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LIFE HISTORY STUDIES ON THE DAMSELFLY *Sympecma paedisca* BRULL (ODONATA :LESTIDAE) IN A SHALLOW POND IN GARMAT-ALI, BASRAH

M. R. Annon
Dept. of Biology, College of Education, University of Basrah, Iraq

ABSTRACT

Life history of *Sympecma paedisca* Brull has been investigated in a combined field and laboratory study. The field study is conducted a shallow pond in Garmat-Ali, Basrah in the period from October 1997 to September 1998. Some environmental factors such as temp., D.O., PH. and salinity were measured. The field results indicate that the life cycle is univoltine, however this species is unique in that it does not enter nymphal diapause .Emergence is rather an unsynchronized and dispersed temporally. Sexual maturation requires four weeks. Oviposition site is *potamogeton*. The laboratory study revealed that incubation period was 14 days at 27 °C. The nymphal stage includes twelve instars and requires 252.5 days for completion the development. The whole life cycle requires 266.5 days.

INTRODUCTION

The Zygoptera, or damsel flies are considered amtong the important insects in and around Shatt-Al-Arab river, Basrah province.

In Iraq, so far as author is a ware, prior to the present study the literatures on Zygoptera are largely taxanomic or faunastic records (Khalaf and Al-Omer, 1974; Al-Ali, 1977; Abdul Karim, 1994 a, b).

Sympecma paedisca Brull, was designated as one of the most widely distributed species of the family Lestidae in Iraq (Khalaf and Al-Omer. 1974; Al-Ali, 1977). However, until now, no information was available on the different aspects of the species biology.

Although life history studies are usually done for the sole purpose of elucidating the biology of a particular species, it is often desirble to compare natural individual growth rates between population. Such comparisons are useful in determining differences between populations in separate geographic regions, or in correlating growth rates with separate geographic regions or in correlating growth rates with environmental factors such as temperature (Benke, 1970).

In addition, this study is important as southern part of Iraq has versatile climate, also in this region Shatt-Al-Arab river characterized by oligohaline brackish water.

The present study was carried out as a combined field and laboratory investigation of the life history of *Sympecma paedisca*, particular attention was given to the rate of nymphal growth and to environmental factors as they influenced the timing of moulting , emergence and oviposition.

MATERIALS AND METHODS

I. Field study :

1. Study Area

All field studies were conducted in small pond located on the rigth bank of Shatt-Al-Arab river Garmat-Ali (30' 34 '' N., 47 46" W.)

The pond was permanent , shallow with a maximum depth of one mwter and a surface area of 500 m. A number of jrasses and shrubbs were loccaaated at the land – water intwrface.

Phragmites australis was distributed rather extensively over much of the littoral zone in water less than one meter deep, this emergent plant was served as site for emergence and contributed to the under water environment for nymphs.

Potamogeton, Eloeda and *Ceratophyllum* covered as much as 60% of the bottom. *Myriophyllum* and *Chara* were present but less predominant.

The animal community in the study pond represented by different groups of invertebrates *Lymnea* and *Melanoides* were the major zoobenthos, while the zooplankton represented by *Daphnia* and *Simocephalus*.

The insect fauna showed agreater diversity than others and represented by naids of *Brachythemis* (fam.: Libellulidae), nymphs and adults of *Notencta* (order: Coleoptera). Different species of Chironomidae were present in addition to the nymphs of studies species *Sympecma paedisca* .

2 . Measurement of environmental factors:

A number of physical and chemical factors of pond water such as temperature, dissolved oxygen, salinity and PH were measured every month along the period of field work .

3. Sampling in the field:

From October 1997 to September 1998, samples of nymphs of *S.paedisca* were taken at 2-4 weeks intervals. A shorter sampling interval was adapted in summer because nymphal development was expected to take place more quickly in the higher water temperature of summer .

An open–ended tin with an area of (25 x 25) cm^2 was used for sampling. Five samples were taken on each sampling occasion on a stratified random basis. The pond perimeter was divided into five equal zones and one sample taken at random (using random number tables) within each zone.

