



Taxonomic Review on the Butterfly Diversity (Rhopalocera: Lepidoptera)-A Preliminary Study

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ABSTRACT: The present paper deal with the introduction of the insect diversity, position of order Lepidoptera, term butterflies, stages and their families, brief notes on the higher classification of the order Lepidoptera and detail review on the butterflies families are suitable highlighted.

Key Words: Butterfly, Rhopalocera, taxonomic, Lepidoptera

INTRODUCTION

On this Earth, 75-80% of total animal species are insects which are found in extreme habitats i.e., very cold conditions of polar regions, high mountains, streamy jungles, parched deserts, fresh water ponds and streams. They are minute size, high fecundity, capacity for flight and dispersal ability to feed on variety of materials, presence of chitinous skeleton and water retention ability. Due to these factors insects are out number in all other biota both in quality and quantity (Varshney, 1998). India is recognized as one of the 12th megadiversity countries of the world which has two biodiversity hot spots viz, the North-Eastern Himalayas and the Western Ghats. Out of a total of 1,719,183 species on global basis, 1,26,656 species have been enlisted from India (MoEF, 1998). Hammond (1992) estimated 9,50,000 species of insects, May (1990), quoted 7,50,000 and 7,90,000 species of insects in lower figures. An estimate shows that global species diversity vary from 2 million to 100 million species, having best estimate nearly 10 million (Anonymous, 1992) and insects represent their share of about 56 percent (Groombridge, 1992). Order Lepidoptera is the third largest order after

Coleoptera which comprises moths, butterflies and skippers.

Holloway (1969), there are about 2,00,000 species of Lepidoptera out of which 15,000 species belong to butterflies (Papilionoidea) worldwide. They are characterized by having broad wings covered with minute overlapping scales, usually brightly coloured. From the usage point of view, most familiar division of Lepidoptera is Heterocera (moths) and Rhopalocera (Butterflies) and Microlepidoptera and Macrolepidoptera (Evans, 1932). The term 'Butterfly' is derived from the male of the 'Common Brimstone' of the family Pieridae which is butter yellow in colour. In universal popularity, butterflies are second in number after birds. The butterflies are beautiful in colour and their colours are due to pigments deposited in their scales. These pigment are deposited during last developmental stages of pupa, coiled proboscis, antennae are either knobbed or clubbed at anterior end.

The adult butterflies collect nectar from flowers, cross pollinators, attracted by rotting of ripe fruits, animal dung or birds droppings to suck minerals. However, some collect nutrients near streams on dump and moist ground (Wynter Blyth, 1957). The Lepidopterans have complete metamorphosis (holometabolus) i.e., egg, larva, pupa and adult

present in their life cycle. Larval stage feeds voraciously on the plants leaving which minimizes the fruiting chances of plants so it is one of the most harmful stages of the life cycle (Wynter Blyth, *loc. cit.*).

Out of all the insects, butterflies are ecologically important because they act as pollinators of flowering plants, feed on the nectar of flowering plants. The climatic factors affect the population of butterflies and the same is also affected by host quality (Gilbert and Singer, 1975). Butterflies are also good indicators of the climatic, seasonal and ecological changes and help in formulating strategy for conservation. If the environmental conditions are favourable then butterfly diversity is also abundant (Gadgil, 1996). The present paper deal with the review of butterflies from India.

Brief notes on the higher classification of the order Lepidoptera:

On the basis of some characters such as shape of the wings, antennae and manner of folding of the wings, split Lepidoptera into three groups viz., *Papilio*, *Sphinx* and *Phalaena* to suggest a natural system of classification Linnaeus (1758), who named the order Lepidoptera. *Phalaena* was further divided into seven groups *Bombyx*, *Noctua*, *Geometra*, *Pyrallis*, *Tortrix*, *Tinea* and *Alucita*. In fact, since the inception of the order, a number of divisions have been proposed from time to time to establish a phylogenetic classification of the order. Its division into Heterocera (moths) and Rhopalocera (butterflies), and Microlepidoptera and Macrolepidoptera are quite familiar from the usage point of view only. By taking into account the structure of the eggs (Chapman, 1893, 1896), larvae (Dyar, 1894; Forbes, 1910; Fracker, 1915), pupae (Mosher, 1916), mouth parts (Packard, 1895) and the venation (Hampson, 1892, 1895), the respective worker's have divided the order into a variable number of groups/subgroups/suborders/divisions etc. As a major step, Hampson (1918) has proposed the utilization of as many as, eighty-four family names on the basis of wing venation diversity in this order. On the basis of the presence of jugum and frenulum the order has also been divided into Jugatae and Frenatae in the latter. Besides above Borner (1939) proposed a fundamental division of the order into Monotrysia and Ditrysia on the basis of structure of the female genitalia (Bourgogne, 1951).

