

*Original Article***Genus *Osmolindsaea* (Lindsaeaceae) in Thailand**

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**Abstract**

A revision of the genus *Osmolindsaea* in Thailand is presented based on herbarium specimens and fresh materials from field surveys. Only one species, *Osmolindsaea odorata*, is recognized. A description, illustration, SEM photographs, ecological data, and distribution are provided.

**Keywords:** Lindsaeoid fern, *Osmolindsaea*, pteridophyte, spore, Thailand

**1. Introduction**

*Osmolindsaea* (K.U.Kramer) Lehtonen & Christenh. is a small genus of lindsaeoid ferns comprising seven accepted species: *O. himalaica* (K.U.Kramer) Lehtonen & Christenh., *O. japonica* (Baker) Lehtonen & Christenh., *O. latisquama* Lehtonen & Rouhan, *O. leptolepida* Rouhan & Lehtonen, *O. minor* (Hook.) Lehtonen & Christenh., *O. odorata* (Roxb.) Lehtonen & Christenh., and *O. plumula* (Ridl.) Lehtonen & Tuomisto (Lehtonen, Tuomisto, Rouhan, & Christenhusz, 2013). The genus was previously recognized as a section of *Lindsaea* Dryand. ex Sm. (Kramer, 1968 [‘1967’]), and recently had been raised to generic rank by Lehtonen, Tuomisto, Rouhan, and Christenhusz (2010) based on molecular results and morphological characters. *Osmolindsaea* was separated from *Lindsaea* by the short petiolules, the monolet spores, and the solenostelic rhizome with internal sclerified pith (Lehtonen *et al.*, 2010). The genus is widely distributed from East Africa and Madagascar through India and the Malay Peninsula, north to Japan and Korea and east to the Solomon Islands.

The account of the lindsaeoid ferns in Thailand was published in 1985 and three genera were accepted, *Lindsaea*, *Sphenomeris* Maxon., and *Tapenidium* (C.Presl) C.Ch. (Tagawa & Iwatsuki, 1985), and subsequent works were also published (Boonkerd & Pollawatn, 2000; Lindsay, Middleton,

Boonkerd, & Suddee, 2009). However, the new classification of the family Lindsaeaceae had been proposed in 2010 (Lehtonen *et al.*, 2010), then this classification was accepted by later authors (Lehtonen *et al.*, 2013; Pteridophyte Phylogeny Group [PPG] I, 2016). It became necessary to revise and update account of the family in Thailand. The purpose of this paper is to summarize the current knowledge of the genus *Osmolindsaea* in Thailand and to provide a detailed description and distribution of *O. odorata*.

**2. Materials and Methods**

This study was based on fresh specimens from field surveys as well as herbarium specimens housed in BCU, BKF, BK, KKU, and PSU herbaria. Morphological and anatomical characters were examined with stereo and light microscopes. Mature spores were also examined with an electron microscope. Ecological and geographical data were compiled from field observations and notes on herbarium specimens.

**3. Results and Discussion**

Our study confirmed that there is only one *Osmolindsaea* species in Thailand, *O. odorata*. But more importantly, it resulted in more detailed description, illustrations, distribution, and its conservation assessments.

*Osmolindsaea odorata* (Roxb.) Lehtonen & Christenh., Bot. J. Linn. Soc. 163: 335. 2010. —*Lindsaea odorata* Roxb., Calcutta J. Nat. Hist. 4: 511. 1846.

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Type: India. Garrow Hills, no specimen extant. Original watercolor illustration, plate 2578 in: W. Roxburgh, *Icones* (lectotype K!), designated by Kramer (1967)). For further synonyms see Lehtonen *et al.* (2013) (Figures 1 and 2).

Description: *Plants* lithophyte. *Rhizomes* short creeping, 1–2.5 mm in diam., scaly throughout; solenostelic with a sclerified pith. *Scales* reddish-brown, narrowly triangular, 1–2 mm long, 3–6 cells wide at base, apex long acuminate ending with 4–5 uniseriate cells, margin entire. *Fronds* slightly dimorphic. *Stipes* up to 15 cm long, grooved on adaxial side. *Laminae* simply pinnate, oblong-lanceolate or oblong in outline, 4.5–20 × 1–3 cm, subcoriaceous, with 8–25 pairs of pinnae, terminal part pinnatisect with long attenuate apex. *Rachises* very pale dull yellow or green, grooved on adaxial side, rounded on abaxial side, biangular in cross section. *Pinnae* shortly stalked (less than 2 mm long), alternate except the basal ones often opposite or subopposite, trapezoid in outline; the basal pinnae smaller than or as large as the upper ones; the largest pinnae 4–14 × 2–6 mm; apex subacute or rounded, base cuneate; acroscopic margin lobed, up to 2.5 mm deep; basiscopic margin entire. Veins immersed, hardly visible, dichotomous branching 1–2 times. *Sori* marginal, terminal on 2–6 uniting veins, interrupted by the lobes. *Indusia* sinuate, attached at the base and side reaching to margin, margin entire. *Sporangia* spheroidal, annulus with 17–24 cells, sporangial stalk 2–3 cells long. *Spores* light

brown, bean shape, 45–50 × 27.5–32.5 μm, monolete, smooth without trichome.

