TAXONOMIC STUDY ON THIRTEEN FERNS AND FERN ALLIES FROM HTEE SE KHAR WATERFALL AREA, KAYAH STATE

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Abstract

The taxonomic study on ferns and fern allies from Htee Se Khar Waterfall area, Loikaw Township have been undertaken. The study area is situated between North Latitude 19°52' and 19°53' and East Longitude 97°14' and 97°15'. All the species were collected from June to October 2017. The 13 species belonging to 11 genera and 8 families were included. Most of the ferns are found as terrestrial and epiphytes on the trunk of tree. *Selaginella braunii* Baker, *Selaginella ciliaris* (Retzius) Spring, *Adiantum capillus-veneris* L., *Adiantum caudatum* L., *Cystopteris fragils* (L.) Bernh, *Pteris vitata* L., *Ampelopteris prolifera* (Retz) Copel, *Cyclosorus interruptus* (Wild) Hito are found as terrestrial species. *Drynaria sparsisora* (Desv.) T. Moore, *Microsorum punctatum* (L.) Copel, *Pyrrosia nuda* (Gies) Cheng and *Psilotum nudum* L.P. Beavu are found as epiphytic species, *Equisetum ramosissimum* var. *altissimum* Bir is found as semi-aquatic species. All the collected species are described with figures of photographs. Artifical key of the collected plant, comparable characteristics of the species was conducted.

Keywords: Taxonomic study, ferns and ferns allies, Loikaw Township, Kayah State,an artificial key

Introduction

Pteridophytes (ferns and fern allies) are called as reptile group of plants and are one of the earliest groups of vascular plants. A fern is a kind of plant which produces spores in sporangia borne in patches on the surfaces or edge of a leaf. The patch of sporangia is called a sorous; the presence of sori that can recognize a fern. The pteridophytes constitute a significant part of the earth's plant diversity and being the second largest group of vascular plant

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communities. Pteridophytes are represented by about 305 genera, comprising more than 10,000 species all over the world. About 191 genera and more than 1000 species are reported from India (Joseph & Thomas 2015).

Fern sporophytes are common and very distinctive plants in the vegetation of many parts of the world while a gametophyte is quite inconspicuous. The general sexual life cycle of ferns is characterized by the alternation of two generations consisting of a prominent sporophyte plant and a much smaller but independent plant, the gametophyte. (Sharpe *et al.* 2010).

Spores are formed in sporangia. In eusporangiate ferns, sporangia are formed from a group of cells, which is the plesiomorphic state. Eusporangia are found in all other vascular plants, except in the leptosporangiate ferns, where the sporangium develops from a single cell into a structure with a stalk, wall and spores. Leptosporangiate ferns form a clade that includes the bulk of fern species, but eusporangiate ferns are composed of several independent groups (Christenhusz & Chase 2014).

Pteridophytes have had a long history on the earth. They probably had their maximum development during the carboniferous and started dwindling in numbers and luxuriance thereafter, till the present times when other than the ferns, only seven living genera are now available. These are: *Psilotum*, *Tmesipteris*, *Equisetum*, *Lycopodium* (in the conservative sense), *Phylloglossum*, *Selaginella* and *Isoetes*). The rest are extinct and represented by fossils (Khullar 2000).

There is no detail information of Ferns and their allies in Htee Se khar Waterfall. The Ferns and fern allies are widely distributed and its taxonomic information is still needed to be recorded in Htee Se Khar Waterfall. There were between Shan and Kayah border and the present research area work have forecasted on that area.

The aim and objectives of the study are to classify and identify the fern species, to record their distribution and morphological characteristics, and to provide the knowledge on the natural resources in the study area.

Materials and Methods

Ferns and fern allies were collected from Htee Se Khar Waterfall area in Loikaw Township of Kayah State. The study area is situated between East longitude 97º 14' and 97º 15' and between North latitude 19º 53' and 19º 52', having 899 m above the sea level in elevation, in Loilin lay village area. The specimens were collected from June to October 2017. The members of terrestrial, epiphytes and semi-aquatic species were included. Plant collection and preservation technique of De Vogel 1987 is used to make herbarium.

The plants were pressed directly in the plant press and plant habit, especially the sori bearing surfaces are recorded by coloured photographs.

