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Inventorying the tree fern Genus *Cibotium* of Sumatra: Ecology, population size and distribution in North Sumatra

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ABSTRACT

Praptosuwiryo TNg, Pribadi DO, Puspitaningtyas DM, Hartini S (2011) Inventorying the tree fern Genus Cibotium *of Sumatra: Ecology, population size and distribution in North Sumatra. Biodiversitas 12: 204-211. Cibotium* is one tree fern belongs to the family Cibotiaceae which is easily differentiated from the other genus by the long slender golden yellowish-brown smooth hairs covered its rhizome and basal stipe with marginal sori at the ends of veins protected by two indusia forming a small cup round the receptacle of the sorus. It has been recognized as material for both traditional and modern medicines in China, Europe, Japan and Southeast Asia. Population of *Cibotium* species in several countries has decreased rapidly because of over exploitation and there is no artificial cultivation until now. The aims of this study were: (i) To re-inventory the species of *Cibotiun* in North Sumatra, (ii) to record the ecology and distribution of each species, and (iii) to assess the population size of each species. Field study was carried out by using random search with belt transect. Two species were recorded, namely *C. arachnoideum* dan *C. barometz.* The geographical distribution of the two species in North Sumatra is presented. *Cibotium* is commonly growing terrestrially on opened or rather opened areas in secondary forest and primary forest at hills or lower mountains with a relatively high humidity at 30-90º slopes. *C. arachnoideum* has a strict distribution and only found at 1740-1770 m a.s.l. in primary forest, whereas *C. barometz* has a broad distribution in secondary forest at elevation range from 650-1200 m.

Key words: *Cibotium*, ecology, distribution, tree fern, Sumatra.

INTRODUCTION

It is now widely recognized that current extinction rates of plant and animal species are between hundred and a thousand times higher than back rates throughout life's history of Earth (May 2002). Therefore the world's biodiversity should be inventoried and monitored.

As defined by Stork and Samways (1995) biodiversity inventorying is the surveying, sorting, cataloging, quantifying and mapping of entities such as genes, individuals, populations, species, habitats, biotypes, ecosystem and landscapes or their components, and the synthesis of the resulting information for the analysis of pattern and processes. Inventory refers to a listing of all the species of plants, animals, fungi, protest and microbes in a defined area. Survey refers to methodical exploration of an area in order to discover the species that live there (Wheeler 1995). Inventories for rare plants may be designed to: (i) Locate populations of species; (ii) Determine total number of individuals of species; (iii) Locate all population of rare species within a specific area (often a project area); (iv) Locate all rare species occurring within a specific habitat type; (v) Asses and describe the habitat of rare species (associated species, soils, aspect, elevation); (vi) Asses existing and potential threats to a population (Elzinga et al. 2005)

There are three levels of monitoring for plant population: distribution, population size and demographic monitoring. These can be applied to species according to theirs protection and management objectives (Menges and Gordon 1996). Hutching (1991) described that the status and trends of plant population may be studied on four levels: population distribution, quantitative monitoring of population size and (or) condition, monitoring of population structure, and demographic study the population. Basic information about the distribution and regional dynamics of different species is essential for practical conservation management of rare species, i.e. species with low relative abundance or distribution at continental, and particularly at regional and local levels.

Cibotium Kaulfuss is a genus of about 12 species of tropical tree fern (Holttum 1963; Hassler and Swale 2002) which is subject to much confusion and revision. Therefore it is treated in different family, such as in subfamily Cibotioideae of Cyatheaceae (Holttum 1963), Cibotiaceae (Hassler and Swale 2002; Smith 2006). This genus is distributed in Central America and Mexico, Hawaii, Assam to southern China, southwards to Western Malesia and Philippines (Holttum 1963).

Cibotium comprises large ferns with usually prostrate or erect trunk-like rhizome and large bipinnate fronds. The apex of rhizome is protected by a thick cover of long slender golden yellow-brown hairs. These hairs are also long at the base of the stipe and often matted in appearance.

Sori are marginal, at the ends of veins, protected by two indusia which are alike in texture and diffrent from the green lamina of lobes on which they are borne, the outer indusium deflexed so that the sorus appears to be on the side of the lobe, the inner indusium at maturity bending back towards the costule and elongating, usually becoming oblong, the two indusia joined together for a short distance at the base, thus forming a small cup round the receptacle of the sorus (Holttum 1963; Large and Braggins 2004).

