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LIFE HISTORY AND EXTERNAL EGG AND LARVAL MORPHOLOGY OF *BRACHYTHEMIS CONTAMINATA* (FABRICIUS) (ANISOPTERA: LIBELLULIDAE)

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The eggs, collected at the Ramna Lake, Dacca, Bangladesh, were reared in the laboratory. On average, the larval development took 90 days (10 larval instars). The principal changes in external morphology of different instars are described and illustrated.

INTRODUCTION

Very little information is available from the Indian Subcontinent on the odonate biology. Among the few papers in this field, there are those by e.g. KUMAR (1970, 1971, 1972) on the life history and larval stages of *Orthetrum pruinosum neglectum*, *O. b. brunneum* and *Trithemis festiva*, while BEGUM (1977) reported 18 common species from the Dacca University Campus, Bangladesh. The biology of these has not been reported earlier, therefore an attempt is made in the present paper to elucidate the bionomics of *B. contaminata*, a common dragonfly, found throughout the year in the ponds and lakes of Dacca City.

The final draft of the manuscript was refereed by Dr M.A. Lieftinck (Rhenen, The Netherlands), who has kindly supplied his previously unpublished drawings of two specimens from Java, Indonesia, shown here in Figure 37.

MATERIAL AND METHODS

The work was started on 3rd May 1979, by collecting eggs from an ovipositing female in Ramna Lake, Dacca. Just after oviposition the submerged leaves of aquatic plants containing egg clusters were collected by hand and brought to the laboratory in a test tube half

filled with lake water. In the laboratory they were kept in glass finger bowls (10 cm x 6 cm) filled with lake water. The eggs were incubated at room temperature (30-32°C).

Soon after hatching, the larvae were transferred individually to separate bowls. A twig of *Hydrilla* sp. and some sand grains were kept in each bowl for aeration and helping the very young larvae in ecdysis as suggested by KUMAR (1971). Larvae up to the 4th instar were supplied with water containing various prey organisms (e.g. *Cyclops*, *Daphnia*, etc.), and after the 4th instar they were supplied with 7 to 10 chironomid or mosquito larvae per day. The principal morphological characters e.g., antennal segments, setal arrangement on the prementum and palpus, development of wing sheaths, anal appendages, tibial setae, etc. were described for each instar. Observations on all the instars are based on laboratory-reared specimens. However, the characters of laboratory-reared final-instar larvae were compared with those from specimens collected in the field. After each ecdysis measurements of different parts of the body were taken by oculometer and slide calipers. Some permanent and temporary slides were also made for detailed study of microscopic parts like antennae, labium etc. All figures are drawn with a camera lucida or a microprojector (Metapa). The terminology used for the labium is that of CORBET (1953), for the antennal appendages that of SNODGRASS (1954) and for the tibial comb that of MacNEILL (1967).

OBSERVATIONS

The study of larval stages started with 20 larvae in the 2nd instar. Eleven of them died after the 3rd instar, 2 at the time of emergence and the remaining 7 emerged successfully. The data obtained from 3 of them on the number and duration of larval instars are shown in Table I.

Oviposition took place from March to October, between 14.00-18.30 hr. When a female oviposits, the male protects her by hovering above her and driving away any other males that may try to approach her. The females oviposited by beating the tips of their abdomens again and again at the same spot either on the submerged leaves or stems of the aquatic plants.

