

STUDIES ON THE LIFE HISTORY OF INDIAN DRAGONFLIES,
DIPLACODES TRIVIALIS (RAMBUR, 1842)

(Libellulidae : Odonata)

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(With 3 Text-figures and 3 Tables)

INTRODUCTION

Studies on the larval stages and life history of Indian Odonata are very meagre (Kumar & Khanna, in press) and need a thorough investigation to have a better understanding of taxonomy and ecology of immature stages of these insects. The present paper is eighth in the series by the author, dealing with the larval stages and life history of Indian dragonflies.

Genus *Diplacodes* Kirby, 1889, comprises dragonflies of rather small size, which are widely distributed in tropical zones of the Old World. Within our limits the 3 species recorded (Fraser, 1936) have their larvae in swampy ponds and lakes bordered with thick vegetation. They are local as well as migratory in distribution. *Diplacodes trivialis* (Rambur) is one of the most common dragonflies in India and extends to the Old World tropics and subtropics of South Asia, Taiwan, Thailand, Ryukus, Timor, Sumba, Seychelles to Pacific, Japan, Sunda Island, Phillipines, Micronesia, Iraq and Australia (Kumar & Parsad, 1981).

Within India *D. trivialis* is widely distributed in Western Himalaya, Eastern Himalaya, Bihar and West Bengal.

MATERIAL AND METHODS

On 27. IV. 1976 eggs were collected from a female caught in the wheel position at a perennial pond at vill. Gorakhpur, Dehra Dun [77°-78° E. ; 29°-31° N.]. In the laboratory eggs were kept submerged in water in a glass vessel at Ca. (max.) temp. 28°C. Hatching started on 3. V. 76 and ended on 9. V. 76. Study on larval development was begun on 3. V. 76 by starting rearing of 6 larvae in 2nd instar, which emerged into imagos (2♂, 4♀) after passing through 11 instars (Ca. max. temp. 28°-36°C) and taking 50-53 days respectively from oviposition to emergence. Breeding record of the larvae reared in

TABLE 1. Breeding Record (1976) of larvae of *Diplacodes trivialis* (Rmb.)

Eggs collected on 27.IV.1976
 Eggs hatched from 3-9.V.1976 Duration of egg stage from 7-13 days.

All the eggs which gave rise to larvae recorded in the table were hatched on 3.V.1976.

Instar	Larva I	Larva II	Larva III	Larva IV	Larva V	Larva VI	Average (maximum) temperature during the period
	Duration (in days)	Duration (in days)	Duration (in days)	Duration (in days)	Duration (in days)	Duration (in days)	
2nd	2	3	3	3	3	3	
3rd	2	2	3	3	2	3	
4th	2	2	2	4	2	2	
5th	8	2	3	6	3	3	
6th	4	6	5	3	4	3	
7th	2	4	5	3	4	4	29°—38°C
8th	4	3	5	3	5	4	
9th	4	4	4	3	3	4	
10th	3	4	4	4	4	4	
11th	13	15	13	14	16	15	
Emergence	16.VI.76 (♀)	17.VI.76 (♂)	15.VI.76 (♀)	18.VI.76 (♀)	18.VI.76 (♂)	17.VI.76 (♀)	
Total No. of days (from oviposition to emergence)	51	52	50	53	53	52	

the laboratory is tabulated in table I. In early instars larvae were fed ad libitum on Paramecium and Cyclops and later on mosquito larvae.

