



RAO JODHA DESERT ROCK PARK
SMALL FIELD GUIDE SERIES



butterflies

About the kinds of butterflies you will
find inside Rao Jodha Desert Rock Park

PAYAL MEHTA

RAO JODHA DESERT ROCK PARK FIELD GUIDES

SEE WHY THIS IS
KELLATING



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Image on front cover
Lemon Pansy (Payal Mehta)

A RAO JODHA DESERT ROCK PARK SMALL FIELD GUIDE

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**About the kinds of butterflies you will
find inside Rao Jodha Desert Rock Park**

Published with the generous support of
Frankie Coxe

PAYAL MEHTA



www.raojodhapark.com

Series Editor's Note

In 2013, we asked Payal Mehta - the author of this booklet - to train 2 completely raw Naturalists we recruited in Jodhpur for Rao Jodha Park. She did an amazing job and inspired and moulded these two young lads into skilled naturalist-guides we became immensely proud of.

Here's another field to which Payal has applied her skills. She is not a trained lepidopterologist but the clear-thinking and obvious delight she brings to the telling is infectious and evident. Payal is a Naturalist, so I shouldn't be surprised, but thank you, Payal, so much!

There's a clutch of photographers who have contributed unhesitatingly and generously to Payal's calls for help. To all of you - David Raju, Surya Ramachandran, Milind Bhakare, Karthikeyan S., Jan Gräser, Vinod Goswami Harsha J., and our own 2 naturalists - Denzil Britto and Sachin Sharma - I want to say how wonderful it is to see photographers sharing freely and unselfishly. Thank you, deeply.

I also want to say a very special thank you to Frankie Coxe who offered spontaneously to support this booklet. She wrote us: "As an American visiting India for the second time the Desert Park was an unexpected discovery. There were butterflies everywhere and courageous plants pushing their way through rocks and rugged land to the sunlight. Is it too much to see in this park the symbol of the strength and promise of India? Thank you for the unforgettable experience."

Thank you, Frankie! You're the best kind of Visitor of all! Come back soon.

Pradip Krishen

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Lime Butterfly. This is one of the largest butterflies in the Park. It is so named because of its preference for laying eggs on plants of the citrus family

Pradip Krishen

A Butterfly is an Insect

The word ‘insect’ makes some people think of nasty little biting creatures and creepy-crawlies. Yet here is this large group of beautiful, delicate, colourful creatures, entirely without stings or biting parts or intent to harm, that is also an ‘insect’. Welcome to their beautiful world!

Butterflies are a lot more than just winsome, beautiful insects. Once you begin to peer into their distinctive world you will realize how fascinating they can be. Their unusual life-cycle, their habits and behavior, friends and foes, all make for enduring interest. Once you are ‘hooked’ – as I was several years ago – you will find yourself becoming a butterfly enthusiast. Hang on to it, because it is a hobby and a pastime that you

can pursue with limitless pleasure wherever you are on earth – except, perhaps, on the polar icecaps!

This booklet introduces you to the butterflies you are likely to see inside Rao Jodha Desert Rock Park, which is a relatively new haven for butterflies in the midst of a bustling city. I have described 43 butterflies, which represents the number of species we have seen and counted inside the limits of the Park (RJP) in 2015. It is certain that this list will grow longer as the assemblage of plants in the Park is ‘discovered’ by new butterfly species from the surrounding countryside. This figure of 43 is only an infinitesimal fraction of the 1,500 or so kinds of butterflies that are found inside the territorial limits of India. But it’s enough to start you off on a fascinating journey.

The Park as Habitat

How long does it take to recreate a wilderness? To create conditions in which a wild creature feels at home?

Jodhpur lies at the eastern edge of the Thar Desert, which itself forms the eastern-most verge of the world's largest contiguous zone of hot deserts – the Sahara-Arabian Desert – which sprawls across nearly 12 million sq km. As you travel west from Jodhpur towards Jaisalmer and the border with Pakistan, the Thar Desert becomes more intense, visibly drier and harsher. So think of Jodhpur as a somewhat mild version of the sandy wastes that stretch westwards all the way to the forbidding sand dunes of northern Africa.

