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## Characteristics of butterfly (Lepidoptera) fauna from Kabal, Swat, Pakistan

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**ABSTRACT**

The beautiful creature of nature, butterflies (Lepidoptera) have great aesthetic and commercial values as they are beneficial as pollinator and environmental indicator. The present survey was conducted to determine the characteristics of butterfly fauna from Kabal, Swat, Pakistan during March-June 2013. The study area was divided into 4 quadrates. A total of 170 specimens were collected 13 species, falling in 10 genera and were identified belonging to 3 different families. The species identified, the Indian fritillary (*Argynnis hyperbius*) (Linnaeus, 1763) (female and male); painted lady (*Cynthia cardui*) (Linnaeus, 1758); blue pansy (*Junonia orithya*) Linnaeus, 1758; plain tiger (*Danaus chrysippus*) (Linnaeus, 1758); common leopard (*Phalantha phalantha*) (Drury, 1773) and common sailor butterfly (*Neptis hylas*) (Linnaeus, 1758) were belonging to family Nymphalidae. The great black mormon (*Papilio memnon*) Linnaeus, 1758; Chinese peacock black swallowtail emerald (*Papilio bianor*) Cramer, 1777; dingy swallowtail (*Papilio anactus*) Macleay, 1826 and lime butterfly (*Papilio demoleus*) Linnaeus, 1758 were belonging to family Papilionidae. The common grass yellow (*Eumera hecab*) (Linnaeus, 1758); little orange tip (*Coloti etrida*) (Boisduval, 1836) and Murree green-veined white (*Pieris ajaka*) Moore 1865 were belonging to family Pieridae. The characteristics of butterfly fauna from Kabal are helpful in awareness, education and further research. A detail study is required for further exploration of butterflies' fauna of Kabal.

**Keywords:** Butterfly, exploring, Kabal, identification, Nymphalidae, Papilionidae, Pieridae, Sawat.

**1. Introduction**

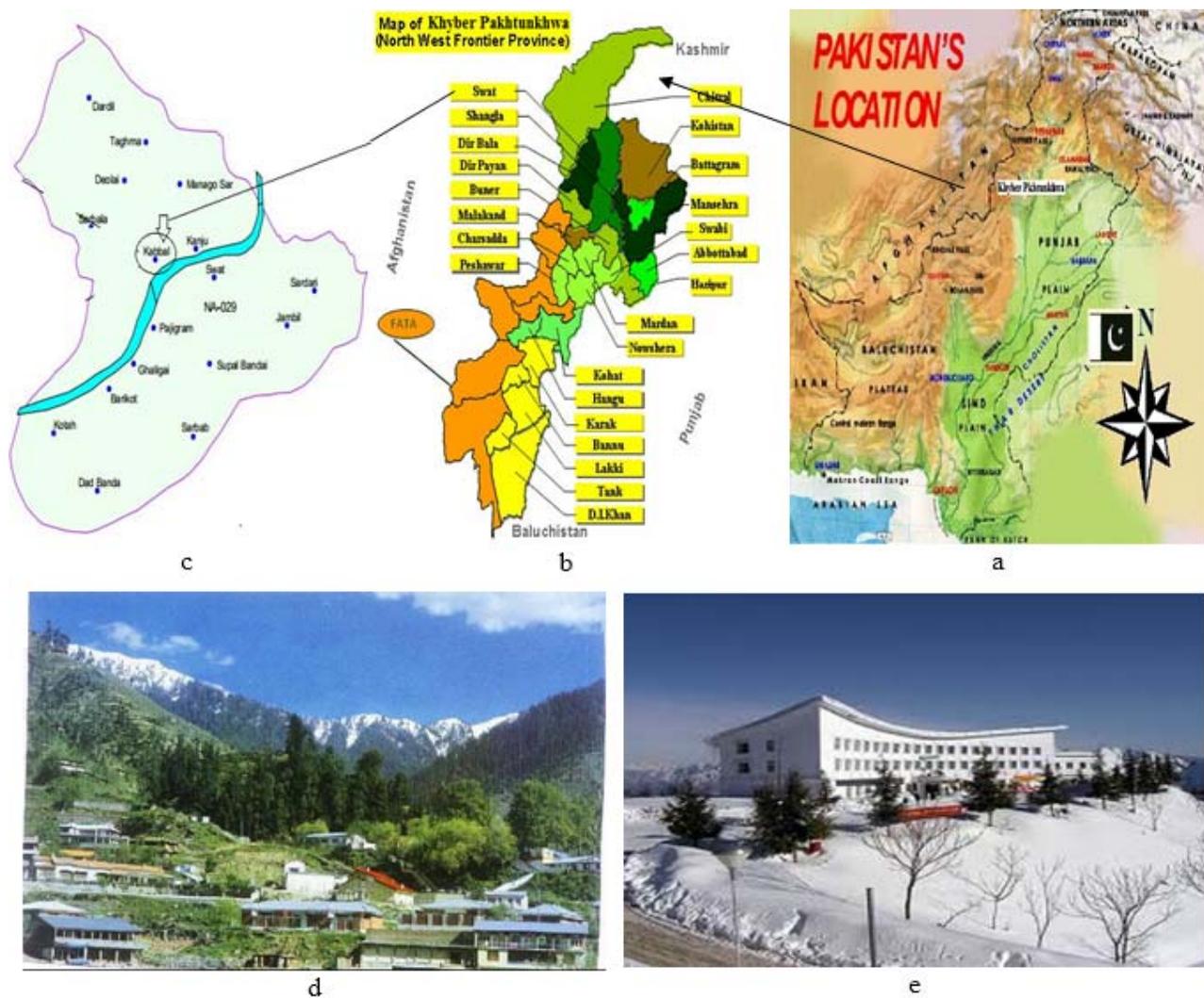
Kabal is a town in Swat district in Khyber Pakhtunkhwa (KP) province of Pakistan. Swat is a valley and an administrative district in KP near the Pakistan-Afghanistan border. It is the upper valley of the Swat river which rises in the Hindu Kush range. The capital of Swat is Saidu Sharif, but the main towns in the Swat valley are Kabal and Mingora (Figure 1)<sup>[1]</sup>. Most the part of Kabal is covered by the quaternary stream channel deposits and weathering products of rocks. It has the heavy metals (HMs) distribution in soils and their uptake by wild plants grown in the soils derived from the mafic and ultramafic terrains. Greater variability was found in the uptake of HMs by various plants grown on the studied soils. High concentrations of Cu and Zn in soft hemp, *Cannabis sativa* L.; Pb in ailanto, *Ailanthus altissima* (Mill.); Ni and Cr in sage, *Indigofera gerardiana* Wall and in plume grass, *Saccharum griffithii* Munro were found. The excessive concentrations of Cr and Ni in these plants can be used for mineral prospecting but their main concern could be of serious environmental problems and health risks in the inhabitants of the study areas<sup>[2]</sup>.

Butterflies are found all over the world and in all types of environments. Most their species, however, are found in tropical areas, especially tropical rainforests. They are beautiful, flying insects with large scaly wings. Like all insects, they have a pair of antennae and an exoskeleton. They have two pairs of large wings cover with colorful, iridescent scales in overlapping rows. Lepidoptera (butterflies and moths) are the only insects that have scaly wings. They take sunbath themselves to warm up in cool weather. As they age, the color of the wings fades and the wings become ragged. The speed varies among butterfly species (the poisonous varieties are slower than non-poisonous varieties). The fastest butterflies (some skippers) can fly at about 30 mile/h or faster. Slow flying butterflies fly about 5 m/h. Many of them migrate in order to avoid adverse environmental conditions (like cold weather). Most of them migrate relatively short distances, like the painted lady, *Vanessa cardui* (Linnaeus, 1758); red admiral, *Vanessa indica* (Linnaeus, 1758) and common buckeye *Junonia coenia* Hübner, 1822, but a few like some Monarchs, *Danaus plexippus* (Linnaeus, 1758) migrate thousands of miles. There are about 28,000 butterfly species worldwide<sup>[1]</sup>.

Butterflies show remarkable mimicry in different forms, which is still a challenge for evolution. Batesian mimicry is between palatable and non-palatable butterfly species, however, Mullerian mimicry, several equally unpleasantly tasting species share a color pattern and all species are mutually benefited, not only the mimic<sup>[3]</sup>. seven species of clearwing butterflies, *Melinaea* Bates, 1862 a genus of butterflies in Peru, and seven morphotypes of numata longwing, *Heliconius numata* (Cramer, 1780), a distantly related coloration, wing shape and precise locations of bars, stripes and spots<sup>[4]</sup>.

