

https://dspace.org/

A morphological study of phlebotomine sandflies and their role in the transmission of human leishmaniasis, with special reference to Namibia

Davidson, Ian Hugh

2015-02-20
http://hdl.handle.net/10539/17033

Downloaded from a DSpace repository. https://dspace.org/

A MORPHOLOGICAL STUDY OF PHLEBOTOMINE SANDFLIES AND THEIR ROLE IN THE TRANSMISSION OF HUMAN LEISHMANIASIS, WITH SPECIAL REFERENCE TO NAMIBIA.

---

by Ian Hugh Davidson

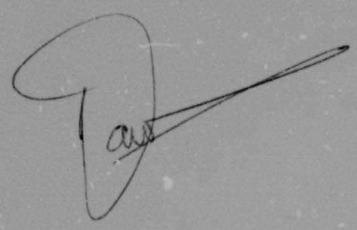
Dissertation submitted to the Faculty of Medicine,
University of the Witwatersrand, Johannesburg,
in fulfilment of the requirements for the
degree of Master of Science.

JOHANNESBURG

July 1987

DECLARATION BY **CANDIDATE**

I declare that this dissertation is my own work and that it has not been submitted for any degree to any other university. Throughout this study I have been an employee of the South African Institute for Medical Research.



I H DAVIDSON

July 1987

ABSTRACT

In East Africa and Namibia leishmaniases are transmitted by sandflies belonging to the subgenus **Synphlebotomus**.

The diagnosis of cutaneous leishmaniasis in Namibia led to the discovery of **Phlebotomus rossi**. Morphological and behavioural differences backed up by statistical analysis suggests that **P. rossi** may be more than one species. Data collected on the biology of **P. rossi** in Namibia leads to speculation on how these factors affect the transmission of the disease in nature.

This work shows that **P. martini** can be differentiated from **P. vansomerenae** and **P. celiae** but the discrimination of the latter two species is less clear.

The taxonomy of the subgenus **Sergentomyia** is revised as it has been implied that certain species in this group may confer partial immunity against infection with **Leishmania donovani**.

This dissertation is dedicated to my parents.

ACKNOWLEGEMENTS

I thank my supervisors Richard Hunt and Professor Margaretha Isaäcson for making this project possible; for without their supervision and encouragement throughout this work it may never have been completed. To Dr John Ledger (former Head of Department) who initiated the leishmaniasis research project in Namibia/SWA and who was responsible for my working on this project, I offer my thanks for his support and encouragement. I also thank Professor Arnon Gunders for his company and useful discussions during field work in Namibia and for constructive critisisms of the final draft. Thanks are also due to my colleagues Debra Gilmartin (for the competition as to who would finish first), Maureen Coetzee and Joyce Segerman, of the Department of Medical Entomology for telling me to get a move on and for assistance in various ways.

I especially thank Dr Donald Minter for his collection of **Synphlebotomus** from Kenya without which this work would not have been possible. I thank the following for access to museum material: the late Dr David Lewis, Dr Richard Lane (ex BMNH), Mr Bruce Townsend of the British Museum (Natural History), London; Professor Gisèle Vattier-Bernard and Dr Jean Trouillet

(now in Senegal) of Université Marien Ngouabi, Brazzaville for material and for hospitality during my stay with them; the USA Medical Research Unit, Nairobi, Kenya for colony material; Dr Bob Killick-Kendrick, Tony Wilkes of Imperial College, Ascot, England and Prof. J A Rioux of the Faculty of Medicine, University of Montpellier, France for the expertise, ideas and knowledge engendered whilst a guest of the Anglo/French project on **Phlebotomus ariasi**, the vector of visceral leishmaniasis in the Cévenne, France.

Computations, which are gratefully acknowledged, were carried out by the statistical department of the South African Medical Research Council.

This project was made possible by the support of Prof. J Metz, Director of the South African Institute for Medical Research, and partial funding by the South African Medical Research Council.

