



**UNIVERSITI PUTRA MALAYSIA**

**SOME ASPECTS OF THE BIOLOGY AND ECOLOGY OF *NEUROTHEMIS TULLIA* (DRURY) (ODONATA:LIBELLULIDAE ) IN THE LABORATORY AND RAINFED RICE FIELD IN PENINSULAR MALAYSIA**

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**By**

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**Dissertation Submitted in Fulfillment of the Requirements for  
the Degree of Doctor of Philosophy in the Faculty of  
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## TABLE OF CONTENTS

	<b>Page</b>
ACKNOWLEDGEMENTS .....	ii
LIST OF TABLES .....	viii
LIST OF FIGURES .....	x
LIST OF PLATES .....	xvi
LIST OF ABBREVIATIONS .....	xvii
ABSTRACT .....	xviii
ABSTRAK .....	xxi
CHAPTER	
I. INTRODUCTION .....	1
II. LITERATURE REVIEW .....	4
Life History .....	5
Life Cycle and Voltinism .....	5
Larval Growth .....	6
Metamorphosis .....	8
Emergence .....	9
Maturation .....	10
Reproduction .....	11
Population Ecology of Immatures .....	12
Larval Abundance .....	12



	Physico-chemical Factors of the	
	Environment .....	13
	Pesticides .....	16
	Population Ecology of Adults .....	16
	Abundance .....	16
	Survivor and Longevity .....	17
	Feeding Activity .....	19
	Sex Ratio and Age Structure .....	20
	Dispersal .....	21
	Larval Interactions .....	22
	Predators and Preys .....	22
	Cannibalism .....	23
III.	GENERAL DESCRIPTION OF STUDY AREA, SPECIES AND LARVAL DISTRIBUTION .....	25
	The Rice Field .....	25
	The Species .....	28
	Phenology of Rice Growth .....	31
	Analysis of Larval Distribution .....	40
IV	LIFE CYCLE IN THE LABORATORY.....	43
	Introduction .....	42
	Materials and Methods .....	44
	Results .....	45
	Discussion .....	58
V.	LIFE HISTORY OF <i>NEUROTHEMIS TULLIA</i> LARVAE IN THE RICE FIELD .....	62
	Introduction .....	62



Materials and Methods .....	64
Larval Sampling .....	64
Emergence .....	67
Results .....	68
Larval Growth .....	68
Instar (Head Width) Distribution .....	70
Emergence .....	82
Patterns of Survival .....	86
Discussion .....	88
Larval Growth .....	88
Instar (Head Width) Distribution .....	90
Survivorship and Emergence .....	92
VI. POPULATION ECOLOGY OF <i>NEUROTHEMIS</i>	
<i>TULLIA</i> LARVAE .....	98
Introduction .....	98
Materials and Methods .....	100
Larval Sampling .....	100
Physico-chemical Parameters of Water ....	100
Statistical Treatment of Results .....	101
Results .....	101
Larval Abundance in the Rice Field. ....	107
Physico-chemical Parameters of Water ....	115
Influence of Water Parameters on Larval Abundance .....	115
Discussion .....	115
Larval Abundance .....	121



Physico-chemical Parameters of Water ....	124
VII. POPULATION ECOLOGY OF ADULTS OF	
<i>NEUROTHEMIS TULLIA</i> .....	124
Introduction .....	124
Materials and Methods .....	126
Seasonal Abundance of Adult of	
<i>Neurothemis tullia</i> .....	126
Diurnal Feeding Pattern. ....	133
Results .....	134
Seasonal Abundance of <i>Neurothemis</i>	
<i>tullia</i> .....	134
Survival Rate .....	143
Longevity .....	145
Age Structure .....	149
Home Range .....	155
Diurnal Feeding Pattern .....	161
Discussion .....	166
Seasonal Abundance of Adult of	
<i>Neurothemis tullia</i> .....	166
Survival Rate .....	176
Longevity .....	178
Age Structure .....	180
Home Range .....	183
Diurnal Feeding Pattern .....	186
Synthesis .....	190





VIII. CORRELATIONS BETWEEN <i>NEUROTHEMIS</i> <i>TULLIA</i> LARVAE AND OTHER SPECIES IN THE RICE FIELD .....	191
Introduction .....	191
Materials and Methods .....	193
Sampling of Invertebrates .....	193
Statistical Treatment of Results .....	193
Results .....	193
Species Compositions .....	193
Species Correlations .....	208
Discussion .....	210
IX. GENERAL DISCUSSION AND CONCLUSION .....	216
REFERENCES .....	228
APPENDIX .....	247
VITA .....	257



