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Butterfly Assemblages as Bioindicators of Environmental health across different habitat types in the Son Basin, Shahdol division

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Abstract: For a country or area to thrive sustainably, protecting and conserving biodiversity must be a top priority on both the national and international levels. As a group, butterflies are among the most significant insects because of the roles they play as both markers of biodiversity and gardeners in nature. Worldwide, over 28,000 butterfly species have been identified. The watershed of Bansagar reservoir in Shahdol, Madhya Pradesh was the subject of a comprehensive biodiversity research that included Lepidoptera (Butterflies). As a first step in documenting biodiversity in various human-impacted wetlands, this research served as a baseline. A variety of features of forest ecology in their native habitats have been studied via the use of butterfly bionomics. In this case, assemblages of butterflies were collected from the concession and classified using diversity indices and plant type.

Keywords: Butterfly, Environmental, Biodiversity, ecological , ecosystems

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INTRODUCTION

The insect kingdom is home to some of the most fascinating animals on Earth. To the naked eye, butterflies stand out among insects due to their vibrant colors and striking patterns. Butterflies are the only insect order in which nature has achieved such a state of flawless aesthetic perfection. Numerous kinds of butterflies call India home, and the country is also considered one of the world's top ten biodiversity hotspots. Among the many insect classes, butterflies are right up there with beetles in terms of variety. Lepidoptera is the order to which butterflies and moths belong. Nighttime flight is more common for moths than for butterflies.

As a first step in documenting biodiversity in various human-impacted wetlands, this research served as a baseline. Research into natural, managed, and degraded forest ecosystems has made use of butterfly bionomics. Many species of butterflies call wetlands home, and some of these species have very specific needs for their environment and cannot move far from areas where they may thrive.

The allure of butterflies has persisted throughout human history. They are among the most researched insects perhaps because they are the most well-known and widely-recognized category of insects. Their taxonomy, migratory patterns, mimicking abilities, speciation history, and evolutionary biology have all been extensively studied. Butterflies are loved by people of all ages for their vibrant wing patterns, which have earned them the nickname "living jewels" of the planet. In the past, people used to gather butterflies for fun and research purposes. This sparked a plethora of knowledge about these insects, including their

identification, classification, migration, mimicry, speciation, and evolution. The butterfly's hue is caused by its layers of minuscule scales.

There has been life on Earth for butterflies for at least 150 million years, when they first formed. When looking for signs of climate change or environmental deterioration, butterflies are a good bet. Reason being, they are great indicator species due to how fast they respond to even little changes in their environment. Their biology and taxonomy have both been extensively researched and characterized. Because a butterfly's life cycle is rather brief.

As a phytophagous insect, butterflies rely on host plants to complete their metamorphosis. In order to develop and finish the transition to adulthood, the plant supplies all the nutrition they need. Some caterpillars seek out milkweed plants and collect the poisonous chemical to stave against predators. Using chemoreceptors, butterflies are able to make a very precise sense when choosing host plants. Preserving the host plants is crucial for maintaining butterfly populations.

LITERATURE REVIEW

An, Jeongseop et.al (2020). Butterflies are not only common in riparian settings, but they also eat a lot of plants on land. Since butterflies get both their larval food and their adult nectar from plants, the diversity of butterflies seen in a given riverine habitat can be a good indicator of the quality of that environment. With data gathered from 33 sites around the country in three distinct riparian habitat types, we analyzed the relationship between environmental parameters and the number of butterfly species and quality index. Species richness in plants and butterflies was very consistent across all three types of riparian habitats. Butterfly populations in the three riparian environments did not differ significantly with respect to any ecological feature. The main variable used to analyze butterfly assemblages was the butterfly riparian quality index. Non-metric multi-dimensional scaling ordination showed that the three kinds of riparian habitats varied.

Ismail, Norradihah et.al. (2020). Bukit Reban Kambing, Bukit Belading, and Bukit Tukau in Johor, Malaysia are being designated as conservation zones with the help of the butterfly, which is being utilized as a bioindicator. Articles pertaining to biodiversity are published in the journal Biodiversitas. Bukit Reban Kambing, Bukit Belading, and Bukit Tukau in Johor, Malaysia are being designated as conservation zones with the use of the butterfly as a bioindicator. It is common practice to utilize butterflies as proxies for other indicators when assessing ecosystem health. This is made feasible because of how sensitive they are to changes in their habitat and other environmental factors.

