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# HABITAT PREFERENCE OF ODONATES (DRAGONFLY AND DAMSELFLY) ALONG WITH ITS DIVERSITY, ABUNDANCE, AND RICHNESS IN MADAN-KAMDEV TEMPLE AREA (DEWANGIRI HILL) OF KAMRUP (R) DISTRICT OF ASSAM, INDIA

Priyanka Kumar[1], Suraj Sharma[2*], Jonali Barman[1]

[1]Postgraduate Department of Eco-Restoration, Dimoria College, Khetri (Affiliated under Dibrugarh University, Department of Life Sciences), Assam, India
[2*]Department of Ecology and Environmental Science, Assam University, Silchar, Assam, India.

**ABSTRACT:** The present study was piloted at Madan Kamdev Temple area of the Kamrup (R) district, Assam during December 2017 to May 2018. A total of 32 species of Odonata including 19 species of Anisoptera and 13 species of Zygoptera under 2 families were recorded. 12 species were documented from zone1 (forest area), 31 species were documented from zone 2 ( river bank) and 20 species were from zone 3 (crop fields). 11 species were common in all the zones. The most abundant Anisopteran species was *Pantala flavescens and* most abundant Zygopteran species was *Ceriagrion coromandelianum*. Shannon Weiner Index (H′) was estimated to be 2.644, in forest it was 2.126, near river 2.649 and in crop field it was 2.366. Margalef's Richness Index (DMg) was found to be 4.705, in forest it was 2.456; in near river 4.898 and in crop field it was 3.654.In the present study 4 species i.e. *Crocothemis servilia, Neurothemis fulvia, Orthetrum sabina* and *Ceriagrion coromandelianum* used all types of habitat. Maximum number of species and individuals of Odonates were recorded during the mid-day time when temperature is high.
**Key words**: Anisoptera, Odonata, Zygoptera, Madan Kamdev Temple**,** Diversity, Richness

*Corresponding Author: Suraj Sharma, Department of Ecology and Environmental Science, Assam University, Silchar; Email: dudckecr@gmail.com


## INTRODUCTION

Dragonflies and Damselflies are among the most attractive creatures on earth belonging to the most popular insect order Odonata [1]. Odonata constitute a small well known order of insects that are widely distributed over the world [2]. The order is subdivided into three sub-orders i.e. Anisoptera, Anisozygoptera, and Zygoptera. The Zygoptera and Anisoptera are well dispersed groups. The Anisozygopterais represented by one species in India which is also endangered in nature [3]. Approximately 6000 species and sub-species to 630 genera in 28 families are known from all over the world [3], out of which 499 species and sub-species of Odonata under 139 genera in 17 families are represented in India [4] [5]. The order Odonata is one of the ancient groups of insect. These magnificent insects have been around from the carboniferous era about 250 million years ago[6] [7]. Odonata taxa are ideal models for the investigation of the impact of environmental warming and climate change due to their tropical evolutionary history and adaptations to temperate climates [8].

The Odonata fauna of Assam is not well documented. Some of the recent studies [9][10][11] have provided sporadic information regarding the distribution of Odonates in different parts of Assam. To the best knowledge of the authors, no diversity, abundance, and richness and habitat preference based research effort on Odonata was carried out in Madan Kamdev Temple area. Subsequently the aim of the present investigation was to carry out the first comprehensive study on Odonata diversity and habitat preference in Madan Kamdev area, Assam, India.

## MATERIALS AND METHODOLOGY

### Study area

Madan Kamdev Temple area is a heritage site located in Dewangiri Hill of Kamrup district near Baihata Chariali which is about 40 km drive away from Guwahati city (Figure 1). Madan Kamdev Temple area lies between 26˚19′13.22″N latitude and 91˚44′37.38″E longitude. The total area is 0.5 $km^2$. The Madan Kamdev area is a place of utmost scenic beauty with abundance of greenery all around**.**

### Study design

Three zones are selected from the area on the basic of different habitat, which may be important according to influencing the diversity of Odonates. Study area is divided by into following zones [9].

