FERN DIVERSITY OF THE MOSSY FOREST REMNANTS OF THE BSU-AGROFORESTRY PROJECT, BEKTEY, WANGAL, LA TRINIDAD, BENGUET

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ABSTRACT

The study identified the fern species existing in the mossy forest remnants of BSU Agroforestry Project, Bektey, Wangal, La Trinidad, Benguet and determined their abundance (density), dominance rank and economic importance. A total of 18 species of ferns were recorded in the study site.

In terms of number, ***Pneumatopteris nitidula*** *is the most abundant, followed in descending order by* ***Pteridium aquilinum, Dicranopteris spp., Davallia solida, Dicranopteris linearis, Pneumatopteris glabra, Amphineuron terminans, Dipteris cojugata, Christella parasitica, Cyathea contaminans, Angiopteris palmiformis, Pteris glaucoverins, Araiostegia davalloides,*** X_1 ***(unindentified), Blechnum spp.,*** *and* ***Angiopteris evecta. Dryopteris costalisora*** *and* X_2 ***(unindentified)*** *have the least density. In terms of the overall sum dominance ratio (SDR)* ***Cyathea contaminans*** *is the most dominant, followed in descending order by* ***Pteridium aquilinum, Pneumatopteris nitidula, Dicranopteris spp., Christella parasitica, Davallia solida, Angiopteris evecta Dicranopteris linearis, Blechnum spp., Amphineuron terminans, Araiostegia davalloides, Angiopteris palmiformis, Pneumatopteris glabra*** *and* ***Dipteris cojugata.*** *The non-dominant species are* X_2 ***(unindentified),*** X_1 ***(unindentified), Pteris glaucoverins,*** *and* ***Dryopteris costalisora.***

The identified economic importance of ferns includes the following: used as food, medicine, ornamental plants, materials for stage decorations, raw materials in posts, and poles. Weaving and novelty industries.

Follow up study to validate the identity of the encountered species, identify the two unidentified species, and further determine the economic importance of the species is recommended.

KEYWORDS: Ferns, Mossy Forest Remnants

INTRODUCTION

According to Berg (1997), ferns are the largest and most diverse group of spore-producing vascular plants that had undergone a major evolutionary advancement over mosses. Ferns and allies are ancient group of plants that one time dominated the earth's habitable landmasses, but now reduced to about 12,000 species (Moore *et al.*, 1995). They are economically and ecologically important.

The industrial society in which we live depends on energy from fossil fuels such as coals which have been formed from the remains of ancient organisms. Of the five main groups of plants that contributed to coal formation, three of them were seedless vascular plants: the club mosses, horsetails and ferns (Berg, 1997). Ferns are very good indicator of the condition of their immediate environment. Conducting survey of ferns in an area provides a valuable ecological tool to measure environments to the micro level (Nicholls and Nicholls, 1998). It also provides baseline information for analyzing and understanding the dynamics and distribution of plant species or communities and how they relate to the physical environment (www.wildspecies.ca/wildspecies2000/en/SP04DE.html). In general, data on vegetation serves as basis for land-use decisions by government, industry and the general public. The information is used in the decision making on habitat conservation and natural resource management.

Objectives of the Study

This study aimed to Identify, characterize and photo-document fern species existing in the mossy forest remnants of BSU Agroforestation Project, Bektey, Wangal, La Trinidad, Benguet and to determine their abundance, dominance rank and economic importance.

Scope and Delimitation of the Study

The identification of the ferns relied on the services of available professionals and folks knowledgeable or familiar on the species that were encountered, and the use of available herbarium specimens, floral checklist, and literatures. In botanical characterization, only the following were described: leaf shape, margins, base, apex, size, color, arrangement and surface features; and stem or "petiole" diameter, height and surface features.

METHODOLOGY

Locale and Time of the Study

The study site, is located in Lot 1a of BSU Land Reservation, Bektey, Wangal, La Trinidad, Benguet (Figure 1). The topography is characterized by steep slopes. The first sampling plot has an elevation range of 1372-1395 masl, the second sampling plot is at 1434-1475 masl and the third plot is at 1298-1348 masl elevation. The study was conducted from December 2006 to March 2007.

Data Gathering

The data were gathered from established three sampling plots measuring 20 x 20 meters. The data gathered are the species and their botanical characteristics, the number of plants in each species, and the species size (height and diameter). Photos and botanical specimen for each species encountered were obtained. From the number and size of each species, species dominance names were determined.

Fern Identification

A botanical specimen was collected from each fern species encountered and a picture of representative fern specimen was taken. To identify the ferns, comparing the morphological characteristics of the collected specimen with available herbarium specimens and published pictures or illustrations of ferns was applied. The specimens and photos were also shown to a dendrologist for identification.

