

A Project report on



To be presented by the students of
Lodha World School, Palava

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Abstract:

The research was initiated to study if the ecological health of the study site (Mothi-Desaigaon) could be assessed using its butterfly population as an indicator species. Our primary objective was to explore potential correlations between the lepidopteran populations, and their host and nectar plants, and to study the causes for the presence or absence of these plants and the associated butterflies at the study site. Rigorous field visits and ecology awareness surveys were conducted to validate our initial hypothesis. Our research findings revealed a steady decline in the number of butterflies as compared to the previous data. This phenomenon was attributed to the increased anthropogenic pressure exerted on the local biota through activities like the conversion of pre-existing green cover to residential areas, the clearance of forests for wood and other resources, and the associated contamination of the habitat through the release of numerous pollutants.

Research Question:

Does a relationship exist between the density and diversity of lepidopteran populations and the human activities occurring in their habitat at Mothi-Desaigaon?

Keywords: Lepidoptera, bio-indicators, anthropogenic pressure

Hypothesis:

Yes. We believe that there should exist a relationship between the density and diversity of lepidopteran populations and the human activities (redevelopment and pollution) occurring in their habitat because we have observed a noticeable shift in the butterfly dynamics in the study area during our time in the school's nature club and the data that we collected from our seniors of their explorations in the study area (Mothi Desaigaon). There has been a noticeable change in the landscape of the study site due to rapid urbanization that has occurred here caused by various redevelopment activities being undertaken here. The ramifications of this expedited transformation of the study site have been observed in the form of ever-increasing land, water and air pollution which is unquestionably affecting the local biota. With our research, we hope to find the visible impact of human activity and haphazard development occurring at the study site on the local ecosystem and its components. We also intend to investigate if butterflies can be utilized as an indicator organism for analyzing the effect of anthropogenic pressure.

Rationale:**Personal response:**

I, Suryanshu Shah, am a student of class 8 at Lodha World School, Palava. Earlier I resided in Nerul where I used to see a variety of butterfly species around the parks near my house during the second or third week of June. The days went normally as I was seeing the butterflies coming the same way they used to do. At that time, I was quite less mature to understand things but now, after researching the incident I have gone into the depth of the matter. After that day in June, the number of butterflies started to reduce. I was shocked to see all this happening. Finally, after a few days, the whole area suffered a huge loss of habitat due to a devastating flood. At that time nobody could have related the incidents to the decreasing number of butterflies but now after doing the research and seeing some more real-life examples of this case, I came to know that the butterflies could be bio-indicators which could indicate the

impact of climate change. I found this intriguing and hence thought of taking it up as a project along with other similar-minded schoolmates.

I, Pranavi Kulkarni, am enthusiastic about joining the project due to several compelling reasons. This project aligns with my passion for environmental conservation, and it presents a unique opportunity to contribute to scientific research while making a positive impact on the natural world. Butterflies are not only fascinating creatures but also serve as vital indicators of the health and diversity of ecosystems. By studying butterflies as bioindicators, we can gain insights into the overall ecological well-being of an area. The project offers an avenue for scientific exploration and discovery. By monitoring butterfly populations and studying their responses to environmental changes, we can deepen our understanding of ecological processes. Being a part of the project allows me to connect with like-minded individuals. In conclusion, the project resonates strongly with my passion for environmental conservation, scientific exploration, and community engagement. I am eager to contribute to this project, working alongside a team dedicated to understanding the intricate relationships between butterflies, their habitats, and broader ecological processes. Through this project, I aim to make a meaningful difference in biodiversity conservation and inspire others to appreciate and protect our natural world.

Other reasons:

While undertaking a literature review to find evidence aligning with our research objectives, we found the following information.

To sustain the increasing migration, skyrocketing real estate prices, demand for better living space and a pressing need for community living, every metro city needs a twin or sister city to thrive. Building a new micro-market not only provides a cushion for an ever-growing pressure on the infrastructure of the metro city but also makes life easy for the city dwellers. Low property prices and the availability of green and open spaces are among the key factors that attract home buyers to consider investing in the region. The ongoing infrastructural development and connectivity that connects these markets/areas to the main city, and one such market is the Kalyan – Dombivli region in Mumbai including our study site. The region has been witnessing swift and steady growth over the last few years.^[1]

The Mumbai Metropolitan Region Development Authority (MMRDA) stated that structural development has been at the heart of growth in the Nilje-Taloje region. The recently approved Metro 5 corridor connecting Thane-Bhiwandi-Kalyan will give a boost to the proposed Nilje growth centre near Kalyan in

future. As the metro rail route will be extended to Taloja in Navi Mumbai in the next phase, it will provide connectivity to the growth centre from the satellite cities.^[2]

But as we have learnt in Physics, every action has an equal and opposite reaction. Similarly, the rapid growth observed in the region brought along with it, its own set of pitfalls. Pollution and fragmentation of habitat were identified as the biggest issues affecting the local biota and to assess the nature and extent of its impact we identified lepidopteran populations (butterflies) as a yardstick to measure it. Phil Schappert (2000) suggests that, due to their interdependence with plants and sensitivity to disturbance, butterflies can be considered the “modern-day equivalent of ‘canaries in the coal mines.’” In other words, butterflies can be used to indicate changes in the environment in which they inhabit. ^[3]

Butterflies are easy to visually monitor along transect lines during the day. There are major groups of butterflies that are easily recognized in the field by non-experts. Thus, butterflies can serve as representative bioindicators for the overall Lepidoptera community of herbivores. In contrast to the plant monitoring alternative, butterfly monitoring produces more valuable qualitative data than quantitative data in evaluating ecosystem diversity and productivity. This is because Lepidoptera populations can fluctuate drastically from year to year due to seasonal weather variations, in contrast to the greater permanence of plant populations.^[4]

Assessing the evidence that we collected, we could conclude that there does exist a relationship between the density and diversity of lepidopteran populations and the human activities occurring in their habitat at Mothi-Desai Gaon and we intend to study the extent of it through this current research project.

