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NOTE

A record of gynandromorphism in the libellulid dragonfly *Crocothemis servilia* (Insecta: Odonata) from India

R.V. Renjith [1] & A. Vivek Chandran [2]

[1] Sreekailasam House, Palappuram P.O., Ottapalam, Palakkad, Kerala 679103, India.
[2] Department of Geology and Environmental Science, Christ College, Irinjalakuda, Thrissur, Kerala 680125, India.
[1] renjith14041991@gmail.com, [2] avivekchandran@gmail.com (corresponding author)

Gynandromorphs are genetically and phenotypically chimeric specimens and differ from intersexes which are genetically uniform (Narita et al. 2010). Gynandromorphism can be bilateral, appearing to divide down the middle into male and female sides, or they may be a mosaic, with patches characteristic of one sex appearing in a body part characteristic of the other sex. Gynandromorphism is a rare phenomenon in nature and is usually detected in species that show distinct sexual dimorphism. It is known to occur in different arthropod taxa such as Crustacea (Farmer 2004), Arachnida, e.g., scorpions (Cokendolpher & Sissom 1988), spiders (Palmgren 1979), ticks (Labruna et al. 2002), and Insecta, e.g., stoneflies (Klotzek 1971), hymenopterans (Gjershaug et al. 2016), beetles (Le Gall 2006), butterflies (Nielsen 2010), dipterans such as mosquitoes (Kronefeld et al. 2013) and fruit flies (Morgan & Bridges 1919). In vertebrates it has been detected in reptiles (Krohmer 1989), birds (Peer & Motz 2014), and mammals (Hollander et al. 1956). Gynandromorphs occasionally afford a powerful tool in genetic, developmental, and behavioural analyses. In *Drosophila melanogaster*, for instance, gynandromorphs were used to provide evidence that male courtship behaviour originates in the brain (Hotta & Benzer 1972).

Gynandromorphism is rare in odonates (Corbet 1962) and so far has been reported from 30 individuals belonging to seven families: Calopterygidae, Coenagrionidae, Aeshnidae, Gomphidae, Cordulegastridae, Corduliidae, and Libellulidae (Tennessen 2008; Torralba-Burrial & Ocharan 2009; Pix 2011; Futahashi 2017). There are other forms of colour variation seen in odonates. Andromorphic females are common in many odonate families. They have normal female reproductive organs and are fertile (Robertson 1985; Andrew 2013). Immature male imagoes of many Anisoptera resemble females in colouration, but can be distinguished by the male reproductive structures. Gynandromorphism, on the contrary, is believed to be a genetic aberration caused by abnormal mitosis in the embryo leading to unequal distribution of sex chromosomes (May 1988). As a result, the developed individual has both male and

