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Study of Ecological Markers in Narmada Valley of Jabalpur Region : A Case Study

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Abstract

The Smart City mission of Jabalpur intends to promote adoption with basic infrastructure to give a decent quality of life, a clean and sustainable environment through application of smart solutions where environment disturbed through anthropogenic activities. This smart city mission with "Clean Narmada, Green Jabalpur" intends to promote adoption in environment with basic infrastructure to give a decent quality of life. Biodiversity encompasses the variety of all life on earth. Jabalpur is major city of Madhya Pradesh in India which is rich is biodiversity. The present study was carried out from January 2014 to December 2016. The whole Narmada valley of Jabalpur region including river, forest, grassland and urban area were selected as study site for the collection of sample. In the study total 101 Bioindicator species of various classes were recorded viz., Odonata 37 species (7 Families), Lepidoptera 25 Species (5 Families), Spiders 26 Species (10 Families) and Mollusca 13 Species (2 Class). This study aimed in contributing to plane of biodiversity restoration in studied region and development of management strategies so as to ensure sustenance of all the recorded species and ecosystem services derived from them. The content of this paper will be useful step for future studies.

Keywords: Narmada, Fauna, Diversity, Pollution, Biomarker.

Introduction

Water is one among the prime necessities of life required for growth and activity of all living beings an globe. The river Narmada is third holy and the fifth longest westward flowing river of central India as well Madhya Pradesh state. Narmada is rise from Maikala range in east central Madhya Pradesh state and follows a tortuous course through the hill near Amarkantak. Water is one among the prime necessities of life required for growth and daily activity of all living organism in the globe. The river Narmada valley is one of the major hot spot for aquabiodiversity in India. 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). The use of indicator taxa in conservation efforts from pollution control to biodiversity has been the focus of attention (Landers et al., 1988). Worldwide there are more than 28,000 species of butterflies, with about 80% found in tropical regions (Robbins and Oplar, 1997) while Silsby (2001) described about 6000 species of dragonflies and Schorr and Paulson (2014) documented about 5,952 species and subspecies of Odonata belonging to 652 genera world-wide, in all over the world. Bhandari and Shukla (2015) Studied on benthic macroinvertebrate community of river Narmada and their correlation with Physico-Chemical parameters from the water body. They recorded, a total of Forty two species of benthic macro-invertebrates fauna belonging to three phyla (Annelida, Arthropoda and Mollusca), five classes (Oligochaeta, Crustacea, Hexapoda, Gastropoda, Pelecypoda) and five families (*Baetidae, Caenoidae, Ephemeridae, Heptagenidae, and Chironomidae*) in the river Narmada during which Mollusca was dominating group with 47% species constitution. Life on Earth is diverse at many levels, beginning with genes and extending to the wealth and complexity of species, life forms, and functional roles, organized in spatial patterns from biological communities to ecosystems, regions, and beyond. Within biological communities and ecosystems, functional diversity refers to the variety and number of species that fulfill different functional roles. A food web and some measure of its complexity and connectivity is one way to depict the functional diversity of a community.

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Material and Methods

Study Site

The present study was carried out for two year from January 2014 to December 2016 due to which include all four seasons. Different species reproduce in different season hence, we choose whole year for study.

The Narmada basin lies in the central India between 70° 20" E to 81°45" E longitude and 21°20" N to 23°45" N latitude with a drainage area of 98,796 sq. km and mean elevation of 760 meters (Sharma and Shukla et al., 2015) while Jabalpur is located at 23°10'N 79°57'E and 23.17°N 79.95°E. The city has an average elevation of 411 meters from sea level. The whole Narmada valley of Jabalpur region including river, forest, grassland and urban area were selected as study site for the collection of samples which was rich in all the taxa of animals. Four study sites were selected for the investigation namely, Bargi dam, Gwarighat, Tilwaraghat and Bhedaghat (Figure I and II).

