0	18	0
A0839	Gazella cuvieri	Gazella	Antilopini	-6.52812110	33.55722330	http://www.iucnredlist.org	33.4	4.2	74	0
A0840	Gazella cuvieri	Gazella	Antilopini	-2.02342924	32.44177579	http://www.iucnredlist.org	37.7	1.9	24	2
A0841	Gazella cuvieri	Gazella	Antilopini	-0.54063483	34.66529706	http://www.iucnredlist.org	30.1	0.4	40	10
A0842	Gazella cuvieri	Gazella	Antilopini	0.25573034	33.16306276	Mallon & Kingswood, 2001	35.7	0.7	25	5
A0843	Gazella cuvieri	Gazella	Antilopini	1.79416305	33.74223743	Mallon & Kingswood, 2001	33.5	0.3	30	6
A0844	Gazella cuvieri	Gazella	Antilopini	3.89367122	34.75579310	Mallon & Kingswood, 2001	32.6	-0.5	33	9
A0845	Gazella cuvieri	Gazella	Antilopini	3.51358784	35.08157885	Mallon & Kingswood, 2001	30.9	1.0	35	7
A0846	Gazella cuvieri	Gazella	Antilopini	1.03399630	35.40736460	Mallon & Kingswood, 2001	31.8	3.4	68	2
A0847	Gazella cuvieri	Gazella	Antilopini	4.81716536	35.07382836	http://www.iucnredlist.org	35.0	2.6	24	4
A0848	Gazella cuvieri	Gazella	Antilopini	6.36163114	35.13818110	http://www.iucnredlist.org	30.4	-2.8	50	11
A0849	Gazella cuvieri	Gazella	Antilopini	7.87392055	35.20253384	http://www.iucnredlist.org	32.7	-0.3	53	14
A0850	Gazella cuvieri	Gazella	Antilopini	8.16350788	34.75206465	http://www.iucnredlist.org	36.1	1.6	32	7
A0851	Gazella cuvieri	Gazella	Antilopini	-7.32300230	30.08861708	http://www.iucnredlist.org	39.6	1.2	35	0
A0852	Gazella cuvieri	Gazella	Antilopini	-5.06487689	31.59403401	http://www.iucnredlist.org	39.9	1.8	24	3
A0853	Gazella cuvieri	Gazella	Antilopini	9.79364369	34.53782546	Mallon & Kingswood, 2001	34.4	4.1	23	2
A0854	Gazella d. pelzelni	Gazella	Antilopini	45.25000000	4.56667000	http://data.gbif.org/ws/rest/occurrence/get?key=61863890	36.9	21.6	70	0
A0855	Gazella d. pelzelni	Gazella	Antilopini	44.83330000	10.20000000	http://data.gbif.org/ws/rest/occurrence/get?key=61863902	38.5	17.6	13	1
A0856	Gazella d. pelzelni	Gazella	Antilopini	43.31570208	11.08407139	http://www.iucnredlist.org	40.8	20.9	15	1
A0857	Gazella d. pelzelni	Gazella	Antilopini	43.71845419	10.74844463	http://www.iucnredlist.org	41.0	21.0	10	1
A0858	Gazella d. pelzelni	Gazella	Antilopini	43.34926476	10.61419393	http://www.iucnredlist.org	39.3	19.1	20	3

A0859	Gazella d. pelzelni	Gazella	Antilopini	43.31570208	10.84913266	http://www.iucnredlist.org	40.2	20.0	17	2
A0860	Gazella d. pelzelni	Gazella	Antilopini	45.35040545	10.28208586	East, 1988	38.4	17.7	10	0
A0861	Gazella d. pelzelni	Gazella	Antilopini	45.97575113	10.61709247	East, 1988	37.9	18.3	8	0
A0862	Gazella d. pelzelni	Gazella	Antilopini	47.03660540	10.58359181	East, 1988	28.4	10.1	60	1
A0863	Gazella d. pelzelni	Gazella	Antilopini	47.29344381	10.73992823	East, 1988	23.4	4.5	101	3
A0864	Gazella dorcas	Gazella	Antilopini	16.48333000	14.23570000	http://data.gbif.org/ws/rest/occurrence/get?key=79785535	42.0	15.0	109	0
A0865	Gazella dorcas	Gazella	Antilopini	30.00000000	15.00000000	http://data.gbif.org/ws/rest/occurrence/get?key=56693044	39.7	13.5	69	0
A0866	Gazella dorcas	Gazella	Antilopini	-15.76700000	16.55000000	http://data.gbif.org/ws/rest/occurrence/get?key=240066884	38.6	14.7	83	0
A0867	Gazella dorcas	Gazella	Antilopini	-15.80000000	16.60000000	http://data.gbif.org/ws/rest/occurrence/get?key=151705258	38.2	14.7	81	0
A0868	Gazella dorcas	Gazella	Antilopini	34.00000000	18.00000000	http://data.gbif.org/ws/rest/occurrence/get?key=61864495	42.9	14.4	22	0
A0869	Gazella dorcas	Gazella	Antilopini	36.05000000	22.11670000	http://data.gbif.org/ws/rest/occurrence/get?key=61865475	36.4	13.3	14	0
A0870	Gazella dorcas	Gazella	Antilopini	36.33330000	22.20000000	http://data.gbif.org/ws/rest/occurrence/get?key=91212111	33.9	10.7	17	0
A0871	Gazella dorcas	Gazella	Antilopini	36.26670000	22.25000000	http://data.gbif.org/ws/rest/occurrence/get?key=61865474	36.5	13.7	16	0
A0872	Gazella dorcas	Gazella	Antilopini	36.36670000	22.25000000	http://data.gbif.org/ws/rest/occurrence/get?key=61864295	36.7	14.1	17	0
A0873	Gazella dorcas	Gazella	Antilopini	36.36670000	22.26670000	http://data.gbif.org/ws/rest/occurrence/get?key=61864304	36.8	14.2	17	0
A0874	Gazella dorcas	Gazella	Antilopini	36.30000000	22.28330000	http://data.gbif.org/ws/rest/occurrence/get?key=61865473	36.7	14.0	17	0
A0875	Gazella dorcas	Gazella	Antilopini	33.90000000	22.53330000	http://data.gbif.org/ws/rest/occurrence/get?key=61865454	38.7	10.9	2	0
A0876	Gazella dorcas	Gazella	Antilopini	33.36670000	22.55000000	http://data.gbif.org/ws/rest/occurrence/get?key=61865455	40.1	11.1	1	0
A0877	Gazella dorcas	Gazella	Antilopini	32.75000000	23.08330000	http://data.gbif.org/ws/rest/occurrence/get?key=61865456	41.1	10.3	0	0
A0878	Gazella dorcas	Gazella	Antilopini	32.31900000	23.90300000	http://data.gbif.org/ws/rest/occurrence/get?key=86876554	40.9	7.8	0	0
A0879	Gazella dorcas	Gazella	Antilopini	33.06670000	25.03330000	http://data.gbif.org/ws/rest/occurrence/get?key=61865445	39.9	7.8	0	0
A0880	Gazella dorcas	Gazella	Antilopini	34.81670000	25.05000000	http://data.gbif.org/ws/rest/occurrence/get?key=61865446	35.1	12.4	3	0
A0881	Gazella dorcas	Gazella	Antilopini	32.45000000	25.25000000	http://data.gbif.org/ws/rest/occurrence/get?key=61864272	40.7	6.0	0	0
A0882	Gazella dorcas	Gazella	Antilopini	33.60000000	26.01670000	http://data.gbif.org/ws/rest/occurrence/get?key=61865615	35.0	7.6	1	0
A0883	Gazella dorcas	Gazella	Antilopini	32.71670000	26.16670000	http://data.gbif.org/ws/rest/occurrence/get?key=61865613	39.7	5.4	0	0
A0884	Gazella dorcas	Gazella	Antilopini	32.73670000	26.22280000	http://data.gbif.org/ws/rest/occurrence/get?key=91212450	39.3	5.7	0	0
A0885	Gazella dorcas	Gazella	Antilopini	33.86670000	26.35000000	http://data.gbif.org/ws/rest/occurrence/get?key=61865616	34.1	9.7	1	0
A0886	Gazella dorcas	Gazella	Antilopini	32.20000000	26.56670000	http://data.gbif.org/ws/rest/occurrence/get?key=91212443	37.0	4.2	1	0

A0887	Gazella dorcas	Gazella	Antilopini	33.95000000	26.58330000	http://data.gbif.org/ws/rest/occurrence/get?key=61865453	34.1	10.4	1	0
A0888	Gazella dorcas	Gazella	Antilopini	32.76670000	26.65000000	http://data.gbif.org/ws/rest/occurrence/get?key=91212078	37.0	5.8	0	0
A0889	Gazella dorcas	Gazella	Antilopini	-10.91700000	28.00000000	http://data.gbif.org/ws/rest/occurrence/get?key=240066794	31.1	9.2	23	0
A0890	Gazella dorcas	Gazella	Antilopini	-10.90000000	28.00000000	http://data.gbif.org/ws/rest/occurrence/get?key=151705249	31.1	9.1	23	0
A0891	Gazella dorcas	Gazella	Antilopini	28.83330000	28.35000000	http://data.gbif.org/ws/rest/occurrence/get?key=61865472	36.6	4.3	1	0
A0892	Gazella dorcas	Gazella	Antilopini	34.50000000	28.58330000	http://data.gbif.org/ws/rest/occurrence/get?key=61865476	32.8	6.4	3	0
A0893	Gazella dorcas	Gazella	Antilopini	26.53330000	28.66670000	http://data.gbif.org/ws/rest/occurrence/get?key=61865439	37.2	4.4	2	0
A0894	Gazella dorcas	Gazella	Antilopini	26.73330000	28.70000000	http://data.gbif.org/ws/rest/occurrence/get?key=61865436	36.9	4.6	2	0
A0895	Gazella dorcas	Gazella	Antilopini	-10.23300000	28.76700000	http://data.gbif.org/ws/rest/occurrence/get?key=240066897	28.6	8.9	26	1
A0896	Gazella dorcas	Gazella	Antilopini	-10.20000000	28.80000000	http://data.gbif.org/ws/rest/occurrence/get?key=151705248	28.6	8.8	26	1
A0897	Gazella dorcas	Gazella	Antilopini	30.33330000	29.08330000	http://data.gbif.org/ws/rest/occurrence/get?key=61864280	36.4	4.1	2	0
A0898	Gazella dorcas	Gazella	Antilopini	30.45000000	29.11670000	http://data.gbif.org/ws/rest/occurrence/get?key=61865470	36.2	3.9	2	0
A0899	Gazella dorcas	Gazella	Antilopini	28.91670000	29.59240000	http://data.gbif.org/ws/rest/occurrence/get?key=61865447	33.2	4.5	6	0
A0900	Gazella dorcas	Gazella	Antilopini	25.66670000	29.60510000	http://data.gbif.org/ws/rest/occurrence/get?key=61864289	36.1	4.1	5	0
A0901	Gazella dorcas	Gazella	Antilopini	26.51670000	29.61670000	http://data.gbif.org/ws/rest/occurrence/get?key=61865452	35.2	5.5	6	0
A0902	Gazella dorcas	Gazella	Antilopini	25.51670000	29.83160000	http://data.gbif.org/ws/rest/occurrence/get?key=61865479	35.6	4.5	6	0
A0903	Gazella dorcas	Gazella	Antilopini	29.58330000	30.03140000	http://data.gbif.org/ws/rest/occurrence/get?key=61865054	32.9	5.2	12	0
A0904	Gazella dorcas	Gazella	Antilopini	29.25000000	30.23330000	http://data.gbif.org/ws/rest/occurrence/get?key=61865483	32.3	5.7	14	0
A0905	Gazella dorcas	Gazella	Antilopini	28.91670000	30.25000000	http://data.gbif.org/ws/rest/occurrence/get?key=61865480	32.3	6.3	13	0
A0906	Gazella dorcas	Gazella	Antilopini	29.12450000	30.25000000	http://data.gbif.org/ws/rest/occurrence/get?key=61865478	32.3	5.9	14	0
A0907	Gazella dorcas	Gazella	Antilopini	29.48330000	30.35000000	http://data.gbif.org/ws/rest/occurrence/get?key=61865038	32.1	5.9	16	0
A0908	Gazella dorcas	Gazella	Antilopini	29.53330000	30.45000000	http://data.gbif.org/ws/rest/occurrence/get?key=61865046	31.8	6.0	18	0
A0909	Gazella dorcas	Gazella	Antilopini	29.65000000	30.53330000	http://data.gbif.org/ws/rest/occurrence/get?key=61865428	31.6	6.0	19	0
A0910	Gazella dorcas	Gazella	Antilopini	29.94580000	30.60140000	http://data.gbif.org/ws/rest/occurrence/get?key=61865444	32.5	7.1	20	0
A0911	Gazella dorcas	Gazella	Antilopini	24.86670000	31.40000000	http://data.gbif.org/ws/rest/occurrence/get?key=61865440	30.6	6.7	21	0
A0912	Gazella dorcas	Gazella	Antilopini	24.96900000	31.41170000	http://data.gbif.org/ws/rest/occurrence/get?key=61864276	30.3	6.8	21	0
A0913	Gazella dorcas	Gazella	Antilopini	7.35016354	16.99983456	http://www.iucnredlist.org	41.7	12.3	61	0
A0914	Gazella dorcas	Gazella	Antilopini	7.00097468	16.76704198	http://www.iucnredlist.org	41.1	12.2	73	0

A0915	Gazella dorcas	Gazella	Antilopini	7.75755055	16.59244755	http://www.iucnredlist.org	41.4	12.3	64	0
A0916	Gazella dorcas	Gazella	Antilopini	8.22313570	23.40163040	http://www.iucnredlist.org	37.8	5.7	3	1
A0917	Gazella dorcas	Gazella	Antilopini	7.00097468	22.52865824	http://www.iucnredlist.org	38.9	7.3	4	0
A0918	Gazella dorcas	Gazella	Antilopini	7.69935241	22.64505453	http://www.iucnredlist.org	38.3	6.5	3	0
A0919	Gazella dorcas	Gazella	Antilopini	7.58295612	23.05244154	http://www.iucnredlist.org	38.3	6.2	3	0
A0920	Gazella dorcas	Gazella	Antilopini	11.16112923	32.65575959	http://www.iucnredlist.org	35.8	5.8	23	0
A0921	Gazella dorcas	Gazella	Antilopini	11.18818200	32.80454984	http://www.iucnredlist.org	35.3	5.7	25	0
A0922	Gazella dorcas	Gazella	Antilopini	11.05291814	32.77749707	http://www.iucnredlist.org	35.8	5.8	24	0
A0923	Gazella dorcas	Gazella	Antilopini	8.69932693	35.26635214	http://www.iucnredlist.org	36.5	2.3	34	9
A0924	Gazella dorcas	Gazella	Antilopini	8.63169500	35.17166744	http://www.iucnredlist.org	33.4	-0.5	53	13
A0925	Gazella dorcas	Gazella	Antilopini	12.67608449	32.41228464	http://www.iucnredlist.org	34.0	5.7	38	0
A0926	Gazella dorcas	Gazella	Antilopini	12.82487474	32.34465271	http://www.iucnredlist.org	35.4	5.7	40	0
A0927	Gazella dorcas	Gazella	Antilopini	-16.10806550	19.61632323	http://www.iucnredlist.org	34.8	14.0	14	0
A0928	Gazella dorcas	Gazella	Antilopini	-16.05395995	19.94095650	http://www.iucnredlist.org	34.7	13.9	12	0
A0929	Gazella dorcas	Gazella	Antilopini	-15.94574886	20.18443145	http://www.iucnredlist.org	34.6	13.9	11	0
A0930	Gazella dorcas	Gazella	Antilopini	-16.14864466	20.49553833	http://www.iucnredlist.org	33.6	13.7	8	0
A0931	Gazella dorcas	Gazella	Antilopini	-16.36506684	20.75253967	http://www.iucnredlist.org	32.6	13.5	6	0
A0932	Gazella dorcas	Gazella	Antilopini	-16.58148902	21.10422572	http://www.iucnredlist.org	31.4	13.3	5	0
A0933	Gazella dorcas	Gazella	Antilopini	-16.60854179	20.90132992	http://www.iucnredlist.org	31.8	13.3	5	0
A0934	Gazella dorcas	Gazella	Antilopini	34.92040000	29.56110000	http://data.gbif.org/ws/rest/occurrence/get?key=84050865	37.6	8.7	6	0
A0935	Gazella dorcas	Gazella	Antilopini	34.96170000	29.57020000	http://data.gbif.org/ws/rest/occurrence/get?key=48456660	39.6	9.8	7	0
A0936	Gazella dorcas	Gazella	Antilopini	34.93070000	29.59540000	http://data.gbif.org/ws/rest/occurrence/get?key=84106270	37.7	8.7	6	0
A0937	Gazella dorcas	Gazella	Antilopini	34.95540000	29.62250000	http://data.gbif.org/ws/rest/occurrence/get?key=84008429	38.9	9.2	7	0
A0938	Gazella dorcas	Gazella	Antilopini	34.99870000	29.62980000	http://data.gbif.org/ws/rest/occurrence/get?key=84079977	39.8	9.6	8	0
A0939	Gazella dorcas	Gazella	Antilopini	35.01310000	29.67220000	http://data.gbif.org/ws/rest/occurrence/get?key=84010838	39.6	9.4	7	0
A0940	Gazella dorcas	Gazella	Antilopini	34.87150000	29.68100000	http://data.gbif.org/ws/rest/occurrence/get?key=84050816	33.7	5.8	7	0
A0941	Gazella dorcas	Gazella	Antilopini	34.95620000	29.71000000	http://data.gbif.org/ws/rest/occurrence/get?key=48464054	37.8	8.3	7	0
A0942	Gazella dorcas	Gazella	Antilopini	35.00270000	29.73270000	http://data.gbif.org/ws/rest/occurrence/get?key=84044930	38.9	8.9	8	0

A0943	Gazella dorcas	Gazella	Antilopini	34.86930000	29.73420000	http://data.gbif.org/ws/rest/occurrence/get?key=84093079	33.4	5.5	8	0
A0944	Gazella dorcas	Gazella	Antilopini	34.86500000	29.78920000	http://data.gbif.org/ws/rest/occurrence/get?key=84050735	33.7	5.8	8	0
A0945	Gazella dorcas	Gazella	Antilopini	34.98080000	29.79130000	http://data.gbif.org/ws/rest/occurrence/get?key=84013714	38.1	8.4	8	0
A0946	Gazella dorcas	Gazella	Antilopini	34.92490000	29.82270000	http://data.gbif.org/ws/rest/occurrence/get?key=48464057	34.0	5.8	9	0
A0947	Gazella dorcas	Gazella	Antilopini	34.84210000	29.82700000	http://data.gbif.org/ws/rest/occurrence/get?key=84155348	34.2	6.1	8	0
A0948	Gazella dorcas	Gazella	Antilopini	34.95680000	29.86880000	http://data.gbif.org/ws/rest/occurrence/get?key=84104851	34.4	6.0	9	0
A0949	Gazella dorcas	Gazella	Antilopini	34.90610000	29.87950000	http://data.gbif.org/ws/rest/occurrence/get?key=84050807	35.0	6.6	9	0
A0950	Gazella dorcas	Gazella	Antilopini	34.90590000	29.93090000	http://data.gbif.org/ws/rest/occurrence/get?key=84103889	35.3	6.8	9	0
A0951	Gazella dorcas	Gazella	Antilopini	34.95050000	29.93100000	http://data.gbif.org/ws/rest/occurrence/get?key=84157710	35.7	7.0	9	0
A0952	Gazella dorcas	Gazella	Antilopini	34.86240000	29.94890000	http://data.gbif.org/ws/rest/occurrence/get?key=84092378	34.4	6.3	10	0
A0953	Gazella dorcas	Gazella	Antilopini	35.03330000	29.95550000	http://data.gbif.org/ws/rest/occurrence/get?key=84055953	35.5	6.7	9	0
A0954	Gazella dorcas	Gazella	Antilopini	34.98660000	29.96270000	http://data.gbif.org/ws/rest/occurrence/get?key=48464757	35.7	6.9	10	0
A0955	Gazella dorcas	Gazella	Antilopini	34.98140000	30.00330000	http://data.gbif.org/ws/rest/occurrence/get?key=84106266	35.7	6.9	10	0
A0956	Gazella dorcas	Gazella	Antilopini	34.87460000	30.00390000	http://data.gbif.org/ws/rest/occurrence/get?key=84058443	34.4	6.3	11	0
A0957	Gazella dorcas	Gazella	Antilopini	35.09530000	30.03410000	http://data.gbif.org/ws/rest/occurrence/get?key=84058039	37.7	8.1	9	0
A0958	Gazella dorcas	Gazella	Antilopini	34.91280000	30.05720000	http://data.gbif.org/ws/rest/occurrence/get?key=84092717	35.2	6.8	11	0
A0959	Gazella dorcas	Gazella	Antilopini	34.82770000	30.07330000	http://data.gbif.org/ws/rest/occurrence/get?key=84091813	34.7	6.6	12	0
A0960	Gazella dorcas	Gazella	Antilopini	34.97080000	30.07540000	http://data.gbif.org/ws/rest/occurrence/get?key=48462230	35.7	7.1	11	0
A0961	Gazella dorcas	Gazella	Antilopini	34.76850000	30.08840000	http://data.gbif.org/ws/rest/occurrence/get?key=84021273	34.0	6.3	12	0
A0962	Gazella dorcas	Gazella	Antilopini	34.86710000	30.09320000	http://data.gbif.org/ws/rest/occurrence/get?key=84024618	35.0	6.9	12	0
A0963	Gazella dorcas	Gazella	Antilopini	34.97490000	30.10340000	http://data.gbif.org/ws/rest/occurrence/get?key=84093201	35.8	7.2	11	0
A0964	Gazella dorcas	Gazella	Antilopini	35.06930000	30.10890000	http://data.gbif.org/ws/rest/occurrence/get?key=84093226	36.2	7.3	11	0
A0965	Gazella dorcas	Gazella	Antilopini	34.89810000	30.11130000	http://data.gbif.org/ws/rest/occurrence/get?key=48462164	35.3	7.0	12	0
A0966	Gazella dorcas	Gazella	Antilopini	34.89800000	30.13840000	http://data.gbif.org/ws/rest/occurrence/get?key=84142167	35.2	7.0	12	0
A0967	Gazella dorcas	Gazella	Antilopini	35.12840000	30.14500000	http://data.gbif.org/ws/rest/occurrence/get?key=84092876	36.8	7.5	10	0
A0968	Gazella dorcas	Gazella	Antilopini	35.13160000	30.14500000	http://data.gbif.org/ws/rest/occurrence/get?key=84094355	36.8	7.5	10	0
A0969	Gazella dorcas	Gazella	Antilopini	35.02050000	30.15220000	http://data.gbif.org/ws/rest/occurrence/get?key=84056623	36.2	7.4	11	0
A0970	Gazella dorcas	Gazella	Antilopini	34.93950000	30.15650000	http://data.gbif.org/ws/rest/occurrence/get?key=48462386	35.7	7.2	12	0

A0971	Gazella dorcas	Gazella	Antilopini	34.83460000	30.16170000	http://data.gbif.org/ws/rest/occurrence/get?key=84091743	34.3	6.5	14	0
A0972	Gazella dorcas	Gazella	Antilopini	35.05990000	30.17020000	http://data.gbif.org/ws/rest/occurrence/get?key=84044450	36.6	7.6	11	0
A0973	Gazella dorcas	Gazella	Antilopini	34.93950000	30.17460000	http://data.gbif.org/ws/rest/occurrence/get?key=84157495	35.4	7.0	12	0
A0974	Gazella dorcas	Gazella	Antilopini	35.04330000	30.17470000	http://data.gbif.org/ws/rest/occurrence/get?key=48462307	36.4	7.5	11	0
A0975	Gazella dorcas	Gazella	Antilopini	35.00800000	30.18640000	http://data.gbif.org/ws/rest/occurrence/get?key=84091964	36.1	7.4	12	0
A0976	Gazella dorcas	Gazella	Antilopini	35.04110000	30.23790000	http://data.gbif.org/ws/rest/occurrence/get?key=84092748	36.1	7.5	12	0
A0977	Gazella dorcas	Gazella	Antilopini	34.98600000	30.26030000	http://data.gbif.org/ws/rest/occurrence/get?key=84052585	35.7	7.4	13	0
A0978	Gazella dorcas	Gazella	Antilopini	35.13140000	30.29660000	http://data.gbif.org/ws/rest/occurrence/get?key=84092867	36.7	7.7	12	0
A0979	Gazella dorcas	Gazella	Antilopini	34.77790000	30.31850000	http://data.gbif.org/ws/rest/occurrence/get?key=84157038	32.8	5.8	19	0
A0980	Gazella dorcas	Gazella	Antilopini	34.99110000	30.32440000	http://data.gbif.org/ws/rest/occurrence/get?key=48464201	35.6	7.4	13	0
A0981	Gazella dorcas	Gazella	Antilopini	34.89740000	30.35490000	http://data.gbif.org/ws/rest/occurrence/get?key=48462233	34.4	6.8	16	0
A0982	Gazella dorcas	Gazella	Antilopini	34.69970000	30.36330000	http://data.gbif.org/ws/rest/occurrence/get?key=84016925	32.3	5.7	20	0
A0983	Gazella dorcas	Gazella	Antilopini	34.83490000	30.36370000	http://data.gbif.org/ws/rest/occurrence/get?key=84021209	33.9	6.6	17	0
A0984	Gazella dorcas	Gazella	Antilopini	35.00130000	30.39120000	http://data.gbif.org/ws/rest/occurrence/get?key=48462266	34.3	6.6	17	0
A0985	Gazella dorcas	Gazella	Antilopini	34.90750000	30.43880000	http://data.gbif.org/ws/rest/occurrence/get?key=84094003	33.8	6.5	19	0
A0986	Gazella dorcas	Gazella	Antilopini	34.63680000	30.44420000	http://data.gbif.org/ws/rest/occurrence/get?key=84005763	29.7	3.9	32	0
A0987	Gazella dorcas	Gazella	Antilopini	34.94910000	30.45420000	http://data.gbif.org/ws/rest/occurrence/get?key=84123921	34.3	6.8	18	0
A0988	Gazella dorcas	Gazella	Antilopini	34.82400000	30.49000000	http://data.gbif.org/ws/rest/occurrence/get?key=84018922	31.7	5.3	28	0
A0989	Gazella dorcas	Gazella	Antilopini	34.62920000	30.49380000	http://data.gbif.org/ws/rest/occurrence/get?key=84137819	29.3	3.7	37	0
A0990	Gazella dorcas	Gazella	Antilopini	34.73030000	30.49870000	http://data.gbif.org/ws/rest/occurrence/get?key=84125039	31.0	5.0	30	0
A0991	Gazella dorcas	Gazella	Antilopini	34.60730000	30.50900000	http://data.gbif.org/ws/rest/occurrence/get?key=84026430	29.4	3.9	38	0
A0992	Gazella dorcas	Gazella	Antilopini	34.79260000	30.52600000	http://data.gbif.org/ws/rest/occurrence/get?key=84018052	32.0	5.6	27	0
A0993	Gazella dorcas	Gazella	Antilopini	35.12610000	30.53560000	http://data.gbif.org/ws/rest/occurrence/get?key=48462293	36.0	7.8	15	0
A0994	Gazella dorcas	Gazella	Antilopini	34.89160000	30.54430000	http://data.gbif.org/ws/rest/occurrence/get?key=84019556	32.9	6.1	24	0
A0995	Gazella dorcas	Gazella	Antilopini	34.71640000	30.55460000	http://data.gbif.org/ws/rest/occurrence/get?key=84113084	31.5	5.3	28	0
A0996	Gazella dorcas	Gazella	Antilopini	34.71940000	30.58800000	http://data.gbif.org/ws/rest/occurrence/get?key=84150183	30.1	4.4	38	0
A0997	Gazella dorcas	Gazella	Antilopini	34.89140000	30.60290000	http://data.gbif.org/ws/rest/occurrence/get?key=84017311	32.8	6.2	24	0
A0998	Gazella dorcas	Gazella	Antilopini	34.85170000	30.60910000	http://data.gbif.org/ws/rest/occurrence/get?key=84112865	32.7	6.1	26	0

A0999	Gazella dorcas	Gazella	Antilopini	34.94870000	30.62560000	http://data.gbif.org/ws/rest/occurrence/get?key=84103150	33.3	6.4	24	0
A1000	Gazella dorcas	Gazella	Antilopini	34.88800000	30.66790000	http://data.gbif.org/ws/rest/occurrence/get?key=84148457	31.4	5.3	36	0
A1001	Gazella dorcas	Gazella	Antilopini	35.21780000	30.67550000	http://data.gbif.org/ws/rest/occurrence/get?key=84052661	37.2	8.7	13	0
A1002	Gazella dorcas	Gazella	Antilopini	34.92450000	30.67970000	http://data.gbif.org/ws/rest/occurrence/get?key=84112777	31.9	5.7	30	0
A1003	Gazella dorcas	Gazella	Antilopini	35.18860000	30.68000000	http://data.gbif.org/ws/rest/occurrence/get?key=84025467	36.8	8.5	14	0
A1004	Gazella dorcas	Gazella	Antilopini	35.27210000	30.70700000	http://data.gbif.org/ws/rest/occurrence/get?key=84052626	37.5	8.9	13	0
A1005	Gazella dorcas	Gazella	Antilopini	35.28250000	30.72050000	http://data.gbif.org/ws/rest/occurrence/get?key=84018822	37.6	8.9	13	0
A1006	Gazella dorcas	Gazella	Antilopini	35.12590000	30.72510000	http://data.gbif.org/ws/rest/occurrence/get?key=84157297	35.5	7.6	18	0
A1007	Gazella dorcas	Gazella	Antilopini	35.18850000	30.72510000	http://data.gbif.org/ws/rest/occurrence/get?key=84157371	36.8	8.5	15	0
A1008	Gazella dorcas	Gazella	Antilopini	35.26370000	30.73860000	http://data.gbif.org/ws/rest/occurrence/get?key=84051361	37.4	8.9	13	0
A1009	Gazella dorcas	Gazella	Antilopini	35.24700000	30.76570000	http://data.gbif.org/ws/rest/occurrence/get?key=84044679	37.3	8.9	14	0
A1010	Gazella dorcas	Gazella	Antilopini	34.85430000	30.76970000	http://data.gbif.org/ws/rest/occurrence/get?key=84148871	31.5	5.6	36	0
A1011	Gazella dorcas	Gazella	Antilopini	35.24500000	30.80900000	http://data.gbif.org/ws/rest/occurrence/get?key=84018349	37.2	8.9	15	0
A1012	Gazella dorcas	Gazella	Antilopini	34.79140000	30.82810000	http://data.gbif.org/ws/rest/occurrence/get?key=48461979	32.0	6.0	30	0
A1013	Gazella dorcas	Gazella	Antilopini	34.86350000	30.82840000	http://data.gbif.org/ws/rest/occurrence/get?key=48456356	33.5	6.9	27	0
A1014	Gazella dorcas	Gazella	Antilopini	34.43770000	30.87520000	http://data.gbif.org/ws/rest/occurrence/get?key=84038455	32.0	6.9	27	0
A1015	Gazella dorcas	Gazella	Antilopini	34.41460000	30.89400000	http://data.gbif.org/ws/rest/occurrence/get?key=48464785	32.0	7.0	28	0
A1016	Gazella dorcas	Gazella	Antilopini	35.31400000	30.89640000	http://data.gbif.org/ws/rest/occurrence/get?key=84018233	37.9	9.3	14	0
A1017	Gazella dorcas	Gazella	Antilopini	34.63190000	30.92680000	http://data.gbif.org/ws/rest/occurrence/get?key=84031296	32.0	6.4	33	0
A1018	Gazella dorcas	Gazella	Antilopini	34.47700000	30.93050000	http://data.gbif.org/ws/rest/occurrence/get?key=84130765	32.0	7.0	29	0
A1019	Gazella dorcas	Gazella	Antilopini	34.67570000	30.94950000	http://data.gbif.org/ws/rest/occurrence/get?key=84015718	32.4	6.5	33	0
A1020	Gazella dorcas	Gazella	Antilopini	35.07340000	30.95050000	http://data.gbif.org/ws/rest/occurrence/get?key=84018801	33.6	6.7	32	0
A1021	Gazella dorcas	Gazella	Antilopini	34.56050000	30.96700000	http://data.gbif.org/ws/rest/occurrence/get?key=48463991	31.8	6.6	34	0
A1022	Gazella dorcas	Gazella	Antilopini	35.32460000	30.97760000	http://data.gbif.org/ws/rest/occurrence/get?key=84029041	37.8	9.4	15	0
A1023	Gazella dorcas	Gazella	Antilopini	34.52060000	30.98840000	http://data.gbif.org/ws/rest/occurrence/get?key=84050618	31.6	6.6	34	0
A1024	Gazella dorcas	Gazella	Antilopini	34.73300000	31.00380000	http://data.gbif.org/ws/rest/occurrence/get?key=84021211	32.3	6.4	36	0
A1025	Gazella dorcas	Gazella	Antilopini	34.69740000	31.00730000	http://data.gbif.org/ws/rest/occurrence/get?key=84022912	32.4	6.6	35	0
A1026	Gazella dorcas	Gazella	Antilopini	35.31840000	31.01280000	http://data.gbif.org/ws/rest/occurrence/get?key=84028696	37.7	9.3	16	0

A1027	Gazella dorcas	Gazella	Antilopini	34.70980000	31.03350000	http://data.gbif.org/ws/rest/occurrence/get?key=84020297	32.5	6.6	36	0
A1028	Gazella dorcas	Gazella	Antilopini	35.24930000	31.04260000	http://data.gbif.org/ws/rest/occurrence/get?key=84028652	33.8	6.7	35	0
A1029	Gazella dorcas	Gazella	Antilopini	35.33940000	31.05240000	http://data.gbif.org/ws/rest/occurrence/get?key=84036965	37.8	9.3	17	0
A1030	Gazella dorcas	Gazella	Antilopini	35.35510000	31.06590000	http://data.gbif.org/ws/rest/occurrence/get?key=84028687	37.9	9.3	17	0
A1031	Gazella dorcas	Gazella	Antilopini	35.15080000	31.07680000	http://data.gbif.org/ws/rest/occurrence/get?key=84006188	33.8	6.8	37	0
A1032	Gazella dorcas	Gazella	Antilopini	35.21990000	31.08050000	http://data.gbif.org/ws/rest/occurrence/get?key=84006148	33.6	6.6	38	0
A1033	Gazella dorcas	Gazella	Antilopini	34.54900000	31.11400000	http://data.gbif.org/ws/rest/occurrence/get?key=84022482	31.8	7.2	38	0
A1034	Gazella dorcas	Gazella	Antilopini	35.36150000	31.13540000	http://data.gbif.org/ws/rest/occurrence/get?key=84030660	38.2	9.7	17	0
A1035	Gazella dorcas	Gazella	Antilopini	35.32480000	31.16880000	http://data.gbif.org/ws/rest/occurrence/get?key=84018022	35.7	7.8	30	0
A1036	Gazella dorcas	Gazella	Antilopini	34.61160000	31.17020000	http://data.gbif.org/ws/rest/occurrence/get?key=84052544	32.0	7.2	42	0
A1037	Gazella dorcas	Gazella	Antilopini	34.56110000	31.18530000	http://data.gbif.org/ws/rest/occurrence/get?key=84022468	31.7	7.5	42	0
A1038	Gazella dorcas	Gazella	Antilopini	34.51910000	31.19950000	http://data.gbif.org/ws/rest/occurrence/get?key=84026750	31.5	7.6	43	0
A1039	Gazella dorcas	Gazella	Antilopini	34.62170000	31.22890000	http://data.gbif.org/ws/rest/occurrence/get?key=48464092	31.8	7.2	48	0
A1040	Gazella dorcas	Gazella	Antilopini	35.36710000	31.36990000	http://data.gbif.org/ws/rest/occurrence/get?key=84057534	38.1	9.7	24	0
A1041	Gazella dorcas	Gazella	Antilopini	35.39140000	31.40770000	http://data.gbif.org/ws/rest/occurrence/get?key=84107415	38.5	10.1	23	0
A1042	Gazella dorcas	Gazella	Antilopini	34.70430000	31.48260000	http://data.gbif.org/ws/rest/occurrence/get?key=84106357	31.5	7.8	80	0
A1043	Gazella dorcas	Gazella	Antilopini	35.03050000	31.50960000	http://data.gbif.org/ws/rest/occurrence/get?key=84148720	30.2	5.0	93	0
A1044	Gazella dorcas	Gazella	Antilopini	34.89250000	31.84310000	http://data.gbif.org/ws/rest/occurrence/get?key=84055847	31.8	7.7	130	0
A1045	Gazella dorcas	Gazella	Antilopini	35.42220000	32.43840000	http://data.gbif.org/ws/rest/occurrence/get?key=84046051	32.1	7.2	100	0
A1046	Gazella gazella	Gazella	Antilopini	44.35000000	14.76670000	http://data.gbif.org/ws/rest/occurrence/get?key=61864287	28.8	1.8	101	4
A1047	Gazella gazella	Gazella	Antilopini	35.61878384	33.69577164	http://www.iucnredlist.org	28.4	4.5	237	1
A1048	Gazella gazella	Gazella	Antilopini	36.78345887	31.80819487	http://www.iucnredlist.org	36.0	2.8	15	0
A1049	Gazella gazella	Gazella	Antilopini	38.08869812	28.18364586	http://www.iucnredlist.org	36.6	2.9	14	0
A1050	Gazella gazella	Gazella	Antilopini	38.65095503	28.20372647	http://www.iucnredlist.org	37.2	3.4	14	0
A1051	Gazella gazella	Gazella	Antilopini	39.39393737	28.38445190	http://www.iucnredlist.org	37.5	3.2	15	0
A1052	Gazella gazella	Gazella	Antilopini	38.85176107	28.70574156	http://www.iucnredlist.org	37.8	3.4	11	0
A1053	Gazella gazella	Gazella	Antilopini	38.68107594	28.41457281	http://www.iucnredlist.org	37.1	3.0	13	0
A1054	Gazella gazella	Gazella	Antilopini	38.23930265	28.72582217	http://www.iucnredlist.org	37.1	2.5	12	0

A1055	Gazella gazella	Gazella	Antilopini	38.39994748	28.94670881	http://www.iucnredlist.org	37.6	2.9	10	0
A1056	Gazella gazella	Gazella	Antilopini	46.75347871	23.28397851	http://www.iucnredlist.org	42.1	8.5	26	0
A1057	Gazella gazella	Gazella	Antilopini	46.42214874	23.44462334	http://www.iucnredlist.org	40.0	5.7	34	0
A1058	Gazella gazella	Gazella	Antilopini	46.64303539	23.52494576	http://www.iucnredlist.org	41.2	7.3	29	0
A1059	Gazella gazella	Gazella	Antilopini	45.30767523	19.38834135	http://www.iucnredlist.org	40.6	9.7	25	0
A1060	Gazella gazella	Gazella	Antilopini	45.43819915	19.10721289	http://www.iucnredlist.org	40.2	9.9	27	0
A1061	Gazella gazella	Gazella	Antilopini	45.93017395	19.15741440	http://www.iucnredlist.org	40.1	9.9	22	0
A1062	Gazella gazella	Gazella	Antilopini	45.86993214	19.49878467	http://www.iucnredlist.org	40.7	10.0	20	0
A1063	Gazella gazella	Gazella	Antilopini	45.62896489	19.31805924	http://www.iucnredlist.org	40.5	9.9	23	0
A1064	Gazella gazella	Gazella	Antilopini	39.18309103	22.74180220	http://www.iucnredlist.org	40.6	15.3	16	0
A1065	Gazella gazella	Gazella	Antilopini	39.47425979	21.11527329	http://www.iucnredlist.org	40.0	18.6	19	0
A1066	Gazella gazella	Gazella	Antilopini	41.09074841	21.00482996	http://www.iucnredlist.org	35.7	8.9	38	2
A1067	Gazella gazella	Gazella	Antilopini	41.93413377	20.09116249	http://www.iucnredlist.org	36.1	9.2	46	4
A1068	Gazella gazella	Gazella	Antilopini	41.84377105	19.50882497	http://www.iucnredlist.org	37.1	12.2	44	7
A1069	Gazella gazella	Gazella	Antilopini	42.30562494	19.02689048	http://www.iucnredlist.org	31.7	6.5	56	5
A1070	Gazella gazella	Gazella	Antilopini	42.83776095	18.18350511	http://www.iucnredlist.org	30.4	6.7	53	1
A1071	Gazella gazella	Gazella	Antilopini	52.90818381	23.44462334	http://www.iucnredlist.org	40.3	12.5	20	0
A1072	Gazella gazella	Gazella	Antilopini	54.45439031	23.82615481	http://www.iucnredlist.org	39.9	13.2	30	0
A1073	Gazella gazella	Gazella	Antilopini	56.06083862	25.41252252	http://www.iucnredlist.org	37.7	12.5	38	0
A1074	Gazella gazella	Gazella	Antilopini	55.43833990	23.98679965	http://www.iucnredlist.org	40.3	14.3	35	0
A1075	Gazella gazella	Gazella	Antilopini	56.79378067	23.58518757	http://www.iucnredlist.org	35.9	10.2	40	1
A1076	Gazella gazella	Gazella	Antilopini	56.75361946	23.97675934	http://www.iucnredlist.org	39.1	13.0	34	0
A1077	Gazella gazella	Gazella	Antilopini	58.44039019	23.13337398	http://www.iucnredlist.org	36.2	13.9	31	1
A1078	Gazella gazella	Gazella	Antilopini	58.51067230	22.34019012	http://www.iucnredlist.org	37.1	15.2	25	1
A1079	Gazella gazella	Gazella	Antilopini	59.51470250	22.36027073	http://www.iucnredlist.org	37.9	16.0	27	0
A1080	Gazella gazella	Gazella	Antilopini	57.82793177	20.46265366	http://www.iucnredlist.org	36.3	17.3	10	0
A1081	Gazella gazella	Gazella	Antilopini	57.31587637	20.24176702	http://www.iucnredlist.org	36.7	16.5	10	1
A1082	Gazella gazella	Gazella	Antilopini	57.51668241	19.83011464	http://www.iucnredlist.org	36.1	16.8	11	0

