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DIVERSITY OF ENVIRONMENTAL HEALTH MARKERS ODONATA AND LEPIDOPTERA IN GWARIGHAT REGION OF RIVER NARMADA, JABALPUR (M.P.) INDIA

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ABSTRACT

River Narmada is the fifth largest westwards flowing river of India. Biodiversity protection and conservation is a national and international agenda and responsible for sustainable development of a region or a country and secondly Lepidoptera and Odonata are potential bio control agents of many invertebrates. Lepidoptera and Odonata assemblage along with river Narmada bank of Gwarighat region in Jabalpur has been investigated. A total of 41species have been distributed in two orders Odonata with 22 species and Lepidoptera with 19 species were sampled. Libellulidae with 9 species under order Odonata and Nymphalidae with 9 species under Lepidoptera are the most dominating families while others have fewer representatives. Mostly organisms were aggregated due to habitat specific nature and random distribution indicates availability of resource utilization to survive but, in the urban forest area, high anthropogenic disturbances were observed which creates high biotic pressure on forest. A detailed list of Odonata and Lepidoptera recorded from urban forest area is presented.

Keywords:
Biodiversity, Lepidoptera, Odonata, Species Richness, River Narmada, Conservation.

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1. INTRODUCTION

Biodiversity conservation and management are worldwide concern (Ramesh et al., 2010), where determining the diversity levels of indicator groups of ecosystem should permit the prediction of

other taxa to be present i.e., the importance and appropriateness of using invertebrate groups as indicator (Oliver and Beattie, 1993; Pearson, 1994). Biodiversity loss is one of the world's most pressing crisis and there is global concerned about the biological resource on which so much human life depends. The biological change that environmental degradation brings about and enumerated pollution and introduced species as the main cause for the decreased in biodiversity around the world. Relating patterns of biodiversity to spatial phenomena is becoming increasingly important in community ecology and related disciplines such as conservation biology (Spencer et al., 2002). Alternatively, local environmental conditions may prevail because certain species depend on a given set of environmental conditions for survival. Both of these processes are likely to act in concert to determine patterns of community similarity within and among habitats. Partitioning ecological variation exhibited by communities into that explained by purely spatial and that explained by purely environmental phenomena is crucial to understanding the mechanisms behind patterns of biodiversity (Borcard et al., 1992; Condit et al., 2002 and Duivenvoorden et al., 2002).

To focus on the conservation of biodiversity has recently received attention. Various studies and protocols have been proposed to test the appropriate patterns of biodiversity (Wilson, 1988; Noss, 1990; Enrlich and Wilson, 1991) and (Wright et al., 1991) also classified a hierarchical composition of different level of organization as well as groups of taxonomically related species to test the patterns of biodiversity conservation. The use of indicator taxa in conservation efforts from pollution control to biodiversity has been the focus of attention (Landers et al., 1988).

Mass extinctions of the Earth's flora and fauna have occurred before also but those were driven by natural factors. However, the projected extinctions of flora and fauna in the future will be human driven i.e. due to adverse impact of human activities. The growth of human populations around the world, along with attendant pollution and loss of habitat, has set the stage for mass extinctions and large scale alterations in the flora and fauna.

River Narmada is westward flowing lotic water-body of central plateau region which covers 98,797 sq. km of total water-shed area. It is known as the life line of Madhya Pradesh as well as Gujarat In the basin of river Narmada industrial area are less developed as compared to other river basins. Perennial river system with different habitat types provides good opportunities to Odonata as well as Lepidoptera, the wonderful insect groups to flourish and survive. Narmada basin created an excellent habit and source of alteration for many faunal species like insects, reptiles, birds and mammals (Tiple et al., 2010). Both are good indicators of environmental changes as they are sensitive to habitat degradation and climate changes (Kunte, 2000). Butterflies play an important role in ecosystem where they interact with plants as it is one on the major source of pollination and also a herbivorous insect (Tiple et al., 2006).

Different ecological requirements are linked to different dispersal capacities and their high diversity of aquatic habitats in tropical forests (Orr, 2006), especially in mountain areas (Oppel, 2005) as mountains not only provide a greater contemporary diversity of habitats, but also a greater potential for survival in refugia. Species with narrow niches often disperse poorly, while pioneers of temporal habitats are excellent colonisers, making Odonata a particularly good group for evaluating habitat connectivity. Odonata and Lepidoptera are easy-to-study group and are useful for monitor the overall biodiversity of aquatic as well as near-by terrestrial habitats and

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had been identified as good indicators as well as pollinator of environmental health (Corbet, 1999; Kalkman et al., 2008).