One species of *Cibotium*, namely *C. barometz*, has been recognized as material for the traditional medicine and modern medicines in China, Japan and France (Zamora and Co 1986, Praptosuwiryo 2003). In China the species has important value for medicinal purpose which is known in medicinal trade as 'gou ji' (Jia and Zhang 2001, Smith 2009). The gold yellowish-brown hairs on its rhizome and stipes have been used in S.E. Asia and China as a styptic for a bleeding wound (Zamora and Co 1986, Jia and Zhang 2001). The extract of the rhizome ('gouji') is also used by Chinese and Japanese as an antirheumatic, to stimulate the lever and kidney, to strengthen the spinal, to expel wind and damppnesss, and as a prostatic remedy (Zamora and Co 1986).

Population of *Cibotium* species in several countries has decreased rapidly because of over exploitation and there is no artificial cultivation until now. The species has been included in Appendix II of the Convention on International Trade in Endangered Species (CITES) since 1976. In order to utilize it in sustainable use, NDF (*Non Detriments Finding*) system has to be applied for determining the annual quotas. Biological aspect is one of the important information that is needed to be known, including the ecology, population size and distribution. To obtain those data, inventories and monitoring of the population need to be done.

Based on the specimens examined housed at Herbarium Bogoriense (BO) there was only one record of *Cibotium* collected from North Sumatra. It was collected by H. Surbeck in on 30 May 1941 (No. Coll.: H. Surbeck 114) Sibuctan south, Lae Pondom (the correct name is Lao Pondom), 1100 m, edge of primary forest, and identified as *C. barometz*. The correct name of this record is *C. arachnideum*. This paper presents the recently data on ecology, population size and distribution of *Cibotium* species in North Sumatra. For practical consideration, in this study, populations were defined as spatially distinct assemblages of plants at certain sites, without considering the genetic structure of the population. Following those defined by Landi and Angiolini (2008) populations were defined as discrete clusters of plants, separated from other cluster by at least 500 m.

Most studies on the ecology, population and distribution of ferns were based on quantitative methodological approaches, such as Landi and Angiolini (2008; 2010), Banaticla and Buot (2005). However these studies can also be approached by using qualitative methodology (Nitta 2006; Boonkerd et al. 2008; Rusea et al. 2009). The aims of the study were: (i) to re-inventory the species of *Cibotium* in North Sumatra, (ii) to record the ecology and distribution of each species, and (iii) to assess the population size of each species by using random search methodology using belt transect.

MATERIALS AND METHODS

Site studies

Nine localities of *Cibotium* habitats included in six subdistrict of three district, Dairi District, Karo District and Deli Serdang District, were successfully surveyed (Table 1). There is only one locality of *Cibotium* population found in Dairi District, namely Bukit Kota Buluh, Kota Buluh Village, Tanah Pinem subdistrict. Three localities are situated at Karo District, namely: (i) Bukit Butar, Butar Village, Tiga Binanga Subdistrict; (ii) Aik Batu Forest-Lau Pondom, Aik Hotang Village, Merek Subdistrict; (iii) Samperen Secondary Forest, Bukit Layang, Negeri Juhar Village, Juhar Village. Four localities are included in Sibolangit subdistrict, Deli Serdang district, namely: (i) Tikungan Amoi forest, Tahura Bukit Barisan, Bandar Baru Village; (ii) Betimus River, Wely forest, Sukamakmur Village, and (iii) Kataruman Forest, Takur-Takur Hill, Negeri Suah Village; (iv) Gunung Sibayak II, Treck Mata Air Petani, Bandar Baru Village. One locality situated in Kota Limbare Subdistrict of Deli Serdang District, namely Sungai Sae Binge Forest. Habitat characteristics of the nine localities are summarized in Table 2.

Procedures

Data on ecology and distribution was based on observation during field studies and also derived from herbaria sheet information or collection notes of specimens deposited at BO (Herbarium Bogoriense). Field studies were carried out in October-December 2009 in North Sumatra province, Indonesia. Voucher specimens are deposited at BOHB (Herbarium of Bogor Botanic Gardens).