1. Zone 1 :- Forest or hilly area
2. Zone 2 :- River side area
3. Zone 3 :- Crop fields

As Odonates exhibits an interesting response to temperature the time has chosen for survey during 10 pm to 2 pm as they expose more as temperature increases. The Odonata were categorized on basis of their abundance in the area; VC— very common ( >100 sightings), C— common (50-100 sightings), O— occasional (16-49 sightings), R—rare (3-15 sightings) and VR— very rare (<3 sightings) [10].

### Data collection and identification

Different selected zones of the study area was surveyed during December 2017 to May 2018 by using line transect method. In this method 3 permanent 400 m line transects were setup in 3 zones. Through these transect walked once a week in each zones to follow Pollard Walk method for recording the Odonates. A slow 180 degree visual sweep was performed during walking [12]. Collecting live specimens was avoided during the study. Visual survey and photographic documentation was done. Photographs were taken using Nikon D5600 camera. Identification of species (Odonata) was done with the help of various literatures [13] [14] [9] [15] [16]. All the relevant habitat preferred details about Odonates were done through habitat preferred observation study [17].

### Data analysis

**Margalef's Richness Index** (Margalef 1958) is used to determine species richness [6] [11].

$$\mathbf{DMg = \frac{S-1}{LnN}}$$

Where "S" = number of species recorded "N" = total number of individuals in the Sample,

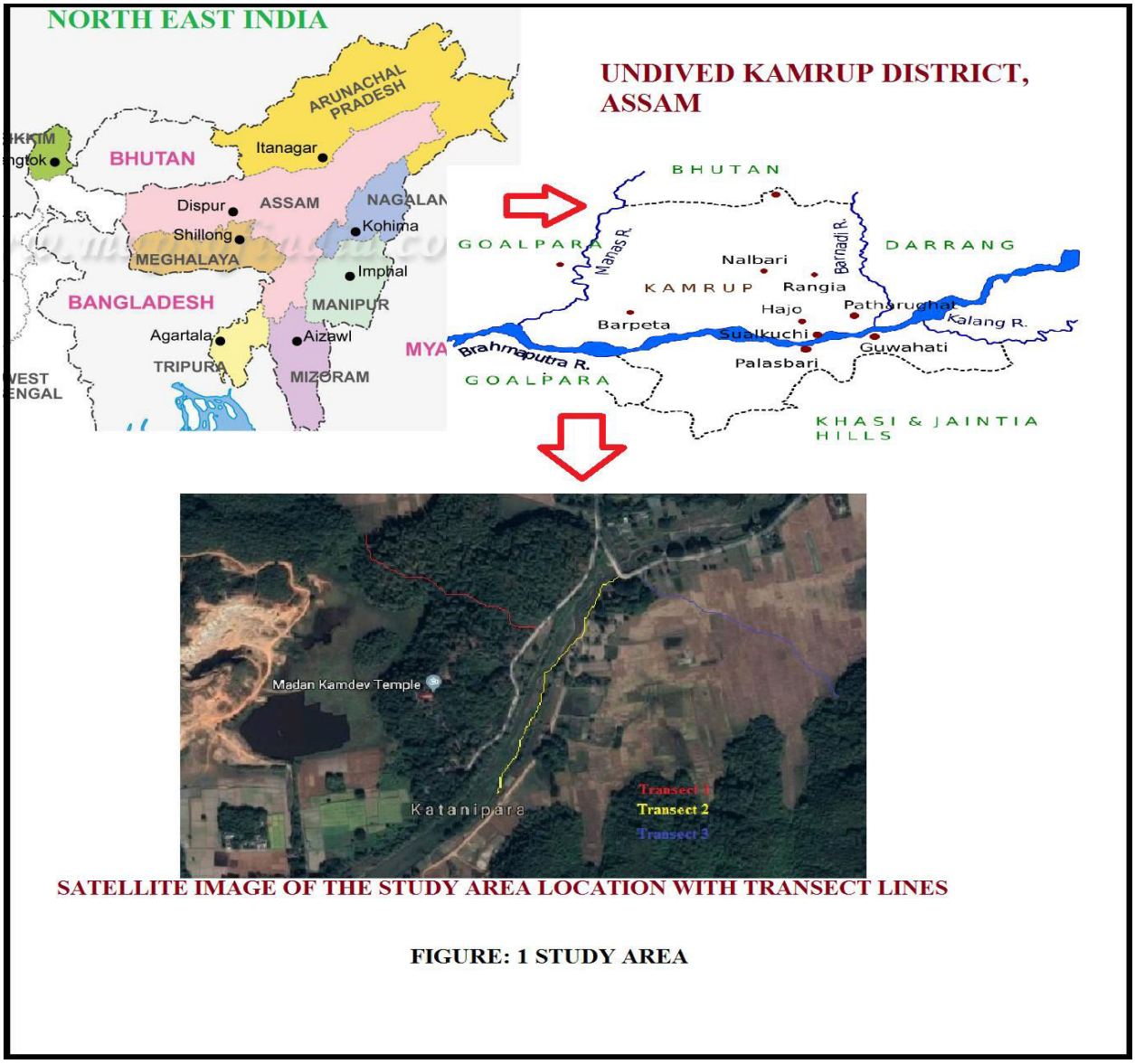
**The Shannon-Weiner index** (Shannon and Weiner 1949) is used to calculate the diversity of species in different habitat[6] [18].

