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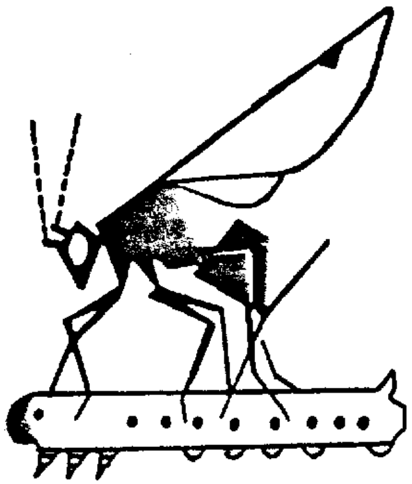

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EFFECTS OF POPULATION DENSITY; PREY DENSITY, STAGE AND TYPE ON THE LIFE HISTORY OF THE MOSQUITO PREDATOR *SPHAERODEMA URINATOR* DUF.

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ABSTRACT

The influence of population density; prey density, stage, and type on the life history of the mosquito predator *Sphaerodema urinator* Duf. was studied. Nymphal duration and mortality were increased and weight of adult males and females were decreased with the increase in rearing density. Adults reared in crowded conditions had shorter oviposition period, longer postoviposition period, lower fecundity and fertility, small weight and shorter longevity than those reared in low density. Nymphs and adults of *S. urinator* were able to fed equally on either larvae or pupae of *Culex pipiens* mosquito. Nymphs reared in high prey density had shorter duration and heavier weights than those reared on low prey density. *S. urinator* females fed on *Culex pipiens* larvae had significantly better fecundity, fertility, longevity and heavier weights than those fed on the alternative preys provided (*Eristalis* sp. and *Orthetrum* sp.).

Key Words: *Sphaerodema urinator*, predator density, prey density, prey stage and type, life history.

INTRODUCTION

A large number of invertebrate predators of mosquito larvae exist naturally in some mosquito producing water but do not appear to serve as an effective control. Further studies are needed to determine the best method for taking advantage of the natural control they offer, and also techniques should be developed for the mass rearing and dispersal of these predators to augment the control programs of mosquito abatement districts (Notestine, 1971).

The belostomatid water bug *Sphaerodema urinator* seems to be the master of aquatic habitats in most places occupied by mosquito larvae and pupae (Lee, 1967) and it represents a good promising predator for mosquito immature stages. So the present work is directed to study the influence of population density; prey density, stage and type on the life history of this predator in order to determine the best conditions for rearing and releasing of this important predator of mosquitoes.

MATERIAL AND METHODS

I. Collection and/or Maintenance of Insects

The Predator (*Sphaerodema urinator*)

Different stages of *S. urinator* were collected from the field using metallic strainer (20 cm. in diameter), with an Aluminum handle (150 cm. long), to be reared in glass aquaria under laboratory conditions using the method described by Tawfik *et al.* (1979) and Abou-Bakr (1984) with certain modifications. Each aquarium (50 x 35 x 35 cm.) was provided with tap water for a depth of only 10 cm.. Electric wires and floating foam rubber pieces were placed in water for resting and crawling of insects instead of aquatic grasses and plants used by other investigators, to avoid fermentation of plants and keeping water quality. Each aquarium was covered by a perforated plastic cover to prevent escaping of insects.

The Preys

Different stages of *Culex pipiens* mosquito, nymphs of *Orthetrum* sp. (Odonata:Corduliidae) and larvae of *Eristalis* sp. (Diptera:Syrphidae) were collected from their natural breeding sites to be used as preys for *S. urinator* or maintained in the laboratory to be used in studying the food menu and host preference of this water bug.

1. Mosquito

A colony of *Culex pipiens* mosquito, originated from a natural breeding place in Benha city was maintained for more than one year in a walk-in insectary at a constant temperature of 27±3°C and 50% relative humidity using the method followed by Abou-Bakr (1984) and Ibrahim (1993).

2. Dragon Fly Nymphs and Rat-Tailed Larvae

Nymphs of *Orthetrum* sp. were collected from the same breeding places of *Shaerodema*. Nymphs were collected from submerged parts of aquatic plants, stones, sand and mud of water bottom using a metallic strainer, then nymphs were washed , picked up by a soft forceps and transported to the laboratory in one litre metallic cones, half full of breeding water.

