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Relative Growth and Description of the nymphal instars of *Tenagogonus fluviorum* (Fabricius) (Hemiptera: Gerridae)

S. Arivoli, Anjali N. Upadhyay and P. Venkatesan

Aquatic Entomology and Biocontrol Research Laboratory, P.G. & Research Department of Advanced Zoology and Biotechnology, Loyola College, Chennai 600 034, Tamilnadu, India

Abstract: Changes and development within and among the taxa over evolutionary time are generally accompanied by changes in shape. Such departures from geometric similarity are termed allometry and studies of allometry and the covariation of size, form and function are the basis of the biology of scaling. Allometric growth through post-embryonic stages till adults was measured. There was a remarkable growth of all leg components with each nymphal instars indicating the relation to marsh treading quality of this semi aquatic bug on the water surface. Morphometric measurements of various body parts were made with reference to total body length.

Key words: Relative growth · Allometry · *Tenagogonus fluviorum*

INTRODUCTION

The first nymphal instars emerging out from the egg passes through post-embryonic stages before becoming an adult. The relative growth of post-embryonic instars is derived by the application of exponential formula of Huxley [1]. Earlier workers also have widely used the method of Huxley [1] to analyze the relative growth in post-embryonic stages in gerrids [2], in notonectids [3], lethocerines [4], nepids - *Ranatra filiformis* and *Laccotrephes griseus* [5], hydrometrid - *Hydrometra butleri* [6] and corixid - *Micronecta scutellaris* [7]. Remarkable differences in the ontogenetic relative growth were highlighted through statistical constants namely growth ratio and growth index [8]. Matsuda and Rohlf [9] have studied the relative growth of leg and antennal segment in population of gerrid *Trephobates trepidus* and compared them using centroid factor analysis as the reference dimension. The reproductive potencies of aquatic and semi aquatic bugs differ in relation to physiological variables. It includes many factors, of which growth of body parts is vital. Body size is a keystone trait, closely correlated with many morphological, physiological and ecological and life history traits in gerrids [10]. Allometric relationships are generally interpreted as reflecting changes in body size [11]. In the present study, it was essential to identify the nymphal instars of *Tenagogonus fluviorum* which are often distributed sympatrically along with closely related species of Gerridae family and to investigate the instars of their life cycle.

MATERIALS AND METHODS

Tenagogonus fluviorum collected from the rearing pond were brought to the laboratory and maintained in aquaria (41 x 41 x 21cm) containing 5 litres of aged tap water and aquatic vegetation. The bug oviposited on aquatic plants and on the walls of the container. Such eggs were isolated from the aquaria and maintained in separate container with water till their eclosion. The emerged nymphs and adults were fed *Culex* mosquito larvae. The freshly laid eggs and the nymphal instars a day after their moult were collected. They were fixed in 5% formalin, treated in alcoholic series from 70 to 100% and in weak solution of 5% potassium hydroxide (KOH) which dissolved the tissues within the egg. Such materials were then cleared in xylene and mounted on the slide (7.5 x 2.5 cm) with canada balsm. Ten trials of each nymphal instars were made in order to record the morphometric measurement. First and second nymphal instars were observed under the microscope and their morphological characters were measured using the stage and ocular micrometers and the remaining stages under Paxiscope.

Corresponding Author: S. Arivoli, Aquatic Entomology and Biocontrol Research Laboratory, P.G. & Research Department of Advanced Zoology and Biotechnology, Loyola College, Chennai 600 034, Tamilnadu, India.

A study on the relationship of body length in terms of various morphological characters namely body width, head length, thorax length, abdomen length, anteoculus, interoculus, pronotum, outer wing (hemelytron), inner wing, antenna, rostrum, prothoracic leg, mesothoracic leg and metathoracic leg were carried out.

Total body length was chosen as the reference measurement. Morphometric measurements of various body parts were made with reference to the total body length of the life stage of *T. fluviorum* following the procedure of Hungerford and Matsuda [2]. All the measurements of the nymphal instars and adults were plotted against their respective total body length in log vs log graph. Regression coefficients were obtained by adopting the procedure of Huxley [1].