## LIST OF TABLES

Table		Page
1.	Characteristics of Larval Instars of <i>Neurothemis tullia</i> .....	51
2.	Emergence Periods of Different Generations of <i>Neurothemis tullia</i> .....	85
3.	Duration Spent by Adults in Each Age Class.....	148
4.	Movement of Male <i>Neurothemis tullia</i> (30 August to 3 April 1995) .....	157
5.	Movement of Female <i>Neurothemis tullia</i> (30 August to 3 April 1995) .....	157
6.	Body (Fresh) and Gut (Dry) Weights (mg) of <i>Neurothemis tullia</i> .....	165
7.	Analysis of Variance (ANOVA) for Gut Weight of <i>Neurothemis tullia</i> .....	165
8.	Gut Weight (Dry:Mean $\pm$ SE) by Age Class in Male and Female <i>Neurothemis tullia</i> .....	167
9.	List of Taxa Identified from the Rice Field Throughout the Sampling Period from September 14, 1993 until December 10, 1994 .....	194
10.	Correlation Analysis Among Variables of Physicochemical Parameters of Rice Field Water ....	248
11.	Characters Used to Denote Age Classes of Adults of <i>Neurothemis tullia</i> .....	249
12.	Male Proportion (Sex Ratio) of Population of <i>Neurothemis tullia</i> over the Study Period .....	250
13.	Population Parameters of <i>Neurothemis tullia</i> (Males and Females) in the Rice Field .....	253



14.	Population Parameters of Males <i>Neurothemis tullia</i> in the Rice Field.....	254
15.	Population Parameters of Females <i>Neurothemis</i> <i>tullia</i> in the Rice Field .....	255
16.	Records of Mark-Release-Recapture of <i>Neurothemis</i> <i>tullia</i> .....	256



## LIST OF FIGURES

Figures	Page
1. Location of the Study Area .....	26
2. Vegetation Type in Part of the Bandar Baru District. Area in the Rectangle is the Study Site, Kampung Sungai Kecil Ulu .....	27
3. Frequency Distribution of Number of <i>Neurothemis tullia</i> Larvae Collected per Sample; Mean = 0.653, Variance = 2.3556. The Data were Fitted into the Negative Binomial Distribution (NBD) Based on the Value of Variance which is Greater than Mean ( $k = 0.2504$ ). The Test of Goodness of Fit Showed that the Distribution was Highly Aggregated and Significantly Different from the NBD at $P = 0.05$ .....	42
4. Length of Head Capsule of Different Instar Stages of <i>Neurothemis tullia</i> Larvae. Instar One was not Measured due to Short Stadium. Bars Represent One Standard Error .....	50
5. Body Length of Larval Instars of <i>Neurothemis tullia</i> Larvae. Instar One was not Measured due to Short Stadium. Bars Represent One Standard Error .....	53
6. Duration of Larval Stadia of <i>Neurothemis tullia</i> . Prolarval Stadium (Instar One) was very Short and not Recorded. Bars Represent One Standard Error .....	54
7. Growth of <i>Neurothemis tullia</i> Larvae .....	55



8.	Relationship between Larval Head Capsule Lengths (Drawn on Log <sub>10</sub> Scale) of <i>Neurothemis tullia</i> and Instar Numbers .....	56
9.	A Generalized Labium of Anisoptera Dragonfly (Drawing not to Scale) Showing the Positions of Premental Setae (pms), Palpal Setae (ps) and End Hook (h) .....	57
10.	Relationship between Larval Head Widths and (a) Larval Body Lengths (b) Larval Wing Bud Lengths. F to F-8 Relates to the Number of Moults Before the Larvae Reach Adult Stage. F = Final Instar, F-1 = Instar 9, F-2 = Instar 8, F-3 = Instar 7, F-4 = Instar 6 and so on .....	69
11.	Relationship of Larval Head Widths (HW) with Larval Body Lengths (BL) and Larval Wing Bud Lengths. (a) Linear Relationship between Body Length and Head Width (b) Quadratic Relationship between Wing Bud Length and Head Width .....	71
12.	Larval Head Width Distribution over the Sampling Periods (8 June 1993 to 3 December 1994, a to ak). Occasions When Emergence Occurred are Noted at the Relevant Dates .....	72
13.	Patterns of Emergence of <i>Neurothemis tullia</i> in the Rice Field. E1 to E4 Denotes Emergence One to Four .....	83
14.	Cumulative Percentage Emergence of Populations of <i>Neurothemis tullia</i> . (i), (ii), (iii) and (iv) Refer to 50% Emergences (E <sub>50</sub> ). E1 to E4 Denotes Emergence One to Four .....	84