Within this vast canvas, the 0.7 sq km of Rao Jodha Park seems like the tiniest drop in the ocean. Not only is the Park just a miniscule island of (rocky) desert habitat, it is entirely surrounded by a busy city which in almost every respect is not a favourable habitat for butterflies, birds or any other form of wildlife. Furthermore, the Park is a relatively new island, beginning its journey towards becoming a rocky desert habitat only in 2006.

Sachin Sharma



A pair of Pea Blues mating on a *Tephrosia* flower inside the Park

Rao Jodha Park has announced its presence to 43 species of butterflies, to more than 170 species of birds, and to impressive numbers of reptiles like lizards, geckoes, monitors, skinks and snakes. It's not quite Noah's Ark but it would be fair to say that the Park has become a vital refuge for wild creatures in the vicinity of Jodhpur

– especially for creatures that can fly over boundaries and obstacles and make their home in a patch of suitable land that offers them a modicum of safety and wilderness.

Birds, bats and butterflies, along with a few other insects like mantids, grasshoppers and beetles, are the

best equipped to seize opportunities offered by a new natural habitat that arises inside a city. Their numbers provide us with an index of how and to what extent the new Park has developed as a suitable wild habitat. It seems a pity that no one counted how many species there were here before the Park was created.

How the Park has Changed

Until 2006, the Park was completely dominated by an invasive small tree – often just a bush – from South America (*Prosopis juliflora*) that is locally called ‘baavlia’. No Indian butterfly has caterpillars that feed on baavlia leaves, so it is no surprise that except for an occasional butterfly that was just passing through, the Park would not have been a good place to spot butterflies.

There’s a simple rule: the more different kinds of plants you have in a habitat, the more likely you are to see a greater number of different kinds of butterflies. This is mostly because different kinds of butterfly – or rather, their larvae – have evolved to feed on different kinds of leaves. Each species has a select number of plants that it feeds on and will thus mate and lay eggs only where those plants are present.

And so, while the Park was mostly a monoculture of baavlia, there was little or hardly any diversity of butterflies to be seen here.

Things began to change soon after 2006 when the Park management undertook to remove all the baavlia and replace it with native plants from rocky parts of the Thar desert. It’s a practise called ‘rewilding’ – bringing back all the plants that you might expect to find here if it was truly a natural wilderness

With the return of native plants from the desert, came the butterflies. In numbers. And surprisingly quickly. Rao Jodha Park is now home to an impressively large variety of butterflies within its small compass and has become a wonderful spot for butterfly watching as it is for its flora, birds and other creatures.



Pradip Krishen

This is what the Park looked like when it was just a monoculture of 'baavlia'

THE BEST TIMES TO SEE BUTTERFLIES IN THE PARK

All that they say about life being hard in arid lands is true. The limiting factor is always the availability of water, and most plants – especially small flowering plants – spring up with the first monsoon rains and rush through their lives in the 3 or 4 months while there is still moisture in the ground. For the rest of the year, these plants live out their lives as dormant seeds, waiting for the next season of rainfall to germinate and flower again.

It is not surprising that this period of plant abundance – from about the end of July till October or November – is also peak-time for butterfly activity. Butterflies need flowers and fruit for nutrition and their caterpillars need plenty of leafy matter to feed on.

July, for example, is when kumatiyo (*Acacia senegal*) puts on new leaves after the long, dry season. Kumatiyo is a host plant for the larvae of the Babul Blue, and these butterflies waste no time in accepting the invitation, fluttering about excitedly as they lay their eggs.

The best times of the day to watch butterflies are when it is warm enough (not too early) and lasts while there is light to see them in.