The exponential formula is $y = bx^k$

Where,

b = The initial growth index of the value of y when x equals unity,

k = The equilibrium constant by which y grows in relation to x throughout the ontogenetic stage,

x = The body length taken as reference measurements and

y = Allometrically growing organ

From the formula, is derived the relation log y = log b + k log x, since regression line is drawn by plotting the data logarithmically. Tests of significance for values of `k' and `b' for various body parts were followed based on the work of Hungerford and Matsuda [2].

Test of Significance

Test for growth ratio (k)

$$t = \frac{k_1 - k_2}{S^2k_1 + S^2k_2}$$

Where,

$$S^2k = \frac{d^2y\ x}{(N-2)x^2}$$

$$d^2y\ x = \left[x\ y \frac{(x)\ (y)}{N} \right]^2$$

Test for growth index (b)

$$t = \frac{b_1 - b_2}{S^2b_1 + S^2b_2}$$

Where,

$S^2b = S^2\ y\ x\ [1/N + x^2/\ x^2]$

$S^2\ y\ x = [d2\ y\ x\ /\ N\text{-}2]$

RESULTS

Taking the body length as a reference, the measurements of differentially growing organs at each developmental stage were fitted to Huxley's formula and the regression lines were drawn. Differentially growing organs of *Tenagogonus fluviorum* included in the present study were body width, length of head, thorax, abdomen, anteoculus, interoculus, pronotum, outer wing, inner wing, antenna, rostrum, prothoracic leg, mesothoracic leg and metathoracic leg and their measurements were recorded. Allometric growth was studied throughout the ontogenetic and adult stages and the data thus obtained were measured. The statistical constants growth ratio (k) and growth index (b) were also derived for comparison of the growth pattern of various organs and for representing the logarithmic growth slopes.

Relative Growth Through Ontogenetic Stages: The overall growth of anteoculus, interoculus, inner wing and antenna were seen to be considerably higher than those of other organs. Results revealed that a number of organs showed significant growth through post-embryonic development. The growth of other organs of nymphal instars was more or less similar and did not exhibit such marked variations as recorded in the above mentioned organs. The growth slopes of various organs through the ontogenetic development were recorded.

Adults Through Nymphal Instars: Regression lines for the allometric growth of the growing organs measured from the first nymphal instars through the adults were drawn. While comparing the relative growth of males and females, the growth pattern of almost all body parts remained more or less similar in both except for a few, with reference to leg components, coxae of the three pairs of legs exhibit distinct growth in females, trochanter of the prothoracic and mesothoracic legs show distinct growth in females than in males. High growth rate was observed in body width, thorax length, inner wing, rostrum, prothoracic leg, metathoracic leg in males than in females.

Comparison of Regression Coefficient: The regression coefficient `b' comprises the initial growth index for the value of `y' when `x' equals unity and `k' is the equilibrium constant by which `y' grows in relation to `x' throughout the ontogenetic development.

Growth Ratio (k): A comparison of relative growth ratio among various growing parts including the leg segments was done. Value of the equilibrium constants or growth ratio `k' differed significantly among different growing organs. The `k' values obtained were subjected to a specific test of significance. The growth ratio of post-embryonic stages was maximum in outer wing, inner wing, prothoracic leg, mesothoracic leg and metathoracic leg. Among the components of three pairs of leg, femur and tibia were noted to exhibit an increased growth ratio in every leg. The `k' test of significance showed that the values of `k' for major body organs were more or less the same irrespective of the development of post-embryonic stages to males or females.

Growth Index (B): Values of growth index (b) obtained by the exponential formula of Huxley (1924) for differentially growing parts were recorded. The value of `b' was statistically significant with reference to thorax length, pronotum, outer wing and inner wing through the nymphal stages. Values were subjected to a `t' test of significance at 5 and 1% level with 9 degrees of freedom.

Description of Nymphal Instars: The first nymphal instar was described in detail. Body length (mm) is measured from tip of the head to that of the abdomen, the width across the pronotum; the space between two eyes including the eyes was measured as anteoculus and the space between two eyes excluding eye was measured as interoculus.

