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Butterflies Community Assemblage and Distribution in Salkhala Game Reserve, Kashmir Himalaya, Pakistan: Conservation Implications

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Abstract
Lack of baseline biodiversity information is widely recognized as a major barrier for identifying temporal changes in landscapes either due to anthropogenic activities or other factors crucial for the management and conservation of biological resources. We present here results of our study conducted in Salkhala game reserve between February to July 2016, Azad Jammu & Kashmir, Pakistan to set baseline on diversity and distribution of butterflies. Five transect of 500m length each were laid down in different habitat type and along altitudinal gradient to record butterflies. A total of 38 species were recorded where two most abundant recorded species were Indian Red Admiral (*Vanessa indica*) and White-Line Hairstreak (*Strymon assamica*) with n=54 individuals each and the least recorded species were Blue Peacock (*Papilio arcturus) and* Common Windmill (*Atrophaneura polyeuctes*) which recorded n=34 individuals. Forest cuttings, grass cuttings, unsustainable utilization of natural Resources, lack of conservation awareness, unmanaged grazing were recorded as the major threats to the butterflies' fauna. Established survey plots provide baseline to be used to monitor the butterfly diversity in future. Development of a conservation and management plan for the game reserve would be of great value towards management of biodiversity in the study area.

Keywords: Butterflies, diversity, conservation, Salkhala Game Reserve, Kashmir Himalaya, Pakistan

1. Introduction
Insects are by far the most diverse group of animals, representing over 50% of terrestrial biodiversity [1]. An estimated 60 to 80 percent of the world's flowering plants depend on insects for pollination [2] Pollinating insects are key to the healthy environment [3]. Five major orders of class insecta stand out for their high species richness: the beetles (Coleoptera); flies (Diptera); wasps, ants and bees (Hymenoptera); the butterflies and moths (Lepidoptera) and the true bugs (Hemiptera) [4]. The butterflies comprise the smaller part of the order Lepidoptera, of which the larger part is the moths [5] and about 18,000 butterfly species have been documented worldwide [6, 7]. Reported species of butterflies from Pakistan are 317 and less than 34 percent are of strictly Oriental zoogeographic origin, whilst 66% are of Temperate Palaearctic affinity, including species typical of the Sino-Japanese phytogeographical zone (the Himalayas) [8].
The distribution of butterflies are considered as good predictor of areas of high biodiversity and species richness [9-11], however butterflies are also considered as good indicator in terms of habitat quality and anthropogenic disturbance [12]. As such no study was conducted in the game reserve to set such an indicator to evaluate environmental health and habitat quality, this study has been conducted to document the butterflies' community assemblage of the park which may be used as a reference for future monitoring under changing land use pattern. This information will further help park managers to develop a conservation and management plan for the park which is much needed to help protect the species and their habitat in the game reserve area.

2. Methods
2.1. Study area
The Salkhala Game Reserve (8.1 km^2, 34.33^0 N and 73.50^0 E) and its surrounding area, is situated 80 km to the north-east of Muzaffarabad city, the capital of Azad Jammu and Kashmir, Pakistan. The area borders the Line of Control (LOC) with India on three sides whereas the river Neelum along with human settlements confines the north-western side of the

reserve (Figure 1). SGR falls under IUCN's protected area Category IV (Habitat/Species Management Area) with an altitudinal range between 1,320-3,150 m [13-14] (Figure 1).

