



Wing scale patterns of *Hypolimnas bolina* (Linnaeus, 1758) (Lepidoptera: Nymphalidae)

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ABSTRACT: *Hypolimnas bolina* (L), exhibit a stunningly bright and lustrous colour wing patches. The present study is focused on the variety of pigmented scales that cover the wings of *H. bolina*. A total of 128 different types of scales (white, brown, blue as well as black scales) were investigated, which includes 63 morphologically different types of scales on the dorsal part and 65 scales from ventral side. For the analysis the scales are taken from the black and violet portion of dorsal part and brown and white colored patches in ventral region. Micrometry of scales on the dorsal side showed a length range of about 86.6 to 102.4 μ and width range of 63 to 78.8 μ . Dimension analysis of ventral region range from 86.6 to 106.3 μ in length and width of 66.8 to 86.6 μ . The shape and distribution of scale depends on their exact location on the wing which are responsible for boggling pattern and brilliant visual appearance. © 2022 Association for Advancement of Entomology

KEYWORDS: Blue moon butterfly, micrometry, pigmented wings, scale dimension

Many butterflies exhibit specific spatial colour patches on wings that are stunningly bright and iridescent in their appearance generating a spectacular vision. The pigmented scales on the dorsal and ventral surface of the wing are responsible for the colour pattern (Smetacek, 2000). This form of coloration is phenotypically variable (Brunton and Majerus, 1995; Kemp, 2006). Structurally colour wing patches are blown up in males showing sexual dimorphic ornamentation (Kemp and Macedonia, 2006). *Hypolimnas bolina* (Linnaeus, 1758) also called the Blue moon or Great eggfly butterfly is a sexually dimorphic belonging to the family Nymphalidae under the order Lepidoptera. It is distributed from west to east, from Madagascar to Easter Island, and a north to south one from Japan to Australasia (Marsh *et al.*, 1977). The female is both monomorphic and a mimic of *Euploea* in the west region. Also polymorphic and

most of the forms are non-mimetic in the east part. Polymorphism is a sex-limited character in the *H. bolina*. It is a black-bodied butterfly with a wingspan of about 7-8cm. The upper side of the wings is jet black, offset with three pairs of white spots, two on the forewing and one on the hindwing. These spots are surrounded by purple iridescence. In addition, the upper side of the hindwing bears a series of small white dots with brown surroundings.

The butterflies of *H. bolina* were collected from the premises of Sree Narayana College, Kollam (8°52' 55" N; 76°36' 4" E) by using handheld insect net. The scales were dislodged from the wing surface as per the standard method of Grodnitsky and Kozlov (1991). Scale samples were shredded from each pigmented region of wing separately on a slide. A drop of xylene was used for fixation of scales and the samples were studied under the light