First Nymphal Instars: Body length 1.561 ±0.043; body width 0.803 ±0.031; entire margin of the body covered with hair like bristles; general colouration deep fuscous on emergence, becoming brownish after pigmentation; head hemispheric; antenna pale brownish, weakly chitinised, four segmented (1.775 ±0.348); fourth segment longer than the other; rostrum yellow with brown transverse furrow, four segmented (0.940 ±0.088), third segment longer than the other; eye paler, anteoculus 0.473 ±0.025, interoculus 0.300 ±0.026; no wing pads; anterior lobe of the pronotum length 0.238 ±0.030. Prothoracic leg short (1.604 ±0.192) with one segmental tarsi; leg covered by bristles, at the end of the tarsi preapical claw present, coxa shorter (0.099 ±0.029) part which embedded in the body; trochanter 0.143 ±0.029; femur longer (0.597 ±0.089) than others; tibia 0.499 ±0.041; tarsus 0.266 ±0.035. Mesothoracic legs longer (4.176 ±0.587) yellowish with one segmented tarsi, entire leg covered with bristles, presence of preapical claw before apex of the tarsus, coxa shorter (0.153 ±0.027); trochanter 0.249 ±0.034; femur 1.308 ±0.034; tibia longer 1.373 ± 0.205; tarsus 1.093 ±0.131. Metathoracic leg 3.227 ±0.233, yellowish with one segmental tarsi; leg covered with bristles, presence of preapical claw before apex of the tarsus; coxa very short 0.085 ±0.016; trochanter 0.157 ±0.014; femur longer 1.504 ±0.159; tibia 0.971 ±0.062; tarsus 0.510 ±0.033. All appendages very thin and smooth; mesothoracic leg longer than pro-and metathoracic legs. Abdomen dorsally yellowish, ventrally pale, segments clear each with dark line.

Second Nymphal Instar: Body length 4.507 ±0.111; body width 1.442 ±0.031; body brownish; head triangular, length 0.688 ±0.047, eyes rounded and prominent, anteoculus 0.980 ±0.040; rostrum four segmented, slightly brownish, third segment longer than others, hollow groove extended at the end of the fourth segment, stylet longer; antenna four segmented, fourth segment longer than others; no wing pads; anterior lobe of pronotum 0.625 ±0.065. Prothoracic leg short (3.489 ±0.348) when compared to meso (8.042 ±0.301) and metathoracic legs (5.581 ±0.199); femur longer in all the three pairs, appendages very thin and rigid; abdominal segments clear and separated by dark line.

Third Nymphal Instar: Body length 6.247 ±0.225; body width 1.743 ±0.096; which is four times longer than the first; body brownish; head triangular; brown patches just appearing on head; weakly chitinised antennae with four segments (4.609 ±0.160); fourth segment longer than others; rostrum slightly brownish black, fourth segment of rostrum strong; third segment longer than the other; eye pale reddish; anteoculus 1.455 ±0.062; interoculus 0.725 ±0.045; presence of anterior lobe of pronotum; prothoracic leg shorter (5.332 ±0.119) than the meso- (12.318 ±0.550) and metathoracic leg (9.983 ±0.344); mesothoracic leg longer than the others; appendages weakly chitinised.

Fourth Nymphal Instar: Body length 9.333 ±0.381; body width 2.100 ±0.090; slightly brownish; head triangular (1.133 ±0.70); antenna brownish and four segmented,

