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STUDIES ON THE LIFE HISTORY OF INDIAN DRAGONFLIES, *CERIAGRION COROMANDELIANUM* (FABRICIUS)

(COENAGRIIDAE : ODONATA)

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(With 3 Text-figures and 2 Tables)

INTRODUCTION

The present communication is a continuation of my earlier studies on the life history of Indian species of Odonata (*cf.* KUMAR, 1971, 72a, 72b, 72c and 73a). In this paper findings are presented of the study on the life history of *Ceriagrion coromandelianum* (Fabricius). The last instar larva of this species has been described (KUMAR, 1973b).

Genus *Ceriagrion* Selys comprises dragonflies of small size which generally breed in still water. Species are widely distributed in S. Europe, the African continent, S. Asia, China, Japan and the Sondaic Archipelago. Within Indian limits the genus is represented by 9 species. *C. coromandelianum* is commonly distributed throughout India, Sri Lanka, Burma, Malaysia, Indo-China and S. China (FRASER, 1933). In Western Himalaya it occurs at Bilaspur, Kangra, Hamirpur, Simla, Sirmaur and Una (Himachal Pradesh), Chamoli, Dehra Dun, Nainital and Uttar Kashi (Uttar Pradesh).

MATERIAL AND TECHNIQUES

Field observations were made during the years 1975—76 at a perennial pond in Vill. Gorakhpur, Dehra Dun. Study on the larval development began in the laboratory by collection of eggs on 19. IV. 1976 from an ovipositing female. The eggs were laid that day by the female in tandem on floating vegetation in the pond.

In the laboratory the vegetation with eggs was kept submerged in water in a glass trough. Hatching started on 2. v. 1976 and continued till 6. v. 1976. Soon after hatching, larvae in the 2nd instar were transferred from the stock dish and each one was kept in a separate petri dish under normal laboratory conditions (average max. temp. during the period 25°—40°c), after entering into the 7th instar they were transfered

into beakers. In the early instars larvae were fed on *Paramecium* and *Cyclops* and later on mosquito larvae.

Studies on various instars are based on laboratory-reared material. Field studies on the seasonal regulations were made by larval and adult sampling from different biotopes.

Terminology used for the labium follows CORBET (1953) ; the tibial comb and tarsi follows MAC NEILL (1967) ; the anal appendages follow SNODGRASS (1954) and MAC NEILL (1960).

Breeding Record

Study on larval development began on 5. v. 1976 in second instar. The three larvae emerged into adults on 6. vi. 76, 7. vi. 76 and 18. vi. 76 after passing through 12 instars, thus taking 49, 50 and 61 days respectively from oviposition to emergence.

The breeding record of the larvae reared in the laboratory is tabulated in table I.

Eggs and Oviposition

Eggs are elongated and cylindrical (measuring 0. 85-0. 89 mm), with nippled anterior pole (Text-fig 1 A). They are white when freshly laid, turning yellowish subsequently.

