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ON THE ANOMALOUS ALTITUDINAL DISTRIBUTION OF WEST HIMALAYAN TROIDINI AND PAPILIONINI (PAPILIONIDAE)

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ABSTRACT. The altitudinal distribution of those Papilioninae species that occur in both eastern and western parts of the Himalayan range is compared. Ten species were found to ascend with the latitude, one descends as latitude increases and fourteen are almost unaffected by latitude. The presence of a suitable larval host plant appears to be one of the decisive factors governing altitudinal distribution of these species. In four Papilioninae species, the same subspecies has exclusively colonized entirely different habitats in different parts of the Himalaya.

Additional key words: *Atrophaneura, Byasa, Graphium, Meandrusa, Pachliopta, Papilio, Troides*

The Himalayan range extends in a great arc from northwest to southeast, across the northern boundary of the Indian subcontinent. The eastern part of the range is several degrees of latitude south of the western part. The southernmost part of the range is nearly 27 degrees North latitude and 90 degrees East longitude in West Bengal, India, while the northernmost part of the range is around 34 degrees North latitude and 75 degrees East longitude in Jammu and Kashmir, India. The western half of the range has a drier, more temperate climate than the eastern half, with greater Palearctic affinities, both in plants (Polunin & Stainton 1984) and butterflies (Evans 1932). Both the tree line and the snow line are lower in the western Himalaya than in the east (Polunin & Stainton 1984) and plant species that occur along the entire length of the range generally grow at lower elevation in the west than in the east (Brandis 1875).

57 (+/- 1) species of Papilioninae are known from the Himalaya east of Sikkim. Of these, 27 species have been recorded from the Himalaya west of Nepal.

In the present study, the altitudinal distribution of the Papilioninae fauna found west of Nepal has been compared with that of the same species in the eastern Himalaya.

Atrophaneura varuna White, *Papilio alcmenor* C. & R. Felder and *Papilio helenus* L. have not been reported from the western Himalaya for nearly a century since Hannyngton (1910) and are therefore excluded from the discussion. However, it is worthy of note that Hannyngton recorded *alcmenor* up to 2100 m elevation while in the eastern Himalaya it is known from 300 m (Arora & Mondal 1981) to 1800 m (Talbot 1939).

MATERIALS AND METHODS

The altitudinal distributions of the Papilioninae species were obtained from three sources: the first, published literature; the second, unpublished notes compiled by my father, the late Fred Smetacek Sr. in Nainital district of the Kumaon Himalaya west of Nepal between 1949 and 1986 and the third, my own observations, mainly in the W. Himalaya, comprising specimens, field notes and the results of breeding experiments compiled since 1980.

The altitudinal distribution of the plant species mentioned was obtained from published botanical works. In all cases, the extreme altitude was taken, since these plants occur at different elevations in different localities. For example, since *Zanthoxylum armatum* DC (Rutaceae) ascends as high as 2100 m in Kumaon (Osmaston 1927) but to 2500 m further west in Kullu (Dhaliwal & Sharma 1999), I used 2500 m as the maximum elevation for the plant in the western Himalaya.

RESULTS

The altitudinal distribution of the Leptocircini (8 species common to both halves of the Himalaya) was found to be practically identical in both areas. Of these, only subgenus *Pazala* Moore of *Graphium* Scopoli containing two or three species and *Meandrusa* Moore are restricted to a montane habitat. There is some confusion regarding the taxonomic position of Himalayan members of *Pazala*, so suffice it to say that they occupy a belt between 1600 m and 2600 m along the entire range, with stragglers descending to 900 m (de Nicéville 1894; Wynter-Blyth 1957) and ascending to 3300 m (Ebert 1966). In the western Himalaya, two species are found, namely *Graphium* (*Pazala*) *eurous caschmirensis* Rothschild and *Graphium* (*Pazala*) *mandarinus garhwalica* Katayama. Although there is a record for a member of the genus ("*Papilio glycerion* Westwood" = *G. (P.) eurous vide* Racheli & Cotton 2009)) being bred on *Persea odoratissima* (Nees) Kosterm. (Lauraceae) in Mussoorie, W. Himalaya

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(Robson 1895), I have only found *G. (P.) eurous* larvae on *Persea duthiei* (King ex Hook. f.) Kosterm. and *Neolitsea umbrosa* (Nees) Gamble (both Lauraceae), and both butterfly species entirely absent in areas where only *P. odoratissima* occurs in the Western Himalaya.