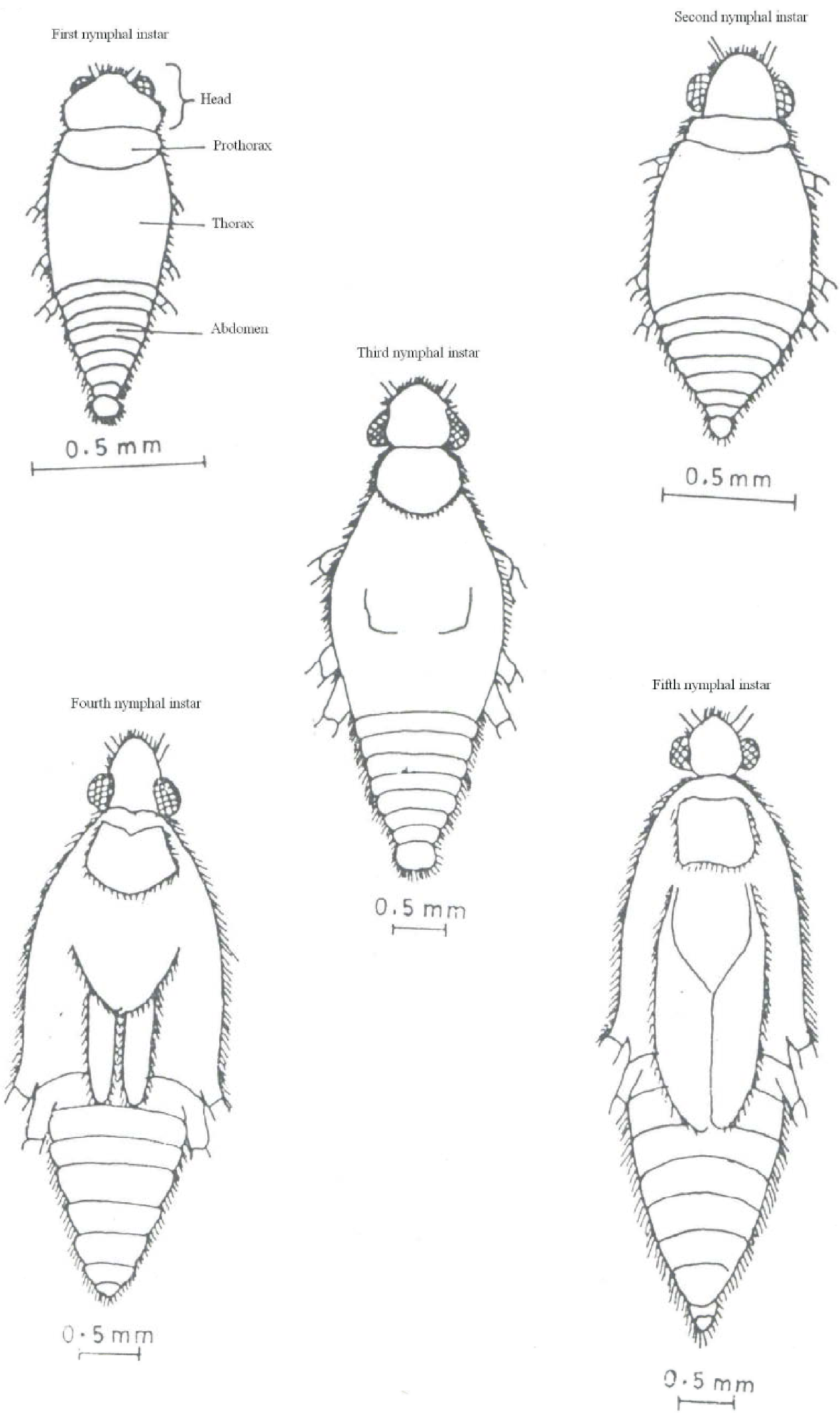

Fig. 1: Post embryonic stages of Tenagogonus fluviorum

Table 1: Morphometric measurements of Post embryonic stages and adults of Tenagogonus fluviorum (in mm)