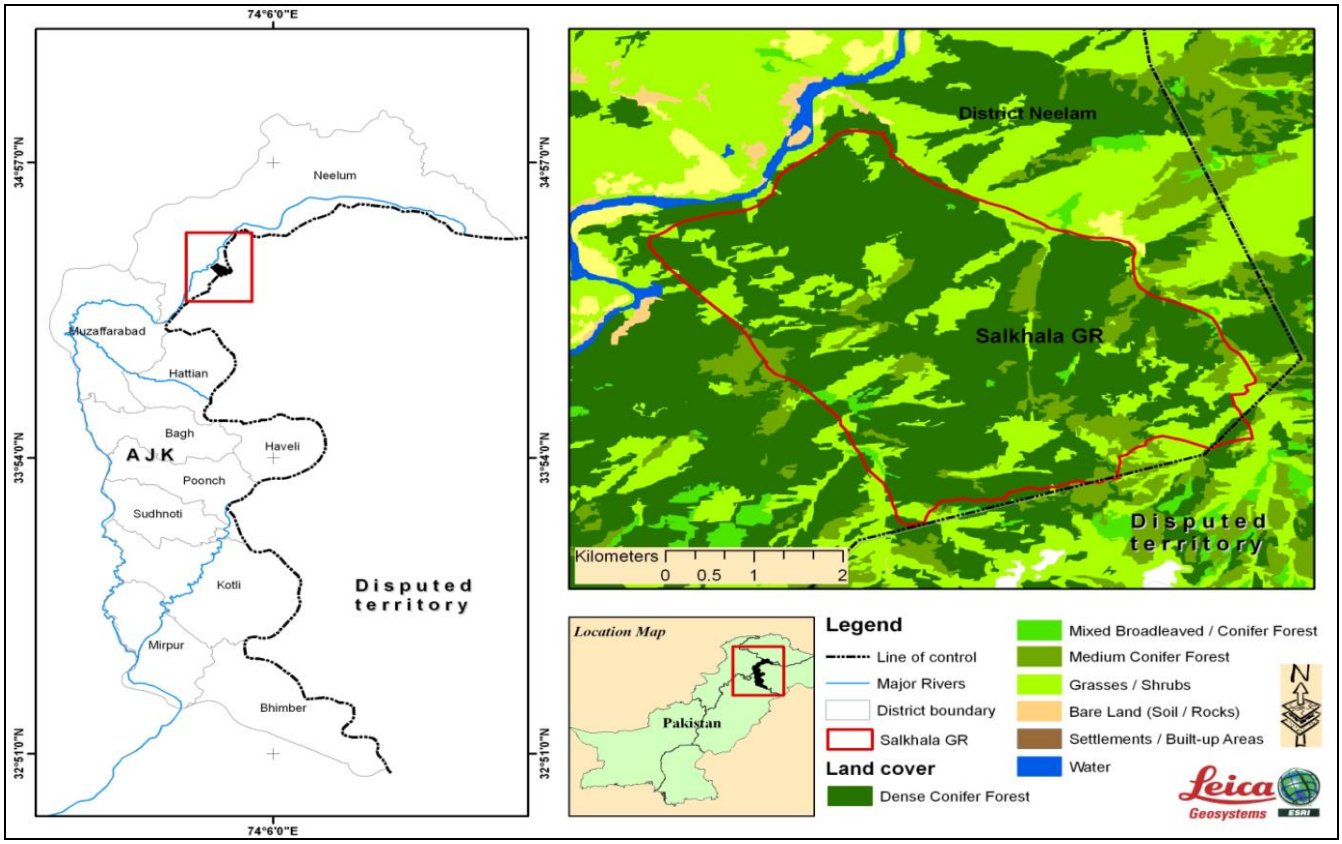

Fig 1: Map showing study area and habitat types in SGR

The Reserve was established in 1982 based on the occurrence of some globally threatened mammals such as Musk Deer (*Moschus chrysogaster*), Black Bear (*Ursus thibetanus*) and Common Leopard (*Panthera pardus*) and birds such as the Western Tragopan (*Tragopan melanocephalus*), Cheer Pheasant (*Catreus wallichii*) and Kashmir Flycatcher (*Ficedula subrubra*) [13].