Table I

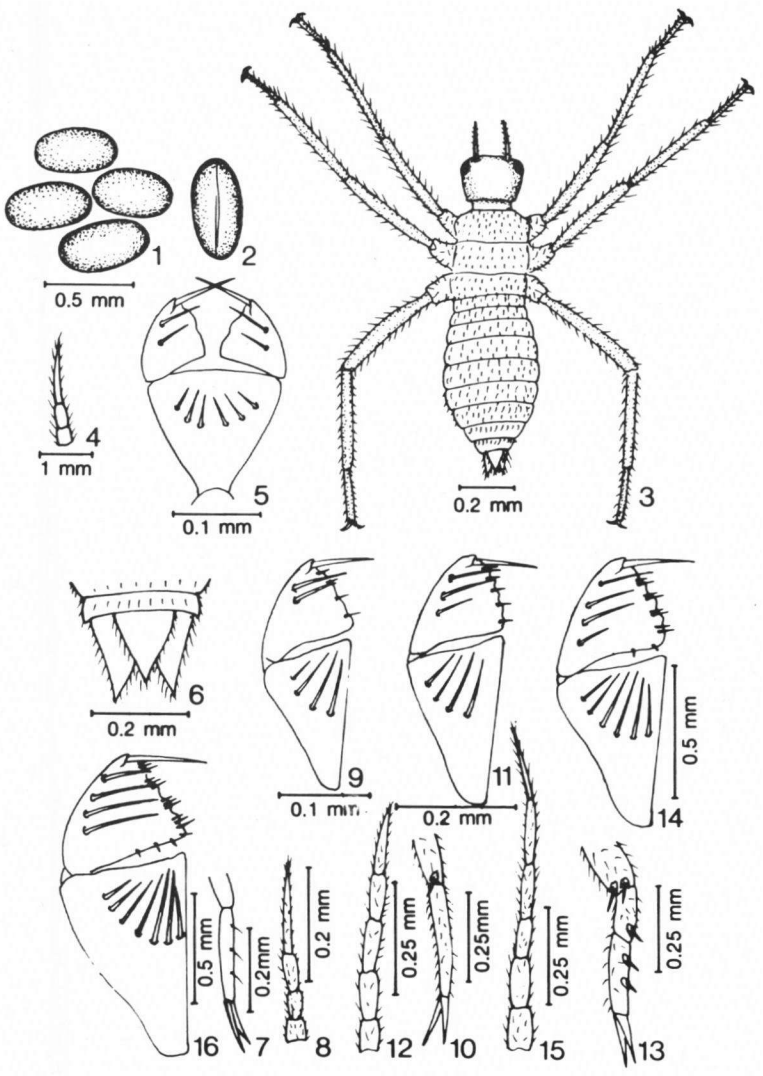
Developmental period (in days) of *Brachythemis contaminata* reared in the laboratory at room temperature*

Incubation period	Larval instars										*Egg to adult*
	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	
8-10	15-30	8-10	7-9	8-11	5-6	4-5	6-8	6-7	10-12	19-22	*85-94*

* Eggs were laid on 3rd May, 1979 and started to hatch from 11th May, 1979, onwards

THE EGG

The eggs (cf. Fig. 1) were milky white after oviposition, but became pale yellow within 24 hours. As soon as the eggs came into contact with water a gelatinous covering was formed which bound them together. The



Figs 1-16. *Brachythemis contaminata* (Fabr.), egg (Figs 1-2) and early larval instars (Figs 3-16): (1) eggs; – (2) egg, showing the longitudinal slit through which the prolarva hatches; – (3) 2nd instar, general view; – (4) the same, antenna; – (5) the same, labium; – (6) the same, anal appendages; – (7) the same, tarsi; – (8) 3rd instar, antenna; – (9) the same, labium; – (10) the same, tarsi; – (11) 4th instar, labium; (12) the same, antenna; (13) the same, tarsi; – (14) 5th instar, labium; – (15) the same, antenna; (16) 6th instar, labium.

total number of eggs per female in a mass varied between 325 and 450 (10 counts). Average length was 0.48 (0.41-0.55) mm, width 0.21 (0.19-0.25) mm. The incubation period ranged from 8-10 days.

LARVAL STAGES

1st instar. — The prolarva hatched through a longitudinal slit (Fig. 2). The duration of the first larval instar was very short (15-30 min). Body elongated, head broader than long. Antennae 3-jointed, directed anteriorly in living condition. Legs adhering to the body, directed posteriorly. Anal appendages short, consisting of epiproct and paraproct only.

