

A preliminary study on road killed butterflies at National Highway- 50, Kalaburagi district, Karnataka, India

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Abstract

The effect of road networks, traffic on roads affecting the biodiversity. Increased road networks in India fragmenting the natural habitat of animals. The affect of road networks on mortality of animal studies are very fragmentary and most of them are focused on Amphibians, Reptiles, and small mammals. To keep an ecosystem healthy invertebrates are key members and participate greatly in the healthy ecosystem maintenance. There are no such studies conducted from Kalaburagi region of Karnataka; hence the present survey was conducted. A total of 180 individuals were recorded during the study period, belongs to 4 families, 20 genera and 35 species. Among 4 families Nymphalids were highly prone to getting killed on the roads and least killed were Lycaenids. Proper management of road verges serves as a good habitat for butterflies.

Keywords: Butterfly, NH – 50, Road sides, Habitat, Conservation, Kalaburagi

1. Introduction

The National Highway (NH) network of India measured over 100,087km as of June, 2016. India Road Network has different classes namely express ways, total National highways, state highways, major and other district roads, rural and other roads measured 1000 km, 100,087 km, 154,522 km, 2,577,396km, 1,433,577km respectively (<http://en.wikipedia.org/wiki/national-Highway-India>). National highway network of India is the second longest highway system in the world after China (111.950 km). National highways constitute 1.75% of Indian roads; they carry 40% of the traffic (Indian road network- National authority of India). A National Crime Records Bureau (NCRB) report revealed that every year, more than 135,000 traffic collision related deaths occur in India. The frequency of traffic collisions in India is amongst the highest in the world (Murali, 2010). Traffic collision related deaths increased from 13 per hour in 2008 to 14 per hour in 2009. In 2015, one person dies every four minutes in road accidents in India, according to 'Indians for Road Safety' NGO. Further, road network is growing at a rate of seven to ten percent per annum, while the vehicle population growth is increasing 12% per annum (Anonymoys, 2010) [8]. In India there was an eight fold increase in the total length of roads from 0.399 to 3.38 million km and 100 fold increases in the number of motorized vehicles in the last 50 years (1951-2004) (WWW.indiacore.com). Meanwhile, over the past ten years "Road Ecology" has emerged as a bona fide sub discipline within ecology (Lenore and Trina, 2009). Although the ecological effects of roads and traffic are of the same magnitude and importance as any environmental issue, this is not well-known amongst environmental managers and ecologists (Spellerberg, 2002) [11]. The increase in the length of roads in India proportionately raised the concern about detrimental effects of roads on animals that move or fly across the roads (Rao and Girish, 2007; Seshadri *et al.*, 2009; Spitzer *et al.*, 1997) [12, 46, 13, 14]. Clevenger and Kociolek (2006) explains, the barriers or fragmentation effects of roads result when animals within population are unable to approach

or cross roads to connect habitats requirements. Urbanization, industrial revolution, increases human population leads to the dramatic loss in biodiversity as a result disturbance in food chain, food web, nutrient recycle all these effects on ecosystem of an environment and indirectly our living systems and conditions.

Insects have important economic roles, supporting and providing livelihood for numerous people from the silk trade to beekeeping and the pollination of most of our fruit and a range of other agricultural produce (Pyle *et al.*, 1981) [16]. Butterflies induce genetic variation (Pyle, 1976) [22] indirectly reduce the air pollution (Seiler, 2001) [23] butterflies provide food for number of animals such as birds, reptiles, amphibians, and caterpillars provide an occasional meal for scorpions and ants, butterfly population dynamics have been suggested as indicators of species richness for pollinators overall and of the structural and floristic diversity of habitats, as indicators of climate changes and further ecological parameters and of landscape distinctiveness (Pyle, 1976; Heath, 1981; Kremen, 1994; Pe'er, 2008) [22, 19, 20, 21]. Habitat fragmentation is mainly due to developing road networks, increased traffic volume and this aspect have been a growing ecological concern (Seiler, 2001; Forman and Alexander, 1998; Trombulak and Frissell, 2000; Forman *et al.*, 2003; Fahring and Rytwinski, 2009; Selva *et al.*, 2011) [23, 25, 26, 24, 27]. Several studies revealed that road verges also serve as suitable for most insects and especially they are suitable habitat for common and endangered butterflies (Forman and Alexander, 1998; Trombulak and Frissell, 2000; Wynhoff *et al.*, 2011; Munguira and Thomas, 1992; Ries *et al.*, 2001; Saarinen *et al.*, 2005) [25, 31, 28, 42, 30]. Several studies proved that butterflies are most common insect groups being killed on roads (Mckennet *et al.*, 2001; Rao and Girish, 2007) [32, 35, 12, 46]. For conservation of any animal group, invertebrates or vertebrates studies on road mortality is too essential. Munguira and Thomas, (1992) [28, 42] opined that surprisingly there are very few surveys on the number of road kills and the factors determining them. Some studies focused on vertebrates amphibian, reptiles, birds and small mammals (Mckenna *et*

