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Road mortality rate of the butterflies at National Highway in Cuddalore District, Tamil Nadu, India

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Abstract
Road and traffic are the central features of human development, but a severe threat to forests and wildlife. In this study roadkill of butterflies was enumerated along a 19 km road in C.Mutlur to Alappakkam, Cuddalore National Highway. There was a noticeable increase in the number of dead butterflies during road crossings during the monsoon. The Current studies were conducted in the Alappakkam region of Tamil Nadu; A total of 325 individuals were recorded during the study period, belonging to 4 families,18 genera 21 species. Of the four families, Nymphalids were the most likely to die on the roadways, while Lycaenids were the least likely to die. This Present study is a Highlight of the Road-killed Butterflies Survey.

Keywords: Butterflies, Road Kills, Mortality, NH – 42, Roadside

1. Introduction
The authors discovered numerous dead butterflies on the road between March 2023 and February 2024 while taking a regular stroll from the route ran from the Government Arts college in C. Mutlur to Alappakkam, a tiny village in the Cuddalore District of Tamilnadu, along the National Highway (NH32). India has about 63.73 lakh km of road network, which is the second largest in the world. The following is the total length of the several categories of roads: 1,44,634 km for National Highways, 1,86,908 km for State Highways, and 59,02,539 km for Other Roads. India's National Highway network infrastructure. As of 30 November 2022, (Year End Review – 2022: Ministry of Road Transport and Highways). Roads constitute a substantial part of our environment [10]. Road encroachment increases with population growth, which fuels the global automotive industry's explosive growth [16]. The road mortality of animal populations is poorly documented worldwide [13]. Nonetheless, prior research has demonstrated how road traffic affects other faunal populations, with amphibians serving as one example [6]. snakes [2], koala [3], wolves [14], turkeys [9] badgers [4], birds [10] and other vertebrates [12]. Additionally, insects are also largely killed invertebrate groups by traffic [15, 17]. In India, the realization of road kills as a potential concern for wildlife conservation and management has gained attention only in the recent past [1, 15]. Chennai -Nagapattinam National Highway (NH 32). The 299 km-long highway. In this study, we attempted to quantify the road kills of butterflies in C.Mutlur to Cuddalore (Alappakkam) National Highway.

2. Materials and Methods
a. Study Area
The study area was the national highway (NH-32) 19km stretch between Chidambaram to Alappakkam. (between 11° 23' 53.4984" N, 79° 41' 43.2888" E. & 11°44'40.92"N – 79°46'4.89"E. longitude & latitude) on the Cuddalore - Chidambaram road (Fig. 2). This selected stretch of the road passes through the Cuddalore in the East Coast of Tamil Nadu State. The district is also bordered by the Bay of Bengal on the Eastern side. It lies in the Agro Climatic Zone II (East Coast Plains). The East Ghost Rode contains various Agricultural land on both sides. They have more host and nectar plants. The ecosystem is a very good habitat for butterfly diversity. on roads in an agricultural landscape in the environs. Due to traffic, it was

noted that there was a significant mortality rate of butterflies on this road. while travelling on this road there was a high mortality of butterflies due to vehicles. Therefore, we attempted to quantify the magnitude of these butterfly road kills from the area. The selected 19-km road stretch was sampled from March 2023 to Feb 2024 to record the butterfly mortality rate. The vehicular traffic through this road is on the rise have many industries in the area. it's the main reason for butterflies' death rate.

b. Methodology

The butterfly numbers were quantified through the transect counts method. The method used here was modified by [19]**.** Two road transects were used to count the number of vehicle-killed butterflies. Two parallel lines, one on either side of the road (the second being travelled in the other direction), made up each transect walk. One kilo meter separated the two sets of transects. The vehicular traffic on the selected road stretch was also quantified between 08:00 AM to 11:00 AM hr during which butterflies were usually most active. All the vehicles plying in both directions on the road were counted. Butterfly kills were counted and identified up to the species level. used the "slow driving method" to locate the butterflies hit by cars. Using this strategy, the road was viewed as a transect, and bikes were ridden slowly over it. Depending on visibility, the bike was driven at a speed of 10 to 20 km/h. If road-kill butterflies were spotted, they were removed from the road and collected for identification to prevent duplicate counts. The habitat by the side of the road and the site of the roadkill were noted concurrently. When feasible, the species were recognized in the field using the field guides published by [5, 8, 11] up to the species level. Asphalt roads had two or four lanes, were paved, and had an 80 or 100 km/h speed restriction. There was a range in the average traffic density from 1000 to 4000.