The remaining members of the tribe belong to *Graphium* (*Graphium*) Scopoli and are low elevation butterflies that inhabit the plains adjoining the hills and low outer ranges, with two species, *G. cloanthus* Westwood and *G. sarpedon* L. ascending to 2750 m even in the main range (Wynter-Blyth 1957). Recently, Singh (2006) discovered what appears to be an isolated population of *Meandrusa lachinus* Fruhstorfer in a moist temperate forest below the tree line in the Kedarnath Musk Deer Reserve in the Garhwal Himalaya, India. The type locality of the nominate subspecies is Darjeeling, West Bengal, India and Lachen-Lachung, Sikkim, India (Racheli & Cotton 2009), both in the eastern Himalaya, which are more or less at the same elevation as the Kedarnath Musk Deer Reserve in Garhwal.

The Palearctic *Papilio machaon* L. occurs in the Himalaya as far east as Sikkim (Gaonkar 1999). It is the only member of the subfamily that is found at higher elevation in the east than in the west. In the extreme west in Kashmir, it descends to 600 m, but is not found below 2450 m in Sikkim (Wynter-Blyth 1957). This distribution pattern is in keeping with classical views on the subject. It feeds on various umbellifers.

Papilio agestor Gray occurs throughout the range in a belt between 1200 m and 2600 m elevation, occasionally ascending to 2750 m in the western Himalaya (Wynter-Blyth 1957). It has been bred on *Persea odoratissima* (by Fred Smetacek Sr.) and *Persea duthei* (King ex Hook.f.) Kosterm. (Lauraceae) (mihi) in the western Himalaya.

Four species, *Pachliopta aristolochiae* Fabricius, *Papilio polytes* L., *Papilio demoleus* L. and *Chilasa clytia* L. are widespread on the Gangetic plain, which adjoins the Himalayan foothills. They are common along the entire length of the outer Himalaya, ascending to 1500 m with stragglers at 2250 m (Wynter-Blyth 1957; mihi).

The remaining ten species, comprising members of Troidini and Papilionini, were found to ascend with the latitude, occurring at low elevation in the eastern Himalaya and at higher elevation in the west (Table 1).

Concerning the larval host plants in the Himalaya, *Zanthoxylum armatum* is a known host plant of *Papilio bianor* Cramer and *Papilio protenor* Cramer. It grows between 610 m and 915 m in the eastern Himalaya and hills of N.E. India (Hooker 1872) and between 900 m and 2100 m in the Kumaon Himalaya west of Nepal (Osmaston 1927). Further west in Kullu, it ascends to 2500 m (Dhaliwal & Sharma 1999). *Limonia acidissima* L. (Rutaceae) is also a known host plant of *P. bianor*. This butterfly does not appear to use this plant in the western Himalaya, where it grows from the plains to 900 m (Osmaston 1927), but has been bred on it and probably uses it routinely in the eastern Himalaya, where the plant grows to 1200 m (Hooker 1872).

Bailey (1951) reported *Papilio arcturus* Westwood feeding on *Skimmia* Thunberg (Rutaceae) in the Kathmandu valley, Nepal. Recently, the eastern and western populations of Himalayan *Skimmia* have both been raised to species rank. The east Himalayan *S. laureola* Sieb. & Zucc. grows between 1500 m and ?3350 m (Brandis 1875), while the west Himalayan *S. anquetilia* Taylor & Airy Shaw grows between 2100 m (Osmaston 1927) and 3350 m (Brandis 1875; Osmaston 1927 gives 3200 m). These are nearly exactly the altitudinal limits given by Wynter-Blyth (1957) for *arcturus* in the respective areas, although the butterfly has not actually been bred on *S. anquetilia* in the western Himalaya so far.