A1083	Gazella gazella	Gazella	Antilopini	56.66325674	19.42850256	http://www.iucnredlist.org	36.8	16.0	10	1
A1084	Gazella gazella	Gazella	Antilopini	57.43635999	19.13733380	http://www.iucnredlist.org	35.8	17.2	10	0
A1085	Gazella gazella	Gazella	Antilopini	34.97290000	30.53360000	http://data.gbif.org/ws/rest/occurrence/get?key=84019157	34.2	6.8	19	0
A1086	Gazella gazella	Gazella	Antilopini	34.41460000	30.89400000	http://data.gbif.org/ws/rest/occurrence/get?key=48464785	32.0	7.0	28	0
A1087	Gazella gazella	Gazella	Antilopini	34.71910000	31.05520000	http://data.gbif.org/ws/rest/occurrence/get?key=84055577	32.6	6.6	37	0
A1088	Gazella gazella	Gazella	Antilopini	34.27430000	31.22770000	http://data.gbif.org/ws/rest/occurrence/get?key=84026561	30.8	8.0	48	0
A1089	Gazella gazella	Gazella	Antilopini	34.49680000	31.23000000	http://data.gbif.org/ws/rest/occurrence/get?key=48468362	31.3	7.8	46	0
A1090	Gazella gazella	Gazella	Antilopini	34.49300000	31.30470000	http://www.iucnredlist.org	31.1	8.2	55	0
A1091	Gazella gazella	Gazella	Antilopini	34.84170000	31.33790000	http://data.gbif.org/ws/rest/occurrence/get?key=84095152	31.6	6.2	68	0
A1092	Gazella gazella	Gazella	Antilopini	35.26620000	31.34290000	http://data.gbif.org/ws/rest/occurrence/get?key=84043427	34.2	7.0	49	0
A1093	Gazella gazella	Gazella	Antilopini	35.09910000	31.35820000	http://data.gbif.org/ws/rest/occurrence/get?key=84041326	30.5	5.0	75	0
A1094	Gazella gazella	Gazella	Antilopini	34.38730000	31.38810000	http://data.gbif.org/ws/rest/occurrence/get?key=84025351	30.3	8.6	69	0
A1095	Gazella gazella	Gazella	Antilopini	35.12010000	31.39340000	http://data.gbif.org/ws/rest/occurrence/get?key=84041330	30.6	5.1	80	0
A1096	Gazella gazella	Gazella	Antilopini	34.67320000	31.40040000	http://data.gbif.org/ws/rest/occurrence/get?key=84026685	31.6	7.7	67	0
A1097	Gazella gazella	Gazella	Antilopini	35.27260000	31.41050000	http://data.gbif.org/ws/rest/occurrence/get?key=84039367	33.1	6.4	59	0
A1098	Gazella gazella	Gazella	Antilopini	35.18210000	31.43580000	http://data.gbif.org/ws/rest/occurrence/get?key=84037006	31.5	5.6	73	0
A1099	Gazella gazella	Gazella	Antilopini	34.48880000	31.44910000	http://data.gbif.org/ws/rest/occurrence/get?key=84044386	30.3	8.7	74	0
A1100	Gazella gazella	Gazella	Antilopini	34.88960000	31.44990000	http://data.gbif.org/ws/rest/occurrence/get?key=84113907	31.9	6.6	79	0
A1101	Gazella gazella	Gazella	Antilopini	34.51500000	31.46280000	http://data.gbif.org/ws/rest/occurrence/get?key=84102730	30.3	8.6	77	0
A1102	Gazella gazella	Gazella	Antilopini	34.89380000	31.46970000	http://data.gbif.org/ws/rest/occurrence/get?key=84139793	31.8	6.7	82	0
A1103	Gazella gazella	Gazella	Antilopini	35.15880000	31.47150000	http://www.iucnredlist.org	31.1	5.3	82	0
A1104	Gazella gazella	Gazella	Antilopini	34.86220000	31.47590000	http://data.gbif.org/ws/rest/occurrence/get?key=84093319	32.0	6.9	84	0
A1105	Gazella gazella	Gazella	Antilopini	35.07110000	31.47630000	http://www.iucnredlist.org	30.6	5.2	91	0
A1106	Gazella gazella	Gazella	Antilopini	34.65170000	31.48150000	http://data.gbif.org/ws/rest/occurrence/get?key=48467099	31.2	8.0	80	0
A1107	Gazella gazella	Gazella	Antilopini	34.87250000	31.54540000	http://data.gbif.org/ws/rest/occurrence/get?key=48464579	32.2	7.4	91	0
A1108	Gazella gazella	Gazella	Antilopini	35.37800000	31.55650000	http://data.gbif.org/ws/rest/occurrence/get?key=84015589	35.0	7.5	53	0
A1109	Gazella gazella	Gazella	Antilopini	34.92990000	31.57920000	http://www.iucnredlist.org	32.2	7.2	96	0
A1110	Gazella gazella	Gazella	Antilopini	35.40010000	31.59450000	http://www.iucnredlist.org	38.3	9.8	32	0

A1111	Gazella gazella	Gazella	Antilopini	34.50560000	31.59710000	http://data.gbif.org/ws/rest/occurrence/get?key=84145120	30.4	9.0	92	0
A1112	Gazella gazella	Gazella	Antilopini	34.51400000	31.60710000	http://data.gbif.org/ws/rest/occurrence/get?key=48456235	30.5	9.0	94	0
A1113	Gazella gazella	Gazella	Antilopini	35.27800000	31.61350000	http://data.gbif.org/ws/rest/occurrence/get?key=84026332	33.7	6.9	69	0
A1114	Gazella gazella	Gazella	Antilopini	35.49290000	31.62930000	http://www.iucnredlist.org	39.2	10.1	28	0
A1115	Gazella gazella	Gazella	Antilopini	35.41710000	31.63950000	http://data.gbif.org/ws/rest/occurrence/get?key=84092561	38.7	9.9	32	0
A1116	Gazella gazella	Gazella	Antilopini	34.56320000	31.64700000	http://data.gbif.org/ws/rest/occurrence/get?key=84055800	30.6	8.7	102	0
A1117	Gazella gazella	Gazella	Antilopini	34.90370000	31.65370000	http://data.gbif.org/ws/rest/occurrence/get?key=84053985	32.2	7.7	108	0
A1118	Gazella gazella	Gazella	Antilopini	34.87240000	31.67030000	http://www.iucnredlist.org	32.1	7.8	108	0
A1119	Gazella gazella	Gazella	Antilopini	34.97530000	31.69260000	http://data.gbif.org/ws/rest/occurrence/get?key=84047600	32.5	7.7	113	0
A1120	Gazella gazella	Gazella	Antilopini	35.06810000	31.70000000	http://data.gbif.org/ws/rest/occurrence/get?key=48456231	31.1	5.9	109	0
A1121	Gazella gazella	Gazella	Antilopini	34.58400000	31.70030000	http://data.gbif.org/ws/rest/occurrence/get?key=84092271	30.8	8.7	110	0
A1122	Gazella gazella	Gazella	Antilopini	35.33190000	31.71440000	http://data.gbif.org/ws/rest/occurrence/get?key=48467447	33.8	7.0	70	0
A1123	Gazella gazella	Gazella	Antilopini	35.21160000	31.72530000	http://data.gbif.org/ws/rest/occurrence/get?key=48467553	31.0	5.2	102	0
A1124	Gazella gazella	Gazella	Antilopini	34.74520000	31.72540000	http://data.gbif.org/ws/rest/occurrence/get?key=84014761	31.4	8.2	112	0
A1125	Gazella gazella	Gazella	Antilopini	35.12510000	31.74420000	http://data.gbif.org/ws/rest/occurrence/get?key=48456765	31.0	5.8	113	0
A1126	Gazella gazella	Gazella	Antilopini	35.07640000	31.74920000	http://www.iucnredlist.org	31.8	6.7	111	0
A1127	Gazella gazella	Gazella	Antilopini	34.63960000	31.75020000	http://data.gbif.org/ws/rest/occurrence/get?key=84145596	30.9	8.4	115	0
A1128	Gazella gazella	Gazella	Antilopini	35.03110000	31.75220000	http://data.gbif.org/ws/rest/occurrence/get?key=84091832	31.9	6.9	118	0
A1129	Gazella gazella	Gazella	Antilopini	34.60990000	31.76090000	http://data.gbif.org/ws/rest/occurrence/get?key=48464559	30.9	8.7	116	0
A1130	Gazella gazella	Gazella	Antilopini	34.65000000	31.77010000	http://data.gbif.org/ws/rest/occurrence/get?key=84017501	31.0	8.5	117	0
A1131	Gazella gazella	Gazella	Antilopini	35.81280000	31.77040000	http://www.iucnredlist.org	30.4	3.3	86	0
A1132	Gazella gazella	Gazella	Antilopini	34.88220000	31.77090000	http://data.gbif.org/ws/rest/occurrence/get?key=84047363	31.9	7.8	122	0
A1133	Gazella gazella	Gazella	Antilopini	35.45230000	31.78010000	http://data.gbif.org/ws/rest/occurrence/get?key=84102987	38.4	9.3	39	0
A1134	Gazella gazella	Gazella	Antilopini	35.15350000	31.78300000	http://data.gbif.org/ws/rest/occurrence/get?key=84144839	31.5	6.1	111	0
A1135	Gazella gazella	Gazella	Antilopini	34.81880000	31.78880000	http://data.gbif.org/ws/rest/occurrence/get?key=84059117	31.6	8.0	120	0
A1136	Gazella gazella	Gazella	Antilopini	35.02250000	31.81630000	http://data.gbif.org/ws/rest/occurrence/get?key=84019861	32.3	7.5	123	0
A1137	Gazella gazella	Gazella	Antilopini	34.69710000	31.83790000	http://data.gbif.org/ws/rest/occurrence/get?key=84148827	31.1	8.2	126	0
A1138	Gazella gazella	Gazella	Antilopini	35.17250000	31.86150000	http://data.gbif.org/ws/rest/occurrence/get?key=48456917	30.3	5.0	133	0

A1139	Gazella gazella	Gazella	Antilopini	35.12390000	31.86690000	http://data.gbif.org/ws/rest/occurrence/get?key=84030803	30.9	5.9	130	0
A1140	Gazella gazella	Gazella	Antilopini	34.96210000	31.90180000	http://data.gbif.org/ws/rest/occurrence/get?key=84047510	32.0	7.7	132	0
A1141	Gazella gazella	Gazella	Antilopini	35.22540000	31.92460000	http://data.gbif.org/ws/rest/occurrence/get?key=84104102	29.6	4.6	134	0
A1142	Gazella gazella	Gazella	Antilopini	34.71560000	31.93900000	http://data.gbif.org/ws/rest/occurrence/get?key=84153371	31.1	8.3	139	0
A1143	Gazella gazella	Gazella	Antilopini	35.34910000	31.94620000	http://data.gbif.org/ws/rest/occurrence/get?key=84164529	31.1	5.3	110	0
A1144	Gazella gazella	Gazella	Antilopini	34.77040000	31.97350000	http://data.gbif.org/ws/rest/occurrence/get?key=84053871	30.9	7.8	146	0
A1145	Gazella gazella	Gazella	Antilopini	34.98940000	31.98120000	http://data.gbif.org/ws/rest/occurrence/get?key=84046227	32.0	7.7	139	0
A1146	Gazella gazella	Gazella	Antilopini	35.20420000	31.99230000	http://data.gbif.org/ws/rest/occurrence/get?key=48456926	30.0	5.2	142	0
A1147	Gazella gazella	Gazella	Antilopini	35.48040000	32.00460000	http://data.gbif.org/ws/rest/occurrence/get?key=84164512	39.0	9.7	49	0
A1148	Gazella gazella	Gazella	Antilopini	35.33230000	32.02740000	http://data.gbif.org/ws/rest/occurrence/get?key=48467001	30.1	4.9	127	0
A1149	Gazella gazella	Gazella	Antilopini	35.37890000	32.03900000	http://data.gbif.org/ws/rest/occurrence/get?key=48464243	32.8	6.7	79	0
A1150	Gazella gazella	Gazella	Antilopini	35.07190000	32.04180000	http://data.gbif.org/ws/rest/occurrence/get?key=84019149	31.6	7.3	141	0
A1151	Gazella gazella	Gazella	Antilopini	35.42870000	32.05340000	http://data.gbif.org/ws/rest/occurrence/get?key=84017884	37.6	8.8	60	0
A1152	Gazella gazella	Gazella	Antilopini	34.97650000	32.07230000	http://data.gbif.org/ws/rest/occurrence/get?key=84138025	31.9	7.9	146	0
A1153	Gazella gazella	Gazella	Antilopini	35.37900000	32.08770000	http://data.gbif.org/ws/rest/occurrence/get?key=84042047	32.8	6.8	88	0
A1154	Gazella gazella	Gazella	Antilopini	34.97420000	32.14900000	http://data.gbif.org/ws/rest/occurrence/get?key=84139784	32.0	8.4	145	0
A1155	Gazella gazella	Gazella	Antilopini	35.12360000	32.15450000	http://data.gbif.org/ws/rest/occurrence/get?key=48467015	31.6	7.5	143	0
A1156	Gazella gazella	Gazella	Antilopini	35.17980000	32.17530000	http://data.gbif.org/ws/rest/occurrence/get?key=84104167	31.4	7.1	138	0
A1157	Gazella gazella	Gazella	Antilopini	35.48940000	32.17950000	http://data.gbif.org/ws/rest/occurrence/get?key=84093070	36.0	8.2	69	0
A1158	Gazella gazella	Gazella	Antilopini	35.27320000	32.21320000	http://data.gbif.org/ws/rest/occurrence/get?key=84104018	30.7	6.3	133	0
A1159	Gazella gazella	Gazella	Antilopini	34.85520000	32.23070000	http://data.gbif.org/ws/rest/occurrence/get?key=84165012	31.6	9.0	145	0
A1160	Gazella gazella	Gazella	Antilopini	35.51720000	32.23990000	http://data.gbif.org/ws/rest/occurrence/get?key=84041810	35.0	7.7	71	0
A1161	Gazella gazella	Gazella	Antilopini	35.36870000	32.24010000	http://data.gbif.org/ws/rest/occurrence/get?key=84031752	34.8	8.1	88	0
A1162	Gazella gazella	Gazella	Antilopini	35.46520000	32.24990000	http://data.gbif.org/ws/rest/occurrence/get?key=84031629	35.4	8.1	76	0
A1163	Gazella gazella	Gazella	Antilopini	35.06620000	32.31590000	http://data.gbif.org/ws/rest/occurrence/get?key=48466996	31.6	8.4	159	0
A1164	Gazella gazella	Gazella	Antilopini	35.45390000	32.35270000	http://data.gbif.org/ws/rest/occurrence/get?key=84132274	33.8	7.7	82	0
A1165	Gazella gazella	Gazella	Antilopini	35.54950000	32.35700000	http://data.gbif.org/ws/rest/occurrence/get?key=48464720	38.0	8.4	66	0
A1166	Gazella gazella	Gazella	Antilopini	35.08380000	32.43750000	http://www.iucnredlist.org	31.4	8.3	154	0

A1167	Gazella gazella	Gazella	Antilopini	35.43390000	32.44200000	http://data.gbif.org/ws/rest/occurrence/get?key=84094395	33.9	8.0	91	0
A1168	Gazella gazella	Gazella	Antilopini	35.55530000	32.49860000	http://data.gbif.org/ws/rest/occurrence/get?key=84114069	37.2	8.5	75	0
A1169	Gazella gazella	Gazella	Antilopini	35.02490000	32.50260000	http://www.iucnredlist.org	31.1	8.4	157	0
A1170	Gazella gazella	Gazella	Antilopini	34.96990000	32.55920000	http://data.gbif.org/ws/rest/occurrence/get?key=84034882	30.9	8.6	159	0
A1171	Gazella gazella	Gazella	Antilopini	35.53220000	32.57170000	http://data.gbif.org/ws/rest/occurrence/get?key=48477490	35.1	8.3	89	0
A1172	Gazella gazella	Gazella	Antilopini	35.01460000	32.58640000	http://data.gbif.org/ws/rest/occurrence/get?key=84059798	31.1	8.4	157	0
A1173	Gazella gazella	Gazella	Antilopini	35.10300000	32.61800000	http://data.gbif.org/ws/rest/occurrence/get?key=84116762	31.3	8.0	157	0
A1174	Gazella gazella	Gazella	Antilopini	35.59870000	32.67430000	http://data.gbif.org/ws/rest/occurrence/get?key=84116623	36.8	8.7	88	0
A1175	Gazella gazella	Gazella	Antilopini	35.63830000	32.71110000	http://data.gbif.org/ws/rest/occurrence/get?key=84023865	35.5	8.1	96	0
A1176	Gazella gazella	Gazella	Antilopini	35.69480000	32.71270000	http://data.gbif.org/ws/rest/occurrence/get?key=84122653	36.5	8.2	87	0
A1177	Gazella gazella	Gazella	Antilopini	35.65770000	32.75340000	http://data.gbif.org/ws/rest/occurrence/get?key=84164961	33.8	7.2	105	0
A1178	Gazella gazella	Gazella	Antilopini	35.48380000	32.77380000	http://data.gbif.org/ws/rest/occurrence/get?key=84028943	35.4	9.0	121	0
A1179	Gazella gazella	Gazella	Antilopini	35.66330000	32.80120000	http://data.gbif.org/ws/rest/occurrence/get?key=84122513	34.4	7.4	113	0
A1180	Gazella gazella	Gazella	Antilopini	35.02840000	32.80300000	http://www.iucnredlist.org	32.1	9.1	137	0
A1181	Gazella gazella	Gazella	Antilopini	35.69550000	32.83890000	http://data.gbif.org/ws/rest/occurrence/get?key=84153292	34.5	7.2	101	0
A1182	Gazella gazella	Gazella	Antilopini	35.74190000	32.91000000	http://data.gbif.org/ws/rest/occurrence/get?key=84150387	32.8	5.9	123	0
A1183	Gazella gazella	Gazella	Antilopini	35.79960000	32.91060000	http://data.gbif.org/ws/rest/occurrence/get?key=84163655	32.1	5.2	121	0
A1184	Gazella gazella	Gazella	Antilopini	35.71740000	32.92900000	http://data.gbif.org/ws/rest/occurrence/get?key=84119688	34.6	7.2	120	0
A1185	Gazella gazella	Gazella	Antilopini	35.51970000	32.94320000	http://data.gbif.org/ws/rest/occurrence/get?key=84062196	31.5	6.7	165	0
A1186	Gazella gazella	Gazella	Antilopini	35.66190000	32.95450000	http://data.gbif.org/ws/rest/occurrence/get?key=84003580	35.0	7.8	123	0
A1187	Gazella gazella	Gazella	Antilopini	35.71760000	32.96690000	http://data.gbif.org/ws/rest/occurrence/get?key=48478558	33.5	6.6	128	0
A1188	Gazella gazella	Gazella	Antilopini	35.52620000	32.96750000	http://data.gbif.org/ws/rest/occurrence/get?key=48460854	31.7	6.8	165	0
A1189	Gazella gazella	Gazella	Antilopini	35.80950000	32.98720000	http://data.gbif.org/ws/rest/occurrence/get?key=84155665	30.8	4.1	134	0
A1190	Gazella gazella	Gazella	Antilopini	35.55840000	33.01340000	http://data.gbif.org/ws/rest/occurrence/get?key=84013249	33.7	8.0	149	0
A1191	Gazella gazella	Gazella	Antilopini	35.69660000	33.02830000	http://data.gbif.org/ws/rest/occurrence/get?key=48461953	32.4	6.1	141	0
A1192	Gazella gazella	Gazella	Antilopini	35.45260000	33.05700000	http://data.gbif.org/ws/rest/occurrence/get?key=84124507	31.2	6.9	186	0
A1193	Gazella gazella	Gazella	Antilopini	35.76640000	33.06860000	http://data.gbif.org/ws/rest/occurrence/get?key=84164629	29.6	3.6	159	0
A1194	Gazella gazella	Gazella	Antilopini	35.68070000	33.06890000	http://data.gbif.org/ws/rest/occurrence/get?key=48464745	32.1	6.1	148	0

A1195	Gazella gazella	Gazella	Antilopini	35.23390000	33.10630000	http://www.iucnredlist.org	30.7	8.9	206	0
A1196	Gazella gazella	Gazella	Antilopini	35.71160000	33.21760000	http://data.gbif.org/ws/rest/occurrence/get?key=84114066	30.6	5.1	168	0
A1197	Gazella gazella	Gazella	Antilopini	35.67000000	33.25830000	http://data.gbif.org/ws/rest/occurrence/get?key=48464044	31.5	6.3	166	0
A1198	Gazella gazella	Gazella	Antilopini	35.72500000	33.30320000	http://data.gbif.org/ws/rest/occurrence/get?key=84022813	27.1	1.7	209	0
A1199	Gazella leptoceros	Gazella	Antilopini	26.53330000	28.66670000	http://data.gbif.org/ws/rest/occurrence/get?key=61865439	37.0	4.2	2	0
A1200	Gazella leptoceros	Gazella	Antilopini	30.50000000	28.88330000	http://data.gbif.org/ws/rest/occurrence/get?key=61865466	36.4	3.9	2	0
A1201	Gazella leptoceros	Gazella	Antilopini	30.33330000	29.08330000	http://data.gbif.org/ws/rest/occurrence/get?key=61864280	36.4	4.1	2	0
A1202	Gazella leptoceros	Gazella	Antilopini	30.45000000	29.11670000	http://data.gbif.org/ws/rest/occurrence/get?key=61865470	36.1	3.8	2	0
A1203	Gazella leptoceros	Gazella	Antilopini	28.91670000	29.22710000	http://data.gbif.org/ws/rest/occurrence/get?key=61865441	34.0	4.0	4	0
A1204	Gazella leptoceros	Gazella	Antilopini	28.38190000	29.55000000	http://data.gbif.org/ws/rest/occurrence/get?key=61865432	33.2	4.8	6	0
A1205	Gazella leptoceros	Gazella	Antilopini	28.91670000	29.59240000	http://data.gbif.org/ws/rest/occurrence/get?key=61865447	33.2	4.5	6	0
A1206	Gazella leptoceros	Gazella	Antilopini	28.91670000	30.25000000	http://data.gbif.org/ws/rest/occurrence/get?key=61865480	32.3	6.3	13	0
A1207	Gazella leptoceros	Gazella	Antilopini	29.53330000	30.45000000	http://data.gbif.org/ws/rest/occurrence/get?key=61865046	31.8	5.9	18	0
A1208	Gazella leptoceros	Gazella	Antilopini	9.54891573	29.82361158	http://www.iucnredlist.org	42.0	2.7	6	0
A1209	Gazella leptoceros	Gazella	Antilopini	9.42405459	29.07444472	http://www.iucnredlist.org	41.1	1.8	6	0
A1210	Gazella leptoceros	Gazella	Antilopini	6.67710945	23.20597103	http://www.iucnredlist.org	35.5	3.6	5	2
A1211	Gazella leptoceros	Gazella	Antilopini	7.30141516	23.83027674	http://www.iucnredlist.org	36.1	3.5	4	2
A1212	Gazella leptoceros	Gazella	Antilopini	7.30141516	23.08110989	http://www.iucnredlist.org	38.1	6.2	3	1
A1213	Gazella leptoceros	Gazella	Antilopini	9.04947116	26.20263845	http://www.iucnredlist.org	40.6	4.4	5	0
A1214	Gazella leptoceros	Gazella	Antilopini	8.42516545	26.57722188	http://www.iucnredlist.org	42.7	5.4	5	0
A1215	Gazella leptoceros	Gazella	Antilopini	8.92461002	34.56833499	http://www.iucnredlist.org	37.7	3.6	21	3
A1216	Gazella leptoceros	Gazella	Antilopini	8.67488773	34.31861271	http://www.iucnredlist.org	38.9	4.4	17	2
A1217	Gazella leptoceros	Gazella	Antilopini	1.68266376	19.46013676	http://www.iucnredlist.org	41.5	10.9	38	0
A1218	Gazella leptoceros	Gazella	Antilopini	11.04724944	19.70985904	http://www.iucnredlist.org	41.8	9.1	6	0
A1219	Gazella leptoceros	Gazella	Antilopini	11.42183286	23.83027674	http://www.iucnredlist.org	39.7	6.3	1	0
A1220	Gazella leptoceros	Gazella	Antilopini	16.54113970	21.83249846	http://www.iucnredlist.org	38.6	5.4	5	0
A1221	Gazella spekei	Gazella	Antilopini	44.78330000	10.00000000	http://data.gbif.org/ws/rest/occurrence/get?key=61863905	35.6	14.9	26	2
A1222	Gazella spekei	Gazella	Antilopini	46.00000000	10.00000000	http://data.gbif.org/ws/rest/occurrence/get?key=224288064	32.0	12.9	41	1

A1223	Gazella spekei	Gazella	Antilopini	47.14184711	9.03674817	http://www.iucnredlist.org	33.4	14.1	42	0
A1224	Gazella spekei	Gazella	Antilopini	46.13496684	2.62627712	http://www.iucnredlist.org	34.8	22.0	86	1
A1225	Gazella spekei	Gazella	Antilopini	45.80176081	2.35607517	http://www.iucnredlist.org	34.1	22.3	92	0
A1226	Gazella spekei	Gazella	Antilopini	46.49197278	3.09230128	http://www.iucnredlist.org	35.7	21.8	77	2
A1227	Gazella spekei	Gazella	Antilopini	46.89076192	3.55244259	http://www.iucnredlist.org	36.0	21.9	67	2
A1228	Gazella spekei	Gazella	Antilopini	47.28955106	3.93589369	http://www.iucnredlist.org	35.8	21.6	61	2
A1229	Gazella spekei	Gazella	Antilopini	47.71901629	4.38069696	http://www.iucnredlist.org	35.1	21.4	58	2
A1230	Gazella spekei	Gazella	Antilopini	48.39389022	5.43902198	http://www.iucnredlist.org	33.7	21.4	54	0
A1231	Gazella spekei	Gazella	Antilopini	48.01043912	4.85617632	http://www.iucnredlist.org	33.6	20.2	60	1
A1232	Gazella spekei	Gazella	Antilopini	48.80801740	5.85314917	http://www.iucnredlist.org	33.7	20.8	56	0
A1233	Gazella spekei	Gazella	Antilopini	48.83869349	6.28261440	http://www.iucnredlist.org	34.2	20.2	55	0
A1234	Gazella spekei	Gazella	Antilopini	49.25282067	7.21823507	http://www.iucnredlist.org	34.3	18.7	56	0
A1235	Gazella spekei	Gazella	Antilopini	47.64232607	8.59865902	http://www.iucnredlist.org	33.4	13.9	46	0
A1236	Gazella spekei	Gazella	Antilopini	49.26815872	7.87777096	http://www.iucnredlist.org	33.7	16.4	58	0
A1237	Gazella spekei	Gazella	Antilopini	46.32325430	9.01278620	http://www.iucnredlist.org	32.0	12.9	55	0
A1238	Gazella spekei	Gazella	Antilopini	47.78036847	9.50360360	http://www.iucnredlist.org	32.1	12.6	43	0
A1239	Gazella spekei	Gazella	Antilopini	46.59933909	9.47292752	http://www.iucnredlist.org	32.6	13.6	44	0
A1240	Gazella spekei	Gazella	Antilopini	48.39389022	9.94840687	http://www.iucnredlist.org	32.1	12.2	37	0
A1241	Gazella spekei	Gazella	Antilopini	50.47986418	10.19381558	http://www.iucnredlist.org	39.2	18.1	20	0
A1242	Gazella spekei	Gazella	Antilopini	50.84797723	10.25516775	http://www.iucnredlist.org	38.1	18.2	17	0
A1243	Gazella spekei	Gazella	Antilopini	49.48289133	10.14780144	http://www.iucnredlist.org	36.5	15.5	22	0
A1244	Gazella spekei	Gazella	Antilopini	50.49520223	9.79502644	http://www.iucnredlist.org	38.1	17.4	25	0
A1245	Gazella spekei	Gazella	Antilopini	49.71296199	9.07413838	http://www.iucnredlist.org	36.1	16.1	38	0
A1246	Gazella spekei	Gazella	Antilopini	48.80801740	9.68766013	http://www.iucnredlist.org	33.4	12.6	35	0
A1247	Gazella spekei	Gazella	Antilopini	48.65463696	8.64467315	http://www.iucnredlist.org	34.9	15.7	42	0
A1248	Gazella spekei	Gazella	Antilopini	48.47058044	8.07716553	http://www.iucnredlist.org	32.4	13.7	58	0
A1249	Gazella subgutturosa	Gazella	Antilopini	44.03330000	32.60000000	http://data.gbif.org/ws/rest/occurrence/get?key=61864166	43.7	4.3	19	0
A1250	Gazella subgutturosa	Gazella	Antilopini	44.53060000	33.25440000	http://data.gbif.org/ws/rest/occurrence/get?key=61864158	43.5	4.3	31	0

A1251	Gazella subgutturosa	Gazella	Antilopini	44.39390000	33.33860000	http://data.gbif.org/ws/rest/occurrence/get?key=61864161	43.4	4.3	30	0
A1252	Gazella subgutturosa	Gazella	Antilopini	45.00000000	35.55000000	http://data.gbif.org/ws/rest/occurrence/get?key=61864389	39.8	0.7	134	0
A1253	Gazella subgutturosa	Gazella	Antilopini	50.85267913	25.56885297	http://www.iucnredlist.org	39.8	13.3	17	0
A1254	Gazella subgutturosa	Gazella	Antilopini	50.86815154	25.46054609	http://www.iucnredlist.org	40.1	13.2	16	0
A1255	Gazella subgutturosa	Gazella	Antilopini	50.81399809	25.42186506	http://www.iucnredlist.org	40.2	13.1	16	0
A1256	Gazella subgutturosa	Gazella	Antilopini	50.94551360	25.46828229	http://www.iucnredlist.org	40.0	13.2	17	0
A1257	Gazella subgutturosa	Gazella	Antilopini	53.76817824	16.95921962	http://www.iucnredlist.org	33.6	15.8	16	2
A1258	Gazella subgutturosa	Gazella	Antilopini	54.01268056	17.15482147	http://www.iucnredlist.org	34.5	12.2	13	1
A1259	Gazella subgutturosa	Gazella	Antilopini	53.79262847	17.15482147	http://www.iucnredlist.org	33.7	9.8	16	2
A1260	Hippotragus equinus	Hippotragus	Hippotragini	25.79970000	-20.57880000	http://data.gbif.org/ws/rest/occurrence/get?key=61878240	33.5	5.8	81	0
A1261	Hippotragus equinus	Hippotragus	Hippotragini	24.35000000	-18.71670000	http://data.gbif.org/ws/rest/occurrence/get?key=61878249	35.1	6.4	126	0
A1262	Hippotragus equinus	Hippotragus	Hippotragini	20.83330000	-18.53330000	http://data.gbif.org/ws/rest/occurrence/get?key=79793566	34.1	6.0	143	0
A1263	Hippotragus equinus	Hippotragus	Hippotragini	24.00000000	-18.50000000	http://data.gbif.org/ws/rest/occurrence/get?key=79785523	34.9	5.9	130	0
A1264	Hippotragus equinus	Hippotragus	Hippotragini	17.85000000	-15.83330000	http://data.gbif.org/ws/rest/occurrence/get?key=79770774	33.6	5.5	169	0
A1265	Hippotragus equinus	Hippotragus	Hippotragini	32.41670000	-8.11667000	http://data.gbif.org/ws/rest/occurrence/get?key=42077940	33.1	15.5	223	0
A1266	Hippotragus equinus	Hippotragus	Hippotragini	35.83330000	-3.58333000	http://data.gbif.org/ws/rest/occurrence/get?key=42077975	30.2	13.9	153	1
A1267	Hippotragus equinus	Hippotragus	Hippotragini	36.04000000	-2.90000000	http://data.gbif.org/ws/rest/occurrence/get?key=175812428	31.3	14.8	116	0
A1268	Hippotragus equinus	Hippotragus	Hippotragini	34.82500000	-2.44167000	http://data.gbif.org/ws/rest/occurrence/get?key=61879861	27.5	13.0	130	13
A1269	Hippotragus equinus	Hippotragus	Hippotragini	32.56670000	4.41667000	http://data.gbif.org/ws/rest/occurrence/get?key=61878482	37.6	18.7	153	6
A1270	Hippotragus equinus	Hippotragus	Hippotragini	37.13300000	5.91700000	http://data.gbif.org/ws/rest/occurrence/get?key=86876955	29.2	14.1	162	23
A1271	Hippotragus equinus	Hippotragus	Hippotragini	36.28330000	12.83330000	http://data.gbif.org/ws/rest/occurrence/get?key=61878089	39.9	18.4	236	0
A1272	Hippotragus equinus	Hippotragus	Hippotragini	14.38553749	11.22871902	Estes, 1992	40.0	16.4	228	0
A1273	Hippotragus equinus	Hippotragus	Hippotragini	14.36376257	11.14161933	Estes, 1992	40.0	16.6	232	0
A1274	Hippotragus equinus	Hippotragus	Hippotragini	14.48352463	11.15250679	Estes, 1992	40.2	16.6	228	0
A1275	Hippotragus equinus	Hippotragus	Hippotragini	31.56840459	-24.66702698	Estes, 1992	31.7	8.2	113	9
A1276	Hippotragus equinus	Hippotragus	Hippotragini	30.54256386	-23.35085397	Estes, 1992	30.3	8.9	161	7
A1277	Hippotragus equinus	Hippotragus	Hippotragini	31.39420522	-24.08636242	Estes, 1992	33.1	8.7	91	5
A1278	Hippotragus equinus	Hippotragus	Hippotragini	30.85225162	-22.86696683	Estes, 1992	32.3	10.6	122	4

A1279	Hippotragus equinus	Hippotragus	Hippotragini	31.14258391	-22.65405649	Estes, 1992	33.3	10.3	102	3
A1280	Hippotragus equinus	Hippotragus	Hippotragini	29.98125478	-23.13794363	Estes, 1992	28.2	7.0	148	9
A1281	Hippotragus equinus	Hippotragus	Hippotragini	30.32965352	-23.87345208	Estes, 1992	31.1	7.3	145	8
A1282	Hippotragus equinus	Hippotragus	Hippotragini	29.07154696	-23.97022950	Estes, 1992	27.2	3.8	112	3
A1283	Hippotragus equinus	Hippotragus	Hippotragini	28.68443725	-23.13794363	Estes, 1992	31.6	5.2	85	1
A1284	Hippotragus equinus	Hippotragus	Hippotragini	34.30412131	-0.60541675	Lambwe Valley Forest Reserve, Kenya - http://www.iucnredlist.org	30.6	14.8	208	42
A1285	Hippotragus equinus	Hippotragus	Hippotragini	34.31783009	-0.62597992	Lambwe Valley Forest Reserve, Kenya - http://www.iucnredlist.org	30.5	14.6	213	42
A1286	Hippotragus equinus	Hippotragus	Hippotragini	34.24928621	-0.70823257	Lambwe Valley Forest Reserve, Kenya - http://www.iucnredlist.org	28.8	13.0	207	51
A1287	Hippotragus equinus	Hippotragus	Hippotragini	34.32468447	-0.66253665	Lambwe Valley Forest Reserve, Kenya - http://www.iucnredlist.org	29.7	13.7	221	47
A1288	Hippotragus equinus	Hippotragus	Hippotragini	34.26756458	-0.66710624	Lambwe Valley Forest Reserve, Kenya - http://www.iucnredlist.org	30.2	14.6	209	40
A1289	Hippotragus equinus	Hippotragus	Hippotragini	30.64903391	-1.24661072	Kingdon,1989	27.2	13.3	138	6
A1290	Hippotragus equinus	Hippotragus	Hippotragini	30.85443362	-1.29796065	Kingdon,1989	24.6	11.5	186	7
A1291	Hippotragus equinus	Hippotragus	Hippotragini	30.84159614	-1.43917295	Kingdon,1989	27.6	13.9	169	5
A1292	Hippotragus equinus	Hippotragus	Hippotragini	30.96997095	-1.92699725	Kingdon,1989	27.1	14.2	179	3
A1293	Hippotragus equinus	Hippotragus	Hippotragini	31.13685822	-1.56754777	Kingdon,1989	25.4	12.8	189	5
A1294	Hippotragus equinus	Hippotragus	Hippotragini	31.25239555	-1.82429740	Kingdon,1989	27.4	14.8	236	6
A1295	Hippotragus equinus	Hippotragus	Hippotragini	31.56049511	-2.67157119	Kingdon,1989	28.1	15.2	176	2
A1296	Hippotragus equinus	Hippotragus	Hippotragini	31.48347022	-2.95399578	Kingdon,1989	28.2	14.6	174	1
A1297	Hippotragus equinus	Hippotragus	Hippotragini	31.59900755	-3.30060779	Kingdon,1989	29.4	14.6	178	1
A1298	Hippotragus equinus	Hippotragus	Hippotragini	31.32942044	-3.69856972	Kingdon,1989	30.0	14.0	178	0
A1299	Hippotragus equinus	Hippotragus	Hippotragini	30.66187139	-4.46881862	Kingdon,1989	29.9	13.2	181	0
A1300	Hippotragus equinus	Hippotragus	Hippotragini	31.21388311	-4.27625639	Kingdon,1989	30.5	13.5	176	0
A1301	Hippotragus equinus	Hippotragus	Hippotragini	37.26033696	-5.56000456	Kingdon,1989	27.8	10.6	138	8
A1302	Hippotragus equinus	Hippotragus	Hippotragini	37.88937356	-5.32892989	Kingdon,1989	30.1	13.2	174	24
A1303	Hippotragus equinus	Hippotragus	Hippotragini	38.13328571	-5.49581715	Kingdon,1989	31.0	14.6	167	26
A1304	Hippotragus equinus	Hippotragus	Hippotragini	37.46573667	-5.53432959	Kingdon,1989	27.7	10.6	154	13
A1305	Hippotragus equinus	Hippotragus	Hippotragini	35.03945264	-3.86545698	Kingdon,1989	27.7	12.4	141	0
A1306	Hippotragus equinus	Hippotragus	Hippotragini	35.78402657	-3.98099431	Kingdon,1989	29.8	13.5	188	0

A1307	Hippotragus equinus	Hippotragus	Hippotragini	36.29752584	-4.00666928	Kingdon,1989	28.1	11.7	183	2
A1308	Hippotragus equinus	Hippotragus	Hippotragini	36.02793872	-4.40463121	Kingdon,1989	29.6	12.8	145	1
A1309	Hippotragus equinus	Hippotragus	Hippotragini	37.02926229	-1.15674835	Kingdon,1989	29.1	11.5	165	10
A1310	Hippotragus equinus	Hippotragus	Hippotragini	37.09344970	-1.37498554	Kingdon,1989	28.7	11.2	148	5
A1311	Hippotragus equinus	Hippotragus	Hippotragini	30.72605880	-1.29796065	Kingdon,1989	25.9	12.5	165	7
A1312	Hippotragus equinus	Hippotragus	Hippotragini	31.79156978	-8.63586516	Kingdon,1989	27.6	9.8	196	0
A1313	Hippotragus equinus	Hippotragus	Hippotragini	31.38077037	-8.03250352	Kingdon,1989	28.7	10.0	188	0
A1314	Hippotragus equinus	Hippotragus	Hippotragini	30.96997095	-7.41630440	Kingdon,1989	32.9	16.3	200	0
A1315	Hippotragus equinus	Hippotragus	Hippotragini	30.53349658	-6.62038054	Kingdon,1989	31.6	15.7	209	0
A1316	Hippotragus equinus	Hippotragus	Hippotragini	29.94297242	-5.43933223	Kingdon,1989	29.8	15.7	172	1
A1317	Hippotragus equinus	Hippotragus	Hippotragini	30.23823450	-6.17106868	Kingdon,1989	27.4	12.0	205	0
A1318	Hippotragus equinus	Hippotragus	Hippotragini	32.31790653	-8.77707746	Kingdon,1989	29.5	12.6	186	0
A1319	Hippotragus equinus	Hippotragus	Hippotragini	32.85708076	-8.77707746	Kingdon,1989	29.3	12.3	238	0
A1320	Hippotragus equinus	Hippotragus	Hippotragini	33.73002951	-8.34060308	Kingdon,1989	29.8	11.7	217	0
A1321	Hippotragus equinus	Hippotragus	Hippotragini	33.43476743	-7.94264115	Kingdon,1989	29.2	11.4	226	0
A1322	Hippotragus equinus	Hippotragus	Hippotragini	34.26920374	-7.32644203	Kingdon,1989	30.2	12.5	146	0
A1323	Hippotragus equinus	Hippotragus	Hippotragini	33.69151706	-6.92848010	Kingdon,1989	30.4	12.8	158	0
A1324	Hippotragus equinus	Hippotragus	Hippotragini	33.91157206	2.08174333	Kingdon,1989	32.6	16.8	160	21
A1325	Hippotragus equinus	Hippotragus	Hippotragini	33.37239783	1.92769355	Kingdon,1989	33.1	17.0	182	21
A1326	Hippotragus equinus	Hippotragus	Hippotragini	33.97575947	2.81347979	Kingdon,1989	32.2	16.5	127	11
A1327	Hippotragus equinus	Hippotragus	Hippotragini	33.97575947	3.26279164	Kingdon,1989	31.0	15.6	127	8
A1328	Hippotragus equinus	Hippotragus	Hippotragini	33.32104790	3.55805372	Kingdon,1989	33.4	16.8	137	12
A1329	Hippotragus equinus	Hippotragus	Hippotragini	32.98727338	3.75061595	Kingdon,1989	32.5	16.2	155	14
A1330	Hippotragus equinus	Hippotragus	Hippotragini	32.55079900	3.63507861	Kingdon,1989	34.8	17.5	180	11
A1331	Hippotragus equinus	Hippotragus	Hippotragini	32.38391174	3.59656617	Kingdon,1989	35.9	18.1	172	9
A1332	Hippotragus equinus	Hippotragus	Hippotragini	-3.52933066	9.12606348	http://www.iucnredlist.org	35.9	19.1	214	5
A1333	Hippotragus equinus	Hippotragus	Hippotragini	-3.97086470	9.26655158	http://www.iucnredlist.org	36.0	19.1	212	4
A1334	Hippotragus equinus	Hippotragus	Hippotragini	-3.52933066	8.94543592	http://www.iucnredlist.org	35.5	18.9	213	5

