

Notes on the taxonomy and distribution of two rare *Thelypteris* (Thelypteridaceae) species from Arunachal Pradesh, India, *T. repanda* and *T. birii*

Chhandam Chanda^{1✉}, Christopher Roy Fraser-Jenkins² and Vineet Kumar Rawat¹

¹Botanical Survey of India, Arunachal Pradesh Regional Centre, Senki View, Itanagar- 791111, Arunachal Pradesh, India
[✉]chhandambangali@yahoo.com

²Rua de São Mateus 485, S/C Dt., Fontainhas 2750-141, Cascais, Portugal

ARTICLE INFO

Keywords

Arunachal Pradesh, Ferns, Papum Pare, Siang, *Thelypteris repanda*, *T. birii*

Citation:

Chanda, C., Fraser-Jenkins, C.R. and Rawat, V.K., 2022. Notes on the taxonomy and distribution of two rare *Thelypteris* (Thelypteridaceae) species from Arunachal Pradesh, India, *T. repanda* and *T. birii*. *Indian Journal of Forestry*, 45(4), pp.226-232. <https://doi.org/10.54207/bsmps1000-2023-IDVDQ3>

ABSTRACT

Based on recent collections, the present communication reports the presence of authentic *Thelypteris repanda* (Fée) C.V.Morton for the first time from India. Its distinction from another rare and allied species, *Thelypteris birii* (R.D.Dixit & Balkr.) Fraser-Jenk. is made clear. *T. repanda* was recently excluded from India, as all previous reports of it were misidentifications, but it has now been confirmed from two collections from Arunachal Pradesh, one of which had been misreported as a S.E. Asian species, *T. megacuspis*, in error. Both species are currently known in India from Arunachal Pradesh, with *T. birii* also occurring just over its border in northern Assam State. Detailed descriptions and photographs of these two species are provided with specimen citations.

INTRODUCTION

The genus *Thelypteris* (Thelypteridaceae) was established by Schmidel (1763). It is one of the largest, most diverse and widespread fern genera with a minimum of c. 1190 species worldwide (Fawcett & Smith, 2021) distributed throughout warm tropical to temperate regions. Currently, 81 indigenous species, 2 additional subspecies and 16 natural hybrids of *Thelypteris* are known from India (Fraser-Jenkins et al., 2017, Fraser-Jenkins, Gandhi & Kholia, 2018). The species occur mainly in the Himalayan region, Western Ghats of South India and in the hills of North-East India, with a smaller number of species occurring in the Indian plains. So far 49 species and 1 subspecies are known from Arunachal Pradesh (Fraser-Jenkins & Baishya, 2020) though the State remains badly undercollected.

Because of the evident groupings of many thelypteroid species, it has long been realised that divisions within the genus can be made. Thus, following the detailed work of Ching (1963), Iwatsuki (1965), Sledge (1981) and particularly the various monographic studies by Holttum (1971, 1972), the genus *Thelypteris* has been treated as either a single genus with various subgenera or sections within it, or has been split into a number of genera. Recently Fawcett and Smith (2021) revised the generic placements and treated the following 24 microgenera that they accept as being those present in India:

Abacopteris Fée, *Amauropelta* Kunze, *Amblovenatum* J.P.Roux, *Ampelopteris* Kunze, *Christella* H.Lév., *Coryphopteris* Holttum, *Cyclogramma* Tagawa, *Cyclosorus* Link., *Glaphyopteridopsis* Ching, *Gryptothrix* (Holttum) S.E.Fawc. & A.R.Sm., *Leptogramma* J.Sm., *Macrothelypteris* (H.Itô) Ching, *Menisciopsis* (Holttum) S.E.Fawc. & A.R.Sm., *Metathelypteris* (H.Itô) Ching, *Oreopteris* Holub, *Phegopteris* (C.Presl) Fée, *Pseudocyclosorus* Ching, *Pseudophegopteris* Ching, *Reholttumia* S.E.Fawc. & A.R.Sm., *Sphaerostephanos* J.Sm., *Stegnogramma* Blume, *Strophocaulon* S.E.Fawc. & A.R.Sm., *Thelypteris* Schmidel, *Trigonospora* Holttum.