The Literature that have been used for identification are Noteboom (1959), Beddome (1969), and Winter & Amoroso (2003). The valid scientific names have been used by checking in index of international plant name. The classification systems and arrangement followed to Smith *et al*. (2006). Location map of study area was shown in figure 1. The specimens were mounted together with a label of field data on herbarium sheets which will be deposited at the Herbarium of Botany Department, University of Mandalay for references and further scientific studies.

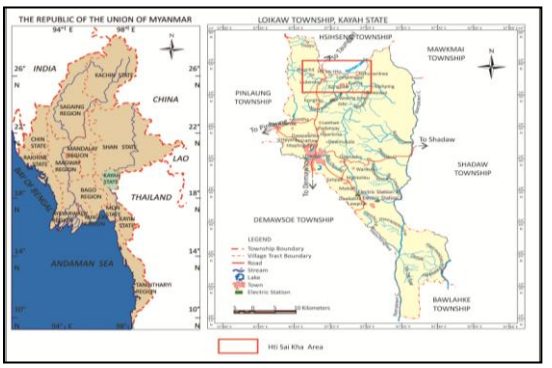

Figure 1. Location map of Htee Se Khar Waterfall Area in Kayah State

Results

In the present study, altogether 13 species of 11 genera belonging to 8 families were collected in Htee Se Khar Waterfall area.

Table 1. The list of collected species

Class	Order	Family	Species
1.Lycopodiospida	1. Lycopodiales	1. Selaginellaceae	1. *Selaginella braunii* Baker.
			2. *Selaginella ciliaris* (Retzius) Spring.
2.Equisetopsida	2. Equisetales	2. Equisetaceae	3. *Equisetum ramosissimum* var. *altissimum* Bir
	3. Psilotales	3. Psilotaceae	4. *Psilotum nudum* L.P. Beavu.
3.Polypodiopsida	4. Polypodiales	4. Adiantaceae	5. *Adiantum capillus-veneris* L.
			6. *Adiantum caudatum* L.
		5. Cystoteridaceae	7. *Cystopteris fragils* (L.) Bernh.
		6. Pteridaceae	8. *Pteris vittata* L.
		7. Thelypteridaceae	9. *Ampelopteris prolifera* (Retz) Copel.
			10. *Cyclosorus interruptus* (Wllid) Hito.
		8. Polypodiaceae	11. *Drynaria sparsisora* (Desv) T. Moore.
			12. *Microsorum punctatum* (L.) Copel.
			13. *Pyrrosia nuda* (Gies.) Ching

Table 2. Comparable attributed characteristics of ferns and fern allies of Htee Se Khar Waterfall area

No.	Botanical name	Habit			Rhizome or caudex			Ramenta	
		Terr es-trial	epip-hyte	semia-quatic	prostrate	erect	colour	shape	colour
1.	*Selaginella braunii* Baker.	+			nil	+		nil	
2.	*Selaginella ciliaris* (Retzius) Spring	+			nil			nil	
3.	*Equisetum ramosissimum* var. *altissimum* Bir			+		+	dark brown	nil	
4.	*Psilotum nudum* L. P. Beavu.		+				dark brown	nil	
5.	*Adiantum capillus-veneris* L.	+			creeping				pale brown
6.	*Adiantum caudatum* L.	+			creeping				dark brown
8.	*Pteris vittata* L.	+				+		linear lanceolate	brownist green
9.	*Ampelopteris prolifera* (Retz.) Copel.	+			creeping			ovate-lanceolate	brownish green
10.	*Cyclosorus interruptus* (Wild). Hito.	+			creeping			linear lanceolate	yellowish brown
11.	*Drynaria sparsisora* (Desv.) T. Moore.		+		creeping		brown	ovate oblong	brownish black
12.	*Microsorum punctatum* (L.) Copel		+		creeping		brown	triangular	brown
13.	*Pyrrosia nuda* (Gies.) Cheng.		+		creeping		dark brown	lanceolate	pale yellow

d

Botanical name	Stipe Colour	Stipe Hair	Frond morphic		Frond	
			mono-	di-	simple	uni
braunii Baker.	yellowish green	nil	+			
ciliaris (Retzius) Spring.	greenish yellow	nil	+			
ramosissimum var.altissimum	green to greenish	glabrous	+			
udum L.P.Beavu.	green	glabrous	+			
capillus-veneris L.	black	glabrous	+			
caudatum L.	dark brown	glabrous				+
fragile (L.) Bemh.	brown	shiny scales	+			
ta L.	brownish green	densely scaly	+			+
is prolifera (Retz) Copel.	plae green	glabrous	+			+
interruptus (Wlid). Hito.	dark brown	glabrous	+			+
parsisora (Desv) T. Moore.	yellowish brown	glabrous		+		
n punctatum (L.) Copel.	strawed colour	glabrous	+		+	
ada (Gies.) Cheng.	pale green	densely	+		+	