2nd instar (Figs 3-7). — Duration 8-10 days. Length 1.1 mm. Light brown in colour. Eyes small, bead-like, black in living condition (Fig. 3). Antennae (Fig. 4) 3-jointed (consisting of scape, pedicel and flagellum). Labium (Fig. 5): spoon-shaped; premental setae 3+3, distal margin of the prementum straight; palpal setae 2&2, distal margin of palpus wavy, not distinctly crenated. Tarsi (Fig. 7) one-jointed. Anal appendages (Fig. 6) consisting of epiproct and paraproct only.

3rd instar (Figs 8-10). — Duration 7-9 days. Length 1.7 mm. Antennae (Fig. 8) 4-jointed, the flagellum consisting of two joints. Labium (Fig. 9): premental setae 4+4, palpal setae 2&2, distal margin crenated and each crenation with one claviform seta. Tibial comb consisting of one tridentate seta. Tarsi (Fig. 10) 2-jointed.

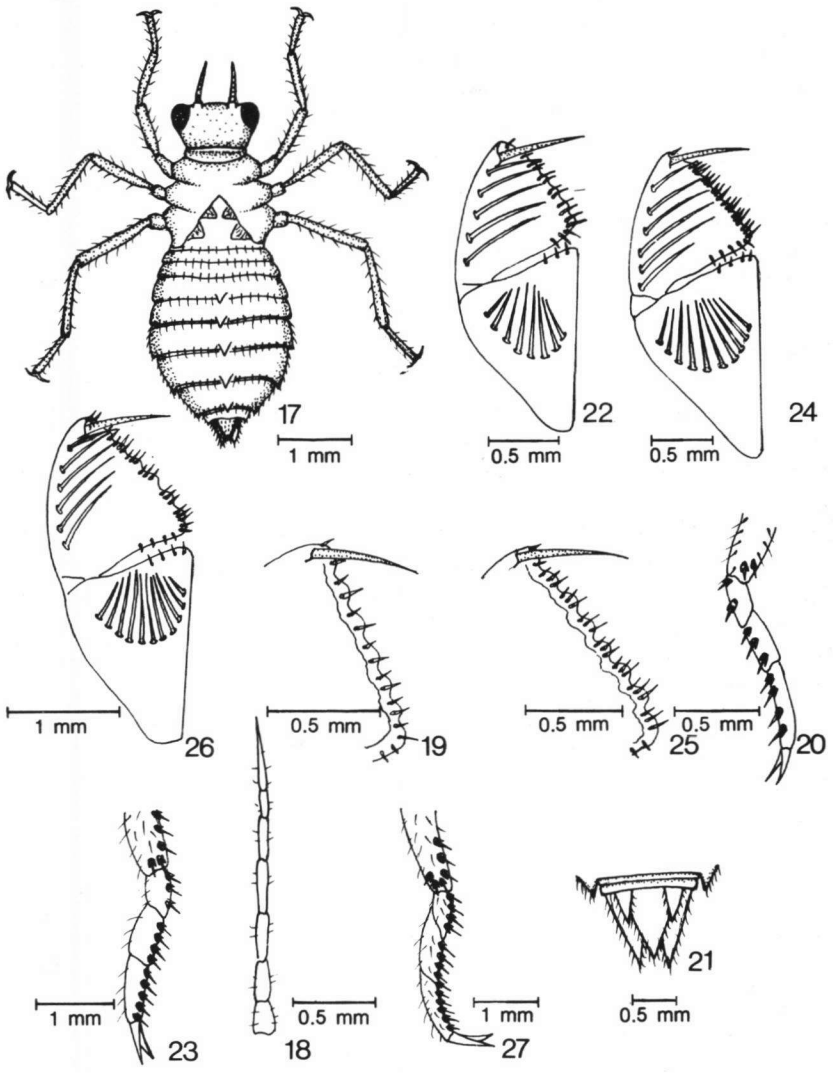
4th instar (Figs 11-13). — Duration 8-11 days. Length 2.5 mm. Antennae (Fig. 12) 5-jointed, directed forward, anterior two joints hairy. Eyes distinct and extended posteriorly. Labium (Fig. 11): Premental setae 4+4, distal margin convex and bearing a number of claviform setae;