The distance of the sample from the pond edge was chosen arbitrarily, but in each the water depth was about 60 cm.The samples were taken by inserting the tin into the bottom among dense stands of floating and emergent vegetation. After replacement in the water, the content (vegitations) of the tin were removed and washed in situ and the nymphs picked out by hand, retentive water was removed by scoop and sieved through a screen 0.200 mm mesh to retain remaining nymphs (Baker, 1986).

Plastic bags were used to transfer the individual samples to the laboratory, where nymph were identified, counted and their head width and wing pad length measured using a microscope with a micrometer eye-piece to the nearest 0.1 mm. Mean instar number was calculated for the nymphs in each collection according to the method described by Benke (1970).

To ovoid cumbersome names of instars the following abbreviated synonms will be used: Ultimate= final= F; Penultimate= P; Antepenultimate= A; Antepenultimate minus-one= A-l; Antepnultimate-minus- two= A-2; etc. (Sawchyn & Gillott, 1974).

II. Laboratory study:

The life cycle of the damsel fly *S. paedisca* was studied in laboratory and performed in cooled incubator under constana temperature of 27°C and Photoperiod of 12 hrs. L12 hrs D.

Newly laid eggs were obtained from fertilized females. Those females were captured in the field and transported to the laboratory. Mated females were placed in individual oviposition chambers with damp filter paper as an oviposition substrate and with wood switch for perching (Cordero, 1990).

Newly hatched nymphs were transferred individually in (5x2) cm. Plastic tube containing 20 ml of dechlorinated water. When the nymphs reached to the ultimate stage they were kept singly in a larger tubes (3x10) cm containing 100 ml water.

The nymphs were fed on a suspension of copepods (*Cyclops* sp.). The water and food were changed twice a week through the whole experiment.

Early nymphs were examined every day while later instars were examined twice a week. After each moult the exuviae were removed and each nymph was transferred with a pipette to a microscope slide for measuring the head-capsule width under a microscope to the nearest 0.1 mm.

RESULTS AND DISCUSSION

I. Environmental factors:

The seasonal changes in air and water temperature ,dissolved oxygen pH, and salinity the period from 15 October 1997 to 15 September 1998 are presented in Figures 1, 2, 3, and 4 respectively.

It is one of the basic tenets of ecology that the success of organisms in a particular ecosystem is determined in part by the suitability of the environment. Among the most obvious aspects of the environment that might affect are the average temperature, the concentration of respirable oxygen, the pH and the ability of the ecosystems to produce sufficient food. (Downing and Rigler, 1984).

Temperature has long been known to influence rates of activity from molecular to an organism scale. It is not surprising, therefore that temperature variation cold have either positive or negative effect on the organism.

The present results revealed that immature stages of *S. paedisca* survived in temperature range of 11-41°C throughout the year. In contrast some species of Lestidae can survive under the rigorous conditions of winter (Sawchyn and Gillott, 1975).

On the other hand values of dissolved oxygen in the study pond which ranged (4.6-9.0) mg/l referred to inverse correlation between temperature and dissolved oxygen. However the pond water never reach the critical value (4.0 mg/l) that reflected the pollution status (Jonson, 1984).

PH was considered to be an important limiting factor and thus to be a promising overall indicator for determining the general ecological condition of aquatic environment (Odum, 1972).

The current investigation described the pond water was moderately alkaline (pH=7.2-9.6) as shown in Figure (3). This alkalinity may be a result of carbon dioxide consumption by phytoplankton in the pond (Rosenberg, 1995).

The results of salinity obtained in the present study show that the pond is oligohaline according to the classification of (Reid, 1961). This value of salinity is comparable to that on other studies in Shatt-Al-Arab region (Al-Asadi, 1996).

II. Life cycle in the field

A. Nymphal development:

The following description is based information obtained from samples for a period of one year and provided in Figure (5). These information also will be considered to develop a picture of the dynamics of nymphal life.