Butterflies have significant economic importance. They are the most efficient pollinators of flowers in addition to moths and bees. They help in production of food crops, seeds and fruits, therefore, they are essential for the survival of man and animals<sup>[5]</sup>. It has well developed silk glands<sup>[6]</sup>. The antennae of butterflies are either slender or knobbed at the tip and in the family Hesperidae (Skippers) are hooked at the tip. In some butterflies genera such as *Taractrothera* and common snout butterfly *Libythea carinenta* (Cramer) the knob is hollowed underneath<sup>[7]</sup>.

Several characters of the butterflies make them good candidates for indicator species. They have a widespread distribution, are comparatively easy to sample and recognize, and both as individuals and as species, they show significant numbers in different ecosystems. They are also strongly influenced by local weather and highly sensitive to environmental changes besides being charismatic insects that could fascinate the public attention. Butterflies are extremely sensitive to changes in vegetation composition and structure, and different types of vegetation show different butterfly species composition<sup>[8]</sup>. Therefore, they are frequently used as bioindicators of ecosystem health and as surrogates for whole biodiversity<sup>[9]</sup>. Increased urban features, including roads, buildings, and mowed lawns, correspond with decreases in butterfly species richness, diversity and abundance. As might be predicted, butterfly species that specialize on particular plant species for ovipositing and disturbance sensitive species are more affected by urbanization than are generalist species<sup>[10]</sup>. The objective of present research is to determine the characteristics butterfly fauna from Kabal, Swat, KP, Pakistan for awareness and education.



**Fig 1:** Map of Swat, Pakistan in which the survey area Kabal is located where from butterflies were collecting: a) map of Pakistan showing Khyber Pakhtunkhwa; b) map of Khyber Pakhtunkhwa showing Swat; c) map of Kabal (encircle:); two views of Kabal in Spring (d) and in winter (e: snow falling)<sup>[11]</sup>.

## 2. Materials and methods

### 2.1 Study area

Kabal is located at 34°47' North, 72°17' East, 34.783° North and 72.283° East coordinates and has an average elevation of 845 m (2,775 ft). It is the most attractive town in Swat (Figure 1) [11]. For the present research, it was divided into 4 quadrants to facilitate the study.

### 2.2 Methods

The study was conducted to determine characteristics of butterflies of Kabal, Swat, Pakistan. Each quadrant was visited daily thrice (morning, afternoon and evening) in a day during March-June 2013 for collection of butterflies by sweep-net. Then they were killed, stretched, pinned and identified by already preserved specimen, internet, literature available [12-13], keys [13-14] and entomologists on the bases of their characteristics. All specimens were tagged and placed one by one on a white paper for photography with digital camera, Kodak (8.2 megapixels), Tokyo, Japan. Then they were arranged in the wooden box with the phenolphthalein balls and submitted to the Zoological Museum, Shaheed Benazir Bhutto University, Main Campus, Sheringal, Khyber Pakhtunkhwa, Pakistan. The literature about these species of butterflies was also collected [15-21].

## 3. Results

The present study was conducted to identify and explore the butterfly fauna of Kabal, Swat, Pakistan. The specimens 170 were collected from 4 quadrates of Kabal (n=170). Identification of these butterflies showed that 13 different species from 10 genera belonging to 3 different families were present in the area. Detail characteristics of each species are provided below:

### 3.1 Great black mormon Butterfly, *Papilio memnon*

The great mormon, *Papilio memnon* Linnaeus, 1758 is a large butterfly that belongs to the swallowtail family and also known to mud-puddle. The wingspan is 13-15 cm and body length 8-9 cm. All body, i.e., head, thorax and abdomen, is black. The fore and hindwings are also black but underside is dark-brown with outer edge with many brown stripes. Next to the body, there is a red spot with wavy edge. The outer half of the wing has blue stripes. The adults usually fly rapidly at treetop height, except when they come down to feed at flowering bushes or look for oviposition sites. An adult stops to feed at flowers; it flutters its forewings while its hindwings are kept relatively still. Occurrence of this species is restricted to the forest areas. It is very common and seen amongst human habitation. It is fond of visiting flowers of the poinsettia, *Euphorbia pulcherrima* Klotzsch, 1825; jasmine, *Jasminum officinale* L., 1758; wild-type Spanish flag, *Lantana camara* L., 1758; Indian shot (false lily) *Canna indica* L., 1758 and meadow sage, *Salvia pratensis* L., 1758. It usually flies 2-4 m above the ground (Figure 2i).

The female is polymorphic with mimetic forms. The basic color of the female is black-brown with shine. Female is polymorphic with both tailed and tailless forms. The tailless male is black dusted with bluish green and below it has red tonal patch and red wing bases. The males are much commoner than females. The female forms *butlerianus* and *alcanor* are especially uncommon. Eggs are pale creamy yellow with a finely roughened surface. Females lay eggs singly on undersides of leaves of the host plant. It is nearly spherical with dm ca. 1.8 mm and takes about 3 days to mature. In

the first 4 instars, caterpillars look like bird droppings as they rest on the leaves. Final instar (5th) has a drastic change in its appearance. The pupa is mainly green with large yellowish markings and suspends itself with a silk girdle from the stem.

### 3.2 Chinese peacock black swallowtail emerald, *Papilio bianor*

The Chinese peacock black swallowtail emerald, *Papilio bianor* Cramer, 1777 is a wonderful butterfly and beautifully dark species looks as it has a sprinkling of iridescent blue dust on its wings. It is black and has many luminous scales. The fore and hindwings are black but hindwings with tails. The entire wings have littered with innumerable individual blue/green/violet scales. At the wings edge, there are dark innumerable brown strips and veins and the underside is brown, however, the outside half of the wing is whitish. The wings' margin is ridge. At the edge, there is a chain of big spots with different color. In the rear part, there is a magenta eye (Figure 2ii).

The male has black velvet hair in the forewings, however, the female does not have but it has red spot in the hindwings. The wingspan really depends on when it was born. If they pupate in the spring tend to be smaller with wingspan 4-8 cm than those emerge in the summer, therefore, summer type is usually larger with wingspan 10-12 cm than spring type. It is common in the forest mostly in wooded areas. It is not so common in suburban and urban, because of their host plant habitation. However, if there are some host plants such as the ailanthus-leaved pepper, *Zanthoxylum ailanthoides* L. and Chinese prickly-ash, *Zanthoxylum kauaense* Gray, it can be seen even in the urban district and city parks. The larval food plants include the corkwood, *Euodia hupehensis* Frost and Frost; *Z. kauaense*; pomelo, *Citrus maxima* L.; staghorn sumac, *Rhus typhina* L.; Japanese orixa, *Orixa japonica* Thunb; amur cork tree, *Phellodendron amurense* Rupr; and Chinese bitter orange, *Poncirus trifoliata* (L.).

### 3.3 Dingy swallowtail butterfly, *Papilio anactus*

The dingy swallowtail butterfly, *Papilio anactus* Macleay, 1826 is commonly known as the dainty swallowtail or small citrus butterfly. It is a medium size butterfly. Body is blackish-brown. Fore and hindwings are also blackish-brown with beautifully arranged white spots. Hindwings edges contain a line of dark red or orange spots. For protection against predators, this non-poisonous butterfly mimics the poisonous male of the big greasy, *Cressida cressida* (Fabricius, 1775), another swallowtail butterfly that obtains its toxic properties through its host plant, the Dutchman's pipe, *Aristolochia baetica* L., 1854 (Figure 2iii).