The most common forest habitats of the reserve include coniferous, broadleaf and mixed coniferous-broadleaf forests which are characterized by Deodar (*Cedrus deodara)*, Blue Pine (*Pinus wallichiana*), Silver Fir (*Abies pindrow*), Spruce (*Picea smithiana*), Himalayan Yew (*Taxus wallichiana*), Brown Oak (*Quercus semecarpifolia*), Himalayan Maple (*Acer caesium*), Walnut (*Juglans regia*), Indian horse chestnut (*Aesculus indica*) and Himalayan Birch (*Betula utilis*). The area has a mean annual rainfall of 1257 mm with March and April being the wettest months, and heavy snowfall during the winter months [13, 15, 16] (Figure1).

2.2. Data Collection

To study the diversity and distribution of butterflies in the study area, [17] transect method was used and transects of equal lengths (500m each) were laid down in different habitat type and along an altitudinal gradient for data collection. Five habitat types were chosen i.e. Agricultural land, Grasslands, Conifers, Mixed broad leave/conifers and Pastures and two transects in each habitat type were laid down (Fig.1). In total 10 transect with a total length of 5000m were surveyed. Each transect was surveyed once in month between February to July 2016 to record the species diversity and distribution following Pollard Walk Method [17]. Observation were made between 07:00 to 11:00 hr and 14:00 to 18:00 hr. Quantitative assessment was done across different habitats to recorded butterfly species density.

2.3. Data analysis

Data collected was pooled and analyzed to understand the diversity of the butterflies using Shannon-Wiener diversity index (H') whereas the encounter rate of the individual's species was calculated by using the equation [17].

Species diversity was calculated using Shannon Index formula.

a) Shannon-wiener diversity index (H')

$$H' = - [\Sigma Pi \ln Pi]$$

Where H'is the diversity index

Pi is the proportion of species relative to total number of species and Log lnPi is the natural logarithm of this proportion

b) Relative abundance

Relative abundance will be calculated by following formula

$$\text{Relative abundance} = Pi = ni/N$$

Where, ni is number of individuals of a species and

N is total population of birds.

c) Species evenness

$$\text{Species evenness} = H'/\ln (s)$$

Where H' is Shannon-Wiener diversity index

S is species richness (number of species) and

In(S) is natural logarithm of species richness.

d) Census index

Census index = N/A

Where N is total population of Butterflies and
A is total study area.

3. Results

3.1 Species diversity and distribution

A total of 38 different species with 1721 individuals of butterflies from ten transects laid down in five different habitat types were observed. Calculated Shannon-wiener diversity index (H') value was -4.561 with an average of 172.1±5.176 (mean± SE) species were recorded from the transects. Calculated census index value was 212.46 individuals/km^2 with0.3424 Encounter Rate. The two most abundant recorded species were Indian Red Admiral (*Vanessa indica*) and White-Line Hairstreak (*Strymon assamica*) with n=54 individuals each whereas the least recorded species were Blue Peacock (*Papilio arcturus)* and Common Windmill (*Atrophaneura polyeuctes*) which recorded n=34 individuals each.