al., 2001) [32, 35] but very few studies attempted to study the effect of road network or traffic on invertebrates. There are some attempt has been made in India as well as Karnataka (Vadivalaganet *al.*, 2012; Basavarajappa and Santhosh, 2014; Baskarn and Bhoominathan, 2010) [48, 47, 49] but no studies from Kalaburagi region, hence the present investigation was conducted. In India wildlife conservation and management understand the effect of road kills on biodiversity and ecosystems, only in the recent past (Rao and Girish, 2007; Baskaran and Bhoominathan, 2010) [12, 46, 49].

2. Material and Methods

A) Study area

We selected an 8.2 km stretch of the NH – 50, that runs from Bidar to Hospet in Karnataka, India. The total length of NH 50 is 260 km. This highway starting from its junction with next NH 161 in Maharashtra (Nanded Road) connecting Bidar, Humanabad, Gulbarga, Jewargi, Bijapur, Hospet and terminating at NH 48 near Lakshimisagar (<http://en.wikipedia.org/wiki/National-Highway-India>). It is geographically located at 15.904440 E longitude and 76.163286N latitude (<http://mynasadata.larc.nasa.gov/latitudelongitude-finder>) and general elevation ranges from 300 to 750 meters above mean sea level. (<http://en.wikipedia.org/wiki/Gulbarga-district>)

The selected stretch 8.2km for studying ends at Uplav Nature Camp, the regional forest division of Kalaburagi, Karnataka, India. This nature camp is a very good habitat for butterflies; Kavya had reported (2016) [33] 61 butterfly species from this nature camp. It was observed butterfly road kills from the selected area while travelling on this road. Therefore we attempted to survey the butterfly road kills from 8.2km stretch, selected road. The vehicular traffic through this road is on the rise as it connects Bidar, Humanabad, Gulbarga, Jewargi, Bijapur, Hospet and terminating at NH 48.

B) Methodology

Field observation was made four days in a week from Sunday to Wednesday from April 2015 to December 2016, at twice per day 7.00AM to 8.00AM and 12.30 PM to 1.30PM. A checklist was prepared based on the survey of road killed butterflies in predetermined NH 50. The butterfly number was quantified through transect counts. Transect walk consists of two parallel lines; one on either side of the road, second walk was opposite to first walk. (Skorka *et al.*, 2014 and Mckenna *et al.*, 2001) [32, 35]. Possibility of over counting was avoided carefully then dead butterflies were closely observed (Kunte, 2005) [36], at an every sighting road kill, butterfly were counted and indentified with the help of field guides (south Indian Butterflies and Butterflies of India) and photographed.

3. Result and Discussion

A total of 180 individuals were recorded during the study period, belonging to four families, 19 genera and 35 species. Among the road kills, in Nymphalidae Dark blue tiger, Common crow; in Papilionidae Common mormon, Common rose; in Pieridae Spotless grass yellow, One-spot-grass yellow, small grass yellow, Common grass yellow registered highest. The species in Lycaenidae were least recorded.

Among the road kills, the Nymphalidae species were highly prone to get killed on the roads, recorded by 13 species Followed by Pieridae with 11, Papilionidae with six and least

species killed were Lycaenidae belongs to four species only. In Nymphalidae 13 species were recorded belongs to eight genera namely, *Tellervo*, *Danaus*, *Eupoea*, *Melanitis*, *Acraea*, *Junonia*, *Hypolimnas*, *Byblia*. In Papilionidae six species were recorded belongs to three genera, *Graphium*, *Papilio*, *Pachilopta* and in Pieridae 11 species were recorded belongs to five genera namely, *Eurema*, *Catopsilla*, *Colotis*, *Ixias*, *Anaphaeis*, in Lycaenidae four butterfly species were recorded belongs to three genera namely, *Castalius*, *Catochrysops* and *Lampides*.