Lepidoptera and Odonata are generally regarded as best taxonomically studied group of insects. With the exception of Antarctica, they are widespread and abundant in all continents, although centres of species richness typically occur in tropical forests (Kalkman et al., 2008). Both are highly specialized insect orders show total metamorphosis and pass through various stages such as egg, larva, pupa and adult stage. Among the invertebrates, Odonata include insects known as dragonflies or damselflies and are always attract the human beings for their, powerful flight and extraordinary sense of vision Lepidoptera for their variety of colour.

Worldwide there are more than 28,000 species of butterflies, with about 80 percent found in tropical regions (Robbins and Oplar, 1997) while Silsby (2001) described about 6000 species of dragonflies and Schorr and Paulson (2014) documented both the dragonflies and damselflies, about 5,952 species and subspecies of Odonata belonging to 652 genera world-wide, in all over the world. At present, the Indian subcontinent hosts about 1,504 species of butterflies (Tiple, 2011) and Odonata fauna of India is known by 3 sub orders, 17 families, 139 genera and 499 species and subspecies (Prasad and Varshney,1995). Mitra (2005) recorded 499 and later on 463 species were confirmed by Subramanian (2009) till date.

In Madhya Pradesh and Vidarbha of central India 177 species of butterfly species have been documented (D'Abreu, 1931). In the recent past, several researchers have studied butterflies from some districts and conservation areas of Madhya Pradesh and Chhattisgarh (Singh 1977; Gupta 1987; Chaudhury 1995; Chandra et al., 2000a, b; 2002; Singh and Chandra, 2002; Siddiqui and Singh 2004; Chandra, 2006). Chandra et al., (2007) recorded 174 species of butterflies belonging to eight families from Madhya Pradesh and Chhattisgarh. Mishra (2007) documented 70 species belonging to 40 genera and 9 families. Odonate fauna from some protected areas of Madhya Pradesh such as 24 species in Pench National Park and 11 species in Satpura National Park (Ramkrishna et al., 2006), 46 species in Kanha National Park (Raju and Narayanan, 2008) 32 species in Bandhavgarh Tiger Reserve (Mishra, 2009), 14speciesPachmarhi Biosphere Reserve (Prasad and Mishra, 2009) and 26 species in Singhori wildlife sanctuary (Talmale, 2011).

The present study was started to examine the diversity of butterflies, dragonflies and damselflies from Gwarighat region of river Narmada in Jabalpur.

2. MATERIAL AND METHOD

2.1.STUDY AREA

The findings presented here are based on random surveys carried out February 2015 to September 2015 in the Gwarighat region of river Narmada. The Gwarighat area of river Narmada basin is surrounded with a very large variety of trees, mini forest, vast grassland and small hill; these are the elements for architecting a preferred habitat or such species.

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2.2.DATA COLLECTION

The sites were visited early in the morning from 5 to 9 am, and evening from 5 to 7 pm hours to note maximum possible species of dragonflies and butterflies to record their activities. The study has been carried out and in such a way there should be least one visit in a week. Observations were made through walking in a wide area of the site with the aid of binocular and digital cameras.

2.3.DATA TREATMENT, ANALYSIS AND IDENTIFICATION

Organisms were primarily identified directly in the field by observation and the difficult cases followed capture or photography of the organism. In critical conditions, specimens were collected only with handheld aerial sweep nets. Each specimen was placed in a plastic bottle and carried to the laboratory for further identification with the help of a field guide (Wynter-Blyth 1957; Kunte 2000; Haribal, 1997).

2.3.1. FOR ODONATA

In the present study, all scientific names of Odonata were followed Varshney (1983) guidelines. The observed butterflies were categorized in five categories on the basis of their abundance in Gwarighat region of river Narmada i.e., Very common, Common, Very rare, Rare, Not Rare (Tiple et al., 2006).

2.3.2. FOR LEPIDOPTERA

The collected adult specimens of Lepidoptera were identified with the help of identification keys provided by Fraser, (1933, 1934 and 1936), Mitra (2006), Subramanian (2005), Andrew et al., (2009), and Subramanian (2009). The Odonata and Lepidoptera were categorized on the basis of their abundance in Gwarighat region of river Narmada Jabalpur as very common, common, rare and very rare. (Tiple et al., 2008).

3. RESULT

This study of Lepidoptera and Odonata were too primarily to identify the different specimen at different habitats and different representative fields. The specimens were categorized into four groups based on their occurrence during the study period on the basis of frequency of sightings. During the intensive survey of Insects in Jabalpur district, 41 species were revealed during the study among these a total of 10 families belonging to 2 orders Odonata and Lepidoptera were recorded from selected site.