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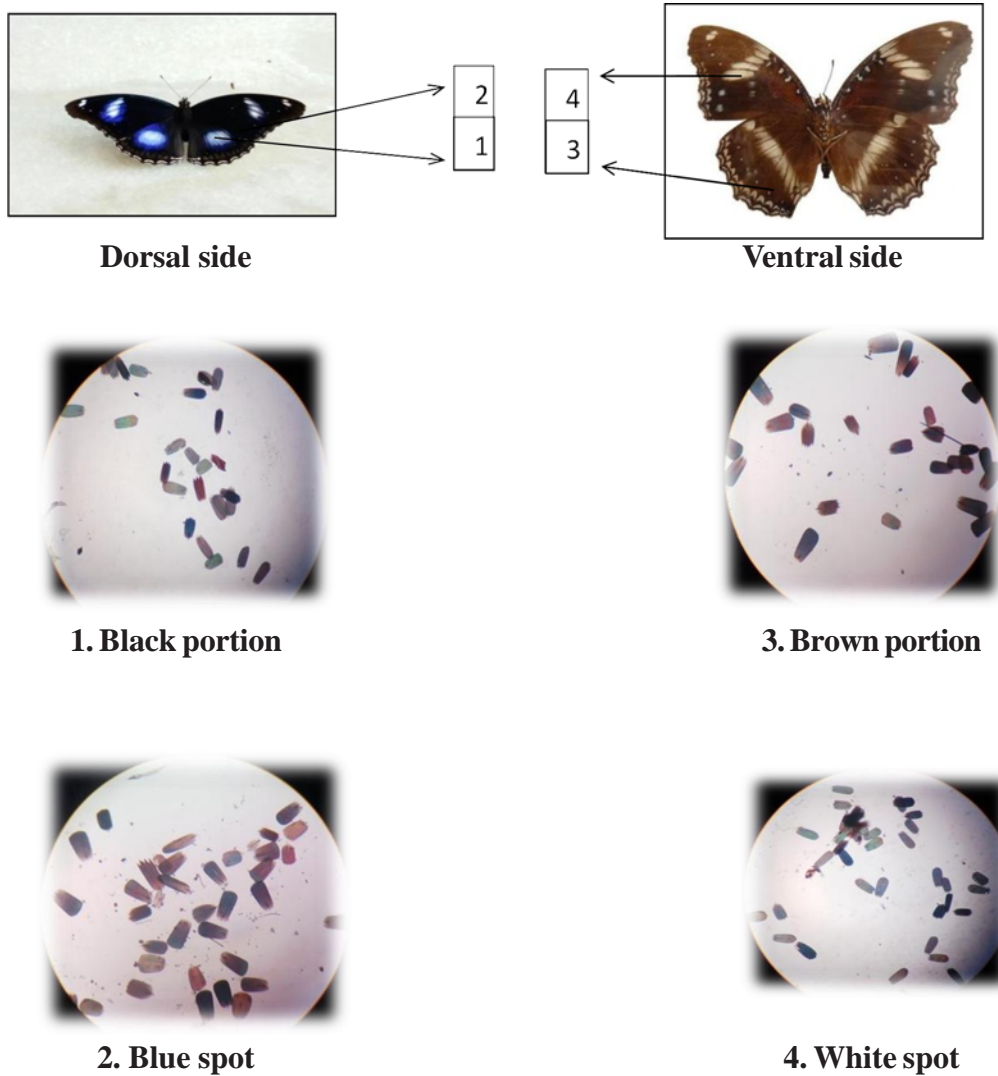
Hypolimnna bolina (Blue Moon Butterfly)

Fig. 1 Different types of scales - white, brown, blue as well as black scales

microscope. The measurements of the scales were made using micrometry. Photomicrographs of the sample scales were prepared for comparison.

In the scales extracted from distinct pigmented regions of the wing, a total of 128 morphologically different types of scales (white, brown, blue as well as black scales) were identified (Fig.1). There were 63 types in the dorsal side and 65 in the ventral side

(Plate 1- 4). An examination of scales from the dorsal side revealed presence of white, blue as well as black scales (Plate 1). Majority of the scales were short and broad. The black region consisted of 32 different scales and the blue region contained 31 types. The apical part of certain scales seen with two or more pointed edges and through this structure difference between the scales are observed.