Papilio paris L. has been bred on *Euodia roxburghiana* Bentham (Rutaceae). This plant does not occur in the west Himalaya although the butterfly does. In the hills of northeast India, this plant ascends to 1200 m (Hooker 1872). The larval host plant in the west Himalaya is still unknown, although Robinson et al. (2001) report a wide variety of rutaceous larval host plants from the eastern Himalaya, notably several species of *Zanthoxylum*, including *Z. armatum*, and *Citrus* L..

The Troidini are believed to be primarily *Aristolochia* L. feeders. Neither of the 2 known west Himalayan members of this plant genus has been reported from below 1950 m (Osmaston 1927; Gupta 1968). *Byasa dasarada* and *B. polyeuctes* Doubleday have been bred by Michael Green on Aristolochiaceae at Chamba in Himachal Pradesh, India (in litt. to Fred Smetacek Sr.). However, no botanical works record any Aristolochiaceae from Himachal Pradesh except Hooker (1885), who included a specimen of *Aristolochia punjabensis* Lace from there in the supplementary section of his work and Dhaliwal & Sharma (1999) who did not find the plant in Kullu but included it on the basis of Hooker (1885) with the observation "origin doubtful". *B. dasarada* and *B. polyeuctes* are known from Kullu and even further west in Kashmir and Pakistan, while *B. latreillei* Donovan has been reported from as far west as Afghanistan (Bozano 2010) so they probably feed on the only known *Aristolochia* in that area, *A. punjabensis*.

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TABLE 1. Comparative altitudinal distribution of some Papilioninae in the Western and Eastern Himalaya.

Species	Minimum Elevation (m)		Maximum Elevation (m)		Remarks
	W. Himalaya	E. Himalaya	W. Himalaya	E. Himalaya	
P. janaka	2000 (1)	900 (8)	2500 (1)	1525 (4)	W. Himalayan LFP unknown.
P. protenor	900 (6)	100 (2)	2600 (8)	900 (7)	LFP: *Z. armatum; Z. acanthopodium.*
P. bianor	900 (6)	200 (2)	2250 (8)	1500 (8)	LFP: *Z. armatum.*
P. paris	1200 (1)	50 (2)	2100 (8)	1525 (2)	W. Himalayan LFP unknown.
P. arcturus	2250 (5)	900 (4)	3350 (8)	2750 (4)	W. Himalayan LFP unknown.
T. aeacus	1750 (1)	50 (2)	2700 (1)	1000 (2)	E. Himalayan low elevation LFP unknown.
A. aidoneus	1200 (1)	100 (2)	2400 (1)	1500 (2)	E. Himalayan low elevation LFP unknown.
B. dasarada	1700 (1)	150 (2)	2750 (8)	2400 (7)	E. Himalayan low elevation LFP unknown.
B. polyeuctes	1700 (1)	150 (8)	3600 (3)	3050 (2)	E. Himalayan low elevation LFP unknown.
B. latreillei	2100 (8)	1600 (2)	2750 (8)	2730 (7)	E. Himalayan low elevation LFP unknown.

1) pers. obs., 2) Arora & Mondal (1981), 3) Bang Haas (1933), 4) de Nicéville (1894), 5) de Rhé Philipe (1931), 6) Peile (1937), 7) Talbot (1939), 8) Wynter-Blyth (1957)

TABLE 2. Comparative altitudinal distribution of known and probable larval host plants of Papilioninae in the Western and Eastern Himalaya.

Species	Minimum Elevation (m)		Maximum Elevation (m)	
	W. Himalaya	E. Himalaya	W. Himalaya	E. Himalaya
Aristolochia dilatata N.E. Brown	2000 (5)		2600 (1)	
Aristolochia punjabensis Lace	1950 (1)		2250 (1)	
Aristolochia platanifolia Duchart		900 (6)		1800 (6)
Aristolochia saccata Wallich		300 (6)		1220 (6)
Aristolochia cathcartii Hooker		600 (6)		900 (6)
Aristolochia tagala Cham.	Cultivated on plains adjoining Himalaya	600 (6)	?400	1500 (6)
Aristolochia griffithii Hooker		1800 (7)		2900 (7)
Aristolochia indica L.	? on plains adjoining Himalaya	on plains adjoining Himalaya (6)		?200
Zanthoxylum armatum DC	900 (1)	600 (2)	2500 (3)	900 (2)
Skimmia anquetilia Tay & Shaw	2100 (1)		3200 (1)	
Skimmia laureola Sieb. & Zucc.		1500 (4)		?3350 (4)
Euodia roxburghiana Bentham		on plains adjoining Himalaya (2)		1200 (2)

