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Review

Very High Food Plant Diversity among Ethnic Groups in Northern Thailand

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Abstract: The combination of the high biodiversity and many ethnicities in Thailand results in extensive ethnobotanical studies, especially in the northern part of the country. Here we have assembled 7620 records from 60 references regarding how plants are used for food among 14 ethnicities in northern Thailand. The uses are based on 1182 different plant species. Vegetables are the most common food category, which contributed more than 60% of all use-reports and involved nearly 900 species. This was followed by the dessert fruit category, which included about 350 species and over 1800 use-reports. The similarity among the different ethnicities was low and the number of uses and species recorded among different ethnicities were significantly related to the number of studies that had been conducted for each group. This implies that additional ethnobotanical studies are still needed in order to conserve and compile the valuable traditional knowledge related to food plants. Many exotic species are now an important part of traditional knowledge, whereas rare endemic species are uncommon among wild food plants. This situation leads to a loss of traditional knowledge about food plants and reduced awareness of their importance. As a key to using this great reservoir of food for local people, traditional knowledge related to local wild food plants can contribute to the zero-hunger goal of the Sustainable Development Goal (SDG). More studies on the nutrient content and health properties of these plants could lead to the development of new crops to meet present consumer demands.

Keywords: biodiversity; edible plants; ethnic diversity; food security; Thai hill tribes

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1. Introduction

Plants are the most important food resource for humans. Plant-based food uses fewer natural and environmental resources, which makes plant-based diets more sustainable than meat-based diets [1]. Globally, agricultural activities take up about 12% of the land surface [2]. Although an estimated 300,000 plant species are edible, the vast majority of food is provided by only about 200 plant species [3]. Dependence on monoculture crops is not sustainable since production often comes at the cost of biodiversity and other ecosystem services [4]. Nevertheless, many edible species with unexploited potential have yet to be discovered among indigenous people around the world.

Wild plant consumption has often been marginalized by modern agricultural production systems [5]. There are many efforts being made to compile the knowledge of edible wild plants, especially in Europe, where regional culinary traditions are receiving increasing attention [6] and around 14% of the population still collects wild food plants and mushrooms for consumption at home [7]. Ethnobotanical research in seven Mediterranean countries documented nearly 300 species of wild food plants that varied among the different countries [8]. A systematic review of wild food plants traditionally used in the gastronomy of Tuscany, Italy, documented more than 350 species [5]. In Spain, more

than 400 species of wild plants are consumed [9]. In Bulgaria, 88 wild plant species were used from the end of the 19th century to the middle of the 20th century [10]. In Estonia, 149 species were recorded as edible wild plants during the 1770s–1960s, most of which were plants eaten as a snack [11]. In the Czech Republic, 175 wild plant species are edible, corresponding to 5% of the plant species in the country [12].

In Asia, Kang et al. [13–16] provided rich data on plant uses in different regions of China. They observed different patterns of wild plant use—-the central region is dominated by wild vegetables, whereas the northwest is dominated by wild edible fruit species. A comparison of four ethnic minorities in southwestern China reported 174 wild edible species, many of which were not used by all ethnic groups [17]. Around 200 species of wild edible plants were reported from the Noto region in Japan, although only 15% were reported to be eaten by the local people [18]. Large numbers of wild plants were also used as food in central Asia, and in addition to their value as food plants, many of them possessed medicinal properties [19–21].

Thailand is an ecologically diverse country, blessed with high biodiversity that includes a flora of vascular plants that surpasses 11,000 species. The patterns of biodiversity vary in different parts of the country [22]. Located in central southeastern Asia, Thailand lies in a global hotspot of biodiversity known as the Indo-Burmese Region [23]. In addition, the country is extremely culturally diverse with over 30 ethnic minorities [24]. The rich biodiversity combined with the ethnic diversity has made Thailand one of the most interesting centers of ethnobiological study [24].

Although many ethnobotanical studies have been conducted in Thailand since 1986 [25,26], most of them have focused on medicinal plants or other plant-use categories. In these studies, the category of food plants was always the largest or second largest category (e.g., [27–29]), including homegarden plants in particular [30,31]. Despite the importance and diversity of food plants used by various ethnic minorities in northern Thailand, no study has compiled and compared the indigenous knowledge of these ethnic minorities regarding the edible plants in Thailand. In this review, which is focused on seven northern provinces, we aim to answer the following questions: (1) How many species of plants are used as food in the seven northern provinces of Thailand? (2) Which plant families and species are the most important and common ones? and (3) Is there a similarity in traditional knowledge of edible plants among different ethnic minorities?

2. Materials and Methods

2.1. Study Area

Our study area in northern Thailand is where most ethnobotanical studies have been carried out in the country [32] (Figure 1). This area is part of the Indo-Burmese floristic region and is covered by dry deciduous forest, dry hill evergreen forest, and montane temperate forest [33].

2.2. Data Source

Our data was extracted from 60 references, some covering more than one province. They included theses, journal articles and proceedings, and unpublished reports (Table S1). The main sources were MSc and Ph.D. theses conducted at the Ethnobotany and Northern Thai Flora Laboratory at the Department of Biology, Chiang Mai University. Plant uses in northern Thailand have been intensively studied by the ethnobotanists from this laboratory over the past 20 years. Another source of ethnobotanical theses and reports is the Sanga Sabhasri Library at Queen Sirikit Botanic Garden, where extensive flora and ethnobotanical documents relating to northern Thailand are kept. Moreover, we compiled ethnobotanical data from online sources such as the Thai Library Integrated System (www.tdc.thailis.or.th; accessed date: 20 June 2022), which houses all the MSc and Ph.D. theses from all the universities in Thailand. To avoid data duplication, such as data that had been presented in both theses and journal articles, only the data from the first source was kept. The list and information of all references are provided in Supplementary Materials.

