

**ESTIMATION OF PRODUCTIVITY OF LARVAL HABITATS OF *Aedes Aegypti* IN
MSAMBWENI, KWALE COUNTY, KENYA**

ALAWIH S. MWAKUTWAA

**A THESIS SUBMITTED TO THE SCHOOL OF APPLIED AND HEALTH SCIENCES
IN THE DEPARTMENT OF ENVIRONMENT AND HEALTH SCIENCES IN
PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF THE
DEGREE OF MASTER IN PUBLIC HEALTH OF TECHNICAL UNIVERSITY OF
MOMBASA**

2023

DECLARATION

This thesis is my original work and has not been presented for a degree award in any other University.

Signature..... Date.....

Name: Alawih S. Mwakutwaa

MPH/2362/2015

This thesis has been submitted with our approval as the University supervisors.

Signature..... Date.....

Dr. Francis Mutuku

DEPARTMENT OF ENVIRONMENT AND HEALTH SCIENCES
TECHNICAL UNIVERSITY OF MOMBASA

Signature..... Date.....

Dr. Shadrack Yonge

DEPARTMENT OF ENVIRONMENT AND HEALTH SCIENCE
TECHNICAL UNIVERSITY OF MOMBASA

Signature..... Date.....

Prof. Laila U. Abubakar

DEPARTMENT OF PURE AND APPLIED SCIENCES
TECHNICAL UNIVERSITY OF MOMBASA

DEDICATION

This work is dedicated to my wife, children and parents whom without their support, this thesis would not have materialized.

ACKNOWLEDGEMENT

I would like to thank the residents at my study site for their support during the study. My sincere gratitude goes to my supervisors Dr. Francis Mutuku, Dr. Shadrack Yonge and Prof Laila Abubakar, for their technical help during this study and not forgetting Mwanamisi Mwadime and Njenga Harun who assisted in the field survey. I greatly appreciate the Vector Borne Disease Control Unit (VBDCU) at the Msambweni County Referral Hospital for laboratory and financial support.

TABLE OF CONTENTS

DECLARATION	ii
DEDICATION	iii
ACKNOWLEDGEMENT	iv
TABLE OF CONTENTS.....	v
LIST OF TABLES	viii
LIST OF FIGURES.....	ix
ABBREVIATIONS.....	x
ABSTRACT	xi
CHAPTER ONE.....	1
INTRODUCTION.....	1
1.1 Background of the Study	1
1.2 Statement of the Problem	3
1.3 Hypothesis	3
1.4 Research Questions.....	4
1.5 Objectives	4
1.5.1 Main Objective.....	4
1.5.2 Specific Objectives	4
1.6 Justification.....	4
CHAPTER TWO.....	6
LITERATURE REVIEW	6
2.1 Epidemiology of Dengue Fever.....	6
2.2. Dengue Fever Vectors.....	7
2.2.1. <i>Aedes aegypti</i> Mosquitoes	7

2.2.2 <i>Aedes Albopictus</i>	8
2.3. Larval Habitats of Dengue Vectors	8
2.4 <i>Aedes Aegypti</i> Larval Development	9
2.5 Determining the Range of Productivity of Larval Habitats.....	10
2.6 Factors Influencing Productivity of <i>Ae. Aegypti</i> Larval Habitats.....	11
2.6.1 Larval Habitat Type.....	11
2.6.2 Location of the habitat.....	12
2.6.3 Purpose of Water in The Larval Habitat.....	13
2.6.4 Source of Water.....	14
2.6.5 Shade.....	14
2.6.6 Covering of Larval Habitats.....	15
2.6.7 Size of Larval Habitats	15
2.6.8 Characteristics of The Larval Habitats of <i>Aedes. Aegypti</i> And <i>Ae. Albopictus</i>	16
2.7 Other Factors	17
CHAPTER THREE:	19
MATERIALS AND METHODS	19
3.1 Study Area.....	19
3.2. Study Design	20
3.2.1 Identification and Mapping <i>Ae. Aegypti</i> Larval Habitats.....	20