Pradip Krishen

The new, young forest at the foot of the Fort



Pradip Krishen

Pulicaria is one of those opportunistic desert plants that bloom luxuriantly after the rains

Growing up

Watching a butterfly grow from egg to adult is a bit like watching a magic trick – it just happens in somewhat jerky slow motion. There are 4 stages in a butterfly's life and part of the magic lies in the fact that each stage looks nothing at all like any of the others.

A butterfly starts life as an egg that hatches to become a worm-like caterpillar or larva. After a length of time during which it eats voraciously, the caterpillar gradually changes into an immobile pupa. Again it pauses, before emerging wondrously as an adult winged butterfly.

As one might expect, a butterfly's eggs are extremely tiny but they come in an amazing array of shapes and forms. Depending on the species, butterfly eggs may be spherical, oval, domed, cigar- or disc-shaped, grooved, spiny... and this is only a small selection of the many forms that their eggs can take.

Eggs are laid singly or in batches and are covered in a thin fluid which, on exposure to air, glues the eggs on to the leaf so they won't roll off. Each species shows a clear preference for laying their eggs on particular plants – or a small selection of closely allied plants – that we call 'host plants'.

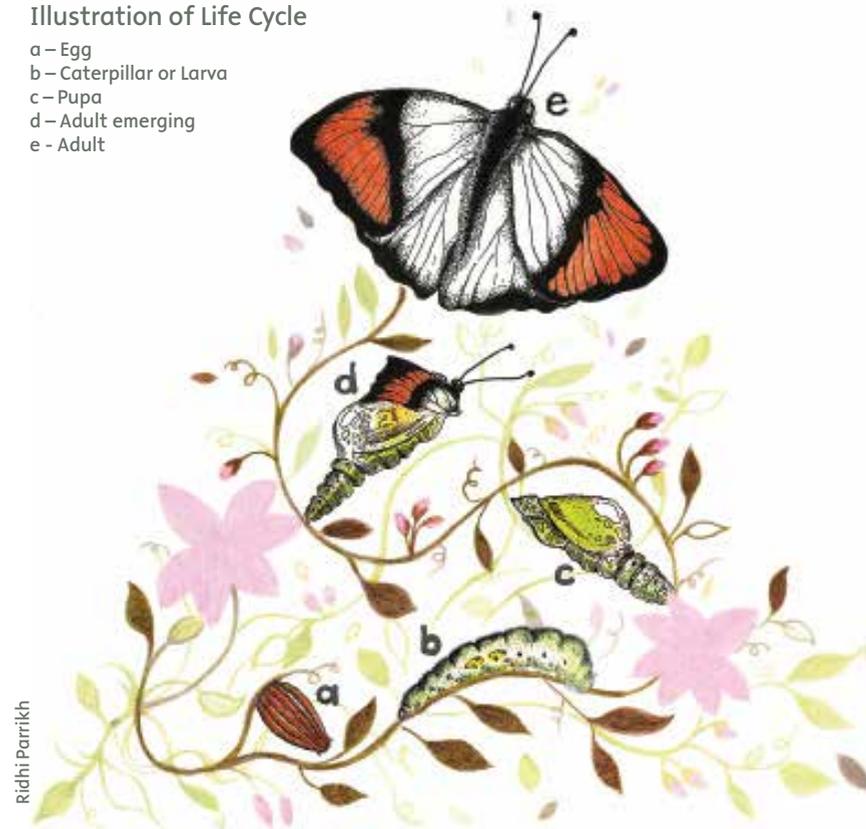


Vinod Goswami

A female Small Salmon Arab laying eggs on a jaal (*Salvadora*) plant in RJP

Illustration of Life Cycle

- a – Egg
- b – Caterpillar or Larva
- c – Pupa
- d – Adult emerging
- e - Adult



Ridhi Parrikh



Karthikeyan Srinivasan

The eggs of a few different species of butterflies

Eggs are nearly always laid on young, tender leaves so that as soon as the caterpillar chews its way out of its egg, there will be fresh, juicy food available at its doorstep.

