A LABORATORY STUDY ON THE LIFE CYCLE OF *ISCHNURA EVANSI* (MORTON)(ODONATA : COENAGRIONIDAE) FROM A POND AT BASRAH.

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Abstract

The life cycle of *Ischnura evansi* (Morton) from Basrah region has been studied under laboratory conditions . Females layed their eggs on the stems of the submerged portions of *Bacopa monniera* . Hatching occurred at a temperature limits between 12 and 40 °C. The embryonic development was compeleted within 31 days at 12 °C and 7 days at 40 °C water temperature . Larval development was rapid and signficantly corelated with high temperature . Instar duration were increased with the progress of age while discreasing with the rising of temperature. After hatching the insect showed 13 instar before the attaining of the adult stage. The total period from egg to adult were between 197 and 278 days at a 40 °C and 25 °C respectively .

INTRODUCTION:

The damselfly *Ischnura evansi* (Morton) is abundant insect species in the aquatic habitat of Shatt Al-Arab region.Their larvae are found during the most period of the year in the ponds and tributaries of aquatic vegetation. Recently Ali. *et al*.(2002) had investigated the larval ,ecology, growth , abundance and the seasonal variation of this species in Garmat Ali. The population structure of the month were composed of monomodal or multimodal distribution of the insect larvae ,with a mean monthly density of 196 ind. per m^2 .

Khalaf and Al-Omer, (1974); Al-Ali ,(1977) and Abdul-Karim,(1994), have been reported some informations on the taxonomy and distribution of the species.

As in other species of Zygoptera, *I. evansi* has several instars during the life cycle from hatching to adults insect and the larval development which occur in aquatic habtat varions is highly affected by the ecological factors, particularly, temperature (Gillott,1974; Benke, (1976);

Waringer and Humpesch, 1984; Corbet,1999).

The purpose of this study was to follow the life cycle stages of , *I. evansi* experimentally at different temperatures in laboratory. The results then , would be useful to applied for filed study .

MATERIALS AND METHOD:

The laboratory studies of the different life cycle aspects were based on fertilized females, captured from the field at a tandem condition .In laboratory, each female was inculated in a glass jar (500ml) supplied with a wited filter paper with water and stems of *Bacopa monniera* (L.) (aquatic plant) for a perch (Cordero, 1990) . The mouth of the jars were closed with gauze and the females were watched until oviposition occurred.

The eggs describtion, dimention and development were done using dissecting microscope. When a female lay eggs on the filter paper , the eggs were divided into 10 replicates each with 30 eggs before placed in a plastic petri-dishes (5x 1.5 cm) containing a small quantity of water . Eggs development were investigated at several constant temperatures (10, 12, 15, 20, 25, 30, 35, 40 and 43°C) in cooled incubator.

For larval stage development, several experiments were performed in cooled incubator by using 50 newly-hatched larvae (8h.old) for each experiment. Larvae were placed individually in 40 ml plastic tubes that were filled with tap water and a stem of the plant *Bacopa moniera* for a perch. The larvae were fed on *Artemia salina* nauplii (Cordero, 1990), when the larvae reach the instar five they were transferred to bigger tubes filled with 75ml water . The grouth of successive instars were followd by detecting the larval moults and recording the duration time for each instar. The identification of different instars number were done according to Benke(1970), were the final instar=0, penultimate =1, antepenultimate =2 ,etc.

The morphometric measure-ments were done by using a micrometer fitted with the eye-piece of a dissecting microscope (reading were made to the nearest 0.01mm.). The head width was taken across the widest part of the head, usually from the tip of one eye to the tip of the other and the total body length was measured from the anteriormost point

of the head to the tip of the abdomen without caudal gills (Britt, 1953).The growth and larval development experiments were done at 3 constant temperatures (25,35 and 40 ± 1 °C).Adults that emerge from the final larval instar were maintained in auarium supplied with *Drosophila* as food and they were observed until the appearance of the males and female colors (Cordero,1990).

RESULTS:

Incubation period:

The effects of temperature on eggs hatching and incubation period are shown in (Table 1). The temperatures values 12 and 40 °C were found to be the lower and upper limits of eggs hatching, respectively .However the percentages of hatching were positively increased with increasing temperature and the optimum hatching was recorded at 35°C.

