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continued on the back inside cover

Cover: A male Scarlet Skimmer perching on vegetation by the banks of a waterbody. Ink and watercolour illustration by Anandita Pascal.

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COMMUNICATION

Notes on distribution, identification and typification of the Elongated Sweet Grass *Anthoxanthum hookeri* (Aveneae: Poaceae) with comparative notes on *A. borii*

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Abstract: *Anthoxanthum hookeri* is reported for the first time from western Himalaya. The present collection from Nanda Devi Biosphere Reserve also represents the westernmost extension of its known global distribution. This finding clarifies the typification of the species through a critical analysis of type elements. Moreover, this study provides additional insights into the taxonomic relationship between *A. hookeri* and its closely related species *A. borii*. The second-step lectotypification of *A. borii* is also proposed. These findings underscore the importance of field-based taxonomy and herbarium studies in resolving complex species delimitations in Himalayan grasses.

Keywords: Alpine meadows, biodiversity, flora, Himalaya, India, Nanda Devi Biosphere Reserve, protected areas, recollection, second-step lectotypification, Valley of Flowers.

Hindi: *Anthoxanthum hookeri* को पहली बार पश्चिमी हिमालय से दर्ज किया गया है। नंदा देवी बायोस्फीयर रिज़र्व से किया गया यह संग्रह इसके ज्ञात वैश्विक वितरण की पश्चिमतम सीमा का प्रतिनिधित्व करता है। यह अध्ययन प्रकार (टाइप) तत्वों के समालोचनात्मक विश्लेषण के माध्यम से इस प्रजाति के टाइपिफिकेशन को स्पष्ट करता है। इसके अतिरिक्त, यह शोध *A. hookeri* और इससे निकट संबंधी प्रजाति *A. borii* के बीच टैक्सोनोमिक संबंधों पर नए दृष्टिकोण प्रदान करता है। *A. borii* का द्वितीय-चरण लेक्टोटाइपिफिकेशन भी प्रस्तावित किया गया है। ये निष्कर्ष हिमालयी घासों में जटिल प्रजाति सीमांकन को सुलझाने में क्षेत्र-आधारित वर्गिकी (टैक्सोनॉमी) और हरबेरियम अध्ययनों की महत्ता को रेखांकित करते हैं.

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Author contributions: KS—conducted field surveys and drafted the initial version of the manuscript; MC—conducted field surveys and assisted in preparing the final draft of the manuscript; RN—supervised the research; SG—supervised the research.

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INTRODUCTION

The Himalaya, known as the third pole, supports diverse ecosystems from tropical forests to alpine meadows (Rawat et al. 2023). Poaceae, one of the most diverse plant families, has been the subject of continuous research since *Genera Plantarum* (1753) through to the present (Saha et al. 2024). While molecular methods are now prevalent, field taxonomy remains essential for documenting narrowly distributed grasses (Rouhan & Gaudeul 2021).

In the Valley of Flowers National Park, locally known as "Phoolon ki Ghati" and situated between the Alaknanda and Dhauli Ganga valleys in Chamoli District, Uttarakhand, India, such an occurrence was observed. As part of the Himalayan biodiversity hotspot, this valley holds immense ecological and cultural significance. In Hindu mythology, it is referred to as Nandan Kanan, or the "Garden of Indra in Paradise" (Rawat et al. 2023). During 1999 to 2024, several field explorations were carried out in this region, during which a distinctive grass species—characterized by its long, white, feathery stigmas—was documented. Based on comparisons with various taxonomic references (Bor 1960; Jain & Pal 1975; Wu & Sylvia 2006; Connor 2012; Kandwal 2025), the species was identified as *Anthoxanthum hookeri*.

Macro and micro-morphological study of A. *hookeri* revealed key features, including a lax panicle measuring 6–10 cm, and spikelets 6–10 mm long. The species also has male floret with short awn, a geniculate awn arising near the base of the second floret, along with shiny, awnless, glabrous bisexual 3rd floret (Bor 1960; Jain & Pal 1975; Wu & Sylvia 2006; Connor 2012).