3. Results and Discussion

Throughout the course of the investigation, 325 individuals from four families, 18 genera, and 21 species were recorded. The biggest number of road kills were found in the following families: Papilionidae (Common Mormon, Common Rose, Lime Butterfly); Pieridae (Cabbage White, Common Jezebel, Common grass yellow); Nymphalidae (Plain Tiger, Blue Tiger, Common Crow). The Lycaenidae family has the fewest documented species. Eight different species reported that among the road kills, the Nymphalidae family was most prone to perish on the roadways. Pieridae, with seven, Papilionidae, with four, and Lycaenidae, which only includes two species, were the least number of species wiped out. Eight species belonging to seven genera—Danaus, Ariadne, Junonia, Euploea, Acraea, Tellervo, and Melanitis—have been identified in the Nymphalidae family. Four species from the two genera Papilio and Pachipta have been identified in the Papilionidae family. Seven species from seven genera—Pieris, Eurema, Colotis, Delias, Catopsilia, Leoptosia, and Belenois—have been identified in the Pieridae family. Two butterfly species belonging to the genera Lampides and Castalius have been identified in the Lycaenidae family. In addition, the case study of [18] showed that, in comparison to other families, species of butterflies in the Nymphalidae family had a higher documented number of road deaths. (Nymphalidae - 34%, Pieridae- 26%, Papillionidae 26%, and Lycaenidae - 14% of road killed butterflies). In addition, fewer Lycaenidae butterflies than other butterfly species crossed the road, according to a research by [7] There were higher reports of road kills of butterflies from August to December, and less reports from February, March, and April. After three months, the majority of butterflies that have been observed come from the families Pieridae and Nymphalidae, then Papilionidae and Lycaenidae. This is due to the fact that during the reproductive season, which runs from November to December, butterflies migrate locally in search of a mate, which causes them to migrate toward the side of the road. Males prefer to find mates in the shade and react more readily to females who are in the shadow, according to [20]. The richness of UV in the shade, which greatly enhances the UV reflection of the female wings, may be one of the possible explanations for this. Another possibility is that the temperature and UV reflection attract butterflies, which causes them to migrate towards the roadside during mating season. During the study period, observations revealed that the primary cause of butterfly mortality was scooters, followed by cars, as opposed to buses and lorries.