Larvae of *Eristalis* sp. were mainly collected from a stagnant water pool (rich in dry rice stalks and organic matters) located in the Animal Raising Station at the Faculty of Agriculture in Moshtohor, Qaluobiya, Egypt. Decayed rice stalks were pulled from water, and rat-tailed larvae were collected and transported using the same way used for dragon fly nymphs.

II. Effect of Population Density on the Development of the Immature Stage

In order to determine the effect of predator density on the development of *S. urinator* nymphs, newly hatched nymphs, were transferred into plastic cups (12 cm. in diameter and 7 cm. height), half filled with tap water and supplied with pieces of electric wires and floating foam rubber for the insect to crawl on. Three levels of nymph densities were used (low, medium and high) as 10, 25 and 50 nymphs were placed in each cup, respectively. Each density was replicated 5 times.

A number of preys (*4th* larval instar of *Culex pipiens*) were provided daily to each cup. This number was increased with the increase of predator age, as 10, 10, 10, 15 and 20 larvae/nymph were provided to the *1st*, *2nd*, *3rd*, *4th*, and *5th* nymphal instars, respectively. Each cup was covered with a piece of muslin cloth secured with a rubber band.

All experiments were conducted in temperature controlled cabinets at 25±2°C and 16: 8 (Light/dark) photo period/24 hours, provided by 5 watt electric lamps controlled by time switches. All cups were observed daily at the same time until adult emergence. Duration and mortality of each nymphal instar, as well as the sex ratio and weight of emerged adults were recorded.

III. Effect of Population Density on Some Biological Aspects of the Adult Stage

To study the influence of adult density of *S. urinator* on some biological aspects of the adult stage of *S. urinator* , an experiment was designed in the same manner made for nymphs except that newly emerged adults were used instead of nymphs. The adult densities were 5, 10, and 15 pairs of males and females per each cup for low, medium, and high densities, respectively. Each density was replicated 5 times. About 30 *4th* instar larvae of *Culex pipiens* were daily added for each insect as preys. All cups were provided with pieces of plastic wires and floating foam rubber, covered and maintained in incubators at the same conditions described in case of nymphs. All cups were observed daily at the same time and the weights of males and females were recorded after 15 days of initiation of the experiment. The experiment was extended until death of all insects.

IV. Effect of Prey Density (*Culex pipiens*) on the Development of *S. urinator*

In order to determine the effects of prey density (*4th* larval instar of *Culex pipiens)* on the development of *S. urinator* nymphs, one newly hatched nymph, was placed in each testing cup (3.5 cm. in diameter and 7 cm. height). Water was placed in each cup to a depth of about 2 cm. and provided with plastic wires, floating foam rubber, covered and maintained in incubators at the same conditions described before.

4th instar *Culex pipiens* larvae were introduced daily into the testing cups at three levels (low, medium and high), by putting 2, 4 and 10 larvae in each cup, respectively. After a 24-hour exposure, the remaining larvae were counted, discarded and a new set was added for the next 24 hour exposure. The test was continued until the emergence of all adults. The number of *Culex pipiens* larvae provided to each cup (prey density) was increased with the increase of predator age as 3, 5, 10; 4, 6, 10; 5, 8, 15 and 20 larvae were provided for the *2nd*, *3rd*, *4th*, and *5th* instars respectively. Each treatment was replicated 20 times.

All cups were observed daily at the same time. The nymphal development and mortality, as well as the sex ratio and weight of emerged adults were recorded.

V. Effect of Prey Stage on Development of the Immature Stage of *S. urinator*

To test the effect of prey stage on the development of the nymph stage of *S. urinator* , newly hatched nymphs were placed individually in the testing cups and provided daily with either *4th* instar larvae or newly hatched pupae of *Culex pipiens*. A number of mosquito preys was daily provided. This number was increased with the increase of predator age as 10 *4th* larval instar or pupae were daily added as preys for each of the *1st*, *2nd* and *3rd* nymphal instars, whereas 15 and 20 larvae or pupae were daily provided for the *4th* and *5th* nymphal instars respectively. After 24 hours, the remaining larvae or pupae were counted, discarded and new sets were added for the next 24 hours. The number of preys consumed was daily recorded until adult emergence. All cups were daily observed and data were recorded at the same time. The experiment was replicated 20 times.