Height and Diameter Measurement

A graduated measuring stick or pole was used for the measurement of the height of tree ferns and other large ferns found in the sampling plots. Large stem diameter were measured using diameter tape; small stems were measured using a caliper.

Species Population and Density

The population of every fern species in the sampling plots was determined. Using the area of the sampling plot and the population of every fern species, their densities were computed. The following formula was used:

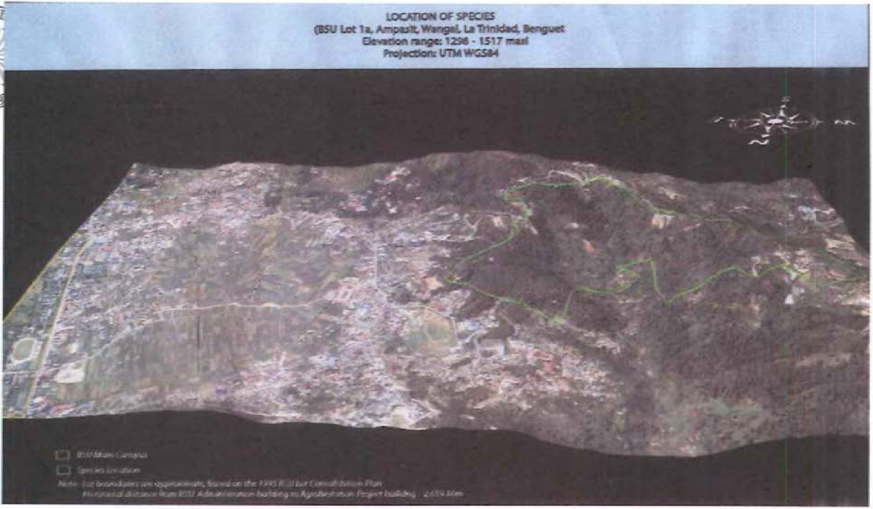

Figure 1. *Location of Species.*

$$\text{Fern Density} = \frac{\text{No. of individuals of a species}}{\text{Area of sampling plot}}$$

Species Characterization

The leaf of ferns encountered was described in terms of the shape, size, color, arrangement and the surface feature. The stem or "petiole" was described in terms of the color, size (diameter and height) and other observeable special structures.

Species Dominance

The data from the population or density and size of the species encountered were used in determining their dominance. The following formula are applied:

1. $\text{Density} = \frac{\text{No. of individuals of a fern species}}{\text{Area of sampling plot}} \times 100$

2. $\text{Relative Density (RDe)} = \frac{\text{Density of a fern species}}{\text{Sum of densities of all fern species}} \times 100$

3. $\text{Relative height (RH)} = \frac{\text{Average height of a fern species}}{\text{Total average of heights of all fern species}} \times 100$

4. $\text{Relative diameter (RDi)} = \frac{\text{Average diameter of a fern species}}{\text{Total average diameters of all fern species}} \times 100$

5. $\text{Sum dominance ratio (SDR)} = \frac{\text{RH + RDi + RDe}}{3}$

Ranking was based on the sum of relative density, relative diameter, and relative height of the species, divided or not by 3 species; the species of the highest sum of RH + RDi + RDe was considered as the most dominant, followed by the next highest, and so on.

RESULTS AND DISCUSSION

Species Identified Their Characteristics and Uses

A total of 18 species were encountered (Table 1). Twelve species were recorded in the first sampling plot, 13 species in the second sampling plot and two species in the third sampling plot. Sixteen species were identified; the other two species were not, thus named X_1 and X_2.

Table 1. *Fern species encountered in the three sampling plots*

COMMON NAME/ CODE NAME	SCIENTIFIC NAME	FAMILY NAME
---	*Pneumatopteris nitidula*	Thelypteridaceae
---	*Pneumatopteris glabra*	Thelypteridaceae
Turnip fern	*Angiopteris evecta*	Marattiaceae
Pakong kalabao	*Angiopteris palmiformis*	Marattiaceae
Kilob	*Dicranopteris linearis*	Gleicheniaceae
---	*Dicranopteris spp.*	Gleicheniaceae
---	*Araiostegia davalloides*	Davalliaceae
Rabbit's foot fern	*Davallia solida*	Davalliaceae
Tree fern	*Cyathea contaminans*	Cyatheaceae
---	*Christella parasitica*	Thelypteridaceae
---	*Pteris glaucoverins*	Pteridaceae
---	*Dipteris conjugate*	Dipteridaceae
---	*Blechnum spp.*	Blechnaceae
---	*Dryopteris costalisora*	Dryopteridaceae
Bracken fern	*Pteridium aquilinum*	Dennstaedtiaceae
Lokdo	*Amphineuron terminans*	Thelypteridaceae
X_1 (unidentified)	---	---
X_2 (unidentified)	---	---

--- Unknown/unidentified

There were 11 genera identified, namely: *Pneumatopteris, Dicranopteris, Angiopteris, Davallia, Cyathea, Pteris, Dipteris, Blechnum, Dryopteris, Pteridium,* and *Amphineuron.* Seven out of the 18 species were identified with both common name and scientific name, another seven were identified with their scientific name only, and two were only identified with their respective genus.