Within family, there is a diversity among the species composition like in family Papilionidae the most common species found was the Common Yellow Swallowtail (*Papilio machaon*) (4.1±0.34) with n=41 individuals and 0.0239 relative abundance whereas in the same family Blue Peacock (3.4±0.4) and Common Windmill (3.4±0.42) were the least common species, both were found with n=34 individuals and 0.019 relative abundance. In family Pieridae, Large Cabbage White (*Pieris brassicae*) (4.9±0.79) and Green-Veined White (*Pieris napi*) (4.9±0.65) has 0.0286 relative abundance and were the most common species with n=49 individuals and Indian Cabbage White (*Pieris canidia*) (4.2±0.53), Himalayan Blackvein (*Aporia leucodice*) (4.2±0.41) and Dark Clouded Yellow (*Colias fieldii*) (4.2±0.53) were the least common species, with n=42 individuals and 0.024 relative abundance. Indian Red Admiral (5.4±0.58) with 0.0315 relative abundance and n= 54 individuals was the most commonly observed specie in family Nymphalidae, and among the same family, the least common species were Common Tiger (*Danaus genutia*) (5±0.80), Mountain Argus (*Erebia shallada*) (4±0.63) and Plain Tiger (*Danaus chrysippus*) (4±0.76) with n=40 individuals and 0.023 relative abundance. White line Hairstreak (5.4±0.68) was most common among the family Lycaenidae with n=54 individuals and 0.0315 relative abundance whereas Cornelian (*Deudorix epijarbus*) (4.5±0.61) was the least observed specie with 0.0262 relative abundance and n=45 individuals, In the family Hesperiidae, the most common species were Himalayan Swift (*Baoris discrete Himalaya)* (4.8±0.74) and Himalayan Spotted Flat (*Celaenorrhinus munda*) (4.8±0.53) with the n=48 individuals and 0.028 relative abundance, whereas the least common species with n=47 individuals and 0.027 relative abundance were the Indian Skipper (*Hesperia galba*) (4.7±0.7) and Himalayan Grass Dart (*Taractrocera danna*) (4.7±0.66) (Fig 2).

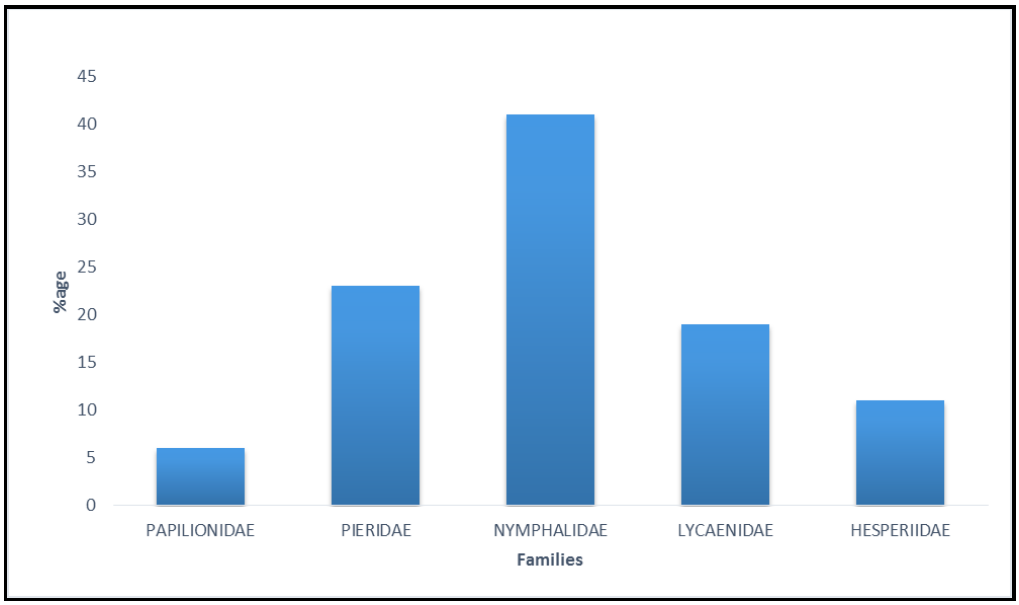

Fig 2: Percentage Frequency of species in different families in SGR

We also calculated family wise diversity and Nymphalidae has been found the most diverse family among the five butterflies families recorded from the study area. Nymphalidae family was recorded n=16 species which formed 42.10% of the total species recorded. Family Pieridae was recorded n=9 species with 23.68%, Lycaenidae with n=6 (15.78%), Hesperiidae with n=4 (10.52%) and family Papilionidae were recorded only n=3 species which were covered 7.89% of the total species recorded.