Random search with belt transect is set up to estimate the population size or the abundance of adult plant of *C. barometz* in a certain area. Belt transect is very commonly used in studies on population biology of plants (see Lutes 2002; Shenoy et al. 2011). In the study of *C. barometz* the belt transect was set up in 20x125 m^2 or 20 x 250 m^2 with 20 x 25 m^2 subplots (Figure 1). The position and number of transect were determined based on the spatial distribution pattern of *C. barometz* in each distribution areas. In general *C. barometz* reveals in the same direction of the contour of hills. Therefore, in this study the belt transect was established in the line of hills contour as this transect method is usually very suitable to be applied on the field areas having hilly or mountainous contour. One transect was set up if the population of *C. barometz* in a certain areas was only found in certain slope. Minimally 3 transects were set up in the situation in which *C. barometz* distributed from lower slopes to upper slope, *viz*. lower, middle and upper slopes. Population size data generated from transects were used to estimate the population size of *C. barometz* in a certain areas in which its population performance were almost similar to the population performance in transect. Transects commonly cover 25-30% of the total distribution areas of *C. barometz*.

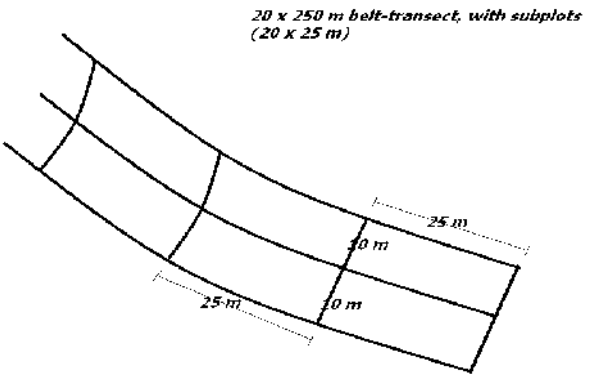

Figure 1. Basic sampling unit of *C. barometz* survey, a long, 20 x 250 m belt-transect, with subplots (20 x 25 m).

The activities that have been carried out in this survey could be described as follows: (i) exploring the habitat of *C. barometz*; (ii) morphological diversity observation; (iii) collecting population data; (iv) recording the associated plants with *C. barometz* and environmental condition around *C. barometz* vegetation (elevation, slope, air temperature and humidity, soil type in general, pH and humidity of soil, the thickness of litter and humus soil).

In collecting population data only the mature plants were recorded for each species which was determined by the following categories: (i) rhizome at least 10 cm height, 8 cm diam. or more; (ii) lamina more than 60 cm long and (iii) presence of fertile fronds. *Cibotium* is usually growing solitary or in a clump (consisted of 2-20 individuals). In this research population size was determined by counting individual plant not clump.