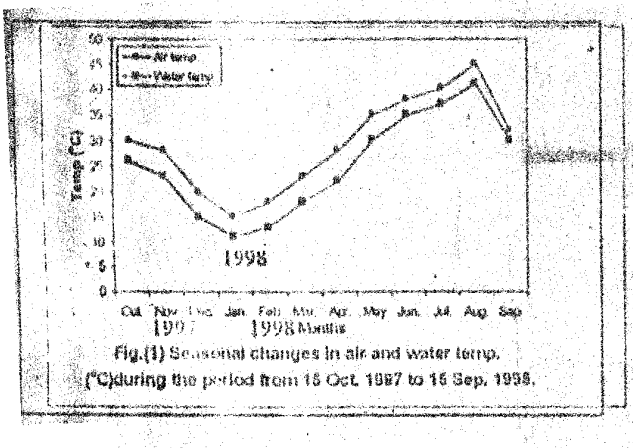

Fig.(1) Seasonal changes in air and water temp. (°C)during the period from 15 Oct. 1997 to 15 Sep. 1998.

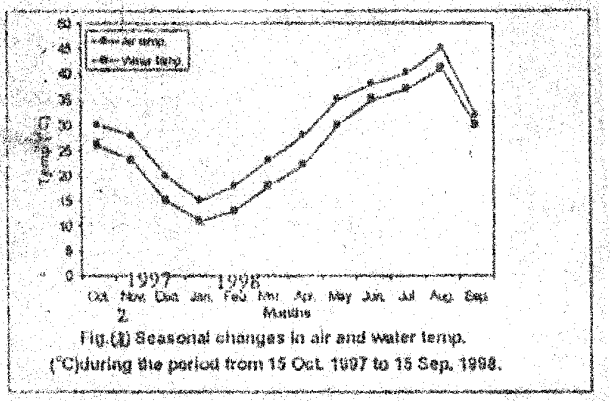

Fig.(2) Seasonal changes in air and water temp. (°C)during the period from 15 Oct. 1997 to 15 Sep. 1998.

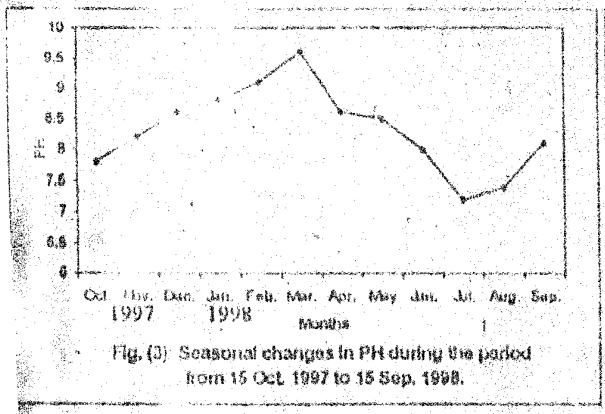

Fig. (3) Seasonal changes in PH during the period from 15 Oct. 1997 to 15 Sep. 1998.

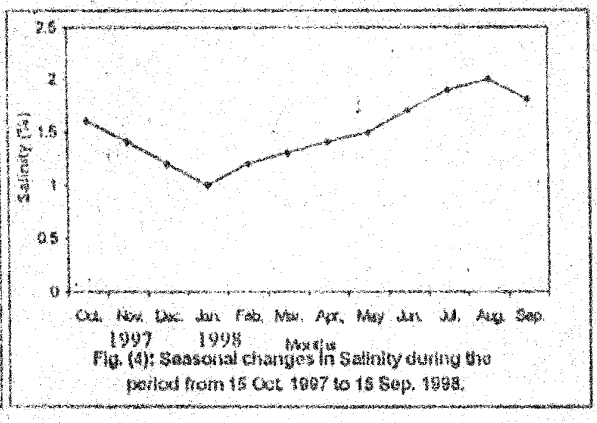

Fig. (4): Seasonal changes in Salinity during the period from 15 Oct. 1997 to 15 Sep. 1998.