3.2.2 Estimating <i>Ae. Aegypti</i> Larval Habitats Productivity Data Collecting Procedure Tool	21
3.2.3 Determining Factors Influencing <i>Ae. Aegypti</i> Larval Habitat Productivity	22
3.3 Data Management and Analysis	22
3.4 Ethical Considerations	23
CHAPTER FOUR.....	24
RESULTS AND DISCUSSION.....	24
4.1 Habitat Census.....	24
Table 4.1	24
4.2 <i>Ae. Aegypti</i> Abundance	25
4.3 Wet and Dry Season Pupal Productivity	29
4.4 Stability of the Larval Habitats During the 30-day Sampling Period.....	35
4.5 Factors Influencing Productivity of <i>Ae. aegypti</i> Larval Habitats.....	36
4.6 Discussion	39
CHAPTER FIVE.....	44
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS	44
5. 1 Summary	44
5.2 Conclusions.....	44
5.3 Recommendations From the Study.....	45
REFERENCES.....	46
APPENDICES	61
APPENDIX I: ETHICAL APPROVAL.....	61

LIST OF TABLES

Table 4.1: Habitat types and mosquito larval prevalence in 664 habitats surveyed in Bomani town, Kwale County, Kenya, in June 2017	24
Table 4.2: Summary statistics for larval and pupal productivity during the baseline survey.....	27
Table 4.3: Univariate and multivariate analysis of predictors for <i>Ae. Aegypti</i> pupal abundance.....	28
Table 4.4: Distribution of larval and pupal productivity during wet and dry season studies	33
Table 4.5: Mean number of larvae and pupae during wet and dry studies in Bomani town, Kwale County.....	34
Table 4.6: Stability of the larval habitats during the 30-day sampling period..	35
Table 4.7: Univariate and multivariate analysis of predictors for <i>Ae. aegypti</i> pupal productivity during wet season.....	37
Table 4.8: Univariate and multivariate analysis of predictors for <i>Ae. aegypti</i> pupal productivity during dry season.....	38

LIST OF FIGURES

Figure 3. 1: Map of the study area. A) Map of Kenya, B) Map of Kwale County showing the location of Msambweni.....20

Figure 4. 1: Mean *Ae. Aegypti* larvae and pupae per day in different larval habitat types wet A and Dry B season in Bomani town, Kwale County, Kenya.....32

ABBREVIATIONS

CDC	Centre of Disease Control
DHF	Dengue hemorrhagic fever
USA	United States of America
DENV	Dengue Virus
SPSS	Statistic package for the social sciences
ANOVA	Analysis of variance
VBDCU	Vector borne disease control unit

ABSTRACT

Accurate identification of epidemiologically important types of larval habitats is considered an essential step in the targeted control of *Aedes aegypti*; an important vector for several arboviruses, including dengue and chikungunya viruses. This study determined larval habitats-specific *Ae. aegypti* productivity in selected habitats in Msambweni, Kwale County, Kenya. The number of *Ae. aegypti* immatures in 83 representative larval habitats were counted daily for 30 days during the wet and dry seasons. All pupae were removed and allowed to emerge in the laboratory. A total of 664 potential larval habitats were identified and classified based on their use and material into seven habitat types, including: buckets, drums, jerrycans, pots, small domestic containers (SDC), tires and others during the habitat census survey. Of 664 larval habitats examined, 144 larval habitats (21.7%) were infested with *Aedes aegypti* larvae. 71% of the pupae were collected from tires and pots, both of which representing 17% of the habitats. On the other hand, buckets and SDC represented 55% of the total habitats with an infestation rate of 11.8%, yet only 13.5% of the pupae were found in them. Multivariate analysis showed that only habitat type and ability of the habitat to be moved were associated with pupal abundance. During the 30-day daily pupal production studies, only a few habitats were persistently found harboring pupae. In the wet season, pupae were collected from 28% (23/83) of the larval habitats. In the dry season, only 12% (10/83) of the habitats were ever found with pupae during the 30-day sampling period, with three habitats accounting for 80% of all the pupae collected. Three drums with 35% (127/365), 33% (121/365) and 12% (45/365) pupae respectively. The results of the multivariate models for the risk factors of pupal productivity showed that habitat type, placing of larval habitats in the backyard (IRR = 0.55; 0.35, 0.86), larval habitats with without purpose (IRR = 2.62; 2.18, 3.14) and rainwater (IRR = 2.33; 1.69, 3.23) were the important predictors of larval habitat productivity during the wet season. Although the multivariate model for habitat type did converge, habitat type and large-size larval habitats (IRR=0.05 0.005, 0.56) were the only important predictors during the dry season. In conclusion, drums, pots and tires covered more than 85% of *Ae. aegypti* pupae; reinforcing the 'key containers concept.' Larval habitat characteristics and human behavior can be used to predict entomological risk. Targeting these three types of habitats makes epidemiological sense, especially during the dry season in the study area.