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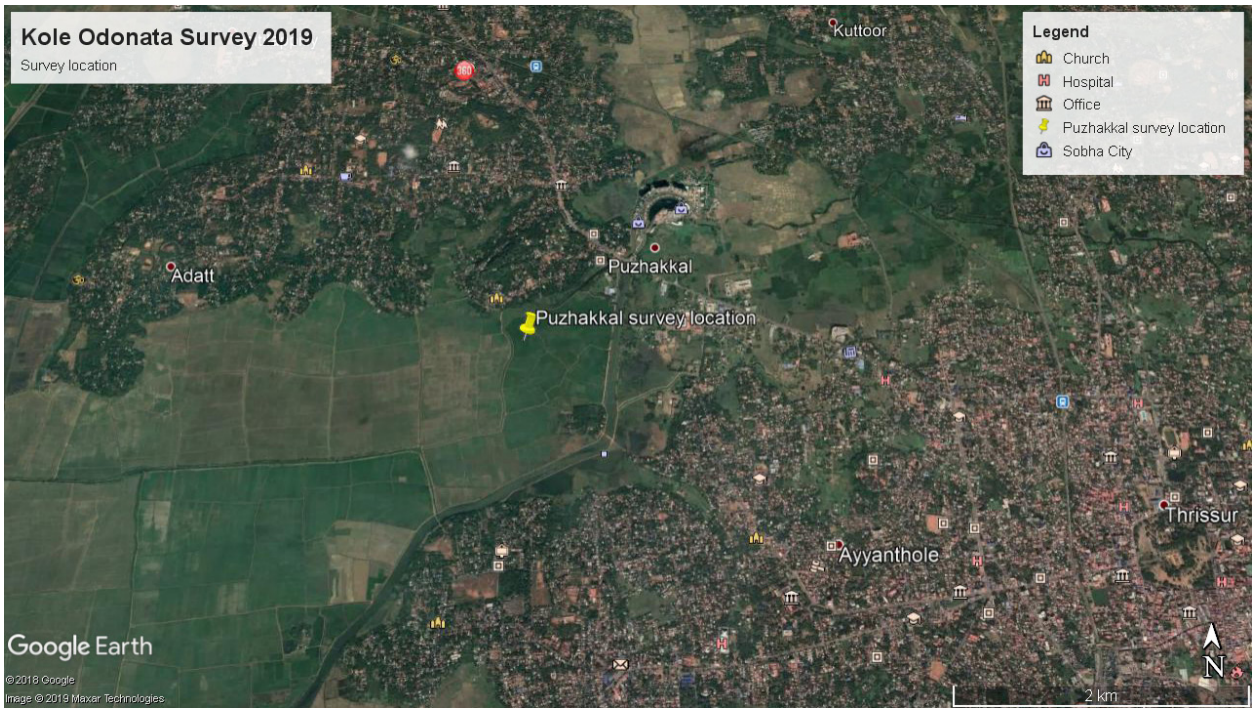

Image 1. Survey location from where *Crocothemis servilia* gynandromorph was recorded.

female tissues and mixed morphological characteristics.

The Kole wetlands are low-lying areas that remain submerged under floodwater for about six months of a year. Wetland agriculture, mainly paddy (rice) cultivation is the most important activity undertaken there. They cover an area of 13,632ha and are spread across Thrissur and Malappuram districts of Kerala (Johnkutty & Venugopal 1993). Kole has been a Ramsar site since 2002, an important bird area since 2004 (Islam & Rahmani 2008), and a high value biodiversity area since 2009 (MoEF 2009). In a survey conducted at Kole wetlands on 14 July 2019 (Image 1), jointly by Kerala Agricultural University, Kole Birders, Society for Odonate Studies, and Kerala Forest Department, 33 species of odonates were recorded.

Crocothemis servilia, is a common dragonfly associated with marshes, ponds, rivers and tanks. It is widely distributed in the Oriental and Australian region (Subramanian 2009). The male has prominent blood red colouration in almost all body parts including the head, thorax, abdomen and legs. The wings are transparent with the base marked with rich amber (Image 2). The female is pale yellow with dark brown thorax and legs (Image 3).

At Puzhakkal region of the Kole wetlands (10.540^{0}N & 76.172^{0}E), an individual of *Crocothemis servilia* that looked part male and part female was photographed during the survey. The specimen could not be collected as it started raining and the individual moved into the deep marshes. Subsequent efforts to collect the specimen failed because of heavy rains that continued for the next few days, submerging the location. The species was initially identified using the field guide by Kiran & Raju (2013) and confirmed by referring to Fraser (1936).

The photographed individual showed bilateral gynandromorphism of only the thorax, half of which showed blood red colouration as in males and the other half pale yellow characteristic of females. The base of the wing of the red half was marked with rich amber, in contrast with the other wing base which was paler. The head, legs and abdomen showed typical female morphology. Status of the anal appendages could not be asserted from the photograph (Image 4). Since the female characters dominated, this cannot be considered a "balanced" gynandromorphy. The individual exhibited a genetic mosaic condition only in the thoracic region. May (1988) reported gynandromorphism in two species of family Corduliidae, namely *Somatochlora filosa* and *Somatochlora provocans* from the United States of America. The specimens he examined had mixtures of male and female external characters ranging from almost entirely female to about equally divided. They were symmetrical in development with normally dimorphic structures mostly having characters intermediate between the typical male and female

Image 2. *Crocothemis servilia* adult male.

