The Butterfly Fauna *of* Sri Lanka

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Chapter 1

Sri Lanka and its butterflies

"Pearl of the Indian Ocean", "Resplendent isle" and "Serendib" are three of the more fanciful names used to refer to the tropical island of Sri Lanka. Marco Polo called it "the best island of its size in the world." It is situated southeast of the southern tip of India, lying between 5 and 10 degrees north of the equator (Fig. 1-1). The island has enticed travelers and merchants at least since the first century AD, having been an important stop on trading routes, mainly for its spices and gems. More recently, it has become known for its excellent tea, planted by the British when they colonized the island, which they called Ceylon. It still entices the modern-day traveler with its beautiful scenery, friendly people, cultural heritage, and bountiful wildlife and nature.

Sri Lanka's varied topography, climate and vegetation provide a rich environment for butterflies despite its small land area. The island is home to 247 species of butterflies (order Lepidoptera) (Table 1-1, Appendix A). Although it is zoogeographically considered a part of the Indian subcontinent, its butterfly fauna has been sufficiently isolated to give rise to 31 endemic species and 84 endemic subspecies. Being an island, however, its butterfly fauna does not match that of a comparable area that is part of a mainland. Costa Rica, for example, is similar to Sri Lanka in area and climate, but has more than 1200 species of butterflies.

Though the butterflies of Sri Lanka have been studied for over 150 years, there is still a dearth of information on the biology of many species. Distributions, habitat requirements, flight periods in different floristic or climatic regions, immature stages and larval food plants are not well-documented for many species, and are unknown for a few. Though butterflies were studied avidly from the late 1800s to the 1950s, the focus of naturalists was mainly on collecting and identifying the butterflies in the island. At that time, there was little interest in the ecology of butterflies, and information on specific location, habitat and behavior was often not recorded. Specimens were often collected by locals who then sold them to those studying butterflies without much information attached to them. Even those who did their own collecting often recorded the location of the butterfly simply as "Kandy" or "Galle" or "Jaffna", which could mean the city, the district or the general area. Though published accounts of the life histories and larval food plants of some species were based on actual rearing studies in Sri Lanka, many were based on records of the species in India.

Much progress has been made, however, in the past 15 years with the revival of interest in the study of butterflies. Detailed records are now being kept and entered into a national database allowing better documentation and analysis of distributions, habitats and flight periods, and surveys are being undertaken more systematically. As a result, several species have been rediscovered,

Fig. 1-1. The island of Sri Lanka, off the southeast coast of India.

some of which had not been recorded for over a century, and their life histories studied. These include the Tamil Oakblue (*Arhopala bazaloides lanka*), Ormiston's Oakblue (*Arhopala ormistoni*), and the African Marbled Skipper (*Gomalia elma albofasciata*). One species, Green's Silverline (*Spindasis greeni*), was rediscovered and confirmed as a valid species more than 100 years after it was first described from a single worn specimen, and its immature stages were documented in part. Two species were recorded from the island for the first time in 2008: the Orange Migrant (*Catopsilia scylla*) and the Yellow Palm Dart (*Cephrenes trichopepla*). They were likely introduced inadvertently, but are now inventoried as breeding residents. As this book was going to press, a third invasive species, *Erionota torus*, was discovered. The immature stages and larval food plants of about 220 species have been researched anew and compared with historical accounts.

The origin of butterflies

Butterflies and moths, along with the closely related caddisflies, evolved about 200 million years ago (mya) from a common ancestor, but the landmasses on which they evolved looked very different from the continents of today. The process by which the present-day continents came into being was first proposed in 1912 by Alfred Wegener, a German geophysicist, in his theory of continental drift. He contended that during the "Jung-Karbon" (around 300 mya), the world consisted of only ocean and a single landmass, a supercontinent now called Pangea ("All of Earth"). Around 150–200 mya, this supercontinent started to break apart

into two landmasses, Laurasia and Gondwana. Gondwana included the present day South America, Africa, Madagascar, India, Sri Lanka, Antarctica and Australia. Over millions of years, Laurasia and Gondwana moved apart and fragmented further into separate plates to become the continents as we know them today. Though it was a radical theory at the time it was proposed, the theory of continental drift is now supported by a wealth of data from many scientific disciplines, though there are disagreements as to the exact sequence and dating of the events.

As the newly formed continents moved apart, the butterflies and moths also evolved, adapting to the specific environments in which they found themselves. A few left footprints in fossils—at 200 million years old, *Archaeolepis*, an extinct moth, is the most ancient Lepidopteran fossil. The adults of the earliest ancestors of butterflies may have fed on the pollen grains of gymnosperms and the spores of ferns, as do some members of the moth family Micropterigidae, which is considered to be the most ancient extant lineage of Lepidoptera. A few present-day species of butterflies feed on the pollen of flowers, such as some species of *Heliconius* in the Nymphalidae family. With the arrival of the angiosperms (flowering plants) around 100 mya, the adult ancestral butterflies adopted nectar as a food source and their larvae evolved to feed on leaves, flowers and fruits. By 80 mya, the modern butterfly families were well-developed and differentiated. With the continued drifting of the landmasses, the butterflies dispersed and continued to evolve, resulting in the species that we know of today.

As might be expected, species that are closely related tend to occur in relatively well-defined geographic areas because of their common origins. These groupings were first comprehensively formulated by Alfred Wallace (1876) based on the geographical distribution of mammals, amphibians and insects. He divided the world into six biogeographical regions, now called zoogeographic regions. Each region has a characteristic fauna that has arisen due to the interactions of geographical, ecological and evolutionary factors. Wallace's six zoogeographic regions—Oriental, Nearctic, Neotropical, Palearctic, African and Australian—are still widely accepted, though other models that incorporate recent phylogenetic data have been proposed (e.g. Holt *et al.*, 2013). The butterfly fauna of Sri Lanka and India belongs to the Oriental region (Fig. 1-2).

The origin of the butterflies of Sri Lanka

The butterfly fauna of Sri Lanka shares its origin with the butterfly fauna of India. Sri Lanka is part of the Indian tectonic plate and has been contiguous with peninsular India for much of its geologic history, most recently until about 10,000 years ago. The Indian plate, which was part of Gondwana, began to break away from Africa about 160 mya, and from Antarctica about 130 mya, as it moved northward (Fig. 1-3b). It carried its own distinct fauna as well as some species that were present at that time in Africa and Madagascar. The plate separated from Madagascar about 90 mya, and 35 million years later, it collided with the southern border of the Eurasian plate. It continued to move northward, pushing into the Eurasian plate, leading to the formation of the Himalayan range of mountains (Fig. 1-3). The Australian plate fused with the Indian plate below the ocean about 45 mya, but above, the two landmasses remained separated.

Because the Indian plate was separated from other landmasses for many millions of years, one would expect large numbers of unique species in peninsular India today, such as we find in Australia. It has long been noted, however, that the present-day butterfly fauna of peninsular India and Sri Lanka is of recent origin and has only a few unique elements. Scientists now believe that much of the original fauna, including butterflies, was largely destroyed by volcanic eruptions that occurred 65–70 mya, before the collision with the Eurasian plate. These eruptions, which occurred at the center of the Indian plate, lasted many thousands of years. The magnitude, extent and severity of these events can be seen even today in the sheer size of the Deccan plateau, which resulted from this volcanic activity.

Fig. 1-2. Zoogeographic regions of the world. Sri Lanka

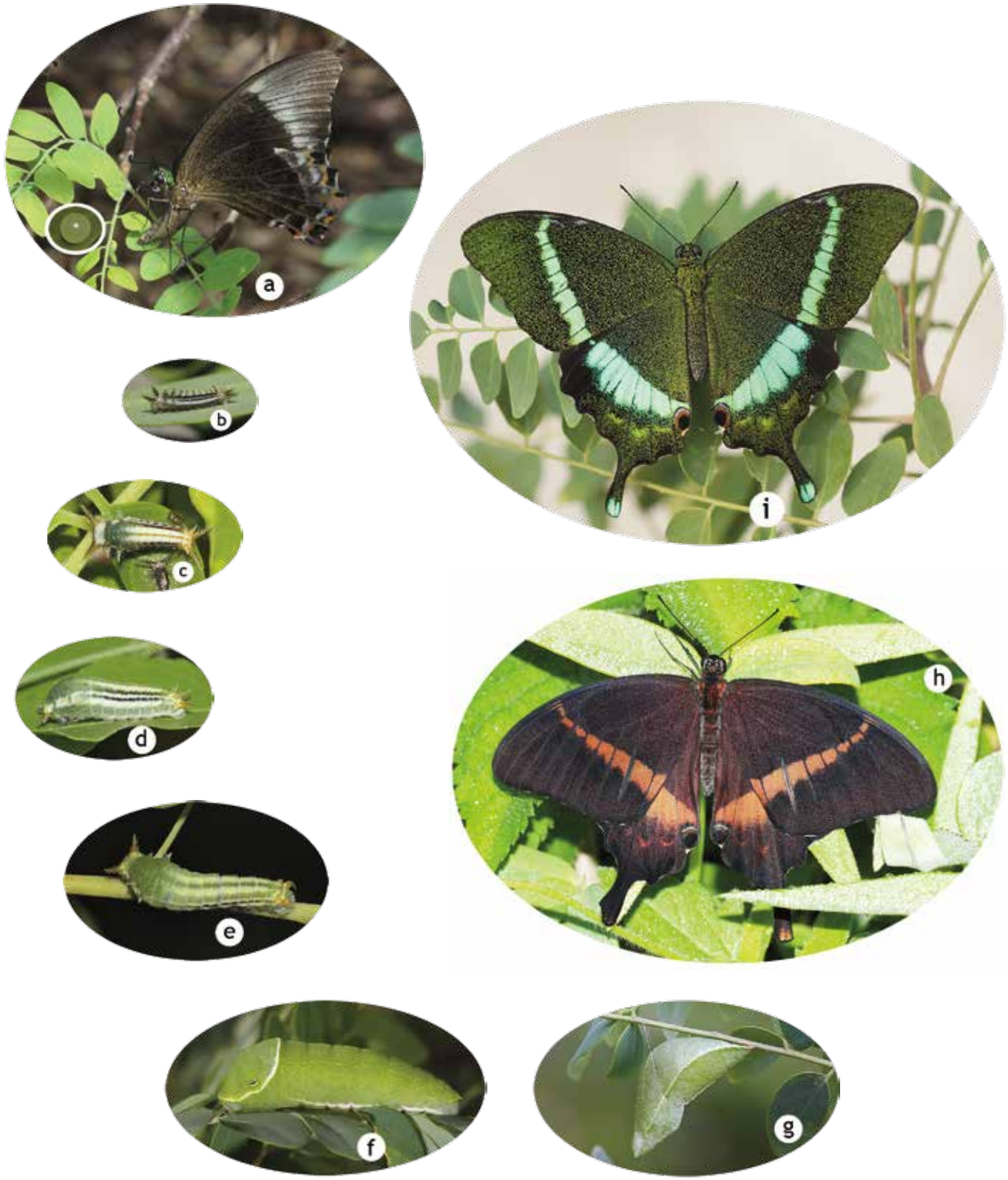


Fig. 2-1. Complete metamorphosis: life cycle of the Common Banded Peacock (*Papilio crino*). a) female laying egg (x0.8); egg (inset, x6); b) larva, first instar (x8); c) larva, second instar, with molted skin and head capsule (x4); d) larva, third instar (x2); e) larva, fourth instar (x1); f) larva, fifth instar (x1); g) pupa (x1); h) adult drying its wings just after emergence (x0.8); i) adult with its mature colors (x0.8)

Chapter 2

The life of a butterfly

Butterfly names

The common English names of butterflies in Sri Lanka were chosen by the British and European butterfly enthusiasts who often took their cues from names used in their own countries. These names were frequently based on criteria such as the appearance of the butterfly, how it behaved, or how abundant it was, and in which habitat it lived. Thus, names such as the Common Bushbrown or the Common Treebrown reflect the species' abundance, geographic range, color and habitat; the Clipper and the Cruiser reflect the style of flight of the butterfly. In some cases, the names were based on titles or ranks used in institutions and military organizations. Names such as the Black Prince, Baron, Baronet and Redspot Duke were based on titles in the British court, whereas names such as the Blue Admiral and the Commander were based on ranks in the British Navy. Still other names, such as the Tawny Rajah and the Common Nawab, were based on vernacular titles of royalty in India.

Although common names are easy to remember, there are no rules governing their use and they are sometimes changed arbitrarily. Further, different names can be used in different countries or regions. To avoid these drawbacks, a formal system of naming was developed by Carolus Linnaeus, and was applied consistently to animals beginning in 1758. Referred to as the Binomial System of Nomenclature, it assigns to each organism a unique two-part name, called the scientific name. For example, the butterfly that is called the Common Bluebottle in Sri Lanka and the Blue Triangle in Australia is known world-wide by its scientific name *Graphium sarpedon* (Fig. 2-2).

Fig. 2-2. *Graphium sarpedon*.

Each species of plant, like each species of butterfly, also has only one scientific name, but can have many common names. In Sri Lanka, *Dregea volubilis* is known by the Sinhala names kiri-anguna, thiththa anguna, anguna and anukkola. Even more confusing is when a single common name refers to several different species of plants—kiri-anguna also refers to *Cynanchum tunicatum*, *Parsonsia alboflavescens* and a species of *Tylophora*. Selecting a larval food plant for a butterfly based on a common name that references several species of plants can have dire consequences for the larva. The larva of the Blue Tiger (*Tirumala limniace*) feeds on the leaves of *Dregea volubilis*, but not on those of *Cynanchum tunicatum* or *Parsonsia alboflavescens*. Likewise, the larva of the Common Tiger (*Danaus genutia*) feeds only on *Cynanchum tunicatum* whereas the Ceylon Tree Nymph (*Idea iasonia*) feeds only on *Parsonsia alboflavescens*. Selecting the incorrect "kiri-anguna" would lead to the death of the larva by starvation, but there is no mistake when the plant is selected using its scientific name.

The first part of the scientific name designates the genus to which the organism belongs. A genus denotes a group of animals or plants with similar characteristics and with a common evolutionary ancestry. The second part of the scientific name designates the species to which the organism belongs. A species can be defined as a group of individuals that breed freely among themselves, but not with others, and that produce viable offspring. Thus we have *Junonia almana* as the scientific name for the Peacock Pansy and *Junonia lemonias* for the Lemon Pansy—they both belong to the same genus, *Junonia*, and have similar general characteristics, but are classified as different species because of differences in appearance, behavior and reproductive structures and because they do not interbreed. A third name, the subspecies name, is sometimes added after the species name—this is referred to as the Trinomial System of Nomenclature. The subspecies name designates a population that is different in appearance due to isolation in space or time or both. For instance, the Great Orange Tip (*Hebomoia glaucippe*) in Japan looks similar to its counterpart in Sri Lanka, but since the black scaling on the upperside of its wings is consistently more extensive, the population in Japan is treated as the subspecies *Hebomoia glaucippe liukiuensis* and that in Sri Lanka as *Hebomoia glaucippe ceylonica*. It is often a matter of opinion whether the differences between populations are significant enough to warrant subspecies status, and some scientists, for other reasons as well, do not use the Trinomial System. Nevertheless, the fundamentals of using scientific names are well-established, and the rules governing them are based on the conventions of the International Code of Zoological Nomenclature (ICZN). These rules are followed by scientists worldwide. In this publication, binomial names are used in Chapters 1–4 while trinomial names are used in the account of each species and in Appendix A.