$$\mathbf{H' = -\sum pi\ Ln\ pi}$$

Where "S" = number of species "pi" = proportion of individuals of each species belonging to the "i" $^{th}$ species of the total number of individuals.

Relative Abundance (RA). [18]

$$\mathbf{RA = \frac{Number\ of\ individuals\ of\ the\ species}{Number\ of\ individuals\ of\ all\ species} x100}$$




SATELLITE IMAGE OF THE STUDY AREA LOCATION WITH TRANSECT LINES

**FIGURE: 1 STUDY AREA**

## RESULTS

A total of 726 individuals of Odonates were encountered in the study period of 3 December 2017 to May 2018 in Madan Kamdev Temple area. A total of 32 species belonging to 2 families were recorded among which 19 species were Dragonflies and 13 species were Damselflies (Table1 & 2). 12 species were found in Transect 1 (forest), 31 species were found in Transect 2 (River bank), and 20 species were found in Transect 3 (Crop field); 11 species were common in all Transects. Out of 32 species C*eriagrion coromandelianum* (Photo ID: DCK/18/ECR/026) was found to be dominant with highest relative abundance of 18.04 belonging to sub-order Zygoptera. The species *Ishnura rufostigma* (Photo ID: DCK/18/ECR/028) and *Palpopleura sexmaculata* (Photo ID: DCK/18/ECR/013) were found to have lowest relative abundance 0.14. In present study a total of 7 Very Rare species, 14 Rare species, 6 Occasional, 2 Common and 3 Very Common species were recorded. In Transect 1 (Forest) *Brachythemis contaminate* (Photo ID: DCK/18/ECR/005) and *Pantala flavescens* (Photo ID: DCK/18/ECR/014) species were found to be dominant species with equal number of sightings and relative abundance. In transect 2 (River bank) *Ceriagrion coromandelianum* (Photo ID: DCK/18/ECR/026) was dominant species and in the transect 3 (Crop fields) *Pantala flavescens* (Photo ID: DCK/18/ECR/014) was found to be as dominant species.

In the present study the different habitat of Odonata have been surveyed using customary method. Each zone were allocated into 6 habitat pattern such as Shrub Land (SB), Short Grassland (SG), Tall Grassland (TG), Open Area (OA), Emergent Vegetation (EV), and Free Floating emergent Vegetation (FFV) and the preference of habitat by Odonates was observed.

4 species i.e. *Crocothemis servilia* (Photo ID: DCK/18/ECR/006), *Ceriagrioncoro mandelianum* (Photo ID: DCK/18/ECR/026), *Neurothemis fulvia* (Photo ID: DCK/18/ECR/008), *Orthetrum sabina* (Photo ID: DCK/18/ECR/012) used all types of above mentioned habitat types. Other 23 species used Shrub land (SB), 20 species used Emergent Vegetation (EV), 10 species used Free Floating emergent Vegetation (FFV), 5 species used Open Area (OA), 14 species used Short Grassland (SG) and 5 species used Tall Grassland (TG) (Table: 3). The River bank Transect provides appropriate habitat for Dragonfly and Damselfly species and support a healthy breeding ground. The vegetation in the river and crop field were not engulfed by the fire and provided the right roosting spots for species while the underground vegetation (herbs and shrubs) provided perching spots for low flying species.