The case study of Sony and Arun (2015) [39] also revealed that butterfly species belonging to Nymphalidae were highly recorded for road kills compared to other families. (Nymphalidae - 70%, Pieridae- 13%, Papilionidae- 17% of road killed butterflies). Fjellstad (1998) [40] and Norberg (2002) [41] states that “neither can the result be directly generalized to all butterfly species, which can have various reactions to different barriers and boundaries such as roads, walls, trees and shades”. The study of Fjellstad (1998) [40] also reported, a lower proportion of butterflies of the family Lycaenidae crossed the road compared to other butterfly species. Roads have also been reported to restrict the movements of small and sedentary butterfly species.

Road kill of butterflies were more recorded between September to December and least were recorded during February, March and April months. In later three months, recorded butterflies mainly belong to family Pieridae and Nymphalidae followed by Papilionidae then Lycaenidae. This is because during reproductive season that is November to December there is a local migration of butterflies for mate finding this leads to the migration in the butterfly towards road side. According to Yoshiakiobara *et al.*, (2008) [44] the males prefer to locate mates in the shade and respond more readily to shaded females. The possible reasons for this includes that, the shaded females, are more visible to the males when staying in the shade, this is because to the richness of UV in the shade which significantly enhance the UV reflection of female wings, the temperature and UV reflection attract butterfly leads to the migration towards road side during mating season.

According to the observation made during the study period, mortality of butterflies was mainly because of scooter followed by car compared to mortality of butterflies because by bus and lorry.

4. Conclusion

Increased road networks and traffic is one among the several reasons for decreasing biodiversity. Proper management of road verges also serves as habitats for a variety of organisms including butterflies. Anu concluded in his thesis that the availability of nectar along the road sides was positively associated with high butterfly abundance in roadside environments. According to Hopwood incorporating native plants into roadside management strategies will not only made these areas better for wildlife, but it can also promote motorist safety, reduce maintenance costs, and improve roadside aesthetics. Proper management of road verges serves as habitat for several varieties of organisms including butterflies.

- Planting native plants,
- Mowing in specific seasons and
- Partial mowing offer shelter for butterflies.

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

S. No	Family	Genera	Species
1	I) Family – Lycaenidae	3	4
2	II) Family - Nymphalidae	8	13
3	III)Family - Papilionidae	3	6
4	IV) Family - Pieridae	5	12
Total		19	35