Table 2. Continued

No.	Botanical name	Frond						Sporangia	Sp
		Pinnae		Texture				No. of annulus	colour
		pin-nate	pinna-tifid	membr-anous	thin	coria-ceous	firm		
1.	*Selaginella braunii* Baker.			herbaceous					yellowish orange
2.	*Selaginella ciliaris* (Retzius) Spring.								yellow to orange
3.	*Equisetum ramosissimum* var.altissimum Bir					+		nil	bright green
4.	*Psilotum nudum* L.P.Beavu.							nil	lemon yellow
5.	*Adiantum capillus-veneris* L.				+			20	Reddish brown
6.	*Adiantum caudatum* L.	+				+		17	brown
7.	*Cystopteris fragils* (L.) Bemh.		+				+	14	dark brown
8.	*Pteris vittata* L.	+		herbaceous				25	greenish yellow
9.	*Ampelopteris prolifera* (Retz) Copel.					+		16	yellowish brown
10.	*Cyclosorus interruptus* (Wlid). Hito.		+	characteous		+		16	yellowish brown
11.	*Drynaria sparsisora* (Desv) T. Moore.		+					19	Pale yellow
12.	*Microsorum punctatum* (L.) Copel.					+		14	pale yellow
13.	*Pyrrosia nuda* (Gies.) Cheng.					+		16	yellowish brown

+ = Present

Figure 2 A. Habit B. Frond with Sori C. Sporangium D. Spores of *Selaginella braunii* Baker

Figure 3. A. Habit B. Frond with Sori C. Sporangium D. Spores of *Selaginella ciliaris* (Retzius) Spring.

Figure 4. A. Natural Habit B. Habit C. Strobilus D.Spore of *Equisetum ramosissimum* var. *altissimum* SS. Br

Figure 5. A Habit B. Frond with Sori C. Sporangium D. Spores of *Psilotum nudum* L.P. Beavu.

Figure 6. A. Habit B. Frond with Sori C. Sporangium D. Spores of*Adiantum capillus-veneris* L.

Figure 7. A. Habit B. Frond with Sori C. Sporangium D. Spores of *Adiantum caudatum* (L.)

Figure 8. A. Habit B. Frond with Sori C. Sporangium D. Spores of *Cystopteris fragils* Linn.

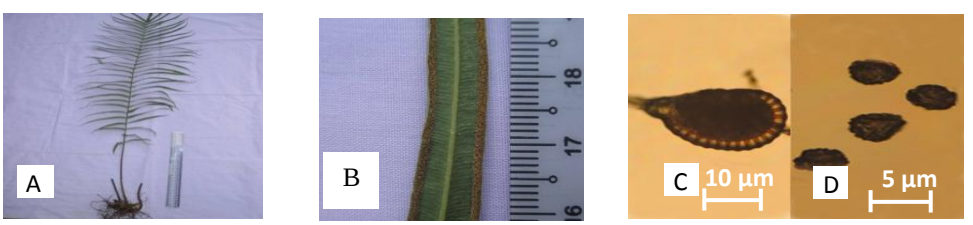

Figure 9. A. Habit B. Frond with Sori C. Sporangium D. Spores of Spore of *Pteris vittata* L.

Figure 10. A. Habit B. Frond with Sori C. Sporangium D. Spores of *Ampelopteris prolifera* (Retzius.) Copel.

Figure 11. A. Habit B. Frond with Sori C. Sporangium D. Spores of *Cyclosorus interrupts* (Wild.) Hito.