Females only lay eggs on newly grown leaves of the host plant. They are laid at the edge of larger leaves, either above or beneath. They are large, light yellow and roughly spherical. The eggs change to orange color when the larvae are almost ready to emerge. They normally hatch in approximately 3-4 days but sometimes less depending on how late or early females lay them. They are prone to small predators that eat the contents of the egg and are commonly parasitized by small wasps, parasitoid stingless wasps, *Trichogramma chilonis* (Ishii). Sometimes unfertilized eggs are laid. The first instar is dark, with 2 rows of short, bristly spines. The anterior parts have broad yellowish bands, black head, with some short hairs; the first 3 instars retain them. The fleshy spines also become less bristly in later instars and towards last instar are almost absent. After emergence, the immature larva eats the eggshell, before moving on to eat new leaf shoots. Later instars eat

fully developed new leaves, but not usually matured leaves. In warm areas, the larvae go through 1-5 instar and larvae in cold areas can have 1-6 instars before developing to a pupa. Mature larvae are about 35 mm long, generally black, with 2 sub-dorsal rows of fleshy black spines, sub-lateral and lateral rows of large orange or yellow blotches with numerous small, light blue and white spots. The strength of yellow can vary and some larvae can be a strong yellow or pale. The amount of orange can also vary and it may be absent. There are sub-dorsal blue dots on the anterior part of the larva. Later instars head is large, black, with a white upside-down with V mark on the front, which becomes most visible in the last instar. When disturbed, the larvae can erect and secrete a reddish-orange coloured, osmeterium from behind the head, which releases a citrus-like smell of rotting oranges. This smell acts as a repellent to predators. The larvae attempt to throw their heads either backwards or sideways, if a predator attacks because it is more effective if the chemical hits the predators. The secretion is usually composed of an irritant butyric acid. The osmeterium exists in all stages of the larvae. It is straight, approximately 30 mm long. The thorax becomes notably out-stretching forward. Usually, it is attached to the stems of the host-plant and always on other side of the tree from where the larva was lastly feeding. The larva sometimes leaves the host plant to pupate. A central silken girdle attaches the pupa with the stem. It either moves back vertically or is held horizontally. The color is dimorphic, being either green or grey-brown with other variable markings. The color pattern mimics the stem that the pupa is attached, therefore, it looks like a snapped extension of the stem. If the stem is green or is surrounded by leaves, then the color of the pupa is mostly green. The life span of the pupa is varied, may be 2 weeks in summer or up to 4 weeks in autumn. Often those pupae formed in autumn will not become adults until the following spring or even longer with diapause records of 1-2 years.

### 3.4 Lime butterfly, *Papilio demoleus*

The Lime butterfly, *Papilio demoleus* Linnaeus, 1758 can live in a broad variety of climatic conditions due to its wide range ecological tolerance ability. The wingspan is 8-9 cm and body length 2-3 cm. It is dorsally black in color with large number of yellow strips or spots. Ventral body has paler yellow color, with the black areas dusted with yellow. Upper side is pale creamy, when it is freshly emerged. Later on, it changes to deeper yellow with sexes are similar. The underside is very similar to the upside but all yellow marks are bigger than the marks on the upside. The forewings are black with at outer edge; there is a chain of yellow spots. Next to the body, there are 4 chains of little yellow spots. There are some other yellow spots at the rest of wings. Apex of the forewing has yellow spots present in a distal band. The hindwings are black without any tail. Red spot is present at anal margin of hindwings. Blue-black spot is also present along with red spot. The hindwings edge is wavy and is dominated by a broad and yellow band. This band contains a big eye. At the outer edge, there are 5 yellow spots. In the middle of the wings there are blue and orange spots (Figure 2iv).

The number of generations is dependent upon temperature. Near the equator 9, while in warm temperate, 5 generations have been recorded. In ideal conditions of a laboratory, a generation has been recorded to take place in just over 30 days. The average time for 1 generation to mature in the field ranges from 26-59 days. In cold climates, the lime butterfly is known to pass the winter as pupae.

Typically, the butterfly undergoes 5 instar as a caterpillar. The female butterfly goes from plant to plant, laying a single egg at a time on top of a leaf, which it holds onto with its legs, and flies off as soon as the egg is laid. The egg is round, light yellowish in color, flattened at the base, smooth-surfaced and about 1.5 mm in height. Fertile eggs develop a small red mark at the apex. Newly hatched caterpillar stays in middle of the upper side of the leaf. The 1<sup>st</sup> instar of the caterpillar is black, with a black heads and 2 rows of sub-dorsal fleshy spines. The 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> instars are dark, with glossy, dark-brown head, and white markings on 8-9 segments of the caterpillar, which resemble a white patch of uric acid deposited in a bird's droppings, helping them escape predation, while remaining in moderately open places. As the instars progress, this resemblance is lost. From the 5<sup>th</sup> instar onwards, the caterpillars now turn cylindrical in shape, tapered towards the rear and uniformly pale green in color with a white sub-spiracular band. An additional black band is developed on 4<sup>th</sup> and 5<sup>th</sup> segments with 2 each black and bluish spots on them. The 8<sup>th</sup> and 9<sup>th</sup> segments, which earlier provided the camouflage markings now develop a brown and white band. At this stage, the caterpillars are forced to inhabit secluded places. The pupa is roguish, stout and 30 mm in length, has 2 projections to front on its head and also 1 on its thorax and resembles that of the common mormon, *Papilio polytes* Linnaeus, 1758. The difference being that *P. polytes* pupa has a deeper cut between the projections and its abdomen is more protruded on the sides, having a small point. The pupa is dimorphic in color, it depends on prevalent and texture of background color. The green morph, which is found amongst green vegetation and smoother textures, is light green and unmarked; or with yellow dorsal markings, when situated among brown or dry objects. The pupa tends to turn light grey-brown to pink-brown and develop cryptic dark brown and black striation. The adults fly in every month but are particularly abundant during and after the monsoons.

### 3.5 Common grass yellow, *Eurema hecabe*

The common grass yellow, *Eurema hecabe* (Linnaeus, 1758) is a small pierid butterfly species found in Asia or Africa. The wingspan of is 3.7±0.787 cm and body length is 1.4±0.216 cm. The body is lemon yellow both on upper and lower surface with terminal and apical borders are blackish brown. Slightly pale yellow color underside comprises red brown markings, which is only present on part of apex region. Under side cell base embraces 2 small spots. Large kidney shaped ring spot is also present in the disco-cellular region. Under hindwings include disco-cellular red ringed blotch along with post-distal region curved lines. Sexes are similar. They are found flying close to the ground, in open grass and scrub habitats. It is simply known as the grass yellow in parts of its range. It exhibits seasonal polyphenism with darker summer morph, triggered by a long day exceeding 13 hours in duration, while the shorter diurnal period of 12 hours or less induces a fairer morph in the post-monsoon period. In wet-season form, the male's upper-side is yellow or variable in tint from sulphur to rich lemon-yellow, according to locality with a light or heavy rainfall. Forewing's apex and termen are deep black. This color continued narrowly along the costal margin to base of wing, near which it often becomes diffuse. The inner margin of the black area is from costa to vein 4 very oblique and irregular. Between veins 2 and 4 excavate on the inner side, this excavation outwardly rounded between the veins and inwardly toothed on vein 3. Below vein 2, the black area is suddenly dilated into a square spot, which occupies the whole of the tornal angle. The inner margin of this

dilatation is variable, in the typical form slightly concave. Hindwings' terminal margin with a narrow black band which is attenuated anteriorly and posteriorly. Dorsal margin is broadly paler than the ground-color. In the same, i.e., wet-season form, the male's under-side is yellow, generally with a slightly paler shade than that of the upper-side, with the following reddish-brown markings. Forewings are with 2 small spots or specks in basal half of cell and a reform spot or ring on the discocellulars. Hindwings are a slightly curved with sub basal series of 3 small spots. An irregular slender ring or spot is present on the discocellulars, followed by a highly irregular, curved, transverse, discal series of spots or specks, some or all of which are often obsolete. On both fore and hindwings, the veins, which attain the costal and terminal margins end in minute reddish-brown specks. Antenna is greyish yellow and club black. Head, thorax and abdomen are yellow shaded with fuscous scales. Beneath the palpi, the thorax and abdomen are yellowish white. The sex-mark seen from above appears as a thickening of the basal half of the median vein on the forewing. In the same, i.e., wet-season form, the female upper-side is very similar to that of the male but without the sex-mark. The black areas on both fore and hindwings are slightly broader, with the inner edge of the black terminal band on the hindwings often diffuse. The underside is ground-color and markings as in the male. Antennae, head, thorax and abdomen have the same color (Figure 2v).