A1335	Hippotragus equinus	Hippotragus	Hippotragini	-3.93072524	9.00564510	http://www.iucnredlist.org	35.7	19.1	212	5
A1336	Hippotragus equinus	Hippotragus	Hippotragini	-3.30856364	9.02571483	http://www.iucnredlist.org	35.1	18.5	218	5
A1337	Hippotragus equinus	Hippotragus	Hippotragini	-3.56947012	9.34683049	http://www.iucnredlist.org	35.9	18.8	216	4
A1338	Hippotragus niger	Hippotragus	Hippotragini	21.13330000	-25.31670000	http://data.gbif.org/ws/rest/occurrence/get?key=61878243	35.1	1.3	50	1
A1339	Hippotragus niger	Hippotragus	Hippotragini	31.60000000	-24.98330000	http://data.gbif.org/ws/rest/occurrence/get?key=201261994	31.7	7.8	114	9
A1340	Hippotragus niger	Hippotragus	Hippotragini	26.50000000	-19.16670000	http://data.gbif.org/ws/rest/occurrence/get?key=70143311	33.8	5.7	134	0
A1341	Hippotragus niger	Hippotragus	Hippotragini	24.25000000	-18.75000000	http://data.gbif.org/ws/rest/occurrence/get?key=61878245	35.1	6.4	124	0
A1342	Hippotragus niger	Hippotragus	Hippotragini	24.96670000	-17.83330000	http://data.gbif.org/ws/rest/occurrence/get?key=61878242	35.6	7.3	154	0
A1343	Hippotragus niger	Hippotragus	Hippotragini	25.30000000	-17.77700000	http://data.gbif.org/ws/rest/occurrence/get?key=213179666	35.7	7.7	163	0
A1344	Hippotragus niger	Hippotragus	Hippotragini	31.07000000	-17.19000000	http://data.gbif.org/ws/rest/occurrence/get?key=175812429	27.1	3.9	224	1
A1345	Hippotragus niger	Hippotragus	Hippotragini	15.90000000	-9.05000000	http://data.gbif.org/ws/rest/occurrence/get?key=61878255	28.6	10.4	192	0
A1346	Hippotragus niger	Hippotragus	Hippotragini	33.41000000	-8.53000000	http://data.gbif.org/ws/rest/occurrence/get?key=175811139	29.7	11.9	248	0
A1347	Hippotragus niger	Hippotragus	Hippotragini	32.41670000	-8.11667000	http://data.gbif.org/ws/rest/occurrence/get?key=42077940	33.1	15.5	223	0
A1348	Hippotragus niger	Hippotragus	Hippotragini	36.81667000	-1.28333000	http://data.gbif.org/ws/rest/occurrence/get?key=79787230	27.6	11.1	191	14
A1349	Hippotragus niger	Hippotragus	Hippotragini	34.95673918	-14.38789859	own observation (TS)	31.9	13.7	236	1
A1350	Hippotragus niger	Hippotragus	Hippotragini	34.95673918	-14.48141480	own observation (TS)	31.4	13.0	236	2
A1351	Hippotragus niger	Hippotragus	Hippotragini	34.89439504	-14.60610308	own observation (TS)	31.8	13.0	232	2
A1352	Hippotragus niger	Hippotragus	Hippotragini	35.61997359	-11.34079658	Kingdon,1989	31.1	15.0	277	3
A1353	Hippotragus niger	Hippotragus	Hippotragini	36.72770174	-11.34079658	Kingdon,1989	31.8	16.3	257	1
A1354	Hippotragus niger	Hippotragus	Hippotragini	37.58462352	-11.27809499	Kingdon,1989	32.5	17.1	239	1
A1355	Hippotragus niger	Hippotragus	Hippotragini	38.19073892	-10.90188543	Kingdon,1989	33.3	17.1	214	1
A1356	Hippotragus niger	Hippotragus	Hippotragini	38.62965007	-10.10766524	Kingdon,1989	32.6	17.0	180	2
A1357	Hippotragus niger	Hippotragus	Hippotragini	39.31936760	-9.50154984	Kingdon,1989	31.3	18.6	174	5
A1358	Hippotragus niger	Hippotragus	Hippotragini	39.08946176	-8.70732965	Kingdon,1989	30.2	18.8	224	6
A1359	Hippotragus niger	Hippotragus	Hippotragini	37.87723095	-9.64785356	Kingdon,1989	30.4	16.3	200	2
A1360	Hippotragus niger	Hippotragus	Hippotragini	32.77750135	-9.16714134	Kingdon,1989	30.3	14.0	235	1
A1361	Hippotragus niger	Hippotragus	Hippotragini	33.69712472	-8.62372753	Kingdon,1989	30.9	13.1	234	2
A1362	Hippotragus niger	Hippotragus	Hippotragini	31.39806629	-8.49832434	Kingdon,1989	28.4	10.4	205	0

A1363	Hippotragus niger	Hippotragus	Hippotragini	33.32091516	-8.41472222	Kingdon,1989	30.0	12.4	244	0
A1364	Hippotragus niger	Hippotragus	Hippotragini	32.81930241	-8.08031372	Kingdon,1989	31.2	13.7	222	0
A1365	Hippotragus niger	Hippotragus	Hippotragini	30.39484080	-6.49187335	Kingdon,1989	30.6	14.9	208	0
A1366	Hippotragus niger	Hippotragus	Hippotragini	30.03953177	-5.36324467	Kingdon,1989	28.7	14.5	181	1
A1367	Hippotragus niger	Hippotragus	Hippotragini	30.43664186	-4.38091970	Kingdon,1989	29.2	12.5	189	0
A1368	Hippotragus niger	Hippotragus	Hippotragini	30.41574133	-4.69442767	Kingdon,1989	29.3	13.6	176	0
A1369	Hippotragus niger	Hippotragus	Hippotragini	31.52346948	-2.56257349	Kingdon,1989	26.5	14.4	188	2
A1370	Hippotragus niger	Hippotragus	Hippotragini	31.48166842	-3.16868889	Kingdon,1989	28.8	14.5	177	1
A1371	Hippotragus niger	Hippotragus	Hippotragini	32.40129179	-2.95968358	Kingdon,1989	29.2	14.7	152	4
A1372	Hippotragus niger	Hippotragus	Hippotragini	32.40129179	-3.69120217	Kingdon,1989	31.0	14.6	145	0
A1373	Hippotragus niger	Hippotragus	Hippotragini	39.36116866	-4.27641705	Kingdon,1989	30.8	17.8	218	21
A1374	Hippotragus niger	Hippotragus	Hippotragini	38.83865538	-4.92433351	Kingdon,1989	32.7	17.9	182	45
A1375	Hippotragus niger	Hippotragus	Hippotragini	38.16983839	-4.42272076	Kingdon,1989	32.2	15.1	129	5
A1376	Hippotragus niger	Hippotragus	Hippotragini	38.00263414	-5.82305635	Kingdon,1989	31.1	15.0	182	22
A1377	Hippotragus niger	Hippotragus	Hippotragini	38.00263414	-6.07386273	Kingdon,1989	32.0	16.3	186	17
A1378	Hippotragus niger	Hippotragus	Hippotragini	37.77272830	-6.45007229	Kingdon,1989	32.5	16.3	172	13
A1379	Hippotragus niger	Hippotragus	Hippotragini	37.73092723	-7.05618769	Kingdon,1989	31.5	15.9	315	25
A1380	Hippotragus niger	Hippotragus	Hippotragini	39.73737822	-2.54167296	Kingdon,1989	32.7	19.6	137	15
A1381	Kobus ellipsiprymnus	Kobus	Reduncini	32.08330000	-28.08330000	http://data.gbif.org/ws/rest/occurrence/get?key=70143590	28.5	10.6	126	28
A1382	Kobus ellipsiprymnus	Kobus	Reduncini	26.61670000	-27.36670000	http://data.gbif.org/ws/rest/occurrence/get?key=61886333	29.6	-3.6	100	8
A1383	Kobus ellipsiprymnus	Kobus	Reduncini	31.52207000	-25.09963000	http://data.gbif.org/ws/rest/occurrence/get?key=49926817	31.1	8.2	121	9
A1384	Kobus ellipsiprymnus	Kobus	Reduncini	31.54000000	-24.39000000	http://data.gbif.org/ws/rest/occurrence/get?key=232209781	32.1	8.5	107	7
A1385	Kobus ellipsiprymnus	Kobus	Reduncini	31.26482000	-24.36363000	http://data.gbif.org/ws/rest/occurrence/get?key=49926833	31.5	8.9	110	6
A1386	Kobus ellipsiprymnus	Kobus	Reduncini	31.08130000	-23.92250000	http://data.gbif.org/ws/rest/occurrence/get?key=201262790	32.1	9.3	97	4
A1387	Kobus ellipsiprymnus	Kobus	Reduncini	15.03000000	-23.57000000	http://data.gbif.org/ws/rest/occurrence/get?key=42080808	32.1	9.3	6	0
A1388	Kobus ellipsiprymnus	Kobus	Reduncini	35.25000000	-22.13300000	http://data.gbif.org/ws/rest/occurrence/get?key=240105915	31.2	13.3	166	17
A1389	Kobus ellipsiprymnus	Kobus	Reduncini	35.20000000	-22.10000000	http://data.gbif.org/ws/rest/occurrence/get?key=151887762	31.2	13.1	164	16
A1390	Kobus ellipsiprymnus	Kobus	Reduncini	26.50000000	-19.16670000	http://data.gbif.org/ws/rest/occurrence/get?key=70143310	33.8	5.7	134	0

A1391	Kobus ellipsiprymnus	Kobus	Reduncini	17.85000000	-15.83330000	http://data.gbif.org/ws/rest/occurrence/get?key=79770794	33.6	5.5	169	0
A1392	Kobus ellipsiprymnus	Kobus	Reduncini	12.39140000	-15.14250000	http://data.gbif.org/ws/rest/occurrence/get?key=61884438	28.7	13.4	40	0
A1393	Kobus ellipsiprymnus	Kobus	Reduncini	36.91670000	-7.08333000	http://data.gbif.org/ws/rest/occurrence/get?key=61884668	31.3	15.8	183	8
A1394	Kobus ellipsiprymnus	Kobus	Reduncini	35.83330000	-3.58333000	http://data.gbif.org/ws/rest/occurrence/get?key=42080651	30.2	13.9	153	1
A1395	Kobus ellipsiprymnus	Kobus	Reduncini	35.81000000	-3.37000000	http://data.gbif.org/ws/rest/occurrence/get?key=175813001	28.6	12.7	207	2
A1396	Kobus ellipsiprymnus	Kobus	Reduncini	37.35000000	-3.35278000	http://data.gbif.org/ws/rest/occurrence/get?key=48227734	33.0	15.4	282	14
A1397	Kobus ellipsiprymnus	Kobus	Reduncini	35.16670000	-3.18333000	http://data.gbif.org/ws/rest/occurrence/get?key=61886275	25.6	11.1	171	1
A1398	Kobus ellipsiprymnus	Kobus	Reduncini	34.82500000	-2.44167000	http://data.gbif.org/ws/rest/occurrence/get?key=42080065	27.5	13.0	130	13
A1399	Kobus ellipsiprymnus	Kobus	Reduncini	36.00000000	-2.25000000	http://data.gbif.org/ws/rest/occurrence/get?key=175813819	33.8	16.9	101	3
A1400	Kobus ellipsiprymnus	Kobus	Reduncini	36.98330000	-1.45000000	http://data.gbif.org/ws/rest/occurrence/get?key=61884559	28.7	11.4	139	6
A1401	Kobus ellipsiprymnus	Kobus	Reduncini	36.81667000	-1.28333000	http://data.gbif.org/ws/rest/occurrence/get?key=79787226	27.6	11.1	191	14
A1402	Kobus ellipsiprymnus	Kobus	Reduncini	29.11670000	-0.63333000	http://data.gbif.org/ws/rest/occurrence/get?key=61884515	25.9	13.3	153	67
A1403	Kobus ellipsiprymnus	Kobus	Reduncini	37.46700000	-0.53300000	http://data.gbif.org/ws/rest/occurrence/get?key=86877124	31.2	10.1	273	18
A1404	Kobus ellipsiprymnus	Kobus	Reduncini	36.25000000	-0.45000000	http://data.gbif.org/ws/rest/occurrence/get?key=61884564	28.1	8.3	131	29
A1405	Kobus ellipsiprymnus	Kobus	Reduncini	36.03000000	-0.36000000	http://data.gbif.org/ws/rest/occurrence/get?key=175813708	27.6	7.9	134	26
A1406	Kobus ellipsiprymnus	Kobus	Reduncini	37.01670000	-0.16666700	http://data.gbif.org/ws/rest/occurrence/get?key=42481797	25.5	6.6	158	29
A1407	Kobus ellipsiprymnus	Kobus	Reduncini	29.86670000	-0.13333000	http://data.gbif.org/ws/rest/occurrence/get?key=49780565	30.7	16.7	118	28
A1408	Kobus ellipsiprymnus	Kobus	Reduncini	37.64100000	0.05780000	http://data.gbif.org/ws/rest/occurrence/get?key=142332387	27.8	9.1	416	14
A1409	Kobus ellipsiprymnus	Kobus	Reduncini	36.08330000	0.63333000	http://data.gbif.org/ws/rest/occurrence/get?key=201262780	33.4	15.0	89	21
A1410	Kobus ellipsiprymnus	Kobus	Reduncini	35.45000000	1.25000000	http://data.gbif.org/ws/rest/occurrence/get?key=61886313	19.3	4.6	208	34
A1411	Kobus ellipsiprymnus	Kobus	Reduncini	29.86670000	1.45000000	http://data.gbif.org/ws/rest/occurrence/get?key=61884514	31.3	16.5	155	53
A1412	Kobus ellipsiprymnus	Kobus	Reduncini	29.71670000	3.73330000	http://data.gbif.org/ws/rest/occurrence/get?key=213183516	33.1	18.0	224	24
A1413	Kobus ellipsiprymnus	Kobus	Reduncini	32.56780000	4.41333000	http://data.gbif.org/ws/rest/occurrence/get?key=61885036	37.6	18.7	153	6
A1414	Kobus ellipsiprymnus	Kobus	Reduncini	34.16670000	5.95000000	http://data.gbif.org/ws/rest/occurrence/get?key=61885033	35.6	19.5	139	9
A1415	Kobus ellipsiprymnus	Kobus	Reduncini	40.06670000	8.83333000	http://data.gbif.org/ws/rest/occurrence/get?key=61884531	35.3	13.0	137	7
A1416	Kobus ellipsiprymnus	Kobus	Reduncini	18.99373000	9.15536000	http://data.gbif.org/ws/rest/occurrence/get?key=79785522	38.8	16.0	239	0
A1417	Kobus ellipsiprymnus	Kobus	Reduncini	30.00000000	10.00000000	http://data.gbif.org/ws/rest/occurrence/get?key=142332317	38.4	17.7	182	0
A1418	Kobus ellipsiprymnus	Kobus	Reduncini	35.00000000	12.33330000	http://data.gbif.org/ws/rest/occurrence/get?key=42504087	40.6	17.1	215	0

A1419	Kobus ellipsiprymnus	Kobus	Reduncini	36.28330000	12.83330000	http://data.gbif.org/ws/rest/occurrence/get?key=61884532	39.9	18.4	236	0
A1420	Kobus ellipsiprymnus	Kobus	Reduncini	34.89869133	-14.25679618	own observation (TS)	32.5	14.8	243	1
A1421	Kobus ellipsiprymnus	Kobus	Reduncini	35.01392251	-14.30069377	own observation (TS)	32.2	14.3	238	1
A1422	Kobus ellipsiprymnus	Kobus	Reduncini	35.07428170	-14.42689935	own observation (TS)	31.6	13.4	234	2
A1423	Kobus ellipsiprymnus	Kobus	Reduncini	34.94807612	-14.36105296	own observation (TS)	32.0	13.9	237	1
A1424	Kobus ellipsiprymnus	Kobus	Reduncini	-1.82190510	8.22723493	own observation (TS)	36.6	20.8	206	4
A1425	Kobus ellipsiprymnus	Kobus	Reduncini	11.00365850	-2.62516504	http://www.iucnredlist.org	31.9	17.3	316	1
A1426	Kobus ellipsiprymnus	Kobus	Reduncini	11.94913274	-3.28288624	http://www.iucnredlist.org	31.6	17.8	264	0
A1427	Kobus kob	Kobus	Reduncini	29.83330000	-0.98333000	http://data.gbif.org/ws/rest/occurrence/get?key=61884534	21.6	8.8	180	30
A1428	Kobus kob	Kobus	Reduncini	29.69580000	-0.73333000	http://data.gbif.org/ws/rest/occurrence/get?key=201262814	28.4	15.0	141	33
A1429	Kobus kob	Kobus	Reduncini	29.86670000	-0.13333000	http://data.gbif.org/ws/rest/occurrence/get?key=49780565	30.7	16.7	118	28
A1430	Kobus kob	Kobus	Reduncini	30.30000000	0.90000000	http://data.gbif.org/ws/rest/occurrence/get?key=151887837	31.5	17.2	139	36
A1431	Kobus kob	Kobus	Reduncini	30.33300000	0.93300000	http://data.gbif.org/ws/rest/occurrence/get?key=240105886	31.9	17.6	138	33
A1432	Kobus kob	Kobus	Reduncini	34.55000000	1.13300000	http://data.gbif.org/ws/rest/occurrence/get?key=61884471	15.2	2.0	253	57
A1433	Kobus kob	Kobus	Reduncini	31.70000000	2.50000000	http://data.gbif.org/ws/rest/occurrence/get?key=151887386	33.1	15.7	159	19
A1434	Kobus kob	Kobus	Reduncini	31.68300000	2.55000000	http://data.gbif.org/ws/rest/occurrence/get?key=240105932	33.0	15.5	162	18
A1435	Kobus kob	Kobus	Reduncini	27.86670000	3.70000000	http://data.gbif.org/ws/rest/occurrence/get?key=213184637	33.3	17.3	247	18
A1436	Kobus kob	Kobus	Reduncini	29.71670000	3.73330000	http://data.gbif.org/ws/rest/occurrence/get?key=213183516	33.1	18.0	224	24
A1437	Kobus kob	Kobus	Reduncini	-4.70000000	7.80000000	http://data.gbif.org/ws/rest/occurrence/get?key=151887823	35.6	20.5	188	8
A1438	Kobus kob	Kobus	Reduncini	-4.68300000	7.81700000	http://data.gbif.org/ws/rest/occurrence/get?key=240105938	35.7	20.6	187	8
A1439	Kobus kob	Kobus	Reduncini	33.20000000	8.13333000	http://data.gbif.org/ws/rest/occurrence/get?key=49781396	38.7	19.5	196	2
A1440	Kobus kob	Kobus	Reduncini	19.50000000	8.75000000	http://data.gbif.org/ws/rest/occurrence/get?key=49781075	38.1	15.8	240	0
A1441	Kobus kob	Kobus	Reduncini	19.15000000	9.00000000	http://data.gbif.org/ws/rest/occurrence/get?key=79787631	38.5	15.8	239	0
A1442	Kobus leche	Kobus	Reduncini	21.13330000	-25.31670000	http://data.gbif.org/ws/rest/occurrence/get?key=61884598	35.1	1.3	50	1
A1443	Kobus leche	Kobus	Reduncini	23.74500000	-20.29380000	http://data.gbif.org/ws/rest/occurrence/get?key=49780375	34.6	6.5	103	0
A1444	Kobus leche	Kobus	Reduncini	23.01130000	-19.60010000	http://data.gbif.org/ws/rest/occurrence/get?key=61886319	34.7	6.6	108	0
A1445	Kobus leche	Kobus	Reduncini	22.94370000	-19.53620000	http://data.gbif.org/ws/rest/occurrence/get?key=61886315	34.7	6.5	108	0
A1446	Kobus leche	Kobus	Reduncini	22.53300000	-19.41700000	http://data.gbif.org/ws/rest/occurrence/get?key=240105951	34.6	6.2	104	0

A1447	Kobus leche	Kobus	Reduncini	22.50000000	-19.40000000	http://data.gbif.org/ws/rest/occurrence/get?key=151887621	34.5	6.2	104	0
A1448	Kobus leche	Kobus	Reduncini	22.53300000	-19.33300000	http://data.gbif.org/ws/rest/occurrence/get?key=240105923	34.5	6.2	104	0
A1449	Kobus leche	Kobus	Reduncini	22.50000000	-19.30000000	http://data.gbif.org/ws/rest/occurrence/get?key=151887622	34.5	6.2	104	0
A1450	Kobus leche	Kobus	Reduncini	21.40000000	-17.86667000	http://data.gbif.org/ws/rest/occurrence/get?key=79785199	34.1	6.3	155	0
A1451	Kobus leche	Kobus	Reduncini	17.85000000	-15.83330000	http://data.gbif.org/ws/rest/occurrence/get?key=79770794	33.6	5.5	169	0
A1452	Kobus leche	Kobus	Reduncini	27.00000000	-15.66670000	http://data.gbif.org/ws/rest/occurrence/get?key=61886354	32.9	6.2	233	0
A1453	Kobus leche	Kobus	Reduncini	17.24221310	-10.59902414	http://www.iucnredlist.org	29.9	10.1	213	0
A1454	Kobus leche	Kobus	Reduncini	17.45940096	-11.16371257	http://www.iucnredlist.org	30.1	8.7	226	0
A1455	Kobus leche	Kobus	Reduncini	17.76346396	-11.46777557	http://www.iucnredlist.org	31.1	8.1	223	0
A1456	Kobus leche	Kobus	Reduncini	22.38956535	-14.48668680	http://www.iucnredlist.org	34.2	6.5	234	0
A1457	Kobus leche	Kobus	Reduncini	22.88909742	-14.98621888	http://www.iucnredlist.org	35.2	8.6	231	0
A1458	Kobus leche	Kobus	Reduncini	23.10628528	-16.41965874	http://www.iucnredlist.org	34.0	7.7	176	0
A1459	Kobus leche	Kobus	Reduncini	25.45191415	-14.22606137	http://www.iucnredlist.org	32.5	6.0	233	0
A1460	Kobus leche	Kobus	Reduncini	25.82113351	-14.00887351	http://www.iucnredlist.org	32.6	6.3	237	0
A1461	Kobus leche	Kobus	Reduncini	29.77395253	-11.92387007	http://www.iucnredlist.org	31.0	9.0	300	0
A1462	Kobus leche	Kobus	Reduncini	30.31692218	-11.68496343	http://www.iucnredlist.org	30.9	9.7	293	0
A1463	Kobus leche	Kobus	Reduncini	30.16489067	-12.09762036	http://www.iucnredlist.org	31.1	9.2	283	0
A1464	Kobus leche	Kobus	Reduncini	25.99488379	-8.53573948	http://www.iucnredlist.org	31.2	13.6	199	1
A1465	Kobus leche	Kobus	Reduncini	25.66910201	-9.10042792	http://www.iucnredlist.org	32.5	14.0	213	0
A1466	Kobus leche	Kobus	Reduncini	26.36410315	-9.07870913	http://www.iucnredlist.org	32.4	12.7	164	0
A1467	Kobus leche	Kobus	Reduncini	25.95144622	-9.53480363	http://www.iucnredlist.org	32.8	12.3	185	0
A1468	Kobus leche	Kobus	Reduncini	31.90239354	-10.25152356	http://www.iucnredlist.org	31.5	10.7	256	0
A1469	Kobus leche	Kobus	Reduncini	27.42832366	-14.05231109	http://www.iucnredlist.org	32.0	7.6	238	0
A1470	Kobus leche	Kobus	Reduncini	27.64551152	-14.00887351	http://www.iucnredlist.org	32.2	7.7	242	0
A1471	Kobus leche	Kobus	Reduncini	27.42832366	-14.37809287	http://www.iucnredlist.org	32.3	7.8	239	0
A1472	Kobus leche	Kobus	Reduncini	21.19503212	-11.75011979	http://www.iucnredlist.org	31.6	8.0	229	0
A1473	Kobus leche	Kobus	Reduncini	21.80315813	-12.01074522	http://www.iucnredlist.org	31.3	6.9	226	0
A1474	Kobus leche	Kobus	Reduncini	21.45565755	-12.64059001	http://www.iucnredlist.org	30.7	5.9	219	0

A1475	Kobus leche	Kobus	Reduncini	21.97690841	-12.61887122	http://www.iucnredlist.org	30.5	5.1	220	0
A1476	Kobus leche	Kobus	Reduncini	22.60675320	-14.79074980	http://www.iucnredlist.org	34.8	7.6	240	0
A1477	Kobus leche	Kobus	Reduncini	21.80315813	-13.20527844	http://www.iucnredlist.org	30.9	4.7	213	0
A1478	Kobus leche	Kobus	Reduncini	21.12987577	-15.48575095	http://www.iucnredlist.org	32.8	5.3	194	0
A1479	Kobus leche	Kobus	Reduncini	22.19409627	-17.00606596	http://www.iucnredlist.org	34.0	6.6	165	0
A1480	Kobus megaceros	Kobus	Reduncini	29.64168169	8.74131616	Mallon & Kingswood, 2001	37.5	17.8	193	0
A1481	Kobus megaceros	Kobus	Reduncini	29.16205757	8.20955898	Mallon & Kingswood, 2001	37.7	18.1	203	0
A1482	Kobus megaceros	Kobus	Reduncini	30.01703970	7.32329702	Mallon & Kingswood, 2001	37.0	18.0	173	0
A1483	Kobus megaceros	Kobus	Reduncini	30.97628794	8.01145337	Mallon & Kingswood, 2001	37.2	18.5	172	0
A1484	Kobus megaceros	Kobus	Reduncini	32.94691748	9.82568373	Mallon & Kingswood, 2001	39.0	19.7	166	0
A1485	Kobus megaceros	Kobus	Reduncini	33.22843598	8.84558227	Mallon & Kingswood, 2001	38.9	19.4	169	0
A1486	Kobus megaceros	Kobus	Reduncini	33.65592704	8.04273320	http://www.iucnredlist.org	38.5	19.3	191	3
A1487	Kobus megaceros	Kobus	Reduncini	33.30142226	7.98017353	http://www.iucnredlist.org	38.6	19.6	201	3
A1488	Kobus vardonii	Kobus	Reduncini	24.96670000	-17.83330000	http://data.gbif.org/ws/rest/occurrence/get?key=61884593	35.6	7.3	154	0
A1489	Kobus vardonii	Kobus	Reduncini	31.50000000	-13.16670000	http://data.gbif.org/ws/rest/occurrence/get?key=61886320	35.8	10.8	220	0
A1490	Kobus vardonii	Kobus	Reduncini	16.80597791	-10.57337794	http://www.iucnredlist.org	29.7	9.9	209	0
A1491	Kobus vardonii	Kobus	Reduncini	17.65966398	-10.19989028	http://www.iucnredlist.org	29.7	10.7	216	0
A1492	Kobus vardonii	Kobus	Reduncini	18.21989546	-9.31952652	http://www.iucnredlist.org	31.4	12.1	226	0
A1493	Kobus vardonii	Kobus	Reduncini	19.12693691	-9.95979108	http://www.iucnredlist.org	31.0	10.8	230	0
A1494	Kobus vardonii	Kobus	Reduncini	18.19321777	-10.25324566	http://www.iucnredlist.org	29.5	9.6	243	0
A1495	Kobus vardonii	Kobus	Reduncini	18.11318470	-10.76012177	http://www.iucnredlist.org	30.2	9.1	240	0
A1496	Kobus vardonii	Kobus	Reduncini	27.93057452	-4.30412086	http://www.iucnredlist.org	30.5	16.7	188	19
A1497	Kobus vardonii	Kobus	Reduncini	28.35741755	-4.62425313	http://www.iucnredlist.org	30.7	16.8	167	10
A1498	Kobus vardonii	Kobus	Reduncini	27.26363228	-9.63965880	http://www.iucnredlist.org	33.4	10.4	152	0
A1499	Kobus vardonii	Kobus	Reduncini	27.37034304	-10.22656797	http://www.iucnredlist.org	33.3	9.4	179	0
A1500	Kobus vardonii	Kobus	Reduncini	22.72842503	-17.29615575	http://www.iucnredlist.org	34.1	6.4	156	0
A1501	Kobus vardonii	Kobus	Reduncini	22.46164813	-17.10941192	http://www.iucnredlist.org	34.0	6.6	161	0
A1502	Kobus vardonii	Kobus	Reduncini	24.86264020	-18.14984182	http://www.iucnredlist.org	35.0	6.7	143	0

A1503	Kobus vardonii	Kobus	Reduncini	24.48915255	-17.90974261	http://www.iucnredlist.org	35.2	5.7	148	0
A1504	Kobus vardonii	Kobus	Reduncini	29.02435980	-16.30908123	http://www.iucnredlist.org	33.1	9.6	189	0
A1505	Kobus vardonii	Kobus	Reduncini	29.58459128	-16.12233740	http://www.iucnredlist.org	34.3	9.8	192	0
A1506	Kobus vardonii	Kobus	Reduncini	30.38492197	-15.98894895	http://www.iucnredlist.org	34.5	10.4	194	0
A1507	Kobus vardonii	Kobus	Reduncini	30.97183115	-13.90808915	http://www.iucnredlist.org	36.6	11.8	229	0
A1508	Kobus vardonii	Kobus	Reduncini	31.66545108	-12.70759312	http://www.iucnredlist.org	34.8	10.7	218	0
A1509	Kobus vardonii	Kobus	Reduncini	31.66545108	-13.56127919	http://www.iucnredlist.org	34.7	10.4	240	0
A1510	Kobus vardonii	Kobus	Reduncini	32.19900487	-12.30742777	http://www.iucnredlist.org	34.7	11.3	215	0
A1511	Kobus vardonii	Kobus	Reduncini	32.51913715	-11.61380784	http://www.iucnredlist.org	34.0	11.7	221	0
A1512	Kobus vardonii	Kobus	Reduncini	32.57249253	-10.70676639	http://www.iucnredlist.org	32.7	12.1	225	0
A1513	Kobus vardonii	Kobus	Reduncini	33.61292243	-10.89351022	http://www.iucnredlist.org	29.1	8.4	205	1
A1514	Kobus vardonii	Kobus	Reduncini	33.95973240	-10.57337794	http://www.iucnredlist.org	24.8	6.1	253	4
A1515	Kobus vardonii	Kobus	Reduncini	33.23943477	-12.86765926	http://www.iucnredlist.org	29.3	9.6	216	0
A1516	Kobus vardonii	Kobus	Reduncini	35.90720374	-9.18613808	http://www.iucnredlist.org	32.5	17.7	296	3
A1517	Kobus vardonii	Kobus	Reduncini	36.17398064	-8.67926197	http://www.iucnredlist.org	32.5	18.6	301	4
A1518	Kobus vardonii	Kobus	Reduncini	37.26776592	-8.11903049	http://www.iucnredlist.org	30.7	18.0	314	9
A1519	Kobus vardonii	Kobus	Reduncini	32.11897180	-8.17238587	http://www.iucnredlist.org	33.0	15.2	214	0
A1520	Kobus vardonii	Kobus	Reduncini	31.79883953	-7.47876593	http://www.iucnredlist.org	33.5	15.0	186	0
A1521	Kobus vardonii	Kobus	Reduncini	29.39784745	-8.57255121	http://www.iucnredlist.org	30.2	12.6	212	0
A1522	Kobus vardonii	Kobus	Reduncini	29.15774825	-9.15946039	http://www.iucnredlist.org	31.9	13.0	201	0
A1523	Kobus vardonii	Kobus	Reduncini	29.15774825	-9.47959266	http://www.iucnredlist.org	30.0	11.2	236	0
A1524	Kobus vardonii	Kobus	Reduncini	29.85136818	-9.07942732	http://www.iucnredlist.org	31.3	13.0	218	0
A1525	Kobus vardonii	Kobus	Reduncini	30.33156659	-8.59922890	http://www.iucnredlist.org	32.1	14.6	228	0
A1526	Kobus vardonii	Kobus	Reduncini	30.38492197	-8.81265042	http://www.iucnredlist.org	31.5	13.7	232	0
A1527	Kobus vardonii	Kobus	Reduncini	24.67589637	-12.46749391	http://www.iucnredlist.org	31.3	6.1	253	0
A1528	Kobus vardonii	Kobus	Reduncini	26.40994621	-12.84098157	http://www.iucnredlist.org	31.4	5.7	262	0
A1529	Kobus vardonii	Kobus	Reduncini	25.07606172	-13.37453536	http://www.iucnredlist.org	32.3	6.2	246	0
A1530	Kobus vardonii	Kobus	Reduncini	25.92974779	-15.61546130	http://www.iucnredlist.org	33.1	5.3	218	0

A1531	Litocranius walleri	Litocranius	Antilopini	34.86000000	-6.56000000	http://data.gbif.org/ws/rest/occurrence/get?key=175819651	30.8	13.0	128	0
A1532	Litocranius walleri	Litocranius	Antilopini	38.06670000	-4.73333000	http://data.gbif.org/ws/rest/occurrence/get?key=61888801	33.0	15.2	62	5
A1533	Litocranius walleri	Litocranius	Antilopini	35.83330000	-3.58333000	http://data.gbif.org/ws/rest/occurrence/get?key=42080658	30.2	13.9	153	1
A1534	Litocranius walleri	Litocranius	Antilopini	35.83330000	-3.50278000	http://data.gbif.org/ws/rest/occurrence/get?key=61889169	30.4	14.1	143	1
A1535	Litocranius walleri	Litocranius	Antilopini	35.81000000	-3.37000000	http://data.gbif.org/ws/rest/occurrence/get?key=175818334	28.8	12.8	199	1
A1536	Litocranius walleri	Litocranius	Antilopini	36.00000000	-2.25000000	http://data.gbif.org/ws/rest/occurrence/get?key=175819652	33.8	16.9	101	3
A1537	Litocranius walleri	Litocranius	Antilopini	37.16667000	-2.18333000	http://data.gbif.org/ws/rest/occurrence/get?key=79787370	29.9	13.2	118	1
A1538	Litocranius walleri	Litocranius	Antilopini	39.36700000	-0.13300000	http://data.gbif.org/ws/rest/occurrence/get?key=86876775	37.0	20.0	94	2
A1539	Litocranius walleri	Litocranius	Antilopini	37.60000000	0.33300000	http://data.gbif.org/ws/rest/occurrence/get?key=86876870	33.1	13.8	200	6
A1540	Litocranius walleri	Litocranius	Antilopini	37.58000000	0.35000000	http://data.gbif.org/ws/rest/occurrence/get?key=175819596	33.3	14.1	187	6
A1541	Litocranius walleri	Litocranius	Antilopini	37.68330000	0.65000000	http://data.gbif.org/ws/rest/occurrence/get?key=61889168	33.7	14.8	124	3
A1542	Litocranius walleri	Litocranius	Antilopini	37.61783000	2.56813000	http://data.gbif.org/ws/rest/occurrence/get?key=79778451	36.5	18.4	102	1
A1543	Litocranius walleri	Litocranius	Antilopini	36.93333000	2.71667000	http://data.gbif.org/ws/rest/occurrence/get?key=79773194	27.1	10.4	143	14
A1544	Litocranius walleri	Litocranius	Antilopini	41.03330000	7.83333000	http://data.gbif.org/ws/rest/occurrence/get?key=61888802	29.3	11.3	167	6
A1545	Litocranius walleri	Litocranius	Antilopini	44.00000000	8.00000000	http://data.gbif.org/ws/rest/occurrence/get?key=61888710	34.2	12.6	87	2
A1546	Litocranius walleri	Litocranius	Antilopini	46.50000000	8.00000000	http://data.gbif.org/ws/rest/occurrence/get?key=61888708	33.4	14.6	55	0
A1547	Litocranius walleri	Litocranius	Antilopini	38.61670000	8.81667000	http://data.gbif.org/ws/rest/occurrence/get?key=61889197	28.3	7.9	247	6
A1548	Litocranius walleri	Litocranius	Antilopini	44.80000000	9.16667000	http://data.gbif.org/ws/rest/occurrence/get?key=61888690	32.5	12.9	57	1
A1549	Litocranius walleri	Litocranius	Antilopini	43.91910000	9.61263000	http://data.gbif.org/ws/rest/occurrence/get?key=61888700	29.9	10.2	85	2
A1550	Litocranius walleri	Litocranius	Antilopini	44.68330000	9.76667000	http://data.gbif.org/ws/rest/occurrence/get?key=61888870	30.9	10.6	62	3
A1551	Litocranius walleri	Litocranius	Antilopini	44.31670000	9.83333000	http://data.gbif.org/ws/rest/occurrence/get?key=61888698	33.7	13.5	46	2
A1552	Litocranius walleri	Litocranius	Antilopini	44.71670000	9.90000000	http://data.gbif.org/ws/rest/occurrence/get?key=61888689	33.7	13.2	39	2
A1553	Litocranius walleri	Litocranius	Antilopini	44.78330000	10.00000000	http://data.gbif.org/ws/rest/occurrence/get?key=61888688	35.6	14.9	26	2
A1554	Litocranius walleri	Litocranius	Antilopini	46.00000000	10.00000000	http://data.gbif.org/ws/rest/occurrence/get?key=224303329	32.0	12.9	41	1
A1555	Litocranius walleri	Litocranius	Antilopini	45.01670000	10.43330000	http://data.gbif.org/ws/rest/occurrence/get?key=61888868	42.1	20.4	3	0
A1556	Litocranius walleri	Litocranius	Antilopini	40.23911541	1.40814824	Kingdon,1989	37.6	20.6	96	2
A1557	Litocranius walleri	Litocranius	Antilopini	43.77095410	3.52725146	Kingdon,1989	36.0	18.1	157	2
A1558	Litocranius walleri	Litocranius	Antilopini	46.48489331	4.49385994	Kingdon,1989	37.2	20.3	56	1

A1559	Litocranius walleri	Litocranius	Antilopini	36.55856772	4.23361920	Kingdon,1989	35.4	20.6	62	1
A1560	Madoqua guentheri	Madoqua	Neotragini	35.56667000	1.40000000	http://data.gbif.org/ws/rest/occurrence/get?key=79785545	32.0	14.3	129	18
A1561	Madoqua guentheri	Madoqua	Neotragini	36.85000000	2.13333000	http://data.gbif.org/ws/rest/occurrence/get?key=79821796	23.2	6.5	150	27
A1562	Madoqua guentheri	Madoqua	Neotragini	36.93333000	2.71667000	http://data.gbif.org/ws/rest/occurrence/get?key=79773277	27.1	10.4	143	14
A1563	Madoqua guentheri	Madoqua	Neotragini	38.31670000	4.08333000	http://data.gbif.org/ws/rest/occurrence/get?key=61894413	26.6	9.1	163	8
A1564	Madoqua guentheri	Madoqua	Neotragini	33.10000000	4.10000000	http://data.gbif.org/ws/rest/occurrence/get?key=61895704	33.4	17.4	147	11
A1565	Madoqua guentheri	Madoqua	Neotragini	32.56670000	4.38333000	http://data.gbif.org/ws/rest/occurrence/get?key=61895706	37.4	18.7	155	6
A1566	Madoqua guentheri	Madoqua	Neotragini	32.56670000	4.40000000	http://data.gbif.org/ws/rest/occurrence/get?key=61895715	37.6	18.7	153	6
A1567	Madoqua guentheri	Madoqua	Neotragini	32.56670000	4.41667000	http://data.gbif.org/ws/rest/occurrence/get?key=61895703	37.6	18.7	153	6
A1568	Madoqua guentheri	Madoqua	Neotragini	33.77610000	4.58521000	http://data.gbif.org/ws/rest/occurrence/get?key=61895777	34.1	18.5	81	8
A1569	Madoqua guentheri	Madoqua	Neotragini	40.70000000	7.75000000	http://data.gbif.org/ws/rest/occurrence/get?key=61894375	29.9	11.6	165	5
A1570	Madoqua guentheri	Madoqua	Neotragini	44.00000000	8.00000000	http://data.gbif.org/ws/rest/occurrence/get?key=61894325	34.2	12.6	87	2
A1571	Madoqua guentheri	Madoqua	Neotragini	46.79509825	10.70190448	http://www.iucnredlist.org	36.5	17.8	12	0
A1572	Madoqua guentheri	Madoqua	Neotragini	47.45035709	11.04880621	http://www.iucnredlist.org	33.8	15.1	21	0
A1573	Madoqua kirkii	Madoqua	Neotragini	12.58330000	-16.66670000	http://data.gbif.org/ws/rest/occurrence/get?key=79770799	26.4	11.6	39	0
A1574	Madoqua kirkii	Madoqua	Neotragini	35.76580000	-7.79806000	http://data.gbif.org/ws/rest/occurrence/get?key=61896422	27.8	11.3	152	0
A1575	Madoqua kirkii	Madoqua	Neotragini	38.08330000	-4.63333000	http://data.gbif.org/ws/rest/occurrence/get?key=61894378	32.7	14.9	75	4
A1576	Madoqua kirkii	Madoqua	Neotragini	35.86670000	-3.88333000	http://data.gbif.org/ws/rest/occurrence/get?key=61896374	30.0	13.7	172	0
A1577	Madoqua kirkii	Madoqua	Neotragini	35.83330000	-3.58333000	http://data.gbif.org/ws/rest/occurrence/get?key=42082031	30.2	13.9	153	1
A1578	Madoqua kirkii	Madoqua	Neotragini	36.43330000	-3.48333000	http://data.gbif.org/ws/rest/occurrence/get?key=61895780	28.9	12.6	221	4
A1579	Madoqua kirkii	Madoqua	Neotragini	39.95000000	-3.40000000	http://data.gbif.org/ws/rest/occurrence/get?key=61894320	32.2	20.5	266	12
A1580	Madoqua kirkii	Madoqua	Neotragini	35.16670000	-3.18333000	http://data.gbif.org/ws/rest/occurrence/get?key=61895932	25.6	11.1	171	1
A1581	Madoqua kirkii	Madoqua	Neotragini	34.82500000	-2.44167000	http://data.gbif.org/ws/rest/occurrence/get?key=61896352	27.5	13.0	130	13
A1582	Madoqua kirkii	Madoqua	Neotragini	36.37790000	-1.59790000	http://data.gbif.org/ws/rest/occurrence/get?key=61895910	32.0	14.4	144	5
A1583	Madoqua kirkii	Madoqua	Neotragini	35.38333000	-1.10000000	http://data.gbif.org/ws/rest/occurrence/get?key=79787378	26.2	9.1	185	33
A1584	Madoqua kirkii	Madoqua	Neotragini	35.50000000	-1.06667000	http://data.gbif.org/ws/rest/occurrence/get?key=49791104	26.1	8.7	181	33
A1585	Madoqua kirkii	Madoqua	Neotragini	36.56670000	-0.93333000	http://data.gbif.org/ws/rest/occurrence/get?key=61894347	25.6	8.2	236	29
A1586	Madoqua kirkii	Madoqua	Neotragini	36.25000000	-0.45000000	http://data.gbif.org/ws/rest/occurrence/get?key=61894341	28.1	8.3	131	29

