

Preliminary ecological studies on the Lepidoptera from Khajjiar lake catchment, Himachal Pradesh, India

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ABSTRACT

A study on the Lepidoptera from Khajjiar lake of District Chamba of Himachal Pradesh revealed the presence of 49 species of butterflies belonging to 41 genera and 10 families. Analysis of data revealed that family Nymphalidae and Satyridae (12 species each) dominated the Lepidoptera fauna of Khajjiar lake catchment, followed by Pieridae and Lycaenidae (6 species each), Hesperidae (4 species), Papilionidae (3 species), Erycinidae and Danaidae (2 species each), and Acraeidae and Riodinidae (1 species each). Categorization of the species further revealed that of these 49 species, 5 were very common, 32 common, 5 uncommon and 7 were rare. Moreover, 3 species were listed in Indian Wildlife Protection Act (1972), *Lethe scanda* (Moore, 1857) and *Lampides boeticus* (Linnaeus, 1767) placed under scheduled II and *Castalius rosimon* (Fabricius, 1775) under scheduled IV of the Act. Our study revealed that forest area supports the highest diversity of butterflies followed by lake areas and human settlements.

KEY WORDS

Butterflies; ecology; biodiversity; India.

Received 22.02.2014; accepted 08.03.2014; printed 30.03.2014

INTRODUCTION

A recent estimate shows the occurrence of about 142,500 species of Lepidoptera around the globe, but estimates within Lepidoptera from the Indian sub-continent revealed that the group comprises over 15,000 species and many more subspecies distributed over 84 families and 18 superfamilies (Alfred et al., 1998). In India nearly 1500 species of butterflies are reported (Gay et al., 1992). Many scientists have studied the butterflies from Himalayas including Moore (1882), Marshall & de Niceville (1890), Evans (1932), Talbot (1939; 1947), Wynter-Blyth (1940; 1945a, b; 1957), Mani (1986) and Thakur et al. (2002; 2006). Arora et al. (2005) listed 288 species from the recently created state of Himachal Pradesh distributed in 12 districts

with altitudes ranging from 400-4500 m. However very few studies are there on the ecological aspects of the butterflies in Himachal Pradesh. Apart from Thakur et al. (2006) who have listed butterflies of Kalatop-Khajjiar wildlife sanctuary, there is little information about butterflies from Chamba district. However recently Singh & Banyal (2013) enlisted butterflies of Khajjiar along with insect fauna. But that work was focused only on presenting a checklist of insects and did not account the ecological aspects of butterflies. The area under investigation is one of the oldest conservation areas for wildlife in Himachal Pradesh and, being a favoured tourist destination, is also under remarkable anthropological pressure which may severely influence habitat conservation and egg laying habits of butterflies. Keeping this in mind we explored Khajjiar Lake to

assess ecological aspects of butterflies such as abundance, seasonal occurrence, habitat preference and conservation status. Besides, an effort was also made to identify the existing threats to the habitat of butterflies in the study area.

MATERIAL AND METHODS

Study Area. Khajjiar Lake “The Mini Switzerland of Himachal Pradesh” is situated in the western part of Chamba district of Himachal Pradesh. Khajjiar Lake lies 32°32′ North and 76°03′ East about 1920 m above sea level between Chamba and Dalhousie (Fig. 1). The average depth of this lake is stated to be thirteen feet as per district gazetteer (Singh & Banyal, 2012). Khajjiar Lake has a clump of reeds and grasses exaggeratedly called an island in it. This lake is placed in the centre of large glade and is fed by slim streams. This glade is greenish in its turf and contains in its centre a small lake having an approximate area of 464.52 square meters. Khajjiar Lake has thick forest of Kala Top sanctuary

(20.69 sq. km) surrounding the green grass. This small sanctuary lies in the catchments of the Ravi river, located in the western part of Chamba District. It is one of the oldest preserved forests of the state (notified on 01.07.1949). There is a ‘golden’ domed temple at the edge of this meadow, dedicated to the deity ‘Khajjinag’, from whom the area derives its name (Fig. 2). It experiences south-western monsoon rains in July-September and the average annual rainfall is about 800 mm. The climate of Khajjiar, summers being mild and winters cold and bitter, shows a temperature range from -10° C to 35°C. The vegetation consists of mature mixed Blue Pine (*Pinus wallichiana* A. B. Jacks.) and Deodar cedar forests (*Cedrus deodara* (Roxb.) G. Don), with some Green Oak and *Rhododendron* plants. Study area was broadly divided into three main types depending upon the vegetation and human intervention like dense forests, lake meadow and human settlements. Different butterfly species were sampled at regular intervals from all three localities.