Dry-season form, the upper-side is ground-color and markings are much as in wet-season specimens, the emargination on the inner side of the black area and the tornal dilatation on the forewings similar. On the hindwings, in the great majority of individuals, the black terminal band is also similar but in a few, it is narrower and diffuse inwardly in both sexes. The under-side is ground-color, similar to that in wet-season specimens, but in many, it is with a greater or less arrogation of black scales over the yellow parts of the wing. The reddish-brown markings on both fore and hindwings are also similar, but the spots are larger, more clearly defined, darker, therefore, far more conspicuous. In addition, on the forewing, there is a pre-apical, very prominent, transverse, elongate spot or short bar or reddish brown extended downwards from the costa. This spot is irregular in shape and of variable width, but does not seem ever to spread outwards to the actual edge of the termen. In a few specimens, there is also a small reddish-brown spot in interspace 1 near the tornus. Antennae, head, thorax and abdomen, are the same as in wet-season specimens. In male, the sex-mark is the same as in wet-season.

Females lay eggs on the jequirity, *Abrus precatorius* L., 1753; thorn tree, whistling thorn or wattle, *Acacia* spp L., 1773; jointvetches, *Aeschynomene* spp L., 1753; silk plants or silk trees, *Albizzia* spp Durazz., 1772 and numerous other Leguminosae, Euphorbiaceae and Cucurbitaceae species. Studies suggest that females can discriminate colors when choosing host plants for oviposition. Larva is long, green, rough, cylindrical, or slightly depressed, with a large head. Pupa is suspended by the tail and by a moderately long band. The abdominal segments are round, but the thorax is much compressed, the wing cases uniting to form a deep sharp keel. The head-case terminates in a short pointed snout. Ordinarily, the pupa is solitary and green, but sometimes on a twig in large numbers. Many Pierinae and other larvae seek each other's company at that time. Having selected a dead branch of some neighboring bush, they acquired the color of their surroundings as nearly all Pierinae and Papilionine pupae do to a greater or less

extent. This species is found to be parasitized by multiple strains of *Wolbachia*. These bacteria can alter the sex-ratios of the species.

### 3.6 Little orange tip, *Colotis etrida*

The upper surface of the little orange tip, *Colotis etrida* (Boisduval, 1836) is white with the forewing apical area orange, bordered all around with black including the inner side and with the veins outlined black as they cross the orange tip. There is a minute black spot in the end cell and the upper hindwings bear small black spots around the termed. Females have 2 black spots on the forewings below vein 1b and another below vein 3. The forewings' orange area is slightly more restricted and more heavily outlined in black. The hindwings bear prominent grayish-black spots in a curve around the hind margin termed. The underside of the forewings, in the apical area is coriaceous yellow, as is the whole of the hindwings. There is a ring of dark fuscous spots in a curve around hindwings margin. The food plants are toothbrush tree, *Salvadora persica* Wall; vann, *S. oleoides* Decne; Indian cadaba, *Cadaba indica* Lamk etc. This butterfly is found throughout Pakistan and India. The ground color on the upper-side of the males is white, sparsely arrogated at base of fore and hindwings with black scales. Forewings have a small black spot on the discocellulars, apex broadly black with an enclosed oval, curved, rich orange patch placed obliquely and traversed by the veins, which are black and inner edge of black area diffuse. Hindwings are uniform, except for a pre-apical short diffuse black streak from the costa, sometimes absent, and a series of terminal black spots that in specimens from moist localities are very large. Under side is white with the cell and apex of forewings suffused with sulphur-yellow. The upper-side orange patch shows by transparency. Its inner edge margined, anteriorly with a very obscure oblique fuscous band. Hindwings have pre-apical short transverse black streak on the upper-side obscurely indicated (Figure 2vi).

The female is very similar to the male but can be distinguished as follows: upper side of forewings has a narrower orange patch enclosed within the black apical area with a small black spot in middle of interspace 1 and another in interspace 3. Hindwings have the terminal spots slightly larger. On the underside the apex of fore and whole surface of hindwings suffused lightly, or in specimens from very dry localities heavily with ochraceous. Forewings have spots in interspaces 1 and 3 as on the upper-side. Hindwings are a curved, almost complete, discal series of fuscous spots, otherwise, as in the male. In both sexes, the antennae vary from white to pale brownish. The head, thorax and abdomen are black. The head and thorax have short greyish-brown hairs, however, beneath the palpi, thorax and abdomen is white.

It has the black apical area on forewings darker, broader, occupying about a 3<sup>rd</sup> of the wing; the orange patch enclosed within it, is proportionately narrower, therefore, the black on its inner margin has the appearance of being broader proportionately than it is in the typical form. Very often, this inner edge is border by a suffusion of sulphur-yellow. Specimens from south Indian hills resemble with this species closely. Larva is much resemble that of a moth caterpillar, being very narrow, the anal segment much prolonged, color uniform green, with a narrow line along each side just above the roots of the legs, sometimes broader, yellow or pinkish-white. It has the curious habit of resting with the anal segment not attached to a twig. Pupa is compressed, the snout much prolonged and turned upwards. At first, it is greenish but afterwards becomes a greyish white, beautifully marbled with brown.

### 3.7 Murree green-veined white, *Pieris ajaka*

The wingspan of Murree green-veined white, *Pieris ajaka* (Linnaeus, 1763) is  $5.85 \pm 0.919$  cm and body length  $1.85 \pm 0.07$  cm. Pale yellow color is present at underside on both upper and hind wings. Grey dusting is on margins of underside. It is a widespread genus of butterflies of the family Pieridae. The caterpillars feed on cabbage and other members of the Brassicaceae. The chemical basis of this association with a certain plant group has been studied for over 100 years, and is now known to occur via a number of biochemical adaptations to chemicals called *glucosinolates* in these plants. In contrast to the most other insects, *Pieris* caterpillars are able to detoxify these chemicals, and have become specialized that they will not eat any food without glucosinolates. The crop-damaging species have spread from Eurasia to the most of the rest of the world and are considered insect pests almost everywhere (Figure 2vii).

Generally, males have less dark scaling and are paler on underside. Male forewings have no trace of black spots in between vein 3 and 4 whereas females have prominent black spotting between vein 3 and 4 and between 1a and 1b. The *Pieris* females, in turn, check for the presence of glucosinolates before laying eggs on a plant. The females of many *Pieris* butterflies are UV reflecting, while the male wings are strongly UV absorbing due to pigments in the scales. It is known to cause damage to garden vegetables, such as broccoli, cabbage, cauliflower, Brussels sprouts, collard, horseradish, kale and kohlrabi. It is often confused with other insects and can be quite difficult to spot. It appears frequently in North America. The life cycle is about 3-6 weeks. The weather helps determine the exact cycle. There is usually more than one generation of this insect.

The adults lay eggs one at a time. They are usually found on the outer leaves on the lower surface. The eggs measure about 0.5 mm wide and 1 mm long. The egg's initial color is white and turns a shade of yellow. The larva can take anywhere from 11-33 days to mature. It appears green and velvety with 5 pairs of prolegs and 5 instars. Each of the instars, except for the 1<sup>st</sup> one, has a yellow stripe down the back. Yellow spots are visible on the sides of the instars. The pupation stage lasts around 11 days. It usually occurs on the plant food or sometimes on debris found close by. A chrysalis is present during this stage and is 18-20 mm long. It is attached from the tip of the abdomen of the cabbage worm to a silk pad. A silk thread is wrapped or spun, around the thorax. The color of the chrysalis varies, but can be a combination of yellow, green, gray and brown. Once the chrysalis is opened, the adult emerges. The span of the insect's wings measure 4.5-6.5 cm. Adult lives about 3 weeks. During this time, the female may lay 300-400 eggs. The wing color is white with black at the tips. A female has 2 black spots on the front wings, and the male typically has only one spot.