A1587	Madoqua kirkii	Madoqua	Neotragini	36.83333000	-0.45000000	http://data.gbif.org/ws/rest/occurrence/get?key=79803034	23.8	5.8	293	55
A1588	Madoqua kirkii	Madoqua	Neotragini	39.58300000	-0.26700000	http://data.gbif.org/ws/rest/occurrence/get?key=86873760	37.6	20.5	95	3
A1589	Madoqua kirkii	Madoqua	Neotragini	37.33330000	-0.16667000	http://data.gbif.org/ws/rest/occurrence/get?key=91191915	9.7	-3.6	296	79
A1590	Madoqua kirkii	Madoqua	Neotragini	36.62000000	2.39000000	http://data.gbif.org/ws/rest/occurrence/get?key=175821358	36.5	19.7	64	2
A1591	Madoqua kirkii	Madoqua	Neotragini	38.31670000	4.08333000	http://data.gbif.org/ws/rest/occurrence/get?key=61894413	26.6	9.1	163	8
A1592	Madoqua kirkii	Madoqua	Neotragini	16.16373816	-19.58562465	http://www.iucnredlist.org	34.3	6.2	113	0
A1593	Madoqua kirkii	Madoqua	Neotragini	17.71352576	-19.85515293	http://www.iucnredlist.org	31.2	6.0	124	0
A1594	Madoqua kirkii	Madoqua	Neotragini	17.98305404	-18.97918602	http://www.iucnredlist.org	33.7	8.0	124	0
A1595	Madoqua piacentinii	Madoqua	Neotragini	48.66170023	5.83961443	East, 1988	33.7	20.6	56	0
A1596	Madoqua piacentinii	Madoqua	Neotragini	45.88318982	2.78583364	East, 1988	34.5	20.7	93	1
A1597	Madoqua piacentinii	Madoqua	Neotragini	46.34770859	3.11271722	East, 1988	35.3	21.0	81	2
A1598	Madoqua piacentinii	Madoqua	Neotragini	46.86384055	3.61164478	East, 1988	36.0	21.6	67	2
A1599	Madoqua piacentinii	Madoqua	Neotragini	47.10470214	3.99014156	East, 1988	35.2	20.3	65	2
A1600	Madoqua piacentinii	Madoqua	Neotragini	47.43158571	4.35143393	East, 1988	34.4	19.6	63	2
A1601	Madoqua piacentinii	Madoqua	Neotragini	47.71545830	4.71272631	East, 1988	33.8	19.5	61	2
A1602	Madoqua piacentinii	Madoqua	Neotragini	48.03373967	5.10842748	East, 1988	33.5	19.9	59	1
A1603	Madoqua piacentinii	Madoqua	Neotragini	48.24019246	5.52133306	East, 1988	33.9	20.8	55	0
A1604	Madoqua saltiana	Madoqua	Neotragini	45.25000000	4.56667000	http://data.gbif.org/ws/rest/occurrence/get?key=61896530	36.9	21.6	70	0
A1605	Madoqua saltiana	Madoqua	Neotragini	40.70000000	7.75000000	http://data.gbif.org/ws/rest/occurrence/get?key=61894375	29.9	11.6	165	5
A1606	Madoqua saltiana	Madoqua	Neotragini	41.03330000	7.83333000	http://data.gbif.org/ws/rest/occurrence/get?key=61896627	29.3	11.3	167	6
A1607	Madoqua saltiana	Madoqua	Neotragini	44.00000000	8.00000000	http://data.gbif.org/ws/rest/occurrence/get?key=61894325	34.2	12.6	86	2
A1608	Madoqua saltiana	Madoqua	Neotragini	40.06670000	8.83333000	http://data.gbif.org/ws/rest/occurrence/get?key=61896628	35.3	13.0	137	7
A1609	Madoqua saltiana	Madoqua	Neotragini	38.43330000	9.13333000	http://data.gbif.org/ws/rest/occurrence/get?key=61896624	23.9	5.4	273	10
A1610	Madoqua saltiana	Madoqua	Neotragini	44.80000000	9.16667000	http://data.gbif.org/ws/rest/occurrence/get?key=61896444	32.5	12.9	57	1
A1611	Madoqua saltiana	Madoqua	Neotragini	44.70000000	9.70000000	http://data.gbif.org/ws/rest/occurrence/get?key=61896448	30.5	10.4	65	3
A1612	Madoqua saltiana	Madoqua	Neotragini	44.68330000	9.76667000	http://data.gbif.org/ws/rest/occurrence/get?key=61896447	30.9	10.6	62	3
A1613	Madoqua saltiana	Madoqua	Neotragini	41.75000000	9.81667000	http://data.gbif.org/ws/rest/occurrence/get?key=61896266	36.3	15.7	100	4
A1614	Madoqua saltiana	Madoqua	Neotragini	44.31670000	9.83333000	http://data.gbif.org/ws/rest/occurrence/get?key=61896450	33.7	13.5	46	2

A1615	Madoqua saltiana	Madoqua	Neotragini	44.78330000	10.00000000	http://data.gbif.org/ws/rest/occurrence/get?key=61896534	35.5	14.9	26	2
A1616	Madoqua saltiana	Madoqua	Neotragini	44.83330000	10.20000000	http://data.gbif.org/ws/rest/occurrence/get?key=61896532	38.5	17.6	13	1
A1617	Madoqua saltiana	Madoqua	Neotragini	45.41670000	10.38330000	http://data.gbif.org/ws/rest/occurrence/get?key=61896531	39.4	18.7	7	0
A1618	Nanger dama	Nanger	Antilopini	-6.50557813	19.04110762	East, 1990	44.4	12.6	20	0
A1619	Nanger dama	Nanger	Antilopini	-6.22575607	18.76128556	East, 1990	44.3	12.6	22	0
A1620	Nanger dama	Nanger	Antilopini	1.72818589	15.68324294	East, 1990	40.8	15.2	97	0
A1621	Nanger dama	Nanger	Antilopini	-2.22430066	15.15857658	East, 1990	41.2	15.8	134	0
A1622	Nanger dama	Nanger	Antilopini	8.40893749	19.39088519	East, 1990	40.2	8.9	13	0
A1623	Nanger dama	Nanger	Antilopini	9.21342590	19.11106313	East, 1990	39.8	8.4	14	0
A1624	Nanger dama	Nanger	Antilopini	9.00355936	18.23661920	East, 1990	37.8	7.2	24	0
A1625	Nanger dama	Nanger	Antilopini	11.62689114	16.27786481	East, 1990	40.3	11.3	26	0
A1626	Nanger dama	Nanger	Antilopini	12.18653525	16.66262013	East, 1990	40.5	10.8	22	0
A1627	Nanger dama	Nanger	Antilopini	18.93724237	15.68324294	East, 1990	41.6	15.1	41	0
A1628	Nanger dama	Nanger	Antilopini	19.95159732	15.57830967	East, 1990	41.3	15.7	60	0
A1629	Nanger dama	Nanger	Antilopini	18.58746479	14.80879901	East, 1990	41.9	15.3	75	0
A1630	Nanger dama	Nanger	Antilopini	19.70675302	14.73884350	East, 1990	41.6	16.2	93	0
A1631	Nanger dama	Nanger	Antilopini	-16.40678256	15.99974306	East, 1990	32.7	15.0	108	0
A1632	Nanger dama	Nanger	Antilopini	-0.56841694	14.64216886	East, 1990	40.6	14.9	133	0
A1633	Nanger dama	Nanger	Antilopini	-0.13556719	14.66184385	East, 1990	41.0	14.6	121	0
A1634	Nanger dama	Nanger	Antilopini	-5.93411965	29.90502913	http://www.iucnredlist.org	45.8	4.6	12	0
A1635	Nanger granti	Nanger	Antilopini	34.86000000	-6.56000000	http://data.gbif.org/ws/rest/occurrence/get?key=175849127	30.9	13.1	128	0
A1636	Nanger granti	Nanger	Antilopini	35.83330000	-3.58333000	http://data.gbif.org/ws/rest/occurrence/get?key=42077979	30.2	13.9	153	1
A1637	Nanger granti	Nanger	Antilopini	35.83330000	-3.50278000	http://data.gbif.org/ws/rest/occurrence/get?key=61865550	30.4	14.1	143	1
A1638	Nanger granti	Nanger	Antilopini	38.13330000	-3.40000000	http://data.gbif.org/ws/rest/occurrence/get?key=42077748	29.7	13.9	135	10
A1639	Nanger granti	Nanger	Antilopini	39.95000000	-3.40000000	http://data.gbif.org/ws/rest/occurrence/get?key=61863887	32.2	20.5	264	12
A1640	Nanger granti	Nanger	Antilopini	35.81000000	-3.37000000	http://data.gbif.org/ws/rest/occurrence/get?key=175848353	28.6	12.7	207	2
A1641	Nanger granti	Nanger	Antilopini	35.85000000	-3.36000000	http://data.gbif.org/ws/rest/occurrence/get?key=175849029	30.4	14.0	128	1
A1642	Nanger granti	Nanger	Antilopini	37.01670000	-3.05000000	http://data.gbif.org/ws/rest/occurrence/get?key=178299063	28.6	12.4	159	8

A1643	Nanger granti	Nanger	Antilopini	34.82500000	-2.44167000	http://data.gbif.org/ws/rest/occurrence/get?key=61865543	27.5	13.0	130	13
A1644	Nanger granti	Nanger	Antilopini	36.00000000	-2.25000000	http://data.gbif.org/ws/rest/occurrence/get?key=175849128	33.8	16.9	101	3
A1645	Nanger granti	Nanger	Antilopini	36.01670000	-1.86667000	http://data.gbif.org/ws/rest/occurrence/get?key=42077751	30.9	14.0	137	6
A1646	Nanger granti	Nanger	Antilopini	36.80880000	-1.82442000	http://data.gbif.org/ws/rest/occurrence/get?key=91212374	27.2	11.0	114	2
A1647	Nanger granti	Nanger	Antilopini	37.05000000	-1.46667000	http://data.gbif.org/ws/rest/occurrence/get?key=61864067	27.8	10.7	136	5
A1648	Nanger granti	Nanger	Antilopini	36.98330000	-1.45000000	http://data.gbif.org/ws/rest/occurrence/get?key=61864058	28.5	11.4	139	6
A1649	Nanger granti	Nanger	Antilopini	36.81667000	-1.28333000	http://data.gbif.org/ws/rest/occurrence/get?key=79787656	27.6	11.1	191	14
A1650	Nanger granti	Nanger	Antilopini	36.81670000	-1.28333000	http://data.gbif.org/ws/rest/occurrence/get?key=49767391	27.6	11.1	191	14
A1651	Nanger granti	Nanger	Antilopini	35.46700000	-1.21700000	http://data.gbif.org/ws/rest/occurrence/get?key=86876862	26.3	9.1	175	27
A1652	Nanger granti	Nanger	Antilopini	36.35000000	-1.18333000	http://data.gbif.org/ws/rest/occurrence/get?key=79821783	24.5	7.9	190	18
A1653	Nanger granti	Nanger	Antilopini	35.38333000	-1.10000000	http://data.gbif.org/ws/rest/occurrence/get?key=79787361	26.2	9.1	185	33
A1654	Nanger granti	Nanger	Antilopini	36.56670000	-1.05000000	http://data.gbif.org/ws/rest/occurrence/get?key=42077750	27.7	10.3	203	20
A1655	Nanger granti	Nanger	Antilopini	36.90000000	-0.35000000	http://data.gbif.org/ws/rest/occurrence/get?key=42077980	25.9	6.7	175	32
A1656	Nanger granti	Nanger	Antilopini	39.36700000	-0.13300000	http://data.gbif.org/ws/rest/occurrence/get?key=86876777	37.1	20.0	94	2
A1657	Nanger granti	Nanger	Antilopini	36.36700000	0.06700000	http://data.gbif.org/ws/rest/occurrence/get?key=86876859	23.0	5.4	140	32
A1658	Nanger granti	Nanger	Antilopini	30.58330000	0.31666700	http://data.gbif.org/ws/rest/occurrence/get?key=42427681	28.7	14.6	148	37
A1659	Nanger granti	Nanger	Antilopini	37.60000000	0.33300000	http://data.gbif.org/ws/rest/occurrence/get?key=86877121	33.0	13.7	200	6
A1660	Nanger granti	Nanger	Antilopini	36.08330000	0.63333000	http://data.gbif.org/ws/rest/occurrence/get?key=201259836	33.4	15.0	89	21
A1661	Nanger granti	Nanger	Antilopini	37.68330000	0.65000000	http://data.gbif.org/ws/rest/occurrence/get?key=61865544	33.7	14.8	124	3
A1662	Nanger granti	Nanger	Antilopini	36.70000000	1.10000000	http://data.gbif.org/ws/rest/occurrence/get?key=79787655	26.1	7.1	100	15
A1663	Nanger granti	Nanger	Antilopini	36.75000000	1.28333000	http://data.gbif.org/ws/rest/occurrence/get?key=42429945	30.4	10.0	120	14
A1664	Nanger granti	Nanger	Antilopini	35.63333000	1.73333000	http://data.gbif.org/ws/rest/occurrence/get?key=79785541	32.4	15.3	108	13
A1665	Nanger granti	Nanger	Antilopini	37.06670000	1.90874000	http://data.gbif.org/ws/rest/occurrence/get?key=91210880	32.9	14.1	124	7
A1666	Nanger granti	Nanger	Antilopini	36.85000000	2.13333000	http://data.gbif.org/ws/rest/occurrence/get?key=79787660	23.2	6.5	150	27
A1667	Nanger granti	Nanger	Antilopini	36.93333000	2.71667000	http://data.gbif.org/ws/rest/occurrence/get?key=79773192	27.1	10.4	138	11
A1668	Nanger granti	Nanger	Antilopini	38.58330000	3.73333000	http://data.gbif.org/ws/rest/occurrence/get?key=61864096	30.6	10.7	199	9
A1669	Nanger granti	Nanger	Antilopini	38.38330000	4.01667000	http://data.gbif.org/ws/rest/occurrence/get?key=61864093	28.3	9.9	176	6
A1670	Nanger granti	Nanger	Antilopini	37.93330000	5.16359000	http://data.gbif.org/ws/rest/occurrence/get?key=61864090	30.7	14.1	126	12

A1671	Nanger granti	Nanger	Antilopini	34.16700000	5.50000000	http://data.gbif.org/ws/rest/occurrence/get?key=240225732	36.0	20.2	105	8
A1672	Nanger granti	Nanger	Antilopini	34.20000000	5.50000000	http://data.gbif.org/ws/rest/occurrence/get?key=152148921	35.9	20.1	104	8
A1673	Nanger granti	Nanger	Antilopini	34.16670000	5.95000000	http://data.gbif.org/ws/rest/occurrence/get?key=61865597	35.6	19.5	138	9
A1674	Nanger soemmerringii	Nanger	Antilopini	45.25000000	4.56667000	http://data.gbif.org/ws/rest/occurrence/get?key=61863914	36.9	21.6	70	0
A1675	Nanger soemmerringii	Nanger	Antilopini	39.96670000	8.20000000	http://data.gbif.org/ws/rest/occurrence/get?key=61864057	17.5	2.3	235	19
A1676	Nanger soemmerringii	Nanger	Antilopini	40.06670000	8.83333000	http://data.gbif.org/ws/rest/occurrence/get?key=61864033	35.3	13.0	137	7
A1677	Nanger soemmerringii	Nanger	Antilopini	40.25000000	8.96667000	http://data.gbif.org/ws/rest/occurrence/get?key=61864034	35.9	13.6	136	9
A1678	Nanger soemmerringii	Nanger	Antilopini	40.48000000	9.14000000	http://data.gbif.org/ws/rest/occurrence/get?key=175848974	33.6	12.3	154	11
A1679	Nanger soemmerringii	Nanger	Antilopini	44.80000000	9.16667000	http://data.gbif.org/ws/rest/occurrence/get?key=61863916	32.5	12.9	57	1
A1680	Nanger soemmerringii	Nanger	Antilopini	44.50000000	9.21667000	http://data.gbif.org/ws/rest/occurrence/get?key=61863922	32.2	12.5	61	1
A1681	Nanger soemmerringii	Nanger	Antilopini	46.00000000	10.00000000	http://data.gbif.org/ws/rest/occurrence/get?key=224288065	31.8	12.7	41	1
A1682	Nanger soemmerringii	Nanger	Antilopini	35.00000000	12.33330000	http://data.gbif.org/ws/rest/occurrence/get?key=42431264	40.6	17.1	214	0
A1683	Nanger soemmerringii	Nanger	Antilopini	37.52315026	17.91774220	East, 1988	42.3	19.5	21	0
A1684	Nanger soemmerringii	Nanger	Antilopini	36.54146448	17.34509216	East, 1988	41.1	16.8	44	0
A1685	Nanger soemmerringii	Nanger	Antilopini	36.29604303	16.56792425	East, 1988	41.7	15.8	57	0
A1686	Nanger soemmerringii	Nanger	Antilopini	35.88700729	15.70894919	East, 1988	41.9	14.4	78	0
A1687	Nanger soemmerringii	Nanger	Antilopini	45.07395009	5.48305560	East, 1988	35.5	19.1	85	0
A1688	Nanger soemmerringii	Nanger	Antilopini	44.09226430	6.38293423	East, 1988	35.0	17.4	115	0
A1689	Nanger soemmerringii	Nanger	Antilopini	43.60142141	5.36034488	East, 1988	36.2	17.8	124	0
A1690	Nanger soemmerringii	Nanger	Antilopini	37.05684952	14.89087770	East, 1988	36.8	13.3	199	0
A1691	Nanger soemmerringii	Nanger	Antilopini	37.30227096	15.99527421	East, 1988	40.9	17.5	80	0
A1692	Nanger soemmerringii	Nanger	Antilopini	38.44757104	17.38599573	East, 1988	39.7	18.1	43	5
A1693	Nanger soemmerringii	Nanger	Antilopini	40.57455691	14.52274553	East, 1988	38.7	20.5	42	2
A1694	Nanger soemmerringii	Nanger	Antilopini	41.47443555	13.66377047	East, 1988	36.8	18.2	34	3
A1695	Nanger soemmerringii	Nanger	Antilopini	40.65636406	13.13202400	East, 1988	40.1	20.3	40	3
A1696	Nanger soemmerringii	Nanger	Antilopini	40.77907478	12.02762749	East, 1988	39.3	18.3	58	5
A1697	Nanger soemmerringii	Nanger	Antilopini	40.57455691	11.16865243	East, 1988	38.1	16.3	107	5
A1698	Nanger soemmerringii	Nanger	Antilopini	33.21191353	9.53250946	East, 1988	39.1	19.8	162	0

A1699	Nanger soemmerringii	Nanger	Antilopini	33.21191353	8.75534155	East, 1988	38.8	19.4	171	0
A1700	Nanger soemmerringii	Nanger	Antilopini	33.37552783	7.89636649	East, 1988	38.6	19.6	202	3
A1701	Nanger soemmerringii	Nanger	Antilopini	30.88040979	6.79196998	East, 1988	36.0	18.1	155	0
A1702	Nanger soemmerringii	Nanger	Antilopini	29.53059184	8.30540223	East, 1988	37.6	18.1	192	0
A1703	Nanger soemmerringii	Nanger	Antilopini	31.37125268	9.24618444	East, 1988	38.4	18.6	180	0
A1704	Nanger soemmerringii	Nanger	Antilopini	30.63498834	8.10088436	East, 1988	37.3	18.3	183	0
A1705	Neotragus batesi	Neotragus	Neotragini	30.15000000	0.80000000	http://data.gbif.org/ws/rest/occurrence/get?key=79787117	31.5	17.3	137	41
A1706	Neotragus batesi	Neotragus	Neotragini	28.35000000	1.25000000	http://data.gbif.org/ws/rest/occurrence/get?key=49802952	31.8	18.5	196	66
A1707	Neotragus batesi	Neotragus	Neotragini	15.20000000	2.10000000	http://data.gbif.org/ws/rest/occurrence/get?key=152160690	31.8	19.1	224	55
A1708	Neotragus batesi	Neotragus	Neotragini	15.18300000	2.15000000	http://data.gbif.org/ws/rest/occurrence/get?key=240237564	31.4	18.6	225	54
A1709	Neotragus batesi	Neotragus	Neotragini	26.46670000	2.41667000	http://data.gbif.org/ws/rest/occurrence/get?key=61939583	31.3	17.8	257	54
A1710	Neotragus batesi	Neotragus	Neotragini	10.85000000	2.66667000	http://data.gbif.org/ws/rest/occurrence/get?key=61939258	28.7	18.1	346	44
A1711	Neotragus batesi	Neotragus	Neotragini	10.53330000	2.78333000	http://data.gbif.org/ws/rest/occurrence/get?key=91155636	29.4	19.1	386	51
A1712	Neotragus batesi	Neotragus	Neotragini	27.86670000	3.70000000	http://data.gbif.org/ws/rest/occurrence/get?key=214074655	33.3	17.3	247	18
A1713	Neotragus batesi	Neotragus	Neotragini	29.98693514	-0.37685726	Kingdon,1989	29.4	15.4	131	28
A1714	Neotragus batesi	Neotragus	Neotragini	30.14978278	-0.25472153	Kingdon,1989	28.8	14.7	143	33
A1715	Neotragus batesi	Neotragus	Neotragini	13.02816298	3.34350762	http://www.iucnredlist.org	29.6	17.9	291	29
A1716	Neotragus batesi	Neotragus	Neotragini	13.02816298	3.56867967	http://www.iucnredlist.org	29.7	17.9	292	25
A1717	Neotragus batesi	Neotragus	Neotragini	10.11701013	1.57429871	http://www.iucnredlist.org	28.2	17.2	397	27
A1718	Neotragus batesi	Neotragus	Neotragini	16.26099018	2.66799149	http://www.iucnredlist.org	31.5	18.3	219	36
A1719	Neotragus batesi	Neotragus	Neotragini	15.92323211	3.34350762	http://www.iucnredlist.org	30.7	16.9	205	34
A1720	Neotragus batesi	Neotragus	Neotragini	16.32532505	3.35959134	http://www.iucnredlist.org	31.6	17.7	214	29
A1721	Neotragus batesi	Neotragus	Neotragini	14.87779048	0.91486629	http://www.iucnredlist.org	31.0	18.3	256	37
A1722	Neotragus batesi	Neotragus	Neotragini	11.75754931	-0.11449162	http://www.iucnredlist.org	32.6	19.8	283	3
A1723	Neotragus batesi	Neotragus	Neotragini	28.23770056	-0.94935569	http://www.iucnredlist.org	27.7	15.3	172	79
A1724	Neotragus moschatus	Neotragus	Neotragini	33.00000000	-21.50000000	http://data.gbif.org/ws/rest/occurrence/get?key=152160505	33.3	9.7	143	2
A1725	Neotragus moschatus	Neotragus	Neotragini	33.26700000	-16.83300000	http://data.gbif.org/ws/rest/occurrence/get?key=240237576	35.6	13.2	170	0
A1726	Neotragus moschatus	Neotragus	Neotragini	33.30000000	-16.80000000	http://data.gbif.org/ws/rest/occurrence/get?key=152160700	35.7	13.4	169	0

A1727	Neotragus moschatus	Neotragus	Neotragini	32.80000000	-16.50000000	http://data.gbif.org/ws/rest/occurrence/get?key=152160699	35.5	12.2	175	1
A1728	Neotragus moschatus	Neotragus	Neotragini	32.78300000	-16.48300000	http://data.gbif.org/ws/rest/occurrence/get?key=240237577	35.7	12.3	174	1
A1729	Neotragus moschatus	Neotragus	Neotragini	39.78300000	-3.55000000	http://data.gbif.org/ws/rest/occurrence/get?key=86873070	32.1	20.1	235	15
A1730	Neotragus moschatus	Neotragus	Neotragini	39.50000000	-3.50000000	http://data.gbif.org/ws/rest/occurrence/get?key=328414043	31.3	18.4	125	22
A1731	Neotragus moschatus	Neotragus	Neotragini	39.83300000	-3.50000000	http://data.gbif.org/ws/rest/occurrence/get?key=86879191	31.8	19.8	235	15
A1732	Neotragus moschatus	Neotragus	Neotragini	39.83300000	-3.46700000	http://data.gbif.org/ws/rest/occurrence/get?key=86879190	31.5	19.5	223	16
A1733	Neotragus moschatus	Neotragus	Neotragini	36.56670000	-0.93333000	http://data.gbif.org/ws/rest/occurrence/get?key=61939254	25.6	8.2	227	28
A1734	Neotragus moschatus	Neotragus	Neotragini	36.83333000	-0.45000000	http://data.gbif.org/ws/rest/occurrence/get?key=79803033	23.8	5.8	276	52
A1735	Neotragus moschatus	Neotragus	Neotragini	37.10000000	-0.30000000	http://data.gbif.org/ws/rest/occurrence/get?key=152160701	25.2	6.9	204	35
A1736	Neotragus moschatus	Neotragus	Neotragini	37.11700000	-0.28300000	http://data.gbif.org/ws/rest/occurrence/get?key=240237570	24.7	6.6	204	36
A1737	Neotragus moschatus	Neotragus	Neotragini	37.40000000	-0.27000000	http://data.gbif.org/ws/rest/occurrence/get?key=61939248	21.9	5.4	334	46
A1738	Neotragus moschatus	Neotragus	Neotragini	36.81700000	-0.23300000	http://data.gbif.org/ws/rest/occurrence/get?key=86879661	24.9	5.9	144	34
A1739	Neotragus moschatus	Neotragus	Neotragini	32.14371583	-27.67829465	http://www.iucnredlist.org	28.8	10.0	118	18
A1740	Neotragus moschatus	Neotragus	Neotragini	37.67646327	-1.49945065	http://www.iucnredlist.org	31.2	13.5	229	1
A1741	Neotragus moschatus	Neotragus	Neotragini	34.93121096	-14.84251897	http://www.iucnredlist.org	32.0	13.0	231	3
A1742	Neotragus pygmaeus	Neotragus	Cephalophini	-1.86700000	4.95000000	http://data.gbif.org/ws/rest/occurrence/get?key=240237568	31.1	21.3	327	33
A1743	Neotragus pygmaeus	Neotragus	Cephalophini	-1.90000000	5.00000000	http://data.gbif.org/ws/rest/occurrence/get?key=152160673	31.2	21.3	316	35
A1744	Neotragus pygmaeus	Neotragus	Cephalophini	-4.10000000	5.70000000	http://data.gbif.org/ws/rest/occurrence/get?key=152160694	32.3	20.7	304	24
A1745	Neotragus pygmaeus	Neotragus	Cephalophini	-4.08300000	5.70000000	http://data.gbif.org/ws/rest/occurrence/get?key=240237587	32.3	20.7	304	24
A1746	Neotragus pygmaeus	Neotragus	Cephalophini	-6.80000000	5.80000000	http://data.gbif.org/ws/rest/occurrence/get?key=152160676	32.2	20.6	228	28
A1747	Neotragus pygmaeus	Neotragus	Cephalophini	-6.75000000	5.81700000	http://data.gbif.org/ws/rest/occurrence/get?key=240237572	32.1	20.6	224	28
A1748	Neotragus pygmaeus	Neotragus	Cephalophini	-1.00000000	5.86700000	http://data.gbif.org/ws/rest/occurrence/get?key=240237583	32.2	20.9	247	29
A1749	Neotragus pygmaeus	Neotragus	Cephalophini	-1.00000000	5.90000000	http://data.gbif.org/ws/rest/occurrence/get?key=152160696	32.4	21.0	242	27
A1750	Neotragus pygmaeus	Neotragus	Cephalophini	-0.98333000	5.91667000	http://data.gbif.org/ws/rest/occurrence/get?key=61939374	32.4	20.8	241	27
A1751	Neotragus pygmaeus	Neotragus	Cephalophini	1.30000000	6.40000000	http://data.gbif.org/ws/rest/occurrence/get?key=152160693	33.4	21.7	183	13
A1752	Neotragus pygmaeus	Neotragus	Cephalophini	1.28300000	6.43300000	http://data.gbif.org/ws/rest/occurrence/get?key=240237589	33.2	21.3	178	14
A1753	Neotragus pygmaeus	Neotragus	Cephalophini	-5.60000000	7.00000000	http://data.gbif.org/ws/rest/occurrence/get?key=152160689	32.5	18.5	202	19
A1754	Neotragus pygmaeus	Neotragus	Cephalophini	-5.61700000	7.05000000	http://data.gbif.org/ws/rest/occurrence/get?key=240237563	33.8	19.6	207	18

A1755	Neotragus pygmaeus	Neotragus	Cephalophini	-3.50000000	7.40000000	http://data.gbif.org/ws/rest/occurrence/get?key=152160686	35.3	20.7	178	5
A1756	Neotragus pygmaeus	Neotragus	Cephalophini	-3.46700000	7.43300000	http://data.gbif.org/ws/rest/occurrence/get?key=240237569	35.3	20.5	177	5
A1757	Neotragus pygmaeus	Neotragus	Cephalophini	-11.10000000	7.65000000	http://data.gbif.org/ws/rest/occurrence/get?key=49804683	33.2	20.0	449	16
A1758	Neotragus pygmaeus	Neotragus	Cephalophini	-11.16670000	8.88333000	http://data.gbif.org/ws/rest/occurrence/get?key=49803233	35.0	15.2	438	10
A1759	Neotragus pygmaeus	Neotragus	Cephalophini	-1.21371042	5.28838904	own observation (TS)	31.6	21.4	295	30
A1760	Oreotragus oreotragus	Oreotragus	Cephalophini	15.93330000	-25.30000000	http://data.gbif.org/ws/rest/occurrence/get?key=49810437	24.8	3.5	31	2
A1761	Oreotragus oreotragus	Oreotragus	Cephalophini	28.50000000	-20.48330000	http://data.gbif.org/ws/rest/occurrence/get?key=42920090	29.0	3.3	131	1
A1762	Oreotragus oreotragus	Oreotragus	Cephalophini	26.15770000	-18.24380000	http://data.gbif.org/ws/rest/occurrence/get?key=70152232	35.4	7.8	164	0
A1763	Oreotragus oreotragus	Oreotragus	Cephalophini	36.68330000	-3.37083000	http://data.gbif.org/ws/rest/occurrence/get?key=49921752	27.9	11.8	322	12
A1764	Oreotragus oreotragus	Oreotragus	Cephalophini	36.00000000	-2.25000000	http://data.gbif.org/ws/rest/occurrence/get?key=175858999	33.8	16.9	101	3
A1765	Oreotragus oreotragus	Oreotragus	Cephalophini	37.05000000	-1.46667000	http://data.gbif.org/ws/rest/occurrence/get?key=61962263	27.8	10.7	136	5
A1766	Oreotragus oreotragus	Oreotragus	Cephalophini	36.98330000	-1.45000000	http://data.gbif.org/ws/rest/occurrence/get?key=61962261	28.5	11.4	139	6
A1767	Oreotragus oreotragus	Oreotragus	Cephalophini	36.35000000	-1.15000000	http://data.gbif.org/ws/rest/occurrence/get?key=61963684	26.6	9.3	168	15
A1768	Oreotragus oreotragus	Oreotragus	Cephalophini	36.56670000	-1.05000000	http://data.gbif.org/ws/rest/occurrence/get?key=42091853	27.7	10.3	203	20
A1769	Oreotragus oreotragus	Oreotragus	Cephalophini	36.31670000	-0.91667000	http://data.gbif.org/ws/rest/occurrence/get?key=61963024	26.6	8.4	149	22
A1770	Oreotragus oreotragus	Oreotragus	Cephalophini	36.03330000	-0.66667000	http://data.gbif.org/ws/rest/occurrence/get?key=61963749	20.5	4.8	148	37
A1771	Oreotragus oreotragus	Oreotragus	Cephalophini	36.06670000	-0.28333000	http://data.gbif.org/ws/rest/occurrence/get?key=61963740	28.0	8.2	133	23
A1772	Oreotragus oreotragus	Oreotragus	Cephalophini	37.60000000	0.16700000	http://data.gbif.org/ws/rest/occurrence/get?key=86879234	28.0	9.6	367	11
A1773	Oreotragus oreotragus	Oreotragus	Cephalophini	39.45000000	7.91667000	http://data.gbif.org/ws/rest/occurrence/get?key=61962431	15.5	0.7	234	22
A1774	Oreotragus oreotragus	Oreotragus	Cephalophini	38.21670000	9.51667000	http://data.gbif.org/ws/rest/occurrence/get?key=61962433	24.9	6.2	283	7
A1775	Oreotragus oreotragus	Oreotragus	Cephalophini	38.23330000	13.25000000	http://data.gbif.org/ws/rest/occurrence/get?key=61962441	17.5	-1.5	305	3
A1776	Oreotragus oreotragus	Oreotragus	Cephalophini	22.85038347	-32.30307481	Kafue National Park, Zambia - http://www.iucnredlist.org	30.4	2.8	40	9
A1777	Oreotragus oreotragus	Oreotragus	Cephalophini	31.48916434	-25.08741372	Kruger Nationalpark, South Africa - http://www.iucnredlist.org	31.1	8.3	121	9
A1778	Oreotragus oreotragus	Oreotragus	Cephalophini	31.17185260	-23.52970150	Kruger Nationalpark, South Africa - http://www.iucnredlist.org	32.6	8.8	92	4
A1779	Oreotragus oreotragus	Oreotragus	Cephalophini	31.57570391	-24.59702283	Kruger Nationalpark, South Africa - http://www.iucnredlist.org	31.9	8.2	110	8
A1780	Oreotragus oreotragus	Oreotragus	Cephalophini	27.01848754	-18.77661367	Hwange National Park, Zimbabw - http://www.iucnredlist.org	33.2	4.3	161	0
A1781	Oryx beisa	Oryx	Hippotragini	37.35000000	-4.52220000	http://data.gbif.org/ws/rest/occurrence/get?key=61962290	29.4	12.3	124	6
A1782	Oryx beisa	Oryx	Hippotragini	35.83330000	-3.58333000	http://data.gbif.org/ws/rest/occurrence/get?key=42092584	30.2	13.9	153	1

A1783	Oryx beisa	Oryx	Hippotragini	35.83330000	-3.50278000	http://data.gbif.org/ws/rest/occurrence/get?key=61962999	30.4	14.1	143	1
A1784	Oryx beisa	Oryx	Hippotragini	38.13330000	-3.40000000	http://data.gbif.org/ws/rest/occurrence/get?key=42091846	29.7	13.9	135	10
A1785	Oryx beisa	Oryx	Hippotragini	38.13330000	-3.40000000	http://data.gbif.org/ws/rest/occurrence/get?key=42091846	29.7	13.9	135	10
A1786	Oryx beisa	Oryx	Hippotragini	35.81000000	-3.37000000	http://data.gbif.org/ws/rest/occurrence/get?key=175858053	28.6	12.7	207	2
A1787	Oryx beisa	Oryx	Hippotragini	35.85000000	-3.36000000	http://data.gbif.org/ws/rest/occurrence/get?key=175858922	30.4	14.0	128	1
A1788	Oryx beisa	Oryx	Hippotragini	37.35000000	-3.06667000	http://data.gbif.org/ws/rest/occurrence/get?key=48234645	1.6	-10.4	335	68
A1789	Oryx beisa	Oryx	Hippotragini	36.04000000	-2.90000000	http://data.gbif.org/ws/rest/occurrence/get?key=175858543	31.3	14.8	115	0
A1790	Oryx beisa	Oryx	Hippotragini	36.70000000	-2.68333000	http://data.gbif.org/ws/rest/occurrence/get?key=61962291	25.1	9.5	196	4
A1791	Oryx beisa	Oryx	Hippotragini	36.00000000	-2.25000000	http://data.gbif.org/ws/rest/occurrence/get?key=175859000	33.8	16.9	101	3
A1792	Oryx beisa	Oryx	Hippotragini	37.60000000	0.33300000	http://data.gbif.org/ws/rest/occurrence/get?key=86879657	33.0	13.7	200	6
A1793	Oryx beisa	Oryx	Hippotragini	37.60000000	0.33300000	http://data.gbif.org/ws/rest/occurrence/get?key=86879657	33.0	13.7	200	6
A1794	Oryx beisa	Oryx	Hippotragini	36.08330000	0.63333000	http://data.gbif.org/ws/rest/occurrence/get?key=201322709	33.4	15.0	89	21
A1795	Oryx beisa	Oryx	Hippotragini	37.68330000	0.65000000	http://data.gbif.org/ws/rest/occurrence/get?key=61963002	33.7	14.8	124	3
A1796	Oryx beisa	Oryx	Hippotragini	37.06000000	0.74000000	http://data.gbif.org/ws/rest/occurrence/get?key=175858921	31.7	11.9	203	14
A1797	Oryx beisa	Oryx	Hippotragini	36.70000000	1.10000000	http://data.gbif.org/ws/rest/occurrence/get?key=79787237	26.1	7.1	100	15
A1798	Oryx beisa	Oryx	Hippotragini	38.58330000	3.73333000	http://data.gbif.org/ws/rest/occurrence/get?key=61962461	30.6	10.7	199	9
A1799	Oryx beisa	Oryx	Hippotragini	41.03330000	7.83333000	http://data.gbif.org/ws/rest/occurrence/get?key=61962436	29.3	11.3	166	6
A1800	Oryx beisa	Oryx	Hippotragini	46.50000000	8.00000000	http://data.gbif.org/ws/rest/occurrence/get?key=61961082	33.4	14.6	55	0
A1801	Oryx beisa	Oryx	Hippotragini	44.80000000	9.16667000	http://data.gbif.org/ws/rest/occurrence/get?key=61961072	32.5	12.9	57	1
A1802	Oryx beisa	Oryx	Hippotragini	44.50000000	9.21667000	http://data.gbif.org/ws/rest/occurrence/get?key=61961079	32.2	12.5	61	1
A1803	Oryx beisa	Oryx	Hippotragini	44.06670000	9.58333000	http://data.gbif.org/ws/rest/occurrence/get?key=61961081	31.1	11.5	69	2
A1804	Oryx beisa	Oryx	Hippotragini	40.64000000	13.59000000	http://data.gbif.org/ws/rest/occurrence/get?key=175859002	38.4	19.0	41	4
A1805	Oryx beisa	Oryx	Hippotragini	38.01714992	-1.94971187	http://www.iucnredlist.org	32.0	15.1	209	1
A1806	Oryx beisa	Oryx	Hippotragini	36.28712228	-4.40058437	http://www.iucnredlist.org	29.6	12.8	137	1
A1807	Oryx dammah	Oryx	Hippotragini	-16.37533722	16.03023780	http://www.iucnredlist.org	33.0	14.9	105	0
A1808	Oryx dammah	Oryx	Hippotragini	-16.29617437	16.10940064	http://www.iucnredlist.org	33.6	14.8	99	0
A1809	Oryx dammah	Oryx	Hippotragini	-14.06522143	15.94387833	http://www.iucnredlist.org	41.1	15.0	110	0
A1810	Oryx dammah	Oryx	Hippotragini	-14.19476063	15.63442357	http://www.iucnredlist.org	41.0	14.9	130	0

A1811	Oryx dammah	Oryx	Hippotragini	-14.13718765	15.39693503	http://www.iucnredlist.org	41.0	15.1	148	0
A1812	Oryx dammah	Oryx	Hippotragini	-13.73417680	15.51208099	http://www.iucnredlist.org	41.3	15.2	145	0
A1813	Oryx dammah	Oryx	Hippotragini	-13.95727210	15.67760330	http://www.iucnredlist.org	41.2	15.1	130	0
A1814	Oryx dammah	Oryx	Hippotragini	-9.70324862	29.89900960	http://www.iucnredlist.org	28.7	8.9	35	0
A1815	Oryx dammah	Oryx	Hippotragini	-9.58325567	30.30594221	http://www.iucnredlist.org	27.5	7.9	49	0
A1816	Oryx dammah	Oryx	Hippotragini	9.66906104	34.48749631	http://www.iucnredlist.org	35.3	4.8	21	1
A1817	Oryx dammah	Oryx	Hippotragini	9.56532598	34.47366497	http://www.iucnredlist.org	35.6	4.3	21	2
A1818	Oryx dammah	Oryx	Hippotragini	10.33988108	32.91072344	http://www.iucnredlist.org	36.6	4.9	26	0
A1819	Oryx dammah	Oryx	Hippotragini	11.36340031	32.53727723	http://www.iucnredlist.org	35.6	5.8	22	0
A1820	Oryx dammah	Oryx	Hippotragini	25.82053028	20.11198327	East, 1988	39.5	7.4	7	0
A1821	Oryx dammah	Oryx	Hippotragini	24.95688440	18.79111310	East, 1988	39.8	9.3	13	0
A1822	Oryx dammah	Oryx	Hippotragini	24.85527900	16.60659706	East, 1988	39.4	10.2	45	0
A1823	Oryx dammah	Oryx	Hippotragini	24.09323852	15.28572689	East, 1988	38.0	9.2	90	0
A1824	Oryx dammah	Oryx	Hippotragini	26.83658425	16.96221595	East, 1988	39.8	9.9	42	0
A1825	Oryx dammah	Oryx	Hippotragini	29.73233807	17.87666452	East, 1988	42.0	10.6	30	0
A1826	Oryx dammah	Oryx	Hippotragini	27.19220314	18.68950770	East, 1988	40.0	8.3	18	0
A1827	Oryx dammah	Oryx	Hippotragini	-14.56778339	21.61259742	Mallon & Kingswood, 2001	36.0	13.0	9	0
A1828	Oryx dammah	Oryx	Hippotragini	-14.56778339	22.12482993	Mallon & Kingswood, 2001	34.9	12.4	8	0
A1829	Oryx dammah	Oryx	Hippotragini	-14.62077296	22.54874648	Mallon & Kingswood, 2001	33.9	12.1	8	0
A1830	Oryx dammah	Oryx	Hippotragini	-14.95637357	22.53108329	Mallon & Kingswood, 2001	32.4	12.1	8	0
A1831	Oryx dammah	Oryx	Hippotragini	-15.27431099	22.53108329	Mallon & Kingswood, 2001	31.1	12.2	8	0
A1832	Oryx dammah	Oryx	Hippotragini	-15.75121712	22.53108329	Mallon & Kingswood, 2001	29.7	12.5	8	0
A1833	Oryx dammah	Oryx	Hippotragini	-14.97403676	22.24847225	Mallon & Kingswood, 2001	32.9	12.3	8	0
A1834	Oryx dammah	Oryx	Hippotragini	-14.99169995	21.71857656	Mallon & Kingswood, 2001	34.1	12.8	7	0
A1835	Oryx dammah	Oryx	Hippotragini	0.59508388	21.78530416	Mallon & Kingswood, 2001	44.0	11.2	13	0
A1836	Oryx dammah	Oryx	Hippotragini	1.16030596	21.56549558	Mallon & Kingswood, 2001	43.5	11.1	16	0
A1837	Oryx dammah	Oryx	Hippotragini	1.59992313	21.25148331	Mallon & Kingswood, 2001	43.0	11.0	19	0
A1838	Oryx dammah	Oryx	Hippotragini	1.41151577	20.96887227	Mallon & Kingswood, 2001	43.0	11.3	22	0