The genus *Anthoxanthum* L. belongs to the subtribe Alopecurinae (Clayton & Renvoize 1986), tribe Aveneae (Bor 1960), subfamily Pooideae, within the family Poaceae. Initially established by Carl Linnaeus (1753) with three taxa the genus now comprises 52 taxa (POWO 2025) with nine taxa reported from India to date (Prasanna et al. 2020). Key characteristics of the genus include panicle inflorescence, lanceolate spikelets with three florets, the two lower staminate or barren and terminal floret is usually bisexual and protogynous, rachilla is not produced beyond the third floret, and lodicules absent (Bor 1960; Schouten & Veldkamp 1985; Connor 2012; de Lange & James 2024).

While herbaria play a crucial role in verifying species records (Zych et al. 2023), misidentified specimens have caused significant confusion. Kellogg et al. (2020) reported several questionable grass occurrences, including *A. hookeri*. One such specimen labelled as *A. hookeri* from the Palni Hills (Kodaikanal), Pondicherry (HIFP022578, digital image!), appeared doubtful due to the clear ecological mismatch between its tropical environment and the known habitat of *A. hookeri*—high-altitude open grassy slopes, rocky ridges, and alpine meadows in temperate and cold desert regions. Detailed taxonomic and ecological studies later determined that the specimen likely represented *Anthoxanthum borii* (Matthew 1996; Kabeer & Nair 2009), highlighting the challenges of habitat misidentification and overlooked records.

Long-term field data are critical for conservation sciences, as they help monitor population stability and persistence over time (Hoffmann et al. 2020). Amid growing concerns about flora reduction and medicinal plant loss, this research confirms the recollection of population of *A. hookeri* on multiple occasions between 1999 to 2024. Specimens were collected in 1999, 2012, 2017, 2018, 2019, and 2024 from the Valley of Flowers, a UNESCO World Heritage Site. The subpopulations were found scattered across various habitats within this protected area, including glacier moraines, open alpine meadows (Bugyal), and in association with other species such as *Meconopsis aculeata* Royle, *Codonopsis rotundifolia* Benth, *Juncus* sp., and *Dactylis glomerata* L. Despite threats such as climate change, biodiversity loss, and over-tourism, the population of *A. hookeri* remains stable and well-conserved in these protected areas. Interestingly, although the genus *Anthoxanthum* is known for its distinct coumarin fragrance (Bor 1960; Schouten & Veldkamp 1985; Kandwal 2025), this feature was not observed in *A. hookeri* during our field survey, consistent with the observations made by Kandwal (2025).

During the present study, seven herbarium specimens of *Anthoxanthum hookeri* were identified, all of which represent type specimens. Due to the absence of a designated holotype, all these specimens are treated as syntypes in accordance with Articles 9.4 and 9.6 of the ICN. Following Article 9.3 of the Shenzhen Code (Turland et al. 2018), a lectotype was designated. To confirm original material, TL-2 (Stafleu & Cowan 1976) was consulted for details on collectors, authors, and herbarium holdings. Specimens were traced and reviewed across several herbaria (BM, CAL, DD, E, GOET, K, L, P, W, and S; Thiers 2024), and each was critically compared with the protologue. The most representative specimen was selected as the lectotype (Image 3), following Articles 9.3 and 9.17 of the Shenzhen Code. While *A. borii* required a second-step lectotype (Image 4) designation according to Art. 9.17 of Turland et al.

(2018), as Jain & Pal (1975) indicated gatherings rather than a single specimen as their type.

Previous studies (Bor 1960; Uniyal et al. 2007; Prasanna et al. 2020; Kandwal 2025; POWO 2025) did not report the occurrence of A. *hookeri* in western Himalaya. The present study provides the first confirmed record of this species from the western Himalaya, northern India, thereby documenting newly identified habitats. To facilitate field identification, field photographs were provided (Image 1), a detailed morphological plate showing key structural features (Image 2), a comprehensive taxonomic description, and a collection site map (Figure 1) created with QGIS version 3.36.2. The herbarium specimen has been deposited at herbarium of Forest Research Institute, Dehradun (DD). Additionally, a comparative discussion highlighting distinguishing characters between *A. hookeri* and *A. borii* is presented, along with the lectotypification of both taxa.