Image 3. *Crocothemis servilia* adult female.

conditions, particularly noticeable in the development of the genital lobes, cerci, and metathoracic legs. Torralba-Burrial & Ocharan (2009) reported gynandromorphism in the libellulid *Sympetrum striolatum* from Spain. One of the two specimens they examined was a bilateral gynandromorph which looked like a female in general appearance but had male structures in the right side of the abdomen. Their second specimen resembled a male in general appearance, but had a female gonopore. Mosaic gynandromorphy in *Ischnura senegalensis* (Family: Coenagrionidae) and *Crocothemis servilia* (Family: Libellulidae) was reported by Futasahi from Japan (2017). In South Asia, gynandromorphy was reported in *Neurothemis tullia* (Family: Libellulidae) from Bangladesh (Shome et al. 2019), in which the specimen's head and thorax, including wings were bilaterally gynandromorphic. The abdomen was androchromic but had female appendages at the tip. In India, gynandromorphism was reported in *Neurothemis tullia* (Family: Libellulidae) and *Heliocypha bisignata* (Family: Chlorocyphidae) (Emiliyamma 2009), but photographs or illustrations were unavailable for confirmation or comparison. According to Siva-Jothy (1987), gynandromorphs have been reported to fail in mating because of aberrant sex organs but in the present individual the abdomen is typically female and since the internal and external female reproductive organs/ genitalia are abdominal, this individual could be a fertile

Image 4. *Crocothemis servilia* gynandromorph.

female. May (1988) after observing eggs on the vulvar laminae of three *Somatochlora filosa* gynandromophic individuals proposed that they were functionally female. Gynandromorphism is a multifactorial issue caused by different genetic factors which are well documented (Narita et al. 2010), but further research has to be undertaken to investigate the influence of environmental factors on this phenomenon.

References

Andrew, R. (2013). Andromorphic female of the dragonfly *Neurothemis tullia tullia* (Drury) (Odonata: Libellulidae), central India. *Journal of Threatened Taxa* 5(1): 3571–3573. https://doi.org/10.11609/JoTT.o3143.155

Cokendolpher, J.C. & W.D. Sissom (1988). New gynandromorphic Opiliones and Scorpiones. *British Arachnological Society* 7(9): 278–280.

Corbet, P.S. (1962). *A Biology of Dragonflies*. Witherby, London, 247pp.

Emiliyamma, K.G. (2009). Gynandromorphism in *Neurothemis tullia tullia* (Drury) and *Rhinocypha bisignata* (Selys) (Odonata: Insecta) from Kerala. *Records of the Zoological Survey of India* 109: 73–75.

Farmer, A.S. (2004). A bilateral gynandromorph of *Nephrops norvegicus* (Decapoda: Nephropidae). *Marine Biology* 15: 344–349. https://doi.org/10.1007/BF00401394

Fraser, F.C. (1936). *The Fauna of British-India including Ceylon and Burma, Odonata.* Vol. III. Taylor and Francis Ltd., London, 461pp.

Futasahi, Ryo. (2017). Molecular mechanisms underlying color vision and color formation in dragonflies, pp. 303–307. In: Toshio, S. & H. Frederik Nijhout (eds.). *Diversity and Evolution of Butterfly Wing Patterns - An Integrative Approach.* Springer Open, 320pp.

Gjershaug, J., F. Ødegaard, A. Staverløkk & K. Olsen (2016). Records of bilateral gynandromorphism in three species of ants (Hymenoptera, Formicidae) in Norway. *Norwegian Journal of Entomology* 63: 65–70.

Hollander, W.F., J.W. Gowen & J. Stadler (1956). A study of 25 gynandromorphic mice of the bagg albino strain. *Anatomical Record* 124: 223–243.

Hotta, Y. & S. Benzer (1972). Mapping of Behaviour in Drosophila mosaics. *Nature* 240: 527–535.

Islam, M.Z. & A.R. Rahmani (2008). *Potential and Existing Ramsar Sites in India*. Indian Bird Conservation Network: Bombay Natural History Society, BirdLife International and Royal Society for the Protection of Birds. Oxford University Press, 592pp.

Johnkutty, I. & V.K. Venugopal (1993). *Kole Lands of Kerala*. Kerala Agricultural University, Vellanikkara, Thrissur, 68pp.