Methodology:

Study Area: Mothi Desaigaon: (19.1684°N, 73.0549°E)



Mothi Desaigaon is a locality in Thane City in Maharashtra State, India. It belongs to the Konkan region. The study area comprises of four major villages: Mothi Desaigaon, Desai Village, Domkhar Village and Padlegaon. The study site is located at an altitude of 8 meters above sea level and mostly is a continuous plain region by topography. Mothi Desaigaon is a small hamlet located on the outskirts of Dombivli on Kalyan – Shilphata road. More than ample availability of food and host plants throughout the year and a suitable climate conducive to the growth and prosperity of its species have led to these areas being popular breeding grounds for many butterfly species generating a tremendous interest among butterfly experts and enthusiasts.

Based on the vegetation diversity observed in this site, the area can be broadly divided into three parts: shrubby grassland, woody forest and marshy wetland, each displaying a varied diversity of butterfly population. The study area starts at Padlegaon with a long patch of grasses interspersed with varieties of shrubs like *Calotropis* sp. and certain varieties of *Ficus* like *Ficus benghalensis*, *Ficus religiosa*, etc. and few varieties of bamboo and palm trees, leading to Domkhar village with a region containing dense forest comprising of trees like *Bridelia*

retusa, *Morinda pubescens*, etc. and ending at Desai creek with vegetation comprising mostly of mangrove cover with plants like *Ceriops tagal*, *Rhizophora sp.*, etc. Due to the favourable conditions available in these regions, it is rich not only in lepidopteran diversity but also in arachnid, avian and herpetofauna.

Assessment methodology:

The study area was explored by all the participants under the guidance of the mentor teachers from **June 2023** to **October 2023** and probable areas at the study sites were decided and studied. The study area was visited at least twice monthly during these five months.

Field data was collected by the **Pollard walk method**^[5] i.e., walking along the fixed paths while recording and counting the species when butterflies are most active, that is from 0700h to 1730h.

Butterfly species were identified directly in the field visually with the help of photography followed by field guide verification and a checklist of their density and diversity was created. The collection of specimens was strictly avoided. Butterflies were identified with the help of field guides (Kehimkar 2008, 2016)^[6]. Websites like [Butterflies of India](#), [Moths of India](#), [Biodiversity Atlas - India](#), [Flowers of India](#), [Indian Plants](#) and [Indian Biodiversity Portal](#) and mobile applications like Butterflies of India, PlantSnapp and inaturalist were utilised for on-field identification of the specimens.

Bentham & Hooker (1862) system of classification and visual recognition by verifying using various field guides and mobile applications was followed for plants^[7]. Butterflies were categorized into five groups based on their occurrence during the study period based on the frequency of sightings.

A- Abundant- Seen on 80-100% of field visits in most habitats

C- Common- Seen on 60-80% of field visits in most habitats

U- Uncommon- seen on 40-60% of field visits in most habitats

R- Rare- seen on 20-40% of field visits in most habitats

VR- Very Rare- seen on less than 20% of field visits

NA- Not Available- Not observed at all during the field visits

All the collected data, physical and digital, was documented and stored in MS Word and Google Doc format and will be stored in the school laptop as well on the participant's Google drives. The data acquired during the study was compared to the pre-existing **secondary data** to reach clear conclusions regarding the result of the research undertaken.

Assessment of anthropogenic activities was done by **questionnaire** method for which 50 locals living in the study area for at least 10 years were interviewed in person or through Google Forms. All participating students were trained in effective communication and interview conduction skills. A collection of **photographic evidence** was undertaken to document the effects of human activities on the local habitat.

The participants visited the study site after receiving express permission in the form of a signed undertaking from the parents and the school authorities to conduct the research. Permission was obtained from the local residents participating in the survey and interviews so that the information obtained from them could be used in our project.

Method	What we did	Advantages
Field Survey/ Interview	We prepared a questionnaire about the RQ and asked 50 people (residing near the study site) to fill in the same.	-Easy to conduct -We were able to obtain first-hand data from local people's observations.
Field analysis	We undertook basic butterfly counting to estimate population size and diversity.	-We were able to measure quantitative data to aid our hypothesis. -We got real numbers and did not have to rely on trusting what people say.
Secondary Data Collection	- Our nature club has been documenting data from the study site for the past 8 years which will be our prime source of data. -We obtained secondary data from magazine and newspaper articles,	- Nature club data from the previous batches provided an insight into the details of the conditions of the study site. -Public records were readily available.

	research papers published on related topics and other online articles.	-It is time-saving and cost-efficient. - Research papers provided scientifically proven and accepted data. -Provided a variety of expert perspectives and insights.
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The delegation of duties for the conduction of the project work is as follows:

Name of the student	Field data collection	Creation of question naire	Conducting survey/ interviews	Primary and secondary data compilation	Data analysis and report generation
Pranavi Kulkarni	✓	✓	✓	✓	✓
Niharika Singh	✓		✓	✓	✓
Aardhya Shukla	✓		✓		✓
Akshara Birdar	✓		✓		✓
Suryans hu Shah	✓		✓		✓
Saanim Setia	✓	✓	✓		✓

Pollard Walk Method data form format

Site Name _____

Date _____ Observer _____

Transect Location _____

Transect UTMs: Start: N _____ E _____

End: N _____ E _____

Start Time _____ End Time _____

Weather:

Start Temp °C _____ End Temp °C _____ % Sun _____ Wind _____

Butterflies observed

Species	Section						Notes
	1	2	3	4	5	6	

Questionnaire link: <https://forms.gle/uPLSWv3GnjZSWv6U7>

Technical instrument information:

Cameras:

Canon DSLR EOS 1100D, Canon 18-55 mm lens, Canon 55-250 mm lens

Mobile Phone camera, 25 mm and 10 mm macro lenses

Observations:

On-site observations:

A comprehensive checklist of a total of 63 species of butterflies was prepared after surveying the study area during the period of five months (June- October 2023) and the results were compared with the available pre-existing data (2015-2017). The family-wise abundance of the total species found to occur in the study area during our research period is Hesperidae: 4 species, Papilionidae: 5 species, Pieridae: 15 species, Lycaenidae: 19 species and Nymphalidae: 20 species (Table 1). A list of host plants of the butterfly species observed is provided to assess the population density of these plants to attempt and establish a relationship between anthropogenic pressures, host plant density and its subsequent effects on lepidopteron diversity and density in the study area. (Table 2). **The following butterfly pictures were taken by the student participants during our visit to the study area.**