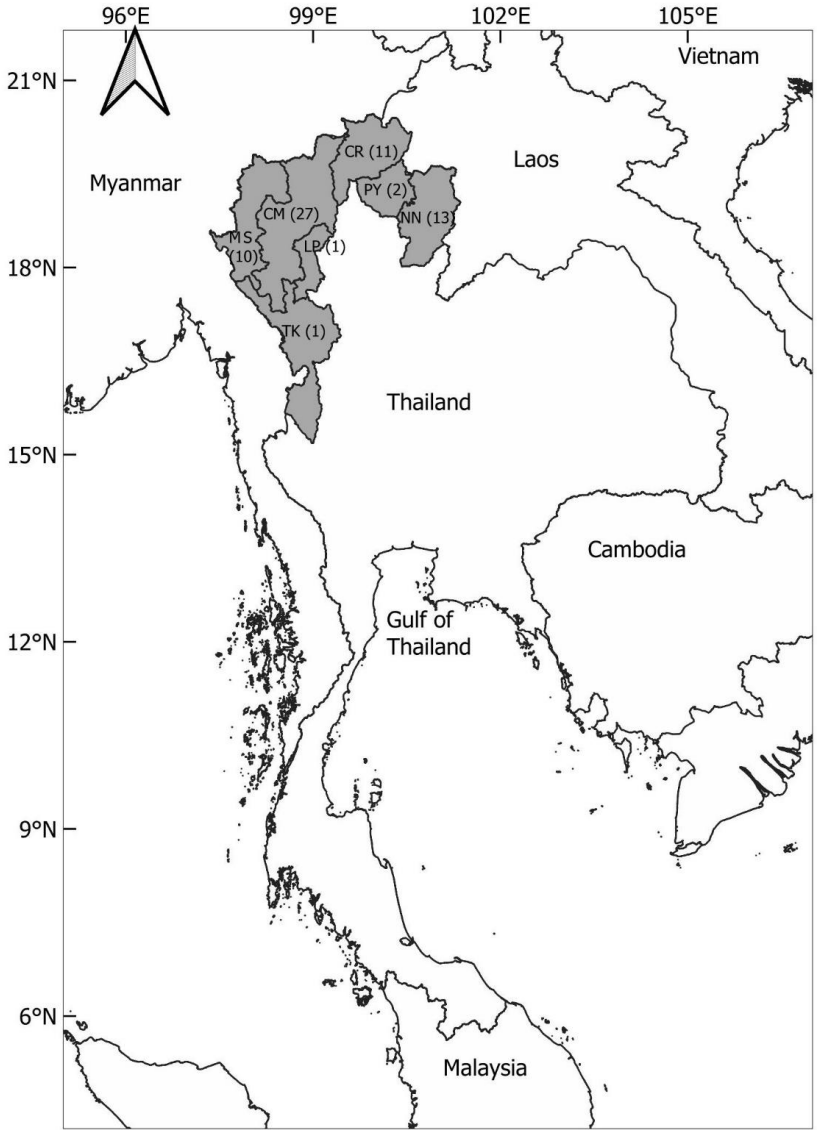

Figure 1. The seven Thai provinces covered in this study (grey). The number after the abbreviation of the province name is the number of studies carried out in each of the provinces. (CM = Chiang Mai, CR = Chiang Rai, LP = Lamphun, MS = Mae Hong Son, NN = Nan, PY = Phayao, and TK = Tak).

2.3. Data Management

For each research reference, the following data was extracted when available: locality, vegetation type, scientific name of the species, plant part used, ethnic group, and the use description. Each use was classified and sorted following the Economic Botany Data Collection Standard [34] into one of the following categories: cereals, pseudocereals, pulses, nuts, dessert fruits, vegetables (including green and root/tuber vegetables), starches, oils/fats, sugar, and other food categories (including beverages.) The categories of leaf protein concentrates and gums/mucilage were excluded because there were no use-reports in these categories.

Plant parts were categorized as the root (including rhizome and other underground organs), young shoot, stem, bark, exudate, leaf sheath, petiole, palm heart, entire leaf, flower, inflorescence, bract, fruit, seed, aerial part, and the entire plant. When the edible plant part was not specified in the reference it is listed here as "N/A" (not available).

To unify nomenclature, we followed Plants of the World Online [35] for the flowering plants. Their names were confirmed with the Flora of Thailand, current documents of Thai plant taxonomy, and data in the QBG Herbarium database which covers about 90% of all species in northern Thailand. For ferns, we followed Ferns of Thailand, Laos, and

Cambodia [36]. The classification of native and exotic species followed Thai plant names Tem Smitinand [37]. Plant form was assigned to one of the following categories: bamboo, climber, fern, herb, parasitic plant, shrub, or tree.

For conservation status, we followed Threatened Plants in Thailand [38] which is based on IUCN version 1994 for endemic and rare species and version 2001 for vulnerable and endangered species. In the first version, plants were classified as rare or not rare, while the latter version included seven conservation categories—-Extinct, Extinct in the wild, Critically endangered, Endangered, Vulnerable, Near threatened, and Least concern.

2.4. Data Analyses

We defined a "plant use" for a given species as use associated with a unique combination of use states for a specific ethnicity. We defined a "use-report" as the citation of a "plant use" from a reference [39]. For example, if the fruits of species A (reported in a reference) were eaten as a dessert fruit between meals (dessert fruit) and cooked as part of the main dish (vegetable) by two different ethnicities, it would be counted as four use-reports (URs) for species A.

To identify the most frequently mentioned food plant species, we calculated a Use Value (UV) index for each species, "s." We followed the simplified version of the equation, $UV = \sum Ui/N$, which was proposed by Rossato et al. [40], where Ui is the number of use-reports and N is a pseudo-informant [32]. Here, a pseudo-informant represented an ethnicity in a reference. For example, in Panyadee [41], the ethnobotany of plants in homegardens was studied among seven different ethnic groups, who counted as seven pseudo-informants. However, the pseudo-informants would count as one if we could not identify the origin of use-reports in such references. A total of $N = 89$ pseudo-informants were used to calculate the UVs. The same formula was used to calculate the Family Use Value (UV_f) and Species Use Value (UVs). Among the quantitative techniques, the UV index has been widely used to estimate the importance of a species [42]. The index required only one variable (use-report) for the calculation, which could be acquired from any bibliographic references. Therefore, it was well suited for our meta-analysis of data from diverse written sources.

3. Results

3.1. Plants Used as Food

We registered 7620 use-reports for 1182 species in 157 plant families (Tables S2–S4), which were used by 14 ethnic minority groups from seven provinces in northern Thailand. The accumulation curve (Figure 2) suggests that more species could be found if more studies were carried out. Without singletons, the accumulation curve approaches 600 species. The number of ethnobotanical studies that include food plants has increased over the past three decades from 13 to 33.