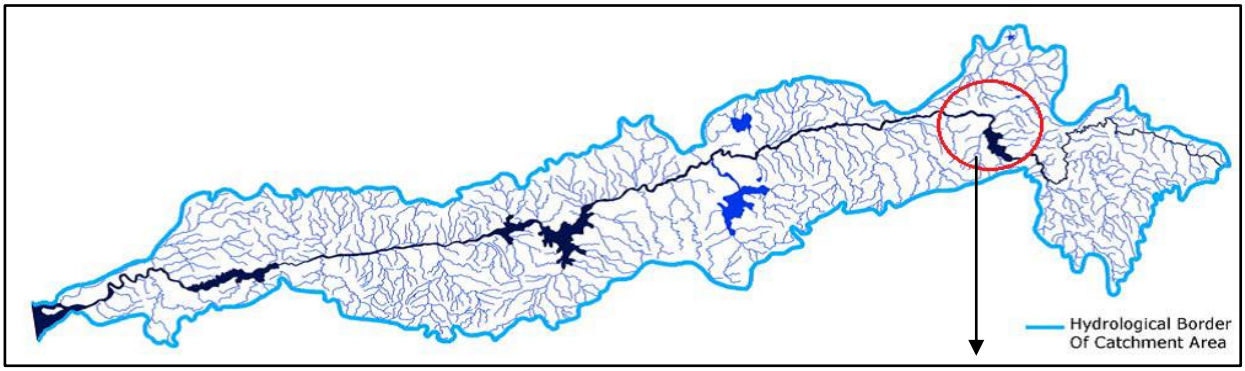

Figure I
Hydrobiological Border of River Narmada with Catchment Area encircled Jabalpur region