Common (1970, 1975) has divided the Lepidoptera into four suborders viz., Zeugloptera (Micropterigoidea), Dacnonypha (Eriocranioidea), Monotrysia (Hepialoidea, Nepticuloidea, Incurvarioidea) and Ditrysia (Cossoidea,

Tortricoidea, Tineoidea, Yponomeutoidea, Gelechioidea, Corpomorpoidea, Castinoidea, Zygaenoidea, Pyraloidea, Pterophoroidea, Hesperioidea, Papilionoidea, Geometroidea, alliduloidea, Bombycoidea, Sphingoidea, Notodontoidea and Noctuoidea) on the basis of immature eggs having the respective number of superfamily/ies. These four suborder have also been followed by Richards and Davies (1977). However, except the former, Nielsen (1985), has proposed three other group names viz., Aglossata, Heterobathmia and Glossata as suborders. The latter has further been split up into Dacnonypha, Neopseustina, Exoporia and Heteroneura (Monotrysia and Ditrysia). Though, Minet (1986) has also followed four suborders of Nielsen (*loc. cit.*), yet divided the suborder Glossata into five infraorders i.e., Dacnonypha, Neopseustina, Nepticulina, Exoporia and Eulepidoptera. According to Eliot (1992), it is best to follow eight suborders viz., Zeugloptera, Aglossata, Heterobathmia, Dacnonypha, Neopseustina, Exoporia, Monotrysia and Ditrysia for an appropriate placement of different families/superfamilies.

Scoble (1995) has made a remark, "the choice of classification is a compromise, for lepidopterists adopt various different systems. Moreover classifications are constantly being modified as phylogenetic relationships between taxa are better understood. But despite variations in the system a general consensus exists partly because the classification or the order continues to rest on many long established families. To that extent existing classification exhibit considerable stability". Heppner (1998) system for the classification of Lepidoptera has followed. Authors Heppner has divided the order into four suborders viz., Zeugloptera, Aglossata, Heterobathmia and Glossata. The latter suborder is divided into five infraorders i.e., Dacnonypha, Lophocoronina, Neopseustina, Exoporia and Heteroneura. The Heteroneura is further divided into two divisions Monotrysia and Ditrysia. Under division Ditrysia two sections Tineina and Cossina has been considered. Two subsection i.e., Cossina and Bombicina are also divided under section Cossina. Besides superfamily Papilionoidea, the remaining seven has also been divided under subsection Bombycina. Under Papilionoidea author has considered seven families i.e., Nymphalidae, Papilionidae, Pieridae, Hesperidae, Lycaenidae, Riodinidae and Libytheidae. The review on these butterflies families are suitable highlighted.

REVIEW OF LITERATURE

J.B. Heppner (1998) classify the order Lepidoptera into nineteen superfamilies and one hundred and twenty-four families. In his publications, butterflies are placed under superfamily Papilionoidea which include seven families viz., Hesperidae (Skipper butterflies), Papilionidae (Swallowtail butterflies), Pieridae (Yellow-white butterflies), Lycaenidae (Gossamer winged butterflies), Riodinidae (Metal mark butterflies), Libytheidae (Snout butterflies) and Nymphalidae (Brush footed butterflies). During the course of present studies, barring the families i.e., Hesperidae, Lycaenidae, Riodinidae and Libytheidae the work has been carried out on three families viz., Nymphalidae, Papilionidae and Pieridae. The geographical distribution and diversity of these families are also given. Besides above, an attempt has been made to review various work on the superfamily i.e, Papilionoidea (Heppner, *loc.cit.*).