15.	Changes of Population Sizes of Three Populations of <i>Neurothemis tullia</i> over Their Growing Periods. The Horizontal Broken Lines Represent the Theoretical Carrying Capacities (K1~ 2511,K2 ~ 3980, K3 ~ 1600). The Three Populations Occurred in (a) Fallow Phase (b) Young Field through Tiller Phases (c) Mature, Preharvest, Harvest and Plough Phases. E1, E2 and E3 Denote Emergences. During the Dry Period (c), There was Very Little Water to Enable Proper Sampling to be Done .....	87
16.	Seasonal Abundance (Mean ± SE) of the Larvae of <i>Neurothemis tullia</i> in Relation to Water Level and Rice Growing Phases. F = Fallow, P = Plough, S = Seeding, YF = Young Field, T = Tiller or Middle Field, MF = Mature Field, PH = Preharvest. E Represents Emergence. Bar Represents One Standard Error .....	102
17.	Larval Abundance (Mean ± SE) of <i>Neurothemis tullia</i> in Relation to Pesticide and Fertilizer Applications. F = Fertilizer, H = Herbicide, I = Insecticides and O = Diesel Oil. Bars Represent One Standard Error .....	106
18.	Abundance of <i>Neurothemis tullia</i> Larvae in Relation to Water Levels in the Rice Field .....	108
19.	Abundance of <i>Neurothemis tullia</i> Larvae in Relation to Temperature and Dissolved Oxygen.....	108
20.	Abundance of <i>Neurothemis tullia</i> Larvae in Relation to pH and Conductivity of Water .....	111
21.	Abundance of <i>Neurothemis tullia</i> Larvae in Relation to Nitrate Levels in the Water .....	111
22.	Abundance of <i>Neurothemis tullia</i> Larvae in Relation to Orthophosphate Levels in the Water .	114



23.	Abundance of <i>Neurothemis tullia</i> Larvae in Relation to Height of Plants in the Rice Field ...	114
24.	Abundance of <i>Neurothemis tullia</i> Larvae in Relation to Chlorophyll a Levels in the Water ..	116
25.	Sketch Map of the Study Area Showing Stations One to Eight in the MRR Study .....	128
26.	Diagram of a Dragonfly Adult Showing the Locations of Stations and Age Classes Marked on the Wings. Numbers Indicate the Stations and the Number of Dots are the Age Classes of the Adults .....	131
27.	Seasonal Abundance of Adults (Mean $\pm$ SE) of <i>Neurothemis tullia</i> in the Rice Field. Arrows Indicate Herbicide Applications (H). E Represents Emergence. The Horizontal Broken Line Represents Half of the Theoretical Carrying Capacity (K/2) .....	135
28.	Seasonal Abundance of Male and Female of <i>Neurothemis tullia</i> in the Rice Field .....	137
29.	Height of Rice Plants (and Weeds) in the Rice Field .....	138
30.	Depth of Water in the Rice Field .....	138
31.	Estimated Population Numbers of Adults ( $\pm$ SE) of <i>Neurothemis tullia</i> (Male and Female) by MRR Technique in the Rice Field. The Horizontal Broken Line Represents Half of the Theoretical Carrying Capacity (K/2) .....	140
32.	Estimated Population of (a) Male (b) Female of <i>Neurothemis tullia</i> in the Rice Field .....	142



