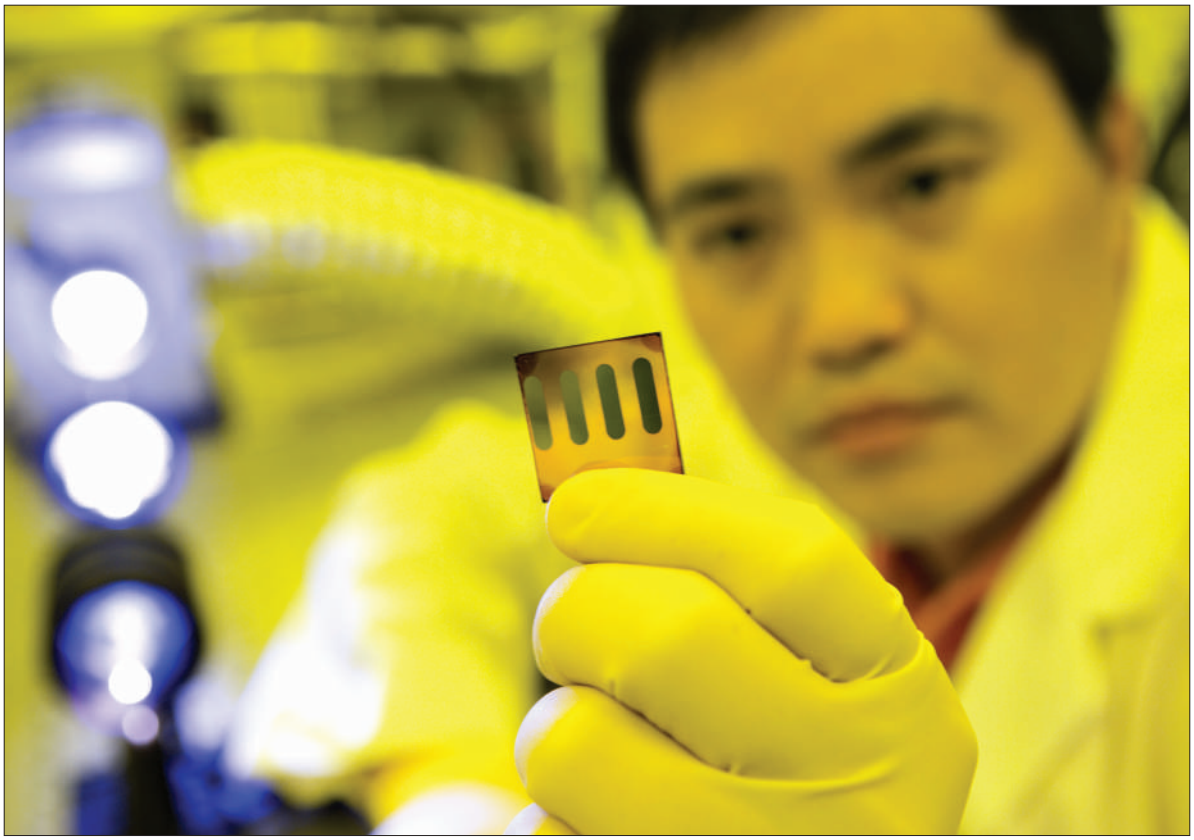

Singapore Journal of

Scientific Research

ISSN: 2010-006x

science alert

http://scialert.net/sjsr

OPEN ACCESS Singapore Journal of Scientific Research

ISSN 2010-006x
DOI: 10.3923/sjsres.2016.7.12

Research Article
Identification of New-morpho-variant of Dragonfly, *Neurothemis tullia tullia* from Carpet Dye Polluted Region Bhadohi