Sampling of butterflies. Butterflies were sampled using the line transect walk method (Pollard &

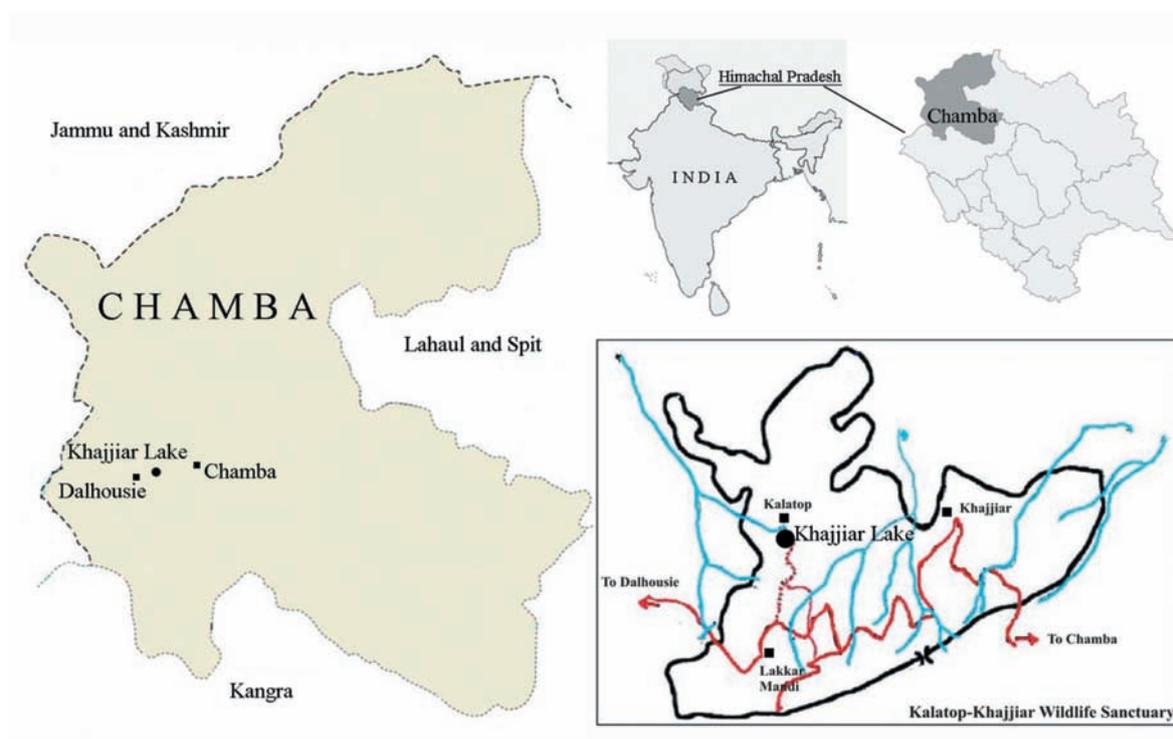


Figure 1. Study area: Khajjiar Lake, in the western part of Chamba district of Himachal Pradesh (India).

Yates, 1993). Six transects measuring 500 m each, were randomly laid for sampling (two in each site). Point counts were made after interval of 200 meters along each transect to record butterfly species and their number. All butterflies seen within two meters on either side of the transect were recorded. Transects were walked between 10:00 hrs and 13:00 hrs which corresponds to the peak activity period for most butterflies. Nylon net with long handle was used for sweeping free flying and free living butterflies. After collection specimens were put into killing bottles containing chloroform. These insects were transferred to paper envelopes. Each envelop was numbered carefully and the details of specimen number, date, host etc. were written in a field notebook. Thereafter, insects were properly stretched and pinned by rust-free entomological pins. These stretched and pinned specimens were kept in wooden insect boxes in dry conditions providing naphthalene balls (Arora, 1990) to protect them from fungal infections and other attacks.

Butterfly Identification. Identification of species was done from description given by Marshall & de Niceville (1890), Evans (1932), Wynter-Blyth (1957). Some species were identified after comparison with reference collections housed at Indian Agriculture Research Institute (I.A.R.I.), New Delhi; High Altitude Regional Centre, Zoological Survey of India, Saproon, Solan; Himachal Pradesh and Forest Research Institute (F.R.I.), Dehradun. Dr. M.S. Thakur of Department of Biosciences, Himachal Pradesh University, Shimla was also consulted for authentication of identification.

