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RESEARCH ARTICLE

DIVERSITY AND HABITAT PREFERENCE OF ODONATE IN CHAKRASHILA WILDLIFE SANCTUARY, WESTERN ASSAM, INDIA

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Abstract

The study was conducted in Chakrashila Wildlife Sanctuary of western Assam to explore diversity and habitat preference of odonata (both dragonflies and damselfly) from April 2018 to March 2019. During study period we recorded total 57 species of odonate from 39 genera and 8 families out of which, dragonfly (Anisoptera) represented by 37 species and damselfly (Zygoptera) represented by 20 species. Suborder Zygoptera were represented by the families Chlorocyphidae, Coenagrionidae, Platycnemididae, Euphaeidae, Calopterygidae and suborder Anisoptera by the Aeshnidae, Gomphidae and Libellulidae. Libellulidae was the largest family with 29 species, while Chlorocyphidae and Euphaeidae represent only single species. Among the five habitats highest species were recorded from wetland (63%) and lowest from dense forest (41%) while 20 species were recognized as habitat specialist and 7 species were habitat generalist.

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Introduction:-

Odonata are charismatic, culturally important species. They play important functional roles in ecosystems as both predators and prey and have the potential to provide valuable pest-control services to agricultural systems (Corbet 1999). It constitutes a small, well known order of insects that are widely distributed all over the world (Tillyard 1917). Due to their sensitivity to environmental conditions odonate are considered as excellent biological indicators of environmental conditions (Brown 1991; Clark & Samways 1996; Clausnitzer 2003; Smith *et al.* 2007; Samways, *et al.* 2010). This group of insects is also used as an ideal model for the investigation of the impact of environmental warming and climate change due to their tropical evolutionary history and adaptations to temperate climates (Nesemann *et al.* 2011).

There are about 6,000 known species of odonates distributed globally which belong to 630 genera in 28 families (Tsuda 1991; Subramanian 2009). Tsuda 1991 catalogued approximately 906 odonate species in his world list of odonata from continental Asia, out of these 499 species belongs to 139 genera and 17 families recorded from India (Prasad and Varshney 1995). Odonate fauna of Western Ghats were extensively studied by Fraser (1933; 1934; 1936), Prasad and Varshney (1995), Emiliyamma and Radhakrishnan (2000), Subramanian (2005) and Subramanian *et al.* (2008). Some workers also explored odonate diversity in northern India (Lahiri 1979; Kumar and Mitra 1998; Sharma and Joshi 2007). Of late odonate have been documented from central India (Tiple *et al.* 2011; Das *et al.* 2013).

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Odonate of Northeastern India is also well documented. Joshi & Kunte (2014) reported 90 species from Nagaland, Prasad (2007) reported 64 species from Mizoram, Srivastava & Sinha (2004) reported 68 species from Manipur, Mitra (2003) reported 65 species from Sikkim and Majumder *et al.*, (2014) reported 53 species from Tripura, Mitra (2006) reported 92 species from Arunachal Pradesh and Srivastava & Sinha (1995) reported 151 species from Meghalaya. Assam is a part of the Eastern Himalayan and the house of many rare and endemic plants and animal species. Odonate of Assam was documented only in few pockets. Borah *et al.*, (2012) recorded seven species of damselflies from Gauhati University campus, Assam; Kalita & Ray (2015) reported 39 species with 22 genera from Deepar Beel Bird Sanctuary, Assam. Recently, Boruah *et al.* (2016) reported 82 species under 51 genera belonging to 10 families in Kaziranga-karbi hills in central Assam. The present study provides information on the diversity and habitat preference of odonate in different habitats in the Chakrashila Wildlife Sanctuary, Assam.

Materials And Methods:-

Chakrashila Wildlife Sanctuary (26°15'–26°26'N, 90°15'–90°20'E; 4,500 ha) is located in the districts of Kokrajhar and Dhubri in Assam (Figure 1). The sanctuary is the only protected area for the golden langur (*Trachypithecus geei*) in India. The hilly terrain is covered with dense forest which is mostly semi-evergreen and moist deciduous, with patches of grassland and scattered bushes (scrubland). The forest type falls in the category 3C/C.1.a(ii) following Champion and Seth (1968). It is supported by number of streams named as Mauriagaon, Bhalukjhora, Bakuamari and Jornagra. The southern boundary is connected with the Deepalai Beel.