VI. Effect of Prey Stage on Some Biological Aspects of *S. urinator* Adults

Adults of *S. urinator* were sexed and paired in the plastic cups and provided daily with either 60 *4th* instar larvae or pupae of *Culex pipiens*. All cups were daily observed and data were recorded until death of all insects whereas, the weight of males and females was recorded after 15 days of initiation of the experiment. Each treatment was replicated 20 times.

VII. Effect of Prey Type on Some Biological Aspects of the Adult Stage

Three groups of newly emerged adults were sexed and paired (one male and one female) in plastic cups. The *1st* group was provided daily with 60 *4th* larval instar of *Culex pipiens*/cup, the second with 10 *5th* instar rat-tailed larvae (*Eristalis* sp.) and the third group was daily provided with 6 dragon fly nymphs (*Orthetrum* sp.). All cups were inspected daily and data were recorded until death of all insects whereas, the weight of males and females was recorded after 15 days of initiation of the experiment. Each treatment was replicated 20 times.

RESULTS AND DISCUSSION

1. Density of *S. urinator*

1.1. Effect of Density on the Development of Immature Stages of *S. urinator*

Results of the present work (Table 1) indicated that the duration of each nymphal instar as well as the total duration of the nymph stage were increased with the increase in predator density. The average total durations of the nymph stage reared in three density levels (low, medium and high) were 25.8, 27 and 31 days respectively. Nymphs reared in crowded conditions acquire a limited space which may reduce the chance of nymphs in catching preys which consequently lead to a reduced amount of food, decrease in metabolism and delay in growth. As predator density increases consumption rate decreases, indicating mutual interference among predators (Holling, 1961). A recorded decrease in growth of insects under crowded conditions was observed by Ankersmit and Van Der Meer (1973) on *Adoxophyes orana* (Lepidoptera), and Poirier and Borden (1992) 0n *Choristoneura rosaceana* Harris (Lepidoptera).

Nymphal mortality was increased with the increase of rearing density (Fig. 1). Mortalities among the nymphs reared in low, medium, and high density levels were 17.5, 30.5 and 54.8 %, respectively. This increase in mortality may be due to the limited space which can reduce the amount of food taken and cause malnutrition. In the same time at crowded conditions nymphs tended to crawl over each other and hence, induce higher rate of cannibalism among the insects during moulting, where nymphs are weak and fragile. This conclusion may be confirmed by our results which indicated that, at medium and high nymphal densities, big number of nymphs died during moulting.

The weight of adult males and females was decreased with the increase in rearing density during the nymphal stage (Table, 1). This decrease in weight may be attributed to a decrease in the amount of food taken in crowded conditions. Although the number of larvae provided/nymph/day was kept constant in all conditions, the ability of nymphs to catch the prey (larvae of *Culex pipiens*) may be reduced under crowded conditions.

The sex ratio of adults, emerged from nymphs reared under different density levels (Table 1) was skewed towards males with the increase of nymph density. These results are in accordance with earlier prediction of Andersen (1961) on the effect of density on the proportion of males for species with heterogametic females. These results indicated that with increasing nymphal density, the proportion of male pupae increases. Similar findings were also found by Mauffette and Jobin (1985) with the gypsy moth *Lymantria dispar*, however, the biased sex ratio may be a consequence of sex related mortality rather than the result of direct selection of skewed sex ratio. In many insect populations, the sex ratio is an important indicator of the dynamic state of the population and possibly a measure of the quality of the population (Wallner and Walton, 1981). A high proportion of males could be interpreted as an indicator that the insect population is declining, a low male proportion may indicate that the insect population is increasing. In case of *S. urinator*, the proportion of males and females is an important factor that should not be overlooked in any program for mass rearing and/or releasing of this promising predator because the presence of male in a sufficient number is an essential requirement for carrying egg rafts until they hatch. Our observations revealed that when egg rafts were removed from the back of a male, no eggs were hatched. The increase in number of males in *S. urinator* population is an advantage because it provides sufficient site coping with the high egg productivity of females (Tawfik *et al.*, 1979).

