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New records of dragonflies (Odonata) from Toebirongchhu sub-watershed in Punakha District, Western Bhutan

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ABSTRACT

Opportunistic survey of dragonfly diversity and distribution was done in Toebirongchhu sub-watershed within Punakha Dzongkhag, Western Bhutan to give updated list of species within the study area and the Dzongkhag, and update the species list for Bhutan. Total of 24 species belonging to 19 genera and 11 families were recorded of which 22 species are new record for the study area, 20 species for the Punakha Dzongkhag and 1 for Bhutan. The updated list of species for Punakha Dzongkhag is 28 species and for Bhutan is 85 species. Important records are *Anisogomphus caudalis* a Data Deficient species and a new record for Bhutan, *Aristocypha (Rhinocypha) cuneata*, another Data Deficient species, *Epiophlebia laidlawi* a Near Threatened species and *Anisopleura bella* a recently described species currently recorded only from Bhutan.

Keywords: Dragonfly, odonata, new record, Toebirongchhu sub-watershed, Punakha, Bhutan.

1. Introduction

Dragonflies belong to order Odonata and are among the most ancient of winged insects [1, 2]. The extant dragonflies are divided into two suborders, the Zygoptera or damselflies and the Anisoptera or true dragonflies, and the erstwhile third suborder Anisozygoptera is either included in Anisoptera or combined with them under the new name Epirocta in recent times [1]. The dragonflies are relatively small order of insects with extant species of 5680 with actual number that could be close to 7000 [1] comprised of almost 3000 species each belonging to Zygoptera and Anisoptera and four species belonging to Anisozygoptera [2]. In Bhutan 84 species and subspecies are known till date [3].

The Odonata is a well studied order worldwide [1, 4], but much work is required in the Oriental region which holds the highest number of undescribed species along with Australasian and Neotropical regions, and the region is the most species-rich along with Neotropical out of the eight bio-geographical regions [1]. Also in Eastern Himalaya there is lack of quality research and recent data on Odonata [5].

Following the regional level study status, Odonata in Bhutan has not received adequate attention and it is especially true for parts of Bhutan other than Eastern and South-Eastern Bhutan [4]. The current study follows nearly after half a century (41 years) of dragonfly collection by the members of Zoologische Expedition des Naturhistorischen Museums Basel in das Königreich Bhutan in 1972 in Western and Central Bhutan [6] apart from 10 days survey by [3]. Thus, the aim of the study is to give the recent record of dragonfly diversity and distribution within the Toebirongchhu sub-watershed that falls under Punakha district in Western Bhutan and update the number of dragonfly species in Bhutan.

2. Material and methods

2.1 Study site

Toebirongchhu sub-watershed spans Toepisa and Bapisa Gewogs (blocks) within Punakha Dzongkhag (district) in western Bhutan (Figure 1 & 2). Though the elevation of Punakha Dzongkhag ranges from 1200 to 4800 m [7] and Toebirongchhu sub-watershed have wide range of elevation, the actual studied area's elevation ranged from 1200 m at the confluence of Toebirongchhu and Punatshangchhu to 2692 m in Royal Botanical Garden at Lamperi as determined by GPS Garmin etrex 10, and the coordinates for the studied area ranged from 27°30'N-27°31'N and 89°45'E-89°53'E