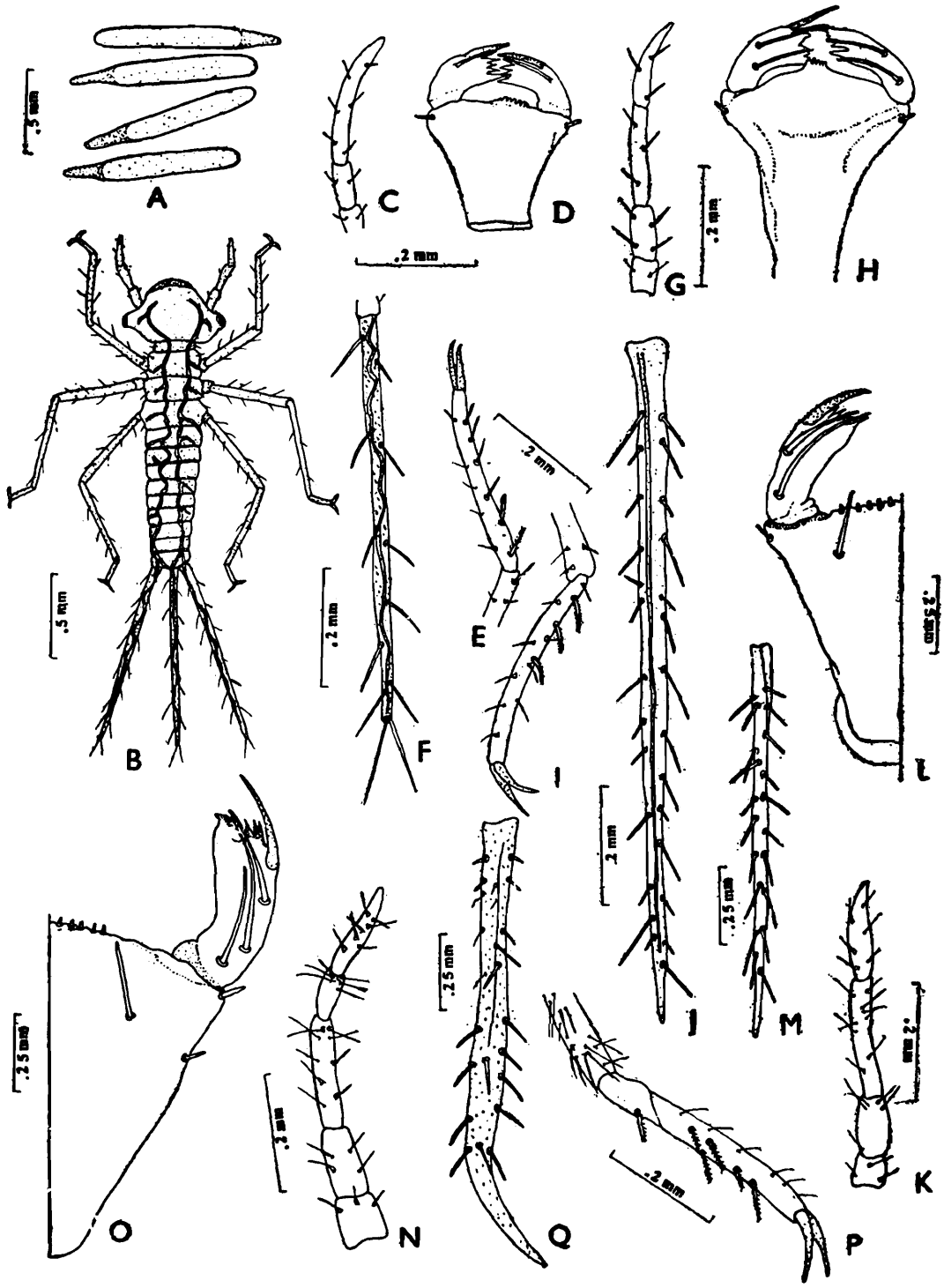
Oviposition is endophytic and the eggs are laid in submerged vegetation. Eggs are laid irregularly in the aquatic plants. While ovipositing, the female stays in tandem.

Larval Stages

1st INSTAR OR PROLARVA : Hatches through ruptured end of the egg ; of very short duration. Head a bit squarish, abdomen elongated with ventrally folded legs ; caudal lamellae thin elongated.

2nd INSTAR (Text-fig. 1B-F) : Almost transparent, thin, elongated larva (Text-fig. 1B) ; tracheae distinctly visible in the abdominal region, *antenna* (Text-fig. 1C) 3-segmented, beset with a few simple setae , *labium* (Text-fig. 1D) small, flat, squarish, premental setae absent, distal margin of prementum straight but for a few minute crenations, a lateral spiniform seta present near the base of palpus ; palpal setae 1 & 1 ; distal margin of palpus deeply crenulated ; *tarsi* (Text-fig. 1E) single segmented, beset with a few spiniform and rare pectinate setae ; *caudal lamellae* (Text-fig. 1F) thin, long process with distinct undulating tracheae traversing throughout its length, beset with setae. Length 1.9 mm.

