

A NEW RECORD OF THE RHEOPHYTIC FERN *Osmunda angustifolia* (OSMUNDACEAE) FROM SUMATRA INCLUDING A NEW CYTOLOGICAL RECORD

Catatan Baru Tumbuhan Paku Reofit *Osmunda angustifolia* (OSMUNDACEAE) dari Sumatera Mencakup Catatan Sitologi Baru

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Abstrak

Osmunda angustifolia Ching ex Ching et Wang (Osmundaceae) sebelumnya diketahui tersebar di Cina (Guandong), Hainan, and Taiwan. Saat ini, *O. angustifolia* dilaporkan sebagai jenis rekaman baru di Sumatera. Pertelaan morfologi lengkap dengan fotografinya disajikan. Jenis ini dinyatakan sebagai jenis yang berstatus jarang di Indonesia. Catatan sitologi juga dilaporkan untuk pertama kalinya bagi jenis *Osmunda* dari Sumatera. Jumlah kromosom somatik dari sel-sel ujung akar *O. angustifolia* adalah $2n = 44$ (diploid).

Kata kunci: jenis jarang, jumlah kromosom somatic, *Osmunda angustifolia*, Sumatera

Abstract

Osmunda angustifolia Ching ex Ching et Wang (Osmundaceae) was, formerly, known to be distributed in China (Guandong), Hainan, Hongkong, and Taiwan. Now, *O. angustifolia* is reported as a newly recorded species in Sumatra. A complete morphological description with photographs is presented. It is defined as a rare species in Indonesia. A cytological record is also reported for the first time for the Sumatran species. The somatic chromosome number of root tip cells of *O. angustifolia* is $2n = 44$ (diploid).

Keywords: *Osmunda angustifolia*, rare species, somatic chromosome number, Sumatra

INTRODUCTION

Osmunda L. (Osmundaceae) is an ancient fern genus that originated in the Triassic period (Foster and Gifford, 1959). This genus is widely distributed in the temperate and tropical region; it is locally but widely distributed throughout most of the world except in the cold and arid climates, and in islands of the Pacific (Tryon and Tryon, 1982).

Hassler and Swale (2002) and Li *et al.* (2003) stated that *Osmunda* is comprised of 15 species. Zhang *et al.* (2013) stated that *Osmunda* is comprised of about 10 species in the world with some native hybrids. Statement of Zhang *et al.*, (2013) is more reasonable as they have revised the family Osmundaceae. Moreover closely related species of fern, including the genus *Osmunda*, may be intergametophytic-mating to form a hybrid. It is

considered that ferns have evolved by hybridization and doubling (Wagner, 1954). Natural hybrids of *Osmunda* are not rare. For example, an enigmatic fern found in Laos and Myanmar, which was described as *Osmunda hybrida*, is a tetraploid ($n = 44$, $2n = 88$) and of hybrid origin from *O. regalis* and *O. japonica* (Tsutsumi *et al.*, 2011). *Osmunda* x *intermedia* is a natural hybrid between *O. japonica* and *O. lancea* (Yatabe *et al.*, 2009; 2011).

Osmunda is characterized morphologically as follows: Terrestrial fern with stout, woody, erect or creeping rhizome without scales. Stipes arise as a crown at the apex of rhizome with hair on the basal stipes when young. The base of stipes swollen and with flaplike stipules. Lamina 1- or 2-pinnate, fertile portion reduced to a midrib with almost no lamina present. Fronds are dimorphic or more commonly hemidimorphic with dimorphic pinnae; pinnae articulate to rachis. Sporangia large, naked with a small patch annulus (Zhang *et al.*, 2013).

Studies on Osmundales, the smallest but most ancient order of leptosporangiate ferns, are very important as this group occupies an important phylogenetic position as sister to all other extant leptosporangiates (Hasebe *et al.*, 1995; Metzgar *et al.*, 2008). When I was studying the medicinal fern *Cibotium barometz* in Sumatra I found a species of *Osmunda* which seemed similar to *O. javanica* Blume, but it looked very different to the *O. javanica* Blume. Using morphological comparison with the description of *O. javanica* by Zhang *et al.* (2013), I concluded that this species was not *O. javanica*. The aims of this research were: (1) to determine an unidentified specimen of *Osmunda* from Sumatra; (2) to determine the conservation status and observe the somatic chromosome number of the identified *Osmunda*.