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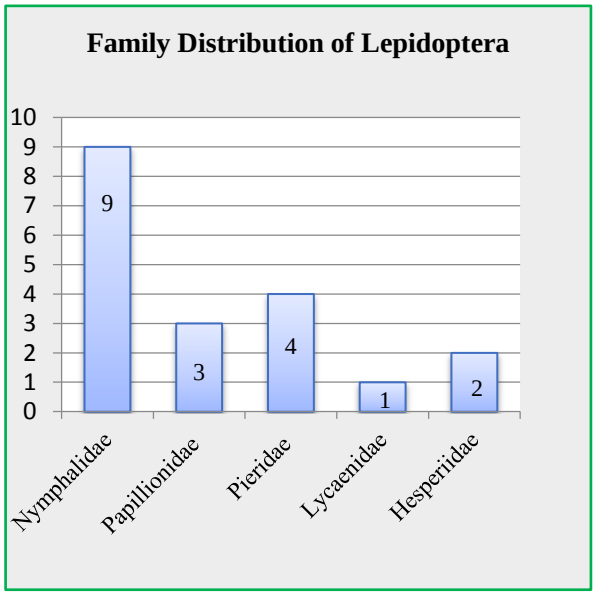

Figure 1: Families distribution of Lepidoptera in Gwarighat region of river Narmada

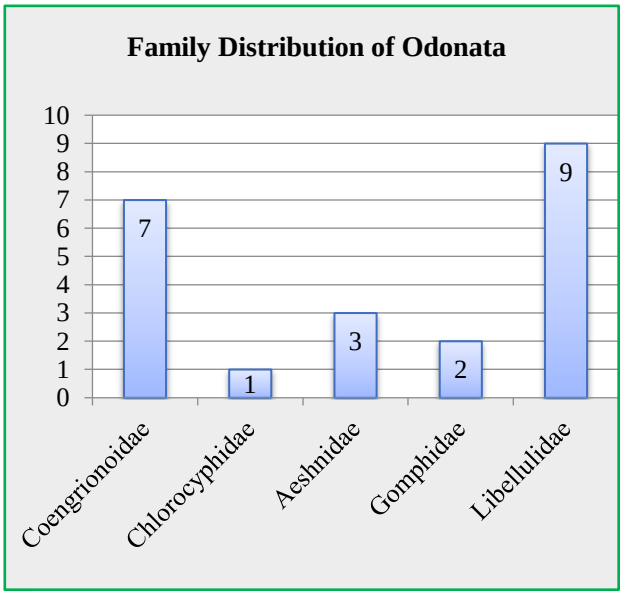

Figure 2: Families distribution of Odonata in Gwarighat region of river Narmada

A total of 41 species of insects, 22 species of order Odonata, damselflies have 8 species under 2 families out of which *Coenagrionoidae* with 7 species is consisting of maximum number of species followed by *Chlorocyphidae* with 1 species each while dragonflies are comprise of 14 species under 3 families out of which *Libellulidae* or Skimmers are the most diverse and dominating family of dragonflies with 9 species that is followed by others such as *Aeshnidae* with 3 species and Gomphidae with 2 species (Figure. 1).

Out of 19 species under Lepidoptera belonging to 14genera of 5 families' viz., *Nymphalidae, Papillionidae, Piridae, Lycaenidae and Hesperiidae*. In terms of number of species result revealed that, out of total 5 families the Nymphalidae with 9 species was the most dominant family, after which Pieridae with 4 species, followed by the *Papilionidae* with 3 species, Hesperiidae with 2 species and *Lycaenidae* with 1 species (Figure 2.).

4. RELATIVE ABUNDANCE

The relative abundance showed that among the 22 species of Odonates recorded, 8 species were found to be very common, 3 species were common, 10 species were rare and 1 species were very rare while from 19 species of order Lepidoptera 7 very common species, 9 common species and 3 rare species were found to the study area. These 10 species of Odonata and 3 species of butterflies from the study area were designated rare, suggesting the need for strict conservation measure.