3rd INSTAR (Text-fig. 1G-J) ; Larva with tracheae distinct in thorax and abdominal region, *antenna* (Text-fig. 1G) 4-segmented,



Text-fig. 1.—Life history of *C. coromandelianum* (Fabr.) : (A) The eggs ; (B-F) 2nd Instar (B, larva ; C, antenna ; D, labium ; E, tibial comb and tarsi ; F, epiproct) ; —(G-J) 3rd Instar (G, antenna ; H, labium ; I, tibial comb and tarsi ; J, epiproct) ; —(K-M) 4th Instar (K, antenna ; L, labium ; M, epiproct) ; —(N-Q) 5th Instar (N, antenna ; O, labium ; P, tibial comb and tarsi ; Q, epiproct).

flagellum having divided into two ; *labium* (Text-fig. 1H) premental setae still absent, distal margin of prementum becoming a bit curved ; palpal setae 2 & 2, distal margin of palpus with deep crenulations ; *tarsi*

(Text-fig. 1I) single segmented ; *caudal lamellae* (Text-fig. 1J) further enlarging, broader proximally. Length 3.2 mm.

4th INSTAR (Text-fig. 1K-M) : *Antenna* (Text-fig. 1K) still 4-segmented ; *labium* premental setae 1+1, distal margin of prementum formed into a number of small crenations, each with a claviform seta ; palpal setae 2 & 2 ; distal margin formed into deep crenulations ; *tarsi* 2-segmented ; *caudal lamellae* (Text-fig. 1M) becoming slightly broader proximally, pointed distally. Length 5.4 mm.

5th INSTAR (Text-fig. 1N-Q) : *Antenna* 5-segmented, first flagellar segment having divided into two (Text-fig. 1N) ; premental setae still 1+1, a few lateral spiniform setae present ; distal margin of prementun formed into a number of crenations, each bearing a claviform seta ; palpal setae 3 & 3, 3rd seta added at the base, distal margin of palpus differentiating into two lobes, the outer comprises 4 teeth while the inner one formed into a curved hook (Text-fig. 10), *tarsi* (Text-fig. 1P) 2-segmented ; *caudal lamellae* further broadening proximally becoming ribbon-like (Text-fig. 1Q). Length 6.3 mm.

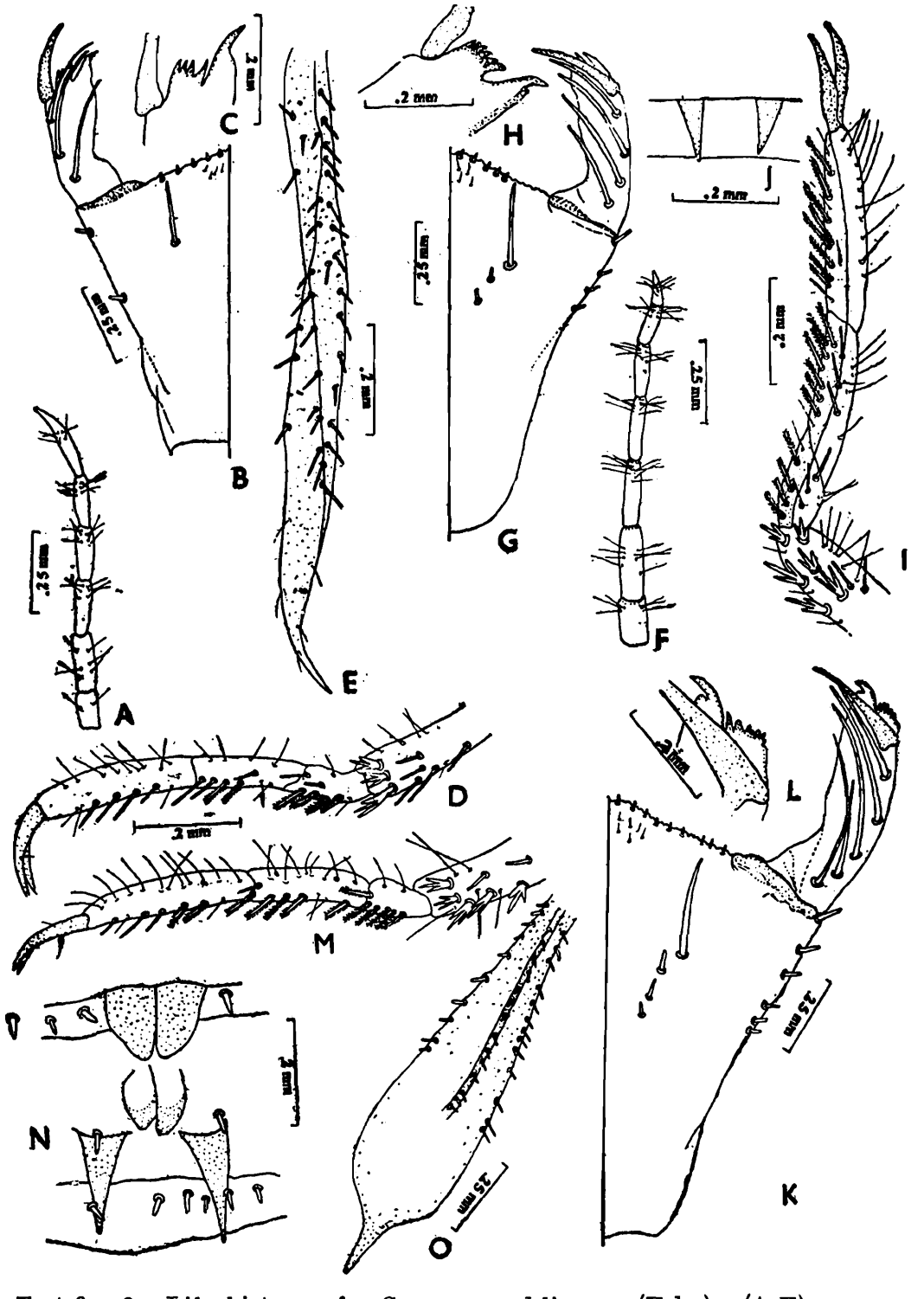
6th INSTAR (Text-fig. 2A-E) : *Antenna* 6-segmented, first flagellar segment having divided into two (Text-fig. 2A) ; premental setae 1+1 ; palpal setae 3 & 3, distal margin of palpus further differentiated into two lobes (Text-fig. 2B & C) ; rudimentary paired wing buds appear. *Tarsi* 3 segmented; tibial comb comprises a few tridentate setae while the tarsi beset with pectinate setae (Text-fig. 2D). *Caudal lamellae* becoming foliaceous (Text-fig. 2E). Length 7·5 mm.

