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Urban Demand for Wild Foods in Northeast Thailand: A survey of edible wild species sold in the Khon Kaen municipal market

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Research

Abstract

Rural people in Northeast Thailand consume a wide range of wild species. Little is known, however, about the extent to which the urban populations of the region's rapidly growing towns and cities consume these products, and no detailed study has been made of the edible wild species that are sold in urban markets. To help fill this knowledge gap, this paper presents findings of a survey about the wild species sold in the main urban market in Khon Kaen Municipality. The survey included identification of all species of plants, fungi, and animals being sold and recording of the quantities and prices of each species. Data were obtained by interviewing vendors selling these products in the market on 18 randomly selected nights in the dry season and 12 nights in the rainy season.

The diversity of wild species sold in the market is high. Eighty-one species were identified, of which 54 were plants, 6 were fungi, and 21 were animals. Species diversity was greater in the rainy season, when 65 species were on sale, than in the dry season, when 49 species were available. Plant species were much more diverse in the rainy season than in the dry season, reflecting the better growth conditions for vegetation when water is not a limiting factor. Many species were available only in a specific season.

The wild species were obtained from several different habitats. Upland fields were the habitat for the largest number of species, followed by house areas, forests, and paddy fields. Gardens and aquatic ecosystems were habitats for a smaller number of species.

The supply-shed for the urban market in Khon Kaen Municipality is quite a large one. Wild species sold in the market are obtained from 8 provinces in the Northeast, although rural areas of Khon Kaen Province itself are the source of the largest number of species.

Collection of wild species to supply the urban market can have both negative and positive effects on rural biodiversity in Northeast Thailand. In their desire to earn cash income, villagers may over-exploit some of these species, causing wild populations to decline in numbers or even become locally extinct. On the other hand, villagers may intensify their efforts to cultivate them so as to allow more stable production, thus contributing to biodiversity conservation. This has already begun to happen in the case of some highly valued species.

Introduction

Previous research on collection and consumption of edible wild species in Northeast Thailand has been mostly focused on rural areas. Relatively little attention has been paid to the consumption of wild species by urban people. This paper presents findings of a survey of the edible wild

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and cultivated species of plants, fungi, and animals sold in the urban market system in Khon Kaen Municipality in Northeast Thailand.

There is much literature related to people's collection and use of wild and semi-domesticated products in different parts of the world that raises many important issues in terms of conservation of forests and biodiversity, economic value of wild products, and the evolution of domestication and commercialization of wild products (Catling & Small 2006, Chamberlain et al. 2004, Chardonnet *et al*. 2002, FAO 1995, Lindsay 1999, Sather 2002). These issues are relevant for Thailand, which is situated in one of the richest areas of the world with regard to biological resources (Baimai & Brockelman 1998). It is hardly surprising that wild products play important roles in the livelihoods of rural people there, especially in the Northeast Thailand region (Isan), which remains the most rural and poorest part of the kingdom. It is estimated that approximately 80% of Isan households engage in collection of various kinds of non-timber forest products (NTFPs), both edible and non-edible (Boonchote & Pasandhanatorn 1998). Numerous studies have been published on the collection and use of edible wild species by rural people in Northeast Thailand (Miyagawa 1993, Moreno-Black 1994, Moreno-Black *et al*. 1996, Moreno-Black & Somnasang 2000, Prachiyo 2000, Shibahara 2002, Somnasang *et al*. 1986, 1988, 1998). Some attention has also been paid to collection of non-edible wild products. For example, Wanida (1994) reported on the importance of rattan, bamboo, lac, honey, gums and resins, bark, agarwood, and medicinal plants in terms of harvesting and the processing, exports, and imports. Northeast Thai villagers collect natural products from all of the components of their agroecosystems including forests, upland fields, rice paddies, gardens, and house areas, as well as various water sources e.g., canals, ponds, swamps, rivers, and reservoirs (Grandstaff 1986, Somnasang *et al*. 1988). It is now widely recognized that wild products make an important contribution to the livelihoods and nutritional status of rural people in the Northeast.