Field work was carried out 1 day in each habitat [(Paddy field (PF), Dense Forest (DF), Degraded Forest (DEF), Wetland (WL), Hill Stream (HS)] in each month and selection of days was not chronological but clear, windless and sunny days were selected. Sampling was done between 10.00 and 13.00 h (Junior *et al.* 2013), when odonates activities found in peak to regulate their body temperature in sunlight (Das *et al.* 2013). Odonates were recorded by direct search technique (Sutherland 1996) in all the habitats. Individual specimens were photographed from various angles and cross-checked with field identification guides (Mitra 2006; Subramanian 2009). Those specimens which were difficult to identify in the field, collected in the paper envelopes and identified in the laboratory with the help of taxonomic keys (Fraser 1933, 1934, 1936).

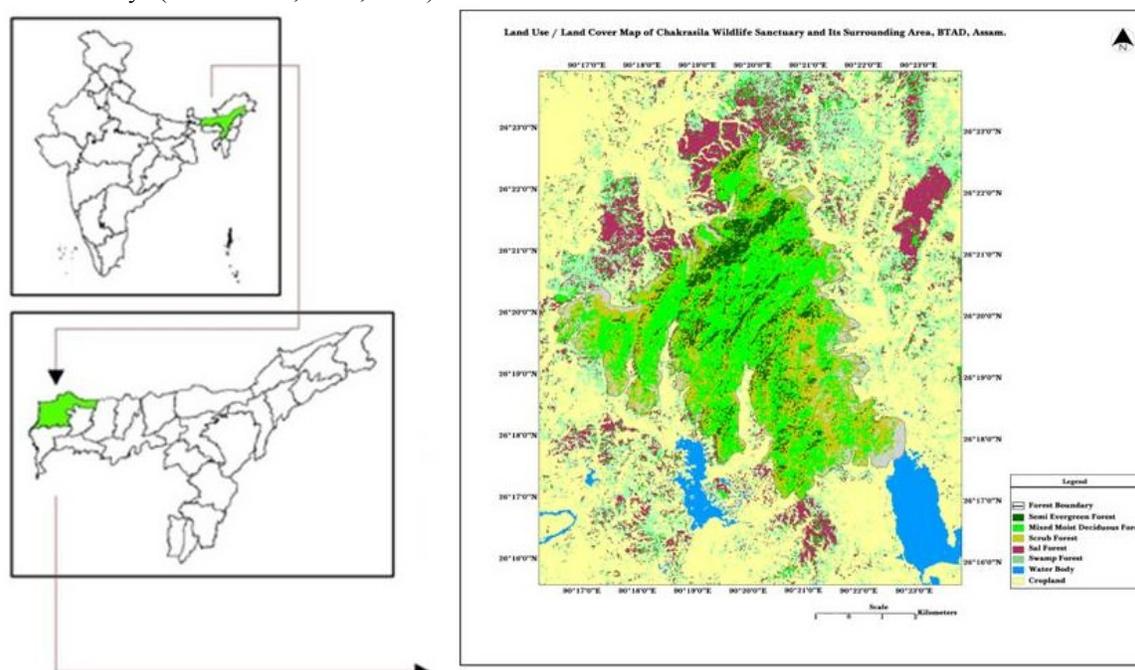


Figure 1:- Satellite image of the Chakrashila Wildlife Sanctuary.

Results:-

A total of 57 species belonging to 39 genera and 8 families were recorded from the study area. Suborder Anisoptera (64%) was represented by 3 families, 25 genera and 37 species whereas 5 families, 14 genera and 20 species are represented in the suborder Zygoptera (36%). (Table 1 and Table 2 and Figure 4).

The Family wise composition of odonates shows that out of the 8 families, the highest number of species were recorded from Libellulidae (52%) followed by Coenagrionidae (14%); Gomphidae (9%), Aeshnidae, Platycnemididae, Calopterygidae and Chlorocyphidae (4%) whereas Euphaeidae (1%, one species) recorded the lowest number of species (Figure 2).

Odonate habitat preference among the five different habitats shows diverse result. Highest number of species were recorded from the wetland (n=35, 63%) that was followed by paddy field (n=29, 52%), degraded forest (n=26, 46%), hill stream (n=25, 44%) and dense forest (n=23, 41%). The study shows that total 20 species were recorded as habitat specialist to different habitats while 7 species were recorded as habitat generalist. Figure 3 represents the ratio between the habitat generalist and habitat specialist species in the study area.

Table 1:- Number of Sub-order, Family, Genera and Species recorded in Chakrashila Wildlife Sanctuary.