Taxonomic treatment

Anthoxanthum hookeri (Griseb.) Rendle, J. Linn. Soc., Bot. 36: 380 (1904).

Ataxia hookeri Griseb. in Nachr. Königl. Ges. Wiss. Georg-Augusts-Univ. 3: 77 (1868).

Type: — INDIA: Sikkim, 9000'-12000', Regio. Temp, *2 Ataxia*, s.d., Coll. J.D. Hooker lectotype designated here [L0043608 (digital image!)]; isolectotypes: INDIA: Sikkim, 9000'-12000', Regio. Temp, *2 Ataxia*, s.d., Coll. J.D. Hooker [W0028397 (digital image!)]; INDIA: Sikkim, 9000'-12000', Regio. Temp, *2 Ataxia*, s.d., Coll. J.D.

Image 1. *Anthoxanthum hookeri* (Griseb.) Rendle: a—natural habitat | b&c—close-up of inflorescence. © Kuntal Saha.

Hooker [BM011027783 (digital image!)]; INDIA: Sikkim, 9000'-12000', Regio. Temp, *2 Ataxia*, s.d., Coll. J.D. Hooker [GOET006527 (digital image!)]; INDIA: Sikkim, 9000'-12000', Regio. Temp, *2 Ataxia*, s.d., Coll. J.D. Hooker [S1421991 (digital image!)]; INDIA: Sikkim, Regio. alp, *2 Ataxia*, s.d., Coll. J.D. Hooker [K000032286 (digital image!)]; INDIA: Sikkim, 11000', Regio. alpina, *2 Ataxia*, s.d., Coll. J.D. Hooker [K000032287 (digital image!)].

Perennial, loosely tufted. Culms 45–60 cm, green, erect, nerved, nerves scabrid; 4–5 nodes, brown, short pubescent, no nerved. Leaf sheaths open 2/3 of culms, green, glabrous, nerved, scabrid. Ligule 4–6 mm, membranous-lacerate, apex truncate. Leaf blades 10–24 cm × 3–3.5 mm, green, glabrous, linear, apex subulate, margin serrate, involutely rolled when dry. Panicle 6–14 cm, lax, erect; semi-whorled branched, primary branches (racemes) borne along a central axis; each whorl bearing 1–3 branches, 3–5 spikelets. Spikelets 6–10 mm, solitary, pedicelled, lanceolate, laterally compressed, reddish-green, with up to 1 cm long white feathery stigma. Lower glume 4–6.5 mm, persistent, keeled, membranous, lanceolate, apex acuminate. Upper glume 7–8.5 mm, persistent, keeled, two veined, membranous, ovate, apex acuminate. Floret 3, in cluster, compactly arranged; bearing two sterile florets, one fertile floret, without rhachilla extension; callus glabrous, shinning. 1st floret 5–6 mm, ciliate on back, male; lemma equal to floret, linearly-oblong, apex two-fid, lobes acute, awned; awn median to sub-apical, straight, arising from sinus, up to 4.5 mm; palea 3–3.5 mm, oblong, smooth, transparent, two-nerved,apex two-lobed; anther 3, 2.1–2.3 mm. 2nd floret 7–9 mm, densely long ciliate, golden-brown, shinning, sterile, no palea; lemma equal to floret, oblong, apex shortly two-lobed,awned; awn median, geniculate, 10–12 mm. 3rd floret 3–3.5 mm, glabrous, shiny, bisexual; lemma equal to floret, cartilaginous, keeled, ovate, apex obtuse or boat-shaped, rolled in convolute, covering of entire palea; palea less than 2.5 mm, smooth, membranous, oblong, one-nerved, nerve upwardly scabrid; Stigmas 1; white feathery, bifurcated; ovary 1.3–1.5 mm, glabrous, apex two-lobed; anther 2, 2.3–2.5 mm. Caryopsis 0.5–1 mm, golden-brown, elliptical-lanceolate.

