A Preliminary Study on Diverse Plant Uses of Rukai Tribe in Wutai District of Pingtung County, Southern Taiwan

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ABSTRACT: The Rukai tribe is concentrated in the Wutai Township of Pingtung County, southern Taiwan. From 2000 to 2003 people of the Rukai in Wutai were interviewed on the traditional uses of plants and samples of such plant species were collected in an effort to remedy the situation of insufficient quantitative data on Taiwan's ethnobotany. The number of citations per species and total number of citations were recorded in order to calculate diversity indices such as Shannon-Wiener index, evenness index, and rarefaction curves. Thirty-seven interviewed informants cited 245 plant species, which were then classified into thirteen types of usages, such as food, medicine, tools, and decoration. Among the 245 plant species, 93 species are used as food, 73 as tools, 52 for decoration and 45 for medicinal purposes. Informants described six types of usages for *Hibiscus taiwanensis* Hu and *Vitex negundo* L. *Sambucus chinensis* Nakai and *Chamaesyce hirta* (L.) Millsp. had the highest number of citations for medicinal usages. The Shannon-Wiener index was 2.27. The evenness values was 0.95, showing that the Wutai Rukai people had a low dominance concerning the uses of a few species and an equitability of plant uses. The diversity indices and the Coleman rarefaction curves of the Taiwan Rukai tribe could be available to compare ethnobotanical data with different areas.

KEY WORDS: Diversity indices, quantitative ethnobotany, rarefaction curve, Rukai tribe, Taiwan.

INTRODUCTION

Taiwan, an island with an area of about 36,000 km^2, is situated on the continental shelf of eastern Asia and is divided by the Tropic of Cancer. Fourteen native tribes (Lin et al.; 2007) inhabit different regions of Taiwan. Of these tribes, the Rukai tribe is distributed throughout Pingtung and Taitung Counties. The largest concentration can be found in Wutai Township of Pingtung County (Fig. 1), with smaller concentrations in Beinan Township of Taitung County, Maolin Township of Kaohsiung County, and Sandimen Township of Pingtung County. There are qualitative descriptions (e.g. Chuang, 2002; Chang, 2003; Gao, 2003) of plant uses among aboriginal inhabitants of Taiwan, but quantitative information on plant utilization by tribes such as the Rukai is scare.

In recent years, literature about quantitative ethnobotany is steadily increasing (e.g. James and Rathbun, 1981; Phillips et al., 1994; Begossi, 1996, Rossato et al., 1999; Gomez-Beloz, 2002; Amiguet et al., 2006; Weckerle et al., 2006) and ethnobotanical research on medicinal plants used by different native populations has gained more attention (Begossi, Hanazaki and Tamashiro, 2002; Leonti et al., 2003; Salick et al., 2006). The concepts and methods of diversity indices have been proven to be useful in understanding the relationship between aboriginal people and their environment. Diversity indices may also help to evaluate the intensity of resource use by native populations. Among diversity indices, the Shannon-Wiener index, evenness index, and rarefaction curves are especially important for ethnobotanical studies because they allow comparisons on the use of plants by people in different regions on a larger scale. Begossi (1996) compared the use of plants among ten native populations in different areas of the Atlantic Forest along the coast of Brazil with the use of plants among populations in other parts of the world. She used the percent of usage type per species in order to obtain the number of informants for retrieving the Shannon-Wiener index and rarefaction curves. Kainer and Duryea (1992) recorded 145 common plants used in the Cachoeira Extractive reserve in the state of Acre, Brazil. The reserve has an area of 29,974 ha and is populated with 68 families. The Shannon-Wiener index was 2.09 and the evenness value was 0.95.

This study aimed to document the plant species used and to classify different plant usages of the Pingtung Wutai Rukai tribe. A further goal was to provide a better knowledge about the plant uses of Rukai tribes and available to compare the relationship between different aboriginal tribes.

MATERIALS AND METHODS

The study was conducted in communities located in Wutai Township, Pingtung County, southern Taiwan (Fig. 1). The investigation area ranged from 250 to 2,000

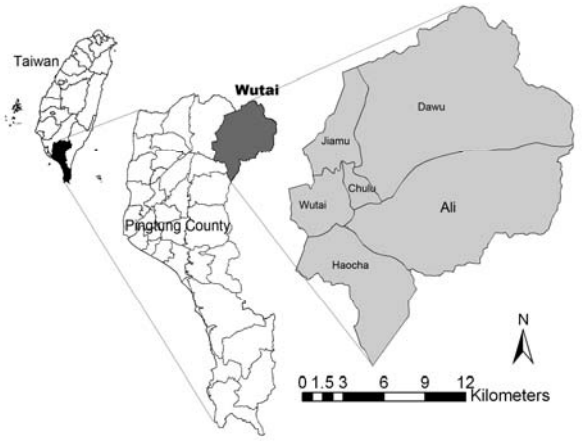

Fig. 1. Location of the study area, Wutai Township, Pingtung County, southern Taiwan.

m in altitude and covered an area of 2,790 ha. Data was collected in the field during the years 2000 and 2003. Thirty-seven adults, 24 men and 13 women, all over 60 years old, were interviewed separately about local plant utilization. Collected plant specimens were identified and preserved in the herbarium of PPI, National Pingtung University of Science and Technology and scientific names of plants as well as their usages were put into a data matrix. All plant binominals followed the Flora of Taiwan (Boufford et al., 2003).