The Shannon Weiner index (H′) of the study area was 2.644 ( in River bank H′=2.649; Forest, H′= 2.126, and in Crop field, H′= 2.366). Margalef's Richness Index (DMg) was found to be 4.705 in the area (Table 4). The Diversity and Richness of Odonates in the River bank Transect was higher than other two transects. The river transect provides suitable habitat for both Dragonfly and Damselfly species and support a healthy breeding ground. And in the Crop field during cultivated season is being provided to the species with the availability for their food stock.

**Table 1: Relative Abundance of the Odonata species in Madan Kamdev Temple area**

| Species | Photo ID | Common name | Total | RA | LS |
|---|---|---|---|---|---|
| **Sub-order: Anisoptera Family: Libellulidae** | | | | | |
| *Acisoma panorpoides* (Rambur 1842) | DCK/18/ECR/001 | Trumpet Tail | 8 | 1.10 | R |
| *Brachydiplax chalybea* (Brauer 1868) | DCK/18/ECR/002 | Rufous-backed Marsh hawk | 6 | 0.83 | R |
| *Brachydiplax farinose* (Fraser 1936) | DCK/18/ECR/003 | Black Tailed Dasher | 7 | 0.93 | R |
| *Brachydiplax sobrina* (Rambur 1842) | DCK/18/ECR/004 | Little Blue Marsh Hawk | 5 | 0.69 | R |
| *Brachythemis contaminate* (Fabricius 1793) | DCK/18/ECR/005 | Ditch Jewel | 101 | 13.91 | VC |
| *Crocothemis servilia* (Drury 1770) | DCK/18/ECR/006 | Ruddy Marsh Skimmer | 31 | 4.27 | O |
| *Diplacodes trivialis* (Rambur 1842) | DCK/18/ECR/007 | Ground skimmer | 9 | 1.24 | R |
| *Neurothemis fulvia* (Drury 1773) | DCK/18/ECR/008 | Fulvous Forest Skimmer | 52 | 7.16 | C |
| *Neurothemis intermedia* (Rambur 1842) | DCK/18/ECR/009 | Ruddy Meadow Skimmer | 26 | 3.58 | O |
| *Neurothemis tullia* (Drury 1773) | DCK/18/ECR/010 | Pied Paddy Skimmer | 4 | 0.55 | R |
| *Orthetrum chrysis* (Selys 1891) | DCK/18/ECR/011 | Spine-tufted Skimmer | 2 | 0.28 | VR |
| *Orthetrum sabina* (Drury 1770) | DCK/18/ECR/012 | Green Marsh hawk | 23 | 3.17 | O |
| *Palpopleura sexmaculata* (Fabricius 1987) | DCK/18/ECR/013 | Blue Tailed Yellow Skimmer | 1 | 0.14 | VR |
| *Pantala flavescens* (Fabricius 1998) | DCK/18/ECR/014 | Wandering Glider | 105 | 14.46 | VC |
| *Potamarcha congener* (Rambur 1842) | DCK/18/ECR/015 | Yellow Tailed Ashy Skimmer | 5 | 0.69 | R |
| *Rhodothemis rufa* (Rambur 1842) | DCK/18/ECR/016 | Spine Legged Redbolt | 2 | 0.28 | VR |
| *Rhyothemis variegate* (Linnaeus 1763) | DCK/18/ECR/017 | Common Picture Wing | 21 | 2.89 | O |
| *Trithemis pallidinervis* (Kirby 1889) | DCK/18/ECR/018 | Long Legged Marsh Hawk | 3 | 0.41 | R |
| *Urothemis signata* (Rambur 1842) | DCK/18/ECR/019 | Greater Crimson Glider | 51 | 7.02 | C |