Flowering and Fruiting: July–September.

Habitats: near glacier moraines, in moist, shaded areas beneath large trees, or on open grassy slopes and dry rocky ridges at elevations of 2000–3500 m.

Distribution: INDIA [Sikkim, Arunachal Pradesh, Meghalaya, West Bengal, Uttarakhand (Present report)], South & Central China, Bhutan, Myanmar, Nepal, Tibet.

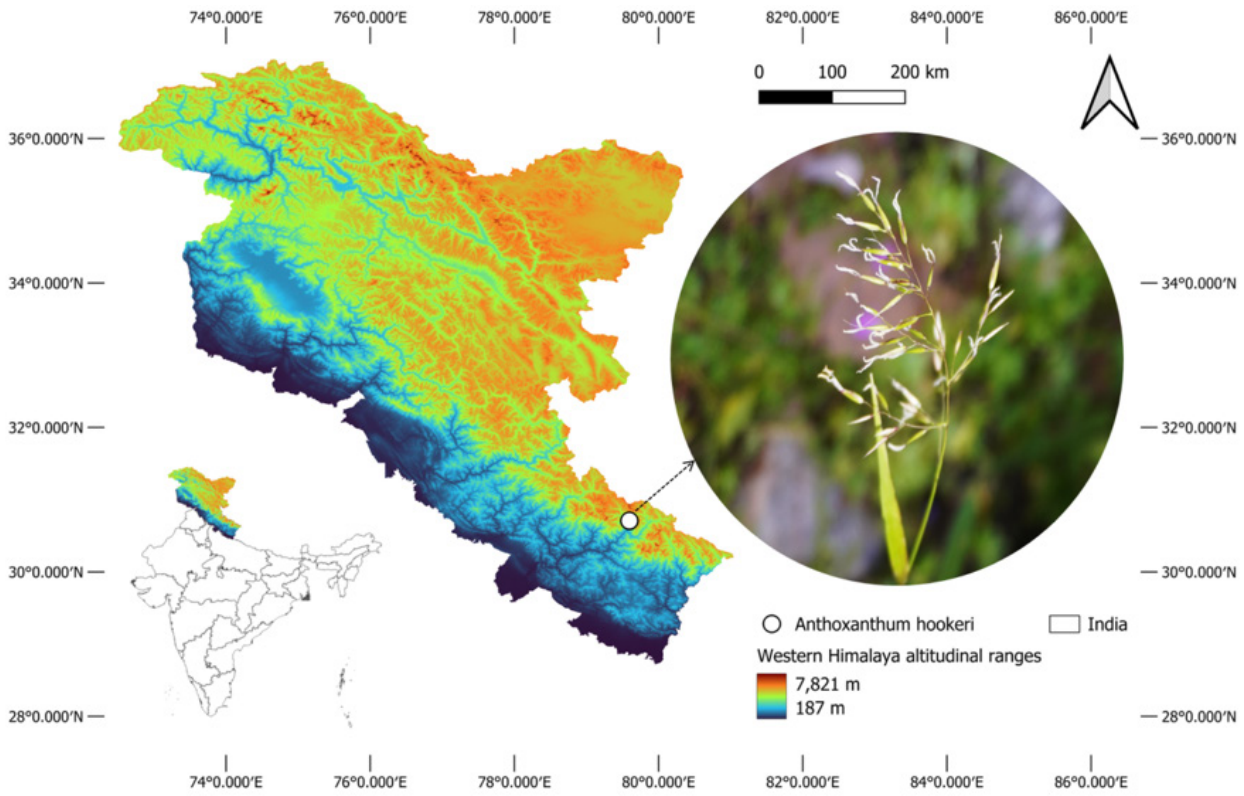

Figure 1. Map depicting the place of collection of *Anthoxanthum hookeri* (Griseb.) Rendle in northern India. © Kuntal Saha.