TABLE OF CONTENTS

		Page
Title page	.....	i
Declaration by Candidate		ii
Abstract	.....	iii
Dedication	.....	iv
Acknowledgements	.....	v
Table of Contents	.....	vii
List of Tables	.....	xiv
List of Figures	.....	xv

CHAPTER ONE

Page

GENERAL INTRODUCTION

1.1	Subsaharan Leishmaniases	.....	1
1.2	Resumé of Leishmaniasis in Southern and East Africa	.....	2
1.2.1	Southern Africa	.....	2
1.2.2	East Africa	.....	4
1.3	Background to Phlebotomine classification	.....	7
1.3.1	Introduction	.....	7
1.3.2	Southern Africa	.....	7

Page

1.3.3 East Africa (Kenya) 11

1.4 Aims of Research 16

CHAPTER TWO

MATERIALS AND METHODS

2.1 Field techniques 17

2.1.1 Collecting sandflies 17

2.1.2 Dissection of phlebotomines 21

2.1.3 Isolation of **Leishmania** from sandflies 24

2.1.4 Age grading 25

2.2 Laboratory techniques 26

2.2.1 Deoiling 26

2.2.2 Clearing 27

2.2.3 Mounting 28

2.2.4 Ringing Agents 30

2.2.5 Cryopreservation of **Leishmania** 30

Page

CHAPTER THREE

SYSTEMATICS OF THE SYNPHLEBOTOMUS COMPLEX

3.0 Overview 32

SECTION ONE - Southern Africa

3.1 Introduction 33

3.2 Habitat preferences of

P.rossi sensu lato 35

3.3 Morphological differences 37

3.3.1 Discrepancies in the ascoid

formulae 37

3.3.2 Differences in ascoid lengths 39

3.4 Computer analysis 39

3.4.1 Discriminant Function Analysis 39

3.4.2 Results of DFA of **P. rossi s.l.** 40

3.4.3 Results of DFA of **P. rossi s.l.**

and **P. grovei** 42

3.5 Discussion 44

SECTION TWO - East Africa

3.6 Introduction 46

3.7 Methods 47

		Page
3.8	Computer analysis	51
3.9	Results of DFA of the East African **Synphlebotomus** complex	52
3.10	Taxonomy of the **Synphlebotomus** complex	55
3.11	Discussion	55

CHAPTER FOUR

SYSTEMATICS OF THE SUBGENUS SERGENTOMYIA

4.1	Introduction	57
4.2	Review of relevant morphology and terminology used	59
4.2.1	Mouthpart morphology	59
4.2.1.1	The hypopharynx	61
4.2.1.2	The mandibles	61
4.2.1.3	The cibarium	61
4.2.1.4	The labrum	62
4.2.1.5	The pharynx	64
4.2.2	Body morphology	66
4.2.2.1	Abdominal tergites	66
4.3	Differentiation of the subsaharan species groups	66
4.3.1	The "**bedfordi** group"	67
4.3.2	The "**fallax** group"	67

		Page
4.3.3	The "**schwetzi** group"	69
4.4	Systematics, species descriptions and material examined	69
4.5	Checklist to species groups and species of the subgenus **Sergentomyia** in Africa south of the Sahara	70
4.5.1	"**bedfordi** group"	70
4.5.2	"**fallax** group"	71
4.6	Explanation of terms and characters used in keys	71
4.7	Key to the species groups of the subgenus **Sergentomyia**	74
4.8	Key to the females of the **bedfordi** species group	75
4.9	Key to males of the "**bedfordi** group" ..	80
4.10	Key to females of the "**fallax** group" ..	83
4.11	Key to males of the "**fallax** group"	84
4.12	Discussion	101