Sharma, Neeraj et.al. (2021). Butterflies' seasonal rhythms and assembly. The purpose of this research was to learn about the seasonality and habitat types of three distinct subtropical ecosystems' butterfly communities and how they operate. From April to December 2018, researchers collected butterfly samples from 21 stratified-random linear transects located in diverse mosaic landscapes, urban parks, and natural woods. The samples were analyzed for abundance, variety, and host plant specialization. Six families and twenty subfamilies were represented by the 6384 specimens of 118 butterfly species. The butterflies belonged to 81 genera.

Kyerematen, Rosina et.al (2018). Within the field of environment and natural resources, butterfly diversity is used as a measure of environmental health. Mining for metals and fossil fuels provide money for many human communities, while biodiversity provides resources. But mining poses a danger to biodiversity protection and the sustainable use of natural resources. In order to gauge the extent of vegetation change inside the concession, we collected butterfly assemblages and analyzed them using diversity indices and plant type. Butterflies are recognized as bioindicator species. Butterfly populations were assessed using charaxes traps, aerial netting, and transect counts. The findings revealed a high density of indicator species associated with degraded forest and savanna habitats.

RESEARCH METHODOLOGY

The Bansagar reservoir is a multi-use river valley project in Madhya Pradesh, India, on the Sone River, which is located in the Ganga basin. Located 51.4 kilometers from Rewa, the research area is situated at 24°11'30" N 81°17'15" E. From January 2016 through November 2016, a continuous eleven months of monthly sunny-weather butterfly surveys were conducted. Between the hours of 5 and 9 in the morning and 5 and 7 in the evening, transect counting was used to observe the quantity and seasonality. Most butterfly identifications were based on direct field observation; for more challenging situations, capture or picture of the creature was then used. Handheld aerial sweep nets were the sole tools available for specimen collection under the emergency circumstances. Using a field guide, we transported each specimen in a plastic container to the lab for further identification. Every single scientific name used in this research adhered to the rules. The abundance of the butterflies in Bansagar reservoir was used to classify them into five groups.

Table 1: Catalogue of Lepidoptera (Butterflies) Recorded in the Bansagar Reservoir Catchment Area, Shahdol, Madhya Pradesh

S.No.	Common Name	Scientific Name	Status	Flight period
Order: Lepidoptera Suborder: Rhopalocera Family: *Papillionidae* (3 Species)				
1.	Common Mormon	*Papilio polytes* (Linnaeus)	VC	S, M, PM, W
2.	Common Jay	*Graphium doson* (Felder)	C	S, M
3.	Lime Butterfly	*Papilio demoleus* (Linnaeus)	VC	S, M, PM, W
Nymphalidae (9 Species)				
4.	Blue Pansy	*Junonia orithiya* (Linnaeus)	NR	S, PM
5.	Striped Tiger	*Danaus genutia* (Cramer)	VC	S, M, PM, W
6.	Lemon Pansy	*Junonia lemonias* (Linnaeus)	NR	W
7.	Common Crow	*Euploea core* (Cramer)	VC	S, PM, W
8.	Plain Tiger	*Danaus chrysippus* (Linnaeus)	VC	PM, W
9.	Peacock Pansy	*Junonia almana* (Linnaeus)	NR	PM, W
10.	Common Castor	*Ariadne merione* (Cramer)	C	S, PM, W
11.	Common Evening Brown	*Melanitis leda* (Linnaeus)	VC	S, M, PM, W
12.	Glassy Tiger	*Parantica aglea* (Stoll)	NR	S, M, PM, W
Pieridae (5 Species)				
13.	Common Grass Yellow	*Eurema hecabe* (Linnaeus)	VC	S, M, PM
14.	Psyche	*Leptosia nina* (Fabricius)	VC	S, PM
15.	Yellow Orange Tip	*Ixias pyrene* (Linnaeus)	VR	PM, W
16.	Common Emigrant	*Catopsilia pomona* (Fabricius)	C	S, M, PM, W
17.	Indian Cabbage White	*Pieris canidia* (Sparrman)	NR	S, PM, W
Lycaenidae (3 Species)				
18.	Common Pierrt	*Castalius rosimon* (Fabricius)	VC	S, M
19.	Pale Grass Blue	*Pseudozizeeria maha* (Kollar)	VC	S, M
20.	Plains Cupid	*Chilades pandava* (Horsfield)	C	PM, W
Hesperiidae (1 Species)				
21.	Small Branded Swift	*Pelopidas mathias* (Fabricius)	NR	PM