Blue Mormon



Common Banded Awl



Common Albatross



Common Baron



Common Castor



Common Cerulean



Common Evening Brown



Common Gull



Common Mormon



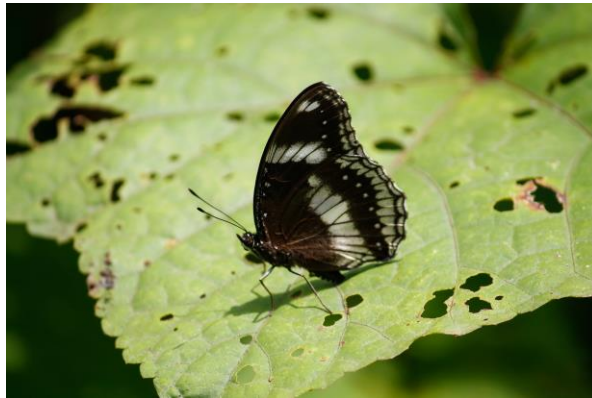
Common Pierrot



Common Sailer



Common Wanderer



Danaid Eggfly



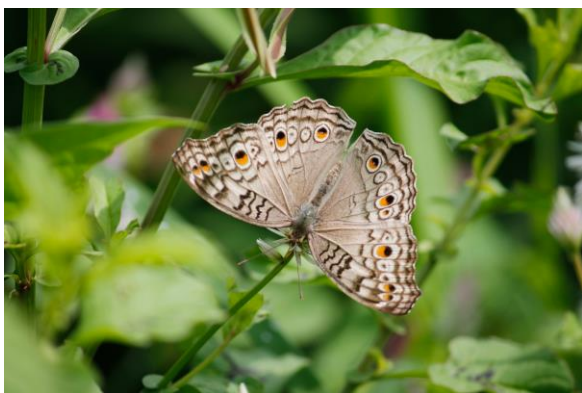
Dark Grass Blue



Forget-me-not



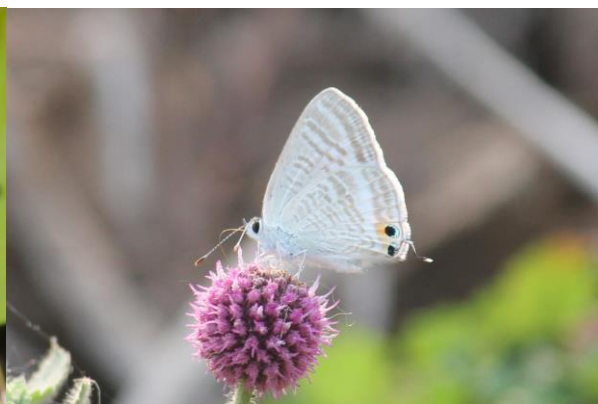
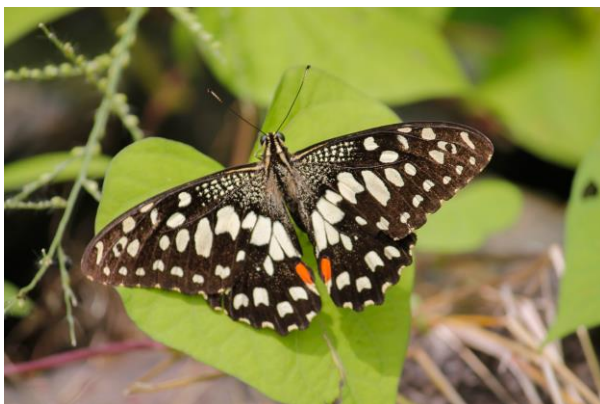
Great Eggfly



Grey Pansy



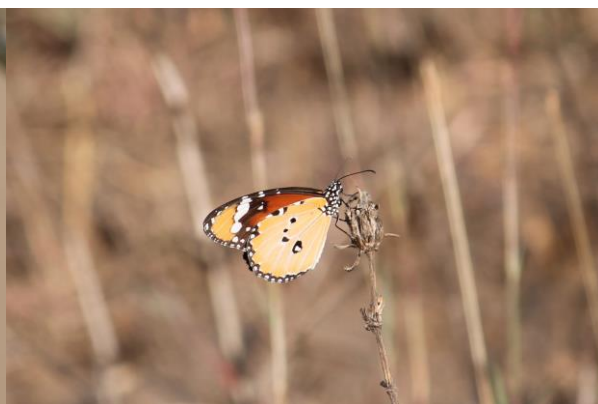
Indian Sunbeam



Lime Butterfly Pea Blue



Pioneer



Plain Tiger



Rounded Pierrot



Striped Tiger



White orange Tip



Yellow Orange-tip



Zebra Blue



Blue Tiger



Common Emigrant



Peacock Pansy



Tailed Jay



Psyche



Plains Cupid



Tawny Coster

Table 1– Checklist of butterflies and their abundance

Srl. no.	Name of species	Abundance			
		2015	2016	2017	2023
Family: Hesperidae					
1.	Common Banded Awl, <i>Hasora cramus</i>	U	U	VR	VR
2.	Plain Banded Awl, <i>Hasora vitta</i>	R	R	R	VR
3.	Bevans swift, <i>Pseudoborbo bevani</i>	R	R	R	R
4.	Rice swift, <i>Borbo cinnara</i>	C	C	C	C
Family: Papilionidae					
1.	Common Jay, <i>Graphium doson</i>	C	C	U	U
2.	Tailed Jay, <i>Graphium agamemnon</i>	A	C	C	C
3.	Common Mormon, <i>Papilio polytes</i>	A	A	A	A
4.	Blue Mormon, <i>Papilio, polymnestor</i>	A	C	C	R
5.	Lime butterfly, <i>Papilio demoleus</i>	A	C	C	C
Family: Pieridae					
1.	Three Spot Grass Yellow, <i>Eurema blanda</i>	C	C	C	C
2.	Common Grass Yellow, <i>Eurema hecabe</i>	A	A	A	C
3.	Common Emigrant, <i>Catopsilia pomona</i>	A	C	A	C