33.	Seasonal Abundance of Adults of <i>Neurothemis tullia</i> (Male and Female Combined) in the Rice Field (Sampled by Visual Count). ( $K/2$ ) Represents Half of the Theoretical Carrying Capacity .....	144
34.	Survival Rates of (a) Male (b) Female Adults of <i>Neurothemis tullia</i> in the Rice Field .....	146
35.	Age Composition of Males (a) Marked (b) New (c) Recaptured in the Adult Population of <i>Neurothemis tullia</i> .....	150
36.	Percentage Age Composition of Males of <i>Neurothemis tullia</i> (a) Marked (b) Recaptured ....	151
37.	Age Composition of Females (a) Marked (b) New (c) Recaptured in the Adult Population of <i>Neurothemis tullia</i> .....	153
38.	Percentage Age Composition of Females of <i>Neurothemis tullia</i> (a) Marked (b) Recaptured ...	154
39.	Age Composition of (a) Marked (b) Recaptured Females of <i>Neurothemis tullia</i> in the Rice Field. Line Graph Shows the Number of Females that Had Oviposited .....	156
40.	Composition of Recaptured Adult of <i>Neurothemis tullia</i> at Different Released Stations. (a) Station One (b) Station Two (c) Station Three (d) Station Four (e) Station Five (f) Station Six (g) Station Seven (h) Station Eight .....	159
41.	Home Range of Recaptured Adults of <i>Neurothemis tullia</i> at Indicated Stations. (a) Station One (b) Station Two (c) Station Three (d) Station Four (e) Station Five (f) Station Six (g) Station Seven (h) Station Eight .....	160





42.	Gut Status of Adult of <i>Neurothemis tullia</i> . Full, Partial and Empty Refer to Gut Content .....	162
43.	Diurnal Feeding Pattern (Mean $\pm$ SE) of Adults of <i>Neurothemis tullia</i> . (a) Adults (Males and Females Combined) (b) Males and Females .....	164
44.	Abundance of <i>Neurothemis tullia</i> versus <i>Orthetrum sabina</i> (Mean $\pm$ SE).....	197
45.	Abundance of <i>Neurothemis tullia</i> versus Baetidae (Mean $\pm$ SE) .....	197
46.	Abundance of <i>Neurothemis tullia</i> versus Chironomidae (Mean $\pm$ SE).....	199
47.	Abundance of <i>Neurothemis tullia</i> versus Zygoptera (Mean $\pm$ SE).....	199
48.	Abundance of <i>Neurothemis tullia</i> versus Anisoptera (Mean $\pm$ SE) .....	200
49.	Abundance of <i>Neurothemis tullia</i> versus Veliidae (Mean $\pm$ SE) .....	200
50.	Abundance of <i>Neurothemis tullia</i> versus Corixidae (Mean $\pm$ SE).....	202
51.	Abundance of <i>Neurothemis tullia</i> versus Dytiscidae (Mean $\pm$ SE) .....	202
52.	Abundance of <i>Neurothemis tullia</i> versus Hydrophilidae (Mean $\pm$ SE).....	203
53.	Abundance of <i>Neurothemis tullia</i> versus Noteride (Mean $\pm$ SE).....	203
54.	Abundance of <i>Neurothemis tullia</i> versus Pleidae (Mean $\pm$ SE) .....	204
55.	Abundance of <i>Neurothemis tullia</i> versus Notonectidae (Mean $\pm$ SE).....	204



56.	Abundance of <i>Neurothemis tullia</i> versus Belostomatidae (Mean ± SE) .....	205
57.	Abundance of <i>Neurothemis tullia</i> versus Nepidae (Mean ± SE) .....	205
58.	Abundance of <i>Neurothemis tullia</i> versus <i>Anopheles</i> spp. (Mean ± SE) .....	207
59.	Abundance of <i>Neurothemis tullia</i> versus <i>Culex</i> spp. (Mean ± SE) .....	207
60.	Abundance of <i>Neurothemis tullia</i> versus Acarina (Mean ± SE) .....	209
61.	Abundance of <i>Neurothemis tullia</i> versus Oligochaeta (Mean ± SE) .....	209
62	Hypothetical Trophic Linkage of <i>Neurothemis tullia</i> with other Organisms in the Rice Field Ecosystem. → Means One Way Interaction and ↔ Means Two Way Interaction .....	225
63	Survival Strategies of <i>Neurothemis tullia</i> in Rainfed Rice Field .....	227



## LIST OF PLATES

Plates		Page
1.	The Male of <i>Neurothemis tullia</i> (Drury) .....	29
2.	The Female of <i>Neurothemis tullia</i> (Drury).....	30
3.	The Fallow Phase .....	33
4.	The Plough Phase .....	34
5.	The Young Field Phase .....	36
6.	The Middle or Tiller Phase .....	37
7.	The Mature Field.....	38
8.	The Preharvest Phase .....	39
9.	Dorsal View of <i>Neurothemis tullia</i> Larva .....	47
10.	Ventral View of <i>Neurothemis tullia</i> Larva .....	48
11.	Eggs of <i>Neurothemis tullia</i> .....	49
12.	Sampling of <i>Neurothemis tullia</i> Larvae in the Rice Field .....	65
13.	The Flood in October, 1993 .....	104
14.	A Mosquito Cage (30 x 30 x 30 cm) Used for Temporary Storage of <i>Neurothemis tullia</i> Adults in MRR Study .....	130