1) Osmaston (1927), 2) Hooker (1872), 3) Dhaliwal & Sharma (1999), 4) Brandis (1875), 5) Gupta (1968), 6) Hooker (1885), 7) Polunin & Stainton (1984)

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G. Flutsch (pers. comm.) found a *Troides* Hübner larva on *Aristolochia dilatata* N.E. Brown at 2400 m in the Binsar Wildlife Sanctuary in Almora district, Uttarakhand state in the west Himalaya. Since *T. aeacus* C. & R. Felder is the only *Troides* in the area, it is reasonable to assume that it was a *T. aeacus* larva.

I have found *T. aeacus* to be selective in the forests it inhabits. I bred it on *A dilatata* in the western Himalaya, feeding the larvae leaves only. However, Igarashi (1966) noted the predilection of the larvae for leaf stalks and stems, eventually consuming more stems and leafstalks than leaves in the later larval instars. I found final instar larvae of *T. aeacus* consuming the seed pods of *A dilatata* and must note that the individuals bred by me only on a diet of leaves emerged rather stunted. Having examined numerous plants of *A. dilatata* in different forests, I was struck by the fact that *T. aeacus* only occurs in forests where mature, seed bearing plants of *A. dilatata* grow, unlike the members of *Atrophaneura* Reakirt and *Byasa* Moore, that willingly lay eggs on and complete their life cycles on what may best be described as seasonal plants of *A. dilatata*, with up to 20 leaves during the summer months from April to June and a spurt of growth during the wet summer season from late June to September. Such plants, growing in dry upland locations, do not bear seed pods while plants growing near perennial water have stems up to 5 inches in circumference with hundreds of leaves and dozens of seed pods. Such plants support populations of *T. aeacus*.

The only resident, low elevation Troidine in the west Himalaya is *Pachliopta aristolochiae* Fabricius, whose larval host plant in the area is unknown. Seitz (vide Sevastopulo 1973) includes Piperaceae among the known larval hosts of this butterfly. Robinson et al. (2001) overlooked this latter record but report *Dioscorea wallichii* (Dioscoreaceae) as a larval host plant as reported by Beeson (1941). Certainly, *Dioscorea* is a common plant in the western Himalaya and might account for this butterfly's abundance at suitable seasons.

As an experiment, ten potted plants of *Aristolochia dilatata* were brought down from 2400m and placed in a garden at Bhimtal in the Western Himalaya at 1500m from July 2010 to June 2011. During this period, although at least 50 female *Pachliopta aristolochiae* flew past these pots and investigated nearby plants for flowers and larval host plants, none of these butterflies either investigated the *A. dilatata* plants nor oviposited on them. This shows that *A. dilatata* is not likely a larval host plant of *Pachliopta aristolochiae* and this factor perhaps limits its altitudinal distribution in the western Himalaya .In other parts of India and S.E. Asia, it has been reported to feed on at least 15 species of Aristolochiaceae (Robinson et al. 2001). It undoubtedly feeds on cultivated *Aristolochia tagala* Cham. plants at the foot of the hills, but this plant is not part of the original flora of the area, although the butterfly appears to have been present before the introduction of this plant. Therefore, it must feed on some other, wild, plant in the area.

In the eastern Himalaya, six species of *Aristolochia* occur (Hooker 1885; Polunin & Stainton 1984). Only one occurs in the temperate zone between 1800 and 2900 m (Polunin & Stainton 1984). The remainder occurs from low elevation to 900 m (2 species), 1200 m (1 species); 1500 m (1 species) and 1800 m (1 species). The 2 west Himalayan *Aristolochia* species do not occur in the east Himalaya (Table 2).