Table 2: Check list of recorded road killed butterflies during study period

Serial number	Common name	Scientific name
I) Family – Lycaenidae		
1	COMMON PIERROT	<i>Castalius rosimon</i> (Fabricius, 1775)
2	FORGET ME NOT	<i>Catochrysops strabo</i> (Fabricius, 1793)
3	SILVER FORGET ME NOT	<i>Catochrysops panormus</i> (Felder, 1860)
4	PEABLUE	<i>Lampides boeticus</i> (Linnaeus, 1767)
II) Family - Nymphalidae		
5	BLUE TIGER	<i>Tellervo limniace</i> (Cramer, 1775)
6	DARK BLUE TIGER	<i>Tellervo septentrionis</i> (Butler, 1874)
7	STRIPED TIGER	<i>Danaus genutia</i> (Cramer, 1779)
8	PLAIN TIGER	<i>Danaus chrysippus</i> (Linnaeus, 1758)
9	COMMON CROW	<i>Euploea core</i> (Cramer, 1780)
10	COMMON EVENING BROWN	<i>Melanitis leda</i> (Linnaeus, 1758)
11	TAWNY COSTER	<i>Acraea violae</i> (Fabricius, 1775)
12	JOKER	<i>Byblia ithyia</i> (Drury, 1773)
13	BLUE PANSY	<i>Junonia orithya</i> (Linnaeus, 1764)
14	PEACOCK PANSY	<i>Junonia almana</i> (Linnaeus, 1758)
15	YELLOW PANSY	<i>Junonia hierta</i> (Fabricius, 1798)
16	LEMON PANSY	<i>Junonia lemonias</i> (Linnaeus, 1758)
17	DANAID EGGFLY	<i>Hypolimnas misippus</i> (Linnaeus, 1764)
III)Family - Papilionidae		
18	COMMON JAY	<i>Graphium doson</i> (Felder, 1864)
19	TAILED JAY	<i>Graphium agamemnon</i> (Linnaeus, 1758)
20	COMMON MORMON	<i>Papilio polytes</i> (Linnaeus, 1758)
21	LIME BUTTERFLY	<i>Papilio demoleus</i> (Linnaeus, 1758)
22	COMMON ROSE	<i>Pachliopta aristolochiae</i> (Fabricius, 1775)
23	CRIMSON ROSE	<i>Pachliopta hector</i> (Linnaeus, 1758)
IV) Family - Pieridae		
24	ONE-SPOT GRASS YELLOW	<i>Eurema andersoni</i> (Moore, 1886)
25	THREE-SPOT GRASS YELLOW	<i>Eurema blanda</i> (Boisduval, 1836)
26	SMALL GRASS YELLOW	<i>Eurema brigitta</i> (Cramer, 1780)
27	COMMON GRASS YELLOW	<i>Eurema hecabe</i> (Linnaeus, 1758)
28	SPOTLESS GRASS YELLOW	<i>Eurema laeta</i> (Boisduval, 1836)
29	COMMON EMIGRANT	<i>Catopsillia pomona</i> (Fabricius, 1775)
30	MOTTLED EMIGRANT	<i>Catopsillia pyranthe</i> (Linnaeus, 1758)
31	CRIMSON TIP	<i>Colotis danae</i> (Fabricius, 1775)
32	LARGE SALMON ARAB	<i>Colotis fausta</i> (Olivier, 1801)
33	PIONEER	<i>Anaphaeis aurota</i> (Fabricius, 1793)
34	WHITE ORANGE TIP	<i>Ixias marianne</i> (Cramer, 1779)
35	YELLOW ORANGE TIP	<i>Ixias pyrene</i> (Linnaeus, 1764)

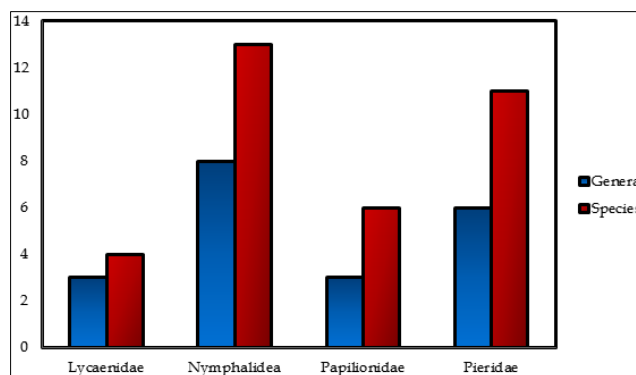
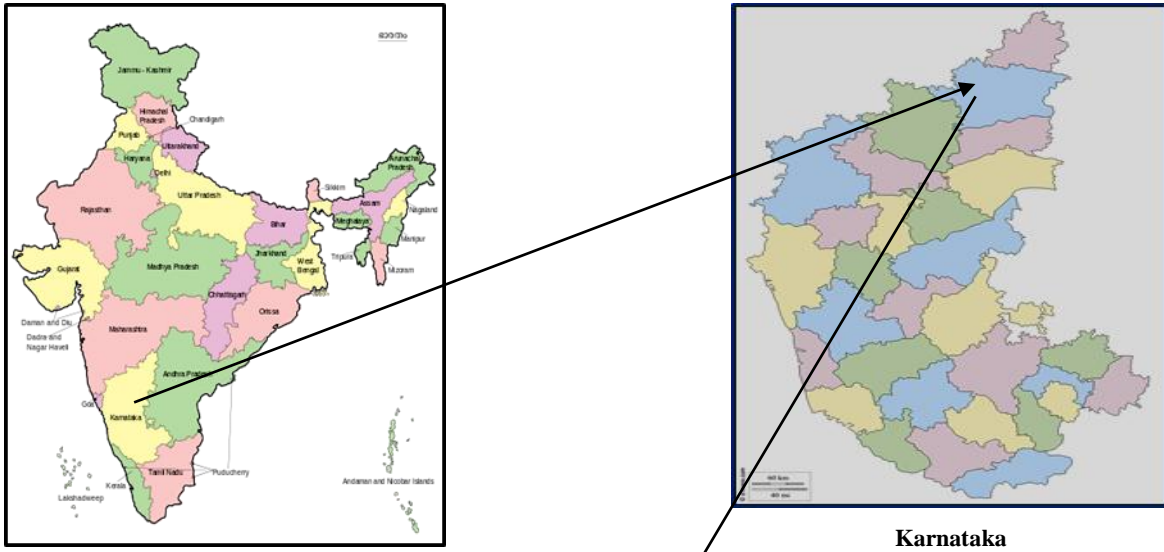


Fig 1: Road killed butterfly observed during study period – Number of genus and species recorded in each family.