Leguminosae was the most important family, with 123 species of food plants and 894 use-reports ($UV_f = 10.4$). This number significantly surpasses the number of food plants in Asteraceae (52 spp.) and Poaceae (40 spp.). In terms of family use value (UV_f), Cucurbitaceae ($UV_f = 4.60$) and Moraceae ($UV_f = 3.94$) were the second and third largest families, respectively. Overall, the number of species and use-reports were significantly correlated ($r = 0.90$, $p < 0.01$).

The most dominant growth form categories were herbs, shrubs, trees, and climbers, which together made up 93% of the species (Figure 3). The number of species in each family was perfectly correlated with the number of use-reports.

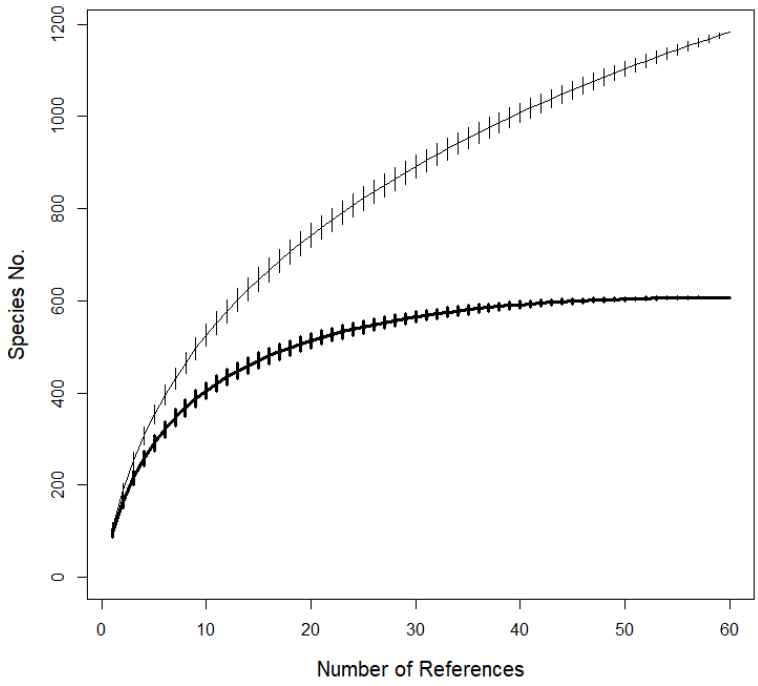

Figure 2. Species accumulation curve of food plant species reported for 14 ethnic minorities in northern Thailand plotted against an increasing number of references (upper curve). The solid line includes all species cited in all references. We excluded singletons to produce the lower line which includes only species mentioned in at least two references.

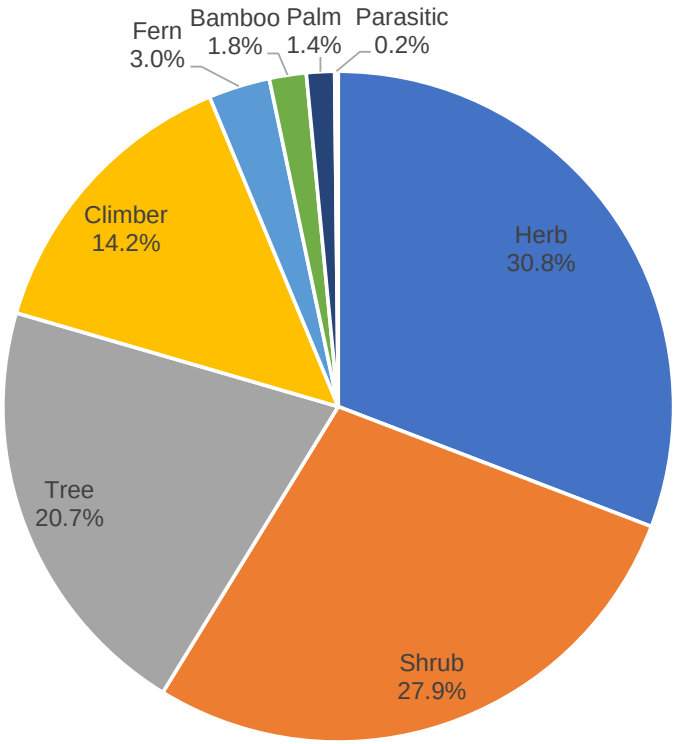

Figure 3. Percentage of species in each of the life forms of food plants used by 14 ethnic minority groups in northern Thailand as reported in 60 references.

Herbs, shrubs, and trees were the most used life forms and contributed 80% of all URs and species. The number of species and URs were, as expected, significantly correlated

(r = 0.99, $p < 0.01$). Two parasitic plants, *Cuscuta chinensis* Lam. and *C. reflexa* Roxb. (Convolvulaceae), were eaten as vegetables by various ethnic groups.

Vegetables was the most common food category, and they contributed more than 60% of all use-reports and involved nearly 900 species. Fruits eaten as dessert was another important food category with more than 350 species and about 1800 use-reports.

The most dominant food category in all life forms, except for trees, was vegetables (Figure 4), which was represented among all life forms. Some life forms, such as species of bamboo and ferns, were used only as vegetables, while some food categories were confined to only one or two life forms. The food category cereals were all herbs, specifically in the grass family (Poaceae). Plants used for their content of sugars were mostly herbs (Poaceae), but one was from the palm *Caryota obtusa* Griff.