The life cycle of a butterfly

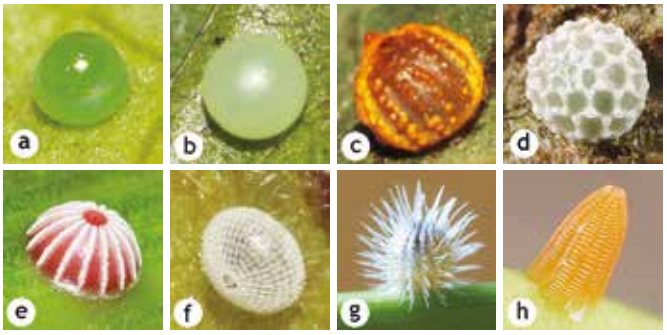
Butterflies are a fascinating group of insects. The adults are highly visible and admired for their colorful displays and dazzling designs. However, their immature stages—egg, larva (caterpillar) and pupa (chrysalis)—are far less visible despite their own awe-inspiring shapes, designs, colors, and ornamentations (Fig. 2-1). Each stage in the life history of a butterfly is very different in physical appearance; the transitions are well-defined, and the successful completion of each stage requires a different set of resources. This four-stage development is called complete metamorphosis and is seen in several groups of insects, including flies, ants and beetles as well as in butterflies and moths. Other groups of insects, such as grasshoppers and dragonflies, undergo incomplete metamorphosis. They have only three stages—egg, nymph, and adult, without a pupal stage. The nymph usually looks like a miniature adult with stubby wing buds, and it proceeds to adulthood with incremental changes in size, with no abrupt transitions. One of the drawbacks of incomplete metamorphosis is that nymphs and adults usually feed on the same food resources and therefore compete with each other. This can be detrimental to individuals in both stages when resources are limiting.

The development of complete metamorphosis was a great advance since it enabled each stage to exploit widely different resources, eliminating competition between the different stages. In the case of butterflies, the larvae usually feed on vegetative and reproductive parts of plants while the adults, depending on the species, feed on nectar, tree sap, scat, decaying animal matter and fallen fruit.

The duration of each stage in the life of a butterfly varies and depends largely on the particular species and the environment under which development takes place. In general, cooler temperatures extend the durations and warmer temperatures reduce the durations. In the warm tropics, the durations of the four stages are seldom as long as in the temperate regions. In the lowlands of Sri Lanka, typical durations in the field range from 1–3 weeks for the adult, 2–4 days for the egg, 10–30 days for the larva and 5–15 days for the pupa. In some species, however, the pupal stage can last many months under certain environmental conditions.

Egg

Butterfly eggs are wonderful structures to behold, and are well-adapted to meet the challenges of the environment. The surface of the egg is covered by tiny pores, sometimes as many as 15,000, occupying 10% of its surface. The structure of the pore minimizes the loss of water so that the egg resists dessication. It also allows efficient air exchange so that the egg can survive even when it is temporarily submerged by rain. At its simplest, the egg is smooth, spherical, slightly flattened on the bottom and uniformly colored. In some species, the egg has a complex surface structure with furrows, ridges, facets, projections, or filaments with sticky droplets at the tip. Each family, or sometimes each genus, has its own characteristic egg architecture (Fig. 2-3). Most eggs are whitish, though in many species they are shades of yellow, green, brown or blue. The color and markings on the egg change during development in some species, sometimes within minutes of being laid, but usually in a day or two.



Fig, 2-3. Eggs. a) Plum Judy, *Abisara echerius* (Riodinidae); b) Common Jay, *Graphium doson* (Papilionidae); c) Common Rose, *Pachliopta aristolochiae* (Papilionidae); d) Redspot, *Zesius chrysomallus* (Lycaenidae); e) Indian Palm Bob, *Suastus gremius* (Hesperiidae); f) Cornelian, *Deudorix epijarbas* (Lycaenidae); g) Joker, *Byblia ilithyia* (Nymphalidae); h) Plain Orange Tip, *Colotis aurora* (Pieridae).

Egg-laying commences with the release of an egg from the ovaries and its subsequent fertilization (see details under Mating and egg-laying). Most species lay eggs singly, though some lay in batches (Fig. 2-4).

Fig. 2-4. Egg-laying behavior. a) eggs laid singly (Common Indian Crow, *Euploea core*); b) eggs laid in a batch (Common Jezebel, *Delias eucharis*).

The female usually takes great care to place its eggs on the correct food plant since the larvae of most species feed on only a limited number of species of plants. Some species lay their eggs rather randomly on the larval food plant. Others lay them in a particular position, such as on the upperside of a leaf, or within a leaf axil or flower bud. The Tiny Grass Blue (*Zizula hylax*) inserts its eggs carefully into the tight cluster of vegetative buds. This ensures their safety by making them inaccessible to predators and parasitoids and protects them from adverse environmental conditions (Fig. 2-5a). A few species are rigid in their egg-laying behavior. The female Commander (*Moduza procris*) always lays a single egg at the tip of a leaf. Others, however, take a different approach. The Chocolate Soldier (*Junonia iphita*) and the Lemon Pansy (*Junonia lemonias*) not only lay their eggs anywhere on the larval food plant, but also on objects nearby such as a dead twig, a dried-up leaf, a pebble or a bare rock (Fig. 2-5b). The burden of finding the appropriate food plant in such cases is placed on the larva, which must now wander around to locate it. There are, however, advantages to this practice: placing eggs away from the larval food plant minimizes the losses caused by parasitoids that seek eggs first by locating the scent of the larval food plant and then by searching for eggs on the selected plant.

present-day butterflies, the basic plan has been modified extensively to give rise to the characteristic venation of each family. In this publication, we follow the Comstock-Needham system (Fig. 2-31). The veins of the anterior set are named the costa, subcosta, radius and media; those of the posterior set, are named the cubitus, and 1st, 2nd and 3rd anal veins. In the forewing, the costa and subcosta are unbranched. The radius has five branches (R1, R2, R3, R4, R5) that may be fused together in various combinations. The media has three branches (M1, M2, M3), and the cubitus has two (Cu1, Cu2). In the hindwing, the configuration is similar except for the following differences: a humeral vein may be present at the base of the costa; R1 is always fused with the subcosta and is known as Sc+R1; the remaining branches of the radius (R2–R5) run to the margin as a single vein called the radial sector (Rs); and there are usually additional anal veins. The space at the center of the wing that is enclosed by the veins is called the discal cell or cell. In most species, it is closed at the distal end by crossveins (called discocellulars in the older literature). The crossveins are named according to the veins: for instance, the crossvein between M1 and M2 is named M1–M2. In some members of the Hesperiidae, the discal cell does not have crossveins and is referred to as an open cell. The discal cell and the circular area around it is sometimes called the discal area or the disc, especially in the older literature. The space between two veins elsewhere on the wing is named after the upper vein. Thus the space between vein R1 and vein R2 is called cell R1; the space between Sc+R1 and Rs is called cell Sc+R1. The terms used to describe the areas of the wing are given in Fig. 2-32.

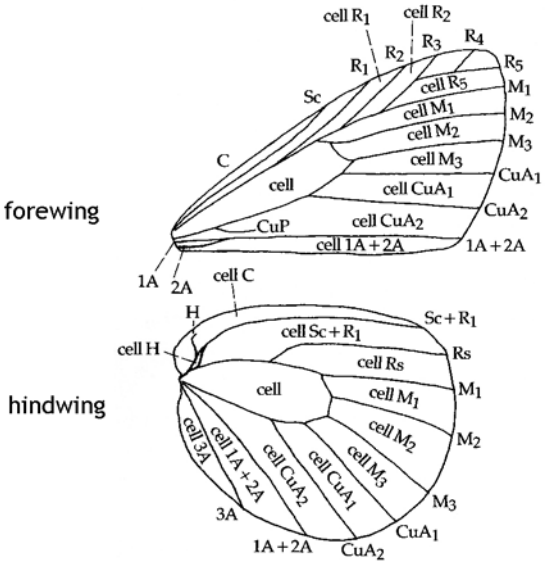


Fig. 2-31. Wing venation. The Comstock-Needham system of naming. "Cell" also called discal cell. From Scott (1986).

The wings of butterflies are clothed with scales that overlap like tiles on a roof. The order is named after this feature: "lepidoptera" means scale-wing (lepido=scale; ptera=wing). The scales provide insulation and aid in gliding flight. They are usually colored and these colors play an important role in

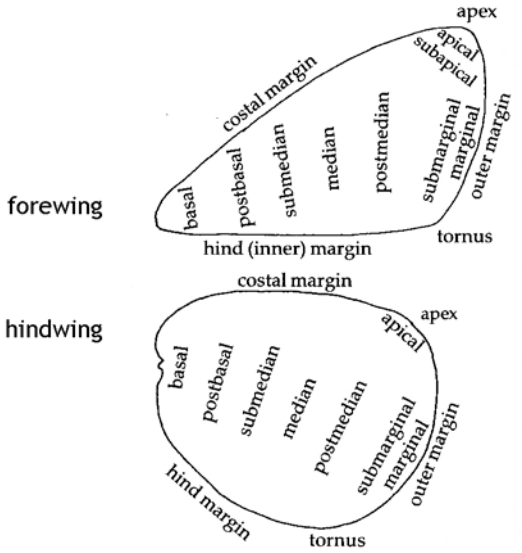


Fig. 2-32. Areas of the wing. Outer margin also called the termen; hind (inner) margin also called the dorsum. From Scott (1986).

mate recognition, mimicry, courtship and predator avoidance. A scale comprises two laminae (thin plates) joined by trabeculae (crossbars): the lower lamina is a flattened plate while the upper one consists of parallel ridges with crossribs. Some colors are produced by pigments within the scale whereas others are structural, produced by the interaction of light and the physical structure and arrangement of the scales. In the Pieridae, for instance, the yellow, orange and white colors are produced by pigments called pterins, whereas the brilliant blue and green of the Common Banded Peacock (*Papilio crino*) are structural. The laminae in each species have a characteristic structure. In most species, the light that is reflected from the scale due to its specific structure interacts with the pigments in the scale that absorb or reflect light selectively to produce the butterfly's characteristic wing color. Structural color is also termed iridescence: the color changes depending on the angle at which it is viewed.

In some species, the scales reflect ultraviolet (UV) light and the patterns created by this reflection are important in mate recognition. In many species, the male also has specialized scales on its wings, called androconia or scent-scales, that differ in shape and size from the normal ones. Each androconium produces pheromones used in courtship and has a basal gland that connects it to the wing membrane. The androconia are located in various sites on the wing, individually, or in patches, depending on the species. In some, the androconial patches are hidden within an area where the forewing and hindwing overlap, probably for protection or to minimize the escape of volatile pheromones. These patches have a characteristic color, composition and shape, and are useful in distinguishing species that otherwise look similar, such as those belonging to the genus *Mycalesis*. Males in the tribe Pyrginae (Hesperiidae) have tufts of androconia that look like long hairs. At rest, they are tucked away in a pouch on the front part of the thorax near the forelegs. During courtship, the pouch is opened and the androconia exserted to scent the air with pheromones (Fig. 2-44b).

Chapter 5

The Skippers: Hesperiidae

Introduction to the Hesperiidae

The members of Hesperiidae (Hesperiids) are widely distributed worldwide and the family comprises over 4000 species. The adults are small to medium-sized butterflies that are usually some shade of brown or black with orange or white markings. Their common name derives from their fast, irregular flight.

Distinguishing characters: Members of this family are distinguished by the following characters in the adult: The head is broad, the thorax is large and the body is stout with relatively short wings. The proboscis is often exceptionally long compared to the size of the butterfly. The antenna is usually expanded towards the tip into a bent club which ends in a short hook (the apiculus); the antennae are widely separated at the base. Like the Papilionidae, most species have an epiphysis on the tibia of the foreleg. Tibial spurs are often absent on the midleg, but one or two pairs are found on the hindleg. In the forewing, vein R1 and all branches of Rs usually arise directly from the discal cell without a stalk, and all radial veins extend free to the wing margin; there is one anal vein. The hindwing has two anal veins and usually a humeral vein. Vein CuP is absent from both wings. A typical Hesperiid wing venation is shown in Fig. 5-1.

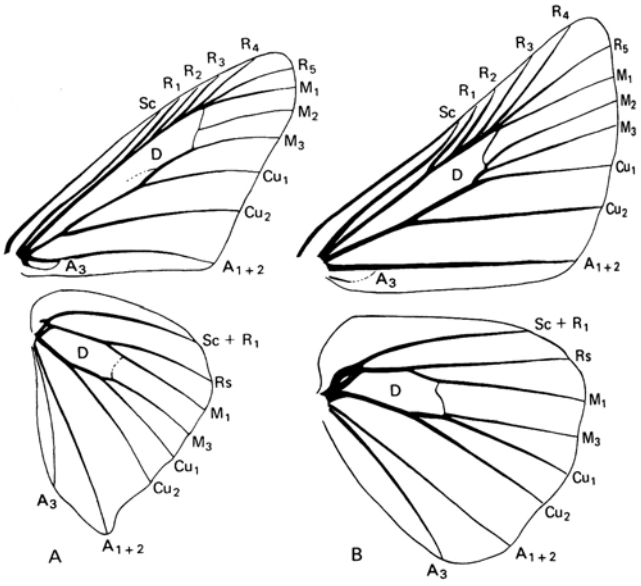


Fig. 5-1. Wing venation. Hesperiidae. A (on the left): *Epargyreus* (subfamily Pyrginae); B (on the right): *Pseudocopaeodes* (subfamily Hesperiinae). D=discal cell. A3=3A. A1+2=A1+A2. From Borror *et al*. (1989).

Fig. 5-2. Dark Palmdart (*Telicota bambusae lanka*) female taking off.

Adult behavior: The adults are usually strong fliers with a fast, irregular, darting flight. Some species of Hesperiids rest with their wings folded up above the body, while some rest with the hindwings opened flat and the forewings held vertical or slanting slightly. Still others hold both wings spread horizontally. While some species are readily attracted to nectar, others feed only, or additionally, on tree-sap, bird-droppings, dung and rotting fruit. The males of many species mudsip, often on dry rock or dry ground; they excrete a liquid from their abdomen onto the dry substrate in order to suck up the nutrients with their proboscis. The habitats they occupy range from arid thorn scrub to wet tropical forests.