The eggs of a butterfly are often so small that they are easily overlooked or mistaken for a small blemish on a piece of foliage. The easiest way to locate them is to look out for an adult butterfly laying her eggs but of course you need to be at the right place at the right time.

Caterpillars are voracious feeders. They need to be. This is a time in a butterfly's life-cycle when it needs

to pack away a huge amount of nutrition. By the time it reaches adulthood, a caterpillar will have grown 100 times larger than it was at birth and all of this phenomenal increase in size needs to be fuelled by what it eats. It's equivalent to a 3 kilogram human baby growing into a 300 kilogram giant!

How does a caterpillar know what's right to eat? A caterpillar 'tastes' its food through sensors in its small, stubby legs. Once it finds the food that tastes just right, it just eats and eats. You can often locate a caterpillar just by looking for the evidence of chewed-up leaves.

At this stage, the caterpillar is somewhat delicate, soft-bodied, slow-moving and, of course, unable to fly and is therefore at greatest risk of being hunted by birds, lizards or any of its many predators. Many kinds of caterpillar rely on often wonderful camouflage for protection. Only the unpalatable or poisonous ones can afford to be brightly coloured because this is their way of warning off predators.

As a caterpillar grows progressively larger, it outgrows its skin and 'moults' – exchanging its old skin for a bigger one, just like a snake does, and indeed as all insects do. It goes

through 3 to 5 moults before it is ready for the next stage of its life. The stage in the life of a larva between two consecutive moults is called an 'instar'. Many caterpillars go through an instar known as a 'bird dropping stage' because in this form, the caterpillar looks just like bird droppings! This is just another way of looking uninteresting to predators.

Once a caterpillar has grown to its full size, it chooses a suitable spot and moults for one last time. Now the caterpillar is ready for the next stage of its life – as a pupa – when it spins a cocoon with its silk and wraps itself inside like a mummy in a catacomb.



Payal Mehta

A caterpillar of a Lime butterfly in 'bird-dropping' form



Payal Mehta

The next stage of a Lime butterfly caterpillar – bigger and greener



Payal Mehta

The lime butterfly pupa turns translucent just before it emerges



Payal Mehta

A freshly emerged adult Lime Butterfly. Notice the empty pupa at top left

There is no more feeding now. Pupae appear in many different shapes and sizes and you need some experience to tell what Family of butterflies a pupa belongs to just by looking at its external features and colour.

A butterfly pupa is known as a 'chrysalis'. The word derives from an ancient Greek word – *khrusos* – that means 'gold', because of the metallic sheen that is a feature of many different cocoons.

What happens within the tightly wrapped packet of the chrysalis is one of nature's most fascinating procedures. Inside the silk-casing, which seems to have barely enough room for it to wriggle or move about

in, a caterpillar manages to change its shape completely and turn into a full-grown butterfly. The form and colour of its body changes. The biting mouth-parts are lost and replaced by a straw-like proboscis. Thin antennae appear, 6 long legs are formed and a pair of large, intricately patterned veined wings develop.

Once this unimaginably magical transformation is complete, a butterfly needs to break out of its cocoon. When the pupa becomes translucent and you can just begin to see the compressed wings through it, you will know that it is nearly time for the butterfly to emerge, usually in no more than a few hours at most.

As it emerges, the butterfly's body expands and its heart beats furiously, pushing blood into its veins and making its wet, crumpled wings expand. A little sunlight at this time is good for the butterfly's wings, helping them to dry and giving the butterfly a little energy and strength to undertake its first flight. That is why butterflies usually emerge in the early hours of the morning, to take advantage of the sun. Also, in order to be able to take off before its predators become active.

This process of a butterfly's transformation, from start to finish, is called 'complete metamorphism' – from a Greek word which means 'change in form'.

