

Ain Shams University Faculty of Science Department of Entomology

Population Dynamics and Host Fitness Analysis of The Pigeon Chewing Lice (O: Phthiraptera) with Notes on Genus *Columbicola*/Columbiformes Co-Evolutionary Roots

A thesis submitted for the degree of Doctor of Philosophy of Science (PhD) "Entomology"

By

Eslam Saad Adly Abbas

(BSc. 2013 & MSc. 2017)

Supervised by

Prof. Dr. Magdi Gebril Shehata

Professor of Medical Entomology Entomology Department Faculty of Science, Ain Shams University

Dr. Doaa Elsayed A. Soliman

Assistant professor of Medical Entomology Entomology Department Faculty of Science, Ain Shams University

Dr. Mohamed Gamal El-Din Nasser

Lecturer of Entomology Entomology Department Faculty of Science, Ain Shams University

> Department of Entomology Faculty of Science Ain Shams University Cairo, Egypt 2020

Approval sheet

Ph.D thesis

Name: Eslam Saad Adly Abbas (BSc. 2013 & MSc. 2017)

Title: Population Dynamics and Host Fitness Analysis of The Pigeon Chewing Lice (O: Phthiraptera) with Notes on Genus *Columbicola*/Columbiformes Co-Evolutionary Roots

Board of Supervision

Prof. Magdi Gebril Shehata

Emeritus Professor of Medical Entomology, Entomology Department, Faculty of Science, Ain Shams University, Cairo, Egypt.

Dr. Doaa Elsayed A. Soliman

Assistant professor of Medical Entomology, Entomology Department, Faculty of Science, Ain Shams University.

Dr. Mohamed Gamal El-Din Nasser

Lecturer of Entomology, Entomology Department, Faculty of Science, Ain Shams University

Thesis Examination Committee

Name	Title	Signature

Biography

Name: Eslam Saad Adly Abbas (Eslam Adly)

Date and Place

of birth: February 28, 1993/ Cairo, Egypt

Degrees award: MSc. of Science in Entomology, September

2017, Department of Entomology Faculty of

Science, Ain Shams University, Egypt

B.Sc. of **Science** in **Entomology**, May 2013,

Department of Entomology Faculty of Science,

Ain Shams University, Egypt.

Occupation: Assistant Lecturer "November 2017- Present"

Department of Entomology, Faculty of

Science, Ain Shams University, Abbassia

11566, Cairo, Egypt.

Date of

registration

April 10, 2018

for the PhD.

degree:

My mother always told me that as you go through life, no matter what you do, or how you do it, you leave a little footprint, and that's your legacy.

Lan Brower



Documentation of our first field work at Ras Seder, South Sinai, Egypt; under title of First Campfire at the website of NATIONAL GEOGRAPHIC which made me very excited to do my best to complete this thesis.

The comment of photo at the website of NATIONAL GEOGRAPHIC https://yourshot.nationalgeographic.com/photos/11973493/

Biological Ph.D. students usually missing anyone who documented how they are suffering and facing many risks during their field works, Here, Eslam Adly an entomology Ph.D. student of Faculty of Science, Ain Shams University, Egypt during his first campfire near Ras Seder, South Sinai. Adly used his mist nets to catch migratory birds as a part of his work on parasitic chewing lice of Columbiformes in Egypt.

Dedication

I am pleased to dedicate this work to my parents, brothers, sisters, and all my friends.

Acknowledgement

Acknowledgement

"I wish to express my deep thanks to ALLAH who fulfilled my hopes, offered every possible aid for any one in need to it".

I am deeply indebted to **Prof. Dr. Magdi Gebril Shehata** (Professor of Medical Entomology, Entomology Department, Faculty of science, Ain Shams University, Cairo, Egypt) for his kind supervision, his faithful encouragement, valuable advice and guidance during the progress of this study.

I wish to express my deep gratitude to **Dr. Doaa Elsayed Abd El kareem Soliman** (Assistant Professor of Medical Entomology,
Faculty of science, Ain Shams University) **for** her kind supervision,
assistance sincere during the progress of this study.

I am particularly grateful to **Dr. Mohamed Gamal El-Din**Nasser (Lecture of Entomology, Entomology Department, Faculty of science, Ain Shams University) for his supervision, help criticism, kind encouragement and precious advice during the progress of this study.

My deepest appreciation for **Prof. Dr. Mohamed Ragaa El-Sotohi** (Dean, Faculty of Science, Ain Shams University, Cairo, Egypt) for his Kind help and always support.