In the beginning of eighteenth century, Linnaeus (1758) and Fabricius (1775) named and described a large number of butterfly fauna from Indian region including northern region. Horsfield and Moore (1857) published the first account on Indian butterflies in their Lepidoptera Catalogue in the museum of the East India Company and included many species coloured figures, larvae and pupae from Java. Moore (1865) published paper on the Lepidopterous insects of Bengal. Other major contribution on butterfly were by Moore (1866-68) from Kashmir in India. de Niceville and Marshall (1882, 1886, 1890, 1883-1890) studied the fauna of Lepidoptera from India, Ceylon and Burma. After this, many papers on new butterflies from India were published by Moore (1880-87) and Butler (1860, 1869-74, 1877-89). Moore (*loc.cit.*) done a comprehensive work on the 'Lepidoptera of Ceylon' in which detailed descriptions and coloured figures of one hundred and two species of butterflies from Island were present. de Niceville (1881) published series of papers on butterflies. Moore (1890, 1896-1899) published 'Lepidoptera Indica' which contains habitats, distribution, figures of every known butterfly alongwith their description in detail. This work includes ten volumes of which Moore written seven volumes before his death and the remaining three were written by Colonel Charles Swinhoe (1909-1913). The first volume on butterflies, containing families i.e., Danaidae, Satyridae, Amathusidae, Nymphalidae and Riodinidae and another publications includes families viz., Papilionidae, Pieridae and a part of Lycaenidae were published by Bingham (1905, 1907). Later on Evans (1932) recorded nine hundred and sixty-two species of

butterflies from North Eastern region. Vallhonrat (1983) studied Lepidoptera (including butterflies, moths and skippers) occurring in *Catalonia* (eastern Spain) and recorded three hundred seventy-two species and four sub-species.

Heppner (1989) completed a month long study on the Lepidoptera diversity of the Dumoga-Bone National Park, Sulawesi and described three thousand seven hundred species of Lepidoptera. The faunal diversity index of North Sulawesi is seventy-four, out of four thousand five hundred species of Lepidoptera in world. It represents 1.64% of the world faunal diversity. Balasubramanian (1992) and Shrinivasan *et.al.*, (1992) listed species of butterflies from the sandal ecosystem of South India.

Varshney (1993) reported fifteen genera of family Papilionidae, twenty-five of Pieridae and six of Danaidae occurring in Pakistan, India, Nepal, Bhutan, Sri Lanka, Bangladesh and Myanmar. In the same region Varshney (1994) described forty-nine genera of families Satyridae (including Amathusiinae), eighty-one of Nymphalidae (including Heliconiinae and Acraeinae), one of Libytheidae and seven of Riodinidae. A list of one hundred forty eight butterflies from primary forests and secondary habitats of Colombia was given by Andrane (1994). In the same publication, notes on behaviour, food plant, nectar resources, variation and mimicry are also mentioned. Later on Varshney (1997) listed 144 genera from a single family Lycaenidae (including Liphyridae and Curetidae) from above mentioned localities.

Rose and Sidhu (1994) recorded Lycaenid butterfly diversity of Mussorie (Uttar Pradesh). Rose and Sharma (1995a) gave complex on the variations of species *Junonia orithya* complex of family Satyridae (Lepidoptera) from Mussorie. In another publication, authors briefly highlighted on the species *Junonia hierta* complex. They also reported new subspecies (Lepidoptera) from West Himalaya (Rose and Sharma 1995b). Variations of two species of the genus *Polyommatus* Latreille was studied by Sidhu and Rose (1995). In the next year, Rose and Sidhu (1996) revised the genus *Tarucus* Moore of superfamily Papilionoidea from North-West India. Further, the authors studied the wing maculation and genetical variation in the type-species i.e., *Aricia agestis* (Dennis and Shiffermuller) of family Lycaenidae from the area mentioned above. Rose and Sidhu (1997) made some comments on *Freyeria trochylus* complex of family Lycaenidae and gave some notes on Lycaenid genus *Chilade* Moore from North West India. Rose and Sidhu (1997a). They also reported the distribution of family Lycaenidae from Western

Himalaya. Rose and Sharma (1998) discussed the species complex of *Maniola* of the family Satyridae. In another publication, they described two new Satyrid species of the genus *Ypthima* Hübner from North-West Himalaya (Rose and Sharma 1998a). Further in the same year, authors discussed the role of genitalia in the identification of *Melanitis* species of family Satyridae (Rose and Sharma, 1998b). Inventory of Satyridae was also prepared from North-West India (Rose and Sharma, 1998c). The population status and male genitalic studies on *Lethe europa niladana* and *Parage eversmani cashmirensis* of the family Satyrid were suitably highlighted (Rose and Sharma, 1999). Rose and Sidhu (1999) studied distribution and identification of seven species belonging to the genera *Rapala* Moore and *Everes* Hübner of family Lycaenidae. The distribution of genus *Lethe* Hübner of family Satyridae from North Western Himalaya (Rose and Sharma, 2000). Rose and Sharma (2000a) made some additional notes on Himalayan Satyrid species i.e., *Dallacha hydriva* (Moore) and reported the distribution of four species of *Callerebia* Butter from North-West Himalaya (Rose and Sharma, 2000b). An inventory of butterflies of Punjab and Chandigarh was prepared by Rose and Sidhu (2001) and Rose and Walia (2003) respectively.