Immature stages: The eggs are variable in size and shape though they are frequently dome-shaped. They are usually white, pale yellow, brown or green. They are smooth in some species and ribbed in others. The larvae of most species are covered with secondary setae on the head and body. The head is usually larger than the thorax and there is a constricted area behind the head, called the neck. The larvae of some species are brightly colored whereas those of others are green or brown. Hesperiid larvae often construct a shelter using leaves of the larval food plant and silk from their silk glands, which is exuded through spinnerets at the base of the mouth. The shelter can be open or closed and is often lined with a waxy secretion from glands, called powder glands, on the ventral surface of the abdomen. Though the shelters differ in structure from species to species, the basic method of construction is the same. The larval lays down silk from its spinnerets from one part of a leaf to another; the silk dries on contact with air and

contracts, which draws the two sides of the leaf together. The pupae of many species bear a horn on the head and the proboscis sheath is usually long. In many species, the larva pupates within its larval shelter, which is often coated with fine silk and a waxy secretion. The pupa is attached by the cremaster and, in some species, additionally by a silk girdle. The larvae feed on leaves, and larval food plants include members of the Poaceae (grasses and bamboos) as well as Acanthaceae, Zingiberaceae, and Leguminosae.

The immature stages and larval food plants of some species are still undescribed and those of many others have been described only from either the same or a related subspecies in India. The immature stages and larval food plants of the Yellow Palm Dart (*Cephrenes trichopepla*) were described in van der Poorten & van der Poorten (2013c). The immature stages of the following species have not yet been described elsewhere and are given in this publication: Ceylon Ace (*Halpe ceylonica*), Rare Ace (*Halpe egena*), Ceylon Palm Bob (*Suastus minuta minuta*), Hedge Hopper (*Baracus vittatus*), Paintbrush Swift (*Baoris penicillata*), Philippine Swift (*Caltoris philippina seriata*), Little Branded Swift (*Pelopidas agna agna*), Pale Palmdart (*Telicota colon kala*), Water Snow Flat (*Tagiades litigiosa ceylonica*) and Tropic Dart (*Potanthus satra*). Others (for example, *Pelopidas mathias mathias*) have to date been described only for the species in India and are described for Sri Lanka here for the first time. The immature stages and larval food plants of six species are still unknown: Ceylon Golden Angle (*Caprona alida lanka*), Banded Redeye (*Gangara lebadea subfasciata*), Decorated Ace (*Thoressa decorata*), Common Dart (*Potanthus pseudomaesa pseudomaesa*), Large Branded Swift (*Pelopidas subochracea subochracea*), and Pallid Dart (*Potanthus pallida*).

Taxonomy: The Hesperiidae are classified under 7 subfamilies: Coeliadinae, Eudaminae, Euschemoninae, Hesperiinae, Heteropterinae, Pyrginae and Trapezitinae (Warren *et al.*, 2008, 2009). Only 3 of these subfamilies are represented in Sri Lanka: Coeliadinae, Hesperiinae and Pyrginae, with 50 species classified within 35 genera containing 8 endemic species and 14 endemic subspecies. The subspecific status of many species is not clear and needs further investigation. The Hesperiidae represent 20% of the butterfly fauna of Sri Lanka. Information about each subfamily is given in the text before the accounts of the species of that subfamily.

Many adult members of the Hesperiidae are difficult to differentiate based on external morphological characters alone, which has led to much confusion in classification and field identification. It is hoped that molecular work currently being conducted on the Hesperiidae will resolve some of these issues, which are outlined in Appendix A (e.g. *Pelopidas agna agna*, *Pelopidas mathias mathias* and *Pelopidas subochracea subochracea*).

Conservation issues: In the National Red List 2012, 14 species of Hesperiidae are classified as LC (Least Concern). Five species are classified as CR (Critical), while 8 are classified as EN (Endangered), 13 as VU (Vulnerable), 8 as NT (Near Threatened), and 1 as DD (Data Deficient). One species, *Erionota torus*, was not known to occur in Sri Lanka when the 2012 Red List was published.

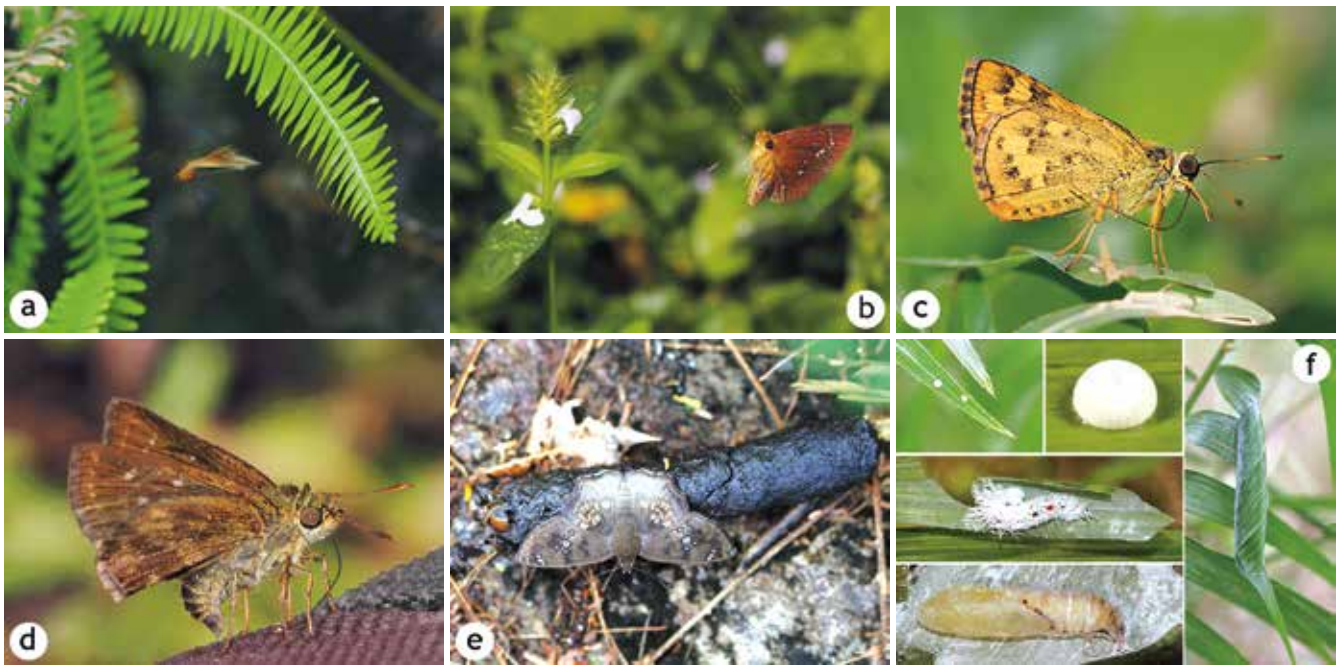


Fig. 5-3. Hesperiidae. a) Common Redeye (*Matapa aria*) in flight; b) Chestnut Bob (*Iambrix salsala luteipalpis*) female in flight; c) Tropic Dart (*Potanthus satra*) using front legs to clean its long proboscis; d) Rare Ace (*Halpe egena*) feeding on liquid droplet between its legs; e) Golden Angle (*Caprona r. ransonnettii*) feeding on scat; f) immature stages of the Giant Redeye (*Gangara thyrsis clothilda*): eggs on leaf of rattan (*Calamus rotang*); egg; larva, final instar; pupa; pupal shelter.

Indian Awl King (*Choaspes benjaminii benjaminii*)

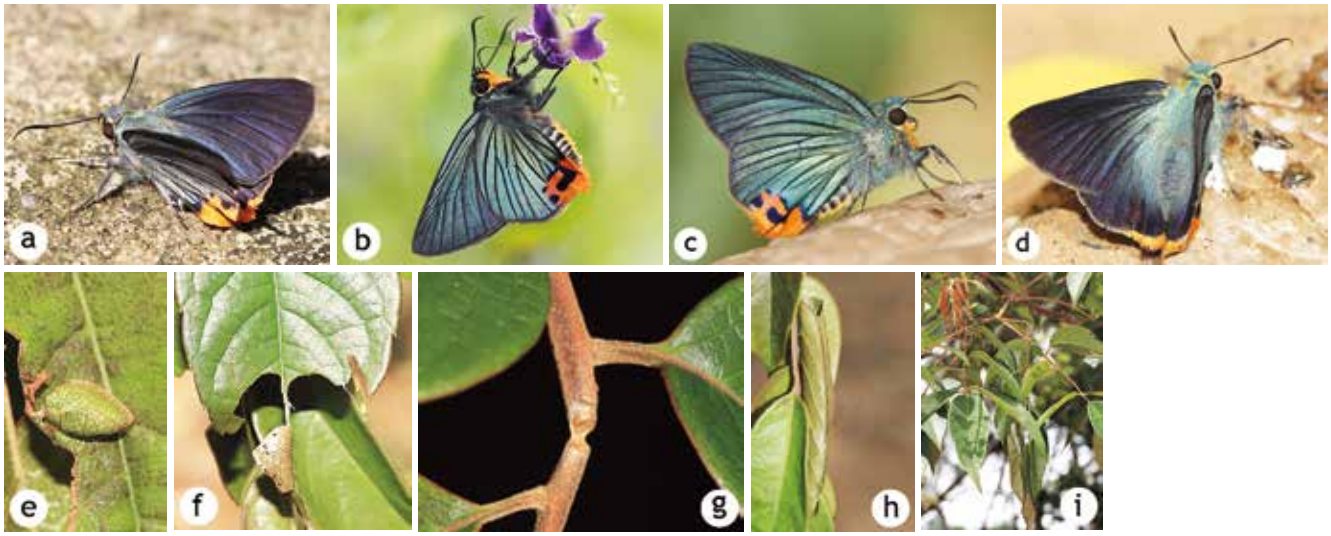


Fig. 5-7. Indian Awl King (*Choaspes b. benjaminii*). a) male, upperside; b) male feeding on nectar of *Duranta erecta*, underside; c) female, underside; d) female, upperside; e) – f) larval shelter, early instar; g) leaf stem cut by larva; h) rolled-leaf larval shelter of late instar; i) clump of wilted leaves of late instar larval shelter.

Wingspan: 50–60 mm

■ **Description (Fig. 5-7):** This medium-sized Skipper is greenish-blue on the underside, and has a large bright orange tornal spot. The upperside of the male is a blending of iridescent shades of indigo blue with purplish hairs basally; in the female the greenish iridescence is confined to the area below the median line, and the hairs on the body are gray.

■ **Similar species:** None.

■ **Status, distribution and habitat:** This species is uncommon (5). A few individuals are seen year-round, but its main flight season is between February and May. It is restricted to the forested areas of the central hills above 1500 m asl though a few stragglers are found at slightly lower elevations. Its numbers have declined significantly over the years due to loss of forest habitats. Threat status: VU.

■ **Adult behavior:** The adult has a powerful flight and moves about a great deal, spending little time at any given location. When encountered, it is usually a male settled on a gravel road or jungle path feeding on a bird dropping. The female is more likely to be seen feeding on the nectar of flowers of trees and shrubs, but neither sex visits flowers of herbaceous plants.

■ **Immature stages:** The female lays its eggs singly, usually on the underside of a young leaf of the larval food plant, sometimes at a considerable height. The newly emerged larva creates a shelter for itself by eating at the margin of the leaflet to make a small, more or less circular piece of leaf tissue, which remains attached to the leaflet by a small bridge (Fig. 5-7e). It then brings the piece of leaf tissue over itself and attaches it securely to the upperside of the leaflet with silk placed along the edges except for a space for exit and entry. It also builds shelters in the next two instars by simply bringing cut sides of a leaf together (Fig. 5-7f). In the later instars it creates its shelter by rolling up the leaflet lengthwise to form a tubular structure (Fig. 5-7h). The larva leaves the ends of the rolled-up leaflet open for entry and exit, and to allow water from the frequent rains in the hills to run through. The larva also wilts the entire compound leaf on which the shelter is created by partly severing the petiole some distance away from the shelter (Fig. 5-7g). To prevent the part below the cut from falling away, the larva lays down silk threads around the cut and above it. All the leaflets of the compound leaf below the cut soon wither and crumple, and often roll up like the rolled-up shelter (Fig. 5-7i). The larger number of similar-looking rolled up leaves probably makes the larva less vulnerable to predators since the entire dried up structure now looks more like a large broken twig than a place where a bird might find a tasty morsel of food. The larva enhances this image further by laying down fair amounts of silk to hold the leaflets to the rachis of the leaf as well. The mature larva is brightly colored with red, black, yellow and blue. To avoid daytime predators, it remains hidden inside the shelter. When darkness falls it begins to feed on the leaves. The larva pupates within a shelter, but one in which the margins of the leaflet are held more loosely over the midrib. The only known larval food plant in Sri Lanka is *Meliosma pinnata*.

Pale Palmdart (*Telicota colon kala*)

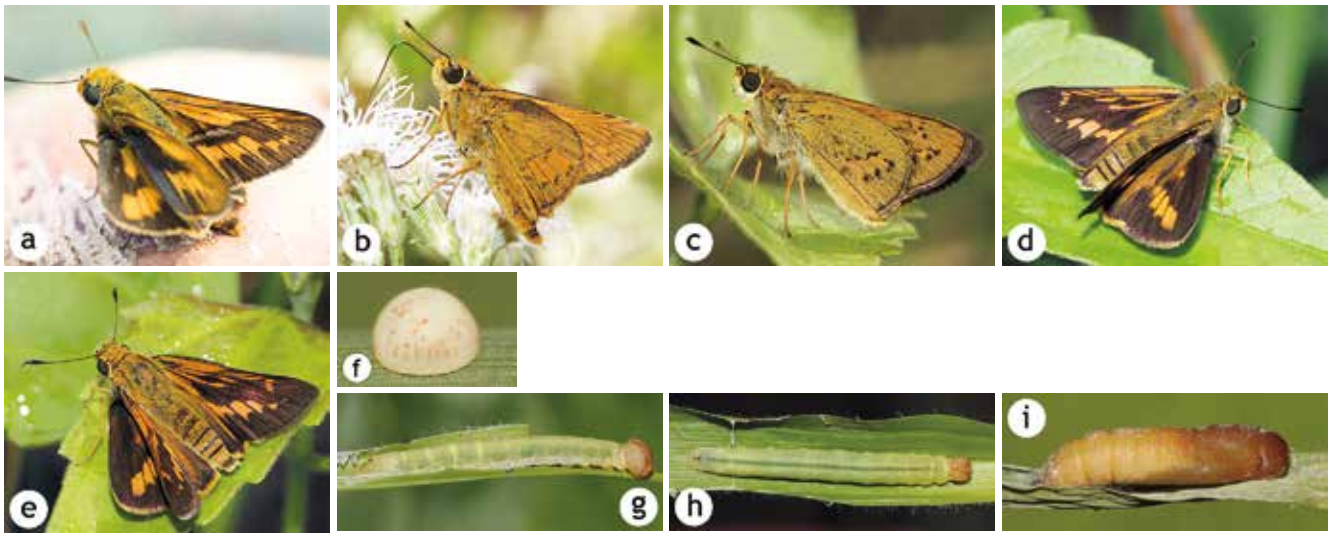


Fig. 5-49. Pale Palmdart (*Telicota colon kala*). a) male, upperside; b) male feeding on nectar of *Chromolaena odorata*, underside; c) female, underside; d) – e) female, upperside; f) egg; g) larva, final instar, lateral view; h) larva, final instar, dorsal view; i) pupa.