Acknowledgement

My deepest appreciation for **Prof. Dr. Khalid M. Alghamdi** (Vice Dean, Faculty of science, King Abdulaziz University (KAU), Jeddah, Saudi Arabia) **for** always support and inspirational words.

My deepest appreciation for **Prof. Dr. Dale Clayton** (Utah University, USA) **for** his help and support.

My grateful thanks are passed to **Dr. Daniel R, Gustafsson** (Guangdong Institute of Applied Biological Resources, Guangzhou, Guangdong, China) **for** his help and advice especially in confirmation of specimens' identification and valuable discussion that help to improve this work.

My deepest thanks to all Giza Zoo staff members especially in the medical veterinary unite: **Dr. Maha, Dr. Osama Mahmoud, Dr. Mohammed Badr, Dr. Nourhan Elmarawany for** their help and unlimited support during some field work in the study of chapter four.

Also, my grateful to **Prof. Dr. Mohamed Kenawy** (Professor of Medical Entomology department, faculty of science, Ain Shams University) **for** helping in some Data Analysis of the study of chapter four.

Also, my grateful to **Dr. Sara Elashaal** (Lecture of Entomology department, faculty of science, Ain Shams University) for helping in some specimens sampling in the study of chapter four.

Acknowledgement

Also, my grateful to **Awatef Fleifel** (Graduate student, Entomology department, faculty of science, Ain Shams University) **for** helping in some specimens sampling in the study of chapter four.

Special thanks to **Prof. Dr. Ragaa El Mohamady,** Professor of Medical Entomology and Head of Entomology Department.

My thanks must be extended to all my professors and colleagues at the Faculty of Science, Ain Shams University and Research and Training Centre on Vectors of Diseases (RTC).

Finally, I am indebted forever to my Mother, Father and to my beloved sisters; Nada & Joudi for their help, support and continuous encouragement.

Special thanks to my childhood friends

Eslam Saad Adly

Contents

Contents

Chapter One I: Introduction and Literature Review
I.1. Introduction
I.2. Statement of research problem6
I.3. Objectives of the study
I.4. Review of Literatures9
I.4.1. History of Genus <i>Columbicola/spp</i> . Investigations
I.4.2. Investigations of phylogenies studies of chewing lice
Chapter Two II: New records of chewing lice (Phthiraptera: Amblycera,
Ischnocera) from Egyptian pigeons and doves (Columbiformes), with
description of one new species
II.1. Introduction
II.2. Materials and Methods21
II.3. Results
II.4. Discussion
Chapter Three III: Seasonal population dynamics of Columbicola columbae
(Linnaeus, 1758) (Ischnocera: Philopteridae) infesting domestic pigeons
Columba livia (Gmelin, 1789) (Columbiformes:
Columbidae)45
III.1. Introduction
III.2. Materials and Methods
III.3. Results

Contents

III.4. Discussion.	57
Chapter Four IV: Assumptions and evidences on phoretic rela	ition of
Hippoboscid flies and chewing lice on domestic pigeons (C	Columba
livia)	61
IV.1. Introduction.	61
IV.2. Materials and Methods	64
IV.3. Results	67
IV.4. Discussion	72
Chapter Five V: Phylogenetic study of Coevolutionary Roc	ots and
Geographical distributions of doves (Columbiformes) and chewing lice	e Genus
Columbicola (Phthiraptera: Ischnocera)	76
V.1. Introduction.	76
V.2. Materials and Methods	78
V.2.1. Data collection.	78
V.2.2. Chewing lice phylogeny and geographical distribution	84
V.3. Results.	86
V.3.1. Columbiformes phylogeny	87
V.3.2. Chewing lice phylogeny	89
V.3.3. Chewing lice and Columbiformes Co-phylogeny	93
V.3.4. Chewing lice phylogeny and geographical distribution	94
V.4. Discussion.	95
Conclusion and Recommendations	99