Table II

Characters of the different larval instars of *Brachythemis contaminata*

Characters	Instars									
	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
Antennal segments	3	3	4	5	6	7	7	7	7	7
Premental setae	0+0	3+3	4+4	5+5	6+6	7+7	8+8	10+10	11+11	12+12
Palpal setae	—	2&2	2&2	3&3	4&4	4&4	5&5	6&6	7&7	7&7
Tarsal segments	1	1	2	2	2	3	3	3	3	3
Wing sheaths	—	—	—	—	—	*r*	*i*	*i*	*i*	*i*
Anal cerci	—	—	—	—	—	*r*	*i*	*i*	*i*	*i*
Body length in (mm)	0.9	1.1	1.7	2.5	3.4	4.5	6.0	8.1	11.0	13.5

(—) absent, *r* (rudimentary), *i* (increasing)



Figs 17-27. *Brachythemis contaminata* (Fabr.), larval instars 6-9: (17) 6th instar, general view; — (18) the same, antenna; — (19) the same, prementum; — (20) the same, tarsi; — (21) the same, cerci; — (22) 7th instar, labium; — (23) the same, tibia; — (24) 8th instar, labium; — (25) the same, prementum; — (26) 9th instar, labium; — (27) the same, tibia.

palpal setae 3&3, last seta added posteriorly. Tibial comb consisting of two tridentate setae. Tarsi 2-jointed (Fig. 13).

5th instar (Figs 14-15). — Duration 5-6 days. Total length 3.4 mm. Light brown in colour. All legs black banded. Antennae (Fig. 15) 6-jointed, the flagella divided into two joints. Labium (Fig. 14): premental setae 6+6; palpal setae 4&4, new one added posteriorly, each distal crenation with two claviform setae. Tarsi 2-jointed.

6th instar (Figs 16-21). — Duration 4-5 days. Length 4.5 mm. Light brown but somewhat pale green at the lateral side of the abdomen, thorax and head. Antennae (Fig. 18) 7-jointed, apical one pointed and anterior two joints fringed with hairs. Labium (Fig. 16): premental setae 7+7, distal margin of the prementum consisting of 13 claviform setae; palpal setae 4&4, each palpal crenation bearing 2 setae (Fig. 19). Tarsi (Fig. 20) 3-jointed. Wing sheaths rudimentary and appearing as small outgrowths (Fig. 17). Cerci (Fig. 21) also rudimentary on either side of the epiprocts.