Wingspan: 32–36 mm

■ **Description (Figs. 5-49, 5-50c, d):** It is very similar in appearance to the Dark Palmdart. In the male, the sex brand on the upperside of the forewing consists of three broad streaks that are situated closer to the upper margin of the black band within which they lie; on the upperside of the forewing, the yellow streaks from the postdiscal band run along the veins to the termen. In the female, these yellow streaks do not extend to the termen along the veins, but the markings in the cells below vein M3 have their lower edges produced slightly; the markings on the upperside are much smaller, enhancing the black ground color and making the butterfly appear darker.

■ **Similar species:** Dark Palmdart—see under that species. All other Darts are smaller.

■ **Status, distribution and habitat:** The species is rare (5), but appears to fly year-round. It is confined to the hills of the Uva, Sabaragamuwa provinces and the drier parts of the Central province. A few are occasionally encountered at lower elevations. Ormiston (1924) recorded it as "plentiful" in Haldummulla and had observed it in Galle and Wellawaya. Woodhouse (1949) wrote that it was found "all over the island, all the year round, below 5000 feet". Its range within the island has certainly contracted since historical times. Threat status: NT.

■ **Adult behavior:** Its behavior is similar to that of the Tropic Dart except that it inhabits grasslands and large open meadows.

■ **Immature stages:** Its immature stages are similar to those of the Dark Palmdart except that it feeds on grasses instead of bamboo though the species of grass has not yet been identified. Ormiston (1924) recorded that it fed on sugarcane. The mature larva has a light brown head and is more yellowish than the larva of the Dark Palmdart, while the pupa is paler.

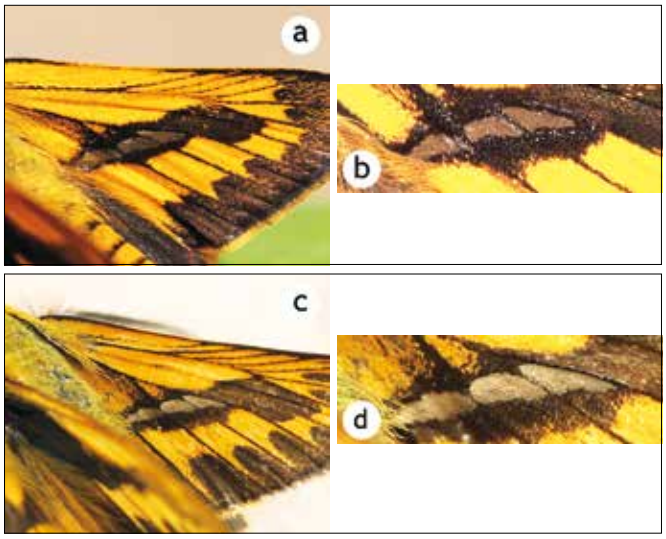


Fig. 5-50. Differentiating male Dark Palmdart and male Pale Palmdart by wing pattern and sex brand.
a) – b) Dark Palmdart (*Telicota bambusae lanka*); orange-colored scales do not extend to margin; sex brand lies closer to the lower margin of the black band within which it lies.
c) – d) Pale Palmdart (*Telicota colon kala*); orange-colored scales extend to margin; sex brand lies closer to the upper margin of the black band within which it lies.

Chapter 6

The Blues: Lycaenidae

Introduction to the Lycaenidae

The members of the Lycaenidae (Lycaenids) are widely distributed and the family comprises about 5000 species worldwide. The majority of the species are found in the tropics, and about 30% of all species of butterflies in the world belong to this family. The adults are small to medium-sized butterflies. Most species are some shade of iridescent blue or purple on the upperside of the wings, with various patterns and colors on the underside. Despite their common group name, the "Blues", many species have no blue, but are varying shades of red, orange, brown or black.

Distinguishing characters: Members of this family are distinguished by the following characters in the adult: The antennae are set close together on top of the head and the eyes are large and close together. Many species have eyespots on the underside of the hindwing and hair-like tails. In the male, the front legs are reduced in most species. In the forewing, the radial vein has only 3 or 4 of the 5 branches (usually R3 and R4 are missing). The hindwing usually has two anal veins, but no humeral vein. A typical Lycaenid wing venation is illustrated in Fig. 6-1.

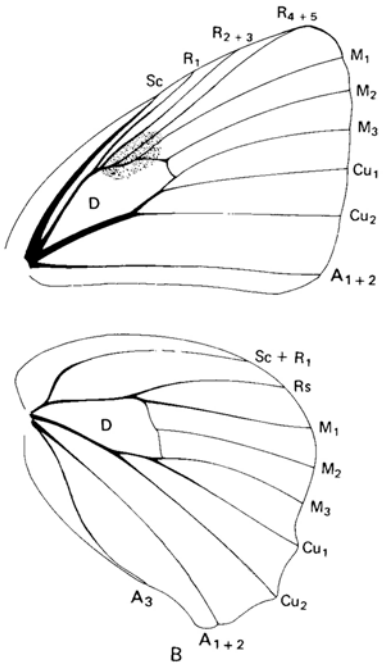


Fig. 6-1. Wing venation. Lycaenidae. Theclinae. *Thecla*. The dark spot near the end of the discal cell on the forewing is a scent patch. D=discal cell. A3=3A. A1+2=A1+A2. From Borror *et al*. (1989).

Fig. 6-2. Plain Hedge Blue (*Celastrina l. lavendularis*) male in flight.

Adult behavior: The adults are generally moderate to strong fliers despite their small size though some species have a weak, fluttering flight. Most species feed on the nectar of flowers; others feed on fruit, tree sap or decaying matter. Several species mudsip. They are generally found in open sunny places though some species are forest or canopy dwellers. Many species have tornal spots and tails on the hindwing; at rest, they sit head-down and move their hindwings rhythmically so that the tornal spots and tails imitate the head of an adult butterfly when viewed from the side. A predator that is deceived by the false head and attacks it would be rewarded with only a mouthful of wing. Some species have additional lobing on the hindwing, and when these individuals are viewed from behind, they too present a false head with eyes and antennae.

Immature stages: The egg is usually a smooth or a pitted flattened dome though in some species, the egg is almost spherical. The color ranges from white to cream to orange. The larva is usually flattened and slug-like (onisciform), triangular in cross-section, and with a small retractable head. The larvae of many Lycaenids are associated with ants and these have three specialized organs to interact with them: a single dorsal nectar organ (DNO) on segment A7, a pair of tentacle organs (TO) on segment A8 and minute pore cupola organs (PCO) distributed over the dorsal surface of the body (Figs. 6-3a, b). The DNO is a complex structure, consisting of four glandular cells below the skin that secrete a mixture of sugars and amino acids into a central sac. When it chooses, the larva releases a drop of this mixture to the surface. These secretions are used as a source of food by the ants associated with the larva.

Red Pierrot (*Talicada nyseus nyseus*)

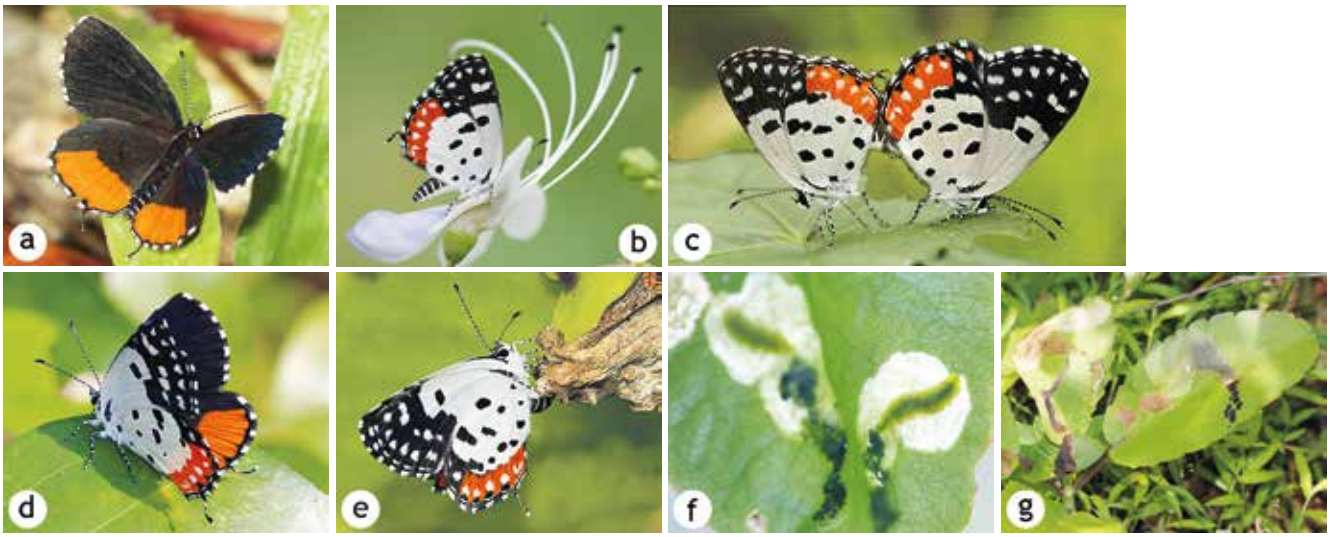


Fig. 6-58. Red Pierrot (*Talicada n. nyseus*). a) male, upperside; b) male feeding on nectar of *Clerodendrum* sp., underside; c) mating pair, male on left, underside; d) female; e) female laying egg on dried leaf of *Bryophyllum pinnatum*, underside; f) larva, early instar, feeding within leaf of *B. pinnatum*; frass visible; g) larva, later instar, feeding within leaf of *B. pinnatum*; frass visible.

Wingspan: 28–35 mm

■ **Description (Fig. 6-58):** A distinctive butterfly, but the color on the hindwing varies from red to orange to yellow. The female is a trifle larger with more rounded wings.

■ **Similar species:** None.

■ **Status, distribution and habitat:** This species is common (50) and is seen year-round, but is most numerous from December to March. It is widely distributed over the island below 1200 m asl though a few colonies persist as high as 1500 m asl at Agrapatana. It is almost always found in the vicinity of its larval food plant, *Bryophyllum pinnatum*—a plant that usually grows in profusion amidst sparse vegetation on or near rocky outcrops of mountains and hills. Threat status: LC.

■ **Adult behavior:** It flies slowly, seldom more than a few centimeters above the ground. Despite its slow flight, it appears that birds do not prey on it; it is probably unpalatable and toxic because of the compounds sequestered by the larva from its larval food plant. It stops frequently while flying around, and habitually rubs its wings together while they are folded up above its abdomen. It is active from early morning to sundown and flies in dappled shade and full sun, and sometimes even in light rain. In home gardens, it is particularly fond of feeding on the flowers of introduced plants such as *Kalanchoe blossfeldiana* and *Cuphea hyssopifolia*. In its native habitat, it is often seen on the flowers of *Cyanthillium cinereum*, *Justicia procumbens* and species of *Oldenlandia* with occasional visits to bird droppings. It also settles on dry soil and rock outcrops and sucks up minerals after wetting the soil or rock with its saliva. Like many other butterflies, it is quite lethargic in the early morning hours, particularly in the hills where the temperature drops significantly at night. It roosts in small colonies, hanging on to a small twig or leaf near the ground. The female disperses very widely to colonize new areas despite its slow, weak flight. The appearance of this butterfly in home gardens after its larval food plants have become established is ample evidence of its powers of dispersal.

■ **Immature stages:** The female lays its eggs singly anywhere on the larval food plant, but usually on a leaf. On occasion, the female lays an egg on a fallen leaf of the larval food plant or on the debris around it. The newly emerged larva probably has no difficulty finding fresh leaves because the food plant grows in dense stands that sometimes cover several square meters of ground. On emergence, the larva bores into the leaf and feeds on the tissue between the upper and lower epidermis leaving the upper and lower surfaces intact. Feeding within the leaf probably protects the larva to varying degrees from predators, parasitic wasps and flies. The droppings it leaves behind initially are often visible just outside the point of entry; in the later stages, they are seen within the leaf through the transparent layer of surface cells left behind as the larva eats its way forward. The damaged parts of the leaf, which initially appear as water-soaked spots, dry up and leave behind a characteristic pattern. At maturity the larva exits the leaf and pupates somewhere on the larval food plant or on debris nearby, but sometimes as far as 3–5 m away. Some larvae that fed on a potted plant of *Kalanchoe blossfeldiana* in our home pupated on walls five meters away. Such long-distance travel may be the exception in the wild. The pupa is bright yellow and probably unpalatable or toxic to predators. Common Babblers do not feed on them. The larva also feeds on the leaves of *Kalanchoe laciniata*, a plant to which the female is more partial to than the

Green's Silverline, Sri Lanka Green's Silverline (*Spindasis greeni*)

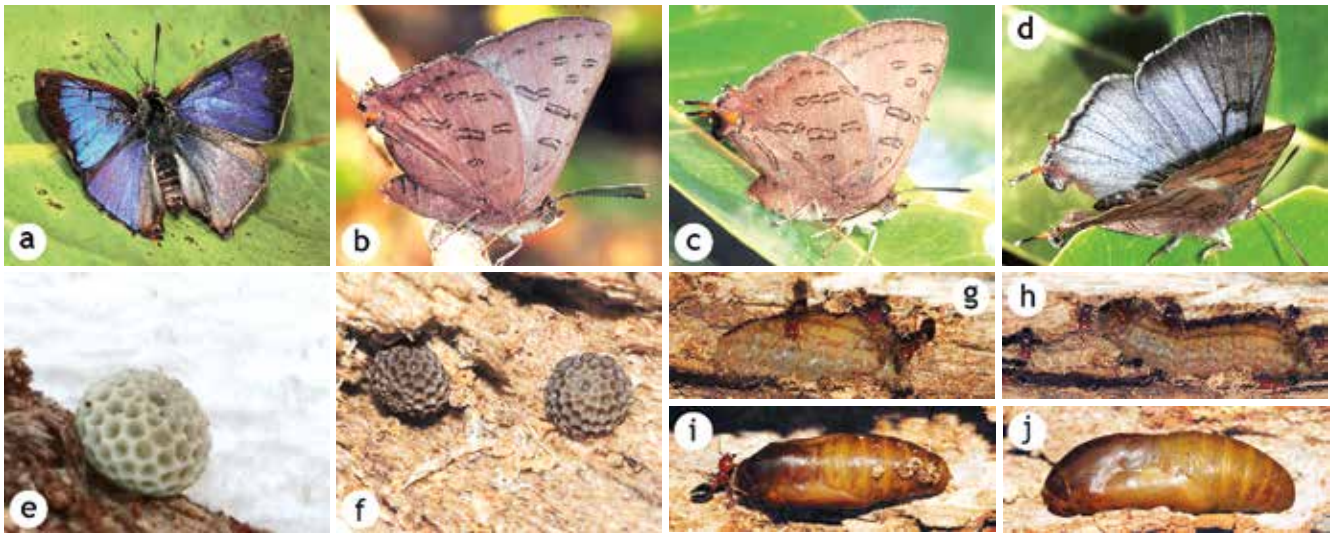


Fig. 6-73. Green's Silverline (*Spindasis greeni*). a) male, upperside; b) male, underside; c) female, underside; d) female, upperside; e) – f) eggs; g) – h) larvae, final instar, attended by *Crematogaster rothneyi* ants; i) – j) pupa, attended by *C. rothneyi* ants; k) below: habitat at World's End.