A1839	Oryx dammah	Oryx	Hippotragini	1.78833049	20.84326737	Mallon & Kingswood, 2001	42.3	10.5	24	0
A1840	Oryx dammah	Oryx	Hippotragini	2.47915747	20.43505142	Mallon & Kingswood, 2001	40.9	9.1	30	0
A1841	Oryx dammah	Oryx	Hippotragini	3.29558936	20.27804529	Mallon & Kingswood, 2001	40.6	8.6	30	0
A1842	Oryx dammah	Oryx	Hippotragini	3.64100286	19.68142198	Mallon & Kingswood, 2001	41.4	9.9	34	0
A1843	Oryx dammah	Oryx	Hippotragini	3.57820040	19.33600849	Mallon & Kingswood, 2001	41.5	10.4	39	0
A1844	Oryx dammah	Oryx	Hippotragini	4.39463229	19.36740972	Mallon & Kingswood, 2001	41.6	10.7	34	0
A1845	Oryx dammah	Oryx	Hippotragini	5.36807032	19.65002076	Mallon & Kingswood, 2001	41.3	10.5	25	0
A1846	Oryx dammah	Oryx	Hippotragini	7.25214391	21.28288454	Mallon & Kingswood, 2001	40.3	9.0	6	0
A1847	Oryx dammah	Oryx	Hippotragini	7.22074268	21.84810662	Mallon & Kingswood, 2001	39.8	8.3	5	0
A1848	Oryx dammah	Oryx	Hippotragini	6.74972428	21.69110048	Mallon & Kingswood, 2001	39.9	8.5	6	0
A1849	Oryx dammah	Oryx	Hippotragini	9.51303222	22.75874219	Mallon & Kingswood, 2001	39.8	7.6	2	0
A1850	Oryx dammah	Oryx	Hippotragini	9.01061260	29.51000590	Mallon & Kingswood, 2001	42.4	2.4	6	0
A1851	Oryx dammah	Oryx	Hippotragini	8.50819297	31.77089421	Mallon & Kingswood, 2001	41.2	4.0	8	0
A1852	Oryx dammah	Oryx	Hippotragini	1.59992313	35.50764017	Mallon & Kingswood, 2001	31.8	2.6	57	3
A1853	Oryx dammah	Oryx	Hippotragini	9.76424203	31.04866600	Mallon & Kingswood, 2001	38.7	3.8	6	0
A1854	Oryx dammah	Oryx	Hippotragini	8.00577335	33.84337516	Mallon & Kingswood, 2001	39.7	5.3	12	0
A1855	Oryx dammah	Oryx	Hippotragini	9.38742732	33.78057271	Mallon & Kingswood, 2001	37.3	4.6	18	1
A1856	Oryx dammah	Oryx	Hippotragini	9.07341505	32.96414082	Mallon & Kingswood, 2001	39.4	4.4	15	0
A1857	Oryx dammah	Oryx	Hippotragini	10.10965553	32.30471506	Mallon & Kingswood, 2001	37.4	4.2	15	0
A1858	Oryx dammah	Oryx	Hippotragini	26.28128720	28.81917891	Mallon & Kingswood, 2001	36.7	3.7	2	0
A1859	Oryx dammah	Oryx	Hippotragini	26.59529947	28.81917891	Mallon & Kingswood, 2001	36.5	4.2	2	0
A1860	Oryx dammah	Oryx	Hippotragini	30.23784175	28.44236419	Mallon & Kingswood, 2001	36.0	3.3	2	0
A1861	Oryx dammah	Oryx	Hippotragini	30.33204543	30.26363533	Mallon & Kingswood, 2001	34.3	7.0	13	0
A1862	Oryx dammah	Oryx	Hippotragini	30.55185401	29.98102429	Mallon & Kingswood, 2001	34.4	5.5	8	0
A1863	Oryx dammah	Oryx	Hippotragini	30.89726751	24.07759370	Mallon & Kingswood, 2001	40.2	6.5	0	0
A1864	Oryx dammah	Oryx	Hippotragini	30.86586628	25.30224154	Mallon & Kingswood, 2001	38.2	4.2	0	0
A1865	Oryx dammah	Oryx	Hippotragini	29.45281108	25.27084031	Mallon & Kingswood, 2001	38.6	4.5	0	0
A1866	Oryx gazella	Oryx	Hippotragini	24.55000000	-32.25000000	http://data.gbif.org/ws/rest/occurrence/get?key=61963726	31.3	5.2	49	11

A1867	Oryx gazella	Oryx	Hippotragini	15.77000000	-25.41000000	http://data.gbif.org/ws/rest/occurrence/get?key=79775463	24.5	4.6	24	2
A1868	Oryx gazella	Oryx	Hippotragini	15.93330000	-25.30000000	http://data.gbif.org/ws/rest/occurrence/get?key=49811703	24.8	3.5	31	2
A1869	Oryx gazella	Oryx	Hippotragini	22.15000000	-25.01700000	http://data.gbif.org/ws/rest/occurrence/get?key=240259093	34.4	2.1	59	2
A1870	Oryx gazella	Oryx	Hippotragini	22.10000000	-25.00000000	http://data.gbif.org/ws/rest/occurrence/get?key=152187973	34.4	2.1	58	2
A1871	Oryx gazella	Oryx	Hippotragini	18.81670000	-24.78330000	http://data.gbif.org/ws/rest/occurrence/get?key=49811045	34.9	1.6	49	0
A1872	Oryx gazella	Oryx	Hippotragini	24.48330000	-23.31670000	http://data.gbif.org/ws/rest/occurrence/get?key=42092643	32.3	4.0	80	1
A1873	Oryx gazella	Oryx	Hippotragini	24.61670000	-23.18330000	http://data.gbif.org/ws/rest/occurrence/get?key=61962469	32.3	4.0	80	1
A1874	Oryx gazella	Oryx	Hippotragini	23.25000000	-22.55000000	http://data.gbif.org/ws/rest/occurrence/get?key=61962467	33.0	4.5	86	0
A1875	Oryx gazella	Oryx	Hippotragini	22.53430000	-22.26910000	http://data.gbif.org/ws/rest/occurrence/get?key=61963025	33.2	4.4	90	0
A1876	Oryx gazella	Oryx	Hippotragini	22.45000000	-22.10000000	http://data.gbif.org/ws/rest/occurrence/get?key=61962471	33.3	4.4	92	0
A1877	Oryx gazella	Oryx	Hippotragini	25.79970000	-20.57880000	http://data.gbif.org/ws/rest/occurrence/get?key=61962466	33.5	5.8	81	0
A1878	Oryx gazella	Oryx	Hippotragini	23.74500000	-20.29380000	http://data.gbif.org/ws/rest/occurrence/get?key=49809707	34.6	6.5	103	0
A1879	Oryx gazella	Oryx	Hippotragini	20.38300000	-19.83300000	http://data.gbif.org/ws/rest/occurrence/get?key=240259100	33.5	5.5	125	0
A1880	Oryx gazella	Oryx	Hippotragini	20.40000000	-19.80000000	http://data.gbif.org/ws/rest/occurrence/get?key=152187966	33.4	5.5	126	0
A1881	Oryx leucoryx	Oryx	Hippotragini	35.08430000	30.57170000	http://data.gbif.org/ws/rest/occurrence/get?key=85057898	34.7	7.0	19	0
A1882	Oryx leucoryx	Oryx	Hippotragini	41.76879448	22.23714096	http://www.iucnredlist.org	39.8	9.7	29	0
A1883	Oryx leucoryx	Oryx	Hippotragini	41.91605114	22.12669846	http://www.iucnredlist.org	39.8	9.6	30	0
A1884	Oryx leucoryx	Oryx	Hippotragini	45.48702531	19.47607846	http://www.iucnredlist.org	41.0	10.3	22	0
A1885	Oryx leucoryx	Oryx	Hippotragini	45.67109614	19.32882179	http://www.iucnredlist.org	40.5	10.0	22	0
A1886	Oryx leucoryx	Oryx	Hippotragini	57.00985946	19.18156513	http://www.iucnredlist.org	36.2	16.5	10	1
A1887	Oryx leucoryx	Oryx	Hippotragini	57.30437279	19.62333513	http://www.iucnredlist.org	35.9	16.3	11	1
A1888	Ourebia ourebi	Ourebia	Antilopini	33.97100000	-21.31300000	http://data.gbif.org/ws/rest/occurrence/get?key=79803030	32.3	11.3	148	6
A1889	Ourebia ourebi	Ourebia	Antilopini	34.28300000	-19.31700000	http://data.gbif.org/ws/rest/occurrence/get?key=240263914	34.1	13.6	204	11
A1890	Ourebia ourebi	Ourebia	Antilopini	34.30000000	-19.30000000	http://data.gbif.org/ws/rest/occurrence/get?key=152194547	34.1	13.7	203	11
A1891	Ourebia ourebi	Ourebia	Antilopini	34.31360000	-18.69030000	http://data.gbif.org/ws/rest/occurrence/get?key=49814269	35.0	13.1	224	15
A1892	Ourebia ourebi	Ourebia	Antilopini	34.40000000	-18.00000000	http://data.gbif.org/ws/rest/occurrence/get?key=152194548	34.6	13.5	229	12
A1893	Ourebia ourebi	Ourebia	Antilopini	34.38300000	-17.96700000	http://data.gbif.org/ws/rest/occurrence/get?key=240263925	34.7	13.5	225	11
A1894	Ourebia ourebi	Ourebia	Antilopini	17.85000000	-15.83330000	http://data.gbif.org/ws/rest/occurrence/get?key=79770780	33.6	5.5	169	0

A1895	Ourebia ourebi	Ourebia	Antilopini	32.66670000	-2.51667000	http://data.gbif.org/ws/rest/occurrence/get?key=61968272	28.9	15.3	181	9
A1896	Ourebia ourebi	Ourebia	Antilopini	40.82000000	-1.77000000	http://data.gbif.org/ws/rest/occurrence/get?key=79776016	32.5	21.1	174	4
A1897	Ourebia ourebi	Ourebia	Antilopini	35.38333000	-1.10000000	http://data.gbif.org/ws/rest/occurrence/get?key=79787366	26.2	9.1	185	33
A1898	Ourebia ourebi	Ourebia	Antilopini	36.00000000	-0.60000000	http://data.gbif.org/ws/rest/occurrence/get?key=61968034	22.0	5.7	151	36
A1899	Ourebia ourebi	Ourebia	Antilopini	30.74530000	-0.52074000	http://data.gbif.org/ws/rest/occurrence/get?key=201322920	27.3	13.2	125	21
A1900	Ourebia ourebi	Ourebia	Antilopini	30.80440000	-0.46127000	http://data.gbif.org/ws/rest/occurrence/get?key=201323006	27.7	13.4	126	20
A1901	Ourebia ourebi	Ourebia	Antilopini	35.28330000	0.22558000	http://data.gbif.org/ws/rest/occurrence/get?key=61968718	26.5	8.2	191	39
A1902	Ourebia ourebi	Ourebia	Antilopini	32.58330000	0.31666700	http://data.gbif.org/ws/rest/occurrence/get?key=42943253	28.5	15.6	182	62
A1903	Ourebia ourebi	Ourebia	Antilopini	35.45000000	1.25000000	http://data.gbif.org/ws/rest/occurrence/get?key=61968713	19.0	4.4	208	34
A1904	Ourebia ourebi	Ourebia	Antilopini	31.40000000	2.96667000	http://data.gbif.org/ws/rest/occurrence/get?key=61968273	34.9	14.3	154	11
A1905	Ourebia ourebi	Ourebia	Antilopini	32.05000000	3.60000000	http://data.gbif.org/ws/rest/occurrence/get?key=61968469	37.1	18.8	158	8
A1906	Ourebia ourebi	Ourebia	Antilopini	27.86670000	3.70000000	http://data.gbif.org/ws/rest/occurrence/get?key=214093615	33.3	17.3	247	18
A1907	Ourebia ourebi	Ourebia	Antilopini	29.71670000	3.73330000	http://data.gbif.org/ws/rest/occurrence/get?key=214093608	33.1	18.0	224	25
A1908	Ourebia ourebi	Ourebia	Antilopini	32.48520000	4.33046000	http://data.gbif.org/ws/rest/occurrence/get?key=61968458	36.6	18.4	166	6
A1909	Ourebia ourebi	Ourebia	Antilopini	32.56670000	4.40000000	http://data.gbif.org/ws/rest/occurrence/get?key=61968471	37.6	18.7	153	6
A1910	Ourebia ourebi	Ourebia	Antilopini	32.56670000	4.41667000	http://data.gbif.org/ws/rest/occurrence/get?key=61968460	37.6	18.7	153	6
A1911	Ourebia ourebi	Ourebia	Antilopini	32.50000000	4.66667000	http://data.gbif.org/ws/rest/occurrence/get?key=61968468	37.6	19.2	144	5
A1912	Ourebia ourebi	Ourebia	Antilopini	33.50000000	4.66700000	http://data.gbif.org/ws/rest/occurrence/get?key=240263901	35.0	19.0	99	7
A1913	Ourebia ourebi	Ourebia	Antilopini	33.50000000	4.70000000	http://data.gbif.org/ws/rest/occurrence/get?key=152194529	35.1	19.2	99	7
A1914	Ourebia ourebi	Ourebia	Antilopini	34.50000000	5.30000000	http://data.gbif.org/ws/rest/occurrence/get?key=152194295	35.6	20.2	85	9
A1915	Ourebia ourebi	Ourebia	Antilopini	34.50000000	5.33300000	http://data.gbif.org/ws/rest/occurrence/get?key=240263932	35.5	20.1	87	9
A1916	Ourebia ourebi	Ourebia	Antilopini	39.45000000	7.91667000	http://data.gbif.org/ws/rest/occurrence/get?key=61968197	15.5	0.7	234	22
A1917	Ourebia ourebi	Ourebia	Antilopini	33.58330000	9.86667000	http://data.gbif.org/ws/rest/occurrence/get?key=61968606	39.1	19.8	154	0
A1918	Ourebia ourebi	Ourebia	Antilopini	32.30000000	10.10000000	http://data.gbif.org/ws/rest/occurrence/get?key=61968615	38.6	19.2	172	0
A1919	Ourebia ourebi	Ourebia	Antilopini	32.53330000	10.32020000	http://data.gbif.org/ws/rest/occurrence/get?key=61968605	38.8	19.0	153	0
A1920	Ourebia ourebi	Ourebia	Antilopini	3.00000000	10.40000000	http://data.gbif.org/ws/rest/occurrence/get?key=152194535	37.2	16.8	256	0
A1921	Ourebia ourebi	Ourebia	Antilopini	3.01700000	10.41700000	http://data.gbif.org/ws/rest/occurrence/get?key=240263903	37.2	16.7	257	0
A1922	Ourebia ourebi	Ourebia	Antilopini	38.20000000	10.45000000	http://data.gbif.org/ws/rest/occurrence/get?key=61968207	25.1	7.5	322	8

A1923	Ourebia ourebi	Ourebia	Antilopini	32.50000000	10.46670000	http://data.gbif.org/ws/rest/occurrence/get?key=61968632	38.8	18.9	146	0
A1924	Ourebia ourebi	Ourebia	Antilopini	32.51670000	10.46670000	http://data.gbif.org/ws/rest/occurrence/get?key=61968622	38.8	18.9	146	0
A1925	Ourebia ourebi	Ourebia	Antilopini	32.53330000	10.46670000	http://data.gbif.org/ws/rest/occurrence/get?key=61968621	38.8	18.9	146	0
A1926	Ourebia ourebi	Ourebia	Antilopini	32.53330000	10.64240000	http://data.gbif.org/ws/rest/occurrence/get?key=61968381	38.9	18.6	142	0
A1927	Ourebia ourebi	Ourebia	Antilopini	37.41670000	10.66670000	http://data.gbif.org/ws/rest/occurrence/get?key=61968212	28.9	9.2	345	5
A1928	Ourebia ourebi	Ourebia	Antilopini	37.95000000	10.66670000	http://data.gbif.org/ws/rest/occurrence/get?key=61968209	19.3	1.7	404	17
A1929	Ourebia ourebi	Ourebia	Antilopini	32.53330000	10.75960000	http://data.gbif.org/ws/rest/occurrence/get?key=61968617	38.9	18.5	140	0
A1930	Ourebia ourebi	Ourebia	Antilopini	37.33330000	11.00000000	http://data.gbif.org/ws/rest/occurrence/get?key=61968036	27.5	7.8	376	7
A1931	Ourebia ourebi	Ourebia	Antilopini	-4.51700000	11.88300000	http://data.gbif.org/ws/rest/occurrence/get?key=240263924	37.0	14.3	255	0
A1932	Ourebia ourebi	Ourebia	Antilopini	-4.50000000	11.90000000	http://data.gbif.org/ws/rest/occurrence/get?key=152194512	36.9	14.3	254	0
A1933	Ourebia ourebi	Ourebia	Antilopini	0.93300000	12.16700000	http://data.gbif.org/ws/rest/occurrence/get?key=240263916	39.1	16.8	216	0
A1934	Ourebia ourebi	Ourebia	Antilopini	0.90000000	12.20000000	http://data.gbif.org/ws/rest/occurrence/get?key=152194476	39.0	16.6	216	0
A1935	Ourebia ourebi	Ourebia	Antilopini	35.00000000	12.33330000	http://data.gbif.org/ws/rest/occurrence/get?key=42944581	40.6	17.1	214	0
A1936	Ourebia ourebi	Ourebia	Antilopini	36.28330000	12.83330000	http://data.gbif.org/ws/rest/occurrence/get?key=61968203	39.9	18.4	236	0
A1937	Ourebia ourebi	Ourebia	Antilopini	36.20000000	12.96670000	http://data.gbif.org/ws/rest/occurrence/get?key=61968201	40.3	18.7	231	0
A1938	Pelea capreolus	Pelea	Peleini	19.03333000	-34.15000000	http://data.gbif.org/ws/rest/occurrence/get?key=79742288	25.1	5.4	152	29
A1939	Pelea capreolus	Pelea	Peleini	20.70000000	-32.60000000	http://data.gbif.org/ws/rest/occurrence/get?key=152200716	26.2	-2.5	31	15
A1940	Pelea capreolus	Pelea	Peleini	20.68300000	-32.56700000	http://data.gbif.org/ws/rest/occurrence/get?key=240269395	26.2	-2.5	32	14
A1941	Pelea capreolus	Pelea	Peleini	24.76670000	-28.73330000	http://data.gbif.org/ws/rest/occurrence/get?key=61972931	32.6	1.5	74	7
A1942	Pelea capreolus	Pelea	Peleini	29.07738818	-29.90185202	http://www.iucnredlist.org	21.4	-2.4	145	11
A1943	Pelea capreolus	Pelea	Peleini	29.49177458	-29.37114662	Ukahlamba-Drakensberg Park, South Africa - http://www.iucnredlist.org	20.9	-3.6	173	8
A1944	Pelea capreolus	Pelea	Peleini	31.24297263	-26.21029526	East, 1989	25.2	6.4	225	20
A1945	Pelea capreolus	Pelea	Peleini	29.06854506	-29.90682213	East, 1989	21.1	-2.6	143	11
A1946	Pelea capreolus	Pelea	Peleini	20.77853994	-34.03823452	East, 1989	28.9	4.6	59	31
A1947	Pelea capreolus	Pelea	Peleini	23.03450855	-32.48895487	East, 1989	31.3	3.7	38	9
A1948	Pelea capreolus	Pelea	Peleini	24.80123095	-32.35305315	East, 1989	28.9	2.1	58	15
A1949	Pelea capreolus	Pelea	Peleini	28.36185610	-28.54780490	East, 1989	24.7	-1.8	123	12
A1950	Philantomba maxwellii	Philantomba	Cephalophini	-0.98333000	5.91667000	http://data.gbif.org/ws/rest/occurrence/get?key=61832603	32.4	20.8	241	27

A1951	Philantomba maxwellii	Philantomba	Cephalophini	-8.10000000	6.20000000	http://data.gbif.org/ws/rest/occurrence/get?key=152284721	34.1	19.1	344	20
A1952	Philantomba maxwellii	Philantomba	Cephalophini	-8.13300000	6.21700000	http://data.gbif.org/ws/rest/occurrence/get?key=240314917	34.3	19.2	345	20
A1953	Philantomba maxwellii	Philantomba	Cephalophini	-11.59310000	8.30963000	http://data.gbif.org/ws/rest/occurrence/get?key=49680491	33.7	18.2	551	7
A1954	Philantomba maxwellii	Philantomba	Cephalophini	-1.50481969	5.36274115	own observation (TS)	31.4	21.2	282	36
A1955	Philantomba maxwellii	Philantomba	Cephalophini	-7.04205774	5.81284660	Tai National Park, Ivory Coast - http://www.iucnredlist.org	32.1	20.3	254	26
A1956	Philantomba maxwellii	Philantomba	Cephalophini	-7.00551539	5.50223664	Tai National Park, Ivory Coast - http://www.iucnredlist.org	31.9	20.9	264	32
A1957	Philantomba maxwellii	Philantomba	Cephalophini	-16.68505860	13.40535606	East, 1990	33.8	15.7	354	0
A1958	Philantomba maxwellii	Philantomba	Cephalophini	-15.87861544	13.41745270	East, 1990	38.3	15.0	279	0
A1959	Philantomba maxwellii	Philantomba	Cephalophini	-16.53989883	13.57874133	East, 1990	34.5	16.6	302	0
A1960	Philantomba maxwellii	Philantomba	Cephalophini	-11.13899004	9.20058645	East, 1990	29.2	9.8	434	13
A1961	Philantomba maxwellii	Philantomba	Cephalophini	-12.05142672	8.72787829	East, 1990	35.6	18.9	652	5
A1962	Philantomba maxwellii	Philantomba	Cephalophini	-10.64979205	7.78795858	East, 1990	33.5	18.7	416	16
A1963	Philantomba maxwellii	Philantomba	Cephalophini	-10.96859523	7.62855699	East, 1990	32.6	19.2	450	17
A1964	Philantomba maxwellii	Philantomba	Cephalophini	-11.06753415	7.46915540	East, 1990	32.8	20.1	469	17
A1965	Philantomba maxwellii	Philantomba	Cephalophini	-8.40717659	5.72123452	East, 1990	33.3	19.8	394	56
A1966	Philantomba maxwellii	Philantomba	Cephalophini	-10.55451754	7.60473836	East, 1990	33.2	18.9	435	19
A1967	Philantomba maxwellii	Philantomba	Cephalophini	-7.43977384	5.60397358	East, 1990	32.6	20.8	290	36
A1968	Philantomba monticola	Philantomba	Cephalophini	23.05000000	-34.05000000	http://data.gbif.org/ws/rest/occurrence/get?key=142336257	25.3	7.6	82	51
A1969	Philantomba monticola	Philantomba	Cephalophini	17.08330000	-9.22146000	http://data.gbif.org/ws/rest/occurrence/get?key=61832895	30.4	10.9	240	0
A1970	Philantomba monticola	Philantomba	Cephalophini	14.04000000	-5.07000000	http://data.gbif.org/ws/rest/occurrence/get?key=142336460	31.3	17.5	216	0
A1971	Philantomba monticola	Philantomba	Cephalophini	39.95000000	-1.10000000	http://data.gbif.org/ws/rest/occurrence/get?key=79787375	35.6	19.8	101	6
A1972	Philantomba monticola	Philantomba	Cephalophini	29.83330000	-0.58333300	http://data.gbif.org/ws/rest/occurrence/get?key=61833935	29.0	15.4	130	30
A1973	Philantomba monticola	Philantomba	Cephalophini	29.46000000	0.49000000	http://data.gbif.org/ws/rest/occurrence/get?key=142336278	29.1	16.8	184	65
A1974	Philantomba monticola	Philantomba	Cephalophini	34.76000000	1.09000000	http://data.gbif.org/ws/rest/occurrence/get?key=142336297	25.2	8.7	179	27
A1975	Philantomba monticola	Philantomba	Cephalophini	28.35000000	1.25000000	http://data.gbif.org/ws/rest/occurrence/get?key=49680901	31.8	18.6	196	66
A1976	Philantomba monticola	Philantomba	Cephalophini	29.88000000	1.45000000	http://data.gbif.org/ws/rest/occurrence/get?key=142336365	31.2	16.4	152	52
A1977	Philantomba monticola	Philantomba	Cephalophini	31.58333000	1.75000000	http://data.gbif.org/ws/rest/occurrence/get?key=79784680	31.3	16.7	175	33
A1978	Philantomba monticola	Philantomba	Cephalophini	28.49000000	1.99000000	http://data.gbif.org/ws/rest/occurrence/get?key=175889390	31.0	17.6	211	68

A1979	Philantomba monticola	Philantomba	Cephalophini	21.85000000	2.58300000	http://data.gbif.org/ws/rest/occurrence/get?key=240314931	32.0	19.6	229	54
A1980	Philantomba monticola	Philantomba	Cephalophini	21.90000000	2.60000000	http://data.gbif.org/ws/rest/occurrence/get?key=152284785	32.1	19.5	229	55
A1981	Philantomba monticola	Philantomba	Cephalophini	10.53330000	2.78333000	http://data.gbif.org/ws/rest/occurrence/get?key=91155453	29.3	19.1	386	51
A1982	Philantomba monticola	Philantomba	Cephalophini	13.58330000	3.15000000	http://data.gbif.org/ws/rest/occurrence/get?key=42311117	29.9	17.8	289	32
A1983	Philantomba monticola	Philantomba	Cephalophini	27.86670000	3.70000000	http://data.gbif.org/ws/rest/occurrence/get?key=213128202	33.3	17.3	247	18
A1984	Philantomba monticola	Philantomba	Cephalophini	10.13330000	3.80000000	http://data.gbif.org/ws/rest/occurrence/get?key=61832276	32.5	21.8	462	33
A1985	Philantomba monticola	Philantomba	Cephalophini	32.56670000	4.00000000	http://data.gbif.org/ws/rest/occurrence/get?key=61832744	32.0	16.0	201	12
A1986	Philantomba monticola	Philantomba	Cephalophini	32.85000000	4.10000000	http://data.gbif.org/ws/rest/occurrence/get?key=61832623	27.8	13.2	204	14
A1987	Philantomba monticola	Philantomba	Cephalophini	9.97521777	2.82726162	own observation (TS)	30.4	21.4	474	70
A1988	Philantomba monticola	Philantomba	Cephalophini	39.89783050	-10.31675287	Kingdon,1989	31.1	18.1	194	9
A1989	Philantomba monticola	Philantomba	Cephalophini	38.67367857	-6.25081969	Kingdon,1989	34.2	19.5	149	18
A1990	Philantomba monticola	Philantomba	Cephalophini	33.99566943	-2.84068219	Kingdon,1989	29.7	14.9	155	3
A1991	Philantomba walteri	Philantomba	Cephalophini	5.76667000	6.91667000	http://data.gbif.org/ws/rest/occurrence/get?key=61832393	33.2	20.1	276	8
A1992	Philantomba walteri	Philantomba	Cephalophini	3.89639000	7.38778000	http://data.gbif.org/ws/rest/occurrence/get?key=61833257	33.9	20.7	188	6
A1993	Philantomba walteri	Philantomba	Cephalophini	1.24928591	6.78614486	Colyn et al., 2010	34.6	21.3	156	14
A1994	Philantomba walteri	Philantomba	Cephalophini	1.10056960	7.64869947	Colyn et al., 2010	33.4	19.1	214	10
A1995	Philantomba walteri	Philantomba	Cephalophini	0.95185329	9.49278175	Colyn et al., 2010	36.8	18.5	270	3
A1996	Philantomba walteri	Philantomba	Cephalophini	2.79593556	9.81995764	Colyn et al., 2010	36.8	17.4	228	1
A1997	Philantomba walteri	Philantomba	Cephalophini	2.23081358	8.86817324	Colyn et al., 2010	36.6	18.8	191	3
A1998	Philantomba walteri	Philantomba	Cephalophini	2.08596172	8.11942792	Colyn et al., 2010	36.4	20.8	170	5
A1999	Philantomba walteri	Philantomba	Cephalophini	2.23081358	6.99434770	Colyn et al., 2010	35.5	21.9	164	4
A2000	Philantomba walteri	Philantomba	Cephalophini	6.04430500	4.51902800	Colyn et al., 2010	32.1	22.0	558	57
A2001	Raphicerus campestris	Raphicerus	Neotragini	24.55000000	-32.25000000	http://data.gbif.org/ws/rest/occurrence/get?key=62000055	31.3	5.2	49	11
A2002	Raphicerus campestris	Raphicerus	Neotragini	24.53330000	-32.13330000	http://data.gbif.org/ws/rest/occurrence/get?key=43169405	30.6	3.6	50	12
A2003	Raphicerus campestris	Raphicerus	Neotragini	19.90000000	-31.50000000	http://data.gbif.org/ws/rest/occurrence/get?key=152338117	31.1	2.6	27	9
A2004	Raphicerus campestris	Raphicerus	Neotragini	19.90000000	-31.46700000	http://data.gbif.org/ws/rest/occurrence/get?key=240344331	28.6	0.5	29	11
A2005	Raphicerus campestris	Raphicerus	Neotragini	22.20000000	-29.00000000	http://data.gbif.org/ws/rest/occurrence/get?key=152338109	34.9	3.6	50	4
A2006	Raphicerus campestris	Raphicerus	Neotragini	22.18300000	-28.98300000	http://data.gbif.org/ws/rest/occurrence/get?key=240344352	35.1	3.9	49	4

A2007	Raphicerus campestris	Raphicerus	Neotragini	24.80000000	-28.80000000	http://data.gbif.org/ws/rest/occurrence/get?key=152338114	32.6	1.7	74	7
A2008	Raphicerus campestris	Raphicerus	Neotragini	24.76700000	-28.75000000	http://data.gbif.org/ws/rest/occurrence/get?key=240344101	32.4	1.4	74	7
A2009	Raphicerus campestris	Raphicerus	Neotragini	27.40000000	-28.60000000	http://data.gbif.org/ws/rest/occurrence/get?key=152338116	28.3	-1.1	101	10
A2010	Raphicerus campestris	Raphicerus	Neotragini	27.35000000	-28.55000000	http://data.gbif.org/ws/rest/occurrence/get?key=240344203	28.4	-1.1	99	10
A2011	Raphicerus campestris	Raphicerus	Neotragini	26.80000000	-28.11700000	http://data.gbif.org/ws/rest/occurrence/get?key=240344168	30.0	0.3	92	9
A2012	Raphicerus campestris	Raphicerus	Neotragini	26.80000000	-28.10000000	http://data.gbif.org/ws/rest/occurrence/get?key=152338115	30.0	0.4	92	9
A2013	Raphicerus campestris	Raphicerus	Neotragini	28.50000000	-27.30000000	http://data.gbif.org/ws/rest/occurrence/get?key=152338110	27.4	-2.5	111	7
A2014	Raphicerus campestris	Raphicerus	Neotragini	28.50000000	-27.28300000	http://data.gbif.org/ws/rest/occurrence/get?key=240343978	27.2	-2.6	111	8
A2015	Raphicerus campestris	Raphicerus	Neotragini	27.10000000	-26.71700000	http://data.gbif.org/ws/rest/occurrence/get?key=240344330	28.6	0.5	109	6
A2016	Raphicerus campestris	Raphicerus	Neotragini	27.10000000	-26.70000000	http://data.gbif.org/ws/rest/occurrence/get?key=152338112	28.6	0.4	109	6
A2017	Raphicerus campestris	Raphicerus	Neotragini	19.85776000	-25.82021000	http://data.gbif.org/ws/rest/occurrence/get?key=79775467	35.1	-0.2	53	0
A2018	Raphicerus campestris	Raphicerus	Neotragini	19.55546000	-25.54575000	http://data.gbif.org/ws/rest/occurrence/get?key=79775468	35.1	0.6	47	0
A2019	Raphicerus campestris	Raphicerus	Neotragini	18.58333000	-25.46667000	http://data.gbif.org/ws/rest/occurrence/get?key=79791743	34.5	2.6	52	0
A2020	Raphicerus campestris	Raphicerus	Neotragini	19.95000000	-25.42000000	http://data.gbif.org/ws/rest/occurrence/get?key=79775522	35.0	0.1	51	1
A2021	Raphicerus campestris	Raphicerus	Neotragini	27.40000000	-24.70000000	http://data.gbif.org/ws/rest/occurrence/get?key=152338113	32.5	4.8	111	2
A2022	Raphicerus campestris	Raphicerus	Neotragini	27.36700000	-24.66700000	http://data.gbif.org/ws/rest/occurrence/get?key=240344160	32.1	4.7	112	2
A2023	Raphicerus campestris	Raphicerus	Neotragini	32.16700000	-24.50000000	http://data.gbif.org/ws/rest/occurrence/get?key=240344131	33.4	8.9	109	12
A2024	Raphicerus campestris	Raphicerus	Neotragini	32.20000000	-24.50000000	http://data.gbif.org/ws/rest/occurrence/get?key=152338131	33.3	9.0	112	13
A2025	Raphicerus campestris	Raphicerus	Neotragini	25.53330000	-24.41670000	http://data.gbif.org/ws/rest/occurrence/get?key=201370586	31.1	2.8	90	3
A2026	Raphicerus campestris	Raphicerus	Neotragini	24.45000000	-23.31670000	http://data.gbif.org/ws/rest/occurrence/get?key=61999495	32.3	4.0	80	1
A2027	Raphicerus campestris	Raphicerus	Neotragini	24.61670000	-23.18330000	http://data.gbif.org/ws/rest/occurrence/get?key=61999488	32.3	4.0	80	1
A2028	Raphicerus campestris	Raphicerus	Neotragini	18.48000000	-22.96000000	http://data.gbif.org/ws/rest/occurrence/get?key=175900774	32.8	2.6	60	0
A2029	Raphicerus campestris	Raphicerus	Neotragini	33.51700000	-22.81700000	http://data.gbif.org/ws/rest/occurrence/get?key=240344017	33.8	12.6	135	3
A2030	Raphicerus campestris	Raphicerus	Neotragini	33.50000000	-22.80000000	http://data.gbif.org/ws/rest/occurrence/get?key=152338130	33.8	12.6	135	3
A2031	Raphicerus campestris	Raphicerus	Neotragini	19.43000000	-22.66000000	http://data.gbif.org/ws/rest/occurrence/get?key=79803105	32.7	2.0	74	1
A2032	Raphicerus campestris	Raphicerus	Neotragini	23.25000000	-22.55000000	http://data.gbif.org/ws/rest/occurrence/get?key=61999496	33.0	4.5	86	0
A2033	Raphicerus campestris	Raphicerus	Neotragini	26.50000000	-22.20000000	http://data.gbif.org/ws/rest/occurrence/get?key=152338171	29.9	3.1	91	0
A2034	Raphicerus campestris	Raphicerus	Neotragini	26.50000000	-22.16700000	http://data.gbif.org/ws/rest/occurrence/get?key=240344252	30.0	3.1	90	0

A2035	Raphicerus campestris	Raphicerus	Neotragini	22.45000000	-22.10000000	http://data.gbif.org/ws/rest/occurrence/get?key=61999487	33.3	4.4	92	0
A2036	Raphicerus campestris	Raphicerus	Neotragini	27.30000000	-21.90000000	http://data.gbif.org/ws/rest/occurrence/get?key=152338169	31.4	4.4	82	0
A2037	Raphicerus campestris	Raphicerus	Neotragini	27.26700000	-21.88300000	http://data.gbif.org/ws/rest/occurrence/get?key=240344062	31.4	4.4	82	0
A2038	Raphicerus campestris	Raphicerus	Neotragini	22.27140000	-21.87360000	http://data.gbif.org/ws/rest/occurrence/get?key=61999489	33.3	4.5	96	0
A2039	Raphicerus campestris	Raphicerus	Neotragini	21.65870000	-21.66670000	http://data.gbif.org/ws/rest/occurrence/get?key=61999493	32.9	3.9	103	0
A2040	Raphicerus campestris	Raphicerus	Neotragini	33.00000000	-21.50000000	http://data.gbif.org/ws/rest/occurrence/get?key=152338129	33.3	9.7	143	2
A2041	Raphicerus campestris	Raphicerus	Neotragini	18.50000000	-21.41700000	http://data.gbif.org/ws/rest/occurrence/get?key=240343885	31.3	3.2	100	0
A2042	Raphicerus campestris	Raphicerus	Neotragini	18.50000000	-21.40000000	http://data.gbif.org/ws/rest/occurrence/get?key=152338120	31.3	3.2	100	0
A2043	Raphicerus campestris	Raphicerus	Neotragini	25.79970000	-20.57880000	http://data.gbif.org/ws/rest/occurrence/get?key=61999492	33.5	5.8	81	0
A2044	Raphicerus campestris	Raphicerus	Neotragini	20.58300000	-20.33300000	http://data.gbif.org/ws/rest/occurrence/get?key=240343966	33.5	5.3	112	0
A2045	Raphicerus campestris	Raphicerus	Neotragini	20.60000000	-20.30000000	http://data.gbif.org/ws/rest/occurrence/get?key=152338122	33.6	5.2	113	0
A2046	Raphicerus campestris	Raphicerus	Neotragini	20.48300000	-20.25000000	http://data.gbif.org/ws/rest/occurrence/get?key=240344143	33.3	5.2	115	0
A2047	Raphicerus campestris	Raphicerus	Neotragini	20.50000000	-20.20000000	http://data.gbif.org/ws/rest/occurrence/get?key=152338121	33.4	5.2	116	0
A2048	Raphicerus campestris	Raphicerus	Neotragini	21.46700000	-20.03300000	http://data.gbif.org/ws/rest/occurrence/get?key=240343972	34.3	5.8	109	0
A2049	Raphicerus campestris	Raphicerus	Neotragini	21.50000000	-20.00000000	http://data.gbif.org/ws/rest/occurrence/get?key=152338177	34.2	5.8	110	0
A2050	Raphicerus campestris	Raphicerus	Neotragini	20.38300000	-19.83300000	http://data.gbif.org/ws/rest/occurrence/get?key=240344205	33.5	5.5	125	0
A2051	Raphicerus campestris	Raphicerus	Neotragini	20.40000000	-19.80000000	http://data.gbif.org/ws/rest/occurrence/get?key=152338227	33.4	5.5	126	0
A2052	Raphicerus campestris	Raphicerus	Neotragini	18.43330000	-19.71670000	http://data.gbif.org/ws/rest/occurrence/get?key=79803106	32.2	6.5	112	0
A2053	Raphicerus campestris	Raphicerus	Neotragini	22.26670000	-19.66670000	http://data.gbif.org/ws/rest/occurrence/get?key=49839261	34.6	6.2	104	0
A2054	Raphicerus campestris	Raphicerus	Neotragini	20.50000000	-19.50000000	http://data.gbif.org/ws/rest/occurrence/get?key=152338226	33.5	5.6	133	0
A2055	Raphicerus campestris	Raphicerus	Neotragini	20.23300000	-19.23300000	http://data.gbif.org/ws/rest/occurrence/get?key=240343911	33.5	5.6	137	0
A2056	Raphicerus campestris	Raphicerus	Neotragini	20.20000000	-19.20000000	http://data.gbif.org/ws/rest/occurrence/get?key=152338224	33.6	5.7	137	0
A2057	Raphicerus campestris	Raphicerus	Neotragini	21.75000000	-18.73300000	http://data.gbif.org/ws/rest/occurrence/get?key=240344102	33.8	5.9	113	0
A2058	Raphicerus campestris	Raphicerus	Neotragini	21.80000000	-18.70000000	http://data.gbif.org/ws/rest/occurrence/get?key=152338173	33.9	6.0	112	0
A2059	Raphicerus campestris	Raphicerus	Neotragini	21.06700000	-18.53300000	http://data.gbif.org/ws/rest/occurrence/get?key=240344225	34.0	6.0	138	0
A2060	Raphicerus campestris	Raphicerus	Neotragini	21.10000000	-18.50000000	http://data.gbif.org/ws/rest/occurrence/get?key=152338176	34.1	6.0	138	0
A2061	Raphicerus campestris	Raphicerus	Neotragini	26.15770000	-18.24380000	http://data.gbif.org/ws/rest/occurrence/get?key=70164572	35.4	7.8	164	0
A2062	Raphicerus campestris	Raphicerus	Neotragini	17.85000000	-15.83330000	http://data.gbif.org/ws/rest/occurrence/get?key=79770787	33.6	5.5	169	0