1.2. Effect of Density on Some Biological Aspects of Adult *S. urinator*

The oviposition period of adult *S. urinator* was decreased with the increase in adult density. The oviposition periods for adults reared in low, medium

VI. Effect of Prey Stage on Some Biological Aspects of *S. urinator* Adults

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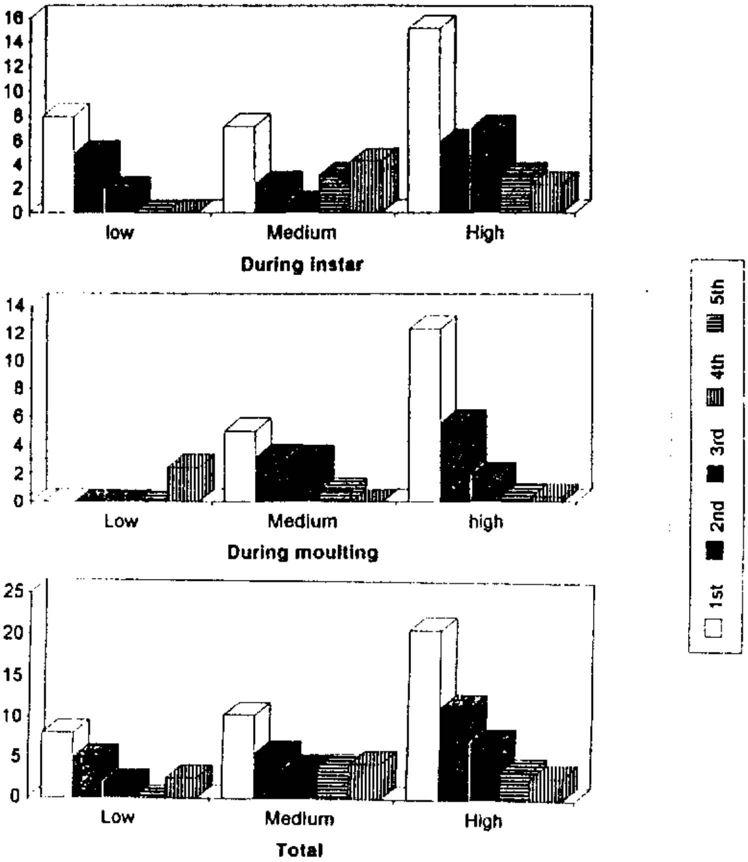

Fig. (1): Effect of prey density (*Culex pipiens*) on the mortality percentage of the nymphal instars of *Sphaerodema urinator*.

Table (1): Duration of nymphal instars, sex ratio and weight of *S. urinator* adults emerged from nymphs• reared in different density levels under laboratory conditions (at temp. of 25±2°C and 16 L: 8 D photoperiod).

Nymphal density*	Duration of nymphal instars (in days) Mean• ± S.E.						Adult weight (in grams) Mean• ± S.E		Sex ratio
	1st	*2nd*	*3rd*	*4th*	*5th*	Total average	Male	Female	Female : Male
Low	4.0 ± 0.27	4.0a ± 0.46	3.4 ± 0.18	4.5a ± 0.36	9.0a ± 0.34	25.8a ± 0.8	0.1318a ± 0.0033	0.1451a ± 0.0032	1 : 1.5
Medium	4.4 ± 0.32	4.1a ± 0.28	3.8 ± 0.33	5.1ab ± 0.32	9.3ab ± 0.22	27.0a ± 3.4	0.13ab ± 0.0023	0.1325a ± 0.0042	1 : 1.9
High	5.5 ± 0.27	4.7 ± 0.25	4.9 ± 0.50	5.1b ± 0.66	10.3b ± 0.25	31.5 ± 1.69	0.116ab ± 0.0013	0.1246 ± 0.0033	1 : 2.3

Means in a column followed by the same letter are not significantly different at P>0.05.

