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Distribution of constitutive heterochromatin in four species of genus *Copera* of family Platycnemididae (Odonata: Zygoptera) from India

Walia Gurinder Kaur and Devi Monika

Department of Zoology and Environmental Sciences, Punjabi University, Patiala- 147002. Punjab, India.
Email- gurinderkaur_walia@yahoo.co.in, monika15kondal@gmail.com

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ABSTRACT

C–heterochromatin distribution in four species of genus Copera of family Platycnemididae have been described. *Copera marginipes* and *Copera vittata* assamensis were collected from Bilaspur and Renuka lake (Sirmour, Himachal Pradesh), respectively, while *Copera annulata* and *Copera vittata* were collected from Nongkhyllem (Meghalaya), India. All the species possess n=13m as haploid chromosome number, which is the type number of the family and X0-XX sex determining mechanism. In all the species, autosomal bivalents show dark/light terminal C-bands on chiasmatic/nonchiasmatic ends, while m bivalent and X chromosome possess variation in distribution of C-heterochromatin. m bivalent is C-negative in *Copera marginipes*, while shows terminal C-bands in *Copera annulata*, *Copera vittata* and *Copera vittata* assamensis. X chromosome possesses less amount of C-heterochromatin in *Copera marginipes*, *Copera annulata* and *Copera vittata*, whereas X chromosome is bipartite and entirely C-negative in *Copera vittata* assamensis. Chromosome complement of *Copera vittata* assamensis has been studied for the first time.

Key words-: Zygoptera, Platycnemididae, X chromosome, m chromosomes, C- heterocromatin.

INTRODUCTION

Family Platycnemididae includes predominantly black coloured damselflies with blue/red/yellow markings and narrow, transparent wings, which are rounded at the tip. Males have widened tibiae, which are the characteristic feature of the family. Taxonomically, this family consists of 43 genera referable to 455 species all over the world, while 14 genera, 52 species are present in India (Subramanian and Babu, 2017). So far, 11 species have been studied cytogenetically, among these, 6 species are from India.

Majority of the species possess 2n = 25m, which is considered as type number of the family (Dasgupta 1957; Handa and Kochhar 1980; Kiauta 1971; Kiauta 1975; Kichijo 1941, 1942a, b; Oksala 1945; Tyagi 1978a, b; Walia and Kaur 2011; Walia 2012). The only exception is *Risiocnemis incisa* with chromosome number 2n=21 and n=11, which has been secondarily originated by the fusion of six elements of primary complement, 2n=25 (Kiauta and Kiauta, 1981). Taxonomically, 9 species of genus *Copera* are available worldwide, while no cytogenetical data is available on these species. In India, Out of 5 species of genus *Copera*, only 3 species (*Copera annulata, Copera marginipes, Copera vittata*) with n=13m have been described, cytogenetically. During the present study, chromosome complement and distribution of constitutive heterochromatin have been studied in four species of genus *Copera*. All the species possess 2n=25m, n=13m with X0-XX sex determination. Variation in distribution of C-heterochromatin has been studied in all the species.