RA=Relative Abundance, LS= Local Status, R=Rare, VC=Very Common, O=Occasional, VR=Very Rare, C=Common

| Table 2:Relative Abundance of the Odonata species in Madan Kamdev Temple area | | | | | |
|---|---|---|---|---|---|
| **Species** | **Photo ID** | **Common name** | **Total** | **RA** | **LS** |
| **Sub-order- Zygoptera Family- Coenagrionidae** | | | | | |
| *Aciagrion pallidum* (Selys 1891) | DCK/18/ECR/020 | Pale Slender Darlet | 2 | 0.28 | VR |
| *Agriocnemis keralensis* (Peter 1981) | DCK/18/ECR/021 | Kerela Darlet | 4 | 0.55 | R |
| *Agriocnemis lacteola* (Selys 1876) | DCK/18/ECR/022 | Milky Darlet | 7 | 0.96 | R |
| *Agriocnemis pieris* (Laidlaw 1919) | DCK/18/ECR/023 | White Darlet | 42 | 5.79 | O |
| *Agriocnemis pygmaea* (Rambur 1842) | DCK/18/ECR/024 | Pigmy Darlet | 34 | 4.68 | O |
| *Ceriagrion cerinorubellum* (Brauer 1865) | DCK/18/ECR/025 | Orange Tailed Marsh Dart | 12 | 1.65 | R |
| *Ceriagion coromandelianum* (Fabricius 1798) | DCK/18/ECR/026 | Coromandel Marsh Dart | 131 | 18.04 | VC |
| *Ceriagrion olivaceum* (Laidlaw 1914) | DCK/18/ECR/027 | Rusty Marsh Dart | 2 | 0.28 | VR |
| *Ischnura rufostigma* (Selys 1876) | DCK/18/ECR/028 | N/A | 1 | 0.14 | VR |
| *Pseudagrion decorum* (Rambur 1842) | DCK/18/ECR/029 | Elegant Sprite | 3 | 0.41 | R |
| *Pseudagrion microcephalum* ( Rambur 1842) | DCK/18/ECR/030 | Blue Grass Dart | 9 | 1.24 | R |
| *Pseudagrion rubriceps* (Selys 1876) | DCK/18/ECR/031 | Saffron Faced Blue Dart | 15 | 2.07 | R |
| *Pseudagrion spencei* (Fraser 1922) | DCK/18/ECR/032 | N/A | 2 | 0.28 | VR |
| RA=Relative Abundance, LS- Local Status, R=Rare, VC=Very Common, O=Occasional, VR=Very Rare, C=Common N/A= Not Applicable | | | | | |

| Table 3: Transect wise Diversity and Richness of the Odonata Species in Madan Kamdev Temple | | | | |
|---|---|---|---|---|
| Variables | Transect[1] | Transect[2] | Transect[3] | Overall |
| Total | 88 | 457 | 181 | 726 |
| H′ (Diversity) | 2.126 | 2.649 | 2.366 | 2.644 |
| DMg (Richness) | 2.456 | 4.898 | 3.654 | 4.705 |
| $\text{Shannon} - \text{Weiner index } (H') = -\sum pi \ln pi, \text{and Margalef's Richness Index } (DMg) = \frac{S-1}{\ln N}$ | | | | |

| Table 4 :- Habitat used by Odonates species at Madan Kamdev Temple area | | | |
|---|---|---|---|
| S.No | **Species** | **Common Name** | **Habitat Types** |
| **Sub-order :- Anisoptera Family :- Libellulidae** | | | |
| 1 | *Acisoma panorpoides* | Trumpet Tail | FFV,EV |
| 2 | *Brachydiplax chalybea* | Rufous-backed Marsh hawk | EV,SB,FFV |
| 3 | *Brachydiplax farinose* | Black Tailed Dasher | SB,SG,EV |
| 4 | *Brachydiplax sobrina* | Little Blue Marsh Hawk | EV,SB,FFV |
| 5 | *Brachythemis contaminata* | Ditch Jewel | SB,SG,OA,EV |
| 6 | *Crocothemis servilia* | Ruddy Marsh Skimmer | SB,SG,OA,EV,TG,FFV |
| 7 | *Diplacodes trivialis* | Ground skimmer | OA,SB |
| 8 | *Neurothemis fulvia* | Fulvous Forest Skimmer | SB,SG,EV,FFV,OA,TG |
| 9 | *Neurothemis intermedia* | Ruddy Meadow Skimmer | SB,SG |
| 10 | *Neurothemis tullia* | Pied Paddy Skimmer | SB,EV,TG |
| 11 | *Orthetrum chrysis* | Spine-tufted Skimmer | SB,EV,FFV |
| 12 | *Orthetrum sabina* | Green Marsh hawk | SB,SG,EV,OA,FFV,TG |
| 13 | *Palpopleura sexmaculata* | Blue Tailed Yellow Skimmer | SB,EV |
| 14 | *Pantala flavescens* | Wandering Glider | SB,TG |
| 15 | *Potamarcha congener* | Yellow Tailed Ashy Skimmer | SB,EV,TG |
| 16 | *Rhodothemis rufa* | Spine Legged Redbolt | SB |
| 17 | *Rhyothemis variegate* | Common Picture Wing | SB,EV,TG |
| 18 | *Trithemis pallidinervis* | Long Legged Marsh Hawk | SB,EV |
| 19 | *Urothemis signata* | Greater Crimson Glider | SB,SG,EV,FFV,OA,TG |