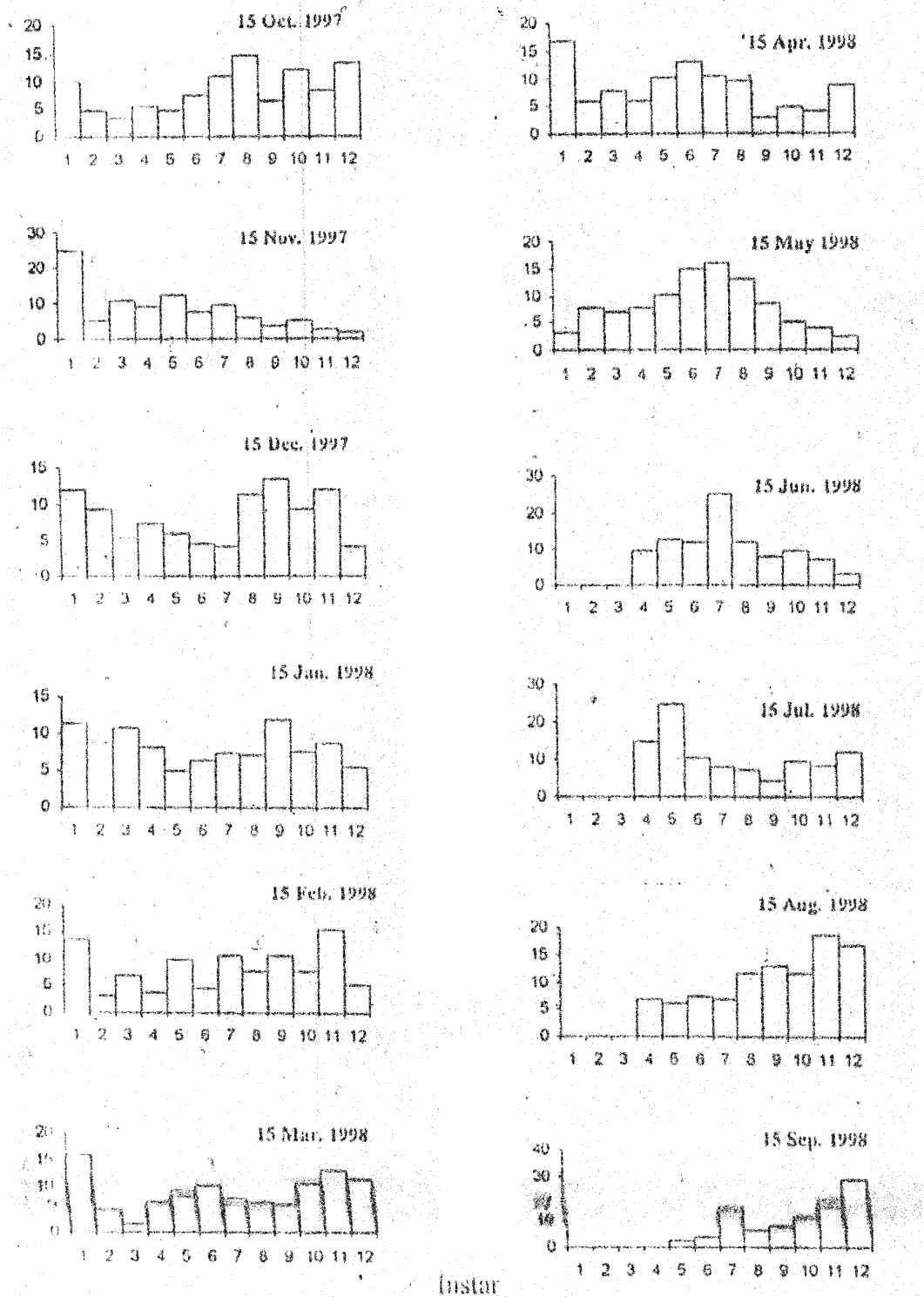

Fig. (5) The instar frequency distribution of *S. paedisca* nymphs on each sampling occasion at the study pond during the period from 15 Oct. 1997 to 15 Sep. 1998

In the collection made between mid-October 1997 and mid-may 1998, the nymphal population represented by twelve instars and population structure persisted with a noticeable increase or decrease in frequency percentages for each instars. This reflects a continuous recruitment to the population is associated with continuous unsynchronized development.

