

Taxonomic revision of the Angolan amphibians and reptiles of Francisco Newton's Collection, 1903– 1906

Bruna Sofia Costa Eiras dos Santos

Mestrado em Ecologia e Ambiente

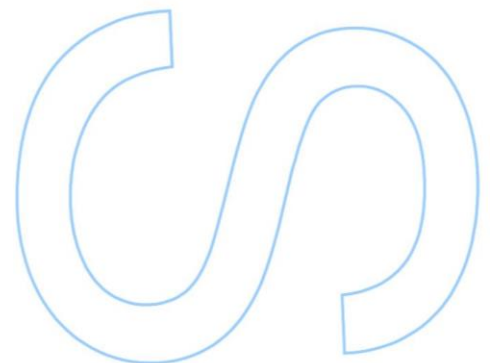
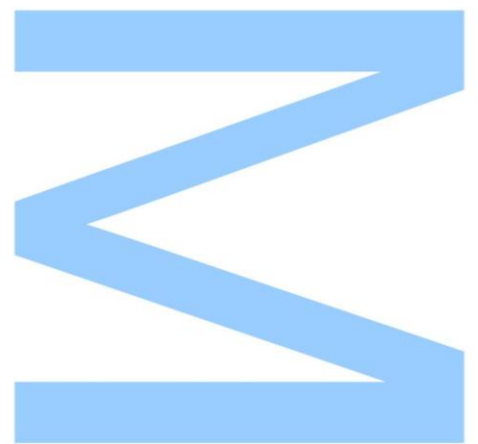
Departamento de Biologia

2019/2020

Orientador

Luis Miguel Pires Ceríaco, PhD

Museu de História Natural e da Ciência da Universidade do Porto

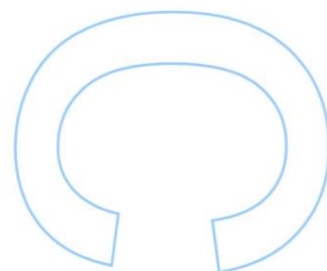
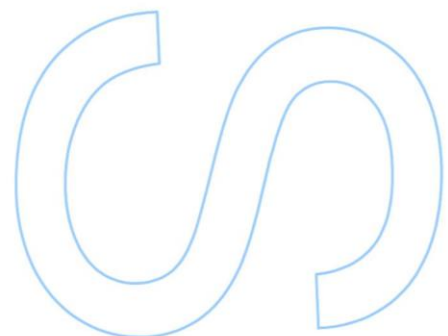
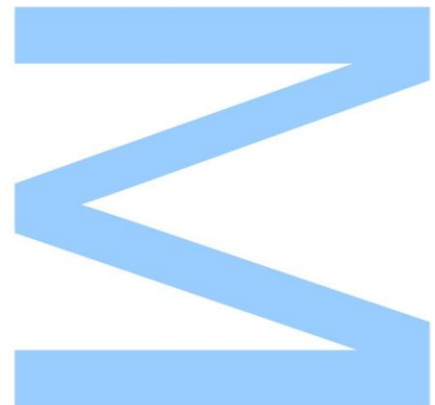




Todas as correções determinadas
pelo júri, e só essas, foram efetuadas.

O Presidente do Júri,

Porto, ____ / ____ / ____



Agradecimentos

Ao Luis e à Mariana, pela excelente orientação no último ano e meio e toda a paciência do mundo a responder às minhas infinitas perguntas sobre tudo e mais alguma coisa. A experiência que me proporcionaram foi melhor do que alguma vez podia ter imaginado e estou imensamente agradecida por tudo aquilo que me ensinaram. Sinto que esta experiência me fez crescer como bióloga, mas também como pessoa. Obrigada por tudo.

À minha família, por acompanhar todo o meu percurso. Aos meus pais, pelas horas que me ouviram entusiasmadamente falar sobre os meus “bichinhos” e todas as coisas novas que estava a aprender; à minha mãe, obrigada por me apoiares sempre e te entusiasmares comigo. À João, por às vezes ser boa pessoa, boa irmã e me ouvir quando lhe peço.

À Rita, por ser a minha melhor amiga e ter estado comigo durante todo este tempo. A faculdade e o museu não tinham sido os mesmos sem a tua presença. À sisterhood, pela amizade ridícula, mas tão importante que temos os quatro e me dá forças para sair de casa e inventar passinhos de dança no meio da rua. Que venham mais saídas e tentativas de vermos um filme.

À incrível equipa do MHNC-UP, por toda a ajuda e apoio, e em especial à Joana Salgueiro, por me ter mostrado um pouquinho do mundo do restauro e conservação e aquilo que podemos fazer pelos espécimes históricos.

Às muitas pessoas que me foram marcando ao longo da faculdade e são demasiadas para aqui nomear. Ao pessoal de Lisboa (ya'll know who you are), obrigada por estarem a uma mensagem de distância e me alegrarem o dia sempre que precisei, tenho saudades vossas e mal posso esperar que estejamos juntos de novo.

Um grande obrigado a todos pela ajuda indispensável nesta etapa do meu percurso!

Resumo

As coleções de história natural são há muito os repositórios do conhecimento passado e são cruciais para o estudo da biodiversidade. Apesar disso, muitas delas continuam por estudar, nunca foram formalmente publicadas e acabaram por ser esquecidas. A expedição de Francisco Newton a Angola (1903–1906) é uma dessas coleções. Apesar da importância que teve para o museu zoológico da Academia Politécnica do Porto (APP) e ter servido como base para a descrição de várias novas espécies, é uma das missões menos estudadas do naturalista. Neste trabalho são reconstruídos os itinerários da sua expedição e apresenta-se uma revisão taxonómica atualizada dos espécimes herpetológicos. Adicionalmente, uma nova espécie de rã de borracha, *Phrynomantis newtoni*, é descrita em homenagem a Francisco Newton, a partir de um dos espécimes da coleção. Newton coletou 155 anfíbios e 173 répteis, constituindo a maior coleção herpetológica presente no Museu de História Natural e da Ciência da Universidade do Porto (MHNC-UP). No total, a expedição resultou em 74 espécies coletadas, pertencentes a 39 géneros e 20 famílias.

Palavras-chave: Coleções de história natural, MHNC-UP, Taxonomia, Herpetologia angolana, Novas espécies.

Abstract

Natural history collections have long been the repository of the knowledge of the past and are crucial to the study of biodiversity. However, many of them remain unstudied, unpublished and have been forgotten. Francisco Newton's expedition to Angola (1903–1906) is one of these. Despite the importance it had to the zoological museum of the Academia Politécnica do Porto (APP) and the several descriptions of new taxa that resulted from it, it's one of the naturalist's least studied missions. In this thesis, his expedition and itineraries are reconstructed and an updated taxonomic revision of the herpetological specimens is also presented. Additionally, a new species of rubber frog, *Phrynomantis newtoni*, named after Newton, is described here from one of the collection's specimens. Newton collected 155 amphibian and 173 reptile specimens, constituting the biggest herpetological collection extant at the Museu de História Natural e da Ciência da Universidade do Porto (MHNC-UP). In total, the expedition resulted in 74 collected species, belonging to 39 genera and 20 families.

Key words: Natural history collections, MHNC-UP, Taxonomy, Angolan herpetology, New taxa.

Índice

Agradecimentos	iii
Resumo	iv
Abstract	v
Índice	vi
List of Figures	viii
List of Tables	xvi
List of abbreviations I	xvii
List of abbreviations II (Museums)	xviii
Main Introduction	1
Main objectives	2
Chapter I	4
Paper I – Francisco Newton’s Zoological Expedition to Angola (1903–1906). I.	
Itineraries and main results.	5
Introduction	6
Materials and Methods	8
The Academia Politécnica do Porto expedition	9
Newton’s 1903–1906 Angola Expedition	10
Main results	19
References	29
Chapter II	38
Paper II – Francisco Newton’s Zoological Expedition to Angola (1903–1906). III.	
A catalogue and taxonomic revision of the amphibians and reptiles.	39
Introduction	40
Materials & Methods	44
Results	45
Taxonomic Accounts	46
Other specimens	135
Discussion	136

References	138
Chapter III	151
Paper III – Social media meets specimens in old formalin filled jars: A new species of Banded Rubber Frog, genus <i>Phrynomantis</i> (Anura: Microhylidae) from Angola.	152
Introduction	153
Materials & Methods.....	162
Results	164
Discussion.....	169
Acknowledgments	171
References.....	173
Final considerations	180
References of Main Introduction	182
References of Final considerations	184

List of Figures

Fig. 1 (Fig. 1 Paper I) Portrait of Francisco Newton (1864–1909) (Source: Arquivo Histórico Museu Bocage).	7
Fig. 2 (Fig. 2 Paper I) Map of collecting localities for the first part of Newton's expedition (March to September 1903). From left to right (pink shaded polygons): Luanda, Bengo, Kwanza Norte (top) and Kwanza Sul (bottom) provinces.	12
Fig. 3 (Fig. 3 Paper I) Portrait of Captain Frederico Cezar Trigo Teixeira (dates of birth and death unknown) (Source: Arquivo Histórico Ultramarino).	14
Fig. 4 (Fig. 4 Paper I) Map of collecting localities for the second part of Newton's expedition (October to December 1903). From left to right (pink shaded polygons): Luanda, Bengo and Kwanza Norte provinces.	15
Fig. 5 (Fig. 5 Paper I) Map of collecting localities for the third part of Newton's expedition (January to May 1904). From left to right (pink shaded polygons): Bengo and Kwanza Norte provinces.	16
Fig. 6 (Fig. 6 Paper I) Map of collecting localities for the last part of Newton's expedition (June 1904 to February 1905). Pink shaded polygon: Namibe province.	17
Fig. 7 (Fig. 1 Paper II) Portrait of Francisco Newton (1864–1909) (Source: Arquivo Histórico Museu Bocage).	41
Fig. 8 (Fig. 2 Paper II) Map of collecting localities from the Newton expedition. Dotted white circles: collecting localities from the herpetological specimens; Red circles: remaining georeferenced collecting localities.	42
Fig. 9 (Fig. 3 Paper II) Specimen of <i>Xenopus petersii</i> (MHNC-UP/ANF228), from unknown locality. Photo by Bruna Santos.	47
Fig. 10 (Fig. 4 Paper II) Specimen of <i>Sclerophrys funerea</i> (MHNC-UP/ANF161), from Cabiri. Photo by Bruna Santos.	48
Fig. 11 (Fig. 5 Paper II) Specimen of <i>Sclerophrys pusilla</i> (MHNC-UP/ANF231), from unknown locality. Photo by Bruna Santos.	49
Fig. 12 (Fig. 6 Paper II) Specimen of <i>Sclerophrys regularis</i> (MHNC-UP/ANF159), from Cabiri. Photo by Bruna Santos.	51

Fig. 13 (Fig. 7 Paper II) Specimen of <i>Phrynomantis newtoni</i> (MHNC-UP/ANF194), from Chingo (Novo Redondo). Photo by Bruna Santos.	52
Fig. 14 (Fig. 8 Paper II) Specimen of <i>Afrixalus osorioi</i> (MHNC-UP/ANF212), from Quilombo. Photo by Bruna Santos.	53
Fig. 15 (Fig. 9 Paper II) Life photo of <i>Afrixalus osorioi</i> , from Serra do Pingano. Photo by Luis Ceríaco.	54
Fig. 16 (Fig. 10 Paper II) Specimen of <i>Hyperolius adspersus</i> (MHNC-UP/ANF211), from Cabiri. Photo by Bruna Santos.	55
Fig. 17 (Fig. 11 Paper II) Specimen of <i>Hyperolius angolensis</i> (MHNC-UP/ANF296), from unknown locality. Photo by Bruna Santos.	58
Fig. 18 (Fig. 12 Paper II) Specimen of <i>Hyperolius angolensis (Rappia plicifera)</i> (MHNC-UP/ANF173), from N'Golla Bumba. Photo by Bruna Santos.	59
Fig. 19 (Fig. 13 Paper II) Specimen of <i>Hyperolius angolensis (Rappia tolsoni)</i> (MHNC-UP/ANF177), from Golungo Alto. Photo by Bruna Santos.	60
Fig. 20 (Fig. 14 Paper II) Specimen of <i>Hyperolius angolensis (Rappia marmorata insignis)</i> (MHNC-UP/ANF200), from unknown locality. Photo by Bruna Santos.	61
Fig. 21 (Fig. 15 Paper II) Specimen of <i>Hyperolius angolensis (Rappia marmorata)</i> (MHNC-UP/ANF182), from unknown locality. Photo by Bruna Santos.	62
Fig. 22 (Fig. 16 Paper II) Specimen of <i>Hyperolius angolensis (Rappia marmorata paralella)</i> (MHNC-UP/ANF138), from unknown locality. Photo by Bruna Santos.	63
Fig. 23 (Fig. 17 Paper II) Specimen of <i>Hyperolius angolensis (Rappia marmorata plicifera)</i> (MHNC-UP/ANF207), from unknown locality. Photo by Bruna Santos.	64
Fig. 24 (Fig. 18 Paper II) Specimen of <i>Hyperolius benguellensis</i> (MHNC-UP/ANF174), from Quilombo. Photo by Bruna Santos.	65
Fig. 25 (Fig. 19 Paper II) Specimen of <i>Hyperolius bocagei</i> (MHNC-UP/ANF219), from unknown locality. Photo by Bruna Santos.	66
Fig. 26 (Fig. 20 Paper II) Specimen of <i>Hyperolius cinnamomeoventris</i> (MHNC-UP/ANF176), from Quilombo. Photo by Bruna Santos.	67

Fig. 27 (Fig. 21 Paper II) Specimen of <i>Hyperolius platyceps</i> (MHNC-UP/ANF205), from Quilombo. Photo by Bruna Santos.	69
Fig. 28 (Fig. 22 Paper II) Specimen of <i>Arthroleptis carquejai</i> (MHNC-UP/ANF188), from Cambondo. Photo by Bruna Santos.	70
Fig. 29 (Fig. 23 Paper II) Life photo of <i>Arthroleptis carquejai</i> , from Serra do Pingano. Photo by Luis Ceríaco.	71
Fig. 30 (Fig. 24 Paper II) Specimen of <i>Leptopelis bocagii</i> (MHNC-UP/ANF186), from unknown locality. Photo by Bruna Santos.	72
Fig. 31 (Fig. 25 Paper II) Specimen of <i>Ptychadena ansorgii</i> (MHNC-UP/ANF332), from unknown locality. Photo by Bruna Santos.	73
Fig. 32 (Fig. 26 Paper II) Specimen of <i>Ptychadena oxyrhynchus</i> (MHNC-UP/ANF305), from unknown locality. Photo by Bruna Santos.	74
Fig. 33 (Fig. 27 Paper II) Specimen of <i>Phrynobatrachus</i> cf. <i>mababiensis</i> (MHNC-UP/ANF305), from Nonguai. Photo by Bruna Santos.	75
Fig. 34 (Fig. 28 Paper II) Life photo of <i>Phrynobatrachus</i> cf. <i>mababiensis</i> , from Maungo. Photo by Luis Ceríaco.	76
Fig. 35 (Fig. 29 Paper II) Specimen of <i>Phrynobatrachus</i> cf. <i>natalensis</i> (MHNC-UP/ANF312), from unknown locality. Photo by Bruna Santos.	77
Fig. 36 (Fig. 30 Paper II) Specimen of <i>Amietia angolensis</i> (MHNC-UP/ANF192), from N'dalatando. Photo by Bruna Santos.	78
Fig. 37 (Fig. 31 Paper II) Specimen of <i>Tomopterna ahli</i> (MHNC-UP/ANF225), from Moçâmedes. Photo by Bruna Santos.	79
Fig. 38 (Fig. 32 Paper II) Specimen of <i>Tomopterna tuberculosa</i> (MHNC-UP/ANF192), from unknown locality. Photo by Bruna Santos.	80
Fig. 39 (Fig. 33 Paper II) Specimen of <i>Chondrodactylus pulitzeræ</i> (MHNC-UP/REP203), from Baía dos Tigres. Photo by Bruna Santos.	82
Fig. 40 (Fig. 34 Paper II) Specimen of <i>Hemidactylus bayonii</i> (MHNC-UP/REP208), from Ambaca. Photo by Bruna Santos.	83

Fig. 41 (Fig. 35 Paper II) Specimen of <i>Hemidactylus longicephalus</i> (MHNC-UP/REP214), from Gumba. Photo by Bruna Santos.	84
Fig. 42 (Fig. 36 Paper II) Specimen of <i>Hemidactylus mabouia</i> (MHNC-UP/REP212), from Catete. Photo by Bruna Santos.	85
Fig. 43 (Fig. 37 Paper II) Specimen of <i>Pachydactylus rangei</i> (MHNC-UP/REP217), from Baía dos Tigres. Photo by Bruna Santos.	86
Fig. 44 (Fig. 38 Paper II) Life photo of <i>Pachydactylus rangei</i> , from Baía dos Tigres. Photo by Luis Ceríaco.	86
Fig. 45 (Fig. 39 Paper II) Specimen of <i>Meroles anchietae</i> (MHNC-UP/REP220), from Moçâmedes. Photo by Bruna Santos.	87
Fig. 46 (Fig. 40 Paper II) Life photo of <i>Meroles anchietae</i> , from Baía dos Tigres. Photo by Luis Ceríaco.	88
Fig. 47 (Fig. 41 Paper II) Specimen of <i>Meroles reticulatus</i> (MHNC-UP/REP227), from Moçâmedes. Photo by Bruna Santos.	89
Fig. 48 (Fig. 42 Paper II) Specimen of <i>Meroles reticulatus</i> from Baía dos Tigres. Photo by Luis Ceríaco.	89
Fig. 49 (Fig. 43 Paper II) Specimen of <i>Gerrhosaurus multilineatus</i> (MHNC-UP/REP233), from unknown locality. Photo by Bruna Santos.	90
Fig. 50 (Fig. 44 Paper II) Specimen of <i>Feylinia currori</i> (MHNC-UP/REP247), from unknown locality. Photo by Bruna Santos.	92
Fig. 51 (Fig. 45 Paper II) Specimen of <i>Mochlus sundevallii</i> (MHNC-UP/REP200), from unknown locality. Photo by Bruna Santos.	93
Fig. 52 (Fig. 46 Paper II) Specimen of <i>Panaspis cabindae</i> (MHNC-UP/REP267), from Catete. Photo by Bruna Santos.	94
Fig. 53 (Fig. 47 Paper II) Specimen of <i>Sepsina angolensis</i> (MHNC-UP/REP345), from Zembe. Photo by Bruna Santos.	95
Fig. 54 (Fig. 48 Paper II) Specimen of <i>Trachylepis albopunctata</i> (MHNC-UP/REP269), from Ambaca. Photo by Bruna Santos.	96

- Fig. 55** (Fig. 49 Paper II) Specimen of *Trachylepis bayonii* (MHNC-UP/REP276), from unknown locality. Photo by Bruna Santos. 97
- Fig. 56** (Fig. 50 Paper II) Specimen of *Trachylepis binotata* (MHNC-UP/REP268), from unknown locality. Photo by Bruna Santos. 98
- Fig. 57** (Fig. 51 Paper II) Specimen of *Trachylepis maculilabris* (MHNC-UP/REP272), from unknown locality. Photo by Bruna Santos. 99
- Fig. 58** (Fig. 52 Paper II) Specimen of *Trachylepis occidentalis* (MHNC-UP/REP273), from Baía dos Tigres. Photo by Bruna Santos. 100
- Fig. 59** (Fig. 53 Paper II) Specimen of *Trachylepis punctulata* (MHNC-UP/REP263), from Moçâmedes. Photo by Bruna Santos. 101
- Fig. 60** (Fig. 54 Paper II) Specimen of *Typhlacontias johnsonii* (MHNC-UP/REP281), from Moçâmedes. Photo by Bruna Santos. 102
- Fig. 61** (Fig. 55 Paper II) Specimen of *Typhlacontias punctatissimus bogerti* (MHNC-UP/REP284), from Moçâmedes. Photo by Bruna Santos. 103
- Fig. 62** (Fig. 56 Paper II) Specimen of *Chamaeleo dilepis* (MHNC-UP/REP303), from Moçâmedes. Photo by Bruna Santos. 105
- Fig. 63** (Fig. 57 Paper II) Specimen of *Chamaeleo gracilis* (MHNC-UP/REP293), from Hocco. Photo by Bruna Santos. 106
- Fig. 64** (Fig. 58 Paper II) Female specimen of *Agama sp.* (MHNC-UP/REP305), from unknown locality. Photo by Bruna Santos. 108
- Fig. 65** (Fig. 59 Paper II) Male specimen of *Agama sp.* (MHNC-UP/REP307), from unknown locality. Photo by Bruna Santos. 108
- Fig. 66** (Fig. 60 Paper II) Specimen of *Afrotyphlops lineolatus* (MHNC-UP/REP316), from Rio Luinha. Photo by Bruna Santos. 109
- Fig. 67** (Fig. 61 Paper II) Specimen of *Leptotyphlops cf. scutifrons* (MHNC-UP/REP333), from N'dalatando. Photo by Bruna Santos. 111
- Fig. 68** (Fig. 62 Paper II) Specimen of *Atheris cf. squamigera* (MHNC-UP/REP318), from Golungo Alto. Photo by Bruna Santos. 112

- Fig. 69** (Fig. 63 Paper II) Specimen of *Bitis (Bitis) arietans* (MHNC-UP/REP343), from Coroca. Photo by Bruna Santos. 113
- Fig. 70** (Fig. 64 Paper II) Specimen of *Bitis (Calechidna) caudalis* (MHNC-UP/REP322), from Moçâmedes. Photo by Bruna Santos. 114
- Fig. 71** (Fig. 65 Paper II) Specimen of *Bitis (Macrocerastes) gabonica* (MHNC-UP/REP346), from unknown locality. Photo by Bruna Santos. 115
- Fig. 72** (Fig. 66 Paper II) Specimen of *Causus resimus* (MHNC-UP/REP327), from unknown locality. Photo by Bruna Santos. 116
- Fig. 73** (Fig. 67 Paper II) Specimen of *Atractaspis bibronii* (MHNC-UP/REP321), from Moçâmedes. Photo by Bruna Santos. 117
- Fig. 74** (Fig. 68 Paper II) Specimen of *Atractaspis congica* (MHNC-UP/REP320), from unknown locality. Photo by Bruna Santos. 118
- Fig. 75** (Fig. 69 Paper II) Specimen of *Boaedon angolensis* (MHNC-UP/REP165), from unknown locality. Photo by Bruna Santos. 119
- Fig. 76** (Fig. 70 Paper II) Specimen of *Boaedon bocagei* (MHNC-UP/REP166), from unknown locality. Photo by Bruna Santos. 120
- Fig. 77** (Fig. 71 Paper II) Specimen of *Lycophidion meleagre* (MHNC-UP/REP325), from unknown locality. Photo by Bruna Santos. 121
- Fig. 78** (Fig. 72 Paper II) Specimen of *Lycophidion multimaculatum* (MHNC-UP/REP326), from unknown locality. Photo by Bruna Santos. 122
- Fig. 79** (Fig. 73 Paper II) Specimen of *Polemon colaris* (MHNC-UP/REP170), from Golungo Alto. Photo by Bruna Santos. 123
- Fig. 80** (Fig. 74 Paper II) Specimen of *Psammophis leopardinus* (MHNC-UP/REP173), from Rio Coróca. Photo by Bruna Santos. 124
- Fig. 81** (Fig. 75 Paper II) Specimen of *Psammophis mossambicus* (MHNC-UP/REP179), from unknown locality. Photo by Bruna Santos. 125
- Fig. 82** (Fig. 76 Paper II) Specimen of *Psammophis namibensis* (MHNC-UP/REP172), from unknown locality. Photo by Bruna Santos. 126

- Fig. 83** (Fig. 77 Paper II) Specimen of *Psammophis subtaeniatus* (MHNC-UP/REP175), from Moçâmedes. Photo by Bruna Santos. 127
- Fig. 84** (Fig. 78 Paper II) Specimen of *Naja nigricincta* (MHNC-UP/REP341), from África Occidental [=Occidental Africa]. Photo by Bruna Santos. 128
- Fig. 85** (Fig. 79 Paper II) Specimen of *Crotaphopeltis hotamboeia* (MHNC-UP/REP187), from N'dalatando. Photo by Bruna Santos. 129
- Fig. 86** (Fig. 80 Paper II) Specimen of *Dasypeltis palmarum* (MHNC-UP/REP194), from unknown locality. Photo by Bruna Santos. 130
- Fig. 87** (Fig. 81 Paper II) Specimen of *Dasypeltis* cf. *scabra* (MHNC-UP/REP193), from unknown locality. Photo by Bruna Santos. 131
- Fig. 88** (Fig. 82 Paper II) Specimen of *Grayia smythii* (MHNC-UP/REP196), from Cambondo. Photo by Bruna Santos. 132
- Fig. 89** (Fig. 83 Paper II) Specimen of *Philotamnus angolensis* (MHNC-UP/REP182), from unknown locality. Photo by Bruna Santos. 133
- Fig. 90** (Fig. 84 Paper II) Specimen of *Philotamnus* cf. *hoplogaster* (MHNC-UP/REP198), from unknown locality. Photo by Bruna Santos. 134
- Fig. 91** (Fig. 85 Paper II) Specimen of *Philotamnus* cf. *semivariiegatus* (MHNC-UP/REP197), from unknown locality. Photo by Bruna Santos. 135
- Fig. 92** (Fig. 1 Paper III) Dorsal and ventral a view of *Phrynomantis affinis* (MHNC 90.001 (or 2)) from Mulondo, Huila Province, Angola. Photo by Nicolas Marcgraf. 155
- Fig. 93** (Fig. 2 Paper III) Live photo (a) and ventral view of the left hand (b) of *Phrynomantis annectens* (LMPC 1149) from Malowe, base of Serra da Neve, Namibe Province, Angola. Photos by Luis M. P. Ceríaco. 156
- Fig. 94** (Fig. 3 Paper III) Dorsal view of *Phrynomantis annectens* (RMCA A.469) from Benguela, Benguela Province, Angola. Photo by Garin Cael. 156
- Fig. 95** (Fig. 4 Paper III) Live photo of *Phrynomantis bifasciatus* from Mozambique. Photo by Harith Farooq. 156
- Fig. 96** (Fig. 5 Paper III) Plate with the illustrations of Angolan *Phrynomantis bifasciatus* from Bocage (1895) *Herpétologie d'Angola et du Congo*. Adapted from Bocage (1895) 159

- Fig. 97** (Fig. 6 Paper III) Specimen of *Phrynomantis* cf. *bifasciatus* from “Chingo (Novo Redondo)” collected by Francisco Newton in 1903 (MHNCUP/ANF-194). Photo by Bruna Santos. 160
- Fig. 98** (Fig. 7 Paper III) Live photo of *Phrynomantis* cf. *bifasciatus* from Calumbo region, near Luanda. Specimen photographed in June 2019, but not collected. Photo by Manuel Castanho. 161
- Fig. 99** (Fig. 8 Paper III) Live photo of *Phrynomantis* cf. *bifasciatus* from Benfica neighborhood, city of Luanda. Specimen photographed in 24 April 2020, but not collected. Photo by Eduardo Catumbela. 161
- Fig. 100** (Fig. 9 Paper III) Distribution map of the three species of *Phrynomantis* in Angola and general distribution of the species in Africa. Blue circles: confirmed records of *P. affinis*; Open red triangles: confirmed records of *P. annectens*; Dotted red triangles: historical records of *P. annectens*; Open purple pentagons: confirmed records of *P. newtoni* **sp. nov.**; Dotted purple pentagon: historical records possibly referring to *P. newtoni* **sp. nov.**; Purple star: Type locality of *P. newtoni* **sp. nov.**. Historical records from Marques *et al.* (2018), confirmed records from this paper (Table 1). In the general map, blue: *P. affinis*; red: *P. annectens*; bright green: *P. bifasciatus*; orange: *P. microps*; purple: *P. newtoni* **sp. nov.**; dark green: *P. somalicus*. 168

List of Tables

Table 1. (Table 1 Paper I) Collecting localities from Newton’s Expedition. 22

Table 2. (Table 1 Paper II) Unlocated specimens published by Ferreira (1904, 1906).
..... 136

Table 3. (Table 1 Paper III) Specimens used for morphological and coloration
comparisons. 163

List of abbreviations I

AHA – Arquivo Histórico de Angola
AHU – Arquivo Histórico Ultramarino
APP – Academia Politécnica do Porto
CAC – Companhia Agrícola de Cazengo
ED – Eye diameter
EN – Eye-nostril distance
Fin4DW – Finger IV disk width
FT – Foot length
FLL – Forearm length
HAL – Hand length
HL – Head length
HW – Head width
IND – Internarinal distance
IOD – Interorbital distance
SL – Snout length
SVL – Snout-vent length
THL – Thigh length (THL)
TL – Tibia length
UEW - Upper eyelid width

List of abbreviations II (Museums)

AMNH – American Museum of Natural History

BMNH – Natural History Museum, London

CAS – California Academy of Sciences

INBAC/AMB – Instituto Nacional da Biodiversidade e Áreas de Conservação

MD – Museu Regional do Dundo

MHNC - Musée d' Histoire Naturelle de La Chaux-de-Fonds

MHNC-UP – Museu de História Natural e da Ciência da Universidade do Porto

RMCA – Royal Museum for Central Africa

UF – Florida Museum of Natural History

Main Introduction

Natural museum collections are our window into the past. Over centuries, they have become repositories of knowledge, helping us better understand how biodiversity has evolved through time and at the same time, allowing us to improve the way we do biodiversity research and conservation (Ponder *et al.* 2001; Suarez & Tsutsui 2004). Historical and type specimens are housed in these institutions and constitute the basis for systematic research – it can even be said that museums are the places that safeguard the planet's biodiversity (Dupérré 2020). However, a significant part of what is extant in museum collections remains unstudied, unpublished and has not been properly inventoried or inserted in modern databases (Ponder *et al.* 2001).

The early days of what is known today as Museu de História Natural e da Ciência da Universidade do Porto (MHNC-UP) date back to the second half of the nineteenth century (Ceríaco *et al.* 2014). Augusto Nobre (1865–1946), a Porto born zoologist and assistant professor at Academia Politécnica do Porto (APP; precursor of University of Porto) was assigned to create a small zoological museum at the institution little before the turn of the century. At time, in regards to natural history, the city of Porto was lagging behind what had already started being developed in Lisbon and Coimbra, both with zoological museums of their own and commissioning expeditions to collect in Africa and Portugal (Ceríaco *in press*). With time, the zoological section of the museum grew, and other areas of science had their own major collections. MHNC-UP today encompasses both the old natural history and science museums of the university (Museu de História Natural da U.Porto and Museu da Ciência da U.Porto) and is presently being restructured and refurbished. It houses historical collections of zoology, botany, geology, archaeology, paleontology, ethnography and science. Its collections have recently begun to be reassessed and this project is one of the few currently ongoing.

In late nineteenth century, Angola was a hotspot for zoological expeditions from institutions from all around the world, during a particular period known as “Scramble for Africa”, and Portugal was no exception (Marques *et al.* 2018). In order to enrich APP's collections, Nobre entrusted his childhood friend Francisco Newton (1864–1909) (Nobre 1945) to conduct a zoological expedition to Angola. When commissioned by the APP, Francisco Newton was already an experienced naturalist, having conducted several expeditions to Africa. By 1902, he had already traveled and collected in Cabo Verde, Guinea-Bissau, Timor, São Tomé and Príncipe and Angola, where he first began his career as a naturalist (Figueiredo *et al.* 2019). This expedition would result in a collection

of several hundred zoological specimens collected from over 80 localities in the provinces of Bengo, Luanda, Kwanza Norte, Kwanza Sul and Namibe. The herpetological collection constitutes the largest collection of amphibians and reptiles housed today in MHNC-UP (328 specimens) and is the main topic of this thesis.

Besides being one of the biggest African countries at 1,250,000 km², Angola has a heterogenous landscape that supports a very rich and diverse biota (Marques *et al.* 2018; Huntley *et al.* 2019). In comparison to neighboring countries, it is one of the richest in terms of both amphibian and reptile diversity, at the same time it has a high number of endemic species (Marques *et al.* 2018). Despite that, it also has one of the most poorly studied faunas, especially when it comes to amphibians and reptiles. Since Bocage's publication of *Herpétologie d'Angola et du Congo* in 1895, the only major compilation of Angolan herpetofauna is Marques *et al.* (2018) recent atlas of amphibians and terrestrial reptiles. The armed conflicts that closed the country off to scientific research majorly hindered the scientific progress, but recent years have seen a new wave of researchers focusing on Angolan herpetology and discovering dozens of new species.

Main objectives

Newton's collection has remained practically untouched since the 1900's and little is known from the expedition itself. After the initial studies on the material he collected and that were published by some of his peers (herpetological specimens: Ferreira 1904, 1906; mammals and birds: Seabra 1905a, 1905b, 1905c, 1906a, 1906b, 1906c, 1907, 1909; and the mollusks: Nobre 1905), most of the specimens have since then never been properly reviewed.

Given this, the main objectives of this thesis were to: 1) reconstruct Newton's expedition and his itineraries; 2) reassess the taxonomic status of the herpetological specimens; 3) showcase the importance of zoological missions to the study of biodiversity; and finally, 4) highlight the knowledge hidden in old museum shelves that needs to be critically reassessed.

For that purpose, this dissertation is divided in three chapters, each construed as a stand-alone scientific paper. The first paper has been submitted to *Bibliotheca Herpetologica*, the second one to *Zootaxa* and the third to *Alytes*, where it is currently under review by two anonymous reviewers. All papers have been formatted according to the rules of the journal they are being submitted to, and are composed by an

introduction, material and methods, results, discussion and references of their own. The versions hereby presented are not final as they do not constitute published work. In accordance to article 8.2 of the International Code of Zoological Nomenclature, a work that contains a statement to the effect that it is not issued for public and permanent scientific record, or for purposes of zoological nomenclature, is not published within the meaning of the Code (ICZN 1999).

Chapter I

**Paper I – Francisco Newton's Zoological
Expedition to Angola (1903–1906). I.
Itineraries and main results.¹**

¹ Paper submitted to *Biblioteca Herpetologica*.

Paper I – Francisco Newton's Zoological Expedition to Angola (1903–1906). I. Itineraries and main results.

Abstract

Francisco Newton (1864–1909) was an important Portuguese naturalist who conducted several expeditions for more than 25 years during the late nineteenth and early twentieth century and who greatly contributed to the study of Portuguese overseas colonies. In 1902, Newton was nominated for a zoological survey of Angola, commissioned by the Academia Politécnica do Porto (APP; precursor of University of Porto), an institution that had recently started to develop a zoological museum. Between 1903 and 1906, Newton collected several hundred zoological specimens that resulted in the description of 28 new taxa. Here we present a reconstruction of the expedition, providing georeferenced collecting localities and other historical data.

Key words History of Science; Natural history collections; Angolan zoology; Taxonomy; Scramble for Africa.

Resumo

Francisco Newton (1864–1909) foi um importante naturalista Português que encabeçou várias expedições durante mais de 25 anos durante o fim do século XIX e início do século XX, tendo contribuído sobejamente para o estudo das colónias Portuguesas no Ultramar. Em 1902, Newton foi nomeado para uma expedição zoológica a Angola, contratado pela Academia Politécnica do Porto (APP; precursora da Universidade do Porto), uma instituição que tinha recentemente começado a desenvolver um museu zoológico. Entre 1903 e 1906, Newton coletou várias centenas de espécimes zoológicos que resultaram na descrição de 28 novas espécies. Neste artigo apresentamos uma reconstrução cronológica da expedição, com as localidades de coleta georreferenciadas e outros dados históricos.

Palavras chave História da Ciência; Coleções de História Natural; Zoologia Angolana; Taxonomia; Scramble for Africa.

Introduction

Francisco Xavier Oakley de Aguiar Newton (1864–1909; **Fig. 1**), commonly known as Francisco Newton, was a Portuguese naturalist that dedicated his career to the exploration of several former Portuguese territories in Africa and Asia. Despite the importance of his work to the study and knowledge of fauna and flora of many African countries, his life and work remain poorly known by modern day researchers and historians of science. Only two short biographical notes were ever published about his life (Silva, 1940; Figueiredo et al., 2019), and aside from these, Francisco Newton's name is only known from the eponyms of the species described in his honor, through the labels on the specimens he collected and that are still extant in natural history collections, and in the credits/acknowledgments on the papers published by several authors who used specimens he collected. Francisco Newton was born in Porto, northern Portugal, on 18 May 1864, being the second eldest son (Anonymous 1878) of Isaac Newton (1840–1906), a Porto salesman and clerk of English and Irish descent who was also an amateur naturalist who actively collected for the natural history museums and herbariums of Lisbon, Coimbra and Porto (Sampaio 1946, 1947). Among his childhood friends was Augusto Pereira Nobre (1865–1946), who would later become naturalist and director of the Zoological Museum of the Academia Politécnica do Porto (APP; Polytechnic Academy of Porto) from 1891 to 1935 (Nobre, 1945).

Although there is no information regarding Francisco Newton's education or activities as a young man, at the young age of 16, when he embarked to the Portuguese colony of Angola (southwestern Africa) to conduct botanical surveys (Figueiredo et al., 2019) he was already fluent in English and French (Anonymous 1892a). This expedition lasted from 1880 to late 1884 or early 1885 and can be understood as Newton's own initiative to gain experience in field work in Africa and promote himself as a naturalist (Figueiredo et al., 2019). During this trip, Newton collected extensively in the southwestern parts of Angola in the company of well-known botanical collectors and naturalists, such as the Swedish settler and explorer Axel Wilhelm Eriksson (1846–1901), the English explorer Henry Hamilton Johnston (1858–1927), the French missionary and explorer Charles Victor Aubert Duparquet (1830–1888), the Earl of Mayo, Dermot Robert Wyndham-Bourke (1851–1927) and the famous “lion-hunter” from southern Angola, Nestor da Costa (dates of birth and death unknown) (Henriques, 1885; Figueiredo et al., 2019). The results of this expedition consisted of hundreds of plant specimens distributed through several herbarium across the world, as well as the description of over fifty new botanical taxa (Figueiredo et al., 2019).



Fig. 1 – Portrait of Francisco Newton (1864–1909) (Source: Arquivo Histórico Museu Bocage).

After the success of his first expedition in Africa, Newton proposed a zoological mission to São Tomé and Príncipe to the Portuguese Government on 27 July 1885 (Newton, 1885; Silva, 1940; Figueiredo et al., 2019). From October 1885 to January 1892, Newton collected specimens from the Gulf of Guinea islands, as well as in the Portuguese protectorate of Dahomey (currently Benin) in 1886 (Figueiredo et al., 2019). Back in Portugal in 1892, Newton gave a conference on 30 May at the Ateneu Comercial do Porto, a cultural association created by clerks and merchants, to which he donated ethnographic objects from his previous excursions (Anonymous, 1892b). Part of these objects were sent in the early 1990's to the Faculty of Sciences of the University of Porto and were integrated in its museum (currently Museu da História Natural e da Ciência da Universidade do Porto, MHNC-UP). After a few months in Portugal, Newton returned to the Gulf of Guinea to resume the expedition, which would last until April of 1895, with

surveys in the São Tomé and Príncipe islands, Fernando Pó (currently Bioko, Equatorial Guinea) and Annobon (currently part of Equatorial Guinea) (Figueiredo et al., 2019). After completing his commission to explore the Gulf of Guinea, Newton was re-assigned on 15 October 1895 by the Portuguese Government for another two-year mission, this time to the Portuguese colony of Timor (Anonymous, 1895). This mission lasted from 1896 to April 1897 (Anonymous, 1897; Newton, 1897). In 1898, Newton requested a new assignment for naturalistic surveys of the Portuguese overseas (Newton, 1898), which was granted by the Government as a contract to explore Guinea-Bissau and the islands of Cabo Verde, where he stayed from 1898 to 1902, collecting specimens of fauna and flora (Figueiredo, et al., 2019). Back in Portugal he was nominated for an expedition to Angola (Anonymous, 1902), commissioned by the Academia Politécnica do Porto. This expedition lasted from 1903 to 1906. After returning from the Angolan trip, Newton was assigned to a new excursion to Guinea-Bissau in 1907 (Anonymous, 1907a), which was eventually changed to Cabo Verde due to the heavy rains in the colony (Anonymous, 1907b). Shortly after, his contract was terminated by the Portuguese Government, following a complaint regarding his behavior issued by the province's governor (Anonymous, 1908a; Anonymous, 1908b; Anonymous, 1908c). Before passing away, the naturalist would request to be sent one more time to overseas (Newton, 1909), either “to Angola or Guinea-Bissau” but the request ended up being denied (Ferreira, 1909) and he died some months later on 9 December 1909 from a liver infection (pers comm from the Cemetery Offices of Matosinhos Municipality). His collections were crucial for many of the first descriptions of fauna in São Tomé and Príncipe, Annobon, Bioko, Timor and Cape Verde, resulting in numerous publications. Silva (1940) considers Newton one of the most important zoological explorers of the Portuguese overseas colonies.

In this paper we review the history and itineraries (including collecting localities) of Francisco Newton's expedition to Angola (1903–1906) and provide a baseline for further research on the extant collections housed in the MHNC-UP.

Materials and Methods

In order to review and reconstruct the itineraries and history of the expedition, we consulted archives, bibliography and museum specimens. We focused mainly on records archived on MHNC-UP, on the Arquivo Histórico Ultramarino (AHU) and on Arquivo Histórico de Angola (AHA). As for bibliography, we consulted the published papers resulting from the study of the Newton's Angolan expedition collections (Ferreira 1904, 1906; Nobre, 1905; Seabra 1905a, 1905b, 1905c, 1906a, 1906b, 1906c, 1907,

1909) as well as recent reviews done by Ceríaco et al. (2014) and Marques et al. (2018). The MHNC-UP collection specimens were examined and all present data was cross-referenced with the museum internal databases, documentation and the resulting papers. Locality data is hereby reported in the form of decimal degrees and uses the WGS 84 map datum (**Table 1**). Records derive mainly from Marques et al. (2018), from research conducted in old maps (georeferenced using GEOLocate's web application [<https://www.geo-locate.org/web/WebGeoref.aspx>]) and the website "Falling Rain" (<http://fallingrain.com/world/>). Elevations are all reported as meters above sea level.