CHAPTER FIVE

ECOLOGICAL ASPECTS OF CUTANEOUS LEISHMANIASIS IN SWA/NAMIBIA

5.1	Distribution of Cutaneous Leishmaniasis	103

		Page
5.2	Man	105
5.3	Vertebrate hosts	106
5.4	Sandfly vector	107
5.5	Aspects of the biology and bionomics of the sandfly vector	107
5.5.1	Introduction	107
5.5.2	Materials and methods	108
5.5.3	Dispersal parameters	110
5.5.4	Factors affecting the infection rate	113
5.5.5	Age composition	114
5.5.6	Blood feeding	121

CHAPTER SIX

CONCLUSION

6.1	Southern African ***Synphlebotomus***	123
6.2	East African ***Synphlebotomus***	123
6.3	Ecological aspects of CL in Namibia	124
6.4	Systematics of the subgenus ***Sergentomyia***	125

Page

APPENDIX ONE

CHARACTERS MEASURED FOR COMPUTER ANALYSIS 127

APPENDIX TWO

DEPOSITORIES OF MATERIAL 129

APPENDIX THREE

TAXONOMY AND MATERIAL EXAMINED OF THE
SUBGENUS **SYNPHLEBOTOMUS** 130

APPENDIX FOUR

TAXONOMY OF THE SPECIES GROUP **FALLAX** 136

REFERENCES 151

LIST OF TABLES

		Page
Table 1	Subsaharan **Leishmania** (L.) parasites causing disease in man.	3
Table 2	Comparison of data of three members of the Southern African **Synphlebotomus** group	38
Table 3	Comparison of data of three members of the East African **Synphlebotomus** group	49
Table 4	Infection rates of female **P. rossi** species B dissected during 1980 and 1981	113
Table 5	Biting behaviour of **P. rossi** species B under laboratory conditions	118
Table 6	Gravid females collected after rain	120

LIST OF FIGURES

Page

Fig. 1 Map showing the distribution of sporadic cases of VL and CL to the south of Kenya and to the north of the Zambezi river. 5

Fig. 2 Map showing the distribution of human cases of CL in SWA/Namibia and the northern Cape. The overlay maps the known distribution of the potential vector species listed ... 9

Fig. 3 Map of Kenya showing the distribution of VL and CL foci. Overlays show the distribution of the proven and potential vector species. 12

Fig. 4 Oiled cards ***in situ***. 18

Fig. 5 A4 sized freezer container with oiled cards ready for use. 18

Fig. 6 Diagram showing dissection technique used for removing the entire gut from the body

		Page
	of a sandfly	23
Fig. 7	Male terminalia of **P. rossi sensu lato**	36
Fig. 8	Male terminalia of **P. grovei**	36
Fig. 9	Histogram showing the discrimination [in both sexes] between **P. rossi** sp. A and **P. rossi** sp. B	41
Fig. 10	Computer plot showing the graphical separation of **P. rossi** sp. A, **P. rossi** sp. B and **P. grovei**	43
Fig. 11-13	Male terminalia of **P. martini**, **P. celiae** and **P. vansomerenae**	48
Fig. 14	Graphical plot [complete data set] showing the separation of **P. martini** from **P. celiae** and **P. vansomerenae**	53
Fig. 15	Graphical plot [reduced data set] showing the separation of **P. martini** from **P. celiae** and **P. vansomerenae**	54

Author Davidson I H
Name of thesis A Morphological study of Phlebotomine Sandflies and their role in the transmission of Human Leishmaniasis with special reference to Namfbia 1987

PUBLISHER:
University of the Witwatersrand, Johannesburg
©2013

LEGAL NOTICES:

Copyright Notice: All materials on the University of the Witwatersrand, Johannesburg Library website are protected by South African copyright law and may not be distributed, transmitted, displayed, or otherwise published in any format, without the prior written permission of the copyright owner.

Disclaimer and Terms of Use: Provided that you maintain all copyright and other notices contained therein, you may download material (one machine readable copy and one print copy per page) for your personal and/or educational non-commercial use only.

The University of the Witwatersrand, Johannesburg, is not responsible for any errors or omissions and excludes any and all liability for any errors in or omissions from the information on the Library website.