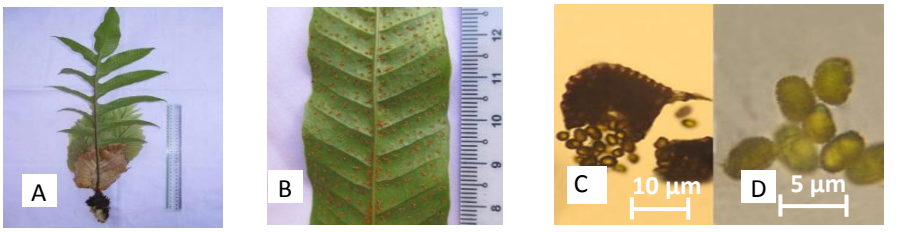

Figure 12. A. Habit B. Frond with Sori C. Sporangium D. Spores of *Drynaria sparsisora* (Desv.) Moore.

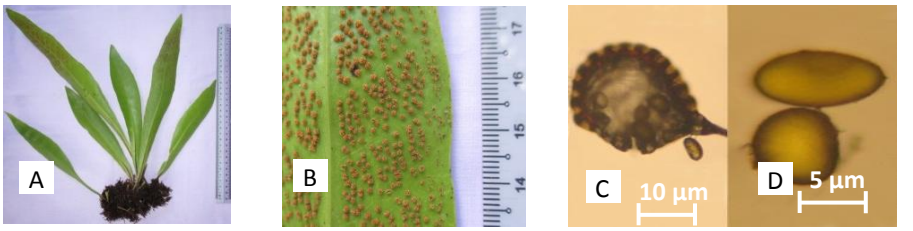

Figure 13. A. Habit B. Frond with Sori C. Sporangium D. Spores of *Microsorum punctatum* (L.) Copel.,

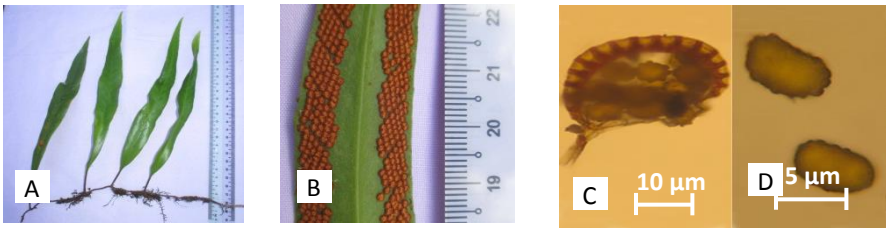

Figure 14. A. Habit B. Frond with Sori C. Sporangium D. Spores of *Pyrosia nuda* (Gies.) Cheng.

An Artificial Key to the Studied Species

1. Reproductive organs in strobilous or synangia ---------- 2
1. Reproductive organs in sorus ---------- 5
   2. Leaves scaly ---------- 3
   2. Leaves well-developed ---------- 4
3. Plants semiaquatic; stem hollow; sporangia on cone-like strobilous -----
   ---------- 3. *Equisetum rammosissimum*
3. Plants creeping; epilethic or epiphytic; stem solid; sporangia forming in synangia ---------- 4. *Psilotum nudum*
   4. Rhizophores absent ---------- 1. *Selaginella barunii*
   4. Rhizophores present ---------- 2. *Selaginella cilaris*
5. Plant epiphytic ---------- 6
5. Plant terrestrial, creeper or climber ---------- 7
   6. Frond dimorphic ---------- 11. *Drynaria sparsisora*
   6. Frond monomorphic ---------- 8

7. Stipe glabrous; laminae ovate to linear elliptic; spores pale-yellow ---------- ----------12. *Microsorum punctatum*

7. Stipe densely hairy; laminae oblong-lanceoalte; spores yellowish-bro---------- ----------13. *Pyrrosia nuda*

8. Indusia absent or false-indusiate ---------- 9

8. Indusia present ---------- 10

9. Sori borned on basal, united veinlets; proliferous buds common in axile of pinnae ----------9. *Ampelopteris prolifera*

9. Sori borned on reflex margin of the lobe; proliferous bud absent ---------11

10. Fronds unipinnate; annuli about 17-celled ---------- ---------- 6. *Adiantum caudatum*

10. Fronds bipinnate; annuli about 20-celled ---------- ---------- 5. *Adiantum capillus veneris*

11.Rhizome short-creeping; ramenta linear; pale brown; stipes hairy at base ---------- 12

11.Rhizome long-creeping; ramenta linear-lanceolate; yellowish brown; stipes glabrous –---------- 10. *Cyclosorus interrupts*