MATERIALS AND METHODS

Determination and Morphological Observations

Species determination followed the key to the species of *Osmunda* by Zhang *et al.* (2013) and

photographs of *Osmunda* from ‘Lycophytes and Ferns of China’ by Zhang (2012). Personal communication directly with Prof Xian-Chun Zhang (Bogor, 3 September 2013) was also conducted to state the result of species determination. Dried and living specimens were observed using standard methods used in fern taxonomy.

Field study and determining regional rarity

This study was carried out from 2008 to 2011 in four provinces of Sumatra (Bengkulu, North Sumatra, West Sumatra and Riau). Globally, assessing the conservation status of species uses the IUCN Red List Categories and Criterias (IUCN, 2001; 2012). However for the purposes of regional conservation assessments there are important reasons to assess species' extinction risk and publish Red Lists within specific geographically defined areas. The word *regional* indicates any sub global geographically defined areas, such as a continent, country, state, or province (IUCN, 2012).

Forty-six localities were chosen for observation of rarity of ferns using the method described by Schoener (1987) and Sanchez (2006): (1) a species was categorized as rare if it was encountered in less than 10 sites and/or the population was less than 20 plants.; (2) a random search with belt transect was set up to record the occurrence of species in one or more hectare; (3) a random search was set up in an area 20 m x 500 m with a sub set 20 m x 100 m.

Herbarium records were used to identify provincially uncommon, rare, and very rare plant taxa recorded in an area (MacDougall *et al.*, 1998). In this study herbarium records in BO (Herbarium Bogoriense) were also used to identify the rarity of *Osmunda angustifolia* in Indonesia.

Chromosome observation

Root tips were pre-treated in 2 mM 8-hydroxyquinoline solution for 24 hours at 3–4°C. They were fixed in 45% acetic acid for 10 minutes

and macerated in a mixture of CH_3COOH 45% : 1 N HCl = 1 : 3 at 60°C for 3–4 minutes. The fixed roots were stained and pressed in aceto-orcein solution. Chromosome observation was carried out under the microscope using 1000x magnification.

RESULTS AND DISCUSSION

Description

Osmunda angustifolia Ching ex Ching et Wang. Rhizome erect. Fronds congested at apex of the rhizome. Stipes stramineous or light green when living, short, up to 18 cm long, less than 4 mm in diameter; laminae pinnate with a distinct apical pinna, moderately acute at apex, one pair of basal pinnae slightly shortened; lateral pinnae 15–18 pairs, stalked to 8 cm long, linear, both gradually narrowing towards acute apex, less than 14 cm long, 1.2 cm wide, margin; veins forked up to two times; texture papyraceous to subcoriaceous, fresh green in color; 8–12 pairs of sub basal to middle pinnae fertile, contracted to 4 mm wide or less; sori golden yellow when mature, brown after shedding the spores; sporangia trilete, radially symmetrical, heteropolar; polar outline rounded, equatorial view rounded (Figure 1).

Specimens Examined

Sumatera: Sungai Batang Bio, Secondary forest, Bukit Pemberhentian Papan, Kampung Batang Bio, Desa Salasuang, Kec. Kampar Kiri, Kab. Kampar, Prop. Riau. E 100°47'10.8"–100°47'12" S 00°06'42.0"–00°06'43.0". 270–292 m asl. 12 June 2011. T.Ng. Praptosuwiryo 3296C (Cytotype) (BOHB, Herbarium Hortus Botanicus Bogoriense, at Center for Plant Conservation, Bogor Botanic Gardens). Borneo: East Kalimantan, *en route* from Pa Raya to Sinar Baru, north of Long Bawan, Krayan. E 115°. N 4°. 1150 m. 17 July 1981. M. Kato, M. Okamoto & E.B. Walujo B–9079 (BO). Distribution in Indonesia: Sumatra (Riau), East Kalimantan.