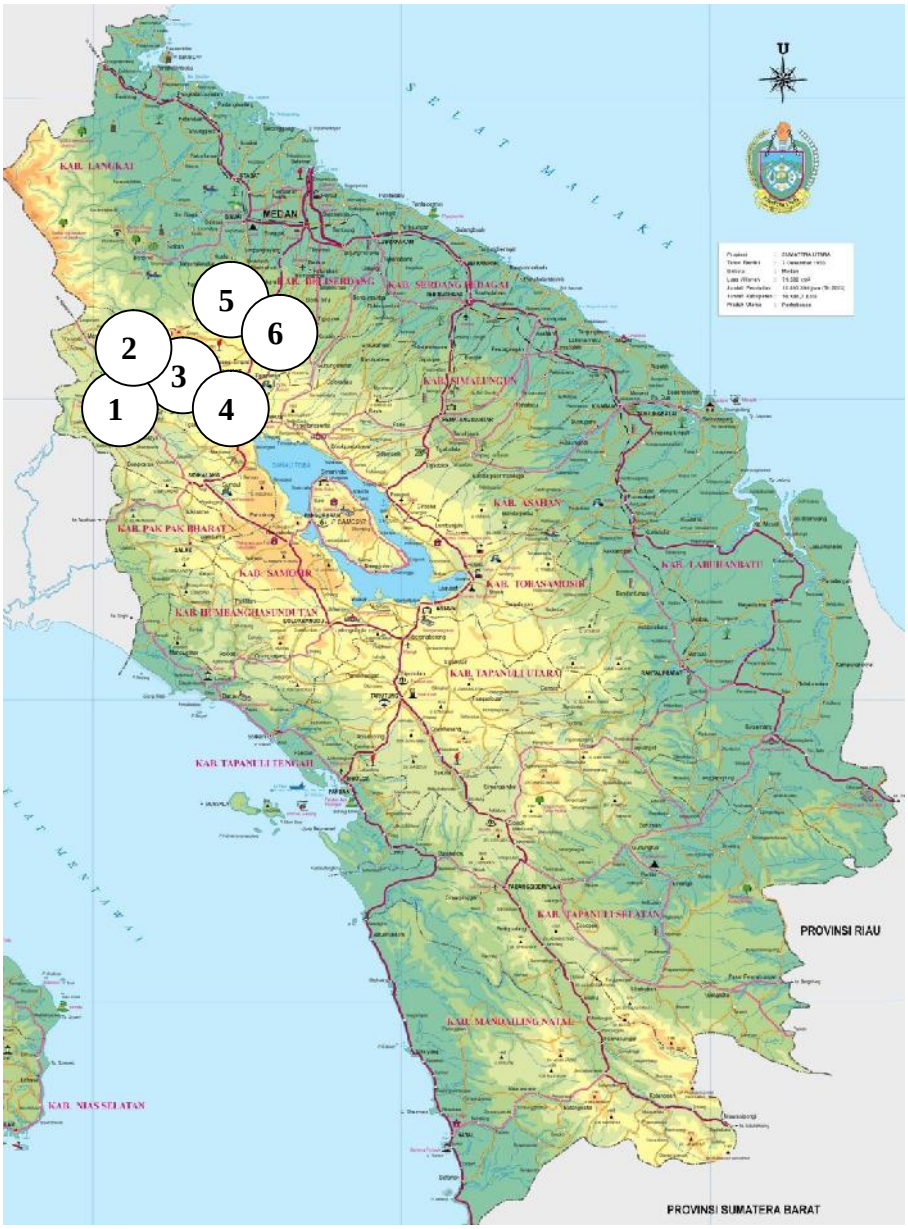

Figure 4. Distribution map of *Cibotium* in North Sumatra. 1. Tanah Pinem Subdistrict; 2. Tiga Binanga Subdistrict; 3. Juhar Subdistrict; 4. Merek Subdistrict; 5. Kuta Limbare Subdistrict; 6. Sibolangit Subdistrict.

Table 1. The geographical distribution of *Cibotium* species in North Sumatra

District	Subdistrict	Locality	Species
Dairi	Tanah Pinem	Bukit Kota Buluh, Kota Buluh Village	*C. baromertz*
Deli Serdang	Kota Limbare	Sungai Sae Binge forest	*C. baromertz*
	Sibolangit	Tikungan Amoi forest, Tahura Bukit Barisan, Bandar Baru Village	*C. baromertz*
	Sibolangit	Betimus River, Wely forest, Sukamakmur Country,	*C. baromertz*
	Sibolangit	Kataruman Forest, Takur-Takur Hill, Negeri Suah Village	*C. barometz*
	Sibolangit	Gunung Sibayak II, trek Mata Air Petani, Bandar Baru Village	*C. baromertz*
Karo	Tiga Binanga	Bukit Butar, Butar Village,	*C. barometz*
	Juhar	Samperen Secondary Forest, Bukit Layang, Negeri Juhar Village	*C. baromertz*
	Merek	Aik Batu Forest-Lau Pondom, Aik Hotang Village	*C. arachnoideum*

RESULTS AND DISCUSSION

Floristic

There are only two species found in North Sumatra, viz. *C. arachnoideum* and *C. barometz* (Table 1, 2; Figure 2, 3). The two species are distinguished by three characters combinations: (i) the existence the hairs on costa and costule of the adult fronds; (ii) the incision of pinnulae segments, (iii) the pair number of sori. *Cibotium barometz* differs from *C. arachnoideum* by combination of diagnostic characters as follows: *C. barometz* has sori 2 or more pairs on each pinnule-lobe of larger fronds, largest pinnules 20-35 mm wide, pinnules on the two sides of a pinna not greatly different in length, hairs on lower surface of costae and costules almost always thin and flaccids and never spreading. Meanwhile *C. arachnoideum* always has two pairs of sori on large fronds, largest pinnules 15-26 mm wide, pinnules on basiscopic side of lower pinnae much shorter than those on acroscopic side, spreading hairs lacking, but rigid (often red) appressed hairs always present and sometimes abundant, small flaccid hairs present on lower surface of lamina between vein. Those characters combinations are met those specimens described by Holttum (1963).