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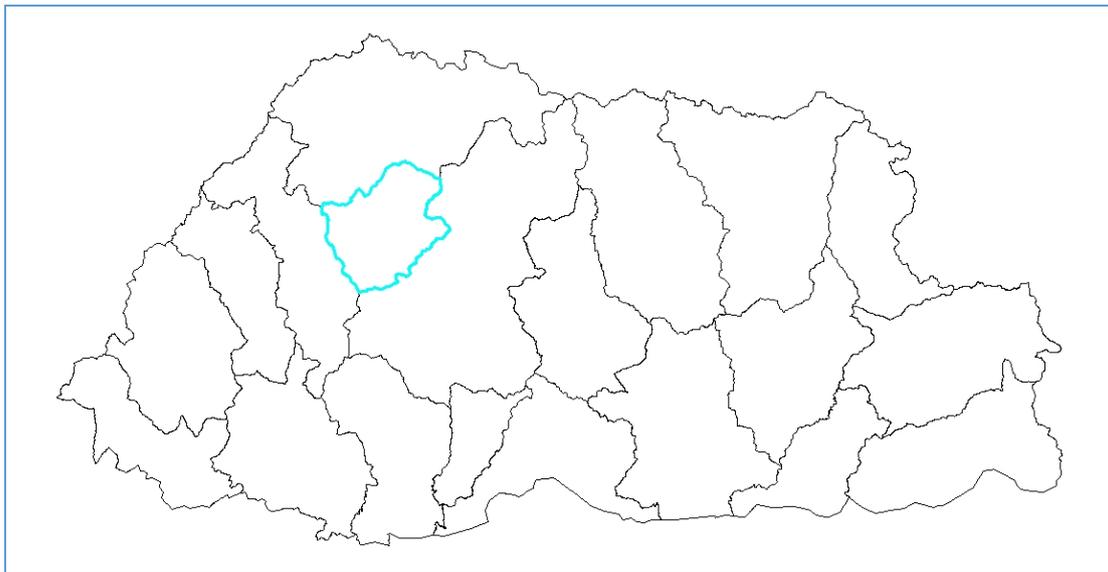


Fig 1: Bhutan map with Punakha Dzongkhag (district) highlighted.

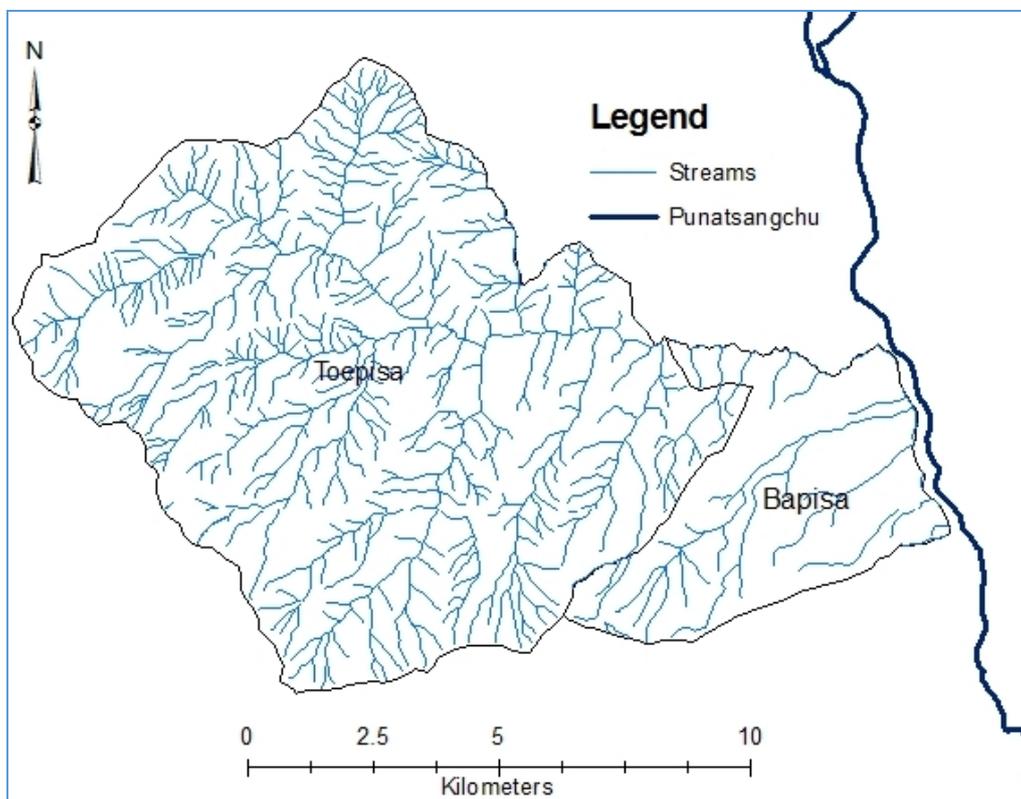


Fig 2: Toebirongchhu sub-watershed within Toepisa and Bapisa Gewogs along with Punatsangchhu river.

