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COMMUNICATION

Occurence and distribution of two new libellulids (Odonata: Insecta) of the Kashmir Valley, India: *Orthetrum sabina* (Drury, 1770) and *Palpopleura sexmacaluta* (Fabricius, 1787)

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Abstract: Odonates from the Kashmir Himalaya have been least studied with only 22 species reported from this region. After a long gap of 41 years, the present work forms the first observations on occurence and distribution of two new odonates from the Kashmir valley. Two dragonflies *Orthetrum sabina* (Drury, 1770) and *Palpopleura sexmaculata* (Fabricius, 1787) belonging to the family Libellulidae are reported for the first time from this region. The findings open new insights about phenology, distribution patterns, behaviour, and the effects of climate change on Himalayan Odonata.

Keywords: Anisoptera, Blue-tailed Yellow Skimmer, Green Marsh Hawk, habitat characterization, Jhelum basin, paddy fields, presence, Zygoptera

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Author contributions: TG designed the study, conducted surveys, data collection, data analysis and wrote the manuscript. MK contributed in data analysis, wrote and reviewed the manuscript.

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INTRODUCTION

Globally, 6,392 species of odonates belonging to 693 genera have been documented (Paulson et al. 2021), of which 588 taxa are known from the Indian Subcontinent (Kalkman et al. 2020). Not much is known about the ecology and distribution of odonates from the Kashmir region of northwestern Himalaya, India. The earliest record of Odonata provides a checklist of 15 species (Calvert 1898) from the erstwhile Kashmir, followed by 22 species by Fraser (1933, 1934, 1936). Studies from Kashmir (Singh & Baijal 1954; Asahina 1978; Kumar & Prasad 1981) have either reported synonyms or previously-described species like *Anaciaesna kashmirense,* or species of doubtful identity *Coenagrion kashmirus* (Chowdhary & Das 1975) which require further investigation. After 1981, no new contributions have been made to the checklist of Odonata of Kashmir. Even the studies from Kashmir (Riyaz & Sivasankaran 2021; Qureshi et al. 2022) have made no mention of new species. A recent study of Paray & Mir (2023) makes a mention of *O. sabina* but provides little information about its distribution and other attributes which are very important for establishing confirmed presence of new odonates from any area. We report latest additions to odonate fauna along with their confirmed presence, distribution records, phenology and habitat specificity based on elaborate studies.

Orthetrum sabina (Drury, 1770), commonly known as Slender Skimmer or Green Marsh Hawk, is an Indo-Malayan species, widely distributed in Ethiopian, Oriental, and Australian regions (Mitra 2002; Subramanian 2005). Its broad distribution stretches from Australia, Japan, and Samoa in the east to Somaliland – northern Africa (Boudot et al. 2009), including central Asia (Fraser 1936) and most of the Indian Subcontinent (Kalkman et al. 2020). *Palpolpleura sexmaculata* (Fabricius, 1787), Blue-Tailed Yellow Skimmer or Asian Widow, is widely spread throughout the Oriental region (Mitra 2002; Subramanian 2005; Nair 2011) to Tibet and throughout Malaysian and Indo-China to China (Fraser 1936), excluding Sri Lanka and Andaman & Nicobar Islands (Kalkman et al. 2020). There being no confirmed record of these two species from the Kashmir region, this study establishes their presence in Kashmir Valley and adds two new libellulids to the Odonata of Kashmir.

Study area

Kashmir Valley (33–35 °N & 73–75.2 °E) is in the northwestern Himalayan region of the Indian Subcontinent (Dar et al. 2012). It is an oval-shaped valley approximately 135 km long and 32 km wide. This valley is surrounded by the main Himalayan range in the north-east and the Pir Panjal mountain range in the south-west (Drew 1875; Wadia 1931). Pir Panjal acts as a natural barrier (Rashid et al. 2011), dividing Kashmir valley from the Jammu division and separating various biogeographic elements between the Indian mainland and the valley (Puri 1943), covering an area of 15,520.3 km^2. The valley plains have long stretches of paddy and low-lying water bodies on either side of river Jhelum, which flows south–north of the valley. For this study, the lower plains of the valley; wetlands, and paddy fields forming a stretch of 300 km^2, within an elevation gradient of 1,500–2,000 m is the intensive study area (ISA) (Image 1).