| Sub-order :- Zygoptera Family:-coenagrionidae | | | |
|---|---|---|---|
| 20 | *Aciagrion pallidum* | Pale Slender Darlet | SB |
| 21 | *Agriocnemi skeralensis* | Kerela Darlet | SB,SG,EV |
| 22 | *Agriocnemis lacteola* | Milky Darlet | SG,EV |
| 23 | *Agriocnemis pieris* | White Darlet | SG,FFV,EV,OA |
| 24 | *Agriocnemis pygmaea* | Pigmy Darlet | SG,EV,FFV |
| 25 | *Ceriagrion cerinorubellum* | Orange Tailed Marsh Dart | SB,SG,EV,FFV |
| 26 | *Ceriagion coromandelianum* | Coromandel Marsh Dart | SB,SG,EV,OA,FFV,TG |
| 27 | *Ceriagrion olivaceum* | Rusty Marsh Dart | SB,SG |
| 28 | *Ischnura rufostigma* | N/A | SG |
| 29 | *Pseudagrion decorum* | Elegant Sprite | SB,EV |
| 30 | *Pseudagrion microcephalum* | Blue Grass Dart | SB,SG,EV,OA,FFV |
| 31 | *Pseudagrion rubriceps* | Saffron Faced Blue Dart | SB,SG,EV,FFV |
| 32 | *Pseudagrion spencei* | N/A | SB,SG |
| *EV – Emergent Vegetation, FFV - Free Floating emergent Vegetation, OA - Open Area, SB - Shrub Land, SG - Short Grassland, TG - Tall Grassland,* | | | |