Wingspan: 23–26 mm

■ **Description (Fig. 6-73):** The markings on the underside are greatly reduced in size and disconnected from each other.

■ **Similar species:** None.

■ **Status, distribution and habitat:** This endemic species is very rare (5) and seasonal, having been recorded only in March and April. It is a butterfly of the mountains above 2000 m asl. Heron (1896) described the species based on a single male collected by E.E. Green at the peak of the Great Western Mountain range near Pundalu-Oya. It was not accepted as a valid species by many authors since the description was based on a single worn individual. The species was rediscovered, however, in March 2008 at Horton Plains National Park at the top of World's End. In March 2012, immature stages and adults of both sexes were recorded at the same location and its status as a valid species was established. Threat status: CR.

■ **Adult behavior:** It spends most of its time in the stunted canopy and is seldom seen near the ground. Because the habitat in which it is found is cool, often misty and rainy, the butterfly basks frequently in the sun with its wings spread open partway. It probably feeds on the nectar of flowers of trees, but we have not observed it doing so. It is difficult and risky to study the behavior of the butterfly in the field because of the steep terrain in which it flies and its tendency to fly near exceptionally precipitous locations.

■ **Immature stages:** The female lays its eggs singly or in small batches of 3–5 on the bark of dead trees that harbor colonies of the ant, *Crematogaster rothneyi*. On emergence, the larva nibbles on the eggshell and soon finds a hole in the bark through which it enters into the galleries of the tree trunk that have been created by ants and coleopteran larvae. It is not clear on what the larva feeds as it moves about freely within the galleries. The larva is always attended by the ants, which feed on the secretions of its DNO. The mature larva is light brown with a dark brown dorsal line; the subdorsal and lateral bands are narrow, discontinuous and pale brownish-pink; the bands are often obscure; the lateral edges below the spiracles have transparent tufts of hair. At maturity, the larva exits the galleries and pupates just underneath the bark with its head pointing towards an exit hole close by. The pupa is pale yellowish-brown with dark dorsal areas on segments T1 and T2; the wing buds are a lighter color than the abdomen. It is also always attended by ants. For more details, see van der Poorten & van der Poorten (2012b).

■ **Conservation issues:** With little information on its biology and only two known locations, this species is at risk particularly because of the loss of habitats due to encroachment and removal of dead wood for fuel.

Chapter 7

The Brush-footed butterflies: Nymphalidae

Introduction to the Nymphalidae

The members of the Nymphalidae (Nymphalids) are distributed world-wide. The family comprises over 6000 species and includes many familiar species such as the large blue *Morpho* butterflies of South America and the Monarch butterfly of North America. The adults are mostly medium-sized to large butterflies that are usually orange, brown, or black with white markings. Their common group name refers to their hairy, brush-like legs.

The single character that unites all members of this family is rather obscure: 3 longitudinal ridges on the ventromesial surface of the antenna of the adult butterfly (Figs. 7-3g, h). Another character shared by both sexes of all species (except females in the subfamily Libytheinae) is the presence of greatly reduced front legs, which are usually held pressed against the underside of the thorax. These reduced legs are not used for walking. The females of some species, however, use them to "drum" on leaves in order to identify the larval food plant correctly—the spines on the leg puncture the surface of the leaf as the female drums and the sense receptors on the last segment of the leg detect the released chemicals. The forewing has a single anal vein, and the radial veins have 5 branches, some of which are stalked. The hindwing usually has a humeral vein (though it is sometimes greatly reduced), and two anal veins. The tornus is usually rounded. A typical Nymphalid wing venation is shown in Fig. 7-1.

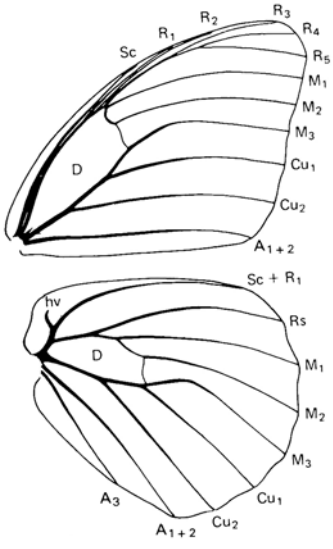


Fig. 7-1. Wing venation. Nymphalidae. Heliconiinae. *Speyeria*. Discal cell in hindwing closed. hv=humeral vein. D=discal cell. A3=3A. A1+2=A1+A2. From Borror *et al*. (1989).

Fig. 7-2. Peacock Pansy (*Junonia a. almana*) in flight, with several Silverlines (*Spindasis* sp.) below feeding on the nectar of the flowers of *Mikania cordata*.

Adult behavior: The appearance, behavior and habitats of the members of the Nymphalidae are varied as might be expected from such a large, diverse group. The adults are usually strong fliers. Some species are migratory. While some species are readily attracted to nectar, others feed only or additionally on tree-sap, bird-droppings, dung and rotting fruit. The habitats they occupy range from arid thorn scrub to wet tropical forests.

Immature stages: The eggs are variable in size and shape and are often white, pale yellow, brown or green. They range from being smooth and rounded as in the subfamily Satyrinae to being intricately sculptured with fine projections as in some *Euthalia* in the subfamily Limenitidinae. The mature larva is more or less cylindrical though in some species the anterior segments are expanded into a hump. The larvae of some species are smooth whereas others have branched spines, filaments or hairs of varying lengths on the thorax and abdomen. The head capsule of some species bears horns, which are simple or elaborately branched. The last abdominal segment in some species is bifid, forming two tail-like projections. Larvae are often cryptically colored though the larvae of some species are brightly colored, suggesting an aposematic warning coloration. They are often gregarious. In many species, the larva builds a shelter using its own silk and the leaves of the larval food plant. The pupa is usually some shade of green or brown with white and black markings, usually cryptically colored. The pupae of different species assume quite different shapes, but in all species, they hang solely by the cremaster from a pad of silk and are not supported by a girdle around the thorax. The life history of

Plain Tiger (*Danaus chrysippus chrysippus*)

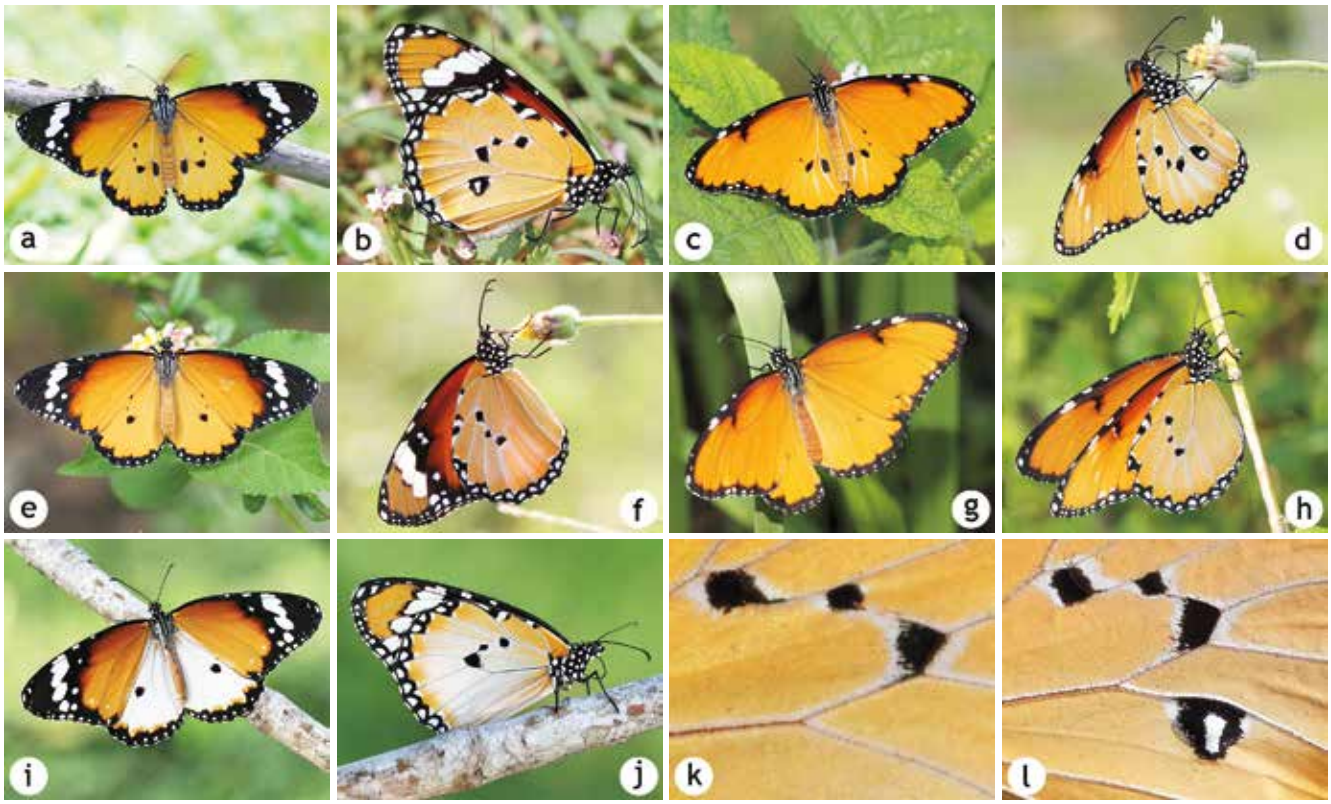


Fig. 7-12. Plain Tiger (*Danaus c. chrysippus*). a) male, upperside; b) male feeding on nectar of *Phyla nodiflora*, underside; c) male, form dorippus, feeding on nectar of *Heliotropium indicum*, upperside; d) male, form dorippus, feeding on nectar of *Tridax procumbens*, underside; e) female feeding on nectar of *Lantana camara*, upperside; f) female feeding on nectar of *Tridax procumbens*, underside; g) female, form dorippus, upperside; h) female, form dorippus, underside; i) female, form alcippoides, upperside; j) female, form alcippoides, underside; k) female, underside of hindwing, no sex brand; l) male, underside of hindwing; sex brand present.

Wingspan: 60–75 mm

■ **Description (Figs. 7-12, 7-13):** The sexes are superficially similar in appearance, but the male can be identified by its sex brand, which is a black patch with a white center that is located immediately below vein CuA2 on the underside of the hindwing. On the upperside of the hindwing, the corresponding black patch is present, but not the white center. Both sexes have a prominent spot at the base of the discal cell. The Plain Tiger occurs in three forms. In the normal form, the apex of the forewing is black while in the more scarce dorippus form it is tawny. The scarcest is the alcippoides form in which both sides of the hindwing have a large white patch. Dwarfs are not uncommon.

■ **Similar species:** Danaid Eggfly female—the margin of the hindwing is shallowly scalloped and there is no black spot at the base of the discal cell.

■ **Status, distribution and habitat:** This species is common (20) and seen year-round. It is widespread in the arid zone, the dry zone and the intermediate zone. It is less common in the wet zone though it is not uncommon along the southwest coast. It frequents fallow land, coastal areas, scrub jungle, neglected agricultural lands and roadsides. It has expanded its range into the higher hills up to 1500 m asl after the introduction of two ornamental plants, *Asclepias curassavica* and *Gomphocarpus physocarpus*, which it uses as larval food plants. Threat status: LC.

■ **Adult behavior:** The adult is an insect of the bright sun and prefers to spend its time in open fields where it flies within a meter or two of the ground in a slow leisurely manner. Despite its slow flight, however, it seldom falls prey to birds because of the toxic chemicals in its body inherited from the larva. For example, when the larva feeds on *Calotropis gigantea*, it sequesters poisons such as calotropin and cardenolide glycosides, which are toxic to vertebrates. Similar toxins have been found in other plants on which the larva feeds. The adult obtains nourishment from flowers of a wide range of native and introduced plants. The male also feeds on the exudates of the vegetative parts of plants such as *Crotalaria retusa* or of the dead tissues of plants such as *Heliotropium indicum* and *Chromolaena odorata* in order to obtain substances that are used in pheromone synthesis and defense. To obtain these exudates, it injures the surface of the vegetative parts using the sharp claws on its middle set of legs. Males mudsip, but

only under very dry weather conditions (Fig. 7-13c). Although it flies in open spaces, at day's end, it prefers to roost inside the canopy of trees.

■ **Immature stages:** The female lays its eggs singly on the underside of a leaf of the larval food plant near the ground, but occasionally higher up. When laying eggs on *Calotropis gigantea*, the female preferentially selects small plants. The newly emerged larva feeds on the underside of the leaves by gnawing on the leaf tissue, and since *C. gigantea* leaves contain a sticky poisonous latex, the larva takes special precautions to avoid its deleterious effects. First, it chews the leaf tissue around itself to create a shallow circular trench (Fig. 7-13b). The latex that oozes out as a result of the injury flows into the trench from the cut edges and the center of the circle becomes latex-free. The larva now feeds on the leaf tissue inside the circle. Although the larva tries to avoid the intake of latex, it probably ingests some of it inadvertently while cutting the trench, which in any case may help it to gradually build up its tolerance. Because the latex is sticky, the larva expends considerable effort and time to cut the trench. A few are occasionally trapped by the sticky latex and do not make it to the next instar. As the larva grows and molts, its capacity to deal with the latex improves, which allows it to eventually consume a leaf without bleeding it. Nevertheless, many later instar larvae still bleed the leaf tissue before feeding on it, though the technique is now different—it bites half-way through the petiole or midrib of the leaf to allow the latex to ooze out. The larva also feeds on the flowers and flower buds of *Calotropis gigantea*, and while on them, it can be easily overlooked because it is well-camouflaged amongst them. The larva usually pupates on a leaf near the ground, often without any attempt at concealment. At maturity, the larvae that feed on small plants often move away from the food plant to pupate elsewhere.