***Pneumatopteris nitidula* (C. Presl.) Holttum.**

Botanical description. Terrestrial fern, rhizomes are short and erect. Stipes are straw colored, up to 50 cm long. Leaf blades are pinnate and thin, up to 100 cm long. Reduced pinnae up to 8 pairs, with auricle, or dilated; basal normal pinnae not arrowed at their bases; middle pinnae evenly attenuated at apex.

Habitat, distribution and use. Common at low altitudes, sometimes in open places but usually near streams; endemic to the Philippines; maybe cultivated as an ornamental plant (Edwino, 2004).

***Pneumatopteris glabra* (Copel.) Holtt**

Botanical description. Rhizomes creeping. Stipes short, with 50-100 cm long pinnae, dark glossy, bearing 1 mm long irregular spines. Reduced pinnae many pairs, consisting of a conical aeophore and very small lamina. Lamina up to 120 cm long, caudate to acuminate, lobed; veins 8-10 pairs; lower surface strongly postular; and postules and veins bearing minute capitate hairs.

Habitat and distribution. Frequently petrophytic; found on rocky outcrops along streams or in moist, more or less exposed low to middle altitude forests; occurring on forest at about 1,000m elevation in Benguet; common on forest at about 300-450m elevation elsewhere in Kalinga, Apayao, Benguet , Quezon Province, Mt. Banahaw, Leyte, Baybay municipality, and Bohol (Zamora, *et al.*, 1986).

***Angiopteris evecta* (G. Frost) Hoffm**

Botanical description. A terrestrial fleshy robust fern, develops a stout, nearly globose stem of up to 60 cm thick. Leaves are ovate up to 7 m long; the oblong pinnae linear are succulent, dark green and finely toothed. Sori are elongated, submarginal and in double rows along the veins.

Habitat and distribution. Terrestrial; native to the warmer regions of Japan, Polynesia and Madagascar; and grows in some gardens in the Philippines (Madulid, 2000).

***Angiopteris palmiformis* (Cav. Christ)**

Botanical description. Robust, giant ground fern with very short, wooly, brown stem; sometimes almost stemless. Leaf stalk is cylindrical up to 1 m long and covered with brownish scales. Leaves are bipinnate, about 1.5 m long and 1.3 m wide. Leaflets are up 13 cm long, and more than 20 on one

side of the rachis. Pinnae are about 68 mm long and 30 mm wide, stalked; the stalk is swollen and fleshy. Rhizome is about 26 cm or more in diameter.

Habitat, distribution and uses. Terrestrial, occuring along streams, trails and edges of open areas in forests; reportedly indigenous to China, Taiwan, Philippines and the Marianas Islands. The form has fiddle heads are eaten as a component of stew, cultivated as an ornamental (Madulid, 2000).

Dicranopteris spp.

Botanical description. Rhizomes are long, usually creeping near the surface of soil, covered with branched hairs or fringed scales; stipes usually distant, slender, terete, and wiry; fronds are pseudo-dichotomously branched, with a dormant apical bud between branches; apical bud is covered with hairs and scales and often with stipule-like bracts, the dormant ones give rise to an extension of the rachis at a later season, thus producing a very long rachis with the side branches; ultimate branches pinnatifid or bipinnatifid, cut nearly up to costa; veins free, simple or forked. Sori on back veins exindusiate.

Habitat, distribution and uses. Terrestrial, usually occurs on exposed and semi-exposed areas of mountains throughout the Philippines, frequently forming dense tangles. Splints from rachis are excellent material for weaving coiled baskets and in making belts and mats (Brown, 1921). The stems may be woven into partition walls for houses, fish traps, chairs or stools, caps and pouches. The leaves are medicinal as a poultice and an infusion or a decoction from it is sometimes drunk by people suffering from fever (Burkill, 1935).

Dicranopteris linearis Underw.

Botanical description. A vigorously creeping ground fern with long stems and slender rhizomes. Leaves are branched equally or unequally into two forks. Ultimate branches are about 30 cm long and 12 cm wide, with brown sori on the underside.

Habitat distribution and use. Terrestrial, usually thrives on exposed and semi-exposed areas on mountains throughout the Philippines, frequently forming dense tangles. Occasionally grown as an ornamental plant and used as floral decoration during fiestas and religious rituals (Edwino, 2004).