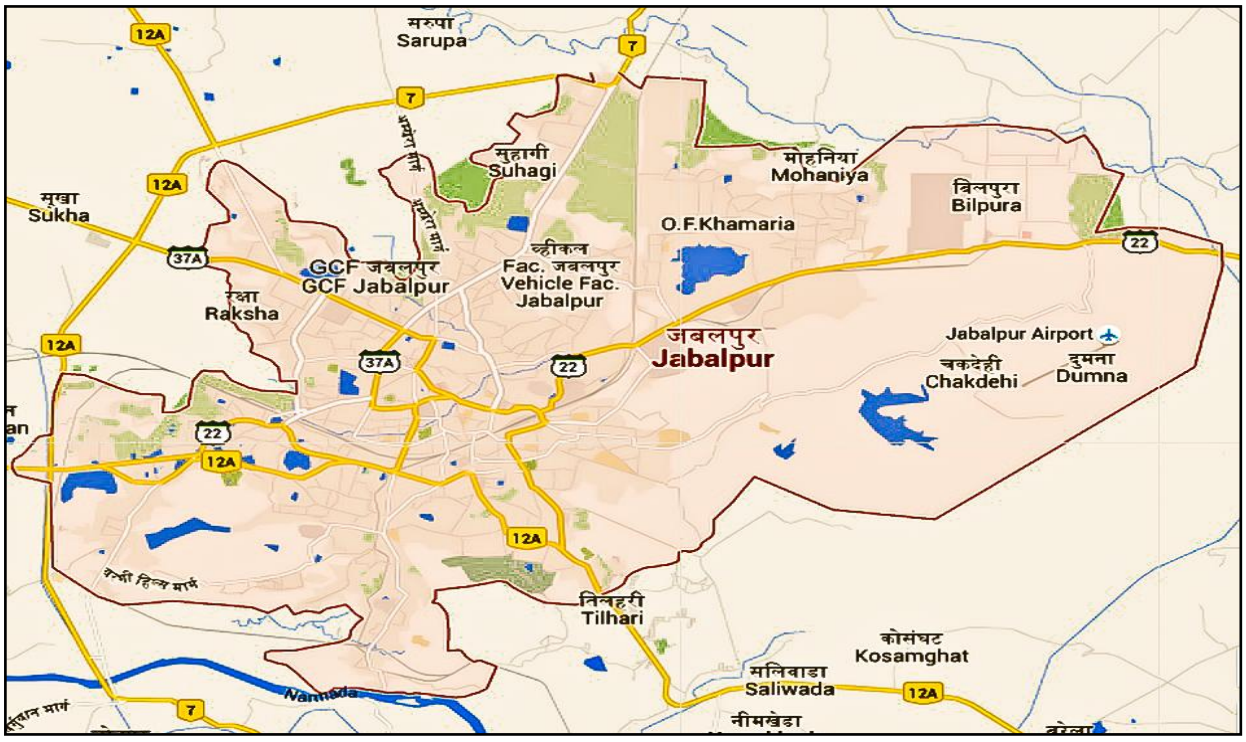

Figure II
Jabalpur Narmada Valley Map

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 to record their activities. The study has been carried out in such a way that there should be at 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. Collected specimens were photographed in live condition identified and then released to their natural habitat. Few specimens were observed under microscope for identification and study of some morphological characteristics. The plankton samples were collected by following the guidelines of (Lind, 1979; Welch, 1953), Wetzel (1983), by filtering 20 Liters of water through plankton net having pore size 64 µm.

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.

1. **Odonata:** In the present study, all scientific names of Odonata were followed by Fraser, (1933, 1934 and 1936), Mitra (2006), Subramanian (2005), Andrew et al., (2009), and Subramanian (2009) guidelines.
2. **Lepidoptera:** The collected adult specimens of Lepidoptera were identified with the help of identification keys provided by Wynter-Blyth (1957) and Kunte (2000) were used. In the present study, all scientific names of Lepidoptera were followed Varshney (1983) guidelines.
3. **Spider:** The specimens were preserved in 70% alcohol and labeled. Bushes, tree trunks, ferns, forest floor, foliage and grass lands were all searched for spiders and collected by hand picking method as suggested by Tikader (1987). Identification was done on the basis of Morphometric characters of various body parts with the help of keys and catalogues provided by Kaston (1978), Tikader (1962,1973,1982), (Biswas and Biswas, 1992), Gajbe (1987) and Platnick (2004).
4. **Mollusca:** Mollusca was collected from Profundal zone by using Ekman grab and at shallow Profundal zone by using surber sampler following Wetzel (2001) in the river. All the samples were preserved in field with 5% formalin solution. Organisms were identified by using standard keys, such as Tonapi (1980), Adoni et al., (1985) and Rao (1993).

The observed fauna were categorized in four categories on the basis of their abundance in Jabalpur region of river Narmada i.e., Very common, Common, Rare, Very rare (Tiple *et al.*, 2008).

Result and Discussion:

In the study total 101 species of Bioindicators of various fauna were recorded viz., Odonata 37 species (7 Families), Lepidoptera 25 Species (5 Families), Spiders 26 Species (10 Families) and Mollusca 13 Species (2 Class).

Odonata

The preliminary study of Odonata was carried out to identify the different specimen at different habitats and different representative fields. During the intensive survey of Insects in Jabalpur district, 37 species were revealed among these a total of 7 families belonging to order Odonata recorded from selected sites. Total 37 species of order Odonata, under two suborders was found, where suborder Zygoptera have 15 species under 4 families out of which *Coenagrionoidae* with 12 species is consisting of maximum number of species followed by *Chlorocyphidae*, *Platycnemididae* and *Lestiae* with 1 species each while another suborder Anisoptera was comprise of 22 species under 3 families out of which *Libellulidae* or Skimmers are the most diverse and dominating family of dragonflies with 17 species that was followed by others such as *Aeshnidae* with 3 species and *Gomphidae* with 2 species (Figure III.).