## LIST OF ABBREVIATIONS

$\mu\text{ohms/m}$	micro mhos per liter
df	degree of freedom
DO	dissolved oxygen
E	east
e.g.	for example
$E_{50}$	emergence of 50% of total population emerged
et. al	and others
hrs	hours
i.e.	that is
$LC_{50}$	lethal concentration that kills 50% of test animals
$m^2$	meter square
mg/l	milligrams per liter
min	minute
MRR	mark-release-recapture
N	north
ppm	part per million
SE	standard error
spp.	species
T-L-TS	tanda-lepas-tangkap semula



Abstract of dissertation submitted to the Senate of Universiti Pertanian  
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**SOME ASPECTS OF THE BIOLOGY AND ECOLOGY OF *NEUROTHEMIS  
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LABORATORY AND RAINFED RICE FIELD**

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NOVEMBER 1996

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Faculty: Science and Environmental Studies

The life cycle, life history, feeding biology and ecology of *Neurothemis tullia* (Drury) larvae and adults were studied from June 1993 through April 1995 in a rice field of Bandar Baru District in Kedah, Malaysia. An aquatic net was used to sample the larvae in the field and the adult ecology was studied using visual counting and Mark-Release-Recapture (MRR) techniques. The results showed that the egg incubation period was eight days followed by forty four days of larval developmental period in the laboratory. Thus, the mean life cycle from egg to adult emergence was fifty two days. Growth of both head capsule and body length was faster from instar one to six and slowed gradually at higher instars.

Larval development was asynchronous and a maximum of eight different instars was found at one sampling occasion. Four emergences were observed in the year of 1994. The onset of emergence occurred in March, May, July and October,



1994. The size of emerging populations varied according to the availability of water during larval growth and rice growing phases. Some of the larvae were able to survive in the rice field during short dry periods of less than four weeks.

The abundance of the larvae was higher in 1994 compared to 1993. Generally more larvae were found during tiller, mature field and fallow phases of rice cultivation. No correlation was found between the abundance of the larvae and any of the water parameters i.e. temperature, pH, dissolved oxygen, conductivity, nitrate, phosphate, chlorophyll a and height of plants. The availability of water in the field however, determined the presence or absence of the larvae. Fifty one aquatic animal taxa coexisted with *N. tullia* of which the abundance of each of *Orthetrum sabina* (Drury), Anisoptera, *Anopheles* spp., Chironomidae, Corixidae and hemipteran Veliidae correlated positively with that of *N. tullia*. A hypothetical trophic relationship of *N. tullia* in the rice field is proposed.

The highest estimated population of adults was 2400 individuals per 4.6 ha (~ 522 adults per ha). The male population peaked slightly earlier than the female population, possibly an indication of longer maturation period of the females. Adult populations were high when rice plants were growing in the field but decreased drastically after harvest. Prolonged drought further reduced the adult population density. A general pattern of adult abundance was obtained either by MRR technique or visual count method with the former generating more information than the latter.

Survival rates of both male and female adults of *N. tullia* were  $>0.5$  throughout the study. The mean life span durations were 42.4 and 36.5 days and the maximum life span durations were sixty five and fifty three days, respectively. The populations of

*N. tullia* were unstable because the proportions of age classes varied through time. The adults were widely distributed within its home range of about 40 m. Their maximum distance travelled was approximately 130 m. The adults started feeding as early as 0730 hrs with two peaks of heaviest gut weights at 1030 hrs and 1730 hrs. At anytime of the day, the females guts were significantly heavier than the guts of the males (ANOVA,  $P=0.05$ ) reflecting higher feeding activity and nutritive requirement by the females.