Jaksic and Mihajlovic (1996) recorded one hundred and forty-nine species of butterflies and moths (Lepidoptera) from the Durmitor National Park in Montenegro, Yugoslavia. The checklist of Azorean Lepidoptera include one hundred and forty-nine species and subspecies of which 22.8% are endemic. They are found in different islands of the Archipelago, namely fifty-three taxa in Santa Maria, ninety-four in Sao Miguel, eighteen in Vila Franca Islet, one hundred and six in Terceira, sixty-seven in Pico, sixty-eight in Faial, fifty-two in Sao Jorge, fifty in Graciosa, sixty-one in Flores and twenty-eight in Cario.

Dawson (1997) described one hundred and fourteen species of different families of butterflies in Greece. In all, three species of family Papilionidae, one species of Pieridae, three species of Nymphalidae, eight species of Satyridae, twenty-three species of family Lycaenidae and twelve species of family Hesperidae were described. Loxdale and Riles (1997) identified thirty-two species of butterflies of families viz., Papilionidae, Pieridae and Nymphalidae. The identification of these species have been finalized by using the field guides of Barcant (1970), Lewis (1974), Riley (1975), Harris (1989), Gerberg and Arnett (1989) and Scott (1992). Olivier (1997) reported sixteen species i.e.,

Gegenes pumilio pumilio (Hoffmansegg), *Carchorodus alceae alceae* (Esper), *Zerynthia cerisy cerisy* (Godart), *Iphiclydes podalirius podalirius* (Linnaeus), *Papilio machaon syriacus* Eller, *Colias crocea* (Fourcroy), *Euchloe ausonia taurica* Rober, *Pieris brassicae brassicae* (Linnaeus), *Pieris rapae rapae* (Linnaeus), *Lycaena phlaeas phlaeas* (Linnaeus), *Lycaena thersamon* (Esper), *Plebeius loewii loewii* (Zeller) *Polyommatus icarus* (Rottemburg), *Maniola telmessia* (Zeller), *Vanessa atlanta atlanta* (Linnaeus) and *Vanessa cardui* (Linnaeus) from the island of Patmos (Greece). Out of these nine species viz., *Gegenes pumilio pumilio* (Hoffmansegg), *Carchorodus alceae alceae* (Esper), *Zerynthia cerisy cerisy* (Godart), *Gegenes pumilio pumilio* (Hoffmansegg), *Carchorodus alceae alceae* (Esper), *Zerynthia cerisy cerisy* (Godart), *Colias crocea* (Fourcroy), *Euchloe ausonia taurica* Rober, and *Vanessa atlanta atlanta* (Linnaeus) were newly recorded. Avtzi et al., (1997) made the first attempt to register lepidoptera (Rhopalocera) at the mountain region of Paiko. Authors has dealt with fifty-seven different species of families Lepidoptera (Rhopalocera) in the area mentioned above. In the measurement done between 1985-86 at the National Park of Olympus, only forty-two species of Lepidoptera were registered. Gunatheraj et al., (1998) and Kunte (2000) provide detailed description of different butterflies (Lepidoptera) and their habitats from South India and Penninsular India. Quek et al., (1999) recorded seventy-eight species belonging to fifty-seven genera and five families from the island of Pulau Tioman (Malaysia). Out of these twenty-five species were new records from said localities. A list of sixty-five butterfly species was furnished from the western part of Bydgoszcz, Poland (Machnikowski, 1999). In the same year, Karisch (1999) enlisted approximately two thousand two hundred species of (Rhopalocera) in oberlausitz region in S.E.Germany.