Araiostegia davalloides

The leaf is pinnately compound, finely dissected into small pinnules. It could be grown as an ornamental and used in landscaping.

***Davallia solida* (Forst.) Sw.**

Botanical description. Fronds are dimorphic. Sterile lamina broadly deltoid, about 19 cm long and 25 cm wide, and with well-spaced, usually sub-opposite pinnae; tripinnate at the base only, the middle part tripinnatifid; pinnae rather narrowly deltoid, deeply lobed at base and shallowly lobed towards the apex, the lobes are broadly elliptic at the base with crenate edges and rounded apices. Fertile lamina is more deeply lobed, tripinnate at the lower half, the pinnules and their lobes somewhat narrower than that of the sterile lamina and each lobe bear several sori.

Habitat, distribution, and uses. It occurs at sea level up to about 600 m altitudes, widespread in Malay Peninsula, Philippines and Polynesia and cultivated in gardens as a hanging plant or an air plant (Zamora, *et al.* 1986).

***Cyathea contaminans* (Hook.) Copel**

Botanical description. Grows up to 7 m tall. The trunk is covered with black, stiff interlacing roots. Leaves are bipinnate, up to 2.5 m long. Leaf stalk is stout, spiny, purplish, glaucous and glabrous when mature; when young, it is densely scaly; the scales is about 18mm long and nearly 1 mm wide, dirty white, linear and with dark setae along edges. Pinnae are up to 56 cm long and 24 cm wide. Middle pinnules are about 8 cm long and 1.8 cm wide.

Habitat, distribution and uses. Terrestrial, usually occur in open places of up to 1,300 m elevation. Widely distributed in India to New Guinea and the Philippines. Thrives well in places with a simulated forest ground. All *Cyathea spp.* are highly prized ornamentals. The trunks can be used as house post, poles and support for ornamental climbers. Sections of the trunks are often made into vases, pencil holders and umbrella holders. The trunks may be also splitted and the hard parts are used for inlaying or for making small fancy boxes and frames (Brown, 1992). Roots and trunks are shaped like pots and used for potting orchids (Quisumbing, 1957, Madulid, 2000 and Zamora, *et. al.*, 1986).

***Christella parasitica* (Linn) Lev.**

Botanical description. Rhizomes are short, creeping; with brown scales of about 1 cm or longer, and that are broad, thin, aciculate at apex and hairy at the edges and surfaces. Fronds are contiguous and bipinnatifid. Stipes measure about 30 cm long, scaly at base (the scales are similar with that of its rhizome), straw-colored to very light purplish, and densely clothed with acicular hairs. Rachis is more or less densely clothed throughout with acicular hairs of about 1 mm long. Leaves measure about 50 cm long and 17

Plate 2. *Pneumatopteris nitidula* (C. Presl.) Holttum. Family Thelypteridaceae

Plate 3. *Pneumatopteris glabra (Copel.) Holtt. Family Thylepteridaceae*

Plate 4. *Angiopteris evecta (G. Frost) Hoffm Local name: Turnip fern Family Marattiaceae*

Plate 5. *Angiopteris palmiformis (Cav.) Christ Local name: Giant fern Common name: Salaguisog Family Marattiaceae*

Plate 6. *Dicranopteris spp., Family Gleicheniaceae*

Plate 7. *Dicranopteris linearis Underw., Family Gleicheniaceae*

cm wide, ovate-oblong, pinnatifid, with about 16 pairs of pinnae; lowest pair of pinnae not or only slightly reduced and deflexed. Pinnae is about 9 cm long and 1.5 cm wide, stalkless, truncate at base, rounded or broadly truncate and auricled on acroscopic side at apex.

Habitat, distribution and use. Terrestrial, occuring throughout Southeast Asia on fairly open or lightly shaded places along banks of canals or ditches, can be grown as an ornamental plant and for landscaping (Zamora, *et al.* 1986).

***Pteris glaucoverins* Goldm.**

Botanical description. Rhizome stout, ascending; with castaneous, lanceolate- attenuate paleae, commonly 3 mm long. Stipe up to 80 cm (commonly 30 to 40 cm) long, grooved on the ventral face and rounded on the dorsal side, glabrescent except near the base, stramineous to brown; lamina rather longer than the stipe, bipinatifid except at the base and apex, the pinnatifid apex larger than the pinnae below it, the basal pinnae as long as or a little longer than the succeeding pinnules, each with a basiscopic pinnule (prong or auricle) that is smaller than the body of the pinnae. Intermediate lateral pinnae commonly 7 to 10 pairs, subsessile or sessile or the lowest is stalked, up to 35 cm long and 5 cm broad, acuminate to long caudate, pinnatifid.