SP2 catchment pond vegetation stretch - late succession secondary forest degraded damp evergreen woodland on a steep slope A remnant of a once-thriving multi-story wet evergreen forest, the GAG border stretch Areas with the same number of (*) were sampled together as one area. *South heap leach facility - a remnant of a once-thriving multi-story WE forest. *Wetlands - a combination of naturally regenerating

stands of vegetation surrounding a large river or wetland. *Old West heaps (Reclaimed site) - a mixture of exotic and naturally regenerating stands of vegetation. (A tailings storage facility is the path that every TSF takes.)

Table 2. Summary of type and environmental impact scale of sampling sites in Son Basin, Shahdol Division

Name of site	Type of site	Environmental impact scale
VC	Secondary forest	Fair impact
C	Re-vegetated forest	Fair impact
VC	Secondary forest	Fair impact
NR	Secondary forest	High impact
VC	Secondary forest	High impact
NR	Secondary forest	High impact
VC	Secondary forest	Fair impact
VC	Secondary forest	Fair impact
NR	Secondary forest	Fair impact
C	Secondary forest	Fair impact
VC	Re-vegetated forest	Fair impact
VC	Re-vegetated forest	Low impact
VR	Secondary forest	Low impact
C	Residential area	High impact
VC	Secondary forest	Low impact
VC	Secondary forest	High impact
C	Secondary forest	Fair impact

DATA ANALYSIS

The five families of lepidoptera are the Nymphalidae, Papillionidae, Pieridae, Hesperiidae, and Lycaenidae, with a total of twenty-one species. The Nymphalidae family, which includes nine species, has the highest species richness (34% of all species reported from the reservoir region), whereas the other families had fewer members (Figure 1.) (i.e., five Pieridae species, three Lycaenidae species, three Papillionidae species, and one Hesperiidae species)

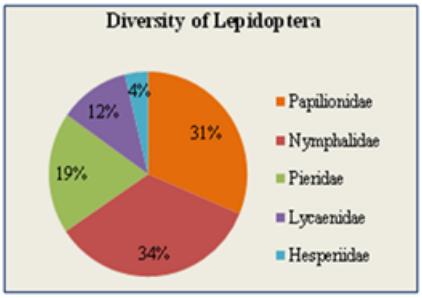

Figure 1: The Bansagar reservoir butterfly family distribution

Wherever there are plants that can support butterfly larvae and adult nectar plants, that's where the butterflies will be most likely to be found. Bansagar reservoir is home to a diverse array of floral species, as seen by the abundance of butterflies, particularly nymphalids. Due to the tropical environment, the dominant vegetation in the study location is a mixture of herbaceous and shrubby species. The research area may have had an abundance of Nymphalidae because larval feeding plants were dominant, to the fact that the Nymphalidae, Lycaenidae, and Pieridae families all had the highest levels of species diversity.

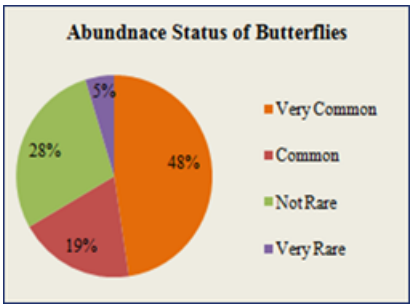

Figure 2: Abandence Status of Butterflies in Bansagar reservoir

Figure 2 shows that out of the total number of species, 1 (or 5% of the total) were very uncommon, 6 (or 28%) were not unusual, 4 (19%) were common, and 10 (or 48%) were quite frequent. Additionally, it was observed that all six species were present throughout the year. After the monsoon, the variety of species was at its peak. The summer saw a total of fifteen species, while the winter saw fourteen. Species diversity was at its lowest during the monsoon, as seen in Figure 2. For only a small portion of the year and completely nonexistent for the rest the peak months for butterfly abundance in India, according to Wynter-Blyth, are March–April and October. The arrival of summer, together with high relative humidity and increased precipitation, had a good effect on the abundances of several species. Consistent with previous research showing that species abundance was lowest during the monsoon, the current study found that butterfly populations maximized in the months after the rains (late August to October).