A2063	Raphicerus campestris	Raphicerus	Neotragini	36.43330000	-3.48333000	http://data.gbif.org/ws/rest/occurrence/get?key=61999905	28.9	12.6	221	4
A2064	Raphicerus campestris	Raphicerus	Neotragini	35.85000000	-3.36000000	http://data.gbif.org/ws/rest/occurrence/get?key=175900515	30.4	14.0	128	1
A2065	Raphicerus campestris	Raphicerus	Neotragini	35.16670000	-3.18333000	http://data.gbif.org/ws/rest/occurrence/get?key=62000012	25.5	11.0	171	1
A2066	Raphicerus campestris	Raphicerus	Neotragini	36.04000000	-2.90000000	http://data.gbif.org/ws/rest/occurrence/get?key=175899547	31.3	14.8	115	0
A2067	Raphicerus campestris	Raphicerus	Neotragini	34.82500000	-2.44167000	http://data.gbif.org/ws/rest/occurrence/get?key=62000029	27.5	13.0	130	13
A2068	Raphicerus campestris	Raphicerus	Neotragini	34.83330000	-2.33333000	http://data.gbif.org/ws/rest/occurrence/get?key=62000028	27.6	13.1	130	15
A2069	Raphicerus campestris	Raphicerus	Neotragini	33.95000000	-2.08333000	http://data.gbif.org/ws/rest/occurrence/get?key=42098818	29.4	15.9	155	8
A2070	Raphicerus campestris	Raphicerus	Neotragini	34.61670000	-2.08333000	http://data.gbif.org/ws/rest/occurrence/get?key=42099064	28.7	14.2	152	17
A2071	Raphicerus campestris	Raphicerus	Neotragini	37.05000000	-1.46667000	http://data.gbif.org/ws/rest/occurrence/get?key=61999398	27.8	10.7	140	5
A2072	Raphicerus campestris	Raphicerus	Neotragini	36.98330000	-1.45000000	http://data.gbif.org/ws/rest/occurrence/get?key=61999394	28.5	11.4	139	6
A2073	Raphicerus campestris	Raphicerus	Neotragini	39.95000000	-1.10000000	http://data.gbif.org/ws/rest/occurrence/get?key=79787376	35.6	19.8	101	6
A2074	Raphicerus campestris	Raphicerus	Neotragini	35.73330000	-0.25000000	http://data.gbif.org/ws/rest/occurrence/get?key=61999401	23.0	6.5	174	35
A2075	Raphicerus campestris	Raphicerus	Neotragini	36.81700000	-0.23300000	http://data.gbif.org/ws/rest/occurrence/get?key=86881642	24.8	5.9	146	35
A2076	Raphicerus melanotis	Raphicerus	Neotragini	25.04000000	-33.52000000	http://data.gbif.org/ws/rest/occurrence/get?key=175900688	28.4	4.1	48	19
A2077	Raphicerus melanotis	Raphicerus	Neotragini	19.05002041	-34.14937050	East, 1989	25.2	5.6	150	30
A2078	Raphicerus melanotis	Raphicerus	Neotragini	19.02757818	-32.51108804	East, 1989	31.6	4.2	67	8
A2079	Raphicerus melanotis	Raphicerus	Neotragini	20.26190058	-34.48600388	East, 1989	26.9	7.8	59	25
A2080	Raphicerus melanotis	Raphicerus	Neotragini	20.71074509	-34.10448605	East, 1989	29.0	5.1	63	33
A2081	Raphicerus melanotis	Raphicerus	Neotragini	23.76288775	-33.90250602	East, 1989	24.1	5.3	96	59
A2082	Raphicerus melanotis	Raphicerus	Neotragini	25.26651685	-33.65564154	East, 1989	26.4	4.2	57	28
A2083	Raphicerus melanotis	Raphicerus	Neotragini	25.35628575	-33.83517934	East, 1989	26.5	6.5	53	27
A2084	Raphicerus melanotis	Raphicerus	Neotragini	26.77014595	-33.43121929	East, 1989	26.4	8.1	71	37
A2085	Raphicerus sharpei	Raphicerus	Neotragini	25.90000000	-18.36000000	http://data.gbif.org/ws/rest/occurrence/get?key=175899869	34.4	6.8	163	0
A2086	Raphicerus sharpei	Raphicerus	Neotragini	24.46670000	-18.16670000	http://data.gbif.org/ws/rest/occurrence/get?key=61999522	35.2	6.1	140	0
A2087	Raphicerus sharpei	Raphicerus	Neotragini	34.40000000	-18.00000000	http://data.gbif.org/ws/rest/occurrence/get?key=152338215	34.6	13.5	229	12
A2088	Raphicerus sharpei	Raphicerus	Neotragini	34.38300000	-17.96700000	http://data.gbif.org/ws/rest/occurrence/get?key=240344152	34.7	13.5	224	11
A2089	Raphicerus sharpei	Raphicerus	Neotragini	24.96670000	-17.83330000	http://data.gbif.org/ws/rest/occurrence/get?key=61999494	35.6	7.3	154	0
A2090	Raphicerus sharpei	Raphicerus	Neotragini	33.56700000	-17.15000000	http://data.gbif.org/ws/rest/occurrence/get?key=240344066	33.9	13.2	184	2

A2091	Raphicerus sharpei	Raphicerus	Neotragini	33.60000000	-17.10000000	http://data.gbif.org/ws/rest/occurrence/get?key=152338213	34.2	13.3	181	2
A2092	Raphicerus sharpei	Raphicerus	Neotragini	33.26700000	-16.83300000	http://data.gbif.org/ws/rest/occurrence/get?key=240344049	35.6	13.2	170	0
A2093	Raphicerus sharpei	Raphicerus	Neotragini	33.30000000	-16.80000000	http://data.gbif.org/ws/rest/occurrence/get?key=152338208	35.7	13.4	169	0
A2094	Raphicerus sharpei	Raphicerus	Neotragini	32.80000000	-16.50000000	http://data.gbif.org/ws/rest/occurrence/get?key=152338205	35.5	12.2	175	1
A2095	Raphicerus sharpei	Raphicerus	Neotragini	32.78300000	-16.48300000	http://data.gbif.org/ws/rest/occurrence/get?key=240344173	35.8	12.3	174	1
A2096	Raphicerus sharpei	Raphicerus	Neotragini	33.60000000	-16.20000000	http://data.gbif.org/ws/rest/occurrence/get?key=152338206	36.6	15.1	169	2
A2097	Raphicerus sharpei	Raphicerus	Neotragini	33.63300000	-16.20000000	http://data.gbif.org/ws/rest/occurrence/get?key=240344180	36.7	15.1	169	2
A2098	Raphicerus sharpei	Raphicerus	Neotragini	34.20000000	-16.00000000	http://data.gbif.org/ws/rest/occurrence/get?key=152338204	35.4	14.5	191	4
A2099	Raphicerus sharpei	Raphicerus	Neotragini	34.16700000	-15.98300000	http://data.gbif.org/ws/rest/occurrence/get?key=240344324	35.3	14.6	193	4
A2100	Raphicerus sharpei	Raphicerus	Neotragini	31.73300000	-15.81700000	http://data.gbif.org/ws/rest/occurrence/get?key=240344343	34.9	10.8	190	0
A2101	Raphicerus sharpei	Raphicerus	Neotragini	31.70000000	-15.80000000	http://data.gbif.org/ws/rest/occurrence/get?key=152338211	34.9	10.8	190	0
A2102	Raphicerus sharpei	Raphicerus	Neotragini	34.50000000	-15.80000000	http://data.gbif.org/ws/rest/occurrence/get?key=152338203	33.8	13.9	204	5
A2103	Raphicerus sharpei	Raphicerus	Neotragini	34.46700000	-15.76700000	http://data.gbif.org/ws/rest/occurrence/get?key=240344018	32.7	13.4	216	6
A2104	Raphicerus sharpei	Raphicerus	Neotragini	33.80000000	-15.70000000	http://data.gbif.org/ws/rest/occurrence/get?key=152338209	36.8	15.1	204	4
A2105	Raphicerus sharpei	Raphicerus	Neotragini	33.80000000	-15.68300000	http://data.gbif.org/ws/rest/occurrence/get?key=240344258	36.8	15.1	205	5
A2106	Raphicerus sharpei	Raphicerus	Neotragini	30.43300000	-15.63300000	http://data.gbif.org/ws/rest/occurrence/get?key=240344269	37.4	12.4	183	0
A2107	Raphicerus sharpei	Raphicerus	Neotragini	30.40000000	-15.60000000	http://data.gbif.org/ws/rest/occurrence/get?key=152338214	37.8	12.6	182	0
A2108	Raphicerus sharpei	Raphicerus	Neotragini	31.40000000	-15.00000000	http://data.gbif.org/ws/rest/occurrence/get?key=152338216	33.5	11.1	253	1
A2109	Raphicerus sharpei	Raphicerus	Neotragini	31.38300000	-14.96700000	http://data.gbif.org/ws/rest/occurrence/get?key=240344188	33.5	11.1	254	1
A2110	Redunca arundinum	Redunca	Reduncini	30.61000000	-28.90000000	http://data.gbif.org/ws/rest/occurrence/get?key=175903136	25.7	3.9	130	12
A2111	Redunca arundinum	Redunca	Reduncini	32.08330000	-28.08330000	http://data.gbif.org/ws/rest/occurrence/get?key=70164675	28.5	10.6	127	28
A2112	Redunca arundinum	Redunca	Reduncini	32.20000000	-26.70000000	http://data.gbif.org/ws/rest/occurrence/get?key=152354005	31.5	9.6	113	9
A2113	Redunca arundinum	Redunca	Reduncini	32.16700000	-26.66700000	http://data.gbif.org/ws/rest/occurrence/get?key=240360499	31.1	9.5	114	9
A2114	Redunca arundinum	Redunca	Reduncini	27.20000000	-25.80000000	http://data.gbif.org/ws/rest/occurrence/get?key=152354037	30.0	2.2	123	8
A2115	Redunca arundinum	Redunca	Reduncini	27.16700000	-25.78300000	http://data.gbif.org/ws/rest/occurrence/get?key=240360515	29.4	2.1	127	8
A2116	Redunca arundinum	Redunca	Reduncini	22.26700000	-19.41700000	http://data.gbif.org/ws/rest/occurrence/get?key=240360550	34.5	6.3	103	0
A2117	Redunca arundinum	Redunca	Reduncini	22.30000000	-19.40000000	http://data.gbif.org/ws/rest/occurrence/get?key=152354016	34.5	6.3	103	0
A2118	Redunca arundinum	Redunca	Reduncini	22.53300000	-19.33300000	http://data.gbif.org/ws/rest/occurrence/get?key=240360494	34.5	6.2	104	0

A2119	Redunca arundinum	Redunca	Reduncini	22.50000000	-19.30000000	http://data.gbif.org/ws/rest/occurrence/get?key=152354017	34.5	6.2	104	0
A2120	Redunca arundinum	Redunca	Reduncini	34.30000000	-19.30000000	http://data.gbif.org/ws/rest/occurrence/get?key=152354031	34.1	13.7	203	11
A2121	Redunca arundinum	Redunca	Reduncini	34.28300000	-19.28300000	http://data.gbif.org/ws/rest/occurrence/get?key=240360548	34.2	13.7	203	10
A2122	Redunca arundinum	Redunca	Reduncini	20.83330000	-18.53330000	http://data.gbif.org/ws/rest/occurrence/get?key=79793565	34.1	6.0	143	0
A2123	Redunca arundinum	Redunca	Reduncini	21.06700000	-18.53300000	http://data.gbif.org/ws/rest/occurrence/get?key=240360547	34.0	6.0	138	0
A2124	Redunca arundinum	Redunca	Reduncini	21.10000000	-18.50000000	http://data.gbif.org/ws/rest/occurrence/get?key=152354014	34.1	6.0	138	0
A2125	Redunca arundinum	Redunca	Reduncini	17.85000000	-15.83330000	http://data.gbif.org/ws/rest/occurrence/get?key=79770775	33.6	5.5	169	0
A2126	Redunca arundinum	Redunca	Reduncini	33.80000000	-15.70000000	http://data.gbif.org/ws/rest/occurrence/get?key=152354033	36.8	15.1	204	4
A2127	Redunca arundinum	Redunca	Reduncini	33.80000000	-15.68300000	http://data.gbif.org/ws/rest/occurrence/get?key=240360495	36.8	15.1	205	5
A2128	Redunca arundinum	Redunca	Reduncini	29.41000000	-15.40000000	http://data.gbif.org/ws/rest/occurrence/get?key=175903071	32.6	8.6	206	0
A2129	Redunca arundinum	Redunca	Reduncini	27.47732266	-3.14160584	Kingdon,1989	28.2	15.7	242	46
A2130	Redunca arundinum	Redunca	Reduncini	31.58655863	-2.95303277	Kingdon,1989	28.3	14.7	173	1
A2131	Redunca arundinum	Redunca	Reduncini	31.72942207	-4.73882580	Kingdon,1989	31.5	13.6	169	0
A2132	Redunca arundinum	Redunca	Reduncini	34.58669092	-7.59609465	Kingdon,1989	29.6	12.0	142	0
A2133	Redunca arundinum	Redunca	Reduncini	30.72937797	-7.13178846	Kingdon,1989	33.2	17.0	210	0
A2134	Redunca arundinum	Redunca	Reduncini	31.76513793	-8.38184358	Kingdon,1989	27.7	9.4	189	0
A2135	Redunca arundinum	Redunca	Reduncini	32.26515998	-8.88186563	Kingdon,1989	29.9	13.1	187	0
A2136	Redunca arundinum	Redunca	Reduncini	38.05112940	-10.88195383	Kingdon,1989	32.8	16.9	217	1
A2137	Redunca arundinum	Redunca	Reduncini	35.33672399	-11.06053313	Kingdon,1989	29.8	12.8	280	2
A2138	Redunca arundinum	Redunca	Reduncini	36.40819981	-9.27474010	Kingdon,1989	29.8	14.9	316	5
A2139	Redunca fulvorufula	Redunca	Reduncini	35.85000000	-3.36000000	http://data.gbif.org/ws/rest/occurrence/get?key=175903070	30.4	14.0	128	1
A2140	Redunca fulvorufula	Redunca	Reduncini	36.35000000	-1.18333000	http://data.gbif.org/ws/rest/occurrence/get?key=42100981	24.5	7.9	183	16
A2141	Redunca fulvorufula	Redunca	Reduncini	36.56670000	-1.05000000	http://data.gbif.org/ws/rest/occurrence/get?key=42100979	27.7	10.3	203	20
A2142	Redunca fulvorufula	Redunca	Reduncini	37.60000000	0.16700000	http://data.gbif.org/ws/rest/occurrence/get?key=86881852	28.5	9.6	367	11
A2143	Redunca fulvorufula	Redunca	Reduncini	36.08330000	0.63333000	http://data.gbif.org/ws/rest/occurrence/get?key=201372420	33.4	15.0	89	22
A2144	Redunca fulvorufula	Redunca	Reduncini	11.53508578	7.07521195	http://www.iucnredlist.org	32.9	15.7	286	2
A2145	Redunca fulvorufula	Redunca	Reduncini	11.30287896	6.75592758	http://www.iucnredlist.org	29.3	13.4	306	4
A2146	Redunca redunca	Redunca	Reduncini	35.83330000	-3.58333000	http://data.gbif.org/ws/rest/occurrence/get?key=42101325	30.2	13.9	153	1

A2147	Redunca redunca	Redunca	Reduncini	34.82500000	-2.44167000	http://data.gbif.org/ws/rest/occurrence/get?key=42100973	27.5	13.0	130	13
A2148	Redunca redunca	Redunca	Reduncini	33.96670000	-1.56667000	http://data.gbif.org/ws/rest/occurrence/get?key=42100976	28.8	16.0	178	21
A2149	Redunca redunca	Redunca	Reduncini	36.65000000	-1.36667000	http://data.gbif.org/ws/rest/occurrence/get?key=42100978	25.0	9.1	189	14
A2150	Redunca redunca	Redunca	Reduncini	36.81670000	-1.28333000	http://data.gbif.org/ws/rest/occurrence/get?key=49841360	27.6	11.1	191	14
A2151	Redunca redunca	Redunca	Reduncini	30.16670000	-0.33330000	http://data.gbif.org/ws/rest/occurrence/get?key=79805119	28.2	14.3	150	32
A2152	Redunca redunca	Redunca	Reduncini	36.81700000	-0.23300000	http://data.gbif.org/ws/rest/occurrence/get?key=86881862	24.8	5.9	146	35
A2153	Redunca redunca	Redunca	Reduncini	29.81670000	-0.15000000	http://data.gbif.org/ws/rest/occurrence/get?key=201372421	30.4	16.6	120	31
A2154	Redunca redunca	Redunca	Reduncini	29.86670000	-0.13333000	http://data.gbif.org/ws/rest/occurrence/get?key=49840488	30.5	16.5	118	28
A2155	Redunca redunca	Redunca	Reduncini	27.86670000	3.70000000	http://data.gbif.org/ws/rest/occurrence/get?key=214171129	33.3	17.3	247	18
A2156	Redunca redunca	Redunca	Reduncini	29.71670000	3.73330000	http://data.gbif.org/ws/rest/occurrence/get?key=214171119	33.1	18.0	224	24
A2157	Redunca redunca	Redunca	Reduncini	34.20000000	5.30000000	http://data.gbif.org/ws/rest/occurrence/get?key=152354029	36.0	20.3	91	8
A2158	Redunca redunca	Redunca	Reduncini	34.16700000	5.33300000	http://data.gbif.org/ws/rest/occurrence/get?key=240360535	36.0	20.3	94	8
A2159	Redunca redunca	Redunca	Reduncini	33.20000000	8.13333000	http://data.gbif.org/ws/rest/occurrence/get?key=49841331	38.7	19.5	196	2
A2160	Redunca redunca	Redunca	Reduncini	-4.51700000	11.88300000	http://data.gbif.org/ws/rest/occurrence/get?key=240360570	37.0	14.3	255	0
A2161	Redunca redunca	Redunca	Reduncini	-4.50000000	11.90000000	http://data.gbif.org/ws/rest/occurrence/get?key=152353988	36.9	14.3	254	0
A2162	Redunca redunca	Redunca	Reduncini	35.00000000	12.33330000	http://data.gbif.org/ws/rest/occurrence/get?key=43166833	40.6	17.1	214	0
A2163	Redunca redunca	Redunca	Reduncini	14.52880632	11.22608287	Waza National Park, Cameroon - http://www.iucnredlist.org	40.2	16.4	223	0
A2164	Redunca redunca	Redunca	Reduncini	14.55532464	11.08465183	Waza National Park, Cameroon - http://www.iucnredlist.org	40.2	16.9	228	0
A2165	Redunca redunca	Redunca	Reduncini	-9.63310245	13.69217898	http://www.iucnredlist.org	39.9	14.8	252	0
A2166	Redunca redunca	Redunca	Reduncini	-13.27569176	13.17972345	http://www.iucnredlist.org	39.4	15.5	243	0
A2167	Sylvicapra grimmia	Sylvicapra	Sylvicapra	25.04000000	-33.52000000	http://data.gbif.org/ws/rest/occurrence/get?key=175947769	28.4	4.1	48	19
A2168	Sylvicapra grimmia	Sylvicapra	Sylvicapra	24.08580000	-32.25000000	http://data.gbif.org/ws/rest/occurrence/get?key=201397249	29.8	1.8	51	12
A2169	Sylvicapra grimmia	Sylvicapra	Sylvicapra	24.55000000	-32.25000000	http://data.gbif.org/ws/rest/occurrence/get?key=62021191	31.3	5.2	49	11
A2170	Sylvicapra grimmia	Sylvicapra	Sylvicapra	25.55000000	-30.63300000	http://data.gbif.org/ws/rest/occurrence/get?key=240418003	31.8	1.8	75	11
A2171	Sylvicapra grimmia	Sylvicapra	Sylvicapra	25.60000000	-30.60000000	http://data.gbif.org/ws/rest/occurrence/get?key=152408759	31.9	1.5	75	11
A2172	Sylvicapra grimmia	Sylvicapra	Sylvicapra	25.53330000	-24.41670000	http://data.gbif.org/ws/rest/occurrence/get?key=201397250	31.1	2.8	90	3
A2173	Sylvicapra grimmia	Sylvicapra	Sylvicapra	24.45000000	-23.31670000	http://data.gbif.org/ws/rest/occurrence/get?key=62020839	32.3	4.0	80	1
A2174	Sylvicapra grimmia	Sylvicapra	Sylvicapra	33.51700000	-22.81700000	http://data.gbif.org/ws/rest/occurrence/get?key=240418007	33.8	12.6	135	3

A2175	Sylvicapra grimmia	Sylvicapra	Sylvicapra	33.50000000	-22.80000000	http://data.gbif.org/ws/rest/occurrence/get?key=152408725	33.8	12.6	135	3
A2176	Sylvicapra grimmia	Sylvicapra	Sylvicapra	34.11700000	-22.03300000	http://data.gbif.org/ws/rest/occurrence/get?key=240417929	31.5	10.4	141	4
A2177	Sylvicapra grimmia	Sylvicapra	Sylvicapra	34.10000000	-22.00000000	http://data.gbif.org/ws/rest/occurrence/get?key=152408726	31.5	10.4	142	4
A2178	Sylvicapra grimmia	Sylvicapra	Sylvicapra	27.30000000	-21.90000000	http://data.gbif.org/ws/rest/occurrence/get?key=152408707	31.4	4.4	82	0
A2179	Sylvicapra grimmia	Sylvicapra	Sylvicapra	27.26700000	-21.88300000	http://data.gbif.org/ws/rest/occurrence/get?key=240417965	31.4	4.4	82	0
A2180	Sylvicapra grimmia	Sylvicapra	Sylvicapra	31.80000000	-21.70000000	http://data.gbif.org/ws/rest/occurrence/get?key=152408762	32.3	10.5	116	4
A2181	Sylvicapra grimmia	Sylvicapra	Sylvicapra	31.75000000	-21.66700000	http://data.gbif.org/ws/rest/occurrence/get?key=240417975	32.2	10.3	120	5
A2182	Sylvicapra grimmia	Sylvicapra	Sylvicapra	33.00000000	-21.50000000	http://data.gbif.org/ws/rest/occurrence/get?key=152408724	33.3	9.7	142	2
A2183	Sylvicapra grimmia	Sylvicapra	Sylvicapra	33.97100000	-21.31300000	http://data.gbif.org/ws/rest/occurrence/get?key=79803029	32.3	11.3	148	6
A2184	Sylvicapra grimmia	Sylvicapra	Sylvicapra	32.40000000	-21.30000000	http://data.gbif.org/ws/rest/occurrence/get?key=152408763	33.5	9.8	118	2
A2185	Sylvicapra grimmia	Sylvicapra	Sylvicapra	32.38300000	-21.28300000	http://data.gbif.org/ws/rest/occurrence/get?key=240417963	33.4	9.8	117	2
A2186	Sylvicapra grimmia	Sylvicapra	Sylvicapra	31.50000000	-21.00000000	http://data.gbif.org/ws/rest/occurrence/get?key=152408753	32.4	7.8	117	4
A2187	Sylvicapra grimmia	Sylvicapra	Sylvicapra	31.53300000	-21.00000000	http://data.gbif.org/ws/rest/occurrence/get?key=240418012	32.4	8.0	116	4
A2188	Sylvicapra grimmia	Sylvicapra	Sylvicapra	22.30000000	-20.70000000	http://data.gbif.org/ws/rest/occurrence/get?key=152408699	34.6	5.8	101	0
A2189	Sylvicapra grimmia	Sylvicapra	Sylvicapra	22.33300000	-20.66700000	http://data.gbif.org/ws/rest/occurrence/get?key=240417967	34.7	5.9	101	0
A2190	Sylvicapra grimmia	Sylvicapra	Sylvicapra	23.06700000	-20.63300000	http://data.gbif.org/ws/rest/occurrence/get?key=240417970	34.1	5.8	105	0
A2191	Sylvicapra grimmia	Sylvicapra	Sylvicapra	23.10000000	-20.60000000	http://data.gbif.org/ws/rest/occurrence/get?key=152408698	34.2	5.9	104	0
A2192	Sylvicapra grimmia	Sylvicapra	Sylvicapra	28.90000000	-20.30000000	http://data.gbif.org/ws/rest/occurrence/get?key=152408764	30.3	5.1	129	0
A2193	Sylvicapra grimmia	Sylvicapra	Sylvicapra	28.93300000	-20.30000000	http://data.gbif.org/ws/rest/occurrence/get?key=240417920	30.4	5.1	128	0
A2194	Sylvicapra grimmia	Sylvicapra	Sylvicapra	20.60000000	-19.80000000	http://data.gbif.org/ws/rest/occurrence/get?key=152408747	33.4	5.3	127	0
A2195	Sylvicapra grimmia	Sylvicapra	Sylvicapra	20.58300000	-19.78300000	http://data.gbif.org/ws/rest/occurrence/get?key=240417972	33.5	5.4	127	0
A2196	Sylvicapra grimmia	Sylvicapra	Sylvicapra	18.08300000	-19.50000000	http://data.gbif.org/ws/rest/occurrence/get?key=240417922	31.9	7.3	130	0
A2197	Sylvicapra grimmia	Sylvicapra	Sylvicapra	18.10000000	-19.50000000	http://data.gbif.org/ws/rest/occurrence/get?key=152408674	31.9	7.3	129	0
A2198	Sylvicapra grimmia	Sylvicapra	Sylvicapra	22.26700000	-19.41700000	http://data.gbif.org/ws/rest/occurrence/get?key=240417996	34.5	6.3	103	0
A2199	Sylvicapra grimmia	Sylvicapra	Sylvicapra	22.30000000	-19.40000000	http://data.gbif.org/ws/rest/occurrence/get?key=152408705	34.5	6.3	103	0
A2200	Sylvicapra grimmia	Sylvicapra	Sylvicapra	22.40000000	-18.80000000	http://data.gbif.org/ws/rest/occurrence/get?key=152408706	34.2	6.1	107	0
A2201	Sylvicapra grimmia	Sylvicapra	Sylvicapra	21.75000000	-18.73300000	http://data.gbif.org/ws/rest/occurrence/get?key=240417980	33.8	5.9	114	0
A2202	Sylvicapra grimmia	Sylvicapra	Sylvicapra	21.80000000	-18.70000000	http://data.gbif.org/ws/rest/occurrence/get?key=152408701	33.9	6.0	112	0

A2203	Sylvicapra grimmia	Sylvicapra	Sylvicapra	34.31360000	-18.69030000	http://data.gbif.org/ws/rest/occurrence/get?key=49871758	35.0	13.1	223	15
A2204	Sylvicapra grimmia	Sylvicapra	Sylvicapra	21.06700000	-18.53300000	http://data.gbif.org/ws/rest/occurrence/get?key=240417979	34.0	6.0	138	0
A2205	Sylvicapra grimmia	Sylvicapra	Sylvicapra	21.10000000	-18.50000000	http://data.gbif.org/ws/rest/occurrence/get?key=152408704	34.1	6.0	138	0
A2206	Sylvicapra grimmia	Sylvicapra	Sylvicapra	33.20000000	-18.10000000	http://data.gbif.org/ws/rest/occurrence/get?key=152408745	33.1	10.8	379	15
A2207	Sylvicapra grimmia	Sylvicapra	Sylvicapra	33.18300000	-18.06700000	http://data.gbif.org/ws/rest/occurrence/get?key=240417898	33.1	10.7	375	13
A2208	Sylvicapra grimmia	Sylvicapra	Sylvicapra	24.96670000	-17.83330000	http://data.gbif.org/ws/rest/occurrence/get?key=62020840	35.6	7.3	154	0
A2209	Sylvicapra grimmia	Sylvicapra	Sylvicapra	25.26670000	-17.78330000	http://data.gbif.org/ws/rest/occurrence/get?key=62020841	35.8	7.7	161	0
A2210	Sylvicapra grimmia	Sylvicapra	Sylvicapra	33.56700000	-17.15000000	http://data.gbif.org/ws/rest/occurrence/get?key=240417978	33.9	13.2	182	1
A2211	Sylvicapra grimmia	Sylvicapra	Sylvicapra	33.60000000	-17.10000000	http://data.gbif.org/ws/rest/occurrence/get?key=152408743	34.2	13.3	181	2
A2212	Sylvicapra grimmia	Sylvicapra	Sylvicapra	33.26700000	-16.83300000	http://data.gbif.org/ws/rest/occurrence/get?key=240417923	35.6	13.2	170	0
A2213	Sylvicapra grimmia	Sylvicapra	Sylvicapra	33.30000000	-16.80000000	http://data.gbif.org/ws/rest/occurrence/get?key=152408742	35.7	13.4	169	0
A2214	Sylvicapra grimmia	Sylvicapra	Sylvicapra	32.80000000	-16.50000000	http://data.gbif.org/ws/rest/occurrence/get?key=152408739	35.4	12.2	175	1
A2215	Sylvicapra grimmia	Sylvicapra	Sylvicapra	32.78300000	-16.48300000	http://data.gbif.org/ws/rest/occurrence/get?key=240418011	35.6	12.2	174	1
A2216	Sylvicapra grimmia	Sylvicapra	Sylvicapra	34.35000000	-16.31700000	http://data.gbif.org/ws/rest/occurrence/get?key=240417966	35.6	14.5	177	4
A2217	Sylvicapra grimmia	Sylvicapra	Sylvicapra	34.40000000	-16.30000000	http://data.gbif.org/ws/rest/occurrence/get?key=152408736	35.4	14.3	179	4
A2218	Sylvicapra grimmia	Sylvicapra	Sylvicapra	33.60000000	-16.20000000	http://data.gbif.org/ws/rest/occurrence/get?key=152408727	36.6	15.1	169	2
A2219	Sylvicapra grimmia	Sylvicapra	Sylvicapra	33.63300000	-16.20000000	http://data.gbif.org/ws/rest/occurrence/get?key=240418022	36.7	15.1	169	2
A2220	Sylvicapra grimmia	Sylvicapra	Sylvicapra	31.73300000	-15.81700000	http://data.gbif.org/ws/rest/occurrence/get?key=240417995	34.9	10.8	189	0
A2221	Sylvicapra grimmia	Sylvicapra	Sylvicapra	31.70000000	-15.80000000	http://data.gbif.org/ws/rest/occurrence/get?key=152408731	34.9	10.8	190	0
A2222	Sylvicapra grimmia	Sylvicapra	Sylvicapra	32.50000000	-15.70000000	http://data.gbif.org/ws/rest/occurrence/get?key=152408729	37.5	13.2	186	0
A2223	Sylvicapra grimmia	Sylvicapra	Sylvicapra	32.53300000	-15.70000000	http://data.gbif.org/ws/rest/occurrence/get?key=240417971	37.6	13.4	186	0
A2224	Sylvicapra grimmia	Sylvicapra	Sylvicapra	33.30000000	-15.60000000	http://data.gbif.org/ws/rest/occurrence/get?key=152408735	37.1	14.7	218	4
A2225	Sylvicapra grimmia	Sylvicapra	Sylvicapra	33.28300000	-15.56700000	http://data.gbif.org/ws/rest/occurrence/get?key=240417918	36.0	14.5	237	4
A2226	Sylvicapra grimmia	Sylvicapra	Sylvicapra	30.80000000	-15.10000000	http://data.gbif.org/ws/rest/occurrence/get?key=152408732	33.3	10.3	260	1
A2227	Sylvicapra grimmia	Sylvicapra	Sylvicapra	35.21670000	-15.06670000	http://www.iucnredlist.org	33.0	13.7	230	4
A2228	Sylvicapra grimmia	Sylvicapra	Sylvicapra	33.60000000	-14.90000000	http://data.gbif.org/ws/rest/occurrence/get?key=152408728	29.9	10.1	253	4
A2229	Sylvicapra grimmia	Sylvicapra	Sylvicapra	33.61700000	-14.90000000	http://data.gbif.org/ws/rest/occurrence/get?key=240417933	30.0	10.1	251	4
A2230	Sylvicapra grimmia	Sylvicapra	Sylvicapra	32.80000000	-14.83300000	http://data.gbif.org/ws/rest/occurrence/get?key=240417981	37.0	12.6	233	2

A2231	Sylvicapra grimmia	Sylvicapra	Sylvicapra	32.80000000	-14.80000000	http://data.gbif.org/ws/rest/occurrence/get?key=152408733	36.9	12.3	235	2
A2232	Sylvicapra grimmia	Sylvicapra	Sylvicapra	28.27320000	-13.25760000	http://data.gbif.org/ws/rest/occurrence/get?key=201397254	32.0	6.2	284	0
A2233	Sylvicapra grimmia	Sylvicapra	Sylvicapra	28.17590000	-13.13330000	http://data.gbif.org/ws/rest/occurrence/get?key=201397252	32.0	5.8	286	0
A2234	Sylvicapra grimmia	Sylvicapra	Sylvicapra	15.18330000	-12.46670000	http://data.gbif.org/ws/rest/occurrence/get?key=62021033	26.1	7.0	247	0
A2235	Sylvicapra grimmia	Sylvicapra	Sylvicapra	14.96000000	-12.39530000	http://data.gbif.org/ws/rest/occurrence/get?key=62021032	28.5	10.3	232	0
A2236	Sylvicapra grimmia	Sylvicapra	Sylvicapra	14.04000000	-5.07000000	http://data.gbif.org/ws/rest/occurrence/get?key=142339823	31.3	17.5	216	0
A2237	Sylvicapra grimmia	Sylvicapra	Sylvicapra	39.83300000	-3.40000000	http://data.gbif.org/ws/rest/occurrence/get?key=86882875	31.5	19.4	206	16
A2238	Sylvicapra grimmia	Sylvicapra	Sylvicapra	29.68330000	-1.28333000	http://data.gbif.org/ws/rest/occurrence/get?key=62020800	23.7	10.6	173	29
A2239	Sylvicapra grimmia	Sylvicapra	Sylvicapra	36.88440000	-1.23380000	http://data.gbif.org/ws/rest/occurrence/get?key=142340537	28.2	11.1	176	14
A2240	Sylvicapra grimmia	Sylvicapra	Sylvicapra	36.56670000	-0.93333000	http://data.gbif.org/ws/rest/occurrence/get?key=42104974	25.6	8.2	227	28
A2241	Sylvicapra grimmia	Sylvicapra	Sylvicapra	36.66670000	-0.50000000	http://data.gbif.org/ws/rest/occurrence/get?key=142341239	18.0	2.5	280	49
A2242	Sylvicapra grimmia	Sylvicapra	Sylvicapra	36.25000000	-0.45000000	http://data.gbif.org/ws/rest/occurrence/get?key=62020739	28.1	8.3	131	29
A2243	Sylvicapra grimmia	Sylvicapra	Sylvicapra	36.63330000	-0.41667000	http://data.gbif.org/ws/rest/occurrence/get?key=62020738	14.9	0.7	243	57
A2244	Sylvicapra grimmia	Sylvicapra	Sylvicapra	35.93330000	-0.33333000	http://data.gbif.org/ws/rest/occurrence/get?key=62021043	25.8	7.3	142	29
A2245	Sylvicapra grimmia	Sylvicapra	Sylvicapra	35.73330000	-0.25000000	http://data.gbif.org/ws/rest/occurrence/get?key=62020737	22.9	6.4	174	35
A2246	Sylvicapra grimmia	Sylvicapra	Sylvicapra	36.81700000	-0.23300000	http://data.gbif.org/ws/rest/occurrence/get?key=86882871	24.8	5.9	146	35
A2247	Sylvicapra grimmia	Sylvicapra	Sylvicapra	38.06000000	0.79000000	http://data.gbif.org/ws/rest/occurrence/get?key=175947811	33.7	15.3	139	1
A2248	Sylvicapra grimmia	Sylvicapra	Sylvicapra	35.01670000	1.01670000	http://data.gbif.org/ws/rest/occurrence/get?key=142339763	28.9	9.3	154	22
A2249	Sylvicapra grimmia	Sylvicapra	Sylvicapra	35.45000000	1.25000000	http://data.gbif.org/ws/rest/occurrence/get?key=62021176	19.0	4.4	208	34
A2250	Sylvicapra grimmia	Sylvicapra	Sylvicapra	28.49000000	1.99000000	http://data.gbif.org/ws/rest/occurrence/get?key=175947765	31.0	17.6	211	68
A2251	Sylvicapra grimmia	Sylvicapra	Sylvicapra	31.23330000	3.01667000	http://data.gbif.org/ws/rest/occurrence/get?key=62020828	34.2	15.8	162	12
A2252	Sylvicapra grimmia	Sylvicapra	Sylvicapra	29.71670000	3.73330000	http://data.gbif.org/ws/rest/occurrence/get?key=214209645	33.1	18.0	224	24
A2253	Sylvicapra grimmia	Sylvicapra	Sylvicapra	32.81670000	4.26667000	http://data.gbif.org/ws/rest/occurrence/get?key=62020960	36.5	19.0	148	7
A2254	Sylvicapra grimmia	Sylvicapra	Sylvicapra	32.56670000	4.40000000	http://data.gbif.org/ws/rest/occurrence/get?key=62020961	37.6	18.7	153	6
A2255	Sylvicapra grimmia	Sylvicapra	Sylvicapra	32.56670000	4.41667000	http://data.gbif.org/ws/rest/occurrence/get?key=62020953	37.6	18.7	153	6
A2256	Sylvicapra grimmia	Sylvicapra	Sylvicapra	-4.70000000	7.80000000	http://data.gbif.org/ws/rest/occurrence/get?key=152408714	35.6	20.5	188	8
A2257	Sylvicapra grimmia	Sylvicapra	Sylvicapra	-4.68300000	7.81700000	http://data.gbif.org/ws/rest/occurrence/get?key=240417913	35.7	20.6	187	8
A2258	Sylvicapra grimmia	Sylvicapra	Sylvicapra	39.45000000	7.91667000	http://data.gbif.org/ws/rest/occurrence/get?key=62020812	15.5	0.7	228	22

A2259	Sylvicapra grimmia	Sylvicapra	Sylvicapra	39.91670000	8.25000000	http://data.gbif.org/ws/rest/occurrence/get?key=62020826	20.5	4.7	215	17
A2260	Sylvicapra grimmia	Sylvicapra	Sylvicapra	18.99373000	9.15536000	http://data.gbif.org/ws/rest/occurrence/get?key=79785536	38.8	16.0	239	0
A2261	Sylvicapra grimmia	Sylvicapra	Sylvicapra	8.41667000	9.60000000	http://data.gbif.org/ws/rest/occurrence/get?key=43352290	31.6	13.7	319	0
A2262	Sylvicapra grimmia	Sylvicapra	Sylvicapra	38.58330000	9.66667000	http://data.gbif.org/ws/rest/occurrence/get?key=62020815	23.2	4.0	302	7
A2263	Sylvicapra grimmia	Sylvicapra	Sylvicapra	46.00000000	10.00000000	http://data.gbif.org/ws/rest/occurrence/get?key=224332628	31.8	12.7	41	1
A2264	Sylvicapra grimmia	Sylvicapra	Sylvicapra	3.00000000	10.40000000	http://data.gbif.org/ws/rest/occurrence/get?key=152408700	37.1	16.8	255	0
A2265	Sylvicapra grimmia	Sylvicapra	Sylvicapra	3.01700000	10.41700000	http://data.gbif.org/ws/rest/occurrence/get?key=240417911	37.2	16.7	257	0
A2266	Sylvicapra grimmia	Sylvicapra	Sylvicapra	37.33330000	11.00000000	http://data.gbif.org/ws/rest/occurrence/get?key=62020503	27.5	7.8	376	7
A2267	Sylvicapra grimmia	Sylvicapra	Sylvicapra	37.13330000	11.03330000	http://data.gbif.org/ws/rest/occurrence/get?key=62020819	24.9	5.5	406	18
A2268	Sylvicapra grimmia	Sylvicapra	Sylvicapra	0.50000000	11.70000000	http://data.gbif.org/ws/rest/occurrence/get?key=152408713	38.9	17.8	229	0
A2269	Sylvicapra grimmia	Sylvicapra	Sylvicapra	-2.13300000	11.80000000	http://data.gbif.org/ws/rest/occurrence/get?key=240417912	38.4	16.0	227	0
A2270	Sylvicapra grimmia	Sylvicapra	Sylvicapra	-2.10000000	11.80000000	http://data.gbif.org/ws/rest/occurrence/get?key=152408718	38.3	16.0	228	0
A2271	Sylvicapra grimmia	Sylvicapra	Sylvicapra	-4.51700000	11.88300000	http://data.gbif.org/ws/rest/occurrence/get?key=240417924	37.0	14.3	255	0
A2272	Sylvicapra grimmia	Sylvicapra	Sylvicapra	-4.50000000	11.90000000	http://data.gbif.org/ws/rest/occurrence/get?key=152408716	36.9	14.3	254	0
A2273	Sylvicapra grimmia	Sylvicapra	Sylvicapra	36.66670000	12.00000000	http://data.gbif.org/ws/rest/occurrence/get?key=62020820	31.0	11.3	360	2
A2274	Sylvicapra grimmia	Sylvicapra	Sylvicapra	0.30000000	12.20000000	http://data.gbif.org/ws/rest/occurrence/get?key=152408719	39.1	16.6	217	0
A2275	Sylvicapra grimmia	Sylvicapra	Sylvicapra	0.26700000	12.25000000	http://data.gbif.org/ws/rest/occurrence/get?key=240417993	39.1	16.5	214	0
A2276	Sylvicapra grimmia	Sylvicapra	Sylvicapra	2.50000000	12.45000000	http://data.gbif.org/ws/rest/occurrence/get?key=201397255	40.2	16.8	197	0
A2277	Sylvicapra grimmia	Sylvicapra	Sylvicapra	36.94480000	12.60000000	http://data.gbif.org/ws/rest/occurrence/get?key=62020502	33.3	13.7	298	1
A2278	Sylvicapra grimmia	Sylvicapra	Sylvicapra	37.43330000	12.60000000	http://data.gbif.org/ws/rest/occurrence/get?key=62020814	29.6	9.8	330	4
A2279	Sylvicapra grimmia	Sylvicapra	Sylvicapra	37.91670000	13.13330000	http://data.gbif.org/ws/rest/occurrence/get?key=62020817	22.4	3.2	303	2
A2280	Sylvicapra grimmia	Sylvicapra	Sylvicapra	38.23330000	13.25000000	http://data.gbif.org/ws/rest/occurrence/get?key=62020816	17.5	-1.5	305	3
A2281	Sylvicapra grimmia	Sylvicapra	Sylvicapra	24.40000000	13.45000000	http://data.gbif.org/ws/rest/occurrence/get?key=62021042	33.2	4.8	197	0
A2282	Sylvicapra grimmia	Sylvicapra	Sylvicapra	38.83330000	15.81670000	http://data.gbif.org/ws/rest/occurrence/get?key=142340427	30.7	10.1	149	25
A2283	Syncerus caffer	Syncerus	Bovini	21.13330000	-25.31670000	http://data.gbif.org/ws/rest/occurrence/get?key=62021501	35.1	1.3	49	1
A2284	Syncerus caffer	Syncerus	Bovini	31.60000000	-24.98330000	http://data.gbif.org/ws/rest/occurrence/get?key=201398390	31.7	7.8	114	9
A2285	Syncerus caffer	Syncerus	Bovini	31.54000000	-24.39000000	http://data.gbif.org/ws/rest/occurrence/get?key=232458520	32.1	8.4	106	7
A2286	Syncerus caffer	Syncerus	Bovini	31.26482000	-24.36363000	http://data.gbif.org/ws/rest/occurrence/get?key=49926835	31.5	8.9	110	6