As is true in other countries in the world, research on collection and consumption of wild products in Northeast Thailand has been largely focused on rural areas, with almost no attention paid to urban areas, although for the past 20 years the region has been undergoing very rapid urbanization. However, other than a brief study of edible insects sold in a market in Khon Kaen Municipality (Watanabe & Satrawaha 1984), no detailed research has been done about the edible wild plant and animal species that are consumed by urban people. In order to help fill this gap in knowledge, a study was conducted during 2006 of all of the edible wild species on sale in the central urban market in Khon Kaen Municipality. In this paper we seek to: 1) identify all wild and cultivated species that are sold in the urban market, 2) describe seasonal variations in their availability, 3) assess the domestication status of these species, 4) identify the habitats in the rural environment from which they are obtained, and 5) delineate the rural areas that are impacted by urban demand for these products.

Research Design and Methods

The study site

This research was carried out in Khon Kaen Municipality, the capital city of Khon Kaen Province, which is located approximately 450 km northeast of Bangkok (Figure 1). Although it was connected to Bangkok by a railroad in 1933, Khon Kaen remained a rather small provincial town until it was designated as a development center for the Northeast Thailand region in 1962. Following this decision, Khon Kaen University was established as the first national university in the Northeast and the regional offices of many government agencies were relocated into the city. The completion in 1964 of the Friendship Highway, which runs from Bangkok to Nong Khai on the border with Laos, and the construction of a nearby airport greatly improved the city's connections to Bangkok and the outside world and created a favorable situation for the rapid development of cash crop production in its rural hinterland (Fukui 1988, 1993).

In 2006, the population of Khon Kaen Municipality was 121,283, making it the ninth largest city in the country (Wikipedia contributors 2007). The Municipality has an area of 46 km^2, making Khon Kaen a relatively low-density city (2,637 persons/km^2).

The urban population is supplied with food by a well-developed system of government and private markets. In 2003, there were four government fresh markets and seven private fresh markets (Khon Kaen Municipality 2006). In addition, there are several supermarkets, but these rarely sell any wild foods. After conducting a preliminary survey of all city markets, Bang Lam Phu Market was found to be the central market for edible wild species where collectors and traders from the countryside bring these products. In the market there are 139 vendors who sell these products, either selling them directly to consumers or distributing them to dealers from all of the other markets in the city for sale to consumers there (Figure 1). Bang Lam Phu Market is open around the clock, but most of the vendors of wild products come to the market at about 2:00 A.M. and stay until they sell out all their products around 9:00 A.M.

Data collection

In an initial survey, all of the vendors engaged in selling edible wild and semi-domesticated products in the market were identified. Thailand does not require researchers to obtain written consent from respondents, but, before interviewing each vendor, the researchers identified themselves, explained the purpose of the research, and