Caselles and Manzano (1999) recorded one hundred twelve species of superfamilies Papilionoidea and Herperioidea at the western most spurs of the La Sierra de Gredos in Caceres province of Spain. In the same publication, they recorded four thousand one hundred and fifty-seven species from systematic sampling, bibliographic data and loaned material of above mentioned superfamilies. Malkiewicz and Marzec (1999) reported four species of butterflies (Lepidoptera) from odra valley Poland. The fauna of butterfly of Keoladeo National Park, Bharatpur was surveyed by Trigunayat (1999). The results of

these survey shows that family Danaidae, Pieridae and Lycaenidae were very common, Nymphalidae were moderately common and Hesperidae were rare in the above mentioned area. Morgun (1999) provided data on localities, flight period and biotic distribution of one hundred twenty-two species of butterflies (Rhopalocera) from Vinnitsa Area (Ukraine). Schwartz *et.al.*, (1999) enlisted thirteen species of butterflies (Lepidoptera) from southern lesser Antillean islands of St. Vincent. Out of fifty-seven species of different families of butterflies from Grenadines and Grenada, thirty-five species are now known from the Grenadines. The species *i.e.*, *Phoebis philea*, *Eurema lisa*, *Vanessa virginienses* and *Lycorea eleobaea* reported for the first time from Southern islands. The species viz., *Proteides mercurius grenadensis* Pinchon and Enrico has recognized as valid taxon. Meerman (1999) described four hundred and thirty-six species of five butterfly families of the order Lepidoptera (Papilionoidea) from Belize. Superfamily Papilionoidea is discussed in his monumental reference work, in which four hundred and thirty six species of five butterfly families were recorded. Author has also provided the distribution and larval food plants of these species.

Korb (2000) dealt with one hundred and eighty-three species of butterfly fauna from the northern Tien Shan, one hundred and forty-six species from Kirghizskii ridge, one hundred and twenty-one species from Kungei Ala –Too, one hundred and forty-six species from Zailiiskii Ala Too, one hundred and seventeen from Terskii Ala-Too and one hundred two species from the Ketmen ridge. Lotzing (2000) worked on the superfamilies *i.e.*, Hesperioidea and Papilionoidea (Lepidoptera) in nature reserve Salzstelle Hecklingen (Sachsen-Anhalt, Germany) and recorded twenty-one species of butterflies from above mentioned area. Cayabyab (2000) made an investigation of one hundred and forty-five species and subspecies of butterflies (Lepidoptera) comprising seventy-four genera belong to eight families of the superfamily Papilionoidea and sixteen genera belong to the family Hesperioidea of the superfamily Hesperioidea from Mount Makiling, University of Philippines Los Banos. Fourteen species and subspecies were new records from Luzon. Spearman *et.al.*, (2000) worked on the nomenclatural problems and synonymy of superfamilies Papilionoidea and Hesperioidea from Bioko island, equatorial Guinea. In all, author enlisted two hundred and forty-four species out of which thirty-three were new to science. Dennis *et.al.*, (2000) studied the geographical and historical influences on butterfly diversity during surveys conducted from thirty-one

islands of Greece and two islands Levantine Sea. Baskaran and Solaiappan (2000) recorded twenty-two butterflies (Lepidoptera) species during the survey conducted in Sattur taluk district of Tamilnadu.

Fernandez (2001) made a faunistic studies on Rhopalocera (Lepidoptera) from western submountain range of the Gudalajara province. The eight species *i.e.*, namely *Tonures ballus*, *Cupido osiris*, *C.minimus*, *Plebejus hespericus*, *Polyomunatus fabresse*, *Euphydryas desfontainii*, *Malitaea trivialis* and *Baleria dia* were reported from the said area. Racheli and Racheli (2001) gave an account of one thousand one hundred and seventy-six species of butterflies out of which sixty-seven species of Papilionidae, one hundred and fifty species of Pieridae and nine hundred fifty-nine species of Nymphalidae from Neotropical realm (Ecuador). Yokovlev and Nakonechnyi (2001) gave a list of one hundred and sixty-five species of butterflies (Lepidoptera) from Russia and Ukraine. Sree Kumar and Balakrishnan (2001) studied the diversity and habitat preferences of butterflies from South Indian tropical rain forest. Authors collected eighty-four species belonging to nine families of butterflies, out of which family Nymphalidae was the largest in number. Chunsheng (2001) investigated three subfamilies *i.e.*, Papilionidae, Zerynthiinae and Parnassiinae of superfamily Papilionoidea from China. During this work, one hundred and thirty-two species and two hundred and eighty-seven subspecies were recorded from above mentioned subfamilies. In the same publication, author also studied the systematic account, morphology, descriptions of eggs, larvae, pupae and male genitalia. The dichotomous key of families, subfamilies, tribe, genera and species of family Papilionidae are provided. The geographical distribution, the biology, food plants, habits, original description, synonyms and nominal transition of each taxon is also cited. Illustration of the male and the female genitalia, the venation, larvae and pupae and other external characters is given are suitably highlighted.