4.	Mottled Emigrant, <i>Catopsilia pyranthe</i>	A	C	U	VR
5.	Small Salmon Arab, <i>Colotis amata</i>	C	U	U	R
6.	Plain Orange Tip, <i>Colotis eucharis</i>	C	U	U	U
7.	White Orange Tip, <i>Ixias marianne</i>	A	A	A	A
8.	Yellow Orange Tip, <i>Ixias pyrene</i>	A	A	A	C
9.	Great Orange Tip, <i>Hebomoia glaucippe</i>	A	A	C	U
10.	Common Wanderer, <i>Pareronia valeria</i>	A	A	A	C
11.	Common Albatross, <i>Appias albina</i>	R	R	VR	VR
12.	Common Gull, <i>Cepora nerissa</i>	A	A	C	C
13.	Common Jezbel, <i>Delias eucharis</i>	A	C	A	C
14.	Psyche, <i>Leptosia nina</i>	A	C	C	A
15.	Pioneer, <i>Belenois aurota</i>	C	C	C	C

Family: Lycaenidae

1.	Indian Sunbeam, <i>Curetis thetis</i>	U	U	R	R
2.	Common Silverline, <i>Spindasis vulcanus</i>	U	VR	VR	NA
3.	Common Pierrot, <i>Castalius rosimon</i>	A	A	A	C
4.	Angled Pierrot, <i>Caleta caleta</i>	R	R	VR	VR

5.	Zebra Blue, <i>Leptotes plinius</i>	A	C	A	C
6.	Common Lineblue, <i>Prosotas nora</i>	C	C	U	U
7.	Common Cerulean, <i>Jamides celeno</i>	A	C	C	C
8.	Forget-me-not, <i>Catochrysops panormus</i>	U	U	VR	R
9.	Pea Blue, <i>Lampides boeticus</i>	C	U	U	U
10.	Rounded Pierrot, <i>Tarucus nara</i>	C	C	C	C
11.	Dark Grass Blue, <i>Zizeeria karsandra</i>	A	A	A	C
12.	Pale Grass Blue, <i>Pseudozizeeria maha</i>	R	R	VR	R
13.	Lesser Grass Blue, <i>Zizina otis</i>	U	R	R	R
14.	Tiny Grass Blue, <i>Zizula hylax</i>	VR	VR	VR	R
15.	Red Pierrot, <i>Talica n nyseus</i>	U	R	VR	VR
16.	Gram Blue, <i>Euchrysops cnejus</i>	A	A	C	C
17.	Lime Blue, <i>Chilades lajus</i>	C	C	C	C
18.	Plains Cupid, <i>Chilades pandava</i>	C	U	U	U
19.	Plum Judy, <i>Abisara echerius</i>	R	R	R	VR
Family: Nymphalidae					
1.	Blue Tiger, <i>Tirumala limniace</i>	A	A	A	A
2.	Striped Tiger, <i>Danaus genutia</i>	A	C	A	A
3.	Plain Tiger, <i>Danaus chrysippus</i>	A	C	A	A
4.	Common Crow, <i>Euploea core</i>	A	A	A	A

5.	Common Evening Brown, <i>Melanitis leda</i>	C	C	U	C
6.	Bamboo Tree Brown, <i>Lethe europa</i>	U	R	R	R
7.	Common Palmfly, <i>Elymnias hypermnestra</i>	C	U	U	U
8.	Tawny Coster, <i>Acraea violae</i>	A	A	C	C
9.	Common Leopard, <i>Phalanta phalantha</i>	A	A	A	A
10.	Common Sailer, <i>Neptis hylas</i>	A	A	A	A
11.	Common Baron, <i>Euthelia aconthia</i>	C	C	U	U
12.	Baronet, <i>Euthelia nias</i>	U	R	R	R
13.	Common Castor, <i>Ariande merione</i>	C	C	C	C
14.	Blue Pansy, <i>Junonia orithiya</i>	VR	VR	VR	NA
15.	Chocolate Pansy, <i>Junonia ephita</i>	A	C	C	C
16.	Grey Pansy, <i>Junonia atlites</i>	A	A	A	A
17.	Peacock Pansy, <i>Junonia almana</i>	A	C	A	A
18.	Lemon Pansy, <i>Junonia lemonias</i>	A	C	C	C
19.	Great Eggfly, <i>Hypolimnas bolina</i>	C	R	U	U
20.	Danaid Eggfly, <i>Hypolimnus misippus</i>	A	A	C	C

Table 2– Checklist of butterflies and their host plants

Srl.no.	Name of species	Host plants
Family: Hesperiiidae		
1.	Common Banded Awl, <i>Hasora cramus</i>	<i>Milletia pinnata</i>
2.	Plain Banded Awl, <i>Hasora vitta</i>	<i>Pongamia spp.</i>
3.	Bevans swift, <i>Pseudoborbo bevani</i>	<i>Imperata cylindrica</i>
4.	Rice swift, <i>Borbo cinnara</i>	<i>Oryza sativa</i>
Family: Papilionidae		
1.	Common Jay, <i>Graphium doson</i>	<i>Annona sp.</i>
2.	Tailed Jay, <i>Graphium agamemnon</i>	<i>Annona sp.</i>
3.	Common Mormon, <i>Papilio polytes</i>	<i>Citrus sp.</i>
4.	Blue Mormon, <i>Papilio, polymnestor</i>	<i>Citrus sp.</i>
5.	Lime butterfly, <i>Papilio demoleus</i>	<i>Citrus sp.</i>
Family: Pieridae		
1.	Three Spot Grass Yellow, <i>Eurema blanda</i>	<i>Albizia sp.</i>
2.	Common Grass Yellow, <i>Eurema hecabe</i>	<i>Caesalpinia pulcherrima</i>
3.	Common Emigrant, <i>Catopsilia pomona</i>	<i>Cassia fistula</i>
4.	Mottled Emigrant, <i>Catopsilia pyranthe</i>	<i>Cassia fistula</i>
5.	Small Salmon Arab, <i>Colotis amata</i>	<i>Salvador asp.</i>
6.	Plain Orange Tip, <i>Colotis eucharis</i>	<i>Cadaba fruticosa</i>
7.	White Orange Tip, <i>Ixias Marianne</i>	<i>Capparis sp.</i>
8.	Yellow Orange Tip, <i>Ixias pyrene</i>	<i>Capparis sp.</i>