2.2 Sampling locations

Sampling was done at the following locations (Figure 3) within the study area:

Loc. 1: Manigang (27°31'39.4"N 89°51'36.4"E, 1332 m) is a small village with a farm road connecting to Punakha-Thimphu highway surrounded with paddy fields and sampling was done mainly along a small stream, and a small pond beside the farm road and the stream.

Loc. 2: Sopsokha (27°32'28.5"N 89°52'11.4"E, 1239 m) is a larger village lying adjacent to Manigang and above lower section of Toebirongchhu stream, and sampling was done in the paddy fields below the village and nearby Toebirongchhu stream.

Loc. 3: Toebirongchhu (27°31'45.0"N 89°52'38.1"E, 1233m) is the main stream that joins the Punatsangchhu river and sampling was done along the lower section of the stream from the bridge crossing the stream till the confluence of Toebirongchhu and Punatsangchhu.

Loc. 4: MENCHUNA village (27°31'37.6"N 89°46'23.3"E, 2068m) is a remote village connected to Punakha-Thimphu highway by farm road and sampling was done along the farm road, terraces and stream flowing through the village and joining Drakarpolumchhu stream, the headwater tributary of Toebirongchhu.

Loc. 5: Jichulum (27°31'02.3" N 89°49'51.8" E, 1653m) is a small stream that joins Toebirongchhu in Chasagang village and

sampling was done along Jichulum stream from about 2 km above Thimphu-Punakha highway down towards the confluence of Jichulum and Toebirongchhu streams.

Loc. 6: Chasagang (27°31'40.1" N 89°50'06.9" E, 1498 m) is a small village towards the lower section of Jichulum and it flanks the Jichulum and Toebirongchhu streams.

Loc. 7: Royal Botanical Park (RBP) (27°30'29.7"N 89°45'10.5"E,

2674 m) is located at Lamperi alongside Thimphu-Punakha highway and the sampling was done along the shore of Baritsho pond within the RBP.

Loc. 8: Dorokna (27°30'17.2" N 89°47'25.6" E, 2068 m) is a forested stream that forms part of head water tributaries of Toebirongchhu and has its sources within Royal Botanical Park.



Fig 3: Sampling locations (Loc. 8 inset *Epiophlebia laidlawi* larvae)

2.3 Dragonfly sampling and identification

Several visits were made between October 2012 and October 2013 to different locations initially and then to locations described above in later part of the study period. Being an explorative work, opportunistic survey was done wherein the time spent at different sites varied from about five minutes to about an hour depending on sightings of dragonflies within the locations. When unidentified and uncollected dragonflies were sighted the standard butterfly net was used to catch the dragonflies, and the specimens were stored in paper triangles in the field. Once in the laboratory specimens were preserved either in 70% alcohol or soaked in acetone to kill and then left in paper triangles dipped in acetone overnight to help preserve dry specimens. Specimens have been deposited in the laboratory of College of Natural Resources. Live photos were also taken as and when caught in the field. The identification work was done using the help of appropriate literatures [3, 8, 9, 10, 11, 12, 13, 14, 15, 16].

3. Results and Discussion

A total of 24 species belonging 19 genera and 11 families were recorded from the entire study area during the study period. Out of 11 families seven belong to suborder Zygoptera and four to Anisoptera including Epiophlebiidae (Table 1) and 10 families were confirmed from the study of adult dragonfly, while the family Epiophlebiidae was confirmed from the study of larva. The current

study being detailed compared to [3] within the study area and being first of its kind after nearly half a century after the collection of dragonfly samples from Western and Central Bhutan by the Zoologische Expedition des Naturhistorischen Museums Basel in das Königreich Bhutan in 1972 [6], it contributes to the much needed study of Odonata in the study area and Western Bhutan [3, 13]. Out of 24 species 22 are new record for the study area excluding *Sympetrum commixtum* and *Calicnemia mortoni*, and 20 species are new record for the Punakha district as a whole excluding the earlier two and *Anax indicus* and *Acisoma p. panorpoides* [3, 4], and the total number of dragonfly species in Punakha Dzongkhag becomes 28 including the list of [3].