3.2. Species encounter rate

The Encounter Rate of the most common specie of family Nymphalidae, Indian Red Admiral was 0.0108, which was the highest among family. Large Cabbage White and Green-Veined White of family Pieridae has the same encounter rate 0.0098, and in family Papilionidae, the highest encounter rate was of Common Yellow Swallowtail that was 0.0082. The Encounter Rate was varied among the species of the same family. The encounter rate of White-Line Hairstreak and Cornelian was 0.0084 and 0.009 respectively, which was the highest and lowest among the species of family Lycaenidae. The encounter rate of least common species of family Hesperidae like Indian Skipper and Himalayan Grass Dart was 0.0094.

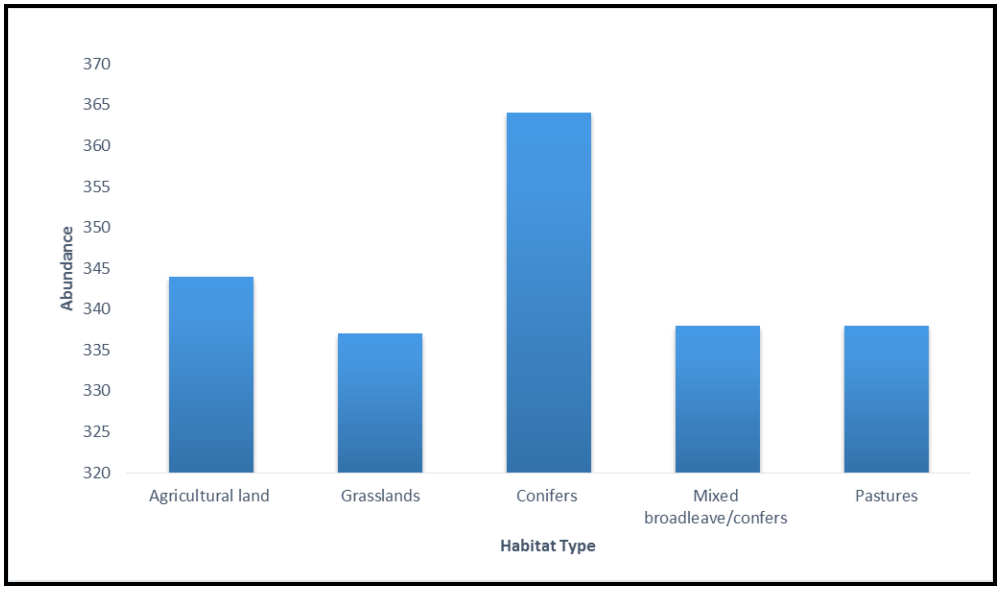

Fig 3: Species abundance in relation to different habitat type in SGR

The largest Encounter rate was 0.1434 of Family Nymphalidae, whereas Family Papilionidae exhibited the least Encounter rate 0.0218. Furthermore, the calculated Encounter rate of Family Pieridae was 0.081, Family Lycaenidae was 0.0582 and 0.038 was the ER of Family Hesperiidae.

During the surveys, conifers forests type was found the richest habitat for the butterflies which recorded species with ER=7.28. Agricultural land was recorded as the second most rich habitat with ER=6.88.Species encounter rate in Mixed broad leave/conifers and pastures habitat were recorded ER=6.78 from the study area. Grasslands were found to be the least rich habitat with species encounter rate ER=6.74, which is may be due to high disturbance by the locals for grass cutting and grazing activities.

4. Discussion

The current study collected data on butterfly community assemblage which recorded 38 different species with 1721 individuals in Salkhala game reserve (Table 1). The study was conducted in a smaller area in a short period of time so, the number of species recorded during this study was low whereas Pakistan has rich diversity of butterflies [8] The diversity index (H') value was recorded -4.561 with 212.46 individuals/km^2 from the reserve area, though this information is from a quite smaller area but is of great conservation value being existing in global biodiversity hotspot of the Himalaya [18]. Other research suggested that butterfly diversity is closely correlated to plant diversity and there is some evidence to suggest that the proportion of butterfly diversity may indicate a higher diversity of birds [19-21].