Sub-order	Family	Genera	Species	Total
Anisoptera	Aeshnidae	1	2	37
	Gomphidae	5	6	
	Libellulidae	19	29	
Zygoptera	Coenagrionidae	8	13	20
	Chlorocyphidae	1	2	
	Platycnemididae	2	2	
	Euphaeidae	1	1	
	Calopterygidae	2	2	

Table 2:- Odonate fauna along with their habitat preference in Chakrashila Wildlife Sanctuary.

Family	Species	Paddy field (PF)	Dense Forest (DF)	Degraded Forest (DEF)	Wetland (WL) (Lentic)	Hill stream (HS) (Lotic)
Sub-order: Anisoptera						
Aeshnidae	1. <i>Gynacantha bainbriggei</i>	-	+	-	-	-
	2. <i>Gynacantha dravida</i>	+	+	+	-	-
Gomphidae	1. <i>Stylogomphus inglisi</i>	+	-	+	-	-
	2. <i>Ictinogomphus distinctus</i>	-	-	-	+	-
	3. <i>Ictinogomphus rapax</i>	-	-	-	+	-
	4. <i>Paragomphus lineatus</i>	-	-	-	+	-
	5. <i>Macrogomphus annulatus</i>	-	+	-	+	-
	6. <i>Burmagomphus sp.</i>	-	-	-	+	-
Libellulidae	1. <i>Brachythemis contaminata</i>	+	-	+	+	+
	2. <i>Rhodothemis rufa</i>	+	+	+	+	+
	3. <i>Rhyothemis variegata</i>	-	+	+	+	+
	4. <i>Neurothemis intermedia</i>	+	+	+	-	-
	5. <i>Neurothemis tullia</i>	+	+	+	+	-
	6. <i>Neurothemis fulvia</i>	+	+	+	+	-
	7. <i>Bracydiplax sobrina</i>	+	+	+	+	-
	8. <i>Palpopleura sexmaculate</i>	-	+	+	+	-
	9. <i>Potamarcha congener</i>	-	+	+	-	-
	10. <i>Orthetrum pruinosum</i>	+	+	+	+	+
	11. <i>Orthetrum luzonicum</i>	+	-	+	+	-
	12. <i>Orthetrum Sabina</i>	+	+	+	+	+
	13. <i>Orthetrum triangulare</i>	-	-	-	+	-
	14. <i>Orthetrum glaucum</i>	-	-	-	+	-
	15. <i>Orthetrum chrysis</i>	+	-	-	+	-
	16. <i>Crocothemis servilia</i>	+	+	+	+	+
	17. <i>Tholymis tillarga</i>	+	+	-	+	-
	18. <i>Urothemis signata</i>	+	+	+	+	+

	19. <i>Trithemis festiva</i>	-	-	-	+	+
	20. <i>Trithemis pallidinervis</i>	-	-	-	+	+
	21. <i>Trithemis aurora</i>	-	-	-	-	+
	22. <i>Diplacodes trivialis</i>	+	+	+	+	+
	23. <i>Brachydiplax chalybea</i>	+	+	+	+	+
	24. <i>Pantala flavescens</i>	+	+	+	+	+
	25. <i>Acisoma panorpoides</i>	-	+	+	+	-
	26. <i>Onychothemis testaceae</i>	-	-	-	-	+
	27. <i>Bradynopyga geminate</i>	-	-	-	-	+
	28. <i>Aethriamanta brevipennis</i>	-	+	-	-	-
	29. <i>Camacinia gigantean</i>	+	-	+	-	-
Sub-order: Zygoptera						
Coenagrionidae	1. <i>Ceriagrion cerinorubellum</i>	+	-	-	-	-
	2. <i>Ceriagrion rubiae</i>	+	-	+	-	-
	3. <i>Ceriagrion olivaceum</i>	+	-	-	-	-
	4. <i>Ceragrion coromandelianum</i>	+	-	+	+	-
	5. <i>Agriocnemis pygmaea</i>	+	+	+	+	-
	6. <i>Agriocnemis pieris</i>	+	-	+	-	-
	7. <i>Agriocnemis femina</i>	+	-	-	-	-
	8. <i>Ischnura aurora</i>	+	+	+	+	-
	9. <i>Onychargia atrocyana</i>	-	-	-	-	+
	10. <i>Pseudagrion decorum</i>	-	-	-	+	+
	11. <i>Mortonagrion aborensis</i>	-	-	-	+	+
	12. <i>Ischnura rufostigma</i>	+	-	-	+	-
	13. <i>Amphiallagma parvum</i>	+	-	-	+	-
Chlorocyphidae	1. <i>Aristrocypha quadrimaculata</i>	-	-	-	-	+
	2. <i>Aristrocypha fenestrella</i>	-	-	-	-	+
Platycnemididae	1. <i>Copera vittata</i>	-	-	-	-	+
	2. <i>Coeliccia marginipes</i>	-	-	-	+	+
Euphaeidae	1. <i>Euphaea ochracea</i>	-	-	-	-	+
Calopterygidae	1. <i>Neurobasis chinensis</i>	-	-	-	-	+
	2. <i>Vestalis gracilis</i>	-	-	-	-	+