Fawcett & Smith's revision was based on wide-reaching molecular sequencing and has added several new ones to those previously known, adjusting and correcting many previous misplacements of species in various genera (thus stated to

Received: 02-05-2023; Revised: 24-05-2023; Accepted: 26-05-2023;
Published: 31-05-2023

© 2023 Indian Journal of Forestry. All rights reserved.

DOI: <https://doi.org/10.54207/bsmps1000-2023-IDVDQ3>

have been polyphyletic) and have produced a considerably more accurate scheme and listing of constituent species, though unfortunately constituting an even more extreme splitting of the single genus *Thelypteris*.

However, such molecular studies and the mere existence of monophyletic groups are unable to decide the ranking of these groups, and several genera they treated are rather obviously too closely related to others and could well be combined, even when splitting *Thelypteris*. It remains an arbitrary choice as to whether to recognise the groupings simply as genera, or whether to treat all as subgenera and sections within a single genus, *Thelypteris*. Infra-generic (and infraspecific ranks) are seldom considered by molecular workers who all too frequently ignore the importance of morpho-taxonomic factors in deciding ranking. We prefer here to treat a single genus, *Thelypteris*, following Fraser-Jenkins et al. (2017) and Fraser-Jenkins and Kandel (2019) and his previous treatments, and several earlier workers (now also followed by POWO, Kew), because the difference between all the microgenera is generally quite insignificant, based on minute characters, such as glands or hairs on sporangia, and there are many exceptions and thus much overlap between them. Furthermore, all can readily be seen as constituting a morphologically close, discrete and obvious generic group. It remains the case that most workers identify the species first, rather than the microgenus, and then place it accordingly. The groups, though certainly existing, are considerably closer morphologically than in most other widely accepted genera. We do not think it valuable to overspill *Thelypteris* in the way that PPG-1 (2016) does, automatically following any and all molecular studies simplified into often inappropriate taxonomic classifications and setting out to recognise only families, genera and species as ranks to be used.

The two species discussed in this paper were both placed in the largely very shallowly lobed pinna'd group with many anastomosing pairs of opposite veins, *Pronephrium*, under Holttum's (1972) concept of that microgenus, but no species of the considerably narrower *Pronephrium* circumscribed by

Fawcett and Smith are present in the Indian subcontinent. Holttum's sections within the old *Pronephrium* have been recognised by Fawcett and Smith as constituting 4 genera (sections in our opinion) *Pronephrium*, not present in India, *Abacopteris*, *Menisciopsis* and *Gryptothrix*. Both species, *T. repanda* (Fée) C.V.Morton and *T. birii* (R.D.Dixit & Balkr.) Fraser-Jenk., that we discuss in the present paper have now been placed in the microgenus, or section, *Abacopteris*, distinguished mainly by its unhooked hairs, lack of glands on the rarely coalescing indusia, and setulose sporangia.

Confusion between *T. repanda* and *T. birii*

Thelypteris repanda was previously misreported from C. India, by Vasudeva and Bir (1993), but their material was actually *T. penangiana* (Fraser-Jenkins et al., 2017). Chandra (2000) also reported it from Uttarakhand, Sikkim, Bhutan, Bangladesh, Madhya Pradesh and Sri Lanka, among others, mainly in error for *T. nudata* (Roxb.) C.V.Morton. It still occasionally continues to be misreported from Uttarakhand and elsewhere. But following clarification of these errors it was excluded from India (Fraser-Jenkins et al., 2017).

However, Fraser-Jenkins and Benniamin (2010) reported another species, *T. megacuspis* (Baker) C.F.Reed, in sect. *Gryptothrix*, from Mechuka, West Siang District, Arunachal Pradesh, from a unique collection made by A. Benniamin in 2008, different from any other collections from India. But later Fraser-Jenkins et al. (2017) listed it with a query and doubted that identity, though the name was still listed by Fraser-Jenkins and Baishya (2020) where the query was left out in error by the type-setter.

In the meantime, the present first-named author collected further material from West Siang in Mouling National Park and sent photographs of it to the second author, who then sent them to Dr S.E. Fawcett and to Dr A.R. Smith, who both identified it as *Abacopteris repanda*, i.e., *Thelypteris repanda*. The specimen was very similar in morphology to Benniamin's

Table 1. Comparison of characters between confusable species.