During the current study, forest habitat were recorded to hold highest number of butterflies i.e. n=364 which forms 21.51% (Figure 1), similarly Species richness and diversity of butterfly were recorded high in the forest system somewhere in Indian Himalaya [18] which may be due to the fact that forests system comprised undisturbed patch of vegetation with tall trees and abundant flowering plants which provide favorable habitat to the butterflies. Butterfly community is significantly affected by habitat loss and modification [12-22-23].

During the study, Common Windmills was recorded between an altitudinal range of 1320-3120m in Salkhala Game Reserve whereas it was reported between an altitudinal range of 1500-2700m in Machiara National Park, Azad Kashmir [8]. White-Line Hairstreaks were recorded between an altitudinal range of 1320-3120m during the current study, already reported by [24] from Northern Kashmir and Baltistan and already recorded between 1200-1300m in Pakistan [8]

The least preferred habitat of the butterflies are the grasslands which found holding n=337 individuals and cover 19.58% of the butterflies recorded from the current survey, and there are few records of family Nymphalidae and Pieridae species, they were also recorded within the grasslands including grassy clearings in wood, open grassland habitats of Great Himalayan National Park [25].

This study provides information on distribution of butterflies in different habitat type e.g. conifers forests type were recorded as the richest habitat for the butterflies which recorded species with ER=7.28 encounter rate, agricultural land (ER=6.88), mixed broad leave/conifers and pastures (ER=6.78) and grasslands (ER=6.74). Considering encounter rate of the species as detection rate may provide best indicator of the habitat and ecosystem health. Some other studies elsewhere also recorded the similar results and highlighted that specialist and rare species are mostly encountered in forests and metric decreases with increasing forest habitat disturbance levels [26-27].

Table 1: Showing the Diversity index of the species in Salkhala Game Reserve, Kashmir Himalaya, Pakistan.

Scientific Name	Common Name	Abundance	Relative Abundance	Encounter rate
Papilio arcturus	Blue Peacock	34	0.019	0.0068
Papilio machaon	Common Yellow Swallowtail	41	0.0239	0.0082
Atrophaneura polyeuctes	Common Windmill	34	0.019	0.0068
Pieris brassicae	Large Cabbage White	49	0.0286	0.0098
Pieris canidia	Indian Cabbage White	42	0.024	0.0084
Aporia leucodice	Himalayan Blackvein	42	0.024	0.0084

Gonepteryx rhamni	The Common Brimstone	44	0.025	0.0088
Gonepteryx mahaguru	Lesser Brimstone	44	0.025	0.0088
Colias fieldi	The Dark Clouded Yellow	42	0.024	0.0084
Eurema hecabe	Common Grass Yellow	46	0.0268	0.0092
Pontia chloridice	Small Bath White	47	0.027	0.0094
Pieris napi	Green- Veined White	49	0.0286	0.0098
Argynnis childreni	Large Silverstripe	50	0.029	0.01
Aulocera swaha	Common Satyr	48	0.028	0.0096
Vanessa indica	Indian Red Admiral	54	0.0315	0.0108
Vanessa cashmiriensis	Indian Tortoiseshell	50	0.029	0.01
Danaus genutia	Common Tiger	40	0.023	0.008
Polygonia vau-album	Comma Tortoiseshell	41	0.0239	0.0082
Vanessa xanthomelas	Large Tortoiseshell	42	0.024	0.0084
Dodona durga	Common Punch	41	0.0239	0.0082
Erebia shallada	Mountain Argus	40	0.023	0.008
Danaus chrysippus	Plain Tiger	40	0.023	0.008
Paralasa annada	Ringed Argus	41	0.0239	0.0082
Eurema laeta	Spotless Grass Yellow	43	0.025	0.0086
Libythea lepita	The Common Beak	47	0.027	0.0094
Junonia hierta	Yellow Pancy	46	0.0268	0.0092
Junonia almana	Peacock Pancy	47	0.027	0.0094
Junonia orithya	Blue Pancy	47	0.027	0.0094
Rapala nissa	Common Flash	46	0.0268	0.0092
Deudoryx epijarbus	Cornelian	45	0.0262	0.009
Narathura rama	Dark Himalayan Oakblue	47	0.027	0.0094
Strymon assamica	White-Line Hairstreak	54	0.0315	0.0108
Lycaenopsis vardhana	Dusky Hedge Blue	53	0.03	0.0106
Rapala selira	Red Himalayan Flash	46	0.0268	0.0092
Hesperia galba	The Indian Skipper	47	0.027	0.0094
Baoris discrete himalaya	Himalayan Swift	48	0.028	0.0096
Taractrocera danna	Himalayan Grass Dart	47	0.027	0.0094
Celaenorrhinus munda	Himalayan Spotted Flat	48	0.028	0.0096