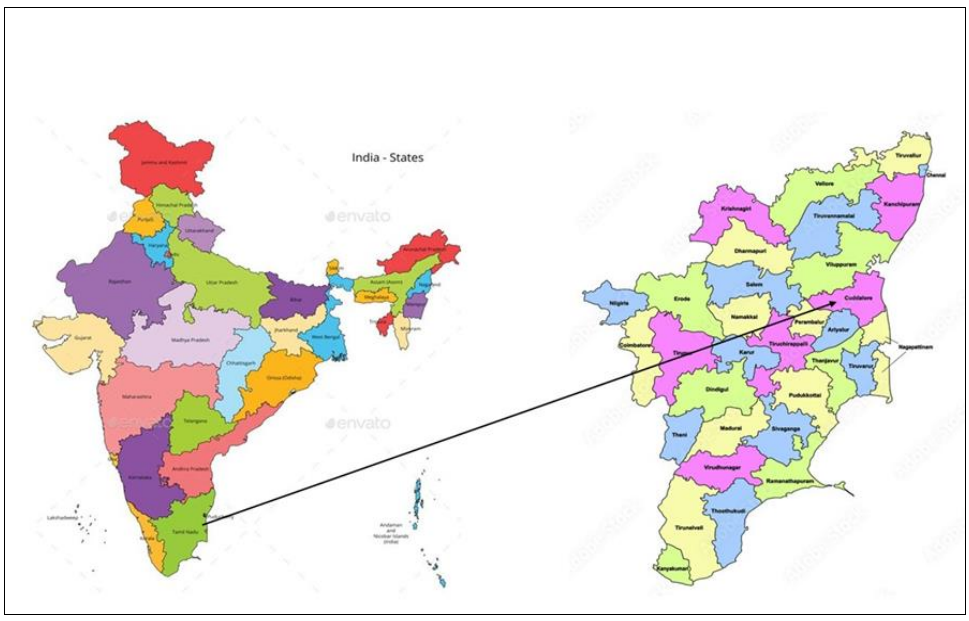


Fig 1: State and District Map

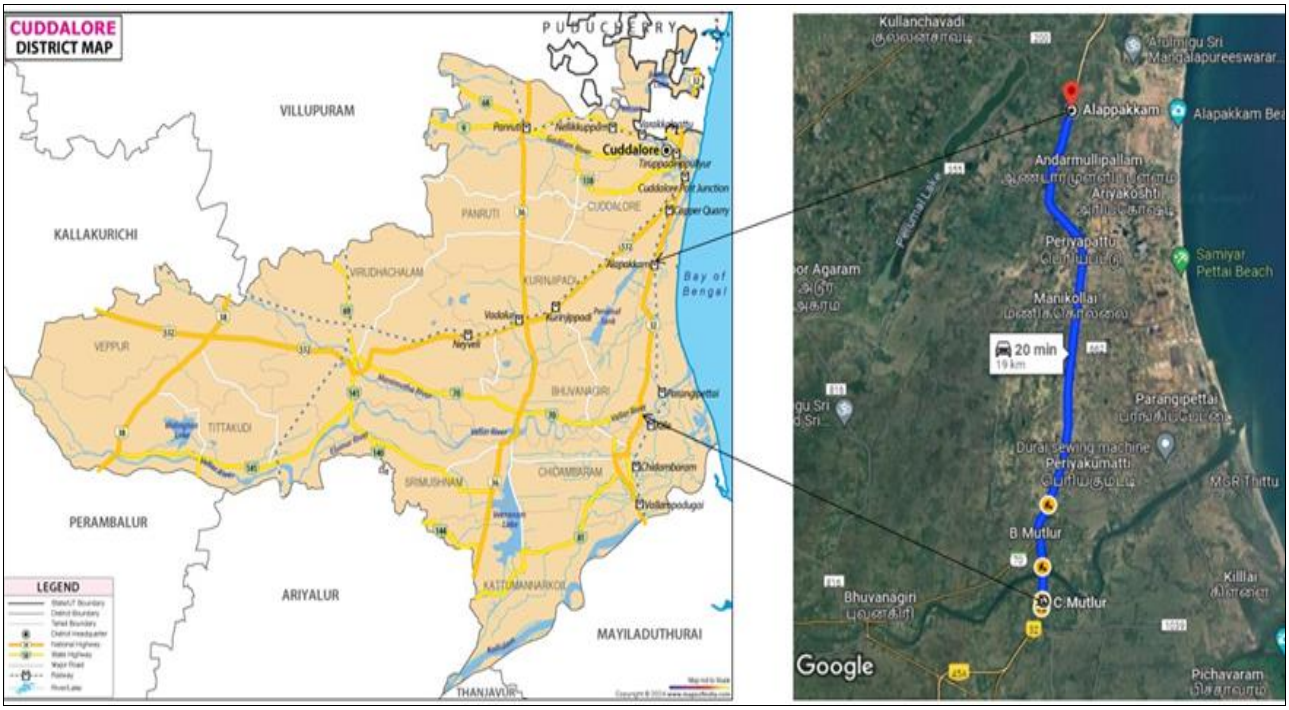


Fig 2: Study Area Road Structure

Table 1: Total number of road killed butterflies, recorded during study period

S. No	Family	Genera	Species
1	Nymphalidae	7	8
2	Papilionidae	2	4
3	Pieridae	7	7
4	Lycaenidae	2	2
Total		18	21

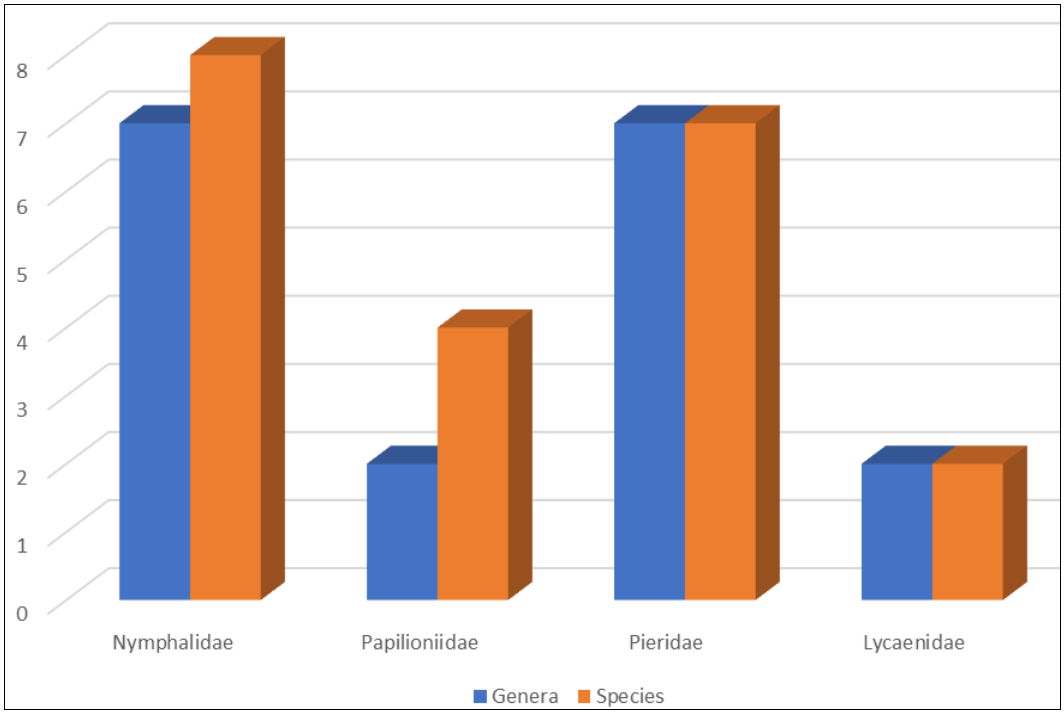


Fig 3: Number of genus and species recorded in each family.