METHODS

Based on an accidental sighting of one of the dragonfly species reported in this study, opportunistic surveys were carried out in the ISA. To ascertain the occurrence of these records, 90 opportunistic surveys were carried out in 2018–2020, during the summer months (June–October) in the potential habitats of the ISA. Surveys were conducted covering a total area of 5 km^2 /day from early morning to late afternoon, as most odonates are active during this time (Paulson 2019; Resende 2002). For census of active and teneral odonate individuals similar survey methods have been used in the past (Ubukata 1974) and are still being used (Renner et al. 2015). Once the dragonflies were sighted, individuals were either photographed, caught live using insect nets, and identified using available literature (Fraser 1933, 1934, 1936) and standard odonates field guides (Subramanian 2005; Mitra 2006; Nair 2011).

RESULTS

An annotated list of Odonata from the Kashmir Valley during the study period (2018–2020) from ISA is shown in Table 1. A total of 26 species, including two new records, belonging to a total of seven families of suborder Zygoptera (4) and Anisoptera (3) were observed. Fifteen species of the family Libellulidae were observed.

Orthetrum sabina (Drury, 1770)

The map (Image 1) shows the locations of *O. sabina*. A total of 44 individuals were sighted including mating

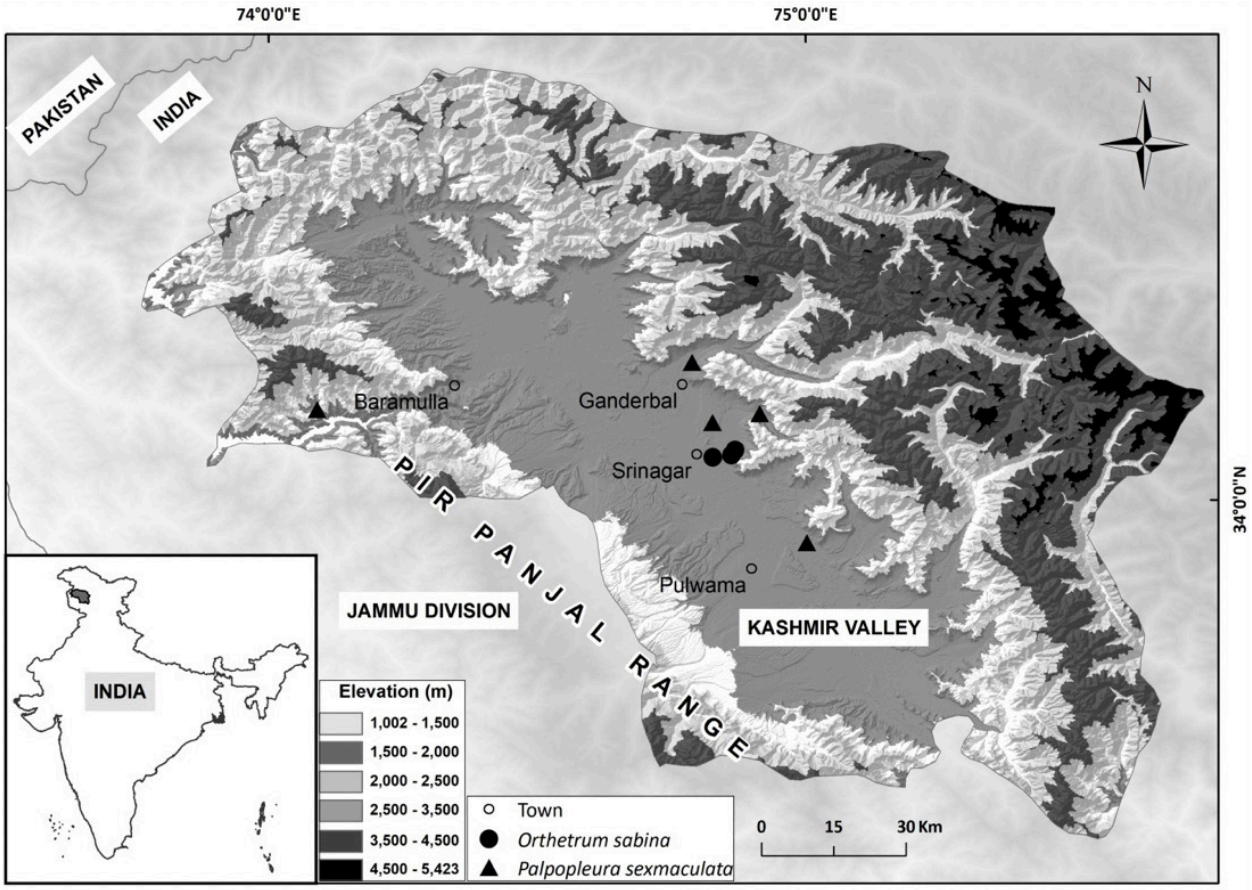

Image 1. Intensive study area (1,500–2,000 m elevation) and locations of two libellulids, *Orthertum sabina* and *Palpopleura sexmaculata*, from Kashmir Valley, India.