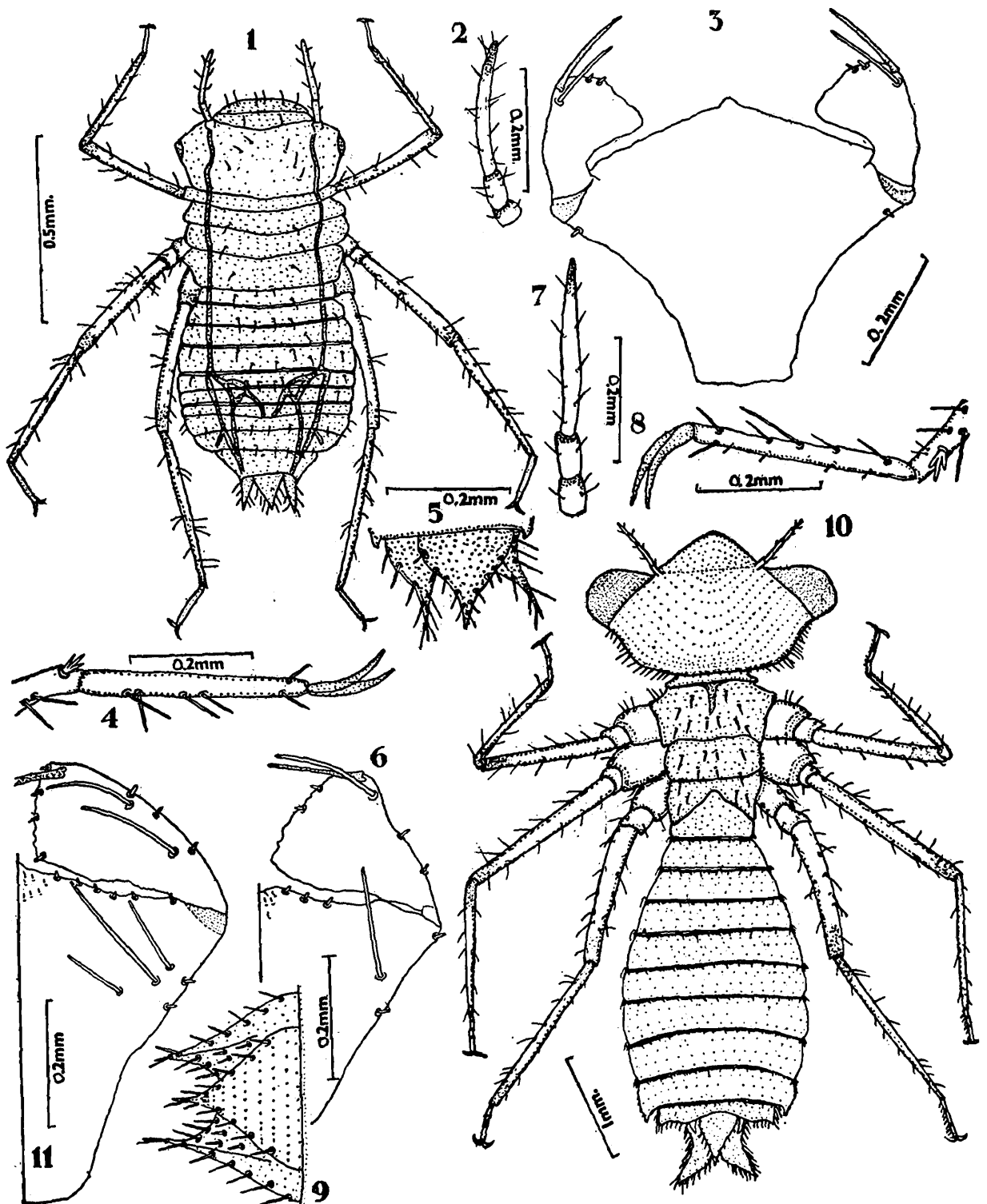
Studies on various instars are based on laboratory reared material. Collections of larval stages and adults by random sampling at monthly intervals were carried out from the above pond in the year 1976, and from other such biotopes in the year 1979, in order to study the life history of the species in field. The stage of instar was determined by its size and the development of wing buds.

The terminology used for the labium is that of Corbet (1953), for tibial comb and tarsi that of Mac Neill (1967), and for anal appendages that of Snodgrass (1954). Larval length was measured from tip of head to tip of anal appendages and is an average for that instar.

OVIPOSITION AND EGG

Oviposition is exophytic and is performed by the unattended female, which dips her abdomen regularly in water while hovering over the ponds.