	Lateral pinnae number	Pinna stalk	Pinna base	Pinna margin	Costal hairs	Soral arrangement	Indusium
<i>T. articulata</i>	Many	Pinnae sessile to subsessile	Usually truncate	Prominently lobed	Present, dense, long	Soral line close to that of next lobe	Present
<i>T. birii</i>	Several	Subsessile to very shortly stalked	Rounded	Entire to very shallowly crenate	Present, straight, dense	Sori medial	Absent
<i>T. lakhimpurensis</i>	Several	Subsessile to very shortly stalked	Cuneate to rounded	Entire to undulate	Absent or rarely a few	Soral line close to that of next lobe	Absent
<i>T. nudata</i>	Several	Sessile to subsessile	Cuneate to truncate	Acutely and deeply crenate	Present, moderately dense	Soral line close to that of next lobe	Present
<i>T. penangiana</i>	Many	Sessile to subsessile	Cuneate to truncate	Shallowly serrate	Present, moderately dense	Soral line slightly closer to costule	Absent
<i>T. repanda</i>	Several	Prominently stalked	Broadly cuneate	Broadly serrate	Present, minute, moderately dense	Sori medial	Absent
<i>T. triphylla</i>	1 pair, rarely more	Very shortly stalked	Cordate or rounded to truncate	Entire to undulate	Hooked hairs present	Sori medial	Absent



Plate 1. *Thelypteris repanda*. a. Frond in field, b. Dried frond, c. Hairs on costa, d. Venation and soral arrangement.