Kiran, C.G. & D.V. Raju (2013). *Dragonflies and Damselflies of Kerala* (Keralathile Thumbikal). Tropical Institute of Ecological Sciences, 156pp.

Klotzek, F. (1971). Gynandromorphism usbei *Leuctra*-Arten des Harzes (Plecoptera-Leuctridae). *Hercynia* 8: 96–101.

Krohmer, R.W. (1989). Reproductive physiology and behaviour of a gynandromorph red sided garter snake, *Thamnophis sirtalis parietalis*, from central Manitoba, Canada. *Copeia* 1989: 1064–1068.

Kronefeld, M., F. Schaffner, H. Kampen & D. Werner (2013). Gynandromorphism and intersexualism in Culicidae (Diptera: Culicomorpha: Culicoidea): description of five individual cases and literature review. *Studia Dipterological* 20: 239–259.

Labruna M.B., A.F. Ribeiro, M.V. Cruz, L.M. Camargo & E.P. Camargo (2002). Gynandromorphism in *Amblyommaca jennense* and *Rhipicephalus sanguineus* (Acari: Ixodidae). *Journal of Parasitology* 88: 810–811.

Le Gall, P. (2006). Deux examples de coléoptères gynandromorphes. *Le Coléoptériste* 9: 79–82.

May, M.L. (1988). Gynandromorphic specimens of Somatochlora (Anisoptera: Corduliidae). *Odonalologica* 17(2): 127–134.

MoEF (2009). *Integrated Development of Wildlife Habitats*. Ministry of Environment & Forests, New Delhi, 83pp.

Morgan, T.H. & C.B. Bridges (1919). The origin of gynandromorphs, pp. 1–122. In: Bridges C.B., T.H. Morgan & A.H. Sturtevant (eds.). *Contributions to the Genetics of Drosophila melanogaster.* Carnegie Institution of Washington, Washington, 388pp.

Narita, S., R.A.S. Pereira, F. Kjellberg & D. Kageyatma (2010). Gynandromorphs and intersexes: potential to understand the mechanisms of sex determination in arthropods. *Terrestrial Arthropod Reviews* 3: 36–96.

Nielsen, J.E. (2010). A review of gynandromorphism in the genus *Ornithoptera* Boisduval (Lepidoptera: Papilionidae). *The Australian Entomologist* 37: 105–112.

Palmgren, P. (1979). On the frequency of gynandromorphic spiders. *Annales Zoologici Fennici* 16: 183–185.

Peer, B.D. & R.W. Motz (2014). Observations of a Bilateral Gynandromorph Northern Cardinal (*Cardinalis cardinalis*). *The Wilson Journal of Ornithology* 126(4): 778–781.

Pix, A. (2011). Ein Gynander von *Cordulegaster bidentata* aus dem Weserbergland (Odonata: Cordulegastridae). *Libellula* 30: 19–24.

Robertson, H.M. (1985). Female dimorphism and mating behavior in a damselfly, *Ischnura ramburi*: female mimicking male. *Animal Behaviour* 33: 805–809.

Shome, A.R., R. Mokhlesur & A. Mahabub (2019). An unusual case of gynandromorphism in *Neurothemis tullia* (Odonata: Libellulidae). *Notulae odonatologicae* 9(3):83–124.

Siva-Jothy, M.T. (1987). External and internal genital structures in a gynandromorphy *Onychogomphus uncatus* (Charp.) (Anisoptera: Gomphidae). *Odonatologica* 16: 307–310.

Subramanian, K.A. (2009). *Dragonflies and Damselflies of Peninsular India - A Field Guide*. Vigyan Prasar, Noida, India, 168pp.

Tennessen, K.J. (2008). Gynandromorphs in the genera *Ophiogomphus* Selys, 1854 and *Ischnura* Charpentier, 1840 (Odonata: Gomphidae, Coenagrionidae). *Insecta Mundi* 37: 1–3.

Torralba-Burrial, A. & F.J. Ocharan (2009). Two gynandromorphs of *Sympetrum striolatum* (Charpentier, 1840) (Odonata: Libellulidae). *Entomological Science* 12: 182–187.

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