“+”= Present, “-”= Absent

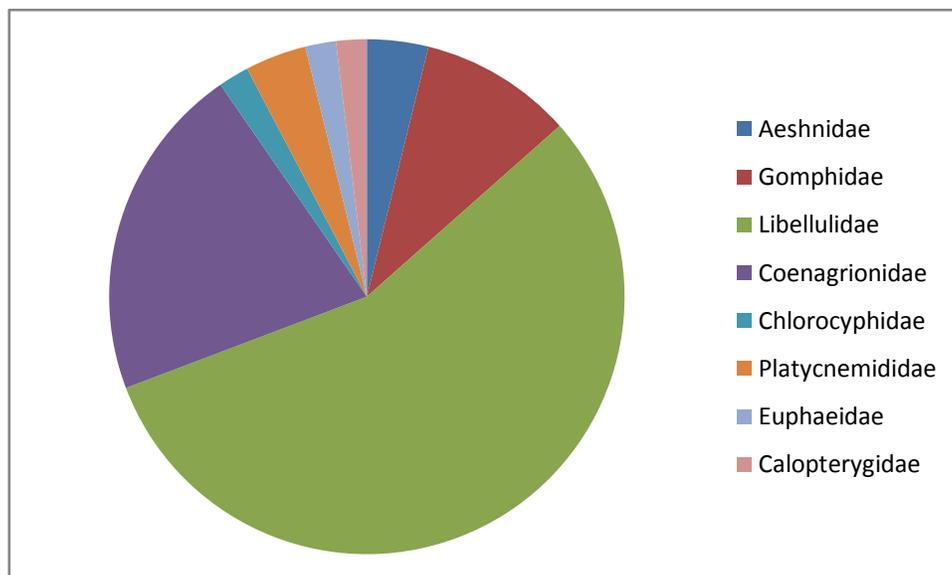


Figure 2:- Number of odonate families with their representatives in Chakrashila Wildlife Sanctuary.

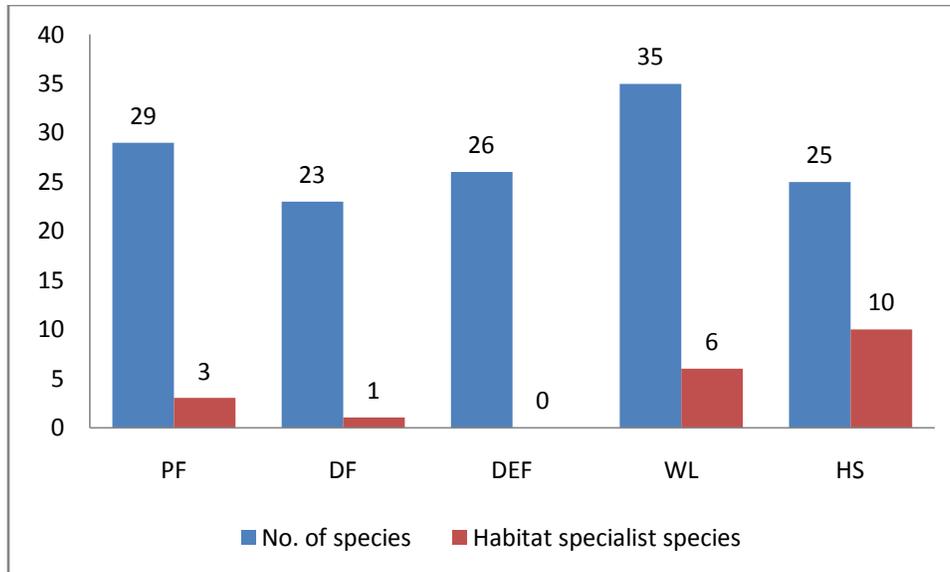


Figure 3:- Representatives of odonate species in each habitat along with their habitat specialist species in Chakrashila Wildlife Sanctuary.