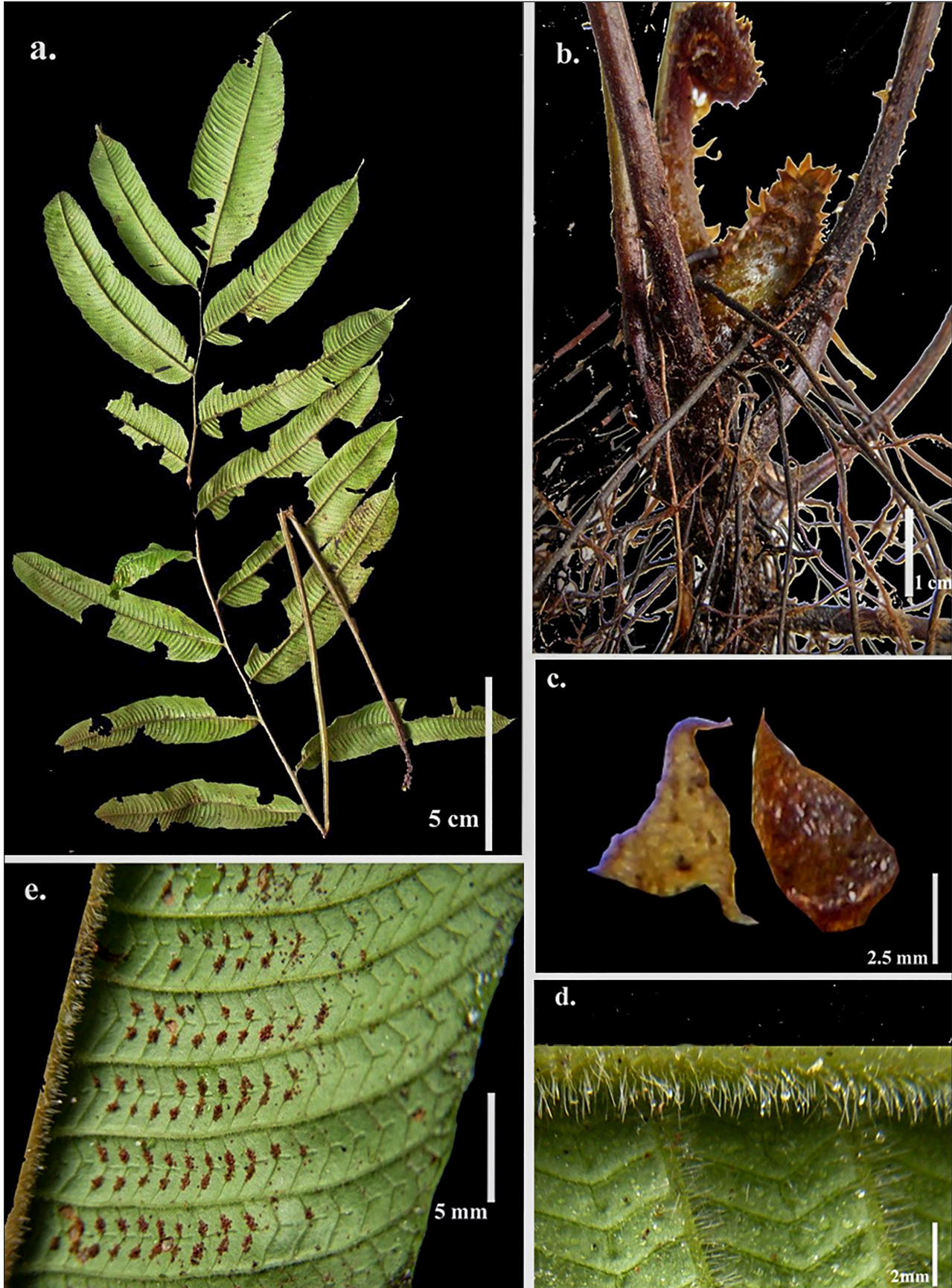


Plate 2. *Thelypteris birii*. a. Frond, b. Rhizome, c. Stipe-base scales, d. Hairs on costa and veins, e. Venation and soral arrangement.

original collection and it was then possible for the second author to reidentify the dubious "*T. megacuspis*" as also belonging to *T. repanda*. These two specimens are the first authentic collections of *T. repanda* from the Indian sub-continent and represent an extension of its range from nearby Myanmar (as well as Thailand, Vietnam, Malaysia and Indonesia). *T. repanda* is now added to the list of Indian pteridophytes and *T. megacuspis* is definitively deleted.

In addition to *T. repanda*, another rare and confused species of the same section, microgenus *Abacopteris*, occurs in Arunachal Pradesh and has often been misidentified there. The confusion around its identity was resolved by second author (Fraser-Jenkins et al., 2017) as *T. birii* (R.D.Dixit & Balkr.) Fraser-Jenk. From his identifications of specimens, this species was first collected in 1959 from Kimin to Khunipahar, Papum Pare District, as "*T. lakhimpurensis* (Rosenst.) K.Iwats. var. *hirsuta* [ined.]" by the well-known Botanical Survey of India pteridologist, G. Panigrahi (19585, ASSAM), and again near Naharlagan, Papum Pare, by Dr G.D. Pal, in 1978 sub "*Abacopteris triphylla* (Sw.) Ching" in error. This was followed by collections by the late Dr R.D. Dixit in 1982 from near and just beyond the Botanical Survey of India campus at Itanagar, and two more collections by the late A.K. Baishya in 1983 from Ganga Lake, Papum Pare District, and near Alo (Along), West Siang, as "*T. lakhimpurensis*". More extensive collections were made by CRFJ from Dixit's B.S.I. locality and nearby Tsiria Kanna Hill and Ganga Lake in 2009, enabling study of its growth and development from five local populations, and a further collection of V.K. Rawat (VKR 33417, 24.10.2015, ARUN) from Tirbin, W. Siang, was identified by CRFJ in 2016. Dixit's collections were misreported by Dixit and Kala (1988) as being *T. aspera* (C.Presl) Holttum, which is not known from the Indian subcontinent. Two of his collections (R.D. Dixit 32160, 32163, BSA) are full-sized, well pinnate fronds, which have been studied by the present second author. But Dixit also collected a small, immature, but precociously fertile plant of the same species there, with only a small simple frond (R.D. Dixit 32272, BSA) and misreported it (Dixit & Kala, 1988) as another non-Indian species, *Pronephrium simplex* (Hook.) Holttum (i.e., *T. simplex* (Hook.) K.Iwats.). Having studied the population concerned, the second author found that all growth stages can be fertile. Dixit and Balkrishnan (1990) then described a small specimen with one pinna (R.D. Dixit 32142, BSA) from Ganga Lake, Itanagar, as the type of a new species, *Pronephrium birii* R.D.Dixit & Balkr. and the following year the species was also described from Guangdong (Kwangtung), S.E. China, as *Pronephrium hirsutum* Ching ex Y.X.Lin. Fraser-Jenkins and Benniamin (2010) first misreported the species as *Thelypteris repanda*, which was later corrected by Fraser-Jenkins et al. (2017) to *T. birii*. Thus, the species had been reported under no less than 7 different names, but although Dixit had entirely misunderstood his *P. birii*,