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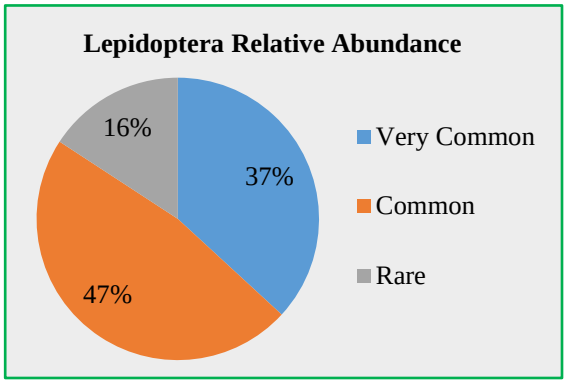

Figure 3: Abundance Status of Lepidoptera in Gwarighat region of river Narmada

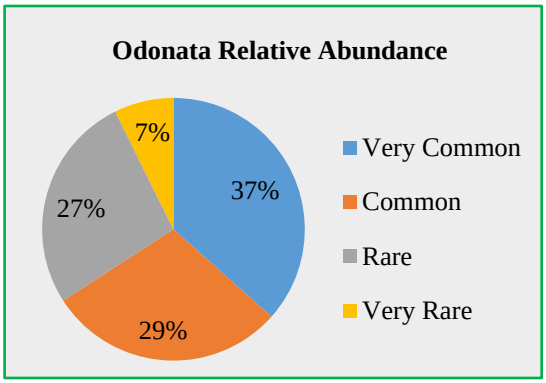

Figure 4: Abundance Status of Odonata in Gwarighat region of river Narmada

Table 1: The observed species of Odonata and Lepidoptera and their relative status in Gwarighat region of River Narmada, Jabalpur.

S. No.	Name of Species	Common Name	Status
Order: Odonata **Sub order: Zygoptera (Damselflies)**			
Family: Coenagrionoidae (7 species)			
	Agriocnemis pieris (Laidlaw,1919)	White Dartlet	**Rare**
	Agriocnemis pygmaea (Rambur, 1842)	Pygmy Dartlet	**Very Common**
	Enallagma parvum (Selys, 1876)	Little Blue	**Rare**
	Ischnura senegalensis (Rambur, 1842)	Common Bluetail	**Very Common**
	Pseudagrion decorum (Rambur, 1842)	Elegant Sprite	**Common**
	Pseudagrion rubriceps (Selys, 1876)	Saffron Faced Blue Dart	**Very common**
	Rhodischnura nursei (Morton,1907)	Pixie Dartlet	**Rare**
Family: Chlorocyphidae (1 species)			
	Libellagolineata indica (Fraser, 1928)	Golden Gem	**Rare**
Sub-order: Anisoptera (Dragonflies) **Family: Aeshnidae (3 species)**			
	Anax guttatus (Burmeister, 1839)	Pale Spotted Emperor	**Very Common**
	Gynacantha bayadera Selys,1891	Small Dusk hawker	**Rare**
	Hemianaxe phippiger (Burmeister, 1839)	Vagrant Emperor	**Rare**
Family: Gomphidae (2 species)			
	Macrogomphus annulatus (Selys,1854)	Keiser's Forktail	**Common**
	Paragomphus lineatus (Selys,1850)	Lined Hooktail	**Common**
Family: Libellulidae (9 species)			
	Brachythemis contaminata (Fabricius,1793)	Ditch Jewel	**Very Common**
	Crocothemis servilia (Drury, 1770)	Scarlet Skimmer	**Very Common**

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	Neurothemis intermedia (Rambur, 1842)	Paddy Field Parasol	**Rare**
	Neurothemis tullia (Drury, 1773)	Pied Paddy Skimmer	**Very Rare**
	Orthetrum luzonicum (Brauer, 1868)	Slender Blue Skimmer	**Rare**
	Rhyothemis variegata (Linnaeus, 1763)	Common Picture Wing	**Rare**
	Tholymis tillarga (Fabricius, 1798)	Coral Tailed Cloudwing	**Rare**
	Trithemis festiva (Rambur,1842)	Black stream glider	**Very Common**
	Trithemis pallidinervis (Kirby, 1889)	Long Legged Mars Glider	**Very Common**
Order: Lepidoptera **Suborder: Rhopalocera**			
Family – Nymphalidae (9 Species)			
	Acraea violae (Fabricius, 1793)	Tawny Pansy	**Common**
	Danaus chrysippus (Linnaeus, 1758)	Plain Tiger	**Very Common**
	Hypolimnas bolina (Linnaeus, 1758)	Great Eggfly	**Common**
	Hypolimnas misippus (Linnaeus, 1764)	DanaidEggfly	**Common**
	Junonia almanac (Linnaeus, 1758)	Peacock Pansy	**Common**
	Junonia lemonias (Linnaeus,1758)	Lemon Pansy	**Very Common**
	Junonia orithya (Linnaeus,1758)	Blue Pansy	**Common**
	Limenitis procris (Cramer, 1777)	Commander	**Rare**
	Tirumala limniace (Cramer,1775)	Blue Tiger	**Very Common**
Family – Papillionidae (3 species)			
	Pachliopta aristolochiae (Fabricius, 1775)	Common Rose	**Common**
	Papilio demoleus (Linnaeus, 1758)	Lime	**Very Common**
	Papilio polytes (Linnaeus, 1758)	Common Mormon	**Common**
Family – Pieridae (4 Species)			
	Anaphaeis aurota (Fabricius, 1793)	Pioneer	**Rare**
	Catopsilia pomona (Fabricius, 1775)	Lemon Emigrant	**Very Common**
	Eurema hecabe (Linnaeus, 1758)	Common Grass Yellow	**Very Common**
	Eurema laeta (Boisduval, 1836)	Spotless Grass Yellow	**Common**
Family – Lycaenidae (1 Species)			
	Castalius rosimon (Fabricius, 1775)		**Rare**
Family – Hesperiidae (2 Species)			
	Borbo cinnara (Wallace, 1866)	Rice Swift	**Common**
	Hasora chromus (Cramer, 1780)	Common Banded Awl	**Very Common**