Discussion:-

India is harbour of 499 species of Odonata (Prasad and Varshney 1995), while present study documents total 56 species of Odonata from Chakrashila Wildlife Sanctuary. Baruah *et al* (2016) reported 82 species of odonata from Kaziranga-karbi Hills of central Assam. Total 45 species of odonata was recorded from Barpeta district of Assam by Baruah and Saikia (2015). Gupta and Veeneela (2016) reported the presence of 14 species in urban landscape of Cachar District of Assam where there is high human disturbance. A total of 39 species belonging to 5 families and 22 genera were recorded from Deepor beel bird sanctuary (Kalita and Ray, 2015). Thus, all the studies indicate that good forest and marsh habitat with less human disturbance support a good number of odonate.

In the study Libellulidae (56%) is the most dominant family followed by Coenagrionidae (20%) probably due their abundance in Indian sub-continent (Kumar and Mitra, 1998). Similar observations were reported by Baruah *et al.* (2016) in Kaziranga NP of Assam; Prasad (2002) in Western Himalaya; Emiliyamma *et al.* (2005) in Kerala; Rangnekar *et al.* (2010) in Goa. Das *et al.* (2013), Mishra (2007), Tiple and Chandra (2013) in Madhya Pradesh.

Since odonate are amphibian in nature they require both terrestrial and aquatic environment to complete their life cycle. It is well established that odonata occupies almost all types of habitat for perching, breeding, hunting and dispersing (Corbet 1999; Clausnitzer *et al.* 2009). But mainly found closely associated with wetlands, because wetlands provide them the breeding ground (Corbet 1999, Mitra 2006 and Sarah *et al.* 2017). In the study area the water body can be further divided into two types—lentic (wetland) and lotic (hill stream). During survey most of the lentic dwelling species recorded in the lotic habitat. But larval stages of odonate were mainly confined to lentic water-bodies than the lotic water-bodies (Painter 1998; Corbet 1999). The fast-flowing lotic water-bodies tend to dry up during the dry season thus the larval survival following oviposition is relatively lower (Samways 1989; Hofmann and Mason 2005). Since the sanctuary possesses many small man made dam for irrigation purpose, those dams along with other standing water-bodies within the study area may be particularly important for dragonfly conservation. Significantly the hill streams alone possess 10 habitat specialist species while no habitat specialist species were recorded from degraded forest (Table 2). *Trithemis aurora*, *Bradinopyga geminate*, *Onycothemis testaceae*, *Onychargia atrocyana*, *Aristrocypha fenestrella*, *Aristrocypha quadrimaculata*, *Coeliccia marginipes*, *Neurobasis chinensis* and *Vestalis gracilis* were strictly confined in the perennial hill streams. These species mostly prefers fast-flowing water-bodies probably because they require cool temperature with high humidity. From the conservation point of view these species should always get priority since they are habitat specialist. Loss of perennial hill streams may cause their local extinction or migration to other part.

The habitat has been defined as the collection of resources and conditions required by, and accessible to, individuals of a species at a location (Dennis *et al.* 2003, 2007). Because the habitat is necessarily the location where an

organism lives out its life-cycle, a suitable habitat must meet the ecological needs of all life-stages. The terrestrial landscape is probably as important as the aquatic habitat (Corbet 1999), as it provides several conditions and resources that are required by the adult phase. 26 species were recorded in degraded forest while family Aeshnidae were recorded in the dense forested only. Many of the species that were recorded in degraded forest were large-bodied, sun-loving, cosmopolitan Anisoptera, including many within the Libellulidae family. It is thought that these would have originally been rare in forested areas, and relied on their long-distance dispersal abilities to travel between the few forest gaps available (Orr 2006). The dense forest dwelling species require forest for hunting, and it is known that many Gomphids and females of other families spend much of their time in the forest canopy. Similar observation was also reported in Bornean tropical rain forests (Orr 2006).

