METHODOLOGY

A. MATERIALS

1. plant press
2. altimeter (m)
3. soil digger
4. pruning shears
5. bamboo poles
6. tape measure
7. shovel
8. soil thermometer (^{0}C)
9. light meter
10. wet + dry thermometer (^{0}C)
11. drying oven for drying plants and soil samples
12. analytical balance (Mettler P165)
13. magnetic compass (Recta, Type DP 10) used in the setting up of transect lines
13. herbarium sheets (44 cm x 28 cm)
14. glue (methyl cellulose)
15. Mercuric chloride ($HgCl_2$)
16. 95% alcohol

B. METHODS

I. Pteridophyte Collection

Two sampling methods were used to investigate the Pteridophyte communities in each study site. These were the extensive qualitative survey and the intensive quantitative survey.

A. Extensive Qualitative Survey

The qualitative survey was done by slowly walking 2-3 times a month through each sampling site and collecting 6 replicates of all species of Pteridophytes encountered. The collected specimens were brought to the CMU Herbarium, Biology Department, Chiang Mai University for study and processing into herbarium specimens.

B. Intensive Quantitative Survey

Quantitative data collection involved determining the number of individuals per species in a particular area. This was done by establishing a 200 m long transect, 6 m wide, in each study site. Bamboo poles painted red were pegged out at 50 m intervals along the transect line. Likewise, pieces of blue cloth were put on trees near the transect, especially at the beginning and at the end of the lines as additional markers. Then ten 2 m x 2 m quadrats at 20 m intervals were established along the transect line. In each quadrat, all Pteridophyte species were identified and the approximate percent cover of each was estimated. The unidentified species were collected after the percent cover was noted and were brought to the Herbarium for identification and processing into herbarium specimens. Likewise, canopy cover and total ground flora cover within the quadrats were estimated. Then light intensity, soil temperature, and relative

humidity were also measured either inside or adjacent to each quadrat using a light meter, soil thermometer, and wet + dry thermometer, respectively.

For the riverine sites, the same procedure was followed except that the quadrats were made in a zigzag pattern since the stream had many bends. Also, the quadrats that fell in the riverbeds were laid down from the very edge of the water and extended towards the stream bank. This method was specifically used to represent the whole riverine area, thus both the stream bed and alluvial margins were equally assessed for the presence of any Pteridophytes.

II. Soil Analysis

About 3 kg soil samples were randomly collected at a maximum depth of 15 cm in each study site and were taken to the Soil Laboratory of the Faculty of Agriculture, Chiang Mai University for analysis of the field capacity, organic matter content, pH, nutrients (N, P, K), and texture. Each sample was replicated 3 times. Likewise, 200 g soil were collected in 3 replicates in each study site during the months of July-November (i.e. rainy season) for the determination of moisture content. The collected samples were placed in plastic bags which were tightly fastened with rubber bands to avoid evaporation. I did the soil moisture analysis myself by first weighing each sample then drying them in an oven at 80 °C for 48 hours and were then reweighed. Percent moisture content (% MC) was calculated using the formula:

$$\% MC = \frac{\text{wt. of fresh soil - wt. of dried soil}}{\text{wt. of dry soil}} \times 100$$

III. Preparation of Herbarium Specimens

The collected Pteridophytes with proper field notes were brought to the Herbarium for a 24 hour drying process. Dried specimens were identified and sorted for the purpose of distribution to other Herbaria. Specimens for the CMU Herbarium were poisoned, air dried and prepared for final mounting. Mounted specimens were glued, sewn, registered (Figure 13), and finally filed in the cabinets.

IV. Pteridophyte Descriptions

Each Pteridophyte species, mostly from mounted specimens, was described in detail e.g. position of the rhizome; type, size, and shape of the scales; type of fronds, venation, indumentum, sori, etc. Finally, two sets of keys, viz. vegetative characters and fertile characters, were made for all species collected in the entire area (see pages 57-134.

V. Data Analysis

1. Species Area Curve

To determine whether the sample area was enough to represent the total study site, species area curves were calculated by a computer using the frequency of occurrence of each species in each quadrat, instead of the number of individuals because it was impossible to determine the number of individuals of each species for some Pteridophytes grow in clumps. The calculation was done by determining the probability of the absence of each species in all quadrats, then the sum of these probabilities was determined, and the total species frequency in the whole area was deducted by the sum probability from each quadrat.

Figure 13. Herbarium specimen of *Davallia trichomanoides* Bl. var. *lorrainii* (Hance) Holtt. (Davalliaceae) in CMU Herbarium.

2. Ecological Indices

Different aspects of the Pteridophyte communities, i.e. richness, evenness, diversity, similarity, and difference at each sampling site were analyzed using methods described by Ludwig and Reynolds (1988). Percent cover was used (rather than number of individuals) in the calculation of all indices for some Pteridophyte species grow in clumps or in dense thickets.

A. Richness

Since the sample size in each sampling site were equal, the direct count method was used in determining the richness of Pteridophytes.

B. Diversity

The following indices were used to compute the diversity of Pteridophytes in each sampling site:

1. $N1 = eH'$
2. $N2 = 1/\lambda$

Where: N1 = number of abundant species in the sample

N2 = number of very abundant species in the sample

Shannon's Index (H') is computed as:

$H' = \sum Pi \log Pi$, while Simpson's Index (λ) is computed as:

$$\lambda = \sum_{i=1}^{(S)} Pi$$

Where: Pi =Proportion of individuals belonging to ith species and is computed as:

$$Pi = \frac{ni}{N}$$

Where: ni = Number of individuals of the ith species

N = total number of individuals

s = number of species

C. Evenness (Modified Hill's Index)

$$E_5 = \frac{(1/\lambda) - 1}{eH'-1}$$

D. Similarity and Difference Indices

To compare the similarities and differences of the Pteridophyte communities in each sampling site, the following indices were used:

1. Sorensen's Index (SI) for similarity coefficient

$$SI = \frac{2C}{A+B}$$

Where: C = number of species common to both communities

A = total number of species in community A

B = total number of species in community B

2. Chord Distance (CRD) for difference coefficient

$$CRDjk = 2\,(1-ccosjk)$$

Where: CRDjk = Chord distance between sample unit j(SUj) and sample unit k (SUk) which range from 0 to 2

ccos = Chord cosine is computed from

$$ccos = \frac{\sum_{i=1} \{(Xij) \times (Xik)\}}{(\sum Xij^2) \times (\sum Xik^2)}$$

Where: Xij = number of individuals of the ith species in sample unit j

Yik = number of individuals of the ith species in sample unit k

S = number of species

3. Statistical Analysis

The Statistical Package for Social Sciences (SPSS) was used to analyse relationships between soil parameters and species richness. However, results of the soil parameters, did not show the expected trend which would match the actual observation of the general conditions of the four sampling areas, and I do not feel confident in using these data for a discussion covering soil versus forest, thus this part was no longer included in this study. Meanwhile, analysis of variance (ANOVA) and the least significance difference (LSD) test was done to investigate whether there were any significant differences among species richness among all sampling sites.