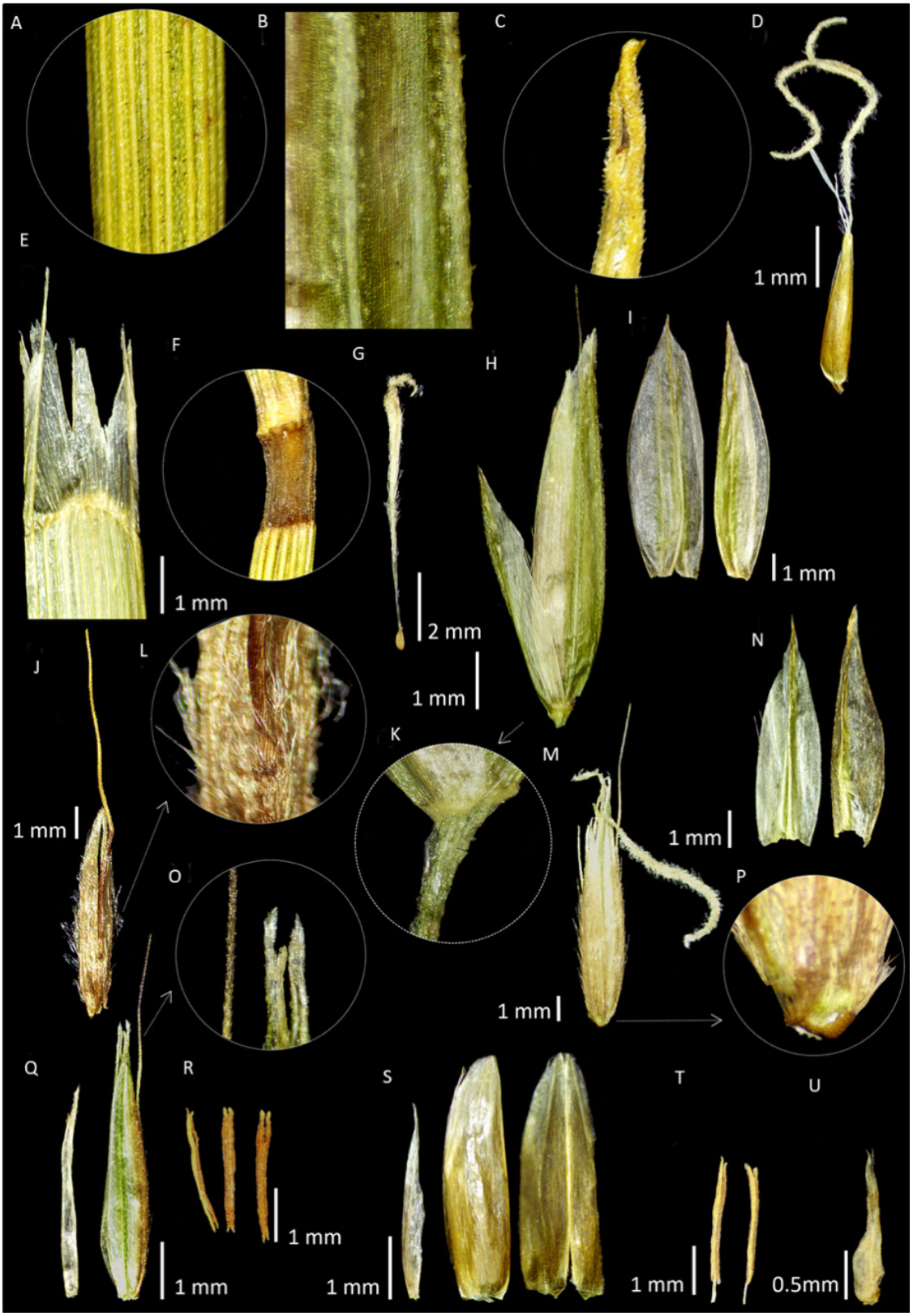

Image 2. ***Anthoxanthum hookeri*** **(Griseb.) Rendle: a—internode | b—scabrid leaf surface | c—subulate leaf tip | d—3rd fertile floret | e—ligule | f—node | g—feathery stigma with caryopsis | h—spikelets | i—upper glume (dorsal & lateral view) | j—lemma of 2nd floret | k—awn attachment with lemma of 2nd floret | l—close-up of pedicel | m—three floret in cluster | n—lower glume (dorsal & lateral view) | o—two-lobed apex of lemma of 1st floret | p—callus | q—palea & lemma of 1st floret | p—anther of 1st floret | s—Palea & lemma (lateral & dorsal view) of 3rd floret | t—anther of 3rd floret | u—ovary. © Kuntal Saha.**