Motta (2002) collected two hundred and fifty-one species of butterfly from Uberlandia region (Minas, Gerais, Brazil). Geographical distribution of some Ithomiinae, as well as interactions of both adults and immatures with plants, reproduction periods for more abundant butterflies species were discussed.

Sielezniew and Stankiewicz (2003) conducted a survey on the butterflies (Papilionoidea and Hesperioidea) from Polish garden. The most common species *i.e.*, *Inachis io* (96%), *Aglais*

urticae (94%), *Vanessa Atlanta* (90%), *Pieris brassicae* (87%) and *Gonepteryx rhamni* (77%), *Lycaena dispar* and *Iphiclydes pcdalirius* (52%) were recorded in the garden. The records of *Colias erate* (Esper) species of family Pieridae (Lepidoptera) from Saxony and Germany were tabulated and shown on map by Reinhardt *et.al.*, (2003). This species was recorded in 1995 for the first time from Oberlqusitz Saxony, Germany. This species was also observed in greater numbers during August-November, 2002. The another species i.e., *Colias croceus* is also recorded in abundance from the same region. Winearska (2003) examined one hundred and four species of families Hesperidae, Papilionidae, Pieridae, Lycaenidae and Nymphalidae (Lepidoptera) from Warsaw and Poland. Out of one hundred and four species, ninety-eight species were recorded in historical times. The species viz., *Pyrgus serratulae*, *Aporia crataegi*, *Colias palaeno*, *Cupido argiades*, *Glaucopteryx alexis*, *Pseudophilotes baton*, *Maculinea arion*, *Plebejus optilete*, *Brenthis daphne*, *Nymphalis xanthomelas*, *Euphydryas aurinia* (*Eurodryas aurinia*), *Melitaea phoebe*, *Melitaea aurelia*, and the migratory *N. vaualbum* were not recorded from the above mentioned area. Seventy-five species were listed after 1961 in these areas. Ten species such as *Pieris brassicae*, *Pieris napi*, *Pieris rapae*, *Anthocharis cardamines*, *Colias hyale*, *Leptidea sinapis*, *Inachis io*, *Gonepteryx rhamni*, *Lycaena phlaeas* and *Lycaena tityrus* were recorded as common species and two viz., *Iphiclydes potalirius* and *Maculinea teleius* were rarely found. Besides this three species i.e., *Colias croceus*, *Vanessa atalanta* and *V. cardui* (*Cynthia Cardui*) were found less common. A collection of sixty-three species of butterflies were recorded from different ecological zones in Jordan. Which were examined with the collection of more than three thousand three hundred and fifty specimens of Jordan Insect Museum and Natural History Museum at Yarmuk University. Two species i.e., *Colotis danae* and *Anthocharis gruner* of the family Pieridae were recorded. On the basis of this study an updated list of butterflies of Jordan is given which bring a total of ninety-one species and subspecies (Katbeh *et.al.*, 2003).

Albelo (2004) reviewed butterfly fauna of Galapagos islands in which ten species were recorded from the Archipelago. The endemic species were *Lepiotes parrhasioides*, *Urbanus dorantes galapagensis* and *Agrautis vanillae golapagensis* and others Neotropical faunal elements. Mohandas (2004) reported one thousand five hundred and one species of

butterflies from India. Llorente *et.al.*, (2004) collected five hundred and thirty-eight species belonging to two hundred and seventy-six genera of five families (Hesperidae, Papilionidae, Pieridae, Nymphalidae and Lycaenidae) from Nayarit, Mexico.

Bhaskaran and Eswaran (2005) reported thirty species i.e., *Pachliopta artistolochiae*, *Pachliopta heter*, *Papilio polytes*, *Euploea core*, *Papilio polymenstor*, *Papilio demoleus*, *Danaus mallisa*, *Delias eucharis*, *Grapium sarpedon*, *Precis hierta*, *Precis lemonias*, *Catopsilia pyranthe*, *Ariadne aradne*, *Hypolimnas missipus*, *Catopsilia pomona*, *Graphium Agamemnon*, *Ixias pyrene*, *Cepora nerissa*, *Acraea violae*, *Junonia almana*, *Atella phalantha*, *Ixias marriane*, *Precis orithya*, *Colotis amata*, *Appias libythea*, *Ypthmia baldus*, *Appias albina*, *Edales pandava*, *Terias hecabe* and *Catopsilia florella* belonging to seven families viz., Papilionidae, Danaidae, Pieridae, Nymphalidae, Acraeidae, Satyridae and Lycaenidae from Shivakasi Taluk. During first wet season, only one species (*Danaus chrypissus* Linnaeus) of family Danaidae was recorded in abundance. In second wet season, four species of family Papilionidae, two species each belonging to family Pieridae, Nymphalidae and Danaidae were recorded. Bhuyal *et.al.*, (2005) recorded seventy species of different butterflies family, out of which forty species were from single family of Nymphalidae from regional Research Laboratory Campus, Jorghat, Assam. Paulraj and Ignacimuthu (2005) collected twenty-nine species from Kodambakkam, thirty-four species from Nugambakkam (Chennai), forty-six species from Manimangalam, forty-five species from Padappai, fifty species from Poonamalle and forty-three species from Sethpattu from Chennai. Forty-six species of eight families viz., Pieridae (eleven), Nymphalidae (eleven), Lycaenidae (seven), Hesperidae (six), Papilionidae (five), Danaidae (three), Satyridae (two) and Acraeidae (one) were recorded for the first time in the area mentioned above.