• Newly hatched nymphs were used.

*10, 25, 50 newly hatched nymphs/cup were used in case of low, medium and high density levels respectively.

• Each treatment was replicated 20 times.

and high density levels were 56.54, 46.95 and 38.05 days respectively. In the same time a significant increase in postoviposition period was observed between those reared in low and high densities. A synchrony was observed between the sexual maturation (preoviposition, oviposition and postoviposition periods), fecundity and fertility of adults reared under each density level (Table 2). The oviposition period, number of egg rafts/female, the number of eggs/raft, the number of eggs/female, the successive intervals between egg rafts, the incubation period of eggs, the total number of rafts laid, the number of rafts separated from the males, the number of rafts hatched and hatchability of eggs appear to be additive.

Adults reared under crowded conditions had short oviposition period and longer postoviposition period. In the same time the number of egg rafts laid/female, the number of eggs/raft, the number of eggs/female, the successive intervals between egg rafts and the incubation period of eggs produced by females reared under high density conditions were all smaller than those reared under low density conditions. Also a synchrony was found between the total number of rafts laid by adults of each group, the number of rafts separated from the males, the number of rafts hatched and the fertility of eggs. Adults reared under high population density conditions produced higher number of egg rafts, but most of these rafts (73.89%) were separated from males or failed to hatch. Separation of egg rafts under crowded conditions may be due to females which may be forced to remove the egg rafts and deposits a new one on the same individual when no other male is reached (Tawfik *et al.*, 1979).

Males and females reared in high population density had significantly smaller weights than those reared in low population density. Again, this decrease in weight may be attributed to the reduced ability of adults to catch the prey (larvae of *Culex pipiens*) under crowded conditions, this may result in a reduction in the amount of food taken by adults and consequently a decreased weight. Females reared in high population density had significantly shorter longevity than those reared in medium and low densities, whereas the longevity of males was not significantly affected at the three density levels studied. This may indicate that females are more sensitive than males to crowded conditions.

2. Density of *Culex pipiens* (Prey Density)

Results of the present work (Table 3) indicate that the density of prey (*4th* instar larvae of *Culex pipiens*) had a marked effect on the duration and survival of *Sphaerodema urinator* nymphs. The duration of all nymphal instars as well as the total duration of the nymphal stage were decreased with the increase in prey density. This means that development of nymphs was faster at higher prey density, and slower at low prey density. The presence of sufficient number of preys may improve the ability of nymphs to catch the prey and provide the required amount of food needed for growth, so faster development takes place and nymphs became healthy and their survival improved.

Mortality of *S urinator* nymphs was decreased with the increase in prey density (Fig. 2). Mortality was generally decreased with the increase in the age of nymphs, as most mortalities were recorded during the *1st* and *2nd* nymphal instars. No mortalities were recorded among *4th* nymphal instars in all experimental treatments, also among 5th nymphal instars which was provided with medium or high prey densities. The total mortalities observed during the nymphal stage provided with low, medium or high prey densities were 55, 25 and 15%, respectively.

Weights of adult males and females emerged from nymphs reared in medium or high prey densities (Table 3) were heavier than those emerged from nymphs reared in low prey density. This increase in weight with the increase of prey density may be attributed to the increase of nymphal chance in catching the preys and consequently an increase in the amount of food taken.

The sex ratio of adults was greatly skewed towards males when nymphs were reared in low prey density. This difference in sex ratio may be a consequence of different insect related mortality rather than the result of direct selection for a skewed sex ratio.

3. Prey Stage

Nymphs and adults of *S. urinator* can equally fed on either larvae or pupae of the prey (*Culex pipiens* mosquito) and without any significant effect on the development of the nymphal stage, the duration and survival of nymphs as well as the weight and sex ratio of emerged adults (Table 4). Our findings revealed that the sexual maturation, (which was represented by preoviposition, oviposition and postoviposition periods), fecundity, successive intervals between egg rafts, incubation period, fertility, weight and longevity of adult *S. urinator* were not significantly different in adults fed on *4th* instar larvae or pupae of *C. pipiens* mosquito.