Ecology and Rarity of Species

The world Conservation Union, IUCN (1984, 1997) established five main categories to highlight the conservation status of species: i) Extinct (no longer known to exist in the wild, ii) Endangered (species that have a high likelihood of becoming extinct in the near future), iii) Vulnerable (species that may become endangered in the near future because populations are decreasing in size throughout the range), iv) Rare (species that have a small total numbers of individuals, often due to limited geographical ranges or low populations densities, and v) Insufficiently known (species that probably belong in one of the preceding categories but are not sufficiently known to be assigned to a specific category). Proposed IUCN conservation assessment for *O. angustifolia* in the word is LC (Least Concern) with the reason that this species widespread and not under any know threats (Lindsay and Middleton, 2014).

Formerly *O. angustifolia* was known to be distributed in China (Guandong), Hainan, Hongkong, and Taiwan (Zhang *et al.*, 2008). It grows on sandy and loamy banks or on wet rocks along streams in dense forest or in shaded areas (Zhang *et al.*, 2013). According to van Steenis's (1981) definition this species is a rheophyte, viz. a plant species which is in nature confined to the beds of swift-running streams and rivers and grows up to flood-level, but not beyond the reach of regularly occurring flash floods.

Forty-six sites in five provinces of Sumatra were observed, namely Bengkulu, Jambi, West Sumatra, North Sumatra, and Riau. *O. angustifolia* was only found in Riau Province, on the riverbank of Sungai Batang Bio, in the secondary forest of Kampar Kiri Subdistrict, Kampar District. This species was found growing on loamy banks and on wet rocks along streams in a rather opened or in semi-shaded areas of secondary forest at 250–300 m asl.



Photo: Titien Ng. Praptosuwiryo

Figure 1. *Osmunda angustifolia*. A. and B. Habit; C. Middle part of sterile lamina showing free veins with once or twice forked; D. Part of lamina with fertile mature pinnae; E. Mature brown sori with brown opened and closed sporangia. F. Brown sporangium spreading the green spores. Green spores was directed by the white row. Bar = 10 cm for A and B, 0.8 mm for E.



Photo: Titien Ng, Praptosuwiryo

Figure 2. Somatic chromosome number of *Osmunda angustifolia* of two cells. $2n = 2x = 44$. Bar = 3 μ m

Based on distribution data and population size, it is proposed that this species is defined as a rare fern species. In Sumatra, Riau Province, this species was encountered in less than 10 sites and each population was less than 20 plants. According to specimen examination in BO, this species had previously been found only in East Kalimantan.

Cytological Record

The first chromosome record of *Osmunda* was *O. regalis* ($2n = 44$) which was reported by Guignard in 1899 (Löve *et al.*, 1977). As stated by He *et al.* (2006), the chromosome numbers or karyomorphology of 15 taxa have been recorded, all with $2n = 44$. Zhang *et al.* (2008) reported somatic chromosome number of five species, including *O. angustifolia*, all with $2n = 44$.

Chromosome number record for *Osmunda* from Sumatra is reported here for the first time from somatic cells of *O. angustifolia*, with $2n = 44$ (Figure 2.). It is defined as the diploid type because Kawakami *et al.* (2012) stated that the autopolyploid plants of *Osmunda lancea* with $2n=88$ were tetraploid. Based on the cytological observations of He *et al.* (2006) and Kawakami *et al.* (2012), it is clearly stated that the basic chromosome number of

Osmunda is $x = 22$, therefore individual plant with chromosome number $2n = 44$ are defined as the diploid type.

CONCLUSIONS

Osmunda angustifolia Ching ex Ching et Wang (Osmundaceae) was, formerly, known to be distributed in China (Guandong), Hainan, Hongkong, and Taiwan. Now, *O. angustifolia* is reported as a new record species in Sumatra. In Indonesia, this species is distributed only in Sumatra and East Kalimantan with small populations in each. Therefore, this species is defined as a rare species in this country. The somatic chromosome number of root tip cells of *O. angustifolia* clearly showed that the specimens examined from Sumatra are diploid ($2n = 44$).

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