Typification Note: August Heinrich Rudolf Grisebach originally described *Ataxia hookeri* Griseb. in 1868, based on specimens collected by Sir Joseph Dalton Hooker from Sikkim, India, at elevations ranging 2,727–3,636 m (9,000–12,000 ft). The material was assigned the collection number "two Ataxia" although no specific collection date was mentioned. During this present study, seven herbarium specimens corresponding to this gathering were identified across several major herbaria, including GOET, K, W, BM, L, and S. Specimens such as 2 Ataxia (GOET006527, W0028397, BM011027783, L0043608, & S1421991) consistently mention the collection region as temperate ("Regio: Temp.") and altitude as 2,727–3,636 m (9,000–12,000 ft), all attributed to J.D. Hooker. Two additional specimens housed at Kew herbarium (K000032286 & K000032287) also correspond to the same collection number and locality. Two Ataxia (K000032286) does not specify altitude and labels the region as alpine ("alp"), while two Ataxia (K000032287) notes an altitude of 3,333 m (11,000 ft) and specifies the region as alpine ("alpina"). All these specimens constitute original material and are thus eligible for lectotypification. Another specimen (K000838011), bearing the same collection number but collected from Lachung, Sikkim, includes only a partial date (July 14/44) and lacks the collector's name. Due to these ambiguities, it was excluded from consideration as type element. Among the syntypes described above, two Ataxia (barcode: L0043608) is designated here as the lectotype (Image 3) for *Anthoxanthum hookeri*, as it offers the most complete set of diagnostic features. This includes detailed morphological information along with clearly indicated locality, collector's name, and collection number, ensuring its reliability for accurate identification.

Tracing the shared traits of *A. borii* and *A. hookeri*

Anthoxanthum borii was first mentioned by Bor (1960) and later described by Dr. S.K. Jain & D.C. Pal in 1975. It was named in honour of Dr. N.L. Bor, who first suspected this taxon to be new. During this study we found that *A. borii* and *A. hookeri* share the common characteristic. Both are perennial, 3 florets: 2 sterile or reduced + 1 hermaphrodite, glume are both with persistent, lemma (1st floret) is 2-fid apex with awn arising from sinus, 2nd floret is sterile, with a geniculate awn, 3rd floret is hermaphrodite, small in size, contains ovary. The distinguishing features that separate *A. borii* (BSID0001097, BSID0001098, & BSID0001099) as a new species, rather than a part of *A. hookeri*, are as follows: culm height and habit: *A. borii* is taller and rhizomatous, whereas *A. hookeri* is shorter and lacks rhizomes. Leaf aroma: *A. borii* has aromatic leaf blades, while *A. hookeri* is non-aromatic. Ligule: *A. hookeri* possesses longer (4–6 mm), lacerate ligules. Spikelet coloration and stigma visibility: spikelets of *A. hookeri* are reddish-green with prominently long white feathery stigmas. Floral awns: the second floret of *A. hookeri* features longer geniculate awns (10–12 mm). Stigma number: *A. hookeri* uniquely has a single bifurcate feathery stigma, in contrast to the two found in *A. borii* (Bor 1960; Jain & Pal 1975; Kabeer & Nair 2009; Kandwal 2025).

Typification

Anthoxanthum borii Jain & Pal, J. Bombay Nat. Hist. Soc. 72(1): 92 (1975).