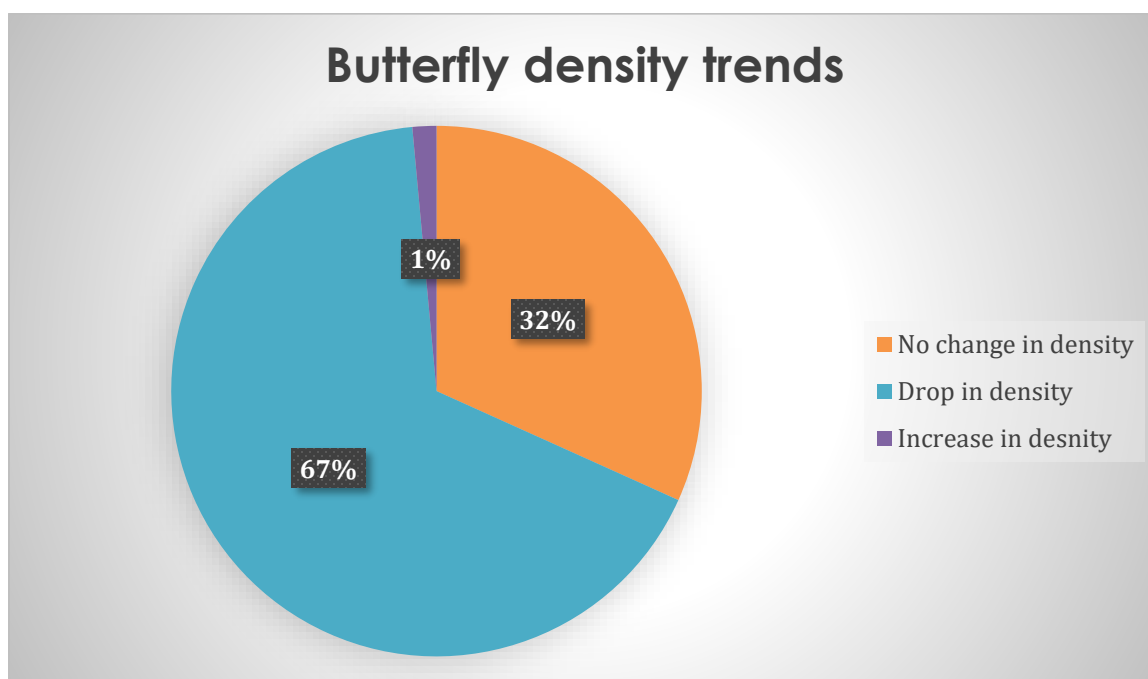
9.	Great Orange Tip, <i>Hebomoia glaucippe</i>	<i>Capparis sp.</i>
10.	Common Wanderer, <i>Pareronia valeria</i>	<i>Capparis sp.</i>
11.	Common Albatross, <i>Appias albina</i>	<i>Drypetes roxburghii</i>
12.	Common Gull, <i>Cepora Nerissa</i>	<i>Cadaba fruticosa</i>
13.	Common Jezbel, <i>Delias eucharis</i>	<i>Dendrophthoe falcata</i>
14.	Psyche, <i>Leptosia nina</i>	<i>Capparis sepiaria</i>
15.	Pioneer, <i>Belenois aurota</i>	<i>Cadaba fruticosa</i>
Family: Lycaenidae		
1.	Indian Sunbeam, <i>Curetis thetis</i>	<i>Butea monosperma</i>
2.	Common Silverline, <i>Spindasis vulcanus</i>	<i>Cadaba fruticosa</i>
3.	Common Pierrot, <i>Castalius rosimon</i>	<i>Ziziphus jujuba</i>
4.	Angled Pierrot, <i>Caleta Caleta</i>	<i>Ziziphus oenoplia</i>
5.	Zebra Blue, <i>Leptotes Plinius</i>	<i>Albizia lebbeck</i>
6.	Common Lineblue, <i>Prosotas nora</i>	<i>Pithecellobium dulce</i>
7.	Common Cerulean, <i>Jamides celeno</i>	<i>Butea monosperma</i>
8.	Forget-me-not, <i>Catochrysops panormus</i>	<i>Millettia pinnata</i>
9.	Pea Blue, <i>Lampides boeticus</i>	<i>Butea monosperma</i>
10.	Rounded Pierrot, <i>Tarucus nara</i>	<i>Ziziphus sp.</i>
11.	Dark Grass Blue, <i>Zizeeria karsandra</i>	<i>Amaranthus spinosus</i>
12.	Pale Grass Blue, <i>Pseudozizeeria maha</i>	<i>Oxalis corniculata</i>
13.	Lesser Grass Blue, <i>Zizina Otis</i>	<i>Alysicarpus vaginalis</i>
14.	Tiny Grass Blue, <i>Zizula hylax</i>	<i>Lantana camara</i>

15.	Red Pierrot, <i>Talicauda nyseus</i>	<i>Kalanchoe pinnata</i>
16.	Gram Blue, <i>Euchrysops cnejus</i>	<i>Butea monosperma</i>
17.	Lime Blue, <i>Chilades lajus</i>	<i>Citrus</i> sp.
18.	Plains Cupid, <i>Chilades pandava</i>	<i>Cycas circinalis</i>
19.	Plum Judy, <i>Abisara echerius</i>	<i>Myrsinaceae Ardisia</i>
Family: Nymphalidae		
1.	Blue Tiger, <i>Tirumala limniace</i>	<i>Calotropis</i> sp.
2.	Striped Tiger, <i>Danaus genutia</i>	<i>Calotropis</i> sp.
3.	Plain Tiger, <i>Danaus chrysippus</i>	<i>Calotropis</i> sp.
4.	Common Crow, <i>Euploea core</i>	<i>Carissa carandas</i>
5.	Common evening Brown, <i>Melanitis leda</i>	<i>Bambusa arundinacea</i>
6.	Bamboo Tree Brown, <i>Lethe europa</i>	<i>Bambusa arundinacea</i>
7.	Common Palmfly, <i>Elymnias hypermnestra</i>	<i>Areca catechu</i>
8.	Tawny Coster, <i>Acraea violae</i>	<i>Passiflora foetida</i>
9.	Common Leopard, <i>Phalanta phalantha</i>	<i>Flacourtia indica</i>
10.	Common Sailer, <i>Neptis hylas</i>	<i>Mucuna pruriens</i>
11.	Common Baron, <i>Euthelia aconthia</i>	<i>Anacardium occidentale</i>
12.	Baronet, <i>Euthelia nias</i>	<i>Diospyros melanoxylon</i>
13.	Common Castor, <i>Ariande merione</i>	<i>Ricinus communis</i>
14.	Blue Pansy, <i>Junonia orithiya</i>	<i>Justicia procumbens</i>
15.	Chocolate Pansy, <i>Junonia ephita</i>	<i>Barleria cristata</i>
16.	Grey Pansy, <i>Junonia atlites</i>	<i>Barleria cristata</i>