## DRAGONFLY

DCK/18/ECR/001

DCK/18/ECR/002

DCK/18/ECR/003

DCK/18/ECR/004

DCK/18/ECR/005

DCK/18/ECR/006

DCK/18/ECR/007

DCK/18/ECR/008

DCK/18/ECR/009

DCK/18/ECR/010

DCK/18/ECR/011

DCK/18/ECR/012

DCK/18/ECR/013

DCK/18/ECR/014

DCK/18/ECR/015

DCK/18/ECR/016

DCK/18/ECR/017

DCK/18/ECR/018

DCK/18/ECR/019

**DAMSELFLY**

DCK/18/ECR/020

DCK/18/ECR/021

DCK/18/ECR/022

DCK/18/ECR/023

DCK/18/ECR/024

DCK/18/ECR/025

DCK/18/ECR/026

DCK/18/ECR/027

DCK/18/ECR/028

DCK/18/ECR/029

DCK/18/ECR/030

DCK/18/ECR/031

DCK/18/ECR/032

## DISCUSSION

39 species belonging to 5 families and 22 genera were reported on a similar study on the diversity and habitat preference of Odonates in Deepor Beel Bird Sanctuary with the help of transect method during December 2013 to September 2014 [9], on the contrary, 32 species belonging to 2 families and 19 genera were reported in this research.Another similar study reported 45 species of Odonates including 29 species under 3 families of Anisoptera and 16 species under 3 families of Zygoptera in Barpeta district of Assam [11]. They found the Shannon-Weiner Index (H′) was 3.323 in pond, followed by 3.310 in open tracts of land, 3.243 in rivers and 3.305 in beels (wetlands) or lakes. Species richness or Margalef's Richness Index was found to be 6.47 in open tracts, 6.36 in River banks and 6.14 in beels and 5.65 in ponds. The most abundant Anisopteran species in ponds was *Diplacodes trivialis*; in beels and rivers it was *Rhyothemis variegate* and *Pantala flavescens* was most abundant in open tracts. Among Zygopteran species the most abundant was *Ceriagrion coromandelianum* in all habitat. In this study a total of 726 individuals of Odonates were encountered in the study period of December 2017 to May 2018 in Madan Kamdev Temple area. A total of 32 species belonging to 2 families were recorded among which 19 species were Dragonflies and 13 species were Damselflies. *Ceriagrion coromandelianum* (Photo ID: DCK/18/ECR/026) was found to be dominant with highest relative abundance of 18.04 belonging to sub-order Zygoptera. The species *Ishnura rufostigma* (Photo ID: DCK/18/ECR/028) and *Palpopleura sexmaculata* (Photo ID: DCK/18/ECR/013) were found to have lowest relative abundance 0.14. The Shannon Weiner Index (H′) of the study area was 2.644 ( in River H′=2.649; Forest, H′= 2.126, and in Crop field, H′= 2.366). Margalef's Richness Index (DMg) was found to be 4.705 in the area.

Study on dragonfly diversity in and around Assam University in two different ecosystem (Eco-forest and Irongmara) reported 17 species of dragonflies belong to family Libellulidae. Orthetrum genus was most abundant of all. Among species *Orthetrum sabina* was the most abundant in both study sites. Species diversity, abundance and richness were determined in both the study area. The Shannon Weiner Index in Ecoforest and Irongmara was 2.37 and 2.32 respectively. The Margalef's Richness Index was observed to be 3.74 and 3.98 [18]. Another study reported a total of 609 individuals belonging to 46 species in 26 genera and 8 families. The most abundant species was *Pantela flavescens*. Margalef"s Richness Index was 3.659 in agricultural field, 3.831 in forest and 5.478 in urban area [19]. Diversity of Odonata in Tinsukia district of Assam recorded total of 39 species. The sub-order Anisoptera consists of 28 species belonging to 20 genus and 3 families and sub-order Zygoptera consist of 11 species belonging to 6 genus and 3 families. The family Libellulidae and Coenagrionidae were dominant. The relative abundance analysis showed that 10 species out of 39 species were found to be very common, 7 were common, 8 were occasional, 9 rare and 5 were very rare. I have found 7 very rare species, 14 rare species, 6 occasional species, 2 common species and 3 very common species [10]. Research on habitat preference found that dragonflies used 24% shrub land, 23% emergent vegetation, 15% free floating emergent vegetation, 14% tall grassland and open area and 10% short grassland as their habitat. However, damselflies occupied 18% Shrub land, Short Grassland and Emergent Vegetation as their habitat, 17% Free Floating emergent Vegetation, 15% of Tall Grassland and 14% open area as their habitat [9]. Similarly, habitat preference of Odonata fauna in Kaziranga, Karbi Hill, Northeast India, among the 6 selected habitats, stream and river sites hold highest species (45) and lowest species found in human habitation (21). Among the recorded species *Orthetrum pruinosum, Orthetrum sabina* and *Pantala flavescens* were found to be occupied in all habitat [17]. In the present study 23 species used Shrub Land (SB), 20 species used Emergent Vegetation (EV), 10 species used Free Floating Emergent Vegetation (FFV), 5 species used Open Area (OA), 14 species used Short Grassland (SG) and 5 species used Tall Grassland (TG). 4 species (4) i.e. *Crocothemis servilia* (Photo ID: DCK/18/ECR/006), *Ceriagrion coromandelianum* (Photo ID: DCK/18/ECR/026), *Neurothemis fulvia* (Photo ID: DCK/18/ECR/008), *Orthetrum sabina* (Photo ID: DCK/18/ECR/012) used all types of habitats.

## CONCLUSION

Odonata diversity of the Madan Kamdev Temple area was blameless but cannot compare with past due to lack of preceding data of that area. The Madan Kamdev Temple area seems to have a rich Odonata diversity of 32 species due to its good habitat quality. The observations recorded in the present study may prove valuable as a reference for assessing the changes due to the environmental conditions in the locality in future. Very less study pronounced on these indicator species. So, further investigations are necessary for this group of insect as indicator species.

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