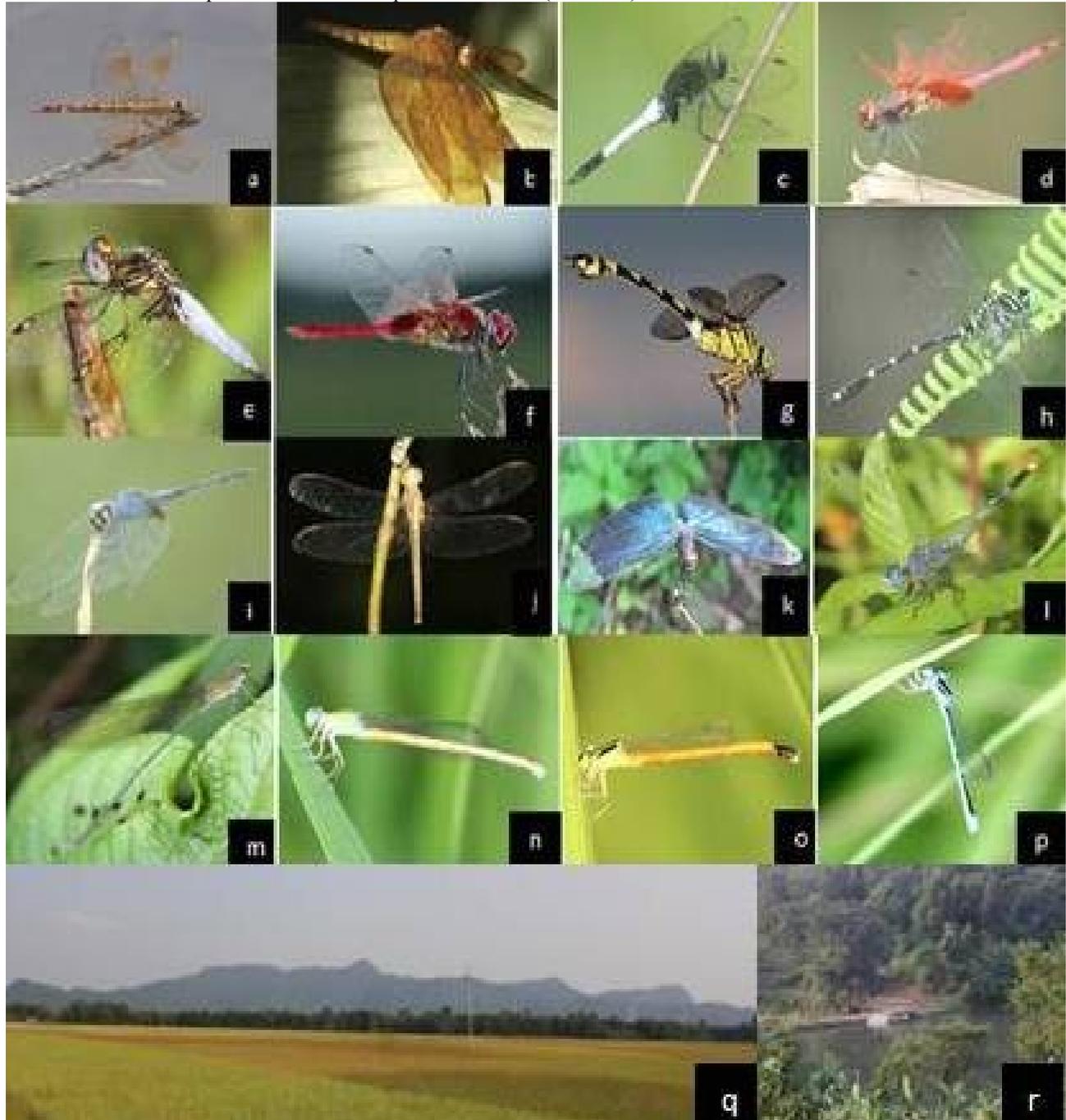


Figure 4:- Images of odonate species recorded in Chakrashila Wildlife Sanctuary (a - *Brachythemis contaminata*, b- *Neurothemis fulvia*, c- *Orthetrum triangulare*, d- *Trithemis aurora*, e- *Palpopleura sexmaculata*, f- *Urothemis*

signata, g- Ictinogomphus distinctus, h- Burmagomphus sp., i- Trithemis festiva. j- Neurothemis intermedia, k- Rhyothemis plutonia, l- Diplacodes trivialis, m- Vestalis gracilis, n- Ceriagrion coromandelianum, o- Ischnura rufostigma, p- Amphiallagma parvum, q- Landscape of Chakrashila Wildlife Sanctuary and r- Man made dam inside the sanctuary).

Conclusion:-

Since the habitat of the studied area is heterogeneous, species shows the complexity and some species are yet to be identified. Since the study area is facing severe anthropogenic disturbance like illegal tree felling, forest fire, grazing by cattle and collection of fire wood odonate also faces the threats of habitat degradation like other taxa as well. Therefore it is necessary that more emphasis should be given on their conservation problems.

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