Thakur *et.al.*, (2006) worked on sixty-seven species of nine butterfly families, out of which, sixteen species belong to family Pieridae, fourteen to Lycaenidae, thirteen to Nymphalidae, ten to Satyridae, five to Danaidae, four to Hesperidae, three to Papilionidae and one each belonging to family Acridae and Erycinidae from Sukhna and catchment area in Chandigarh. Sharma *et.al.*, (2006) collected two thousand and sixty-eight individuals and recorded fifty-one species of butterflies belonging to four families viz. Lycaenidae, Nymphalidae, Papilionidae and

Pieridae in Sandal dominated ecosystem of Karnatka. Among the selected species *Junonia lemonias* Linnaeus and *Papilio polymenster* (Crammer) were found active throughout the year. According to Ackery (1984) there are approximately seventeen thousand and two hundred species of butterflies all over the world out of which one thousand and five hundred species are known from India (Gaonkar,1996; Chatterjee,1935; Mathur and Singh,1961). Chernovn and Tatarinov (2006) made studies on the latitudinal and longitudinal distribution of butterfly species in different parts of Arctic. In all, one hundred and six butterflies belonging to families Papilionidae (6 species), Pieridae (20 species), Lycaenidae (18 species), Nymphalidae (30 species), Satyridae (27 species) and Hesperidae (5 species), respectively. The species *i.e.*, *Boloria chariclea*, *B.polaris*, *B. improba*, *Colias nastes*, *C.hecla* and *Erebia fasciata* survived under high- latitude conditions. Vega (2006) investigated two hundred and thirty-two species (including subspecies) of butterflies, which is distributed in one hundred and twenty-six genera and six families from Ceros de Escazu protected zone of Costa Rica. The family Nymphalidae is reported by one hundred and thirty-four species, Hesperidae is by forty-one and Pieridae is reported by thirty-three species from above mentioned locality. Kolesnichenko (2007) elaborated the external characters, structure of male and female genitalia, biology, ecology and geographical distribution of the genus *Malitaea* Fabricius. Singh and Vartharajan (2007) reported total ninety-five species belonging to five families viz., Nymphalidae (41 species), Lycaenidae (21 species), Pieridae (14 species), Hesperidae (14 species) and Papilionidae (5 species) of the respective number mentioned in bracket from Keibul Lamjao national park, Khoijaman village, Hillocks of Maibam and other small selected gardens of Bishnpur district. On the same publication, they also reported seventy-eight species for the first time from Manipur. Amico (2007) conducted survey on superfamilies Hesperioidea and Papilionoidea from Bosco Siro Negri. They investigated forty species of butterflies, thirty-one species of food plants for adults and fifty-one species of potential food plants for larvae. Maux and Jean Noel (2007) described a new subspecies *i.e.*, *Euchloe tagis averyronensis* sp.nov. from South West France. Sethy *et.al.*, (2007) studied fifty two species under thirty-two genera of five families of butterflies from Similipal Biosphere Reserve, Mayurbhanj, North Orissa in India. Out of these, twenty-six species belong to family Nymphalidae, fifteen species of