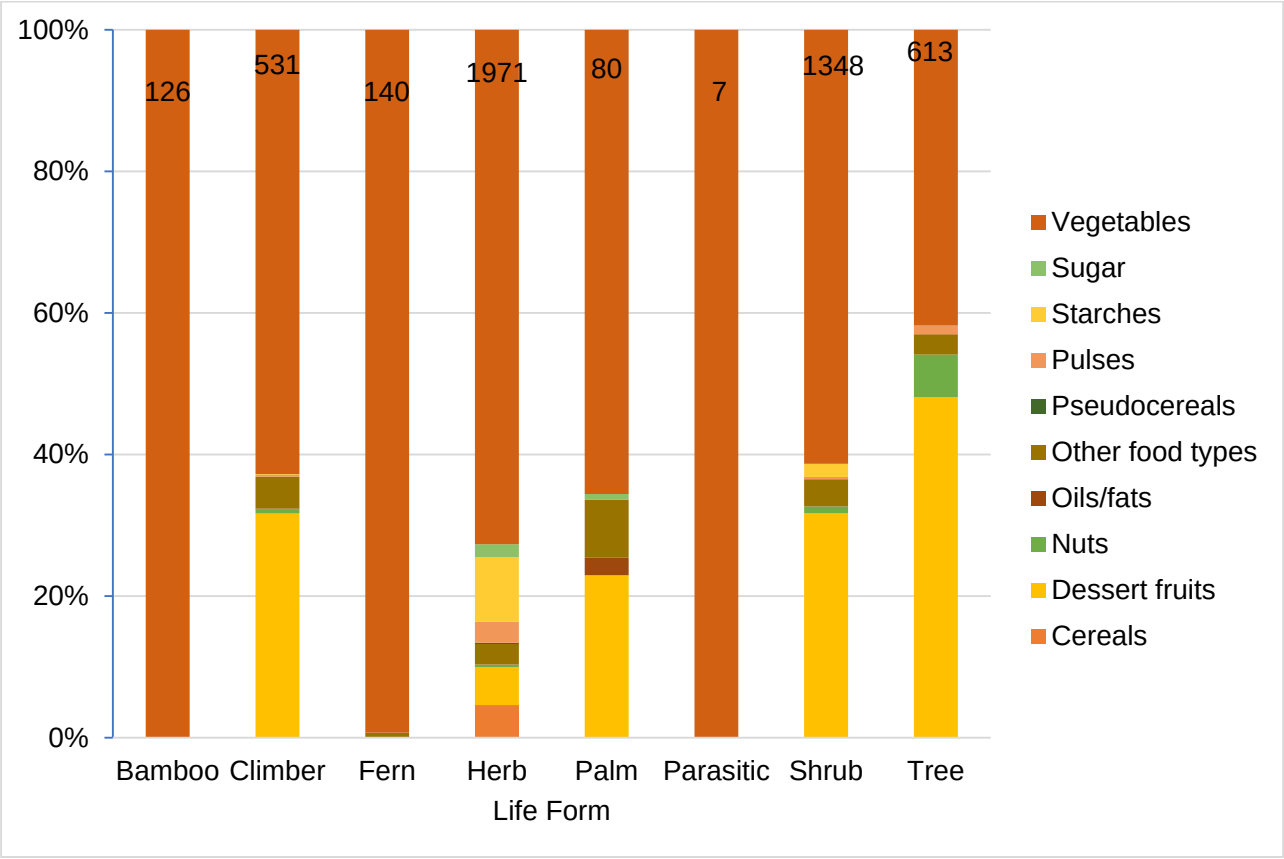

Figure 4. The proportion of different food categories in each plant life form used by 14 ethnic minority groups in northern Thailand.

3.2. Ethnicity and Food Plants

Among the 14 ethnic groups that had been studied in the 60 ethnobotanical references in northern Thailand, Karen and Lawa were the two groups that were most commonly studied by ethnobotanists. Their use of food plants was documented in 17 and 11 references, respectively. These ethnic groups also had the highest numbers of use-reports and used species (Figure 5). Similarities between the different ethnic minority groups were exceptionally low (Figure 6) because half of the registered plant species were mentioned in only a single reference (singleton). The two ethnic groups that had the most edible plants in common were the Mien and the Khamu (49% similarity). On the other extreme, the groups that shared the fewest food plants were the Kachin and the Karen, with only a seven percent overlap.

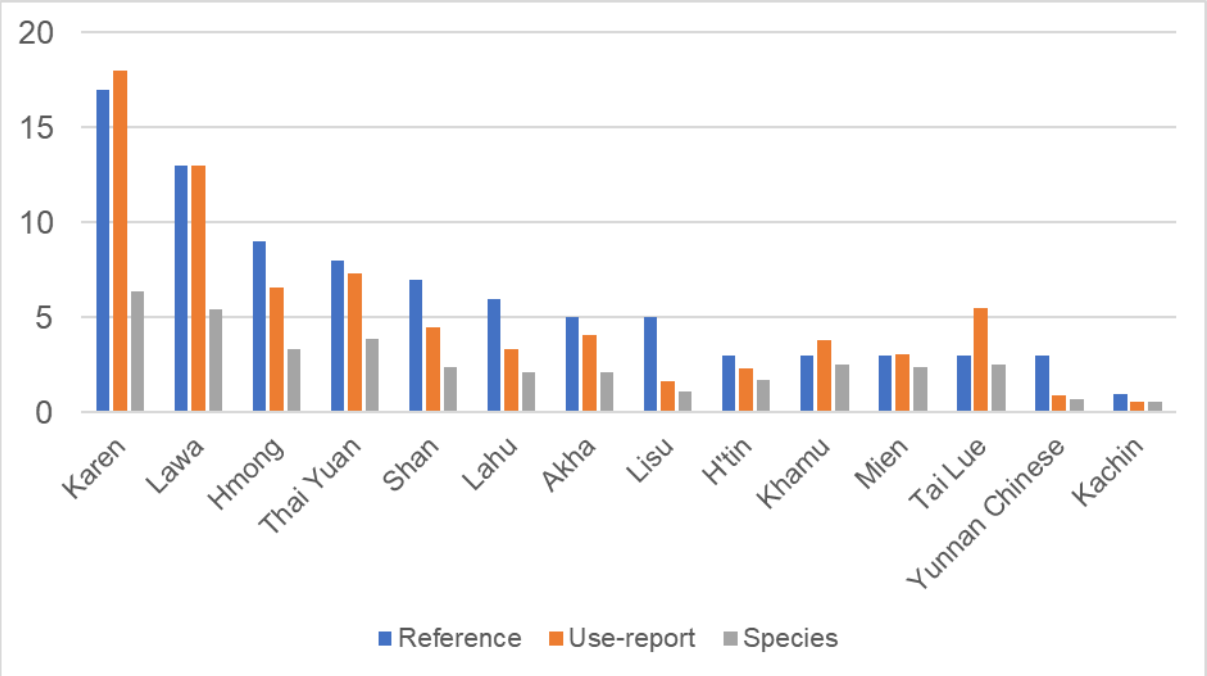

Figure 5. Number of species, use-reports (×100), and references for food plants used by 14 ethnic minority groups in northern Thailand.