The most widely used larval food plant of the butterfly is *Calotropis gigantea*. The plant grows well, and often in abundance, in waste places and areas around human habitations in the intermediate zone, the dry zone and the arid zone. In the dry coastal areas, *Pentatropis capensis* and *Pergularia daemia* are used as frequently as *Calotropis gigantea*. In the higher hills, the larva feeds on *Asclepias curassavica* and *Gomphocarpus physocarpus*. Although we have grown *Pentatropis capensis* successfully in our backyard in the intermediate zone where the Plain Tiger is common, we have not observed egg-laying on this plant; the females always lay their eggs on the plants of *Calotropis gigantea*, which are only a few meters away from the numerous vines of *Pentatropis capensis*. It appears that, even within the same species, different populations have different larval food plant preferences. It is possible, however, that plants that grow in one climatic zone, when planted in another, synthesize their chemicals differently so that they no longer attract females for egg-laying.

Note: The flowers of *Asclepias curassavica* also attract many butterflies, but small butterflies often perish when a proboscis or a leg becomes stuck in the corona of the flower while feeding on the nectar. A few free themselves after much effort.

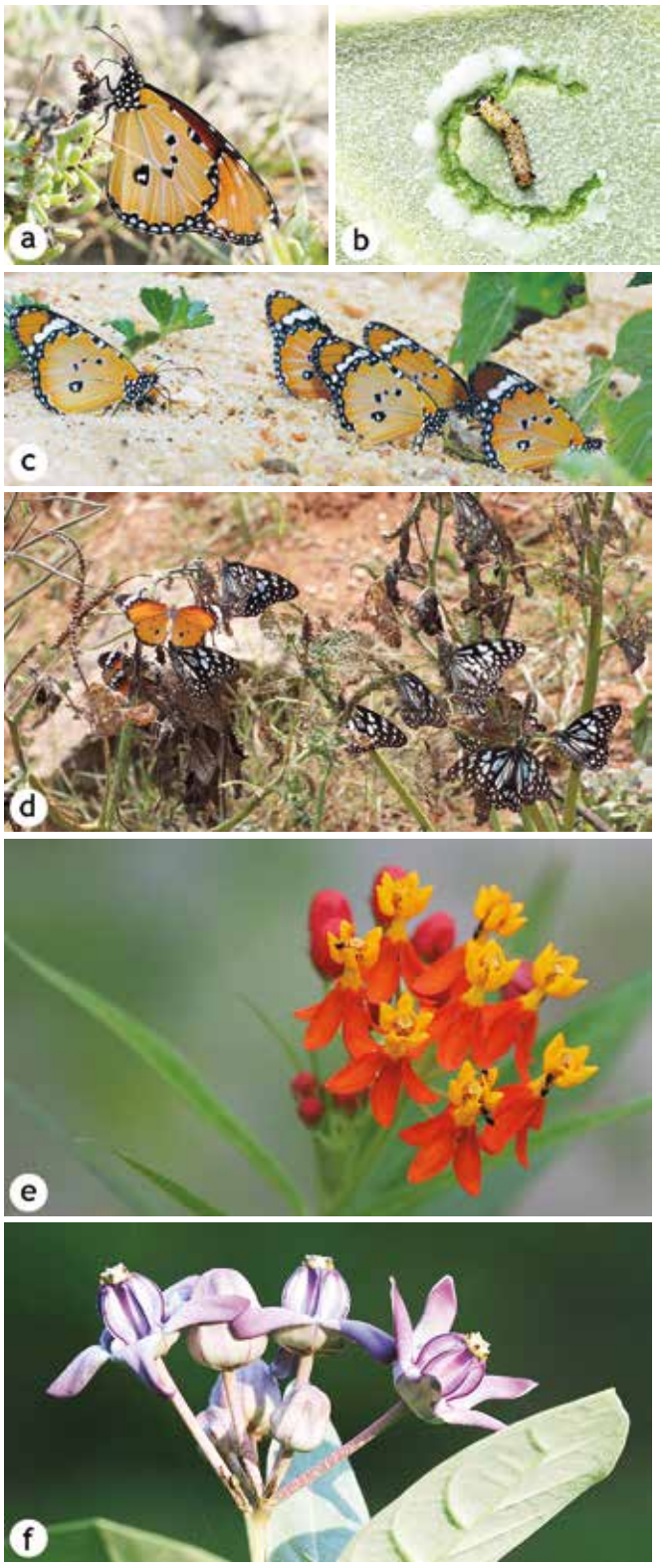


Fig. 7-13. Plain Tiger (*Danaus c. chrysippus*). a) male feeding on dead plant tissue of *Heliotropium scabrum*; b) larva, first instar, cutting trench in leaf of larval food plant, *Calotropis gigantea*; c) males mudsipping; d) males of Plain Tiger and Blue Tiger feeding on dead plant tissues of *H. indicum*; e) *Asclepias curassavica*; f) *Calotropis gigantea*.

Gaudy Baron (*Euthalia lubentina psittacus*)

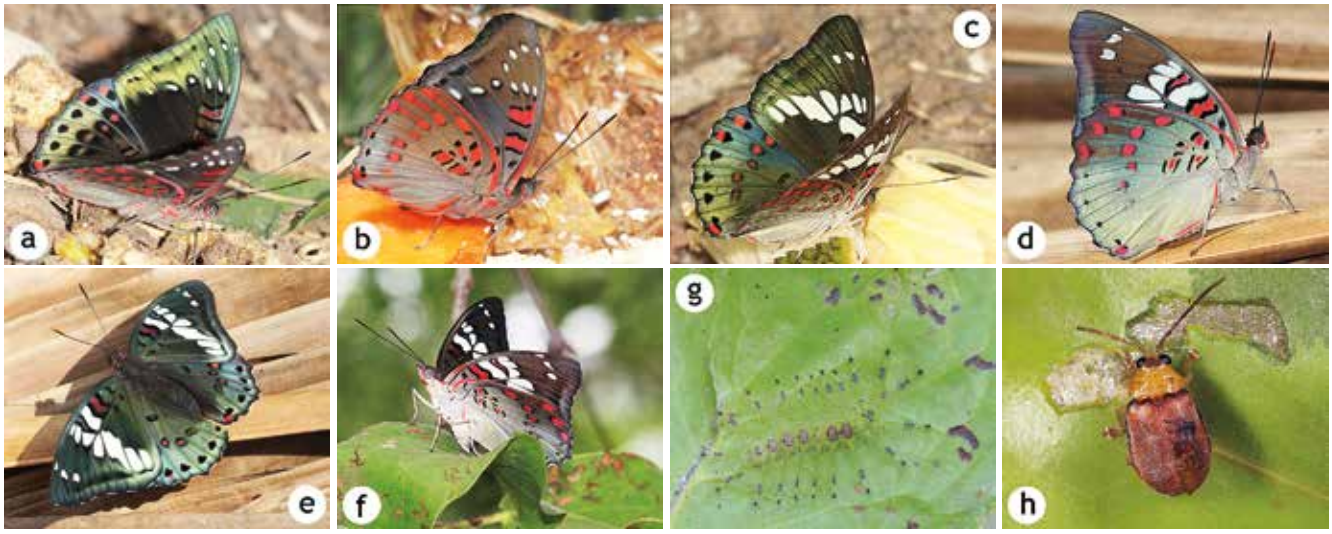


Fig. 7-48. Gaudy Baron (*Euthalia lubentina psittacus*). a) male feeding on fallen jak fruit (*Artocarpus heterophyllus*), upperside; b) male feeding on fallen jak fruit, underside; c) female feeding on fallen jak fruit, upperside; d) female, underside; e) female, upperside; f) female laying egg on leaf of *Dendrophthoe falcata*; g) final instar larva on scarred leaf of *D. falcata*; h) beetle feeding on young leaf of *D. falcata*.

Wingspan: 60–80 mm

■ **Description (Fig. 7-48):** This gorgeous butterfly is seldom seen despite the abundance of its larval food plants, the mistletoes (Loranthaceae). Fresh individuals of both sexes show a lovely iridescent sheen on the upperside. Its brilliant colors are not evident in flight because the butterfly flies so swiftly. Even when settled, the colors take life only when viewed at the appropriate angle in the proper light. Both sexes appear grayish-blue or grayish-green when viewed at other angles. The male is much smaller than the female.

■ **Similar species:** In flight it may be mistaken for the Baron.

■ **Status, distribution and habitat:** This endemic subspecies is rare (1) and though a few fly throughout the year, most sightings have been from July to September. It is widely distributed in the intermediate zone and the wet zone up to about 1500 m asl. It favors mid-elevations from 400–700 m asl and inhabits forests and well-wooded home gardens. Threat status: VU.

■ **Adult behavior:** Its behavior is similar to that of the Baron, but it prefers to live higher up in the canopy or subcanopy where it is often difficult to see, which also contributes to its scarcity. Both sexes descend to the ground now and again to feed on fallen fruits, or to suck up moisture from seepages and edges of streams when conditions are very dry. When settled, it is shy and any sudden movement nearby drives it away instantly.

■ **Immature stages:** The female lays its eggs singly on the upperside of a leaf of the larval food plant, usually 3–5 m above the ground. Plants that grow high up in the canopy where winds are strong are seldom used for egg-laying, probably because branches of mistletoe, being brittle, break off easily. In the intermediate zone, the female selects tattered and scarred leaves for egg-laying. The scarring of the mature leaf is brought about by a small beetle when it feeds on the expanding leaves. As the leaves age, the grooves and holes left behind dry up and turn brown to give the leaves their characteristic scarred appearance—these are the leaves the female eagerly seeks for egg-laying. Leaves without beetle injury are seldom used. Whether the female uses mostly scarred leaves of mistletoe in the other climatic zones is not known. Once a suitable leaf is found, the female clings to the leaf, vertically or nearly so, with its head pointing up, and lays a single egg. The egg is superbly camouflaged and almost indistinguishable from the myriad blotches on the leaves. Under a hand lens, however, the egg is seen to be a beautifully sculptured multi-faceted dome with amber-colored projections that terminate in sticky droplets. The droplets probably act as a defense against parasitoids by trapping them on contact.

The newly emerged larva is armed with four rows of long black spines and two rows of light-colored knobby spines along the length of its amber-colored body. It feeds on its eggshell on emergence, and in the first instar, it rests in a characteristic manner with its body curled up and its head touching the thorax, or nearly so. The dorsal spines of the larva, like the droplets of the egg, are sticky, and probably trap small parasitoids and prevent eggs being laid on the larva, as they do for the egg. Reared larvae often had their droppings attached to these spines, but we were unable to determine if this was accidental or if the larva deliberately placed them for better camouflage.

In the third instar, the larva develops long much-branched black and yellow dorsolateral spines, and a row of brown dorsal spots which are retained until the larva pupates. At this stage,

the larva is superbly camouflaged against the tattered old leaf. It seldom moves about by day and feeds mostly after sunset. When threatened, it quickly raises its spines and the front of its body in a defensive posture that mimics that adopted by some tarantulas. To prevent being dislodged by the wind, the larva lays down a considerable amount of silk on the leaf surface and remains attached to it with the fine hooks on its prolegs. When the larva feeds on *Taxillus*, which has small leaves, the final instar rests in a bent position to accommodate itself on a single leaf.

The larva sometimes lives in trees that harbor colonies of predatory red weaver ants (*Oecophylla smaragdina*) and despite the apparent lack of a symbiotic relationship with the ants, it appears to escape predation. Whether or not the larva has a defense mechanism to neutralize the ant's instinct to attack is not known. The larva feeds on the leaves of *Dendrophthoe falcata*, *Tolypanthus gardneri*, *Taxillus cuneatus*, *Taxillus tomentosus*, *Taxillus incanus* and *Macrosolen capitellatus*.

Baronet (*Symphaedra nais*)

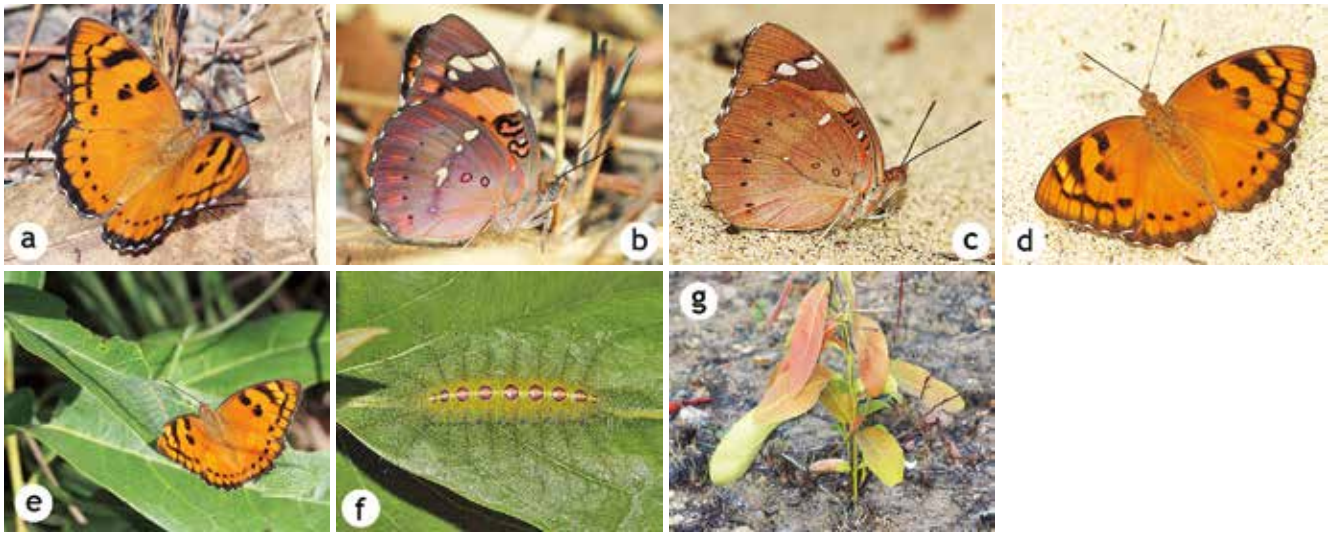


Fig. 7-49. Baronet (*Symphaedra nais*). a) male, upperside; b) male, underside; c) female, underside; d) female, upperside; e) female, upperside, with larva in front; f) larva, final instar on leaf of *Diospyros melanoxylon*; g) *D. melanoxylon* sprouting after a fire; h) next page: habitat of the Baronet at Duvilli Ella; Sarath Sanjeewa standing beside a small tree of *D. melanoxylon* amidst clumps of citronella grass.