The Academia Politécnica do Porto expedition

In January 1902, while still in São Nicolau Island, Cabo Verde, Francisco Newton was informed that his commission as naturalist in Cabo Verde was about to be terminated by direct orders of the Ministry of the Navy. In a letter dated 13 January 1902 to Baltazar Osório (1855–1926), naturalist in the Zoological Section of the Natural History Museum of Lisbon (MBL), Newton expressed his concerns about this decision, and asked "where does the Government want to send a man who has been a servant of the state for 18 years?" (Newton, 1902a). In this letter, Newton also expresses his concerns about his future, denoting that he would be happy to work wherever the Government sent him: "Mozambique, India or other interesting points. I accept anything – as long as they [the Government] don't leave me without bread". In a following letter, dated 22 January 1902, Newton confirms the Ministry's decision to Baltazar Osório, and further disclosures his precarious and grim future – the explorer planned to beg the Ministry to let him stay a few more months in Cabo Verde, even without receiving payment, as he was worried that if he was sent back to Portugal in the middle of the winter, he would eventually not make it through the season (Newton, 1902b). These letters elucidate the difficulties Newton faced as a naturalist explorer. Despite being friends with the high society of Porto, Newton's family was modest and himself, as an explorer working for the Government, did not have enough savings to live a stable life in Portugal.

At the same time Newton's commission was terminated, his hometown of Porto was experiencing important developments regarding its scientific and natural history institutions. While Newton was in Africa, his childhood friend Augusto Nobre was entrusted to establish and develop a zoological museum in the Academia Politécnica do Porto (APP), that would serve to support the natural sciences classes, but also to promote zoological research. Nobre was initially appointed as assistant professor of

Zoology in 1891 and as the main naturalist of the museum in 1901 (Machado, 1946). In order to enrich its collections, but also to foster the study of the natural history of the northern regions of Portugal, the museum promoted several expeditions in the country (Nobre, 1935). After the end of his commission for the Lisbon museum in 1902, Newton returned to Porto to support his ill father (Sampaio, 1946). Given his difficult financial and personal situation, his childhood group of friends arranged a way to support him. Taking advantage of the plans to enrich the collections of the APP, Augusto Nobre managed to assemble a group of local men of influence to hire Newton as an explorer for the museum. Newton was hired by the Academy to lead a zoological expedition to Angola to enrich its museum with new specimens and collections. The expedition was organized not only by the chair of Zoology Aarão Ferreira de Lacerda (1863–1921) and Augusto Nobre, but also by Bento de Sousa Carqueja (1860–1935), a reputable businessman from Porto, co-owner of the local newspaper *O Comércio do Porto* and at the same time naturalist and professor at the APP. It is probable that Carqueja himself provided funds for the expedition.

Newton's 1903–1906 Angola Expedition

Newton's 1903–1906 expedition to Angola occurred at a later stage of the so-called "Scramble for Africa", but nevertheless yielded some of the most important collections of his life. From these collections, a total of nine amphibian taxa, one reptile and sixteen mollusks were described as new to science by its contemporaries (Ferreira 1904, 1906; Nobre, 1905), while two other species (one snake and one frog) have more recently been described using its specimens as type material (Hallermann et al., 2020; Chapter 3). At the time, the colony of Angola was a growing economy, benefitting from both Portuguese and foreign investment in several industries, as coffee, cotton plantations and fishing. Multiple railroad systems had been recently commissioned by the Portuguese Government and were being built or had just been inaugurated, which contributed to connect coastal cities of Luanda, Benguela, Moçâmedes and Porto Amboim to the hinterlands. Newton's expedition was the first major zoological survey commissioned by the Portuguese Government to Angola after the death of the famous naturalist and explorer José de Anchieta (1832–1897), who explored the colony for over thirty years and greatly contributed to the knowledge of its fauna (Marques et al., 2018).

On 29 October 1902, Newton was appointed by the Portuguese Government for a zoologic expedition to Angola (Anonymous, 1902), in order to collect specimens for APP. Newton officially started his appointment on 4 March 1903 (Anonymous, 1906a),

after departing from Portugal on 6 February 1903 (Anonymous [undated] a). Not surprisingly, on the eve of his departure to Angola, his friends including Augusto Nobre, organized him a farewell dinner (Brandão *in* Sampaio, 1946). Although the entry port in Angola is unknown, Newton most likely arrived in Luanda, the colony's capital. Luanda was a city undergoing major economic growth and societal changes and was starting to lose its fame as the slave trade port it had once been (Amaral, 1978). An example of that was the new railroad that connected Luanda to Ambaca-Lucala, constructed from 1886 to 1899 (Pereira, 2017; Diogo & Navarro, 2018), which had a pivotal role on the exportation of coffee crops of the Cazengo region plantations (currently Kwanza Norte province), north of the Cuanza river (Van Dongen, 1961).

From Luanda, the naturalist departed directly to Novo Redondo (today known as Sumbe, capital of the Kwanza Sul province), which he used as a base for the first part of his expedition. Despite being a small port, Novo Redondo was an important economic market, which became particularly significant in early twentieth century, due to its role on the second wave of coffee production in Angola, mostly based on coffee crops from the *concelho* [district] of Seles (Van Dongen, 1961). Together with Porto Amboim, these were two of the most important ports for coffee exportation south of the Cuanza river (Van Dongen, 1961).

In 14 May 1903, the naturalist wrote a first letter from “Gumba, Serra de Selles, Novo Redondo province” [=Gumba] stating that he had already collected some specimens and provided an estimate of the diversity and number of specimens he thought he could collect each month (Newton, 1903a). During this initial period, Newton collected several specimens of mammals (later studied and published by Seabra 1905a, 1906a), amphibians and reptiles (later published by Ferreira, 1904), and several mollusks (later studied and published by Nobre, 1905, some of which were new species) in the localities of Gumba, Lembu, Serra de Selles, Chingo, Ambuim, Encuacre and Novo Redondo (see **Table 1**; see **Fig. 2**). While in the region, Newton experienced logistical difficulties and health problems (Anonymous, 1903a). On 14 June 1903, the Ministry of the Navy addressed the Government of Angola, requesting all needed assistance to be provided to Newton, in order to fulfill his mission (Anonymous, 1903b). A few days later on 25 June 1903, still in Novo Redondo, the naturalist wrote to Aarão de Lacerda and provided an initial report of the difficulties he had experienced during the first three months in the colony, criticizing the lack of logistical and institutional support from the Colonial authorities, which in his opinion had greatly hindered his activities (Newton, 1903b). Nevertheless, the collections resulting of that initial month of work were able to

fill seven boxes of zoological specimens that were sent to Portugal on 6 July 1903 and 25 July 1903 (Anonymous 1903c, 1903d, 1903e).

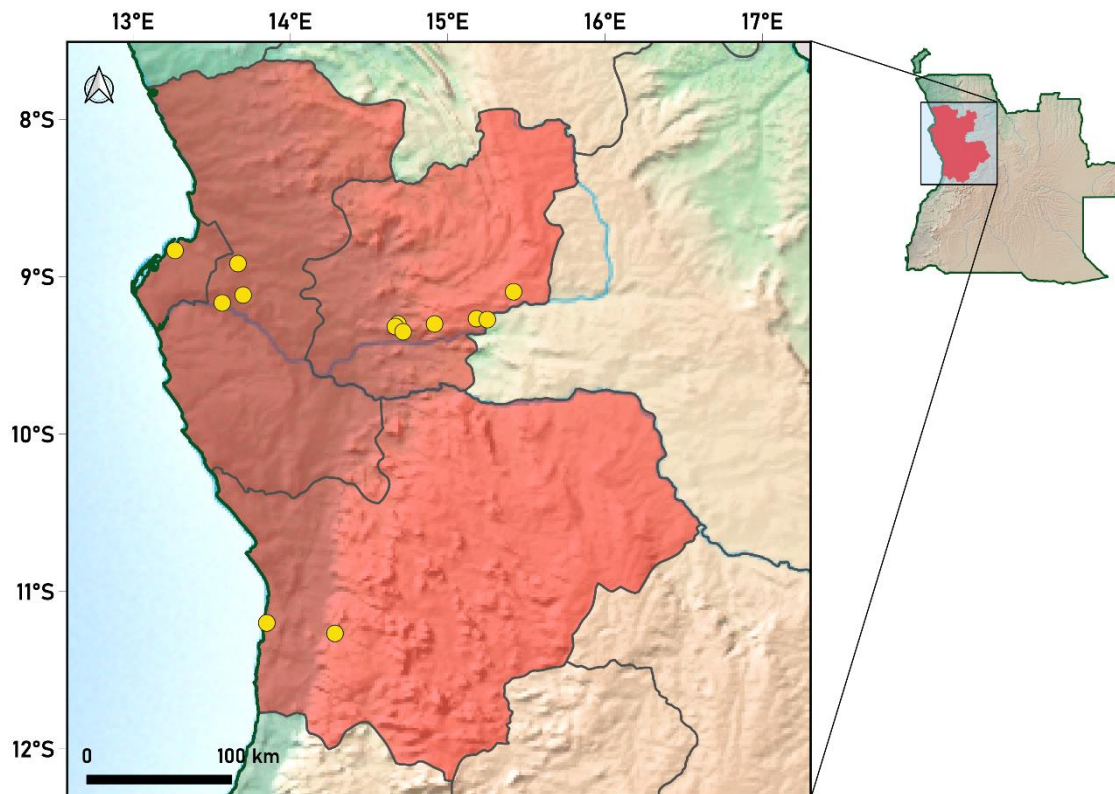


Fig. 2 – Map of collecting localities for the first part of Newton's expedition (March to September 1903). From left to right (pink shaded polygons): Luanda, Bengo, Kwanza Norte (top) and Kwanza Sul (bottom) provinces.

At an unknown date, most likely by the end of May or the beginning of June, Newton departed from Novo Redondo and headed north towards the N'Dalla Tando region, currently in the Kwanza Norte province. *En route* he collected birds from Quitenha (undetermined location; see **Table 1**) and amphibians from Cabiri (Bengo province) in June and July of 1903 respectively. In August 1903, the naturalist collected specimens of mammals (Seabra, 1905a), amphibians and reptiles (Ferreira, 1904) and mollusks (Nobre, 1905) in different localities in Kwanza Norte province, namely Ambaca (Pomba), Lucalla, N'Dalla Tando, Palmyra, Serra de Stombe (undetermined location) and Zembe (see **Table 1**; see **Fig. 2**) (Anonymous [undated c]). During these incursions Newton used Palmyra, a plantation (*fazenda*) from the Cazengo Agricultural Company (CAC) (Mata et al., 2017) as its main base (Newton, 1903c). Founded in 1900, following the 1890s boom in coffee prices, the CAC was one of the few examples of Portuguese funded entrepreneurship in the colony, as the majority of investments in the Portuguese Empire were funded by foreign companies (Mata et al., 2017). This combined with the

recent construction of the railway (Luanda–Ambaca), promoted the growth of the agricultural industry in the region, as well as other localities in the Cazengo district. The railroad perfectly fit the needs of the coffee producers, with the stations of N'Dalla Tando and Lucala receiving most of the shipments (Van Dongen, 1961), and it's very likely that Newton took advantage of these infrastructures during his field work there. On the other hand, the small town of Ambaca was, since late seventeenth century, a mandatory crossing point for slave trade from the interior of the province to Luanda, as well as for the goods headed from the coast towards the inlands (Vansina, 2005). By the time Newton collected in the region, Ambaca was vital as a trade outpost. From there, the naturalist moved to Luanda where, on 16 September 1903 (Anonymous, 1903f), he delivered ten boxes containing the recently collected specimens intended to be shipped to Portugal.

He returned to *fazenda* Palmyra on 19 September 1903 to prepare the next phase of the expedition (Newton, 1903c). The same month was spent collecting specimens of amphibians, reptiles, mammals and mollusks in several localities in the provinces of Kwanza Norte, as Catari, Cabicula, Cazengo, Hôcco, N'Dalla Tando, and Zembe, but also in several localities in Kwanza Sul (Chingo and Novo Redondo) and Bengo (Cabiri and Catete) provinces, as well as from “Quitinha (Rio Quango)” (undetermined locality) (see **Table 1**; see **Fig. 2**) (Anonymous [undated] c). In, Hôcco, also a *fazenda* belonging to the Cazengo Agricultural Company (CAC) (Mata et al., 2017), Newton met the Portuguese captain Frederico Trigo Teixeira (**Fig. 3**), who offered him a chameleon specimen (MHNC-UP/REP 293). The boxes containing these specimens were initially left in Cazengo on 5 October 1903 (Anonymous, 1903g) to be shipped to Luanda, from where they were shipped to Portugal on 8 October 1903 (Anonymous, 1903h).



Fig. 3 – Portrait of Captain Frederico Cezar Trigo Teixeira (dates of birth and death unknown) (Source: Arquivo Histórico Ultramarino).

Newton headed back to Luanda in November, collecting specimens along the way through the provinces of Kwanza Norte (N'Dalla Tando and Prototipo [also known as Prototymo (Mata et al., 2017), another CAC *fazenda*]), Bengo (Bom Jesus, Cacullo, Caxicâne, margens do Quanza, Cunga and Cacuaco), but also in “Dondo Anzêlle”, “Icolo e Bengo” and “Lagoa Quitenha” (undetermined localities) (see **Table 1**; see **Fig. 4**) (Newton 1903d, 1903e). Sometime in December, Newton collected reptiles in Palmyra (Anonymous [undated] c). Two letters addressed to Aarão de Lacerda place Newton in Luanda on 24 November and 5 December (Newton 1903f, g), from where the six boxes of specimens that resulted from this last part of the trip were sent to Portugal on 24 November and 14 December (Anonymous 1903i, 1903j).

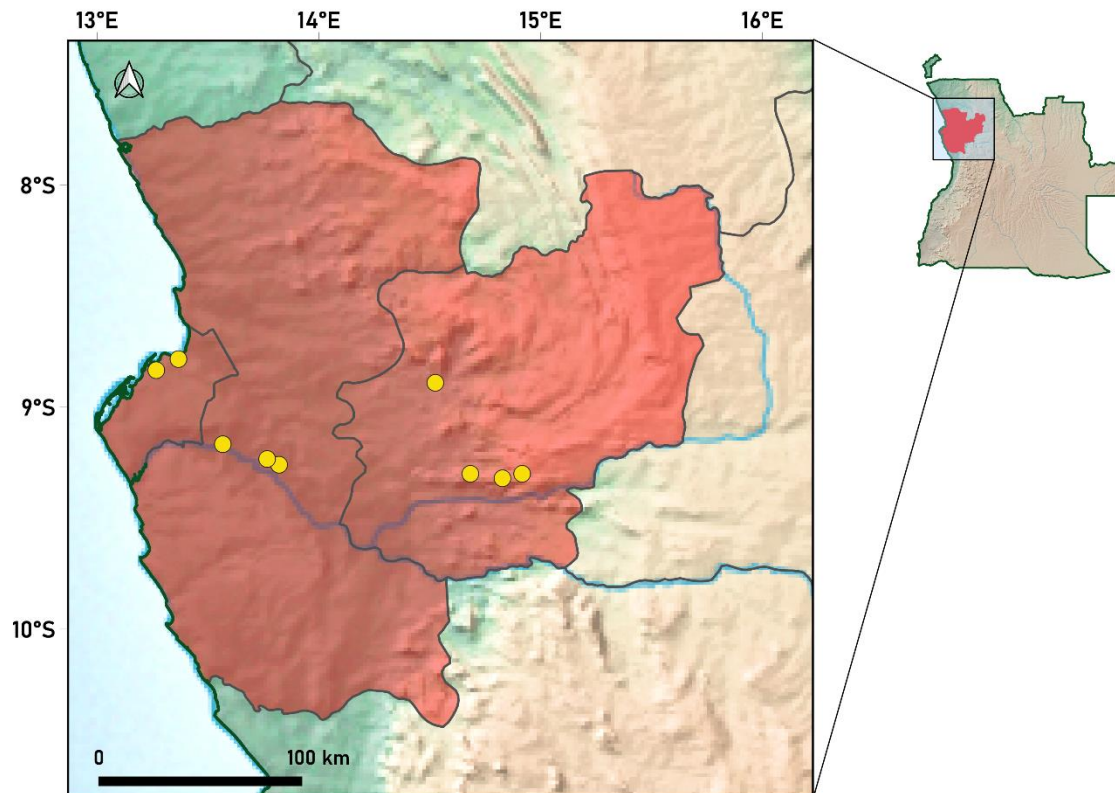


Fig. 4 – Map of collecting localities for the second part of Newton's expedition (October to December 1903).

From left to right (pink shaded polygons): Luanda, Bengo and Kwanza Norte provinces.

From January to May 1904, the naturalist made his last incursion in the northern part of the country, mainly in the provinces of Kwanza Norte (Bango, Bango Aquitamba, Cacólobôlo, Cambondo, Camilungo, Camuanze, Golungo Alto, Luinha, Rio Cuango, Golungo Alto, Messo Cassuco, Monte Alegre, Florestas Mupépe, N'Delle, N'Golla Bumba, Quéta", Quilombo, Zanga) and Bengo (Quissanga) (see **Table 1**; see **Fig. 5**). Newton also collected specimens from Cavernas de Quimvanda, próximo de Golungo Alto, Cafuxi, Florestas Kakolo, Florestas Kalala, Florestas Margens do Quanza, Katála, Margens do Rio Quiapose, Riacho Cate, Rio Lucué and Rio Zenga (undetermined localities, see **Table 1**) (Anonymous [undated] b, c; Newton, 1904a). Some of these localities represent areas of importance to the Portuguese colonial enterprise, as for example Monte Alegre and Bango Aquitamba. Monte Alegre (also "Montealegre") was a *fazenda* that belonged to the CAC. Bango Aquitamba dates back at least from 1689, when the Carmelitas Descalços (Barefoot Carmelites) established a Catholic mission in the locality and built a church (Lima, 1846). The land belonged to the Soba (= traditional leader) of Bango Aquitamba. In 1846, the Soba was known to be one of the most important farmers in Golungo Alto, leading the Luanda Government to try to persuade him to grow crops of cotton, coffee and tobacco, in order to stimulate the agricultural

production in the colony (Ferreira, 2013). From the aforementioned localities, Newton collected specimens of amphibians, birds, crustaceans, fishes, insects, mammals, mollusks and reptiles, of which some were published and include the description of several new species (Ferreira, 1906; Nobre, 1905; Seabra 1905a, 1905b), resulting in eight boxes of specimens (including mineralogical collections), that were shipped from Luanda on 13 February, 13 April and 24 May (Anonymous 1904a, 1904b, 1904c).

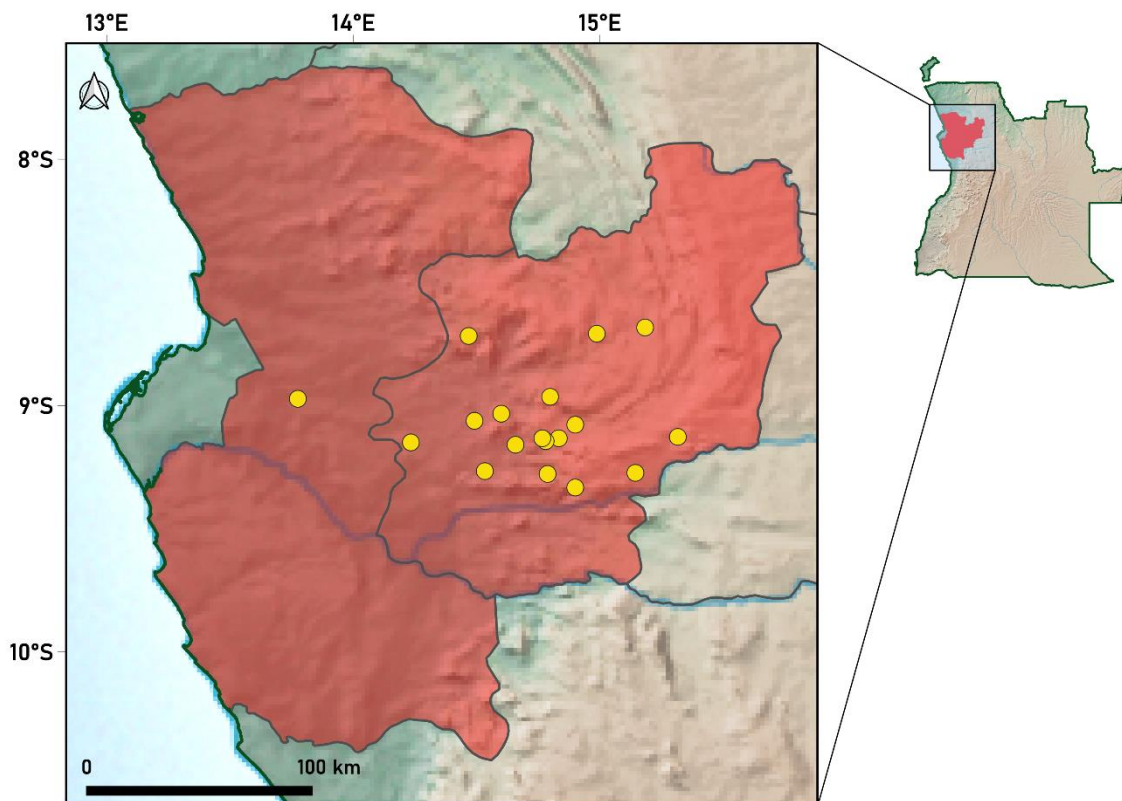


Fig. 5 – Map of collecting localities for the third part of Newton's expedition (January to May 1904). From left to right (pink shaded polygons): Bengo and Kwanza Norte provinces.

The last part of Newton's journey to Angola took place in the southwestern Province of Namibe (see **Fig. 6**). The early colonization of this region started in the end of the 1830's (Pereira, 2018), when settlers from the Azores, Madeira, Algarve and Póvoa de Varzim (northern Portugal) (Medeiros, 1972) established themselves in the towns of Mossâmedes, Porto Alexandre, São Januário and Sá da Bandeira (Pereira, 2018). By 1890, fishing was the main economic activity in southern Angola, becoming known as its "white-gold" (Clarence-Smith, 1976). When Newton collected in the region, Mossâmedes (now Moçâmedes) was a town ("vila") undergoing rapid development, being raised to city status in 1907. At the time, the province was subject to major investments from the Portuguese Government, namely the construction of a railroad

system to connect Mossâmedes to the highlands of Huíla, allowing the city to exponentially grow (Amaral, 1978; Pereira, 2018), while Porto Alexandre (currently Tômbua) was rising in importance as a port due to its fishing industry (Mendes, 2005).

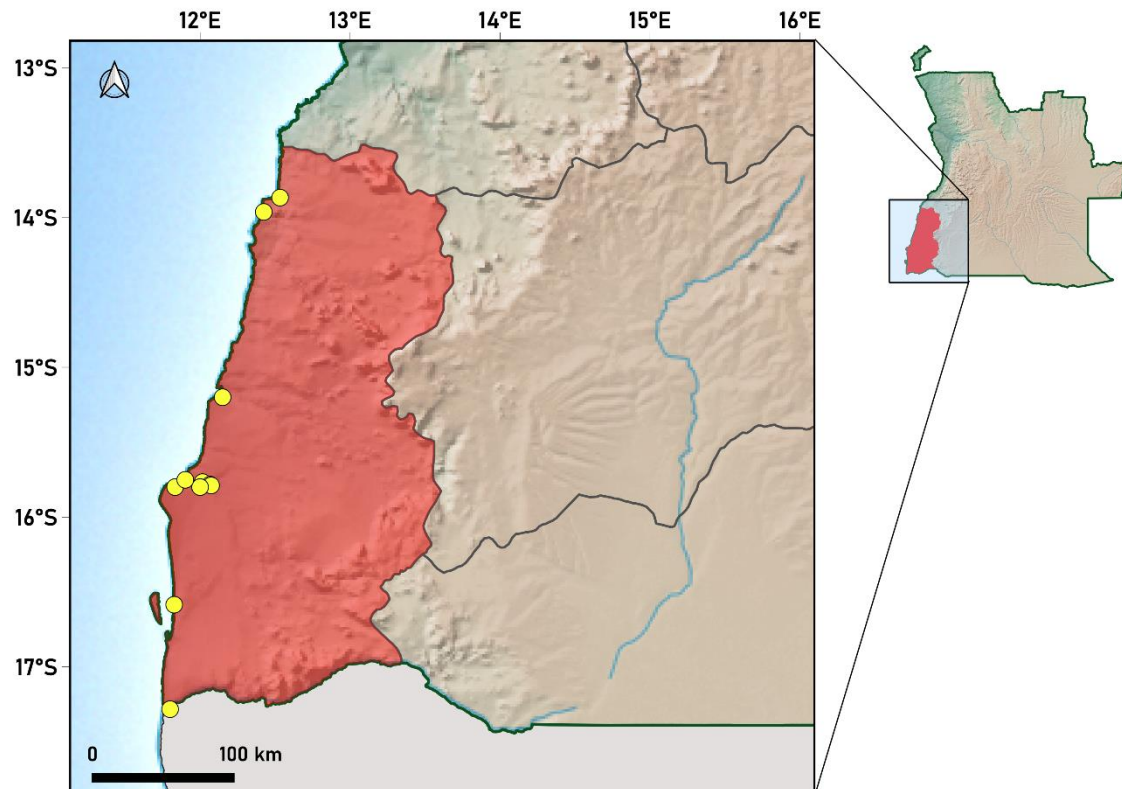


Fig. 6 – Map of collecting localities for the last part of Newton's expedition (June 1904 to February 1905). Pink shaded polygon: Namibe Province.

On June 1904 Newton began his incursion in the southwestern coastal regions of Angola. During the months of June and July, the naturalist explored the coastal town of Porto Alexandre and its vicinity (Bahia de Porto Alexandre and Cabo Negro de Porto Alexandre), as well as the surrounding wetter areas of Camilunga, the Coroca River and its plains and lagoons, Pinda and Unguay [=Nonguai], from where he collected birds (Seabra, 1906c) and reptiles (unpublished) (see **Table 1**; see **Fig. 6**) (Anonymous, [undated] b). In a letter dated 5 July, the naturalist wrote from “Margens do Rio Coroca”, asking for permission to request the materials he needed in order to continue his exploration of the south, namely in the regions between the Coroca and Cunene rivers (Newton, 1904b). Besides the above-mentioned localities, bird specimens extant in MHNC-UP and collected in July 1904 bear the localities of Lagoa do Tua, Mu-rondo and N. Jumbo, which we were unable geolocate (see **Table 1**).

In the months of August, September and October of the same year, Newton surveyed Porto Alexandre and neighboring areas, such as Cabo Negro, Pinda, Coroca river and its lagoons (currently known as Lagoa do Arco) and Chacuto (undetermined), where he continued to collect amphibians, birds, fishes, crustaceans, insects, mammals, mollusks and reptiles (unpublished) (see **Table 1**; see **Fig. 6**) (Anonymous, [undated] c). In November, the naturalist collected birds in Porto Alexandre and Mossâmedes, and in December traveled to the Cunene river mouth, stopping by Bahia dos Tigres on the way (Newton, 1904c) (see **Table 1**; see **Fig. 6**), and collecting once again birds (published by Seabra, 1907), crustaceans, fishes, insects and mammals in both regions (Anonymous, [undated] c). This trip must have been made through the coastal desert strip.

In a letter presented to the authorities of Mossâmedes dated 20 February 1905, Newton requested additional material to continue his trip (Anonymous, 1905a). Extant ornithological specimens still housed in MHNC-UP from Cabo Negro dated from February 1905 show that he was still actively collecting at the time. Additionally, a shipment of eight boxes with zoological specimens departed from Luanda on 11 February (Anonymous, 1905b). Seabra (1907, 1909) cited birds and mammals from Mossâmedes, Pinda and Porto Alexandre for the year of 1905, although with no indication of month. All the amphibians, reptiles, invertebrates and fishes still extant in MHNC-UP from Bahia dos Tigres and Mossâmedes remain unpublished. According to specimen lists from the expedition, Newton also collected in Lucira and Carumjamba (Namibe province), although no specimens from these localities were located in MHNC-UP collections (Anonymous, [undated] c). Furthermore, Seabra (1905c, 1906b, 1906c, 1907) published ornithological specimens from this part of the trip, matching the aforementioned localities, but the majority lacked collecting date, making it difficult to assign them to the corresponding months.

Later that year, five boxes and a case of zoological specimens were shipped from Luanda on 1 September and three additional cases on 10 November from Benguela (Anonymous 1905c, 1905d). Those are the last recorded shipments from the expedition. From that point onwards, Newton's whereabouts are unknown until the moment he leaves the country in 1906. We found no extant specimens dated from February 1905 to April 1906. According to documentation from the Government of Angola, the naturalist returned to Portugal on 12 April 1906, departing from Luanda to Lisbon (Anonymous, 1906b). Newton was said to be ill by the Health Department of the Military Hospital,

suffering from malaria (“Anemia palustre”) (Anonymous, 1906a), and thus justifying the inevitability of his return to the metropole.

Back in Portugal, a request was issued to the Ministry of the Navy on 9 May (Oliveira, 1906), asking for a three-month long subsidy (about half of his monthly salary) on behalf of Francisco Newton, as the explorer was still suffering from malaria. Two extensions were requested, on 26 July (Newton, 1906; Ferreira, 1906) and 2 November (Leão, 1906), as he still needed more time to recover from his acute malaria (“anemia palustre profunda”). The following year, on 10 April 1907, Newton was nominated for a zoological survey of Guinea Bissau, where he would be collecting for APP (Anonymous, 1907a). There are no extant specimens in MHNC-UP from that expedition or any records attesting to his nomination. As stated before, Newton was fired from this mission in 1908. His death came in December of the following year.

Main results

Extant in MHNC-UP are around 150 amphibian specimens, 170 birds, 170 reptiles, 20 mammals and an undetermined number of fishes, mollusks, insects and other invertebrates. Several boxes and jars of both insects and mollusk specimens have been located in MHNC-UP and are currently being inventoried. Newton's specimens from this expedition resulted in the description of 28 new zoological taxa, including two recent descriptions. The herpetological specimens have been addressed by Ceríaco et al. (2014) and Santos et al. (in prep; Chapter 2). Ceríaco et al. (2014) presented an updated catalogue of the amphibian and reptile type specimens extant today in MHNC-UP and located a total of 12 of the 18 type specimens published by Ferreira (1904, 1906). Recently, in a review of the species of the genus *Boaedon* from Angola, Hallerman et al., 2020 used three specimens collected by Newton (MHNC-UP/ANF166–168) as paratypes in the description of *Boaedon bocagei* Hallermann, Ceríaco, Schmitz, Ernst, Conradie, Verburgt, Marques and Bauer 2020. Additionally, Ceríaco et al. (submitted; Chapter 3) described *Phrynomantis newtoni* Ceríaco, Santos, Marques and Bauer, using specimen MHNC-UP/ANF194 as its holotype. Below we list the names of the new species collected by Newton.

Further research is being conducted in order to locate the mollusk type specimens, as well as unpublished specimens present in collection lists. Nobre's 1905 paper on the mollusks seems to not have received further attention after its publication and upon research in online databases, only one of the new species was located. Little

is known about African mollusks and as such we cannot attest to the validity of the new taxa Nobre described.

Amphibia

Hyperoliidae

Rappia bivittata Ferreira, 1906 [= *Hyperolius platyceps* (Boulenger, 1900)]. Syntypes: “N’Golla Bumba”, “Quilombo”, “Rio Luinha”; (MHNC-UP/ANF207–209).

Rappia bocagei var. *maculata* Ferreira, 1906 [= *Hyperolius bocagei* (Steindachner, 1867)]. Holotype: “Golungo Alto” (unlocated).

Rappia fasciata Ferreira, 1906 [= *Hyperolius platyceps* (Boulenger, 1900)]. Holotype: “Quilombo”, 1904; (MHNC-UP/ANF206).

Rappia nobrei Ferreira, 1904 [= *Hyperolius adspersus* Peters, 1877]. Syntypes: “Cabiri”, 1903; (MHNC-UP/ANF210–211).

Rappia osorioi Ferreira, 1906 [= *Afraxalus osorioi* (Ferreira, 1906)]. Syntypes: “Quilombo”; (MHNC-UP/ANF212–214).

Rappia platyceps var. *angolensis* Ferreira, 1906 [= *Hyperolius platyceps* (Boulenger, 1900)]. Syntypes: “Quilombo” (MHNC-UP/ANF205), “N’golla Bumba” (unlocated).

Rappia seabrai Ferreira, 1906 [= *Hyperolius bocagei* (Steindachner, 1867)]. Syntypes: “Quilombo”, “Rio Luinha” (unlocated); Paratype: “Duque de Bragança”, 1865 (MHNC-UP/ANF216).

Arthroleptidae

Hylambates bocagei var. *leucopunctata* Ferreira, 1904 [= *Leptopelis bocagii* (Günther, 1865)]. Syntypes: “Gumba”; (MHNC-UP/ANF184–185).

Arthroleptis carquejai Ferreira, 1906. Holotype: “Cambondo”; (MHNC-UP/ANF188).

Typhlopidae

Typhlops bocagei Ferreira, 1904 [= *Afrotyphlops lineolatus* (Jan, 1864)]. Syntypes: “Cabicula”, “Bom Jesus, margens do Quanza” (unlocated).

Gastropoda

Streptaxis bethencourti Nobre, 1905 [= *Gonaxis bethencourti* (Nobre, 1905)]. “Fôrets de Mupépe, sous les feuilles sèches”.

Ennea carquejai Nobre, 1905. Syntypes: “Rives du fleuve Luce, lieux humides des fôrets”.

Ennea angolensis Nobre, 1905. Holotype: “Fôrets de Mupépe, sous les feuilles sèches”.

Trochozonites furtadoi Nobre, 1905. Holotype: “Gumba”.

Trochozonites newtoni Nobre, 1905. Syntypes: “Fôrets de Mupépe, sous les feuilles sèches”.

Helix lacerdai Nobre, 1905. Syntypes: “Katála”, “Gumba, Serre de Selles; sur les feuilles des graminées”.

Helix isaaci Nobre, 1905. “N’Dalla Gando, Cazengo, dans l’écorce des arbres”.

Amphidromus tavaresi Nobre, 1905. “Sur les sépultures des négres, près de Novo Redondo”.

Opeas bocagei Nobre, 1905. “Fôrets de Mupépe, sous les feuilles sèches”.

Opeas vieirai Nobre, 1905. Syntypes: “Gumba”.

Opeas welwitschi Nobre, 1905. Syntypes: “Forêts de Mupépe”, “Luinha”.

Subulina seabrai Nobre, 1905. Syntypes: “Fôrets de Mupépe, sous les feuilles sèches”.

Homorus sampaioi Nobre, 1905. Syntypes: “Fôrets de Mupépe, sous les feuilles sèches”, “Rives du fleuve Luce, lieux humides des fôrets”.

Homorus paulinoi Nobre, 1905. Syntypes: “Gumba”.

Physa moreleti Nobre, 1905. “Ruisseaux de Luinha”.

Physa osorioi Nobre, 1905. “Gumba”.

Table 1 – Collecting localities from Newton's Expedition.

Province	Locality	Latitude	Longitude	Altitude
Bengo	Bom Jesus [=Bom Jesus, Quanza]	-9.16667	13.56667	37
	Cabiri [=Lagoas pantanosas de Cabiri]	-8.92125	13.66654	31
	Cabicula, Cazengo [=Cubicula (região do Cazengo); Cabiculo, região do Cazengo]	-9.16667	13.56667	37
	Caculo Cazongo, margens da lagôa, região do Quanza [=Cacullo]	-9.25921	13.82048	8
	Catete [=Cotete]	-9.11667	13.70000	21
	Caxicâne, margens do Quanza	-8.89007	14.52526	284
	Cunga [=Cunga, margens do Quanza; Lagôa do Cunha (rio Quanza); Lagoas e charcas da Lagoa Cunha, concelho de Maxima; Quanza (margens da lagôa Cunha)]	-9.23333	13.76667	92
Kwanza Norte	Quissanga	-8.97310	13.77499	46
	Ambaca [=Ambaca (Pomba)]	-9.26667	15.18333	738
	Bango	-8.68330	15.18330	840

	[=Bongo; Golungo Alto (Bango)]			
Kwanza Norte	Bango Aquitamba [=Bango Aquitambo]	-8.70839	14.98725	822
	Cacólombôlo [=Cacolombolo]	-9.12770	15.31600	849
	Camuanze [=Camanze]	-9.06230	14.49150	344
	Cambondo	-9.16349	14.66432	394
	Camilungo	-9.13333	14.83333	756
	Catari	-9.09548	15.41905	1022
	Cazengo [=Região do Cazengo]	-9.33333	14.76667	713
	Florestas de Mupepe [=Florestas de Mupépe, sob folhas secas; Mupépe; Mopepe]	-9.14472	14.78000	641
	Golungo Alto [=Gollungo alto]	-9.13333	14.76667	666
	Hôcco [=Concelho do Cazengo (Hôcco); Hocco]	-9.35422	14.89471	573
	Lucalla	-9.27268	15.25206	708
	Luinha [=Zuinha, Rio Luinha]	-9.26667	14.53333	237

Kwanza Norte	Méssu Casuco [=Messo Cassuco]	-8.96490	14.79800	979
	Monte Alegre	-8.71777	14.46778	547
	N'Dalla Tando [=N'Dalla; N'Dalla Gando; N'Dalla Tando, região do Cazengo]	-9.30000	14.91667	782
	N'Delle [=Florestas de N'Delle]	-9.15000	14.23333	208
	N'Golla Bumba [=N'Golla Bumba, nas florestas]	-9.03333	14.60000	460
	Palmyra [=Palmyra, em Cazengo]	-9.30000	14.68333	403
	Prototipo, Cazengo	-9.32028	14.82806	652
	Quéta [=Serra de Quéta]	-9.27820	14.78777	612
	Quilombo	-9.33333	14.90000	744
	Rio Cuango [=Margens do rio Cuango; Florestas das margens do Rio Quango, no Golungo Alto]	-9.27375	15.14394	724
	Zanga	-9.07815	14.90003	721
	Zembe [=Florestas de Zembe, região do Cazengo]	-9.31667	14.66667	539

Kwanza Sul	Amboim, interior de Novo Redondo [=Ambuim, Serra de Selles]	-10.85000	14.36667	1052
	Chingo, Novo Redondo [=Chingo]	-11.20000	13.85000	11
	Gumba [=Gumba, Serra de Selles, interior de Novo Redondo; Região de Selles, Gumba (Novo Redondo)]	-11.26667	14.28333	784
	Lembu [=Lembu, Serra de Selles; Lembu (Lemba), Serra de Selles]	-10.95547	14.30763	733
	Novo Redondo	-11.20000	13.85000	11
	Serra de Selles [=Selles; Selles (Loanda); Serra de Selles (interior de Novo Redondo); Região de Selles]	-11.41667	14.30000	1005
Luanda	Cacuaco [=Cacuaco, perto Loanda]	-8.78333	13.36667	6
	Loanda [=Ilha de Loanda; Arredores de Loanda]	-8.83333	13.26667	80
Namibe	Bahia dos Tigres [=Baie des Tigres]	-16.58559	11.82709	98
	Camilunga [=Lagoa do Camilunga]	-15.80000	12.00000	48

Namibe	Carunjamba	-13.96225	12.42454	5
	Coroca/Coróca [=Margem do Coroca; Margens do Rio Coroca; Rio Coroca; R. Coroca; Planícies do Rio Coroca]	-15.78333	12.06667	45
	Cunene [=Embocadura do Cunene; Foz do Cunene; Margens do Rio Cunene; Bords du Cunene; Embouchure du Cunene]	-17.28333	11.80000	82
	Lagoa do Coroca [=Lagoa do Caroca; Lagoa do Rio Coroca; margens da Lagoa do Coroca]	-15.78894	12.07353	45
	Lagoas Pinda	-15.74549	11.91301	7
	Lucira	-13.86667	12.53333	51
	Mossamedes	-15.20000	12.15000	24
	Pinda [=Porto Pinda]	-15.75148	11.90116	37
	Porto Alexandre [=Bahia de Porto Alexandre; Cabo Negro de Porto Alexandre; Península de Porto Alexandre; Port Alexandre]	-15.80401	11.84492	11
Namibe	Ungway [=Margens Ungway; Lagoa do Ungway; Lagoas Ungway; Uray]	-15.76667	12.01667	45
Undetermined	Cafuxi			

	Calunga			
	Camanze/Camuange			
	Cavernas Quimvanda, perto de Golungo Alto			
	Chacuto [=Lagoa de Chacuto; margens do Lago Chacuto; margens da Lagoa do Chacuto]			
	Dondo Anzéle, região Quanza			
	Encuacre, interior de Novo Redondo			
	Florestas Kalala			
	Florestas Kakolo			
	Florestas margens Quanza			
	Icolo e Bengo			
	Katála			
	Katúla			
	Matens da Lagoa Cumana, rio Quanza			
	Lagoa Quitenha [=Quitenha/Quitenha (Rio Quango)]			
	Lagoa do Tua			
	Lucinda			
	Lué/Rio Loçué/Rio Lucué/Margens do Rio Luce			
	Monte Bello, região do Cazengo			

Undetermined	Mu-rondo			
	N. Jumbo			
	Quibundo			
	Quinuanda			
	Riacho Caté			
	Rio Quiapose [=Margens Rio Quiapose]			
	Rio Zenga			
	Serra de Stombe			

References

- Amaral, I. 1978. Contribuição para o conhecimento do fenómeno de urbanização em Angola. *Finisterra. Revista Portuguesa de Geografia* 13(25):43–85.
- Anonymous. [undated] a. *Unpublished manuscript, undated*. [important dates from the Newton expedition]. Arquivo Histórico Ultramarino. Identifier: AHU-SEMU-DGU-cx.229.
- Anonymous. [undated] b. *Unpublished manuscript, undated*. [Specimen list from the Newton expedition] Arquivo Histórico do Museu de História Natural e da Ciência da Universidade do Porto.
- Anonymous. [undated] c. *Unpublished manuscript, undated*. [Specimen list from the Newton expedition] Arquivo Histórico do Museu de História Natural e da Ciência da Universidade do Porto.
- Anonymous. 1878. *Manuscript dated 24 April 1878*. [Declaration of Isaac Newton's nationality]. Arquivo Municipal do Porto. Identifier: A-PUB/2332 - f. 123-123v. Available at <http://gisaweb.cm-porto.pt/units-of-description/documents/612205/?q=francisco+newton>. (accessed 8 June 2020).
- Anonymous. 1892a. *Unpublished manuscript dated 31 December 1892*. [Report on Newton's performance on the S.Tomé and Príncipe survey]. Arquivo Histórico Ultramarino. Identifier: AHU-SEMU-DGU-cx.229.
- Anonymous. 1892b. *Relatório do Ateneu Comercial do Porto, 1892*. [Unpublished manuscript]. Porto, Portugal.
- Anonymous. 1895. *Unpublished manuscript dated 15 October 1895*. [Newton's nomination for an expedition to Timor]. Arquivo Histórico Ultramarino. Identifier: AHU-SEMU-DGU-cx.229.
- Anonymous. 1897. *Unpublished manuscript dated 20 April 1897*. [Notice of Newton's return to Portugal from Timor]. Arquivo Histórico Ultramarino. Identifier: AHU-SEMU-DGU-cx.229.
- Anonymous. 1902. *Unpublished manuscript dated 29 October 1902*. [Newton's nomination for an expedition to Angola]. Arquivo Histórico Ultramarino. Identifier: AHU-SEMU-DGU-cx.229.