4. Prey Type

Food quality or prey type may influence the age at which sexual maturation is attained (Hillyer and Thorsteinson, 1969). The present data (Table 5) indi-

Table (2) Effect of adult density on some biological aspects of *Sphaerodema urinator* adults under laboratory conditions (at 25± 2 °C and 16 L : 8 D Photoperiod)

Adult Density*	Sexual maturation Mean• ± S.E. (In days)			Fecundity Mean• ± S.E.			Mean• ± S.E. of						Adult weight (in grams) Mean• ± S.E.		Longevity (in days) Mean• ± S.E.	
	Pre ovi-posi-tion period	Ovi-posi-tion period	Post ovi-posi-tion period	No of egg rafts/ female	No of eggs/ raft	No of eggs/ female	Successive intervals between egg rafts (/days)	Incu-bation period (/ days)	Total no of rafts laid	% no of rafts sepa-rated from male	% no of rafts hat-ched	% ferti-lity	Male	Female	Male	Female
Low	8.25a ± 0.59	56.54 ± 2.34	8.44a ± 1.38	5.68 ± 0.29	61.2 ± 5.35	347.59 ± 22.88	3.84a ± 0.22	9.27 ± 0.18	28.4 ± 1.47	38.9	61.1	91.05	0.1269ab ± 0.012	0.173 ± 0.032	104a ± 5.99	70.8a ± 4.66
Medium	10.3ab ± 1.03	46.95 ± 3.22	10 ab ± 1.04	3.98a ± 0.41	73.75a ± 6.79	293.5a ± 18.38	3.03ab ± 0.27	8.18a ± 0.33	39.8 ± 4.22	55	45	84.47	0.1233ab ± 0.004	0.158b ± 0.006	101.6ab ± 8.05	65.64a ± 6.87
High	10.5ab ± 1.03	38.05 ± 1.3	10.2b ± 0.64	3.56a ± 0.28	75.79a ± 10.89	269.83 ± 17.6	2.69b ± 0.21	8.04a ± 0.22	53.6 ± 4.37	73.89	26.11	79.78	0.1201b ± 0.005	0.1496b ± 0.004	96.2ab ± 5.34	57.58 ± 2.57

Mean in each column followed by the same letter are not significantly different at $P < 0.05$

* 5, 10, and 15 pairs of newly emerged adults/cup were used as low, medium and high density levels respectively.

• Each treatment was replicated 20 times.

Table (3): Duration of nymphal instars, sex ratio and weight of adults of *S. urinator* fed during its nymphal• instars on different prey densities of *C. pipiens* under laboratory conditions (at temp.of 25± 2°C and 16 L: 8 D photoperiod).

Prey density*	Duration of nymphal instars (in days) Mean• ± S.E.						Adult weight (in grams) Mean• ± S.E		Sex ratio
	1st	*2nd*	*3rd*	*4th*	*5th*	Total average	Male	Female	Female : Male
Low	5.95a ± 0.59	5.46 ± 2.34	5.71a ± 1.38	6.9 ± 0.29	10.7 ± 5.35	33.1 ± 1.5	0.1190 ± 0.005	0.1242 ± 0.0047	1 : 2
Medium	4.81 ± 0.25	5.06 ± 0.19	5.33 ± 0.19	6.14 ± 0.48	9.15a ± 0.37	30.854 ± 1.18	0.1241a ± 0.0043	0.1381a ± 0.006	1 : 1.6
High	4.3 ± 0.16	4.65 ± 0.17	4.94 ± 0.25	5.65 ± 0.67	8.94 ± 10.36	27.53 ± 0.63	0.137a ± 0.004	0.1507a ± 0.0077	1 : 1.43

Means in a column followed by the same letter are not significantly different at P>0.05.

• Newly hatched nymphs were used.

* 2, 3, 4, 5 & 10; 4, 5, 6, 8 & 15; 10,10 10 & 20 *4th* instar larvae of *C. pipiens* were provided for the *1st*, *2nd*, *3rd*, *4th*, and *5th* nymphal instars in case of low, medium and high density levels respectively.

• Each treatment was replicated 20 times.