Contents

English Summary	105
References	110
Arabic Summary	

List of Tables

List of Tables

(Table 1) Summary of species of chewing lice collected in Egypt in
2018
(Table 2) Means of the infestation intensity of chewing lice Columbicola
columbae L. on male pigeons
(Table 3) Means of the infestation intensity of chewing lice Columbicola
columbae L. on female pigeons53
(Table 4) Chewing lice species (Phthiraptera) observed on captivated pigeons
(Columba livia Gmelin, 1789) from three sites (Giza Zoo, local nests in Cairo
& local nest around Cairo Egypt) during the year of
201968
(Table 5) Means of the infestation prevalence and intensity of ectoparasites
(pigeons' flies and lice) collected on pigeon69
(Table 6) Prevalence of pigeon's infestation (%) by pigeon' flies and lice in
the three study sites70
(Table 7) Comparison of means of the enumerated pigeon' flies and lice
species per pigeon for site 2 (Hobbyis, n=21 pigeon) and site 3 (poor, n=36
pigeon)71
(Table 8) The b (slope) and R2 (coefficient of determination) of regression
analysis for the relation of relative abundance of the three lice species with
that of hippoboscid fly (P. canariensis)71

List of Tables

(Table 9) Sequences of (COI) gene from 28 species of genus Columbicola
(phthiraptera: Ischnocera) representing most of world species were extracted
in Fasta format from the Gene Bank database
(Table 10) Sequences of (COI) gene from 28 species of Columbiformes
Pigeons & Doves representing most of world species were extracted in Fasta
format from the Gene Bank database82
(Table 11) Sequences of (COI &EF-1) genes from 23 species of genus
Columbicola (phthiraptera: Ischnocera) representing most of world species
were extracted in Fasta format from the Gene Bank database85

List of Figures

List of Figures

(Fig.1) The grap	ph shows new	chewing lice	e species of ge	enus <i>Columbio</i>	cola/spp.
description	through	20-year	intervals	between	1750-
2010					11
(Fig.2) Lice /	Birds phylog	genetic trees	hypotheses:	(a) mirror ph	ıylogeny:
completely intir	nate relation	when new spe	ecies of bird a	ppear a new s	pecies of
lice appear to p	parasitize this	s bird; (b) th	e birds speci	ation have lit	tle or no
relation with lie	ce speciation;	(c) the lice	speciation ha	ve no or little	relation
with birds' spec	iation (Adapt	ed from Lyal	, 1986)		14
(Fig.3) Co-evol	ution of swift	species and	their ectopara	sites of genus	Dennyus
showing more	than 50% of	lice species	have a mirro	r phylogeny v	vith their
hosts (adapted f	rom Clayton,	et. al. 2003).			15
(Fig.4) Co-evo	olution betwe	een Passerifo	ormes phylog	geny includin	g some
species of bul	buls and th	eir ectoparas	sites of gen	us <i>Brueelia</i>	showing
independent eve	olution of lic	ce and their	host (adapted	from Johnso	n, et al.
2002a)					15
(Fig.5) 1. Euras	sian Collared	Dove capture	ed by the mis	st net screened	d around
vegetation area	at Ras Sudo	er, South Sin	ai, Egypt; 2.	Visual inspe	ction of
Laughing Dove	by first auth	nor at Sidi K	irayr, north c	oast, Egypt; 3	. Visual
inspection of L	Laughing Do	ve by second	d author at A	Ain Shams U	niversity
Botanical Garde	en, central C	airo, Egypt;	4. Laughing 1	Dove after fur	migation

List of Figures

chamber that containing cotton filled with 95% chloroform to kill all the lice
on its body
(Fig. 6) a. Type host: Laughing Dove; b. Male Columbicola joudiae; c.
Female Cb. joudiae; d. Head of male Cb. joudiae and female antennae; e.
Genitalia of male Cb. joudiae; f. Sub genital of female Cb.
joudiae40
(Fig. 7) Illustration of Genitalia of male <i>Columbicola joudiae</i> 41
(Fig. 8) Visual inspection of domestic pigeon
(Fig. 9) spar pigeons for Collecting lice for species taxonomic
conformation
(Fig. 10) Construction and building nest of domestic pigeons and housing
pigeons
(Fig. 11) Marking and Ringing new comers' pigeons
(Fig. 12) Wooden cages of pigeons' Nest
(Fig. 13) <i>Columbicola columbae</i> infesting wing of domestic pigeon51
(Fig. 14) The intensity of infestation of chewing lice Columbicola columbae
L. on male pigeons during twelve months of year (2019/2020)53
(Fig. 15) The intensity of infestation of chewing lice Columbicola columbae
L. on female pigeons during twelve months of year (2019/2020)54
(Fig. 16) Mean temperature degree and RH% in relation to the intensity of
infestation of chewing lice Columbicola columbae L. on pigeons throughout
the twelve months from march 2019 to February 202055