Papilionidae, six species of Pieridae, two species of Lycaenidae, three species of Hesperidae were reported. Uniyal (2007) recorded seventy-five species of butterflies belonging to forty-eight genera of five families. Out of seventy-five species, fourteen species belong to five genera of Papilionidae, ten species belong to ten genera of family Pieridae, thirty-seven belong to twenty-three genera of Nymphalidae, ten species belong to seven genera of Lycaenidae and four species belong to three genera of family Hesperidae. Lukhtanov *et.al.*, (2007) analysed the distribution ranges, phenology, biological preferences and taxonomic structure of one hundred and seventy-six species of butterflies (Rhopalocera) of West Atai the western most position in the mountain system of southern Siberia. The genera viz. *Erebia*, *Oenesis*, *Clossina*, *Boeberia* and *Colias* were collected during the present survey. Withrington and Veronik (2008) described one hundred and nine species of butterfly (Rhopalocera) from Croatia islands. Eight species *i.e.*, *Argynnis adippe*, *Araschina levana*, *Hyponephele lycaon*, *Satyrium acaciae*, *Everes argiades*, *Plebeius idas*, *Carcharodus orientalis* and *Thymelicus sylvestris* are reported for the first time in the above mentioned area. Besides above, eighty-eight species of butterfly family are new record. The status of the genus *Hipparchia* species was also discussed in detail. Later, twenty-eight species belonging to nineteen genera *i.e.*, *Aglais Dalman*, *Anosia* Hübner, *Ariadne* Horsfield, *Hypolimnas* Hübner, *Junonia* Hübner, *Lethe* Hübner, *Morpho* Fabricius, *Neptis* Fabricius, *Pyronia* Hübner, *Satyrium* Westwood, *Papilio* Linnaeus, *Atella* Doubleday, *Catopsilia* Hübner, *Cepora* Billberg, *Colias* Fabricius, *Delias* Hübner, *Eurema* Hübner, *Ixias* Hübner and *Pieris* Schrank of the three families *i.e.*, Nymphalidae, Papilionidae and Pieridae of the Superfamily Papilionoidea were collected from fifteen localities of district Una in Himachal Pradesh. Besides detailed redescription of adults, wing venation, material examined their old distribution alongwith host plants (if any) were also provided in (Pathania and Kumari, 2009 & Pathania and Kumari, 2011). Qureshi *et al.*, (2013) described 36 species of butterflies of 08 families of 30 genera from Kupwara from Jammu & Kashmir in India. The same authors, Qureshi *et al.*, (2014) gives the information about the host plants and distribution of Painted Lady butterfly, *Cynthia cardui* (Linnaeus), from different parts of Kashmir Valley in India. Recently, Sharma *et. al.*, 2015 has given the preliminary study of the butterfly diversity of the Kathlaur-Kaushlian Wildlife Sanctuary (Pathankot,

Punjab) India A total of 40 species belonging to 31 genera was recorded, including *Libythea myrrha sanguinalis* Fruhstorfer, a new species added to the butterfly fauna of Punjab. Species richness was greatest for the family Nymphalidae, with 22 species, followed by Pieridae with 10 species, Lycaenidae with four, and Papilionidae and Hesperidae with two each. Out of 40 species reported, 19 were common, 15 less common and the remaining 06 species as uncommon. Observations on their habitats revealed that 13 species prefer scrubby habitat, 13 scrubby and grassy habitat, seven grassy habitats and the remaining seven scrubby and riverine habitats. The relevant literature also shows that work was initiated by workers i.e., Linnaeus, Fabricius, Moore, Butler, Horsfield, Vallhonrat, Heppner, Andrane, Balasubramanian, Shrinivasan, de Niceville, Varshney and is further continued by workers i.e., Swinhoes, Bingham, Rose, Rose and Sidhu, Rose and Sharma, Jaksic and Mihajlovic, Dawson, Loxdale and Rile, Oliver, Avtzis, Gunathraj *et.al.*, Quick *et.al.*, Machnikowski, Karish, Caselles and Manzano, Malkiewicz and Marzec, Trigunayat, Schwartz *et.al.*, Meerman, Korb, Cayabab, Spearman, Dennis *et.al.*, Fernandez, Racheli and Racheli, Thakur *et.al.*, Loxdale, Uniyal, Withrington and Veronik, Sethy *et.al.*, Maux *et.al.*, Amico, Kolesnichenko, Vega, Chernov and Tatarinov, Bhaskaran and Eswaran, Albelo, Mohandas, Motta, Ackery, Alfred *et.al.*, Anonymous, Anthram, Arora, Chapman, Common, Dyar, Eliot, Evans, Gadgil, Hampson, Scoble, Scott, Reinhardt *et.al.*, Pathania and Kumari, Qureshi *et al.*, Sharma *et. al.*, etc. in different parts of India and other countries but yet much more work on different families of butterflies (Rhopalocera) is pending and need more intension from remaining areas of the megadiverse nation like India.

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