Table (4) Effect of prey stage on some biological aspects of *Sphaerodema urinator* nymphs (at 25± 2°C and 16 L:8 D Photoperiod)

Prey stage	Average duration of the nymph[1] stage (in days) Mean ± S.E.	% total Mortality during the nymphal stage	Weight of emerged adults (in grams) Mean*± S.E.		Sex ratio of emerged adults
			Male	Female	
4th larval instar	27.53 ± 0.6	15	0.137 ± 0.004	0.1507 ± 0.0043	1 : 1.43
Pupal stage	26.59 ± 0.51	15	0.1417 ± 0.0054	0.1538 ± 0.0049	1 : 1.5

1: Newly hatched nymphs were used.

* Each treatment was replicated 20 times.

Table (5) Effect of prey stage on some biological aspects of *Sphaerodema urinator* adults* (at 25± 2°C and 16 L:8 D Photoperiod)

Prey Stage	Sexual maturation Mean* ± S.E. /days)			Fecundity Mean* ± S.E.			Mean* ± S.E. of			Adult weight (in grams)[2] Mean* ± S.E.		Longevity (in days) Mean* ± S.E.	
	Pre ovi-position period	Ovi-position period	Post ovi-position period	No of egg rafts/ female	No of eggs/ raft	No of eggs/ female	Successive intervals between egg rafts (/days)	Incubation period (/idays)	% fertility	Male	Female	Male	Female
4*th* larval instar	7.4 ± 0.67	53.1 ± 6.33	8.7 ± 1.29	9 ± 0.78	47.16 ± 2.12	413.1 ± 38.14	6 ± 0.18	9.15a ± 0.9	91.05	0.1358a ± 0.008	0.165 ± 0.005	119.2 ± 10.24	69.2 ± 6.7
Pupal stage	6.38 ± 0.56	50.5 ± 5.78	10.03 ± 2.49	7.5 ± 0.64	49.74 ± 0.09	374.13 ± 37.7	6.48 ± 0.32	8.79 ± 0.32	89.04	0.1301 ± 0.007	0.1695 ± 0.0039	108 ± 12.7	71.2 ± 5.85

1: Newly hatched adults were used.
2: Adult weights were recorded after 15 days of initiation of the experiment.
* Each treatment was replicated 20 times.

Table (6) Effect of prey type on some biological aspects of *Sphaerodema urinator* adults under laboratory conditions (at 25± 2°C and 16 L:8 D Photoperiod)

Prey Type	Sexual maturation Mean* ± S.E. (in days)			Fecundity Mean* ± S.E.			Mean* ± S.E. of			Adult weight (in grams) Mean* ± S.E.		Longevity (in days) Mean* ± S.E.	
	Pre ovi-posi-tion period	Ovi-posi-tion period	Post ovi-posi-tion period	No of egg rafts/ female	No of eggs/ raft	No of eggs/ female	Successive intervals between egg rafts (/days)	Incu-bation period (/ days)	% ferti-lity	Male	Female	Male	Female
Culex pipiens[1]	7.4 ± 0.67	53.1 ± 6.33	8.7 ± 1.29	9 ± 0.78	47.16 ± 2.12	413.1 ± 38.14	6 ± 0.18	9.15a ± 0.9	91.05	0.1358a ± 0.008	0.165 ± 0.005	119.2 ± 10.24	69.2 ± 6.7
Eristalis sp.[2]	14.6 ± 1.09	28.1a ± 2.93	13a ± 1.99	2.6a ± 0.32	33.88 ± 2.34	99.3 ± 12.03	9.08 ± 0.69	8.93a ± 1.0	84.47	0.128ab ± 0.0042	0.131a ± 0.0079	73.9a ± 8.07	51.3a ± 4.09
Orthetrum sp.[3]	17.4 ± 0.57	23.8a ± 2.13	11.6a ± 1.06	2.6a ± 0.2	42.78 ± 2.08	127.4 ± 13.6	12.3 ± 1.79	9.25a ± 0.5	79.78	0.1282b ± 0.0038	0.151a ± 0.0043	88.3a ± 4.47	52.7a ± 3.23