Begossi (1996) used the number of citations per species (or the number of informants per species) to calculate the diversity indices. She suggested if more than one use was mentioned (such as firewood, tools), the highest percentage was considered. The definition of the number of citations as well as the formatting of the primary data matrix followed Begossi (1996). The number of citations per species, total number of citations and the values of the Shannon-Wiener index which were calculated in this study.

The Shannon-Wiener index is widely used in ecology and is regarded as having a moderate sensitivity to sample size. In this study the calculation of the Shannon-Wiener index was made through the formula $H' = -\Sigma\, p_i \log p_i$ (based by 10), where p_i is the proportion of the citations (or informants) per species. The evenness index takes into account both the number of species as well as their relative abundance and is determined by H'/logS (Magurran, 1988). The calculation of the evenness value helps to find out whether the number of species utilized among the Rukai tribe is high or low. A low evenness means a high dominance in the use of few species. The Ecological Methodology program (Krebs, 1999) was used to calculate the two above mentioned indices.

The rarefaction method is a statistical method for estimating the number of species expected in a random sample of individuals taken from a collection (Krebs, 1999). With this method it is also possible to evaluate sampling efforts. In Taiwan only few scientists, such as Hsieh et al. (2000), used the rarefaction method to compare the expected species number between two areas. Colwell et al. (2004) suggested that interpolation and sample-based rarefaction eliminates the need for resampling methods and permits a direct statistical comparison of the species richness between sampled sets. The development of an interpolation curve can express both the expected richness and its confidence limits (Colwell et al., 2004).

Using the Estimate SWin750 program (Colwell, 2005) the following parameters were calculated from the data set of this study: the expected species numbers (total number of species observed in all pooled samples, Sobs), 95% confidence intervals (lower and upper bound of Sobs), and Coleman rarefaction value (number of species expected in the pooled samples, assuming citations were randomly distributed among samples) (Coleman, 1981).

The rarefaction method is as follows:

$$E(\hat{S}n) = \sum_{i=1}^{s}\left[1 - \frac{\binom{N - Ni}{n}}{\binom{N}{n}}\right]$$

$E(\hat{S}n)$ = expected number of species in a random sample of n citations; S = total number of species in the entire collection; Ni = number of citations per species i (or number of informants); N = total number of citations in the collection ($N = \Sigma Ni$); n = value of sample size (number of citations) chosen for standardization ($n \leq N$).

$$\binom{N}{n} = \frac{N!}{(N-n)!n!}$$

The above formula states that the number of combinations of n citations can be chosen from a set of N citations.

RESULTS

About 245 plant species used by members of the Wutai Rukai tribe were mentioned by interviewees in this study. Plant usages were classified into thirteen types, such as food, medicine, threads, building material, firewood, tools, children's traditional toys, commercial use, decoration, cultural use, fertilizer, fodder, and others (Table 1). Among the 245 plant species, 93 are used for food, 73 as tools, 52 for decoration, 45 for medicinal purposes, 44 for commercial use, 34 as fertilizer, 32 for cultural use, 31 as firewood, 30 as building material, ten for children's traditional toys, five for threads, two as fodder, and eight for others purposes. Six types of usages were mentioned for *Hibiscus taiwanensis* Hu and *Vitex negundo* L. The usage types cited for *H. taiwanensis* are medicine (roundworm disease), thr eads (clothes, nets),

firewood, tools (nets), decoration (flower ring) and fodder (for pigs), those for *V. negundo* are medicine (sprains, inflammation, fractures, skin rash, deache), building material (roof), firewood, tools (sticks, handles, hilts), decoration (herb ring) and cultural use.