Type: — India: Tamil Nadu, Pulneys, Pambar stream, near Shenthadikanal, 6 December 1898, Bourne 1954, Coll. Alfred Gibbs Bourne lectotype designated here [CAL0000002343 (digital image!)]; isolectotype: INDIA: Tamil Nadu, Pulneys, Pambar stream, near Shenthadikanal, 6 December 1898, *Bourne* 1954, Coll. Alfred Gibbs Bourne [CAL0000002342 (digital image!)].

Typification Note: *A. borii* was described by Dr. S.K. Jain and D.C. Pal based on specimens collected by Alfred Gibbs Bourne in the Pulney Hills, Tamil Nadu, India (Bourne 1954). The authors designated the type specimen in the protologue as "Holotype: CAL". Upon examination, two specimens were located at the CAL herbarium (CAL0000002342 & CAL0000002343), where CAL0000002343 is annotated as "Holo-TYPE" and CAL0000002342 as "Iso-TYPE". CAL0000002343 (digital image!) were designated as the second-step lectotype (Image 4) according to Art. 9.17 of Turland et al. (2018), as it is well-preserved and aligns with the original description.

Specimens examined

Anthoxanthum hookeri: 175039(DD), India, Uttarakhand, Chamoli District, Valley of Flowers, 30.705 °N 79.595 °E, 3,200 m, 18.viii.1999, coll. Manoj Chandran; 175038(DD), after crossing the Valley of Flowers gate, near the river bridge, 30.708 °N 79.595 °E, 3,267 m, 25.vii.2024, coll. Kuntal Saha; 2 Ataxia, L0043608 (digital image!), Sikkim, 9000'–12000', Regio. Temp, s.d., Coll. J.D. Hooker; 2 Ataxia, W0028397 (digital image!), Sikkim, 9000'–12000', Regio. Temp, s.d., Coll. J.D. Hooker; 2 Ataxia, BM011027783 (digital image!), Sikkim, 9000'–12000', Regio. Temp, s.d., Coll. J.D. Hooker; 2 Ataxia, GOET006527 (digital image!), Sikkim, 9000'-12000', Regio. Temp, s.d., Coll. J.D. Hooker; 2 Ataxia, S1421991 (digital image!), Sikkim, 9000'-12000', Regio. Temp, s.d.,

Image 3. Lectotype of *Anthoxanthum hookeri* L0043608. Digital Image @ L, reproduced with permission (http://data.biodiversitydata.nl/naturalis/specimen/L%20%200043608).

Image 4. Second-step lectotype of *Anthoxanthum borii* CAL0000002343. Digital Image @ CAL, reproduced with permission (http://ivh.bsi.gov.in/phanerogams-Details/en?link=CAL0000002343&column=szBarcode).

Coll. J.D. Hooker; 2 Ataxia, K000032286 (digital image!), Sikkim, Regio. alp, s.d., Coll. J.D. Hooker; 2 Ataxia, K000032287 (digital image!), Sikkim, 11000', Regio. alpina, s.d., Coll. J.D. Hooker; 2 Ataxia, K000838011 (digital image!), Sikkim, Lachung, 11,000'–12,000', 14.vii.1844, Coll. leg. ignot.

Anthoxanthum borii: Bourne 1954(CAL), CAL0000002342 (digital image!), India, Tamil Nadu, Pulneys, Pambar stream, near Shenthadikanal, 6.xii.1898, Coll. Alfred Gibbs Bourne; Bourne 1954(CAL), CAL0000002343 (digital image!), Pulneys, Pambar stream, near Shenthadikanal, 6.xii.1898, Coll. Alfred Gibbs Bourne; 69430(CAL), BSID0001097 (digital image!), India, Kerala, Idukki District, Eravikulam National Park, 16.xi.1980, Coll. P.V. Sreekumar; 67795 (CAL), BSID0001098 (digital image!), India, Kerala, Idukki district, Eravikulam National Park, 26.viii.1980, Coll. P.V. Sreekumar; 67786 (CAL), BSID0001099 (digital image!), India, Kerala, Idukki District, Eravikulam National Park, 25.viii.1980, Coll. P.V. Sreekumar.

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