7th INSTAR (Text-fig. 2F-J) : *Antenna* 7-segmented, last flagellar segment having divided into two (Text-fig. 2F), thickly beset with setae. Premental setae 1_2+2^1, a few setella present mesially, row of spiniform setae present laterally ; paplal setae 4 & 4, last one being added toward the base, inner lobe at distal margin of palpus comprises a number of teeth, outer hook-like (Text-fig. 2G & H). Wing buds cover 1st abdominal segment. *Tarsi* 3-segmented, beset with row of pectinate setae (Text-fig. 2I). *Female gonapophyses* appear as paired triangular structures mesoventrally on 9th abdominal segment (Text-fig. 2J). *Caudal lamellae* becoming more foliaceous, post-nodal region having enlarged and becoming rounded, narrow at apex, anti-nodal region beset laterally with a row each of spiniform setae. Length 8·5 mm.

8th INSTAR (Text-fig. 2K-O) : Larvae acquire characteristic appearance of the species because of change in shape and appearance of caudal lamellae. *Colour* olive-green to brownish due to some mottling.

Antenna 7-segmented becoming larger than the preceeding instar.

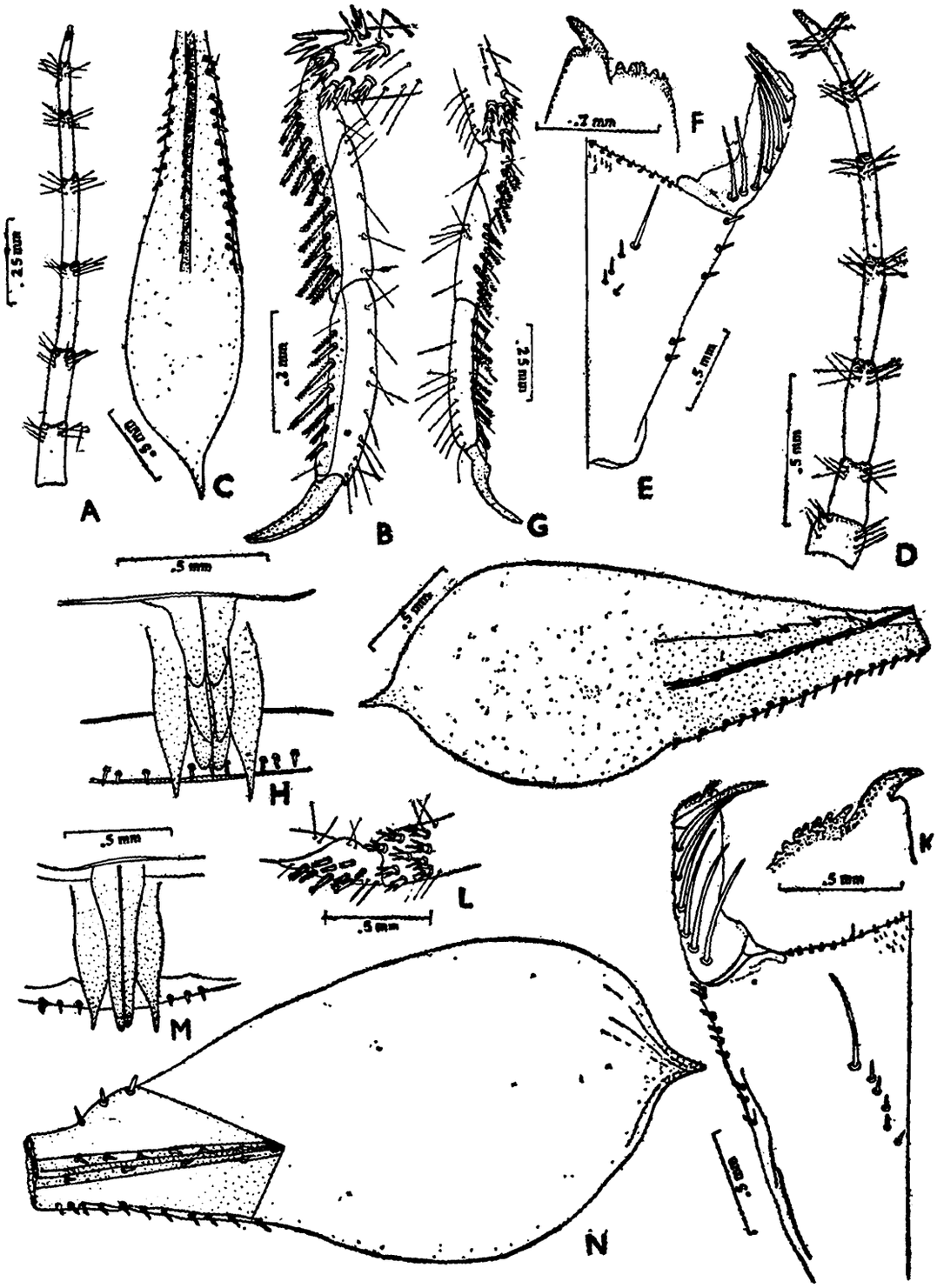
Premental setae 1_3+3^1; a number of lateral spiniform setae present; palpal setae 5 & 5, last added at base, distal margin of palpus with outer