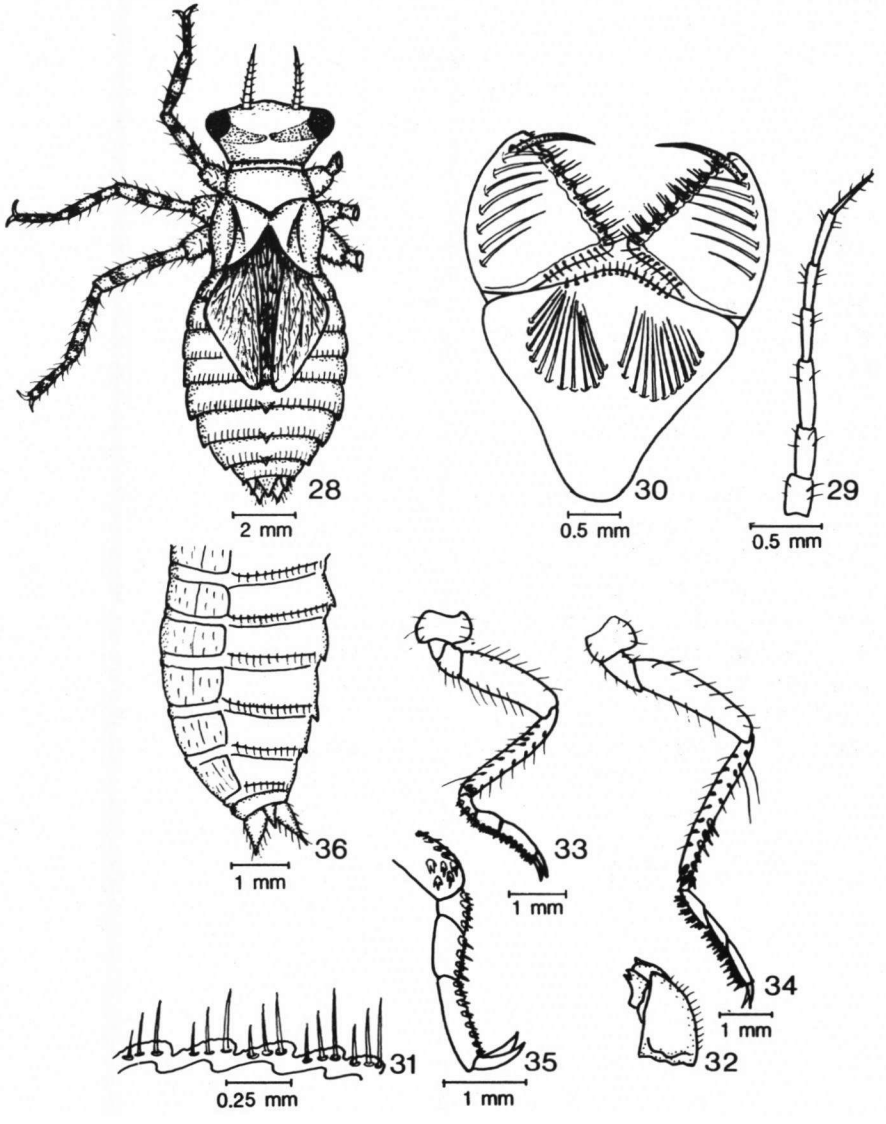
7th instar (Figs 22-23). — Duration 6-8 days. Length 6.0 mm. Pale greenish colour after moulting in living condition. Eyes very prominent. Antennae 7-jointed but increasing in length. Labium (Fig. 22): premental setae 8+8, distal margin consisting of 16 claviform setae; palpal setae 5&5, lower margin of the palpus straight, bearing a number of spiniform setae. Wing sheaths extended upto 2nd abdominal segment. Tibial comb consisting of 5 tridentate setae (Fig. 23). Cerci increasing in length and prominently seen at the side of the epiprocts.

8th instar (Figs 24-25). — Duration 6-7 days. Length 8.1 mm. Antennae 7-jointed. Labium (Fig. 24): premental setae 10+10, the last pair

Table III

Antennal development (in mm) in different instars of *Brachythemis contaminata*

Instar	Scape	Pedicel	Flagellum segments					Total	*Total length of antennae*
			1st	2nd	3rd	4th	5th		
1st	0.02	0.03	0.10	—	—	—	—	0.10	*0.15*
2nd	0.03	0.04	0.13	—	—	—	—	0.13	*0.20*
3rd	0.05	0.07	0.09	0.11	—	—	—	0.20	*0.31*
4th	0.07	0.09	0.13	0.12	0.11	—	—	0.36	*0.52*
5th	0.09	0.12	0.17	0.10	0.09	0.14	—	0.50	*0.71*
6th	0.12	0.14	0.15	0.10	0.11	0.12	0.15	0.63	*0.89*
7th	0.15	0.18	0.16	0.15	0.15	0.17	0.20	0.83	*1.16*
8th	0.19	0.20	0.20	0.17	0.16	0.29	0.27	1.09	*1.48*
9th	0.22	0.23	0.25	0.21	0.19	0.31	0.34	1.30	*1.75*
10th	0.26	0.29	0.41	0.28	0.38	0.34	0.39	1.80	*2.40*



Figs 28-36. *Brachythemis contaminata* (Fabr.), ultimate stage larva, 10th instar: (28) general view; – (29) antenna; – (30) labium; – (31) labial palp; - (32) mandible; – (33) front leg; – (34) middle leg; – (35) hind leg; – (36) abdomen.

added medially, distal margin containing 19 claviform setae; palpal setae 6&6, each palpal crenation consisting of 3 setae (Fig. 25). Wing sheath extending upto the end of 2nd abdominal segment. Tibial comb consisting of 4 tridentate setae.