12. Sporangia 75.0 µm long and 70.0 µm in diameter; annuli 14-celled; sproes sub-globoid ---------- 7. *Cystopteris fragils*

12. Sporangia 87.5 µm long and 70.0 µm in diameter; annuli 20-celled; spores globose----------8. *Pteris vittata*

Discussion and Conclusion

The present research deals with the taxonomic study on ferns and fern allies growing in Htee Se Khar Waterfall area in Loikaw Township of Kayah State. It has been observed that the totally 13 species belonging to 11 genera and 8 families were distributed. The resulting species found in the present research belong to the order Lycopodiales, Equisetales, Psilotales and Polypodiales.

The growing habits of the plant vary in the studied area. The 8species such as *Selaginella braunii* Baker., *Selaginella ciliaris* (Retzius) Spring.,

Adiantum capillus-veneris L., *Adiantum caudatum* L., *Cystopteris fragils* (L.) Bernh., *Pteris vittata* L., *Ampelopteris prolifera* (Retz.) Copel., and *Cyclosorus interruptus* (Wild). Hito were growing as terrestrial. The 4 species such as *Drynaria sparsisora* (Desv.) T. Moore., *Microsorum punctatum* (L.) Copel., *Psilotum nudum* L.P. Beavu and *Pyrrosia nuda* (Gies.) Cheng. were growing as epiphyte. The specie of *Equisetum ramosissimum* var. *altissimum* Bir was growing as semiaquatic.

The rhizophores are borned from base to upper part of the main stem in *Selaginella ciliaris* (Retzius) Spring and rhizophore absent in *Selaginella braunii* Baker. These charcters similar to those stated by Xianchum *et al;* (2013).

The rhizome of *Adiantum capillus-veneris* L., *Adiantum caudatum* L., *Ampelopteris prolifera* (Retz) Copel., *Cyclosorus interruptus* (Wlid). Hito., *Drynaria sparsisora* (Desv) T. Moore., *Microsorum punctatum* (L.) Copel. and *Pyrrosia nuda* (Gies.) Cheng were creeping and the rhizome of *Selaginella braunii* Baker., *Equisetum ramosissimum* var.altissimum Bir, and *Pteris vittata* L. were erect.

The frond of *Drynaria sparsisora* (Desv) T. Moore. was dimorphic and the remaining 12 species were monomorphic. These characters were agreed with Winter & Amoroso (2003).

The various colour of stipe were found in variable. Those were yellowish green colour in *Selaginella braunii* Baker., greenish yellow colour in *Selaginella ciliaris* (Retzius) Spring, green to greenish colour in *Equisetum ramosissimum* var. *altissimum* Bir, green colour in *Psilotum nudum* L. P. Beavu., black colour in *Adiantum capillus-veneris* L., dark brown colour in *Adiantum caudatum* L., brown colour in *Cystopteris fragils* (L.) Bernh., brownish green colour in *Pteris vittata* L., dark brown colour in *Cyclosorus interruptus* (Wild). Hito., yellowish brown colour in *Drynaria sparsisora* (Desv.) T. Moore., strawed colour in *Microsorum punctatum* (L.) Copel., pale green colour *Pyrrosia nuda* (Gies.) Cheng.. These characters were agreed with Tagawa & Iwatsuki (1989).

Family Adiantaceae consists of 2 genera and 2 species were found in Htee Se Khar Waterfall area. The genus *Adiantum* can be easily distinguished from other genera by its fan-shaped to parallelogram-shaped leaflets and the edges usually toothed when sterile. The main characters of the *Adiantum* family are; ferns of small to moderate size, fronds variously divided, sori without indusial. These characters were agreed with Holttum (1960).

Equisetum ramosissimum var *altissimum* Bir and *Psilotum nudum* L. P. Beavu. Possessing jointed hollow stem and bearing nodes and internodes. Spores are isosporous and mixed with the elators. Their strobilus is cone-like. In *Psilotum*, the synangia borne adaxially to the projections, glabrous, green at first, yellow when mature with lemon-yellow or paler spores. These finding were agreed with Winter & Amoroso (2003).

The present research provide valuable information for researchers in various fields of study. This study will fullfil the required information of ferns and fern allies in Htee Se Khar Waterfall area and this research will be partially accomplished the ferns flora of Kayah state in Myanmar.

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