Anonymous. 1903a. *Unpublished manuscript dated 3 July 1903*. [Health deputy reports Newton as being ill]. Arquivo Histórico do Museu de História Natural e da Ciência da Universidade do Porto.

Anonymous. 1903b. *Unpublished manuscript dated 14 June 1903*. [The Ministry of the Navy informs that all requested assistance must be provided to help Newton on his expedition]. Arquivo Histórico de Angola. Identifier: 1732.

Anonymous. 1903c. *Unpublished manuscript dated 6 July 1903*. [Shipment notice of three boxes destined to APP]. Arquivo Histórico Ultramarino. Identifier: AHU-SEMU-DGU-cx.229.

Anonymous. 1903d. *Unpublished manuscript dated 2 June 1903*. [Reception notice of four boxes of zoological specimens destined to APP]. Arquivo Histórico do Museu de História Natural e da Ciência da Universidade do Porto.

Anonymous. 1903e. *Unpublished manuscript dated 25 July 1903*. [Shipment notice of four boxes of zoological specimens destined to APP]. Arquivo Histórico Ultramarino. Identifier: AHU-SEMU-DGU-cx.229.

Anonymous. 1903f. *Unpublished manuscript dated 16 September 1903*. [Reception notice of ten boxes of zoological specimens]. Arquivo Histórico do Museu de História Natural e da Ciência da Universidade do Porto.

Anonymous. 1903g. *Unpublished manuscript dated 5 October 1903*. [Reception notice of two boxes of zoological specimens]. Arquivo Histórico do Museu de História Natural e da Ciência da Universidade do Porto.

Anonymous. 1903h. *Unpublished manuscript dated 8 October 1903*. [Shipment notice of two boxes of zoological specimens destined to APP]. Arquivo Histórico Ultramarino. Identifier: AHU-SEMU-DGU-cx.229.

Anonymous. 1903i. *Unpublished manuscript dated 24 November 1903*. [Shipment notice of four boxes of zoological specimens destined to APP]. Arquivo Histórico Ultramarino. Identifier: AHU-SEMU-DGU-cx.229.

Anonymous. 1903j. *Unpublished manuscript dated 14 December 1903*. [Shipment notice of two boxes of zoological specimens destined to APP]. Arquivo Histórico Ultramarino. Identifier: AHU-SEMU-DGU-cx.229.

Anonymous. 1904a. *Unpublished manuscript dated 13 February 1904*. [Shipment notice of one box of zoological specimens destined to APP]. Arquivo Histórico Ultramarino. Identifier: AHU-SEMU-DGU-cx.229.

Anonymous. 1904b. *Unpublished manuscript dated 13 April 1904*. [Shipment notice of one box of zoological specimens destined to APP]. Arquivo Histórico Ultramarino. Identifier: AHU-SEMU-DGU-cx.229.

Anonymous. 1904c. *Unpublished manuscript dated 24 May 1904*. [Shipment notice of six boxes of zoological specimens destined to APP]. Arquivo Histórico Ultramarino. Identifier: AHU-SEMU-DGU-cx.229.

Anonymous. 1905a. *Unpublished manuscript dated 20 February 1905*. [Notice of Newton's request of additional resources for the expedition]. Arquivo Histórico de Angola. Identifier: 1732.

Anonymous. 1905b. *Unpublished manuscript dated 11 February 1905*. [Shipment notice of eight boxes of zoological specimens, three of which destined to APP]. Arquivo Histórico Ultramarino. Identifier: AHU-SEMU-DGU-cx.229.

Anonymous. 1905c. *Unpublished manuscript dated 1 September 1905*. [Shipment notice of five boxes and a case of zoological specimens, three of which destined to APP]. Arquivo Histórico Ultramarino. Identifier: AHU-SEMU-DGU-cx.229.

Anonymous. 1905d. *Unpublished manuscript dated 10 November 1905*. [Shipment notice of three cases of zoological specimens destined to APP]. Arquivo Histórico de Angola. Identifier: 1732.

Anonymous. 1906a. *Unpublished manuscript dated 12 April 1906*. [Report about Francisco Newton in Angola]. Arquivo Histórico Ultramarino. Identifier: AHU-SEMU-DGU-cx. 229.

Anonymous. 1906b. *Unpublished manuscript dated 12 April 1906*. [Shipment notice of Newton's departure from Angola to Portugal]. Arquivo Histórico Ultramarino. Identifier: AHU-SEMU-DGU-cx. 229.

Anonymous. 1907a. *Unpublished manuscript dated 10 April 1907*. [Newton's nomination for an expedition to Guinea Bissau]. Arquivo Histórico Ultramarino. Identifier: AHU-SEMU-DGU-cx.229.

Anonymous. 1907b. *Unpublished manuscript dated 6 June 1907*. [Request for Newton to move the expedition to Cabo Verde]. Arquivo Histórico Ultramarino. Identifier: AHU-SEMU-DGU-cx.229.

Anonymous. 1908a. *Unpublished manuscript dated 25 January 1908*. [Complaint regarding Newton's activities in the province of Cabo Verde]. Arquivo Histórico Ultramarino. Identifier: AHU-SEMU-DGU-cx.229.

Anonymous. 1908b. *Unpublished manuscript 29 January 1908*. [Complaint regarding Newton's activities in the province of Cabo Verde]. Arquivo Histórico Ultramarino. Identifier: AHU-SEMU-DGU-cx.229.

Anonymous. 1908c. *Unpublished manuscript dated 12 February 1908*. [The Crown exonerates Newton from the expedition]. Arquivo Histórico Ultramarino. Identifier: AHU-SEMU-DGU-cx.229.

Ceríaco, L.M.P., Blackburn, D.C. Marques, M.P., Calado, F.M. 2014. Catalogue of the amphibian and reptile type specimens of the Museu de História Natural da Universidade do Porto in Portugal, with some comments on problematic taxa. *Alytes* 31:13–36.

Clarence-Smith, W.G. 1976. Slavery in coastal southern Angola, 1875–1913. *Journal of Southern African Studies* 2(2):214–223.

Diogo, M.P. & Navarro, B.J. 2018. Re-Designing Africa: Railways and Globalization in the Era of the New Imperialism. Pp. 105–128 *In* Pretel, D. & Camprubí, L. (ed.), *Technology and Globalisation*. Palgrave Macmillan, Cham, London.

Ferreira, J.B. 1904. Reptis e Amphibios de Angola da Região ao Norte do Quanza (Collecção Newton – 1903). *Jornal de Sciencias Mathematicas, Physicas e Naturaes, Segunda Série* 7(26):111–117.

Ferreira, J.B. 1906. Algumas especies novas ou pouco conhecidas de Amphibios e Reptis de Angola (Colecção Newton – 1903–1904). *Jornal de Sciencias Mathematicas, Physicas e Naturaes, Segunda Série* 7(27):159–171.

Ferreira, J.J. 1906. *Unpublished manuscript dated 26 July 1906*. [Request for an extension of the three-month subsidy on behalf of Francisco Newton]. Arquivo Histórico Ultramarino. Identifier: AHU-SEMU-DGU-cx.229.

Ferreira, R. 2013. Agricultural enterprise and unfree labour in nineteenth-century Angola. Pp. 225–242 *In*: Law, R., Schwarz, S. & Strickrodt, S. (ed.), *Commercial Agriculture, the Slave Trade and Slavery in Atlantic Africa*. Boydell & Brewer, Suffolk.

Ferreira, V. 1909. *Unpublished manuscript dated 3 September 1909*. [Notice of Newton's request to return overseas]. Arquivo Histórico Ultramarino. Identifier: AHU-SEMU-DGU-cx.229.

Figueiredo, E., Smith, G.F. & Ceríaco, L.M.P. 2019. The vascular plant collections of Francisco Newton (1864–1909) in Angola. *Phytotaxa* 413(3):207–224.

Hallerman, J., Ceríaco, L.M.P., Schmitz, A., Ernst, R., Conradie, W., Verburgt, L., Marques, M.P. & Bauer, A.M. 2020. A review of the Angolan House snakes, genus *Boaedon* Duméril, Bibron and Duméril (1854) (Serpentes: Lamprophiidae), with description of three new species in the *Boaedon fuliginosus* (Boie, 1827) species complex. *African Journal of Herpetology* 69(1):29–78.

Henriques, J. 1885. Contribuição para o estudo da flora d'algumas possessões portuguesas. Plantas colhidas por F. Newton na Africa occidental. *Boletim da Sociedade Broteriana* 3:129–140.

Leão, J.F.S. 1906. *Unpublished manuscript dated 2 November 1906*. [Request for an extension of the three-month subsidy on behalf of Francisco Newton]. Arquivo Histórico Ultramarino. Identifier: AHU-SEMU-DGU-cx.229.

Lima, J.J.L. 1846. Capítulo VII – Religião e Regimen Ecclesiastico. Pp. 147–160 *In*: Lima, J.J.L. (ed.) *Ensaio sobre a statistica das possessões Portuguezas na Africa Occidental e Oriental; na Asia Occidental; na China e na Oceania. Escriptos de Ordem do Governo de sua Majestade fidelissima a senhora D. Maria II. Livro III. Ensaio sobre a statistica de Angola e Benguella e suas dependências na Costa Occidental d'Africa ao Sul do Equador. Parte I. Statistica Geral*. Imprensa Nacional, Lisboa.

Machado, A. 1946. Dr. Augusto Pereira Nobre. *Annaes Scientificos da Academia Polytechnica do Porto* 31:208–219.

Marques, M.P., Ceríaco, L.M.P., Blackburn, D.C. & Bauer, A.M. 2018. Diversity and distribution of the amphibians and terrestrial reptiles of Angola – Atlas of historical and bibliographic records (1840–2017). *Proceedings of the California Academy of Sciences Series 4* 65(supplement 2):1–501.

Mata, M.E., Ferreira, L.F. & Santos, J.P. 2017. Success and failure in Portuguese Colonial Africa: The case of the Cazengo agricultural company (1900-1945). *Entreprises et histoire* 3(88):53–73.

Medeiros, I.M. 1972. Apontamentos sobre a pesca e a evolução da indústria piscatória em Angola. *Finisterra. Revista Portuguesa de Geografia* 7(13):29–45.

Mendes, A.M. 2005. Pescas em Portugal: Ultramar – um apontamento histórico. *Revista Portuguesa de Ciências Veterinárias* 100(553–554):17–32.

Newton, F. 1885. *Letter dated 27 July 1885, from Lisboa, addressed to the Crown*. Arquivo Histórico Ultramarino. Identifier: AHU-SEMU-DGU-cx.229.

Newton, F. 1897. *Letter dated 21 August 1897, from Lisboa, addressed to the Crown*. Arquivo Histórico Ultramarino. Identifier: AHU-SEMU-DGU-cx.229.

Newton, F. 1898. *Letter dated 8 August 1898, from Lisboa, addressed to the Crown*. Arquivo Histórico Ultramarino. Identifier: AHU-SEMU-DGU-cx.229.

Newton, F. 1902a. *Letter dated 13 January 1902, addressed to Baltasar Osório*. Arquivo Histórico do Museu Bocage/Museu Nacional de História Natural e da Ciência, Lisbon. Identifier: CN/N–145.

Newton, F. 1902b. *Letter dated 22 January 1902, addressed to Baltasar Osório*. Arquivo Histórico do Museu Bocage/Museu Nacional de História Natural e da Ciência, Lisbon. Identifier: CN/N–146.

Newton, F. 1903a. *Letter dated 14 May 1903, from Gumba, Serra de Selles, Novo Redondo*. Arquivo Histórico do Museu de História Natural e da Ciência da Universidade do Porto.

Newton, F. 1903b. *Letter dated 25 June 1903, from Novo Redondo, addressed to Aarão de Lacerda*. Arquivo Histórico do Museu de História Natural e da Ciência da Universidade do Porto.

Newton, F. 1903c. *Letter dated 19 September 1903, from Palmyra, Cazengo, addressed to Aarão de Lacerda*. Arquivo Histórico do Museu de História Natural e da Ciência da Universidade do Porto.

Newton, F. 1903d. *Unpublished manuscript, undated*. [Specimen list sent by Newton regarding shipped boxes (collections from November 1903)]. Arquivo Histórico do Museu de História Natural e da Ciência da Universidade do Porto.

Newton, F. 1903e. *Unpublished manuscript, undated*. [Specimen list sent by Newton regarding shipped boxes (collections from November 1903)]. Arquivo Histórico do Museu de História Natural e da Ciência da Universidade do Porto.

Newton, F. 1903f. *Letter dated 24 November 1903, from Loanda, addressed to Aarão de Lacerda*. Arquivo Histórico do Museu de História Natural e da Ciência da Universidade do Porto.

Newton, F. 1903g. *Letter dated 5 December 1903, from Loanda, addressed to Aarão de Lacerda*. Arquivo Histórico do Museu de História Natural e da Ciência da Universidade do Porto.

Newton, F. 1904a. *Letter dated March 1904*. Arquivo Histórico do Museu de História Natural e da Ciência da Universidade do Porto.

Newton, F. 1904b. *Letter dated 5 July 1904, from Margens do Rio Coróca, addressed to the Secretary General of Angola*. Arquivo Histórico de Angola. Identifier: 1732.

Newton, F. 1904c. *Unpublished manuscript dated 20 December 1904*. [List of materials Newton requested to continue his expedition]. Arquivo Histórico Angola. Identifier: 1732.

Newton, F. 1906. *Letter dated 26 July 1906, from Porto, addressed to the Crown*. Arquivo Histórico Ultramarino. Identifier: AHU-SEMU-DGU-cx.229.

Newton, F. 1909. *Letter dated 6 August 1909, from Lisboa, addressed to the Crown*. Arquivo Histórico Ultramarino. Identifier: AHU-SEMU-DGU-cx.229.

Nobre, A. 1905. Molluscos terrestres e fluviaes da exploração de Francisco Newton em Angola. *Annaes de Sciencias Naturaes* IX:103–118.

Nobre, A. 1935. *Fauna Marinha de Portugal. I. Vertebrados (Mamíferos, Reptis e Peixes)*. Companhia Editora do Minho, Barcelos. 580 p., 77 plates.

Nobre, A. 1945. *Leça da Palmeira. Recordações e estudos de há sessenta anos*. Gráfica Augusto Costa, Porto. 292 p., 7 plates.

Oliveira, A.A. 1906. *Unpublished manuscript dated 9 May 1906*. [Request for a three-month subsidy on behalf of Francisco Newton]. Arquivo Histórico Ultramarino. Identifier: AHU-SEMU-DGU-cx.229.

Pereira, H.S. 2017. *O papel do Estado no caminho-de-ferro de Ambaca (Angola): da concessão a privados à nacionalização*. VII Congresso de Historia Ferroviari, Valencia. 11 p.

Pereira, H.S. 2018. O caminho de ferro de Moçâmedes: entre projeto militar, instrumento tecnodiplomático e ferramenta de apropriação colonial (1881–1914). *Revista de História da Sociedade e da Cultura* 18:157–183.

Sampaio, J. 1946. Subsídios para a História da Botânica em Portugal. I. O colector Isaac Newton e o estudo das Criptogâmicas celulares portuguesas. (Trabalho de investigação bio-bibliográfica). *Broteria, série de Ciências Naturais* 15(1–2):145–189.

Sampaio, J. 1947. Subsídios para a História da Botânica em Portugal. I. O colector Isaac Newton e o estudo das Criptogâmicas celulares portuguesas. (Trabalho de investigação bio-bibliográfica). *Broteria, série de Ciências Naturais* 16(1–2):20–52.

Seabra, A.F. 1905a. Mammiferos e aves da exploração de F. Newton em Angola. *Jornal de Sciencias Mathematicas, Physicas e Naturaes, Segunda Série* 7(26):103–110.

Seabra, A.F. 1905b. Aves de Angola da exploração de F. Newton. *Jornal de Sciencias Mathematicas, Physicas e Naturaes, Segunda Série* 7(26):118–128.

Seabra, A.F. 1905c. Aves da exploração de Fr. Newton em Angola. Subsídios para o conhecimento da distribuição geográfica das aves d'Africa Occidental. *Annaes de Sciencias Naturaes* IX:153–159.

Seabra, A.F. 1906a. A propósito de algumas espécies de Microchiropteros d'Angola. *Annaes de Sciencias Naturaes*, X:81–82.

Seabra, A.F. 1906b. Ribeirinhas e Palmipedes das margens do Rio Cunene. *Annaes de Sciencias Naturaes*, X:83–90.

Seabra, A.F. 1906c. Aves de Porto Alexandre. *Jornal de Sciencias Mathematicas, Physicas e Naturaes, Segunda Série* 7(27):143–148.

Seabra, A.F. 1907. Sur quelques Oiseaux d'Angola envoyés par Francisco Newton. Contribution à l'étude de la distribution géographique des Oiseaux de l'Afrique Occidentale. *Bulletin de la Société Portugaise des Sciences Naturelles* I:41–45.

Seabra, A.F. 1909. Note sur quelques mammifères de l'Afrique occidentale capturés par Fr. Newton en 1905 et appartenant au muséum d'histoire naturelle de Porto. *Annaes Scientificos da Academia Polytechnica do Porto* IV:218–220.

Silva, J.D. 1940. *Francisco Newton. Explorador naturalista. (Apontamentos para uma biografia)*. Colecção Pelo Império nº68, Agência Geral das Colónias, Lisboa. 43 p.

Van Dongen, I.S. 1961. Coffee Trade, Coffee Regions, and Coffee Ports in Angola. *Economic Geography* 37(4):320–346.

Vansina, J. 2005. Ambaca society and the slave trade c. 1760–1845. *The Journal of African History* 46(1):1–27.

Chapter II

Paper II – Francisco Newton's Zoological Expedition to Angola (1903–1906). III. A catalogue and taxonomic revision of the amphibians and reptiles.²

² Paper submitted to *Zootaxa*.

Paper II – Francisco Newton's Zoological Expedition to Angola (1903–1906). III. A catalogue and taxonomic revision of the amphibians and reptiles.

Abstract

Francisco Newton's zoological expedition to Angola undertaken between 1903 and 1906 is one of the least thoroughly studied of the naturalist's life. Until now, only three major papers regarding the herpetofauna collected have been published, and a significant part of the specimens remain unstudied since the 1900's. Here we continue to review the findings of the expedition and present an updated taxonomic revision of the herpetological specimens, with additional commentary on their taxonomic status. A total of 328 specimens (155 amphibians and 173 reptiles), corresponding to 74 species, 39 genera and 20 families, constitute the largest herpetological collection extant today in the Museu de História Natural e da Ciência da Universidade do Porto (MHNC-UP). The critical reassessment of museum collections is crucial moving forward in the study and conservation of biodiversity. This study highlights how much is still hidden in centuries old museum shelves, as some of the collection's specimens were recently used in the description of two new Angolan endemic taxa.

Keywords: Natural history collections; Angolan zoology; amphibians; reptiles; nomenclature; historical collectors; MHNC-UP.

Resumo

A expedição zoológica de Francisco Newton a Angola entre 1903 e 1906 é uma das menos estudadas da vida do naturalista. Até agora, apenas três artigos tinham sido publicados sobre a herpetofauna coletada, e uma parte significativa dos espécimes permanecia por estudar desde o século passado. Aqui continuamos a revelar as descobertas da expedição e apresentamos uma revisão taxonómica atualizada dos espécimes herpetológicos, com comentário adicional do seu estado taxonómico. Os resultados são compostos por 328 espécimes (155 anfíbios e 173 répteis), correspondendo a 74 espécies, 39 géneros e 20 famílias e constituindo a maior coleção herpetológica existente hoje no Museu de História Natural e da Ciência da Universidade do Porto (MHNC-UP). A reavaliação de coleções de museu é fulcral para avançar no

estudo e na conservação de biodiversidade. Este estudo mostra o quanto ainda continua escondido em velhas prateleiras de museu, uma vez que alguns espécimes da coleção foram recentemente usados na descrição de duas novas espécies endémicas de Angola.

Palavras-chave: Coleções de história natural; Zoologia angolana; anfíbios; répteis; nomenclatura; coletores históricos; MHNC-UP.

Introduction

Francisco Xavier Oakley de Aguiar Newton, or, as most commonly known, Francisco Newton (1864–1909) was a Portuguese naturalist born in Porto who dedicated his life to exploring Portuguese overseas territories in Africa and Asia. In 1880, at the young age of sixteen, Newton embarked on his first naturalist expedition to Angola, where he stayed until late 1884 or 1885, collecting botanical specimens (Figueiredo *et al.* 2019; Santos *et al.* in prep – Chapter 1). Throughout his life, Newton conducted collecting trips to territories now part of the countries of Angola, Benin, Cape Verde, Equatorial Guinea, Guinea-Bissau, São Tomé and Príncipe and East Timor. Some of Newton's collections were especially relevant to the knowledge on the fauna of several of these countries, leading to some of the first available checklists of those territories (e.g. Bocage 1887a, 1890, 1892, 1893a, 1895, 1903, 1905; Ozorio 1887, 1888, 1895a, 1895b) and to the description of dozens of new invertebrate (e.g. Nobre 1905) and vertebrate taxa (Ferreira 1898, 1904, 1906; Seabra 1898).



Fig. 1 – Portrait of Francisco Newton (1864–1909) (Source: Arquivo Histórico Museu Bocage).

Despite the importance of his collections, Newton is still unknown to the public and the scientific community. While other contemporaneous naturalists are recognized and praised for their accomplishments, Newton remains in the shadows, as does much of his work. Newton's 1903–1906 zoological expedition to Angola is one of the least known expeditions undertaken by the Portuguese naturalist. Contrary to all of his previous expeditions, which were either instigated through his private initiative or commissioned by the Zoology Section of the National Museum of Lisbon (subsequently renamed as Museu Bocage [MBL]), this expedition was commissioned by the Academia Politécnica do Porto (Polytechnic Academy of Porto, APP). It led Newton to explore and collect zoological specimens in what are now five different Angolan provinces and more than 80 different localities, although we were unable to georeference all of them (**Fig. 2**;

Santos *et al.* in prep. – Chapter 1). The naturalist collected in the northern regions of Angola during 1903 and the first half of 1904, namely Kwanza Sul Province at first and later in Bengo, Kwanza Norte and Luanda provinces. The second half of 1904 and the year of 1905 were spent in the southwestern province of Namibe, collecting mostly in coastal areas. A more detailed history of this expedition was presented by Santos *et al.* (in prep – Chapter 1). The resulting collections of this expedition have also been poorly studied. Besides some papers regarding mammals (Seabra 1905a, 1906a, 1909), birds (Seabra 1905a, 1905b, 1905c, 1906b, 1906c, 1907), amphibians and reptiles (Ferreira 1904, 1906) and mollusks (Nobre 1905), a large part of the specimens were never critically reassessed since the early 1900's, with some authors even assuming that the collection had been lost (e.g. Frost *in* Ceríaco *et al.* 2014b).

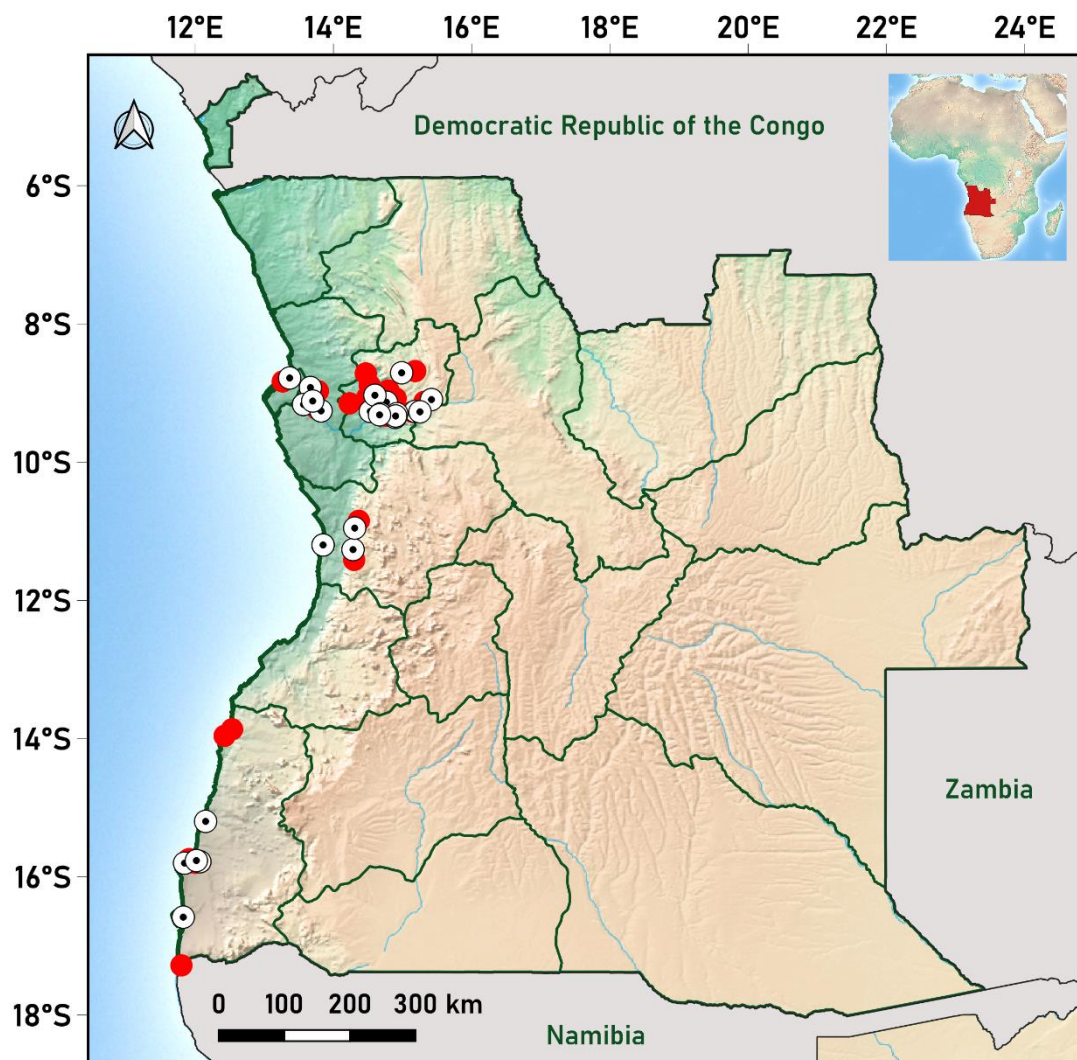


Fig. 2 – Map of collecting localities from the Newton Expedition. Dotted white circles: collecting localities from the herpetological specimens; Red circles: remaining georeferenced collecting localities.

With an area of approximately 1,250,000 km², Angola is one of the largest African countries, but also one with a still poorly documented biodiversity (Marques *et al.* 2018; Huntley *et al.* 2019). The diversity of biomes and landscapes within its territory result in an incredibly diverse and heterogeneous country. Armed conflicts, which lasted for almost four decades (1961–2002) closed the country to scientific research and had a deeply negative impact on biodiversity research and conservation (Marques *et al.* 2018; Huntley *et al.* 2019). This is especially true regarding its herpetofauna. Marques *et al.* (2018) discussed the history and development of herpetological research in Angola, which can be roughly divided into five main phases: the beginning and consolidation of knowledge initiated in the second half of the nineteenth century, that benefited greatly from the work of José Vicente Barbosa du Bocage (1823–1907), a zoologist and director of the zoological section of the National Museum of Lisbon, whose publication *Herpétologie d'Angola et du Congo* constituted a major landmark and advancement in Angolan herpetology; a second phase in early twentieth century, when various international institutions took interest in the country's biodiversity and conducted several zoological expeditions, with special importance attributed to those of the American Museum of Natural History (Vernay Expedition, 1925) and the Swiss Expeditions (1928–1929; 1932–1933) led by Albert Monard; a third phase lasting from the second half of the twentieth century up until Angola's independence in 1975, marked by the works of Raymond Laurent (1917–2005) on the collection of the Museu do Dundo (northeastern Angola); a fourth phase where almost no progress was accomplished, as the country was closed off to scientific research during the civil war period (1975–2002) and finally the ongoing fifth phase, with a wave of new researchers leading the revival of Angolan herpetology.

Newton's 1903–1906 Angolan herpetological collection has not been properly studied thus far, with a considerable part of its specimens remaining both unstudied and unpublished. Only three papers regarding this collection have been published to date.

During the expedition, Newton periodically sent the collected specimens to APP. According to the archival records present in the Arquivo Histórico Ultramarino (AHU), Lisbon, Portugal, a total of forty-six boxes and four cases containing zoological specimens were sent from Angola to Porto (for a detailed and commented list of these records, see Santos *et al.* in prep – Chapter 1). Due to the lack of experts in all of the taxonomic groups represented in Newton's collections, some of them were sent to experts from the Zoological Section of the National Museum of Lisbon to be studied and classified. This was the case of the herpetological collection, which was sent to the

herpetologist José Júlio Bethencourt Ferreira (1866–1936), at the time assistant curator of herpetology in Lisbon, who studied and published the specimens collected by Newton in northern Angola. The results were published in two main publications (Ferreira 1904, 1906). In the first paper, Ferreira (1904) described 14 amphibians and 20 reptiles. These included the description of two new amphibian taxa – *Rappia nobrei* and *Hylambates bocagei* var. *leucopunctata* – and one new reptile species – *Typhlops bocagei*. In the second paper, Ferreira (1906) noted 17 amphibian taxa, seven of them new to science (*Rappia bocagei* var. *maculata*, *Rappia platyceps* var. *angolensis*, *Rappia bivittata*, *Rappia osorioi*, *Rappia seabrai*, *Rappia fasciata* and *Arthroleptis carquejai*), and 21 reptiles. The specimens collected by Newton in Namibe province, although preliminary identified by Ferreira (as attested by the extant handwritten labels in some of the original jars), were never published.

Newton's herpetological material was only revisited in two subsequent occasions. Perret (1976a) reviewed the amphibian type specimens housed in Museu Bocage two years before the fire that destroyed the Lisbon collections, and used that opportunity to borrow and study the type specimens of *Afrixalus osorioi*. In early 2000's, Ceriaco *et al.* (2014b) published an illustrated and commented type catalog of the collection. The authors revised the identification of the majority of type specimens published by Ferreira, commented on problematic taxa, and all but the types specimens of *Rappia bocagei* var. *maculata* Ferreira, 1906 and *Typhlops bocagei* Ferreira, 1904 were located in the collections. Aside from these works, the collection has never been entirely reviewed.

The natural history collections housed in the University of Porto since the late nineteenth century are currently part of the Museu de História Natural e da Ciência da Universidade do Porto (MHNC-UP), a museum housing the different scientific collections belonging to the University of Porto. This study comes in line with the ongoing revisions and cataloguing of the overall natural history collections of the MHNC-UP. This paper aims to present an updated catalog of the extant amphibian and reptile specimens from Francisco Newton expedition to Angola housed in the collections of the MHNC-UP, at the same time that it reviews their taxonomic identity and highlights particularly important details regarding their taxonomy, natural history, distribution and conservation status.

Materials & Methods

Apart from a small collection constituted by nine amphibians and six reptile specimens that was donated by Museu Bocage, and the recent (2017 onwards)

collections by Luis Ceríaco *et al.*, all the herpetological collections from Angola housed in the MHNC–UP belong to those collected by Francisco Newton during the 1903–1906 expedition to Angola (or were offered to him by different individuals).

Most of the specimens were, either individually or up to three specimens, stored in battery jars or early nineteenth century round display jars with glass tops. Some of the jars presented serious conservation issues, such as fractures on the glass tops which caused evaporation of the preservative. A smaller part of the collection was still stored in ground glass jars containing up to twenty specimens of different taxa. Some of these jars still had “National Museum of Lisbon” external labels, indicating that they were never handled after returning from Lisbon to where they were loaned to be reviewed. Whenever external or internal labels were present the associated data was recorded in databases. Whenever possible, the label remained associated with the respective jar, but in some cases it was extracted and deposited in the museum archives. New internal labels were printed in ResistAll™ paper, each of them containing data on new and old catalogue numbers, taxonomic identification, collection data (locality, date of collection), collector and type of preservative. When needed, the specimens were placed in new jars and/or were changed from the original preservative to 70% ethanol, following the procedures suggested by Simmons (2015).

In order to cross-check the data present on the original labels, we consulted museum databases and associated documentation, such as original handwritten letters from Newton, shipment invoices and specimen lists, and we were able to match part of the extant specimens to those published by Ferreira (1904, 1906). Previously unidentified and unpublished specimens were identified to species level and are presented here for the first time. Taxonomic identification was based on external morphology only, following the most updated data available for each taxonomic group (see taxonomic accounts below). All specimens were photographed.

Results

A total of 328 specimens (155 amphibians, 173 reptiles) were identified in the collections. These belong to eight families, 11 genera and representing 24 taxa of amphibians and 12 families, 28 genera and representing 50 taxa of reptiles. For amphibians, families Bufonidae and Hyperoliidae are the most represented with *Sclerophrys regularis* and *Hyperolius angolensis* being the species with the largest number of specimens, 35 and 29 respectively. For reptiles, families Scincidae and

Lamprophiidae are the most represented, with *Feylinia currori* and *Crotaphopeltis hotamboeia* being the species with the largest number of specimens, 17 and 11 respectively. These specimens were collected in 31 different localities from five provinces (**Fig. 2**). A total of 17 specimens present were type specimens, including those already identified by Ceríaco *et al.* (2014b), plus additional type material recently designated by Hallermann *et al.* (2020) and Ceríaco *et al.* (submitted – Chapter 3). In the following species accounts, we provide information on voucher numbers (including former catalog numbers) and sampling localities. Brief notes on identification, taxonomy, and/or natural history are also given when appropriate. Latitude and longitude (WGS-84), and elevation (in meters) of the collection sites are given for each species account. Species accounts are ordered taxonomically by family and alphabetically within families.

Taxonomic Accounts

Amphibia

Anura

Pipidae

Xenopus petersii Bocage, 1895

Material: Four specimens: Two adult specimens (MHNC-UP/ANF171–172), collected from unknown locality in 1904; Two adult specimens (MHNC-UP/ANF228–229, formerly UP-MHNFCP-017354 and UP-MHNFCP-052197; **Fig. 3**), collected from unknown locality, date unknown.

Comments: *X. petersii* is widespread in western and central Angola, southern Gabon to western Democratic Republic of the Congo and northern Namibia (Marques *et al.* 2018). A recent study by Furman *et al.* (2015) on the phylogeny of the *Xenopus laevis* (Daudin, 1903) group recognized *X. petersii* as a valid species and supported the revalidation of *Xenopus poweri* Hewitt, 1927. According to the distribution provided by the authors, *X. petersii* occurs in western and central parts of Angola, whereas *X. poweri* is limited to eastern and southeastern regions (Furman *et al.* 2015; Marques *et al.* 2018). None of the extant specimens has associated localities, but they most likely represent those cited by Ferreira (1906) from “Cambondo” and “Rio Luinha”, matching the expected geographical range for the species.



Fig. 3 – Specimen of *Xenopus petersii* (MHNC-UP/ANF228), from unknown locality. Photo by Bruna Santos.

Bufonidae

Sclerophrys funerea (Bocage, 1866)

Material: One specimen: One juvenile specimen (MHNC-UP/ANF161, formerly UP-MHNFCP-094970; **Fig. 4**), collected from Cabiri [-8.92125, 13.66654, 31] Bengo Province, in 1903.

Comments: *S. funerea* is a species known from West-Central Africa, from Gabon to Uganda and south to the Democratic Republic of the Congo and Angola (Marques *et al.* 2018). Ferreira (1904, 1906) cited several *B. funereus*, with and without locality information data. Specimen MHNC-UP/ANF161 was labeled as *B. regularis*. After reexamining the extant specimens previously identified as *B. funereus* by Ferreira, we found that most of them to correspond to either *Sclerophrys regularis* (Reuss, 1833) or *Sclerophrys pusilla* (Mertens, 1937) (see accounts below). The author mistakenly identified *S. funerea* as *S. regularis* most likely due to the difficult and confusing

characters used to differentiate *S. funerea* from all remaining *Sclerophrys*. This difficulty is still latent, as noted by Channing & Rödel (2019), who commented that *S. funerea* are characterized by the absence of a tarsal fold that is replaced by a row of spiny tubercles.



Fig. 4 – Specimen of *Sclerophrys funerea* (MHNC-UP/ANF161), from Cabiri. Photo by Bruna Santos.

Sclerophrys pusilla (Mertens, 1937)

Material: Eleven specimens: One juvenile specimen (MHNC-UP/ANF114, formerly UP-MHNFCP-094971), collected from Unguay [=Nonguai] [-15.76667, 12.01667, 45] Namibe Province, on June 1904; One adult specimen (MHNC-UP/ANF163), collected from unknown locality in 1904; Three young adult specimens and two adults (MHNC-UP/ANF166–170), collected from unknown locality in 1904; One adult specimen (MHNC-UP/ANF189), collected from Hocco [-9.35422, 14.89471, 573] Kwanza Norte Province, date unknown; Three adult specimens (MHNC-UP/ANF230–232, formerly UP-MHNFCP-094969; **Fig. 5**), collected from unknown locality, date unknown.

Comments: *S. pusilla* is a species that is widespread across western Angola, with the exception of the desert areas in the southwestern regions the country (Marques *et al.* 2018). Poynton *et al.* (2016) recently reinstated *S. pusilla* as a valid species, which was for a long time considered as a synonym of *Sclerophrys maculata* (Hallowell, 1854), in the eastern Central, East and Southern parts of Africa (Poynton *et al.* 2016). Ferreira (1904, 1906) did not cite any *S. pusilla* specimens as the species had not been described yet. Specimen MHNC-UP/ANF189 constitutes the first published record of the species for Kwanza Norte Province and specimen MHNC-UP/ANF114 is the first published record for that region of Namibe Province. Specimens MHNC-UP/ANF114 and ANF163 were previously identified as *S. funerea*.



Fig. 5 – Specimen of *Sclerophrys pusilla* (MHNC-UP/ANF231), from unknown locality. Photo by Bruna Santos.

Sclerophrys regularis (Reuss, 1833)

Material: Thirty-five specimens: Two juvenile specimens (MHNC-UP/ANF113, 115, formerly UP-MHNFCEP-094971), collected from Unguay [=Nonguai] [-15.76667, 12.01667, 45] Namibe Province, in June 1904; One adult specimen (MHNC-UP/ANF140,

formerly UP-MHNFCP-094968), collected from Rio Quanza (impossible to georeference) undetermined province, in 1903; One adult specimen (MHNC-UP/ANF141, formerly UP-MHNFCP-017344), collected from Cabiri [-8.92125, 13.66654, 31] Bengo Province, in July 1903; One adult specimen (MHNC-UP/ANF142, formerly UP-MHNFCP-017346), collected from Novo Redondo [=Sumbe] [-11.20000, 13.85000, 11] Kwanza Sul Province, in 1903; One juvenile specimen (MHNC-UP/ANF143, formerly UP-MHNFCP-017349), collected from Lembu [-10.95547, 14.30763, 733] Kwanza Sul Province, in 1903; Two adult specimens (MHNC-UP/ANF144–145, formerly UP-MHNFCP-017347), collected from Bom Jesus (Quanza) [-9.16667, 13.56667, 37] Bengo Province, in November 1903; Two adult specimens (MHNC-UP/ANF146–147, formerly UP-MHNFCP-017348), collected from Gumba [-11.26667, 14.28333, 784] Kwanza Sul Province, in 1903; One adult specimen (MHNC-UP/ANF148, formerly UP-MHNFCP-017352), collected from Bahia dos Tigres [=Baía dos Tigres] (in error) [-16.58559, 11.82709, 98] Namibe Province, in 1905; One adult specimen (MHNC-UP/ANF149, formerly UP-MHNFCP-052194), collected from Cabiri [-8.92125, 13.66654, 31] Bengo Province, in 1903; Five adults, five young adults and two juvenile specimens (MHNC-UP/ANF150–160, 162, formerly UP-MHNFCP-094970; **Fig. 6**), collected from Cabiri [-8.92125, 13.66654, 31] Bengo Province, in 1903; Two adult specimens (MHNC-UP/ANF164–165), collected from unknown locality, in 1904; Two young adult specimens (MHNC-UP/ANF190–191), collected from Gumba [-11.26667, 14.28333, 784] Kwanza Sul Province, date unknown; One juvenile specimen (MHNC-UP/ANF217, formerly UP-MHNFCP-017328), collected from Bango Aquitamba [=Banza de Quimbamba] [-8.70839, 14.98725, 822] Kwanza Norte Province, date unknown; One adult specimen (MHNC-UP/ANF218, formerly UP-MHNFCP-017345), collected from N'Dalla Tando [=N'dalatando] [-9.30000, 14.91667, 782] Kwanza Norte Province, date unknown; One juvenile specimen (MHNC-UP/ANF233, formerly UP-MHNFCP-017350), collected from unknown locality, date unknown; One adult specimen (MHNC-UP/ANF286, formerly UP-MHNFCP-017353), collected from unknown locality, date unknown; Two adult specimens (MHNC-UP/ANF288–289, formerly UP-MHNFCP-052195 and 052193), collected from unknown locality, date unknown; One juvenile specimen (MHNC-UP/ANF345), collected from Chingo, Novo Redondo [-11.20000, 13.85000, 11] Kwanza Sul Province, in 1903.

Comments: *S. regularis* is a species found across all Angola, except in the southeastern areas of the country, and has one of the most widespread distribution of African amphibians (Marques *et al.* 2018). Ferreira (1904) cited adult and juvenile specimens of “*Bufo regularis*” from “Novo Redondo” (MHNC-UP/ANF142), “Cazengo” and “N’dalla

Tando” (MHNC-UP/ANF218). Ferreira (1904) also cited adult and juvenile specimens of “*Bufo funereus*” from “Gumba” and “Lembu”, matching the extant specimens MHNC-UP/ANF146–147, ANF191 (Gumba) and MHNC-UP/ANF143 (Lembu). The aforementioned specimens have been misidentified by Ferreira as *S. funerea* (see respective account). Additionally, Ferreira (1906) cited an undetermined number of specimens from unidentified locality that could correspond to the extant specimens without data. In the same sense, among those specimens might be some that refer to the “*Bufo funereus*” from “Novo Redondo” and “Cabiri” (Ferreira 1904) and “*Bufo regularis*” from “Cazengo” (Ferreira 1904) that we were unable to locate.