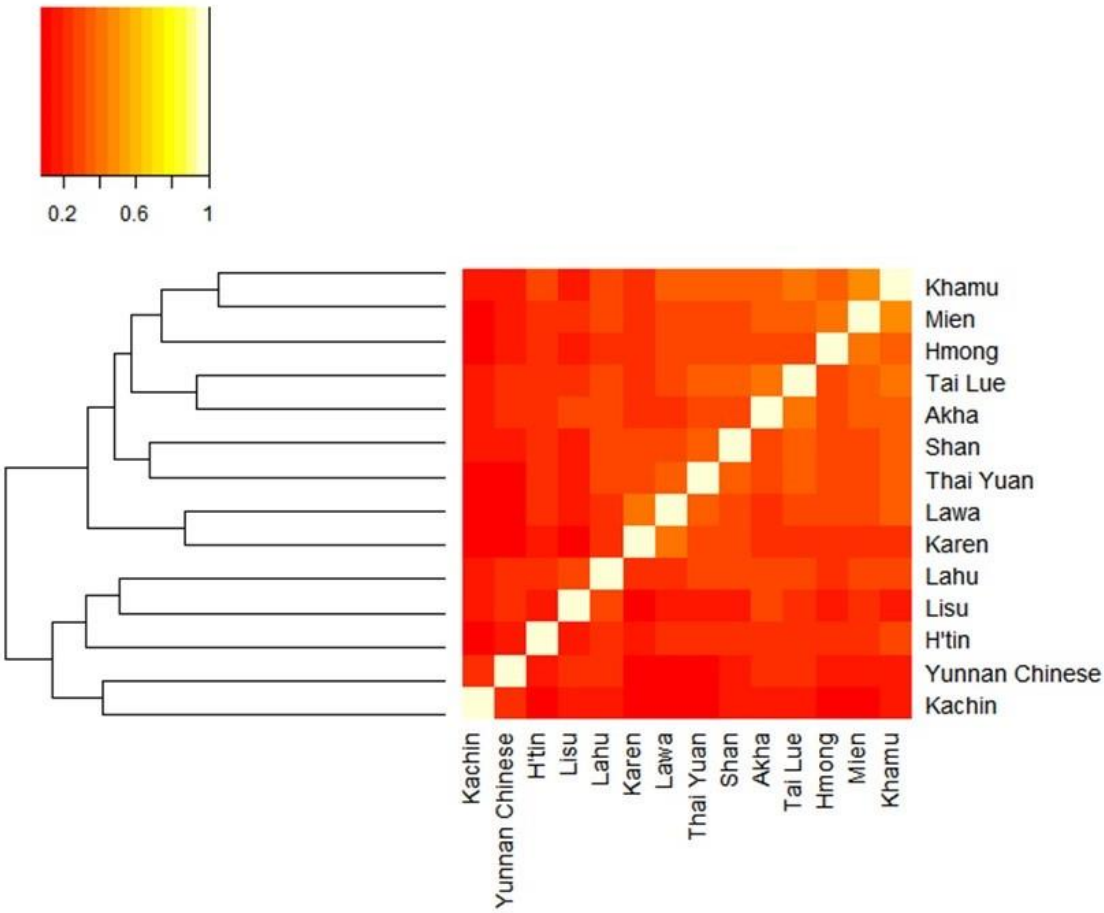

Figure 6. Heat map diagram of the Jaccard's similarity index for food plants used by 14 ethnic minority groups in northern Thailand.

Among 1182 food plant species included in this review, only eight were reported for all 14 studied ethnic groups. These were: taro (*Colocasia esculenta* (L.) Schott), rice (*Oryza sativa* L.), mango (*Mangifera indica* L.), lablab-bean (*Lablab purpureus* (L.) Sweet), cassava (*Manihot esculenta* Crantz), pumpkin (*Cucurbita moschata* Duchesne), pea eggplant (*Solanum torvum* Sw.), and maize (*Zea mays* L.). The first three are native species, while the rest are long-established exotic food plants. Around 14% of the recorded taxa were eaten by at least seven ethnic groups, while around 40% were used as food by only one ethnic group (Figure 7).

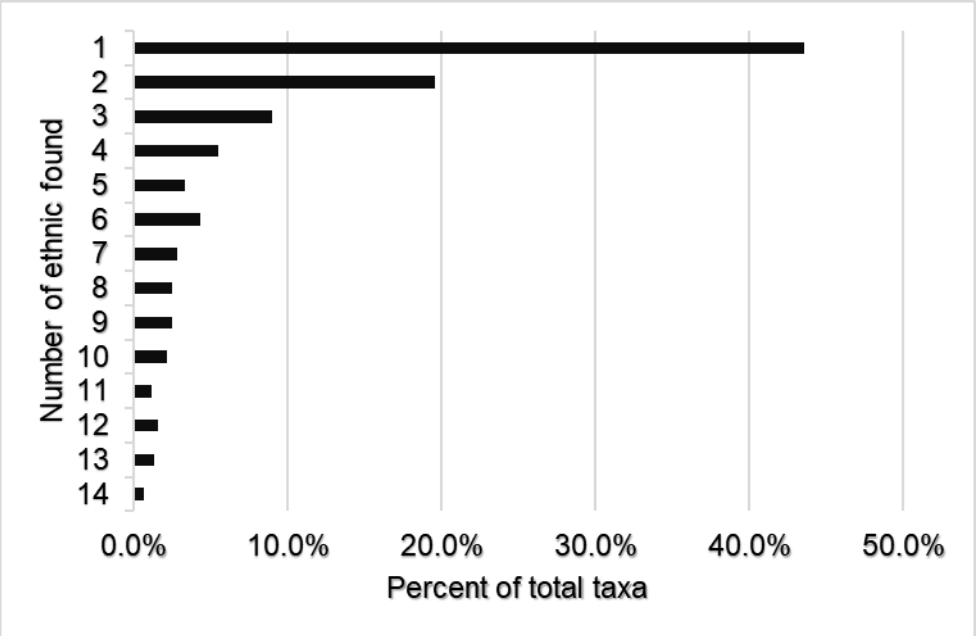

Figure 7. The percentage of food plant species registered in 14 different ethnic groups in northern Thailand.