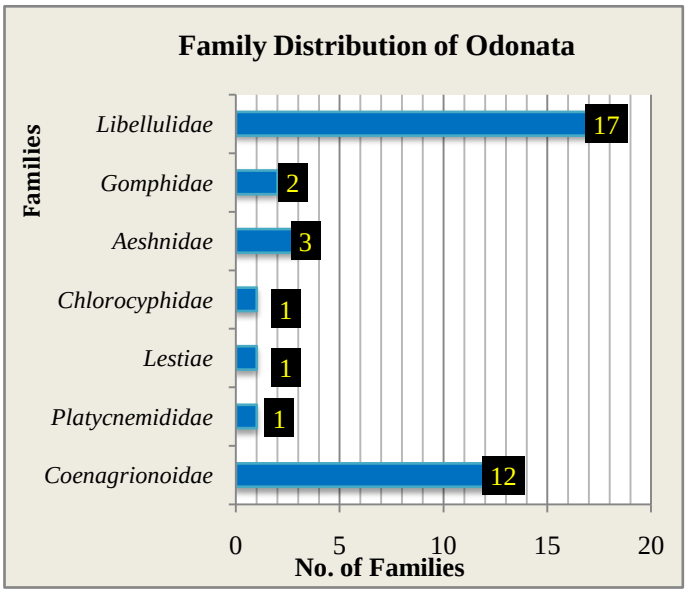

Figure III
Families distribution of Odonata

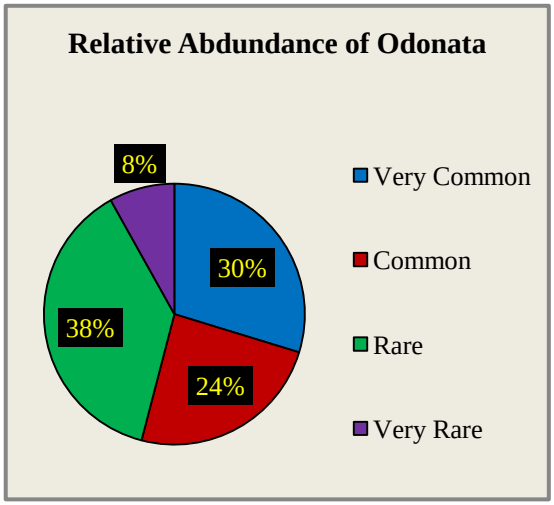

Figure IV
Relative Abdundance of Odonata

The relative abundance showed that, among the recorded 37 species of Odonata, 12 species were found to be very common, 9 species were common, 14 species were rare and 3 species were very rare were found to the

study areas. (Figure IV.) These 37% species of Odonata from the study area were designated rare and 8% species as very rare, suggesting the need for strict conservation.

Lepidoptera

Total 25 species of Lepidoptera belonging to 19 Genus under 5 families viz., *Nymphalidae, Papillionidae, Pieridae, Hesperiidae and Lycaenidae* were recorded in the survey. Among the species recorded from the valley area, 44% are belonging to the family *Nymphalidae* showed the maximum species richness, comprising of 11 species, while the others are shown less representatives (Figure V.) i.e., followed by 4 species of *Lycaenidae*, 4 species of *Pieridae*, 3 species Papillionidae and also 3 species *Hesperiidae*.