### 3.8 Indian fritillary, *Argynnis hyperbius*

The Indian fritillary, *Argynnis hyperbius* Linnaeus 1763 is a large butterfly, with wingspan is 80-98 mm. The under hindwings are bend with buff and broken bands of olive green. Forewings cells have a basal short transverse streak. A medial broad oval loop is present on its outer margin sinuous. A broad transverse streak beyond cell is not reaching to the median nervure. A broad streak is present along the discocellulars. A zigzag discal series of large spots, angulated outwardly in interspace 4 and inwardly in interspace 2. A minute spot is present at base of interspace 1. A somewhat diffuse large post-discal spot is present below the costa in interspace 6. A post-discal sinuous series of round and very

small spots is present in interspaces 1 and 4. An inner complete sub-terminal sinuous series of round spots is present. An outer sub-terminal line is widening on the veins, and a terminal slender line. Hindwings contain a basal, transverse and obscure narrow mark in cell, another above it in interspace 7. A transverse lunular is present across the middle of the cell. A small spot is outwardly bordering the lower disco-cellular. A discal series of transverse spots is present from interspaces 1-7 sinuous, posteriorly. A post-discal series of 5 spots is present in interspaces 2-6. A sub-terminal series of somewhat lunular spots is also present. Finally, a narrow band on term end traversed posteriorly by a series of blue spots and anteriorly by a series of ochraceous lunules. Under-side of forewings is pale terracotta-red and shading into ochraceous towards the apex. The apex is suffusing broadly with pale terracotta-red. It marks on the upper-side with the following exceptions: subcostal spots in interspace 6; upper 2 spots of post-discal and upper 4 spots of the inner sub-terminal are in series. The anterior portions of the outer sub-terminal and the terminal line are olive-brown. The upper 2 post-discal spots are centered with a white spot on each side. The upper 4 spots of the sub-terminal series are connate, forming a short curved band. Hindwings variegated with ochers-olive-brown and silvery-white markings. The last for the most part narrowly margined on the outer side by short black lines. The veins prominently pale ochers. The medial silvery markings form a well-marked sinuous discal series, followed by a curved post-discal series of 5 olive round spots. Each spot and the olive-brown quadrate patch near base of cell with a minute white central spot. A slender black sub-terminal line is widening at the veins, as on forewings, followed by an ochers narrow lunular band and an outer slender black anti-ciliated line. The sub-terminal black line margined on the inner side by a series of slender white lunular, bordered inwardly by a series of broad olive-brown markings in the interspaces. Antennae are brown above and ochers-red beneath. Head, thorax and abdomen are olive tawny but beneath of palpi, thorax and abdomen are pale-ochers (Figure 2viii).

It exhibits sexual dimorphism. In male, upper side of forewings is rich orange-yellow, hindwings are paler yellow, with the following black markings. The female is with a white band across the forewing apex and inky-blue bands below the white area, being a possible mimic of the plain tiger, *Danaus chrysippus* (Linnaeus, 1758). Both sexes are tawny-orange on the upper surface with scattered black spots, with a dull blue border to the hind wing margin outlined with double black looped lines and a sub marginal ring of black spots. Female is similar that of male. It differs from the male as following: upper-side apical half of forewings from about the middle of the costa obliquely to just above the tornus black, inwardly suffused with purple, crossed by a broad white band from costa to sub-terminal series of black spots. Pre-apical has white spots, in which upper 3 are bordering on each side and above one is very obscure ocellus, scarcely visible on the black background. The inner and outer sub-terminals are with transverse series of slender white lunular. Underside of forewings marking is similar to those on the upper-side, but the apex of the wing beyond the white oblique band ochers-green. Hindwings are as in the male, but the markings slightly broader. Antennae, head, thorax and abdomen are as in the male with abdomen paler beneath.

Larva's head and legs are black with black body. This color, however, obscures by orange-tawny markings. A broad orange-tawny is on dorsal stripe. Straight horizontal simple black 4 spines

are on head. Spines on pectoral segments are black, on abdominal segments pink tipped with black and on caudal segments with pink faintly black-tipped. This caterpillar only eats pansies in the garden pots. Pupa's head and wing cases are pale Indian red. Pale metallic 10 spots are on back and abdomen is dark pink with spines faintly black-tipped. The head ends in two well-separated blunt points. There is a pair of spines anteriorly, another in the middle and a 3<sup>rd</sup> the smallest pair is on posteriorly on the thorax, however, the latter being hunched and keeled on the abdominal segments. There are 8 pairs of spines, the 3<sup>rd</sup> anterior pair is the largest. It was approximately 1 1/2 inches long (just under 4 cm) and black with red markings and had lots of spines. When it went into a chrysalis, there were hard gold droplet shaped things on it. The inside and outside markings are completely different. Adult hatched at around 13 days, and upon release found a mate in just minutes.

### 3.9 Painted lady, *Cynthia cardui*

The painted lady, *Cynthia cardui* (Linnaeus 1758) a large butterfly, is well known throughout the most of the world. Its body length is 1.6±0.424 cm and wingspan is 5.65±0.636 cm. It is pinkish red with black markings. Somewhat wavy hindwing is present. Apical half of the forewing is dusky black having white spots on it. Black markings are present on distal and median golden area. Hindwings have dense brown coloration with black spots on orange distal area and termini. Under hindwing is marked with bands, lines and spots. Dark centered 4 ocelli are also present under hindwing around disco-cellular region. It identified by the black and white corners of its mainly deep orange, black-spotted wings. It has 5 white spots in the black forewing tips and while the orange areas may be pale here and there. There are no clean white dots in them. The hindwings carry 4 small submarginal eyespots on dorsal and ventral sides. Those are on the dorsal side are black, but in the summer morph, sometimes small blue pupils are present in some. In Europe, it migrates annually between North Africa using a sun compass for orientation. It was thought that the northward movement was a pied piper migration, but evidence now exists for an autumn southwards return migration (Figure 2ix).

Sexes are alike and freshly emerged specimens have pinkish orange color, which later on changes to dull tawny. The lifespan is 2-4 weeks. It is cold blooded and its life cycle does not depend on a certain number of day/night cycles, temperature can greatly affect the times presented here. At 90 °F (32 °C) the entire life cycles will take roughly 16 days. At 65 °F (18 °C) the life cycles will take months. At such extreme temperatures one can expect some deaths. At room temperatures the egg takes 3-5 days to hatch. The eggs are tiny, as tiny as a sugar crystal. They are green and ribbed and can be observed the best with a magnifying glass. It is possible to view the cap at the top of the egg where the caterpillar will emerge. The embryo can be viewed growing inside the egg using a hand lens or dissecting scope. A high powered dissecting scope allows for watching hatching quite clearly. If eggs turn deep green or become dented and wrinkled, the eggs do not contain living embryos. Just before hatching the embryos fill the whole egg and make the eggs look black or brown. As protection against disease, newly laid eggs may be knocked off the leaf, or left attached to the leaf, and dipped in dilute household bleach solution (1 part household bleach to 200 parts water) for 1-2 minutes and swished about. Afterwards, the eggs are left on a paper towel to dry. This will kill disease on the surface of the eggs and increase caterpillar survival. The caterpillars will emerge as small and black and will begin to eat immediately. As they grow they will shed their skins three times,

called instars. At each instar the caterpillar will need much more food as it has expanded in size. It will also become more spiky. These spikes do not contain poison and are not sharp. The moulted skin appears as a black speck, what looks like dirt, near the caterpillar. Many people believe this to be the excretion of the caterpillar. Occasionally the moult will look like an entire, dead, caterpillar, as snake's skin does. If under stress they will sometimes shed into a 5<sup>th</sup> instar, which is a very large caterpillar. A 5<sup>th</sup> instar is a sign that care is incorrect in some way, typically due to diet.

The 4 instars take 7-11 days to turn into a chrysalis. The caterpillar will spin a patch of silk and attach its hind end to the silk. At this point it begins changing internally, forming a J shape. Once the caterpillar forms a J, it should not be disturbed, as it can no longer reattach itself to the silk pad. A fallen J caterpillar can be laid on its side on a flat piece of cotton and may shed successfully. The chrysalis is very soft at first. It will dent if resting on a hard surface. After hardening, the chrysalis will crack if dropped or struck. The chrysalis can be dark or light colored depending on conditions during development of the caterpillar. It takes 7-11 days for the chrysalis to turn into a butterfly. When emerging from the chrysalis the butterfly pumps its wings with fluid to expand them. This happens within a few minutes of emerging or cannot happen at all. Once the wings are expanded, they are still soft for up to a day. Initially, it prefers not to move as its wings harden, but after the wings harden for a few hours the painted lady will become incredibly sensitive to movement and will damage it's still soft wings when frightened. It is the best to wait a full day after emergence from the chrysalis to handle a painted lady.