In its adult winged form, a butterfly lives only for a short time. It varies quite a lot between species, but in general, an adult lives for about a week or so, ranging up to a month.

As an adult, a butterfly flies, feeds and sometimes even migrates. But its main goal is to perpetuate its own kind by reproducing. To do this it must look for a mate and after mating, the female lays her eggs on a suitable plant, while fertilizing them with the sperm she has collected from her mate. Thus begins the entire life-cycle all over again.

Did you know that in proportion to their size, butterflies have the largest wings of any animal in the world?



The green 'shape' is a newly made pupa of a Lime butterfly. To its right, you can see a dry, empty pupal case of a butterfly that has emerged

Payal Mehta



A Lime Butterfly with a wing span of almost 10cm comes out of a pupa whose diameter is no bigger than 1 cm!

David Raju

MUD PUDDLING

Pea Blues gathered on a patch of damp soil to suck out nutrients from the moisture



Mud Puddling

Have you ever come across large congregations of butterflies gathered together on a patch of moist ground? Or sometimes on animal droppings or even a carcass? Have you ever wondered what's going on there?

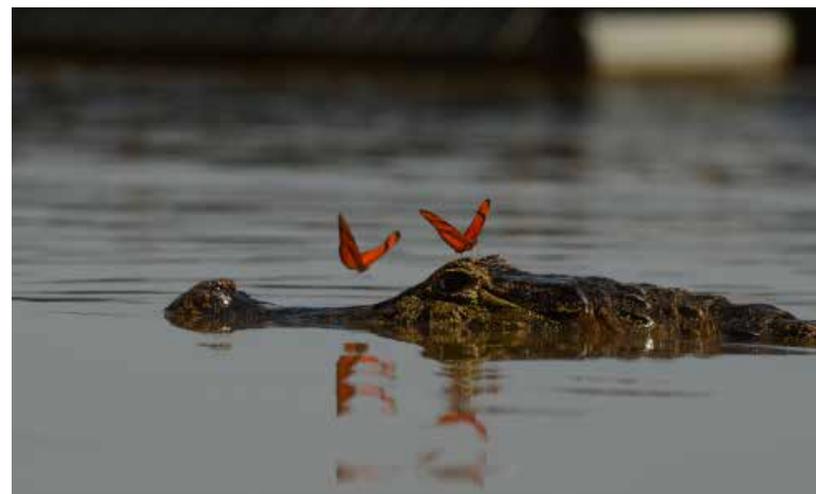
This activity is called 'mud-puddling' and it tends to be an entirely male preserve, or predominantly so.

Scientists who study butterflies (they are called 'lepidopterologists' from the word 'Lepidoptera' – the Order of butterflies) were puzzled by this at first but soon learned that male butterflies need a lot more nutrients than females do because of the manner in which males first woo and then inseminate the females. In the act of mating, a male gives his female partner a packet of goodies (called a 'spermatophore') that contains a lot more than just his sperm or male seed. Typically, a spermatophore contains a range of mineral salts, proteins and amino acids among other nutrients. The female uses this 'wedding gift' in the formation of her eggs, and scientists know that the reproductive success of her eggs has a lot to do with the nutrient-richness of this packet from the male.

In some species, freshly emerged male butterflies will mud-puddle instinctively even before they have mated for the first time. They are stocking up on nutrients. A female is more than likely to reject a suitor whose spermatophore is insufficiently infused with a rich brew of nutrients. So mud-puddling is simply an attempt to stock up on and/or restore some of the strength and vitality that a male has lost (or will lose) when he hands his spermatophore to a female.

It sometimes happens – specially on hot days – when you are in a forest or garden, that a butterfly will come and sit on your skin or hover close by. Have you ever wondered why? I'm sorry to bear the news that it's not love or a butterfly kiss. It is attracted by the dissolved salt in your sweat. It sees your skin as just another mud puddle!