The summer samples showed great difference than those in the preceding months. The population structure characterized by the absence of first three nymphal instars (A-9 to A-7). This reflects that there are no new hatched nymphs entered the population in that period.

By September 1998, there were four instars absent (A-9 to A-6) and the last three instars (F,P and A) comprised about 60% of the population.

B. Emergence:

Nymphs about to emerge move into very shallow water, there they found abundant of growth of emergent vegetations such as reed upon which they can emerge. The exuviae were found up to 10 cm above the water surface. The date on which emergence began was the first week of September. Newly emerged were first seen on 4 September.

Emergence period of this species is long and continuous lasting several months until mid-May. Thus emergence in this species rather unsynchronized and dispersed temporally.

Interesting comparison can be made between the pattern or emergence and the average daily temperatures (average of daily high and low) during emergence period. It appears that emergence in this species is influenced significantly by ambient temperature. The lowered emergence rate observed coincided with above normal average temperatures.

Figure (5) The instars frequency distribution of *S. paedisca* nymphs on each sampling occasion at the study pond during the period from 15 Oct. 1997 to 15 Sep. 1998.

By the second week of May no emerged adult observed in the vicinity of the study pond. During this time the temperature raised to about 35°C. Although emergence terminated on that date and was lasting for June, July and August, Final instars may still be found in the population (Fig. 5).

The results obtained in the current investigation concluded that this species has long emergence and flight periods, consequently its reproductive periods overlap considerably.

Indeed, Zygoptera generally appear to have long reproductive periods compared with Anisopter. Of the British species of Odanate Corbet (1962) found that 75% of Zygoptera but only 25% of the Anisoptera have long asynchronus emergence (and consequently reproductive periods).

Similarly, in a comprehensive study of the Odanate of North Carolina, long flying seasons were observed is 72% of the zygoptera and only 28% of Anisoptera (Paulson and Jener, 1971).

The long reproductive periods of the zygoptera mean that a wide range of nymphal instars are present throughout much of the year, while the short reproductive periods of Anisoptera mean that the nymphs grow in Cohort (Johannsson, 1978).

Corbet (1962) categorized two ecological group of Odanata on the extent to which they achieve seasonal regulation. He used criteria the position of a diapause stag, pattern and duration of emergence periods, and mechanisms by which development and emergence synchronized.

Corbet has designated as "Spring species" those exhibits diapause in the final (last) instars and emerge synchronously i.e., all emergences occurring within a relatively short period . Summer species do not diapause as final instars, the emergence period in these forms is more widely dispersed temporally due to a lesser degree of synchronization caused by the lack of final instars diaplause. The varying degrees of synchrony in summer species required Corbet to recognize two types of summer species, those developing within one year (univoltine) and those required two years to develop (Semivoltine). However it is now recognized that there is a wide spectrum of life history types between these two extremes (Paulson and Jenner, 1971).

The present study has shown that the life cycle of *S. paedisca* in this locality conforms to Corbet's univoltine aummer species as based on a nymphal development and an asynchronus emergence pattern.

The univoltine life cycle of *S. paedisca* is similar to that of most Lestidae, however this species is unique among lestids that have been studied so far in that it does not enter *nymphal diapause*.

C. Mturation and Oviposition.

Teneral individuals (all specimens with typical viterous sheen on the wings; first and second day after emergency) were capable of weak flight and seen in large numbers on the vegetations around the pond.

After emergence *S. paedisca* disappeared for approximately four weeks (period of sexual maturation) before returning to the pond to breed.

First records of adults in tandem were made on the first week of October.

The tandem position is achieved while the females are perched. Mating occurs on the vegetation along the shore. The occurrence of maturation in zygoptera some distance from the emergence site has been well documented (Corbet, 1963).