erial mber	Characters		Nymphs					Adults	
			I	II	III	IV	V	Male	Female
1.	Body length	Mean	1.561	4.507	6.247	9.333	11.340	13.740	13.200
		S.D. ±	0.043	0.111	0.225	0.381	0.437	0.179	0.194
		S.E. ±	0.014	0.035	0.071	0.120	0.138	0.057	0.061
2.	Body width	Mean	0.803	1.442	1.743	2.100	2.754	3.113	3.387
		S.D. ±	0.031	0.031	0.096	0.090	0.083	0.134	0.103
		S.E. ±	0.010	0.010	0.030	0.028	0.026	0.042	0.033
3.	Head length	Mean	0.359	0.688	1.003	1.133	1.220	1.360	1.340
		S.D. ±	0.050	0.047	0.191	0.070	0.032	0.090	0.066
		S.E. ±	0.016	0.015	0.060	0.022	0.010	0.028	0.021
4.	Thorax length	Mean	0.748	2.295	2.732	4.393	5.307	6.420	6.180
		S.D. ±	0.080	0.175	0.082	0.184	0.207	0.104	0.144
		S.E. ±	0.025	0.055	0.026	0.058	0.065	0.033	0.046
5.	Abdomen length	Mean	0.454	1.523	2.505	3.807	4.733	5.960	5.680
		S.D. ±	0.049	0.192	0.067	0.225	0.316	0.110	0.113
		S.E. ±	0.015	0.061	0.021	0.071	0.100	0.035	0.036
6.	Anteoculus	Mean	0.473	0.980	1.455	1.800	1.967	2.200	2.020
		S.D. ±	0.025	0.040	0.062	0.077	0.065	0.089	0.063
		S.E. ±	0.008	0.013	0.020	0.024	0.021	0.028	0.020
7.	Interoculus	Mean	0.300	0.552	0.725	0.844	0.920	0.953	0.940
		S.D. ±	0.026	0.022	0.045	0.035	0.061	0.045	0.038
		S.E. ±	0.008	0.007	0.014	0.011	0.019	0.014	0.012
8.	Pronotum length (*Anterior lobe of pronotum)	Mean	0.238*	0.625*	1.051*	2.854	3.393	4.780	4.460
		S.D. ±	0.030	0.065	0.044	0.155	0.170	0.105	0.135
		S.E. ±	0.009	0.021	0.014	0.047	0.054	0.033	0.043
9.	Outer wing length	Mean	0	0	0	1.960	4.087	8.565	8.377
		S.D. ±				0.225	0.165	0.081	0.025
		S.E. ±				0.072	0.052	0.026	0.008
10.	Inner wing length	Mean	0	0	0	1.393	3.279	8.018	7.762
		S.D. ±				0.124	0.172	0.043	0.046
		S.E. ±				0.039	0.054	0.014	0.015
11.	Antenna length	Mean	1.775	3.358	4.609	5.558	7.024	9.103	8.015
		S.D. ±	0.348	0.260	0.160	0.267	0.380	0.157	0.198
		S.E. ±	0.110	0.082	0.051	0.084	0.120	0.050	0.063
	I segment	Mean	0.313	0.621	1.066	1.495	1.845	2.848	2.479
		S.D. ±	0.087	0.068	0.057	0.146	0.086	0.062	0.070
		S.E. ±	0.026	0.022	0.018	0.046	0.027	0.020	0.022
	II segment	Mean	0.260	0.507	0.828	0.989	1.293	2.031	1.678
		S.D. ±	0.068	0.056	0.046	0.080	0.080	0.054	0.051
		S.E. ±	0.022	0.018	0.015	0.025	0.025	0.025	0.016
	III segment	Mean	0.376	0.723	1.039	1.257	1.611	1.960	1.618
		S.D. ±	0.091	0.068	0.056	0.044	0.101	0.061	0.049
		S.E. ±	0.029	0.022	0.018	0.014	0.032	0.019	0.016
	IV segment	Mean	0.826	1.507	1.676	1.816	2.275	2.264	2.240
		S.D. ±	0.111	0.081	0.081	0.063	0.125	0.037	0.038
		S.E. ±	0.035	0.026	0.026	0.020	0.040	0.012	0.012
12.	Rostrum length	Mean	0.940	1.595	2.072	2.489	3.125	3.960	3.502
		S.D. ±	0.088	0.117	0.051	0.179	0.177	0.172	0.090
		S.E. ±	0.028	0.037	0.016	0.057	0.056	0.054	0.028
	I segment	Mean	0.134	0.146	0.196	0.216	0.292	0.328	0.303
		S.D. ±	0.015	0.015	0.020	0.027	0.036	0.033	0.041
		S.E. ±	0.005	0.005	0.006	0.009	0.011	0.010	0.013
	II segment	Mean	0.174	0.221	0.299	0.300	0.507	0.530	0.471
		S.D. ±	0.240	0.030	0.032	0.036	0.034	0.022	0.027
		S.E. ±	0.076	0.009	0.010	0.011	0.011	0.007	0.009
	III segment	Mean	0.398	0.807	1.015	1.407	1.673	2.518	2.194
		S.D. ±	0.039	0.054	0.044	0.127	0.058	0.203	0.061
		S.E. ±	0.012	0.017	0.014	0.040	0.018	0.064	0.019
	IV segment	Mean	0.234	0.421	0.562	0.566	0.653	0.584	0.534
		S.D. ±	0.030	0.031	0.033	0.035	0.076	0.029	0.028
		S.E. ±	0.009	0.010	0.010	0.011	0.024	0.009	0.009