5. Conclusion and Recommendation

Salkhala game reserve is a small geographic area and time for this study was also short but even then this study provided baseline information which could be used to develop a future plan for the long term monitoring of butterflies fauna. Throughout SE Asia, much forested land area is either being fragmented or converted to other land uses such as agriculture, human settlement, recreation, amenity or industry [28], so this baseline information would be great help to set an indicator for future changes in habitat and biodiversity.

Communities living around is generally uneducated and lack of scientific knowledge about role of butterflies in ecosystem is also lacking, so in order to protect the natural habitat, awareness programs should be conducted. It is need of the time to bring about the science-based activities at school level and educate the community about the importance of their natural resources. After all, local people are directly linked with the maintenance or disturbance of habitats of various wildlife species including butterflies. A conservation and management plan for the game reserve is the need of the time to help mitigate the threats to butterflies and other important wildlife of the SGR.

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7. References

1. Van Swaay CAM, Brereton T, Kirkland P, Warren MS. Manual for Butterfly Monitoring. Report VS.10, De Vlinderstichting/Dutch Butterfly Conservation, Butterfly Conservation UK & Butterfly Conservation Europe, Wageningen, 2012.
2. Kremen C, Williams NM, Aizen MA, Gemmill-Harren B, LeBuhn G, Minckley R, *et al*. Ricketts. Pollination and other Ecosystem services produced by mobile organisms: a conceptual framework for the effects of land use change. Ecol. Lett. 2007; 10(4):299-314.
3. Hopwood J. Pollinators and Roadsides: Managing Roadsides for Bees and Butterflies, the Xerces Society for Invertebrate Conservation, 2010.
4. Gullan PJ, Cranston PS. The Insects: An Outline of Entomology, Wiley-Blackwell, West Sussex, UK. 2014; 5:624.
5. IUCN, Compiled by New, T. R. and N. M. Collins. Swallowtail Butterflies: An Action plan for their Conservation, 1991.
6. Heppner J. Classification of Lepidoptera. Part I. Introduction. Holarctic Lepidoptera. 1998; 5(1):1-148.
7. Martinez AL, Bousquets JL, Fernandez IF, Warren AD. Biodiversity and Biogeography of Mexican butterflies (Lepidoptera: Papilionoidea and Hesperioidea). Proceedings of Entomological Society of Washington. 2003; 105(1):209-244.
8. Roberts TJ. The Butterflies of Pakistan. Oxford University Press, Karachi, 2001.
9. Fleishman E, Thomson JR, MacNally R, Murphy DD, Fay JP. Using Indicator Species to Predict Species Richness of Multiple Taxonomic Groups. Conserv. Biol. 2005; 19(4):1125-1137.