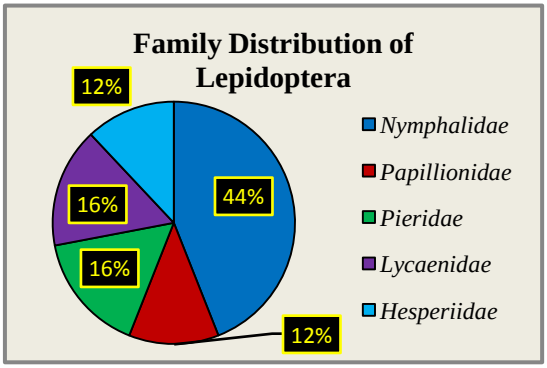

Figure V
Distribution of families of Lepidoptera in Narmada Valley

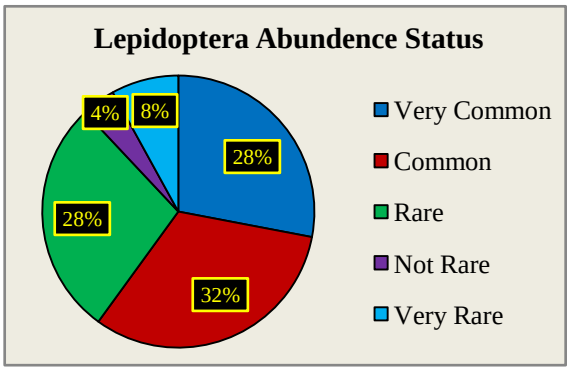

Figure VI
Abandence Status of Lepidoptera in Narmada Valley

Among these 25 species 2 were very rare, 7 were rare, 1 were not rare, 8 were commonly occurring and 7 were very common (Figure VI.). A total of seven species of Lepidoptera from the study area are designated rare, needs conservation. The preference of Lepidoptera for particular habitats is associated with the availability of larval host plants and adult nectar plants.

Spider

Total 26 species under 20 genera and 10 families were recorded in Jabalpur division of Narmada valley. This area is rich in floral diversity. In our observation *Araneidae* (34%) is the most represented family with 9 species subsequently *Salticidae* (15%) with 4 spcies, *Lycosidae* (8%) with 2 species, *Tetragnathidae* (8%) with 2 species, *Theridiidae* (8%) with 2 species, *Thomisidae* (8%) with 2 species, *Erasidae* (7%) with 2 species while *Clubionoidae, Oxyopidae* and *Pholcidae* each contributed below 5% with 1 species shown in figure VII.

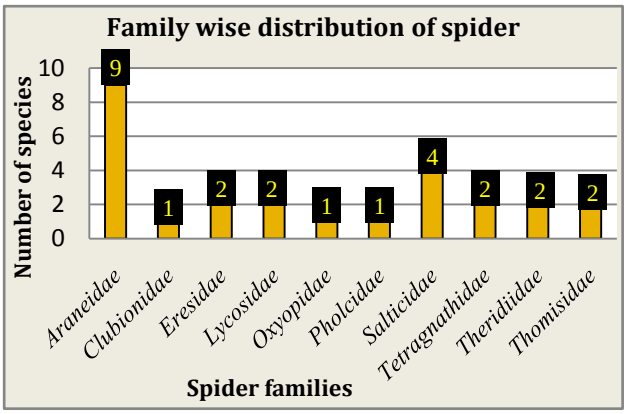

Figure VII
Distribution of species diversity at Narmada valley

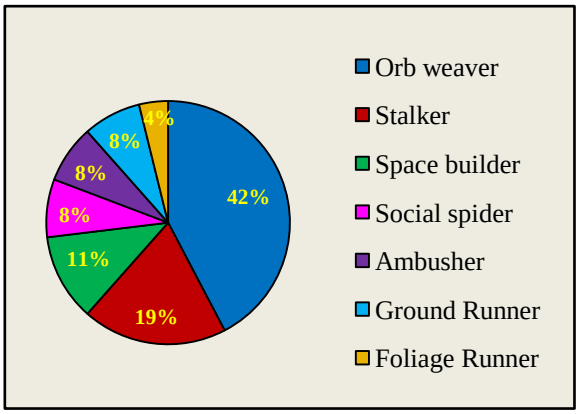

Figure VIII
Guild-wise distribution of species spider

About 1442 species reported from India. Siliwal *et al.*, (2005), recorded 29 species from, central India. The spiders sampled belonged to 7 functional groups (guilds) based on their foraging behavior in the field where Orb Weaver (42%) was dominating, subsequent Stalker (19%), Space Builder (11%), Social Spider (8%), Ambusher (8%), Ground Runner (8%) and Foliage Runner (4%) shown in Figure 8. The peak population densities of spiders coincide with an increase of insect pests (Kiritani, 1972). An increase in the spider population depends on prey availability and, if the density of prey becomes higher, spiders are expected to increase proportionally to some extent. Diversity generally increases when a greater variety of habitat

types are present (Ried and Miller, 1989). Holloway, (2003), observed that conversion of forest to plantation and other man-induced disturbances lead to reduction in the diversity of invertebrates, both in species richness and in the taxonomic and biogeographic quality. (Downie et al., 1999) and New, (1999), have demonstrated that spiders are extremely sensitive to small changes in the habitat structure; including habitat complexity, litter depth and microclimate characteristics.