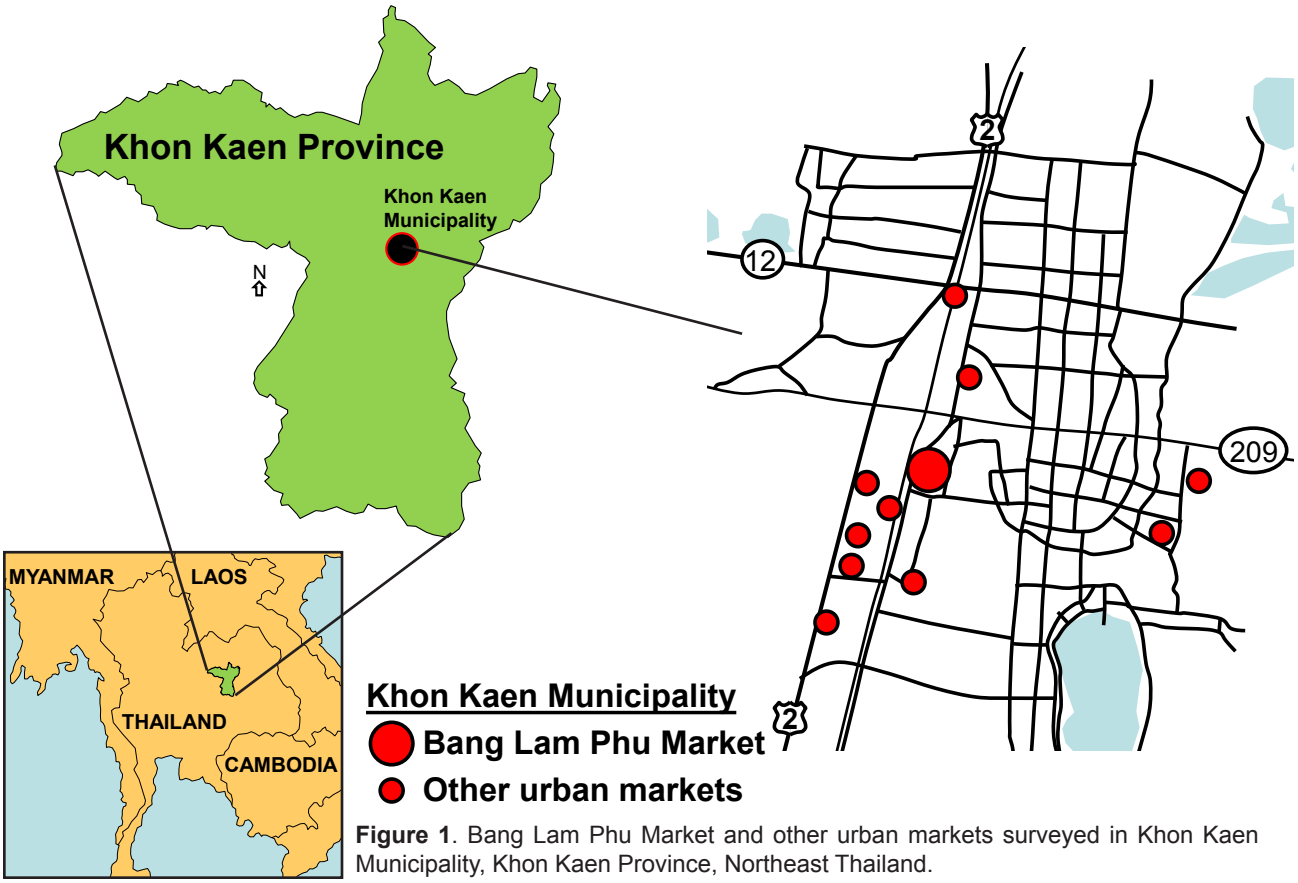

Figure 1. Bang Lam Phu Market and other urban markets surveyed in Khon Kaen Municipality, Khon Kaen Province, Northeast Thailand.

asked permission to collect needed information. Anonymity of respondents has been protected, and no vendors were identified by name in any study reports. This information was used to draw a map of Bang Lam Phu Market that showed the relative location of all vendors. The market area was divided into three blocks (A, B, and C) with each block containing approximately 20 vendors of wild and semi-domesticated products were selected from the total in each block (Figure 1).

Sampling plan

There were 139 vendors, mostly female, who sold edible wild and semi-domesticated products in the Bang Lam Phu Market on a regular or occasional basis. However, only 65 of these sold wild products on a regular basis. It was this group of 65 vendors, of whom all but 3 were female, who were the focus of data collection for this study. Because of the very large number of vendors, it was impossible for a single researcher to interview all of them in one night. Therefore, it was necessary to limit data collection to vendors in just one block on any one night. Data were then collected from vendors in a different block on a subsequent night, followed by the third block on yet another night. The data collected from the three different blocks were aggregated to estimate the total volume of wild and semi-domesticated products sold in the market on an average night.

Because the supply of different kinds of edible wild and semi-domesticated products to the market is affected by seasonal variation, the sampling plan had to include data collection in different seasons. Generally, the climate of Northeast Thailand is differentiated into three seasons: 1) the cool dry season from November to February, 2) the hot dry season from March to May, and 3) the wet season from May to October (Moreno-Black 1996). The sampling plan was designed to include data collection in each of these seasons. In 2006, however, the rains started unusually early so that there was no true hot season. Consequently, data collection was only possible in the wet season and the cool dry season.

Each of the nights and blocks for collecting data were randomly selected. On any single night all the vendors in one block were interviewed to record the kinds, quantities, prices, and sources of all edible wild and semi-domesticated products they were selling. On a subsequent night all the vendors in the second block were interviewed, and then on a following night all the vendors in the third block were interviewed. This data collection cycle was repeated for eighteen nights (representing 6 composite “nights”) during the cool dry season in 2006 and twelve nights (rep-

resenting 4 composite "nights") during the rainy season of 2006.

Data collection method

On a given sample night, each vendor in the selected block was interviewed to ascertain the kinds, quantities, values, and sources of all the edible wild and semi-domesticated products that she or he was selling. In order to identify wild and semi-domesticated products, each vendor was asked if these products had come from natural sources or not and then asked what they were called in both standard Thai and the Isan dialect. Species of 54 plants were collected and deposited as voucher specimens at the Herbarium of the Department of Biology, Faculty of Science, Khon Kaen University (KKU). Associate Professor Sam-ang Homchuen (Faculty of Science, Khon Kaen University) helped us to identify the plant species. References on Thai taxonomy were consulted:

For fish, fungi, and insects: Somnasang *et al*. (1988) and Mahasarakam University (n.d.).