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Abstract
Background: Dragonflies are important predators that eat mosquitos and other small insects like flies, bees, ants, wasps and very rarely butterflies. **Methodology:** In the present study, a new morpho-type of dragonfly *Neurothemis tullia tullia* has been identified for the first time in Anaripura- Hariharpur, Gyanpur S.R.N. Bhadohi, India, a carpet dye polluted area. **Results:** Reported specimen was having comparatively large compound eyes, distinctly separated or just touching dorsally, pterostigma moderately long and narrow and dissimilar fore and hindwings. Forewings narrow and elongated and hindwings broad basally. Half of the both wings (Proximal) are black in color. Apical part was glossy. **Conclusion:** It is evident that present reported insects morphology is unique eco-variant of *Neurothemis tullia tullia*. As the dragonfly completes its nymphal life in water and the water of carpet city, Bhadohi, region is highly polluted with various types of toxic carpet dyes, leading to elevation in temperature, therefore, it is expected that exposure to carpet dye and elevated temperature might played role in modification of morphology of adult dragonfly. Owing to the economic importance, this dragonfly needs to be conserved and utilized for minimizing the mosquitos which cause many lethal diseases to human being. Interestingly, this organism might be used as a tool for detection of weather change and pollution in future if any.

Key words: Pollution, identification, dragonfly, carpet dye, *Neurothemis tullia tullia*

Received: November 10, 2015 Accepted: November 30, 2015 Published: December 15, 2015

Citation: R.K. Tiwari, J.P. Pandey and Dinesh Kumar, 2016. Identification of new-morpho-variant of dragonfly, *Neurothemis tullia tullia* from carpet dye polluted region Bhadohi. Singapore J. Sci. Res., 6: 7-12.

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Insects represent almost all territories of the earth and account around 75% of total animal population. Dragonflies having great economic values are the grand creation of nature having beautiful biodiversity. It is reported that dragonflies are important predators that eat mosquitos and other small insects like flies, bees, ants, wasps and very rarely butterflies. Dragonflies have been the center of magnetism for global researchers during recent past. Xie and Huang[1] studied vortex interactions between forewing and hind-wing of dragonfly in hovering flight. Similarly, Hou *et al.*[2] found effects of blood in veins of dragonfly wing on the vibration characteristics and Pryke *et al.*[3] found an ecological network for conserving dragonflies. Guillermo-Ferreira *et al.*[4] studied the mechanism of wing coloration in the dragonfly *Zenithoptera lanei* and its role in intra-specific communication. Richards *et al.*[5] investigated spatial variation in the impact of dragonflies and debris on recreational ecosystem services in a floodplain wetland. Smolinsky and Gvozdik[6] reported effect of temperature extremes on the spatial dynamics of dragonfly nymphs and newt larvae. Interestingly, Fauziyah *et al.*[7] characterized hindwing nodus from the Libellulidae family of dragonfly and Kandibane *et al.*[8] reported diversity and community structure of aquatic arthropods in an irrigated rice ecosystem. Folorunso *et al.*[9] investigated predatory size of dragonfly nymphs and Ohaga *et al.*[10] investigated susceptibility of non-target aquatic macro-invertebrates and vertebrates to *Piper guineense* and *Spilanthes mauritiana* the dragonfly, as a seasonal symbol in Japan, has been associated with summer and early autumn. Interestingly, dragonflies are symbols of courage, strength, happiness and they often appear in art and literature. But its availability is not everywhere they are choosy towards their niche. They are usually found around marshes, lakes, ponds, streams and wetlands because their larvae, known as "Nymphs" are aquatic. Dragonflies of peninsular India were studied well[11] and common odonates of central India has been reported by Andrew *et al.*[12]. Seasonal variation in *Neurothemis tullia* was also recorded by Asahina[13]. Odonates behavior and ecology[14], colour polymorphism[15] and romorphic female of *Neurothemis tullia tullia*[16-19], biology and ecology of *Neurothemis tullia* has been also documented[20]. The presence of *N. tullia tullia* with marked morphological changes has not been reported till today from this region. It is important to mention that the water of Bhadohi region is highly polluted with various types of carpet dyes. As the dragonflies complete their nymphal life in carpet dyes polluted water, therefore, their exposure to carpet dyes might play a decisive role in modification of morphology of adult dragonfly, *N. tullia tullia*. The present communication deals with their new occurance and distinctive features.