Eggs are oval in shape, a little longer than broad. Their number vary between Ca. 450-500. Length 0.297 to 0.312 mm. Width 0.210 to



Text-figs. 1-11. (1-5) 2nd Instar Larva : 1, larva (D. V.), 2, antenna, 3, labium ; 4, tibial comb and tarsi ; 5, anal appendages ; (6-9) 3rd Instar larva : 6, labium ; 7, antenna ; 8, tibial comb and tarsi ; 9, anal appendages ; (10 & 11) 4th Instar larva : 10, larva ; 11, labium.

TABLE 2. Summary of larval development of *Diplacodes trivialis* (Ramb.)

Instar	1	2	3	4	5	6	7	8	9	10	11
Antennal Segments		3	3	4	4	5	6	7	7	7	7
Premental Setae		—	1+1	3+3	5+5	7+7	8+8	11+11	12+12	13+13	14+14
Palpal Setae		1 & 1	1 & 1	2 & 2	4 & 4	5 & 5	7 & 7	8 & 8	8 & 8	9 & 9	10 & 10
Tarsal Segments		1	1	2	2	3	3	3	3	3	3
Abdominal Segments covered with wing buds		—	—	—	—	$\frac{1}{2}$	$1\frac{1}{2}$	$3\frac{1}{2}$	$4\frac{1}{2}$	$5\frac{1}{2}$	$6\frac{1}{2}$
Hind wing buds length (in mm)		—	—	—	—	1.5	4.2	5.8	6.6	7.0	7.5'
Anal Cerci		—	—	—	+	+	+	+	+	+	+
Body length (in mm) including anal appendage		2.10	2.85	3.64	4.87	5.56	6.39	8.68	10.82	13.10	15.45
Range Body length (in mm)		(2.0-2.21)	(2.81-2.92)	(3.64-3.75)	(4.82-4.98)	(5.20-5.92)	(6.22-7.10)	(8.10-9.24)	(10.20-11.25)	(12.95-14.15)	(15.20-17.55)
Colouration		W	Y	Y	Y	Y	B	B	B	B	B