Table 1: Continued

13.	Length of prothoracic leg	Mean S.D. ± S.E. ±	1.604 0.192 0.061	3.489 0.348 0.110	5.332 0.119 0.038	6.279 0.243 0.077	7.469 0.286 0.090	10.294 0.541 0.171	9.102 0.272 0.086
	Coxa	Mean S.D. ± S.E. ±	0.099 0.029 0.009	0.132 0.016 0.005	0.147 0.019 0.006	0.162 0.012 0.004	0.296 0.019 0.006	0.583 0.076 0.024	0.479 0.034 0.011
	Trochanter	Mean S.D. ± S.E. ±	0.143 0.029 0.009	0.213 0.026 0.008	0.284 0.017 0.005	0.372 0.016 0.005	0.426 0.027 0.009	0.702 0.069 0.022	0.658 0.055 0.017
	Femur	Mean S.D. ± S.E. ±	0.597 0.089 0.028	1.287 0.048 0.037	2.221 0.089 0.028	2.649 0.117 0.037	2.903 0.014 0.036	4.074 0.180 0.057	3.507 0.097 0.031
	Tibia	Mean S.D. ± S.E. ±	0.499 0.041 0.013	1.351 0.160 0.050	1.910 0.079 0.025	2.209 0.116 0.037	2.722 0.113 0.036	3.615 0.157 0.050	3.282 0.093 0.029
	Tarsus	Mean S.D. ± S.E. ±	0.266 0.035 0.011	0.506 0.056 0.017	0.770 0.064 0.020	0.887 0.057 0.018	1.122 0.087 0.028	1.320 0.083 0.026	1.176 0.043 0.014
14.	Length of mesothoracic leg	Mean S.D. ± S.E. ±	4.176 0.587 0.186	8.042 0.301 0.095	12.318 0.550 0.174	15.381 0.395 0.125	18.905 0.386 0.122	28.276 0.450 0.142	24.559 0.268 0.085
	Coxa	Mean S.D. ± S.E. ±	0.153 0.027 0.009	0.236 0.030 0.010	0.290 0.018 0.006	0.326 0.016 0.005	0.408 0.027 0.009	0.774 0.039 0.012	0.625 0.049 0.016
	Trochanter	Mean S.D. ± S.E. ±	0.249 0.034 0.011	0.311 0.023 0.007	0.386 0.031 0.010	0.440 0.015 0.005	0.677 0.049 0.016	0.978 0.523 0.165	0.861 0.043 0.014
	Femur	Mean S.D. ± S.E. ±	1.308 0.034 0.011	3.202 0.103 0.033	4.806 0.284 0.090	6.125 0.115 0.056	7.702 0.213 0.067	11.582 0.125 0.040	9.735 0.100 0.032
	Tibia	Mean S.D. ± S.E. ±	1.373 0.205 0.065	2.654 0.109 0.035	4.546 0.248 0.078	5.734 0.156 0.049	6.845 0.097 0.031	10.565 0.305 0.097	9.509 0.066 0.021
	Tarsus	Mean S.D. ± S.E. ±	1.093 0.131 0.041	1.639 0.080 0.025	2.290 0.111 0.035	2.756 0.182 0.058	3.273 0.179 0.057	4.377 0.086 0.027	3.829 0.076 0.024
15.	Length of metathoracic leg	Mean S.D. ± S.E. ±	3.227 0.233 0.071	5.581 0.199 0.063	9.983 0.343 0.108	12.706 0.235 0.074	16.640 0.430 0.136	24.497 0.637 0.201	21.284 0.592 0.187
	Coxa	Mean S.D. ± S.E. ±	0.085 0.016 0.005	0.153 0.012 0.004	0.291 0.025 0.008	0.363 0.025 0.008	0.458 0.022 0.007	0.677 0.051 0.010	0.579 0.036 0.011
	Trochanter	Mean S.D. ± S.E. ±	0.157 0.014 0.004	0.268 0.013 0.004	0.366 0.033 0.010	0.485 0.035 0.011	0.654 0.076 0.024	0.772 0.037 0.012	0.660 0.061 0.019
	Femur	Mean S.D. ± S.E. ±	1.504 0.159 0.050	2.738 0.105 0.033	5.180 0.156 0.049	5.982 0.099 0.031	8.087 0.111 0.035	12.319 0.256 0.081	10.310 0.246 0.078
	Tibia	Mean S.D. ± S.E. ±	0.971 0.062 0.020	1.672 0.064 0.020	3.077 0.252 0.080	4.576 0.116 0.037	5.768 0.155 0.049	8.651 0.123 0.039	7.929 0.108 0.034
	Tarsus	Mean S.D. ± S.E. ±	0.510 0.033 0.010	0.750 0.035 0.011	1.069 0.051 0.016	1.300 0.059 0.019	1.673 0.215 0.068	2.078 0.222 0.070	1.806 0.108 0.034