Distribution

Geographical distribution of *Cibotium* in North Sumatra is presented in Table 1. and Figure 4. Holttum (1963) reported that *C. arachnoideum* was only distributed in Malesian region in Central and South Sumatra, Sarawak, and N. Borneo. There was one locality of this species found in North Sumatra, namely Lau Pondom (Table 1.) Based on the notation of the specimen examined from BO (Herbarium Bogoriense), this species was found at the margin primary forest in Lau Pondom at 1100 m a.s.l

In North Sumatra *C. barometz* is more widely distributed than *C. arachoideum* (Table 1.). The geographical distribution data of *C. barometz* in North Sumatra is a new record for science. It would give important information in defining the current and future options available to meet human needs, especially for North Sumatra society, in future, and guiding immediate and long term management, policy and decision-making concerning the sustainable uses of *C. barometz.*

In the biogeographic point of view *Cibotium* provides an excellent example combining several kinds of distributional change as well as speciation (Barrington, 1993). *Cibotium* is a Pacific-rim genus of about eight extant species, one in southeastern Mexico (*C. schiedei* Schlect. & Cham.), one or perhaps two (*C. barometz* (L.) J. Sm. and *C. cumingii* Kze.) in the Old-World tropics from Assam to China to Western Malesia region) and the Philippines (Holttum, 1954; Copeland, 1958) and about six in Hawaiian islands (Becker, 1984; Wagner 1990). Holttum (1963) reported three species of *Cibotium* in Malesian region, namely *C. arachnoideum* (C.CHR.) Holttum, *C. barometz* (L.) J. SM. and *C. cumingii* Kze. Holttum (1963) stated that in Malesia *C. barometz* distributes in Malay Peninsula, Sumatra and Java, but there is no new record of this species in Java after Backer and Posthumus (1939).

Habitat characteristics

The habitat characteristics of two species of *Cibotium* are relatively different (Table 1). *Cibotium arachnoideum* in Lao Pondom is found at elevation range from 1740-1770 m. This species grows on a range temperature of 23-23.5ºC, moist condition (RH ± 80%), soil type of sandy quartz-rockery with dust or clay soil, soil acidity of 5.8, humus soil depth 3-4 cm, leaves litter depth 2.5-12.5 cm. It grows on the hill with 0-80 % of slopes. *C. arachnoideum* is found among the terrestrial fern species of *Dipteris conjugata*, *Dicranopteris linearis*, *Blechnum* sp., *Pyrrosia* sp., *Hymmenophyllum* sp., *Hystiopteris stipulaceae*., *Phymatodes* sp. and *Elaphoglossum* sp. In Mt. Kinabalu, Borneo, *C. arachnoideum* usually grows in cultivated areas. This species survives burning when land is cleared for cultivation and persist on steep lading (fields) at 900-1200 m asl. (Parris et al. 1992).

Cibotium barometz has a wide range of habitat, at elevation range from 600-1165 m. It prefers growing on opened areas or shaded areas of secondary forest and margin primary forest. The optimum canopy coverage of *C. barometz* is usually in a range from 40-60%. The localities with a relatively high population size, such as in secondary forest of Butar Hill and secondary-primary forest of Kataruman Forest (Takur-takur Hill), the canopy coverage is on a range from 40-60% and 50-70%, respectively. This species needs warm temperature, 23-30ºC with humidity range from 30-90%.

Figure 2. *Cibotium arachnoideum*. a. Rhizome with stipes; b. Lamina; c. Part of pinnulae with fertile lobes showing one row of sori on each pinnule-lobe; d. Transversal section of basal stipe covered by brown shining hairs and showing the vascular bundles.

Figure 3. *Cibotium barometz*. a. Rhizome with stipes; b. Lamina; c. Part of pinnulae with fertile lobes showing one row of sori on each pinnule-lobe; d. Transversal section of basal stipe covered by brown shining hairs and showing the vascular bundles.

Soil type is main factors which affect on the distribution of *C. barometz*. It is mainly found on yellow podzolik and red inceptisol with soil acidity 5.2-6.6. Nguyen (2009) stated that *C. barometz* is an acid soil indicator species in tropical and subtropical area, but rare in the limespone areas. This species can grow on hard-rock with very thin humus soil or litter to humus rich soil with a depth range from 2-15 cm.

In seconday forest *C. barometz* usually grows with fern pioneer species such as *Nephrolepis hirsutula*, *Dicranopteris linearis*, *Gleichenia truncate*, *Blechnum orientale*, *Pteridium aquilinum*, *Histiopteris stipulace*, *Taenitis blechnoides* and *Dipteris conjugata*. In the margin of primary forest this species can be found among the light shady ferns as well as the opened area ferns. The light shady ferns which are usually found among the *C. barometz* are *Cyathea recomuttata*, *Diplazium bantamense*, *D. cordifolium*, *D. crenatoserratum*, *D. tomentosum*, *Selaginella* spp. While the opened area ferns grow with this species are almost similar to those found in secondary forest areas. *C. barometz* also survives on burning areas when land is cleared for cultivation by producing new shoots from the rhizome. In this condition this species is usually found among and at the margin thicket of *P. aquilinum* (Figure 3).