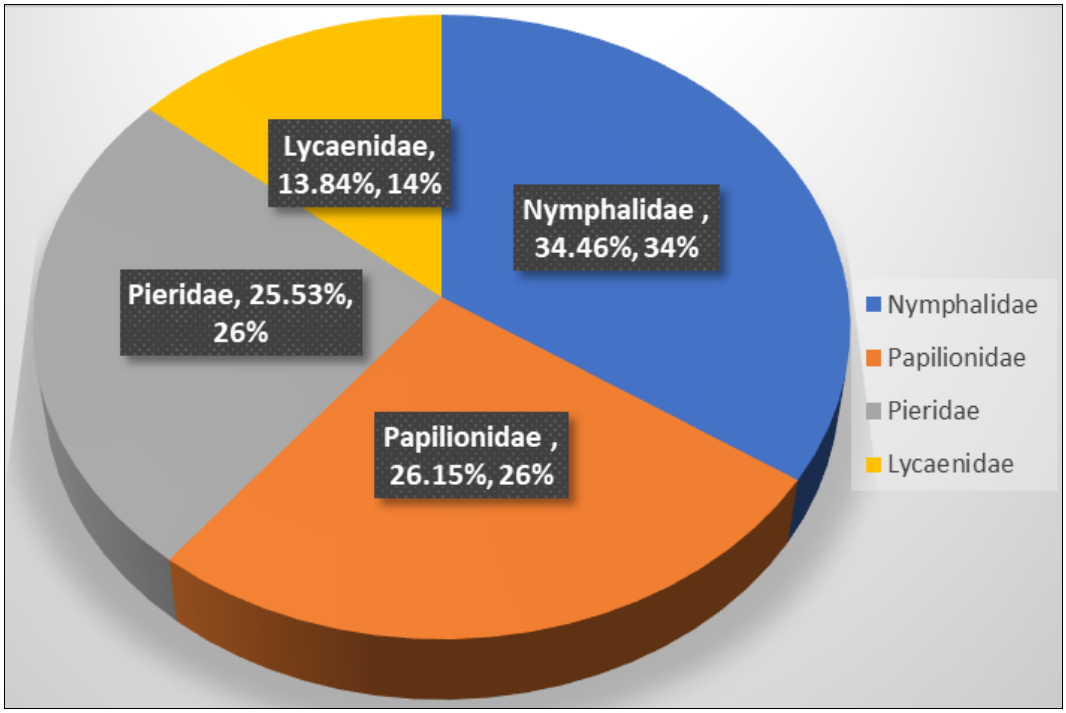
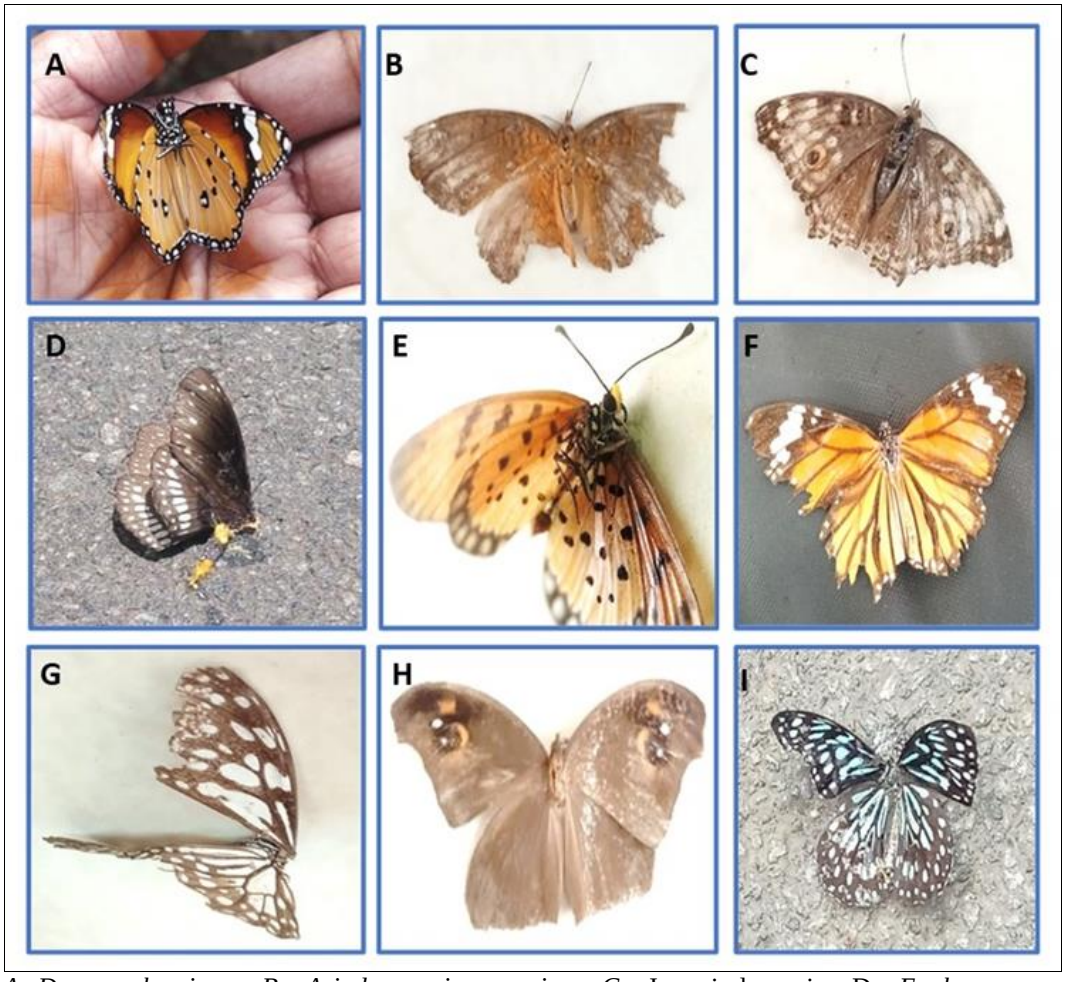