Table 2: Comparison of body organs among male and female *Tenagogonus fluviorum*

Male			Female		
Body width	>	Head length	Body width	>	Head length
Thorax length	>	Abdomen length	Thorax length	>	Abdomen length
Thorax length	>	Head length	Thorax length	>	Head length
Abdomen length	>	Head length	Abdomen length	>	Head length
Outer wing length	>	Inner wing length	Outer wing length	>	Inner wing length
Anteoculus	>	Interoculus	Anteoculus	>	Interoculus
Antenna length	>	Rostrum length	Antenna length	>	Rostrum length
Body width	<	Pronotum	Body width	<	Pronotum
Pro leg < Meso leg > Meta leg			Pro leg < Meso leg > Meta leg		
$Co_i < Tr_i < Fe_i > Ti_i > Ta_i$			$Co_i < Tr_i < Fe_i > Ti_i > Ta_i$		
$Co_{ii} < Tr_{ii} < Fe_{ii} > Ti_{ii} > Ta_{ii}$			$Co_{ii} < Tr_{ii} < Fe_{ii} > Ti_{ii} > Ta_{ii}$		
$Co_{iii} < Tr_{iii} < Fe_{iii} > Ti_{iii} > Ta_{iii}$			$Co_{iii} < Tr_{iii} < Fe_{iii} > Ti_{iii} > Ta_{iii}$		
$Co_i < Co_{ii} > Co_{iii}$			$Co_i < Co_{ii} > Co_{iii}$		
$Tr_i < Tr_{ii} > Tr_{iii}$			$Tr_i < Tr_{ii} > Tr_{iii}$		
$Fe_i < Fe_{ii} < Fe_{iii}$			$Fe_i < Fe_{ii} < Fe_{iii}$		
$Ti_i < Ti_{ii} > Ti_{iii}$			$Ti_i < Ti_{ii} > Ti_{iii}$		
$Ta_i < Ta_{ii} > Ta_{iii}$			$Ta_i < Ta_{ii} > Ta_{iii}$		

Co - Coxa; Tr - Trochanter; Fe - Femur; Ti - Tibia, Ta - Tarsus

Suffix i, ii, iii refers to Pro -, Meso- and Metathoracic legs

fourth segment longer than the others; rostrum four segmented, fourth segment being strong; third segment longer than others; stylet shorter; anteoculus 1.800 ±0.077; interoculus 0.840 ±0.035; pronotum well developed, length 2.854 ±0.150; wing pad appeared, wings very short, blackish, inner wing smaller than the outer one; prothoracic leg shorter 6.279 ±0.243 than the mesothoracic leg (15.381 ±0.395) and metathoracic leg (12.706 ±0.235).