17.	Peacock Pansy, <i>Junonia almanac</i>	<i>Barleria cristata</i>
18.	Lemon Pansy, <i>Junonia lemonias</i>	<i>Barleria cristata</i>
19.	Great Eggfly, <i>Hypolimnys bolina</i>	<i>Barleria cristata</i>
20.	Danaid Eggfly, <i>Hypolimnys misippus</i>	<i>Laportia interrupta</i>

The following trends were observed while studying the changes in the density and diversity of butterflies at the study site.

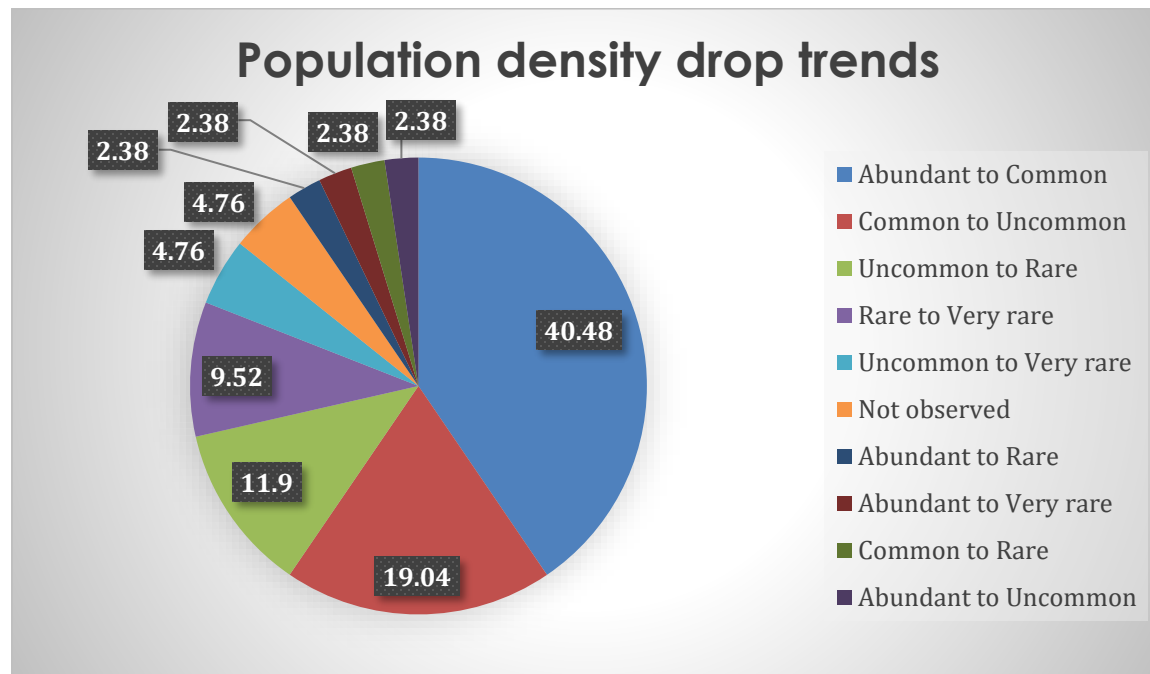
Out of the 63 butterfly species observed in the study area, 42 species (66.67%) showed a drop in their population density, 20 species (31.74%) showed stability in their population density while 1 species (1.59%) showed an increase in their population density.



Among the butterfly species that showed a drop in their population densities, 1 species dropped 4 rungs in the density hierarchy from being 'Abundant' to 'Very rare'. 1 species dropped 3 rungs in the density hierarchy from being 'Abundant' to 'Rare'. 1 species dropped 2 rungs in the density hierarchy from being 'Abundant' to 'Uncommon'. 1 species dropped 2 rungs in the density hierarchy from being 'Common' to 'Rare'. 2 species dropped 2 rungs in the

density hierarchy from being 'Uncommon' to 'Very rare'. 16 species dropped 1 rung in the density hierarchy from being 'Abundant' to 'Common' which was the most common drop in population density observed. 8 species dropped 1 rung in the density hierarchy from being 'Common' to 'Uncommon'. 4 species dropped 1 rung in the density hierarchy from being 'Uncommon' to 'Rare'. 4 species dropped 1 rung in the density hierarchy from being 'Rare' to 'Very rare'.

2 species, namely the Common Silverline (*Spindasis vulcanus*) and the Blue Pansy (*Junonia orithiya*) were not observed in any of our visits during the duration of our study.





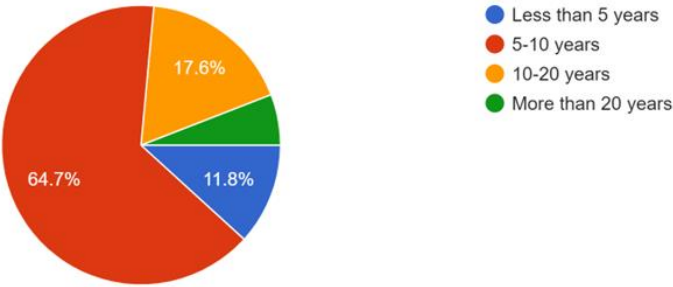
Pollution documented at the study site

The study site displayed the presence of pollution associated with the rampant redevelopment and domestic activities. There has been a visible increase in the number of new construction projects with more than 12+ new residential construction projects being initiated here in the past 8 years. The previous residents who have resided at the site for more than 20+ years have also expanded and renovated their existing abodes, adding to the clearing of green cover in the region. We also noticed that forests and mangrove regions at the site are being used for the excavation of soil that may be used for construction purposes, thus leading to the formation of barren land patches in these regions, deeply affecting the local flora and fauna. There also has been a noticeable increase in commercial agricultural activities and conversion of forest land into agricultural land along with excessive use of fertilizers and pesticides.