Mollusca

The relative abundance of 13 recorded species of Mollusca was figured out, in which 15% species *Pila* and *Bellamya* species were found to be very common belong to class Gastropoda, 31% species were common that are *Potamopyrgus* and *Lymnea* under Gastropoda and *Perreysia* and *Margaritifera* under Bivalvia, 31% species were rare in which one species *Lamellidens* belongs to class Bivalvia, and *Valvatapiscinalis*, *Cremnoconchus* and *Physellaacuta* belongs to Gastrapoda, 8% species that is *Segmentia* was not rare and 15% species were very rare found to the study areas. Dominance of *Pila sp.* was seen in the study site (Figure IX and Figure X).

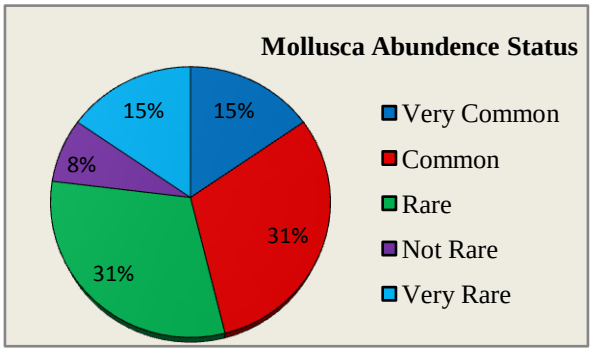

Figure IX

Abandence Status of Mollusca in Narmada River Jabalpur (M.P.)

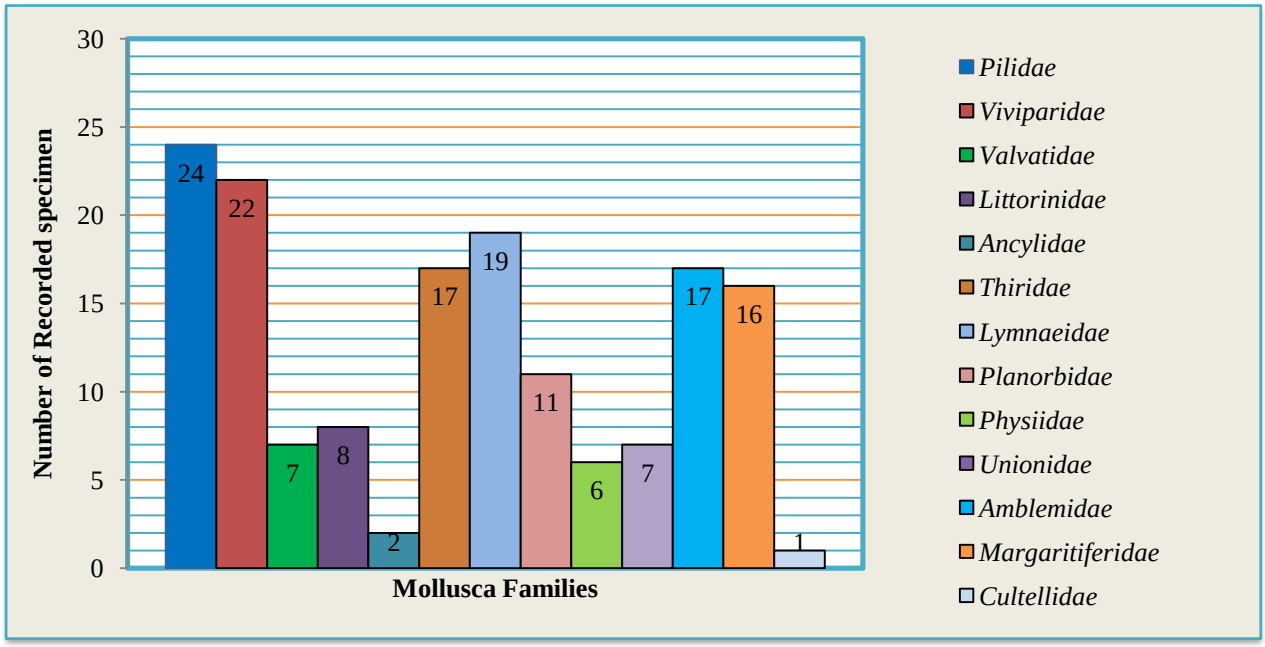

Figure X

Species wise distribution of Mollusca in Narmada River of Jabalpur (M.P.).