A2287	Syncerus caffer	Syncerus	Bovini	22.26670000	-19.66670000	http://data.gbif.org/ws/rest/occurrence/get?key=49874554	34.6	6.2	104	0
A2288	Syncerus caffer	Syncerus	Bovini	23.00000000	-19.50000000	http://data.gbif.org/ws/rest/occurrence/get?key=42105252	34.7	6.5	108	0
A2289	Syncerus caffer	Syncerus	Bovini	26.50000000	-19.16670000	http://data.gbif.org/ws/rest/occurrence/get?key=70175695	33.8	5.7	134	0
A2290	Syncerus caffer	Syncerus	Bovini	24.25000000	-18.75000000	http://data.gbif.org/ws/rest/occurrence/get?key=62021502	35.1	6.4	124	0
A2291	Syncerus caffer	Syncerus	Bovini	34.31360000	-18.69030000	http://data.gbif.org/ws/rest/occurrence/get?key=49876254	35.0	13.1	223	15
A2292	Syncerus caffer	Syncerus	Bovini	23.41670000	-17.78830000	http://data.gbif.org/ws/rest/occurrence/get?key=49875377	34.4	5.5	144	0
A2293	Syncerus caffer	Syncerus	Bovini	14.36670000	-11.12120000	http://data.gbif.org/ws/rest/occurrence/get?key=62021601	29.4	14.8	165	0
A2294	Syncerus caffer	Syncerus	Bovini	14.04000000	-5.07000000	http://data.gbif.org/ws/rest/occurrence/get?key=142339798	31.3	17.5	216	0
A2295	Syncerus caffer	Syncerus	Bovini	37.75000000	-3.56000000	http://data.gbif.org/ws/rest/occurrence/get?key=49874044	32.7	15.7	120	6
A2296	Syncerus caffer	Syncerus	Bovini	35.83330000	-3.50278000	http://data.gbif.org/ws/rest/occurrence/get?key=62021730	30.4	14.1	143	1
A2297	Syncerus caffer	Syncerus	Bovini	35.81000000	-3.37000000	http://data.gbif.org/ws/rest/occurrence/get?key=175949540	28.6	12.7	207	2
A2298	Syncerus caffer	Syncerus	Bovini	39.50000000	-3.00000000	http://data.gbif.org/ws/rest/occurrence/get?key=43367705	32.5	19.5	134	20
A2299	Syncerus caffer	Syncerus	Bovini	34.83330000	-2.33333000	http://data.gbif.org/ws/rest/occurrence/get?key=147887566	27.6	13.1	130	15
A2300	Syncerus caffer	Syncerus	Bovini	36.00000000	-2.25000000	http://data.gbif.org/ws/rest/occurrence/get?key=175950414	33.8	16.9	101	3
A2301	Syncerus caffer	Syncerus	Bovini	34.61670000	-2.08333000	http://data.gbif.org/ws/rest/occurrence/get?key=42105251	28.7	14.2	152	17
A2302	Syncerus caffer	Syncerus	Bovini	29.64190000	-1.38806000	http://data.gbif.org/ws/rest/occurrence/get?key=62021461	16.4	5.9	242	39
A2303	Syncerus caffer	Syncerus	Bovini	36.81667000	-1.28333000	http://data.gbif.org/ws/rest/occurrence/get?key=79787212	27.6	11.1	191	14
A2304	Syncerus caffer	Syncerus	Bovini	36.81670000	-1.28333000	http://data.gbif.org/ws/rest/occurrence/get?key=49876489	27.6	11.1	191	14
A2305	Syncerus caffer	Syncerus	Bovini	29.45010000	-1.18290000	http://data.gbif.org/ws/rest/occurrence/get?key=142340580	27.9	14.5	143	42
A2306	Syncerus caffer	Syncerus	Bovini	36.59000000	-0.95000000	http://data.gbif.org/ws/rest/occurrence/get?key=175950009	25.1	7.8	273	31
A2307	Syncerus caffer	Syncerus	Bovini	36.56670000	-0.93333000	http://data.gbif.org/ws/rest/occurrence/get?key=62021401	25.6	8.2	227	28
A2308	Syncerus caffer	Syncerus	Bovini	36.43330000	-0.71667000	http://data.gbif.org/ws/rest/occurrence/get?key=62021718	27.4	8.4	126	34
A2309	Syncerus caffer	Syncerus	Bovini	37.45000000	-0.53333000	http://data.gbif.org/ws/rest/occurrence/get?key=42104985	31.2	9.9	272	20
A2310	Syncerus caffer	Syncerus	Bovini	37.46700000	-0.53300000	http://data.gbif.org/ws/rest/occurrence/get?key=86882854	31.2	10.1	275	19
A2311	Syncerus caffer	Syncerus	Bovini	36.90000000	-0.35000000	http://data.gbif.org/ws/rest/occurrence/get?key=42105287	25.9	6.7	175	32
A2312	Syncerus caffer	Syncerus	Bovini	37.34000000	-0.30000000	http://data.gbif.org/ws/rest/occurrence/get?key=175950129	22.3	5.6	347	45
A2313	Syncerus caffer	Syncerus	Bovini	20.00000000	-0.00027778	http://www.iucnredlist.org	32.6	20.5	225	124
A2314	Syncerus caffer	Syncerus	Bovini	29.36670000	0.36667000	http://data.gbif.org/ws/rest/occurrence/get?key=62021530	27.0	14.3	173	74

A2315	Syncerus caffer	Syncerus	Bovini	29.46670000	0.50000000	http://data.gbif.org/ws/rest/occurrence/get?key=62021409	29.2	16.9	183	64
A2316	Syncerus caffer	Syncerus	Bovini	29.87550000	1.44800000	http://data.gbif.org/ws/rest/occurrence/get?key=142339873	31.2	16.5	154	53
A2317	Syncerus caffer	Syncerus	Bovini	37.06670000	1.90874000	http://data.gbif.org/ws/rest/occurrence/get?key=91598892	32.9	14.1	124	7
A2318	Syncerus caffer	Syncerus	Bovini	27.86670000	3.70000000	http://data.gbif.org/ws/rest/occurrence/get?key=214212748	33.3	17.3	247	18
A2319	Syncerus caffer	Syncerus	Bovini	29.71670000	3.73330000	http://data.gbif.org/ws/rest/occurrence/get?key=214212750	33.1	18.0	224	24
A2320	Syncerus caffer	Syncerus	Bovini	11.23330000	4.75000000	http://data.gbif.org/ws/rest/occurrence/get?key=62021779	32.2	20.0	299	8
A2321	Syncerus caffer	Syncerus	Bovini	-9.43000000	6.42000000	http://data.gbif.org/ws/rest/occurrence/get?key=175950417	32.8	18.9	424	28
A2322	Syncerus caffer	Syncerus	Bovini	19.15000000	9.00000000	http://data.gbif.org/ws/rest/occurrence/get?key=79787215	38.5	15.8	239	0
A2323	Tragelaphus angasii	Tragelaphus	Tragelaphini	30.61000000	-28.90000000	http://data.gbif.org/ws/rest/occurrence/get?key=175984109	25.2	3.5	129	12
A2324	Tragelaphus angasii	Tragelaphus	Tragelaphini	31.90000000	-28.75000000	http://data.gbif.org/ws/rest/occurrence/get?key=62030900	29.9	11.0	143	44
A2325	Tragelaphus angasii	Tragelaphus	Tragelaphini	32.08330000	-28.08330000	http://data.gbif.org/ws/rest/occurrence/get?key=70181349	28.5	10.6	127	28
A2326	Tragelaphus angasii	Tragelaphus	Tragelaphini	31.60000000	-24.98330000	http://data.gbif.org/ws/rest/occurrence/get?key=201432516	31.7	7.8	114	9
A2327	Tragelaphus angasii	Tragelaphus	Tragelaphini	33.97100000	-21.31300000	http://data.gbif.org/ws/rest/occurrence/get?key=79785516	32.3	11.3	148	6
A2328	Tragelaphus angasii	Tragelaphus	Tragelaphini	35.16670000	-16.55000000	http://data.gbif.org/ws/rest/occurrence/get?key=224333388	36.1	13.9	198	7
A2329	Tragelaphus angasii	Tragelaphus	Tragelaphini	29.50699851	-16.11680936	http://www.iucnredlist.org	34.8	10.1	191	0
A2330	Tragelaphus angasii	Tragelaphus	Tragelaphini	34.55810149	-18.72279242	http://www.iucnredlist.org	34.9	14.0	222	14
A2331	Tragelaphus angasii	Tragelaphus	Tragelaphini	36.03804248	-18.59410190	http://www.iucnredlist.org	32.5	16.2	230	16
A2332	Tragelaphus angasii	Tragelaphus	Tragelaphini	32.69208892	-22.68002596	http://www.iucnredlist.org	34.1	11.5	96	1
A2333	Tragelaphus buxtoni	Tragelaphus	Tragelaphini	39.41670000	7.83333000	http://data.gbif.org/ws/rest/occurrence/get?key=62030216	15.8	0.9	226	22
A2334	Tragelaphus buxtoni	Tragelaphus	Tragelaphini	39.45000000	7.91667000	http://data.gbif.org/ws/rest/occurrence/get?key=62030210	15.5	0.7	228	22
A2335	Tragelaphus buxtoni	Tragelaphus	Tragelaphini	39.96670000	8.20000000	http://data.gbif.org/ws/rest/occurrence/get?key=62030262	17.5	2.3	235	19
A2336	Tragelaphus buxtoni	Tragelaphus	Tragelaphini	39.91670000	8.25000000	http://data.gbif.org/ws/rest/occurrence/get?key=62030250	20.5	4.7	215	17
A2337	Tragelaphus buxtoni	Tragelaphus	Tragelaphini	40.88715901	8.99887250	http://www.iucnredlist.org	24.2	7.7	222	10
A2338	Tragelaphus buxtoni	Tragelaphus	Tragelaphini	38.89902126	7.58832828	http://www.iucnredlist.org	22.0	3.6	168	9
A2339	Tragelaphus buxtoni	Tragelaphus	Tragelaphini	39.14221854	7.34513100	http://www.iucnredlist.org	15.5	1.1	199	26
A2340	Tragelaphus buxtoni	Tragelaphus	Tragelaphini	39.03885969	7.41809018	http://www.iucnredlist.org	17.2	2.4	193	23
A2341	Tragelaphus buxtoni	Tragelaphus	Tragelaphini	39.23949745	6.81009699	http://www.iucnredlist.org	17.3	2.3	159	28
A2342	Tragelaphus buxtoni	Tragelaphus	Tragelaphini	40.23660629	6.89521603	http://www.iucnredlist.org	24.7	6.6	189	10

A2343	Tragelaphus buxtoni	Tragelaphus	Tragelaphini	39.72589201	7.07761399	http://www.iucnredlist.org	16.5	1.2	172	26
A2344	Tragelaphus buxtoni	Tragelaphus	Tragelaphini	39.82317092	6.76753746	http://www.iucnredlist.org	14.6	-0.1	165	31
A2345	Tragelaphus derbianus	Tragelaphus	Tragelaphini	29.71670000	3.73330000	http://data.gbif.org/ws/rest/occurrence/get?key=214224511	33.1	18.0	224	24
A2346	Tragelaphus derbianus	Tragelaphus	Tragelaphini	-8.44035037	12.50769622	East, 1990	38.5	15.0	298	0
A2347	Tragelaphus derbianus	Tragelaphus	Tragelaphini	-8.89541341	13.91839166	East, 1990	40.0	13.8	241	0
A2348	Tragelaphus derbianus	Tragelaphus	Tragelaphini	18.04712972	9.70583806	East, 1990	39.5	16.0	248	0
A2349	Tragelaphus derbianus	Tragelaphus	Tragelaphini	18.26875637	10.43116163	East, 1990	39.7	16.1	238	0
A2350	Tragelaphus derbianus	Tragelaphus	Tragelaphini	19.39703748	10.63264040	East, 1990	39.3	15.5	250	0
A2351	Tragelaphus derbianus	Tragelaphus	Tragelaphini	-13.48440182	12.93871330	East, 1990	39.1	15.0	295	0
A2352	Tragelaphus derbianus	Tragelaphus	Tragelaphini	-13.01792901	13.13863021	East, 1990	39.4	16.2	253	0
A2353	Tragelaphus derbianus	Tragelaphus	Tragelaphini	-12.30156005	13.00535227	East, 1990	39.8	17.1	291	0
A2354	Tragelaphus derbianus	Tragelaphus	Tragelaphini	-3.80509101	9.32354902	East, 1990	36.0	18.9	214	4
A2355	Tragelaphus derbianus	Tragelaphus	Tragelaphini	-3.77177153	9.02367364	East, 1990	36.1	19.3	210	5
A2356	Tragelaphus derbianus	Tragelaphus	Tragelaphini	-3.30529872	8.99035415	East, 1990	35.0	18.6	217	5
A2357	Tragelaphus derbianus	Tragelaphus	Tragelaphini	12.10496375	8.29064494	East, 1990	35.7	15.1	249	0
A2358	Tragelaphus derbianus	Tragelaphus	Tragelaphini	12.47147810	8.95703467	East, 1990	34.4	13.1	253	0
A2359	Tragelaphus derbianus	Tragelaphus	Tragelaphini	12.50479759	7.99076956	East, 1990	34.9	14.6	267	0
A2360	Tragelaphus derbianus	Tragelaphus	Tragelaphini	12.72137425	8.15736699	East, 1990	35.9	15.2	267	0
A2361	Tragelaphus derbianus	Tragelaphus	Tragelaphini	13.70429910	8.59052032	East, 1990	37.2	16.0	264	0
A2362	Tragelaphus derbianus	Tragelaphus	Tragelaphini	13.73761859	8.29064494	East, 1990	36.0	15.2	278	0
A2363	Tragelaphus derbianus	Tragelaphus	Tragelaphini	14.63724472	8.72379826	East, 1990	38.1	16.6	253	0
A2364	Tragelaphus derbianus	Tragelaphus	Tragelaphini	14.72054344	8.50722160	East, 1990	37.7	16.3	266	0
A2365	Tragelaphus derbianus	Tragelaphus	Tragelaphini	19.36629333	8.77717832	East, 1990	38.1	15.8	240	0
A2366	Tragelaphus derbianus	Tragelaphus	Tragelaphini	19.81793288	8.37572094	East, 1990	37.4	15.9	238	0
A2367	Tragelaphus derbianus	Tragelaphus	Tragelaphini	21.12266935	9.59682047	East, 1990	39.3	15.2	247	0
A2368	Tragelaphus derbianus	Tragelaphus	Tragelaphini	21.69140064	9.31245482	East, 1990	38.8	14.4	235	0
A2369	Tragelaphus derbianus	Tragelaphus	Tragelaphini	23.43104928	9.51318351	East, 1990	38.0	12.0	206	0
A2370	Tragelaphus derbianus	Tragelaphus	Tragelaphini	24.61869402	8.04117313	East, 1990	35.4	12.3	252	1

A2371	Tragelaphus derbianus	Tragelaphus	Tragelaphini	29.33581821	3.97641717	East, 1990	33.3	17.8	224	21
A2372	Tragelaphus eurycerus	Tragelaphus	Tragelaphini	37.34000000	-2.94000000	http://data.gbif.org/ws/rest/occurrence/get?key=175983872	21.5	6.3	232	8
A2373	Tragelaphus eurycerus	Tragelaphus	Tragelaphini	36.56670000	-0.93333000	http://data.gbif.org/ws/rest/occurrence/get?key=42108292	25.6	8.2	236	29
A2374	Tragelaphus eurycerus	Tragelaphus	Tragelaphini	36.83333000	-0.45000000	http://data.gbif.org/ws/rest/occurrence/get?key=79787303	23.8	5.8	276	52
A2375	Tragelaphus eurycerus	Tragelaphus	Tragelaphini	27.86670000	3.70000000	http://data.gbif.org/ws/rest/occurrence/get?key=214228568	33.3	17.3	247	18
A2376	Tragelaphus eurycerus	Tragelaphus	Tragelaphini	23.91670000	4.95000000	http://data.gbif.org/ws/rest/occurrence/get?key=49882321	32.0	17.7	254	17
A2377	Tragelaphus eurycerus	Tragelaphus	Tragelaphini	35.88579941	-0.39327068	http://www.iucnredlist.org	23.2	6.5	166	35
A2378	Tragelaphus eurycerus	Tragelaphus	Tragelaphini	37.39211069	-0.17549074	http://www.iucnredlist.org	16.0	1.2	301	59
A2379	Tragelaphus eurycerus	Tragelaphus	Tragelaphini	-7.06144824	5.98747576	Tai National Park, Ivory Coast - http://www.iucnredlist.org	32.6	20.3	266	22
A2380	Tragelaphus eurycerus	Tragelaphus	Tragelaphini	14.90644725	0.86475602	Odzala National Park, Congo - http://www.iucnredlist.org	30.6	18.0	259	37
A2381	Tragelaphus eurycerus	Tragelaphus	Tragelaphini	-8.61018285	5.52694583	http://www.iucnredlist.org	32.6	19.9	440	79
A2382	Tragelaphus eurycerus	Tragelaphus	Tragelaphini	15.70111236	2.56760984	http://www.iucnredlist.org	30.8	17.5	223	41
A2383	Tragelaphus eurycerus	Tragelaphus	Tragelaphini	16.60930107	2.62437164	http://www.iucnredlist.org	31.2	17.9	219	37
A2384	Tragelaphus imberbis	Tragelaphus	Tragelaphini	35.83330000	-3.50278000	http://data.gbif.org/ws/rest/occurrence/get?key=62030851	30.4	14.1	143	1
A2385	Tragelaphus imberbis	Tragelaphus	Tragelaphini	38.13330000	-3.40000000	http://data.gbif.org/ws/rest/occurrence/get?key=42108284	29.8	14.0	135	10
A2386	Tragelaphus imberbis	Tragelaphus	Tragelaphini	35.81000000	-3.37000000	http://data.gbif.org/ws/rest/occurrence/get?key=175983258	28.6	12.7	207	2
A2387	Tragelaphus imberbis	Tragelaphus	Tragelaphini	37.35000000	-3.06667000	http://data.gbif.org/ws/rest/occurrence/get?key=48245260	1.6	-10.4	335	68
A2388	Tragelaphus imberbis	Tragelaphus	Tragelaphini	36.04000000	-2.90000000	http://data.gbif.org/ws/rest/occurrence/get?key=175983652	31.3	14.8	115	0
A2389	Tragelaphus imberbis	Tragelaphus	Tragelaphini	36.98330000	-1.45000000	http://data.gbif.org/ws/rest/occurrence/get?key=62030269	28.5	11.4	139	6
A2390	Tragelaphus imberbis	Tragelaphus	Tragelaphini	35.56667000	1.40000000	http://data.gbif.org/ws/rest/occurrence/get?key=79785544	32.0	14.3	129	18
A2391	Tragelaphus imberbis	Tragelaphus	Tragelaphini	37.21120000	1.61457000	http://data.gbif.org/ws/rest/occurrence/get?key=62030801	31.9	12.3	150	7
A2392	Tragelaphus imberbis	Tragelaphus	Tragelaphini	32.56670000	4.41667000	http://data.gbif.org/ws/rest/occurrence/get?key=62030501	37.6	18.7	153	6
A2393	Tragelaphus imberbis	Tragelaphus	Tragelaphini	40.70000000	7.75000000	http://data.gbif.org/ws/rest/occurrence/get?key=62030218	29.9	11.5	165	5
A2394	Tragelaphus imberbis	Tragelaphus	Tragelaphini	41.03330000	7.83333000	http://data.gbif.org/ws/rest/occurrence/get?key=62030224	29.3	11.3	166	6
A2395	Tragelaphus imberbis	Tragelaphus	Tragelaphini	39.96670000	8.20000000	http://data.gbif.org/ws/rest/occurrence/get?key=62030262	17.5	2.3	230	18
A2396	Tragelaphus imberbis	Tragelaphus	Tragelaphini	40.06670000	8.83333000	http://data.gbif.org/ws/rest/occurrence/get?key=62030221	35.3	13.0	137	7
A2397	Tragelaphus imberbis	Tragelaphus	Tragelaphini	43.91910000	9.61263000	http://data.gbif.org/ws/rest/occurrence/get?key=62030170	29.9	10.2	85	2
A2398	Tragelaphus imberbis	Tragelaphus	Tragelaphini	44.71670000	9.90000000	http://data.gbif.org/ws/rest/occurrence/get?key=62030164	33.7	13.2	39	2

A2399	Tragelaphus imberbis	Tragelaphus	Tragelaphini	44.78330000	10.00000000	http://data.gbif.org/ws/rest/occurrence/get?key=62030163	35.5	14.9	26	2
A2400	Tragelaphus imberbis	Tragelaphus	Tragelaphini	36.39579931	-7.54571465	http://www.iucnredlist.org	31.0	16.0	251	6
A2401	Tragelaphus imberbis	Tragelaphus	Tragelaphini	36.96850649	-7.29428223	http://www.iucnredlist.org	30.5	15.8	206	5
A2402	Tragelaphus imberbis	Tragelaphus	Tragelaphini	38.58884875	-5.70187690	http://www.iucnredlist.org	32.9	17.9	190	36
A2403	Tragelaphus oryx	Tragelaphus	Tragelaphini	22.53430000	-22.26910000	http://data.gbif.org/ws/rest/occurrence/get?key=62028952	33.2	4.4	90	0
A2404	Tragelaphus oryx	Tragelaphus	Tragelaphini	22.45000000	-22.10000000	http://data.gbif.org/ws/rest/occurrence/get?key=62028239	33.3	4.4	92	0
A2405	Tragelaphus oryx	Tragelaphus	Tragelaphini	26.50000000	-19.16670000	http://data.gbif.org/ws/rest/occurrence/get?key=70179921	33.8	5.7	134	0
A2406	Tragelaphus oryx	Tragelaphus	Tragelaphini	24.25000000	-18.75000000	http://data.gbif.org/ws/rest/occurrence/get?key=62028241	35.1	6.4	124	0
A2407	Tragelaphus oryx	Tragelaphus	Tragelaphini	24.35000000	-18.71670000	http://data.gbif.org/ws/rest/occurrence/get?key=62028242	35.1	6.4	126	0
A2408	Tragelaphus oryx	Tragelaphus	Tragelaphini	36.91670000	-7.08333000	http://data.gbif.org/ws/rest/occurrence/get?key=62028954	31.3	15.8	183	8
A2409	Tragelaphus oryx	Tragelaphus	Tragelaphini	38.13330000	-3.40000000	http://data.gbif.org/ws/rest/occurrence/get?key=42108284	29.7	13.9	135	10
A2410	Tragelaphus oryx	Tragelaphus	Tragelaphini	35.81000000	-3.37000000	http://data.gbif.org/ws/rest/occurrence/get?key=175983258	28.6	12.7	207	2
A2411	Tragelaphus oryx	Tragelaphus	Tragelaphini	36.04000000	-2.90000000	http://data.gbif.org/ws/rest/occurrence/get?key=175983652	31.3	14.8	116	0
A2412	Tragelaphus oryx	Tragelaphus	Tragelaphini	34.82500000	-2.44167000	http://data.gbif.org/ws/rest/occurrence/get?key=62028987	27.5	13.0	130	13
A2413	Tragelaphus oryx	Tragelaphus	Tragelaphini	34.83330000	-2.33333000	http://data.gbif.org/ws/rest/occurrence/get?key=200587770	27.6	13.1	130	15
A2414	Tragelaphus oryx	Tragelaphus	Tragelaphini	33.95000000	-2.08333000	http://data.gbif.org/ws/rest/occurrence/get?key=42106090	29.4	15.9	155	8
A2415	Tragelaphus oryx	Tragelaphus	Tragelaphini	34.61670000	-2.08333000	http://data.gbif.org/ws/rest/occurrence/get?key=42106564	28.7	14.2	152	17
A2416	Tragelaphus oryx	Tragelaphus	Tragelaphini	36.88330000	-1.41667000	http://data.gbif.org/ws/rest/occurrence/get?key=62028160	28.2	11.3	149	9
A2417	Tragelaphus oryx	Tragelaphus	Tragelaphini	35.46700000	-1.21700000	http://data.gbif.org/ws/rest/occurrence/get?key=86884115	26.3	9.1	175	27
A2418	Tragelaphus oryx	Tragelaphus	Tragelaphini	36.00800000	-1.00833330	http://data.gbif.org/ws/rest/occurrence/get?key=328449761	25.1	7.5	154	26
A2419	Tragelaphus oryx	Tragelaphus	Tragelaphini	38.20000000	0.31667000	http://data.gbif.org/ws/rest/occurrence/get?key=62028247	33.5	14.9	171	1
A2420	Tragelaphus oryx	Tragelaphus	Tragelaphini	36.08330000	0.63333000	http://data.gbif.org/ws/rest/occurrence/get?key=201410166	33.4	15.0	89	21
A2421	Tragelaphus oryx	Tragelaphus	Tragelaphini	37.06670000	1.90874000	http://data.gbif.org/ws/rest/occurrence/get?key=91598891	32.9	14.1	125	7
A2422	Tragelaphus oryx	Tragelaphus	Tragelaphini	16.81988149	-18.62048487	Etosha National Park, Namibia - http://www.iucnredlist.org	34.5	7.0	117	0
A2423	Tragelaphus oryx	Tragelaphus	Tragelaphini	20.23790033	-24.31718293	Kgalagadi Transfrontier Park, South Africa - http://www.iucnredlist.org	34.0	1.5	50	0
A2424	Tragelaphus oryx	Tragelaphus	Tragelaphini	21.27042685	-25.20729200	Kgalagadi Transfrontier Park, South Africa - http://www.iucnredlist.org	35.0	1.5	51	1
A2425	Tragelaphus oryx	Tragelaphus	Tragelaphini	20.34471341	-25.77696181	Kgalagadi Transfrontier Park, South Africa - http://www.iucnredlist.org	35.4	0.0	49	1
A2426	Tragelaphus scriptus	Tragelaphus	Tragelaphini	32.05000000	3.60000000	http://data.gbif.org/ws/rest/occurrence/get?key=62030502	37.1	18.8	158	8

A2427	Tragelaphus scriptus	Tragelaphus	Tragelaphini	27.86670000	3.70000000	http://data.gbif.org/ws/rest/occurrence/get?key=214228568	33.3	17.3	247	18
A2428	Tragelaphus scriptus	Tragelaphus	Tragelaphini	29.71670000	3.73330000	http://data.gbif.org/ws/rest/occurrence/get?key=214224511	33.1	18.0	224	24
A2429	Tragelaphus scriptus	Tragelaphus	Tragelaphini	-0.98333000	5.91667000	http://data.gbif.org/ws/rest/occurrence/get?key=62030388	32.4	20.8	241	27
A2430	Tragelaphus scriptus	Tragelaphus	Tragelaphini	-8.10000000	6.20000000	http://data.gbif.org/ws/rest/occurrence/get?key=152450621	34.1	19.1	344	20
A2431	Tragelaphus scriptus	Tragelaphus	Tragelaphini	-8.13300000	6.21700000	http://data.gbif.org/ws/rest/occurrence/get?key=240459452	34.3	19.2	345	20
A2432	Tragelaphus scriptus	Tragelaphus	Tragelaphini	-5.60000000	7.00000000	http://data.gbif.org/ws/rest/occurrence/get?key=152450805	32.5	18.5	202	19
A2433	Tragelaphus scriptus	Tragelaphus	Tragelaphini	-5.61700000	7.05000000	http://data.gbif.org/ws/rest/occurrence/get?key=240459459	33.8	19.6	207	18
A2434	Tragelaphus scriptus	Tragelaphus	Tragelaphini	39.45000000	7.91667000	http://data.gbif.org/ws/rest/occurrence/get?key=62030210	15.5	0.7	228	22
A2435	Tragelaphus scriptus	Tragelaphus	Tragelaphini	39.96670000	8.20000000	http://data.gbif.org/ws/rest/occurrence/get?key=62030262	17.5	2.3	230	18
A2436	Tragelaphus scriptus	Tragelaphus	Tragelaphini	39.91670000	8.25000000	http://data.gbif.org/ws/rest/occurrence/get?key=62030250	20.5	4.7	212	17
A2437	Tragelaphus scriptus	Tragelaphus	Tragelaphini	40.25000000	8.96667000	http://data.gbif.org/ws/rest/occurrence/get?key=62030229	35.9	13.6	136	9
A2438	Tragelaphus scriptus	Tragelaphus	Tragelaphini	-7.51700000	9.41700000	http://data.gbif.org/ws/rest/occurrence/get?key=240459444	35.4	14.6	317	4
A2439	Tragelaphus scriptus	Tragelaphus	Tragelaphini	36.28330000	12.83330000	http://data.gbif.org/ws/rest/occurrence/get?key=62030236	39.9	18.4	236	0
A2440	Tragelaphus s. sylvaticus	Tragelaphus	Tragelaphini	31.60000000	-24.98330000	http://data.gbif.org/ws/rest/occurrence/get?key=201432516	31.7	7.8	114	9
A2441	Tragelaphus s. sylvaticus	Tragelaphus	Tragelaphini	27.00000000	-23.66670000	http://data.gbif.org/ws/rest/occurrence/get?key=43517720	33.1	3.2	82	2
A2442	Tragelaphus s. sylvaticus	Tragelaphus	Tragelaphini	23.74500000	-20.29380000	http://data.gbif.org/ws/rest/occurrence/get?key=49882282	34.6	6.5	103	0
A2443	Tragelaphus s. sylvaticus	Tragelaphus	Tragelaphini	34.70000000	-19.60000000	http://data.gbif.org/ws/rest/occurrence/get?key=152450766	32.8	15.0	231	19
A2444	Tragelaphus s. sylvaticus	Tragelaphus	Tragelaphini	34.73300000	-19.58300000	http://data.gbif.org/ws/rest/occurrence/get?key=240459466	32.6	15.0	234	19
A2445	Tragelaphus s. sylvaticus	Tragelaphus	Tragelaphini	33.48300000	-19.11700000	http://data.gbif.org/ws/rest/occurrence/get?key=240459450	30.5	11.1	231	17
A2446	Tragelaphus s. sylvaticus	Tragelaphus	Tragelaphini	33.50000000	-19.10000000	http://data.gbif.org/ws/rest/occurrence/get?key=152450765	30.8	11.1	232	17
A2447	Tragelaphus s. sylvaticus	Tragelaphus	Tragelaphini	34.31360000	-18.69030000	http://data.gbif.org/ws/rest/occurrence/get?key=49882340	35.0	13.1	223	15
A2448	Tragelaphus s. sylvaticus	Tragelaphus	Tragelaphini	24.46670000	-18.16670000	http://data.gbif.org/ws/rest/occurrence/get?key=62030319	35.2	6.1	140	0
A2449	Tragelaphus s. sylvaticus	Tragelaphus	Tragelaphini	24.96670000	-17.83330000	http://data.gbif.org/ws/rest/occurrence/get?key=62030306	35.6	7.3	154	0
A2450	Tragelaphus s. sylvaticus	Tragelaphus	Tragelaphini	32.80000000	-16.50000000	http://data.gbif.org/ws/rest/occurrence/get?key=152450658	35.4	12.2	175	1
A2451	Tragelaphus s. sylvaticus	Tragelaphus	Tragelaphini	32.78300000	-16.48300000	http://data.gbif.org/ws/rest/occurrence/get?key=240459479	35.6	12.2	174	1
A2452	Tragelaphus s. sylvaticus	Tragelaphus	Tragelaphini	33.60000000	-16.20000000	http://data.gbif.org/ws/rest/occurrence/get?key=152450761	36.6	15.0	169	2
A2453	Tragelaphus s. sylvaticus	Tragelaphus	Tragelaphini	33.63300000	-16.20000000	http://data.gbif.org/ws/rest/occurrence/get?key=240459482	36.7	15.0	168	2
A2454	Tragelaphus s. sylvaticus	Tragelaphus	Tragelaphini	34.50000000	-15.80000000	http://data.gbif.org/ws/rest/occurrence/get?key=152450764	33.8	13.9	204	5

A2455	Tragelaphus s. sylvaticus	Tragelaphus	Tragelaphini	34.46700000	-15.76700000	http://data.gbif.org/ws/rest/occurrence/get?key=240459453	32.7	13.4	216	6
A2456	Tragelaphus s. sylvaticus	Tragelaphus	Tragelaphini	33.38300000	-14.43300000	http://data.gbif.org/ws/rest/occurrence/get?key=240459463	30.1	8.3	243	2
A2457	Tragelaphus s. sylvaticus	Tragelaphus	Tragelaphini	33.40000000	-14.40000000	http://data.gbif.org/ws/rest/occurrence/get?key=152450762	30.6	8.4	239	2
A2458	Tragelaphus s. sylvaticus	Tragelaphus	Tragelaphini	31.50000000	-13.16667000	http://data.gbif.org/ws/rest/occurrence/get?key=52180927	35.8	10.8	220	0
A2459	Tragelaphus s. sylvaticus	Tragelaphus	Tragelaphini	39.83330000	-1.83330000	http://data.gbif.org/ws/rest/occurrence/get?key=164443446	34.5	19.7	104	12
A2460	Tragelaphus s. sylvaticus	Tragelaphus	Tragelaphini	29.43000000	-1.48000000	http://data.gbif.org/ws/rest/occurrence/get?key=142341601	15.1	5.0	255	42
A2461	Tragelaphus s. sylvaticus	Tragelaphus	Tragelaphini	29.65000000	-1.36670000	http://data.gbif.org/ws/rest/occurrence/get?key=62030926	19.5	8.1	226	33
A2462	Tragelaphus s. sylvaticus	Tragelaphus	Tragelaphini	29.68330000	-1.28333000	http://data.gbif.org/ws/rest/occurrence/get?key=62030861	23.7	10.6	173	29
A2463	Tragelaphus s. sylvaticus	Tragelaphus	Tragelaphini	35.46700000	-1.21700000	http://data.gbif.org/ws/rest/occurrence/get?key=86884115	26.3	9.1	174	27
A2464	Tragelaphus s. sylvaticus	Tragelaphus	Tragelaphini	29.45010000	-1.18290000	http://data.gbif.org/ws/rest/occurrence/get?key=142341588	28.1	14.8	139	41
A2465	Tragelaphus s. sylvaticus	Tragelaphus	Tragelaphini	36.56670000	-0.93333000	http://data.gbif.org/ws/rest/occurrence/get?key=42108292	25.6	8.2	227	28
A2466	Tragelaphus s. sylvaticus	Tragelaphus	Tragelaphini	31.61670000	-0.60000000	http://data.gbif.org/ws/rest/occurrence/get?key=62030207	27.9	13.9	192	27
A2467	Tragelaphus s. sylvaticus	Tragelaphus	Tragelaphini	36.90000000	-0.31667000	http://data.gbif.org/ws/rest/occurrence/get?key=79803032	25.8	6.7	156	29
A2468	Tragelaphus s. sylvaticus	Tragelaphus	Tragelaphini	37.10000000	-0.30000000	http://data.gbif.org/ws/rest/occurrence/get?key=152450737	25.2	6.9	204	35
A2469	Tragelaphus s. sylvaticus	Tragelaphus	Tragelaphini	37.11700000	-0.28300000	http://data.gbif.org/ws/rest/occurrence/get?key=240459476	24.7	6.6	204	36
A2470	Tragelaphus s. sylvaticus	Tragelaphus	Tragelaphini	36.81700000	-0.23300000	http://data.gbif.org/ws/rest/occurrence/get?key=86884122	24.8	5.9	151	36
A2471	Tragelaphus s. sylvaticus	Tragelaphus	Tragelaphini	29.86670000	-0.13333000	http://data.gbif.org/ws/rest/occurrence/get?key=49881891	30.5	16.5	118	28
A2472	Tragelaphus s. sylvaticus	Tragelaphus	Tragelaphini	36.85000000	2.13333000	http://data.gbif.org/ws/rest/occurrence/get?key=79785537	22.9	6.2	150	27
A2473	Tragelaphus spekii	Tragelaphus	Tragelaphini	23.00000000	-19.00000000	http://data.gbif.org/ws/rest/occurrence/get?key=43517345	34.6	6.2	111	0
A2474	Tragelaphus spekii	Tragelaphus	Tragelaphini	23.41670000	-18.95900000	http://data.gbif.org/ws/rest/occurrence/get?key=49884254	34.7	6.3	116	0
A2475	Tragelaphus spekii	Tragelaphus	Tragelaphini	22.25000000	-18.83300000	http://data.gbif.org/ws/rest/occurrence/get?key=240459441	34.1	6.1	105	0
A2476	Tragelaphus spekii	Tragelaphus	Tragelaphini	22.20000000	-18.80000000	http://data.gbif.org/ws/rest/occurrence/get?key=152450732	34.1	6.1	105	0
A2477	Tragelaphus spekii	Tragelaphus	Tragelaphini	21.80000000	-18.41710000	http://data.gbif.org/ws/rest/occurrence/get?key=49882541	33.7	6.0	127	0
A2478	Tragelaphus spekii	Tragelaphus	Tragelaphini	29.86670000	-1.30000000	http://data.gbif.org/ws/rest/occurrence/get?key=62030202	22.2	8.9	165	16
A2479	Tragelaphus spekii	Tragelaphus	Tragelaphini	-15.17998694	13.67091633	http://www.iucnredlist.org	39.4	15.1	216	0
A2480	Tragelaphus spekii	Tragelaphus	Tragelaphini	-16.19027667	13.07159192	http://www.iucnredlist.org	35.8	15.1	335	0
A2481	Tragelaphus spekii	Tragelaphus	Tragelaphini	-15.06012206	11.34211289	http://www.iucnredlist.org	32.5	19.6	736	0
A2482	Tragelaphus spekii	Tragelaphus	Tragelaphini	30.61801716	8.88692634	http://www.iucnredlist.org	37.7	18.5	177	0

A2483	Tragelaphus spekii	Tragelaphus	Tragelaphini	15.53443239	13.21753374	http://www.iucnredlist.org	41.8	15.0	143	0
A2484	Tragelaphus spekii	Tragelaphus	Tragelaphini	13.39372967	13.14472073	http://www.iucnredlist.org	39.0	12.4	142	0
A2485	Tragelaphus spekii	Tragelaphus	Tragelaphini	15.77495517	2.38789789	Lobeke National Park, Cameroon - http://www.iucnredlist.org	31.4	18.4	224	42
A2486	Tragelaphus spekii	Tragelaphus	Tragelaphini	13.01836376	3.30317238	Dja Wildlife Reserve, Cameroon - http://www.iucnredlist.org	29.6	17.9	291	30
A2487	Tragelaphus spekii	Tragelaphus	Tragelaphini	23.06408011	5.19944404	Bangassou National Park, Central African Republic	33.4	16.4	233	18
A2488	Tragelaphus spekii	Tragelaphus	Tragelaphini	30.13265363	-12.05796841	Bangweulu Game Reserve, Zambia - http://www.iucnredlist.org	31.0	9.2	286	0
A2489	Tragelaphus spekii	Tragelaphus	Tragelaphini	22.78711842	-19.49905279	Okawango Delta Wildlife Menagement Area, Botswana	34.6	6.4	106	0
A2490	Tragelaphus strepsiceros	Tragelaphus	Tragelaphini	31.52207000	-25.09963000	http://data.gbif.org/ws/rest/occurrence/get?key=49926818	31.1	8.3	121	9
A2491	Tragelaphus strepsiceros	Tragelaphus	Tragelaphini	31.60000000	-24.98330000	http://data.gbif.org/ws/rest/occurrence/get?key=201432516	31.7	7.8	114	9
A2492	Tragelaphus strepsiceros	Tragelaphus	Tragelaphini	31.26482000	-24.36363000	http://data.gbif.org/ws/rest/occurrence/get?key=49926834	31.5	8.9	110	6
A2493	Tragelaphus strepsiceros	Tragelaphus	Tragelaphini	31.06670000	-23.73330000	http://data.gbif.org/ws/rest/occurrence/get?key=201432514	32.0	9.1	97	4
A2494	Tragelaphus strepsiceros	Tragelaphus	Tragelaphini	23.25000000	-22.55000000	http://data.gbif.org/ws/rest/occurrence/get?key=62030302	33.0	4.5	86	0
A2495	Tragelaphus strepsiceros	Tragelaphus	Tragelaphini	31.66670000	-21.05000000	http://data.gbif.org/ws/rest/occurrence/get?key=70181332	32.5	8.5	120	3
A2496	Tragelaphus strepsiceros	Tragelaphus	Tragelaphini	17.08580000	-20.80860000	http://data.gbif.org/ws/rest/occurrence/get?key=121604472	31.6	4.4	98	0
A2497	Tragelaphus strepsiceros	Tragelaphus	Tragelaphini	23.74500000	-20.29380000	http://data.gbif.org/ws/rest/occurrence/get?key=49882282	34.6	6.5	103	0
A2498	Tragelaphus strepsiceros	Tragelaphus	Tragelaphini	20.60000000	-20.00000000	http://data.gbif.org/ws/rest/occurrence/get?key=152450785	33.4	5.3	122	0
A2499	Tragelaphus strepsiceros	Tragelaphus	Tragelaphini	20.60000000	-19.96700000	http://data.gbif.org/ws/rest/occurrence/get?key=240459471	33.4	5.3	122	0
A2500	Tragelaphus strepsiceros	Tragelaphus	Tragelaphini	20.38300000	-19.83300000	http://data.gbif.org/ws/rest/occurrence/get?key=240459468	33.5	5.4	125	0
A2501	Tragelaphus strepsiceros	Tragelaphus	Tragelaphini	20.40000000	-19.80000000	http://data.gbif.org/ws/rest/occurrence/get?key=152450789	33.4	5.5	126	0
A2502	Tragelaphus strepsiceros	Tragelaphus	Tragelaphini	23.01130000	-19.60010000	http://data.gbif.org/ws/rest/occurrence/get?key=62030869	34.7	6.6	108	0
A2503	Tragelaphus strepsiceros	Tragelaphus	Tragelaphini	22.94370000	-19.53620000	http://data.gbif.org/ws/rest/occurrence/get?key=62030856	34.7	6.5	108	0
A2504	Tragelaphus strepsiceros	Tragelaphus	Tragelaphini	22.87500000	-19.47830000	http://data.gbif.org/ws/rest/occurrence/get?key=153247877	34.6	6.4	107	0
A2505	Tragelaphus strepsiceros	Tragelaphus	Tragelaphini	20.23300000	-19.23300000	http://data.gbif.org/ws/rest/occurrence/get?key=240459443	33.5	5.6	137	0
A2506	Tragelaphus strepsiceros	Tragelaphus	Tragelaphini	20.20000000	-19.20000000	http://data.gbif.org/ws/rest/occurrence/get?key=152450787	33.6	5.7	137	0
A2507	Tragelaphus strepsiceros	Tragelaphus	Tragelaphini	20.60000000	-19.20000000	http://data.gbif.org/ws/rest/occurrence/get?key=152450786	33.8	5.8	135	0
A2508	Tragelaphus strepsiceros	Tragelaphus	Tragelaphini	17.69000000	-19.19000000	http://data.gbif.org/ws/rest/occurrence/get?key=79775454	33.6	8.0	128	0
A2509	Tragelaphus strepsiceros	Tragelaphus	Tragelaphini	20.65000000	-19.16700000	http://data.gbif.org/ws/rest/occurrence/get?key=240459477	33.8	5.7	135	0
A2510	Tragelaphus strepsiceros	Tragelaphus	Tragelaphini	24.25000000	-18.75000000	http://data.gbif.org/ws/rest/occurrence/get?key=62028241	35.1	6.4	124	0

A2511	Tragelaphus strepsiceros	Tragelaphus	Tragelaphini	21.75000000	-18.73300000	http://data.gbif.org/ws/rest/occurrence/get?key=240459464	33.8	5.9	113	0
A2512	Tragelaphus strepsiceros	Tragelaphus	Tragelaphini	21.80000000	-18.70000000	http://data.gbif.org/ws/rest/occurrence/get?key=152450733	33.9	6.0	112	0
A2513	Tragelaphus strepsiceros	Tragelaphus	Tragelaphini	32.80000000	-16.50000000	http://data.gbif.org/ws/rest/occurrence/get?key=152450658	35.4	12.2	175	1
A2514	Tragelaphus strepsiceros	Tragelaphus	Tragelaphini	32.78300000	-16.48300000	http://data.gbif.org/ws/rest/occurrence/get?key=240459479	35.6	12.2	174	1
A2515	Tragelaphus strepsiceros	Tragelaphus	Tragelaphini	17.83330000	-15.83330000	http://data.gbif.org/ws/rest/occurrence/get?key=79771062	33.6	5.6	169	0
A2516	Tragelaphus strepsiceros	Tragelaphus	Tragelaphini	30.80000000	-15.10000000	http://data.gbif.org/ws/rest/occurrence/get?key=152450760	33.3	10.3	260	1
A2517	Tragelaphus strepsiceros	Tragelaphus	Tragelaphini	32.41670000	-8.11667000	http://data.gbif.org/ws/rest/occurrence/get?key=42108427	33.1	15.5	223	0
A2518	Tragelaphus strepsiceros	Tragelaphus	Tragelaphini	37.35000000	-3.06667000	http://data.gbif.org/ws/rest/occurrence/get?key=48245260	1.6	-10.4	335	68
A2519	Tragelaphus strepsiceros	Tragelaphus	Tragelaphini	35.38333000	-1.10000000	http://data.gbif.org/ws/rest/occurrence/get?key=79785471	26.5	9.3	185	33
A2520	Tragelaphus strepsiceros	Tragelaphus	Tragelaphini	37.21120000	1.61457000	http://data.gbif.org/ws/rest/occurrence/get?key=62030801	30.7	10.9	167	9
A2521	Tragelaphus strepsiceros	Tragelaphus	Tragelaphini	36.62000000	2.39000000	http://data.gbif.org/ws/rest/occurrence/get?key=175984051	36.5	19.7	64	2
A2522	Tragelaphus strepsiceros	Tragelaphus	Tragelaphini	37.93330000	5.16359000	http://data.gbif.org/ws/rest/occurrence/get?key=62030276	30.7	14.1	126	12
A2523	Tragelaphus strepsiceros	Tragelaphus	Tragelaphini	40.70000000	7.75000000	http://data.gbif.org/ws/rest/occurrence/get?key=62030218	29.9	11.5	165	5
A2524	Tragelaphus strepsiceros	Tragelaphus	Tragelaphini	44.68330000	9.76667000	http://data.gbif.org/ws/rest/occurrence/get?key=62030184	30.9	10.6	62	3
A2525	Tragelaphus strepsiceros	Tragelaphus	Tragelaphini	44.71670000	9.85000000	http://data.gbif.org/ws/rest/occurrence/get?key=62030159	30.7	10.4	62	3
A2526	Tragelaphus strepsiceros	Tragelaphus	Tragelaphini	44.71670000	9.90000000	http://data.gbif.org/ws/rest/occurrence/get?key=62030164	33.7	13.2	39	2
A2527	Tragelaphus strepsiceros	Tragelaphus	Tragelaphini	46.00000000	10.00000000	http://data.gbif.org/ws/rest/occurrence/get?key=224333384	31.8	12.7	41	1
A2528	Tragelaphus strepsiceros	Tragelaphus	Tragelaphini	36.33330000	12.80000000	http://data.gbif.org/ws/rest/occurrence/get?key=62030239	39.7	18.3	239	0
A2529	Tragelaphus strepsiceros	Tragelaphus	Tragelaphini	40.64000000	13.59000000	http://data.gbif.org/ws/rest/occurrence/get?key=175984111	38.4	19.0	41	4

SuppTab. 4 **Species and Vegetation Climate Values for Climate-Group Building**. Shown are the median values of four climate variables for the respective observation points (OP, SuppTab. 3) per species and for the major vegetation types (White, 1983). Climate Variables: Bio05 maximum temperature (°C) in warmest month, Bio06 minimum temperature (°C) in coolest month, Bio13 precipitation (mm) in wettest month; Bio14 precipitation (mm) in driest month.