thinking it was a small species with one pinna, he had provided the first valid and specific name for it, which stands today by "pot-luck" rather than through correct taxonomic deduction. All these specimens are readily distinguishable from the similarly shaped *T. lakhimpurensis* by the dense, straight hairs beneath the lamina along the pinna-costae and the lateral veins.

TAXONOMIC TREATMENT

Thelypteris repanda (Fée) C.V.Morton, *Contrib. U.S. Natl. Herb.* 38: 340. 1974.

Basionym: *Goniopteris repanda* Fée, *Mém. Fam. Foug.* 5 Gen. Fil.: 251. 1852. Described from Malaya.

Synonyms: *Pronephrium repandum* (Fée) Holttum, *Blumea* 20(1): 109. 1972.

Cyclosorus repandus (Fée) B.K.Nayar & S.Kaur, *Companion Beddome's Handb.* 66. 1974.

Abacopteris repanda (Fée) S.E.Fawc. & A.R.Sm., *Sida, Bot. Misc.* 59: 23. 2021.

Abacopteris urophylla (Mett.) Ching, *Bull. Fan Mem. Inst. Biol., Bot.*, 8: 251. 1938.

Thelypteris urophylla (Mett.) K.Iwats., *S.E. Asian Stud.* 3(3): 81. 1965.

Further synonyms are given by Fraser-Jenkins et al. (2017).

Description: **Rhizome** long, creeping, thin. **Fronds** simply pinnate, distant; **stipe** nearly as long as or longer than the lamina; **lamina** ovate, imparipinnate, 50-60 × 20-25 cm; **lateral pinnae** simple, lanceolate, sub opposite to alternate, shortly or commonly rather long-stalked, base cuneate, wide (to c. 6 or 7 cm), margins broadly serrate, serrations with apiculate apices, pinna-apex shortly caudate; **costae** very sparsely hairy beneath, hairs straight, hyaline, acicular, 1-2 mm long; **terminal pinna** similar to lateral pinnae but larger, 22-28 × 6-7 cm; **veins** simple, with 10-12 opposite pairs anastomosing to a zig-zag common excurrent vein, sparsely short-hairy. **Sori** exindusiate, round to oblong, forming two rows extending from the costa to near the margin, between two adjacent lateral veins; **Cytotype** unknown.

Habitat: A terrestrial species, growing on the forest floor at c. 1400 m altitude (in Arunachal Pradesh).

Distribution: India (Arunachal Pradesh); Indonesia, Malaysia, Myanmar, Thailand, Vietnam.

Specimens examined: W. Siang, Tato to Mechuka, A. Benniamin 26086, 18.11.2008 (ARUN), illustrated by Fraser-Jenkins & Benniamin (2010); West Siang District, Mouling National Park, C. Chanda 43401, 22.3.2020 (ARUN).

Conservation status: Extremely rare, known only from two nearby populations and of IUCN EN category for India.

Thelypteris birii (R.D.Dixit & Balkr.) Fraser-Jenk., *Annot. Checklist Indian Pterid.* 1: 418. 2016 ("2017").

Basionym: *Pronephrium birii* R.D.Dixit & Balkr., *Indian Fern J.* 7(1 & 2): 20, t. 1-5. 1990. Described from Papum Pare, Arunachal Pradesh, India.

Synonyms: *Cyclosorus birii* (R.D.Dixit & Balkr.) Panigrahi, *Pl. Sci. Res.* (Orissa) 17(1-2): 51. 1995.

Abacopteris birii (R.D.Dixit & Balkr.) S.E.Fawc. & A.R.Sm., *Sida, Bot. Misc.* 59: 22. 2021.

Pronephrium hirsutum Ching ex Y.X.Lin, *Fl. Reipubl. Pop. Sinica* 4(1): 305, 351. 1993.

