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The seasonal variations of abundance and biomass of the two odonate naiads *Ischnura evansi* Morton (*Odonata: Coenagrionidae*) and *Brachythemis fuscopalliata* Selys (*Odonata: Libellulidae*) in the Qarmat Ali region, Basrah

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Abstract

The abundance and biomass of the naiads of two odonate species, *Ischnura evansi* and *Brachythemis fuscopalliata*, in the Qarmat Ali region near Basrah have been investigated. Field samples were taken monthly with a plankton net for the period December 1994 – November 1995. During different months, the population structure may be monomodal, bimodal, or trimodal. The mean density of *I. evansi* was higher (196 individuals/m^3) than that of *B. fuscopalliata* (168 individuals/m^3) and two peaks of density were observed in December 1994 and in May 1995. Minimum values of density were recorded at temperature ranges above 25°C (26-34ºC). The mean monthly biomass (B) for *B. fuscopalliata* was higher (869 mg dry weight/m^3) than that of *I. evansi* (284 mg DW/m^3)

Introduction

AQUATIC INSECTS ARE VERY COMMON animal inhabitants of ponds and creeks and on the aquatic plants of the subtidal zone of the Shatt al-Arab river system. In the last three decades, different aspects of biology such as life history, population dynamics, and production of more than 20 species of macroinvertebrates were studied in this region (e.g. Ali and Salman 1987; Sultan 1987; Ali et al. 1995; Salman et al. 1996; Soud et al. 2000.

Nevertheless, only recently were the full life cycle and production of two aquatic insects were investigated (Thamer 1998; Al-Badran 2000). However, odonates appear to be an important component of the insect community in Qarmat Ali ponds. This was quite obvious from the frequent examination of field samples. Actually the odonate population was composed mainly of two dominant species, the damselfly *Ischnura evansi* and the dragonfly *Brachythemis fuscopalliata*. Some information on the distribution of thes species were given by Khalaf and Al-Omer (1974), Al-Ali (1977), and Abdul-Karim (1994a, b).

The object of this study is to determine the seasonal fluctuation in numbers and masses of these two species as a significant step toward understanding the role of odonates in the aquatic ecosystem.

Materials and Methods

Naiads were captured with a plankton net of 50 µm mesh size and 12.5 cm diameter from a shallow pond (25-50 cm depth) in the Qarmat Ali region, within the Basrah University grounds. The habitat was characterized by abundant aquatic and semi-aquatic plants. Samples were taken monthly from December 1994 to November 1995. Collected naiads were fixed immediately with 4% formaldehyde-brackish water solution.

Naiads were isolated in the laboratory with the aid of microscopes, and the following parameters were measured for all specimens:

- Total length (in mm) from the tip of the head to the end of the last abdominal segment.
- Wing-pad length (in mm) of the mesothoracic wing pad along its median axis.
- Head width (HW, in mm) of the maximum width of the head.

All morphometric measurements were made under a dissecting microscope using a calibrated eyepiece.

Additional mass measurements were made on the basis of fresh collection of 40 specimens of *B. fuscopalliata* naiads and 30 specimens of *I. evansi* naiads. These measurements included:

- Wet weight (WW, in mg); living naiads were anesthetized and external water removed.
- Dry weight (DW, in mg); the naiads were dried for 24h in an oven at 60 C, then were brought to room temperature in a desiccator and weighed.
- Organic content (ash-free dry weight AFDW, in mg) as weight loss on ignition in a maffle furnace at 500 C for 3h. All mass measurements were done on a Cahn electromicrobalance (± 0.1 µg).

An empirical regression equation for each species was used as a biomass conversion factor. Insects were identified according to Khalaf and Al-Omer (1974), Al-Ali (1977), and Abdul-Karim (1974b).

Results

Biometric measurements. Empirical power relationships of FW, DW, and AFDW vs. head width were obtained for the damselfly and dragonfly naiads, and are presented in Table 1. Linear regression relationships ($Y = a + bx$) were obtained as follows:

Table 1. Relationships of FW (mg), DW (mg), and AFDW (mg) vs. head width (mm) of *I. evansi* and *B. fuscopalliata* from a shallow pond at Qarmat Ali. The constants a (the intercept) and b (regression coefficient) of each equation (log y = log a + b log x) are given.

	a	b	r	n	P
FW vs. HW					
I. evansi	2.432	2.290	0.98	45	<0.001
B. fuscopalliata	1.996	2.626	0.99	45	<0.001
DW vs. HW					
I. evansi	0.253	2.900	0.95	45	<0.001
B. fuscopalliata	0.255	3.183	0.97	45	<0.001
AFDW vs. HW					
I. evansi	0.037	4.267	0.98	45	<0.001
B. fuscopalliata	0.238	2.655	0.97	45	<0.001

For *I. evansi* $Y = 0.945x – 0.877$; $r = 0.98$; $n = 45$
For *B. fuscopalliata* $Y = 0.922x – 0.009$; $r = 0.99$; $n = 45$
(Y = AFDW, x = DW in mg)

The dry weight amounted to about 14.8% and 13.1% of the fresh weight for *I. evansi* and *B. fuscopalliata* naiads respectively, and the ash weight amounted to about 6.8% and 8.12% of the dry weight for the two species respectively.