Fig. 6 – Specimen of *Sclerophrys regularis* (MHNC-UP/ANF159), from Cabiri. Photo by Bruna Santos.

Microhylidae

Phrynomantis newtoni Ceríaco, Santos, Marques & Bauer 2020

Material: One specimen: One adult specimen (MHNC-UP/ANF194, formerly UP-MHNFCP-017327; **Fig. 7**), collected from Chingo (Novo Redondo) [-11.20000, 13.85000, 11] Kwanza Sul Province, in 1903.

Comments: *P. newtoni* is a species known from low elevation coastal areas of southern and central Angola, ranging from Benguela to Luanda Province (Ceríaco *et al.* submitted). Ferreira (1904) cited this specimen as an adult “*Phrynomantis bifasciatus*” of “Boulenger’s Var. C”. A recent study by Ceríaco *et al.* (submitted – Chapter 3) used MHNC-UP/ANF194 in the description of the new taxon *P. newtoni*, honoring Francisco Newton as its collector and an important naturalist explorer. After analyzing both historical specimens, specimens from recent field surveys and even recent sightings, the authors concluded that it constituted a separate new species. Boulenger had previously described the Angolan specimens as a *Phrynomantis bifasciatus* (Smith, 1847) variety – “Var. C” (Boulenger 1882).



Fig. 7 – Specimen of *Phrynomantis newtoni* (MHNC-UP/ANF194), from Chingo (Novo Redondo). Photo by Bruna Santos.

Hyperoliidae

Afrixalus osorioi (Ferreira, 1906)

Material: Three specimens: One adult male, one adult female and one juvenile specimen (MHNC-UP/ANF212–214, formerly UP-MHNFCP-017307; **Fig. 8**), collected from Quilombo [-9.33333, 14.90000, 744] Kwanza Norte Province, date unknown.

Comments: The MHNC-UP/ANF212–214 specimens are the syntypes used by Ferreira (1906) in the description of *Rappia osorioi*, a species named in homage to Baltasar Osório (1855-1926), a naturalist from Museu Bocage. Ceríaco *et al.* (2014b) analyzed these specimens in a review of the type specimens published by Ferreira (1904, 1906), confirming the species to be valid and found in northwestern Angola. Until very recently, the species had only been recorded from its type locality in Angola (Marques *et al.* 2018), but field surveys in Serra do Pingano, Uíge Province, uncovered additional records of the species for the country (**Fig. 9**) (Ernst *et al.* 2020; LMPC pers obsv.).



Fig. 8 – Specimen of *Afrixalus osorioi* (MHNC-UP/ANF212), from Quilombo. Photo by Bruna Santos.



Fig. 9 – Life photo of *Afrixalus osorioi* from Serra do Pingano. Photo by Luis Ceriaco.

Hyperolius adspersus Peters, 1877

Material: Two specimens: Two adult female specimens (MHNC-UP/ANF210–211, formerly UP-MHNFCP-017298 and UP-MHNFCP-017292; **Fig. 10**), collected from Cabiri [-8.92125, 13.66654, 31], Bengo Province, in 1903.

Comments: *H. adspersus* was originally described from “Chinchoxo”, Cabinda Province (Peters, 1877), and has been recorded in a few other localities in Bengo, Lunda Sul and Moxico provinces (Marques *et al.* 2018), but its distribution extends northwest to southern Cameroon (Channing & Rödel, 2019). The species has remained understudied and is a part of the *Hyperolius nasutus* Günther, 1865 group (Channing *et al.* 2013). The extant specimens were used by Ferreira (1904) as the type specimens for what he considered a new taxon, *Rappia nobrei*, named in homage to Augusto Nobre. However, after revision of the type series, Ceriaco *et al.* (2014b) suggested that *Rappia* [= *Hyperolius*] *nobrei* is a junior synonym *H. adspersus*.



Fig. 10 – Specimen of *Hyperolius adspersus* (MHNC-UP/ANF211), from Cabiri. Photo by Bruna Santos.

Hyperolius angolensis Steindachner, 1867

Material: Twenty-nine specimens: Six adult specimens (MHNC-UP/ANF134–139, formerly UP-MHNFCP-094966 and UP-MHNFCP-094967), collected from Rio Quanza (impossible to georeference) undetermined province, in 1903; One adult male specimen (MHNC-UP/ANF173, formerly UP-MHNFCP-017304), collected from N'Golla Bumba [-9.03333, 14.60000, 460] Kwanza Norte Province, in 1904; One adult specimen (MHNC-UP/ANF177, formerly UP-MHNFCP-017311), collected from Golungo Alto [-9.13333, 14.76667, 666] Kwanza Norte Province, in 1904; Two adult specimens (MHNC-UP/ANF180-181, formerly UP-MHNFCP-017295), collected from Cabiri [-8.92125, 13.66654, 31] Bengo Province, in July 1903; One adult specimen (MHNC-UP/ANF182, formerly UP-MHNFCP-094961), collected from Quilombo [-9.33333, 14.90000, 744] Kwanza Norte Province, in 1904; One adult male specimen (MHNC-UP/ANF183, formerly UP-MHNFCP-017293), collected from Palmyra, Cazengo [-9.30000, 14.68333, 403] Kwanza Norte Province, in 1903; One adult specimen (MHNC-UP/ANF199, formerly UP-MHNFCP-094963), collected from Cambondo [-9.16349, 14.66432, 394]

Kwanza Norte Province, date unknown; Four adult specimens (MHNC-UP/ANF200–203, formerly UP-MHNFCP-094963), collected from unknown locality, date unknown; One adult specimen (MHNC-UP/ANF204, formerly UP-MHNFCP-094964), collected from unknown locality, in 1904; One adult specimen (MHNC-UP/ANF295, formerly UP-MHNFCP-017317), collected from unknown locality, date unknown; Two adult specimens (MHNC-UP/ANF296–297, formerly UP-MHNFCP-017300; **Fig. 11**), collected from unknown locality, date unknown; Three adult specimens (MHNC-UP/ANF300–302, formerly UP-MHNFCP-017297 and UP-MHNFCP-017299), collected from unknown locality, date unknown; Five adult specimens (MHNC-UP/ANF336–337, ANF340–341, ANF343), collected from unknown locality, date unknown.

Comments: *H. angolensis* is one of the most widespread species of reed frogs in Angola, but also one with most complicated taxonomic and nomenclatural history (Marques *et al.* 2018). The taxonomic identification of the Angolan specimens is currently subject to three different main interpretations. Authors including Wieczorek *et al.* (2000), Frétey *et al.* (2011), Baptista *et al.* (2019) and Frost (2020) consider the Angolan population as representatives of *Hyperolius paralellus* Günther, 1858. Some other authors, as Conradie *et al.* (2012), Ceriaco *et al.* (2016b), Marques *et al.* (2018) or Butler *et al.* (2019) consider the Angolan populations as members of *H. angolensis*, a species described from Duque de Brangaça [=Kalandula] region in Malanje Province, by Steindachner in 1867. The decision of using *H. angolensis* instead of the older nomen *parallelus* is justified by an apparent homonymy of the *parallelus* type material, constituted by specimens from South Africa and Angola. The original description of *parallelus* referred only to material from South Africa (Günther, 1858), and only in a subsequent publication were Angolan specimens noted (Günther “1858” 1859; “Cape of Good Hope” and “Ambris, Angola” [= Ambriz] fide Boulenger (1882)). Most recently Channing & Rödel (2019) consider the Angolan population as part of a widely distributed *H. viridiflavus*, referring to the various populations across the continent, noting that “the advertisement call is very similar and the genetic variation very small between populations”. This claim was not substantiated by the authors with any supporting molecular data. Without more data, we opt to follow Marques *et al.* (2018). The authors noted however that under *H. angolensis* there might be several different biological species, given the apparent correspondence of different coloration patterns to specific and distinct geographical distributions (Marques *et al.* 2018).

Subsequently to the description of both *parallelus* and *angolensis*, Bocage described several species, subspecies and varieties from Angola, namely *Hyperolius Toulsonii*

from “Loanda” [= Luanda] (Bocage 1867), *Hyperolius insignis* from “Benguella” (Bocage 1867) (corrected later by Perret (1976a) to “St. Salvador du Congo” [= M'Banza Congo] and “Novo Redondo” [= Sumbe]), *Hyperolius huillensis* from “Huilla” (Bocage 1873), *Rappia plicifera* from “Caconda” and “Duque de Bragança” (Bocage 1893b), *Rappia marmorata* var. *marginata* from “Duque de Bragança” (Bocage 1895), *Rappia marmorata* var. *taeniolata* from “Duque de Bragança”, “Huilla”, “Caconda” and “Cahata” [= Calandula, Huila, Caconda and Caota] (Bocage 1895) and *Rappia marmorata* var. *variegata* from “Cahata” and “Quindumbo” [= Caota and Quindumbo] (Bocage 1895). Other authors, such as Peters, Ahl and Monard described *Hyperolius vermiculatus* from “Malange” [= Malanje] (Peters 1882a), *Hyperolius marungaensis* from “Marunga” (Ahl 1931), *Hyperolius decoratus* from “Longa” (Ahl 1931), *Hyperolius microtictus* from “Longa” (Ahl 1931) and *Hyperolius erythromelanus* from “Sangevé” [= Sanguéve] (Monard 1937). The aforementioned have all been synonymized with either *H. marmoratus*, a species originally described from “Natal” [= KwaZulu-Natal], South Africa by Rapp (1842), *H. paralellus* or *H. angolensis* (see Marques *et al.* 2018).

Ferreira (1906) cited an adult male specimen of “*Rappia plicifera*” from “N’Golla Bumba” and one “*Rappia toulsoni*” from “Golungo Alto”, matching the extant specimens MHNC-UP/ANF173 (**Fig. 12**) and MHNC-UP/ANF177 (**Fig. 13**) respectively. Ferreira (1906) also cited two specimens of “*Rappia marmorata* var. *insignis*” from “Cambondo” and “Quilombo”, of which MHNC-UP/ANF199 match the former. Specimens MHNC-UP/ANF200–203 (**Fig. 14**), do not present locality data, but are identified in their respective historical label as “*R. marmorata insignis*” and possibly correspond to the cited material from “Quilombo”. We were unable to find matches for some specimens cited by Ferreira (1904), namely the adults of “*Rappia plicifera*” from “Cazengo?”, “Cabiri” and “Cacuaco (Bengo)” and adults and juveniles of “*Rappia marmorata*” from “Gumba” and “Cazengo”. It is possible that among the specimens without information (lacking either locality, date of collection, previous identification or a combination of those – MHNC-UP/ANF295–297, ANF300–302, ANF336–337, ANF340–341, ANF343) are the matches for the remaining cited specimens. Additionally, extant in MHNC-UP are specimens with the following previous identifications (done by Ferreira) – “*Rappia marmorata*” (MHNC-UP/ANF182, **Fig. 15**), “*Rappia marmorata paralella*” (MHNC-UP/ANF136–139, ANF180–181, **Fig. 16**), “*Rappia marmorata* var *insignis*” (MHNC-UP/ANF183) “*Rappia marmorata plicifera*” (MHNC-UP/ANF204, **Fig. 17**) and “*Rappia plicifera*” (MHNC-UP/ANF134–135).

As Bethencourt Ferreira had access to Bocage's original type specimens while working in Lisbon, we consider that the Newton specimens are representatives of the most approximate interpretation of the lost type material, and therefore, can be of crucial importance for future taxonomic revisions of the group.



Fig. 11 – Specimen of *Hyperolius angolensis* (MHNC-UP/ANF296), from unknown locality. Photo by Bruna Santos.



Fig. 12 – Specimen of *Hyperolius angolensis* (*Rappia plicifera*) (MHNC-UP/ANF173), from N'Golla Bumba. Photo by Bruna Santos.



Fig. 13 – Specimen of *Hyperolius angolensis* (*Rappia tosoni*) (MHNC-UP/ANF177), from Golungo Alto. Photo by Bruna Santos.

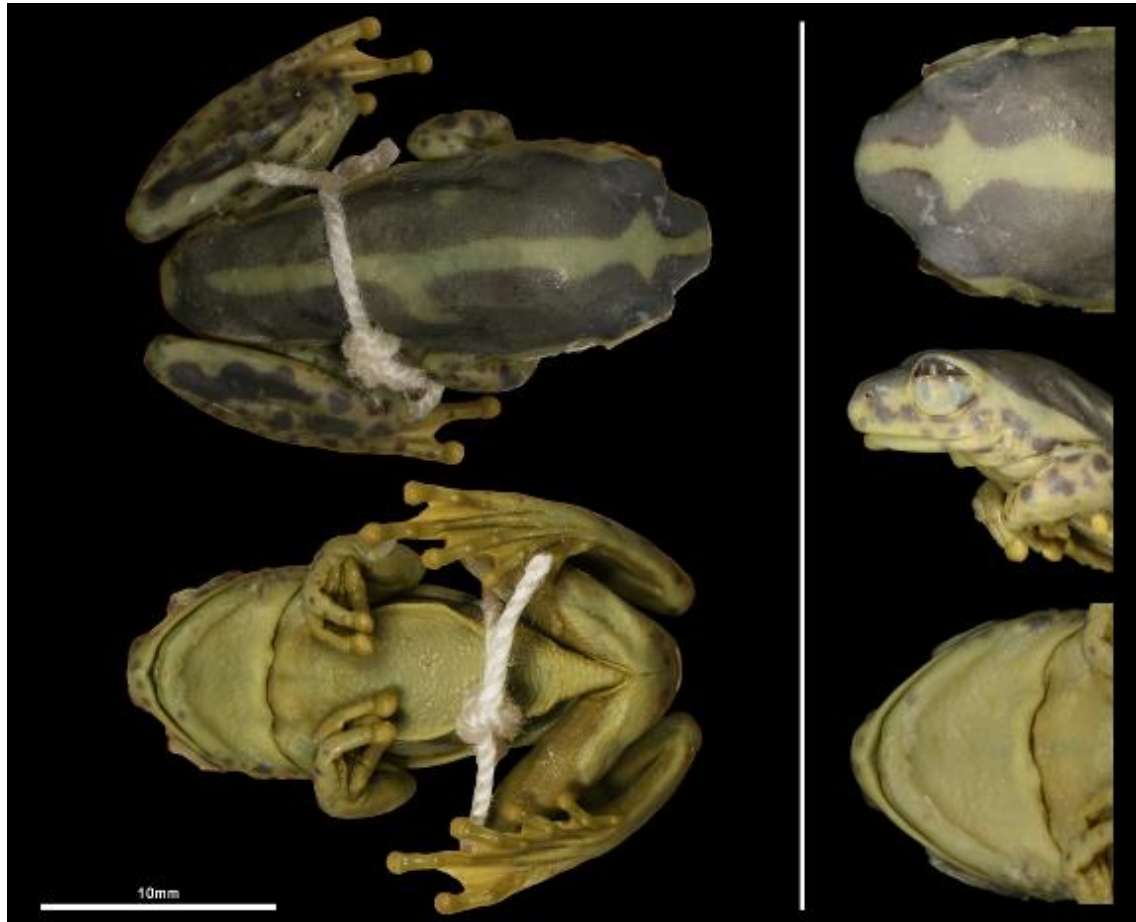


Fig. 14 – Specimen of *Hyperolius angolensis* (*Rappia marmorata insignis*) (MHNC-UP/ANF200), from unknown locality.

Photo by Bruna Santos.



Fig. 15 – Specimen of *Hyperolius angolensis* (*Rappia marmorata*) (MHNC-UP/ANF182), from unknown locality. Photo by Bruna Santos.



Fig. 16 – Specimen of *Hyperolius angolensis* (*Rappia marmorata paralella*) (MHNC-UP/ANF138), from unknown locality. Photo by Bruna Santos.



Fig. 17 – Specimen of *Hyperolius angolensis* (*Rappia marmorata plicifera*) (MHNC-UP/ANF207), from unknown locality.
Photo by Bruna Santos.

Hyperolius benguellensis (Bocage, 1893)

Material: Two specimens: One adult and one juvenile specimen (MHNC-UP/ANF174–175, formerly UP-MHNFCP-017310; **Fig. 18**), collected from Quilombo [-9.33333, 14.90000, 744] Kwanza Norte Province, in January 1904.

Comments: *H. benguellensis* is a species that occurs mainly in western Angola (Marques *et al.* 2018). Newton's specimens are a few of the exceptions, occurring further north in Kwanza Norte Province, being the only published occurrences for “Quilombo” (Marques *et al.* 2018). Ferreira (1906) cited a typical specimen of average dimensions (“1 ex. typico de dimensões medianas”) from “Quilombo”, matching MHNC-UP/ANF174. *H. benguellesis*' taxonomic status was recently reviewed by Channing *et al.* (2013), using molecular data, who considered it as a distinct species.



Fig. 18 – Specimen of *Hyperolius benguellensis* (MHNC-UP/ANF174), from Quilombo. Photo by Bruna Santos.

Hyperolius bocagei Steindachner, 1867

Material: Five specimens: One adult female and one adult male specimen (MHNC-UP/ANF178–179, formerly UP-MHNFCP-017306), collected from Cacuaco [−8.78333, 13.36667, 6] Luanda Province, in 1903; One adult specimen (MHNC-UP/ANF219, formerly UP-MHNFCP-017318; **Fig. 19**), collected from Bahia dos Tigres [=Baía dos Tigres] (in error) [−16.58559, 11.82709, 98] Namibe Province, in 1905; Two adult specimens (MHNC-UP/ANF338–339), collected from unknown locality, date unknown.

Comments: *H. bocagei* is a species found in northeast and western Angola (Marques *et al.* 2018). Ferreira (1904) cites male and female specimens (no precise number) of “*Rappia bocagei* (Stenid.)” from “Cacuaco”, corresponding to specimens MHNC-UP/ANF178–179. Another specimen of this species was used by Ferreira (1906) to describe a new variety – *R. bocagei* var. *maculata* – from “Golungo Alto”. MHNC-UP/ANF219 might correspond to the cited specimen (see Ceríaco *et al.* 2014b). The label for specimen MHNC-UP/ANF219 indicates the locality “Bahia dos Tigres”, a desert

area in the southern coast of Namibe Province. This is certainly a labelling error, as the habitat is not suitable for *Hyperolius* species due to its extreme aridity.



Fig. 19 – Specimen of *Hyperolius bocagei* (MHNC-UP/ANF219), from unknown locality. Photo by Bruna Santos.

Hyperolius cinnamomeoventris Bocage, 1866

Material: Six specimens: One adult specimen (MHNC-UP/ANF176, formerly UP-MHNFCP-017313; **Fig. 20**), collected from Quilombo [-9.33333, 14.90000, 744] Kwanza Norte Province, in 1904; Two adult male specimens (MHNC-UP/ANF197–198, formerly UP-MHNFCP-094965), collected from unknown locality, date unknown; One adult specimen (MHNC-UP/ANF220, formerly UP-MHNFCP-017314), collected from Bahia dos Tigres [=Baía dos Tigres] (in error) [-16.58559, 11.82709, 98] Namibe Province, in 1905; One adult specimen (MHNC-UP/ANF294, formerly UP-MHNFCP-017309), collected from unknown location, date unknown; One adult specimen (MHNC-UP/ANF344), collected from unknown locality, date unknown.

Comments: *H. cinnamomeoventris* is a species found along the western coast of Angola and in the northern part of the country (Marques *et al.* 2018). Ferreira (1906) cites several specimens (without giving the precise number) from “Quilombo”, “Mupèpe” and “Rio Luinha”. Six specimens are extant in the collections, one of which matching the Quilombo locality (MHNC-UP/ANF176). The remaining most likely correspond to the “Mupepe” and “Rio Luinha” specimens, as the adult specimen (MHNC-UP/ANF220) is certainly not from “Bahia dos Tigres” as noted in the label. Specimen MHNC-UP/ANF294 was previously identified as “*Rappia cinctiventris*”. The cited localities are the only published records for the species in Kwanza Norte province (Marques *et al.* 2018).



Fig. 20 – Specimen of *Hyperolius cinnamomeoventris* (MHNC-UP/ANF176), from Quilombo. Photo by Bruna Santos.

Hyperolius platyceps (Boulenger, 1900)

Material: Six specimens: One adult specimen (MHNC-UP/ANF205, formerly UP-MHNFCEP-017303; **Fig. 21**), collected from Quilombo [-9.33333, 14.90000, 744] Kwanza Norte Province, date unknown; One adult specimen (MHNC-UP/ANF206, formerly UP-MHNFCEP-017294), collected from Quilombo [-9.33333, 14.90000, 744] Kwanza Norte

Province, in 1904; One adult male specimen (MHNC-UP/ANF207, formerly UP-MHNFCP-017291) collected from N'Golla Bumba [-9.03333, 14.60000, 460] Kwanza Norte Province, date unknown; One juvenile specimen (MHNC-UP/ANF208, formerly UP-MHNFCP-017296) collected from Quilombo [-9.33333, 14.90000, 744] Kwanza Norte Province, date unknown; One adult male specimen (MHNC-UP/ANF209, formerly UP-MHNFCP-017302) collected from Rio Luinha [-9.26667, 14.53333, 237] Kwanza Norte Province, date unknown; One adult female specimen (MHNC-UP/ANF215, formerly UP-MHNFCP-017301), collected from N'Golla Bumba [-9.03333, 14.60000, 460] Kwanza Norte Province, date unknown.

Comments: *H. platyceps* is a species found in northern Angola and ranging from southern Cameroon to southwestern Republic of Congo, western Democratic Republic of the Congo and southwestern Central African Republic (Marques *et al.* 2018; Frost 2020). Specimens from this species were used by Ferreira (1906) to describe three new taxa - *Rappia platyceps* var *angolensis* ("N'Golla Bumba" and "Quilombo"); *Rappia fasciata* ("Quilombo") and *Rappia bivittata* ("Rio Luinha", "Quilombo" e "N'Golla Bumba"). All of these are currently considered junior synonyms of *H. platyceps* (Ceríaco *et al.* 2014b; Marques *et al.* 2018; Frost 2020). Specimen MHNC-UP/ANF205 is a syntype for *Rappia platyceps* var *angolensis*; MHNC-UP/ANF206 the holotype for *Rappia fasciata* and MHNC-UP/ANF207–209 the syntypes for *Rappia bivittata*. Ceríaco *et al.* (2014b) stated MHNC-UP/ANF209 as a lectotype, while MHNC-UP/ANF207–208 should be considered paralectotypes. Specimen MHNC-UP/ANF215 has an internal label stating "Paratype de *Rappia osorioi* Ferreira / est en fait un *Hyperolius platyceps fasciatus* (Ferreira)". This type-written note was most likely written by either Laurent (1982) or Perret (1976b), as both authors examined the jar (Ceríaco *et al.* 2014b).



Fig. 21 – Specimen of *Hyperolius platyceps* (MHNC-UP/ANF205), from Quilombo. Photo by Bruna Santos.

Arthroleptidae

Arthroleptis carquejai Ferreira, 1906

Material: One specimen: One adult female specimen (MHNC-UP/ANF188, formerly UP-MHNFCEP-018586; **Fig. 22**), collected from Cambondo [-9.16349, 14.66432, 394] Kwanza Norte Province, date unknown.

Comments: *A. carquejai* is an Angolan endemic species, found in the northern part of the country (Marques *et al.* 2018). The specific epithet *carquejai* was in honor of Bento Carqueja (1860–1935), a businessman, writer and professor at APP. The single specimen collected by Newton was used by Ferreira (1906) as the holotype for the species. Ceríaco *et al.* (2014b) recognized *A. carquejai* as a valid species belonging to the same group of species as *Arthroleptis variabilis* Matschie, 1893. The authors also analyzed specimens from the Zoologisches Museum Hamburg collected from “Roca Nova” (Roça Novo Mundo), approximately 135km from the type locality, and determined

them to also be *A. carquejai*. The species was recently collected in Serra do Pingano, Uíge Province, by Luis Ceríaco *et al.* (**Fig. 23**) and Ernst *et al.* (2020). Marques *et al.* (2018) suggested that *A. carquejai* most likely also occurs in the Democratic Republic of the Congo and possibly Gabon.



Fig. 22 – Specimen of *Arthroleptis carquejai* (MHNC-UP/ANF188), from Cambondo. Photo by Bruna Santos.



Fig. 23 – Life photo of *Arthroleptis carquejai*, from Serra do Pingano. Photo by Luis Ceriaco.

Leptopelis bocagii (Günther, 1865)

Material: Six specimens: One juvenile specimen (MHNC-UP/ANF184, formerly UP-MHNFCP-017326), collected from Gumba [-11.26667, 14.28333, 784] Kwanza Sul Province, date unknown; One adult male specimen (MHNC-UP/ANF185, formerly UP-MHNFCP-017324), collected from Gumba [-11.26667, 14.28333, 784] Kwanza Sul Province, in May 1903; One adult specimen (MHNC-UP/ANF186, formerly UP-MHNFCP-017325; **Fig. 24**), collected from unknown locality, date unknown; One adult specimen (MHNC-UP/ANF187, formerly UP-MHNFCP-017323), collected from N’Golla Bumba [-9.03333, 14.60000, 460] Kwanza Norte Province, date unknown; Two juvenile specimens (MHNC-UP/ANF335, ANF342), collected from unknown locality, date unknown.

Comments: *L. bocagii* is a savanna species known from the western and northeast regions of Angola (Marques *et al.* 2018). Based on two specimens, an adult and a juvenile from “Gumba”, Ferreira (1904) described what he considered to be a new variety, “*Hylambates bocagei* var. *leucopunctata* n. var.” (MHNC-UP/ANF184–185). Ceriaco *et al.* (2014b), after examination of the type material, considered *leucopunctata* as a junior synonym of *L. bocagii*, but additional analysis might be needed to address its

taxonomic identity. Ferreira (1906) cited additional specimens of “*Hylambates bocagei* (Gunth.)” [= *Leptopelis bocagii*] from “Rio Luinha”, “Quilombo” and “N’golla Bumba” (MHNC-UP/ANF187). Specimens MHNC-UP/ANF186, ANF335 and ANF342 may correspond to the ones cited by Ferreira (1906) from “Rio Luinha” and “Quilombo”.



Fig. 24 – Specimen of *Leptopelis bocagii* (MHNC-UP/ANF186), from unknown locality. Photo by Bruna Santos.

Ptychadenidae

Ptychadena ansorgii (Boulenger, 1905)

Material: One specimen: One adult specimen (MHNC-UP/ANF332, formerly UP-MHNFCP-052191; **Fig. 25**), collected from unknown locality, date unknown.

Comments: *P. ansorgii* is a species known from the western and extreme northeast regions of Angola (Marques *et al.* 2018). The species was not cited by Ferreira in any of his publications regarding Newton's expedition to Angola (Ferreira 1904, 1906), and therefore constitutes an additional record of this species to the country, even if without associated collecting data.



Fig. 25 – Specimen of *Ptychadena ansorgii* (MHNC-UP/ANF332), from unknown locality. Photo by Bruna Santos.

Ptychadena oxyrhynchus (Smith, 1849)

Material: Four specimens: One juvenile specimen (MHNC-UP/ANF221, formerly UP-MHNFCP-017336), collected from unknown locality, date unknown; One adult specimen (MHNC-UP/ANF222, formerly UP-MHNFCP-017337), collected from unknown locality, date unknown; One adult specimen (MHNC-UP/ANF305, formerly UP-MHNFCP-017342; **Fig. 26**), collected from unknown locality, date unknown; One adult specimen (MHNC-UP/ANF307, formerly UP-MHNFCP-017351), collected from unknown locality, date unknown.

Comments: *P. oxyrhynchus* is a species that occurs across the northeastern and western parts of Angola (Marques *et al.* 2018). Ferreira (1904) cites adult specimens of “*Rana oxyrhyncha*” from “Chingo”, adults and juveniles from “N’dalla Tando” and “Cazengo”, and one juvenile from “Rio Luinha” (1906). All extant specimens in the museum lack collecting data, rendering it impossible to match the specimens to those

published by Ferreira (1904). The species was recently recorded from Bicular National Park, Huila Province (Baptista *et al.* 2019; Butler *et al.* 2019).



Fig. 26 – Specimen of *Ptychadena oxyrhynchus* (MHNC-UP/ANF305), from unknown locality. Photo by Bruna Santos.

Phrynobatrachidae

Phrynobatrachus cf. *mababiensis* FitzSimons, 1932

Material: Eighteen juvenile specimens (MHNC-UP/ANF116–133, formerly UP-MHNFCEP-094971; **Fig. 27**), collected from Unguay [=Nonguai] [-15.76667, 12.01667, 45] Namibe province, in June 1904.

Comments: *P. mababiensis* is known from savannas in central and southern Africa and has been reported from southern Angola (Marques *et al.* 2018). According to Frost (2020), the species occurs in East African savannas from Tanzania to Transkei (Republic of South Africa), west to northern Namibia, in Botswana, and presumably in southern Democratic Republic of the Congo and southern Kenya as well. Marques *et al.* (2018) refers to this species as a part of the taxonomically problematic *Phrynobatrachus*

cryptotis group. A molecular analysis study by Zimkus *et al.* (2010) revealed that, recognized today as *P. cf. mababiensis*, are in fact three different species. Specimens MHNC-UP/ANF116–133 weren't cited by Ferreira (1904, 1906). Recently, Ernst *et al.* (2020) reported *P. cf. mababiensis* from Serra do Pingano, Uíge Province. Luis Ceríaco also recently collected material from Maungo (**Fig. 28**).



Fig. 27 – Specimen of *Phrynobatrachus cf. mababiensis* (MHNC-UP/ANF305), from Nonguai. Photo by Bruna Santos.



Fig. 28 – Life photo of *Phrynobatrachus* cf. *mababiensis*, from Maungo. Photo by Luis Ceríaco.

Phrynobatrachus cf. *natalensis* (Smith, 1849)

Material: Three specimens: Two adult specimens (MHNC-UP/ANF312–313, formerly UP-MHNFCP-017321; **Fig. 29**), collected from unknown locality, date unknown; One adult specimen (MHNC-UP/ANF314, formerly UP-MHNFCP-017343), collected from unknown locality, date unknown.

Comments: Populations referred to as *P. cf. natalensis* have been cited from across sub-Saharan Africa and are well widespread in Angola (Marques *et al.* 2018). Despite that, Marques *et al.* (2018) noted that those records most likely correspond to several undescribed species. Zimkus *et al.* (2010), in a molecular phylogenetic analysis, showed that *P. natalensis* is a species complex and recovered five different clades. Ferreira (1904) cited an adult specimen from “Catete” (the only citation for the locality), and an unspecified number of specimens from unknown location (Ferreira 1906). Extant in the collection, specimens MHNC-UP/ANF312–314 might correspond to the one cited from “Catete”.



Fig. 29 – Specimen of *Phrynobatrachus* cf. *natalensis* (MHNC-UP/ANF312), from unknown locality. Photo by Bruna Santos.

Pyxicephalidae

Amietia angolensis (Bocage, 1866)

Material: Eight specimens: One adult specimen (MHNC-UP/ANF192, formerly UP-MHNFCP-017332; **Fig. 30**), collected from N'Dalla Tando [=N'dalatando] [-9.30000, 14.91667, 782] Kwanza Norte Province, in September 1903; One adult specimen (MHNC-UP/ANF193, formerly UP-MHNFCP-017331), collected from Zembe [-9.31667, 14.66667, 539] Kwanza Norte Province, in August 1903; Two adult specimens (MHNC-UP/ANF195–196, formerly UP-MHNFCP-094960), collected from Zembe [-9.31667, 14.66667, 539] Kwanza Norte Province, in September 1903; One juvenile and one adult specimen (MHNC-UP/ANF223–224, formerly UP-MHNFCP-017334 and UP-MHNFCP-017333), collected from unknown locality, date unknown; One adult specimen (MHNC-UP/ANF308, formerly UP-MHNFCP-017338), collected from unknown locality, date

unknown; One juvenile specimen (MHNC-UP/ANF309, formerly UP-MHNFCP-052192), collected from unknown locality, date unknown.

Comments: *A. angolensis* is known from almost all of Angola, but majorly from the northern and western regions (Marques *et al.* 2018). Ferreira (1904) cited two adult specimens from “N’dalla Tando” and possibly one from “Zembe”, matching the records for MHNC-UP/ANF192 and MHNC-UP/ANF193, ANF195–196. The remaining extant specimens have no locality associated. *A. angolensis* has been restricted to Angolan populations by Channing & Baptista (2013) and Channing *et al.* (2016), although the authors recognize it might have a broader distribution (Marques *et al.* 2018). Ernst *et al.* (2020) recently cited the species from Serra do Pingano, Uíge Province. *A. angolensis* was also recently cited from northeastern Democratic Republic of the Congo (Mali *et al.* 2019), but that identification needs confirmation (Frost 2020).



Fig. 30 – Specimen of *Amietia angolensis* (MHNC-UP/ANF192), from N'dalatando. Photo by Bruna Santos.

Tomopterna ahli (Deckert, 1938)

Material: One specimen: One adult specimen (MHNC-UP/REP225, formerly UP-MHNFCP-017341; **Fig. 31**), collected from Mossamedes [=Moçâmedes] [-15.20000, 12.15000, 24] Namibe Province, in 1905.

Comments: *T. ahli* is a species found in the southwest of Angola, extending to northern and western Namibia (Marques *et al.* 2018; Frost 2020). This specimen is part of the shipment of specimens made by Newton from Namibe Province and therefore was never published by Ferreira or any subsequent authors. *T. ahli* was until very recently known as *Tomopterna damarensis* Dawood & Channing, 2002. The previous name is now considered a junior synonym (Channing & Becker 2019). The first account for the species in Angola, based on specimens collected in Iona National Park, southern Namibe Province was published in 2016 (Ceríaco *et al.* 2016a; Heinicke *et al.* 2017). Butler *et al.* (2019) provided additional record from Bicular National Park, Huíla Province. The present specimen extends the known distribution of the species northwest towards Moçâmedes region.



Fig. 31 – Specimen of *Tomopterna ahli* (MHNC-UP/ANF225), from Moçâmedes. Photo by Bruna Santos.

Tomopterna tuberculosa (Boulenger, 1882)

Material: One specimen: One juvenile specimen (MHNC-UP/REP311, formerly UP-MHNFCP-017322; **Fig. 32**), collected from unknown locality, date unknown.

Comments: *T. tuberculosa* is an open savannah woodland species widespread throughout Angola (Marques *et al.* 2018). Ferreira (1904) cited a juvenile specimen of “*Rana tuberculosa*” from “Novo Redondo” that possibly matches this specimen, although it is identified as “*Rana tuberculata*” on the jar’s label. Among the provinces in which Newton collected, this species is known to occur in Kwanza Sul and Namibe (Marques *et al.* 2018).



Fig. 32 – Specimen of *Tomopterna tuberculosa* (MHNC-UP/ANF192), from unknown locality. Photo by Bruna Santos.

Reptilia

Squamata

(Lizards)

Gekkonidae

Chondrodactylus pulitzeriae (Schmidt, 1933)

Material: Seven specimens: Five adult specimens (MHNC-UP/REP201–205, formerly UP-MHNFCP-094992; **Fig. 33**), collected from Bahia dos Tigres [=Baía dos Tigres] [-16.58559, 11.82709, 98] Namibe Province, in 1905; One adult specimen (MHNC-UP/REP206, formerly UP-MHNFCP-018321), collected from unknown locality, date unknown; One adult specimen (MHNC-UP/REP207, formerly UP-MHNFCP-017359), collected from Bahia dos Tigres [=Baía dos Tigres] [-16.58559, 11.82709, 98] Namibe Province, in 1905.

Comments: *C. pulitzeriae* occurs along the Angolan coast, mainly in the south of the country (Marques *et al.* 2018), with Caop Velha, Bengo Province, being the known northern limit of distribution (Ceríaco *et al.* 2017). It was until recently part of the genus *Pachydactylus* until Bauer & Lamb (2005) transferred it to *Chondrodactylus*. Later Heinz (2011) demonstrated that *C. pulitzeriae* was the correct name for the Angolan lineage. Specimens from the Newton expedition were never cited. MHNC-UP/REP201–205 specimens' jar was labelled as "*Pachydactulus bibroni* (Smith) Newton Bahia dos Tigres 1905" and "11 Baía dos Tigres 1905". This matches the known distribution of the species, as *C. pulitzeriae* has already been cited from Namibe Province (Bocage 1895; Ceríaco *et al.* 2016b; Laurent 1964).



Fig. 33 – Specimen of *Chondrodactylus pulitzeriae* (MHNC-UP/REP203), from Baía dos Tigres. Photo by Bruna Santos.

Hemidactylus bayonii Bocage, 1893

Material: One specimen: One adult specimen (MHNC-UP/REP208; **Fig. 34**), collected from Ambaca [-9.26667, 15.18333, 738] Kwanza Norte province, date unknown.

Comments: *H. bayonii* is an Angolan endemic species first described by Bocage (1893b). Until recently, it was only known from the regions surrounding the Kwanza River (Marques *et al.* 2018). Ceríaco *et al.* (2020a), in a review of the genus *Hemidactylus* from Angola, commented on the systematics of *H. bayonii* and designated a neotype for the species. The authors also reported a collection of several other specimens from Bengo, Benguela, Namibe and Kwanza Sul provinces, widening the previously known range for the species. The presented specimen was never cited in any of Ferreira's (1904, 1906) papers.



Fig. 34 – Specimen of *Hemidactylus bayonii* (MHNC-UP/REP208), from Ambaca. Photo by Bruna Santos.

Hemidactylus longicephalus Bocage, 1873

Material: Two specimens: One adult male specimen (MHNC-UP/REP214, formerly UP-MHNFCP-017357; **Fig. 35**), collected from Gumba [-11.26667, 14.28333, 784] Kwanza Sul Province, in 1903; One juvenile specimen (MHNC-UP/REP215, formerly UP-MHNFCP-017356), collected from Cabiri [-8.92125, 13.66654, 31] Bengo Province, in 1903.

Comments: *H. longicephalus* is a species found mainly in western Angola (Marques *et al.* 2018; Ceríaco *et al.* 2020a). The species has a complicated taxonomic history, recently addressed in detail by Ceríaco *et al.* (2020a). Specimen MHNC-UP/REP214 was cited by Ferreira (1904) as “*Hemidactylus bocagei*”, as well as a male and a female specimen from “Cunga, margens do Quanza” that we were unable to find. An additional adult specimen was also cited by Ferreira (1906), with no indication of locality, possibly matching MHNC-UP/REP215, although we found it to be a juvenile.



Fig. 35 – Specimen of *Hemidactylus longicephalus* (MHNC-UP/REP214), from Gumba. Photo by Bruna Santos.

Hemidactylus mabouia (Moreau De Jonnès, 1818)

Material: Six specimens: One juvenile specimen (MHNC-UP/REP209), collected from Hocco, Cazengo [-9.35422, 14.89471, 573] Kwanza Norte Province, date unknown; One adult specimen (MHNC-UP/REP210), collected from Cabiri [-8.92125, 13.66654, 31] Bengo Province, in 1903; One adult specimen (MHNC-UP/REP211), collected from Lué (undetermined locality) in 1903; Two adult specimens (MHNC-UP/REP212–213; **Fig. 36**), collected from Catete [-9.11667, 13.70000, 21] Bengo Province, in 1903; One adult specimen (MHNC-UP/REP216, formerly UP-MHNFCP-094991), collected from Rio Luinha [-9.26667, 14.53333, 237] Kwanza Norte Province, in 1904.

Comments: *H. mabouia* is commonly found in northern Angola and along the coastline of the country (Marques *et al.* 2018; Ceríaco *et al.* 2020a). This species is frequently associated with urban habitats and it is one of the most widespread *Hemidactylus* species (and geckos in general), with a broad distribution in sub-Saharan Africa, especially south of the Sahel (Ceríaco *et al.* 2020a). Ferreira (1904) cited female specimens from “Cabiri”, “Serra de Stombe” and “Catete” and an additional adult from “Cambondo” (Ferreira 1906). Extant in MHNC-UP exist specimens from both “Cabiri”

(MHNC-UP/REP210) and “Catete” (MHNC-UP/REP212–213). Agarwal *et al.* are preparing a revision of *H. mabouia* and preliminary analysis indicates that it might comprise several cryptic species (Ceríaco *et al.* 2020a). Ceríaco *et al.* (2020a) recently found the Angolan specimens to be conspecific with one another.



Fig. 36 – Specimen of *Hemidactylus mabouia* (MHNC-UP/REP212), from Catete. Photo by Bruna Santos.

Pachydactylus rangei (Andersson, 1908)

Material: One specimen: One adult specimen (MHNC-UP/REP217, formerly UP-MHNFCP-095008; **Fig. 37**), collected from Bahia dos Tigres [=Baía dos Tigres] [-16.58559, 11.82709, 98] Namibe Province, in 1905.

Comments: *P. rangei* occurs in Namibe province, southwestern Angola (Marques *et al.* 2018). This species was never cited by Ferreira (1904, 1906) in any of his papers. MHNC-UP/REP217's locality matches the species distribution range in the country. *P. rangei* was first described as *Palmatogeocko rangei* Andersson, 1908, being the type species for the genus, but it was later synonymized with *Pachydactylus* by Bauer & Lamb (2005). The species was recently collected by Luis Ceríaco and Mariana Marques in the same area where Newton collected the aforementioned specimen (**Fig. 38**).



Fig. 37 – Specimen of *Pachydactylus rangei* (MHNC-UP/REP217), from Baía dos Tigres. Photo by Bruna Santos.



Fig. 38 – Life photo of *Pachydactylus rangei*, from Baía dos Tigres. Photo by Luis Ceríaco.

Lacertidae

Meroles anchietae (Bocage, 1867)

Material: Six specimens: Three adult and one juvenile specimens (MHNC-UP/REP219–222, formerly UP-MHNFCP-094996–094999; **Fig. 39**), collected from Mossamedes [=Moçâmedes] [-15.20000, 12.15000, 24] Namibe Province, in 1905; Two adult specimens (MHNC-UP/REP223–224, formerly UP-MHNFCP-017366), collected from Porto Alexandre [=Tômbua] [-15.80401, 11.84492, 11] Namibe Province, in July 1904.