The incubation period was inversely related to temperature. The period was reduced from 31 days at 12 °C to only 7 days at 40 °C and the ANOVA test showed that the differences is highly significant ($F_{(6,28)}$ 41.9,P<0.001). Furthermore the differences were significant between 12 and 25°C and between 25 and 40°C (P< 0.05).

Table (1): *I. evansi* , laboratory study . Incubation period and egg hatching at different temperatures (different letter represent significant differences, one – way ANOVA).

Temp. (^{o}C)	Incubation period (days) (mean and range)	Hatching (%)
10	- -	No hatching
12	a 31 (26-37)	40
15	a 26 (23-30)	67
20	ab 23 (20-27)	81
25	ab 20 (17-23)	96
30	b 14 (11-19)	99
35	b 10 (9-12)	100
40	c 7 (5-10)	43
43	- -	No hatching

The egg stage:

The egg of *I. evansi* is of cylindrical shape, white-yellowish become orange - brown after 48h. They are narrow and smooth at the front end having a funnel-shape, which is somewhat free. Its length was ranged from 0.71-0.78, X=0.75mm and the diameter ranged from 0.18-0.22, X=0.20mm (n= 52).

The larval development:

The first larval instar was moulted 12 times before emerged (Table 2) and therefore the insect completed through 13 instars. Moreover , the number of instars was remained constant at all tested temperatures (25,35 and 40 °C)

Instars duration times and temperature:

In general it appear that temperature had an effective role on the duration time of various instars. The mean duration time of instars (in days) were ranged from 1.0 ± 0.17 at 25 °C to 0.5 ± 0.01 at 40°C for instar (12) and from 69.9 ± 0.12 at 25°C to 58 ± 0.110 at 40°C for instar (0) (Table 2). It's obvious that temperature and the instar duration times are inversely correlated.

Instars duration times and growth

The duration time become longer as the larvae moulted and growing under all tested temperatures (Table 2). For example in instar (12) it takes 0.5-1.0 day at 40 and 25°C respectively . Whilest in instar (0) it takes 58.0-69.9 days at 40 and 25°C respectively. However, the general relationships between instars duration times and instars number (growth) can be represented by a linear correlation equations as given in (Table 3). The relations equations for the 3 examined temperatures (25,35 and 40°C) indicated that the duration time was increased directly as the larvae become older at all temperatures and the correlation constants (a and b) was increasing too.

Head size increments:

The head size increments represented by the increments of the head width of the larvae at different temperatures are shown in (Table.4) . In general the results showed that increments increased graduelly with highest values of the last two instar (o.327-0.377mm).however ,despite that larvae reared at higher temperature, could have wider heads, for example the mean H.W of the

larvae at instar (12) was 0.37 mm. at 25 °C, 0.39 mm. at 35 °C and 0.40 mm at 40°C. For the final larvel stage, the instar (0). The mean H.W. were 2.89,2.95 and 3.10mm at 25,35 and 40°C respectively, the statistical ANOVA test showed that differences is not significant .

Table (2): *I. evansi* (Garmat Ali , Basrah) , laboratory study. Instar numbers and duration time at different temperatures . final instar = 0 , penultimate =1 , antepenultimate =2 , etc.

Instar	Duration time (days)		
	25 °C	35 °C	40 °C
	(mean ± SD and range)	(mean ± SD and range)	(mean ± SD and range)
12	1.0 ± 0.171 (0.99-2.0)	1.0 ± 0.029 (0.99-2.0)	0.5 ± 0.011 (0.5-1.0)
11	7.6 ± 0.095 (7-16)	4 ± 0.090 (3-6)	2.8 ± 0.120 (2-4)
10	8 ± 0.103 (7-15)	4.4 ± 0.112 (3-6)	3.1 ± 0.70 (2-4)
9	8.3 ± 0.071 (6-21)	5.7 ± 0.192 (4-13)	4.25 ± 0.91 (3-7)
8	9.5 ± 0.05-75 (6-15)	7.3 ± 0.56 (5-12)	4.7 ± 0.022 (5-9)
7	10.7 ± 0.104 (9-12)	7.6 ± 0.171 (6-14)	5.2 ± 0.110 (3-8)
6	13 ± 0.100 (8-16)	9.4 ± 0.121 (6-18)	7.1 ± 0.142 (5-17)
5	15.7 ± 0.920 (14-17)	13.6 ± 0.056 (11-21)	8.5 ± 0.082 (5-13)
4	20.5 ± 0.090 (14-27)	18.8 ± 0.092 (14-28)	11.5 ± 0.012 (10-17)
3	30.3 ± 0.64 (24-24)	24 ± 0.187 (20-46)	22.5 ± 0.101 (31-17)
2	36 ± 0.48 (32-51)	31 ± 0.54 (27-45)	27 ± 0.099 (13 –28)
1	48.2 ± 0.96 (39-57)	42.7 ± 0.090 (34-50)	36.5 ± 0.107 (29-41)
0	69.9 ± 0.124 (41-70)	62 ± 0.104 (44-73)	58 ± 0.110 (43-73)