Seven species, *Acalypha angatensis* Blanco, *Alocasia odora* (Lodd.) Spach, *Aralia bipinnata* Blanco, *Broussonetia papyrifera* (L.) L' Herit. *ex* Vent., *Eriobotrya deflexa* (Hemsl.) Nakai, *Morus australis* Poir., *Pasania konishii* (Hayata) Schottky, were mentioned as having five types of usage. Ten species, *Albizia procera* (Roxb.) Benth., *Dodonaea viscosa* (L.) Jacq., *Euphoria longana* Lam., *Ficus superba* (Miq.) var. *japonica* Miq., *Koelreuteria henryi* Dummer, *Liquidambar formosana* Hance, *Miscanthus floridulus* (Labill.) Warb. *ex* Schum. & Laut., *Pistacia chinensis* Bunge, *Pouzolzia elegans* Wedd. var. *formosana* Li, *Trema orientalis* (L.) Blume, were correlated to four types of usages. The results show that the above-mentioned 19 plant species have at least four types of usages, thus they are especially beneficial to the people of Rukai tribe.

Among 45 medical plants, two species, *Chamaesyce hirta* (L.) Millsp. and *Sambucus chinensis* Lindl., were cited by more than ten informants. Three species, *Commelina auriculata* Blume, *Tinospora dentate* Diels, and *Zingiber officinale* Roscoc, were mentioned by eight informants. One species, *Eupatorium japonicum* Thunb., was named by seven informants. Four species, *Blumea balsamifera* (L.) DC. var. *microcephala* Kitamura, *Elephantopus mollis* Kunth, *Paederia foetida* L. and *Vitex negundo* L., were cited by six informants. Subsequently medicinal plants are listed in alphabetical order by genus, followed by their family name as well as their field of application. 1. *Blumea balsamifera* var. *microcephala* (Asteraceae; measles, headache, sprains, dermatitis, skin rash, tetter). 2. *Chamaesyce hirta* (Euphorbiaceae; inflammation, used as eyewash). 3. *Commelina auriculata* (Commelinaceae; ulcer). 4. *Elephantopus mollis* (Asteraceae; tiredness, arthritis). 5. *Eupatorium japonicum* (Asteraceae; ulcer, fever, extravagated blood, headache, fractures). 6. *Paederia foetida* (Rubiaceae; tooth decay, dental caries). 7. *Sambucus chinensis* (Caprifoliaceae; sprains, headache, internal injury, fractures, breed, extravagated blood). 8. *Tinospora dentata* (Cucurbitaceae; bellyache, ulcer, roundworm). 9. *Vitex negundo* (Verbenaceae; sprains, inflammation, fractures, skin rash, deache). 10. *Zingiber officinale* (Zingiberaceae; sprains, asepticize, swellings, inflammation).

Concerning the number of citations per species (Table 1), the value of Shannon-Wiener index was 2.27 and the evenness index was 0.95. Based on the number of citations per species of Table 1, the following parameters were calculated using the EstimateS program (Colwell 2005): the expected species number, 95% confidence intervals, and Coleman rarefaction value (Table 2). Rarefaction curves of the expected number of plant species in the Taiwanese is shown in Fig. 2.

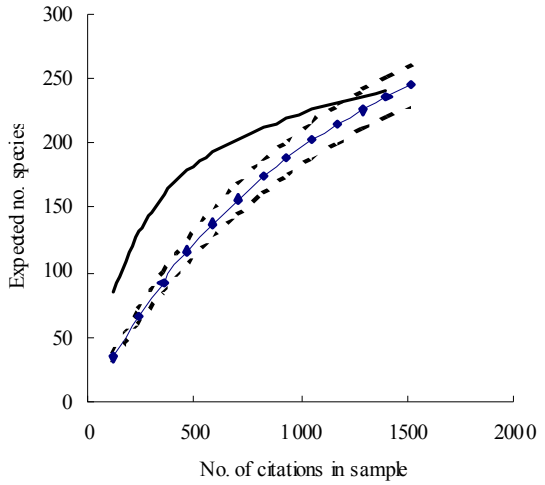

Fig. 2. Expected species number and Coleman rarefaction for the Taiwan Rukai areas. Solid line with dotted-lines indicating the 95% confidence interval.

DISCUSSION

The results show that food, tool, and decoration are the major plant usage types of the Taiwan Rukai tribe. The Shannon-Wiener index (2.27) and species richness (245 species) for the Taiwan Rukai areas is higher than the Shannon-Wiener index (2.09) and species richness (145 species) for Kainer and Duryea (1992), but the evenness value for both areas is almost the same (0.95 and 0.97). It appeared that the diversity of plant uses among the Taiwan Rukai tribe is higher than those of Kainer and Duryea (1992). The evenness indices for the two study areas are high and equitability of plant uses is given, which indicates that people living in the Wutai Rukai tribe do not concentrate on a few types of plant uses.