In the present study adults of *S. paedisca* may be found in hedgerow about 100-150 meters from the study pond. Sexual maturation (time elapse between emergence and oviposition) requires four weeks. This time is comparable to that in Zygoptera (Corbet, 1962).

Gower and Kormondy (1963) recorded 21-24 days interval between emergence and oviposition in *Lestes rectangularis; Leongener* allso required 3 weeks for sexual maturation (Sawchyn and Gillott, 1974).

It is noteworthy that like most Odonates which return to the oviposition site prior to mating, the males preceding the females. Corbet (1956) noted the same thing in *L. sponse* and suggested that this was caused by more rapid maturation of the males rather than earlier emergence.

Oviposition is endphytic. The preferred oviposition site are stems or stalks of the floating plant *Potamogeton*, which emerge 2-3 cm above the water surface, inspite of the occurrence of other aquatic plants.

The eggs are laid singly in an incision spaced 1 mm apart along the length of the stem in spiral arrangement. When oviposition was complete, the mating pair released their grasp and fly.

Corbet (1962) explained that although a variety of vegetaion is available preference of oviposition sites commonly shown by a aparticular species.

L. rectangularis oviposited almost exclusively in leaves of *Typha*(Gower and Kormondy, 1963; *L. eurinus* chose *Sparganium americanum* (Lutz, 1968); *L. disjunctus* and *L. unguiculatus* oviposited exclusively in green stem of *Scirpus*.(Sowchyn and Gillott, 1974) .

III. Life cycle in Laboratory

In this section experiments were conducted not only to investigate the biology of *S. paedisa* under constant temperature, but also to provide additional verifeation of nymphal instars number and development that obtained in the field. Data for development history of *S. paedisa* are presented in Table (1). The current investigation recorded that incubation period was 14 days at 27°C Sawchyn and Gillott (1975) showed that average of 17 days were required at 21°C for embryonic development of *Lestes disjunctus* eggs. The length of the hatching time of *Coenagrion puella* was 12 days at 28°C (Waringer & Humpesch 1984).

After hatching *S. paedisca* has twelve moults before the abult stage is attained as was found in the field study. This number within the usual range of seven to thirteen moults for Odanata (Corbet, 1980). There is no agreement over the total number of moults in Odanata, because some authors include the moult of the (pro-larvae) and that to adult stage whilst others not. (Waringer and Humpesch, 1984).

Table (1): Duration of development (days) for egg and nymphal instars of *S. paedisca* at 27°C .

Stage	Developmental time (Day)		Width of head capsule (mm)	
	Range	Mean + SD	Range	Mean + SD
Egg	12-18	14+00	0	0
A - 9	1-2	1+0.040	0.35-0.52	0.44+0.010
A - 8	7-15	8+0.112	0.47-0.63	0.56+0.022
A - 7	8-16	8.3+0.172	0.58-0.79	0.74+0.052
A - 6	6-22	9.2+0.075	0.72-1.01	0.96+ 0.040
A - 5	8-18	10.5+0.090	0.98-1.36	1.20 +0.042
A - 4	11-19	13.2+0.191	1.30-1.78	1.68+ 0.073
A - 3	14-18	17.3+0.054	1.72-1.97	1.89 +0.010
A - 2	19-35	21+0.104	1.91-2.34	2.13 +0.098
A - 1	22-40	28+0.064	2.26-2.51	2.42 +0.180
A	28-54	34+0.129	2.45-2.90	2.80 +0.012
P	36-58	44+0.096	2.74-3.18	3.07 +0.041
F	44-69	58+0.11	3.32-3.80	3.40 +0.010

The results recorded in Table (1) also suggest ranking of the development period of nymphal instars, i.e., earlier instars have shorter duration of development than would nymphs of later instars, this indicates that duration of development related positively with progression in instars age. A difference in interval between moults has been observed also for *Lestes eurinus* (Pellerin and Pilon, 1977). Therefore the total period for completion the development of nymph stage in the present study was 252.5 days while the whole life span (from egg to adult) requires 266.5 day of 27°C.