Image 2. *Orthetrum sabina* (Drury, 1770) (male) taken at Kashmir Golf Course, Srinagar, Jammu & Kashmir.

Image 3. Habitat of *Orthetrum sabina* (Drury, 1770) at Kashmir golf course, Srinagar, Jammu & Kashmir.

pairs during 2018–2020. These were observed from three different locations (Kashmir Golf Course 34.077785 °N, 74.826818 °E; Police Golf Course 34.082128 °N 74.861290 °E; and Royal Springs Golf Course 34.091302 °N, 74.868227 °E) within 5 km distance during July–September. Observations were made during peak sunshine hours. Image 2 and 3 shows the identified individual as *O. sabina* within its habitat. In successive years the species have been observed from the same areas in July–September, mostly around Dal Lake (Table 2).

***Palpopleura sexmaculata* (Fabricius, 1787)**

The map (Image 1) shows the locations from where

Table 1. Annonated list of Odonata during the study period (2018–2020) from the intensive study area.

Order Odonata Fabricius, 1793
Suborder Zygoptera Selys, 1854
A. Family: Lestidae Calvert,1907
1. *Lestes barbarus* (Fabricius, 1798)
2. *Sympecma paedisca* (Brauer, 1877)

B. Family: Synlestidae Tillyard, 1917
3. *Megalestes major* Selys, 1862

C. Family: *Chlorocyphidae* Cowley, 1937
4. *Rhinocypha quadrimaculata* Selys, 1853

D. Family: Coenagrionidae Kirby, 1890
5. *Enallagma cyathigerum* (Charpentier, 1840)
6. *Ischnura inarmata* Calvert, 1898

Suborder Anisoptera Selys, 1854
E. Family: Aeshnidae Leach, 1815
7. *Aeshna juncea* (Linnaeus, 1758)
8. *Aeshna mixta* Latreille, 1805
9. *Anax ephippiger* (Burmeister, 1839)
10. *Anax parthenope* (Selys, 1839)

F. Family: Cordulegasteridae Hagen, 1875
11. *Cordulegaster brevistigma* Selys, 1854

G. Family: Libellulidae Leach, 1815
12. *Crocothemis erythraea* (Brullé, 1832)
13. *Crocothemis servilia* (Drury, 1770)
14. *Libellula quadrimaculata* Linnaeus, 1758
15. *Orthetrum brunneum* (Fonscolombe, 1837)
16. *Orthetrum glaucum* (Brauer, 1865)
17. *Orthetrum luzonicum* (Brauer, 1868)
18. *Orthetrum sabina* (Drury, 1770)
19. *Orthetrum triangulare* (Selys, 1878)
20. *Palpopleura sexmaculata* (Fabricius, 1787)
21. *Pantala flavescens* (Fabricius, 1798)
22. *Selysiothemis nigra* (Vander Linden, 1825)
23. *Sympetrum commixtum* (Selys, 1884)
24. *Sympetrum fonscolombii* (Selys, 1840)
25. *Sympetrum meridionale* (Selys, 1841)
26. Sympetrum *striolatum* (Charpentier 1840)

P. sexmaculata was found. The first individual was observed in paddy fields near Harwan (34.158821 °N, 74.913766 °E). The specimen was collected, identified, and confirmed as *P. sexmaculata*, (Image 4). Most of the observations have been from paddy fields in July–August. This species was also observed from Mallabagh, Srinagar (34.142^{0}N, 74.826^{0}E), Nunar, Ganderbal (34.254^{0}N, 74.787^{0}E), Bijhama, Uri (34.166^{0}N, 74.089^{0}E), and Awantipora, Pulwama (33.919^{0}N, 75.001^{0}E). A total of 183 individuals along with mating pairs were observed during the study period (Table 2). Image 5, shows the habitat of this species.