MATERIALS AND METHODS

Insect collection: Dragonfly was collected during morning time through an insect-trap using slandared collection protocol. After collection insects were water narcotized and photographs were taken. The morphological features and measurements were recorded.

Insect collection place: The dragonfly was collected from Anaripura-Hariharpur, Gyanpur S.R.N. Bhadohi, U.P., India on Saturday 10/08/2013 at 7:10:05 AM. This is sub-tropical region where total annual rainfall was about 1025.4 mm. with annual average high temperature 29.9°C and average low temperature 19.5°C. At the time of collection weather was hazy, temperature 29°C, wind Speed 9 km h^{-1}, relative humidity 74%, barometer millibars 1002 and visibility; 5 km were noticed.

Climate proviso at collection place: Dragonfly collection place, Anaripura-Hariharpur, Gyanpur S.R.N. Bhadohi U.P., India experiences a high humid subtropical climate with large temperature variations between winter and summer. The dry summer starts in April and lasts until June, followed by the monsoon season from July to October. The temperature ranges between 22 and 48°C in the summers. Winters in Anaripura-Hariharpur, Gyanpur have very large diurnal variations, with warm days and downright cold nights. Cold waves from the Himalayan region cause temperatures to dip across the village in the winter from December to February and temperatures below 5°C are not uncommon. The average annual rainfall is 1,110 mm. Deep fog is very frequent in the winters while hot dry winds, blow in the summer season. In recent years, the unpredictable rain fall and weather condition has been observed due to global warming. Decrease in total rainfall in rainy season have been recorded in the village with low intensity. It is important to mention that the water of village Anaripura-Hariharpur including Bhadohi region is highly polluted with carpet dyes.

Identification of insect: Collected specimen was subjected to rigorous morpho-metric analysis. Subsequent to analysis the details of dragonfly along with high resolution photographs were sent to Dr Pam Taylor Decoy Farm, Decoy Road, Potter Heigham, Norfolk NR29 5LX UK and to ZSI Kolkata, India for indentification. The dragonfly was identified as *Neurothemis tullia tullia* male.

RESULTS AND DISCUSSION

Reported specimen is having large compound eyes distinctly separated or just touching dorsally. Pterostigma moderately long and narrow. Fore and hindwings not similar. Forewing narrow and elongated and hindwing broad basally. Half of the both wings (Proximal) are black in color and apical distal part was glossy (Table 1 and Fig. 1-3). On the basis of aforesaid characters it is an anisopteran odonata. It is assumed that present reported insect is unique collection for this region. Morphometric observation of dragonfly revealed the length-head to tail = 3.1 cm, forewing length = 2.4 cm, forewing maximum width = 0.8 cm, hindwing length = 2.3 cm and hindwing maximum width = 0.9 cm.

Present morpho-variant of *N. tullia tullia* has been found for the first time near carpet city Gyanpur-Bhadohi India. The literature survey suggests that this species has not been reported in this region. Although, several studies have been conducted in different regions. Dragonflies of peninsular India were also studied well[11] and common odonates of central India has been reported by Andrew *et al.*[12]. Thermoregulation and reproductive activity in tropical dragonflies[21,22] and seasonal variation in *Neurothemis tullia* were also recorded by Asahina[13]. Guillermo-Ferreira *et al.*[4] studied mechanism of the wing coloration in the dragonfly *Zenithoptera lanei* and its role in intra-specific communication. Richards *et al.*[5] investigated spatial variation in the impact of dragonflies and debris on recreational ecosystem services in a floodplain wetland. Smolinsky and Gvozdik[6] reported effect of