Comments: *M. anchietae* is endemic to the Namib desert (Branch 1998; Marques *et al.* 2018). Ferreira never published the Newton Expedition specimens but identified the extant specimens as *Pachyrhyncus anchietae*, as noted by the extant labels. Marques *et al.* (2018) referenced specimens MHNC-UP/REP219–222 from “Mossamedes” when discussing the species’ taxonomy and distribution. Up until recently, *M. anchietae* in Angola was only known from its type locality “Rio Coroca, dans le littoral de Mossamedes”, but collections by Ceríaco *et al.* (2016a) showed the species has a broader distribution range, even if confined to the Namib desert regions. The species was recently collected by Luis Ceríaco and Mariana Marques in the same area where Newton collected the aforementioned specimens (**Fig. 40**).



Fig. 39 – Specimen of *Meroles anchietae* (MHNC-UP/REP220), from Moçâmedes. Photo by Bruna Santos.



Fig. 40 – Life photo of *Meroles anchietae*, from Baía dos Tigres. Photo by Luis Ceriáco.

Meroles reticulatus (Bocage, 1867)

Material: Six specimens: One juvenile and two adult specimens (MHNC-UP/REP225–227, formerly UP-MHNFCP-094993–094995; **Fig. 41**), collected from Mossamedes [=Moçâmedes] [–15.20000, 12.15000, 24] Namibe Province, in 1905; One adult specimen (MHNC-UP/REP228, formerly UP-MHNFCP-018332), collected from unknown locality, date unknown; One juvenile and one adult specimen (MHNC-UP/REP229–230, formerly UP-MHNFCP-017365 and UP-MHNFCP-052198), collected from Bahia dos Tigres [=Baía dos Tigres] [–16.58559, 11.82709, 98] Namibe Province, in 1905.

Comments: *M. reticulatus* is a species known from the coastal regions of the Namib desert in southwestern Angola and northern Namibia (Marques *et al.* 2018). Like *M. anchietae*, there are very few published records from Angola, although there are several specimens present in Natural History Museums' collections (Ceriáco *et al.* 2016a; Marques *et al.* 2018). Specimens MHNC-UP/REP229–230 are the first published records for “Bahia dos Tigres”. Ferreira did not publish these specimens, but identified them as “*Scapateira reticulata*”, as noted by the extant labels. The species was recently

collected by Luis Ceríaco and Mariana Marques in the same area where Newton collected the aforementioned specimens (**Fig. 42**).



Fig. 41 – Specimen of *Meroles reticulatus* (MHNC-UP/REP227), from Moçâmedes. Photo by Bruna Santos.



Fig. 42 – Specimen of *Meroles reticulatus* from Baía dos Tigres. Photo by Luis Ceríaco.

Gerrhosauridae

Gerrhosaurus multilineatus Bocage, 1866

Material: Three specimens: One adult specimen (MHNC-UP/REP233, formerly UP-MHNFCP-017373; **Fig. 43**), collected from unknown locality, date unknown; One adult specimen (MHNC-UP/REP234 formerly UP-MHNFCP-094970), collected from Cabiri [-8.92125, 13.66654, 31] Bengo Province, in 1904; One adult specimen (MHNC-UP/REP235, formerly UP-MHNFCP-017371), collected from Bahia dos Tigres [=Baía dos Tigres] (in error) [-16.58559, 11.82709, 98] Namibe Province, in 1905.

Comments: *G. multilineatus* is an Angolan endemic species known from central and western regions of the country (Marques *et al.* 2018). The taxonomic identity of this species has been a topic of confusion as noted by Bates *et al.* (2013) and Marques *et al.* (2018). Ferreira (1904) cited a juvenile specimen from “Cabiri” as “*Gerrhosaurus nigrolineatus*, Hall” that might correspond to MHNC-UP/REP234, as the specimen was identified as such on the label of its jar. The locality “Bahia dos Tigres” found on MHNC-UP/REP235 is most likely an error.



Fig. 43 – Specimen of *Gerrhosaurus multilineatus* (MHNC-UP/REP233), from unknown locality. Photo by Bruna Santos.

Scincidae

Feylinia currori Gray, 1845

Material: Seventeen specimens: Five juvenile and seven adult specimens (MHNC-UP/REP236–247; **Fig. 44**), collected from unknown locality, date unknown; One adult specimen (MHNC-UP/REP248, formerly UP-MHNFCP-017368), collected from Catari [-9.09548, 15.41905, 1022] Kwanza Norte Province, in September 1903; One adult and two juvenile specimens (MHNC-UP/REP249–251, formerly UP-MHNFCP-017367 and UP-MHNFCP-017372), collected from Zembe [-9.31667, 14.66667, 539] Kwanza Norte Province, in September 1903; One adult specimen (MHNC-UP/REP252, formerly UP-MHNFCP-017369), collected from Caculo, Cazengo [-9.25921, 13.82048, 8] Bengo Province, in November 1903.

Comments: *F. currori* is a species known from northern Angola, Cameroon, Central African Republic, Democratic Republic of the Congo, Tanzania and Nigeria (Marques *et al.* 2018) that occurs in forest woodland and high savanna habitats (Wagner & Schmitz 2006). A revision of the genus was published by Brygoo & Roux-Estève (1983), where the authors recognized six valid *Feylinia* species and designated a lectotype for *F. currori*. Ferreira (1904) cited a “large number of specimens, ranging from very young juveniles to larger adults” (translated by the authors from the original in Portuguese) from “N’dalla Tando”, “Zembe”, “Catari” and “Bom Jesus (Quanza)”. Specimens MHNC-UP/REP248 and MHNC-UP/REP249–251 match the cited ones from “Catari” and “Zembe” respectively. It is possible that the remaining specimens with no locality attached correspond to the remaining specimens cited by Ferreira (1904).



Fig. 44 – Specimen of *Feylinia currori* (MHNC-UP/REP247), from unknown locality. Photo by Bruna Santos.

Mochlus sundevallii (Smith, 1849)

Material: Eleven specimens: Two adult specimens (MHNC-UP/REP199–200, formerly UP-MHNFCP-094984–094985; **Fig. 45**), collected from unknown location, date unknown; Six adult specimens (MHNC-UP/REP253–258), collected from unknown locality, date unknown; One adult specimen (MHNC-UP/REP259, formerly UP-MHNFCP-052199), collected from Bahia dos Tigres [=Baía dos Tigres] [-16.58559, 11.82709, 98] Namibe Province, in 1905; One adult specimen (MHNC-UP/REP260, formerly UP-MHNFCP-017382), collected from Sul de Angola [=Southern Angola] (impossible to georeference), date unknown; One adult specimen (MHNC-UP/REP261, formerly UP-MHNFCP-017383), collected from Bahia dos Tigres [=Baía dos Tigres] [-16.58559, 11.82709, 98] Namibe Province, in 1905.

Comments: *M. sundevallii* is a species endemic to Africa (Bates *et al.* 2014), that occurs across the sub-Saharan region, namely north to Uganda, south to South Africa, east to Kenya and Tanzania and west to Namibia and southern Angola (Freitas *et al.* 2018; Marques *et al.* 2018). No *M. sundevallii* from the Newton expedition were ever cited by Ferreira. MHNC-UP/REP259 is the first published record for the species from “Bahia dos

Tigres”. *M. sundevallii* was previously considered a part of the *Lygosoma* genus, but the name has been restricted to Asia (Wagner *et al.* 2009). In a recent study on the *M. afer-sundevallii* species complex, Freitas *et al.* (2018) did not find conclusive evidence to distinguish *Mochlus afer* (Peters, 1854) and *M. sundevallii*, suggesting the use of *M. sundevallii* as the valid name for the widespread lineage across sub-Saharan Africa. Later, Freitas *et al.* (2019) would expand the *Mochlus* genus to include all African writhing skinks. *M. sundevallii* is the only species of the genus found in Angola.



Fig. 45 – Specimen of *Mochlus sundevallii* (MHNC-UP/REP200), from unknown locality. Photo by Bruna Santos.

Panaspis cabindae (Bocage, 1866)

Material: Two specimens: One adult specimen (MHNC-UP/REP266, formerly UP-MHNFCP-017381), collected from Lucálla [=Lucala] [-9.27268, 15.25206, 708] Kwanza Norte Province, in 1903; One adult specimen (MHNC-UP/REP267, formerly UP-MHNFCP-017380; **Fig. 46**), collected from Catete [-9.11667, 13.70000, 21] Bengo Province, in September 1903.

Comments: *P. cabindae* is a species with a distribution extending from southwestern Democratic Republic of the Congo to southwestern Angola (Marques *et al.* 2018; Ceríaco *et al.* 2020b). The presented specimens were cited as “*Ablepharus cabindae*, Boc” by

Ferreira (1904) and are the only published records for the species from “Lucala” and “Catete” localities. Recently, Ceríaco *et al.* (2016a, 2018b, 2020b) and Medina *et al.* (2016) published new records for the species in Angola, including the first accounts for the Bié, Luanda, Uíge, Malanje, Lunda Norte and Huíla provinces. This species is one of the most widespread in the country, despite the lack of published records (Ceríaco *et al.* 2020b).



Fig. 46 – Specimen of *Panaspis cabindae* (MHNC-UP/REP267), from Catete. Photo by Bruna Santos.

Sepsina angolensis Bocage, 1866

Material: One specimen: One adult specimen (MHNC-UP/REP345, formerly UP-MHNFCP-017384; **Fig. 47**), collected from Zembe [-9.31667, 14.66667, 539] Kwanza Norte Province, in September 1903.

Comments: *S. angolensis* is known from Angola, Democratic Republic of the Congo, northern Namibia and Zambia (Ceríaco *et al.* 2018a; Marques *et al.* 2018). Ferreira (1904) published two adult specimens of *S. angolensis* from “Catete” and “Zembe” (MHNC-UP/REP345). Additionally, Ferreira (1906) also cited an adult specimen of “*Sepsina bayoni*” Bocage, 1866 from Golungo Alto (Kwanza Norte Province) that we were unable to locate. *S. angolensis* is the type species for its genus (Bocage 1866).



Fig. 47 – Specimen of *Sepsina angolensis* (MHNC-UP/REP345), from Zembe. Photo by Bruna Santos.

Trachylepis albopunctata (Bocage, 1867)

Material: One specimen: One adult specimen (MHNC-UP/REP269; **Fig. 48**), collected from Ambaca [-9.26667, 15.18333, 738] Kwanza Norte Province, by Américo da Costa (offered to Francisco Newton), date unknown.

Comments: *T. albopunctata* is a widespread species in Angola, although it is absent from southeastern regions of the country (Marques *et al.* 2018). This specimen was presumably offered to Newton by Américo da Costa, as that was the name present in its internal label. Ferreira (1904, 1906) did not cite it in any of his publications but identified it as “*Mabuia varia*”. The Angolan and Zambian specimens of this species have long been considered to be *Trachylepis varia*, however Weinell & Bauer (2018) concluded that *Trachylepis varia* is absent from both countries. Marques *et al.* (2018) referred to the species as *Trachylepis albopunctata* and later, Weinell *et al.* (2019), in a phylogeny study on the genus *Trachylepis*, followed its usage for Angolan (and Zambian) specimens.



Fig. 48 – Specimen of *Trachylepis albopunctata* (MHNC-UP/REP269), from Ambaca. Photo by Bruna Santos.

Trachylepis bayonii (Bocage, 1872)

Material: Two specimens: Two adult specimens (MHNC-UP/REP276–277, formerly UP-MHNFCP-018333 and UP-MHNFCP-040727; **Fig. 49**), collected from unknown locality, date unknown.

Comments: *T. bayonii* is known from central and southwestern Angola, as well as Democratic Republic of the Congo, Kenya and Tanzania (Marques *et al.* 2018). No specimens of *T. bayonii* were published by Ferreira. Bocage first described this species in 1872 and distinguished between two variations, A and B, from “Duque de Bragança” [=Kalandula], Malanje Province and from Huíla’s highlands respectively (Bocage 1872; Marques *et al.* 2018). Variety B was later described as subspecies *Mabuya bayoni huilensis* by Laurent (1964).



Fig. 49 – Specimen of *Trachylepis bayonii* (MHNC-UP/REP276), from unknown locality. Photo by Bruna Santos.

Trachylepis binotata (Bocage, 1867)

Material: One specimen: One adult specimen (MHNC-UP/REP268, formerly UP-MHNFCP-040729; **Fig. 50**), collected from unknown locality, date unknown.

Comments: *T. binotata* is a large arboreal skink found in southwestern Angola and northwestern Namibia (Marques *et al.* 2018; Butler *et al.* 2019). Ferreira (1904, 1906) did not cite this specimen; however, the jar's external tag is noted with the generic identification of "*Mabuia*", an identification most likely done by him. Without locality information, we cannot assess whether the specimen falls inside the expected distribution range. Nevertheless, the specimen was most likely collected by Newton in Namibe Province, from where the species is known (Marques *et al.* 2018).

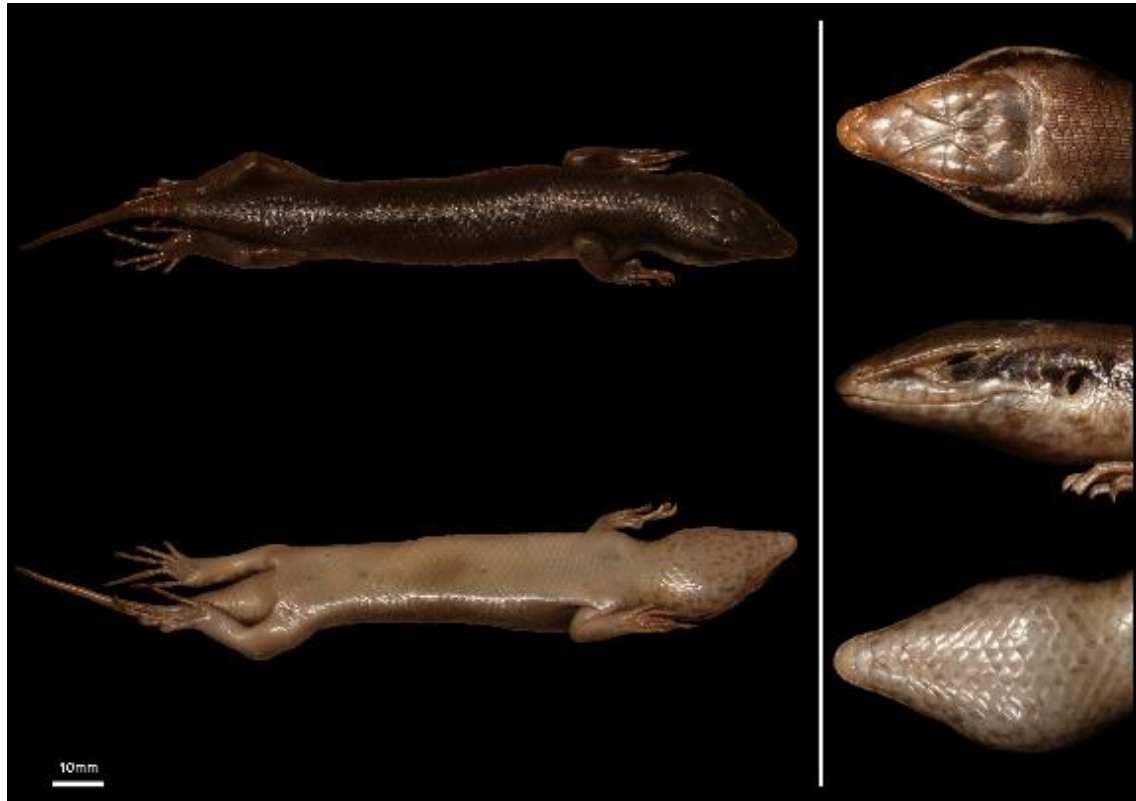


Fig. 50 – Specimen of *Trachylepis binotata* (MHNC-UP/REP268), from unknown locality. Photo by Bruna Santos.

Trachylepis maculilabris (Gray, 1845)

Material: One adult specimen (MHNC-UP/REP272; **Fig. 51**), collected from unknown locality, date unknown.

Comments: *T. maculilabris* is a human commensal species widely spread throughout sub-Saharan Africa that can be found in the northern regions of Angola and scattered southerly (Marques *et al.* 2018). Ceríaco *et al.* (2016c) had previously suggested that *T. maculilabris* constituted a species complex, which was confirmed in a recent phylogenetics study by Allen *et al.* (2019), with the authors uncovering four distinct lineages. Furthermore, Ceríaco *et al.* (2014a) noted that Angolan material seems to match the typical form of *T. maculilabris* and represents its most southwestern populations (Ceríaco *et al.* 2016c). Ferreira (1906) reported specimens from “Cambondo” and “Golungo” (adult and juvenile respectively), to which the extant specimen probably corresponds.



Fig. 51 – Specimen of *Trachylepis maculilabris* (MHNC-UP/REP272), from unknown locality. Photo by Bruna Santos.

Trachylepis occidentalis (Peters, 1867)

Material: Three specimens: One adult specimen (MHNC-UP/REP273, formerly UP-MHNFCP-017375; **Fig. 52**), collected from Bahia dos Tigres [=Baía dos Tigres] [-16.58559, 11.82709, 98] Namibe Province, in 1905; One adult specimen (MHNC-UP/REP274, formerly UP-MHNFCP-017376), collected from Bahia dos Tigres [=Baía dos Tigres] [-16.58559, 11.82709, 98] Namibe Province, in 1905; One adult specimen (MHNC-UP/REP275, formerly UP-MHNFCP-040728), collected from unknown locality, date unknown.

Comments: The distribution range of *T. occidentalis* in Angola is mostly limited to desert regions in Namibe province, southwestern Angola; it also occurs in central and western Namibia as well as western South Africa (Ceríaco *et al.* 2016a; Marques *et al.* 2018). None of these specimens were published by Ferreira (1904, 1906). Recently, Ceríaco *et al.* (2016a) collected the third published record for Angola from “Pico Azevedo” and sighted specimens (uncollected) near Espinheira camp, Namibe Province.



Fig. 52 – Specimen of *Trachylepis occidentalis* (MHNC-UP/REP273), from Baía dos Tigres. Photo by Bruna Santos.

Trachylepis punctulata (Bocage, 1872)

Material: Four specimens: Two adults and one juvenile specimen (MHNC-UP/REP263–265, formerly UP-MHNFCP-095000–095002; **Fig. 53**), collected from Mossâmedes [=Moçâmedes] [-15.20000, 12.15000, 24] Namibe Province, in 1905; One adult specimen (MHNC-UP/REP278, formerly UP-MHNFCP-017378), collected from Bahia dos Tigres [=Baía dos Tigres] [-16.58559, 11.82709, 98] Namibe province, date unknown.

Comments: *T. punctulata* is known from southwestern Angola (Marques *et al.* 2018). Ferreira (1904, 1906) did not publish these specimens, however specimen MHNC-UP/REP278 was labeled as “*Trachylepis acutilabris*”, a misidentification most likely authored by himself. Ceríaco *et al.* (2016a) cited the Newton Expedition specimens as congruent with their collections and commented that the locality “Mossamedes” most likely referred to the Namibe Province as a whole rather than the city. *T. punctulata* was, for a long time, considered a subspecies of *Trachylepis variegata* (Peters, 1870), but a series of studies both on phylogeny and morphological characteristics have established

the two taxa as different species (Portik & Bauer 2012; Bates *et al.* 2014). Weinell *et al.* (2019) reported *T. punctulata* as paraphyletic with respect to *T. variegata*.



Fig. 53 – Specimen of *Trachylepis punctulata* (MHNC-UP/REP263), from Moçâmedes. Photo by Bruna Santos.

Typhlacontias johnsonii Andersson, 1916

Material: Eleven specimens: One adult specimen (MHNC-UP/REP279, formerly UP-MHNFCP-094990), collected from Rio Coroca [-15.78333, 12.06667, 45] Namibe Province, in 1904; Four juvenile specimens (MHNC-UP/REP281–283, REP285, formerly UP-MHNFCP-095003–095005, 095007; **Fig. 54**), collected from Mossamedes [=Moçâmedes] [-15.20000, 12.15000, 24] Namibe Province, in 1905; One adult specimen (MHNC-UP/REP286, formerly UP-MHNFCP-017385), collected from Uay [=Nonguai] [-15.76667, 12.01667, 45] Namibe Province, in July 1904; Four adult specimens (MHNC-UP/REP287–290, formerly UP-MHNFCP-018335, 017387), collected from unknown location, date unknown; One adult specimen (MHNC-UP/REP291, formerly UP-MHNFCP-052200), collected from Bahia dos Tigres [=Baía dos Tigres] [-16.58559, 11.82709, 98] Namibe Province, in 1905.

Comments: *T. johnsonii* is found in Angola and Namibia, with a distribution restricted to Namib desert (Haacke 1997; Marques *et al.* 2018). Ferreira (1904, 1906) did not cite

these specimens. Haacke (1997) reviewed the genus *Typhlacontias* providing descriptions, distribution records and a key to the genus. This species was originally described based on six specimens, of which Haacke (1997) designated the largest and first mentioned specimen as a lectotype and the remaining as lectoparatypes. The author also corrected Bocage's (1895) identification of a *Typhlacontias punctatissimus* from "Coroca" to *T. johnsonii* (Haacke 1997, Marques *et al.* 2018). *T. johnsonii* is characterized by the presence of a subhexagonal to oval shaped frontal shield and the second upper labial scale reaching the eye (Haacke 1997).



Fig. 54 – Specimen of *Typhlacontias johnsonii* (MHNC-UP/REP281), from Moçâmedes. Photo by Bruna Santos.

Typhlacontias punctatissimus bogerti Laurent, 1964

Material: Three specimens: One juvenile specimen (MHNC-UP/REP280, formerly UP-MHNFCP-094986), collected from unknown locality, date unknown; One juvenile specimen (MHNC-UP/REP284, formerly UP-MHNFCP-095006; **Fig. 55**), collected from Mossamedes [=Moçâmedes] [-15.20000, 12.15000, 24] Namibe Province, in 1905; One juvenile specimen (MHNC-UP/REP292, formerly UP-MHNFCP-017386), collected from Bahia dos Tigres [=Baía dos Tigres] [-16.58559, 11.82709, 98] Namibe Province, in 1905.

Comments: *T. punctatissimus bogerti* is known from southwestern Angola and is endemic to Namib desert (Haacke 1997, Marques *et al.* 2018). No *T. punctatissimus bogerti* were cited by Ferreira (1904, 1906), but the locality for specimens MHNC-UP/REP284, REP292 matches the expected range. Haacke (1997) attributed a new status to *T. punctatissimus bogerti*, that was originally described as *Typhlacontias bogerti* by Laurent (1964). Ceríaco *et al.* (2016a) collected specimens from “Espinheira” and “Pico Azevedo”. More recently, Ceríaco *et al.* (*in press*) reviewed the type material of *T. punctatissimus bogerti* from Museu do Dundo: the holotype (detached tail of an adult female), as well as three paratypes. *T. punctatissimus bogerti* is distinguishable from the typical form *Typhlacontias punctatissimus punctatissimus* Bocage, 1873 by having both the second and the third upper labials touch the eye, whereas in *T. punctatissimus punctatissimus* only the third upper labial is in contact with the eye (Haacke 1997).



Fig. 55 – Specimen of *Typhlacontias punctatissimus bogerti* (MHNC-UP/REP284), from Moçâmedes. Photo by Bruna Santos.

Chamaeleonidae

Chamaeleo dilepis Leach, 1819

Material: Two specimens: One adult specimen (MHNC-UP/REP297, formerly UP-MHNFCP-052204), collected from unknown locality, date unknown; One adult female specimen (MHNC-UP/REP303, formerly UP-MHNFCP-094977; **Fig. 56**), collected from Mossamedes [=Moçâmedes] [-15.20000, 12.15000, 24] Namibe province, in 1905.

Comments: *C. dilepis* is a species complex with a very widespread distribution throughout Africa and a particularly homogenous phenotype, with eight recognized subspecies (Tilbury 2018; Main 2019a). Angolan records of *C. dilepis* have historically been referred to as *C. dilepis quilensis*, a form described by Bocage from "Rio Quilo" (Cabinda) (Bocage 1866; Marques *et al.* 2018; Tilbury 2018). Recent molecular results presented by Main (2019a; 2019b) suggest the presence of three candidate species within *C. dilepis*. Clade 1 is presumed to occur in most of Angola, southern Democratic Republic of the Congo and southern Congo; clade 2 covers Tanzania east towards south Angola and western Namibia, south to northwestern Republic of South Africa and west to Mozambique and finally clade 3 is expected to populate northern Tanzania and the borderlands with Uganda and Kenya. Given that "Congo", the type locality of *C. dilepis* is comprised within the expected range for clade 1, we can infer it corresponds to *C. dilepis* and as such, so do the Angolan specimens, including the putative subspecies *C. dilepis quilensis*. Clade 2 seemingly occurs in southernmost Angola, not including Moçâmedes. Given this, the specimen we have locality data for most likely belongs to clade 1 and should be referred to as *C. dilepis*. Neither of the presented specimens were published by Ferreira (1904, 1906).



Fig. 56 – Specimen of *Chamaeleo dilepis* (MHNC-UP/REP303), from Moçâmedes. Photo by Bruna Santos.

Chamaeleo gracilis Hallowell, 1844

Material: Eight specimens: One adult female specimen (MHNC-UP/REP293, formerly UP-MHNFCP-094987; **Fig. 57**), collected from Hocco [-9.35422, 14.89471, 573] Kwanza Norte Province, by Captain Trigo Teixeira (offered to F. Newton) in 1904; Three adult specimens (MHNC-UP/REP294–296, formerly UP-MHNFCP-052205, 052203 and 017390 respectively), collected from unknown locality, date unknown; One adult specimen (MHNC-UP/REP299, formerly UP-MHNFCP-052201), collected from unknown locality, date unknown; One adult specimen (MHNC-UP/REP301, formerly UP-MHNFCP-095009), collected from Lucálla [=Lucala] [-9.27268, 15.25206, 708] Kwanza Norte Province, in August 1903; One adult specimen (MHNC-UP/REP302, formerly UP-MHNFCP-094979), collected from unknown locality, date unknown; One juvenile specimen (MHNC-UP/REP304), collected from Ambaca [-9.26667, 15.18333, 738] Kwanza Norte Province, date unknown.

Comments: *C. gracilis* is commonly found throughout most of sub-Saharan Africa, with the exception of the southernmost countries (Tilbury 2018). Currently, it has two recognized subspecies, *C. gracilis gracilis* Hallowell, 1841 and *C. gracilis etiennei*

Schmidt, 1919. Ferreira (1904) noted two adult females of *Chamaeleon gracilis* from “Lembu, Serra de Selles” and “N’Dalla Tando” as well as two adults of mediocre dimensions (unspecified sex) from “Rio Luinha” (Ferreira 1906). Among the extant specimens, MHNC-UP/REP294–296, REP299 and REP302 might correspond to the citations. Specimen MHNC-UP/REP293 was offered to Newton by Captain Trigo Teixeira, likely when the naturalist collected in *fazenda Hôcco*. A recent phylogenetics study by Main (2019b) recovered three cryptic species within *C. gracilis*: clade 1 from the southern regions of West Africa; clade 2 from the borderlands between Chad, the Republic of Cameroon and the Central African Republic and clade 3 from the borderlands between Kenya and Tanzania. No material from Angola was accessed. Marques *et al.* (2018) has previously treated the Angolan specimens as *C. gracilis etiennei*, following Tilbury (2010). The author had referred to it as a subspecies, although noting that varietal status might be more appropriate, pending further research. As Main (2019) did not analyze material from Angola, the taxonomic status of *C. gracilis etiennei* remains unaddressed.



Fig. 57 – Specimen of *Chamaeleo gracilis* (MHNC-UP/REP293), from Hocco. Photo by Bruna Santos.

Agamidae

Agama sp.

Material: Eleven specimens: One adult female specimen (MHNC-UP/REP305; **Fig. 58**), collected from unknown locality, date unknown; Two adult male specimens (MHNC-UP/REP306–307, formerly UP-MHNFCP-019874 and 019873; **Fig. 59**), collected from unknown locality, date unknown; Two juvenile female specimens (MHNC-UP/REP308–309), collected from Hôcco, Cazengo [-9.35422, 14.89471, 573] Kwanza Norte Province, date unknown; One adult female specimen (MHNC-UP/REP310, formerly UP-MHNFCP-017362), collected from Bahia dos Tigres [=Baía dos Tigres] [-16.58559, 11.82709, 98] Namibe Province, in 1905; One adult male specimen (MHNC-UP/REP 311, formerly UP-MHNFCP-019860), collected from unknown locality, date unknown; Two adult female specimens (MHNC-UP/REP312–313, formerly UP-MHNFCP-017361), collected from unknown locality, in 1904; One adult female specimen (MHNC-UP/REP314, formerly UP-MHNFCP-017360), collected from Lembu, Serra de Selles [-10.95547, 14.30763, 733] Kwanza Sul Province, in 1903; One adult female specimen (MHNC-UP/REP315, formerly UP-MHNFCP-019872), collected from unknown locality, date unknown.

Comments: Currently six species of *Agama* are known from Angola: *Agama aculeata* Merrem, 1820; *Agama anchietae* Bocage, 1896; *Agama congica* Peters, 1877; *Agama mucosoensis* Hellmich, 1957; *Agama planiceps* Peters, 1862 and finally *Agama schacki* Mertens, 1938 (Marques *et al.* 2018). As a revision of the genus is currently ongoing (Wagner *et al.* in prep.), we chose to refer to the presented specimens as *Agama* sp. Ferreira (1904) reported two males (adult and juvenile) of “*Agama colonorum*” from “Lembu, Serra de Selles”, matching MHNC-UP/REP314, and later two juveniles from “Cambondo” and “Golungo” (Ferreira 1906).



Fig. 58 – Female specimen of *Agama* sp. (MHNC-UP/REP305), from unknown locality. Photo by Bruna Santos.



Fig. 59 – Male specimen of *Agama* sp. (MHNC-UP/REP307), from unknown locality. Photo by Bruna Santos.

(Serpentes)

Typhlopidae

Afrotyphlops lineolatus (Jan, 1864)

Material: One specimen: One adult specimen (MHNC-UP/REP316, formerly UP-MHNFCP-017937; **Fig. 60**), collected from Rio Luinha [-9.26667, 14.53333, 237] Kwanza Norte Province, date unknown.

Comments: *A. lineolatus* occurs along the savannas of sub-Saharan and West Africa (see Broadley & Van Wallach 2009; Marques *et al.* 2018); in Angola it's known mainly from western regions and Lunda Norte Province (Marques *et al.* 2018). Ferreira (1906) published an adult specimen of “big dimensions” of “*Typhlops punctatus*” (junior synonym of *A. lineolatus*; MHNC-UP/REP316) from Rio Luinha, as well as two young adults of *Typhlops boulengeri* (also a junior synonym of *A. lineolatus*) from “Cambondo” and “Rio Luinha”. Additionally, Ferreira (1904) described a new species, *Typhlops bocagei* (tentatively synonymized with *A. lineolatus* by Ceríaco *et al.* 2014b), from two adults from “Cabicula, Bom Jesus (margens do Quanza) that we were unable to locate. Ceríaco *et al.* (2014b) reported having located a potential specimen that corresponded to one of the syntypes of *Typhlops bocagei* but it turned out to be the present specimen.



Fig. 60 – Specimen of *Afrotyphlops lineolatus* (MHNC-UP/REP316), from Rio Luinha. Photo by Bruna Santos.

Leptotyphlopidae

Leptotyphlops cf. *scutifrons* (Peters, 1854)

Material: One specimen: One adult specimen (MHNC-UP/REP333; **Fig. 61**), collected from Africa-Congo, A'Dalla Tando [=N'dalatando] [-9.30000, 14.91667, 782] Kwanza Norte Province, in 1903.

Comments: *L. scutifrons* is known from southern Africa and can be found throughout western and central Angola (Marques *et al.* 2018). Ferreira (1904) cited adult specimens with “dark brown or black colour” of “*Glaucania scutifrons*” from “Cazengo” and “Zembe” (Kwanza Norte). Marques *et al.* (2018) tentatively considered them to be *L. scutifrons*, as Broadley & Broadley (1999) had placed *Glaucania scutifrons* in its synonymy and considered the species to occur in the Angolan plateau. We hereby follow this interpretation, as morphological analysis of the specimen proved inconclusive due to its poor conservation state. We were unable to properly review the characters that both Broadley & Broadley (1999) and Broadley & Wallach (2007) used to distinguish *Leptotyphlops* species in their revisions of the genus. Adalsteinsson *et al.* (2009) in a more recent review of the Leptotyphlopidae family, integrated *L. scutifrons* in a new tribe (Leptotyphlopini) and suggested the use of “complex” to refer to it, as they found large sequence divergence between different samples of the species. The generic map the authors presented for *Leptotyphlops* only included the Angolan provinces of Cuando Cubango and Moxico (Adalsteinsson *et al.* 2009; Marques *et al.* 2018). In addition, the authors also designated a new genus, *Namibiana*, to which they allocated the former “*rostratus*” group species of *Leptotyphlops* that Broadley & Wallach (2007) had previously defined. The new genus is known from southwest Africa, including Angola. An integrative taxonomic revision is much needed to address the current difficulties of the group.



Fig. 61 – Specimen of *Leptotyphlops* cf. *scutifrons* (MHNC-UP/REP333), from N'dalatando. Photo by Bruna Santos.

Viperidae

Atheris cf. *squamigera* (Hallowell, “1854” 1855)

Material: Two specimens: One adult specimen (MHNC-UP/REP318, formerly UP-MHNFCP-017432; **Fig. 62**), collected from Golungo Alto [-9.13333, 14.76667, 666] Kwanza Norte Province, date unknown; One adult specimen (MHNC-UP/REP319, formerly UP-MHNFCP-017413), collected from unknown locality, date unknown.

Comments: *A. squamigera* is endemic to West and Central Africa, with a distribution ranging from Nigeria to Kenya and from Tanzania to northern Angola (including the Cabinda enclave) (Marques *et al.* 2018; Chippaux & Jackson 2019). The taxonomic status of other putative valid forms traditionally associated with *A. squamigera*, as *Atheris anisolepis* Mocquard, 1887, *Atheris laeviceps* Boettger, 1887 or *Atheris lucani* Rochebrune 1885, remains problematic (see Ceríaco *et al.* 2020c; Collet & Trape 2020; Spawls & Branch 2020). This is particularly relevant to the study of Angolan populations of *Atheris* cf. *squamigera*, as most of these forms were described from very close to the northern Angolan border, and the diagnostic characters of both are not clearly defined yet. A detailed morphological review of the group is currently underway (Luis Ceríaco

pers. comm.) Ferreira (1906) reported an adult specimen of “*Atheris squamiger*” from “Golungo Alto”, that upon analysis we find likely to match MHNC-UP/REP318, although the specimen had no locality attached. This species was first described from the type locality “near the river Gaboon, Guinea” (Hallowell “1854” 1855). Marques *et al.* 2018 denoted the need for further study regarding this species, to assess whether it constitutes a species complex or it is subject to geographical variation.



Fig. 62 – Specimen of *Atheris cf. squamigera* (MHNC-UP/REP318), from Golungo Alto. Photo by Bruna Santos.

Bitis (Bitis) arietans (Merrem, 1820)

Material: Three specimens: One adult specimen (MHNC-UP/REP342, formerly UP-MHNFCP-017416), collected from Sul de Angola [=Southern Angola] (impossible to georeference), date unknown; One adult specimen (MHNC-UP/REP343, formerly UP-MHNFCP-017417; **Fig. 63**), collected from Coroca [-15.78333, 12.06667, 45] Namibe Province, in June 1904; One adult specimen (MHNC-UP/REP344, formerly UP-MHNFCP-017418), collected from unknown locality, date unknown.

Comments: *B. arietans* is found throughout sub-Saharan Africa as well as the Arabian Peninsula and Morocco, occurring in grassland, open woodland and scrubland habitats (Marques *et al.* 2018; Barlow *et al.* 2019). It is common and widespread in Angola, with

the exception of the southwest desert and some mountain regions (Marques *et al.* 2018). *B. arietans* is the sole representative of the subgenera *Bitis* (Barlow *et al.* 2019). Ferreira (1904, 1906) didn't cite this species, although all specimens were identified on the jars as *Ditera* [sic] *arietans*.



Fig. 63 – Specimen of *Bitis (Bitis) arietans* (MHNC-UP/REP343), from Coroca. Photo by Bruna Santos.

Bitis (Calechidna) caudalis (Smith, 1839)

Material: One specimen: One adult specimen (MHNC-UP/REP322, formerly UP-MHNFCEP-094977; **Fig. 64**), collected from Mossâmedes [=Moçâmedes] [-15.20000, 12.15000, 24] Namibe Province, in 1905.

Comments: *B. caudalis* is commonly found in arid western regions of southern Africa, with southern Angola as its northern distribution limit (Branch 2018; Marques *et al.* 2018). It's an arenicolous species that belongs to the dwarf adders subgenus, *Calechidna*, endemic to southern Africa (Barlow *et al.* 2019). The extant specimen is within the expected range for *B. caudalis*, but as Ferreira did not properly study the specimens from the last part of Newton's Expedition, it was not cited or identified. Recently, Barlow *et al.* (2019) recovered two polyphyletic mitochondrial lineages of *B. caudalis* which they treated as two different taxa. The limited sampling the authors worked with did not

provide firm conclusions, but showcases the need for further studies, given the apparent cryptic nature of *B. caudalis*. In addition, no Angolan material was accessed. A detailed taxonomic revision of the case is being prepared by Ceríaco *et al.* in prep. This specimen appears to be relatively hornless, a characteristic that seems to be common in this species (Ceríaco & Marques 2020; Spawls & Branch 2020).



Fig. 64 – Specimen of *Bitis (Calechidna) caudalis* (MHNC-UP/REP322), from Moçâmedes. Photo by Bruna Santos.

Bitis (Macrocerastes) gabonica Duméril, Duméril and Bibron 1854

Material: One specimen: One juvenile specimen (MHNC-UP/REP346, formerly UP-MHNFCP-017430; **Fig. 65**), collected from unknown locality, date unknown.

Comments: *B. gabonica* is a large-bodied forest adder (Barlow *et al.* 2019), known mainly from the forests and savannas of West and Central Africa and with a distribution ranging from Benin to northern Angola (see Marques *et al.* 2018 for more detail). It is one of five currently recognized species in the subgenus *Macrocerastes* (Ceríaco *et al.* 2020c). From the regions Newton collected in, this species is known from N'dalatando, Kwanza Norte Province (Marques *et al.* 2018). Ferreira (1904, 1906) did not publish the aforementioned specimen.



Fig. 65 – Specimen of *Bitis (Macrocerastes) gabonica* (MHNC-UP/REP346), from unknown locality. Photo by Bruna Santos.

Causus resimus (Peters, 1862)

Material: Six specimens: Four adult specimens (MHNC-UP/REP327–330, formerly UP-MHNFCP-017405, 017424, 017406 and 017425 respectively; **Fig. 66**), collected from unknown locality, date unknown; One juvenile specimen (MHNC-UP/REP331, formerly UP-MHNFCP-095050), collected from unknown locality, date unknown; One adult specimen (MHNC-UP/REP336, formerly UP-MHNFCP-017426), collected from S.Tomé and Príncipe (in error), date unknown.

Comments: *C. resimus* can be found throughout sub-Saharan Africa, with a seemingly disjointed distribution (see Marques *et al.* 2018 for more detail). The species is also known from the coastal savannas and woodlands of western Angola (Marques *et al.* 2018). Ferreira (1904) cited three adult specimens from “Cazengo”, “Caculo” and “Cabicula”, possibly matching extant specimens MHNC-UP/REP327–330. Additionally, Ferreira (1906) published an adult of “*Causus rhombeatus*” from “Golungo Alto” that we were unable to locate. The Angolan population of *C. resimus* is very isolated from its counterparts in East Africa, suggesting that it might be different. According to Branch (2018), the molecular phylogeny of *Causus* is being addressed by Tolley *et al.* (in prep) and preliminary results indicate cryptic diversity within *C. resimus*, thus supporting the

hypothesis of the Angolan population being distinct. In that case, two different names have been proposed to refer to the species – *C. nasalis* Stejneger, 1893 and *C. resimus* var. *angolensis* Bocage, 1895 (Branch 2018). Although *C. nasalis* has seniority, further research needs to be conducted to infer which would be the correct *nomen* to use.



Fig. 66 – Specimen of *Causus resimus* (MHNC-UP/REP327), from unknown locality. Photo by Bruna Santos.

Lamprophiidae

Atractaspis bibronii Smith, 1849

Material: One specimen: One adult specimen (MHNC-UP/REP321; **Fig. 67**), collected from Distrito de Mossamedes [=Moçâmedes] [-15.20000, 12.15000, 24] Namibe Province, date unknown.

Comments: *A. bibronii* is known from sub-Saharan Africa countries, ranging from Kenya and southern Somalia south to Zimbabwe, west to Angola and Democratic Republic of the Congo, as well as eastern populations of South Africa and Swaziland (Marques *et al.* 2018). Portillo *et al.* (2019), in a recent review of the evolutionary history of the subfamily Atractaspidinae, found that several lineages of *A. bibronii* highly differed from each other and are likely to represent several cryptic species, which is not surprising

given the species extensive geographic distribution. Ferreira didn't cite any specimen of *A. bibronii*.



Fig. 67 – Specimen of *Atractaspis bibronii* (MHNC-UP/REP321), from Moçâmedes. Photo by Bruna Santos.

Atractaspis congica Peters, 1877

Material: Four specimens: One adult specimen (MHNC-UP/REP320, formerly UP-MHNFCP-017391; **Fig. 68**), collected from unknown locality, date unknown; One adult specimen (MHNC-UP/REP323), collected from unknown locality, date unknown; One adult specimen (MHNC-UP/REP324, formerly UP-MHNFCP-017393), collected from N'Dalla Gando [=N'dalatando] [-9.30000, 14.91667, 782] Kwanza Norte Province, in August 1903; One adult specimen (MHNC-UP/REP335), collected from unknown locality, date unknown.

Comments: *A. congica* is known from central Africa, occurring from Cameroon to Zambia and is widely spread throughout Angola (Marques *et al.* 2018; Chippaux & Jackson 2019). From the Newton Expedition were published two adult specimens, one from “Cazengo” and one from “Golungo Alto”, possibly matching specimens MHNC-UP/REP320, 323 and 335 (Ferreira 1904, 1906). This species was first described from “Chinchoxo” (Cabinda enclave) by Peters (1877). Portillo *et al.* (2019) found *A. congica*

to likely represent more than a single species, as the topotypic Angolan specimens examined were highly divergent from the material from Democratic Republic of the Congo.