For amphibians, birds, crustaceans, mammals, mollusks, and reptiles: Somnasang *et al.* (1988), Agriculture Extension Department (2007), Rice Department Thailand (2007), Surathanee School (2007), Ubonrachathane University (n.d.).

All the data obtained from each vendor were recorded on a standardized data collection sheet. When the situation did not permit a full interview, we just observed and took note of the names and amounts of products. Color photographs were taken for later analysis of species. Each product was weighed in order to estimate the total annual sales value of wild and semi-domesticated products in an urban market in Khon Kaen Municipality (Shirai & Rambo 2008).

Data analysis

All data were entered into an Excel database. They were separated by day of collection, number of block, name/gender/address of vendor, types, local names, total amount, purchase and selling prices, and source of products. The habitat classification is based on Moreno-Black *et al*. (1996) and extensive discussions with key informants in Nong Ben Village (Shirai *et al*. 2007).

Identification of the sources of wild and semi-domesticated products sold in Bang Lam Phu Market

The sources of all edible wild and semi-domesticated products were plotted on maps of Khon Kaen Province and Northeast Thailand to identify the boundaries of edible wild and semi-domesticated products supply shed for the Bang Lam Phu Market.

Results

The following describes the diversity, seasonal availability, cultivation status, habitat in the rural ecosystem, and geographical area of collection of the edible wild species that we observed being sold in the Ban Lam Phu market in Khon Kaen Municipality. The market channels observed are presented in Figure 2.

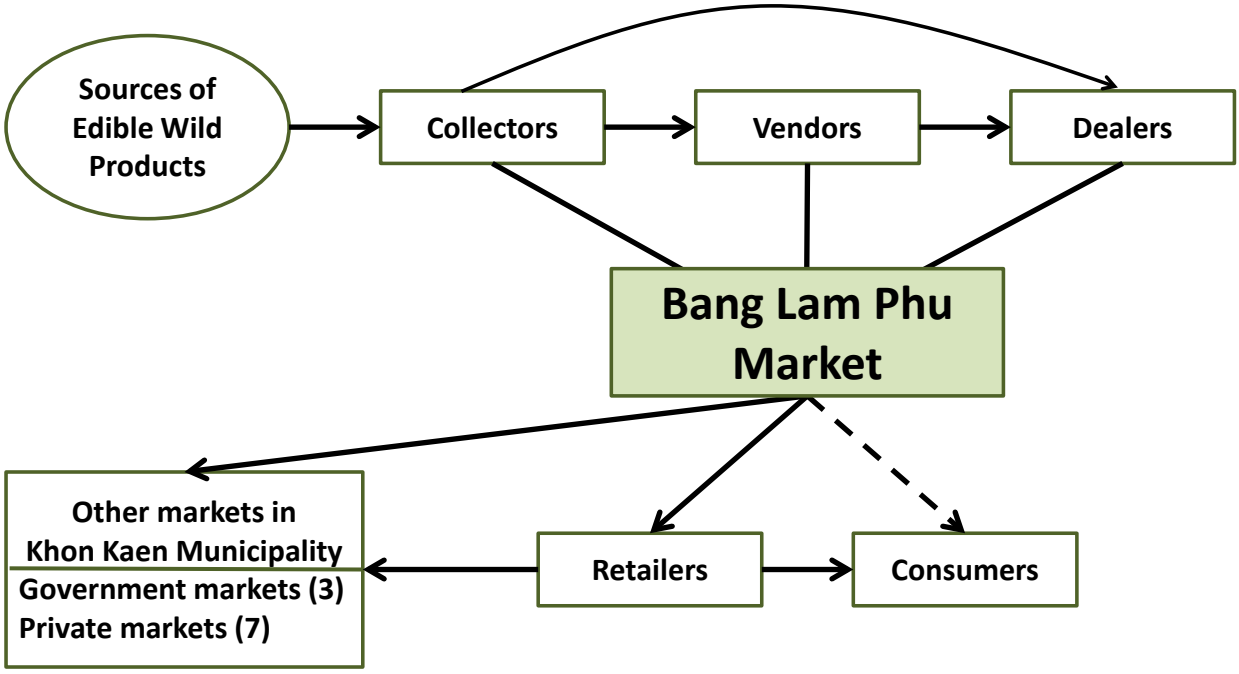

Figure 2. Market channels for edible wild products in Khon Kaen Municipality markets, Northest Thailand.