5. DISCUSSION

Urbanization also is associated with habitat degradation including decreased plant species diversity, reduced water quality, and increased air and soil pollutions. In terrestrial ecosystem, insect fauna represent more than 70% and also play an important role in food chain for the natural balance. Insects are extremely important components of the bioindicators of the world.

Subramanian (2009) reported 11 dragonfliy families, of which 972 species with *Libellulidae* and 958 species with *Gomphidae* are major families throughout the world followed by 436 species in Aeshnida, 249 species in *Corduliidae* and 123 species in *Macromiidae*. Manwar et al., (2012) in

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Maharashtra (India) recorded 22 species of dragonflies and damselflies of 4 families and 17 genera of which 50% species are of family *Libellulidae*. Tijare and Patil (2012) were observed 21 species of dragonflies from Nagpur district and *Libellulidae* family have high species richness. The diversity of Odonata in any region is influenced by two major determinants. Firstly, two bio geographical realms converge in the region, which both contribute assemblages that differ in their radiation history. Secondly, the diversity of dragonflies, being dependent on freshwater habitats, corresponds broadly with humidity gradients.

ZSI incorporated the account of butterflies of 135 species and total 48 species were recorded for the first time from central India. In the present study family Nymphalidae exhibited the maximum species compared to other families. *Nymphalidae* was most predominant in the Gwarighat region of river Narmada. The reason for this extraordinary abundance of *Nymphalidae* family compares then Pieridae and *Papilionidae* butterflies in the study area can be ascribed to the dominance of their larval food plants in the region.

They further demonstrated that most of the species were noticeably absent in the disturbed and human impacted sites (gardens, plantation and grassland) and there was no occurrence of unique species in moderately disturbed areas comparable to those of less disturbed wild areas. The present study site is in constant disturbance due to the cutting of grasses, shrubs and trees for landscaping which may be the reason for the overall reduction of the number of species (Tiple, 2012). The preference of butterflies for particular habitats is associated with the availability of larval host plants and adult nectar plants. The rich diversity of Odonata and Lepidoptera, especially the *Nymphalids* and *Libellulids* in Gwarighat region of river Narmada indicates a varied assemblage of floral species as well as terrestrial area. The flora in studied site is of mixed type with herbs and shrubs dominating the vegetation in the tropical climate.

Butterflies also serve as major pollinators of both wild and cultivated plants (Tiple, 2006) and dragonflies as an environmental indicator. Owing to habitat destruction for developmental activities in urban environment and unscientific management of natural resources, much of our native butterflies are fast disappearing and at present, their survival is under threat. For our next generation we can save wonderful attractive creature on our surrounding garden and forest.

6. CONCLUSION

The summary reports the status and diversity of Odonata and Lepidoptera. With the pressing needs of the growing human population in India, natural greeneries are being clear-felled giving way to urbanization, pollution and overgrazing. Loss of prime habitat is the major threat to all wildlife including dragonflies, damselflies and butterflies. Although we cannot completely nullify the ill effects of urbanization and development, we can at least try to reduce them by planting endemic trees and plants supporting the local wildlife. The group features prominently in nature management and they are often used as indicators for environmental health and conservation management. Large scale and multi-taxa conservation plans for river systems are needed in order to establish a balance between agriculture, development and nature conservation and Development of a sustainable network of local experts and volunteers is needed to facilitate the conservation and monitoring of butterfly, dragonfly and damselfly species and habitats.

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7. RECOMMENDATION CONCERN FOR CONSERVATION

a) Research-notably taxonomy and studies of the distributions and biological requirements of species.
b) Pollution Control
c) Legislation-notably to provide protected areas, to control development and to control pollution.
d) Education and raising public awareness

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