Within this study six types of usages have been discovered for *Hibiscus taiwanensis* and *Vitex negundo*. Members of the Seediq Atayal tribe in Nantou County cited the same number of usage types for the following five species: *Alnus formosana* (Burk.) Makino, *Eriobotrya deflexa* (Hemsl.) Nakai, *Pueraria lobata* (Willd.) Ohwi, *Quercus variabilis* Blume, and *Styrax formosana* Matsum. (Chang 2003). Only one of these species, *E. deflexa*, can also be found in the Rukai areas and informants there mentioned five types of plant uses for this species. Differing wild plant utilization habits among different indigenous tribes might be influenced by the vegetation composition of local forests and traditional knowledge of plant usages.

The values of lower and upper bound of 95% confidence level, the expected species number, and Coleman rarefaction (Table 2) was ploted to show the curves including 95% confidence interval and the Coleman rarefaction curve about the Rukai tribe (Fig. 2). Rarefaction curves also allow an evaluation of sampling efforts. The sample number can be considered sufficient, if the curve does not continue to increase when more informants are added. Interpreting the Coleman rarefaction curves shown in Fig. 2 sampling effort for the Rukai areas was increasing slowly, suggesting that the number of informants was sufficient.

Chuang (2002) recorded six categories of plant usages for 156 different plant species in the territory of the Rukai tribe in Taromak, Taitung County. Since a calculation of the number of citations was not available, a comparison of the diversity of plant uses between the two different areas of the same tribe was not possible. However, this study found out that 64 plant species occur both in Pingtung and Taitung Rukai settlements and the Sorenson's coefficient (Krebs, 1999) for the two areas is 32% (= 2 × 64 / 156 + 245). Plant uses among Rukai people in Pingtung and Taitung are qualitatively different. The low value of similarity could be related to environmental conditions, cultural practices, the sampling size, or informant number. Literatures about Taiwan aboriginal culture or people were reviewed, but these works did not contain raw data such as those found in Table 1. This study investigated the plant uses among the Taiwan Rukai tribe, but did not compare the plant uses among other Taiwanese indigenous tribes. In order to better understand the ethnobotany of Taiwan native populations, a more detailed collection and assessment of quantitative data is needed in the near future.

CONCLUSIONS

The results of this research show variation in plant utilization types among the Pingtung Wutai Rukai tribe. Among 245 plant species, *Hibiscus taiwanensis* and *Vitex negundo*, are most diversely utilized having six types of uses. *Chamaesyce hirta* and *Sambucus chinensis* are the most popular medicinal plants. The Evenness value for the Wutai Rukai tribe is high, indicated that the inhabitants of this areas do not concentrate on only a few species of plant uses.

In ethnobotanical studies, a high correlation can be expected between data obtained from the calculation of the number of citations and that obtained from the calculation of the number of informants (Begossi, 1996). The results of this study show that diversity indices contribute to the interpretation of plant uses and help to analyze ethnobotanical data matrices. Quantitative ethnobotanical studies can be considered very important, because data can be available for comparisons on a larger scale, particularly for the investigation of biological and cultural biodiversity.

Table 1. Common plants used among the Wutai Rukai tribe, Pingtung County, Taiwan.

	Scientific name	F	M	TH	B	FW	T	CTT	COM	D	CUL	FER	F	OT	No. of citation
1	*Acacia confusa* Merr.				1	2									2
2	*Acalypha angatensis* Blanco					3	3			2		1		2	3
3	*Acer serrulatum* Hayata				1			1							1
4	*Albizia procera* (Roxb.) Benth.				4	1					1			1	4
5	*Aleurites fordii* Hemsl.						2		4						4
6	*Aleurites montana* E. H. Wilson		2					1	2						2
7	*Alocasia odora* (Lodd.) Spach		1		6		10					4		1	10
8	*Alpinia zerumbet* (Pers.) B. L. Burtt. & R. M. Sm.	2					8		5						8
9	*Alteranthera ficoidea* (L.) Roem. & Schult		1							1					1
10	*Amaranthus spinosus* L.	4									1				4
11	*Ananas comosus* (L.) Merr.	1													1
12	*Angelica dahurica* (Fisch.) Benth. & Hook. var. *formosana* (Boiss.) Yen								3						3
13	*Anoectochilus formosanus* Hayata		1						7			1			7
14	*Arachis hypogea* L.	7									1				7
15	*Aralia bipinnata* Blanco	1			2	2						1		1	2
16	*Areca catechu* L.	5			1										5
17	*Arenga tremula* (Blanco) Becc.				1		11					1			11
18	*Aristolochia cucurbitifolia* Hayata		3												3
19	*Artemisia capillaries* Thunb.						1	2	1						2
20	*Artemisia indica* Willd.		3							7					7
21	*Arundo formosana* Hack.				6		16								16
22	*Asclepias curassavica* L.									1					1
23	*Asparagus cochinchinensis* (Lour.) Merr.								8	2					8
24	*Aspidistra elatior* Blume var. *attenuata* (Hayata) S. S. Ying						1		1						1

Table 1. Continued.