Figure 3. **Phak tiew kao** (Thai & Isan), *Cratoxylum formosum* (Jacq.) Benth. & Hook.f. ex Dyer, in the Bang Lam Phu Market, Khon Kaen, Thailand.

Species diversity

Appendix A presents a comprehensive list of all species we observed. A total of 81 species were identified, of which 54 are plants, 6 are fungi, and 21 are animals. The animals can be further divided into 2 species of amphibians (frog, toad), 1 bird species, 2 species of crustaceans (crab, prawn), 3 species of fishes (fish, eel), 6 species of insects, 2 species of mammals, 2 mollusk species, and 3 reptile species (lizards, terrapin). Some species are available frequently and in large quantities, but most are available infrequently and in very small quantities. Only 31 species were encountered 10 times or more, including 23 plants, 2 amphibians, 1 crustacean, 3 insects, and 2 mollusks. Figures 3-8 illustrate some of the diversity.

Seasonal availability

Table 1 shows the availability in the market of different species in different seasons. Species diversity is considerably greater in the rainy season, when 65 species were recorded, than in the dry season, when 49 species were

Table 1. Seasonal availability of edible wild species sold in the Bang Lam Phu Market in 2006. Orders of animals: Amphibians (A); Birds (B); Crustaeans (C); Fish (F); Insects (I); Mammals (M); Mollusks (O); Reptiles (R).

Season	Number of edible wild species											
	Kingdoms			Orders of animals								Total
	Plants	Fungi	Animals	A	B	C	F	I	M	O	R	
Dry	35	0	14	1	0	2	1	4	2	2	2	49
Rainy	44	6	15	2	1	2	3	4	0	2	1	65
Total	54	6	21	2	1	2	3	6	2	2	3	81
Only Dry	10	0	6	0	0	0	0	2	2	0	2	16
Only Rainy	19	6	7	1	1	0	2	2	0	0	1	32
Both Seasons	25	0	8	1	0	2	1	2	0	2	0	33

Figure 4. **Ma kok** (Thai & Isan), *Spondias pinnata* (L.f.) Kurz, in the Bang Lam Phu Market, Khon Kaen, Thailand.

Figure 5. **Hed ra ngok** (Thai & Isan), *Amanita* sp., in the Bang Lam Phu Market, Khon Kaen, Thailand.

Figure 6. Honey comb of **Peung** (Thai & Isan), *Apis florea* Fabricius, 1787, in the Bang Lam Phu Market, Khon Kaen, Thailand.

Figure 7. **Mang daa** (Thai & Isan), *Oecophylla smaragdina* Fabricius, 1775, in the Bang Lam Phu Market, Khon Kaen, Thailand.

Figure 8. **Yea** (Thai & Isan), *Liolepis reevesii* Gray, 1831, in the Bang Lam Phu Market, Khon Kaen, Thailand.

observed. Many species are available only in a specific season. Forty percent of all species recorded in the survey were only available in the rainy season, 20% were only available in the dry season, while 40% were available in both seasons. Mushrooms, for example, are only found in the rainy season, whereas rats and lizards are only sold in the dry season. Land crabs are available in both seasons, but their price and quantity is different between the seasons. In the dry season, the quantity of land crabs is higher than in the rainy season, but the price of crabs in the rainy season is higher than in the dry season. This may reflect the different conditions of the paddy fields, where most land crabs are collected, in the different seasons. In the rainy season, the villagers prepare the paddy fields to plant their major rice crop and apply chemical fertilizers and pesticide to the fields, so people prefer not to eat land crabs caught during this season. Moreover, the land crabs in the dry season are bigger and tastier than in the rainy season.