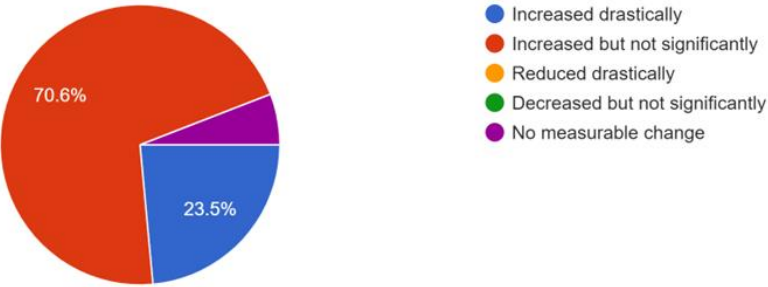
Survey report:

As a part of our research, we conducted a social survey in which we interviewed the residents to answer questions about our study. The questions asked are given below and their response is denoted in graph form.

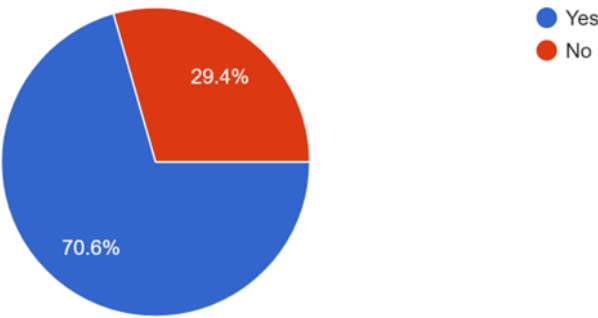
How long have you lived in Mothi Desaigaon?



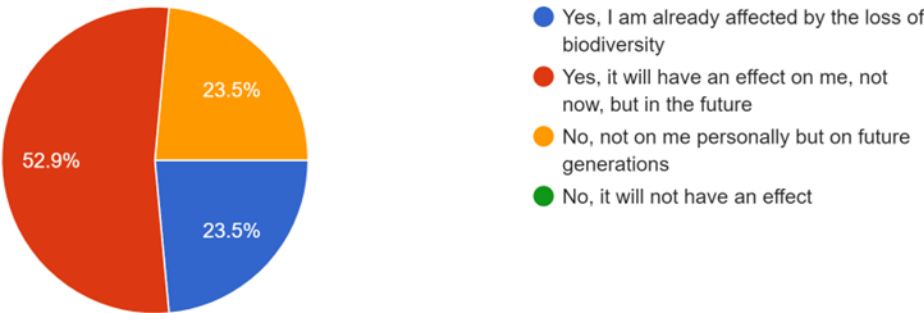
Has the temperature range changed over the years, and how?



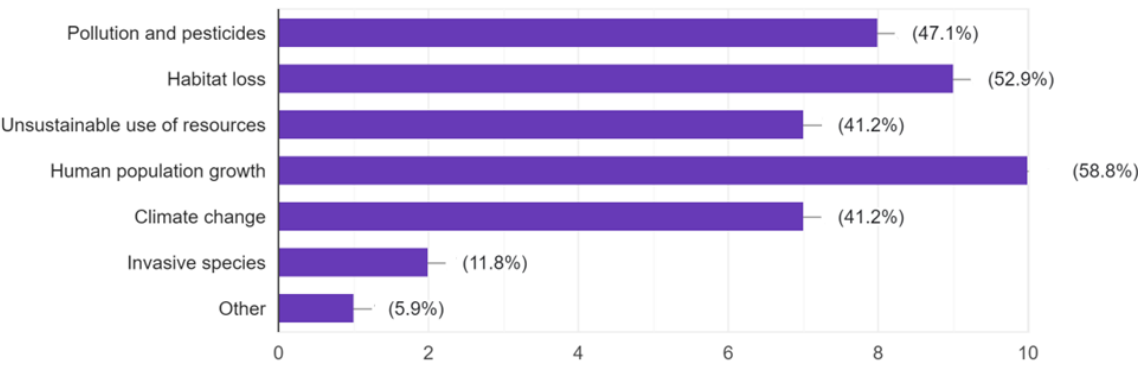
Have you personally noticed changes in animal and plant numbers in your local environment?



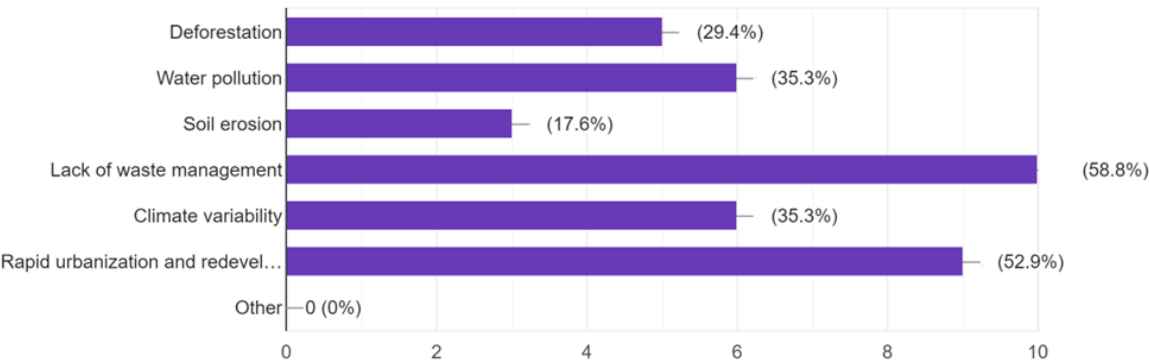
Do you think that the decline and possible extinction of animal and plant species, will have an impact on you, personally?



In your opinion, what is the most important issue impacting the area's biodiversity?