Representative specimens examined: Thailand. Loei, Phu Kradueng National Park, Phu Kradueng, 16°53' N, 101°53' E, 1,200 m, 11 May 1931, *A. F. G. Kerr 20092* (BK); *ibid.*, 1,300 m, 12 May 1951, *T. Smitinand 395* (BKF); *ibid.*, 9 July 1958, *F. Floto 7405* (BKF); *ibid.*, 1,100–1,200 m, 28 November 1965, *M. Tagawa et al. T 595* (BKF); *ibid.*, 1,180 m, 14 January 1966, *E. Hennipman 3658* (BKF); *ibid.*, 4 September 1967, *T. Shimizu et al. T 8952* (BKF); 1,100 m, 7–9 November 1970, *Ch. Charoenphol et al. 4708* (BKF); *ibid.*, 1,190–1,250 m, 16 November 1979, *T. Shimizu et al. T 23068* (BKF); *ibid.*, 13 September 1990, *P. Chantaranonthai et al. 90/188* (KKU); *ibid.*, 21 January 1993, *T. Boonkerd 1102* (BCU); *ibid.*, 11 January 2008, *T. Boonkerd & C. Sangunsab 9* (BCU); *ibid.*, 2015, *P. Jadprajong 5* (BCU); *ibid.*, 14 November 2017, *N. Putthisawong 689, 690* (PSU).

Distribution: Widely distributed from the eastern Himalayas, Indochina, Malesia, to China and Japan.

Ecology: *Osmolindsaea odorata* is a perennial herb, terrestrial or frequently lithophytic along streams, rarely epiphytic on tree trunks (Lehtonen *et al.*, 2013). In Thailand, the species was found growing on sandstone along streams (Figures 2A & B) in dense evergreen forest between 1,100 and 1,300 m a.s.l.

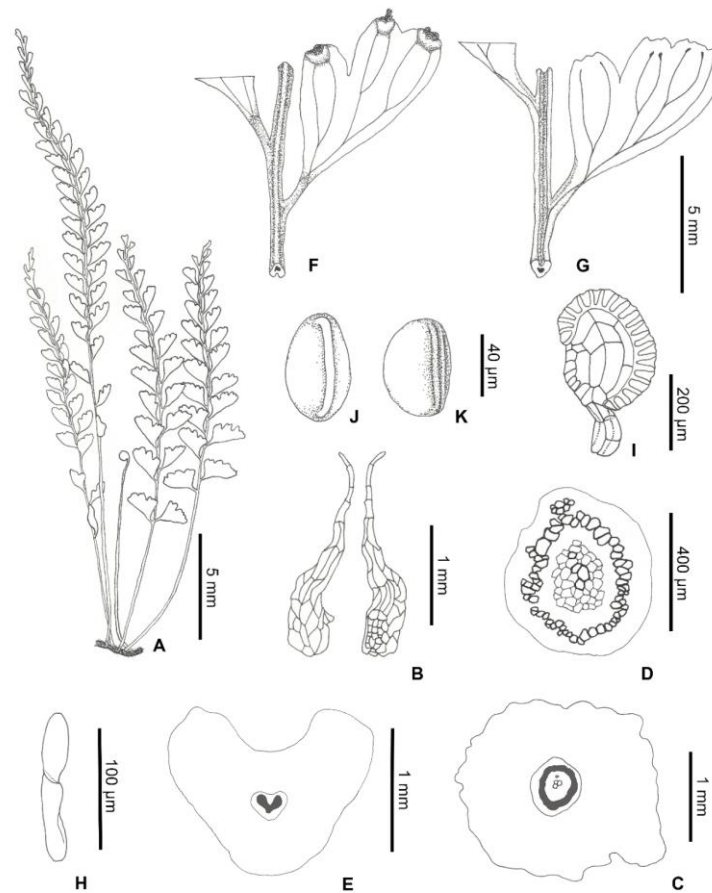


Figure 1. *Osmolindsaea odorata*: A. habit; B. scales; C. cross section rhizome showing solenostele with sclerified pith; D. close up of solenostele with sclerified pith; E. cross section of rachis; F. lower surface of pinna showing sori; G. upper surface of pinna showing groove on adaxial; H. hair; I. sporangium; J. & K. spores, J. proximal view, K. equatorial view. Drawn by N. Putthisawong