The larval host plants of *Byasa latreillei* and *Papilio janaka* Moore in the west Himalaya are unknown, although Igarashi (1966) bred them on *Aristolochia griffithii* Hook.f. & Thoms. *ex* Duchartre and *Zanthoxylum alatum* (=*Zanthoxylum armatum* DC) respectively in Nepal. *A. giffithii* does not occur in the western Himalaya and *P. janaka* does not appear to feed on *Z. armatum* in the western Himalaya. Rather, it appears to be restricted to patches of *Zanthoxylum acanthopodium* DC, although it has not actually been bred on this plant so far.

The altitudes assigned to species in Table 1 are for populations. Stragglers of the following species have been recorded at lower elevation in the western Himalaya: *T aeacus* (1200 m: *mihi*); *B. latreillei* (1500 m: Fred Smetacek's unpublished notes); *B. polyeuctes*: 1200 m: *mihi*); *B. dasarada* (1500 m: *mihi*); *P. protenor*, *P. bianor* and *P. paris* (all at 660 m: Roonwal et al. 1956; Singh & Bhandari 2003). Howarth & Povolny (1973) described *B. latreillei afghana* on the basis of two males recorded from 580 m elevation in Jalalabad, Afghanistan. These are the only two specimens known.

Discussion and Conclusion

It is generally accepted that on a north–south axis, temperate zone species tend to occur at higher elevation towards the Equator, while tropical forms tend to be found at lower elevation as we progress towards the poles.

In butterflies, montane species tend to occur in altitudinal belts. Such species are not generally found above or below their chosen altitudinal limits, although stragglers are occasionally encountered. Factors restricting the altitudinal distribution of species are not wholly understood. Among the factors believed to influence altitudinal distribution are the thermal tolerance of the butterfly, wing color and presence of the larval host plant.

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TABLE 3. Papilioninae with a pan-Himalayan distribution.

Species	Western Subspecies	Eastern Subspecies
Leptocircini		
1.*Graphium* (*Pazala*) *eurous* Leech	*caschmirensis* Rothschild	*sikkimica* Heron
2. *Graphium* (*Pazala*) *mandarinus* Oberthur	*garhwalica* Katyama	*paphus* de Niceville
3. *Graphium* (*Pathysa*) *nomius* Esper	*nomius* Esper	*nomius* Esper
4. *Graphium* (*Graphium*) *doson* C.&R. Felder	*axion* C.&R. Felder	*axion* C.&R. Felder
5. *Graphium* (*Graphium*) *agamemnon* Linnaeus	*agamemnon* Linnaeus	*agamemnon* Linnaeus
6. *Graphium* (*Graphium*) *sarpedon* Linnaeus	*sarpedon* Linnaeus	*sarpedon* Linnaeus
7. *Graphium* (*Graphium*) *cloanthus* Westwood	*cloanthus* Westwood	*cloanthus* Westwood
8. *Meandrusa lachinus* Fruhstorfer	*lachinus* Fruhstorfer	*lachinus* Fruhstorfer
Papilionini		
9. *Papilio agestor* Gray	*govindra* Moore	*agestor* Gray
10. *Papilio clytia* Linnaeus	*clytia* Linnaeus	*clytia* Linnaeus
11. *Papilio janaka* Moore	*janaka* Moore	*janaka* Moore
12. *Papilio alcmenor* C.&R. Felder	*alcmenor* C.&R. Felder	*alcmenor* C.&R. Felder
13. *Papilio protenor* Cramer	*protenor* Cramer	*euprotenor* Fruhstorfer
14. *Papilio bianor* Cramer	*polyctor* Boisduval	*ganesa* Moore
15. *Papilio paris* Linnaeus	*decorosa* Fruhstorfer	*decorosa* Fruhstorfer
16. *Papilio arcturus* Westwood	*arius* Rothschild	*arcturus* WEstwood
17. *Papilio helenus* Linnaeus	*helenus* Linnaeus	*helenus* Linnaeus
18. *Papilio polytes* Linnaeus	*romulus* Cramer	*romulus* Cramer
19. *Papilio demoleus* Linnaeus	*demoleus* Linnaeus	*demoleus* Linnaeus
20. *Papilio machaon* Linnaeus	*asiatica* Menetries	*sikkimica* Heron
Troidini		
21. *Pachliopta aristolochiae* Fabricius	*aristolochiae* Fabricius	*aristolochiae* Fabricius
22. *Troides aeacus* C.&R. Felder	*aeacus* C.&R. Felder	*aeacus* C. &R. Felder
23. *Atrophaneura aidoneus* Doubleday	*aidoneus* Doubleday	*aidoneus* Doubleday
24. *Atrophaneura varuna* White	*astorion* Westwood	*astorion* Westwood
25. *Byasa dasarada* Moore	*ravana* Moore	*dasarada* Moore
26. *Byasa polyeuctes* Doubleday	*letincius* Fruhstorfer	*letincius* Fruhstorfer
27. *Byasa latreillei* Donovan	*latreillei* Donovan	*latreillei* Donovan