Fig. 68 – Specimen of *Atractaspis congica* (MHNC-UP/REP320), from unknown locality. Photo by Bruna Santos.

Boaedon angolensis Bocage, 1895

Material: One specimen: One adult specimen (MHNC-UP/REP165, formerly UP-MHNFCEP-017401; **Fig. 69**), collected from Bahia dos Tigres [=Baía dos Tigres] (in error) [-16.58559, 11.82709, 98] Namibe province, by Francisco Newton in 1905.

Comments: *B. angolensis* is a species endemic to Angola that occurs in the highlands of Cuando Cubango, Uíge, Malanje, Huambo, Kwanza Norte and Huíla provinces (potentially Benguela and Cunene as well) (Marques *et al.* 2018; Hallermann *et al.* 2020). It was recently revised by Hallermann *et al.* (2020) as part of a larger study on the *Boaedon* genus in Angola. The authors revalidated the taxon as a full species and designated a neotype, given that the original type specimens used to describe *Boaedon lineatus* var. *angolensis* Bocage, 1895 had been lost in 1978 MBL fire. The presented specimen was not cited by Ferreira (1904, 1906), but the naturalist identified it as “*Boodon lineatus*”.



Fig. 69 – Specimen of *Boaedon angolensis* (MHNC-UP/REP165), from unknown locality. Photo by Bruna Santos.

Boaedon bocagei Hallermann, Ceríaco, Schmitz, Ernst, Conradie, Verburgt, Marques, Bauer 2020

Material: Four specimens: One adult specimen (MHNC-UP/REP164, formerly UP-MHNFCP-017399), collected from unknown locality, date unknown; One adult specimen (MHNC-UP/REP166, formerly UP-MHNFCP-017397; **Fig. 70**), collected from unknown locality, date unknown; One adult specimen (MHNC-UP/REP167, formerly UP-MHNFCP-017400), collected from Novo Redondo [=Sumbe] [-11.20000, 13.85000, 11] Kwanza Sul Province, in September 1903; One adult specimen (MHNC-UP/REP168, formerly UP-MHNFCP-017402), collected from Bahia dos Tigres [=Baía dos Tigres] [-16.58559, 11.82709, 98] Namibe Province (in error), in 1903.

Comments: *B. bocagei* is an Angolan endemic species that is currently known from the coastal lowlands of the country, namely Luanda, Bengo, Zaire and Kwanza Sul provinces (Hallermann *et al.* 2020). Ferreira (1904) reported adult and juvenile specimens of *Boodon lineatus* from “Novo Redondo” (MHNC-UP/REP167), “Lembu (Serra de Selles)” and “Cacullo” and later a specimen from “Rio Luinha” (Ferreira 1906). *B. bocagei* was recently described as a new species by Hallermann *et al.* (2020) in their revision of the

Boaedon from Angola. The authors designated specimens MHNC-UP/REP166–168 from the Newton Expedition as paratypes, although considering them all to be from Novo Redondo, as Baía dos Tigres was in error as locality and specimen MHNC-UP/REP164 likely corresponds to the published from Rio Luinha, given its pattern.



Fig. 70 – Specimen of *Boaedon bocagei* (MHNC-UP/REP166), from unknown locality. Photo by Bruna Santos.

Lycophidion meleagre Boulenger, 1893

Material: One specimen: One adult specimen (MHNC-UP/REP325, formerly UP-MHNFCEP-017394; **Fig. 71**), collected from unknown locality, 'in September 1903.

Comments: *L. meleagre* has a disjointed distribution, having been recorded from northwestern Angola, northeastern Tanzania, southeastern Democratic Republic of the Congo and southeastern Kenya (Marques *et al.* 2018), although Branch (2018) comments the Tanzanian records need to be critically reviewed. Ferreira (1904) cited a juvenile specimen of "*Lycophidium meleagris*" from "Cabiri", commenting that it was a very rare species, represented then by only two specimens extant in the London museum and one in the Lisbon museum. Although we find the specimen to be an adult, it is likely that it matches the one Ferreira published, as Newton was in Cabiri in September 1903.



Fig. 71 – Specimen of *Lycophidion meleagre* (MHNC-UP/REP325), from unknown locality. Photo by Bruna Santos.

Lycophidion multimaculatum Boettger, 1888

Material: Two specimens: One adult specimen (MHNC-UP/REP169, formerly UP-MHNFCP-017395), collected from Chingo [-11.20000, 13.85000, 11] Kwanza Sul province, by Francisco Newton on unknown date; One adult specimen (MHNC-UP/REP326, formerly UP-MHNFCP-017396; **Fig. 72**), collected from unknown locality, by Francisco Newton in 1903.

Comments: *L. multimaculatum* has a distribution ranging from Central African Republic to Tanzania and Angola (Chippaux & Jackson 2019). According to Marques *et al.* (2018), this species possibly exists throughout Angola, including the Cabinda enclave, with the exception of the southwestern desert regions. Ferreira (1904) published records of two adults of “*Lycophidium capense*” with no locality information, commenting that one had “very light color” (likely to match MHNC-UP/REP169) and the other was “almost totally black”; later he also published an adult from Golungo Alto (Ferreira 1906). Marques *et al.* (2018) stated that the majority of records attributed to *Lycophidium capense* Smith, 1831 from Angola are in fact *L. multimaculatum*, including the Newton Expedition

specimens. Boettger (1888) first described the species as *Lycophidium Capense* mut. *multimaculata*, but Broadley (1992) referred to it as a full species.



Fig. 72 – Specimen of *Lycophidium multimaculatum* (MHNC-UP/REP326), from unknown locality. Photo by Bruna Santos.

Polemon collaris (Peters, 1881)

Material: One specimen: One adult specimen (MHNC-UP/REP170, formerly UP-MHNFCP-017414; **Fig. 73**), collected from Golungo Alto [-9.13333, 14.76667, 666] Kwanza Norte Province, date unknown.

Comments: *P. collaris* is a forest dwelling species found from Nigeria to Uganda and south into western Angola (Branch 2018; Marques *et al.* 2018). The label present in the jar reads “*Microsoma collare*” but has no information regarding the collecting locality, however Ferreira (1906) cited an adult specimen of Bocage’s (1895) “form B” from “Golungo Alto”, which most likely represents this specimen. After comparing Bocage’s original description and plate to MHNC-UP/REP170, we find the specimen to match the same morphology. Boulenger (1905), de Witte & Laurent (1947) and Hellmich (1957) cited specimens from the same locality. Recently, Portilo *et al.* (2018) reported a specimen from “North-west” Angola.



Fig. 73— Specimen of *Polemon colaris* (MHNC-UP/REP170), from Golungo Alto. Photo by Bruna Santos.

Psammophis leopardinus Bocage, 1887

Material: Five specimens: One juvenile specimen (MHNC-UP/REP171, formerly UP-MHNFCP-094982), collected from África Ocidental [Occidental Africa] (impossible to georeference), date unknown; One adult specimen (MHNC-UP/REP173, formerly UP-MHNFCP-094988; **Fig. 74**), collected from Rio Coróca [-15.78333, 12.06667, 45] Namibe Province, in 1904; One adult specimen (MHNC-UP/REP174, formerly UP-MHNFCP-094989), collected from unknown locality, date unknown; Two adult specimens (MHNC-UP/REP176–177, formerly UP-MHNFCP-017422 and 040697), collected from unknown locality, date unknown.

Comments: *P. leopardinus* is found in dry savanna and semi-desert habitats of southwestern Angola, as well as central and northern Namibia (Marques *et al.* 2018). Nowadays, it's treated as a full species (Broadley 2002; Kelly *et al.* 2008; Wallach *et al.* 2014), after being initially described as a subspecies of *Psammophis sibilans* (Linnaeus, 1758) by Bocage (1887b). The aforementioned specimens were previously identified as "*P. sibilans*", with the exception of MHNC-UP/REP171 which was labeled as "*P. sibilans leopardinus*". Ferreira (1904) cited an unspecified number of adult and juvenile

specimens of “Bocage’s var D.” of *P. sibilans* from “Cazengo”, “Cabinda” (in error, Newton did not travel to the Cabinda enclave) and “Chingo”. Trape *et al.* (2019) referred to the published specimens as *P. leopardinus* and noted that they were presumably lost in the MBL fire, which we here refute, whereas Marques *et al.* (2018) had previously treated them as *Psammophis mossambicus* Peters, 1882.



Fig. 74 – Specimen of *Psammophis leopardinus* (MHNC-UP/REP173), from Rio Coróca. Photo by Bruna Santos.

Psammophis mossambicus Peters, 1882

Material: Four specimens: Three adult specimens (MHNC-UP/REP178–180, formerly UP-MHNFCP-040696, 017421 and 040698 respectively; **Fig. 75**), collected from unknown locality, date unknown; One adult specimen (MHNC-UP/REP181, formerly UP-MHNFCP-017423), collected from Cabicula, Cazengo [-9.16667, 13.56667, 37] Bengo Province, in 1903.

Comments: *P. mossambicus* is a moist savanna and grassland species that occurs across Sudan to South Africa (KwaZulu-Natal provinces), west to southeastern Nigeria and northern Namibia and east to Mozambique and Kenya (Marques *et al.* 2018; Trape *et al.* 2019). Like *P. leopardinus*, *P. mossambicus* was also initially described as a variety of *P. sibilans* (Peters 1882b). The extant specimens were previously identified as *P.*

sibilans and might therefore correspond to part of the specimens Ferreira cited (see previous account). Specimen MHNC-UP/REP181 possibly matches the citation from “Cazengo”. The taxonomy of the *P. sibilans* group was recently addressed by Trape *et al.* (2019) using molecular, morphological and field data. The authors reassigned central African populations (north, south and east of the Congo forest block) of *P. phillipsi* (Hallowell, 1844) to *P. mossambicus* and treated *P. occidentalis* Werner, 1919 as a synonym of *P. mossambicus*.



Fig. 75 – Specimen of *Psammophis mossambicus* (MHNC-UP/REP179), from unknown locality. Photo by Bruna Santos.

Psammophis namibensis Broadley, 1975

Material: One adult specimen (MHNC-UP/REP172, formerly UP-MHNFCP-094983; **Fig. 76**), collected from unknown locality, date unknown.

Comments: *P. namibensis* is found in the arid regions of southwestern Africa, namely southwestern Angola to western Namibia and Northern Cape Province in South Africa (Marques *et al.* 2018). *P. namibensis* was initially described by Broadley (1975) as a subspecies of *Psammophis leightoni* Boulenger 1902 but was eventually granted full

species status (Broadley 2002). Ferreira did not cite this specimen but identified it as *P. sibilans*.



Fig. 76 – Specimen of *Psammophis namibensis* (MHNC-UP/REP172), from unknown locality. Photo by Bruna Santos.

Psammophis subtaeniatus Peters, 1882

Material: One adult specimen (MHNC-UP/REP175, formerly UP-MHNFCP-094980; **Fig. 77**), collected from Mossamedes [=Moçâmedes] [-15.20000, 12.15000, 24] Namibe Province, date unknown.

Comments: *P. subtaeniatus* occurs from southern Angola and northern Namibia all the way to western Mozambique, as well as eastern Swaziland and northeastern South Africa (Marques *et al.* 2018). Recently, Butler *et al.* (2019) and Baptista *et al.* (2019) reported specimens from Huila Province, namely “Bicuar National Park, Matunto” and “Carmira Farm” respectively. This is the first published record for the coastal region of Namibe Province.



Fig. 77 – Specimen of *Psammophis subtaeniatus* (MHNC-UP/REP175), from Moçâmedes. Photo by Bruna Santos.

Elapidae

Naja nigricincta Bogert, 1940

Material: One specimen: One adult specimen (MHNC-UP/REP341, formerly UP-MHNFCP-017419; **Fig. 78**), collected from África Ocidental [= “Occidental Africa”] (impossible to georeference), date unknown.

Comments: *N. nigricincta* occurs in southwestern Angola as well as central and northern Namibia (Marques *et al.* 2018). Branch (2018) referred to Angolan records of this species as *Naja (Afronaja) nigricincta nigricincta*, while Marques *et al.* (2018) followed Wüster *et al.* (2007) and their molecular results, using *N. nigricincta*. This specimen was not cited by Ferreira (1904, 1906). From the localities Newton collected in, *N. nigricincta* is known from “Foz do Cunene”, Namibe province (Marques *et al.* 2018).



Fig. 78 – Specimen of *Naja nigricincta* (MHNC-UP/REP341), from África Occidental [=Occidental Africa]. Photo by Bruna Santos.

Colubridae

Crotaphopeltis hotamboeia (Laurenti, 1768)

Material: Eleven specimens: Six adult specimens (MHNC-UP/REP183–187, REP190, formerly UP-MHNFCP-040694, 040691, 040693, 017415, 040692 and 040695 respectively; **Fig. 79**), collected from N'Dalla Tando/N'Dalla Tango/N'Dalla [=N'dalatando] [-9.30000, 14.91667, 782] Kwanza Norte Province, date unknown; One adult specimen (MHNC-UP/REP188), collected from unknown locality, date unknown; One adult specimen (MHNC-UP/REP189, formerly UP-MHNFCP-154857), collected from unknown locality, date unknown; Three juvenile specimens (MHNC-UP/REP337–339), collected from unknown locality, date unknown.

Comments: *C. hotamboeia* is a widespread species, occurring in various habitats of sub-Saharan Africa with the exception of rainforest and arid regions; it can be found throughout Angola apart from the southwestern desert (Marques *et al.* 2018; Engelbrecht *et al.* 2020). Ferreira (1904) cited as “*Leptodira hotamboeia*” adults from “the Quanza river banks and the Lagoon” and “Chingo”. From the second paper, Ferreira (1906) cited

a large number of specimens (adults and juveniles), from “Cafuxi”, “Golungo Alto”, “Rio Luinha”, “Méso Cassuco”, “Cambondo”, “N’Golla Bumba” and “Katála”. Although specimens MHNC-UP/REP183–187, REP190 are all identified as originating from N’dalatando, it is possible that it was a transcription error and among those are some of Ferreira’s citations. The same way, specimens MHNC-UP/REP188–189, 337–339 might also comprise part of the author’s cited specimens. Through molecular analysis, Engelbrecht *et al.* (2020) recently confirmed the monophyly of *C. hotamboeia* and its species status as valid. The authors also obtained six different subspecific clades from the analysis, with “clade 2” being restricted to the southern tip of the Republic of Congo and extending to Angola.



Fig. 79 – Specimen of *Crotaphopeltis hotamboeia* (MHNC-UP/REP187), from N’dalatando. Photo by Bruna Santos.

Dasypeltis palmarum (Leach, 1818)

Material: Three specimens: One adult specimen (MHNC-UP/REP191, formerly UP-MHNFCEP-017420), collected from unknown locality, in 1905; One adult specimen (MHNC-UP/REP192, formerly UP-MHNFCEP-017407), collected from Novo Redondo [=Sumbe] [-11.20000, 13.85000, 11] Kwanza Sul Province, in 1903; One adult specimen

(MHNC-UP/REP194, formerly UP-MHNFCP-017408; **Fig. 80**), collected from unknown locality, date unknown

Comments: *D. palmarum* occurs in Democratic Republic of the Congo, Congo and western Angola, including the Cabinda enclave (Marques *et al.* 2018). It was first described as *Coluber palmarum* from type locality “in palm trees at Embomma” [=Boma], Democratic Republic of the Congo (Marques *et al.* 2018). Ferreira published several *Dasypeltis scabra* (Linnaeus, 1758) (see next account), to which the extant *D. palmarum* might correspond. From the provinces Newton collected in, *D. palmarum* is known from Luanda, Kwanza Norte, Kwanza Sul and Namibe.



Fig. 80 – Specimen of *Dasypeltis palmarum* (MHNC-UP/REP194), from unknown locality. Photo by Bruna Santos.

Dasypeltis cf. *scabra* (Linnaeus, 1758)

Material: Two specimens: Two adult specimens (MHNC-UP/REP193,195, formerly UP-MHNFCP-017410 and 017409 respectively; **Fig. 81**), collected from unknown locality, date unknown.

Comments: *D. scabra* is a savanna and grassland species widely distributed in East African savannas and known from all of Angola, apart from the southwestern desert

(Bates & Broadley 2018; Marques *et al.* 2018). Ferreira (1904) cited several “adult and semi-adult” specimens of *Dasypeltis scabra* with no indication of locality. The author noted that one of the specimens presented an “unusual melanistic coloration” (possibly MHNC-UP/REP195). Later, Ferreira (1906) published two adult specimens, one “dark brown with imperceptible black drawings” (no locality data; likely MHNC-UP/REP193) and another from “Cambondo” as “*D. scabra* var *inornata*” (junior synonym of *D. scabra*). Recently, Bates & Broadley (2018) reviewed the *Dasypeltis* genus snakes from north-eastern Africa and southwestern Arabia, describing three new species previously considered as part of *D. scabra*, Branch (2018) listed *D. confusa* Trapé and Mané 2006 as extant in Angola, following Bates and Broadley’s (2018) claim that the species’ distribution extended to Angola. Further studies need to be done in order to assess the *D. scabra* species complex and its Angolan populations.



Fig. 81 – Specimen of *Dasypeltis* cf. *scabra* (MHNC-UP/REP193), from unknown locality. Photo by Bruna Santos.

Grayia smythii (Leach, 1818)

Material: One specimen: One adult specimen (MHNC-UP/REP196, formerly UP-MHNFCEP-017398; **Fig. 82**), collected from Cambondo [-9.16349, 14.66432, 394] Kwanza Norte Province, date unknown.

Comments: *Grayia smythii* is a species found north into southern Sudan, Lake Victoria west to Senegal and southwest to northern Angola (Marques *et al.* 2018). The label present in the jar reads “*Grayia smithi*” but has no information about its collecting locality. Ferreira (1906) cited a specimen from “Cambondo” which most likely represents this specimen. It is considered a rare species in the country with a limited number of records (Branch 2018; Marques *et al.* 2018).



Fig. 82 – Specimen of *Grayia smythii* (MHNC-UP/REP196), from Cambondo. Photo by Bruna Santos.

Philothamnus angolensis Bocage, 1882

Material: One specimen: One adult specimen (MHNC-UP/REP182, formerly UP-MHNFCEP-017392; **Fig. 83**), collected from unknown locality, date unknown.

Comments: *P. angolensis* is a generalist species that inhabits both subtropical forest and savanna biomes and has a widespread distribution in sub-Saharan Africa, occurring in most of Angola with the exception of the southwestern desert (Marques *et al.* 2018; Engelbrecht *et al.* 2019). Marques *et al.* (2018) commented on the Angolan records of *Philothamnus irregularis* (Leach, 1819) corresponding mainly to both *P. angolensis* and *Philothamnus hoplogaster* (Günther, 1863). Ferreira (1904) cited an adult specimen from “Chingo” as “*Philothamnus irregularis* var *angolensis*” that presented an exceptional

number of temporal scales, 2+2 (MHNC-UP/REP197, see account below) and a “blueish green” specimen of “*Philothamnus irregularis*” from “Cambondo” with 1+1 temporal scales (Ferreira 1906). An additional specimen, without locality, was also cited as “*Philothamnus Guntheri*” (a synonym of *P. angolensis*) with 1+1 temporal scales. Upon analysis, we believe the presented specimen does not represent any of the citations, as it has 1+2 temporal scales. Engelbrecht *et al.* (2019) recently reported *P. angolensis* as a species differentiated by morphological characteristics supported by genetic analysis.



Fig. 83 – Specimen of *Philothamnus angolensis* (MHNC-UP/REP182), from unknown locality. Photo by Bruna Santos.

Philothamnus cf. *hoplogaster* (Günther, 1863)

Material: One specimen: One adult specimen (MHNC-UP/REP198, formerly UP-MHNFCP-017411; **Fig. 84**), collected from unknown locality, date unknown.

Comments: *P. hoplogaster* is known from sub-Saharan Africa, with a distribution across southern Cameroon east to Kenya, south to South Africa and Angola, where it is widespread and is usually found near the water (Marques *et al.* 2018; Chippaux & Jackson 2019). Ferreira cited two specimens with the same temporal formula as this specimen, 1+1 – one from “Cambondo” as “*Philothamnus irregularis*” and another without locality info as “*Philothamnus Guntheri*” (Ferreira 1906), rendering it difficult to

assign the aforementioned specimen to either. After reviewing its morphology, we found it to closely resemble *P. hoplogaster*, to which we here tentatively assign it. Engelbrecht *et al.* (2019) recently found this species to have its morphological characteristics used in diagnosis be supported by genetic analysis.

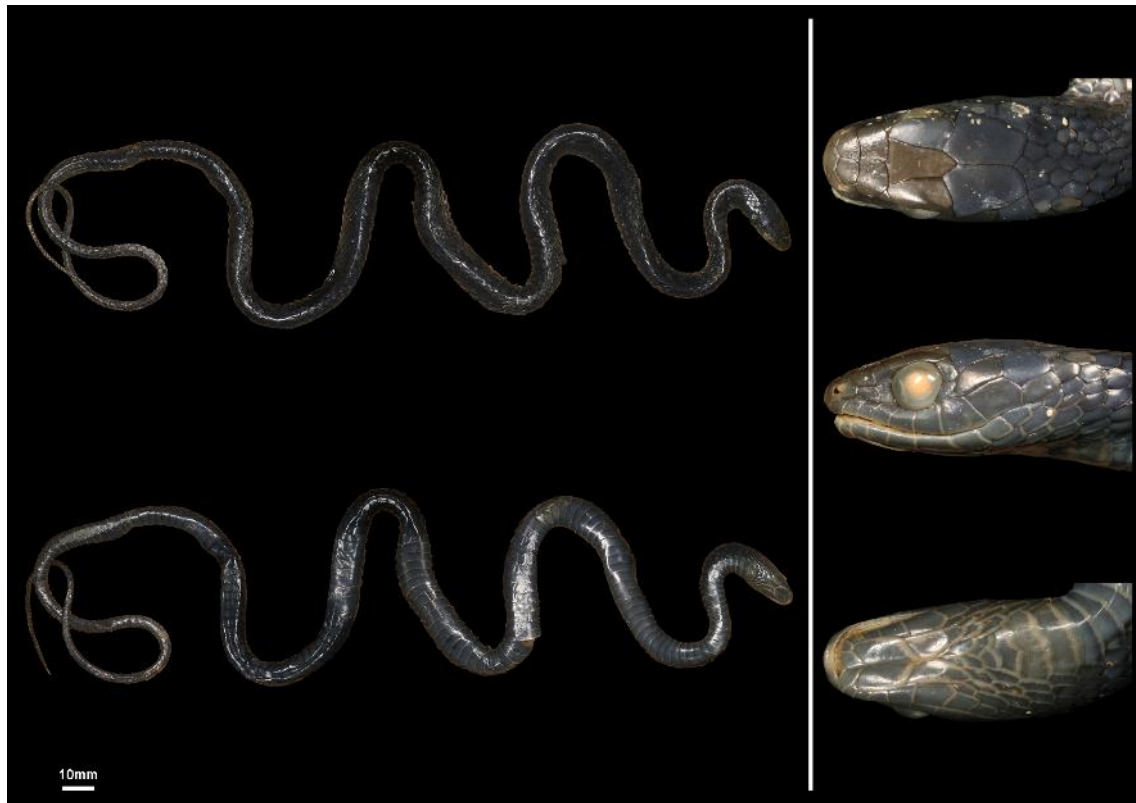


Fig. 84 – Specimen of *Philothamnus* cf. *hoplogaster* (MHNC-UP/REP198), from unknown locality. Photo by Bruna Santos.

Philothamnus cf. *semivariiegatus* (Smith, 1840)

Material: One specimen: One adult specimen (MHNC-UP/REP197, formerly UP-MHNFCP-017412; **Fig. 85**), collected from Chingo [-11.20000, 13.85000, 11] Kwanza Sul province, by Francisco Newton on unknown date.

Comments: *P. semivariiegatus* is widely distributed in sub-Saharan Africa, namely from Senegal to Ethiopia and south to South Africa; it is known mainly from the western parts of Angola, with the exception of the desert regions (Chippaux 2006; Marques *et al.* 2018). As previously mentioned, Ferreira cited a specimen of “*Philothamnus irregularis* var *angolensis*” with 2+2 temporal scales. The author also commented that the fifth and sixth supralabial scales touched the eye. Even though no locality data was written in the specimen’s jar, given that these characteristics are present in specimen MHNC-UP/REP197, we believe they are the same. In addition, although *P. irregularis* var

angolensis is a junior synonym of *P. angolensis*, we find that the specimen's morphology corresponds to *P. semivariegatus*, per Chippaux's (2006) description. It now constitutes the first published record for Kwanza Sul province. Recently, Englebrecht *et al.* (2019) reported *P. semivariegatus* as paraphyletic and constituting four different species.



Fig. 85 – Specimen of *Philotamnus* cf. *semivariegatus* (MHNC-UP/REP197), from Chingo. Photo by Bruna Santos.

Other specimens

Besides the aforementioned, MHNC-UP houses a few more Newton Expedition specimens that are in a suboptimal state of preservation and have no locality data associated with them. In these cases, and when possible, the specimens were identified to genus level – *Hyperolius* sp. (three specimens, MHNC-UP/ANF293, ANF299, ANF303); *Sclerophrys* sp. (one specimen, MHNC-UP/ANF346); Ranidae (three specimens, MHNC-UP/ANF315–317); *Agama* sp. (eleven specimens, MHNC-UP/REP305–315); *Trachylepis* sp. (two specimens, MHNC-UP/REP270–271).

In addition, Ferreira (1904, 1906) published a few more species for which we could not locate matches. Listed below are the taxa according to the order they were published in, their collecting localities and number of specimens (when available), as well as their current taxonomic designation.

Table 1 – Unlocated specimens published by Ferreira (1904, 1906).

Cited name	Present name	Specimen(s)	Locality	Source
<i>Rappia punctulata</i>	<i>Hyperolius nasutus</i> Günther, 1865	One juvenile	“Cabiri (Bengo)”	Ferreira (1904)
<i>Rappia fulvovittata</i>	<i>Afrixalus fulvovittatus</i> (Cope, 1861)	One juvenile	“Cabiri”	Ferreira (1904)
<i>Calamelaps polylepis</i>	<i>Amblyodipsas polylepis</i> (Bocage, 1873)	One adult	“Cabícula, Cazengo”	Ferreira (1904)
<i>Rappia bocagei</i> var. <i>maculata</i>	<i>Hyperolius bocagei</i> Steindachner, 1867	One	“Golungo Alto”	Ferreira (1906)
<i>Typhlops boulengeri</i>	<i>Afrotyphlops lineolatus</i> (Jan, 1864)	Two quasi- adults	“Rio Luinha” “Cambondo”	Ferreira (1906)
<i>Heterolepis poensis</i>	<i>Mehelya poensis</i> (Smith, 1849)	No data	“Cabícula, Cazengo”	Ferreira (1906)
<i>Causus rhombeatus</i>	<i>Causus rhombeatus</i> (Lichtenstein, 1823)	One adult	“Golungo Alto”	Ferreira (1906)
<i>Mabuia petersi</i>	<i>Trachylepis bocagii</i> (Boulenger, 1887)	No data	“Cambondo”	Ferreira (1906)
<i>Sepsina bayoni</i>	<i>Sepsina bayonii</i> Bocage, 1866	One adult	“Golungo Alto”	Ferreira (1906)

Discussion

Francisco Newton's expedition to Angola (1903–1906) remains one of the most productive and important missions ever commissioned by APP. At the time, his childhood friend Augusto Nobre (1865–1946) was beginning to develop a zoological museum in the institution and had in previous years promoted several expeditions to collect in northern Portugal (Santos *et al.* in prep). This overseas expedition allowed the museum to enrich its collection, at the same time it helped support Newton, who was in a precarious financial situation and had returned to Porto in 1902 to care for his ill father.

The expedition resulted in a considerable diversity of collected species, as it was not focused on any particular zoological group. Given the lack of governmental aid and the conditions he worked in, Newton would have had an easier time collecting small amphibians, reptiles and birds rather than big mammals, which is reflected in the overall results of the expedition. In the case of herpetological species, some genera are

significantly represented in Newton's collections, when in comparison to the diversity currently known from the Angolan provinces he collected in. The most relevant of those genera are *Hyperolius*, *Sclerophrys*, *Hemidactylus*, *Trachylepis* and *Dasyplepis*. The naturalist also collected some rare material, as is the case of *Polemon collaris* and *Grayia smythii*, two species with few published records and hard to find even nowadays. Furthermore, this mission also holds special historical relevance. It was the first major Portuguese expedition conducted in the colony following the death of José de Anchieta (1832–1897) who was, for over thirty years, the official Portuguese explorer of Angola. Anchieta collected exclusively for MBL, contributing to many of the first descriptions of Angolan fauna and is the patronym for dozens of species.

Initially, the major results from Newton's expedition were the description of ten new herpetological taxa (Ferreira 1904, 1906) and sixteen mollusks (Nobre 1905). In addition to those publications, recent works have also used Newton's specimens in the description of two endemic Angolan species – *Phrynomantis newtoni* and *Boaedon angolensis* (Ceríaco *et al.* submitted – Chapter 3; Hallerman *et al.* 2020), which further highlights the importance of the expedition.

With this study, we help bring light to the life and work of Francisco Newton, who has remained hidden in the shadows despite the key role he played in the description of African biodiversity. It also showcases the potential still hidden in museum shelves around the world and reveals the need to reassess old collections. They provide a special insight to the past, a window of times gone by, that is crucial moving forward in the study and conservation of biodiversity.

References

- Adalsteinsson, S.A., Branch, W.R., Trape, S., Vitt, L.J. & Hedges, S.B. (2009) Molecular phylogeny, classification, and biogeography of snakes of the Family Leptotyphlopidae (Reptilia, Squamata). *Zootaxa*, 2244, 1–50.
- Ahl, E. (1931) *Amphibia, Anura III, Polypedatidae*. Das Tierreich, 55. 477 pp.
- Allen, K.E., Tapondjou N., W.P., Greenbaum, E., Welton, L.J. & Bauer, A.M. (2019) High levels of hidden phylogenetic structure within Central and West African *Trachylepis* skinks. *Salamandra*, 55 (4), 231–241.
- Baptista, N.L., António, T. & Branch, W.R. (2019) The herpetofauna of Bicular National Park and surroundings, southwestern Angola: A preliminary checklist. *Amphibian & Reptile Conservation*. 13 (2), 96–130 (e203). [Special Section].
- Barlow, A., Wüster, W., Kelly, C.M.R., Branch, W.R., Phelps, T. & Tolley, K.A. (2019) Ancient habitat shifts and organismal diversification are decoupled in the African viper genus *Bitis* (Serpentes: Viperidae). *Journal of Biogeography*, 46 (6), 1234–1248.
- Bates, M.F. & Broadley, D.G. (2018) A revision of the egg-eating snakes of the genus *Dasypeltis* Wagler (Squamata: Colubridae: Colubrinae) in north-eastern Africa and south-western Arabia, with descriptions of three new species. *Indago*, 34 (1), 1–95.
- Bates, M.F., Branch, W.R., Bauer, A.M., Burger, M., Marais, J., Alexander, G.J., & de Villiers, M.S. (2014) *Atlas and Red List of the Reptiles of South Africa, Lesotho and Swaziland. Suricata 1*. South African National Biodiversity Institute, Pretoria, South Africa. xvii + 485 pp.
- Bates, M.F., Tolley, K.A., Edwards, S., Davids, Z., Da Silva, J.M. & Branch, W.R. (2013) A molecular phylogeny of the African plated lizards, Genus *Gerrhosaurus* Wiegmann, 1828 (Squamata: Gerrhosauridae), with the description of two new genera. *Zootaxa*, 3750 (5), 465–493.
- Bauer, A.M. & Lamb, T. (2005). Phylogenetic relationships of southern African geckos in the *Pachydactylus* group (Squamata: Gekkonidae). *Africa Journal of Herpetology*, 54 (2), 105–129.
- Bocage, J.V.B. (1866) Reptiles nouveaux ou peu connus recueillis dans les possessions portugaises de l'Afrique occidentale, qui se trouvent au Muséum de Lisbonne. *Jornal de Sciencias Mathematicas, Physicas e Naturaes*, I, 57–78.

Bocage, J.V.B. (1867) Batraciens nouveaux de l'Afrique occidentale (Loanda et Benguella). *Proceedings of the Zoological Society of London*, 1867, 843–846.

Bocage, J.V.B. (1872) Diagnoses de quelques espèces nouvelles de reptiles d'Afrique occidentale. *Jornal de Sciencias Mathematicas, Physicas e Naturaes*, 4, 72–82.

Bocage, J.V.B. (1873) Mélanges erpétologiques. II. Sur quelques reptiles et batraciens nouveaux, rares ou peu connus d'Afrique occidentale. *Jornal de Sciencias Mathematicas, Physicas e Naturaes*, 4, 209–227.

Bocage, J.V.B. (1887a) Mélanges herpétologiques. II. Reptiles de Dahomey. *Jornal de Sciencias Mathematicas, Physicas e Naturaes*. 11, 192–197.

Bocage, J.V.B. (1887b) Mélanges erpétologiques. IV. Reptiles du dernier voyage de MM. Capello et Ivens à travers l'Afrique. *Jornal de Sciencias Mathematicas, Physicas e Naturaes*, 11, 201–208.

Bocage, J.V.B. (1890) Sur une espèce nouvelle à ajouter à la faune erpétologique de St. Thomé et Rolas. *Jornal de Sciencias Mathematicas, Physicas e Naturaes*. Segunda Série, 2 (5), 61–62.

Bocage, J.V.B. (1892) Aves do Dahomé. *Jornal de Sciencias Mathematicas, Physicas e Naturaes*. Segunda Série, 2 (7), 185–187.

Bocage, J.V.B. (1893a) Mammiferos, aves e reptis da ilha de Anno-Bom. *Jornal de Sciencias Mathematicas, Physicas e Naturaes*. Segunda Série, 3 (9), 43–46.

Bocage, J.V.B. (1893b) Diagnoses de quelques nouvelles espèces de reptiles et batraciens d'Angola. *Jornal de Sciencias Mathematicas, Physicas e Naturaes*, Segunda Série, 3 (10), 115–121.

Bocage, J.V.B. (1895) *Herpétologie d'Angola et du Congo*. Ministério da Marinha e das Colónias, Lisboa, Portugal. 203 pp + 20 pls.

Bocage, J.V.B. (1903) Contribution à la faune des quatre îles du Golfe de Guinée. *Jornal de Sciencias Mathematicas, Physicas e Naturaes*. Segunda Série, 7 (25), 25–59.

Bocage, J.V.B. (1905) Contribution à la faune des quatre îles du Golfe de Guinée (suite). *Jornal de Sciencias Mathematicas, Physicas e Naturaes*. Segunda Série, 7 (26), 65–96.

Boettger, O. (1888) Materialien zur Fauna des unteren Congo II. Reptilien und Batrachier. *Bericht über die Senckenbergische Naturforschende Gesellschaft in Frankfurt am Main*, 1888, 3–108.

Boulenger, G.A. (1882) *Catalogue of the Batrachia Salientia, s. Ecaudata, in the collection of the British Museum*. The Trustees of the British Museum, London. xvi + 530pp, 30 pls.

Boulenger, G.A. (1905) A list of the batrachians and reptiles collected by Dr. W. J. Ansorge in Angola, with descriptions of new species. *Annals and Magazine of Natural History*, Series 7, 16, 105–115, pl. 4.

Branch, W.R. 1998. *Field Guide to Snakes and Other Reptiles of Southern Africa*, 3rd edition. Struik Publishers, Cape Town, South Africa. 328 pp.

Branch, W.R. (2018) Snakes of Angola: An annotated checklist. *Amphibian & Reptile Conservation*, 12 (2), 41–82 (e159). [General Section]

Broadley, D.G. (1975) A review of *Psammophis leightoni* and *Psammophis notostictus* in southern Africa (Serpentes: Colubridae). *Arnoldia (Rhodesia)*, 7 (13), 1–17.

Broadley, D.G. (1992) The taxonomy and zoogeography of the genus *Lycophidion* (Serpentes: Colubridae). *The Journal of the Herpetological Association of Africa*, 40 (1), 30–36.

Broadley, D.G. (2002) A review of the species of *Psammophis* Boie found south of Latitude 12° S (Serpentes: Psammophiinae). *African Journal of Herpetology*, 51 (2), 83–119.

Broadley, D.G. & Broadley, S. (1999) A review of the African Worm Snakes from south of Latitude 12°S (Serpentes: Leptotyphlopidae). *Syntarsus*, 5, 1–36.

Broadley, D.G. & Wallach, V. (2007) A revision of the genus *Leptotyphlops* in northeastern Africa and southwestern Arabia (Serpentes: Leptotyphlopidae). *Zootaxa*, 3–78.

Broadley, D.G. & Wallach, V. (2009) A review of the eastern and southern African blind-snakes (Serpentes: Typhlopidae), excluding *Letheobia* Cope, with the description of two new genera and a new species. *Zootaxa*, 2255, 1–100.

Brygoo, É.R. & Roux-Estève, R. (1983) *Feylinia*, genre de Lézards africains de la famille des Scincidae, sous-famille des Feyliniinae. *Bulletin du Muséum National d'Histoire Naturelle*, 4^e série, Section A, Zoologie, 5 (1), 307–341.

Butler, B.O., Ceríaco, L.M.P., Marques, M.P., Bandeira, S., Júlio, T., Heinicke, M.P., & Bauer, A.M. (2019) Herpetological Survey of Huíla Province, Southwest Angola, Including First Records from Bicular National Park. *Herpetological Review*, 50 (2), 225–240.

Ceríaco, L., Marques, M., Bandeira, S. Heinicke, M., Boye, C., Stanley, E., Blackburn, D. & Bauer, A. (2018a) *A taxonomic review and phylogeny of the African Burrowing Skinks (Squamata: Scincidae: Sepsina Bocage, 1866)*. Joint meeting of Ichthyologists and Herpetologists, Rochester, New York, USA.

Ceríaco, LMP & Marques, MP (2020) *Serpentes venenosas de Angola. Guia de identificação e primeiros socorros*. Arte e Ciência, Porto, 216 pp.

Ceríaco, L.M.P., Agarwal, I, Marques, M.P. & Bauer, A.M. (2020a) A review of the genus *Hemidactylus* Goldfuss, 1820 (Squamata: Gekkonidae) from Angola, with the description of two new species. *Zootaxa* 4746 (1), 001–071.

Ceríaco, L.M.P., Bauer, A.M., Blackburn, D.C. & Lavres, A.C.F.C. (2014a) The herpetofauna of the Capanda Dam Region, Malanje, Angola. *Herpetological Review* 45 (4), 667–674.

Ceríaco, L.M.P., Bauer, A.M., Heinecke, M.P. & Blackburn, D.C. (2017) GEKKONIDAE: *Chondrodactylus pulitzerae* (Schmidt, 1933) - Pulitzer's thick-toed gecko in Angola. *African Herp News* 64, 41–44.

Ceríaco, L.M.P., Blackburn, D.C. Marques, M.P., Calado, F.M. (2014b) Catalogue of the amphibian and reptile type specimens of the Museu de História Natural da Universidade do Porto in Portugal, with some comments on problematic taxa. *Alytes*, 31, 13–36.

Ceríaco, L.M.P., De Sá, S.A.C., Bandeira, S., Valério, H., Stanley, E.L., Kuhn, A.L., Marques, M.P., Vindum, J.V., Blackburn, D.C. & Bauer, A.M. (2016a) Herpetological survey of the Iona and Namibe National Park, Angola, with a Synoptic List of the Amphibians and Reptiles of Namibe Province, Southwestern Angola. *Proceedings of the California Academy of Sciences*, Series 4, 63 (2), 15–61.

Ceríaco, L.M.P., Heinicke, M.P., Parker, K.L., Marques, M.P. & Bauer, A.M. (2020b) A review of the African snake-eyed skinks (Scincidae: *Panaspis*) from Angola, with the description of a new species. *Zootaxa*, 4747 (1), 077–112.

Ceríaco, L.M.P., Marques, M.P., André, I., Afonso, E., Blackburn, D.C. & Bauer, A.M. (*in press*) Illustrated type catalogue of the “lost” herpetological collections of Museu do Dundo, Angola. *Bulletin of the Museum of Comparative Zoology*, 162 (7).

Ceríaco, L.M.P., Marques, M.P. & Bandeira, S.A. (2016b) *Anfíbios e Répteis do Parque Nacional da Cangandala*. Instituto Nacional da Biodiversidade e Áreas de Conservação, Angola & Museu Nacional de História Natural e da Ciência, Lisboa, Portugal, 97 pp.

Ceríaco, L.M.P., Marques, M.P., Bandeira, S., Blackburn, D.C. & Bauer, A.M. (2018b) Herpetological survey of Cangandala National Park with a Synoptic List of the Amphibians and Reptiles of Malanje Province, central Angola. *Herpetological Review*, 49 (3), 408–431.

Ceríaco, L.M.P., Marques, M.P. & Bauer, A.M. (2016c) A review of the genus *Trachylepis* (Sauria: Scincidae) from the Gulf of Guinea, with descriptions of two new species in the *Trachylepis maculilabris* (Gray, 1845) species complex. *Zootaxa*, 4109 (3): 284–314.

Ceríaco, L.M.P., Tolley, K.A., Marques, M.P., Heinicke, M.P. & Bauer, A.M. (2020c) A dwarf among giants: phylogenetic position of the elusive Angolan Adder (*Bitis heraldica*) and biogeographic affinities of Angolan Afromontane regions. *African Journal of Herpetology*, 1–11.

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

Channing, A., & Becker, F. (2019). Correction to the type locality of *Tomopterna ahli* (Deckert, 1938) (Anura: Pyxicephalidae), with the designation of a neotype. *Zootaxa*, 4688 (4), 549–560.

Channing, A. & Rödel, M.-O. (2019) *Field Guide to the Frogs & Other Amphibians of Africa*. Penguin Random House South Africa, South Africa, 408pp.

Channing, A., Dehling, J.M., Lötters, S. & Ernst, R. (2016) Species boundaries and taxonomy of the African river frogs (Amphibia: Pyxicephalidae: *Amietia*). *Zootaxa*, 4155 (1), 001–076.

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

Chippaux, J.-P. (2006) *Les serpents d'Afrique occidentale et centrale. Edition revue et augmentée*. IRD Éditions, Paris, 312 pp.

Chippaux, J.-P. & Jackson, K. (2019) *Snakes of Central and Western Africa*. Johns Hopkins University Press, Baltimore. 448 pp.