Text-fig. 2.—Life history of *C. coromandelianum* (Fabr.) : (A-E) 6th Instar (A, antenna ; B, Labium ; C, enlarged view distal margin of palpus ; D, tibial comb and tarsi, E, epiproct) ; (F-J) 7th Instar (F, antenna ; G, labium, H, enlarged view distal margin of palpus ; I, tibial comb and tarsi, J, female gonapophyses) ; (K-O) 8th Instar (K, labium, L, enlarged view distal margin of palpus ; M, tibial comb and tarsi ; N, female gonapophyses ; O, epiproct).

lobe formed into 6 small teeth, inner in the form of a distinct curved hook (Text-fig. 2K & L). Hind wing buds reach upto middle of 2nd abdominal segment. Number of setae in tibial comb and on tarsi

increasing further (Text-fig. 2M). Female gonapophyses developing further ; paired anterior appendages distinct on the distal side of 8th



Text-fig. 3.—Life history of *C. coromandelianum* (Fabr.) : (A-C) 9th Instar (A, antenna ; B, tibial comb and tarsi : C, epiproct) ; (D-I) 10th Instar (D, antenna, E, labium ; F, enlarged view distal margin of palpus ; G, tibial comb and tarsi ; H, female gonapophyses ; I, epiproct) ; (J-N) 11th Instar (J, labium, K, enlarged view distal margin of palpus ; L, tibial comb and tarsi ; M, female gonapophyses ; N, epiproct).

abdominal segment (Text-fig. 2N). Distal side of caudal lamellae becoming further rounded in shape (Text-fig. 2O). Length 9·7 mm.