Habitat, distribution and use. Terrestrial, occuring in moist, exposed areas, fairly common at low altitudes (near sea level to more or less 1,000 m) throughout Luzon and Central Philippines; can be grown in home garden as an ornamental plant (Zamora, *et al.* 1986).

***Dipteris conjugata* Reinw.**

Botanical description. Rhizome is about 1 cm in diameter. Fronds is fan-shaped, cut into two halves, main lobe of each half is narrowly lanceolate with 2 main veins in each lobe, divided over ¾ of way from margin to base, apex is acuminate, margins thickened with coarse serrations; main veins prominently raised; young fronds are densely covered with soft reddish-brown tomentum, especially on apices of lobes, mature fronds are glabrous and glaucous beneath.

Habitat, distribution and use. Found in the Philippines, Indonesia, Island of Pacific, Taiwan and South West China; can be observed along the road/trail to the mossy forest from 1,700m to 2,400m elevation. Leaves can be used as a substitute for anahaw leaves in making wedding decorations (Aguilar, 2000).

Blechnum spp.

Leaflets are lanceolate, sub-opposite, leathery, oblique, serrated at margins, acute at base and acuminate at apex; midrib is pale green.

It can be utilized as an ornamental plant.

***Dryopteris costalisora* Geobot**

Botanical description. Rhizome is thick, densely covered with ovate-lanceolate scales that are reddish brown to pale brown. Stipes about 20 cm long, stramineous, scaly at base; lamina lanceolate in outline, bipinnatifid, about 20 cm long by 7 cm broad; pinnae ascending, 4-5 cm long, with 1-2 mm long petioles; pinnules obtuse, crenulate; veins simple or once forked; scales on rachis and under surface sparse, narrowly lanceolate, and brown.

Habitat, distribution and use. Terrestrial, distributed in Himalayas Region and Taiwan; ornamental (Geobot, 1934).

***Pteridium aquilinum* (Linn.) Kuhnn**

Botanical description. Rhizomes are branched long and hairy; the hairs are pale brown. Fronds have large stipes up to 70 cm long; laminae is large, over 1 meter long, tripinnate-quadripinnatifid, deltoid to lanceolate, sequence of pinnules catadrous but secondary architecture is mostly anadromous, coriaceous, and densely hairy beneath; pinnae, rachis and costae are hairy above. Basal pinnae not reduced, largest pinnae up to more than 40 cm long; basal acroscopic pinnule often much reduced, pinnules up to 13 cm long, linear, pinnatifid almost to costa or fully pinnate, segments entire. Sori submarginal, linear; indusia two, one consisting of a thin reflexed edge of the lamina.

Habitat and distribution. Terrestrial, forms thickets in open places of 800-2,500m in elevation; cosmopolitan and found throughout the Philippines (Zamora, *et al.* 1986).

***Amphineuron terminans* (Hook.) Holtt**

Botanical description. Rhizome is slender and long. Scales are brown or dull reddish, about 6 mm long. Fronds are tufted, pinnate, with up to 25 pairs of pinnae that are thin and about 70 cm long. Middle pinnae is acuminate at apex, shallowly lobed at its half towards costa, not narrowed at bases; basal pinnae up to 2 pairs, either not reduced or somewhat reduced, rarely strongly reduced, and narrowed at bases. Apex of fronds usually similar to lateral pinnae, with small yellow glands along veins at the tip of lobes. Veins

Plate 8. *Araiostegia davalloides,*
Family Davalliaceae

Plate 9. *Davallia solida (Forst.) Sw.*
Local name: Rabbit's foot fern
Family Davalliaceae

Plate 10. *Cyathea contaminans (Hook.) Copel*
Local name: Tannapo (Kankana-ey)
Common name: Tree fern, Pakong Buaya
Family Cyatheaceae

Plate 11. *Christella parasitica (Linn.) Lev*
Family Thylepteridaceae

Plate 12. *Pteris glaucovirens Goldm.*
Local name: Tabtabi sapa
Family Pteridaceae

Plate 13. *Dipteris conjugata Reinw*
Family Dipteridaceae

anastomosing. Sori are marginal, confined to the tip of lobes.

Habitat, distribution and use. Endemic to the Philippines; commonly occuring on rocky stream banks of 100 to 700 m altitude; cultivated as an ornamental plant (Zamora, *et al.* 1986).

X_1 (unidentified)

Botanical description and use. Leaflets are subopposite, glabrous and shiny; the lower ones are shortly stalked, the upper are usually stalkless; margin is slightly crenated and apex is broadly pointed. It can be used as an ornamental plant.

