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Probable temperature mediated leucism and phenology of *Byasa polyeuctes* (Doubleday, 1842) (Lepidoptera: Papilionidae) in the Western Himalaya, India

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Abstract: The first instance of leucism in troidine larvae is reported. The change of one larva from leucistic to normal when brought to lower elevation is linked to an increase in temperature. The phenology of *Byasa polyeuctes* (Doubleday, 1842) in the Western Himalaya is discussed.

Wahrscheinlich temperaturbeeinflußter Leukismus und Phänologie von *Byasa polyeuctes* (Doubleday, 1842) (Lepidoptera: Papilionidae) im Westhimalaya, Indien

Zusammenfassung: Ein erstes bekanntgewordenes Beispiel für einen Raupenleukismus bei Troidini-Raupen wird berichtet. Die Verfärbung einer aufgehellten Raupe zurück zur Normalfärbung wurde durch einen Temperaturanstieg ausgelöst. Die Phenologie von *Byasa polyeuctes* (Doubleday, 1842) im Westhimalaya wird diskutiert.

Introduction

Byasa polyeuctes (Doubleday, 1842) is an Asian troidine, with a known distribution along the Himalaya from Pakistan to Myanmar, Thailand, Vietnam, China and Taiwan (Racheli & Cotton 2010). In the western Himalaya, it inhabits the region between 1800 m and 2700 m (Smetacek 2011), which is the zone where its larval hostplant, *Aristolochia dilatata,* occurs. This is the only species of *Aristolochia* in the area, and *B. polyeuctes* shares this hostplant with three other troidines, *Troides aeacus* (C. & R. Felder, 1860), *Atrophaneura aidoneus* (Doubleday, 1845) and *Byasa dasarada* (Moore, 1858).

Seasons are well marked in the subtropical belt occupied by *B. polyeuctes,* so the flight time of the species is also well defined into several broods. The early summer brood is conspicuous, as the butterflies congregate in numbers at flowering horse chestnut trees (*Aesculus indica*) and are easily observed at the time. The other broods do not have such a conspicuous flower at which they can congregate, and hence they are usually seen singly, even though observations on their early stages suggest that they may be more numerous than the spring brood.

Material and methods

Byasa polyeuctes was reared over several years from larvae collected opportunistically in the wild (Figs. 1–8). It was not possible to breed them continuously in captivity because the ♂♂ emerged well before the ♀♀ and died before the latter emerged.

Most larvae of the west Himalayan population of *Byasa polyeuctes* match those of the central Nepalese population bred by Igarashi (1966). However, on 30. ix. 2011, two leucistic (albinotic) larvae were found on an *Aristolochia dilatata* plant at 2200 m in Rata Forest, Nainital district, Uttarakhand, India, that were unlike any previously known larvae of this butterfly (Fig. 9). They lacked most of the dark streaks and the distinctive subventral white tubercle on the 3rd abdominal segment, white dorsal tubercle on the 4th abdominal segment; white dorsal tubercle on the 7th abdominal segment and white subventral tubercle on the 8th abdominal segment were indistinguishable from other tubercles except by the lack of crimson on their tips. One larva was in the 5th instar and the second was in the 4th instar. On the same plant was a normal 3rd instar larva (Fig. 9) which, after being photographed, was left in situ. On the same day, two normal 1st instar larvae were found on another *Aristolochia* plant 500 m away from the first. Of these 5 larvae, the 2 leucistic larvae from the first plant and one normal larva from the second plant, were brought down to Bhimtal at 1500 m elevation to rear through to the adult stage.

Observations

The 5th instar leucistic larva (Figs. 10–13) pupated without change on 7. x. 2011 and the pupa was also relatively paler than normal pupae. The imagine emerged on 3. xi. 2011 (Figs. 14, 15).

The 4th instar leucistic larva moulted in Bhimtal on 5. x. 2011 and, astonishingly, changed its appearance to that of a normal 5th instar larva (Figs. 16–18). The minimum temperature in Bhimtal on that day and the preceding days was 16 °C. It pupated on 13. x. 2011. The imago emerged on 8. xi. 2011 (Figs. 19, 20).

Since it did not rain during the period at either site, the only difference between the two sites, Rata where the larvae were found and Bhimtal where the larva moulted, was temperature, Bhimtal being warmer due to its lower elevation. A minimum/maximum thermometer was placed at Rata near the plant where the leucistic larvae were found on 6. x. 2011 and left in situ for twelve days. In this time, the maximum temperature recorded was 24 °C and the minimum 10 °C.