	Scientific name	F	M	TH	B	FW	T	CTT	COM	D	CUL	FER	F	OT	No. of citation
25	*Asplenium antiquum* Makino	1					1								1
26	*Asplenium nidus* L.	1					2				1				2
27	*Bambusa stenostachya* Hackel				1										1
28	*Bauhinia championii* (Benth) Benth						2								2
29	*Begonia formosana* (Hayata) Masam.	8													8
30	*Begonia wutaiana* Chen & Peng	1													1
31	*Billis perennis* L.									1					1
32	*Bischofia javanica* Blume	1					1					6			6
33	*Blumea balsamifera* (L.) DC. var. *microcephala* Kitamura		6						1						6
34	*Blumea lanceolaria* (Roxb.) Druce								2						2
35	*Boehmeria nivea* (L.) Gaudich. var. *tenacissima* (Gaudich.) Miq.			5											5
36	*Boehmeria nivea* (L.) Gaudich.			9											9
37	*Bombax malabarica* DC.		2						7						7
38	*Brassica chinensis* L.	1													1
39	*Breynia officinalis* Hemsl.						1				4				4
40	*Bridelia tomentosa* Blume		2			2		2							2
41	*Broussonetia papyrifera* (L.) L'Herit. *ex* Vent.	4		5			1		4			5			5
42	*Brugmansia suaveolens* (Willd.) Bercht. & C. Presl									6					6
43	*Bryophyllum pinnatum* (Lam.) Kurz	4	2					7							7
44	*Buddleia asiatica* Lour.				2	1			2						2
45	*Caesalpinia pulcherrima* Sw.										9				9
46	*Cajanus cajan* (L.) Millsp.	7													7
47	*Calamus formosanus* Becc.	1					1								1
48	*Callerya nitida* (Benth.) R. Geesink						1								1
49	*Callicarpa formosana* Rolfe	1					1			1					1
50	*Canna indica* L.									8					8
51	*Capsicum annum* L.	4	4												4
52	*Carex cruciata* Wahl.										1				1
53	*Carica papaya* L.	2													2
54	*Castanopsis indica* A. DC.				2	2						1			2
55	*Celtis formosana* Hayata						1								1
56	*Chamaesyce hirta* (L.) Millsp.		10												10
57	*Champereia manillana* (Blume) Merr.	7					1								7
58	*Chenopodium purpurascens* Jacqin.	6					4							8	8
59	*Cibotium taiwanense* C. M. Kuo								1						1
60	*Clerodendrum kaempferi* (Jacq.) Sieb. *ex* Steud.									4	1				4
61	*Clerodendrum trichotomum* Thunb.		1												1
62	*Cleyer japonica* Thunb. var. *morii* (Yamamoto) Masamune											1			1
63	*Codiaeum variegatum* Blume									5					5
64	*Coleus* x *hybridus* Voss									8					8
65	*Colocasia escutenta* (L.) Schott	3													3
66	*Colocasia formosana* Hayata	7					2					3			7
67	*Commelina auriculata* Blume		8								1	2			8
68	*Crassocephalum rabens* (Benth.) S. Moore	8													8
69	*Crotalaria pallida* Ait. var. *obovata* (G. Don) Polhill												4		4
70	*Crotalaria zanzibarica* Benth.												10		10
71	*Cucurbita moschata* Duchesne var. *melonaeformis* Makino	6													6
72	*Cyathea lepifera* (J. Sm.) Copel.						8								8
73	*Cyclobalanopsis glauca* (Thunb.) Oerst.				1	1						4			4
74	*Cyclosorus acuminatus* (Houtt.) Nakai										1				1
75	*Cyclosorus truncates* (Poir.) Farw.	1													1
76	*Cymbopogon tortilis* (J. Presl) A. Camus	9			1							1			9
77	*Davallia formosana* Hayata	3							3	4					4
78	*Debregeasia orientalis* C. J. Chen	1													1
79	*Derris elliptica* Benth.		2				2								2
80	*Desmodium sequax* Wall.								5						5

Table 1. Continued.