While this is the gist of what mud-puddling is all about, it's actually a fairly complicated behavior that is not fully understood. While young males of most species are known to mud-puddle, in some species it's mostly just the old males, while in others it's only old females, and we do not know why this is so.



Harsha J.

Males of the South American *Julia* butterfly are often seen fluttering around the eyes of yellow-throated caimans. This may seem puzzling and foolhardy but the butterflies are merely using the caiman's salty tears as a mud-puddling site!

Furthermore, some species show a clear preference for sodium-rich sources while others seem to prefer nitrogen-rich puddles. And to complicate the picture, there are a few species that don't seem to need to mud-puddle at all. Clearly, mud-puddling must mean different things to different species and a butterfly's need to mud-puddle varies not just with respect to the species, but with age and gender and perhaps with other factors as well that we know next to nothing about.

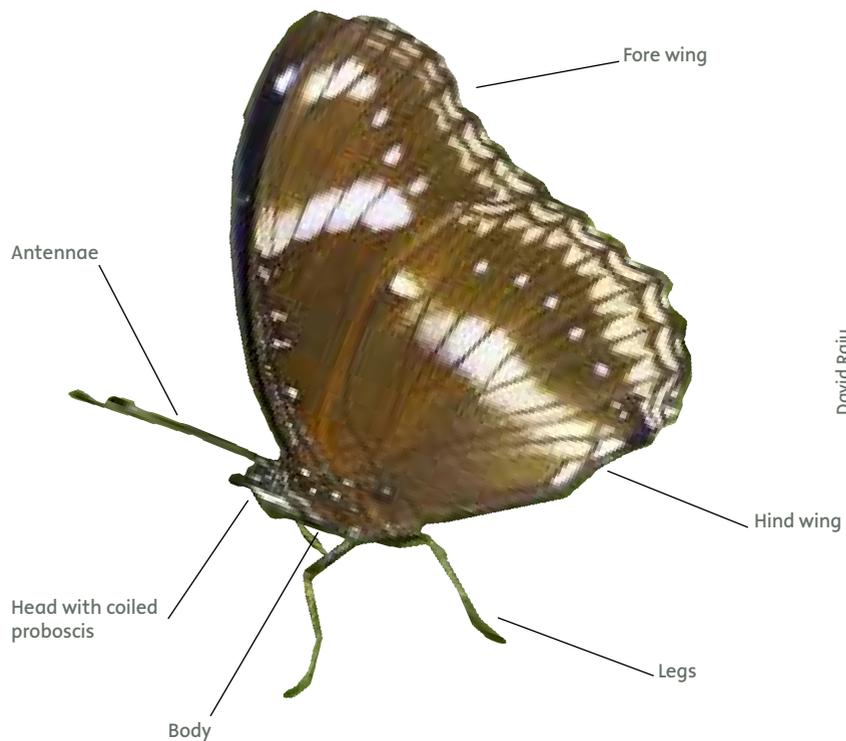
Nevertheless, we do know or can at least infer that mud-puddling is a terribly important activity for most butterflies because they

take such enormous risks to mud-puddle. A butterfly in the midst of mud-puddling activity is exposed for a relatively long time, making it an easy target for predators. A butterfly would be extremely unlikely to risk its life in this way unless it was doing something vitally important for its own well-being.

Next time you are wandering somewhere and come across a gathering of mud-puddling butterflies, notice how quickly they gather together again even when they are disturbed. It barely takes a few seconds for them to settle again like tiny little ballerinas in the Bolshoi, to make one of the most enduringly beautiful sights of all.