TABLE 4. Papilioninae that do not exhibit anomalous altitudinal distribution in the Himalaya.

Species	Minimum Elevation (m)	Maximum Elevation (m)
Leptocircini		
Graphium eurous	1800 (1)	2900 (1)
Graphium mandarinus	W. Himalaya:2200 (1); E. Himalaya: 900 (3)	2500 (1)
Graphium nomius	Plains adjoining Himalaya (1)	900 (4)
Graphium doson	Plains adjoining Himalaya (2)	848 (2)
Graphium agamemnon	Plains adjoining Himalaya (1)	1500 (1)
Graphium sarpedon	100 (2)	2750 (4)
Graphium cloanthus	227 (2)	2750 (4)
Meandrusa lachinus	1524 (4)	2133 (4)
Papilionini		
Papilio agestor	1524 (2)	2424 (4)
Papilio clytia	Plains adjoining Himalaya (4)	2750 (4)
Papilio polytes	Plains adjoining Himalaya (4)	1601 (2)
Papilio demoleus	Plains adjoining Hmalaya (1)	2133 (4)
Papilio machaon	609 in west (Kashmir); 2438 in east (Sikkim) (4)	4876 (4)
Troidini		
Pachliopta aristolochiae	Plains adjoining Himalaya (1)	1500 (1)

1) pers. obs., 2) Arora & Mondal (1981), 3) de Nicéville (1894), 4) Wynter-Blyth (1957)

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There seems to be a strong positive correlation between the altitudinal belt occupied by the various Papilionidae and their larval host plants in the west Himalaya.

While Ferris (1974) drew attention to the fact that different subspecies of a butterfly can occur in widely disparate habitats, in the case of *Troides aeacus aeacus* in the Himalaya, the same subspecies occurs in widely disparate habitats at either end of the mountain range. In the west, it is found in temperate and higher elevation subtropical forests and never in the tropical zone below 1000 m elevation, while in the east it occurs mainly in tropical forests at low elevation. Igarashi (1966) reported that in the Central Himalaya in Nepal, the species mainly inhabits lowland forests but occasionally was seen up to 3000 m elevation. *Byasa dasarada, Atrophaneura aidoneus, Papilio janaka* and *Papilio paris* also occur at low elevation in the east and higher elevation in the west.

In the case of *T. aeacus*, the presence of a suitable larval host plant appears to be the decisive factor governing its distribution. However, this is not necessarily the case with other birdwing butterflies. The Papuan *Ornithoptera priamus* L. and *O. goliath* Oberthur have been bred on *Aristolochia tagala* Cham. in Papua New Guinea (Borch & Schmid 1973; Straatman & Schmid 1975). This plant also occurs naturally in S. India, Sri Lanka and the E. Himalaya, where these butterflies do not occur.

In the case of *Zanthoxylum armatum* feeders such as *P. bianor* and *P. protenor* and *Skimmia*-feeding *P. arcturus*, the similarity in the altitudinal distribution of the butterflies and the plants is too striking to be ignored (Tables 3 & 4). Interestingly, *P. protenor* also feeds on *Zanthoxylum acanthopodium* in the western Himalaya and so occurs at higher elevation than *P. bianor*, which appears not to feed on this plant and is therefore found at lower elevation, as high as *Zanthoxylum armatum* occurs.