Cibotium in the secondary forest community of North Sumatra can be included in the key species. In North Sumatra *Cibotium* often dominates an area where this species occurs, such as in Aik Batu Forest of Lao Pondom, Kataruman Forest of Bukit Takur-Takur, Samperen Forest

Table 2. Distribution, population size and habitat characteristics of *Cibotium* in North Sumatra

Locality, forest type, and Species	Population size (Σmature individual/ ha)	Habitats characteristics of species									
		Slope (°)	Altitude (m)	Tempe-ratures	Air humi-dity	Canopy coverage (%)	Major soil type	Leaves litter depth (cm)	Humus soil depth (cm)	Soil acidity (pH)	Terrestrial fern species and seed plants commonly associated
Aik Batu Forest, Lao Pondom Primary forest-secondary forest *C. arachnoideum*	372/0.25	30-80	1740-1770	23-23.5	80-80.5	50-70	Sandy quartz-rockery with dust or clay soil	2.5-12.5	3-4	5.8	*Dipteris conjugata*, Dicranopteris *linearis*, *Blechnum* sp., *Pyrrosia* sp., *Hymmenophyllum* sp., *Hystiopteris stipulaceae*., *Phymatodes* sp. dan *Elaphoglossum. Leptospermum flavescens, Dacrycarpus imbricatus*,, Podocarpaceae, Myrtaceae, Ericaceae, Melastomataceae, Pandanaceae, Nephentaceae
Bukit Butar Secondary forest *C. barometz*	1128/1	45-80	Ca. 875-900	24-25	75-80	40-60	Yellow podzolid	3-10	2.5-4	5.8	*Pteriudium aquilinum, Adiantum sp., Taenintis blechnoides, Selaginella sp., Drypteris sp., Dicarnopteris linearis, Davallia sp. Gleichenia sp, Gleichenia truncate Schima wallichii, Sloanea sigun, Zingiberaceae*,, Apocynaceae, Fagaceae, Theaceae
Kataruman Forest of Takur-takur Hill Primary forest-secondary forest *C. barometz*	1464/1	30-70	650-817	24-25.5	80-80.5	50-70	Red inseptisol	6.5-12.5	2-6.5	6.4-6.5	*Diplazium simplicivenium , Pleocnemia irregilaris, Tectaria* sp., *Nephrolepis* sp., *Diplazium crenatoserratu, Eurya nitida, Arenga pinnata, Arecaceae, Theaceae, Moraceae*
Tekungan Amoi Forest (TAHURA Bukit Barisan I) Secondary forest *C. barometz*	17/2	25-35	650-700	23-24	80-85	60-70	Yellow podzolid	2-4	6-10	6.0-6.4	*Cyathea recomuttata, Diplazium bantamense, D. cordifolium, D. crenatoserratum, D. pallidum, D. simplicivenium, D. tomentosum, Selaginella* sp, *Nephrolepis acuminata, Histiopteris stipulaceae,* Araceae, Fagaceae, Elaeocarpaceae
Wely Forest-Betimus River Secondary forest *C. barometz*	13/2		760-780	24-25	80-85	50-60	Yellow podzolid	10-15	10-12.5	6.4	*Diplazium betimusense, Cyathea contaminans, Cyathea* sp., Thelypteridaceae, *Sellaginela* sp., *Syzygium* sp., *Artocarpus* sp., *Araceae*, Moraceae, Myrtaceae, Theaceae, Fagaceae
Gunung Sibayak II (Trek Mata Air Petani). Primary-secondary forest *C. barometz*	4/1	35-40	980-1090	23.3-25.0	80-96	60-70	Yellow podzolid	5	5-10	5.0	*Selaginella* sp, *Cyathea contaminans, Cyathea* sp., *Dydimochlaena truncatula, Pleocnemia* sp., Thelypteridaceae, *Asplenium* cf. *laserpitiifolium, Diplazium bantamense* var. *bantamense, D. bantamense* var. *alternifolium, D. subserratum, D. betimusense, D. tomentosum, D. xiphophyllum* dan *D. sorzogonense*. Araceae, Moracceae, Myrtaceae, Rubiaceae
Samperen Forest, Bukit Layang *C. barometz*	385/0.5	45-50	1110-1165	27	72	50-75	Red Inseptisol	3-7	2-3	6.2	*Pteridium aquilinum, Woodwardtia* sp., *Lindsaea* sp., *Cheiopleura biscupsis, Taenitis blechnoides* Araceae, Myrtaceae,
Forest of Bukit Kuta Buluh Secondary forest *C. barometz*	402/0.5	30-40	800	29.4	78	30-40	Red Inseptisol	3-10	2.5-4	5.5	*Dicranopteris linearis, Gleichenia truncata, Pteridium aquilinum, Nephrolepis hisutula*. *Piper aduncum*, Moraceae,
Sungai Sae Binge Forest Secondary forest *C. barometz*	163/0.5	0-90	740-760	25-26.4	83-88	40-45	Yellow podzolid	3	3	5.2-5.8.	*Blechnum orientale, Lindsaea* sp., *Taenitis blechnoides* Araceae, Arecaceae, Myrtaceae,