9th INSTAR (Text-fig. 3A-C) : Antenna further increasing in length (Text-fig. 3A). Premental setae 1_4+4^1, row of lateral spiniform setae present on prementum, distal margin of prementum formed into crenations, each beset with a claviform seta. Hind wing buds extend upto the end of 2nd abdominal segment. *Tibial comb* and tarsi thickly beset with tridentate and pectinate setae respectively (Text-fig. 3B). Anterior lobe of female gonapophyses extending up to middle of 9th segment while posterior lobes reach distal to 10th segment. *Caudal lamellae* mottled, beset with spiniform setae in the antinodal region (Text-fig. 3C). Length 10.8 mm.

10th INSTAR (Text-fig. 3D-I) : Premental setae 1_5+5^1 ; palpal setae 6 & 6, last seta added at base, distal margin of palpus with outer lobe formed into a number of teeth (Text-fig. 3 E & F). Hind wing buds further extending upto middle of 3rd segment. Number of tridentate setae on tibial comb and pectinate setae an tarsi futher increasing (Text-fig. 3G). Anterior lobe of female gonapophyses extending upto distal half of 9th segment and the posterior lobe distinctly distal to 10th segment (Text-fig. 3H). *Caudal lamellae* almost napiform in shape, post-nodal region mottled, rounded with narrow apex (Text-fig. 3H). Length 12·0 mm.

Colour : becoming further dark brownish green, sienna an head, abdomen ; caudal lamellae brownish mottled with dense pale spots.

11th INSTAR (Text-fig. 3 J-N) : *Antennae* piliform ; 7-segmented, sparsely beset with setae. Premental setae 1_5+5^1, row of lateral spiniform setae present in the distal half, and a group of setae also present mesoapically on prementum ; palpal setae 6 & 6 (Text-fig. 3J), outer lobe of distal margin of palpus with a number of saw-like teeth (Text-fig. 3K). Hind wing bud completely covers three abdominal segments. Anterior lobe of female gonapophyses developed further and extends distally to 10th segment, posterior lobe narrow, pointed apically and reaches almost same length as anterior ones (Text-fig. 3M). *Tibial comb and tarsi*, with scattered tridentate setae on tibial comb and paired row of pectinate setae on tarsi (Text-fig. 3L). *Caudal lamellae* duplex, almost oval with a small process apically ; distinctly mottled, brownish and pale spots scattered over its whole surface ; tracheae densely traversing obliquely throughout the surface of lamellae ; beset with spiniform setae in anti-nodal region (Text-fig. 3N). Length 13.6 mm.

12th or LAST INSTAR : As described elsewhere (KUMAR, 1973*b*).

Biology

C. coromandelianum is a common species in the foothills of W. Himalaya almost throughout the year around slow running marshy streams, and perennial and seasonal monsoon ponds in the sub-montaneous tracks. Adults hover lazily amidst the vegetation around the aquatic habitats.

Larval development is rapid and the summer and monsoon broods are each completed in almost 2 months. It is a multivoltine species (KUMAR, in press) and the first batch of adult emergence occurs in March-April from perennial ponds. After being on the wing for a while, adults oviposit in the same biotopes. Larval development is completed about 2 month's time and the 2nd batch of emergence from perennial ponds place in May-June (Rafer to the breeding record presented in this paper, Table I). Around this time a number of ephe-

TABLE 1.—Breeding Record (1976) of 3 larvae of *Ceriagrion coromandelianum* (Fabr.)
Eggs collected on 19. iv. 1976
Eggs hatched on 2. v. 1976