• Means in a column followed by the same letter are not significantly different at P>0.05.
* Newly hatched nymphs were used.
1. Early 4*th* larval instar. 2. 5*th* larval instar. 3. 4*th* nymphal instar

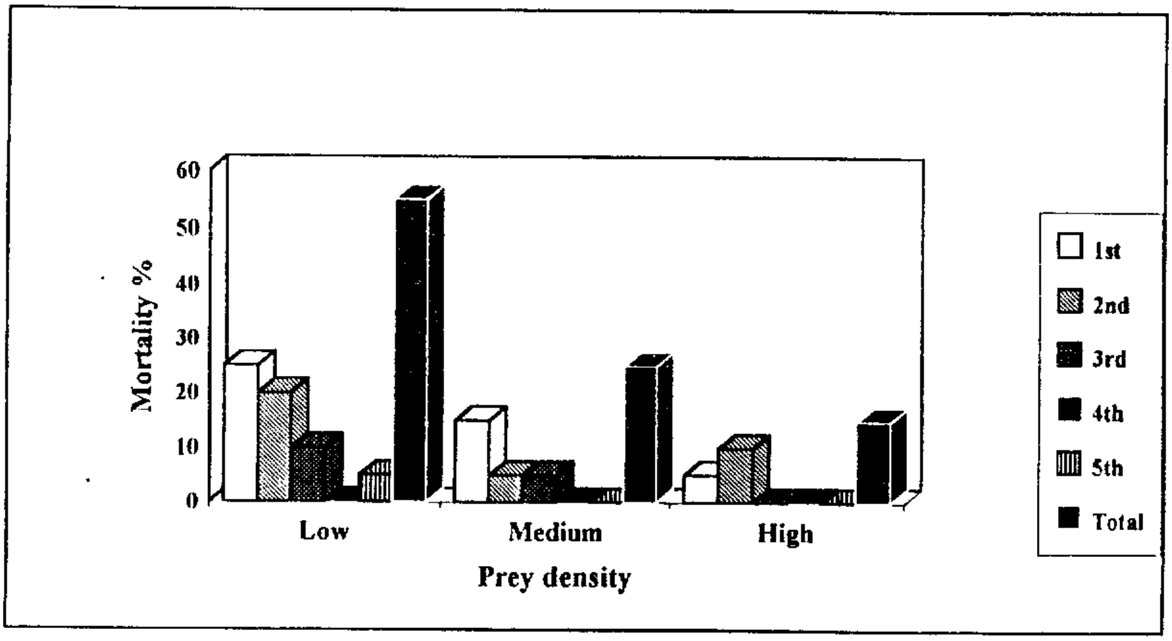

Fig. (2): Effect of prey density (*Culex pipiens*) on the mortality percentage of the nymphal instars of *Sphaerodema urinator* under laboratory conditions.

cate that females fed on larvae of *Culex pipiens* mosquito had significantly shorter preoviposition period and longer oviposition period than those fed on *Eristalis* sp. or *Orthetrum* sp., whereas no significant difference was found between the preoviposition, oviposition and postoviposition periods of females fed on the last two preys. In the same time the fecundity (number of egg rafts/female, no of eggs/raft and number of eggs laid/female) of females fed on *C. pipiens* larvae were significantly higher than the fecundity of females fed on *Eristalis* sp. or *Orthetrum* sp.. The successive intervals between egg rafts and incubation period of eggs were shorter in case of females fed on *C. pipiens* larvae.

The reduction in fertility of eggs produced by adults fed on *C. pipiens* larvae may be attributed to the high number of egg rafts produced. A female may be forced to remove an egg raft and deposits a new one on the same individual before hatching is completed.

Females fed on *C. pipiens* larvae had significantly heavier weights than those fed on the other two preys. The longevities of males and females fed on *C. pipiens* larvae were significantly longer than the longevities of those fed on the other preys studied.

These findings may indicate that *C. pipiens* larvae are the most preferred prey for *S. urinator*. These findings may also highlights the role of this predator in mosquito control programs in Egypt.

The ability of *S. urinator* to fed on other preys, usually associated with mosquito larvae, is an advantage in case of this predator because these alternative preys may provide alternative food when mosquito larvae and pupae are rare or absent.

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