India

Karnataka

Gulbarga District

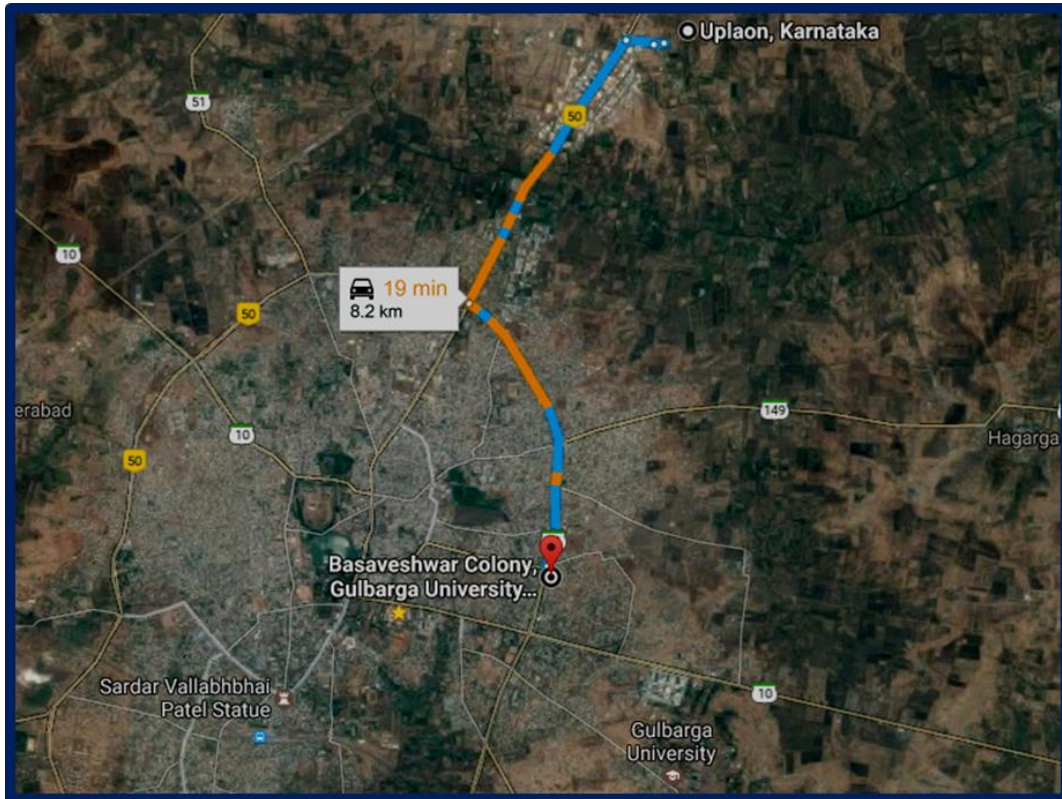
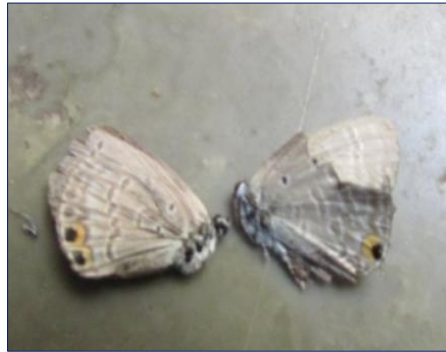


Photo courtesy-<http://www.google.co.in>, <http://www.google.co.in/map>.