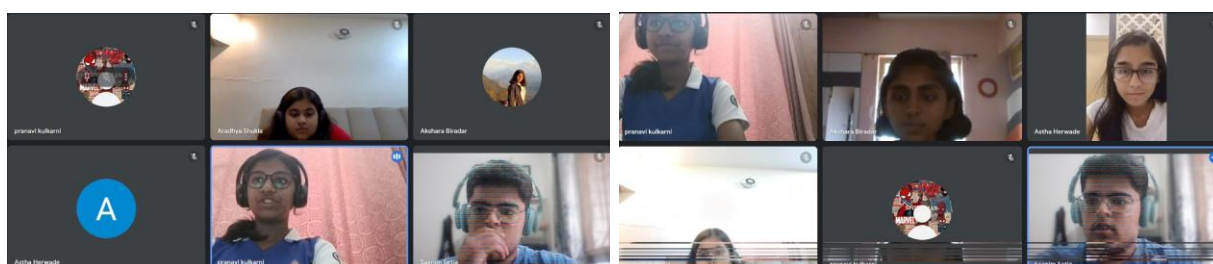


Are there any environmental challenges that the community in your vicinity faces?





Interviews conducted with Mothi Desaigaon residents during field visits



Online interviews conducted with Mothi Desaigaon residents

The residents were also asked to suggest measures that they would like to implement in their vicinity for the conservation of the local biodiversity.

The residents suggested that promoting a sustainable and ecologically balanced environment involves a multifaceted approach. Firstly, implementing better waste management practices is crucial, encompassing waste segregation, recycling, and minimizing littering. Rainwater harvesting methods could be adopted to efficiently use water resources and prevent erosion. Afforestation initiatives play a pivotal role in enhancing green cover, reducing carbon footprint, and conserving ecosystems. Additionally, minimizing the cutting of trees and discouraging the construction of new residential areas that contribute to deforestation is essential. Embracing renewable energy sources such as solar power and reducing plastic usage are imperative steps. Encouraging the use of public transport over private cars could contribute to reducing carbon emissions. Erecting fences and water thresholds in areas prone to heavy rain could help manage water flow. Furthermore, fostering nature preservation by planting more trees, creating natural habitats, and establishing nature trails for educational purposes could engage the local community in conservation efforts. Spreading awareness and involving citizens in initiatives like citizen science projects on biodiversity is essential for long-term environmental stewardship. Implementing surveillance measures, such as

CCTV installations, and specifying punishments for environmental offences can act as deterrents. Ultimately, according to the residents, a comprehensive strategy encompassing waste management, afforestation, energy efficiency, and community engagement is essential for building a sustainable and resilient environment.

Conclusion:

Inference:

Results observed from our studies have shown that the existing level of disturbances in the study site has led to a marked decrease in the levels of diversity and richness of butterflies, but a greater cause of concern, however, was the decreased population densities of lepidopteran fauna. The disturbances observed include the destruction and fragmentation of natural habitats, rapid deforestation, clearing of green cover for agricultural, domestic and commercial purposes, use of pesticides for agricultural practices, prominently observed land, water and air pollution, and the reduction in the number of larval host plants and nectar plants. An apt example displaying a drop in density is the number of sightings of the state butterfly of Maharashtra, Blue Mormon (*Papilio polymnestor*) in the study area, which has gone down from being abundantly sighted (80-100%) to rarely sighted (20-40%) in the span of eight years. Interestingly, the numbers of other butterflies like the Common Mormon (*Papilio polytes*) and Lime butterfly (*Papilio demoleus*), which share the same host plant with Blue Mormon have not shown as drastic of a drop in number.

Among the 63 species studied during the extent of our research, 42 species (67% of total species observed) have shown a drop of at least one level in the current study when compared to earlier studies. We could document through our studies that an increase in the extent of human activities has led to the clearing of pre-existing green spaces leading to a substantial decline in host and nectar plant density having a distinct negative effect on butterfly diversity and density, thus creating an imbalance in the biotic composition of the region. The study can be used to gauge the extent of the deteriorating health of the ecosystem in the study area and propose measures for its restoration and conservation.

Significance:

The study site of Mothi Desaigaon contains exceptional levels of plant and animal diversity. Besides the lepidopteran diversity, the region is also a popular birding destination with more than 200 bird varieties documented here. The abundance and diversity in vegetation providing a wide array of food and host

plants coupled with conducive climatic for survival has led to the region being rich in butterfly fauna in both diversity and abundance scales, in turn creating a credible effect on the coexisting biota. The study sites show a rich lot of butterfly populations which if properly studied, documented and worked upon may provide a new attraction to the local population and also provide ample study material to butterfly experts and enthusiasts for future studies. It will also help to explore the correlation between the availability of specific food plants leading to the presence of certain endemic species and the effect of the loss of the said plant cover on butterfly population density. The study will also underline the extent and impact of various anthropogenic pressures in the study site leading to fragmentation of habitat and hence the need for generating strategies to conserve such an ecologically diverse and rich region.

Proposed remedial actions:

Based on the observations of our research, we proposed the following measures to restore and conserve the biota of the study site.

- Creating awareness about the current situation:

There is an immense need to educate the residents about the environmental changes and their subsequent effects on the endemic biota. Nature trails, photographic exhibitions, awareness campaigns and drives can be conducted to generate interest and enlighten the masses.

- Establish and maintain a Devrai:

Promote the establishment of Devrai (Sacred groove) by planting trees like Ficus sp. etc. which are considered religiously sacred and hence might not come under the axe and thus repopulate the faunal biota.

- Conducting social activities in an environmentally friendly manner:

Activities like idol immersion or disposal of religious wastes in water bodies should be restricted. Immersion of eco-friendly idols and segregation of related biodegradable waste should be promoted.

- Compulsion on maintaining green cover:

Since huge stretches of green patches are cleared for construction purposes, it should be mandatory for these projects to maintain at least 50% of green cover in their project areas to maintain the balance.

- Encouraging segregation of waste and bio composting:

Waste disposal spaces should be set up for the collection and segregation of biodegradable and non-biodegradable waste. Uncontrolled disposal of waste in open spaces should be strictly prohibited. Bio-composting centres should be

established for the safe conversion of biodegradable waste to fertilizers and manures.

- Establishing butterfly gardens

Butterfly gardens should be established as a measure to repopulate and attract butterflies to the study site. It may also serve as an attraction for natives and tourists alike.

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Zest for Environmental Nurturing Foundation