Collet, M. & Trape, J.-F. (2020) Une nouvelle espèce du genre *Atheris* Cope, 1862, de la province de l'Équateur en République Démocratique du Congo (Squamata: Viperidae). *Bulletin de la Société Herpétologique de France*, 173, 27–40.

Conradie, W., Branch, W.R., Measey, G.J., & Tolley, K.A. (2012). A new species of *Hyperolius* Rapp, 1842 (Anura: Hyperoliidae) from the Serra da Chela Mountains, south-western Angola. *Zootaxa*, 3269, 1–17.

De Witte, G.-F. & Laurent, R (1947) Revision d'un groupe de Colubridae Africains genres *Calamelaps*, *Miodon*, *Aparallactus* et forms affines. *Mémoires de Musée Royal d'Histoire Naturelle de Belgique*, 2 (29), 1–134.

Engelbrecht, H.M., Branch, W.R., Greenbaum, E., Alexander, G.J., Jackson, K., Burger, M., Conradie, W., Kusamba, C., Zassi-Boulou, A-G., Tolley, K.A. (2019) Diversifying into the branches: species boundaries in African green and bush snakes, *Philothamnus* (Serpentes: Colubridae). *Molecular Phylogenetics and Evolution*, 130, 357–365.

Engelbrecht, H.M., Branch, W.R., Greenbaum, E., Burger, M., Conradie, W. & Tolley, K. (2020) African Herald snakes, *Crotaphopeltis*, show population structure for a widespread generalist but deep genetic divergence for forest specialists. *Journal of Zoological Systematics and Evolutionary Research*, 0, 1–14.

Ernst, R., Lautenschläger, T., Branquima, M.F. & Hölting, M. (2020) At the edge of extinction: a first herpetological assessment of the proposed Serra do Pingano Rainforest National Park in Uíge Province, northern Angola. *Zoosystematics and Evolution*, 96 (1), 237–262.

Ferreira, J.B. (1898) Reptis de Timôr no Museu de Lisboa. *Jornal de Sciencias Mathematicas, Physicas e Naturaes*, Segunda Série, 5 (19), 151–156.

Ferreira, J.B. (1904) Reptis e Amphibios de Angola da Região ao Norte do Quanza (Collecção Newton 1903). *Jornal de Sciencias Mathematicas Physicas e Naturaes*, Segunda Série, 7 (25), 111–117.

Ferreira, J.B. (1906) Algumas especies novas ou pouco conhecidas de Amphibios e Reptis de Angola (Colecção Newton – 1903–1904). *Jornal de Sciencias Mathematicas Physicas e Naturaes*, Segunda Série, 7 (26), 159–171.

Figueiredo, E., Smith, G.F., Ceríaco, L.M.P. (2019) The vascular plant collections of Francisco Newton (1864–1909) in Angola. *Phytotaxa*, 413 (3), 207–224.

Freitas, E.S., Bauer, A.M., Siler, C.D., Broadley, D.G. & Jackman, T.R. (2018) Phylogenetic and morphological investigation of the *Mochlus afer-sundevallii* species complex (Squamata: Scincidae) across the arid corridor of sub-Saharan Africa. *Molecular Phylogenetics and Evolution*, 127, 280–287.

Freitas, E.S., Datta-Roy, A., Karanth, P., Grismer, L.L. & Siler, C.D. (2019) Multilocus phylogeny and a new classification for African, Asian and Indian supple and writhing skinks (Scincidae: Lygosominae). *Zoological Journal of the Linnean Society*, 186 (4), 1067–1096.

Frétley T., Dewynter, M., & Blanc, C.P. (2011) *Amphibiens d'Afrique central et d'Angola. Clé de Détermination Illustrée des Amphibiens du Gabon et du Mbini/Illustrated Identification Key of the Amphibians from Gabon and Mbini*. Biotope, Mèze/Muséum national d'Histoire naturelle, Paris, France, 232 pp.

Frost, D.R. (2020) Amphibian Species of the World: an online reference. Version 6.0. American Museum of Natural History, New York, USA. Available from <http://research.amnh.org/herpetology/amphibia/index.html>. (Accessed 19 September 2020).

Furman, B.L.S., Bewick, A.J., Harrison, T.L., Greenbaum, E., Gvoždík, V., Kusamba, C., & Evans, B.J. (2015). Pan-African phylogeography of a model organism, the African clawed frog '*Xenopus laevis*'. *Molecular Ecology*, 24 (4), 909–925.

Günther, A.C.L.G. (1858) Neue Batrachier in der Sammlung des Britischen Museums. *Archiv für Naturgeschichte*, 24, 319–328.

Günther, A.C.L.G. ("1858" 1859) *Catalogue of the Batrachia Salientia in the Collection of the British Museum*. Trustees of the British Museum (Natural History), London, United Kingdom, xvi + 160 pp., 12 pls.

- Haacke, W.D. (1997) Systematics and biogeography of the southern African scincine genus *Typhlacontias* (Reptilia: Scincidae). *Bonner Zoologische Beiträge*, 47 (1-2), 139–163.
- Hallermann, J., Ceríaco, L.M.P., Schmitz, A., Ernst, R., Conradie, W., Verburgt, L., Marques, M.P. & Bauer, A.M. (2020) A review of the Angolan House snakes, genus *Boaedon* Duméril, Bibron and Duméril (1854) (Serpentes: Lamprophiidae), with description of three new species in the *Boaedon fuliginosus* (Boie, 1827) species complex. *African Journal of Herpetology*, 1–50.
- Hallowell, E. (“1854” 1855) Descriptions of new reptiles from Guinea. *Proceedings of the Academy of Natural Sciences of Philadelphia*, 7, 193–194.
- Heinicke, M.P., Ceríaco, L.M.P., Moore, I.M., Bauer, A.M. & Blackburn, D.C. (2017) *Tomopterna damarensis* (Anura: Pyxicephalidae) is broadly distributed in Namibia and Angola. *Salamandra* 53 (3), 461–465.
- Heinz, H.M. (2011) *Comparative Phylogeography of Two Widespread Geckos from the Typically Narrow-ranging Pachydactylus Group in Southern Africa*. Unpublished M.S. Thesis, Villanova University, Villanova, Pennsylvania, USA. viii + 107 + [1] pp.
- Hellmich, W. (1957) Herpetologische Ergebnisse einer Forschungsreise nach Angola. *Veröffentlichungen der Zoologischen Staatssammlung München*, 5, 1–92.
- Huntley, B.J., Russo, V., Lages, F. & Ferrand, N. (2019) *Biodiversity of Angola. Science & Conservation: A Modern Synthesis*. Springer, Cham, Switzerland. XVIII + 549 pp.
- Kelly, C.M.R., Barker, N.P., Villet, M.H., Broadley, D.G. & Branch, W.R. (2008) The snake family Psammophiidae (Reptilia: Serpentes): phylogenetics and species delimitation in the African sand snakes (*Psammophis* Boie, 1825) and allied genera. *Molecular Phylogenetics and Evolution*, 47, 1045–1060.
- Laurent, R.F. (1964) Reptiles et Amphibiens de l'Angola (Troisième contribution). *Publicações Culturais. Companhia de Diamantes de Angola*, Lisboa, 67, 1–165.
- Laurent, R.F. (1982) Le genre *Afrixalus* Laurent (Hyperoliidae) en Afrique centrale. *Annales du Musée Royal de l'Afrique Centrale*. Tervuren, Belgique, series in-8°, *Sciences Zoologiques*, 235, i–vi + 1–58.

- Main, D.C. (2019a) *A phylogeny of the genus Chamaeleo with investigation of cryptic speciation*. Unpublished M.S. Thesis, University of Johannesburg, Johannesburg, Republic of South Africa, vi + 86 pp.
- Main, D.C., Tilbury, C., van Vuuren, B. & Tolley, K.A. (2019b) Phylogeny, species delimitation and ancestral biogeography in *Chamaeleo*. *African Herp News*, 72, 70.
- Marques, M.P., Ceríaco, L.M.P., Blackburn, D.C. & Bauer, A.M. (2018) Diversity and distribution of the amphibians and terrestrial reptiles of Angola atlas of historical and bibliographic records (1840-2017). *Proceedings of the California Academy of Sciences*, Series 4, 65 (Supplement 2), 1–501.
- Mali, F.M.M., Laudisoit, A., Yendema, M.K., Babangenge, G.B., Mukobya, M., Ewango, C., Katuala, P., Akaibe, D., Bongo, G.N., Anio, J.A., Ngbolua, J.P.K.-te-N. & Tungaluna, G. (2019) A preliminary study on the Batraco-herpetological Fauna in the Forest Refuge of Albertine Rift, the Democratic Republic of the Congo. *Asian Journal of Research in Zoology*, 2 (4), 1–11.
- Medina, M.F., Bauer, A.M., Branch, W.R., Schmitz, A., Conradie, W., Nagy, Z.T., Hibbitts, T.J., Ernst, R., Portik, D.M., Nielsen, S.V., Colston, T.J., Kusamba, C., Behangana, M., Rödel, M.-O. & Greenbaum, E. (2016) Molecular phylogeny of *Panaspis* and *Afroablepharus* skinks (Squamata: Scincidae) in the savannas of sub-Saharan Africa. *Molecular Phylogenetics and Evolution*, 100, 409–423.
- Monard, A. (1937) Contribution à la batrachologie d'Angola. *Bulletin de la Société Neuchâteloise des Sciences Naturelles*, 62, 1–59.
- Nobre, A. (1905) Molluscos terrestres e fluviaes da exploração de Francisco Newton em Angola. *Annaes de Sciencias Naturaes*, 9, 103–118.
- Ozorio, B. (1887) Liste des crustacés des possessions portugaises d'Afrique occidentale dans les collections du Muséum d'Histoire Naturelle de Lisbonne. *Jornal de Sciencias Mathematicas, Physicas e Naturaes*, 11 (44), 220–231.
- Ozorio, B. (1888) Liste des crustacés des possessions portugaises d'Afrique occidentale. *Jornal de Sciencias Mathematicas, Physicas e Naturaes*, 11 (47), 186–192.
- Osorio, B. (1895a) Peixes da ilha d'Anno Bom. *Jornal de Sciencias Mathematicas, Physicas e Naturaes*, Segunda Série, 3 (12) 243–247.

Osorio, B. (1895b) Peixes de Dahomey. *Jornal de Sciencias Mathematicas, Physicas e Naturaes*, Segunda Série, 3 (12), 252–253.

Perret, J.-L. (1976a) Revision des amphibiens africains et principalement des types conservés au musée Bocage de Lisbonne. *Arquivos do Museu Bocage*, 6, 15–34.

Perret, J.-L. (1976b) Identité de quelques *Africalus* (Amphibia, Salientia, Hyperoliidae). *Bulletin de la Société Neuchâteloise des Sciences Naturelles*, 99, 19–28.

Peters, W.C.H. (1877) Übersicht der Amphibien aus Chinchoxo (Westafrika), welche von der Afrikanischen Gesellschaft dem Berliner zoologischen Museum übergeben sind. *Monatsberichte der Königlich Preussische Akademie des Wissenschaften zu Berlin*, 1877, 611–621, 1 pl.

Peters, W.C.H. (1882a) Über neue Batrachier der Gattung *Hyperolius* und *Limnodytes* (*Hylorana*) aus Africa. *Sitzungsberichte der Gesellschaft Naturforschender Freunde zu Berlin*, 1882, 8–10.

Peters, W.C.H. (1882b) *Naturwissenschaftliche Reise nach Mossambique auf Befehl seiner Majestät des Königs Friedrich Wilhelm IV. Zoologie, III. Amphibien*. G. Reimer, Berlin, Germany. xv + 191 pp., 33 pls.

Portik, D.M. & Bauer, A.M. (2012) Untangling the complex: molecular patterns in *Trachylepis variegata* and *T. punctulata* (Reptilia: Scincidae). *African Journal of Herpetology*, 61 (2), 128–142.

Portillo, F., Branch, W.R., Conradie, W., Rödel, M.-O., Penner, J., Barej, M.F., Kusamba, C., Muninga, W.M., Aristote, M.M., Bauer, A.M., Trape, J.-F., Nagy, Z.T., Carlino, P., Pauwels, O.S.G., Menegon, M., Burger, M., Mazuch, T., Jackson, K., Hughes, D.F., Behangana, M., Zassi-Boulou, A.-G. & Greenbaum, E. (2018) Phylogeny and biogeography of the African burrowing snake subfamily Aparallactinae (Squamata: Lamprophiidae). *Molecular Phylogenetics and Evolution*, 127, 288–303.

Portillo, F., Stanley, E.L., Branch, W.R., Conradie, W., Rödel, M.-O., Penner, J., Barej, M.F., Kusamba, C., Muninga, W.M., Aristote, M.M., Bauer, A.M., Trape, J.-F., Nagy, Z.T., Carlino, P., Pauwels, O.S.G., Menegon, M., Ineich, I., Burger, M., Zassi-Boulou, A.-G., Mazuch, T., Jackson, K., Hughes, D.F., Behangana, M. & Greenbaum, E. (2019) Evolutionary history of burrowing asps (Lamprophiidae: Atractaspidinae) with emphasis on fang evolution and prey selection. *PLOS ONE*, 14 (4), e0214889, 1–32.

Poynton, J.C., Loader, S.P., Conradie, W., Rödel, M.-O., & Liedtke, H.C. (2016) Designation and description of a neotype of *Sclerophrys maculata* (Hallowell, 1854), and reinstatement of *S. pusilla* (Mertens, 1937) (Amphibia: Anura: Bufonidae). *Zootaxa*, 4098 (1), 073–094.

Rapp, W.V. (1842) Neue batrachier. *Archiv für Naturgeschichte*, 8, 289–291, pl. 6.

Seabra, A.F. (1898) Noticia sobre uma nova especie do genero "*Cynonycteris*" e annotação das especies d'este genero que existem nas collecções do Museu Nacional de Lisboa. *Jornal de Sciencias Mathematicas, Physicas e Naturaes*, Segunda Série, 5 (19), 157–162.

Seabra, A.F. (1905a) Mammiferos e aves da exploração de F. Newton em Angola. *Jornal de Sciencias Mathematicas, Physicas e Naturaes*, 7 (26), 103–110.

Seabra, A.F. (1905b) Aves de Angola da exploração de F. Newton. *Jornal de Sciencias Mathematicas, Physicas e Naturaes*, Segunda Série, 7 (26), 118–128.

Seabra, A.F. (1905c) Aves da exploração de Fr. Newton em Angola. Subsidios para o conhecimento da destribuição geographica das aves d'Africa Occidental. *Annaes de Sciencias Naturaes*, IX, 153–159.

Seabra, A.F. (1906a) A propósito de algumas espécies de Microchiropteros d'Angola. *Annaes de Sciencias Naturaes*, X, 81–82.

Seabra, A.F. (1906b) Ribeirinhas e Palmipedes das margens do Rio Cunene. *Annaes de Sciencias Naturaes*, X, 83–90.

Seabra, A.F. (1906c) Aves de Porto Alexandre. *Jornal de Sciencias Mathematicas, Physicas e Naturaes*, Segunda Série, 7 (27), 143–148.

Seabra, A.F. (1907) Sur quelques Oiseaux d'Angola envoyés par Francisco Newton. Contribution à l'étude de la distribution géographique des Oiseaux de l'Afrique Occidentale. *Bulletin de la Société Portugaise des Sciences Naturelles*, I, 41–45.

Seabra, A.F. (1909) Note sur quelques mammifères de l'Afrique occidentale capturés par Fr. Newton en 1905 et appartenant au muséum d'histoire naturelle de Porto. *Annaes Scientificos da Academia Polytechnica do Porto*, IV, 218–220.

Simmons, J.E. (2015) *Herpetological collecting and collections management. Third Edition*. Society for the Study of Amphibians and Reptiles, Herpetological Circular, 42, 1–191.

Spawls, S. & Branch, W.R. (2020) *The Dangerous Snakes of Africa*. Bloomsbury Wildlife, London. 336 pp.

Tilbury, C. (2010) *Chameleons of Africa, an Atlas Including the Chameleons of Europe, the Middle East and Asia*. Edition Chimaira, Frankfurt am Main, Germany. 831 pp.

Tilbury, C. (2018) *Chameleons of Africa. An Atlas, Including the Chameleons of Europe, the Middle East and Asia. Second, thoroughly revised edition*. Edition Chimaira, Frankfurt am Main, Germany, 643 pp.

Trape, J-F., Crochet, P.-A., Broadley, D.G., Sourouille, P., Mané, Y., Burger, M., Böhme, W., Saleh, M., Karan, A., Lanza, B. & Mediannikov, O. (2019) On the *Psammophis sibilans* group (Serpentes, Lamprophiidae, Psammophiinae) north of 12°S, with the description of a new species from West Africa. *Bonn zoological Bulletin*, 68 (1), 61–91.

Wagner, P. & Schmitz, A. (2006) *Feylinia currori* Gray, 1845 (Squamata: Scincidae): new distribution records from Kenya. *Salamandra*, 42 (2/3), 187–190.

Wagner, P., Böhme, W., Pauwels, O.S.G. & Schmitz, A. (2009) A review of the African red-flanked skinks of the *Lygosoma fernandi* (Burton, 1836) species group (Squamata: Scincidae) and the role of climate change in their speciation. *Zootaxa*, 2050, 1–30.

Wallach, V., Williams, K.L. & Boundy, J. (2014) *Snakes of the World: A Catalogue of Living and Extinct Species*. CRC Press, Boca Raton, Florida, USA, xxvi + [2] + 1209 pp.

Weinell, J.L. & Bauer, A.M. (2018) Systematics and phylogeography of the widely distributed african skink *Trachylepis varia* species complex. *Molecular Phylogenetics and Evolution*, 120, 103–117.

Weinell, J.L., Branch, W.R., Colston, T.J., Jackman, T.R., Kuhn, A., Conradie, W. & Bauer, A.M. (2019) A species-level phylogeny of *Trachylepis* (Scincidae: Mabuyinae) provides insight into their reproductive mode evolution. *Molecular Phylogenetics and Evolution*, 136, 183–195.

Wieczorek, A.M., Drewes, R.C. & Channing, A. (2000) Biogeography and evolutionary history of *Hyperolius* species: application of molecular phylogeny. *Journal of Biogeography*, 27 (5), 1231–1243.

Wüster, W., Crookes, S., Ineich, I., Mané, Y., Pook, C.E., Trape, J.-F. & Broadley, D.G. (2007) The phylogeny of cobras inferred from mitochondrial DNA sequences: Evolution of venom spitting and the phylogeography of the African spitting cobras (Serpentes: Elapidae: *Naja nigricollis* complex). *Molecular Phylogenetics and Evolution*, 45 (2), 437–453.

Zimkus, B.M., Rödel, M.-O. & Hillers, A. (2010) Complex patterns of continental speciation: Molecular phylogenetics and biogeography of sub-Saharan puddle frogs (*Phrynobatrachus*). *Molecular Phylogenetics and Evolution*, 55 (3), 883–900.

Chapter III

Paper III – Social media meets specimens in old formalin filled jars: A new species of Banded Rubber Frog, genus *Phrynomantis* (Anura: Microhylidae) from Angola.³

³ Paper submitted to Alytes, currently in review by two anonymous reviewers.

Paper III – Social media meets specimens in old formalin filled jars: A new species of Banded Rubber Frog, genus *Phrynomantis* (Anura: Microhylidae) from Angola.

Abstract

Three species of *Phrynomantis* Peters, 1867, have been historically recorded for Angola: *P. affinis*, *P. annectens* and *P. bifasciatus*. As noted by all the authors who have dealt with specimens of *P. bifasciatus* from the country, the Angolan population presented an odd coloration pattern for the species, which even led Boulenger to consider it a different variety. A revision of the extant specimens Angolan *Phrynomantis* available in natural history collections, specimens collected in recent field surveys, as well as recent sightings and photographs allows the recognition of the Angolan population of *P. cf. bifasciatus* as a new species, endemic to the coastal lowlands of western Angola. The new taxon is described solely based on its coloration pattern and morphology, and it is separated from nominotypic *P. bifasciatus* by more than one thousand kilometers. The revision of these historical specimens also allowed us to confirm a second record of *P. affinis* in the country and to contribute to an overall better understanding of the distribution of the species of the genus on the continent.

Key words: Taxonomy, species description, morphology, Africa, coastal lowlands, coloration patterns

Resumo

Três espécies de *Phrynomantis* Peters, 1867, têm sido historicamente reportadas para Angola: *P. affinis*, *P. annectens* e *P. bifasciatus*. Como referido por todos os autores que têm lidado com espécimes de *P. bifasciatus* no país, a população de Angola apresenta uma coloração atípica para a espécie, o que levou mesmo Boulenger a considerá-la uma variedade diferente. A revisão de todos os espécimes de *Phrynomantis* de Angola existentes em coleções de história natural, de espécimes recentemente colectados em novos trabalhos de campo, bem como observação e fotografias recentes, permitem o reconhecimento da população Angolana de *P. cf. bifasciatus* como uma nova espécie, endémica das zonas costeiras de baixa elevação do oeste de Angola. O novo táxon é descrito apenas com base no seu padrão de coloração e morfologia, e encontra-se

separado da forma nominotípica de *P. bifasciatus* por milhares de quilómetros. A revisão destes espécimes históricos permitiu também confirmar um segundo registo de *P. affinis* para o país, contribuindo para uma melhor compreensão da distribuição das espécies deste género no continente.

Palavras Chave: Taxonomia, descrição de espécies, morfologia, África, zonas baixas costeiras, padrões de coloração.

Introduction

After being closed for research for approximately four decades due to violent armed conflicts, Angola has in the last years experienced a renaissance of its biodiversity studies (Marques *et al.* 2018; Huntley *et al.* 2019). This is especially true for herpetology. In little more than a decade, dozens of papers have been published regarding the country's herpetofauna (see Marques *et al.* 2018 for a synthesis), with several new species being described from several different families and genera of amphibians and reptiles. These include the amphibian genera *Hyperolius* (Conradie *et al.* 2012a, 2013) and *Poyntonophrynus* (Ceríaco *et al.* 2018), and the reptile genera *Boaedon* (Hallermann *et al.* 2020), *Cordylus* (Stanley *et al.* 2016; Marques *et al.* 2019a), *Hemidactylus* (Ceríaco *et al.* 2020a,b), *Limnophis* (Conradie *et al.* 2020), *Lygodactylus* (Marques *et al.* 2020), *Nucras* (Branch *et al.* 2019), *Panaspis* (Ceríaco *et al.* 2020c), *Pedioplanis* (Conradie *et al.* 2012b), and *Trachylepis* (Marques *et al.* 2019b). Many other species from these and other genera are currently in the process of being described, and certainly many more await detailed study.

The curious and visually striking microhylid frogs of the genus *Phrynomantis* Peters, 1867, commonly known as Rubber Frogs due to their smooth, rubber-like dorsal skin, are one such group. *Phrynomantis* is a relatively small genus comprising five currently recognized species, all of them endemic to sub-Saharan Africa: *Phrynomantis affinis* Boulenger, 1901, *Phrynomantis annectens* Werner, 1910, *Phrynomantis bifasciatus* (Smith, 1847), *Phrynomantis microps* Peters, 1875, and *Phrynomantis somalicus* (Scortecci, 1941). Three of these have been recorded for Angola, namely *P. affinis*, *P. annectens*, and *P. bifasciatus* (Marques *et al.* 2018).

Phrynomantis affinis was originally described from “Pweto, Lake Mweru” in the former Katanga region of the Democratic Republic of the Congo, and its known distribution ranges from southern Democratic Republic of the Congo, southern Tanzania, Western Zambia, northeastern Namibia and eastern Angola (Channing 2001; Channing

& Rödel 2019). Parker (1940) described *Phrynomantis hoeschi* from northern Namibia (Type locality: “Ombujamatemba (1450 m), near the Waterberg” *fide* Parker (1940)), which was later considered as a synonym of *P. affinis* by Laurent (1964), a decision followed by all subsequent authors (e.g. Mertens 1971; Dubois 1988; Channing 2001; Channing & Rödel 2019; Frost 2020). In Angola the species is historically known only from a single male specimen from the Lake Calundo area (-11.80°, 20.86°, 1119 m) in Moxico Province, eastern Angola (Laurent 1964). Recent reexamination of the specimens reported by Monard (1938) as *P. bifasciatus*, reveals that the author misidentified the species, and this records actually refers to *P. affinis*. Monard (1938) reported based on seven juvenile specimens collected in June 1933 in Mulondo (-15.6479158°, 15.1955508°, 1158 m), on the high plateau of Huíla Province. Monard noted that all of the specimens at his disposal were “dark, leaden black, decorated with very small white spots, more or less arranged in longitudinal lines”, in which “the spots behind the eye are the ones that are better arranged in line”, and all the specimens had a “whitish underside” [translation by the authors from the original in French]. Monard stated that this coloration was “abnormal” for *P. bifasciatus*, which is “normally ornamented by yellow or red lines over a brown or black background” [translation by the authors from the original in French] (Monard 1938). Two of the seven specimens are still present in the collections of the Musée d’ Histoire Naturelle de La Chaux-de-Fonds (MHNC; MHNC 90.001–002; **Fig. 1**) and are unambiguously assigned to *P. affinis*, extending the known distribution of the species approximately 750 km southwest in Angola.



Fig. 1 – Dorsal and ventral a view of *Phrynomantis affinis* (MHNC 90.001 (or 2)) from Mulondo, Huila Province, Angola.

Photo by Nicolas Marcgraf.

Contrasting with the relatively stable taxonomic and nomenclatural history of *P. affinis*, the Namib specialist *P. annectens* has a more complex history. The species was originally described by Werner (1910) from the “Aar-Rivier” in southwestern Namibia. Several subsequent authors described three other taxa, all currently considered as junior synonyms of *P. annectens* – Methuen & Hewitt (1913) described *Phrynomantis nasuta* from the Great Karas mountains region in southern Namibia; Ahl (1934) described *Hoplophryne marmorata* from Okahandja, central Namibia; and Ahl (1935) described *Ctenophryne marmorata* (a junior secondary homonym of the latter) based on two specimens without locality data (for a discussion on the identity of this taxon see Zweifel 1989). This synonymy is currently accepted by all authors who have dealt with the species (e.g. Loveridge 1936; Parker 1936; Mertens 1971; Dubois 1988; Zweifel 1989; Bauer *et al.* 1996; Channing 2001; Channing & Rödel 2019; Frost 2020). The species is an arid regions specialist, and occurs from the xeric areas of southwestern Angola, through western and central Namibia to the Augrabies area of the western Northern Cape Province in South Africa (Channing 2001; Marques *et al.* 2018; Channing & Rödel 2019). In Angola, the species is known from a handful of records from the coastal lowlands of western Angola (Parker 1936; Poynton & Haacke 1993; Ceríaco *et al.* 2016; see Marques *et al.* (2018) for details on the available published data on the distribution

of the species in the country), and has recently been extensively collected in several localities in Benguela and Namibe provinces (this paper, **Fig. 2**, see **Table 1**). Besides the published historical records, there is an unpublished specimen from “Benguela” (-12.5833°, 13.41667°, 15 m above sea level), Benguela Province, collected by William John Ansorge in his 1903–1909 exploration of Angola, which is deposited in the collections of the Royal Museum for Central Africa (RMCA) in Tervuren, (accession number RMCA B.469; **Fig. 3**).



Fig. 2 – Live photo (a) and ventral view of the left hand (b) of *Phrynomantis annectens* (LMPC 1149) from Malowe, base of Serra da Neve, Namibe Province, Angola. Photos by Luis M. P. Ceríaco.

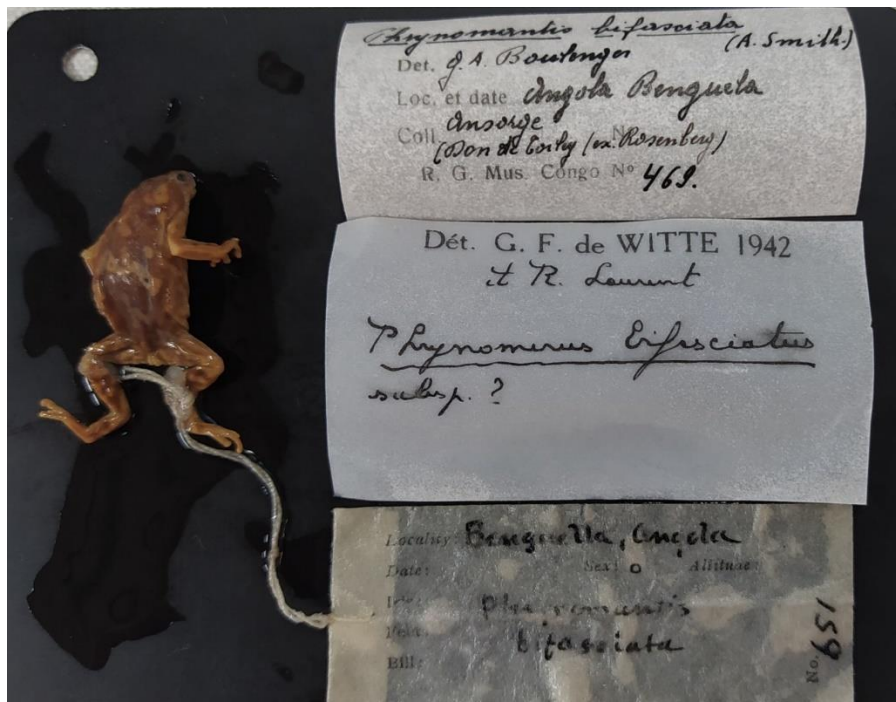


Fig. 3 – Dorsal view of *Phrynomantis annectens* (RMCA A.469) from Benguela, Benguela Province, Angola. Photo by Garin Cael.

Regarding *P. bifasciatus*, the most widely distributed member of the genus in southern Africa, its taxonomic and nomenclatural history is also complex, with the description of two taxa that would be later sunk into synonymy, and its allocation at different times to several genera: *Brachymerus*, *Dendrobates*, *Bombinator*, *Phrynomerus* and *Phrynomantis* (see Dubois (1988) and Frost (2020)). This visually striking species, easily identifiable by the two, usually continuous broad orange to red dorsolateral bands (**Fig. 4**), was originally described by Smith (1847) based on specimens from the “country to the east and north-east of the Cape Colony”. Poynton & Broadley (1985) noted that although Smith did not provide many details regarding the type series and that the author’s material in the BMNH do not correspond exactly to the original description, the specimens BMNH 1845.5.11.131 and 1858.4.25.171–172 likely correspond to the type material of the species. The two other nominal taxa currently in synonymy are *Dendrobates inhambanensis* described by Bianconi (1849 “1848”) from the Inhambane region in Mozambique, and *Phrynomerus bifasciatus nyasalandensis*, described by Hoffman (1944) from “Chitjala, Nyasaland” [= Chitala River], in Malawi. While it is clear that Bianconi did not have access to Smith’s publication at the time he wrote the description of *Dendrobates inhambanensis* (the publications are separated by only a year – 1847 and 1848), the subspecies *nyasalandensis* was diagnosed against the nominotypical taxon on the basis of the different shape and sizes of the snout, second finger, third toe and hind limb (Hoffman 1944; Loveridge 1953). Both these taxa are unambiguously conspecific with the nominotypical form and have been considered junior synonyms by all authors that have subsequently reviewed the group (e.g. Peters 1882; Loveridge 1953; Poynton & Broadley 1985; Channing 2001; Channing & Rödel 2019; Frost 2020). The species is widely distributed in sub-Saharan Africa, ranging from Somalia through the Democratic Republic of the Congo, western Angola, central and eastern Namibia, to northeastern South Africa (Channing 2001; Channing & Rödel 2019).



Fig. 4 – Live photo of *Phrynomantis bifasciatus* from Mozambique. Photo by Harith Farooq.

In Angola, the species has been historically recorded from the western regions of the country by Boulenger (1882), Bocage (1895), Ferreira (1904) and Monard (1938). However, as noted above, Monard's (1938) specimens represent a misidentification of *P. affinis* (see above). All historical records of *P. bifasciatus* in Angola present a common characteristic that differentiates them from the majority of the specimens from the rest of the species distribution. Boulenger (1882) notes that the single specimen (BMNH 1873.7.28.14) from "Angola" (no specific locality provided, but surely from Luanda region, as it was the area where the collector was based at the time – LMPC pers. obs.) at his disposal, collected by Joachim John Monteiro, has its "upper surfaces with large round light spots" and "no light bands". This coloration pattern led Boulenger (1882) to designate the Angolan specimen as "Var. C.", contrasting with the nominotypical "Var. A" (for which Boulenger consulted Smith's type material), which has "white (or red), sometimes interrupted streak on each side of the body, beginning on the upper eyelid", "a white subtriangular or heart-shaped markings on coccygeal region", and "limbs spotted with white"; and "Var. B" (Shiré Valley and Zambeze region material), which is "similar to the preceding [Var. A], but the space between the white bands with dark and light longitudinal lines", and "markings on the legs arranged in cross bars."

This coloration difference was also noted by Bocage (1895) on the two specimens available at the time in the Lisbon Museum collections, one specimen from "Quissange" (-12.43333°, 14.0500°, 870 m above sea level) and another from "Benguela", both in

Benguela Province. According to the author the specimen from Quissange “belongs” to Boulenger’s (1882) “var. C”, and presented a “dark dorsal coloration, with large white or yellow spots in the dorsum and the limbs but lacking the longitudinal lines of the typical form, the throat, the chest and well as the posterior part of the thighs and the underside of the legs brown, speckled with chestnut-white, the abdomen greyish with dark markings, and the upper side of the limbs the same color as the dorsal coloration” [translation by the authors from the original in French]. Regarding the specimen from Benguela, Bocage (1895) noted that the “upper parts” exhibited no lines or spots, had a reddish-brown background, brighter and finely dotted with brown in the head region and dorsum, paler and uniform on the sides, with small brown spots on the upper sides of the limbs; the undersides of brownish-grey, without any markings” [translation by the authors from the original in French]. This latter specimen was illustrated in a plate (Bocage 1895; **Fig. 5**). These two specimens were lost in the fire that destroyed the Lisbon museum in 1978.



Fig. 5 – Plate with the illustrations of Angolan *Phrynomantis bifasciatus* from Bocage’s (1895) *Herpétologie d’Angola et du Congo*. Adapted from Bocage (1895).

Later, Ferreira (1904) reported on an adult specimen “of Boulenger’s Var. C” from “Chingo (Novo Redondo)” [= Chingo, in Sumbe district, formerly Novo Redondo district], Kwanza Sul Province, Angola collected by Francisco Newton in 1903. According to the author, the specimen had the gular region “strongly” darkly pigmented, and all the other characters were in accordance with Boulenger’s description. This specimen is still extant

in the collections of the Museu de História Natural e da Ciência da Universidade do Porto (MHNCUP), Porto (Portugal), under the accession number MHNCUP/ANF-194 (**Fig. 6**).



Fig. 6 – Specimen of *Phrynomantis* cf. *bifasciatus* from “Chingo (Novo Redondo)” collected by Francisco Newton in 1903 (MHNCUP/ANF-194). Photo by Bruna Santos.

More recently some photographs, putatively attributed to this species, have been published in social media networks, namely in Facebook pages dedicated to the dissemination of the biodiversity of Angola (“Biodiversidade de Angola” and “Angola Selvagem” Facebook groups). One specimen was found in the Calumbo area (-9.1499994°, 13.3991574°, 3 m above sea level), Luanda Province, in June 2019. The specimen was not collected but was photographed while still alive (**Fig. 7**), and it shows the same type of coloration pattern as those described by previous authors for the Angola population of *P. bifasciatus*. In 24 April 2020, another specimen was also found in the Luanda neighborhood of Benfica (-8.972175°, 13.142503°, 18 m above sea level), Luanda Province, in 24 April 2020. This specimen was also not collected but it was photographed (**Fig. 8**) and it also presents the same coloration pattern.



Fig. 7 – Live photo of *Phrynomantis* cf. *bifasciatus* from Calumbo region, near Luanda. Specimen photographed in June 2019, but not collected. Photo by Manuel Castanho.



Fig. 8 – Live photo of *Phrynomantis* cf. *bifasciatus* from Benfica neighborhood, city of Luanda. Specimen photographed in 24 April 2020, but not collected. Photo by Eduardo Catumbela.

Currently there is no available phylogeny including all the members of the genus, and a full and detailed taxonomic treatment of the genus is also lacking. The most recent summary on the morphology and diagnostic characters of species of the genus was provided in the recent field guide on African amphibians provided by Channing & Rödel (2019). As noted by these authors the main way to differentiate *Phrynomantis* species, besides molecular data and probably vocalizations, is through their color patterns and distribution ranges. Other characters, such as the shape and proportions of the body and the presence or absence of enlarged disks on the terminal part of the finger- and toe-tips, are also important to diagnostic characters. In the light of the distinctive coloration pattern and considerable geographic distance of the Angolan population of *P. bifasciatus* from the closest records of the species in Zambia and northern Namibia, we consider that the Angolan population as a distinct taxon that we describe herein.

Materials & Methods

For comparisons we examined 54 specimens (see **Table 1**) of *Phrynomantis* sp. deposited in the California Academy of Sciences (CAS), San Francisco, USA; American Museum of Natural History (AMNH), New York, USA; Florida Museum of Natural History (UF), Gainesville, USA; the Natural History Museum (BMNH), London, UK, the Royal Museum for Central Africa (RMCA), Tervuren, Belgium; the Musée d'Histoire Naturelle de La Chaux-de-Fonds (MHNC), La Chaux-de-Fonds, Switzerland; Instituto Nacional da Biodiversidade e Áreas de Conservação (INBAC/AMB), Kilamba-Kiaxi, Angola; Museu Regional do Dundo (MD), Dundo, Angola; and the Museu de História Natural e da Ciência da Universidade do Porto (MHNCUP), Porto, Portugal. Information on morphological characters of species and/or type material that could not be examined, as well as supplementary data for the species of the genus was obtained in the relevant literature (Passmore & Carruthers 1979; Poynton & Broadley 1985; Auerbach 1987; Lambiris 1989; Channing 2001; Pickersgill 2007; Channing & Howell 2006; Spawls *et al.* 2006; Farook *et al.* 2014; Channing & Rödel 2019). In order to check the coloration patterns of the different species across its known distribution, we also checked the research grade records of the genus *Phrynomantis* published on the online platform iNaturalist (www.inaturalist.org; (GBIF 2020).

Relevant specimens were measured with a digital caliper and coloration patterns were noted. The following measurements (following Watters *et al.* 2016) were taken (to the nearest 0.1 mm): snout-vent length (SVL); head width (HW) at the widest point/angle of the jaws; head length (HL) from the posterior of the jaws to the tip of the snout; snout

length (SL) from the tip of the snout to the anterior corner of the eye; interorbital distance (IOD) as the shortest distance between the anterior corners of the orbits; internarial distance (IND) as the shortest distance between the inner margins of the nostrils; eye-nostril distance (EN) from the anterior corner of the eye to the posterior margin of the nostril; eye diameter (ED) horizontally from the anterior to posterior corner of the eye; upper eyelid width (UEW) as the greatest width of the upper eyelid margins; forearm length (FLL) from the flexed elbow to the base of the outer palmar tubercle; hand length (HAL) from the base of the outer palmar tubercle to the tip Finger IV; Finger IV disk width (Fin4DW) as the widest horizontal diameter of Finger IV; tibia length (TL) as the distance from the outer surface of the flexed knee to the heel; thigh length (THL) as the distance from the vent to the knee; and foot length (FL) from the base of the inner metatarsal tubercle to the tip of Toe IV. Locality data are reported in the form of decimal degrees and use the WGS 84 map datum. Older (non-GPS) records are mostly derived from Marques *et al.* (2018) and have been georeferenced using GEOLocate web application (<http://www.geo-locate.org>). Elevations are all reported as meters above sea level.

Table 1 – Specimens used for morphological and coloration comparisons.

Taxon	Accession number	Locality
<i>Phrynomantis affinis</i>	MD 5726	ANGOLA: Lake Calundo region (-11.80°, 20.86°, 1119 m), Moxico Province
<i>Phrynomantis affinis</i>	MHNC 90.001–90.002	ANGOLA: Mulondo (-15.6479158°, 15.1955508°, 1158 m), Huíla Province
<i>Phrynomantis annectens</i>	RMCA B.469	ANGOLA: Benguela (-12.5833°, 13.41667°, 15 m), Benguela Province
<i>Phrynomantis annectens</i>	CAS 263085–263088; UF 187252–187279; INBAC/AMB 10058, 10060–10064, 10078	ANGOLA: Chimalavera Nature Reserve, Waterhole (-12.79168°, 13.12738°, 225 m), Benguela Province
<i>Phrynomantis annectens</i>	CAS 255056	ANGOLA: Omauha Lodge (-16.19872°, 12.40008°, 338 m), Namibe Province

<i>Phrynomantis annectens</i>	AMB 11353, 11354; INBAC/AMB 11355	ANGOLA: Maungo Dam (-14.57922°, 12.68057°, 549 m), Namibe Province
<i>Phrynomantis annectens</i>	UF 187250–187251; INBAC/AMB 10344	ANGOLA: Dolondolo (-13.81328°, 13.13618°, 681 m) Namibe Province
<i>Phrynomantis annectens</i>	LMPC 1149	ANGOLA: Malowe (-13.83424°, 13.27669°, 803 m)), Namibe Province
<i>Phrynomantis annectens</i>	BMNH 1845.5.11.131; 1858.4.25.171–172 (syntypes)	SOUTH AFRICA: “South Africa” [without specific locality]
<i>Phrynomantis newtoni</i> sp. nov.	MHNCUP/ANF-194 (holotype)	ANGOLA: Chingo (-11.2°, 13.85°, 11 m a.s.l.), Kwanza Sul Province
<i>Phrynomantis newtoni</i> sp. nov.	BMNH 1873.7.28.14	ANGOLA: “Angola” [without specific locality]

Results

Angolan *Phrynomantis* belong to three separate species – *P. affinis*, *P. annectens* and a new species, historically referred as *P. bifasciatus*. The three taxa of *Phrynomantis* occurring in Angola differ from each other and for other African species, in several consistent morphological and coloration characters, and they are identified through the key presented below. Our results support the observations of all the other authors who previously dealt with Angolan population of *P. bifasciatus* (Boulenger 1882; Bocage 1895; Ferreira 1904). All Angolan specimens present a distinct coloration pattern that allows it to be differentiated from the nominotypical form, as well as from most of its congeners. This pattern consists of large irregular yellowish, red or silver blotches, sometimes arranged in the appearance of an interrupted dorsolateral band, whereas, despite some slight variation, all the specimens of *P. bifasciatus* from across its known distribution in Northern Namibia Botswana, Zambia, Zimbabwe, South Africa, Mozambique, Tanzania and Kenya, almost always exhibit two well marked and uninterrupted orangish to reddish dorsolateral bands (GBIF 2020). Even in the very few cases where these bands are slightly interrupted, the band is always quite conspicuous, contrary to the Angolan population, where there is never a complete band. The Angolan

population is therefore here described as a new species – *Phrynomantis newtoni* **sp. nov.** Consequently, *P. bifasciatus* is excluded from the list of currently known species for the country. A detailed differential diagnosis of the newly described species and its congeners is presented in the systematic account below. Our reexamination of historical specimens, namely those cited by Monard (1938), resulted in a second record and considerable range extension of *P. affinis* in the country. Newly collected specimens of *P. annectens* contribute to knowledge of the species' distribution range with additional records in the southwestern areas of the country.