Wingspan: 60–70 mm

■ **Description (Fig. 7-49):** The sexes are superficially similar in appearance, but the female is slightly larger with a paler ground color and rounded wings. The black markings on the upperside of the wings and the white markings on the underside vary between and within seasons.

■ **Similar species:** None.

■ **Status, distribution and habitat:** This species is common (10), very local and confined to the dry savanna grasslands of the Uva and Sabaragamuwa provinces. It flies year-round and is seen in fair numbers after the onset of the northeast monsoon, particularly near rivers and streams flowing through the savannas. The butterfly has also been reported from Ratnapura and a few adjoining areas in the wet zone, but these are probably strays or migrants. Ormiston (1924) recorded it migrating towards Adam's Peak during March and August. Threat status: EN.

■ **Adult behavior:** Its behavior is similar to that of a Pansy (*Junonia*). It settles on the ground frequently, and if disturbed flies away a short distance, but often returns in a short while. It has been observed on sandy riverbeds of the Gal Oya river near the estuary, feeding on the fallen flowers of *Madhuca longifolia*. These flowers were used in times gone by to make treacle, a tasty sugary syrup. Although the butterfly spends much of its time near the ground, it also flies in the canopy to feed on tree sap and gum. It has not been observed feeding on the nectar of herbaceous flowers. During the wet season (October to January), the butterfly is widely distributed within the savanna and may be seen anywhere within it.

■ **Immature stages:** The female lays its eggs on the new flush of leaves of its only known larval food plant, *Diospyros melanoxylon*, a tree that usually flushes after the rains or fires in its habitat. The eggs are laid on the upper surface of the leaf, usually towards the tip. Most eggs are laid on small plants up to 1 m tall. It is not clear

Chapter 8

The Swallowtails: Papilionidae

Introduction to the Papilionidae

The members of the Papilionidae (Papilionids) are distributed worldwide, but most are found in the tropics. The family comprises about 500 species. The adults are mostly medium-sized to large butterflies, often colorful and strikingly patterned. Despite their common group name, many are without tails.

Distinguishing characters: Members of this family are distinguished by the following characters in the adult: The bases of the antennae are close together. The proboscis is long except in the members of the tribe Leptocircini (Figs. 8-4b, c). Each leg has a pair of simple, well-developed tarsal claws; the forelegs are fully developed with an epiphysis on the tibia (Fig. 8-3). The epiphysis is used to clean the antennae and is found only in the Papilionidae and the Hesperiidae. On the forewing, the radial vein consists of five branches with R4 and R5 usually being stalked; there are two anal veins, one of which (A3) curves down to the dorsum. On the hindwing, there is a humeral vein and a single anal vein (except in the Mexican species *Baronia brevicornis*, which has two). A typical Papilionid wing venation is shown in Fig. 8-1.

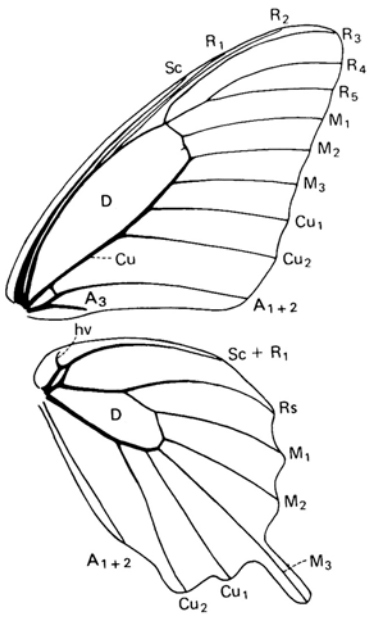


Fig. 8-1. Wing venation. Papilionidae. *Papilio*. hv=humeral vein. D=discal cell. A3=3A. A1+2=A1+A2. From Borror *et al*. (1989).

Fig. 8-2. Common Jay (*Graphium d. doson*) in flight.

Adult behavior: Adult Swallowtails are strong fliers. Most species feed on the nectar of flowers, though a few feed on scat and dead animal matter when available. Many mudsip. Males use patrolling as a mating strategy to encounter females. Courtship is usually a long drawn-out encounter, with the male hovering near the female for a considerable time (Fig. 8-3e). They are found in many different habitats, from forests to meadows to urban areas, and are widespread over the island. Some species join migratory flights.

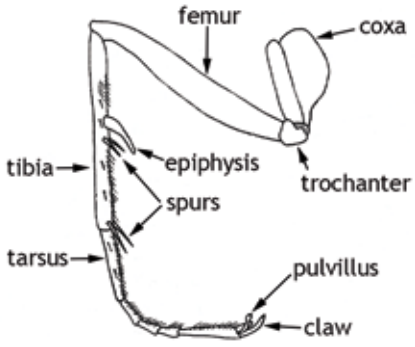


Fig. 8-3. Leg showing epiphysis on tibia of foreleg.

Immature stages: The eggs are spherical, usually smooth, and colored variously from white to cream to orange. In many species, the egg is covered with a glue-like substance that makes it look ribbed. The final instar larva is stout and smooth and sometimes bears fleshy tubercles; the thorax is sometimes humped

Red Helen (*Papilio helenus mooreanus*)

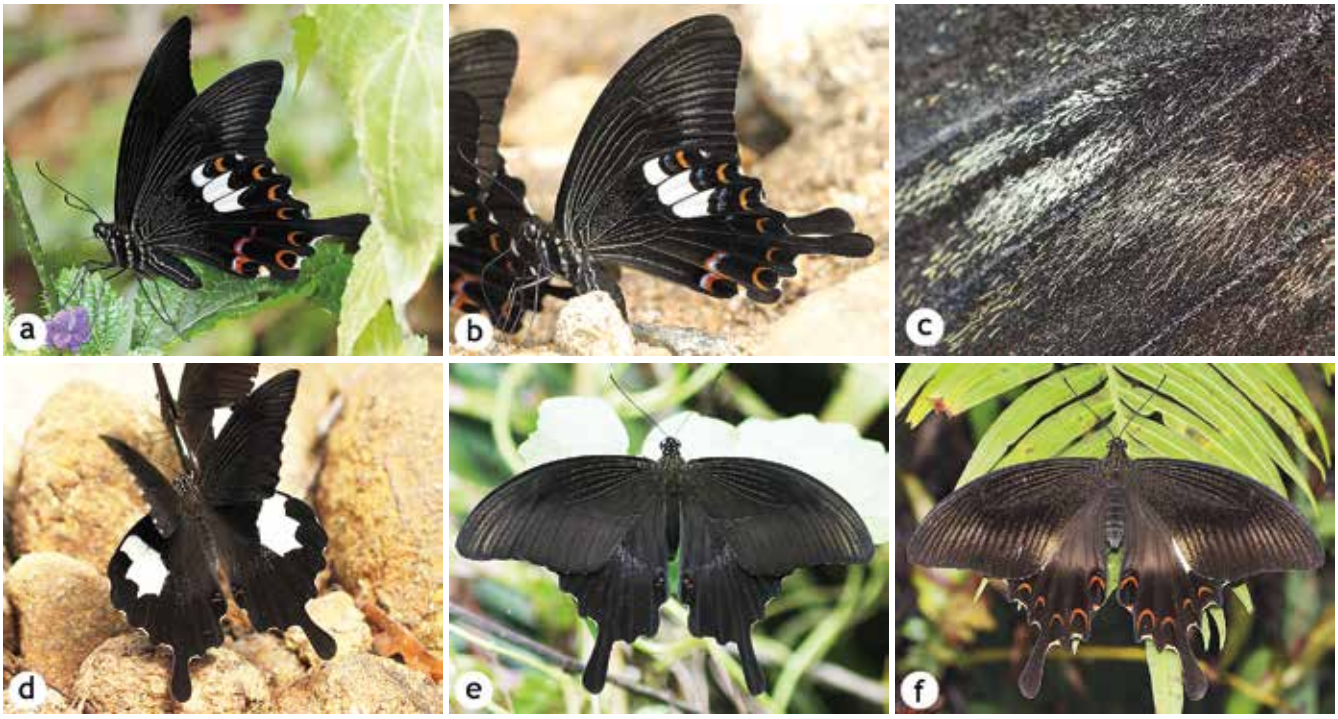


Fig. 8-13. Red Helen (*Papilio helenus mooreanus*). a) male feeding on nectar of *Stachytarpheta* sp., underside; b) male mudsipping, underside; c) male, hair-like scales on the upperside of the wing; d) male, upperside; e) male, upperside; f) female, upperside.

Wingspan: 110–130 mm

■ **Description (Fig. 8-13):** Despite its name, the adult only hints at the red on its wings. The female is larger than the male and has more extensive yellow streaks on the upperside of the forewing. In the male, the yellow streaks are modified hair-like scales; the white patch on the underside is smaller, and on the upperside, is often hidden when the butterfly is at rest.

■ **Similar species:** None.

■ **Status, distribution and habitat:** This endemic subspecies is uncommon (5) and confined to the wet zone. It flies throughout the year, but the main flight season is from February to May. It is commonly found above 800 m asl. On the southern slopes, however, it descends as low as 100 m asl. This forest-loving species is fond of habitats along small streams and waterways surrounded by dense vegetation. Threat status: VU.

■ **Adult behavior:** A patrolling species, it does its rounds within its territory day after day, often late into the evening. It weaves skillfully in and out of the dense vegetation in which it lives, usually keeping to within a meter or two of the ground. It also flies in the canopy or near the ground to exploit the resources at those levels. When flying along a forest road, it flies much faster and in a straight line for longer distances, swaying unpredictably from side to side, and then, it suddenly veers off to disappear into the forest or over the treetops; a behavior that makes it less vulnerable to attacks by birds. When threatened, it flies swiftly and erratically.

In the lowlands, it feeds on the nectar of flowers of a variety of plants, such as *Clerodendrum infortunatum*, *Stachytarpheta urticifolia* and *Hedyotis fruticosa.* In the highlands around Nuwara Eliya, it feeds on species such as *Cestrum elegans*, *Passiflora ligularis* and *Ageratina riparia*. In the Knuckles Conservation Area, it eagerly feeds on the nectar of *Asystasia chelonoides*. It is also an opportunistic feeder that helps itself to the remains of a dead crab or fish along a stream. In hot dry weather, the males mudsip on wet soil, sometimes in fair numbers.

At dusk, it moves into a shaded thicket alongside a stream to roost on a twig with its wings spread open, usually within 1 m of the ground. In the morning, it basks in the sun to warm itself before taking flight, especially at the higher elevations.

■ **Immature stages:** The female lays its eggs singly on a tender leaf of the larval food plant, usually about 1 m above the ground, but sometimes as high as 6–9 m. The final instar is similar in appearance to others in its genus except that the bands on the middle of the abdomen (segments A5 & A6) join dorsally. It usually pupates on a twig on the larval food plant. The pupa has many color forms, ranging from green to brown, with varied cryptic markings. The larva fed on the leaves of *Citrus madurensis* and *Citrus sinensis* when offered, but has not been recorded feeding on species of *Citrus* in the field. In the wild, the larva feeds mostly on *Toddalia asiatica*, which is widely distributed, and on *Zanthoxylum tetraspermum*, which is a rare plant of the higher hills.

Chapter 9

The Whites and Yellows: Pieridae

Introduction to the Pieridae

The members of the Pieridae (Pierids) are widely distributed throughout the world. The family comprises about 1000 species. The adults are medium-sized butterflies that are predominantly white, yellow, or cream-colored, often with orange-colored markings. The pigments that make up these colors, called pterins, are unique to the Pieridae, and absorb or reflect UV light to varying degrees. The word "butterfly" may well have had its origins in the color of this group.

Distinguishing characters: Members of this family are distinguished by the following characters in the adult: The legs are well-developed with conspicuous bifid tarsal claws and a single pulvillus (Fig. 9-3), but no epiphysis on the tibia of the foreleg as in the Papilionidae or Hesperiidae. The forewing has one anal vein and 3–5 radial veins, one or more of which is stalked. The hindwing always has 2 anal veins. A typical Pierid wing venation is shown in Fig. 9-1.

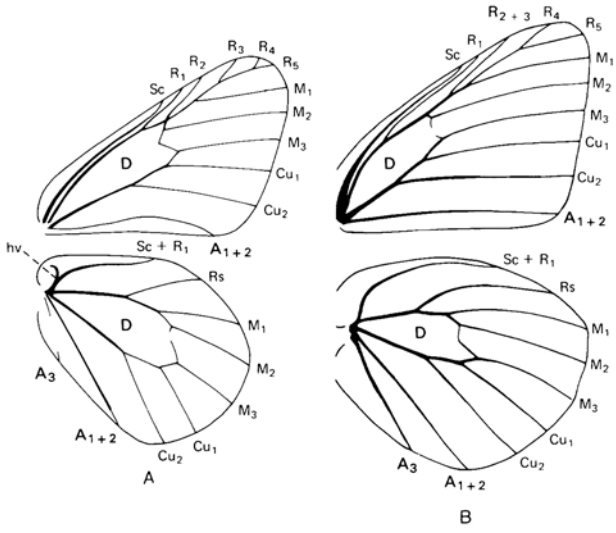


Fig. 9-1. Wing venation. Pieridae. A (on the left): an orange-tip (*Euchloe*, subfamily Pierinae). B (on the right): a sulphur (*Colias*, subfamily Coliadinae). hv=humeral vein. D=discal cell. A3=3A. A1+2=A1+A2. From Borror *et al*. (1989).

Adult behavior: The adults of most genera are strong fliers (Fig. 9-2). Several species take part in migrations within the island, sometimes numbering in the millions. They feed mostly on the nectar of flowers, but some species occasionally feed on scat or dead animal matter. Their preferred habitats are open meadows

Fig. 9-2. Lesser Albatross (*Appias galene*) in flight (female, form lankapura, subform fasciata).

though a few species are forest-dwellers. Most species in the island are widespread, but a few are confined either to the arid zones and the dry zone or to the hills in the wet zone above 1000 m asl. The largest number of species is found in the dry plains. Many of the species have seasonal forms, but they often fly together. Though some species look similar in appearance, their patterns of UV reflectance on the wings are different for each species; the butterflies use these differences to identify their partners correctly.

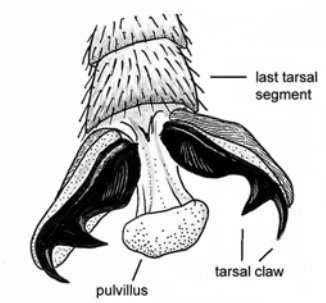


Fig. 9-3. Last tarsal segment of mid-leg of *Delias harpalyce* female, showing bifid tarsal claws and pulvillus. From Orr and Kitching (2010).