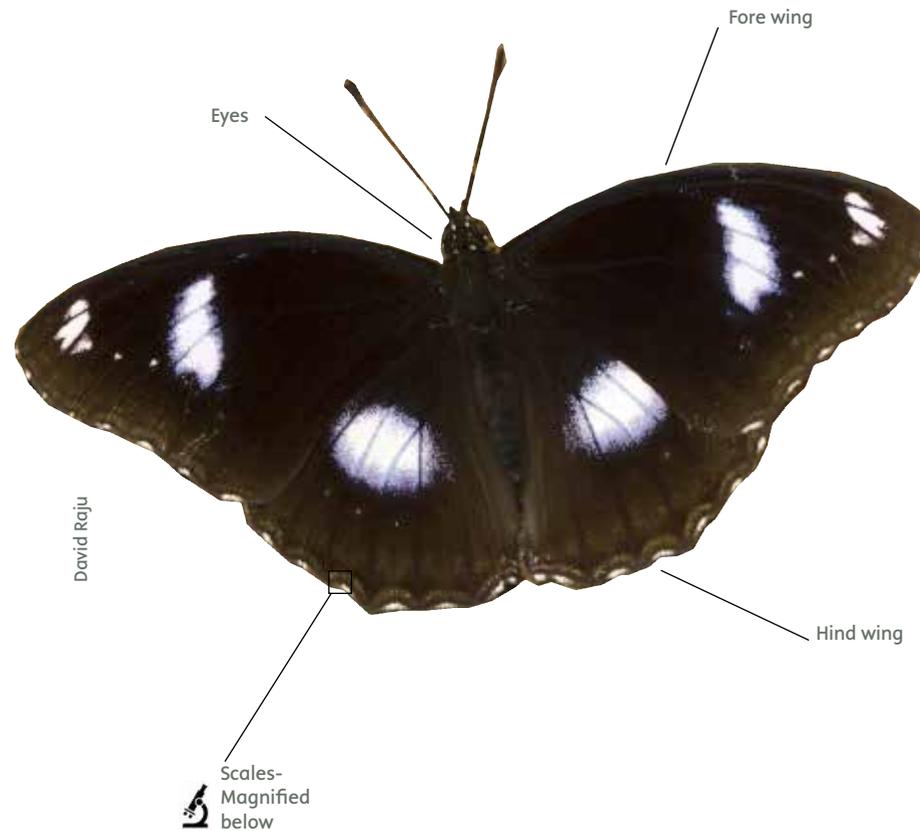
Butterfly Anatomy

A Great Eggfly male in a closed-wing perch, showing its UNDERWING patterns

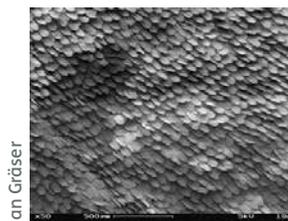


David Raju

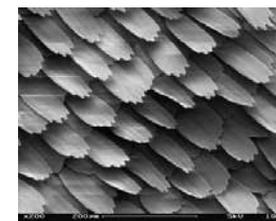
A Great Eggfly in an open-winged perch, showing its UPPER WING patterns



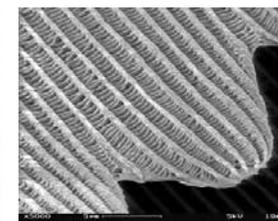
David Raju



Scalcs close up (about x200)



A single scale (about x1000)



Microstructure of a scale (about x5000)

Jan Gräser

Butterflies vs. Moths

How is a butterfly different from a moth? Is it simply that butterflies are active by day, while moths are nocturnal? This is generally true but there are a few more specific features that help to tell them apart.

Moths and butterflies belong to the same category – technically, an ‘Order’ – of insects called *Lepidoptera*. The word ‘lepidoptera’ means ‘scaly-winged’. If you have ever touched the wing of a butterfly or a moth, you might have noticed a smooth powdery substance that gets left behind on your fingers. These particles are actually minute ‘scales’ that have become detached from the

wings and they serve to distinguish the members of this Order from all other kinds of winged insects such as beetles, flies, wasps, and so on, whose wings are *not* scaly and who are therefore placed in other Orders. (See P21 for pictures of scales.)

Butterflies and moths are clubbed together also because they share a general body-plan consisting of a head with compound eyes, a pair of antennae and a proboscis; and a body with two pairs of scaly wings and 6 legs.