	Scientific name	F	M	TH	B	FW	T	CTT	COM	D	CUL	FER	F	OT	No. of citation
81	*Dianella ensifolia* (L.) DC.									3					3
82	*Dicliptera chinensis* (L.) Juss.		2				1								2
83	*Dioscorea alata* L.	5													5
84	*Dioscorea matsudai* Hayata								1						1
85	*Diospyros japonica* Sieb. & Zucc.	1				1						2			2
86	*Diplazium amamianum* Tagawa	1													1
87	*Diplazium esculentum* (Retz.) Sw.	7													7
88	*Dodoneae viscosa* (L.) Jacq.	1				1	2				2				2
89	*Dumasia villosa* DC. ssp. *bicolor* (Hayata) Ohashi & Tateishi						1								1
90	*Ecdysanthera rosea* Hook. & Arn.				5		8								8
91	*Ehretia acuminata* R. Br.	3					2								3
92	*Ehretia dicksonii* Hance					2									2
93	*Elephantopus mollis* Kunth		6												6
94	*Emilia sonchifolia* (L.) DC. var. *japonica* (Burm. F.) Mattfeld	8													8
95	*Engelhardtia roxburghiana* Wall.						2								2
96	*Epipremnum pinnatum* (L.) Engl.											3			3
97	*Eriobotrya deflexa* (Hemsl.) Nakai	6			1	1	2					4			6
98	*Eupatorium cannabinum* L. subsp. *asiaticum* Kitam.		4							4					4
99	*Eupatorium clematideum* (Wall & DC.) Sch.Bip.								2	7					7
100	*Eupatorium japonicum* Thunb.		7							10					10
101	*Euphorbia pulcherrima* Klotzsch							4		2					4
102	*Euphoria longana* Lam.	4				1	4					1			4
103	*Ficus fistulosa* Reinw. *ex* Blume	4													4
104	*Ficus microcarpa* L. F.										1				1
105	*Ficus pumila* L. var. *awkeotsang* (Makino) Corner	4													4
106	*Ficus septica* Burm. f.											3			3
107	*Ficus superba* (Miq.) Miq. var. *japonica* Miq.	3	4				3					5			5
108	*Ficus virgata* Reinw. *ex* Blume											3			3
109	*Flueggea virosa* (Roxb.) Pax & Hoffm.	5				2						3			5
110	*Fraxinus griffithii* C. B. Clarke				5	2	1								5
111	*Fraxinus insularis* Hemsl.						1								1
112	*Freesia* × *hybrida* Hort.						1								1
113	*Gardenia jasminoides* Ellis						1		10	6					10
114	*Glochidion rubrum* Blume							1							1
115	*Glycosmis citrifolia* (Willd.) Lindl.									1					1
116	*Gonostegia hirta* (Blume) Miq.	1													1
117	*Gynura bicolor* (Willd) DC.	7													7
118	*Gynura divaricata* (L.) DC. subsp. *formosana* (Kitam.) F. G. Davies	4	2						2						4
119	*Gynura japonica* (Thunb.) Juel.								2						2
120	*Hibiscus taiwanensis* Hu		2	2		1	11			3		1			11
121	*Hypoestes purpurea* R. Br.								1						1
122	*Hyptis suaveolens* (L.) Poir.		5			2	3								5
123	*Imperata cylindrica* (L.) Beauv. var. *major* (Nees) Hubb. *ex* Hubb. & Vaughan	2	1		8										8
124	*Ipomoea batatas* (L.) Lam.	4	1							1					4
125	*Ipomoea indica* (Burm. F.) Merr.						1								1
126	*Iresine herbstii* Hook.													1	1
127	*Ixeridium laevigata* (Blume) J. H. Pak & Kawano								1						1
128	*Ixeris chinensis* (Thunb.) Nakai								1			1			1
129	*Jasminum nervosum* Lour.	2								2					2
130	*Justicia procumbens* L.								4						4
131	*Kalanchoe blossfeldiana* cv. *Poellnitz*									1					1
132	*Kalanchoe spathulata* (Poir.) DC.		3												3
133	*Kleinhovia hospita* L.						2								2
134	*Koelreuteria henryi* Dummer				1	1	1			4					4
135	*Lactuca sativa* L.	1													1
136	*Lagerstroemia subcostata* Koehne				2	4					1				4
137	*Lepidagathis formosensis* C. B. Clarke *ex* Hayata								2		1				2

Table 1. Continued.