Cultivation status

Figure 9 shows the percent of species in each cultivation category. Of the total 81 species sold in the market, 59% are only wild, 19% are mostly wild, 12% mostly cultivated, and 10% only cultivated. Plants have been most effected by human efforts at cultivation, with only 23 species

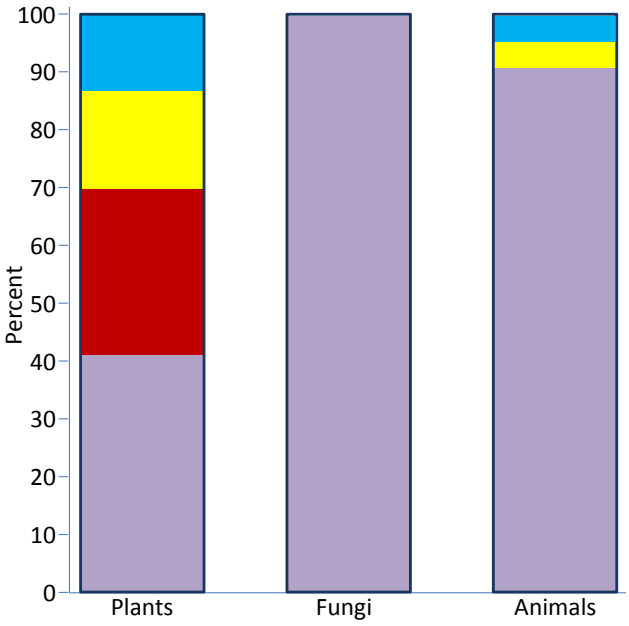

Figure 9. Cultivation status of edible wild products in Bang Lam Phu Market, Khon Kaen, Northeast Thailand.

Table 2. Habitats of edible wild species sold in the Bang Lam Phu Market in 2006, Khon Kaen, Thailand. Note that species may occur in more than one habitat.

	Forests	Paddy Fields	Upland Fields	Gardens	House Areas	Canals	Ponds	Swamps	Rivers
Plants	18	11	21	13	28	1	5	4	4
Fungi	6	0	6	0	0	0	0	0	0
Animals	6	16	8	0	1	6	8	11	10
Orders of animals									
Amphibians	0	2	0	0	0	0	0	2	2
Birds	0	1	1	0	0	0	0	0	0
Crustaceans	0	1	0	0	0	1	1	2	1
Fish	0	3	0	0	0	3	3	3	3
Insects	2	3	3	0	1	0	1	1	1
Mammals	2	2	2	0	0	0	0	0	0
Mollusks	0	2	0	0	0	2	2	2	2
Reptiles	2	2	2	0	0	0	1	1	1
Total	30	27	35	13	29	7	13	15	14

(42%) classified as still entirely wild, 15 species (28%) mostly wild, and 16 species (30%) either mostly or only cultivated. In contrast, all 6 fungi species and 19 out of 21 animal species are classified as only wild.

Habitats of wild species in the rural ecosystem

Edible wild species are obtained from several different habitats in the rural ecosystems of Northeast Thailand, including forests, upland fields, upland gardens, home gardens in house areas, paddy fields, canals, ponds, swamps, and rivers. Some species are found in only a single habitat while others may be found in several habitats. Table 2 shows the number of species found in each type of habitat.

Upland fields are the habitat for the largest number of species (35 species), followed by forest (30 species), home gardens in house areas (29 species), and paddy fields (27 species). Upland gardens and aquatic ecosystems (e.g., swamps, ponds, canals) provide habitats for smaller numbers of species.

The highest diversity of plant species is found in home gardens in house areas (28), followed by upland fields (21), forest (18), upland gardens (13), and paddy fields (11). Between 1 and 5 species are found in each of the aquatic habitats.

The 6 species of fungi are all found both in forests and upland fields. Animal species diversity is highest in paddy fields (16 species), followed by swamps (11 species), rivers (10 species), ponds and upland fields (8 species each), and forest (6 species). No animal species are found in upland gardens and only one species (crickets) in home gardens in house areas.

Sources of supply of wild species to the urban market

Figure 10 shows the provinces from which wild species flow to the urban market in Khon Kaen Municipality. Species are obtained from 8 provinces in the Northeast. Rural areas of Khon Kaen Province itself are the source of the largest number of species (68 out of a total 81 species found in the market). Mahasarakam and Kalasin provinc-