It uses over 300 recorded host plants according to the host database. Larvae feed on species of family Asteraceae, including bull thistle, *Cirsium* sp L.; musk thistle, *Carduus* sp L.; centaury, *Centaurea* sp L.; burdock, *Arctium* sp L.; sunflower, *Helianthus* sp L. and wormwood, *Artemisia* spp L. For raising in the classroom one need only sprout a bed of black oil sunflower seeds, as are used for bird seed. The caterpillars will eat the true adult leave (not the sprouts) and in this way, one may inexpensively produce many host plants. Soak the seeds for 8 hours in 10% diluted household bleach (1: 9; bleach: water) to ensure a disease free, even sprouting. The seeds are placed upon the surface of the soil and keep moist until they grow roots and can be watered normally.

### 3.10 Blue pansy, *Junonia orithya*

The blue pansy, *Junonia orithya* (Linnaeus 1758) is also known as the eyed pansy and blue argus. It is usually found in areas where there is open grassland. The wingspan is 3.85±0.50 cm and body length 1.4±0.108 cm. Basal half of underside fore wing consists of 3 black-edged, broad, orange transverse bands. Red brown black ringed 2 ocelli are present on upper hindwing and wing is iridescent blue. Across the cell, narrow black paired lines are present on under forewing. Under hindwing is of pale greyish buffy color. Brown bands are almost obsolete. Antenna is brown, head is reddish brown, thorax and abdomen are above brownish black palpi. Beneath the thorax and abdomen is dull white. A blue patch is present above the tornus. The outer margin of the basal black area is obliquely zigzag in a line from the middle of costa to apex of vein 2, including a large discal, generally obscure ocellus, which in some specimens is prominently ringed with orange-yellow. Beyond this a broad white irregularly oblique discal band followed by a short oblique pre-apical bar from costa. A small black orange-ringed ocellus is present beneath the bar. A sub-terminal

continuous line of white spots is present in the interspaces with a terminal jet-black slender line. Cilia are alternately dusky black and white. Hindwings are blue shaded with velvety black towards base. A post-discal black white-centered orange and black-ringed ocellus is present in interspace 2. A round minutely white-centered velvety black spot (sometimes entirely absent) is present in interspace 5. The terminal is narrowly white, traversed by an inner and outer sub-terminal and a terminal black line. Under-side of forewings have basal half with 3 black-edged, sinuous, broad, ochraceous-orange transverse bands, followed by pale discal band, ocelli pre-apical, short bar, sub-terminal and terminal markings much as on the upper side. The discal band margined inwardly by a broad black angulated line, which follows the outline of the black area of the upper side. Hindwings are irrotated with dusky scales and transversely crossed by sub-basal and discal slender zigzag brown lines and a post-discal dark shade, on which are placed 2 ocelli as on the upper side. Sub terminal and terminal have faint brown lines and a brownish short streak tipped black at the tornal angle below the lower ocellus (Figure 2x).

In male, more than half of the forewing from base is velvety black to some extent, apical half dull fuliginous. Male upper-side is somewhat more than half the forewing from base velvety black, apical half dull fuliginous, cell-area with or without 2 short transverse orange bars. In females, dull blue areas are present and ocelli are conspicuous. They have similar but larger and more clearly defined ocelli and markings. The basal half of the fore and hindwings on the upper-side are fuliginous brown and scarcely any trace of blue on the hind wing. Head and body of larvae are very dark shining black with shading into brown. Head connects with a short neck. Caudal extremities also tipped with orange. Body covers with perpendicular spines armed with strong radial hairs. Head is bifurcated with reddish spot in center of face. A small spinous process is present in the angle of each eye. Pupa is suspended by tail and neck. Wing-covers are muddy yellow. Rest of body is a purplish with variegated by dull creamy white lines. Light projections are present along the angular region of the abdomen. The adults are found in open areas, often sitting on bare ground. It has a stiff flap with glide style of flight and maintains a territory, driving away other butterflies that enter it. Larval host plants are recorded from the families Acanthaceae, Annonaceae, Convolvulaceae, Labiatae, Plantaginaceae, Scrophulariaceae, Verbenaceae and Violaceae. The specific plants are Willowleaf Angelon, *Angelonia salicariifolia* Humb and Bonpl; Jumbukungo, *Annona senegalensis* Pers; Snapdragon, *Antirrhinum majus* L.; Ganges Primrose, *Asystasia gangetica* (L.); Coromandel, *Asystasia scandens* (Lindau); Blackrod, *Buchnera linearis* R Br; frog fruit, *Phyla nodiflora* (L.); common violet, *Viola odorata* L.; water-willow, *Justicia procumbens*, L. and Asiatic witchweed, *Striga asiatica* (L.) etc. The butterfly is a sun-loving species, which can usually be found on grassy patches in open areas. Males can sometimes be found in numbers, frolicking in the bright sunshine. They can fly quite rapidly and occasionally engage in a spiral dance going up some height from the ground.

### 3.11 Plain tiger, *Danaus chrysippus*

The plain tiger, *Danaus chrysippus* (Linnaeus 1758) also known as the plain tiger or African monarch and is a common butterfly which is widely spread. It is non-edible butterfly, which is mimicked by multiple species. It is a medium-sized body tawny color with about 2.5 cm with and wingspan of is 7-8 cm. The body is black with many white spots. The wings are tawny in color. The upper-side is

brighter and richer than the under-side. The apical half of the forewing is black with a white band and upper margin of forewing is black with white spots. Hindwings contain 3 black spots in male around the center and 2 in female. They have a thin border of black encircling a series of hemispherical white spots. Background color and extent of white on the forewings varies somewhat across the wide range. It is an exotic and glamorous butterfly but incredibly restless (Figure 2xi).

In addition, male has a number of secondary sexual characteristics: the male has a pouch on the hindwings. This spot is white with a thick black border and bulges slightly. It has cluster of specialized scent scales used to attract females. The males possess 2 brush-like organs which can be pushed out of the tip of the abdomen. As it is known to be parasitized at least occasionally by *Spiroplasma* bacteria, which selectively kill off male hosts. It is a somewhat migratory species. It flies from dawn to dusk, frequenting gardens, sipping from flowers and late in the day, fluttering low over bushes to find a resting place for the night. As usual for diurnal butterflies, this species rests with its wings closed. When basking, it sits close to the ground and spreads its wings with its back to the sun, therefore, the wings are fully exposed to the sun's rays. It is protected from attacks due to the unpalatable alkaloids ingested during the larval stages. Therefore, the butterfly flies slowly and leisurely, generally close to the ground and in a straight line. This gives a predator ample time to recognize and avoid attacking it. Inexperienced predators will try attacking it, but will learn soon enough to avoid this butterfly as the alkaloids in its body cause vomiting. The butterfly also has a tough, leathery skin to survive such occasional attacks. When attacked it fakes death and oozes nauseating liquid, which makes it smell and taste terrible. This encourages the predator to release the butterfly quickly. The plain tiger thus has the ability to recover miraculously from predator attacks that would kill the most other butterflies. The protection mechanisms of the plain tiger, indeed of all colorful unpalatable butterflies, result in predators learning this memorable aspect at 1<sup>st</sup> hand. Predators soon associate the patterns and habits of such butterfly species with unpalatability to avoid hunting them in future. This advantage of protection has led to a number of edible butterfly species, referred to as mimics, evolving to resemble inedible butterflies, which are referred to as the model. The resemblance is not only in color, shapes, and markings, but also in behavioural and flight patterns. This form of mimicry, where an edible species mimics an inedible species is known as Batesian mimicry.

The mimics can resemble the models very closely. In some cases, it requires examination in the hand and reference to field guides to tell them apart. It is specifically mimicked by the following butterflies: Indian fritillary, *Argyreus hyperbius* females and danaid eggfly, *Hypolimnas misippus* females. It is believed to be one of the 1<sup>st</sup> butterflies to be used in art. A 3500-year-old Egyptian fresco in Luxor features the oldest illustration of this species. It can be considered the archetypical danaine of India. Accordingly, this species has been studied in greater detail than other members of its subfamily occurring in India. Its striking tawny-orange colouration serves as a warning to predators that this species is distasteful, which ultimately deters predators from attacking. Framing the startlingly orange hues is a bold black border interlaced with white specks. Similar to the adult butterfly, its caterpillar has extremely vivid colouration, which also acts as a warning signal protecting it from bird attacks. As the caterpillar grows, it attains 10 horizontal

black bands interspersed with paired yellow spots, as well as acquiring 3 pairs of long, black, tentacle-like appendages, which sometimes become a deep crimson at the base. Fully grown caterpillar then forms a pupa which can range from a green-brown color in a normal environment to a pink colour, if the surroundings are dry or unnatural. A horizontal band of miniscule black and golden specks decorate the abdominal segment of the pupa.