Data analysis. Abundance status was assessed on an arbitrary frequency scale as: very common (VC), collected more than in eight spots from the three areas; common (C), collected from four to seven spots from the three areas; uncommon (UC), collected from two or three spots from the three areas; rare (Ra), collected from one spot from the three areas, according to Davidar et al. (1996).

RESULTS

Present study revealed the presence of 49 species of butterflies belonging to 41 genera and 10 families (Table 1). Analysis of data revealed that family

Nymphalidae and Satyridae (12 species each) dominated the Lepidoptera fauna of Khajjiar area, followed by Pieridae and Lycaenidae (6 species each), Hesperidae (4 species), Papilionidae (3 species), Erycinidae and Danaidae (2 species each), and Acraeidae and Riodinidae (1 species each) (Fig. 2). Analysis of these species for abundance revealed that of these 49 species, 5 were very common, 32 common, 5 uncommon and 7, namely *Parnassius hardwickei hardwickei*, *Lethe insane insane*, *Lethe scanda*, *Ypthima ceylonica hubneri*, *Pseudergolis wedah*, *Issoria lathonia*, *Polytremata eltola*, were rare (Fig. 3). Moreover, three species were placed under Wildlife Protection Act (1972). These included *Lethe scanda* and *Lampides boeticus* placed under scheduled II and *Castalius rosimon* under scheduled IV of the Act.

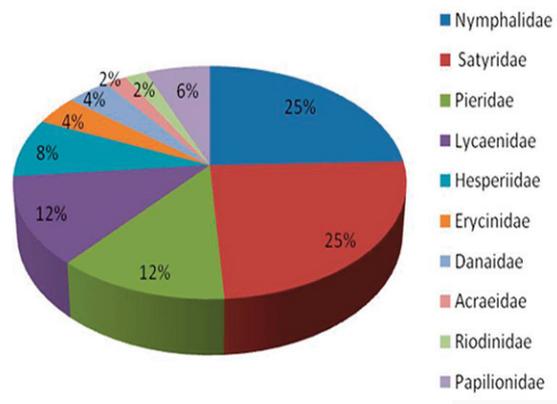


Figure 2. Lepidoptera diversity of the Khajjiar Lake, India.

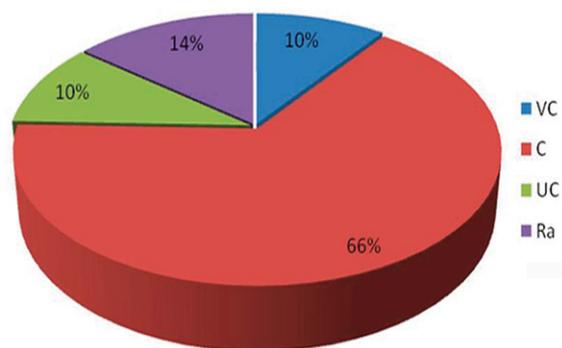


Figure 3. Lepidoptera abundance of the Khajjiar Lake, India; explanation in the text.