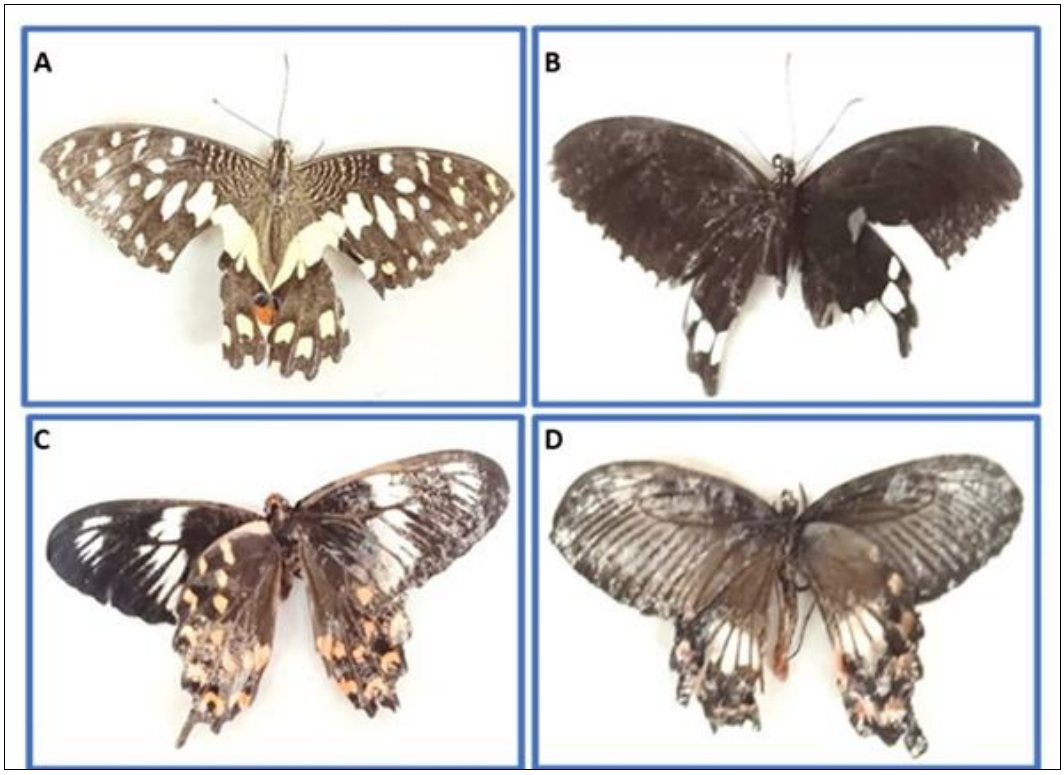