*Neurothemis tullia* is well adapted to the vagaries of the rainfed rice field ecosystem through developmental, reproductive and behavioural strategies. Asynchronous larval development, overlapping of multi generations larvae, short-circuiting development and drought resistant larvae, the larval ability to emerge at earlier than the final instar stage coupled with high daily survival rate of adults were means to overcome the unstable environments. The age distributions of larvae and adults showed that multiple ovipositions and repeated egg laying occurred in the long lived female adults of *N. tullia*. In the adult stage, higher body masses of the females as compared to the males, ensured high egg production. The adults were dominant during the dry periods although larval existence was threatened. They inhabited marginal grasses around irrigation canals when no plant was available in the field. Thus, within their breeding habitat of the study area, both larvae and adults of *N. tullia* were highly adapted and widely distributed.



Abstrak disertasi yang dikemukakan kepada Senat Universiti Pertanian Malaysia sebagai memenuhi keperluan Ijazah Doktor Falasafah.

**BEBERAPA ASPEK BIOLOGI DAN EKOLOGI *NEUROTHEMIS TULLIA* (DRURY) (ODONATA:LIBELLULIDAE) DI DALAM MAKMAL DAN DI SAWAH YANG BERGANTUNG KEPADA HUJAN**

Oleh

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NOVEMBER 1996

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Fakulti: Sains dan Pengajian Alam Sekitar

Kitar dan riwayat hidup, biologi pemakanan, ekologi larva dan dewasa *Neurothemis tullia* (Drury) telah dikaji dari bulan Jun 1993 hingga April 1995 di sawah padi, daerah Bandar Baru, Kedah, Malaysia. Larva disampel menggunakan net akuatik dan pengkajian ekologi populasi dewasa menggunakan kaedah pengiraan visual dan Tanda-Lepas-Tangkap Semula (T-L-TS). Keputusan menunjukkan bahawa pengeraman telur mengambil masa lapan hari diikuti oleh 44 hari perkembangan larva di dalam makmal. Jadi min kitar hidup dari telur hingga ke kemunculan dewasa ialah 52 hari. Pertumbuhan kapsul kepala dan panjang badan adalah lebih cepat pada instar pertama hingga enam tetapi beransur perlahan pada instar berikutnya.

Pertumbuhan larva menunjukkan cara tak serentak dan jumlah maksimum sebanyak lapan peringkat instar telah didapati pada satu penyampelan. Empat kemunculan





dewasa telah diperhatikan pada tahun 1994. Kemunculan-kemunculan tersebut berlaku dalam bulan Mac, Mei, Julai dan Oktober, 1994. Perbezaan saiz populasi yang muncul bergantung pada ketersediaan air ketika pertumbuhan larva dan fasa penanaman padi. Terdapat larva yang boleh hidup ketika sawah kering kurang dari empat minggu.

Kelimpahan larva adalah lebih tinggi pada tahun 1994 dibandingkan dengan tahun 1993. Umumnya lebih banyak larva dijumpai pada fasa pokok padi beranak, padi matang dan fasa rang. Tiada korelasi di antara kelimpahan larva dan parameter-parameter air i.e. suhu, pH, oksigen terlarut, konduktiviti, nitrat, posfat, klorofil a dan ketinggian pokok. Ketersediaan air di dalam sawah menentukan ada atau tidaknya larva di sawah. Lima puluh satu taxa haiwan akuatik hidup bersama *N. tullia* dan hanya kelimpahan *Ortherum sabina* (Drury), Anisoptera, *Anopheles* spp., Chironomidae, Corixidae dan hemipteran Veliidae sahaja berkolerasi positif dengan kelimpahan *N. tullia*. Pertalian trofik hipotetikal *N. tullia* di ekosistem sawah telah dicadangkan.

Anggaran populasi dewasa yang tertinggi ialah 2400 individu per 4.6 ha (~522 dewasa per ha). Populasi dewasa tinggi semasa pokok padi sedang membesar tetapi turun dengan mendadak setelah padi dituai. Kemarau panjang mengurangkan lagi ketumpatan populasi dewasa. Corak kelimpahan dewasa yang umum telah didapati dengan menggunakan teknik Tanda-Lepas-Tangkap Semula (T-L-TS) dan kiraan visual tetapi lebih banyak keterangan dihasilkan oleh teknik T-L-TS.

Kadar kemandiran dewasa jantan dan betina *N. tullia* adalah >0.5 di sepanjang kajian. Min jangka hayat jantan dan betina adalah 42.2 dan 36.5 hari dan umur maksimum ialah 65 hari dan 53 hari masing-masing. Populasi *N. tullia* didapati tidak stabil kerana kandungan kelas-kelas umur berubah di sepanjang kajian. Dewasa bertabur