9th instar (Figs 26-27). — Duration 10-12 days. Length 11.0 mm. Pale green in colour immediately after moulting but gradually turning into brown. Labium (Fig. 26): premental setae 11+11; palpal setae 7&7, last pair added posteriorly. Wing sheaths extending upto the 4th abdominal segment. Tridentate setae on tibial comb appearing haphazardly (Fig. 27).

10th instar (Figs 28-36). — Duration 19-22 days. Length 13.5 mm. Head roughly rectangular, broader than long, width maximum over the eyes. Antennae (Fig. 29) 7-jointed. Labium (Fig. 30): spoon-shaped, premental setae 12+12, the middle ones longest, distal margin of prementum convex

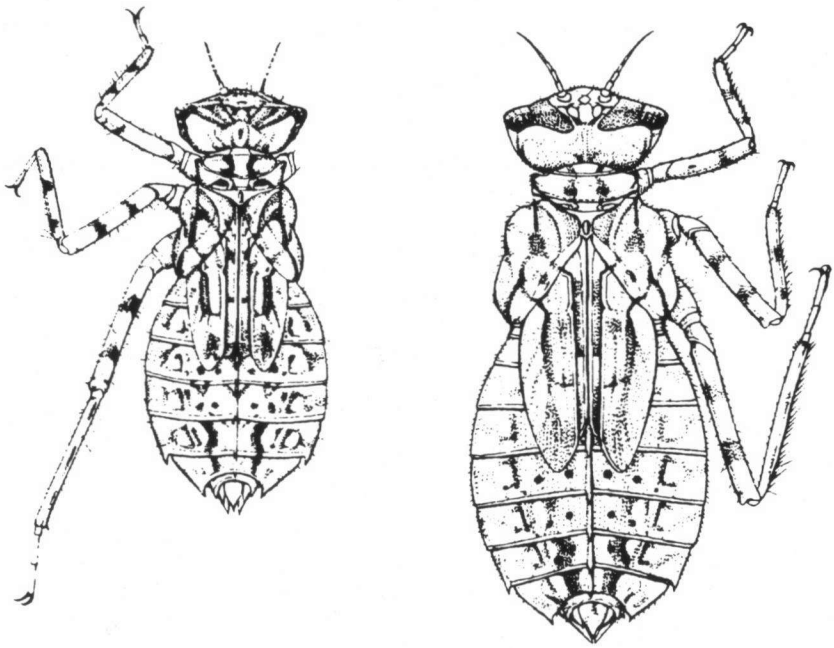


Fig. 37. *Brachythemis contaminata* (Fabr.), drawings of live specimens from Telaga Gadok, West Java, Indonesia; laboratory bred (1932) from a very early instar. Exuviae in collection of the Rijksmuseum van Natuurlijke Historie, Leiden, The Netherlands. Dark marks on top of head and on wings red-brown. Rest of the body ground colour pale yellow-green with olive green markings, very variegated. With next moults spots become more and more coalescent. Magnification: left specimen, x 4; right specimen, x 5. [Figures and caption by Dr M.A. LIEFTINCK, unpublished original].

and with 24 claviform setae; palpal setae 7&7, eight palpal crenations each bearing 3 claviform setae (Fig. 31), moveable hook moderately long and reddish in colour. Mandible strong and stout (Fig. 32) bearing 7 ridges. Wing sheaths extending up to the 5th abdominal segment (Fig. 28), hairy and transparent, the impression of the developing wing venation of the imago is clearly visible. Tridentate setae haphazardly arranged on tibial comb of each leg (Figs 33-35). Abdomen elongated and hairy. Mid-dorsal spines on segments 2-8 (Fig. 36) and lateral abdominal setae on segment 6-8. Epiprocts gradually narrowing to a slender point, paraprocts also straight and gradually pointed distally. All larval characters are summarised in Table II and the antennal development in Table III.

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