X_2 (unidentified)

Botanical description and use. Stipes stout and hairy, with dense hairs at the base. Laminae is glabrous with caudate apex and cuneate base. Pinnae have hairy rachis, acute apex, oblique base, and crenate edges; the lower ones are shortly stalked, the uppers one are almost stalkless. It can be used as an ornamental plant.

Species Dominance

Species dominance reflects the functional values of the species such as their density, height and diameter. The species of greater density, height and diameter are said to be more dominant than those which have less.

Population and Density

As shown in the Table 2, *Pneumatopteris nitidula* has the highest population, followed in descending order by *Pteridium aquilinum, Dicranopteris spp., Davallia solida, Dicranopteris linearis, Pneumatopteris glabra, Amphineuron terminans, Dipteris conjugata, Christella parasitica, Cyathea contaminans, Angiopteris palmiformis, Araiostegia davalloides, X1, Blechnum spp., Angiopteris evecta, Pteris glaucoverins, Dyropteris costalisora* and *X2.*

As shown in Table 3, *Pneumatopteris nitidula* has the highest density, followed in descending order by *Pteridium aquilinum, Dicranopteris spp., Davallia solida, Dicranopteris linearis, Pneumatopteris glabra, Amphineuron terminans, Dipteris conjugata, Christella parasitica, Cyathea contaminans, Angiopteris palmiformis, Pteris glaucoverins, Araiostegia davalloides, X_1, Blechnum spp.* and *Angiopteris evecta. Dyropteris costalisora* and X_2 were the least in density.

Plate 14. *Blechnum spp.*
Family Blechnaceae

Plate 15. *Dryopteris costalisora Geobot*
Family Dryopteridaceae

Plate 16. *Pteridium aquilinum (Linn.) Kuhn*
Local name: Anam-am (Kankana-ey)
Common name: Bracken fern
Family Dennstaedtiaceae

Plate 17. *Amphineuron terminans (Hook.) Holtt*
Common name: Lokdo
Family Thelypteridaceae

Plate 18. X_1 *(unidentified)*

Plate 19. X_2 *(unidentified)*

Table 2. Number of individuals per species encountered in the three sampling plots

SPECIES		SAMPLING AREA			NUMBER OF INDIVIDUALS PER SPECIES
COMMON NAME/ CODE NAME	SCIENTIFIC NAME	1	2	3	
	Pneumatopteris nitidula	422	62		484
	Pneumatopteris glabra		30		30
Turnip fern	*Angiopteris evecta*	2			2
Pakong kalabao	*Angiopteris palmiformis*	1	13		14
Kilob	*Dicranopteris linearis*	67			67
	Dicranopteris spp.	151	13		164
	Araiostegia davalloides	4			4
Rabbit's foot fern	*Davallia solida*	30	71		101
Tree fern	*Cyathea contaminans*	6	3	5	14
	Christella parasitica	22	1		23
	Pteris glaucoverins		1		1
	Dipteris conjugata	28			28
	Blechnum spp.		2		2
	Dryopteris costalisora		1		1
Bracken fern	*Pteridium aquilinum*	6		467	473
Lokdo	*Amphineuron terminans*		30		30
X_1		3	1		4
X_2			1		1
TOTAL		**772**	**236**	**472**	**1480**

Table 3. Density and relative density of species

SPECIES	DENSITY (PER HECTARE)	RELATIVE DENSITY (PERCENT)
Pneumatopteris nitidula	4,033.33	33.38
Pneumatopteris glabra	250	2.07
Angiopteris evecta	16.67	0.14
Angiopteris palmiformis	116.67	0.96
Dicranopteris linearis	558.83	4.62
Dicranopteris spp.	1,366.67	11.31
Araiostegia davalloides	33.33	0.27
Davallia solida	841.67	6.96
Cyathea contaminans	116.67	0.97
Christella parasitica	191.67	1.59
Pteris glaucoverins	66.67	0.55
Dipteris conjugata	233.33	1.93
Blechnum spp.	16.67	0.14
Dryopteris costalisora	8.33	0.07
Pteridium aquilinum	3,941.67	32.62
Amphineuron terminans	250	2.07
X_1	33.33	0.27
X_2	8.33	0.07
TOTAL	**12,083.84**	**99.99**

Average and Relative Diameter

As shown in Table 4, *Cyathea contaminans* has the largest average and relative diameter, followed in descending order by *Angiopteris evecta, Blechnum spp., Pteridium aquilinum, Angiopteris palmiformis, Christella parasitica, Dicranopteris spp., Amphineuron terminans, X_2, Araiostegia davalloides, Davallia solida, Pneumatopteris nitidula, Pneumatopteris glabra, Dipteris conjugata, X_1, Dicranopteris linearis* and *Pteris glaucoverins. Dryopteris costalisora* has the smallest average and relative diameter.