	Species	**Bio05**	**Bio06**	**Bio13**	**Bio14**	**Nr. OP**
1	*Addax nasomaculatus*	37.8	11.2	36.4	0.0	19
2	*Aepyceros melampus*	29.6	10.1	141.3	12.9	27
3	*Alcelaphus b. lichtensteinii*	30.9	4.2	98.1	6.1	32
4	*Alcelaphus b. lelwel*	30.2	12.6	158.4	13.9	42
5	*Alcelaphus b. major*	38.1	16.6	245.1	0.8	32
6	*Ammodorcas clarkei*	34.9	18.5	68.4	0.5	24
7	*Antidorcas marsupialis*	31.7	5.3	76.9	0.7	28
8	*Beatragus hunteri*	33.8	19.4	99.0	12.0	4
9	*Cephalophus adersi*	31.8	20.8	206.8	6.9	10
10	*Cephalophus brookei*	33.0	19.7	352.5	29.0	19
11	*Cephalophus callipygus*	31.1	18.2	283.0	24.2	22
12	*Cephalophus dorsalis*	29.3	17.0	224.1	66.4	31
13	*Cephalophus harveyi*	28.7	12.7	200.6	18.6	37
14	*Cephalophus jentinki*	32.5	18.8	430.0	25.6	21
15	*Cephalophus leucogaster*	32.0	17.6	222.1	33.9	20
16	*Cephalophus natalensis*	28.5	6.9	146.4	10.3	19
17	*Cephalophus niger*	33.8	18.8	281.7	20.5	19
18	*Cephalophus nigrifrons*	23.9	10.8	272.7	40.6	19
19	*Cephalophus ogilbyi*	31.7	20.5	422.1	31.9	11
20	*Cephalophus rufilatus*	36.0	17.9	253.8	6.4	50
21	*Cephalophus silvicultor*	27.8	11.6	207.1	38.1	59
22	*Cephalophus spadix*	23.8	8.8	252.3	12.8	19
23	*Cephalophus weynsi*	26.4	11.2	196.2	35.3	21
24	*Cephalophus zebra*	33.0	20.2	333.2	30.4	16
25	*Connochaetes gnou*	27.0	0.9	125.9	11.4	16
26	*Connochaetes taurinus*	31.7	10.4	157.3	4.6	67
27	*Damaliscus lunatus*	31.3	15.1	150.8	9.9	64
28	*Damaliscus pygargus*	28.4	2.9	76.8	18.0	12
29	*Dorcatragus megalotis*	34.4	14.6	42.1	2.3	25
30	*Eudorcas rufifrons*	39.7	17.4	174.8	0.0	24
31	*Eudorcas thomsoni*	29.2	12.8	146.5	13.3	17
32	*Gazella arabica*	36.2	7.9	38.0	0.0	9
33	*Gazella cuvieri*	34.0	2.1	36.2	4.6	18
34	*Gazella d. pelzelni*	36.5	17.1	32.4	1.2	10
35	*Gazella dorcas*	35.1	7.7	20.8	0.1	182
36	*Gazella gazella*	33.7	7.9	87.1	0.2	153
37	*Gazella leptoceros*	37.5	4.9	8.0	0.5	22
38	*Gazella spekei*	34.5	17.3	49.0	0.5	28
39	*Gazella subgutturosa*	39.3	9.5	29.5	0.5	11
40	*Hippotragus equinus*	31.2	13.2	172.3	7.5	78
41	*Hippotragus niger*	31.2	13.4	194.5	5.2	43
42	*Kobus ellipsiprymnus*	31.5	12.7	173.8	11.6	46
43	*Kobus kob*	31.9	15.7	187.4	20.9	15
44	*Kobus leche*	32.7	7.6	195.6	0.1	38
45	*Kobus megaceros*	38.1	18.8	183.5	0.8	8
46	*Kobus vardonii*	32.3	10.9	215.0	1.2	43
47	*Litocranius walleri*	33.1	14.7	104.8	2.7	29

	Species	Bio05	Bio06	Bio13	Bio14	Nr. OP
48	*Madoqua guentheri*	32.6	14.6	119.9	8.5	13
49	*Madoqua kirkii*	28.8	11.0	160.4	14.1	22
50	*Madoqua piacentinii*	34.5	20.4	66.7	1.3	9
51	*Madoqua saltiana*	33.3	13.6	91.0	3.3	14
52	*Nanger dama*	40.9	12.6	59.7	0.0	17
53	*Nanger granti*	29.8	12.8	147.9	12.0	39
54	*Nanger soemmerringii*	37.0	16.6	112.2	2.4	31
55	*Neotragus batesi*	30.5	17.6	243.2	39.1	19
56	*Neotragus moschatus*	30.0	11.9	200.9	18.1	18
57	*Neotragus pygmaeus*	32.9	20.4	263.3	21.4	18
58	*Oreotragus oreotragus*	27.7	7.3	168.5	10.4	21
59	*Oryx beisa*	30.0	12.4	141.6	7.5	26
60	*Oryx dammah*	38.0	8.9	30.8	0.1	59
61	*Oryx gazella*	32.2	4.2	75.5	1.4	15
62	*Oryx leucoryx*	38.3	11.3	20.4	0.3	7
63	*Ourebia ourebi*	33.6	14.8	194.2	10.0	50
64	*Pelea capreolus*	26.0	0.7	104.4	15.2	12
65	*Philantomba maxwellii*	33.3	18.5	375.3	19.3	18
66	*Philantomba monticola*	30.7	16.7	221.1	33.3	23
67	*Philantomba walteri*	34.9	20.1	241.5	11.1	10
68	*Raphicerus campestris*	31.7	5.5	106.1	4.3	75
69	*Raphicerus melanotis*	27.2	5.7	73.8	29.6	9
70	*Raphicerus sharpei*	35.3	12.4	190.6	2.5	25
71	*Redunca arundinum*	31.9	10.1	168.3	5.5	29
72	*Redunca fulvorufula*	29.5	12.3	223.1	10.9	7
73	*Redunca redunca*	33.5	15.3	185.5	11.9	21
74	*Sylvicapra grimmia*	32.2	10.1	184.2	7.1	116
75	*Syncerus caffer*	30.6	12.0	183.5	20.5	40
76	*Tragelaphus angasii*	32.0	11.0	159.8	13.7	10
77	*Tragelaphus buxtoni*	18.4	2.8	197.6	20.3	12
78	*Tragelaphus derbianus*	37.2	15.7	248.8	2.2	27
79	*Tragelaphus eurycerus*	27.8	13.1	259.9	36.2	12
80	*Tragelaphus imberbis*	29.3	12.0	157.9	10.9	19
81	*Tragelaphus oryx*	31.4	9.7	126.3	7.2	23
82	*Tragelaphus scr. sylvaticus*	30.1	10.4	182.6	16.6	33
83	*Tragelaphus scr. scriptus*	31.1	14.7	237.6	16.0	14
84	*Tragelaphus spekii*	34.1	12.0	212.8	6.2	17
85	*Tragelaphus strepsiceros*	32.5	8.6	130.4	4.4	40
	Major Vegetation Type					
1	Bushland & Thicket	31.9	8.5	169.5	3.6	-
2	Desert & Semi Desert	29.9	-0.4	61.4	11.4	-
3	Forest	31.4	16.6	250.8	36.6	-
4	Grassland	35.5	13.3	120.5	2.8	-
5	Grassy Shrubland	40.3	7.3	9.5	0.1	-
6	Shrubland	30.6	8.9	177.0	7.8	-
7	Wooded Grassland	38.1	14.9	181.4	0.4	-
8	Woodland	32.8	13.3	201.7	1.3	-

SuppTab. 5 **Species List of Climate-Groups.** Given are the 88 Afro-Arabian species assigned to five climate-groups established by the use of k-means clustering and the information of four climate variables (Bio05, Bio06, Bio13 and Bio14). Next to the species name its assorted IUCN category (http://www.iucnredlist.org/, see *box* for abbreviation). Shading indicates species assigned to either ARID (reddish) or HUMID (greenish) tribes in the *Chapter 1* and *2*.

#	**Desert-Group**	**IUCN**	**Grassland-Group**	**IUCN**	**Woodland-Group**	**IUCN**	**Forest-Group**	**IUCN**	**Lowland-RF-Group**	**IUCN**
1	*Addax nasomaculatus*	CR	*Aepyceros melampus*	LC	*Alcelaphus b. cokei*	LC	*Alcelaphus b. major*	NT	*Cephalophus brookei*	NE
2	*Ammodorcas clarkei*	VU	*Alcelaphus b. lichtensteini*	LC	*Cephalophus adersi*	CR	*Cephalophus callipygus*	LC	*Cephalophus jentinki*	EN
3	*Antidorcas marsupialis*	LC	*Beatragus hunteri*	CR	*Cephalophus harveyi*	LC	*Cephalophus dorsalis*	LC	*Cephalophus ogilbyi*	LC
4	*Damaliscus pygargus*	LC	*Cephalophus natalensis*	LC	*Cephalophus silvicultor*	LC	*Cephalophus leucogaster*	LC	*Cephalophus zebra*	VU
5	*Dorcatragus megalotis*	VU	*Connochaetes gnou*	LC	*Cephalophus weynsi*	LC	*Cephalophus niger*	LC	*Philantomba maxwellii*	LC
6	*Gazella arabica*	DD	*Damaliscus lunatus*	LC	*Connochaetes taurinus*	LC	*Cephalophus nigrifrons*	LC		
7	*Gazella cuvieri*	EN	*Eudorcas thomsoni*	NT	*Eudorcas rufifrons*	VU	*Cephalophus rufilatus*	LC		
8	*Gazella d. pelzelni*	VU	*Gazella gazella*	VU	*Hippotragus equinus*	LC	*Cephalophus spadix*	EN		
9	*Gazella dorcas*	VU	*Litocranius walleri*	NT	*Hippotragus niger*	LC	*Neotragus batesi*	LC		
10	*Gazella leptoceros*	EN	*Madoqua guentheri*	LC	*Kobus ellipsiprymnus*	LC	*Neotragus pygmaeus*	LC		
11	*Gazella spekei*	EN	*Madoqua saltiana*	LC	*Kobus kob*	LC	*Philantomba monticola*	LC		
12	*Gazella subgutturosa*	VU	*Nanger granti*	LC	*Kobus leche*	LC	*Philantomba walteri*	NE		
13	*Madoqua piacentinii*	DD	*Nanger soemmerringii*	VU	*Kobus megaceros*	EN	*Redunca fulvorufula*	LC		
14	*Nanger dama*	CR	*Oryx beisa*	NT	*Kobus vardonii*	NT	*Tragelaphus derbianus*	LC		
15	*Oryx dammah*	EX	*Pelea capreolus*	LC	*Madoqua kirkii*	LC	*Tragelaphus eurycerus*	NT		
16	*Oryx gazella*	LC	*Raphicerus campestris*	LC	*Neotragus moschatus*	LC	*Tragelaphus scriptus*	LC		
17	*Oryx leucoryx*	VU	*Tragelaphus oryx*	LC	*Oreotragus oreotragus*	LC				
18	*Raphicerus melanotis*	LC	*Tragelaphus strepsiceros*	LC	*Ourebia ourebi*	LC				
19					*Raphicerus sharpei*	LC				
20					*Redunca arundinum*	LC				
21					*Redunca redunca*	LC				
22					*Sylvicapra grimmia*	LC				
23					*Syncerus caffer*	LC				
24					*Tragelaphus angasii*	LC				
25					*Tragelaphus buxtoni*	EN				
26					*Tragelaphus imberbis*	NT				
27					*Tragelaphus s. sylvaticus*	NE				
28					*Tragelaphus spekii*	LC				

Index:

LC	Least Concern
NT	Near Threatened
VU	Vulnerable
EN	Endangered
CR	Critically Endangered
EX	Extinct

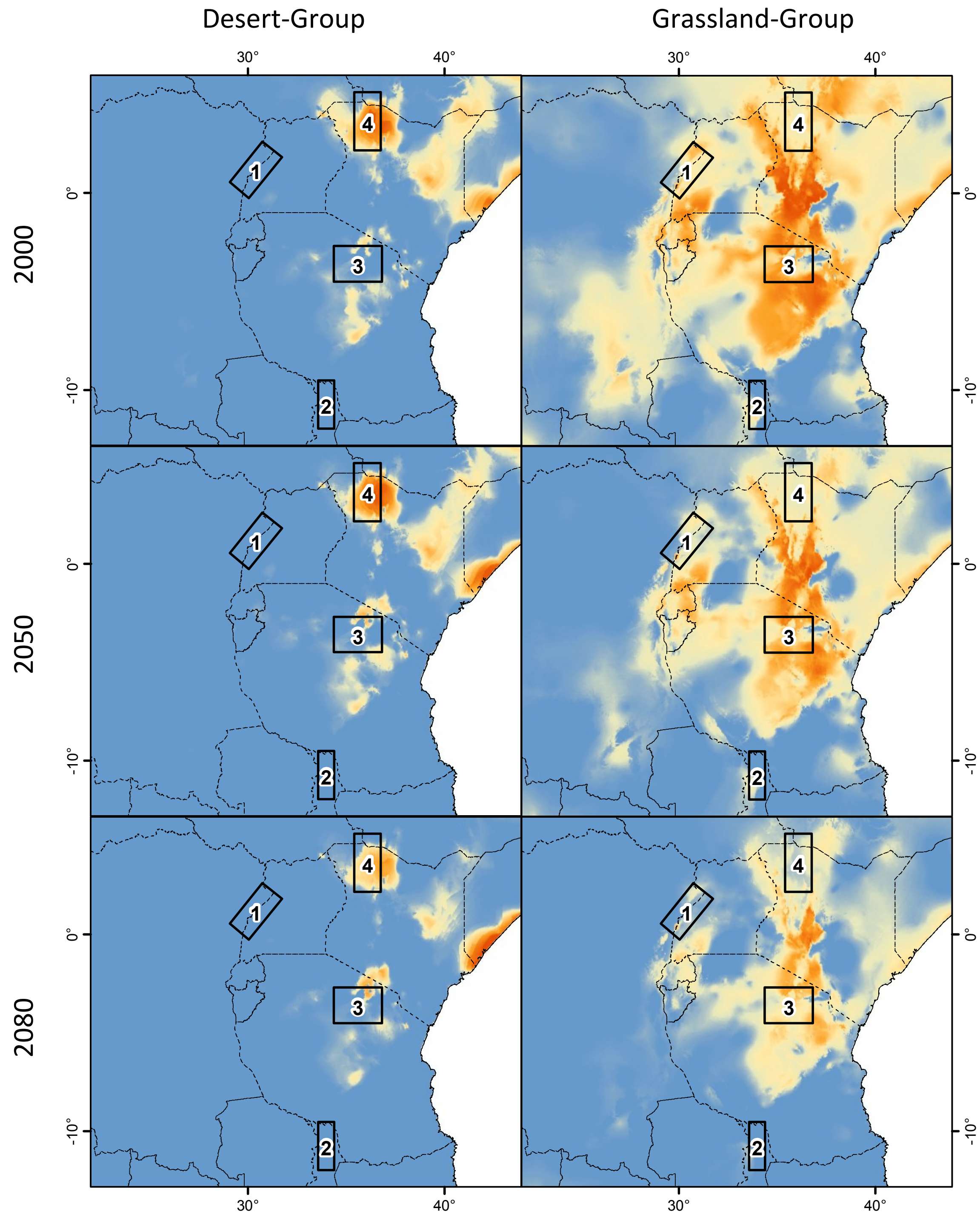
SuppTab. 6 **Matrix for the Principal Component Analyses (PCA) of Test Areas under Past Climate Conditions.** The PCA was performed using the mean HSI of all climate-groups at six test areas for the climate scenarios postBDS, preBDS and Present. For a comparison the mean HSI of modern ecozones (White, 1983) were included. The resulting PCA coordinates of the first two components (F1, F2) were used in the PCA scatterplot.

		Mean HSI per Climate-Group					**PCA Coordinates**	
	Area	**Desert**	**Grassland**	**Woodland**	**Forest**	**Lowland**	**F1**	**F2**
Modern Ecozones	I	1.22	7.73	11.54	68.72	9.07	3.80	-1.14
	II	7.50	22.60	42.93	13.47	0.62	0.13	0.57
	III	8.07	10.09	8.17	23.70	2.54	0.82	-0.85
	IV	43.16	43.37	50.50	36.84	2.92	0.50	0.50
	V	38.98	74.84	5.56	2.20	0.00	-1.91	-0.08
	VI	56.25	49.36	7.53	2.99	0.09	-1.75	-0.74
	VII	79.65	57.81	4.10	2.19	0.00	-2.32	-1.04
	VIII	11.48	54.88	57.75	19.87	0.39	-0.19	1.58
	X	10.49	13.18	21.48	40.25	2.33	1.28	-0.34
	XI	4.62	11.99	15.54	48.71	9.08	3.09	-1.09
	XIII	43.78	31.04	47.32	51.08	5.75	1.71	-0.05
	XIV	8.50	63.22	11.62	2.91	0.02	-1.17	0.36
	XVI	27.35	17.71	0.79	4.95	0.28	-0.73	-1.08
	XVII	43.16	10.70	0.14	0.66	0.01	-1.08	-1.45
	XVIII	72.91	38.48	1.77	1.51	0.00	-1.95	-1.35
Present	Albertine Rift	0.00	6.36	53.01	45.61	0.01	1.42	0.90
	Chiwondo	3.29	29.53	70.46	9.39	0.12	0.04	1.61
	Laetoli	56.11	72.27	90.07	20.89	0.40	-0.94	2.18
	Swartkrans	11.76	93.64	14.89	2.49	0.00	-1.69	0.95
	Toros-Menalla	60.79	14.05	0.12	1.80	0.03	-1.38	-1.66
	Turkana	6.52	70.98	77.12	27.84	0.24	-0.01	2.57
preBDS	Albertine Rift	0.00	21.38	37.53	47.45	0.06	1.16	0.70
	Chiwondo	1.57	13.75	53.20	13.76	0.51	0.41	0.82
	Laetoli	41.81	38.18	67.82	29.67	1.35	0.15	1.07
	Swartkrans	11.13	88.73	16.23	2.65	0.00	-1.59	0.91
	Toros-Menalla	57.99	19.48	0.15	1.80	0.03	-1.41	-1.52
	Turkana	27.97	35.77	39.72	35.13	1.32	0.39	0.42
postBDS	Albertine Rift	0.16	22.22	12.95	52.45	0.45	1.22	-0.03
	Chiwondo	0.55	0.75	25.79	24.67	1.80	1.07	-0.29
	Laetoli	20.09	11.54	31.30	42.47	4.84	1.83	-0.46
	Swartkrans	8.67	76.61	6.41	2.50	0.00	-1.43	0.44
	Toros-Menalla	54.29	18.47	0.14	1.79	0.03	-1.34	-1.48
	Turkana	13.38	7.33	11.86	44.15	4.49	1.85	-0.97

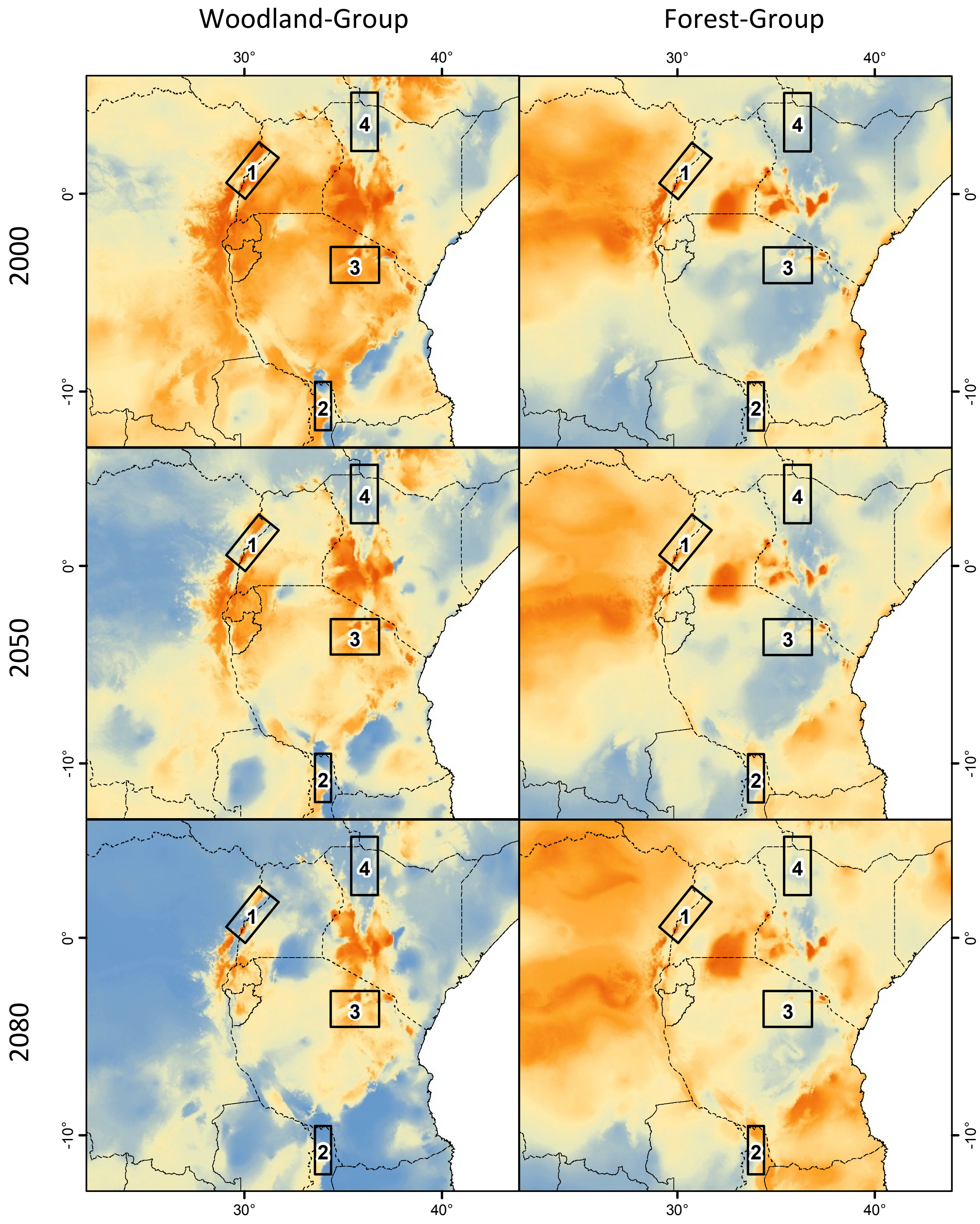
SuppTab. 7 **Mean Climate Variable Values at Test Areas under Past Climate Conditions.** Shown are the mean and the standard deviation (stdv) of four climate variables per climate scenario and test area. t_{max}: maximum temperature in warmest month (°C, Bio05), t_{min}: minimum temperature in coolest month (°C), Bio06, p_{max}: precipitation in wettest month (mm, Bio13), p_{min}: precipitation driest month (mm, Bio14).

Test Area	**Scenario**	t_{max}		t_{min}		p_{max}		p_{min}	
		mean	stdv.	mean	stdv.	mean	stdv.	mean	stdv.
Albertine Rift	*preBDS*	27.1	0.3	16.6	0.3	184.9	7.0	61.7	7.3
	postBDS	28.9	0.2	17.9	0.2	196.0	3.5	49.7	7.0
	Present	31.0	0.2	19.1	0.1	212.7	4.2	39.9	5.7
Chiwondo	*preBDS*	27.8	0.3	14.0	0.2	217.1	4.8	4.8	0.5
	postBDS	29.5	0.3	15.8	0.2	223.3	1.3	2.9	0.2
	Present	31.2	0.3	17.8	0.1	236.5	2.0	2.0	0.2
Laetoli	*preBDS*	26.8	0.4	17.0	0.8	162.8	3.9	10.4	2.3
	postBDS	28.3	0.1	18.4	0.6	185.7	6.2	8.0	2.2
	Present	30.2	0.0	19.9	0.4	210.0	5.0	7.1	2.0
Swartkrans	*preBDS*	25.5	0.2	8.0	0.5	198.4	3.0	20.0	1.9
	postBDS	27.3	0.2	9.3	0.5	184.0	3.9	13.3	1.5
	Present	30.3	0.3	10.7	0.5	148.9	4.6	11.7	1.2
Toros-Menalla	*preBDS*	35.4	0.4	14.7	0.6	43.1	19.3	0.1	0.0
	postBDS	35.0	0.3	14.3	0.6	50.6	16.6	0.1	0.0
	Present	35.2	0.3	14.4	0.7	51.7	16.2	0.0	0.0
Turkana	*preBDS*	28.0	0.3	17.3	0.3	168.6	19.8	27.0	7.2
	postBDS	30.0	0.4	18.6	0.2	199.9	21.0	15.7	2.3
	Present	32.4	0.5	19.8	0.1	224.0	22.4	11.2	0.9

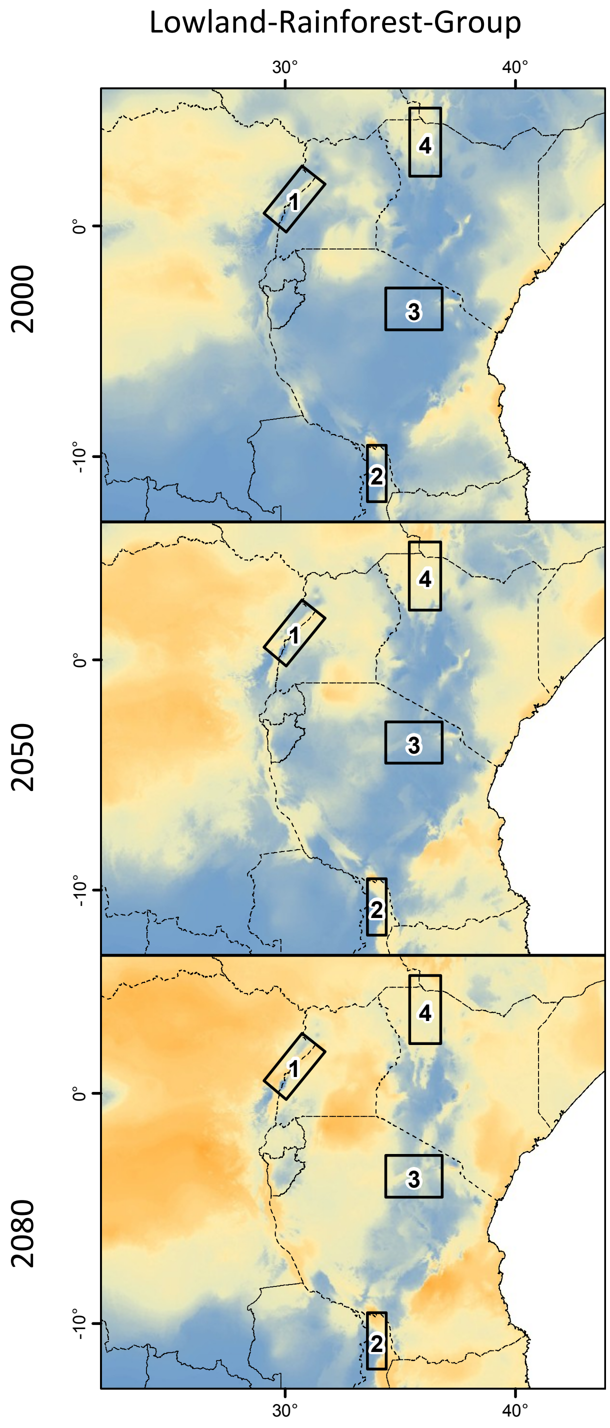
East African Test Areas



SuppFig. 2 **Overview of East African Test Areas and Habitat Suitability for the Desert-Group and Grassland-Group.** Projections for the year 2000 (top), 2050 (middle) and 2080 (bottom). The warmer the colour, the higher is the habitat suitability. (1) Albertine-Rift Area; (2) Chiwondo Area; (3) Laetoli Area; (4) Turkana Area.



SuppFig. 2 (continued) **Overview of East African Test Areas and Habitat Suitability for the Woodland-Group and Forest-Group.** Projections for the year 2000 (top), 2050 (middle) and 2080 (bottom). The warmer the colour, the higher is the habitat suitability. (1) Albertine-Rift Area; (2) Chiwondo Area; (3) Laetoli Area; (4) Turkana Area.



SuppFig. 2 (continued) **Overview of East African Test Areas and Habitat Suitability for the Lowland-Rainforest-Group.** Projections for the year 2000 (top), 2050 (middle) and 2080 (bottom). The warmer the colour, the higher is the habitat suitability. (1) Albertine-Rift Area; (2) Chiwondo Area; (3) Laetoli Area; (4) Turkana Area.

SuppTab. 8 **Matrix for the Principal Component Analyses (PCA) of Test Areas under Future Climate Conditions.** The PCA was performed using the mean HSI of all climate-groups at six test areas for the climate scenarios 2000, 2050 and 2080. For a comparison the mean HSI of modern ecozones (White, 1983) were included. The resulting PCA coordinates of the first two components (F1, F2) were used in the PCA scatterplot.

		Mean HSI per Climate-Group					PCA Coordinates	
	Area	**Desert**	**Grassland**	**Woodland**	**Forest**	**Lowland**	**F1**	**F2**
Modern Ecozones	I	0.00	3.00	23.10	71.70	41.56	3.51	-1.27
	II	1.31	25.82	50.16	14.21	4.51	0.02	0.99
	III	0.27	5.03	18.34	19.15	9.30	0.24	-0.58
	IV	36.97	45.98	31.65	13.20	9.68	-0.93	0.29
	V	54.37	45.56	36.20	6.76	0.97	-1.80	0.33
	VI	61.43	21.46	8.47	2.21	0.82	-2.18	-1.22
	VII	31.40	41.56	9.70	1.44	0.40	-1.87	-0.16
	VIII	1.76	40.65	73.54	37.56	6.07	0.99	2.01
	X	0.52	12.36	51.20	37.01	17.23	1.53	0.37
	XI	0.01	5.26	26.44	44.40	25.29	1.90	-0.72
	XIII	3.68	17.92	40.64	37.29	19.42	1.37	0.11
	XIV	25.63	51.26	12.64	1.85	0.41	-1.81	0.28
	XVI	18.25	13.58	5.80	2.72	1.98	-1.23	-0.83
	XVII	20.18	2.59	0.43	0.27	0.23	-1.37	-1.27
	XVIII	47.60	17.24	3.11	0.83	0.31	-2.01	-1.25
2080	Albertine Rift	0.11	35.95	67.25	50.89	13.43	1.76	1.56
	Chiwondo	0.01	10.90	49.13	29.46	10.95	1.00	0.43
	Laetoli	3.49	58.18	77.54	20.27	5.39	0.20	2.59
	Swartkrans	2.44	87.63	32.28	3.22	0.34	-1.49	2.19
	Toros-Menalla	27.76	5.54	1.59	1.17	1.38	-1.45	-1.31
	Turkana	57.38	39.71	17.69	17.41	19.92	-0.83	-0.86
2050	Albertine Rift	0.02	19.68	45.31	50.08	22.89	2.06	0.26
	Chiwondo	0.02	5.62	31.06	34.15	16.65	1.23	-0.37
	Laetoli	6.87	54.58	68.11	20.25	7.72	0.16	2.11
	Swartkrans	5.76	80.11	23.85	2.65	0.51	-1.59	1.69
	Toros-Menalla	6.83	2.53	1.83	2.00	2.10	-0.96	-1.06
	Turkana	57.72	29.78	13.98	24.26	29.50	-0.12	-1.47
2080	Albertine Rift	0.00	8.46	24.48	52.19	37.64	2.65	-0.99
	Chiwondo	0.01	1.24	12.55	47.76	27.93	1.99	-1.30
	Laetoli	6.68	41.23	57.90	28.73	15.09	0.80	1.28
	Swartkrans	3.99	62.26	13.12	1.80	0.53	-1.52	0.93
	Toros-Menalla	1.43	0.30	1.17	4.08	3.40	-0.71	-1.08
	Turkana	37.60	18.11	8.88	24.68	32.06	0.46	-1.66

SuppTab. 9 **Mean Climate Variable Values at Test Areas under Future Climate Conditions**. Shown are the mean and the standard deviation (stdv) of four climate variables per climate scenario and test area. tmax: maximum temperature in warmest month (°C, Bio05), tmin: minimum temperature in coolest month (°C), Bio06, pmax: precipitation in wettest month (mm, Bio13), pmin: precipitation driest month (mm, Bio14).

Test Area	**Year**	**Bio05**		**Bio06**		**Bio13**		**Bio14**	
		mean	stdv.	mean	stdv.	mean	stdv.	mean	stdv.
Albertine Rift	2000	29.0	3.0	15.1	2.9	161.5	24.3	41.7	15.7
	2050	31.6	3.1	17.1	2.8	166.9	23.7	43.7	16.9
	2080	35.3	3.1	19.8	2.8	168.3	29.5	37.9	15.3
Chiwondo	2000	29.2	2.5	11.2	3.7	275.2	83.1	2.8	1.9
	2050	32.2	2.5	13.7	3.8	342.5	85.4	1.6	1.4
	2080	35.2	2.5	16.6	3.8	296.7	81.1	1.2	1.7
Laetoli	2000	27.3	2.4	11.6	1.9	169.9	41.7	2.7	2.9
	2050	29.4	2.4	14.1	1.9	163.3	28.7	2.0	2.7
	2080	31.1	2.4	17.3	1.9	191.0	38.4	1.5	2.2
Swartkrans	2000	26.8	0.9	-0.7	1.4	118.8	11.2	7.0	1.1
	2050	29.3	1.0	2.3	1.5	116.7	10.4	2.3	0.6
	2080	33.5	0.9	4.3	1.5	121.5	7.0	3.0	1.3
Toros-Menalla	2000	41.3	0.4	13.8	0.8	36.4	13.4	0.0	0.0
	2050	44.0	0.4	15.8	0.8	58.6	17.2	0.0	0.0
	2080	48.0	0.4	19.1	0.7	35.8	14.1	0.0	0.0
Turkana	2000	35.4	1.4	20.3	1.6	67.6	17.3	4.9	5.3
	2050	36.8	1.3	22.7	1.8	77.2	17.7	5.1	6.0
	2080	39.3	1.5	25.7	1.7	79.9	18.9	5.6	6.6

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ERKLÄRUNG

Ich erkläre hiermit an Eides Statt, dass ich die vorgelegte Dissertation:

„Climate-Linked Temporal and Spatial Patterns in the Evolution of African Bovidae",

selbständig angefertigt und mich anderer Hilfsmittel als der in ihr angegebenen nicht bedient habe, insbesondere, dass alle Entlehnungen aus anderen Schriften mit Angabe der betreffenden Schrift gekennzeichnet sind.

Ich versichere, nicht die Hilfe einer kommerziellen Promotionsvermittlung in Anspruch genommen zu haben

Frankfurt am Main, den 05. April 2012 ....

(Unterschrift)

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Schikora, T., Bibi, F. and Schrenk, F. (**201X**): *A dense and dated bayesian phylogeny shows response in diversity of Bovidae to climatic changes since the Late Miocene in Africa.* (in prep.)

Schikora, T. & Schrenk, F. (**2011**): Tempo-Spatial Patterns in the Evolution of Extant African Bovidae based on Molecular, Fossil and Climate Niche Data; Oral Presentation, 71st Annual Meeting of the Society of Vertebrate Paleontology, Las Vegas, USA. Abstract: Journal of Vertebrate Paleontology, Abstracts of Papers, p.188

Schikora, T. & Schrenk, F. **(2011):** *The Impact of Climate onto Evolution and Diversity of African Antelopes*; Oral Presentation, 85th Annual Conference of the German Society of Mammalogy, City of Luxembourg, Luxembourg. Abstract: Mammalian Biology 76S (2011), p.20; 10.1016/j.mambio.2011.07.005

Schikora, T. & Schrenk, F. (**2010**): *What Does the Past Show Us About the Future? - Reconstructing Antelope's Evolution*, Student Conference on Conservation Science 2011; Oral Presentation, American Museum of Natural History New York, USA

Schikora, T. & Schrenk, F. (**2010**): *The Impact of Changing Environment on Bovid's Evolution in Africa*, 40th Anniversary Conference; Oral Presentation, Gesellschaft für Ökologie, Gießen, Germany

Schikora, T. & Schrenk, F. (**2009**): *Combining modern molecular phylogenies with classic morphometric fossil studies*. Oral Presentation, 15th European Meeting of PhD Students in Evolutionary Biology, Schoorl, The Netherlands

Ebert, C., Kolodziej, K., **Schikora**, **T**., Schulz, H., Hohmann, U. (**2009**). *Is Non-invasive Genetic Population Estimation via Faeces Sampling Feasible for Abundant Mammals with Low Defecation Rates? A Pilot Study on Free Ranging Wild Boar (Sus scrofa) in South-West Germany*. Acta Silvatica et Lignaria Hungarica, Vol. 5, pp 167-177

Schikora (**2007**): *Felduntersuchung zur nicht-invasiven Kotprobengewinnung von Wildschweinen (Sus scrofa) im Pfälzerwald, zwecks Verwendung bei der Bestandesdichteschätzung auf Grundlage der Genotypisierung*.- Diploma Thesis, Goethe University Frankfurt

Wunn, U., Ebert, C., Huckschlag, D., Kolodziej, K., **Schikora, T**., Schulz, H., Hohmann, U. **(2008):** *Die Zählung von Wildschweinen mit einer Fang-Wiederfang-Methode.* Oral Presentation, "Die Grüne Reihe", 19th Tagung Deutscher Verband Forstlicher Forschungsanstalten

Schikora, T., Ebert, C., Huckschlag, D., Nikolov, I., Schulz, H.K., Hohmann, U. (**2007**)**:** *Feasibility of scat sampling field protocols for population estimates of wild boar (Sus scrofa) based on a sampling-genotyping-resampling model*. Oral Presentation, 28th Congress of International Union of Game Biologists (IUGB), Uppsala, Sweden Abstract: Sjöberg, K. & Rooke, T. (eds): Book of Abstracts of the International Union of Game Biologists XXVII Congress. Uppsala 2007, p.157

Ebert, C., Huckschlag, D., Kolodziej, K., **Schikora**, T., Schulz, H., Hohmann, U. (**2007**): *Is non-invasive hair sampling a feasible option to estimate wild boar (Sus scrofa) population densities?* Poster, 28th Congress of International Union of Game Biologists (IUGB), Uppsala, Sweden

Ebert, C., Berger, K., Huckschlag, D., Nikolov, I., **Schikora**, T., Schulz, H., Hohmann, U. (**2007**): *Kann man Wildschweine zählen? Eine Untersuchung über die nicht-* **-** *invasive Gewinnung von Gewebeproben zur Verwendung bei der Bestandesschätzung von Wildschweinen*. Tagungsband der Sektion forstliche Biometrie und Informatik im DVFFA "Die grüne Reihe", Vol. 18, pp 63-72