Table 1: Showing the comparative morphological parameter of *Neurothemis tullia tullia*

Parameter	Earlier reports	Present report	Remarks
Wings	Basal half opaque blue/brown black with a white broad border towards the tip. Wing tips transparent	Pterostigma moderately long and narrow. Fore and hindwings not similar. Forewing narrow and elongated and hindwing broad basally. Half of the both wings (proximal) are black in color. Apical distal part glossy	Dissimilar
Abdomen	Black with a broad mid-dorsal creamy white stripe on the upper side	Blackish brownish with a broad mid-dorsal creamy white stripe on the upper side	Slightly varied
Legs	Black	Blackish-with patchy spots	Slightly varied
Thorax	Black with a mid-dorsal cream stripe	Black-with a mid-dorsal cream stripe	Comparable
Head-face	Black	Black	Roughly identical
Eyes	Black brown above with olive green below	Black brown above with olive green below	Comparable

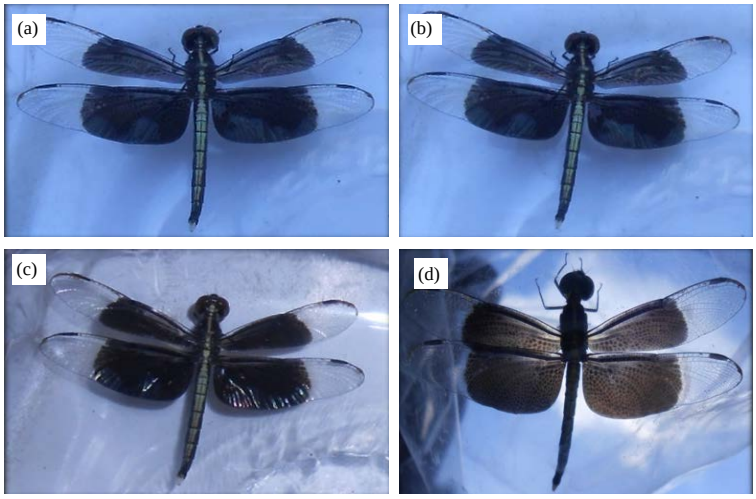

Fig. 1(a-d): Different photographs of dragonfly, *Neurothemis tullia tullia* with blackish-brownish clear wings with white band

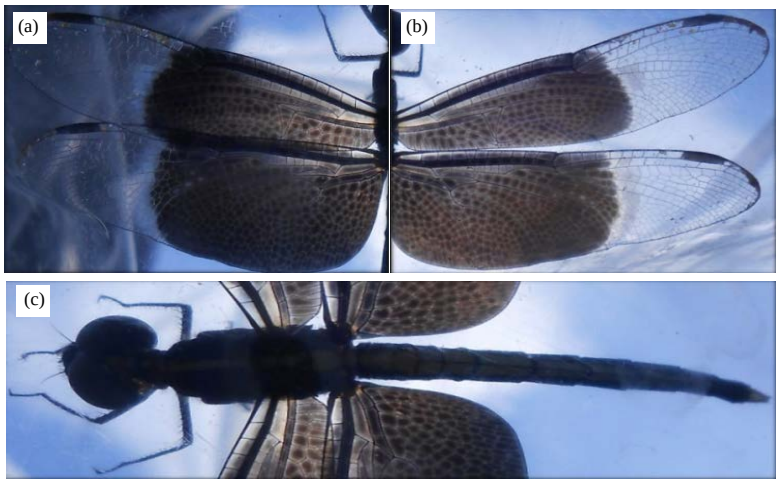

Fig. 2(a-c): Showing *Neurothemis tullia tullia* having black and clear wings with white vertical band (enlarged view)