Table 4. Average diameter and relative diameter of species

SPECIES	AVERAGE DIAMETER (cm.)	RELATIVE DIAMETER (PERCENT)
Pneumatopteris nitidula	0.56	2.43
Pneumatopteris glabra	0.43	1.87
Angiopteris evecta	1.68	7.30
Angiopteris palmiformis	1.00	4.34
Dicranopteris linearis	0.36	1.56
Dicranopteris spp.	0.91	3.95
Araiostegia davalloides	0.61	2.65
Davallia solida	0.58	2.52
Cyathea contaminans	10.89	47.31
Christella parasitica	1.03	4.47
Pteris glaucoverins	0.35	1.52
Dipteris conjugata	0.40	1.74
Blechnum spp.	1.18	5.12
Dryopteris costalisora	0.16	0.69
Pteridium aquilinum	1.11	4.82
Amphineuron terminans	0.75	3.26
X_1	0.38	1.65
X_2	0.64	2.78
TOTAL	**22.99**	**99.98**

Average and Relative Height

As shown in Table 5, *Cyathea contaminans* has the highest average height and relative height, followed in descending order by *Christella parasitica, Dicranopteris spp., Pteridium aquilinum, Blechnum spp., Angiopteris evecta, Araiostegia davalloides, Dicranopteris linearis, Amphineuron terminans, Pneumatopteris nitidula, Pneumatopteris glabra, Davallia solida, Angiopteris palmiformis, X_1, Dipteris conjugata, X_2* and *Pteris glaucoverins. Dryopteris costalisora* was the shortest species in the sampling area.

Table 5. Average height and relative height of species

SPECIES	AVERAGE HEIGHT (cm)	RELATIVE HEIGHT (PERCENT)
Pneumatopteris nitidula	131.58	5.11
Pneumatopteris glabra	120.3	4.68
Angiopteris evecta	155.09	6.03
Angiopteris palmiformis	93.17	3.62
Dicranopteris linearis	144.41	5.61
Dicranopteris spp.	182.52	7.09
Araiostegia davalloides	154.23	5.99
Davallia solida	104.28	4.05
Cyathea contaminans	490.07	19.05
Christella parasitica	210.15	8.17
Pteris glaucoverins	53	2.06
Dipteris conjugata	70.07	2.73
Blechnum spp.	167.25	6.50
Dryopteris costalisora	48	1.86
Pteridium aquilinum	167.27	6.50
Amphineuron terminans	139.16	5.41
X_1	74.08	2.88
X_2	68	2.64
TOTAL	**2,572.63**	**99.98**

Sum Dominance Ratio

Based on the computed sum dominance ratio (SDR) as shown in Table 6, *Cyathea contaminans* is the most dominant, followed in descending order by *Pteridium aquilinum, Pneumatopteris nitidula, Dicranopteris spp., Christella parasitca, Davallia solida, Angiopteris evecta, Dicranopteris linearis, Blechnum spp., Amphineuron terminans, Araiostegia davalloides, Angiopteris palmiformis, Pneumatopteris glabra* and *Dipteris conjugata*. The non-dominant species are X_1, X_2, *Pteris glaucoverins* and *Dryopteris costalisora*.

Table 6. Relative density, relative diameter, relative height and sum dominance ratio of fern species encountered in the three sampling plots

COMMON NAME/CODE NAME	SCIENTIFIC NAME	RELATIVE DENSITY %	RELATIVE DIAMETER %	RELATIVE HEIGHT %	SUM DOMINANCE RATIO	RANK
	Pneumatopteris nitidula	33.38	2.43	5.11	13.64	3
	Pneumatopteris glabra	2.07	1.87	4.68	2.87	12
Turnip fern	*Angiopteris evecta*	0.14	7.30	6.03	4.49	7
Pakong kalabao	*Angiopteris palmiformis*	0.96	4.34	3.62	2.97	11
Kilob	*Dicranopteris linearis*	4.62	1.56	5.61	3.93	8
	Dicranopteris sp.	11.31	3.95	7.09	7.45	4
	Araiostegia davalloides	0.27	2.65	5.99	2.97	11
Rabbit's foot fern	*Davallia solida*	6.96	2.52	4.05	4.51	6
Tree fern	*Cyathea contaminans*	0.97	47.31	19.05	22.16	1
	Christella parasitica	1.59	4.47	8.17	4.74	5
	Pteris glaucoverins	0.55	1.52	2.06	1.38	16
	Dipteris conjugata	1.93	1.74	2.73	2.13	13
	Blechnum sp.	0.14	5.12	6.50	3.92	9
	Dryopteris costalisora	0.07	0.69	1.86	0.87	7
Bracken fern	*Pteridium aquilinum*	32.62	4.82	6.50	14.65	2
Lokdo	*Amphineuron terminans*	2.07	3.26	5.41	3.58	10
X_1		0.28	1.65	2.88	1.60	15
X_2		0.07	2.78	2.64	1.83	14
	TOTAL	**99.99**	**99.98**	**99.98**		