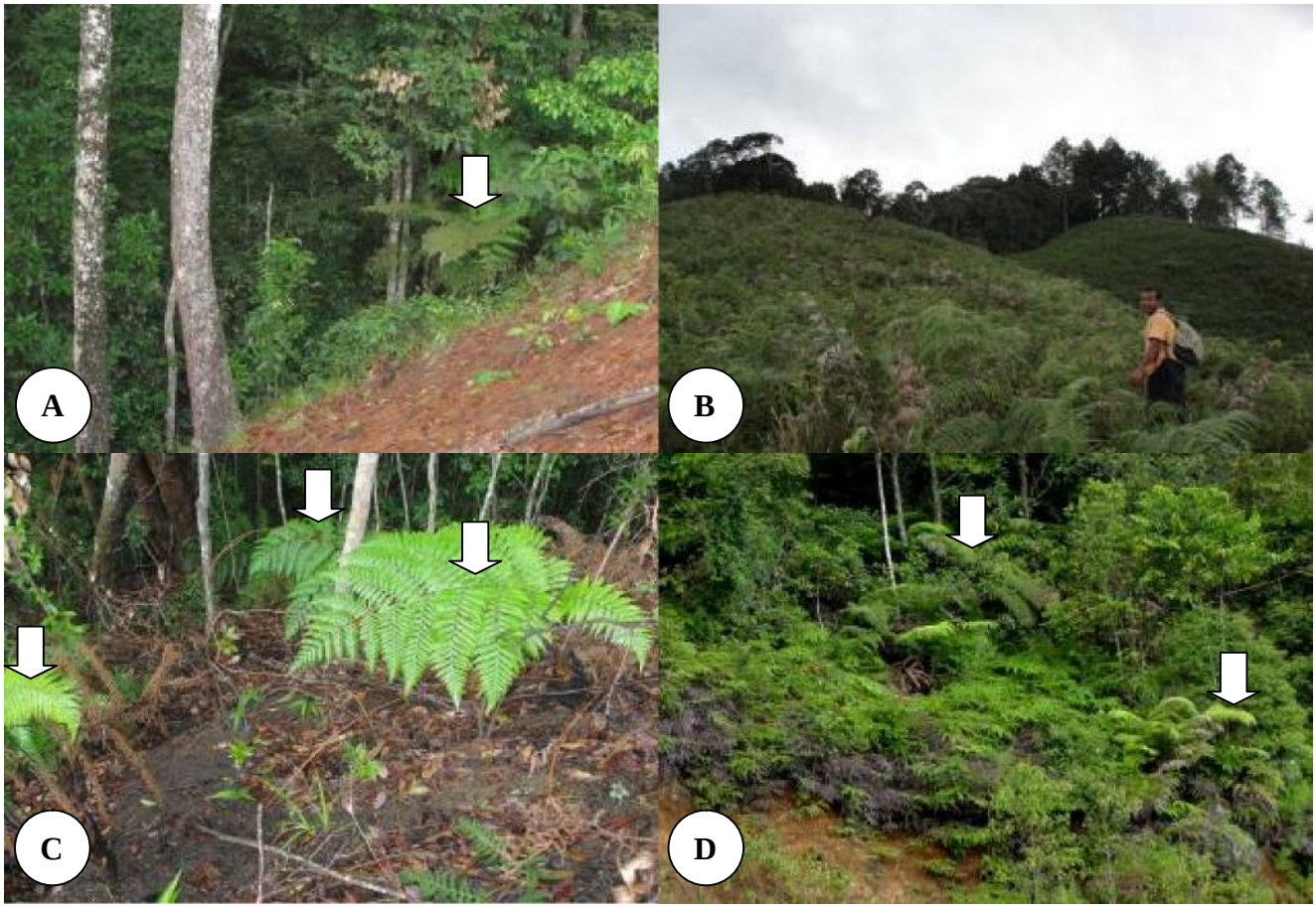

Figure 5. Habitat characteristics of *Cibotium barometz*. a. and b. Margin of primary forest at Bukit Layang; c. Burning areas of secondary forest of Bukit Layang showing three plants of *C. barometz*; d. Margin of secondary forest at Bukit Butar showing the associated fern species of *C. barometz*, *Dicranopteris linearis* and *Gleichenia truncate*. White arrow showing individual or clump of *C. barometz*

of Bukit Layang and Bukit Butar. The species which is usually the dominants or more robust ones in the community, in particular they are those whose population dynamics has a strong effect on other species in the community is included in key species (Mueller-Dombois 2005). In the mature Hawaiian rainforest *Cibotium* spp revealed the characteristic of key species.

Population size

Population size data of *Cibotium* species in North Sumatra is presented in Table 2. These are new potential distribution of *Cibotium* in Sumatra. Secondary forest of Bukit Butar and Kataruman Forest, Bukit Takur-Takur, showed a relatively high population size of *C. barometz* , more than 1000 adult plants in one hectare areas. Bukit Layang and Bukit Kuta Buluh were also revealed a high enough population size as the two localities showed an estimation population size of 350-400 individuals of adults plant in 0.5 hectare areas. The relative density of *C. barometz* per hectare is usually determined by distance among the individual plants or clumps, clumps size, the dominance of the habit whether solitary or forming a clump.

In comparison with the population of *C. barometz* the population size *C. rachnoideum* in Lao Pondom is very small as it was only 372 individuals in 2500 m^2. Habit type appears significant in determining the population size of the two species. In North Sumatra *C. arachnoideum* is usually grows solitary or forms a clump which is only consisted of 2-3 plants whereas *C. barometz* in can form a clump in a range from 2-5 individuals. Habitat characteristics are also significant factors on the population size (Table 2). Referring the categories the criteria of the IUCN Standarts and Petition Subcommittee (2010) used to evaluate if a taxon belongs in threatened categories (Critically Endangered, Endangered or Vulnerable) *C. arachnoideum* in North Sumatra is vulnerable as there is only one population found and the size of population is less than 500 individuals in 2500 m^2 of the areas occupancy.