De Rhé Philipe (1931) and Wynter-Blyth (1957) noted the absence of *B. dasarada* and *B. polyeuctes* from the area around Shimla (=Simla) in the western Himalayan state of Himachal Pradesh, although both species are ubiquitous at suitable altitudes east, west and north of Shimla. Wynter-Blyth (1957) suggested that it was only a temporary phase and that both populations would eventually re-establish themselves and become common again. However, Collett (1921) did not find any Aristolochiaceae in the area around Shimla, which probably accounts for the absence of these butterflies from that area.

Besides the ten Papilionidae species mentioned in this paper, at least eight satyrine species and three nymphalines also ascend with the latitude on the Himalaya while one danaine and three satyrines exhibit the reverse tendency (Wynter-Blyth 1957). Unfortunately, very little is known about the larval host plants of the satyrines.

From the above, it is evident that a butterfly subspecies does not necessarily occur in the same type of habitat throughout its range; that a butterfly species' altitudinal distribution can increase with the latitude when, in the classical view, the opposite should be the case; and that the presence of a larval host plant can decisively influence the altitudinal distribution of a butterfly.

These observations in turn suggest that some butterflies possess a hitherto unsuspected ability to adapt to different climatic conditions; that such adaptation does not necessarily express itself in the colors or patterns on the wings in the form of melanism or otherwise; that Himalayan Troidini and Papilionini are generally only found more or less in the altitudinal belt of their larval host plants; that two major factors governing a butterfly's distribution are the presence or absence of a suitable larval host plant and the butterfly's ability or inability to adapt to the ***plant's*** habitat.

This still leaves unresolved the question why some plant species ascend with the latitude on the Himalaya, but that is beyond the scope of this paper. However, Hooker (1849) while referring to this phenomenon noted that the same tendency is exhibited in some plant groups in the high southern and Antarctic latitudes. In fact, he stressed the fact that the snowline ascends with the latitude in the Himalaya from 14,000 feet (4267 m) (in the eastern Himalaya) south of the Brahmaputra river in latitude 27 degrees N to 20,000 feet (6096 m) at the north western extremity of the range beyond the Sutlej river in latitude 36 and 37 degrees N. He pointed out that on the Himalaya, the range of tropical forms is extended upward to greater elevation and temperate forms descend to lower elevation, of which Rosaceae and Ericaceae are good examples. However, there is no accepted explanation why this happens.

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LITERATURE CITED

ARORA, G.S.& D.K. MONDAL. 1981. On the Papilioninae (Papilionidae: Lepidoptera) from Arunachal Pradesh and adjoining areas of Assam in North Eastern India. Rec. zool. Sur. India. Occasional Paper 29: 1–65, 7 pl.

BAILEY, F.M. 1951. Notes on butterflies from Nepal. J. Bombay nat. Hist. Soc. 50: 64–87.

BANG-HAAS, O. 1933. Neubeschreibungen und Berichtigungen der Palaearktischen Macrolepidopterenfauna IV. Ent. Zeit. 46 (24): 261–263.

BEESON, C.F.C. 1941. The ecology and control of the forest insects of India and the neighbouring countries. Forest Research Institute, Dehra Dun.

BORCH, H. & F. SCHMID. 1973. On *Ornithoptera priamus caelestis* Rothschild, *demophanes* Fruhstorfer and *boisduvali* Montrouzier (Papilionidae). J. Lep. Soc.27: 196–205.

BOZANO, G.C. (ed.). 2009. Guide to the butterflies of the Palearctic Region, Papilionidae part 1. Subfamily Papilioninae Tribes Leptocircini, Teinopalpini. Omnes Artes, Milano.

COLLETT, H. 1921. Flora Simlensis. Vol. 2. Bishen Singh Mahendra Pal Singh, Dehra Dun. 3rd reprint 1971.

DE NICÉVILLE, L. 1894. Butterflies. Pp. 116–187. *In* Anonymous, The Gazetteer of Sikkim. The Bengal Secretariat Press, Calcutta.

DE RHÉ PHILIPE, G.W.V. 1931. The butterflies of the Simla Hills. Part 1. J. Bombay nat. Hist. Soc. 35: 172–183.

DHALIWAL, D.S. & M. SHARMA.1999. Flora of Kullu District (Himachal Pradesh). Bishen Singh Mahendra Pal Singh, Dehra Dun.