SUMMARY, CONCLUSIONS AND RECOMMENDATION

Summary

The study was conducted at the BSU- Agroforestry Project, Bektey, Wangal, La Trinidad; Benguet from December 2006 to March 2007. Three sampling plots measuring 20m x 20m were established where data were gathered. The study aimed to identify, characterize and photo-document, the fern species existing in the study site and to determine the dominance rank and economic importance.

Findings. A total of 18 species were encountered; two of them were not identified. The identified species belong to genera *Pneumatopteris, Dicranopteris, Angiopteris, Dipteris, Davallia, Araiostegia, Cyathea, Pteris, Blechnum, Dryopteris, Pteridium,* and *Amphineuron and Christella.*

Pneumatopteris nitidula has the highest population (most abundant) and density, followed in descending order by *Pteridium aquilinum, Dicranopteris spp., Davallia solida, Dicranopteris linearis, Pneumatopteris glabra, Amphineuron terminans, Dipteris cojugata, Christella parasitica, Cyathea contaminans, Angiopteris palmiformis, Pteris glaucoverins, Araiostegia davalloides,* X_1*, Blechnum spp., Angiopteris evecta, Dryopteris costalisora* and X_2 have the least population and density.

In terms of stem size, *Cyathea contaminans* has the largest average stem diameter, followed in descending order by *Angiopteris evecta, Blechnum spp., Pteridium aquilinum, Angiopteris palmiformis, Christella parasitica, Dicranopteris spp., Amphineuron terminans,* X_2*, Araiostegia davalloides, Davallia solida, Pneumatopteris nitidula, Pneumatopteris glabra, Dipteris cojugata,* X_1*, Dicranopteris linearis,* and *Pteris glaucoverins. Dryopteris costalisora* has the lowest stem average.

In terms of average height, *Cyathea contaminans* has the highest followed in descending order by the *Christella parasitica, Dicranopteris sp., Pteridium aquilinum, Blechnum sp., Angiopteris evecta, Araiostegia davalloides, Dicranopteris linearis, Amphineuron terminans, Pneumatopteris nitidula, Pneumatopteris glabra, Davallia solida, Angiopteris palmiformis,* X_1*, Dipteris conjugata,* X_2*,* and *Pteris glaucoverins. Dryopteris costalisora* has the smallest average height.

Based on the computed sum dominance ratio (SDR), the most dominant is the *Cyathea contaminans,* followed in descending order by *Pteridium aquilinum, Pneumatopteris nitidula, Dicranopteris spp., Christella parasitica, Davallia solida, Angiopteris evecta, Dicranopteris linearis, Blechnum spp.,*

Amphineuron terminans, Araiostegia davalloides, Angiopteris palmiformis, Pneumatopteris glabra and *Dipteris conjugata.* The non-dominants are X_2, X_1, *Pteris glaucoverins* and *Dryopteris costalisora.*

The species encountered are assessed to have potentials as landscaping or ornamental species; they can be used for decorating stages, walls, and corridors. The fiddle heads of *Angiopteris palmiformis* is reported to be edible; The *Dicranopteris sp.* is reportedly used as poultice and decoration or ifusion from its leaves can be use to treat fever. Many are used as raw materials in weaving baskets, fish traps, belts, nets, chairs/stools, caps, and pouches. the *Cyathea contaminans* used as posts, poles, support for climbing plants, and as raw material in making vases, pencil and umbrella holders, fancy boxes and frames.

Conclusions

Based on the results of the study, the following conclusions are drawn:

1. There is high fern species diversity within the BSU- Agroforestry Project, Bektey, Wangal, La Trinidad, Benguet.

2. Being the most dominant fern species in the study site, *Cyathea contaminans, Pteridium aquilinum, Pneumatopteris nitidula, Dicranopteris sp., Christella parasitica, Davallia solida, Angiopteris evecta, Dicranopteris linearis, Blechnum spp., Amphineuron terminans, Araiostegia davalloides angiopteris palmiformis, Pneumatopteris glabra* and *Dipteris conjugata* can be the most easily and commonly observed species in the study site.

3. The study site has a high economic potential as to its fern resources alone.

Recommendations

It is recommended that the mossy forest remnants of BSU-Agroforestry Project should be preserved for its high fern diversity that is of high economic potential and ecological importance. Follow up study should be conducted to validate the identity of fern species encountered, identify the two unidentified species and further determine their economic and ecological importance.

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