Size distribution. The size frequency histograms of the two odonate species for the period 19 December 1994 – 11 November 1995 are shown in Figure 1. The population of *B. fuscopalliata* appeared trimodal during December 1994, January 1995, and February 1995. The smaller dominant size class was the 0.75 mm HW naiads and the large dominant size class was the 3.75 mm HW naiads. In the following seven months (March - September) the population structures were bimodal, with one medium and one large modal size class. In the last two months of the sampling period (October and November) the population appeared monomodal, and naiads of 1.75 mm HW dominated the samples.

The population of *I. evansi* was bimodal during December 1994 and January 1995, and the smaller 0.75 HW naiads dominated the samples. In the latter five months, the histograms showed one clear peak, but actually the population structure appeared to be bimodal. However, the modal size class was 2.25 mm HW in February and March, whereas it was 1.25 mm HW during April, May, and June. Moreover, the 1.25 mm size class dominated the population during the three following months (July – September), although the population was obviously bimodal. However, the population appeared monomodal during the last two months (October and November) of the sampling period, and was dominated by the smaller (0.75 mm HW) size class naiads.

[Figure 1 about here]

Abundance. The abundance (individuals/m^3) of *I. evansi* and *B. fuscopalliata* and the total number of odonate naiads are shown in Figure 2. Generally, two peaks can be observed. The first peak was registered for both species in December 1994, the month when sampling was begun. The mean density of *I. evansi* and *B. fuscopalliata* were 314 and 301 individuals/m^3 respectively, and the total naiad density was 615 ind./m^3. Thereafter the populations' density declined from January to April 1995, and the minimum total density during this period was recorded in March (360 ind./m^3). The second peak occurred in May. The mean density values were 225, 305, and 530 ind./m^3 for *I. evansi* and *B. fuscopalliata* and the total naiads respectively. However, the population numbers declined sharply from June toward September when they reached their minimum values (57, 57, and 164 ind./m^3 for both species and the totals). During this period, water temperature rose above 25 C, and the monthly ranges were between 26 and 34 C.

The annual means of monthly density of *I. evansi* and *B. fuscopalliata* and the total naiads were 196, 198, and 351.4 ind./m^3.

Biomass. The mean monthly biomass values of *B. fuscopalliata* and *I. evansi* showed three peaks (Fig. 3), the first in December 1994, the second in February 1995, and the third in May 1995 for *B. fuscopalliata* and the total naiads, and in July for *I. evansi*. A sharp decline in biomasses of both species occurred in January 1995. Furthermore, the *B. fuscopalliata* biomass sharply declined again in June and July and steadily then after towards October when the value was only 34.0 mg/m^3.

The mean biomass of *I. evansi* declined gradually after the February peak toward June when it reached 200 mg/mg^3. It then rose again in July, when the second smaller peak occurred. Biomass values then dropped steadily and biomass reached its minimum value in October (34.0 mg/m^3). The maximum biomass value of *I. evansi* was recorded in February (680 mg/m^3), and that of *B. fuscopalliata* (2448 mg/m^3) was recorded in May. However, the annual mean of monthly biomass (B) values were 284, 869, and 1153 mg DW/m^3 for *I. evansi, B. fuscopalliata,* and the total naiads, respectively.

Discussion

The little-reported information concerning the ecology of odonates seems to be largely due to the general problem of sampling microinvertebrates, living in the habitat of aquatic plants, on a quantitative basis. Hence different workers may use different sampling procedures (Anderson 1959; Waters and Crawford 1973; Benke 1976; Downing and Rigler 1984). The examination of odonate naiads for this study was done as part of a study of the insect community in the shallow ponds of the Qarmat Ali region. The data showed that the two species of odonates, *I. evansi* and *B. fuscopalliata*, and the chironomid larvae were the most dominant species in the samples. However, results revealed that *I. evansi* naiads were more abundant than *B. fuscopalliata* naiads during most of the year (December 1994 – September 1995). However, they were having nearly the same trend of seasonal variation in numbers.

[Figures 2 and 3 about here]

Oppositely, the biometrics data showed that the dragonfly naiads of *B. fuscopalliata* have much larger mean individual weight values (0.102 – 36.340 mg DW) than the damselfly naiads of *I. evansi* (0.100 – 7.719 mg DW). Therefore, one can say (Figure 3) that most of the total naiads' biomass is related to the population biomass of *B. fuscopalliata*. The latter species' biomass was nearly three times that of *I. evansi*.

Obviously temperature, as it is well known that it affects other species (Edmonson and Windberg 1971), was the main factor controlling the population abundance and biomass of *I. evansi* and *B. fuscopalliata*. These effects were very clear, at least in two situations. The first was in January 1995 when the temperature reached a minimum value of 13 C. However, the observed decline in numbers and masses at this time may actually be not only related to mortality but presumably also due to the hiding behavior of the naiads (Sawchyn and Gillott 1974; 1975). The second situation can be observed when the water temperature rose above 30 C or nevertheless when it reached 34 C in August 1995. Under these conditions, the values of the naiads' density and biomass dropped rapidly because of the inclement temperature.

Knowledge of their feeding behavior makes it evident that odonate naiads are active carnivores. They can consume at least 30% of their own body weight in a day, and they eat other insect larvae such as mayflies, besides eating each other in lower proportions (Benke 1976). Thus, the predator/prey relationship is supposed to be a further control factor regulating the numbers and biomasses of *I. evansi* and *B. fuscopalliata*. Actually, the role of this effective biological factor (Begon and Mortimer 1986) may increase in the shallow enclosed and semienclosed water bodies such as the pond we studied in the Qarmat Ali region.

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