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THESIS

BIONOMICS AND CONTROL EFFECTS OF *ANOPHELES STEPHENSI* IN MANNAR AND JAFFNA DISTRICTS OF SRI LANKA

Submitted by

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in

Medical Entomology

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DECLARATION

I declare that the work embodied in the thesis is my own and has not been submittedfor any degree in this university or any other institute, and to the best of myknowledge and belief, it does not contain any material previously published orwritten or orally communicated by another person except, where due reference ismade in the text.

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ABBREVIATIONS

CBTC	Cattle Baited Trap Collection
CBHC	Cattle Baited Hut Collection
HLNC	Human Landing Night Collection
WHO	World Health Organization
AMC	Anti Malaria Campaign
RF	Total Rainfall
RH	Relative Humidity
MT	Mean Temperature
SEAR	South East Asia Region
IRS	Indoor Residual Spray
WL	Wing Length
WW	Wing Width
ATL	Thoracic Length
ATW	Thoracic Width
AAL	Abdominal Length,
AAB	Abdominal Breadth
LHL	Larva Head Length
LHW	Larva Head Width
LLT	Larval Thoracic Length
LWT	Larval Thoracic Width
LLA	Larval Abdominal Length
LWA	Larval Abdominal Width
LTL	Larval Total Length
PoR	Prevention of Re-introduction
Sp.	Species

C	Celsius
cm	Centimeter
g	Gram
h	Hour
m	Meter
min	Minutes
ml	Milliliter
ppt	Parts per thousand
s	Second

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ABSTRACT

Background: Sri Lanka was declared as a country that eliminated malaria disease in 2016 by the World Health Organization. Recent report of *Anopheles stephensi* as an invasive vector in the northern part of Sri Lanka is one of the challenges to maintain themalaria free states in the country.

Methods: Entomological surveys were conducted at three selected localities in Jaffna and Mannar Districts of Sri Lanka from January 2019 to January 2020 using three entomological techniques. Detailed biology and life cycle related information namely were assessed. Further, effectiveness of insecticide based control efforts (novaluron andtemephos) and application of larvivorous fish *Poecilia reticulata* were evaluated under laboratory set-up. The Vectorial Capacity (VC) was calculated using a mathematical-based approach.

Results: According to the egg morphology, *Mysorensis* biotype (47%) was the predominant followed by type (38.1%) and intermediate (14.9%). The mating success was 80.7 ± 4.45%. The mean hatching period was 1.9 ± 0.03 days, with a hatching rate of 86.2 ± 0.77%. Overall, 8.0 ± 0.14 days were required for larval development and

30.3 ± 0.14 h were spent in the pupal stage. The pupation success was 94.5 ± 0.37%, and the majority were males (53.1 ± 0.73%). The mean fecundity was 106.5 ± 6.38 eggs and a gonotrophic cycle of 3.4 ± 0.06 days. The female survival rate was 43.2 ± 2.4%, with a mean biting frequency of 66.6 ± 3.5%. The average VC of adult *An. stephensi* was estimated to be 18.7. Significant variations in adult emergence were observed from both larval stages at different salinity levels ($P < 0.05$). The lowest survival rate was reported as 15.8 ±2.47% at 25 ppt. The highest mortality rate (100%) at a 1-hour exposure period was observed from temephos at >100 ppm. The mortality rates varied significantly for different concentrations and larvicides ($P < 0.05$). At 24-h of the exposure period, the 100% mortality of *An. stephensi* larvae were observed from both temephos and novaluron even at 0.04 ppm. In larvivorous fish study, the survival rate of *P. reticulata* in both Jaffna and Mannar Districts was significantly different at different chlorine levels ($P<0.05$). At 1-hour, the lowest survival rate was 53.4 ± 4.4% in Jaffna and Mannar at 1 mg/L, while the survival rate was >80% even at 0.75 mg/L. At the 24-hours, the mean survival rates of 70.0± 5.8% (Jaffna) and 81.7 ± 4(Mannar) were observed at 0.75 mg/L. At 48 hours, the fish survived only at 0.75 mg/Lindicating a higher survival rate from Mannar (81.7 ± 4.4%), while the fish from Jaffna denoted 70.0 ± 5.8% of survival.

Conclusions: The type biotype, which is an effective vector in the Indian subcontinent is present in Sri Lanka. *Anopheles stephensi* indicated a vectorial capacity of over 18. There is a high potential of increasing density of *An. stephensi* in coastal ecosystems. The temephos and novaluron can be recommended as effective larvicides for chemical-based control of *An. stephensi* in Jaffna, Sri Lanka. The fish captured from Mannar demonstrated a higher tolerance to chlorine levels.

Keywords: Bionomics, malaria, vectorial capacity, control.