Based on previous rearing records of this species, there appear to be 3 generations annually in the area, the first emerging in the second half of April and continuing to the first half of May; the second in July and the third in September. The larvae collected in Rata were evidently from eggs laid by the September generation. Normally, these would have overwintered as pupae and emerged the following April. However, the imagines of the two leucistic larvae both emerged in November. Both butter-

Figs. 1–2: L_2 normal larva. **Fig. 1:** Lateral view. **Fig. 2:** Dorsal view. **Figs. 3–4:** L_3 instar normal larva. **Fig. 3:** Lateral view. **Fig. 4:** Dorsal view. **Fig. 5:** L_4 instar normal larva, lateral view. **Fig. 6:** Final instar normal larva, lateral view. **Fig. 7:** Normal larva pupating. **Fig. 8:** Normal pupa, lateral view. **Fig. 9:** Two leucistic and one normal larva. **Fig. 10–11:** Leucistic final instar larva. **Fig. 10:** Lateral. **Fig. 11:** Dorsal. **Fig. 12:** Leucistic larva pupating. **Fig. 13:** Pupa of leucistic larva, lateral view. **Figs. 14–15:** Imago of leucistic larva. **Fig. 14:** Dorsal view. **Fig. 15:** Ventral view. **Figs. 16–17:** Final instar of leucistic larva that became normal. **Fig. 16:** Lateral view. **Fig. 17:** Dorsal view. **Fig. 18:** Leucistic larva that became normal, pupating. **Figs. 19–20:** Imago of leucistic larva that became normal. **Fig. 19:** Dorsal view. **Fig. 20:** Ventral view.

flies were normal in appearance and indistinguishable from other individuals found in the area.

Igarashi (1966) illustrated an egg and pupa of *B. polyeuctes*. Here, the early stages from the 2nd instar onward are illustrated (Figs. 1–8).

Discussion

Racheli & Cotton (2010) stated that "the status of the west Himalayan subspecies *letincius* (Fruhstorfer, 1908) is fluid due to the variability of characters with a trend to *polyeuctes*, probably representing a cline ... We retain this subspecies for the differences found in the ♂ genitalia, while awaiting more material for comparison." While material bred in the present study is assignable to *letincius* on the basis of geography, I have refrained from assigning subspecific status to the material bred in deference to the opinion expressed above.

The above observations indicate the following. First, in addition to the normal dark form of the larva, there is a leucistic variety. Second, both leucistic larvae were apparently siblings. The discovery of normal first instar larvae on another larval host plant at the same time suggests that larval leucism is not a universal phenomenon for that generation. Third, leucistic larvae produce somewhat paler pupae than normal but the leucism does not appear to be carried over to the imago. It is presumed that the leucistic L_4 larva would have gone on to become a leucistic L_5 larva had it been left in Rata. Because the L_4 leucistic larva moulted to the normal dark form in the L_5 stage when brought down to a lower elevation at Bhimtal, it appears that leucism in the larval stage of this species is at least partly temperature-dependent. The trigger point appears to be between 10 and 16°C, for these were the minimum temperatures recorded from Rata and Bhimtal (outdoors), respectively, during the period that the larvae were feeding.

The emergence of the imagos from the pupae also appears to be governed by temperature, the critical point again appearing to be between 10 and 16°C, which is the difference between the minimum temperature in Rata and the temperature indoors in Bhimtal (where the pupae were kept) around the time that the imagos emerged from the pupae. (Prior to this, the doors were open most of the time, so there was little difference between external and room temperature.)

Racheli & Cotton (2010) stated that there are 2 annual generations of the species. While this may be true for other parts of the butterfly's range, in the Kumaon Himalaya there are 3 generations. If *B. polyeuctes* was not restricted to the region above 1800 m by the inability of its hostplant to survive at lower elevations in the area (Smetacek 2011), the butterfly might have a fourth generation in November. The only troidine found at low elevations in the area, *Pachliopta aristolochiae* (Fabricius, 1775), does have a generation in late October and early November in the Kumaon Himalaya; its foodplant in this region is thus far unknown.

Conclusion

Two leucistic larvae bred in the Kumaon Himalaya during autumn 2011 developed into normal adults of *Byasa polyeuctes*. One L_4 larva moulted into a normal L_5 larva, while a L_5 leucistic larva did not change when brought down from 2200 m elevation to 1500 m elevation. It is suggested that the change to a normal L_5 larva was mediated by the increase in temperature.

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