Plate 1

Dorsal side

1. Black region



Plate 2

2. Blue spot



Plate 3

Ventral side

3. Brown portion

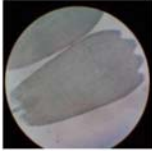


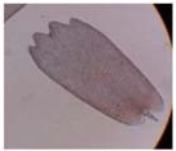

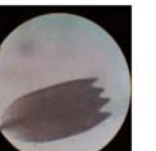







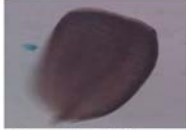

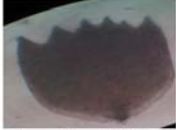







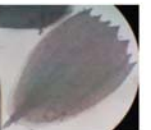



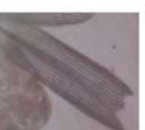


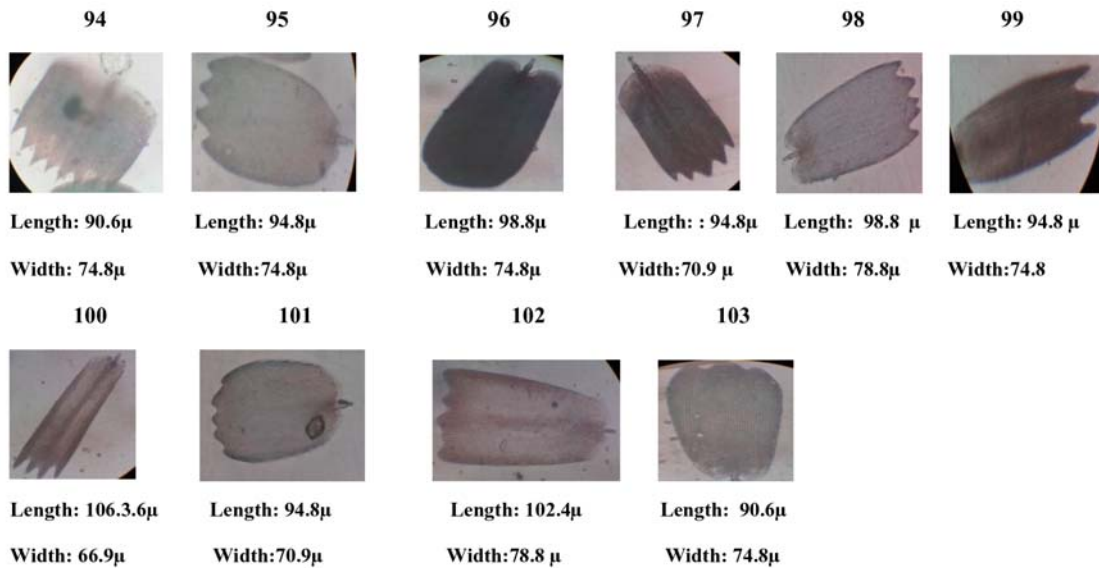
63	64	65	66	67	68
					
Length:94.5 μ Width: 70.9 μ	Length: 86.6 μ Width: 74.8 μ	Length: 98.8 μ Width: 78.6 μ	Length: : 94.8 μ Width: 74.8 μ	Length: 98.8 μ Width: 74.8 μ	Length:94.5 μ Width:70.9 μ
70	71	72	73	74	75
					
Length:94.5 μ Width: 74.8 μ	Length: 94.5 μ Width: 74.8 μ	Length: 90.6 μ Width: 70.9 μ	Length: : 86.6 μ Width: 74.8 μ	Length: 98.8 μ Width: 70.9 μ	Length: 94.5 μ Width: 70.9 μ
76	77	78	79	80	81
					
Length:94.5 μ Width: 70.9 μ	Length: 90.6 μ Width: 74.8 μ	Length: 90.6 μ Width: 74.8 μ	Length: : 90.6 μ Width: 74.8 μ	Length: 86.6 μ Width: 70.9 μ	Length: 94.5 μ Width: 70.9 μ
82	83	84	85	86	87
					
Length: 90.6 μ Width: 66.8 μ	Length: 94.8 μ Width:74.8 μ	Length: 94.8 μ Width: 74.8 μ	Length: 98.8 μ Width:74.8 μ	Length: 90.6 μ Width: 70.9 μ	Length:94.8 μ Width:74.8 μ
88	89	90	91	92	93
					
Length: 94.8 μ Width: 74.8 μ	Length: 90.9 μ Width:70.9 μ	Length: 94.8 μ Width: 70.9 μ	Length: : 98.8 μ Width: 66.8 μ	Length: 94.8 μ Width: 74.8 μ	Length: 90.6 μ Width:66.8 μ