Among the 11 families Libellulidae was the most common and wide spread, and also rich in genera (n=7) and species (n=9), while the families Coenagrionidae and Calopterygidae had 2 genera and 2 species each (Table 1). The possible higher number of species belonging to the Libellulidae and Coenagrionidae families could be due to sampling being done more in open areas as the Libellulidae and Coenagrionidae species are ubiquitous, dominate unshaded habitats with both artificial and natural stagnant water, and are also the most specious among Odonata families [1]. The current record from the studied area almost reflects the species distribution among the families within Bhutan [3, 4].

Table 1: Sampling details and species record for Toebirongchhu sub-watershed.

Family	Species	Sampling Date	Location	No. of individuals	
				M**	F**
Coenagrionidae	<i>*Ceriagrion fallax cerinomelas</i> Lieftinck, 1927	14.IX.2013	Loc. 1	2	2
		14.IX.2013	Loc. 3	1	1
		30.VI.2013	Loc. 4	1	√
	<i>*Ischnura a. aurora</i> Brauer, 1865	14.IX.2013	Loc. 1	2	1
		14.IX.2013	Loc. 3	√	√
		4.XI.2012	Loc. 1	1	√
		17.III.2013	Loc. 2	1	1
Platycnemididae	<i>*Calicnemia eximia</i> Selys, 1863	15.VI.2013	Loc. 5	2	2
		15.VI.2013	Loc. 6	√	√
		30.VI.2013	Loc. 4	√	1
	<i>Calicnemia mortoni</i> Laidlaw, 1917	30.VI.2013	Loc. 4	1	-
Platystictidae	<i>*Protosticta himalaiaca</i> Laidlaw, 1917	15.VI.2013	Loc. 5	2	-
		15.VI.2013	Loc. 6	1	-
		20.VI.2013	Loc. 5	2	-
Chlorocyphidae	<i>*Aristocypha (Rhinocypha) cuneata</i> (Selys, 1853)	3.X.2013	Loc. 6	1	1
Calopterygidae	<i>*Caliphaea confuse</i> Hagen in Selys, 1859	23.IV.2013	Loc. 5	2	√
		15.VI.2013	Loc. 5	2	1
		15.VI.2013	Loc. 6	1	√
	<i>*Neurobasis chinensis</i> Linnaeus, 1758	13.IV.2013, 14.IX.2013	Loc. 3	1+1	√
Euphaeidae	<i>*Anisopleura bella</i> Mitra & Thinley, 2006	30.VI.2013	Loc. 4	2	√
		15.VI.2013	Loc. 5	3	1
		15.VI.2013	Loc. 6	1	√
	<i>*Anisopleura comes</i> Hagen, 1880	15.VI.2013	Loc. 5	2	1
		15.VI.2013	Loc. 6	√	√
Lestidae	<i>*Indolestes cyaneus</i> Selys, 1862	15.VI.2013	Loc. 6	2	1
#Epiophlebiidae	<i>*Epiophlebia laidlawi</i> Tillyard, 1921	19.X.2013	Loc. 8	1	
		10.III.2014	Loc. 8	3	
		3.X.2013	Loc. 5	3	
		3.X.2013	Loc. 5	2	
Aeshnidae	<i>*Anax indicus</i> Lieftinck, 1942	14.IX.2013	Loc. 3	√	√