3.3. Plant Prevalence, Category, and Origin

The Use Values (UVs) varied between 0.01 (for singleton species) and 0.82. All species, except rice and maize, which were found in all ethnic groups, were also the species with the highest UVs. The other species were bitter gourd (*Momordica charantia* L.), *Oroxylum indicum* (L.) Benth. ex Kurz, banana (*Musa* × *paradisiaca* L.), *Crassocephalum crepidioides* (Benth.) S. Moore, and jack fruit (*Artocarpus heterophyllus* Lam.), which were used by at least 12 of the 14 ethnic groups. Therefore, the UVs are significantly correlated to plant occurrence ($r^2 = 0.94$, $p < 0.01$, Spearman's rank).

The uses of most species (76%) were limited to only one use-category. About half of them were singleton species (Figure 8). The maximum number of categories that a species was used in was three, which was true for about 50 species. Most of them were vegetables or dessert fruits which could also be eaten as another food category. For example, *Solanum americanum* Mill. was normally eaten as a cooked vegetable, but the fruit was also eaten as a dessert fruit and the leaves could be used to make tea. The tamarind (*Tamarindus indica* L.) was a common dessert fruit, but the young shoot was also eaten as a vegetable in a spicy salad or in vegetable curried soup, and, additionally, its seeds could be eaten as pulse. Most species were used only in one category, but species with higher UVs tended to be used in more categories. The Spearman's rank confirmed this trend ($r^2 = 0.5$, $p < 0.01$). It should be noted that the URs of plants that were used in two or three categories were mostly distributed unequally across the categories (Figure 9).

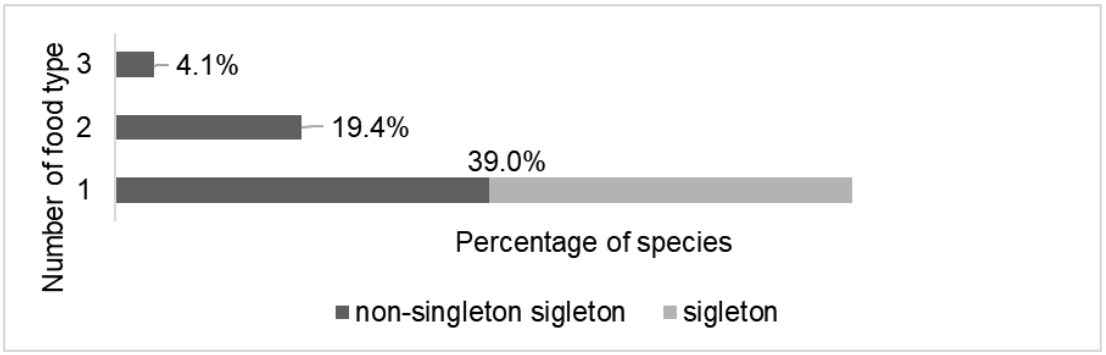

Figure 8. The percentage of species used in one, two, and three food categories, respectively, among 14 ethnic minorities in northern Thailand.

Figure 9. Comparing the number of use-reports from different use-categories for 49 food plant species that are the most frequently used by 14 ethnic groups in northern Thailand.

Among 1182 species of food plants found in this study, about 20% were exotic. The ratio increased when only plants with large UVs were considered. For example, exotic

species made up 31% of the 50 species with the highest UVs, but the proportion increased to 45% when only the top ten highest UV plants were considered (Table 1). Moreover, the UV of exotic plants (excluding singleton species) was significantly higher than the UV of native species (p = 0.003, Kruskal-Wallis test).

Table 1. The proportions of native and exotic food species used by 14 ethnic minority groups in northern Thailand according to their top position of use values (UVs).

Top Ranked for UV	Native%	Exotic%
10	55	45
30	63	37
50	69	31
100	65	35
200	69	31
500	73	27
1000	79	21

3.4. Uses of Rare Species

Forty-eight rare species were edible, including forty rare species and eight vulnerable species in the IUCN classification. These included four species of shrubby trees: *Ardisia gracillima* K.Larsen & C.M.Hu, *Cycas pectinata* Buch.-Ham., *C. siamensis* (Smitinand) K.D.Hill, and *Flemingia macrophylla* (Willd.) Kuntze ex Merr.; two species of palms: *Caryota maxima* Blume and Ca. *obtusa*; and a species of tree and an herb: *Lithocarpus echinophorus* (Hickel & A.Camus) and *Platostoma siamense* (Murata) A.J.Paton, respectively.

Among the rare species, those with the highest number of use-reports were *Tupistra muricata* (Gagnep.) N.Tanaka (18), *Clinacanthus nutans* (Burm.f.) Lindau (16) *Caryota maxima* (10), *Antidesma bunius* (L.) Spreng. (9), and *Caryota obtusa* (7). Most rare species were used as vegetables (35 spp.) or dessert fruits (10 spp.) (Figure 10). Herbs were the most dominant plant life form, especially among the vegetable species (Figure 10).