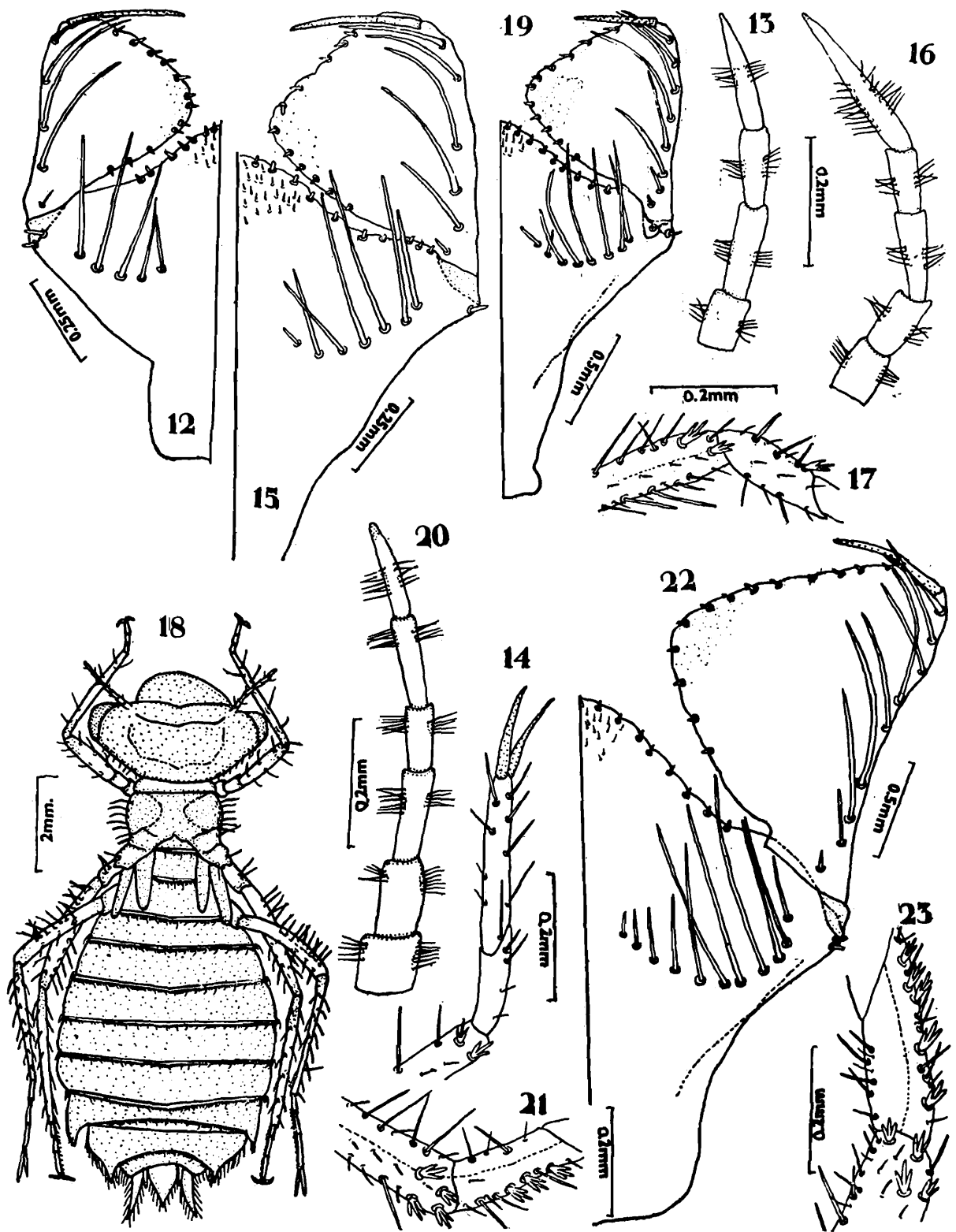
(-) absent

(+) present

(W) whitish

(Y) Yellowish

(B) Brownish



Text-fig. 12-23. (12-14) 5th Instar larva : 12, labium ; 13, antenna ; 14, tibial comb and tarsi ; (15-17) 6th Instar larva : 15, labium ; 16, antenna ; 17, tibial comb (18-21) 7th Instar larva : 18, larva (D. V.) ; 19, labium ; 20, tibial comb ; (22 & 23) 8th Instar larva : 22, labium ; 23, tibial comb.