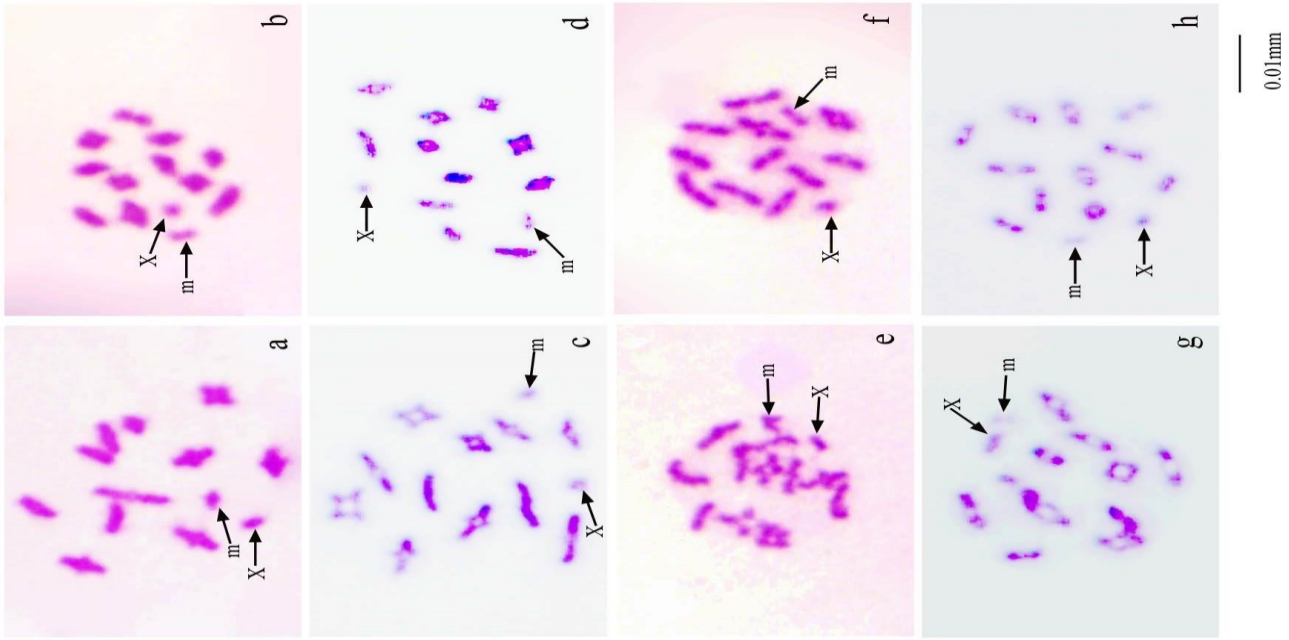
METHODOLOGY

Live adult male specimens of *Copera vittata assamensis* were collected from (Renuka Lake, Sirmour) and *Copera marginipes* from (Bilaspur), Himachal Pradesh area during the months of June and September, 2015, respectively. *Copera annulata* and *Copera vittata* were collected from Nongkhyllem, (Meghalaya) during the months of October, 2017. Specimens were dissected in (0.67) % saline solution in the field. Testes were put in sodium citrate (0.9) % for 45 minutes and fixed in freshly prepared Carnoy's fixative (3: 1, absolute alcohol: glacial acetic acid). After this, testes were teased on the grease free slides and slides were air dried. For the conventional staining, prepared slides were stained in Carbol fuchsin for 3-4 hour as suggested by Carr and Walker (1961). For the induction of C-bands, technique suggested by Sumner (1972) was followed with minor modifications.

RESULTS

CONVENTIONAL STAINING:

In all the species, during diakinesis, 13 elements are present, which include 11 autosomal bivalents, small m bivalent and oval shaped, X chromosome. Autosomal bivalents and m bivalent appear rectangular shaped due to the presence of single chiasma per bivalent (Figs. a, e, i, m). In the metaphase-I, all the autosomal bivalents show rod shaped structure due to the condensation and terminalization of chiasmata. X chromosome and m bivalent are distinct because of oval shape and small size, respectively (Figs. b, f, j, n).