N.	Name of Butterfly	Family	Wing Size (in mm)	Conservation Status	Months of Dominance from-to
1	<i>Papilio protenor</i> Cramer, 1775	Papilionidae	100- 130	Common	March-September
2	<i>Papilio polyctor polyctor</i> Boisduval, 1836		90-130	Common	March-October
3	<i>Parnassius hardwickei hardwickei</i> Gray, 1831		50-65	Rare	May-September
4	<i>Delias belladonna horsfieldi</i> (Gray, 1831)	Pieridae	70-96	Uncommon	April-July September-November
5	<i>Pieris canidia indica</i> Evans, 1926		45-55	Common	April-October
6	<i>Catopsilia crocale</i> Cramer, 1775		55-75	Common	May-October
7	<i>Gonepteryx rhamni nepalensis</i> Doubleday, 1847		60-70	Common	March-October
8	<i>Eurema hecabe fimbriata</i> (Wallace, 1867)		30-40	Common	April-November
9	<i>Colias electo fieldi</i> Menetries, 1885		42-45	Very common	February-November
10	<i>Danaus genutia</i> (Cramer, 1779)	Danaiidae	70-78	Common	March-November
11	<i>Parantica sita sita</i> (Kollar, 1844)		85-105	Common	April-November
12	<i>Mycalesis perseus blasius</i> (Fabricius, 1798)	Satyridae	38-55	Very common	March-November
13	<i>Lethe insane insane</i> (Kollar, 1844)		55-60	Rare	May-October
14	<i>Lethe scanda*</i> (Moore, 1857)		55-65	Rare	June-September
15	<i>Lethe verma verma</i> (Kollar, 1844)		55-60	Common	April-October
16	<i>Lasiommata schakra schakra</i> (Kollar, 1844)		45-60	Common	April-October
17	<i>Aulocera swaha swaha</i> (Kollar, 1844)		60-75	Common	May-September
18	<i>Aulocera saraswati saraswati</i> (Kollar, 1844)		60-75	Common	July-October
19	<i>Callerebia annada</i> (Moore, [1858])		55-70	Common	April-October
20	<i>Ypthima nareda nareda</i> (Kollar, 1844)		30-32	Common	April-October
21	<i>Ypthima ceylonica hubneri</i> Kirby, 1871		30-40	Rare	April-October
22	<i>Ypthima sakra nikaea</i> Moore, 1875		45-55	Very common	March-November
23	<i>Melanitis leda ismene</i> (Cramer, [1775])		60-80	Very common	March-November
24	<i>Athyma opalina</i> (Kollar, [1844])	Nymphalidae	55-70	Common	March-November
25	<i>Parathyma asura asura</i> (Moore, 1857)		65-75	Uncommon	July-August

Table 1. Check list and ecological data of the Lepidoptera from Khajjiar Lake, India (continued).

N.	Name of Butterfly	Family	Wing Size (in mm)	Conservation Status	Months of Dominance from-to
26	<i>Neptis mahendra</i> Moore, 1872		55-60	Common	April-October
27	<i>Neptis hylas astola</i> Moore, 1872		50-60	Common	March-October
28	<i>Pseudergolis wedah</i> Kollar, 1844		55-65	Rare	April-November
29	<i>Precis iphita</i> (Cramer , [1779])		55-65	Uncommon	Jan-December
30	<i>Cynthia cardui</i> (Linnaeus, 1758)		55-70	Common	April-November
31	<i>Vanessa indica</i> (Herbst, 1794))		55-65	Common	March-December
32	<i>Kaniska canace</i> (Linnaeus, 1763)		60-75	Uncommon	March-November
33	<i>Aglais cashmirensis</i> (Kollar, 1844)		55-65	Common	March-November
34	<i>Childrena childreni</i> (Gray, 1831)		75-100	Common	May-November
35	<i>Issoria lathonia</i> (Linnaeus, 1758)		55-60-78	Rare	February-October
36	<i>Acraea issoria anomala</i> Kollar, 1848	Acraeidae	45-65	Common	April-September
37	<i>Libythea myrrha</i> Godart, 1819	Erycinidae	45-55	Common	March-October
38	<i>Libythea lepita</i> (Moore, 1857)		55-60	Common	March-September
39	<i>Dodona durga</i> (Kollar, 1844)	Riodinidae	30-40	Common	March-October
40	<i>Pseudozizeeria maha</i> (Kollar, [1844])	Lycaenidae	20-30	Common	January-November
41	<i>Lampides boeticus</i> * (Linnaeus, 1767)		24-36	Common	March-October
42	<i>Lycaena pavana</i> (Kollar, [1844])		37-40	Common	March-October
43	<i>Heliophorus sena</i> (Kollar, [1844])		28-33	Very common	March-October
44	<i>Castalius rosimon</i> ** (Fabricius, 1775)		25-27	Common	January-November
45	<i>Rapala manea schistacea</i> (Moore, 1879)		30-33	Common	June-October
46	<i>Coladenia dan</i> (Fabricius, 1787)	Hesperiidae	35-45	Common	May-October
47	<i>Sarangesa purendra</i> (Moore, 1882)		28	Uncommon	May-June
48	<i>Polytremis eltola</i> (Hewitson, 1869)		32	Rare	March-November
49	<i>Borbo bevani</i> (Moore, 1878)		30	Uncommon	April-October

Table 1 (continued). Check list and ecological data of the Lepidoptera from Khajjiar Lake, India.

Maximum richness was observed in the forest area which is rich of trees with well developed undergrowth. Minimum richness was present in the human settlement of the study area which is a degraded habitat where continuous intervention of humans generated severe pollution. Intermediate values of species richness were observed in the lake meadow area.