Description: **Rhizome** short, thick, horizontal. **Fronde** pinnate, oblong-lanceolate, borne slightly apart on rhizome, 40-50 × 7-10 cm; **stipe** short, thick, papillate at its base, bearing small brown, narrowly lanceolate scales and a fine scurf-like indument; **lamina** imparipinnate; **lateral pinnae** 5-7 pairs (but develop with growth from a single terminal segment to having first one pair of pinnae, then more), shortly stalked, widely ovate or bi-elliptical, with narrowly cuneate to more normally widely ovate, rounded bases and with short abruptly caudate apices, entire or very slightly lobed, densely covered with pale, straight hairs beneath on lateral veins, 6-8 × 2-3 cm; **costae** densely hairy beneath with long, slightly stiff, pale, straight hairs; **terminal segment** large, similar to a pinna, but longer and often shallowly lobed; **veins** 20-25 pairs of veinlets in each group, hairy, opposite pairs fusing, and in places forming a discontinuous common excurrent vein. **Sori** borne at tips of lateral veinlets, opposite pairs of sori becoming confluent, exindusiate, plants often precociously fertile. **Cytotype** unknown.

Habitat: A terrestrial species, growing among bushes in semi-open, marshy land by streams, at c. 300-500 m altitude.

Distribution: India (Arunachal Pradesh, Assam), China (Chongqing, Fujian, Guangdong, Guizhou, Yunnan).

Specimens examined: Papum Pare, Kimin to Khunipahad, *G. Panigrahi* 19585, 25.9.1959 (ASSAM); Papum Pare, Naharlagan, Kankonalha/Kankonella, *G.D. Pal* 70178, 9.11.1978 (ARUN); Papum Pare, Ganga Lake [sub "Ganga Sagar Lake" in error], Itanagar, *R.D. Dixit* 32142, 22.5.1982 (BSA, CAL); Papum Pare, New Itanagar, streamside, *R.D. Dixit* 32160, 32163, 23.5.1982 (BSA); New Itanagar, Hydrel Project Area, *R.D. Dixit* 32272, 24.5.1982 (BSA); Papum Pare, Ganga Lake, Itanagar, *A.K. Baishya* 1169, c. 11.1983 (ASSAM); Papum Pare, E. side of Tsiria Kanna hill and wildlife centre, just outside the wall, W. of State Forest Research Institute colony, Chimpu, c. 5-6 km W. of Itanagar, densely forested luxuriant stream-valley, *C.R. Fraser-Jenkins* 33605, 33606 (FN 67-68), 25.1.2009 (ARUN, TAIF); Papum Pare, path through secondary forest by multiple stony stream-courses behind the Botanical Survey of India residential flat complex, Senki View, c. 3 km N. of Itanagar, *C.R. Fraser-Jenkins* with *A.A. Mao* 33639 (FN 101), 30.1.2009 (ARUN (destroyed),

TAIF); dense mixed tropical evergreen type forest by the perimeter path at Ganga Lake, c. 6-7 km N.W. of Itanagar, c. 450 m, *C.R. Fraser-Jenkins* with *A. Benniamin* 33666 (FN 128), 31.1.2009 (ARUN (destroyed), TAIF); forested stream behind Botanical Survey of India residential colony, Senki View, N. of Itanagar, *C.R. Fraser-Jenkins* 33709 (FN 172), 14.2.2009 (ARUN (destroyed), TAIF); West Siang, near Along, *A.K. Baishya* 1375, 15.1.1984 (ASSAM); West Siang, Community Reserve Police Force Camp, on way Tirbin to Basar, *V.K. Rawat* 33417, 27.10.2015 [corrected data from field-book] (ARUN).

Conservation status: Rare, IUCN NT status for India.

ACKNOWLEDGEMENT

The authors are grateful to Dr A.A. Mao, Director, Botanical Survey of India, for providing all necessary logistical support. The authors are also grateful to Department of Environment and Forest, Government of Arunachal Pradesh, for providing necessary permission and facilities during field survey. We gratefully acknowledge the contribution of Dr Alan Smith and Dr Susan Fawcett, University of California, Berkeley, in identifying the specimen of *T. repanda*. We also acknowledge Mr. Rohan Maity, Junior Project Fellow, Arunachal Pradesh Regional Centre, Botanical Survey of India, for his assistance during this work.