Table (3): *I. evansi* (Garmat Ali , Basrah) , laboratory study . Linear correlation equations between duration times and instars at 3 temperatures, Y = a + bX , Y is instars and X is duration time , a and b are constants.

Temp.(°C)	Relation	R	N	P
25	Y = 3.23 + 0.17 X	0.89	13	< 0.05
35	Y = 3.66 + 0.19 X	0.88	13	< 0.05
40	Y = 4.03 + 0.197 X	0.86	13	< 0.05

Table (4): *I. evansi* (Garmat Ali , Basrah) , laboratory study. Mean head width (mm) at different temperatures. No, number at speimaes final instar =0 penultimate =1 , antepenultimate =2 , etc. ,mean moult increment (Mo.)

Instars	Head width (mm)			Mo.
	25 °C	35 °C	40 °C	
	(mean ± SD and range and No)	(mean ± SD and range and No)	(mean ± SD and range and No)	
12	0.25 ± 0.016 (0.03-0.30) 50	0.25 ± 0.017 (0.23-0.30) 50	0.25 ± 0.020 (0.23-0.30) 50	
11	0.37 ± 0.025 (0.32 – 0.40) 50	0.39 ± 0.019 (0.30 – 0.42) 41	0.40 ± 0.021 (0.30 – 0.49) 50	0.137
10	0.47 ± 0.050 (0.40 – 0.55) 50	0.51 ± 0.05 (0.40 – 0.57) 39	0.54 ± 0.22 (0.47 – 0.69) 50	0.120
9	0.61 ± 0.065 (0.50 – 0.65) 50	0.64 ± 0.073 (0.55 – 0.80) 39	0.78 ± 0.012 (0.67-0.97)50	0.170
8	0.73 ± 0.069 (0.63 – 0.85) 48	0.86 ± 0.107 (0.63 – 1) 34	0.93 ± 0.11 (0.82 – 1.17) 50	0.163
7	0.85 ± 0.079 (0.75 – 0.97) 45	1.08 ± 0.065 (0.97 – 1.25) 34	1.22 ± 0.120 (1.10 – 1.45) 50	0.21
6	1.01 ± 0.094 (0.89 – 1.19) 45	1.26 ± 0.104 (1.12 – 1.50) 30	1. 45 ± 0.110 (1.35 – 1.72) 42	0.19
5	1.24 ± 0.104 (1.12 – 1.42) 42	1.43 ± 0.112 (1.30 – 1.69) 30	1.70 ± 0.120 (1.52 – 1.89) 40	0.217
4	1.44 ± 0.108 (1.29 – 1.62) 42	1.64 ± 0.121 (1.37 – 1.85) 30	1.97 ± 0.164 (1.77 – 2.25) 36	0.227
3	1.64 ± 0.065 (1.60 – 1.77) 40	1.98 ± 0.214 (1.62 – 2.32) 29	2.29 ± 0.141 (2.17 – 2.52) 36	0.253
2	1.92 ± 0.012 (1.75 – 2.25) 39	2.27 ± 0.191 (2.10 – 2.72)25	2.62 ± 1.90 (2.54 – 2.90) 34	0.286
1	2.30 ± 0.192 (2.15 – 2.55) 37	2.62 ± 0.019 (2.44 – 2.87) 23	2.89 ± 0.097 (2.57 – 3.01) 34	0.327
0	2.89 ± 0.120 (2.25 – 3.01) 37	2.95 ± 0.131(2.75 – 3.12) 20	3.10 ± 0.99 (2.75 – 3.22) 34	0.377

Adults:

Laboratory observations showed that the adult insect emerged from the final larval instar by a departure on the dorsal plate of the head and thorax. The male of the insect were found to have one colour, they are only blue, whereas the females were polymorphis in colours and may be like male (homeochromes, andromorphs), brown (heteroc-hromes, gynochrome) or orange-brown (heterochromes, androchrom-otypics).