Image 4. Photograph of *Palpopleura sexmaculata* (Fabricius, 1787) (female) taken at Bijhama, Uri, Jammu & Kashmir.

Image 5. Habitat of *Palpopleura sexmaculata* (Fabricius, 1787) at Bijhama, Uri, Jammu & Kashmir.

DISCUSSION

Distributed throughout the Indian subcontinent, *O. sabina* has never been reported from the Kashmir Valley. All the previous studies limit its distribution to the southern part of the Pir Panjal range of the Himalaya. Found near warm waters, covered and open canopies, this dragonfly perches for a long time on branches, twigs, rocks, or ground (Subramanian 2005; Nair 2011). This species is known to be a voracious predator (Subramanian 2005; Emiliyamma et al. 2007) preying on a range of flying insects and odonates including conspecifics. From our observations, we found the males perching on concrete structures near small water bodies. This species was found in undisturbed habitats, perched motionless generally on rocks or cement surfaces, mostly large open golf courses, gardens around Dal Lake, and adjoining areas with elevations ranging from 1585–1595 m. Individuals of *O. sabina* were found solitary and never found associated with any other species of dragonfly. The presence of

Table 2. Year-wise summary (2018–2020) of the number of individuals observed of *O. sabina* and *P. sexmaculata*.

Species	Year-wise number of individuals observed			Location and elevation (m)	Habitat features
	2018	2019	2020		
O. sabina	11	8	25	a) 34.07778 °N, 74.82681 °E (1585) b) 34.08212 °N 74.86129 °E (1590) c) 34.09130 °N, 74.86822 °E (1595)	- Reeds, rocks or parapets, undisturbed shallow water bodies. - Canopy absent.
P. sexmaculata	57	38	88	a) 34.15882 °N, 74.91376 °E (1675) b) 34.14297 °N, 74.82615 °E (1590) c) 34.25444 °N, 74.78783 °E (1690) d) 34.16621 °N, 74.08976 °E (1690) e) 33.91933 °N, 75.00148 °E (1590)	- Paddy fields with knee-high grasses and water. - Low-lying aquatic grass lands dominated by monocots.

mating pairs suggests that this species breeds here too. And thereby, confirming its presence in this region.

Previous distribution records of *P. sexmaculata* do not include the Kashmir Valley of the northwestern Himalayan region. Even though it is known to be distributed in higher altitudes of Tibet, Indo-China–China (Fraser 1936), very little evidence is available on its distribution from northwestern Himalaya. Known to occur in large colonies in marshy spots and watered rice fields where they breed (Kumar & Prasad 1981; Subramanian 2005), this small dragonfly is a weak flyer for short distances (Nair 2011). The study area has numerous rice fields, and most of our observations are from paddy fields from across the valley. Since our observations are from July–August, paddy fields are well-watered and possibly form the best breeding grounds for this dragonfly. Swarms of *P. sexmaculata* were always found associated with other species such as *Pantala flavescens, Libellula quadrimaculata, Crocothemis servilia,* and *Sympetrum fonscolombii*. Our results suggest the continuous occurrence of both these species during 2018–2020 from different parts of the study area. The findings hint towards climate change induced spatio-temporal distribution, habitat shifts, and range extension of Odonates (Cancellario et al. 2022). Both these are Oriental species whose distribution is limited by the southern slopes of the Himalaya, but their dispersion extends further north in the transitional zone between the Oriental and the Palaearctic region (Heiser & Schmitt 2013). Kashmir valley falls in this transition zone hence explaining the presence of these two dragonflies here.

As this study was carried out in a militarised border zone of India, security was always a concern. Few of the potential habitats could not be surveyed due to security restrictions. Due to limited resources available, little attempt was made to collect larvae or exuvia to study the emergence of these dragonflies. Similarly, studies to understand winter survival weren't conducted which could reveal important information on longevity and survival through successive years. It was challenging to quantify whether the same individual was encountered through successive years of the study duration. Further investigations need to be carried out to understand the migration of odonates and their range extensions across different geographic regions.

CONCLUSION

This is the first confirmed addition to the odonates of Kashmir Valley in four decades with established presence, mating records, and their distribution. The records of new species could lead into new insights into the dispersion of odonates. Further research is mandated to understand the spatiotemporal distribution of odonates in the Kashmir Valley region.

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