### 3.12 Common leopard, *Phalantha phalantha*

The common leopard, *Phalantha phalantha* (Drury 1773) resembles with the Indian fritillary, with upper wing surface orange-tawny covered with small black spots. The forewing apex is acute with the termini slightly concave. In this species, there are 4 narrow wavy lines across the forewing cell and the sub marginal regions of both fore and hindwings which bear looped black lines bordering the black spots along the margin. The under sides is overlaid with violet-tinged scales making the black spots less distinct, except for a prominent black spot between veins 1a and 1b. It is a sun-loving butterfly of the Nymphalid or Brush-footed Butterfly family. The Common Leopard is a medium-sized butterfly with a wingspan of 50-55 mm with a tawny color and marked with black spots. The underside of the butterfly is glossier than the upper and both the male and female are similar looking. A more prominent purple gloss on the under-side is found in the dry season form (Figure 2xii).

It is seen in the plains, gardens and edges of clearings. It has active and sharp flight movements and visits flowers regularly especially, Wild-type Spanish Flag, *Lantana camara* L.; Duranta, *Duranta erecta* L.; Muyna, *Meyenia laxiflora* Schlechtendal; vikro, *Gymnosporia montana* Benth; and thistles, *Cirsium arizonicum* (Gray). It is often seen mud puddling from damp patches in the ground, either alone or in groups. A regular basker with wings spread wide open. It is the commonest in dry areas with dry weather and absent from the wetter parts of India during the monsoon. It often perches on edges of clearing with wings half open and has the habit of chasing away other butterflies and guarding its territory.

Food plants of larvae are species of family *Bixaceae*. It has been recorded breeding on Indian plum, *Flacourtia indica* Burm; chapa plum, *Flacourtia montana* Graham; green brier, *Smilax* L.; brush holly tree, *Xylosma longifolium* Clos, and snowbed willow, *Salix herbacea* L. Larval host plants recorded from families Acanthaceae, Compositae, Flacourtiaceae, Primulaceae, Salicaceae, Rubiaceae and Violaceae. The specific plants are porcupine flower, *Barleria prionitis* L.; Coffee, *Coffea arabica* L.; Flintwood, *Scolopia* spp Schreb; whitlow grass *Dovyalis* spp Meyer and cottonwood, *Populus* spp L. This is most likely due to the fact that the caterpillar of this butterfly feeds on the Weeping Willow tree, *Salix* spp, which is an ornamental tree found in many gardens and urban areas. Occasionally, several individuals are encountered flying around a *Salix* spp. It is the commonest and most widespread member of the genus. This is primarily a butterfly of Acacia thorn scrub and savannah / woodland habitats, but can also be found in clearings within rainforest. The migratory nature of the butterfly also takes it to coastal grasslands, city parks, gardens and many other habitats. It can be found at altitudes from sea level to at least 1500 m. The adult butterflies are usually seen in two's and three's, nectaring at coat buttons, *Tridax* L.; bonesets, *Eupatorium* L. and other wild flowers. Males sometimes imbibe moisture from damp sand along riverbanks, but are more strongly attracted to patches of

urine, and dung, at which they sometimes gather in dozens. The butterfly is a rich orange brown above and ornamented with black spots and streaks, reminiscent of the Fritillary butterflies of the west - to which the Leopard is probably distantly related. The underside is a lighter orange with a purplish sheen in side light. The Leopard is found in secondary growth and is fond of Lantana blossoms, on which is shown feeding here. It is usually encountered in urban areas, parks and gardens in Singapore.

### 3.13 Common sailor butterfly, *Neptis hylas*

The common sailor butterfly, *Neptis hylas* (Linnaeus, 1758) has characteristic of stiff gliding flight achieved by short and shallow wing-beats just above the horizontal. In dry-season, it has upper-side black, with pure white markings. Forewings have discoidal streak clavate, apically truncate, sub-apically either notched or sometimes indistinctly divided. Hindwings have sub-basal band of even or nearly oval width. The brown markings and the underside are subjected to considerable seasonal variation, ranging from chocolate to golden brown. Antennae, head, thorax and abdomen are black. Wet-season form differs only in the narrowness of the white markings and in the slightly darker ground-color and broader black margins to the spots and bands on the underside. This species has been observed to make sounds whose function has not been known. The adults can be found along the fringes of nature reserves and in many wastelands where its multiple host plants grow in abundance. The common sailor adults are sun-loving and fly in a slow sailing fashion. They also visit flowers and ripening fruits for energy intakes. These butterflies have zebra like markings in dark brown and white, with white streaks made up of a series of closely placed oval shaped markings. The hind wings are closely spaced to form a band at the center of the wing (Figure 2xiii).

The eggs are laid singly after landing on a selected leaf and concluding that it belongs to a suitable host. The female of common sailor reverses along the leaf surface until its abdomen tip reaches the leaf tip. Each egg is somewhat globular in shape, with the surface marked with hexagonal pits and thin spines at pit corners. Freshly laid eggs are green in color, but turning pale green and then yellowish when maturing. Each egg has a base diameter of about 0.9 mm and a height about 1 mm. The egg takes about 3-3.5 days to hatch. There are 1-5 instars larvae. The newly hatched caterpillars measuring about 2.2 mm in length, proceeds to consume the remaining egg shell as its first meal. Its cylindrical dark green body is covered with many small tubercles and short setae. The head capsule is brown to pale brown and dotted with a few short setae. The early instars eat the lamina of each leaf from the tip with the midrib typically left uneaten. It has the habit of cutting and hanging leaf fragments for concealment as part of its feeding routine. The pupa suspends itself via a cremastral attachment to the silk mound with no supporting silk girdle. It is almost entirely yellowish except for the thoracic area of the dorsum, which is pale pinkish brown.

One day after pupation, the body surface takes on a silvery sheen. The pupa has the ability to flex laterally when disturbed. Length of pupae is 16-18 mm. After about 5.5 days of development, the pupal turns dark as the development within the pupal case comes to an end. The white markings on the forewing upper-sides become visible through the pupal skin. The next morning, the adult butterfly emerges from the pupal case.

#### 4. Discussion

The present survey was the 1<sup>st</sup> attempt to collect butterfly fauna of Kabal, Swat, Pakistan. Specimens 170 were collected and preserved from 4 different study sites of Kabal. Identification revealed that 13 different species in 10 genera belonging to 3 families were present in this area.

Shah et al.<sup>[22]</sup> made a survey of Kohat and collected 10 species belonging to only family Pieridae from 7 different localities over a period of 7 months during 1999. Perveen and Ahmed<sup>[16-17]</sup> surveyed Kohat, Pakistan, species belonging to different families were reported. At the present, 170 specimens were collected of 13 species, falling in 10 genera and were identified belonging to 3 different families. *E. hecabe* was recorded from all 3 surveys whereas *P. ajaka* was recorded from the present and Perveen and Ahmed<sup>[16-17]</sup> surveys. It may be due to differences in climatic conditions of 3 different areas.

Perveen and Ahmad<sup>[16-17]</sup> evaluate the butterfly fauna of Kohat, Pakistan during September-December 2008. Pieridae is reported as dominant family during survey. Similarly, these 3 families were also reported from Hazara University. Family Pieridae constitute the largest number of individuals followed by Nymphalidae and Papilionidae as reported in Kohat fauna<sup>[19-21]</sup>. However, in the present survey with respect to the numbers of species and specimens, family Nymphalidae was the 1<sup>st</sup> followed by Papilionidae and then by family Pieridae.

Martinez et al.<sup>[23]</sup> reported biodiversity and biogeography of butterfly's fauna in Mexico. About 1800 species of butterflies were documented, constituting about 10% of the butterfly fauna of the world. The 21 sites were acknowledged in Mexico for the abundance of butterfly fauna and comparisons were made between these sites. Perveen et al.<sup>[18]</sup> reported the characterization and Perveen<sup>[15]</sup> described the distribution of butterflies of 5 sites of Kohat, Khyber Pakhtunkhwa, Pakistan. About 21 species of butterflies were documented. The collected species covered families Nymphalidae, Papilionidae and Pieridae yielded 33, 10, and 57% butterfly diversity of the area, respectively. In contrast, only 10 species were recorded from the survey did by Perveen and Fazal<sup>[19-21]</sup>. In contrast, only 13 species were recorded from the present survey from Kabal, therefore, difference was due differences in area covered in 4 studies. Comparison cannot be possible, however, almost same ecological conditions were found in the study areas.