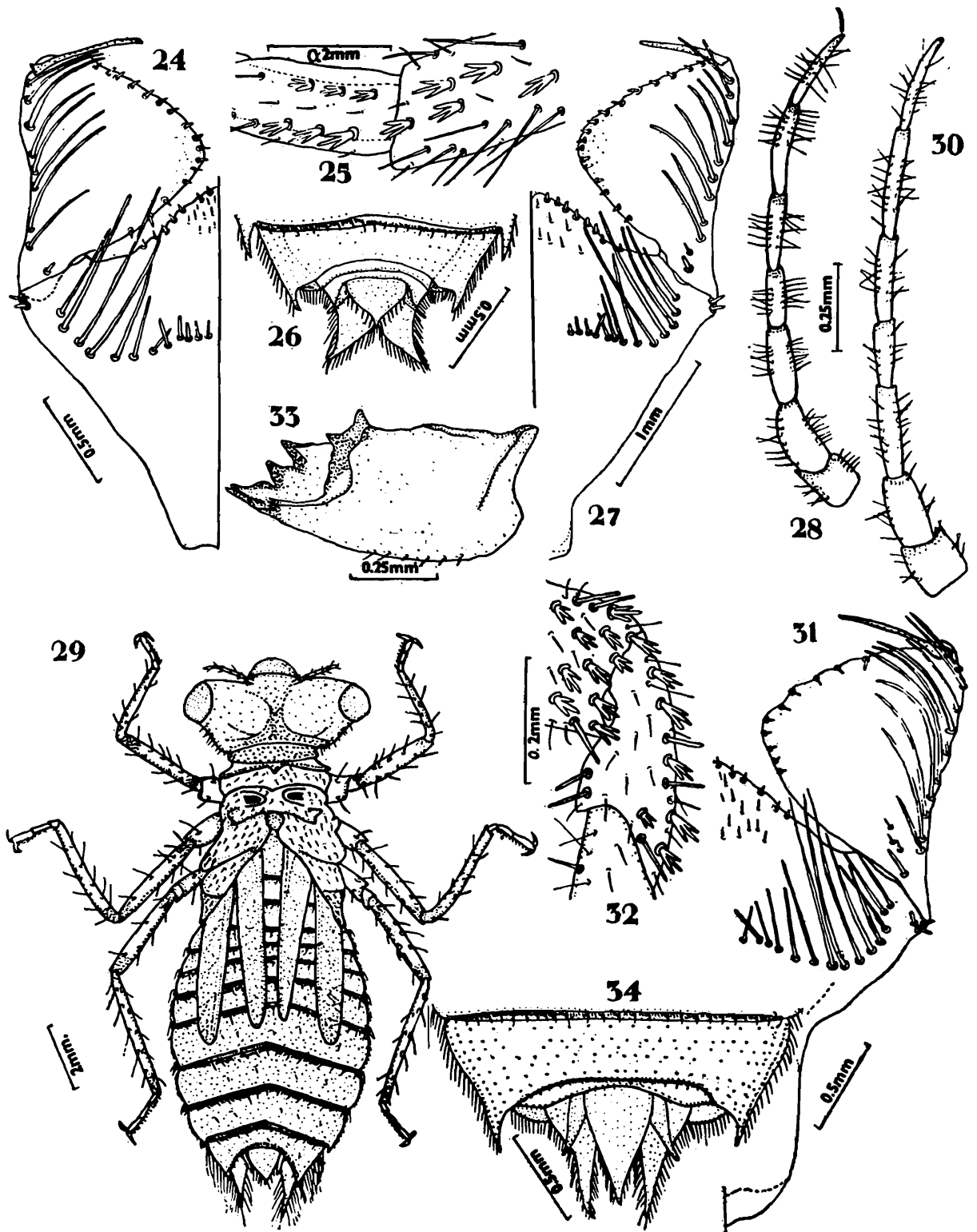
0.211 mm. Freshly laid eggs are white but become yellowish-brown within a few days. The incubation lasted 7 to 13 days (Ca. temp. 28°C).

LARVAL DEVELOPMENT

The prolarva has a very brief duration. The external morphological characters from 2nd to 11th instar are summarised in Table 2. The larval change in brief are as follows ;

TABLE 3. Average duration of life cycle of *Diplacodes trivialis* (Rambur) during different seasons of the year at Dehra Dun.

Egg laid (date)	Egg hatched (date)	Incubation period (in days)	Adult emerged (date)	Larval period (in days)	Total duration of egg & larval stages (in days)	Average temperature (max.) during the period	Remarks
27.IV.1976	3.V.1976	7	17.VI.1976	45	52		<i>Ist Larval generation</i>
"	"	7	18.VI.1976	46	53	29°—38°C	(April to July)
6.VII.1976	15.VII.1976	10	8.X.1976	85	95	24°—35°C	<i>IIInd Larval genera- tion</i> (July to October)
15.X.1979	30.X.1979	15	2.IV. 1980	154	169	16°—24°C	<i>IIIrd Larval generation</i> (October to April)



Text-fig. 24-34. (24-26) 9th Instar larva : 24, labium ; 25, tibial comb and tarsi ; 26, anal appendages ; (27 & 28) 10th Instar larva : 27, labium ; 28, antenna ; (29-34) 11th or Last Instar larva : 29, larva (D. V.) ; 30, antenna ; 31, labium ; 32, tibial comb and tarsi ; 33, mandible ; 34, anal appendages.

Head : During the development of *D. trivialis* the shape of head and eyes do not change distinctly. The head is broadly triangular with antero-dorsally placed eyes. In each instar the size and width of head increases considerably.

Antennae : In instar 2 the antennae are three-segmented (Text-fig. 2). They become four-segmented in instar 4, five-segmented in instar 6 and attains the final seven-segments in instar 8 (cf. Table 2).

Labium : From instar 2 to 11 the general shape of the labium does not change much and remain characteristically that of the family Libellulidae. Major changes occur in the form of addition of labial setae (cf. Table 2).