Fig 1: Study Area Map

I. Butterfly Species belonging to Lycaenidae family



II. Butterfly species belonging to Nymphalidae family





III. Butterflies species belonging to Papilionidae family



IV. Butterflies species belonging to Pieridae family



Fig 2: Road Killed Butterfly Species Recorded During study period

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6. References

1. Title; Mean sea level of Gulbarga. Web link: <http://en.wikipedia.org/wiki/Gulbarga-district>. Accessed on 7/1/2017 at 2:9 pm.
2. Title:LatitudeLongitudefinder.Weblink:<http://myNASAdata.larc.nasa.gov/latitudeLongitude-finder/>, Accessed on 7/1/2017 at 2:1pm.
3. Title: National Highway. Web link: [http://en.wikipedia.org/wiki/National-Highway-\(India\)](http://en.wikipedia.org/wiki/National-Highway-(India)), Accessed on 6/1/2017 at 11 am.
4. <http://www.google.co.in/map>. Accessed on 10/1/2017 at 4.30 PM
5. <http://www.google.co.in>. Accessed on 10/1/2017 at 4.45 PM (Satellite map).
6. Indian road network – National Highways Authority of India. 2015.

7. Traffic Kill. Muarali Krishnan. India has the highest number of roads accidents in the world.2010.
8. Anonymous. Statistical data of Chamarajanagar, District Statistical office, Chamarajanagar.2010, 21-75.
9. Title. Road length increase. Web link: www.indiacore.com. Accessed on 7/1/2017 at 3pm.
10. Fahrig L, Rytwinski T. Effects of roads on animal abundance: An empirical review and synthesis. *Ecology and Society*. 2009; 14(1):21.
11. Spellerbeg IF. Ecological effects of roads. Science Publisher, Enfield. 2002,251.
12. Rao RS, Girish MK. Road kills: Assessing insect causalities using flagship taxon. *Current Science*.2007; 92(6):831-837.
13. Seshadri KS, Yadav A, Gururaja KV. Road kills of amphibians in different land use areas from Sharavathi River basin, Central Western Ghats, Indian Journal of Threatened Taxa. 2009; 1(11):549-552.
14. Spitzer K, Jaros J, Havelka J, Leps J. Effect of small scale disturbance communities of an Indochinese montane rainforest. *Biological Conservation*.1997; 80:9-15.
15. Anthony PC, Angela VK. Highway median impacts on wildlife movement and mortality state of the practice survey and gap analysis. A report prepared for the state of California Department of transportation office of Materials and Infrastructure Research western Transportation Institute College of Engineering Montana State University. 2006.
16. Pyle RM, Bentzien, Opler P. Insect conservation. Annual review of Entomology. 1981; 26(1):233-258.
17. Kearney L. Web link:<http://www.onegreenplanet.org/environment/how-the-butterfly-can-shape-an-ecosystem-and-why-we-need-to-protect-them>.2015.
18. <http://www.butterflyskye.com.au/greenweddig.html>.
19. Heath J. Threatened Rhopocera (butterflies) in Europe: Strasbourg council of Europe. 1981, 23.
20. Kremen C. Biological inventory using target taxa: A case study of the butterflies of Madagascar. *Ecological Applications*, 1994; 4:407-422.
21. Pe'er G, Settele J. The rare butterfly *Tomaresnesimachus* (Lycanidae) as a bio indicator for pollination services and ecosystem functioning in northern Israel. *Israel Journal of Ecology and Evolution*.2008; 54(1):111-136.
22. Pyle RM. The eco-geographic basis for Lepidoptera Conservation. PhD thesis. Yale University, New Haven. In: Pyle R, M. Bentzien and P. Opler. Insect conservation, Annual Review of Entomology. 1976-1981; (1926):1233-1258.
23. Seiler A. Ecological effects of roads: A review. Department of conservation Biology, Swedish University of Agricultural Science, Uppsala, Sweden.2001.
24. Fahrig L, Rytwinski T. Effects of roads on animal abundance; an empirical review and synthesis. *Ecol. Soc*. 2009;14(1):21.<http://www.ecologyandsociety.org/vol14/issue1/art21>.
25. Forman RTT, Alexander LE. Roads and their major ecological effects. *Annu. Rev. Ecol. Syst*. 1998; 29:207-231.
26. Forman RTT, Sperling D, Bissonet JA, Clevenger AP, Cutshall CD, Dale VH.*et al*. Road Ecology: Science and Solutions. Island press, Washington, DC, USA. 2003.