Complete fauna: Faunal diversity that comprise of Odonata, Spiders Lepidoptera and Mollusca shows a large abundance in river Narmada at central India.

Table 1
List of 155 recorded species of various phyla from Jabalpur region

Fauna of Jabalpur Recorded (2014-16)	No. of Species	No. of Groups
Odonata	37	7 (Families)
Lepidoptera (Butterfly)	25	5 (Families)
Spider	26	10 (Families)
Mollusca	13	2 (Class)
TOTAL	101	

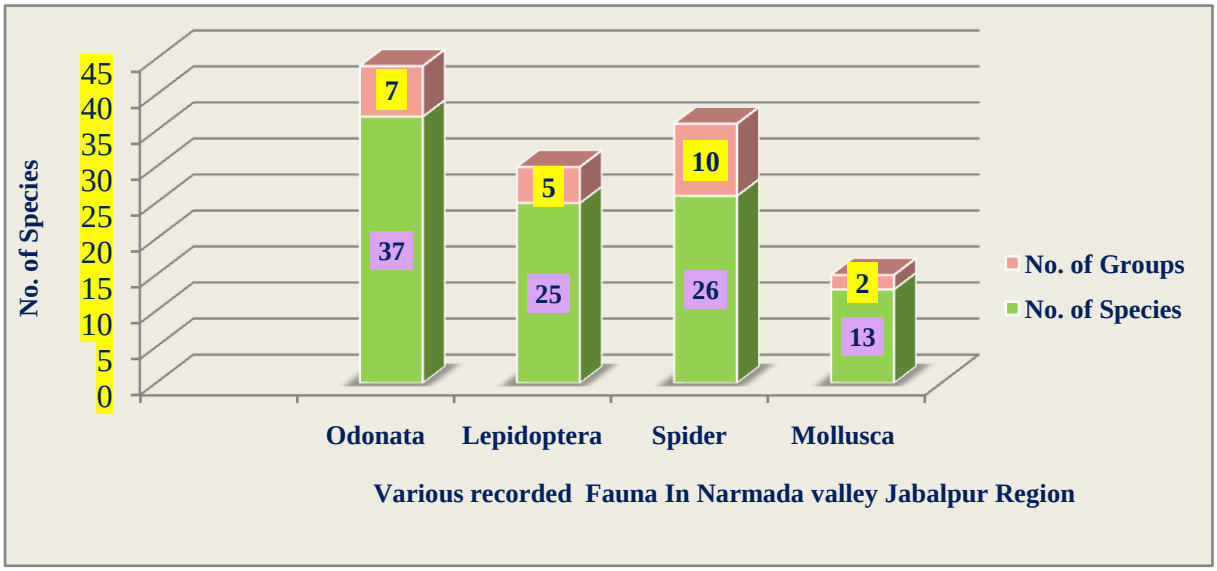

Figure XI
Recorded species of various phyla from Narmada Valley Jabalpur region.

Various papers show a drastic decrement caused by climatic changes, insufficient attempts in preservation and uncontrolled human interference throughout the river track. The eradicated animal population followed by disturbed ecological stigma will tend to lead local and distant human beings to compromise with economically countable productivity from the same natural resource.

Conclusion

The relative taxonomic report summarizes to reveal the studies during 2014-2016 works on various fauna of Jabalpur around river Narmada. This report provides knowledge of diversity of various species for further detailed study. Conservation of biodiversity is necessary for a healthy environment so we can use bioindicator species in place of chemical for pollution assessment as well as anthropogenic activities. Hence there is an urgent need to create awareness among local peoples on the importance of the riverine habitat as well as its fauna and the need to conserve them for future generations.

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