Instar	Larva I		Larva II		Larva III	
	Date of entry	Duration (in days)	Date of entry	Duration (in days)	Date of entry	Duration (in days)
2nd	3.v.1976	2	2.v.1976	2	6.v.1976	3
3rd	5.v.1976	3	4.v.1976	3	9.v.1976	4
4th	8.v.1976	2	7.v.1976	3	13.v.1976	5
5th	10.v.1976	3	10.v.1976	3	18.v.1976	4
6th	13.v.1976	4	13.v.1976	3	22.v.1976	3
7th	17.v.1976	3	16.v.1976	3	25.v.1976	3
8th	20.v.1976	2	19.v.1976	4	28.v.1976	3
9th	22.v.1976	3	23.v.1976	3	31.v.1976	3
10th	25.v.1976	5	26.v.1976	2	2.vi.1976	5
11th	30.v.1976	5	28.v.1976	3	7.vi.1976	6
12th	4.vi.1976	3	31.v.1976	6	13.vi.1976	5
Emergence	8.vi.1976		6.vi.1976		18.vi.1976	
Total number of days (from oviposition to emergence)		51		49		61

meral monsoon ponds are also formed with the advent of S. W. monsoons. The next batch of eggs is laid now either in perennial or monsoon ponds and the 3rd batch of emergence occurs in September-October. Monsoon ponds starts drying up by the time the above larval generation is completed and hence are not available for another larval brood. The slow running streams also recede by now. The adults

which have emerged in the September-October period lay another batch of eggs after being on the wing for a few weeks. The eggs are laid now in aquatic vegetation either in slow-running streams or in the

TABLE 2.—Summary of larval changes in *Ceriagrion coromandelianum* (Fabr.)

Instar	2	3	4	5	6	7	8	9	10	11	12
Antennl Segments	3	4	4	5	6	7	7	7	7	7	7
Premental setae	—	—	1+1	1+1	1+1	1_2+2^1	1_3+3^1	1_4+4^1	1_5+5^1	1_5+5^1	1_7+7^1
Palpal setae	1&1	2&2	2&2	3&3	3&3	4&4	5&5	5&5	6&6	6&6	6&6
Tarsal segments	1	1	2	2	3	3	3	3	3	3	3
Abdominal segments	—	—	—	—	$\frac{1}{2}$	1	$1\frac{1}{2}$	2	$2\frac{1}{2}$	3	4
Covered with wing buds											
Female gonapophyses	—	—	—	—	—	r	i	i	i	i	i
Body length (in mm) including the caudal lamellae.	1.9	3.2	5.4	6.3	7.5	8.5	9.7	10.8	12.0	13.6	15.1

perennial ponds. Larval development of this brood is slowed down considerably with the advent of winter and is completed in 5-6 months—thus postponing the next emergence till March-April of the following year. *C. Coromandelianum* is thus able to complete 3 larval generations in a year with a slight overlapping of summer and winter broods.

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SUMMARY

Life history of *Ceriagrion coromandelianum* (Fab.) has been studied in the field and 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. 1933. *Fauna of British India,* Odonata – *1.* Taylor & Francis Ltd., London.

KUMAR, A. 1971, The larval stages of *Orthetrum brunneum brunneum* (Fonscolombe) with a description of the last instar larva of *O. taeniolatum* (Schneider) (Odonata : Libellulidae). *J. nat. Hist.* **5** : 121-132.

KUMAR, A. 1972a. The life history of *Lestes praemorsa praemorsa* Selys (Odonata : Lestidae). *Treubia*, **28** (1) : 3-20.

KUMAR, A. 1972b. Studies on the life history of *Trithemis festiva* (Rambur, 1842) (Odonata : Libellulidae). *Odonatologica* **1** (2) : 103-112.

KUMAR, A. 1972c. Bionomics of *Orthetrum pruinosum neglectum* (Rambur) (Odonata : Libellulidae). *Bull. Ent.*, **11** (1) : 85-93.

KUMAR, A. 1973a. The life history of *Bradinopyga geminata* (Rambur) (Odonata : Libellulidae). *G. K. J. Sci. Res.*, **5** (1 & 2) : 51-57 ; pls. 3.

KUMAR, A. 1973b. Description of the last instar larvae of Odonata from the Dehra Dun Valley (India), with notes on Biology I (Suborder Zygoptera)—*Oriental Ins.*, **7** (1) 83—118.

MAC NEILL, N. 1960. A study of the caudal gills of dragonfly larvae of the Sub-order Zygoptera. *Proc. R. Irish Acad.*, **61** : 140—155.

MAC NEILL, N. 1967. Pedal comb of the larvae of dragonflies. *Proc. R. Irish Acad.*, **65** B : 391—406.

SNODGRASS, R. E. 1954. The dragonfly larva. *Smithson. misc. coll.*, **123** (2) : 1—38.