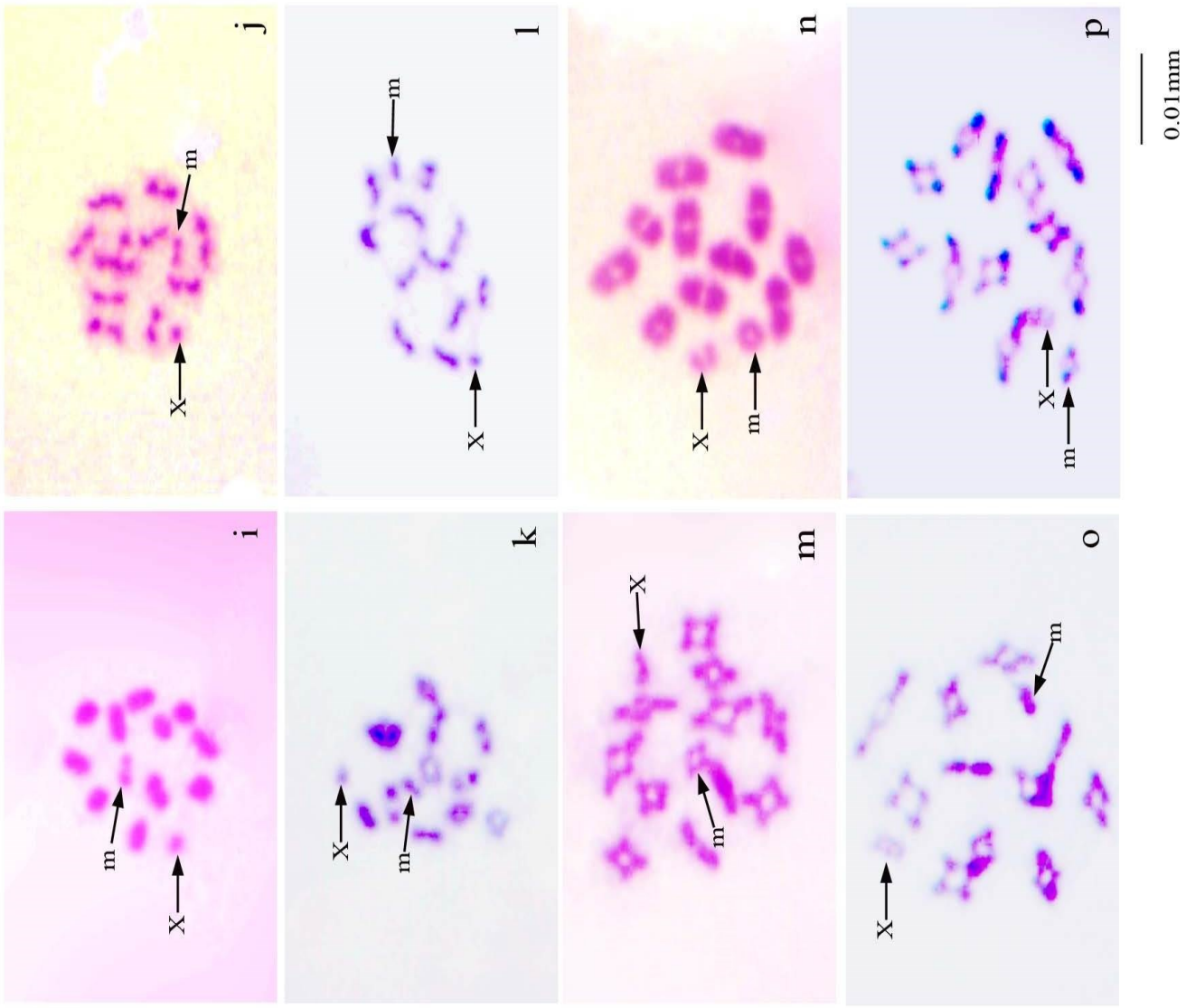


Copera annulata

Conventional staining-: Fig. a-: Diakinesis, Fig. b-: Metaphase-I., C-banding-: Fig. c-: Diakinesis, Fig. d-: Metaphase-I

Copera marginipes

Conventional staining-: Fig. e-: Diakinesis, Fig. f-: Metaphase-I, C-banding-: Fig. g-: Diakinesis, Fig. h-: Metaphase-I



Copera vittata

Conventional staining-: Fig. i-: Diakinesis, Fig. j-: Metaphase-I, C-banding-: Fig.k-: Diakinesis, Fig. l-: Metaphase-I

Copera vittata assamensis

Conventional staining-: Fig. m-: Diakinesis, Fig. n-: Metaphase-I, C-banding-: Fig.o-: Diakinesis, Fig. p-: Metaphase-I

C-BANDING:

In *Copera annulata*, during diakinesis, 8 autosomal bivalents show dark terminal C-bands, 3 bivalents including m bivalent possess light terminal C-bands and one bivalent has dark terminal C-band on one side, only. X chromosome shows less amount of C-heterochromatin (Fig. c). In metaphase-I, all the bivalents including m bivalent show dark terminal C-bands due to condensation of elements, while X chromosome possesses less amount of C- heterochromatin (Fig. d). In *Copera marginipes*, during diakinesis and metaphase-I, all the autosomal bivalents show dark/light terminal C-bands on both sides. X chromosome possesses less amount of C-heterochromatin, while m bivalent is C-negative (Figs. g, h). In *Copera vittata,* during diakinesis and metaphase-I, all the autosomal bivalents including m bivalent possess terminal C-bands, while two autosomal bivalents show light C-bands during diakinesis. X chromosome is showing less amount of C-heterochromatin (Figs. k, l). In *Copera vittata assamensis*, during diakinesis and metaphase-I, all the autosomal bivalents including m bivalent possess dark/light terminal C-bands, while X chromosome is bipartite and entirely C-negative (Figs. o, p).

DISCUSSION

Type number of the family Platycnemididae is 2n=25m (22A+2m+XO), which is present in all the cytogenetically studied species of genera *Calicnemia*, *Copera*, *Platycnemis* and *Coeliccia* (Dasgupta, 1957; Handa and Kochhar, 1980; Kiauta, 1971; Kiauta, 1975; Kichijo, 1941; 1942a, b; Oksala, 1945; Tyagi, 1978a, b; Walia and Kaur, 2011; Walia, 2012) except *Risiocnemis incisa*, (2n=21; n=11), which was secondarily originated by the fusion of six elements of primary complement 2n=25 (Kiauta and Kiauta, 1981).

Taxonomically, 9 species of genus *Copera* are available worldwide, while no cytogenetical data is available on these species. However, out of 5 Indian species of same genus, 3 have been reported, cytologically. Dasgupta (1957) studied *Copera annulata* under the genus *Platycnemis* and reported n=13m from Calcutta. Later, this species shifted under the genus *Copera* by Lahiri (1987). Later, Walia and Kaur (2011) from Manglore (Karnatka) and Walia (2012) from Silchar (Assam) and Mansar lake (Jammu and Kashmir) also observed (n=13m) in *Copera annulata*. Present results on the same species from Nongkhyllem (Meghalaya) are in accordance to the earlier reports. Similarly, *Copera marginipes* from Dehradun (Uttrakhand) (Tyagi, 1978a, b) and *Copera vittata* from Udhampur (Jammu and Kashmir) (Walia, 2012; Gill, 2014) also possess n=13m. During the present study, same chromosome number (n=13m) has been noticed in these species although the species were collected from the different localities. Chromosome complement of *Copera vittata assamensis* collected from Renuka lake (Sirmour, Himachal Pradesh) also possesses n=13m and is described for the first time.

So far, only two species, *Calcnemia eximia* and *Copera vittta* of family Platycnemididae have been studied on basis of C-banding (Gill, 2014). She observed terminal C-bands in all the autosomal bivalents, whereas m bivalent is C-negative and X chromosome is C-positive in both the species. Similarly, during the present study in all the species, autosomal bivalents show dark/light terminal C-bands on chiasmatic/nonchiasmatic ends, while m bivalent and X chromosome possess variation in distribution of C-heterochromatin. m bivalent is C-negative in *Copera marginipes* and show terminal C-bands in *Copera annulata, Copera vittata* and *Copera vittata assamensis*. X chromosome possesses less amount of C-heterochromatin in *Copera marginipes, Copera annulata* and *Copera vittata* whereas in *Copera vittata assamensis*, X chromosome is bipartite and entirely C-negative. In the present study, variation in distribution of C-heterochromatin from earlier reports of *Copera vittata* has been observed as Gill, (2014) reported C-negative m bivalent and C-positive X-chromosome in the species, while, m bivalent possess terminal C-bands and X chromosome show less amount of C-heterochromatin in the present study. Distributions of C-heterochromatin have been done for the first time in *Copera annulata, Copera marginipes* and *Copera vittata assamensis* species.

CONCLUSION

During the present study, chromosomal complement of *Copera vittata assamensis* has been reported for the first time and distributions of C-heterochromatin in *Copera annulata, Copera marginipes* and *Copera vittata assamensis* have also been done for the first time

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