	Scientific name	F	M	TH	B	FW	T	CTT	COM	D	CUL	FER	F	OT	No. of citation
138	*Leucaena leucocephala* (Lam.) de Wit					3									3
139	*Lilium formosanum* Wallace								4	4	9				9
140	*Liquidambar formosana* Hance				3					5		1		4	5
141	*Liriope spicata* (Thunb.) Lour.								1	1					1
142	*Litsea akoensis* Hayata				2				1						2
143	*Litsea coreana* Levl.						1								1
144	*Litsea hypaphaea* Hayata							1							1
145	*Lophatherum gracile* Brongn.						1								1
146	*Lycianthes biflorum* (Lour.) Bitter	8													8
147	*Lygodium japonicum* (Thunb.) Sw.		1							1	2				2
148	*Lysimachia capillipes* Hemsl.		1						1	7					7
149	*Macaranga tanarius* (L.) Muell-Arg.				1		8			3					8
150	*Machilus japonica* Sieb. & Zucc. var. *kusanoi* (Hayata) J. C. Liao	1			1							1			1
151	*Machilus thunbergii* Sieb. & Zucc.					1									1
152	*Mallotus japonicus* (Thunb.) Muell- Arg.					1	2				2				2
153	*Mallotus paniculatus* (Lam.) Muell-Arg.					1									1
154	*Mangifera indica* L.	1					1								1
155	*Manihot esculenta* Crantz.	13					1			2					13
156	*Melia azedarach* L.				1										1
157	*Michelia compressa* (Maxim.) Sargent				4		2								4
158	*Millettia pachycarpa* Benth		2				2								2
159	*Miscanthus floridulus* (Labill.) Warb. *ex* Schum. & Laut.	1			9		6	2							9
160	*Momordica cochinchinensis* (Lour.) Spreng.										1				1
161	*Morus australis* Poir.	12		3			5		4			4			12
162	*Mucuna macrocarpa* Wall.						8								8
163	*Murraya paniculata* (L.) Jack						9			4	1				9
164	*Musa sapientum* L.	2													2
165	*Mussaenda parviflora* W. T. Aiton										8				8
166	*Nephrolepis auriculata* (L.) Trimen	10								9					10
167	*Nicotiana tabacum* L.		1												1
168	*Ocimum basilicum* L.		5							8					8
169	*Onychium japonicum* (Thunb.) Kunze	2							5						5
170	*Ophiopogon reversus* C. C. Huang									2	2				2
171	*Orthosiphon aristatus* (Blume) Miq.		3												3
172	*Paederia foetida* L.		6							6					6
173	*Paraboea swinhoii* (Hance) B. L. Burtt						10	5							10
174	*Pasonia konishii* (Hayata) Schottky	5			1	1	7					5			7
175	*Pennisetum polystachion* (L.) Schult.										1				1
176	*Peucedanum formosanum* Hayata								3						3
177	*Phyllanthus multiflorus* Willd.										1	2			2
178	*Pilea funkikensis* Hayata									2					2
179	*Pilea melastomoides* (Poir.) Wedd.		2							7					7
180	*Piper betle* L.	6					1			1					6
181	*Piper kadsura* (Choisy) Ohwi	3													3
182	*Pisonia aculeate* L.						1								1
183	*Pistacia chinensis* Bunge				4	2				3	1				4
184	*Polygonatum odoratum* (Miller) Druce var. *pluriflorum* (Miq.) Ohwi								6	7					7
185	*Polygonum chinense* L.		4												4
186	*Polygonum multiflorum* Thunb. var. *hypoleucum* (Ohwi) Liu, Ying & Lai									1					1
187	*Polygonum senticosum* (Meisn.) Fr. & Sav.								1						1
188	*Pothos chinensis* (Raf.) Merr.						7								7
189	*Pouzolzia elegans* Wedd.	1	1				4			3					4
190	*Prunus campanulata* Maxim.	2								6					6
191	*Prunus persica* Stokes	3								2					3
192	*Psidium guajava* L.	9	4												9
193	*Pteris cretica* L.		2						2						2

Table 1. Continued.