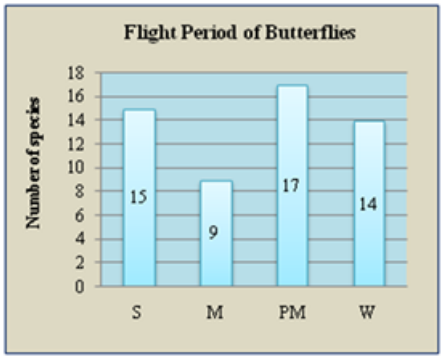

Figure 3: Flight Period of Butterflies in Bansagar reservoir

Because they need on native plants to complete their life cycle, butterflies not only serve as a conspicuous indicator of biodiversity, but they also play the role of our native gardener. Consequently, a thriving ecology is often marked by a multitude of butterflies.

A variety of patterns emerged from butterfly diversity studies conducted in different locations. Section of vegetation along South LV Road in the southern division, consisting mostly of a slope built from waste rocks and including an established secondary forest. *Assay lab stretches of vegetation - mature secondary forest on a low hilltop in TSF 4 stretch; this area has been damaged.

At a single sample location, ten different butterfly species were documented, with the majority of these species having just one individual.

Table 3. Butterflies unique only to a single site

Butterfly Species	NR	VC	NR	VC	C
Protogoniomorpha anacardii Linné 1758	X				
Hamanumida daedalus Fabricius 1775		X			
Bebearia mardania Fabricius 1793			X		
Ypthimomorpha itonia Hewitson 1865				X	
Papilio chrapkowskoides Koçak 1983			X		
Papilio cynorta Fabricius 1793					X

Graphium adamastor Boisduval 1836					X
Papilio dardanus Brown 1776	X				
Colotis euippe Linné 1758			X		
Charaxes tiridates Cramer 1777			X		

Given the challenges posed by the seasonality and localization of butterfly distributions in such studies, it is impossible to attribute such a scenario to the species' rarity. The concession may be in a different vegetative zone than the one where some of the documented species Godart (1819), Graphium adamastor (1836), Ypthima condamini (1982), Bicyclus italus (1865), Colotis ione (1819), and Belenois gidica (1819).

The group medians for the variety and number of butterfly species were significantly different across two areas: the wet or moist evergreen forest (EF) and the dry Guinea or Sudan Savanah vegetation zones (DF). The group median also differed significantly between EF-designated species and ALF-designated generalists.

Table 4. ANOVA for abundance and species richness of butterflies in VC

Diversity indices	EF vs. DF (Kruskal-Walli's test)	EF vs. ALF (Kruskal-Walli's test)
Abundance (N)	H = 0.28, p = 0.59	H = 2.16, p = 0.14
Species richness (S)	H = 0.07, p = 0.80	H =1.13, p = 0.29

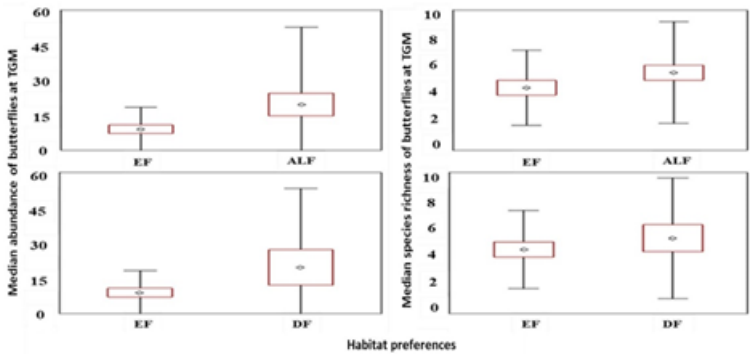

Figure 5. Butterfly group medians at VC for NR, C, and VC

CONCLUSION

Dam catchment is an ideal environment for butterfly populations, according to the results of this research. Bansagar reservoir on the Sone River has never before been investigated for its abundance of butterflies. Most butterfly identifications were based on direct field observation; for more challenging situations, capture or picture of the creature was then used. Handheld aerial sweep nets were the sole tools available

for specimen collection under the emergency circumstances. Due to the tropical environment, the dominant vegetation in the study location is a mixture of herbaceous and shrubby species. Regardless, the most diverse families were Lycaenidae, Pieridae, and Nymphalidae.

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