		14.IX.2013	Loc. 2	1	√
Gomphidae	* <i>Anisogomphus bivittatus</i> Selys, 1854	14.IX.2013	Loc. 3	1	-
	* <i>Anisogomphus caudalis</i> Fraser, 1926b	15.VI.2013	Loc. 5	2	1
Libellulidae	* <i>Orthetrum japonicum internum</i> Mac Lachlan, 1894	23.III.2013	Loc. 4	1	1
	* <i>Orthetrum t. triangulare</i> Selys, 1878	13.IV.2013	Loc. 1	2	1
		15.VI.2013	Loc. 5	1	-
	* <i>Orthetrum s. sabina</i> Drury, 1770	17.III.2013	Loc. 1	1	√
		17.III.2013	Loc. 2	1	1
		4.XI.2012	Loc. 1	1	-
	* <i>Acisoma p. panorpoides</i> Rambur, 1842	13.IX.2013	Loc. 3	1	1
	* <i>Crocothemis s servilia</i> Drury, 1770	4.XI.2012, 12.II.2013, 17.III.2013, 3.VII.2013, 14.IX.2013	Loc. 1, Loc. 2, Loc. 3	3	1
		23.III.2013, 20.X.2012	Loc. 4	2	1
	* <i>Diplocodes trivialis</i> Rambur, 1842	24.V.2013, 3.VII.2013	Loc. 1	2	2
		24.V.2013, 3.VII.2013	Loc. 2	√	√
	* <i>Palpopleura s. sexmaculata</i> Fabricius, 1798	4.XI.2012, 17.III.2013, 30.VI.2013,	Loc. 1	2	1
		17.III.2013, 3.VII.2013, 14.IX.2013	Loc.2	1	1
		* <i>Pantala flavescens</i> Fabricius, 1798	30.VI.2013	Loc. 4	-
		24.V.2013, 3.VII.2013, 14.IX.2013	Loc. 2, Loc. 3	2	1
	<i>Sympetrum commixtum</i> Selys, 1884	15.IX.2013	Loc. 7	√	1
<p>* New records for the study area. * *Numbers of male and female individuals mentioned is the specimen collected. # Sex not determined and identified from larva. √ Dragonflies sighted during the sampling dates. - No sightings.</p>					

The significant contribution of current study is *Anisogomphus caudalis* (Figure 4: a. abdomen with anal appendages (ab): 35 mm, hind wing (hw): 33 mm; b. Female (left) ab: 39.4 mm, hw: 37.5 mm, Male (right) ab: 36.9 mm, hw: 34.2 mm)), a new record for Bhutan and the number of dragonfly species for Bhutan now increasing to 85 adding to that of [3, 4]. *Anisogomphus caudalis* is a Data Deficient species and it was expected to be found in Bhutan [17]. The current location of this species is along Jichulum, a small

first order forested stream which is being disturbed along certain section by cattle grazing and withdrawal of water for irrigation (Figure 1: Loc. 5). The study captured 1 male and 1 copulating pair, and the numbers of sighting were very few along the current location on other occasions. Therefore it needs further study in the current study area and its other potential habitats for its updated IUCN red list category.

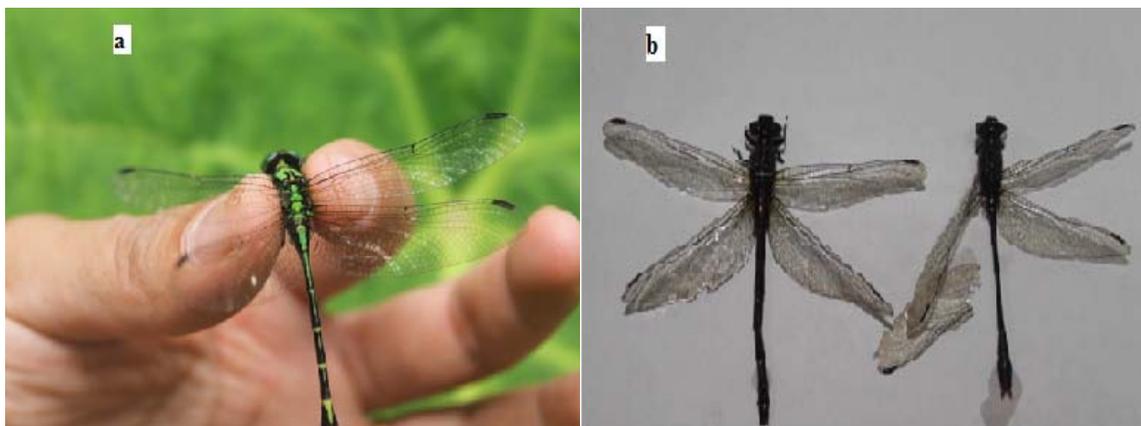


Fig 4: *Anisogomphus caudalis*: a. Live photo in the field; b. Preserved copulating female (left) and male (right).