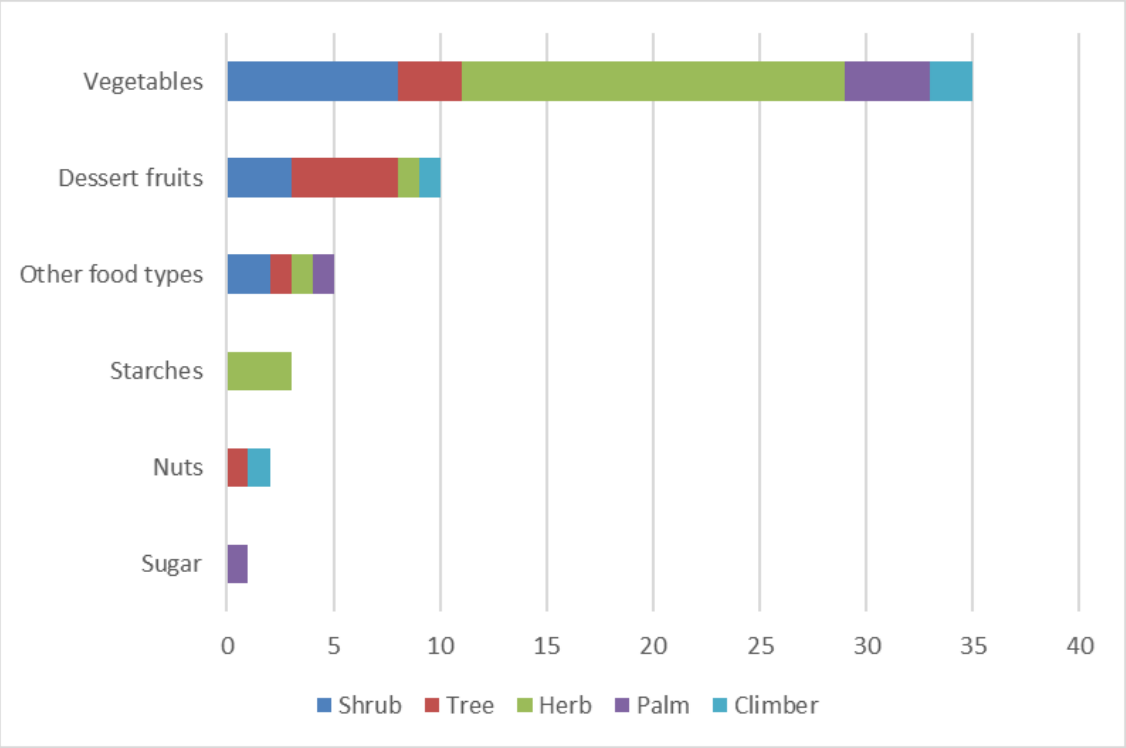

Figure 10. The number of rare species and different life forms that were used in different food categories.

4. Discussion

4.1. Food Plant Diversity

A great diversity of food plants was consumed by people belonging to 14 ethnic minorities in northern Thailand. Although 1182 food plant species were recorded, the accumulation curve suggested that more could be discovered (Figure 2). None of the previous studies mentioned in the introduction to this paper come anywhere near the diversity of food plants documented here. The vast biodiversity and the cultural diversity in the region surely drive this high diversity of food plants [24].

The plant family most used for food in this study was Leguminosae, which agrees with many other studies in this region (e.g., [43–45]). Leguminosae is an important plant family at both global and local scales [46]. In Thailand, it is also an important family that is used in traditional medicine [32,47]. Globally, Leguminosae is one of the largest plant families, and its richness is one of the reasons why it has the highest UV_f since this index is greatly affected by the prevalence of plants [48] and is significantly correlated to the number of species reported.

Herbs were the most common life form among food plants. This result is consistent with other studies from nearby regions (e.g., [13,17,49]). Herbs are an important source of many different kinds of food. Some food categories, such as cereals, pseudocereals, and sugar, were derived only or almost entirely from herb species. Herbs were the main source of vegetables and were used mostly for their green parts, such as the leaves or young fruit. The preference for herbs is called *herbophilia*, which is also found in other countries in the region, such as China or Japan [50]. In this study, the preference for green vegetables was also confirmed for northern Thailand. It should be noted that, unlike other food categories, plants used as vegetables were not limited to any particular life forms, plant part, or taxonomic group. Fruits eaten as desserts, for example, were limited to only flowering plants and were not found among the bamboo or the parasitic life forms. This could be considered a bias of classification.

Although trees were also one of the important sources of vegetables, contributing about 140 species and 600 use-reports, the most important food category in this life form was dessert fruits. Another important source of dessert fruits was shrubs. Fruits were eaten with or without processing and mostly consumed raw. This pattern of consumption is common in other regions in Asia and Europe [51–53]. Fruit trees are particularly important in local people's diets because, in addition to providing micronutrients and supplementary minerals, they can serve as a famine food during the dry season [54–56]. The fruit species play a crucial role in combatting food insecurity, especially the problem of micronutrients, vitamins, and mineral deficiencies [57,58]. Among the fruit species, the most common ones were cosmopolitan fruits, such as guava (*Psidium guajava* L.), tamarind (*Tamarindus indica* L.), jack fruit (*Artocarpus heterophyllus* Lam.), and papaya (*Carica papaya* L.). Among native species, the following were the most common: Burmese grape (*Baccaurea ramiflora* Lour.), *Elaeagnus latifolia* L., banana (*Musa* × *paradisiaca* L.), emblic (*Phyllanthus emblica* L.), mango (*Mangifera indica* L.), and longan (*Dimocarpus longan* Lour.). These were common species that could be cultivated in the homegardens of many ethnic groups [41].

More than 40% (~500) of the species found in this study were mentioned in only one reference (singleton). Such heterogeneity was also found in a study of medicinal plants [59] in which the same ethnic group used different plants to treat the same ailments. The high number of singletons points to the importance and urgent need for additional ethnobotanical studies, especially in the current situation when knowledge erosion is rapidly increasing [60,61]. The singletons could be viewed as a less preferred species, which could be due to their taste, rarity, etc. However, from another point of view, the knowledge of these species is prone to disappear.

4.2. Use of Rare Species

Rare species were not often used for food by ethnic people. A total of 1442 species were listed in the manual Threatened Plants in Thailand [38], and of these, only 48 species

(~3.3%) were used as food. Rare species occur in small numbers and are less likely to be encountered. Moreover, the edible plant could be effortlessly substituted by other similar species. This could be one of the reasons why only a small number of rare species were reported for their use as food.

In addition to the small number of rare species used as food, rare species also have few use-reports in general. Compared to common species, especially exotic or cultivated species, the availability of rare species is prohibitively low. This in turn means that the use of rare plants by the ethnic groups for food is not an important threat to their existence. However, efforts are needed to increase social awareness of the importance of rare species. More studies are needed to promote the sustainable use of rare species.

4.3. Exotic Species in Traditional Knowledge

Knowledge of exotic species is important in ethnobotany. The presence of numerous exotic species reflects the effect of years of international crop exchange in Thailand [62]. These exotic food species include crop vegetables, fruit plants such as maize or cassava, exotic weeds, and plants that were brought by immigrants long ago [63]. Most exotic species were widespread and easy to recognize [48]. Therefore, the average UV of exotic plants was significantly higher than the UV of native species.