Wing-Buds : Rudimentary wing-buds in the form of pleural ridges on meso- and meta-thorax appear first in instar 5. They cover $\frac{1}{2}$ of first abdominal segment in instar 6. Thereafter they increase in size gradually (cf. Table 2).

Anal cerci : These appear first in instar 5 and, then during larval development increase in size.

Colouration : When hatched larvae are dirty white. Instar 2 to 6 larvae are yellowish and thereafter become brownish, being darker dorsally.

BIOLOGY

Diplacodes trivialis is also in the group of some multivoltine species occurring at Dehra Dun (Kumar, 1979). Adults could be observed on the wing amidst vegetation around ponds and marshy streams almost throughout the year save during extreme winters.

Life history of *D. trivialis* is almost identical to those of other multivoltine species of dragonflies occurring at Dehra Dun viz., *Ceragrion coromandelianum*, *Pseudagrion rubriceps* (Fam. Coenagriidae), *Crocothemis s. servilia* and *Acisoma p. panarpoides* (Fam. Libellulidae) (Kumar, 1979). Larvae occur in perennial ponds and at muddy banks amidst vegetation of slow running marshy streams in the flatter areas of the valley.

Larval development was studied both in the laboratory and in the field. Larval samples were made from the selected pond round the year at regular intervals. Larval development is rapid and with slight overlapping of broods the species is able to complete 3 larval generations in a year. The summer broods (i.e., March-April to May-June and June-July to August-September) are completed in about 2 months each (Ca. (max.) water temp. varies 24°C to 36°C) (cf. the breeding record presented in this paper, Table 1 & Table 3) thus the 1st batch of adult emergence in a year occurs during the months of March-April from perennial ponds, oviposition takes place soon after and the 2nd batch of emergence occurs in June-July. Adults of 2nd batch now

either oviposit in perennial ponds, from which they have emerged, or in temporary monsoon ponds which are formed during this period because of onset of S. W. monsoon. The 2nd larval brood is again completed rapidly like the preceding summer brood and the 3rd batch of adults emerge in September-October. These adults remain on the wing and soon oviposit in perennial ponds in fields and forests in the flat and sub-mountainous areas of the Valley. Development of this larval generation is slowed down and is completed in not less than 5-6 months due to the advent of the rather severe winter (*Ca.* (max.) temp. varies 16°C to 24°C); larvae in various intermediate instars, after passing the winter, start emerging into adults in the following March-April, thus adopting the pattern of other multivoltine species at Dehra Dun [*cf.* Table 3].

ACKNOWLEDGEMENTS

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SUMMARY

The life history of *Diplacodes trivialis* (Rmb.) has been studied in the field and the laboratory. Specimens were reared from egg to adult. The principal changes in external morphology in different instars and the characters which are helpful in distinguishing various instars are described in detail. The seasonal regulation of the Species has also been studied in the field.

REFERENCES

- CORBET, P. S. 1953. A terminology for the labium of larval Odonata. *Entomologist*, **86** : 191-196.
- FRASER, F. C. 1936. *Fauna of British India, Odonata-3*. London, Taylor & Francis Ltd.
- KUMAR, A. 1979. On the occurrence of multivoltine generations are some Indian dragonflies. *Sci. & Cult.*, **45** : 126-127.

- KUMAR, A. & M. PRASAD, 1981. Field ecology, zoogeography and taxonomy of the Odonata of Western Himalaya, India. *Occ. Publ. Rec. zool. Surv. India*, **20** : 1-118.
- KUMAR, A. & V. KHANNA, 1983. Taxonomic and ecological studies on Odonata larvae from India : A review. *Proc. Workshop on Advances in Insect Taxonomy in India and Orient. Orient. Ins.*, **17** (in press).
- MAC NEILL, N. 1967. Pedal comb of the larvae of dragonflies. *Proc. R. Ir. Acad.*, **65B** : 391-406.
- SNODGRASS, R. E. 1954. The dragonfly larva. *Smithson. misc. Collns.* **123** (2) : 1-38.