The other important species within the study area are *Epiophlebia laidlawi* and *Aristocypha (Rhincocypha) cuneata* which are among the Odonata species though present in more than one ecoregion, but are confined to Eastern Himalayan Hotspot [5]. *Epiophlebia laidlawi* was confirmed from the larva collected as part of macroinvertebrate diversity study and dragonfly larva diversity study in the current study area, and its presence in earlier study was also confirmed from larval study and adult is yet to be recorded from Bhutan [18]. It is the only species belonging to the relict Family Epiophlebiidae found from Central Nepal to Bhutan beside other three sister species of the family [19] and assessed as Near Threatened, there is need to study its population size and distribution range [20]. The current study thus increases the distribution range of *Epiophlebia laidlawi* to four Dzongkhags, viz., Haa, Thimphu, Punakha and Trongsa including the work of [18].

But, all the four Dzongkhags are within Western and Central Bhutan, thus making it important to do further studies on its distribution in Eastern Bhutan.

Aristocypha cuneata was assessed as Data Deficient [21], and was recorded from South East and South West of Bhutan [3, 4] and [3] suggest it to be classified as Least Concern. While the present study did record and thus increases its distribution range, the study recorded only three males and one female in the Chasagang village along the lower section of Jichulum stream, which is impacted by anthropogenic activities like abstraction of water for irrigation, landslide from farm road and waste disposal from a roadside vegetable market shed (Figure 1 & 5), therefore it may need further studies of its distribution range, threats to its habitats and population size in order to give its updated IUCN red list category.



Fig 5. a. Waste dumped into Jichulum stream; b. water abstraction for irrigation at Chasagang from Jichulum stream.

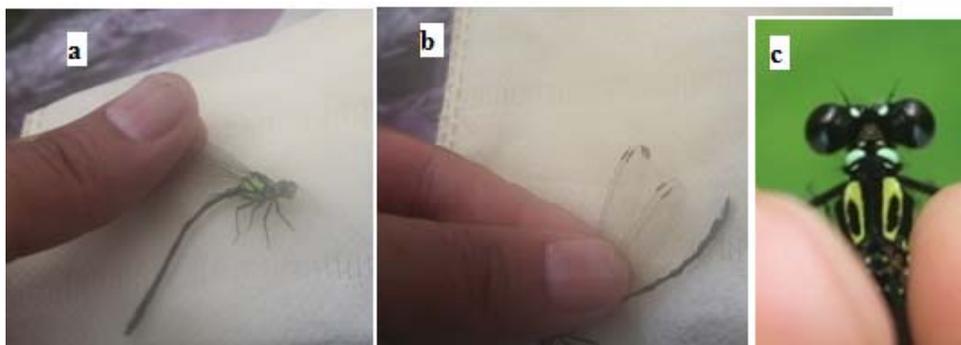


Fig 6: *Anisopleura bella*:(a) whole specimen, (b) wing tips and abdomen (c) head and thorax showing characteristic markings

Besides the above species, *Anisopleura bella* (Figure 6) being described first from Trashi Yangtze in eastern Bhutan by ^[15] was recorded from the study area and its distribution range has been increased from Eastern Bhutan to Western Bhutan. It may be either endemic to Bhutan or awaits record from neighboring countries India and Nepal.

4. Conclusion

Current study adds to much needed data on dragonfly diversity and distribution within Western Bhutan and Bhutan. A total of 24 species belonging to 19 genera and 11 families were recorded of which 22 species are new record for the study area, 20 species for the Punakha Dzongkhag and 1 for Bhutan. The updated list of species for Punakha Dzongkhag is 28 species and for Bhutan is 85 species. Important records are *Anisogomphus caudalis* a Data Deficient species and a new record for Bhutan, *Aristocypha (Rhinocypha) cuneata*, another Data Deficient species, *Epiophlebia laidlawi* a Near Threatened species and *Anisopleura bella* a recently described species currently recorded only from Bhutan. The current study being done only for a period of one year and within only few selected habitats will not have recorded all the species present within the study area, and further works are required for the study area as well for Western Bhutan and other parts of Bhutan to come up with updated data on dragonfly diversity and distribution.

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