Khan et al.<sup>[24]</sup> reported 16 species from Kotli, 20 from Mirpur and 19 from Bhimber, which showed great resemblance with species collected from Hazara University<sup>[19-21]</sup>. The research of butterfly fauna of Skardu region by Khan et al.<sup>[25-26]</sup> had revealed 16 species belonging to 5 families. Ahson and Iqbal<sup>[27]</sup> surveyed butterfly fauna of Lahore from a number of localities. In another study, 21 species were identified belonging to 3 different families from Kohat, Pakistan during September-December 2008. The reported

families Nymphalidae covered 33%, Papilionidae 10%, and Pieridae 57% biodiversity of butterflies of Kohat<sup>[15-18]</sup>. The butterfly species from fore mentioned studies, i.e., *P. demoleus*, *D. chrysippus* and *E. hecabe* were recorded showed resemblance with the presently reported 13 species of butterflies from Kabal, Pakistan.

Ambrose and Raj<sup>[28]</sup> evaluated Kalakad-Mundanthurai Tiger reserve Southern India butterfly fauna. Survey of about 7 months was done from September 2002-March 2003. Study revealed 24 species of butterflies. Reported species of India belongs to 9 families but only 4 families were studied in detail. However, from the Hazara University, only 10 species of 8 genera belonging to 3 families were recorded in restricted small areas administration and main campus and residential area<sup>[19-21]</sup>. Moreover, from the present research, only 13 species of 10 genera belonging to 3 families were recorded in restricted small area of Kabal, Pakistan.

Hiller<sup>[29]</sup> studied the male genital structures of 3 species of butterflies from Rio Grande do Sul, Brazil. Same area was resided by 3 species at the same time of the year and their external morphology did not vary greatly, therefore, genital structures were taken into consideration for their identification. In the present research, species identified by distinguishable external morphology, therefore, genital structures were not studied.

Borang et al.<sup>[30]</sup> yielded 134 species of butterflies from area of Dihang Dibang Biosphere Reserve of Arunachal Pradesh, India. Recorded butterflies belong to 81 genera and 8 families whereas in the present research 13 genera belonging to 3 families were reported. Nymphalidae comprises 28 genera, Papilionidae 9 and Pieridae 10 genera from the India. In contrast, from the present survey, it was found that Nymphalidae comprised of 6 genera, Papilionidae 4 and Pieridae 3 genera from the Kabal. Sharma et al.<sup>[31]</sup> collected butterflies from new campus area of Punjab from June-September, study was based on the relationship of temperature, humidity and population of butterflies. The occurrence of butterflies was more in moderate temperature but in June and September there were decline. Relationship between temperature and population of butterflies was positive.

However, Fitzherbert et al.<sup>[32]</sup> studied that the diversity and distribution of butterflies in the context of ecological preference and altitude range. There 90 species were recorded between Gilgit and Khunjerab at high altitude. Some of them were highly distributed but other are less tolerant species present in colonies. Therefore, isolation plays a very important role in evolution of many species and ecological races. Species composition and abundance is always dependent upon maintenance of natural habitat. Another reason is shortage of time, i.e., survey was carried out only for 4 months. If survey was done for long time there would have been a substantial increase in number of butterflies. The present study is continuing for further butterflies finding in Kabal.

**Phylum:** Arthropoda  
**Class:** Insecta  
**Sub class:** Pterygota  
**Infra class:** Neoptera  
**Super order:** Endopterygota  
**Order:** Lepidoptera  
**Sub order:** Glossata  
**Infera order:** Acanthoctesia  
**Super family:** Papilionoidea  
**Family:** Papilionidae  
**Sub family:** Papilioninae



(i): Great black mormon Butterfly, *Papilio memnon* Linnaeus, 1758



(ii): Chinese peacock black swallowtail emerald, *Papilio bianor polyctor* Cramer, 1777 (female)



(iii): Dainty swallowtail butterfly, *Papilio anactus* Macleay, 1826

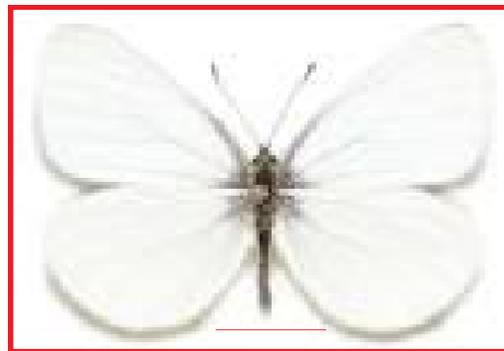


(iv): Lime butterfly, *Papilio demoleus* Linnaeus, 1758

**Family:** Pieridae  
**Sub family:** Coliadinae



(v): Common grass yellow, *Eumera hecab* (Linnaeus, 1758)



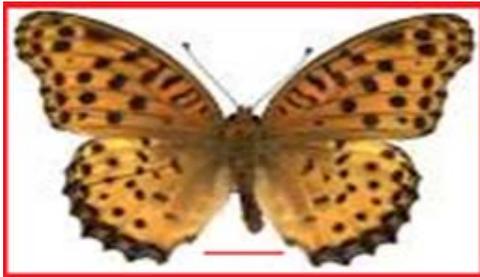
(vi): Appias drusilla Little orange tip, *Colotis etrida* (Boisduval, 1836)

**Sub family:** Pierinae

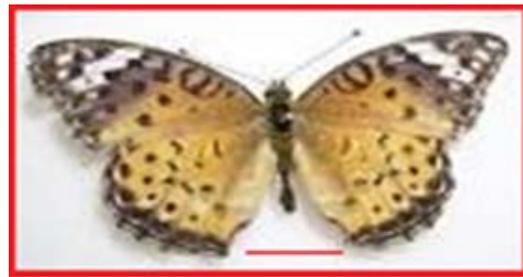


(vii): Murree green-veined white, *Pieris ajaka* Moore 1865

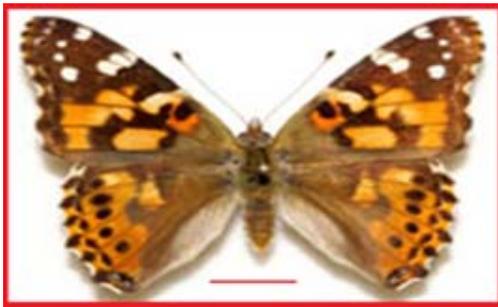
**Family:** Nymphalidae  
**Sub family:** Nymphalinae



(viii)a: Indian fritillary, *Argynnis hyperbius* (Linnaeus, 1763) (male)



(viii)b: Indian fritillary, *Argynnis hyperbius* (Linnaeus, 1763) (female)



(ix): Painted lady, *Cynthia cardui* (Linnaeus 1758)  
**Subfamily:** Danainae



(x): Blue pansy, *Junonia orithya* Linnaeus 1758  
**Subfamily:** Heliconiinae



(xi): Plain tiger, *Danaus chrysippus* (Linnaeus 1758)



(xii): Common leopard, *Phalantha phalantha* (Drury, 1773)

**Sub family:** Limenitidinae



(xiii): Common sailor butterfly, *Neptis hylas*  
(Linnaeus, 1758)

**Fig 2:** Butterfly fauna were collected from the survey area, Kabal is located in Swat, Khyber Pakhtunkhwa, Pakistan during March-June 2012; bars in photographs indicate 30 mm.

### 5. Conclusion

The present research was conducted to evaluate the butterfly fauna of Kabal, Swat, Pakistan during March-June 2013. Total number of specimens was 170. The 10 genera comprised 13 different species belonging to 3 families were recorded. All collected butterflies have different characteristics and found in different habitats.

### 6. Recommendation

Proper preventive measures should be taken in order to minimize the natural habitat loss, as butterfly fauna is dependent upon proper environmental conditions. Frequent similar surveys on large scales are recommended to fully evaluate the butterfly fauna of Kabal (Swat). In the future, further research should be conducted with respect to the factors affecting butterfly fauna in Kabal.

### 7. Competing interest

The authors declare that they have no competing interest.

### 8. Acknowledgement

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