BUTTERFLIES WITH THE WESTERNMOST KNOWN GLOBAL DISTRIBUTION IN NAINITAL DISTRICT, UTTARAKHAND (PAPILIONIDAE & PIERIDAE)

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The Indian state of Uttarakhand comprises a section of the Himalayan range west of Nepal and east of Himachal Pradesh. It is divided into two administrative divisions, Kumaon in the east and Garhwal to the west. The state is mountainous and largely forested.

Evans (1932) in describing the fauna of different parts of India, described this part of the Himalaya as a bastard zone where eastern Palaearctic and Indo-Malayan elements meet. As a result, it is a highly bio-diverse state, with more than 450 species of butterflies recorded so far (Smetacek, 2016). Comparing this figure to the total of 346 species recorded from the Western Ghats and peninsular India (Bhakare & Ogale, 2018) it is evident that Uttarakhand supports an unusual concentration of species in a small geographical area.

The present study focusses on those butterflies whose western limit of their global distribution is in Nainital district of Uttarakhand. All these butterflies have an eastern Himalayan distribution, often extending to China, Vietnam, the Philippines and Indonesia.

Nainital district is biologically diverse because it extends from 400 m to 2600 m elevation, the highest point of the Gagar range, within a short span. It therefore supports insects that typically inhabit three altitudinal belts, i.e., insects found on the plains, up to an elevation of around 500 m. These include *Graphium doson* (C. & R. Felder, 1864), *Apharitus lilacinus* (Moore, 1884), *Tajuria cippus* (Fabricius, 1798), etc.; species that occupy the belt between 800 m and 1800 m, such as *Papilio polyctor* Boisduval, 1836, and those that are only found above 1600 m, e.g. *Graphium eurous* (Leech, [1893]), *Aporia soracta* Moore, 1857, *Gonepteryx mahaguru* Gistel, 1857, etc. A large proportion of the butterfly community occur as stragglers or seasonal migrants above or below their chosen belt.

The locations which have been monitored intermittently for over a century include Nainital (29.3924°N, 79.4534°E; 1800 m), Bhowali (29.3823°N 79.5196°E; 1600 m); Jeolikote (29.3428 °N; 79.4837° E; 1219 m), Bhujiaghat (29.1845°N 79.3141°E; 624 m), Ranibagh (29.2861° N 79.5470° E; 443 m), Bhimtal (29.3461° N 79.5519° E; 1500 m), Pantnagar (29.0222°N 79.4908°E; 243 m) and Haldwani (29.2183° N; 79.5130° E; 424 m).

From the discussion under each species listed in the present paper, it will be noted that each species has an unusual history in Nainital district, either having been recorded long ago or else having moved into the area recently. This is because at the extremity of their distribution, conditions for colonisation by the species are not ideal: in years when conditions change, the population either thrives or goes extinct, depending on the direction of the change.

In Hawkmoths (Sphingidae) (Smetacek, 1994), it was pointed out how dry winters prevent the colonisation in the western Himalaya by typically east Himalayan species; similarly, Smetacek & Agnihotri (2023) pointed out how the decimation of butterfly populations in the Himalaya was a normal phenomenon when faced with a dry winter in El Nino years.

The intention of this note is to draw attention to the fact that these butterflies are likely to occur even further west in the coming years, or else the Kumaon populations might disappear. In either event, it will be useful if a watch is kept on these species in the area to generate data that might help analyse ongoing climatic trends in the future.

Papilionidae

1**.** ***Atrophaneura varuna*** (White, 1842) Common Batwing

Distribution within India and Nepal: Uttarakhand, Nepal, Bhutan to N.E. India (Varshney & Smetacek, 2015).

Extra-Indian distribution: Myanmar, southern China, to Vietnam and the Malay peninsula (Racheli & Cotton, 2010)

Remarks: rare at Nainital in May and September at 7000 feet (Hannyngton, 1910). There appears to be no record of this species from Kumaon after Hannyngton (1910). It has not been recorded from any other location west of Nepal. It is likely that the population in Nainital reported by Hannyngton (1910) died out subsequently. However, Nainital is the westernmost recorded limit for the species, even though the species does not occur there at present.

Hannyngton (1910) did not report *A. aidoneus* (Doubleday, 1845) from Kumaon, but stated that it was rare in the interior of Garhwal in May. We have recorded *A. aidoneus* in numerous locations in Kumaon, eg. Nainital, Ramgarh, Maheshkhan, Bhimtal, Mukteshwar, etc. between 1970 and 2023. Therefore, it is likely that *A. aidoneus* replaced *A. varuna* in this area, although the two species occur sympatrically in N.E. India according to the personal experience of the junior author.

2. ***Papilio alcmenor*** C. & R. Felder, [1864] Redbreast (Figure 1)

Distribution within India and Nepal: Uttarakhand, Nepal, Bhutan to N.E. India (Varshney & Smetacek, 2015).