27. Selva N, Kref S, Kati V, Schuluck M, Jonsson BG, Mihok B.*et al*. Road less and own traffic areas as conservation targets in Europe. *Environ Manage*. 2011; 4:865-877.
28. Muguira ML, Thomas JA. Use of road verges by butterfly and burnet populations, and the effect of roads on adult dispersal and mortality. *J. Appl. Eco*. 1992; 29:316-329.
29. Ries L, Debinski DM, Wieland ML. Conservation value of roadside prairie restoration to butterfly communities. *Conser. Bio*. 2011; 15:401-411.
30. Saarinen K, Valtonen A, Jantunen J, Saarnios. Butterflies and diurnal moths along road verges: does road type affect diversity and abundance? *Bio.Conserve*.2005; 123:403-412.
31. Wynhoff I, Van Gestel R, Van Swaay C, Van Langevelde F. Not only the butterflies: managing ants on road verges to benefit *Phengaris* (Maculinea) butterflies. *J. Insect Conserv*. 2011; 15:189-206.
32. Mckenn DD, Mckenna KM, Malcom SB. Malcom, Berenbaum MR. Mortality of Lepidoptera along roadways in central Illinois. *Journal of the Lepidopterists Society*. 2001; 55(2):63-68.
33. Kavya KS. Butterfly diversity of Uplanv nature camp, Kalaburagi district, Karanataka. *International Journal of Entomology Research*.2016; 1(7):49-53.
34. Skorka P, Lenda M, Moron D, Kalarus K, Tryjanowski P. Factors affecting road mortality and the suitability of road verges for butterflies. *Biological conservation*. 2013; 159:148-157.
35. Mckenna DD, Malcom SB, Berenbaum MR. Mortality of Lepidoptera along road ways in central Illinois. *Journal Lepidopterists Soc*.2001; 55:63-68.
36. Kunte K. Species composition, sex ratio and movement patterns in *Danaia* butterfly migration in Southern India. *JBNH*. 2005; 102(3):280-286.
37. Gunathilagaraj K, Perumal TNA, Jayaram K, Ganesh Kumar M. Field Guide: South Indian Butterflies. Edn 1, Krab Media and Marketing, Bangalore. 2015; 1:359.
38. Isaac K. BNHS Field guides, Butterflies of India. Edn 1, Bombay Natural History Society, Hornbill House, Mumbai. 2016; 1:509.
39. Sony RK, Arun PR. A case study of butterfly road kills from Anaikatty Hills, Western Ghats, Tamil Nadu, India. *Journal of Threatened Taxa*.2015; 7(14):8154-8158.
40. Fjellstad WJ. The landscape ecology of butterflies in traditionally managed Norwegian farmland. PhD Thesis, University of Durham UK.1998.
41. Norenberg U, Enfjall K, Leimar O. Habitat exploration in butterflies an outdoor cage experiment. *Evol. Eco*. 2002; 16:1-14.
42. Munguria ML, Thomas JA. Use of road verges by butterfly and burnet populations and the effect of roads on adult dispersal and mortality. *J.App.ecol*.1992; 29:316-329.
43. Anu Valtonen. Roadside environment as habitat for Lepidoptera, PhD thesis submitted to University of Joensuu, PhD Dissertation in Biology. 42.
44. Yoshiaki O, Hisahuru K, Kentaro A. Better mate in the shade: enhancement of male mating behavior in the Cabbage butterfly, *Pieris rape crucivora*, in a UV-rich

- environment. The journal of experimental Biology. 2008; 211:3698-3702.
45. Jennifer H, Invertebrates conservation Guidelines, Pollinators and Roadsides, Managing Roadsides for Bees and Butterflies, The Xerox Society for invertebrate Conservation.
 46. Rao RSP, Girish MKS. Road kills: assessing insect causalities using flagship taxon. Curr.Sci. 2007; 92:830-837.
 47. Basavarajappa S, Santhosh S. Road mortality of migrant butterflies (Nymphalidae: *Danaiae*) at national Highway – 209 in Chamarajanagar District of Karanataka, India. Indian Journal of Applied Research.2014; 4(9):553-557.
 48. Vadivalagan C, Gunasekaran C, salahudeen M, Heavenlin M, Karthika P. A study based on the survey of Lepidoptera victims on road kill in Coimbatore, (TN) India. International Journal of Recent Scientific Research. 2012; 3(5):340-342.
 49. Baskaran N, Boominatan D. Road kill of animals by highway traffic in the tropical forests of Mudumalai Tiger Reserve, Southern India. Journal of Threatened Taxa.2010; 2(3):753-759.