Fig 4: Composition of Road killed butterflies.



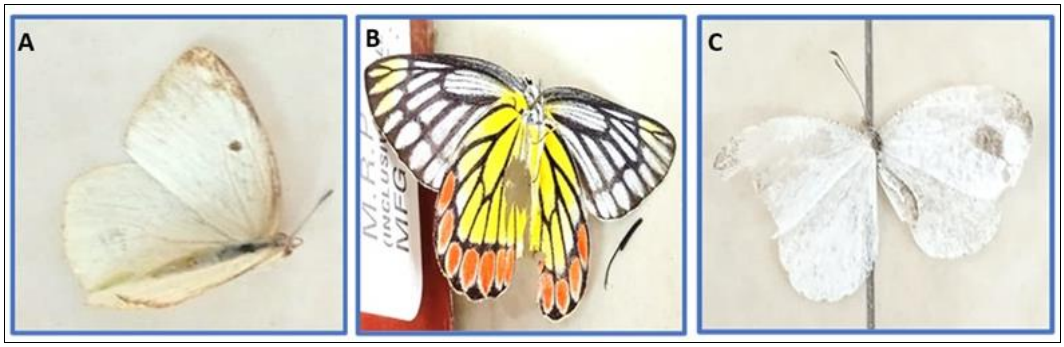
A- Danaus chrysippus, B - Ariadne merione merione, C - Junonia lemonias, D - *Euploea core, E - Acraea terpsicore, F - Danaus genutia, G - Ideopsis vulgaris, H* - Melanitis leda, I - *Tellervo limniace*