10. Grill A, Knoflach B, Cleary DFR, Kati V. Butterfly, spider, and plantcommunities in different land-use types in Sardinia, Italy. Biodivers. Conserv. 2005; 14(5):1281-1300.
11. Maes D, Bauwens D, de Bruyn L, Anselin A, Vermeersch G, van Landuyt W, *et al*. Species richness coincidence: conservation strategies based on predictive modelling. Biodivers. Conserv. 2005; 14(6):1345-1364.
12. Chettri N. Cross-taxon congruence in a trekking corridor of Sikkim Himalaya: Surrogate analysis for conservation planning. Journal for Nature Conservation. 2010; 18:75-88; http://doi.org/10.1016/j.jnc.2009.03.003
13. Awan MN, Buner F. Conservation of Western Tragopan *Tragopan melanocephalus* around Salkhala Game Reserve, Azad Kashmir, Pakistan. Birding Asia. UK. 2014; 21:107-111
14. Dudley N. Guidelines for applying protected area management categories. Gland, Switzerland: IUCN, 2008.
15. Awan MN. Status and Conservation of Western Tragopan Pheasant in and around Salkhala Game Reserve, Distrcit Neelum, Azad Kashmir, Pakistan. Final Progress Report Submitted to Oriental Bird Club. UK, 2010.
16. Termizi SH, Rafique CM. Forestry Statistics of Azad Kashmir.Forest Department Azad Jammu and Kashmir. 2001, 1-4.
17. Pollard E, Yates TJ. Monitoring Butterflies for Ecology and Conservation; The British Butterfly Monitoring Scheme. 1993; 1(1).
18. Chettri PK, Sharma K, Dewan S, Acharya BK. Butterfly diversity in human- Modified ecosystems of southern Sikkim, the eastern Himalaya, India. Journal of Threatened Taxa. 2018; 10(5):11551-11565. http://doi.org/10.11609/jott.3641.10.5.11551-11565
19. New TR. Are Lepidoptera an Effective "Umbrella Group" for Biodiversity Conservation? J. Insect. Conserv. 1997; 1(1):5-12.
20. Van Jaarsveld AS, Freitag S, Chown SL, Muller C, Koch S, Hull H, *et al*. Biodiversity Asessment and Conservation Strategies. Science. 1998; 279(5359):2106-2108.
21. Blair RB. Birds and butterflies along an urban gradient: surrogate taxa for assessing Biodiversity. Ecol. Appl. 1999; 9(1):164-170.
22. Perfecto I, Mas A, Dietsch T, Vandermeer J. Conservation of biodiversity in coffee agroecosystems: a tri-taxa comparison in southern Mexico. Biodiversity and Conservation. 2003; 12:1239-1252. http://doi.org/10.1023/A:1023039921916
23. Bobo KS, Waltert M, Fermon H, Njokagbor J, Mühlenberg M. From forest to farmland: Butterfly diversity and habitat associations along a gradient of forest conversion in Southwestern Cameroon. Journal of Insect Conservation. 2006; 10(1):29-42. http://doi.org/10.1007/s10841-005-8564-x
24. De Niceville L, Marshall GFL. The butterflies of India, Burma and Cylon: A descriptive handbook of all known species of Rhopalocerous Lapidoptera inhibiting that region with notices of allied species occurring in the neighboring countries along the border with numerous illustrations. Calcutta central press company, 1890, 3.
25. Uniyal VP, Mehra BS. Preliminary observations on the diversity of Butterflies (Lepidoptera: Insecta) at high altitude grazing pastures in Great Himalayan National Park. Zoos'Print. Zoo Outreach Organization. Coimbatore. 1996; 12(9):7-8.
26. Mayfield MM, Boni ME, Daily GC, Ackerly D. Species and functional diversity of native and human-dominated plant communities. Ecology. 2005; 86(9):2365-2372; http://doi.org/10.1890/05-0141
27. Vu LV. The effect of habitat disturbance and altitudes on the diversity of butterflies (Lepidoptera: Rhopalocera) in a tropical forest of Vietnam: results of a long-term and large-scale study. Russian Entomological Journal. 2013; 22(1):51-65.
28. McNeely JA, Gadgil M, Leveque C, Padoch C, Redford K. Human influences on biodiversity. Global biodiversity assessment. 1995, 30.