DISCUSSION:

Under controlled conditions *I.evansi,* hatched at relatively wide range of temperatures (12-40°C) and showed a rapid embryonic development, particularly at the upper temperature limits. Hatching was completed in 1day at 40°C. Generally lower embryonic growth, were reported for other species at different other regions. Waringer and Humpesch (1984) had reported that hatching of *Coenagrion puella* from lower Austria occurs within the temperature range 12-28°C. Furthermore, they mentioned to the results of other studies (Boehms, 1971; Sawchyn and Gillott, 1974; Rivard.*et al.,* 1975) for a number of species which have similar ranges (12-28°C) or slightly wider but however, their upper limits were not more than 30°C verteuelly this is 10°C.less that The shortest periods for embryonic development recorded in these studies were, 15 days in *Coenagrion resolutum,* 16 days in *C. angulatum* , 12 days in *C. puella*. Neverthelless, temperature has been shown to be the major factor determining the aggs development time in moulted environments (Corbet, 1960; Waringer and Humpesch, 1984). Obviously, the present results reflects the subtropical habitat of *I. evansi* .

After hatching, odonata could have a number of moults usually, ranged between seven to thirteen moults before the adult stages attained (Corbet, 1980). For *I. evansi* thirteen moults has been found to complete the larval development and this number was found to be constant at all studied temperature conditions (25,35 and 40°C).

Actually the effects of temperature on growth may appear in different ways. In one way temperature has a direct positive effect on the size, so the larvae could

have larger size when hatched and reared at higher temperature. This relationship has been reported in many other species of damselfly such as, *I. elegens*, *C. resolutum, C. puella*, *Pyrrhosoma nymphula* (Lawton, 1971; Thompson, 1978; Baker and Clifford, 1981) and dragonfly such as *Aeschna mixa* and *Papopleura lucia* (Schaller, 1972; Hassan, 1976). From other way the duration time of the larval instars become shorter at rising the temperature as for example in this study when temperature rised from 25°C to 35°C and to 40°C. Actually the reverse relationship between temperature and intermoult period or the instar duration time is well documented for insects and crustacea, in general (Grodzinski, *et al*., 1975; Downing and Rigler, 1984).

On the basis of the results of the present study the life cycle of *I. evensi* can be completed, under laboratory conditions, within 197 days at the upper limit of temperature (40°C) and within 278days at 25°C. Despite the period of development is less than one year it can not be concluded that the population of *I. evensi* is a semivoltine, before further investigation on the ecology of the insect is done in the field. But because of some European Coenagrionidae had been found to have a semivoltine populations, e.g. *C. hastulatum* (Haritonov, 1977) and *C. resolutum* (Baker and Clifford, 1981) as well as many crustacean species, living in the same region *I.evansi* i.e in Shatt Al-Arab river system, have been found semivoltine (Ali and Salman, 1987; Salman*, et al*., 1996), therefor it can be expected that the population of *I. evansi* is able to produce more than one generation during the year.

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دراسة مختبرية لدورة حياة النوع

ISCHNURA EVANSI (MORTON)(ODONATA : COENAGRIONIDAE)

من بركة في البصرة

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الخلاصة

درست دورة حياة الرعاش الصغير *Ischnura evansi* في الظروف المختبرية وبينت النتائج ان الأناث تضع بيضها في سيقان نبات البربين المائي *Bacopa moniera* تحت سطح الماء، و ان فقس البيض يحدث في المدى الحراري بين 12 و 40 ْم ، والتطور الجنيني يكتمل بمدة 13 يوماً في حرارة 12 ْم و 7 ايام في حرارة 40 م ه . التطور اليرقي كان سريعاً نسبياً ويرتبط معنوياً بدرجة الحرارة وان مدة الطور كانت تزداد مع تقدم العمر بينما تقل مع زيادة الحرارة . بعد الفقس تمر الحشرة بثلاثة عشر طوراً حتى تصل مرحلة البلوغ . ان المدة الكلية لقضاء مرحلتي التطور الجنيني واليرقي تتراوح مابين 197 و 278 يوماً تحت ظرفي الحرارة 40 و25 ْم على التوالي .