Key to the genus *Phrynomantis*. Asterisks (*) denotes the presence of the species in the Angola.

- 1a) Dorsal pattern consisting on two continuous broad orange to red dorsolateral bands from the snout to the hind limbs *P. bifasciatus*
- 1b) Dorsal pattern without continuous broad dorsolateral bands 2
- 2a) Dorsal pattern entirely red, sometimes with a fine median black line *P. microps*
- 2b) Dorsal pattern consisting of spots or blotches 3
- 3a) Tips of fingers not expanded, dorsal pattern of small consisting of small spots
..... *P. affinis**
- 3b) Tips of fingers expanded, dorsal pattern consisting in irregular blotches 4
- 4a) Tips of the fingers expanded forming large rounded disks *P. newtoni* **sp. nov.***
- 4b) Tips of fingers expanded forming small truncated disks 5
- 5a) Dorsal coloration marbled with large, irregular-shaped silver, golden, yellow, orange, pink, or red spots on dark background *P. annectens**
- 5b) Dorsal coloration consisting on discontinuous dorsolateral bands, composed of irregular blotches, starting on the snout and extending to the hind limbs *P. somalicus*

Systematics

(Amphibia: Anura: Mycrohilidae)

***Phrynomantis newtoni* sp. nov.**

(Figs. 6–8)

Phrynomantis bifasciata [part]: Boulenger (1882: 173), Bocage (1895: 181, Plate XVIII figure 3).

Phrynomantis bifasciatus: Ferreira (1904: 113), Marques *et al.* (2018: 80), Baptista *et al.* (2019: 273)

Holotype. MHNCUP/ANF-194 (old catalogue number MHNFCUP 127327; Fig. 6), male adult, from Chingo (−11.2°, 13.85°, 11 m), Kwanza Sul Province, Angola, collected by Francisco Newton around May to July 1903.

Additional specimen. One specimen: BMNH 1873.7.28.14, unsexed adult without precise locality (“Angola”), Angola, collected by Joachim John Monteiro on an unknown date.

Diagnosis. *Phrynomantis newtoni* **sp. nov.** has small, short, blunt-head, and an elongated, slightly pear-shaped body. Like all members of the genus, it has a smooth, rubber-like dorsal skin. It can be distinguished from other members of the genus by the following combinations of characters: 1) having a dorsal pattern consisting of large irregular yellowish, red or silver blotches, sometimes arranged in the appearance of an interrupted dorsolateral band; 2) having the tips of fingers expanded into large disks; 3) having a ventral coloration mottled with dark markings; 4) throat dark in males.

Description of the holotype. Small (SVL 41.1 mm), elongated and pear-shaped bodied male, with slender limbs (Fig. 6); head blunt, wider (HW 13.5 mm) than long (HL 10.4 mm); snout projecting beyond upper jaw (SL 4.5 mm); eyes projecting laterally beyond the eyelids and approximately flush with margins of head in dorsal view; eye not projecting about above dorsal margin of head in lateral view (UEW 1.6 mm); interorbital distance 1.2 times eye diameter; pupil large and round; loreal region concave; naris small; round, directed dorsolaterally; canthus rostralis short; eye diameter (ED 3.7 mm) 1.15 times eye-narial distance (EN 3.2 mm); eye diameter (ED 3.7 mm) 0.8 times naris to rostral tip; internarial region bumpy; interorbital distance (IOD 4.3 mm) approximately

two times internarial distance (IND 2.3 mm), tympanum extremely minute. Skin of the limbs, dorsal and dorsolateral surface of head and body smooth, rubber-like. Skin of venter leathery; skin of gular region smooth.

Limbs (FLL 11.2 mm; HAL 11.7 mm; TL 12.9 mm; THL 12.9 mm; FL 13.6 mm) and digits well developed; digits of both manus and pes stout; relative length of fingers: $III > II > IV = I$; finger tips largely expanded forming disks; fingers with rounded, prominent subarticular tubercles, two palmar tubercles distinct and well separated from one another, one at ventromedial surface of first finger and other at proximal plantar surface, latter being about two times larger than first; webbing between manual digits absent; relative length of toes $IV > V = III > II > I$; toe tips expanded forming disks; toes with prominent, single subarticular tubercles; webbing between toes absent; prominent inner metatarsal tubercle, length 40% of first toe length.

Dorsal coloration consisting of large irregular cream blotches arranged in the appearance of an interrupted dorsolateral band, on a dark-brown background; a large irregular blotch above vent; smaller cream blotches on the upper and lateral sides of the limbs; venter and ventral side of the limbs marbled with dark marking on a cream background, throat dark; palm of hands and feet homogenous gray.

Photos of live specimens (see previous figures) agree entirely with the holotype, but blotches sometimes show a more reddish to orangish coloration.

Comparison with other species of the genus. Comparing *P. newtoni* **sp. nov.** with *P. bifasciatus*, the newly described species can be easily distinguished by having a dorsal pattern consisting of large irregular yellowish, red or silver blotches, sometimes arranged in the appearance of an interrupted dorsolateral band (*versus* dorsal pattern consisting on two continuous broad orange to red dorsolateral bands from the snout to the hind limbs in *P. bifasciatus*, (see Passmore & Carruthers 1979; Poynton & Broadley 1985; Auerbach 1987; Lambiris 1989; Channing 2001; Pickersgill 2007; Channing & Howell 2006; Spawls *et al.* 2006; Farook *et al.* 2014; Channing & Rödel 2019; see Fig. 4). Comparing *P. newtoni* **sp. nov.** with *P. affinis*, the newly described species can be easily distinguished by having a dorsal pattern consisting of large irregular blotches (*versus* small orange or red spots in *P. affinis*) and by having the tips of fingers expanded into disks (*versus* tips enlarged but not forming disks in *P. affinis*). Comparing it with *P. annectens*, the newly described species can be easily distinguished by its larger blotches, having the tips of fingers expanded into large disks (*versus* tips of fingers expanded forming small truncated disks in *P. annectens*, see Fig. 2b) and by having a

venter coloration mottled with dark markings (*versus* venter homogeneous pinkish-brown without spots in *P. annectens*). Comparing it with *P. microps*, the newly described species can be easily distinguished by having a dorsal pattern consisting of large irregular blotches (*versus* a dorsal pattern entirely red, sometimes with a fine median black line in *P. microps*). *P. newtoni* **sp. nov.** can be distinguished from *P. somalicus* by having the tips of fingers expanded into large disks (*versus* tips of fingers expanded forming small truncated disks in *P. somalicus*). With exception of *P. annectens* (and possibly *P. affinis*), the distribution of the newly described species does not overlap and is widely separated by 1200 to 1300 km from the remaining species.

Distribution. The species is known from low elevation (below 20 m a.s.l.) in the coastal areas of southern and central Angola, from Benguela to Luanda Province (**Fig. 9**). We tentatively accept the identification of the Quissange specimen cited by Bocage as representative of Boulenger's "var. C" as a representative of a new species, but refrain to assign the Benguela specimen to any form. As both of these specimens were lost in the fire that destroyed the Lisbon collection in 1978, these identifications cannot be confirmed without newly collected material from the same areas.

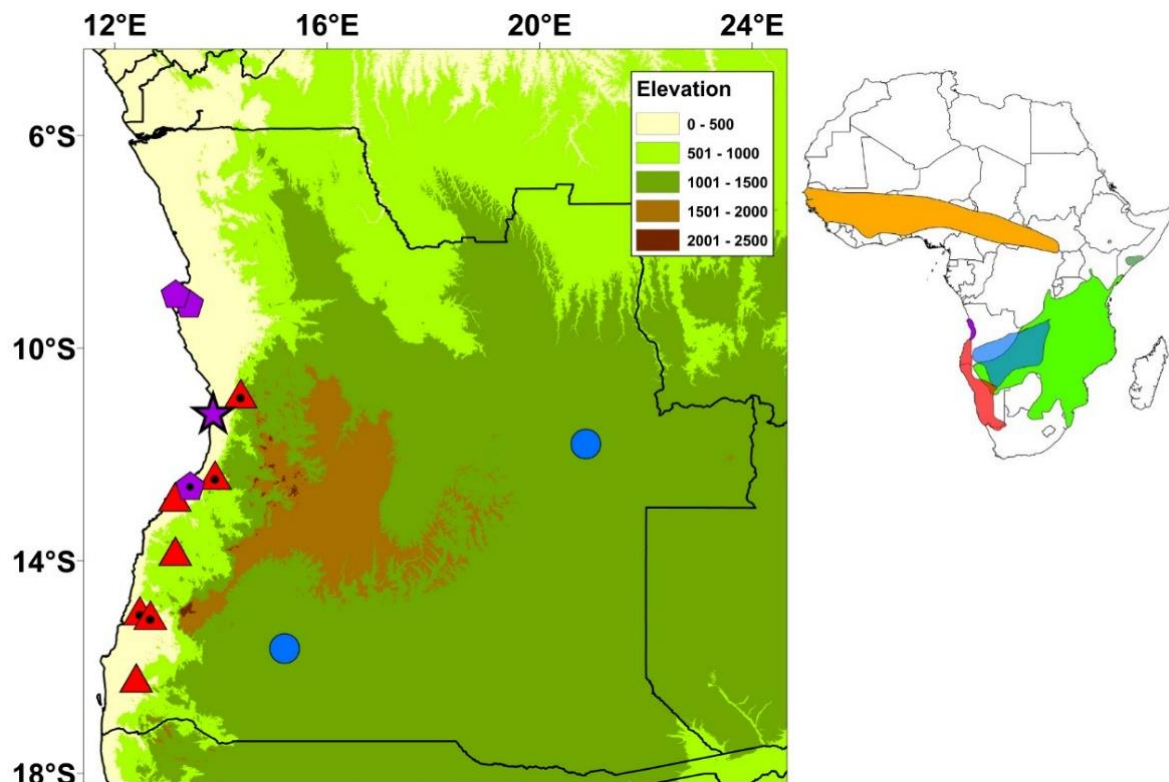


Fig. 9 – Distribution map of the three species of *Phrynomantis* in Angola and general distribution of the species in Africa. Blue circles: confirmed records of *P. affinis*; Open red triangles: confirmed records of *P. annectens*; Dotted red triangles: historical records of *P. annectens*; Open purple pentagons: confirmed records of *P. newtoni* **sp. nov.**; Dotted purple pentagon: historical records possibly referring to *P. newtoni* **sp. nov.**; Purple star: Type locality of *P. newtoni* **sp.**

nov. Historical records from Marques *et al.* (2018), confirmed records from this paper (Table 1). In the general map, blue: *P. affinis*; red: *P. annectens*; bright green: *P. bifasciatus*; orange: *P. microps*; purple: *P. newtoni* **sp. nov.**; dark green: *P. somalicus*.

Habitat and Natural History notes. The dominant habitats where the specimens have been collected, is a typical western Angolan savannah, with sandy soils dominated by *Adansonia digitata*, *Euphorbia conspicua*, *Acacia welwitschi* and *Combretum* spp., together with a good grass coverage (Grandvaux-Barbosa 1970).

Etymology. The specific epithet “*newtoni*” is formed in the genitive masculine singular and honor the Portuguese naturalist and explorer Francisco Newton (1864–1909), who collected the holotype. We propose the Portuguese common name of “Rã de Borracha de Newton”, and the English common name of “Newton’s Rubber Frog”.

Discussion

Although modern species description without the use of molecular supporting data are becoming less common due to the uncertainty surrounding the value of some morphological characters, for the case of *Phrynomantis* species, and especially for *Phrynomantis newtoni* **sp. nov.**, the available morphological data, but especially coloration patterns, are sufficiently convincing and stable to support its recognition as a separate species. This is also supported when considering the biogeographic context of its known distribution. As noted by Marques *et al.* (2018), the coastal lowlands of Angola represent an overlooked hotspot of herpetological endemism. Several species of reptiles are endemic from this region, as the case of *Hemidactylus longicephalus* Bocage, 1873, *Hemidactylus bayonii* Bocage, 1893, *Sepsina bayoni* (Bocage, 1866), *Sepsina copei* Bocage, 1873, *Agama mucosoensis* Hellmich, 1957, and *Boaedon bocagei* Hallermann *et al.* 2020 (see Marques *et al.* 2018; Ceríaco *et al.* 2020a; Hallermann *et al.* 2020). All these species have their known distributions limited by the Atlantic Ocean in the West, and the Angolan Escarpment in the East, being endemic to the thin strip of coastal lowlands that begins north of Luanda and extends south to the Namibe Province. Many of these species have their closest related relatives in the plateau regions, turning them into interesting examples of the role of the Angolan Escarpment in promoting the isolation and diversification of herpetological taxa. Due to the lack of molecular data, it is currently impossible to evaluate the phylogenetic relationship of the newly described species to the remaining members of the genus. There is currently no available phylogeny of the

genus, and therefore the intra-generic relationships are still unknown. Further surveys in Angola are needed in order to secure fresh material that allow placing the newly described species in its phylogenetic context.

The arguments that support the recognition of newly described species – its coloration pattern and geographic distribution – were retrieved from a combination of two completely different, and contrasting, data sources – modern online platforms (iNaturalist) and social media webpages (Facebook) and historical specimens housed in museum collections. This is not the first species to be described after someone had shared a photo on a social media platform. Very recently a new species of millipede fungus was described after a photo was shared on the social media network Twitter (Santamaria *et al.* 2020). As a tool used by millions of people around the world, some of the shared photos by amateurs and citizen scientists can provide important hints and serve as a source of novel data for researchers. Although these photos by themselves can never substitute for the actual specimens (Ceríaco *et al.* 2016), they can provide further evidence to augment specimen-based research.

The fact that the newly described species is described based on the study of historical specimens also highlights the importance of historical, and sometimes overlooked, natural history collections for modern biodiversity studies. As noted by Fontaine *et al.* (2014), many new species wait for decades on museum shelves until they are properly studied by competent taxonomists and subsequently described. For the case of *Phrynomantis newtoni* **sp. nov.**, the specimens were available for researchers for more than a century in the BMNH and the MHNCUP. Although the BMNH is amongst the largest natural history collections in the world, that is certainly not the case of the MHNCUP. Despite their size, small collections can have disproportionate importance (Winker & Withrow 2013). This is certainly the case of the MHNCUP collections, whose number of type specimens is considerable for its size (see Ceríaco *et al.* 2014), but also interesting and rare specimens, as the one used as the holotype of the newly described species. Within the MHNCUP collections, the specimens collected by Francisco Newton during his 1903–1905 expedition to Angola are of special relevance for the study of the herpetofauna of the whole region. This collection was studied in the past by Ferreira (1904, 1906) but was then subsequently abandoned and forgotten by the scientific community until Ceríaco *et al.* (2014) published its type catalog. The collection is currently being studied and a detailed and commented list of its specimens being prepared for publication (Santos *et al.* in prep.). Besides the description of *Phrynomantis newtoni* **sp. nov.**, other specimens are currently being used as type material for the

description of new reptile taxa (Hallermann *et al.* 2020), but the study of historical material results not only on the description of new species but also in the critical revision of previously misidentified records. These revisions have serious implications for the understanding of species distributions, which by itself has different consequences for a vast array of topics and areas, as conservation, countries checklists, species distribution model-based studies, etc. The revision of historical material allowed us to rectify the most recent available checklists for Angolan amphibians (Marques *et al.* 2018, Baptista *et al.* 2019), by adding a new endemic species for the country and taking *P. bifasciatus* from the confirmed species list, with far reaching consequences to understanding of the species distribution throughout the continent. These new data contradict the common belief that the species was likely distributed through Angola, as assumed by Ruas (1996) and subsequently accepted by Channing (2001), Marques *et al.* (2018) and Channing & Rödel (2019). However, we tentatively suggest that the species may still be found in the country, especially in the far-eastern regions of Moxico and Cuando-Cubango provinces, as there are several confirmed records of *P. bifasciatus* for Zambia and northeastern Namibia (GBIF 2020).

Acknowledgments

The present work is a result of the ongoing collaboration between the Instituto Nacional da Biodiversidade e Áreas de Conservação (INBAC) from the Ministry of Environment of Angola and its international partners. INBAC provided institutional and logistical support, as well as the necessary permits for carrying out the field surveys that led to the collection of some specimens used on this research. We thank António “Muloge” Lopes, Arianna L. Kuhn, Jens Vindum, Joyce Janota, Suzana Bandeira, Hilária Valério and Álvaro “Varito” Baptista for their support and camaraderie during field work. We want to thank to the “Angola Ambiente” Facebook group, in the person of its administrators Sara Fernandes, David Elizalde and Luis Querido for providing an important platform for sharing data and photos about Angolan biodiversity, and to Manuel Castanho and Eduardo Catumbela for allowing us to use his photo, previously published in the Facebook group. The following collection managers and curators are thanked for providing data and permission to visit and use the collections their care: Lauren Scheinberg and Erica Ely from the California Academy of Sciences (CAS); Jeff Streicher from the Natural History Museum of London (BMNH); Garin Cael from the Royal Museum for Central Africa (RMCA); Arnaud Maeder and Nicolas Margraf from the the Musée d'Histoire Naturelle de La Chaux-de-Fonds (MHNC); and Ilunga André from the Museu

Regional do Dundo (MD). This work was funded by grant from the JRS Biodiversity Foundation to AMB and David C. Blackburn. MPM is currently supported by FCT, contract SFRH/BD/129924/2017.

References

- Ahl, E. (1934) Über eine kleine Froschsammlung aus Deutsch Südwestafrika. *Zoologischer Anzeiger*, **107**: 333–336.
- Ahl, E. (1935) Beschreibung einer neuen Engmaulkröte der Gattung *Ctenophryne*. *Zoologischer Anzeiger*, **112**: 254–255.
- Auerbach, R.D. (1987) *The amphibians and reptiles of Botswana*. Gaborone (Mokwepa Consultants): 1–295.
- Baptista, N., Conadie, W., Pinto, P.V. & Branch, W.R. (2019) The Amphibians of Angola: Early Studies and the Current State of Knowledge. In: Huntley B., Russo V., Lages F., Ferrand N. (ed.), *Biodiversity of Angola, Science & Conservation: A Modern Synthesis*. Cham, Switzerland: 243–281.
- Bauer, A.M., Günther, R. & Robeck, H.E. (1996) An annotated type catalogue of the hemisotid, microhylid, myobatrachid, pelobatid and pipid frogs in the Zoological Museum, Berlin (Amphibia: Anura: Hemisotidae, Microhylidae, Myobatrachidae, Pelobatidae and Pipidae). *Mitteilungen aus dem Zoologischen Museum in Berlin*, **72**: 259–275.
- Bianconi, G.G. (1849 "1848") Lettera al Dottore Filippo De Filippi, Professore di Zoologia a Torino, sopra alcune nuove specie di Rettili del Mozambiqco. *Nuovi Annali delle Scienze Naturali, Serie 2*, **10**: 106–109.
- Bocage, J.V.B. (1866) Reptiles nouveaux ou peu connus recueillis dans les possessions portugaises de l'Afrique occidentale, que se trouvent au Muséum de Lisbonne. *Jornal de Sciencias Mathematicas, Physicas e Naturaes*, **1**: 57–78.
- Bocage, J.V.B. (1867) Segunda lista dos reptis das possessões portuguezas d'Africa occidental que existem no Museu de Lisboa. *Jornal de Sciencias Mathematicas, Physicas e Naturaes*, **3**: 217–228.
- Bocage, J.V.B. (1873) Melanges erpetologiques. II. Sur quelques reptiles et batraciens nouveaux, rares ou peu connus d'Afrique occidentale. *Jornal de Sciencias Mathematicas, Physicas e Naturaes*, **4**: 209–227.
- Bocage, J.V.B. (1895) *Herpétologie d'Angola et du Congo*. Lisbonne (Ministério da Marinha e das Colónias): i–xx, 1–203 + 19 plates
- Boulenger, G.A. (1882) *Catalogue of the Batrachia Salientia, s. Ecaudata, in the collection of the British Museum*. London (The Trustees of the British Museum): i–xvi, 1–

503 + 30 plates.

Boulenger, G.A. (1901) Batraciens nouveaux. *Annales du Musée Royal du Congo Belge. Sciences Zoologiques*, **2**: 1–14.

Branch, W.R., Conradie, W., Pinto, P.V. & Tolley, K. (2019) Another Angolan Namib endemic species: a new *Nucras* Gray, 1838 (Squamata: Lacertidae) from south-western Angola. *Amphibian & Reptile Conservation*, Special Section, **12**: 85–95.

Ceríaco, L.M.P., Blackburn, D.C., Marques, M.P. & Calado, F.M. (2014) Catalogue of the amphibian and reptile type specimens of the Museu de História Natural da Universidade do Porto in Portugal, with some comments on problematic taxa. *Alytes*, **31**: 13–36.

Ceríaco, L.M.P., Gutiérrez, E.E., & Dubois, A. [plus 493 signatories]. Photography-based taxonomy is inadequate, unnecessary, and potentially harmful for biological sciences. *Zootaxa*, **4196**: 435–445.

Ceríaco, L.M.P., de Sá, S.A.C., Bandeira, S., Valério, H., Stanley, E.L., Kuhn, A.L., Marques, M.P. & Vindum, J.V. (2018) A new earless species of *Poyntonophrynus* (Anura, Bufonidae) from the Serra da Neve Inselberg, Namibe Province, Angola. *ZooKeys*, **780**: 109–136.

<https://doi.org/10.3897/zookeys.780.25859>

Ceríaco, L.M.P., Agarwal, I., Marques, M.P., & Bauer, A.M. (2020a) A review of the genus *Hemidactylus* Goldfuss, 1820 (Squamata: Gekkonidae) from Angola, with the description of two new species. *Zootaxa*, **4746**: 1–71.

<https://doi.org/10.11646/zootaxa.4746.1.1>

Ceríaco, L.M.P., Agarwal, I., Marques, M.P., & Bauer, A.M. (2020b) A correction to a recent review of the genus *Hemidactylus* Goldfuss, 1820 (Squamata: Gekkonidae) from Angola, with the description of two additional species. *Zootaxa*,

Ceríaco, L.M.P., Heinicke, M.P., Parker, K.L., Marques, M.P. & Bauer, A.M. (2020c) A review of the African snake-eyed skinks (Scincidae: *Panaspis*) from Angola, with the description of a new species. *Zootaxa*, **4747**: 77–112.

<http://doi.org/10.11646/zootaxa.4747.1.3>

Channing, A. (2001) *Amphibians of Central and Southern Africa*. Ithaca, New York (Cornell University Press): i–x, 1–470+ 24 pls.

Channing, A. & Howell, K.M. (2001) *Amphibians of East Africa*. Ithaca, New York (Cornell University Press): i–xi, 1–432 + 24 pls.

Channing, A., and Rödel, M.-O. (2019) *Field Guide to the Frogs & Other Amphibians of Africa*. Cape Town, South Africa (Struik Nature): 1–408.

Conradie, W., Branch, W.R., Measey, G.J., & Tolley, K.A. (2012a) A new species of *Hyperolius* Rapp, 1842 (Anura: Hyperoliidae) from the Serra da Chela mountains, south-western Angola. *Zootaxa*, **3269**: 1–17.

<https://doi.org/10.11646/zootaxa.3269.1.1>

Conradie, W., Measey, G.J., Branch, W.R., & Tolley, K.A. (2012b) Revised phylogeny of African sand lizards (*Pedioplanis*), with the description of two new species from south-western Angola. *African Journal of Herpetology*, **61**: 91–112.

<https://doi.org/10.1080/21564574.2012.676079>

Conradie, W., Branch, W.R., & Tolley, K.A. (2013) Fifty shades of grey: giving colour to the poorly know Angolan Ashy reed frog (Hyperoliidae: *Hyperolius cinereus*), with the description of a new species. *Zootaxa*, **3635**: 201–223.

<https://doi.org/10.11646/zootaxa.3635.3.1>

Conradie, W., Deepak, V., Keates, C., & Gower, D.J. (2020) Kissing cousins: a review of the African genus *Limnophis* Gunther, 1865 (Colubridae: Natricinae), with a description of a new species from northern Angola. *African Journal of Herpetology*

<https://doi.org/10.1080/21564574.2020.1782483>

Dubois, A. (1988) Miscelanea nomenclatorica batrachologica (XVII). *Alytes* **7**: 1–5.

Farook, H., Morgado, F.M.R., & Soares, A. (2014) *Anfíbios e Répteis de Pemba*. Porto (Afrontamento): 1–112.

Fontaine, B., Perrard, A. & Bouchet, P. (2014) 21 years of shelf life between discovery and description of new species. *Current Biology*, **22**, R943–R944.

<https://doi.org/10.1016/j.cub.2012.10.029>

Ferreira, J.B. (1904) Reptis e amphibios de Angola da região ao norte do Quanza (Collecção Newton – 1903). *Jornal de Sciencias Mathematicas, Physicas e Naturaes, Segunda Série*, **7**: 111–117.

Ferreira, J.B. (1906) Algumas espécies novas ou pouco conhecidas de amphibios e reptis de Angola (Collecção Newton – 1903). *Jornal de Sciencias Mathematicas, Physicas e Naturaes, Segunda Série*, **7**: 159–171.

Frost, D.R. (2020) Amphibian Species of the World: an Online Reference. Version 6.1 (2002/03/17). Electronic Database. Accessible at <https://amphibiansoftheworld.amnh.org/index.php>. American Museum of Natural History, New York, USA. <https://doi.org/10.5531/db.vz.0001>

GBIF (2020) Research Grade Phrynomantis sp. records from iNaturalist website GBIF Occurrence Download (2020/07/06). Electronic Database. Accessible at <https://doi.org/10.15468/dl.n355va>

Grandvaux-Barbosa, L.A. (1970) *Carta Fitogeográfica de Angola*. Luanda (Instituto de Investigação Científica de Angola): i–xxvi, 1–323.

Hallerman, J., Ceriaco, L., Schmitz, A., Ernst, R., Conradie, W., Verburgt, L., Marques, M.P. & Bauer, A.M. (2020) A review of the Angolan House snakes, genus *Boaedon* Duméril, Bibron & Duméril (1854) (Serpentes: Lamprophiidae), with description of three new species in the *Boaedon fuliginosus* (Boie, 1827) species complex. *African Journal of Herpetology*. <https://doi.org/10.1080/21564574.2020.1777470>

Hellmich, W. (1957) Herpetologische Ergebnisse einer Forschungsreise in Angola. *Veröffentlichungen der Zoologischer Staatssammlung München*, **5**: 1–91.

Hoffman, A.C. (1944) Frogs from Chititala, Nyasaland, together with description of new species. *Soölogiese Navorsing van die Nasionale Museum, Bloemfontein*, **1**: 173–182.

Huntley, B, Russo, V., Lages & Ferrand, N. (2019) *Biodiversity of Angola, Science & Conservation: A Modern Synthesis*. Switzerland (Springer, Cham/ Springer Nature Switzerland AG): i–xviii, 1–549.

Lambiris, A.J.L. (1989) *The frogs of Zimbabwe. Monografia X*. Torino (Museo Regional di Scienze Naturali Torino): 1–200 + 24 pls.

Laurent, R.F. (1964) Subsídios para o estudo da biologia na Lunda. Reptiles et Amphibiens de l'Angola (Troisième contribution). *Publicações Culturais. Companhia de Diamantes de Angola, Lisboa*, **67**: 1–165.

Loveridge, A. (1936) African reptiles and amphibians in Field Museum of Natural History. *Field Museum of Natural History Publication, Zoological Series*, **22**: 1–111.

- Loveridge, A. (1953) Zoological results of a fifth expedition to East Africa. IV. Amphibians from Nyasaland and Tete. *Bulletin of the Museum of Comparative Zoology, Cambridge, Massachusetts*, **110**: 325–406.
- Marques, M.P., Ceríaco, L.M.P., Blackburn, D.C. & Bauer, A.M. (2018) Diversity and distribution of the amphibians and terrestrial reptiles of Angola. Atlas of historical and bibliographic records (1840–2017). *Proceedings of the California Academy of Sciences, 4th Series*, **65** (Suppl. II): 1–501.
- Marques, M.P., Ceríaco, L.M.P., Stanley, E.L., Bandeira, A.S., Agarwal, I. & Bauer, A.M. (2019a) A new species of Girdled Lizard (Squamata: Cordylidae) from the Serra da Neve Inselberg, Namibe Province, southwestern Angola. *Zootaxa*, **4668**: 503–524. <https://doi.org/10.11646/zootaxa.4668.4.4>
- Marques, M.P., Ceríaco, L.M.P., Bandeira, S., Pauwels, O.S.G., Bauer, A.M. (2019b) Description of a new long-tailed skink (Scincidae: *Trachylepis*) from Angola and the Democratic Republic of the Congo. *Zootaxa*, **4568**: 51–68. <http://dx.doi.org/10.11646/zootaxa.4568.1.3>
- Marques, M.P., Ceríaco, L.M.P., Buehler, M.D., Bandeira, S.A., Janota, J.M. & Bauer, A.M. (2020) A revision of the of the Dwarf Geckos, genus *Lygodactylus* (Squamata: Gekkonidae), from Angola, with the description of three new species. *Zootaxa*, **4853**: 301–352. <http://dx.doi.org/10.11646/zootaxa.4853.3.1>
- Mertens, R. (1971) Die Herpetofauna Südwest-Afrikas. *Abhandlungen der Senckenbergischen Naturforschenden Gesellschaft*, **529**: 1–110.
- Methuen, P.A. & Hewitt, J. (1913) Records and descriptions of the reptiles and batrachians of the collection (The Percy Sladen Memorial Expedition to Great Namaqualand, 1912–1913). *Annals of the Transvaal Museum*, **4**: 1–145.
- Monard, A. (1938) Contribution à l'herpétologie d'Angola. *Arquivos do Museu Bocage*, **9**: 52–120.
- Parker, H.W. (1936) Dr. Karl Jordan's expedition to South-West Africa and Angola: Herpetological collections. *Novitates Zoologicae*, **40**: 115–146.
- Parker, H.W. (1940) Undescribed anatomical structures and new species of reptiles and amphibians. *Annals and Magazine of Natural History, Series 11*, **5**: 257–274.
- Passmore, N.I. & Carruthers, V.C. (1979) *South African Frogs*. Johannesburg (Witwatersrand University Press): 1–270.

Peters, W.C.H. (1882) *Naturwissenschaftliche Reise nach Mossambique auf Befehl seiner Majestät es Königs Friedrich Wilhelm IV. Zoologie, III. Amphibien*. Berlin(Druck und Verlang von G. Reimer). i–xv, 1–191 + 33 pls.

Pickersgill, M. (2007) *Frog Search. Results of expeditions to southern and eastern Africa*. Frankfurt (Edition Chimaira): 1–574.

Poynton, J.C., & Broadley, D.G. (1985) Amphibia Zambesiaca 1. Scolecomorphidae, Pipidae, Microhylidae, Hemisidae, Arthroleptidae. *Annals of the Natal Museum*, **26**: 503–553.

Poynton, J.C. & Haacke, W.D. (1993) On a collection of amphibians from Angola, including a new species of *Bufo* Laurenti. *Annales of the Transvaal Museum*, **36**: 9–16.

Ruas, C. (1996) Contribuição para o conhecimento da fauna de batráquios de Angola. *Garcia de Orta. Serie de Zoologia, Lisboa* **21**: 19–41.

Santamaria, S., Enghoff, H., & Reboleira, A.S. (2020) The first Laboulbeniales (Ascomycota, Laboulbeniomycetes) from an American millipede, discovered through social media. *MycKeys* **67**: 45–53.

Smith, A. (1847) *Illustrations of the Zoology of South Africa; Consisting Chiefly of Figures and Descriptions of the Objects of Natural History Collected during an Expedition into the Interior of South Africa, in the Years 1834, 1835, and 1836. Part 26*. London (Smith, Elder, & Co.)

Spawls, S., Howell, K.M., & Drewes, R.C. (2006) *Pocket guide to the reptiles and amphibians of East Africa*. London (A&C Black): 1–144.

Stanley, E.L., Ceríaco, L.M.P., Bandeira, S., Valério, H., Bates, M.F., & Branch, W.R. (2016) A review of *Cordylus machadoi* (Squamata: Cordylidae) in southwestern Angola, with the description of a new species from the Pro-Namib desert. *Zootaxa*, **4061**: 201–226.

<https://doi.org/10.11646/zootaxa.4061.3.1>

Watters, J.L., Cummings, S.T., Flanagan, R.L., & Siler, C.D. (2016) Review of morphometric measurements used in anuran descriptions and recommendations for a standardized approach. *Zootaxa*, **4077**: 477–495.

<https://doi.org/10.11646/zootaxa.4072.4.6>

Werner, F. (1910) Reptilia et Amphibia. In: Schulze, L.(ed.), Zoologische und anthropologische Ergebnisse einer Forschungsreise im westlichen und zentralen Afrika, ausgeführt in den Jahren 1903-1905 mit Unterstützung der Kgl. Preussischen Akademie der Wissenschaften zu Berlin, 4. *Denkschriften der medizinisch-naturwissenschaftlichen Gesellschaft zu Jena* 16: 279–370.

Winker, K. & Withrow, J. (2013) Small collections make a big impact. *Nature*, **493**: 480.
<https://doi.org/10.1038/493480b>

Zweifel, R.G. (1989) Identity of a supposed South American microhylid frog. *Copeia*, **1989**: 229–231.

Final considerations

Natural history museums have been reporting funding cutbacks ever since 1988 (Bourne 1988; Dupérré 2020). Despite their pivotal role in the conservation of species and the assessment of how they have evolved and adapted through time (Shaffer *et al.* 1998; Hendrik *et al.* 2020), there has been a severe lack of investment in recent years that has majorly hindered their existence (Dupérré 2020). Additionally, catastrophic events like the 1978 MBL fire and the more recent burning of the Museu Nacional (Rio de Janeiro) in 2018, have caused incalculable losses to natural history.

The panorama in Portugal was no different from the rest of the world. As time went by, natural history museums went through periods of greater and lesser investment from the government, as their importance would vary depending on who was running the country at the time. MHNC-UP is a classic example of abandonment in a natural history museum. After its inception in late nineteenth century, it went through several stages of investment followed by disinterest and abandonment, much like what was happening in other institutions in the country (Ceríaco *in press*). Due to the cyclic instability, its collections were for the major part never properly cared for or investigated, and much of what remained unstudied has been the focus of recent works. This dissertation is one step further into the renewal of the museum and the new wave of investigation. It has shown that MHNC-UP still has interesting material to be reassessed and that in a project lasting only a year and a half it was possible to uncover and reconstruct an expedition, review an entire collection and even describe a new species.

Natural history museums don't exist merely to display and preserve collections (Lourenço & Dias 2017). A strong research aspect has always been associated with their existence, namely their traditional role of public education and taxonomic studies (Watanabe 2019). They are the time capsules that allow us to look into the past and better predict future changes. Scientific knowledge is not stagnating, and as new discoveries are made and new technologies brewed, it is important to revisit collections that have been deposited centuries ago in these repositories, whether or not they were previously published. Those records need to be rechecked and updated according to what is currently known about the subject. In the case of taxonomy, many specimens have been wrongly identified or their taxonomic designation has since changed. Their reassessment could prove critical in the description of new species, as shown here and in other recent works like Hallermann *et al.* (2020).

Scientific expeditions have been carried out since the eighteenth century. The resulting collections are of special importance to taxonomic research, as well as the reconstruction of the history of science. They are the core of many museums all around the world and have provided a timeline for the distribution of species, as well as of course, served as a base for their initial descriptions. Since then, a lot has changed in the world of taxonomy and thousands of those species have been further studied. The preservation of such specimens and collections is essential moving forward, as technology evolves and new methods of analysis are created every year. Understanding how science was done in the early days of natural history, will grant us a special view on how specimens were preserved and how we can better retrieve information for future studies.

References of Main Introduction

Ceríaco, L.M.P. (*in press*) Zoologia e Museus de História Natural em Portugal (Séculos XVIII – XX). Editorial da Universidade de São Paulo, São Paulo, Brazil.

Ceríaco, L.M.P., Blackburn, D.C. Marques, M.P., Calado, F.M. (2014) Catalogue of the amphibian and reptile type specimens of the Museu de História Natural da Universidade do Porto in Portugal, with some comments on problematic taxa. *Alytes*, 31, 13–36.

Dupérré, N. (2020) Old and new challenges in taxonomy: what are taxonomists up against? *Megataxa*, 001 (1), 059–062.

Ferreira, J.B. (1904) Reptis e Amphibios de Angola da Região ao Norte do Quanza (Collecção Newton – 1903). *Jornal de Sciencias Mathematicas, Physicas e Naturaes*, Segunda Série, 7 (26), 111–117.

Ferreira, J.B. (1906) Algumas especies novas ou pouco conhecidas de Amphibios e Reptis de Angola (Colecção Newton – 1903–1904). *Jornal de Sciencias Mathematicas, Physicas e Naturaes*, Segunda Série, 7 (27), 159–171.

Huntley, B.J., Russo, V., Lages, F. & Ferrand, N. (2019) *Biodiversity of Angola. Science & Conservation: A Modern Synthesis*. Springer, Cham, Switzerland. XVIII + 549 pp.

ICZN (1999) International Code of Zoological Nomenclature. Fourth edition. International Trust for Zoological Nomenclature, London, U.K. Available from: <http://www.iczn.org/iczn/index.jsp> (Accessed 25 September 2020)

Marques, M.P., Ceríaco, L.M.P., Blackburn, D.C. & Bauer, A.M. (2018) Diversity and distribution of the amphibians and terrestrial reptiles of Angola atlas of historical and bibliographic records (1840–2017). *Proceedings of the California Academy of Sciences*, Series 4, 65 (Supplement 2), 1–501.

Nobre, A. (1905) Molluscos terrestres e fluviaes da exploração de Francisco Newton em Angola. *Annaes de Sciencias Naturaes*, 9, 103–118.

Nobre, A. (1945) *Leça da Palmeira. Recordações e estudos de há sessenta anos*. Gráfica Augusto Costa, Porto. 292 pp + 7.

Ponder, W.F., Carter, G.A., Flemons, P. & Chapman, R.R. (2001) Evaluation of Museum Collection Data for Use in Biodiversity Assessment. *Conservation Biology*, 15 (3), 648–657.

Seabra, A.F. (1905a) Mamíferos e aves da exploração de F. Newton em Angola. *Jornal de Sciencias Mathematicas, Physicas e Naturaes*, 7 (26), 103–110.

Seabra, A.F. (1905b) Aves de Angola da exploração de F. Newton. *Jornal de Sciencias Mathematicas, Physicas e Naturaes*, Segunda Série, 7 (26), 118–128.

Seabra, A.F. (1905c) Aves da exploração de Fr. Newton em Angola. Subsídios para o conhecimento da distribuição geográfica das aves d'Africa Occidental. *Annaes de Sciencias Naturaes*, IX, 153–159.

Seabra, A.F. (1906a) A propósito de algumas espécies de Microchiropteros d'Angola. *Annaes de Sciencias Naturaes*, X, 81–82.

Seabra, A.F. (1906b) Ribeirinhas e Palmípedes das margens do Rio Cunene. *Annaes de Sciencias Naturaes*, X, 83–90.

Seabra, A.F. (1906c) Aves de Porto Alexandre. *Jornal de Sciencias Mathematicas, Physicas e Naturaes*, Segunda Série, 7 (27), 143–148.

Seabra, A.F. (1907) Sur quelques Oiseaux d'Angola envoyés par Francisco Newton. Contribution à l'étude de la distribution géographique des Oiseaux de l'Afrique Occidentale. *Bulletin de la Société Portugaise des Sciences Naturelles*, I, 41–45.

Seabra, A.F. (1909) Note sur quelques mammifères de l'Afrique occidentale capturés par Fr. Newton en 1905 et appartenant au muséum d'histoire naturelle de Porto. *Annaes Scientificos da Academia Polytechnica do Porto*, IV, 218–220.

Suarez, A.V. & Tsutsui, N.D. (2004) The Value of Museum Collections for Research and Society. *BioScience*, 54 (1), 66–74.

References of Final considerations

- Bourne, W.R.P. (1988) Cuts at the British Museum (NH). *Nature*, 333, 292.
- Ceríaco, L.M.P. (*in press*) Zoologia e Museus de História Natural em Portugal (Séculos XVIII – XX). Editorial da Universidade de São Paulo, São Paulo, Brazil.
- Dupérré, N. (2020) Old and new challenges in taxonomy: what are taxonomists up against? *Megataxa*, 001 (1), 059–062.
- Hallermann, J., Ceríaco, L.M.P., Schmitz, A., Ernst, R., Conradie, W., Verburgt, L., Marques, M.P. & Bauer, A.M. (2020) A review of the Angolan House snakes, genus *Boaedon* Duméril, Bibron and Duméril (1854) (Serpentes: Lamprophiidae), with description of three new species in the *Boaedon fuliginosus* (Boie, 1827) species complex. *African Journal of Herpetology*, 1–50.
- Hendrik, B.P., Heberling, J.M., Meineke, E.K., Turner, K.G., Grassa, C.J., Park, D.S., Kennedy, J., Clarke, J.A., Cook, J.A., Blackburn, D.C., Edwards, S.V & Davis, C.C. (2020) Digitization and the Future of Natural History Collections. *BioScience*, 70 (3), 243–251.
- Lourenço, M.C. & Dias, J.P.S. (2017) “Time Capsules” of Science: Museums, Collections, and Scientific Heritage in Portugal. *Isis*, 108 (2), 390–398.
- Shaffer, H.B., Fisher, R.N. & Davidson, C. (1998) The role of natural history collections in documenting species declines. *Trends in Ecology & Evolution*, 13 (1), 27–30.
- Watanabe, M.E. (2019) The Evolution of Natural History Collections: New research tools move specimens, data to center stage. *BioScience*, 69 (3), 163–169.