There are many, many more species of moths than there are butterflies – worldwide, something like 18,000

species of butterflies compared to over 1,25,000 moth species known to science. But because moths are active at night we see them less often and know a lot less about them than we do about day-flying – and especially the more brightly coloured – butterflies. This is reflected in our vocabulary in Hindi, for instance, where there are distinct words for a butterfly (*titli*, *patanga*) but no separate words for a moth.

So how do you tell butterflies from moths? In general, it is perfectly true that butterflies are day-flying and usually conspicuous and brightly-coloured, while moths are mostly drab and well-camouflaged and active at night. But there are exceptions to both these cases. There are some species of day-flying moths and a few that are decked out in a myriad colours. Conversely, a small number of butterflies are dull-coloured. So these generalisations are a little fuzzy at their edges!

Let’s try this: at rest, butterflies usually hold their wings together vertically over their bodies, whereas moths keep their wings spread out parallel to the surface they are perched on.

Here again, this is only *mostly* true. There is an entire, prominent family of butterflies (the *Skippers*) many of whose members do not fold their wings when they are at rest.



Death's Head Hawk Moth

Pradip Krishen



Blue Pansy male in an open wing position

Vinod Puri

Vinod Puri



Vinod Puri

On top is a Spotted Small Flat butterfly of the Skipper family while the picture below is that of a moth. Both of them adopt the same resting position with their wings held parallel to the surface and can easily be confused. One clue to the difference lies in the placement of their eyes - butterflies have their eyes on the sides of their head whereas moths have eyes placed on top of their heads

BUTTERFLIES VS. MOTHS

It's easy to see the differences between the foreparts of the Common Crow butterfly (above) and the Death's Head Hawk moth (below). The butterfly has clubbed antennae, clearly distinct from the feathery antennae of the moth (this is a picture of a female hawk moth. The male has even more pronounced antennae). Even the way they hold their antennae can be clearly distinguished. Notice too the slender legs and body of the butterfly compared with the stouter, hairier legs and body of the moth.



Pradip Krishen



Payal Mehta

You need to zoom in a little closer to these insects to begin to spot more reliable differences:

- Butterfly antennae are nearly always club-shaped. Moths have many different kinds of antennae but they are either thin, thread-like and tapering at their ends or broad and feathery.
- Butterflies always hold their antennae out in front of their faces while moths hold them along their backs, or along the front edge of their forewings or even under the forewings. Because of this, it is sometimes difficult to see the antennae of some moths.
- Butterflies find their mates by visual stimuli and not by smell. The most elaborate feather-like antennae are found on males of some species of moths. (Females have smaller feathers or no feather-like hair on their antennae.) Males use these feather-antennae as receptors for sensing large molecules of scent (called 'pheromones') released by females who may be miles away.
- Butterflies tend to have slender, smooth bodies whereas moths are generally more stout and furry-looking.
- Both butterflies and moths have compound eyes but butterfly eyes are smaller and placed on the sides of their heads, whereas moths have larger eyes located towards the tops of their heads. This makes sense because their eyes are designed for different abilities: moths for seeing well in dim light, and butterfly-eyes for resolving colours in daylight.
- Unlike all butterflies, moths have a special hook-and-socket structure that holds their 2 wings on either side together.
- Butterflies and moths exhibit some differences in their larval stage: butterfly caterpillars possess 3 pairs of 'true' legs, plus 4 pairs of 'prolegs' and 2 'claspers'. Moth caterpillars often lack some of the prolegs.
- Most moth caterpillars spin cocoons of silk, inside which their pupae develop. Moth cocoons may be placed loose in leaf litter on the ground or on the bark of a tree. Most butterfly caterpillars, on the other hand, spin their pupa in open sites supported by some silk threads and are nearly always suspended from a plant.

So the 2 divisions of lepidoptera are not so similar after all!