EBERT, G. 1966. Beitrage zur kenntnis der entomologischen sammelgebeite der Nepal–Expedition 1962. Ergebn. Forsch.–Unternehmen Nepal Him. 3: 121-136.

FERRIS, C.D. 1974. A note on habitat and geography. J. Lep. Soc. 28: 166–167.

GAONKAR, H. 1999. Type specimens of Papilionidae and Pieridae (Lepidoptera) in the Zoological Survey of India Collection, Calcutta. South Asian Nat. Hist. 4(2): 219–244, 1 pl.

GUPTA, R.K. 1968. Flora Nainitalensis. Navyug Traders, New Delhi.

HANNYNGTON, F. 1910. The butterflies of Kumaon. Parts 1 & 2. J. Bombay nat. Hist. Soc. 20: 130–142; 361–372.

HOOKER, J.D. 1849. The Rhododendrons of the Sikkim Himalaya. Reeve & Co., London.

———. 1872. The Flora of British India. Vol. 1. Reeve & Co., London.

———. 1885. The Flora of British India. Vol. 5. Reeve & Co., London.

HOWARTH, T.G. & POVOLNÝ. 1973. Beiträge zur Kenntnis der Fauna Afghanistans. Časopis morav. Mus. 58: 131–158, 2 pls.

IGARASHI, S. 1966. Butterflies of Nepal (immature stages), in Contributions to the insect fauna of Nepal. 1. Results of the Lepidopterological Research Expedition to Nepalese Himalaya in 1963. Special Bulletin of the Lepidopterists' Society of Japan, 2: 1–74.

OSMASTON, A.E. 1927. A Forest Flora for Kumaon. Government Press, Allahabad.

PEILE, H.D. 1937. A guide to collecting butterflies of India. Staples Press, London.

POLUNIN, O. & A. STAINTON. 1984. Flowers of the Himalaya. Oxford University Press, New Delhi.

RACHELI, T. & A.M. COTTON. 2009. *In:* G.C. Bozano (ed.), Guide to the butterflies of the Palearctic Region, Papilionidae part 1. Subfamily Papilioninae Tribes Leptocircini, Teinopalpini. Omnes Artes, Milano.

ROBINSON, G.S., P.R. ACKERY, I.J. KITCHING, G.W. BECCALONI & L.M. HERNÁNDEZ. 2001. Hostplants of the moth and butterfly caterpillars of the Oriental Region. The natural History Museum, London and Southdene Sdn Bhd., Kuala Lumpur.

ROBSON, S. 1895. Life history of *Papilio glycerion*, Westwood. J. Bombay nat. Hist. Soc. 9 (4): 497–498.

ROONWAL, M.L., R.N. MATHUR, G.D. BHASIN, P.N. CHATTERJEE, P.K. SEN-SARMA, B. SINGH, A. CHANDRA, R.S. THAPA & K. KRISHNAN. 1956 (1963). A systematic catalogue of the main identified entomological collection at the Forest Research Institute, Dehra Dun. Parts 22–38. Indian Forest Leaflet 121(4)(Entomology): 189–540.

SEVASTOPULO, D.G. 1973. The food-plants of Indian Rhopalocera. J. Bombay nat. Hist. Soc. 70: 156–183.

SINGH, A.P. 2006. Range extension of Brown Gorgon butterfly, *Meandrusa gyas gyas*, into Kedarnath Musk Deer Reserve, Western Himalayas: a lesser known species from North-East India. Indian Forester 132 (12): 187–189.

SINGH, A.P. & R.S. BHANDARI. 2003. Butterfly diversity in Tropical Moist Deciduous Sal (*Shorea robusta*) forests of Dehra Dun valley: the lower Western Himalayas. Indian Forester 129(10): 1257–1269.

STRAATMAN,R. & F. SCHMID. 1975. Notes on the biology of *Ornithoptera goliath* and *O. chimaera* (Papilionidae). J. Lep. Soc. 29: 85–88.

TALBOT, G. 1939. The fauna of British India including Ceylon and Burma. Butterflies Vol. 1. Taylor & Francis, London.

WYNTER-BLYTH, M.A. 1957. Butterflies of the Indian Region. Bombay Natural History Society, Bombay.

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