Fifth Nymphal Instar: Body length 11.340 ±0.437, body width 2.754 ±0.083; body brownish; head length 1.220 ±0.032, triangular, the brown patch on head extending to the posterior region, antennal length 7.024 ±0.380, brownish, four segmented, fourth segment longer than others; rostrum length 3.125 ±0.177, third segment longer than others; mesothoracic leg longer (18.905 ±0.386) than prothoracic leg (7.469 ±0.286) and metathoracic leg (16.640 ±0.430) (Fig. 1, Table 1&2).

DISCUSSION

A statistical approach to the study of growth pattern of body parts of *Tenagogonus fluviorum* belonging to the post-embryonic instars and adulthood elucidate the following aspects. It is interesting to observe that a number of organs revealed significant growth through post-embryonic development. This is well reflected in anteoculus, interoculus, inner wing and antenna. According to Macan [12] the great elongation in head is apparent in *Hydrometra* which is also a supraaquatic hemipteran. The prominent growth of antenna is in confirmity with the earlier work of Hoffmann [13] on *Limnogonus fossarum*.

With reference to leg components, coxa of the three pairs of legs exhibit distinct growth in females, trochanter of the prothoracic and mesothoracic legs show distinct growth in females than in males suggesting thereby the possibility of increased utility of legs in females for various activities. It may hold good to suggest that the leverage of trochanter and coxae in female may assist in the escape from male harassment during the mating process. It is pertinent to report the work of Nummelin [14] that female gerrids increase their dispersal tendency from the area with reduced food availability. Thus the growth of specific components of body parts in a particular sex than the other is noted in gerrids, which is in accordance with the report of Kannappan [6] in hydrometrids. This is particularly observed with regard to the growth pattern of the leg segments. In addition, the phenomenal growth of leg components may assist in oviposition. Krupa *et al*. [15] reported that the female waterstriders actively forage in open water but quickly hide along the shoreline when unpaired males approach them. Such a high leverage coefficient has also been suggested in the forelegs of *Martarega* and *Notenecta* by Gittelman [3].

Also the results on allometric growth pattern on *Tenagogonus fluviorum* indicate the occurrence of sex dependent variation, in particular, the high growth rate observed in body width, rostrum, prothoracic leg, inner wing, thorax length and metathoracic leg in males than those of females. Specifically the growth of thoracic length in male deviates with an increasing trend from the early nymphal instars when compared with those of females. Probably such a deviation may promote the growth pattern of legs, which was also recorded in the present investigation. Though coxa of the legs grow distinctly in females, the overall growth of the legs in males, being distinct may enhance their opportunity of harassment of the females by climbing on them and enjoying the free ride in order to have the mating success. Thus the overall growth pattern of gerrids irrespective of the sex or the nymphal stages-seems to follow the law of single phase allometry. This is in support of the earlier work of Rao [16], on *Gerris spinolae* and *Limnogonus nitidus*. Although the sexual dimorphism in the growth pattern occur in *Tenagogonus fluviorum*, growth in certain body parts namely head length, interoculus and abdominal length was similar in both the sexes.

Recent studies on allometric growth emphasise the geographical pattern of morphometric variation as in *Gerris costae* [17], application of Dyar's rule in waterstriders [18], ontogenetic and evolutionary allometry [19], size and shape related allometry in *Gerris remigis* [10] to the application of statistical analysis namely Canonical Variate Analysis (CVA) and Canonical Trend Surface Analysis (CTSA). It is known that gerrid distribution in India is large and if one analyses the allometric growth of many species of gerrids in India, it may throw light on biodiversity of gerrids related to the heterogenecity in the habitat pattern in Indian water bodies.

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