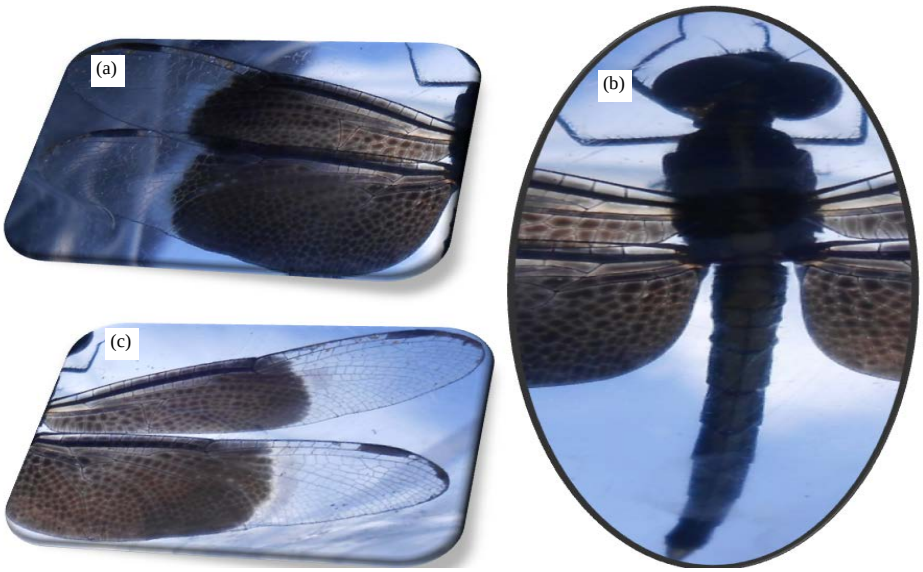

Fig. 3(a-c): Showing *Neurothemis tullia tullia* having black and clear wings with white band (enlarged views)

temperature extremes on the spatial dynamics of dragonfly nymphs and newt larvae. While, Fauziyah *et al.*[7] characterized hindwing nodus from the Libellulidae family of dragonfly, Kandibane *et al.*[8] reported diversity and community structure of aquatic arthropods. Folorunso *et al.*[9] investigated predatory size of dragon-fly nymphs and Ohaga *et al.*[10] observed susceptibility of non-target aquatic macro-invertebrates and vertebrates to *Piper guineense* and *Spilanthes mauritiana*. Identification of morpho-variants of *N. tullia tullia* in this region might have several plausible reasons. (i) As the dragonflies are symbol of seasonal change and seasonal change is associated with change in temperature, therefore, it is assumed that this unique dragonfly's wing pattern/morphology and their rare presence in this region is having relation with weather change which is evident in recent past due to global warming. (ii) Possibility of inter-species natural-breeding cannot be ignored which might have produced insect having different wing pattern. (iii) As the dragonfly completes its nymphal life in water and the water of carpet city 'Bhadohi' region is highly polluted with various types of carpet dyes, therefore, exposure to carpet dye might play its role in modification of morphology of adult dragonfly, *N. tullia tullia*.

CONCLUSION

It is evident that collected insect has been a physio-eco-variant of *N. tullia tullia* which is the unique morho-type not reported earlier in this region. Unique wing pattern/morphology and its rare presence in this region might be having relation with weather change due to global warming. On the other hand, possibility of inter-species natural-breeding cannot be ignored which might have produced dragonfly having different wing pattern and morphology. In addition, natural exposure of dragonfly during nymphal stage in carpet dye polluted water might cause modification of morphology of adult dragonfly, *N. tullia tullia*. Due to the economic importance, present dragonfly need to be conserved and utilized for minimizing the mosquito and other harmful insects which cause many lethal diseases to human being. In addition, this organism can be used as a tad for detection of global weather change in future if any.

ACKNOWLEDGMENTS

Authors are thankful to Dr. K.A. Subramanian from ZSI Kolkata, India and to Dr. Pam Taylor Decoy Farm, Decoy Road, Potter Heigham, UK for their generous help in identification of dragonfly specimen.

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