On the other hand, when the instars number was plotted against head width of the nymphal instar an approximately straight line was obtained on semi-logarithmic scale Fig. (6). Therefore the relationship between the head width (y) and the instars number (x) was assumed to be exponential and given by the regression equation:

$$\mathbf{Log(y) = 0.1873\ X - 0.8336}$$

Where the coefficient of determination (r^2) was 0.96.

This relation reflects the interaction of the size increment per moult and the moulting frequency. A similar relationship has been described for African species *Palpopleura lucia* (Hassan, 1976); *Ischnura elegans* (Thompson, 1978); *Coenagrion resolutum* (Baker and Clifford, 1981); *Coenagrion puell* (Waringer and Humpesch, 1984).

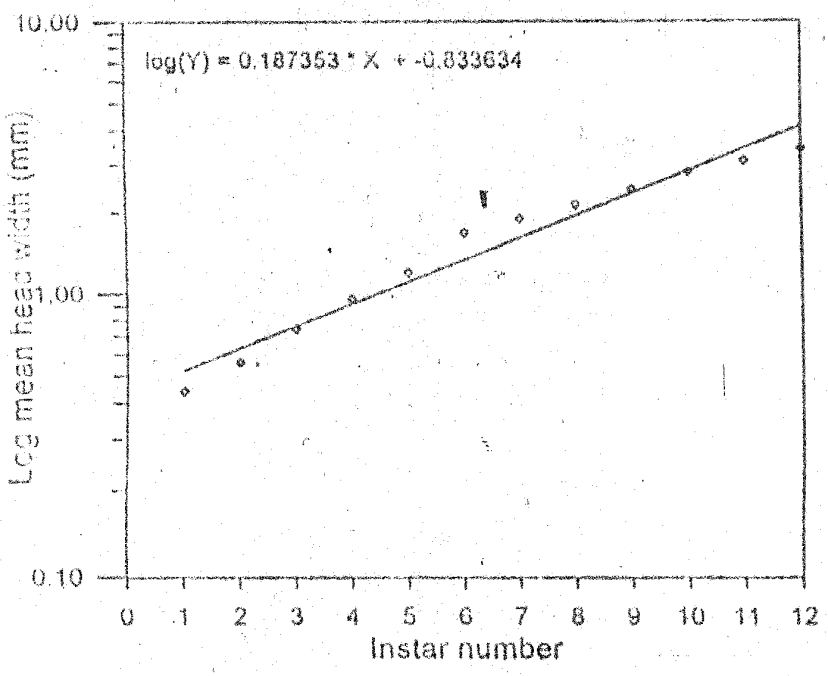

Fig. (6): The relationship between head width and instar number.

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دراسات لدورة حياة الرعاشة الصغيرة *Sympecma paedisca* Brull (Odonata: Lestidae) في بركة ضحلة في كرمة علي، البصرة.

محمد رضا عنون

قسم علوم الحياة، كلية التربية، جامعة البصرة

الخلاصة

درست دورة حياة *Sympecma paedisca* ميدانياً ومختبرياً اجريت الدراسة في بركة ضحلة في كرمة علي – البصرة للفترة من تشرين الاول 1997 ولغاية ايلول 1998. تم قياس بعض العوامل البيئية مثل درجة الحرارة والاوكسجين الذائب واس الهيدروجين والملوحة. أشارت الدراسة الميدانية الى دورة الحياة احادية الجيل، وبالرغم من ذلك فان حوريات هذا النوع لاتمر بتوقف النمو. ان خروج البالغات غير متزامن ويستمر لفترة زمنية طويلة. يتطلب النضج الجنسي للبالغات اربعة اسابيع. ان النبات المفضل لوضع البيض هو *Potamogeton pectinatus* كما اوضحت الدراسة المختبرية ان فترة حضانة البيض 14 يوماً في درجة حرارة 27م وان عدد الاطوار الحورية هي اثنا عشر طوراً وقد بلغت فترة الدور الحوري 252.5 يوماً بينما بلغت دورة الحياة باجمعها 266.5 يوماً.