In addition to common crops such as maize, cassava, and pumpkin, it was reported that many invasive species were also consumed as vegetables, for example, redflower ragleaf (*Crassocephalum crepidioides* (Benth.) S. Moore). This plant is native to Africa and has been recorded as a weed in disturbed habitats with a wide variety of soil types. It also may have been introduced to Asia around one hundred years ago [64]. The tender and succulent parts were eaten raw or cooked, mostly as a side-dish vegetable. In Africa, its native continent, the ragleaf is also commonly used as a vegetable [65]. Because this plant is widespread and could be grown under diverse environmental conditions, its widespread use could be explained by the greater accessibility or availability hypothesis [66].

4.4. Plants and Ethnicities

The similarities of food plants among the different ethnic groups were exceptionally low (Figure 6). The maximum Jaccard's index was 0.49 for the similarity between the Mien and the Khamu. This similarity is a result of close geographical proximity since the ethnobotanical studies of these ethnic groups were conducted in the Nan province. Moreover, part of the data came from the same data sources [67]. However, the number is still lower than 0.5, which is a meaningful threshold [68]. According to this vast difference between the pseudo-informants, we were unable to conclude whether any ethnicity had its own unique culture of food plant uses. The comparison of plants found in homegardens of different ethnic groups, where food plants were the main component, also shows the same trend [41]. The presence of many singleton species could be the explanation for the low similarity since Jaccard's index only accounts for the presence or absence of the species. The divergence of plant uses could happen even if the different ethnic groups lived under the same environmental conditions [69]. The lack of common historical and cultural backgrounds could be the driver behind this situation [70].

The number of references was significantly correlated to the number of species and use-reports for each ethnic group. More than 500 species were reported from both the Karen and the Lawa, which are the ethnic groups that have been the most intensely studied. On the other end of the spectrum, there is only a single reference for food plants used by the Kachin and only 56 species were reported [71]. This trend and the heterogeneity of the current ethnobotanical knowledge underlines the urgent need for more ethnobotanical knowledge, especially from the ethnic groups for which there are few or no ethnobotanical studies, such as the Kachin, the Mien, the Khamu, and some other Thai ethnic minority groups.

The eight common species that were used by all 14 ethnic groups included two species of cereal (rice and maize) and six multi-use vegetables. These species were used

in the same manner among different ethnic groups. Rice (*Oryza sativa*) is a stable food for people in Thailand and nearby countries, while maize (*Zea mays*) was introduced to Southeast Asia long ago [72].

Taro (*Colocasia esculenta*) is common and can be grown under a wide range of environmental conditions [73]. It is common in the homegardens of many ethnic groups [41] and is well-known for its starchy corm, which is an important staple food for rural people in Africa, Asia, and the Pacific Islands [74]. In northern Thailand, taro is not a main staple food, but its corm is commonly consumed. In addition to its underground stem, the petioles were also eaten as curried vegetables by people in northern Thailand.

Mango (*Mangifera indica*) is commonly cultivated in the homegardens of ethnic groups in northern Thailand [30,31,75] and is found across the country. Its raw fruit can be eaten as a snack or used as an ingredient in spicy salads, while the ripe fruits are consumed as dessert fruits. The young leaves were also eaten in a sour salad by various ethnicities (e.g., [30,76,77]).

The other four species were exotic vegetables introduced to Thailand long ago: lablab-bean (*Lablab purpureus*), cassava (*Manihot esculenta*), pumpkin (*Cucurbita moschata*), and pea eggplant (*Solanum torvum*). These plants were often consumed as vegetables, especially the young leaves of cassava which are eaten more commonly than its starchy tuber. In addition to its ripe fruit, the young fruit and the young leaves of pumpkin were also popular vegetables among the ethnic group in northern Thailand. This supports the notion that the *herbophilia* culture is common in our study area, as it is in China and Japan [50].

The prevalence and versatility of the use of foreign species demonstrates the ability of local people to integrate knowledge of exotic plants into their traditional knowledge. However, as a negative consequence, this knowledge could cause the replacement of the traditional native species with uses that are similar to those of the newly imported species. This could lead to the disappearance of the native species and the related knowledge from the communities. The effect of the study of exotic species on the knowledge of native species in an ethnobotanical context is interesting and should be further explored.

5. Conclusions

In northern Thailand, we found a unique balance between natural resources and cultural diversity which resulted in rich traditional knowledge. This work presents and discusses available information regarding plants used as food in the local gastronomic tradition among ethnic minorities in northern Thailand. The use of 1182 plant species with 7620 use-records was documented in the region. This list of food plants included 48 rare species. The richness of northern Thai ethnobotany could be an important source of inspiration for further development in different fields of human activity, e.g., agriculture, tourism, functional foods, etc. However, such biocultural knowledge needs to be protected from the risks of progressive erosion related to ongoing modernization in rural areas. The ethnobotanical knowledge of these food species, especially the wild and rare species, is closely linked to the environment and its conservation. The ongoing use of local traditions is a sustainable way to maintain and underline the importance of the surrounding environment on the community since it is the place where traditional knowledge has been formed and experienced. Further research is needed to explore the potential of the diversity of traditional species used in northern Thailand. Future studies should also focus on the aspect of nutritional and health properties of these plants.

Despite a great number of species compiled in this study, it should be noted that some cultivated taxa are probably presented in different cultivars, e.g., banana (*Musa* spp.), mango (*Mangifera indica*), legumes and pulses, or taro (*Colocasia esculenta*). This is another precious hidden heritage of the different ethnic groups that requires further study.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/d15010120/s1, Table S1: Detail of the 60 references used for analyzing northern Thai food plants data [78–130]; Table S2: List of plant families of edible plant species used by 14 ethnic groups in northern Thailand; Table S3: List of genera of edible plant species used by 14 ethnic groups in northern Thailand; Table S4: List of edible plant species used by ethnic

groups in Thailand. Most use data used for analyzing in this article are published in Thai language. For the readers who require the use data of specific plant groups, kindly contact the corresponding author for such data.

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