Plate 4



4. White spot



PLATE 5

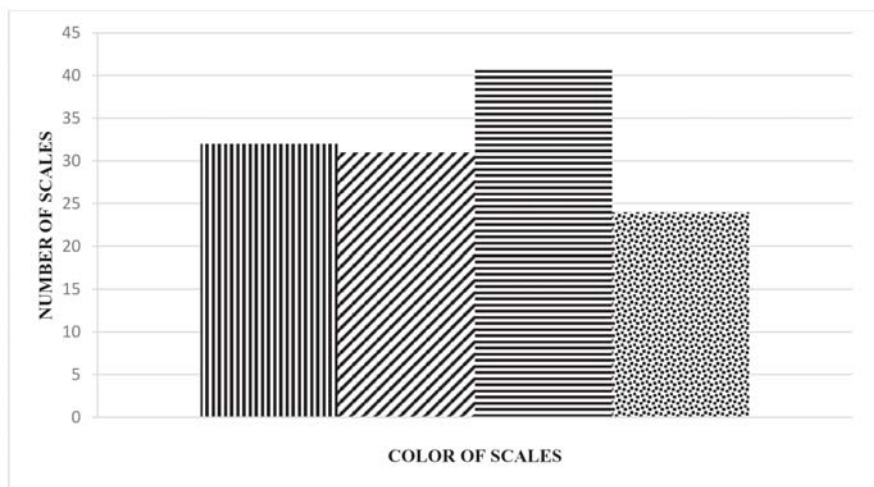
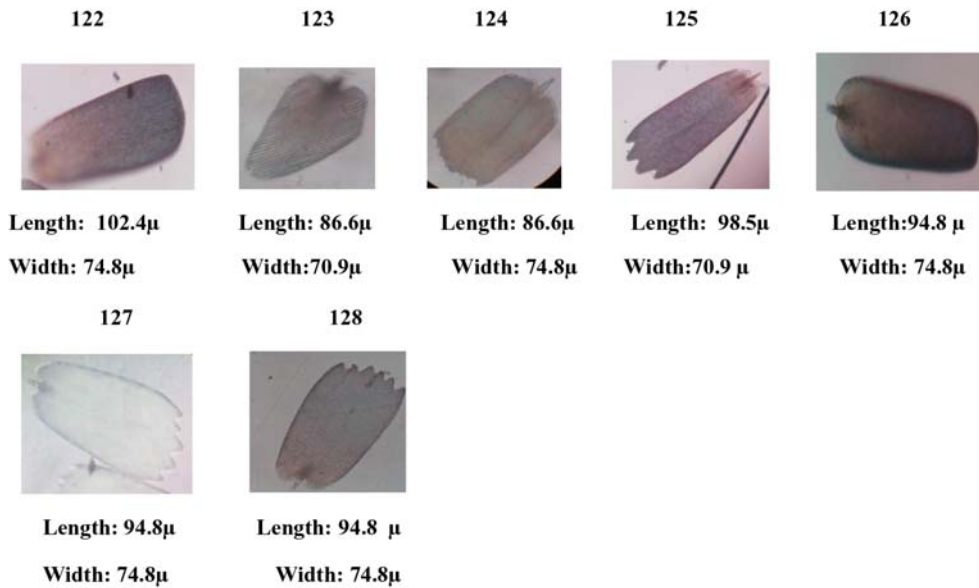


Fig. 1 Dorsal and ventral side pigmented wing scales in *Hypolimnas bolina*

The colour pattern and shape of the scales on the ventral side was similar to that of the dorsal wing. In the ventral side brown colour scales were relatively more. There were 41 types of brown scales and 24 white scales. The coloration of scales is based on the light absorbed by them. The scales on the ventral side were flat and wide. The dorsal scale ranged from 86.6 to 102.4 μ in length and 63

to 78.8 μ in width (Plate 1, 2) and in the ventral side scales, the length and width ranged from 86.6 to 106.3 μ and 66.8 to 86.6 μ respectively (Plate 3, 4).

Wing scale coloration in *H. bolina* exhibit high phenotypic variation, as a sexual ornament, and is a male-limited trait (Kemp and Macedonia, 2006). Total diffusive reflection spectra measured in different regions of the *H. salmacis* wing scales

was in agreement with *H. bolina* indicating similar kind of structural colouration wing scale pattern (Siddique *et al.*, 2016). The colour formation on the scale in *H. bolina* serves as sexual signals and exhibit sexual dimorphism (Kemp and Jones, 2001). The comparison of dorsal side and ventral side scales indicate that the shape of all scale types depends on the location of the scale on the wing. The knowledge on colour iridescence in scales of *H. bolina* is useful for studying mating preferences and signal variation with other *Hypolimnas* butterflies. Besides these several functions of the wing colour, a better understanding on the optical and radiative properties of wing scales provide a better vision on the biological behavior of butterflies. The mechanism of color interaction in wing scales of butterfly might be useful in the field of nano-optics and photonics.

ACKNOWLEDGEMENT

The authors express their gratitude to The Principal, Sree Narayana College, Kollam, Kerala, India for providing facility in the PG and Research Department of Zoology to complete the work.

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(Received December 03, 2021; revised ms accepted May 21, 2022; published June 30, 2022)