Fig 1: Butterfly Species belonging to Nymphalidae family



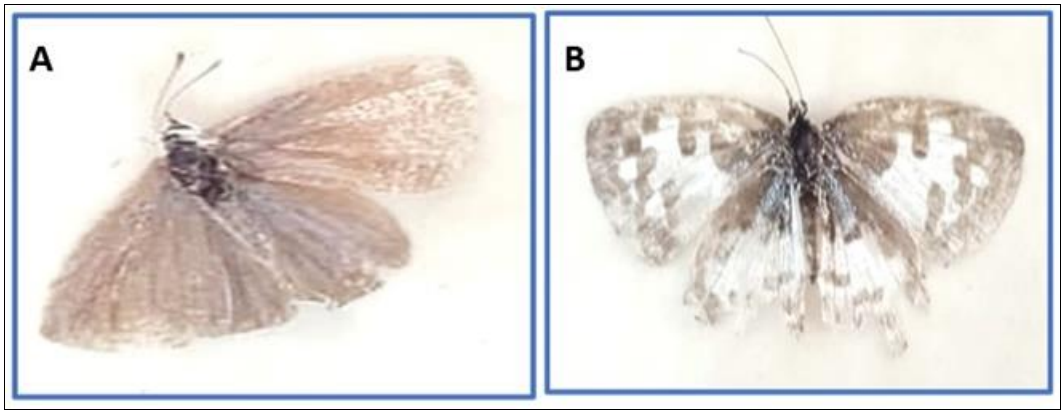
A - Papilio demoleus, B - Papilio polytes, C - Pachliopta hector, D - Pachliopta aristolochiae

Fig 2: Butterfly Species belonging to Papilionidae family



A - Pieris rapae, B - Delias eucharis, C- Leoptosia nina

Fig 3: Butterfly Species belonging to Pieridae family



A - Lampides boetius, B - Castalius rosimon

Fig 4: Butterfly Species belonging to Lycaenidae family

Table 2: Check list of recorded road-killed butterflies

S. No	Scientific Name	Common Name
Nymphalidae		
1	*Danaus chrysippus* (Linnaeus, 1758)	Plain tiger
2	*Ariadne merione merione* (Cramer, 1777)	Common castor
3	*Junonia lemonias* (Linnaeus, 1758)	Lemon pansy
4	*Euploea core* (Cramer, 1780)	Common crow
5	*Acraea terpsicore* (Linnaeus, 1758)	Tawny coster
6	*Danaus genutia* (Cramer, 1779)	Common tiger
7	*Tellervo limniace* (Cramer, 1775)	Blue Tiger
8	*Melanitis leda* (Linnaeus, 1758)	common evening brown
Papilionidae		
9	*Papilio demoleus* (Linnaeus, 1758)	Lime butterfly
10	*Papilio polytes* (Linnaeus, 1758)	Common Mormon
11	*Pachliopta hector* (Linnaeus, 1758)	Crimson Rose
12	*Pachliopta aristolochiae* (Linnaeus, 1775)	common rose
Pieridae		
13	*Pieris rapae* (Linnaeus, 1758)	Cabbage white
14	*Eurema hecabe* (Linnaeus, 1758)	common grass yellow
15	*Colotis aurora* (Lucas, 1852)	sulphur orange tip
16	*Delias eucharis* (Drury, 1773)	Common Jezebel
17	*Catopsilia spp* (Fabricius, 1775)	common emigrant or lemon emigrant
18	*Leoptosia nina* (Fabricius, 1793)	Psyche
19	*Belenois aurota* (Fabricius, 1793)	Caper white
Lycaenidae		
20	*Lampides boetius* (Linnaeus, 1767)	Pea blue
21	*Castalius rosimon* (Fabricius, 1775)	common Pierrot

Road-Killed Butterfly Species Recorded During Study Period

4. Conclusion

Increasing road networks and traffic are a couple of the factors contributing to the decline in biodiversity. This study demonstrates that the particular section of the road has a high mortality risk for butterflies. High butterfly abundance in roadside habitats was positively correlated with the availability of nectar along the sides of the highways. Nonetheless, one of the major conservation problems in these locations is road mortality. This study unequivocally shows that there is a higher risk of road-killed butterflies at forest locations along road verges. This study's large number of butterfly road fatalities emphasizes how important it is to consider how road mortality affects butterfly populations and what that means for conservation and management. The Nymphalidae family, which migrates, was far more likely than other families to die on the roadways.

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