Extra-Indian distribution: Occurs in northern Myanmar (Condamine *et al*., 2023), N.Thailand (Nan), Laos, Vietnam.

Remarks: Occurs sparingly in May and September up to 7,000 ft (Hannyngton, 1910). Although the species had not been recorded between its last report in 1910 and its re-discovery by Butalia *et al*. (2020), it is of interest that the species has re-colonised Nainital district after a gap of over a century. It has not been recorded west of Nainital. We have recorded the species in Bhimtal and Bhowali and it has also been reported from Ranikhet and Mukteshwar (Butalia *et al*., 2020).

3. ***Graphium doson axionides*** (Page & Treadaway, 2014) Common Jay (Figure 2)

Distribution (*G. doson axionides*): Pakistan, Nepal, India (Sikkim, Assam, Reported also from Saitu, Manipur (Irungbam *et al*. 2020)), China (Yunnan),Hong Kong, Bangladesh, Myanmar, Thailand (N. W. Prov.), N. W. Vietnam (Ha Giang Province) (Page & Treadaway, 2014).
Extra-Indian distribution: (for *G. doson*:): Japan, China, Taiwan, Pakistan, Nepal, India, Sri Lanka, Bangladesh, Myanmar, Thailand, Laos, Vietnam, Cambodia, Malaysia, Singapore, Brunei, Indonesia, Philippines (Page & Treadaway, 2014).
Remarks: Rare on eastern border at 2 to 5,000 ft., July and August (Hannyngton, 1910). By 1986, Haldwani and nearby Pantnagar were the westernmost known point from which this species and subspecies had been recorded. During the early years of this century, the subspecies *G. doson eleius* Fruhstorfer, 1907) expanded its distribution north-westwards from southern India across the Gangetic plain until it colonised Jammu (Sharma *et al*., 2019) and Pakistan (Akram & Babar, 2019). However, the subspecies *axionides* did not expand its distribution during this period and Haldwani remains the westernmost known locality for this subspecies, despite the southern Indian subspecies colonising northern India. Also, the two subspecies have not been recorded sympatrically and it remains to be seen what develops when *G. d. eleius* expands into the habitat of *G. d. axionides*.

Pieridae

4. ***Delias acalis*** (Godart, 1819) Red-breast Jezabel (Figure 3)

Distribution within India and Nepal: *D. a. pyramus* (Wallace, 1867): Uttarakhand to Nepal, Bhutan and N.E. India; *D. a. kandha* Doherty, 1886: Andhra Pradesh, ? Odisha (Varshney & Smetacek, 2015).

Extra-Indian distribution: Myanmar to Hainan, Indo-China and Perak (Fruhstorfer, 1910).

Remarks: Wynter-Blyth (1957) recorded this species from Shimla (Himachal Pradesh) with an interrogation mark; there is no explanation for this uncertainty over the presence of this species in Shimla.

This species was first reliably recorded from Uttarakhand in 2001 (Smetacek, 2001) and subsequently has established itself in the area, with regular broods in some years (Panthee, 2019). Almost certainly it is a new entrant since it is very conspicuous and not recorded from the area by previous workers. It has been recorded from Jeolikote (Ambica Agnihotri, *pers. comm*. 2024), which may be considered its westernmost limit at present.

5. ***Appias lyncida*** (Cramer, [1777]) Chocolate Albatross

Distribution within India and Nepal: ssp. *eleonora* (Boisduval, 1836): Ranibagh (Uttarakhand) through Nepal to N.E. India; ssp. *latifascia* Moore, 1881: Maharashtra to Kerala; other subspecies in the Nicobar Is. (Varshney & Smetacek, 2015)

Extra-Indian distribution: Myanmar to Taiwan, Hainan, Japan to Thailand and Malaysia, the Philippines. Java, Bali, Lombok, the Fores, the Solomons (Fruhstorfer, 1910).

Remarks: 1 male from Ranibagh 1000 feet in September (Hannyngton, 1910). The species has not been recorded in Uttarakhand since the abovementioned record. Members of this genus are strong migrants over most of their range.

6. ***Gandaca harina*** (Horsfield, [1829]) Tree Yellow (Figure 4)

Distribution within India and Nepal: Kumaon (Uttarakhand) (Agnihotri, 2022; Sondhi, 2017) through Nepal to Bhutan and N.E. India. Andaman & Nicobar Is. (Varshney & Smetacek, 2015)

Extra-Indian distribution: Myanmar to Hainan, Thailand, Malaysia, Indonesia, Borneo, Philippines, Lombok, Aru Is. (Fruhstorfer, 1910)

Remarks: This species was not recorded from Uttarakhand by Hannyngton (1910). It was first reported from Chorgaliya by Sondhi (2017) and later by Agnihotri (2022) from Bhujiaghat near Ranibagh, the furthest western record so far. It has almost certainly moved into the area recently.

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Fig 1: *Papilio alcmenor*

Fig 2: *Graphium doson axionides*

Fig 3: *Delias acalis*

Fig 4: *Gandaca harina*