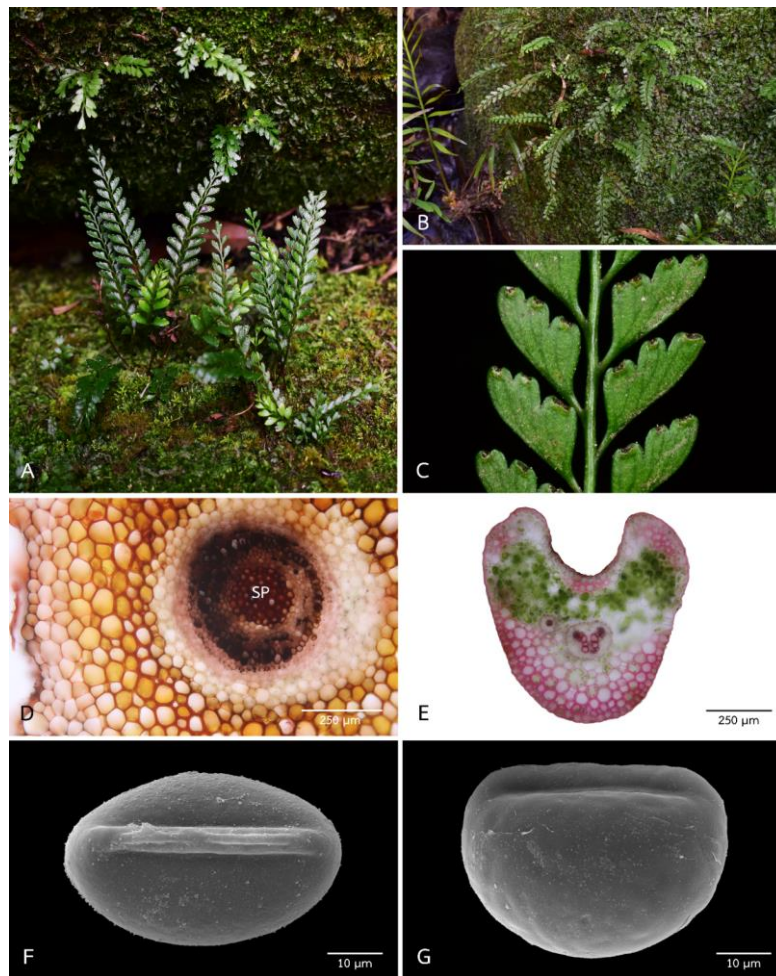


Figure 2. *Osmolindsaea odorata*: A-B. plants in natural habitat (on the rock); C. fertile pinnae showing marginal sori terminal on veins; D. cross section of rhizome with an internal sclerified pith (SP); E. cross section of middle part of rachis showing biangular; F-G. SEM micrographs of smooth spores, F. proximal view, G. equatorial view

Proposed IUCN Conservation Assessment: Least Concern (LC). Although only one location was found in Thailand, it is within the well-protected areas. Based on the recent field survey, more than 500 individuals were observed occurring in an area approximately one square kilometer. Therefore, this species is not under immediate threat. Moreover, this species is the most common and widespread species of *Osmolindsaea* (Lehtonen *et al.*, 2013).

Note: *Osmolindsaea odorata* is one of the most variable and widespread species. It differs from other *Osmolindsaea* species by having the following combination of characters: incised pinna with interrupted sori, rhizome covered by densely scales, and scales up to 3 mm long with a long uniseriate apex. It might be confused with some *Lindsaea* species which also have simply pinnate leaves such as *L. cultrata* (Willd.) Sw. and *L. lucida* Blume. However, *O. odorata* differs from *L. cultrata* and *L. lucida* in having monolet spores and solenostelic rhizome with sclerified pith. While, *L. cultrata* and *L. lucida* have trilete spores and their rhizomes lack internal sclerified pith.

Lehtonen *et al.* (2013) reported *O. odorata* from Chantaburi and Satun provinces based on Put 442 (K) and

Phengkhlai 1299 (K), respectively. After carefully re-examination the duplicates of these specimens in BKF has revealed them to be *L. lucida*. Furthermore, during the field surveys throughout the country and especially in Chantaburi and Satun provinces, *O. odorata* was not found. Therefore, the distribution of *O. odorata* in Thailand seems to be restricted to Phu KraDueng National Park, Loei province.

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