Immature stages: The eggs are usually white, more or less spindle-shaped with longitudinal and horizontal ridges. In most species, the color of the egg acquires a red or orange hue within a day or two of being laid. The final instar larva is slender, cylindrical, and smooth with fine setae covering its body. Each segment of the abdomen

Common Jezebel (*Delias eucharis*)

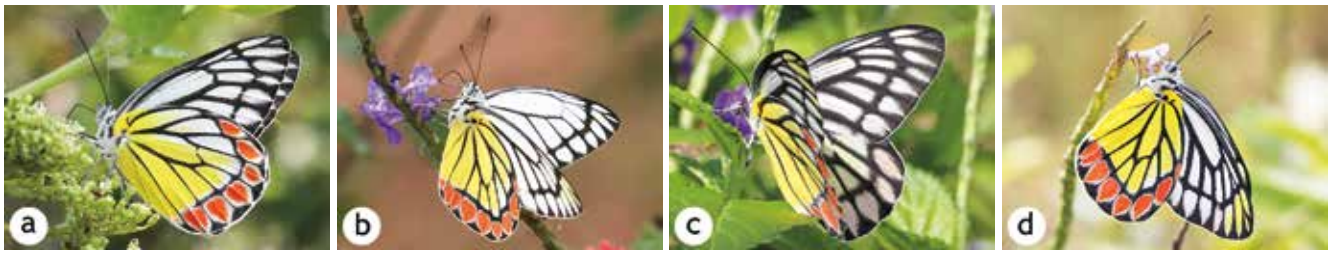


Fig. 9-27. Common Jezebel (*Delias eucharis*). a) male feeding on nectar of *Leea indica*, underside; b) male feeding on nectar of *Stachytarpheta urticifolia*, upperside; c) female feeding on nectar of *S. urticifolia*, upperside; d) female feeding on nectar of *S. jamaicensis*, underside.

Wingspan: 65–75 mm

■ **Description (Fig. 9-27):** This beautiful and easily recognizable butterfly adorns many gardens in both urban and non-urban settings, and is often spotted shortly after sunrise or in the late afternoon. The teardrop-shaped red spots on the underside of the hindwing are unmistakable. In the female, the forewing apex is more rounded and the veins are more heavily lined with black scales.

■ **Similar species:** Painted Sawtooth—the spots on the underside of the hindwing are orange-colored and columnar.

■ **Status, distribution and habitat:** This species is common (5) and flies year-round. It is widely distributed from sea level to the highest hills and is found in urban and agricultural areas, villages, home gardens, forests, or just about anywhere one finds species of mistletoe (Loranthaceae), its larval food plant. Even some monoculture tea plantations at 1800 m asl support small populations of the butterfly, since there is an abundant supply of mistletoe growing on *Grevillea robusta*, a common shade tree of tea fields. The butterfly is common in man-made landscapes because mistletoe grows very well on cultivated softwood trees such as mango, cashew, sapodilla, Indian plum and many other ornamental trees. Threat status: LC.

■ **Adult behavior:** Since the adult is protected by poisonous substances in its body, it flies leisurely in the early morning and late evening, disregarding predatory birds that are active during these times. Its poisonous nature is also shown by its aposematic coloration. Flying about early and late has its advantages—by flying early it can access the nectar of flowers first, and by flying late, it can access flowers that open late in the day. But during the hottest part of the day, especially in the dry plains, it stops foraging and flies into a thicket to rest. Because it has a relatively short proboscis, it feeds on flowers with short corolla tubes, but it visits a wide range of native and non-native plants. *Duranta erecta*, *Stachytarpheta* sp. and *Lantana camara* are three of its favorite nectar sources around human habitations. It also visits flowers of wayside weeds such as *Sida*, *Urena* and *Hyptis*, and flowers of shrubs such as *Clerodendrum* and *Helicteres*. Flowers of large trees such as *Pterocarpus indicus*, *Holoptelea integrifolia*, *Mitragyna tubulosa* and *Wrightia angustifolia* also attract the Common Jezebel, but these trees are highly seasonal and flower only once a year for a short period.

■ **Immature stages:** The female lays its eggs on mistletoe with no apparent height preference: plants growing high up on tall trees are used just as readily as those a meter or two above the ground and we have observed egg-laying on plants as low as half a meter above the ground. Perhaps the female is capable of selecting a safe location irrespective of the height at which the larval food plant is found. The eggs are laid in batches, usually in a cluster of 20–30, or sometimes as many as 80. It lays its eggs on the upper or lower surface of a mature leaf while hanging on to it vertically or nearly so. Eggs are sometimes laid in more or less parallel rows, and are laid in the morning hours just as readily as in the late afternoon. Freshly laid eggs are two-toned, with the lower half yellow and the upper half translucent white with finely suspended strands of silvery threads within. The eggs turn completely yellow within a day. Parasitic wasps frequently destroy entire batches of eggs, which then appear brown and discolored within a few days. The larvae are gregarious and go about their daily activities in a well-synchronized manner until pupation. They feed only on mature leaves. At rest, they usually sit on a leaf in a tight cluster with their heads pointing outwards. When threatened, they wriggle their bodies in unison, perhaps to deter a predator. They are probably poisonous, and appear to be avoided by birds. Wasps, however, appear undeterred and frequently parasitize the larvae. A strong gusty wind can also be a threat since it can dislodge them from the canopy of a tree. When dislodged, the larva puts out a sticky silk thread from its spinnerets as it falls. The thread enables it to remains suspended from the leaf, to alight on a leaf below or to arrive on the ground safely. In any case, with time, those that are suspended climb back onto the plant by reeling in the silk with its front legs and mouth. The threads are also sometimes used to descend from the canopy when the larva is ready to pupate. We once saw a large number of larvae descend using their threads and being drifted by the wind to nearby shrubs and trees. Some that reached the ground climbed onto adjacent plants to pupate, while a few walked a considerable distance to reach the wall of a building nearby. The larva feeds on the leaves of *Dendrophthoe ligulatus*, *Dendrophthoe falcata* and *Taxillus cuneatus* in Sri Lanka. It probably uses other members of the Loranthaceae as well.

Appendix A. Annotated species list

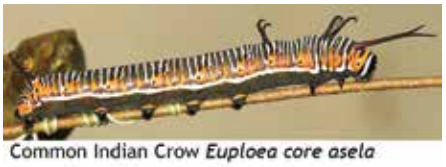
Status: E = endemic species; ESS = endemic subspecies; NE = not endemic; * = see note on page 359 –360.
Climatic zone in which the species is likely to be seen: √ √ = very likely; √ = likely; — =unlikely (this does not mean that the species is found everywhere in that zone; see the species account for specific details of its distribution).
Montane species indicated by (M). Species found only in the northwest arid zone indicated by (N); only in the southeast arid zone by (S).

Family, subfamily, tribe, scientific name	Common name	Status	Wet zone	Inter-mediate zone	Dry zone	Arid zone
Family: Hesperiidae Subfamily: Coeliadinae Tribe: -						
Badamia exclamationis (Fabricius, 1775)	Brown Awl	NE	√ √	√ √	√ √	—
Bibasis sena sena (Moore, [1865])	Orange-tailed Awl	NE	√	√ √	√ √	—
Burara oedipodea ataphus (Watson, 1893)	Branded Orange Awlet	ESS	—	√ √	√	—
Choaspes benjaminii benjaminii (Guérin-Méneville, 1843)	Indian Awl King	NE	√ √ (M)	—	—	—
Hasora badra lanka Evans, 1926	Ceylon Awl	ESS	√ √	—	—	—
Hasora chromus chromus (Cramer, [1780])	Common Banded Awl	NE	√ √	√ √	√ √	—
Hasora taminatus taminatus (Hübner, [1818])	White-banded Awl	NE	√ √	√ √	√ √	—
Family: Hesperiidae Subfamily: Hesperiinae Tribe: Aeromachini						
Ampittia dioscorides singa Evans, 1949	Bush Hopper	ESS	√ √	√ √	√ √	—
Baracus vittatus (C. Felder, 1862)	Hedge Hopper	E*	√ √	√	—	—
Erionota torus Evans, 1941	Banana Skipper	NE	√	√	—	—
Gangara lebadea subfasciata (Moore, 1878)	Banded Redeye	ESS	√ √	—	—	—
Gangara thyrsis clothilda (Herrich-Schäffer, 1869)	Giant Redeye	ESS	√ √	√	√	—
Halpe ceylonica (Moore, 1878)	Ceylon Ace	E*	√ √ (M)	—	—	—
Halpe egena (R. Felder, 1868)	Rare Ace	E*	√ √	—	—	—
Hyarotis adrastus adrastus (Stoll, [1780])	Tree Flitter	NE	√ √	√ √	√ √	—
Iambrix salsala luteipalpis Plötz, 1886	Chestnut Bob	NE	√ √	√ √	√ √	—
Matapa aria (Moore, [1866])	Common Redeye	NE	√ √	√ √	√	—
Notocrypta curvifascia curvifascia (C. & R. Felder, 1862)	Restricted Demon	NE	√ √	—	—	—

Larvae: Nymphalidae: Danainae (Fig. F-11) (continued)


Ceylon Tree Nymph *Idea iasonia*


Ceylon Tree Nymph *Idea iasonia*


Common Indian Crow *Euploea core asela*


Common Tiger *Danaus genutia genutia*


Common Tiger *Danaus genutia genutia*


Dark Blue Tiger *Tirumala septentrionis musikanos*


Dark Blue Tiger
Tirumala septentrionis musikanos


Double-branded Black Crow
Euploea sylvester montana


Glassy Tiger *Parantica aglea aglea*


Glassy Tiger *Parantica aglea aglea*


Great Crow *Euploea phaenareta corus*


Plain Tiger *Danaus chrysippus chrysippus*

Larvae: Nymphalidae: Satyrinae (Fig. F-12)


Ceylon Palmfly *Elymnias singhala*


Ceylon Treebrown *Lethe daretis*


Ceylon Treebrown *Lethe daretis*


Common Bushbrown *Mycalesis perseus typhlus*


Common Evening Brown *Melanitis leda leda*


Common Palmfly *Elymnias hypermnestra fraterna*


Dark Evening Brown *Melanitis phedima tambra*


Dark-brand Bushbrown *Mycalesis mineus polydecta*


Gladeye Bushbrown *Mycalesis patnia patnia*


Jewel Four-ring *Ypthima singala*


Medus Brown *Orsotriaena medus mandata*


Southern Duffer *Discophora lepida ceylonica*


Southern Duffer *Discophora lepida ceylonica*


Tamil Bushbrown *Mycalesis subdita*


Tamil Treebrown *Lethe drypetis drypetis*

Glossary

Abdomen: The third section of the insect body, beyond the last pair of wings; it is the most posterior, major body division of an insect; it carries the reproductive structures.
Abiotic: Non-living components of an ecosystem e.g. temperature, rainfall.
Aedeagus: The penis of a male insect.
Aerial: Occurring in the air.
Aestivate: A dormancy period through a dry season that is a regular feature of the life cycle (also written as estivate)
Anal angle: The point of a wing that is between the outer margin (termen) and the inner margin (dorsum).
Anal fold: The inner margin of the hindwing that folds against the abdomen in a butterfly at rest.
Anal hooks: Minute hooks on the underside of the pupa of some Lycaenids that attach the pupa to its substrate via a silk pad.
Anal plate: A sclerotised plate on the dorsum of the last abdominal segment of the larva.
Anal veins: The lowermost veins, composed of three subveins, not all of which are present in each species; runs parallel to the dorsum of the wing.
Androconium: A specialized, highly modified scale, usually on the wings, that produces chemical compounds that act as sex pheromones, aphrodisiacs or attractants. (plural**:** androconia)
Antenna: A segmented sensory organ, found in pairs, above the mouthparts on the head of an insect. Clubbed in butterflies, generally tapering or filiform in moths. (plural**:** antennae)
Apex: The tip; e.g. the apex of the forewing is the tip of the forewing.
Aphytophagous: Not feeding on plants.
Aposematism: The use of signals to warn a potential predator that the organism is not suitable prey either because it is unpalatable or has some kind of defense, such as a chemical defense. The signals are often conspicuous sounds, odors or contrasting colors (most often red, yellow and black).

Barrier: An abiotic or biotic feature that restricts the movement of individuals from one location to another.
Basal: Towards the base (for example, the part of the wing closest to the body).
Basking: A method of modifying body temperature or thermoregulating depending on the sun.
Batesian mimicry: Mimicry of an unpalatable model by a palatable mimic.
Biogeography: The study of the distribution of organisms and the factors that contribute to the patterns.
Biotic: Living components of an ecosystem e.g. plants, humans.
Binomial nomenclature: The system of naming organisms with two names, the first denoting the genus and the second denoting the species.
Bivoltine: Having two generally discrete generations or broods in each year or season.
Brood: The even-aged offspring of the females of a single species.
Bursa copulatrix: Part of the female genitalia that stores the male's spermatophore.
Camouflage: To imitate, or appear to be, the background.
Caterpillar: The second stage in the life history of Lepidoptera, between the egg and the pupa (chrysalis). See also larva.
Cell: An area of the wing that is enclosed by veins, sometimes called the discal cell.
Chrysalis: The third stage in the life history of Lepidoptera, between the larva (caterpillar) and the imago (adult butterfly), during which the bulk of metamorphosis occurs. See also pupa.
Claspers: Paired organs of the male genitalia that are used to clasp the female during copulation.
Cocoon: Silken casing around a chrysalis or pupa of moths.
Coevolution: The evolution of two or more species in close ecological relationship to each other. Generally assumed to mean reciprocal evolutionary changes in interacting species.
Colony: A geographically discrete population or subpopulation of butterflies with determinable boundaries that is separated from other populations.
Common: A term used to describe an organism that has large populations, is widely distributed geographically, and occurs in many types of habitats.
Community: The assemblage of organisms that interact with each other in some defined habitat.
Compound eye: An eye made up of separate facets or light-gathering units or ommatidia.
Concave: Curving inward.
Congeneric: Species from the same genus.
Conspecific: Individuals of the same species.
Convex: Curving outward; rounded.
Copulatory plug: See sphragis.
Corpus bursae: The part of the female's genitalia that receives the male's spermataphore.
Corridor: A route that allows for the dispersal of individuals from one place to another.
Cosmopolitan: Occurring all over the world, i.e. on essentially all continents
Costa: The forward or leading edge of the wing of a butterfly.
Costal fold: The area of the costal margin that contains androconial scales in some butterfly species.
Counter-shading: In which the coloring of an animal is darker on the upperside of the body and lighter on the underside, which makes the animal harder to detect from below by predators.
Coxa: Basal segment of the leg of an insect leg; the segment closest to the body.
Cremaster: A single hook or several hooks at the posterior end of a pupa that attach it to a silken pad.
Crenate: Scalloped
Crenulate: Finely scalloped.
Crepuscular: Active at dusk or at dawn.
Crossvein: A vein in the wing that runs transversely to the longitudinal veins.
Crochets: Hooks on the prolegs of a larva.
Crypsis: The combination of color, pattern and structure that allow an organism to conceal itself by camouflage.

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