	Scientific name	F	M	TH	B	FW	T	CTT	COM	D	CUL	FER	F	OT	No. of citation
194	*Pteris ensiformis* Burm.		2						1						2
195	*Pteris wallichiana* J. Agardh	1								6					6
196	*Pterocypsela indica* (L.) C. Shih	9										3			9
197	*Pueraria lobata* (Willd.) Ohwi	3													3
198	*Pueraria montana* (Lour.) Merr.		2				11								11
199	*Radermachia sinica* (Hance) Hemsl.						4								4
200	*Rhus chinensis* Mill. var. *roxburghiana* (DC.) Rehd.	3					4				3				4
201	*Rubus alnifoliolatus* H. Lev.	6													6
202	*Rubus formosensis* Kuntze	1							1						1
203	*Rubus fraxinifoliolus* Hayata	1													1
204	*Rubus sumatranus* Miq.	3													3
205	*Sageretia thea* (Osbeck) M. C. Johnst.						1								1
206	*Sambucus chinensis* Lindl.	2	11												11
207	*Sapindus mukorossii* Gaertn.						13								13
208	*Sapium discolor* Muell-Arg.						5					2			5
209	*Sapium sebiferum* (L.) Roxb.					1									1
210	*Schefflera arboricola* Hayata										7				7
211	*Schizostachyum diffusum* (Blanco) Merr.						2								2
212	*Sechium edule* Sw.	2													2
213	*Selaginella repanda* (Desv.) Spring		1						1						1
214	*Selaginella tamariscina* (Beauv.) Spring								4	2	1				4
215	*Setaria italica* (L.) Beauv.	5													5
216	*Setaria palmifolia* (Koen.) Stapf						1							7	7
217	*Smilax bracteata* Presl subsp. *verruculosa* (Merr.) T. Koyama						1			1					1
218	*Smilax china* L.						4								4
219	*Solanum americanum* Miller	5													5
220	*Solanum melongena* L.	1													1
221	*Solanum undatum* Lam.										10				10
222	*Solena amplexicaulis* (Lam.) Gandhi	6							6						6
223	*Sonchus oleraceus* L.	3										3			3
224	*Sorghum bicolor* (L.) Moench.	9					2								9
225	*Stachytarpheta urticaefolia* (Salisb.) Sims.	1													1
226	*Synedrella nodiflora* (L.) Gaertn.	5													5
227	*Syzygium jambas* (L.) Alston	6										2			6
228	*Tagetes patula* L.									6	4				6
229	*Talinum paniculatum* (Jacq.) Gaertn.	2													2
230	*Thelypteris esquirolii* (H. Chris) Ching									1					1
231	*Tinospora dentate* Diels		8						3						8
232	*Trema orientalis* (L.) Blume				2	4	2					5			5
233	*Trichodesma calycosum* Collett & Hemsl.	11									1				11
234	*Triticum aestivum* L.	2													2
235	*Vigna sinesis* (L.) Endl. *ex* Hassk.	2													2
236	*Vigna umbellata* (Thunb.) Ohwi	1													1
237	*Vitex negundo* L.		6		3	4	2			1	4				6
238	*Wendlandia uvariifolia* Hance					2						4		3	4
239	*Xanthosoma sagittifolium* (L.) Schott	2													2
240	*Youngia japonica* (L.) DC.								1						1
241	*Zanthoxylum ailanthoides* Sieb. & Zucc.	10				1			1						10
242	*Zea mays* L.	8													8
243	*Zehneria mucronata* (Blume) Miq.										1				1
244	*Zelkova serrata* (Thunb.) Makino					2	2								2
245	*Zingiber officinale* Roscoc	9	8												9
	No. of species	93	45	5	30	31	73	10	44	52	32	34	2	9	

Sum of No. of citation per species = 1048

Note: F: Food; M: Medicine; TH: Threads; B: Building material; FW: Firewood; T: Tools; CTT: Children's traditional toys; COM: Commercial use; D: Decoration; CUL: Cultural use; FER: Fertilizer; F: Fodder; OT: Others.

Table 2. Expected species number, 95% confidence interval, and Coleman rarefaction values based on the citation number; Taiwan Rukai tribe.

Sample (Plant uses)	Individuals (computed)	Number of species expected	Lower Bound of 95% Confidence level	Upper Bound of 95% Confidence level	Coleman Rarefaction
1	116.69	34.04	30.59	37.48	84.63
2	233.38	65.17	59.07	71.27	131.10
3	350.08	92.50	84.36	100.64	159.67
4	466.77	116.58	106.86	126.30	178.92
5	583.46	137.89	126.92	148.85	192.90
6	700.15	156.81	144.84	168.79	203.69
7	816.85	173.70	160.89	186.50	212.41
8	933.54	188.81	175.29	202.32	219.71
9	1050.23	202.39	188.25	216.52	225.99
10	1166.92	214.63	199.92	229.33	231.51
11	1283.62	225.71	210.46	240.96	236.45
12	1400.31	235.79	219.99	251.59	240.91
13	1517.00	245.00	228.63	261.37	

Note: Coleman rarefaction means the number of species expected in the pooled samples, assuming that individuals are randomly distributed among samples.

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臺灣南部屏東縣霧台鄉魯凱族植物使用多樣性研究

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摘要：魯凱族主要集中於臺灣南部屏東縣霧台鄉。由於國內對民族植物學的量化研究較少，本研究於 2000-2003 年在屏東縣霧台鄉進行採集魯凱族使用的植物與訪談族人以收集相關資料。資料收集記錄每一物種的登錄次數與所有物種的總登錄次數，以計算 Shannon-Wiener 指數、均勻度指數與稀釋曲線等多樣性指數。本研究訪談 37 位魯凱族族人並紀錄 245 種有用途之種類。此 245 種植物分為食用、藥用、用具、裝飾等 13 種使用方式，其中，93 種為食用植物，73 種做為用具，52 種做為裝飾，45 種為藥用植物等。山芙蓉及埔姜仔有 6 種用途為最高。藥用植物以冇骨消、大飛揚草最常被提及。Shannon-Wiener 指數值為 2.27。均勻度指數值為 0.95，顯示本地區族人並沒有集中使用於少數物種，不同植物的使用是均等的。魯凱族多樣性指數與稀釋曲線將有助於說明不同地區的民族植物資料。

關鍵詞：多樣性指數、量化民族植物學、稀釋曲線、魯凱族、臺灣。