CONCLUSION

Two species of *Cibotium* are recorded in North Sumatra, namely *C. arachnoideum* and *C. barometz*. *Cibotium arachnoideum* has a strict distribution and is only

found in one locality (Aik Batu Forest, Pondom Stream (Lao Pondom), Aik Hotang Village, Merek Subdistrict, Karo District) and strictly distributed at 1740-1770 m s.l. *C. barometz* is more widely distributed and found at eight localities, namely Butar Hill, Tikungan Amoi Forest, Betimus River, Kataruman Forest, Gunung Sibayak II, trek Mata Air Petani, Samperen secondary forest (Bukit Layang), Bukit Kota Buluh and Sungai Sae Binge secondary forest from elevation 650 until 1200 m. *Cibotium* is commonly growing in open areas and rather opened areas of secondary forest and primary margin forest of hills and lower montane with a relatively high humidity with a range from 30-90º slope in acid soil. In North Sumatra, the two species of *Cibotium* reveal a relatively different habitat characteristic. The two species will not growing together on the same areas because they are living in different altitudes. Population size of *C. barometz* in North Sumatra showed a relatively high population size in four localities (Bukit Butar, Bukit Takur-takur, Bukit Layang, Bukit Kuta Buluh) with the estimation of 700-1500 individuals in 10,000 m^2. *Cibotium arachnoideum* in North Sumatra is vulnerable as there is only one population found and the size of population is less than 500 individuals with an area of occupancy less than 3000 m^2. Further studies on spatial distribution and habitat characteristics of *C. barometz* and *C. arachnoideum* in Sumatra are needed. Further studies on biological characteristics and mechanism triggering the rarity of *C. arachnoideum* in Sumatra are also very important.

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