DISCUSSION AND CONCLUSIONS

Khajjiar lake catchment, which is an important conserved area of Himalayas, supports a rich fauna of butterflies with 49 species. These records are in accordance with the previous study of Arora et al. (2005) who also recorded some butterfly species of conservation concern from the state of Himachal Pradesh. Similar studies were also conducted by Mehta et al. (2002) who studied butterflies of Pong Dam wetland in District Kangra (H.P.) and Thakur et al. (2006) who reported 50 species belonging to 37 genera under seven families; moreover distributional records of Rhopalocera from Pin Valley National Park were studied and 14 species belonging to 11 genera and four families were reported. Nymphalidae is the largest family of the butterflies in the study area represented by 12 species along with family Satyridae having the same number of species. Nymphalidae is the largest representative family of butterflies from India with 450 species (Varshney, 1993). This may be attributed to their polyphagous habits which probably helps these Lepidoptera to survive in a variety of habitats. Moreover, members of this species can forage in distant areas as they are active fliers.

Maximum numbers of species were observed from March to November and very few species were seen from December to February and only one species was noted in January in a human habitation far from frozen lake. Two species were present for a very short period of the year in the study area, i.e. *Parathyma asura asura* in July and August while the small-sized species *Sarangesa purendra* in May and June. Maximum abundance of butterflies in particular periods of the year (months) is related to seasonal variations and atmospheric temperature. From March to November the temperature of the area is favorable to lepidopterans. In the months from July to September Monsoon is active in this

part of India which results in increased growth of various type of vegetation. Hence, during this time abundance of butterflies is more than in the months from December to February when climatic conditions in the area are very adverse. During this period the area is subject to heavy snow falls resulting in low temperatures and poor vegetation.

When relative abundance of these species was studied it was found that of these 49 species, 5 were very common, 32 common, 5 uncommon and 7 were rare. This shows that 10% species are very common, 66% species are common, 10% species uncommon and 14% are rare species of the total recorded species from the area. In addition, 3 species listed in Wildlife Protection Act (1972) viz., *Lethesca scanda* and *Lampides boeticus* placed under scheduled II and *Castalius rosimon* under scheduled IV of the Act have also been reported from the Khajjiar area. The occurrence of three threatened species suggests the need of immediate need of implementation of strategies of sustainable conservation.

In this study it was revealed that maximum abundance was present in the forest areas of Khajjiar. Similar observations were made in previous studies on diversity and habitat preference of butterflies in various parts of India (Sreekumar & Balakrishnan, 2001; Ramesh et al., 2010; Sarma et al., 2012). Butterflies show distinct patterns of habitat utilization. The nature of vegetation is an important factor which determines the dependence and survival of a species on a particular habitat. Being highly sensitive to environmental changes, they are easily affected by even relatively minor disturbances in the habitat so much that they have been considered as indicators of environmental quality and are also treated as indicators of the health of an ecosystem. The presence of butterflies emphasizes availability of larval food plants. As stated before, most of the butterflies have specific habitat requirements, as females usually tend to lay eggs only on selective food plants occurring in the area (Thakur & Mattu, 2010).

With ever increasing number of tourists reaching Khajjiar every year the number of hotels in the area is increasing. This is good for general socioeconomic development of the area but has adverse impacts on ecology. Many tourists visit deep in the forests and enjoy trekking in the hills. Hotels and tourists produce a large quantity of non-degradable garbage which accumulates in and around the lake

and also deep into the forest. These activities can affect sensitive microhabitat of butterflies. Present study revealed that Khajjiar Lake catchment area is very rich in lepidopteron fauna, which is depicted from the large number of variety of butterflies in term of large number of species. But at the same time 14% of the species comes under the category of rare species which means their specimens have been collected only from limited (single) place i.e. from grassland or dense forest or from human habitations. Additionally, 3 species were placed under Wildlife Protection Act (1972). Therefore this area needs intervention for implementation of measures of sustainable conservation.

ACKNOWLEDGEMENTS

Authors are grateful to University Grants Commission for providing financial assistance in form of Rajeev Gandhi National Fellowship. Authors are also thankful to Dr. M.S. Thakur of Department of Biosciences, Himachal Pradesh University, Shimla and Director, High Altitude Regional Centre, Zoological Survey of India, Saproon, Solan, Himachal Pradesh for help in species identification.

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