REFERENCES

- Chandra, S.**, 2000. *The Ferns of India: Enumeration, Synonyms & Distribution*. International Book Distributors, Dehradun.
- Ching, R.C.**, 1963. A reclassification of the family Thelypteridaceae from the mainland of Asia. *Journal of Systematics and Evolution*, 8(4), pp.289-335.
- Dixit, R.D. and Balkrishna**, 1990. *Pronephrium birii*, a new species of fern from Arunachal Pradesh, India. *Indian Fern Journal*, 7(1/2), pp.18-20.
- Dixit, R.D. and Kala, Y.K.**, 1988. Notes on two species of fern genus *Pronephrium* Presl. *Nelumbo: Bulletin of the Botanical Survey of India*, 30(1-4), pp.146-148.
- Fawcett, S.E. and Smith, A.R.**, 2021. A generic classification of the Thelypteridaceae. *Sida, Botanical Miscellany*, 59, pp.1-102.
- Fraser-Jenkins, C.R. and Baishya, A.K.**, 2020. Pteridophytes of Arunachal Pradesh, N.E. India - List of Verified Species. *Indian J. Forest.*, 43(1), pp.87-95.
- Fraser-Jenkins, C.R. and Benniamin, A.**, 2010. Fifty rarities and additions to the pteridophytic flora of Arunachal Pradesh, N.E. India. *Panjab University Research Journal (Science)*, 59, pp.1-38.
- Fraser-Jenkins, C.R., Gandhi, K.N., Kholia, B.S. and Benniamin, A.**, 2017. *An Annotated Checklist of Indian Pteridophytes, Part - 1 (Lycopodiaceae to Thelypteridaceae)*. Bishen Singh Mahendra Pal Singh, Dehradun.
- Fraser-Jenkins, C.R., Gandhi, K.N. and Kholia, B.S.**, 2018. *An Annotated Checklist of Indian Pteridophytes, Part - 2 (Woodsiaceae to Dryopteridaceae)*. Bishen Singh Mahendra Pal Singh, Dehradun.

- Fraser-Jenkins, C.R. and Kandel, D.R.**, 2019. *Ferns and Fern-allies of Nepal 2*. National Herbarium and Plant Laboratories, Dept. Plant Resources, Ministry of Forests and Soil Conservation, Godavari, Kathmandu.
- Holtum, R.E.**, 1971. Studies in the family Thelypteridaceae III. A new system of genera in the Old World. *Blumea*, **19**(1), pp.17-52.
- Holtum, R.E.**, 1972. Studies in the family Thelypteridaceae IV. The genus *Pronephrium* Presl. *Blumea*, **20**(1), pp.105-126.
- Holtum, R.E.**, 1982. Thelypteridaceae. In *Flora Malesiana*, ser. 2, **1**(5). Martinus Nijhoff, The Hague.
- Iwatsuki, K.**, 1965. Taxonomy of the Thelypteroid Ferns, with Special reference to the Species of Japan and Adjacent Regions 4. Enumeration of the Species of Japan and Adjacent Regions. *Memoirs of the College of Science of the University of Tokyo*, ser. B, **31**(3), pp.125-197.
- PPG I**, 2016. A community-derived classification for extant lycophytes and ferns. *Journal of Systematics and Evolution*, **54**(6), pp.563-603. <https://doi.org/10.1111/jse.12229>
- Schmidel, C.C.**, 1763. In Knorr, G.W. (eds), *Icones Plantarum et Analyses Partium aeri ... quas Composuit D. Casirmirus Christophorus Schmiedel* **3**, 45, t.11. Nürnberg.
- Sledge, W.A.**, 1981. The Thelypteridaceae of Ceylon. *Bulletin of the British Museum (Natural History) Botany*, **8**(1), pp.1-54.
- Vasudeva, S.M. and Bir, S.S.**, 1993. Pteridophytic Flora of Panchmarhi Hills (Central India - II), Key to different taxa and fern families (Ophioglossaceae to Davalliaceae). *Indian Fern Journal*, **10**, pp.40-72.