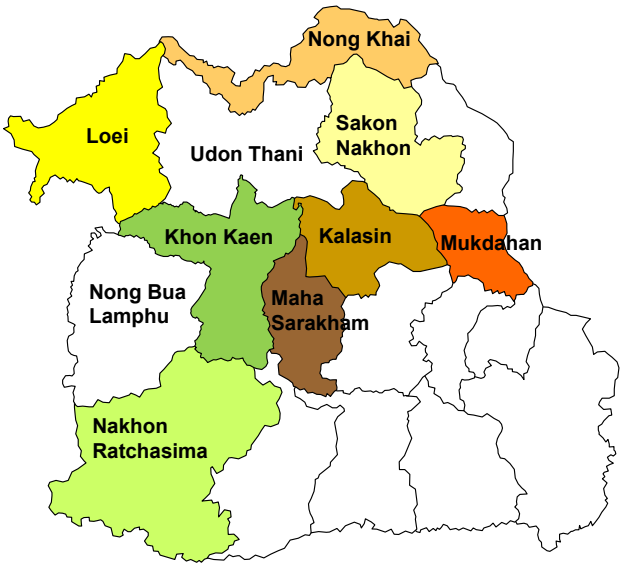

Figure 10. Supply-shed in Northeast Thailand of edible wild species sold in the Bang Lam Phu Market, Khon Kaen, with number of species from each province. Provinces (number of species): Khon Kaen (69); Maha Sarakham (34); Kalasin (27); Loei (6); Sakon Nakhon (4); Nong Khai (1); Nakhon Ratchasima (1); and Mukdahan (1).

es, which border Khon Kaen Province on the east, also supply many species (34 and 27 species, respectively). Smaller numbers of species come from mountainous Loei Province to the west and Sakon Nakon to the northeast.

Discussion

Species diversity

The edible wild species sold in the Ban Lam Phu market are diverse. However, the number of species that we recorded in the Khon Kaen urban market is considerably smaller than the total of 212 species of plants, fungi, and animals that were found by a survey conducted in 11 village, town, and peri-urban markets in Northeast Thailand at the beginning of the 1990s (Moreno-Black *et al*. 1996). In that survey, conducted over the course of 2 years, 110 non-cultivated plant species, 19 species of fungi, 46 varieties of fish, 15 insect species, 9 crustaceans, 7 amphibians, 2 reptiles (lizard, turtle), 2 mammals, and 2 bird species were recorded. However, many of the species recorded in the earlier survey were isolated individuals that were observed in only one or a few markets. Only 37 species were commonly encountered, including 20 plant species, 4 species of fungi, 5 species of insects, 4 species of fish, 2 species of crustaceans, and 2 species of mollusks (Moreno-Black *et al*. 1996:109-110).

Somewhat surprisingly, the diversity of edible wild species available in the urban market in Khon Kaen Municipality is about the same as is now found in rural villages in the Northeast. A survey in 2006 of wild food species collected by farmers in Nong Ben Village in Khon Kaen Province identified a total of 96 species, including 38 plant species, 4 species of fungi, and 54 animal species (Shirai *et al.* 2007). This is a smaller number of species than was found by a survey conducted in 8 villages in several provinces in the Northeast in the mid-1980s. In that survey, 122 species, including 49 plants, 15 fungi, and 58 animals, were recorded as being consumed as food by villagers (Somnasang *et al*. 1988).

Two factors may explain the decrease in the number of species observed in our survey compared to the numbers recorded in surveys conducted in rural villages and markets 15 or 20 years ago (Moreno-Black *et al*. 1996, Somnasang *et al.* 1988). Some of the decrease may reflect an actual decline in rural biodiversity resulting from widespread habitat changes in the Northeast Thailand region in the past several decades (Vityakon *et al*. 2004) while some of the decrease may be the consequence of recent major changes in the rural economy, particularly the increase in employment of villagers as wage laborers, which has reduced the amount of time that villagers have available to collect species occurring in less accessible habitats.

Seasonal availability

Because of the pronounced differences in temperature and rainfall in the different seasons in Northeast Thailand, the supply of wild products to the market is not constant, but varies according to the season of the year. Moreover, there is also a great deal of year-to-year variation in the weather which also causes fluctuations in the supply of wild products. The amount of rain each year is the major factor affecting the availability of natural food (Somnasang *et al.* 1988).

Cultivation status

Given the extent to which rural ecosystems in Northeast Thailand have been subject to continuing human interference for hundreds of years, it is often difficult to determine if a species is truly wild or not. Wild species are defined as species that normally grow under natural conditions without deliberate human management. Semi-domesticated species are formerly wild species that are now to a greater or lesser extent actively managed by humans. Some species that were identified by our informants as being “wild” would appear to be cultivated species that have moved back into wild or cultivated status. For example, star fruit (*Averrhoa carambola* L.) and tamarind (*Tamarindus indica* L.) have long histories of cultivation but can voluntarily propagate themselves to some extent in upland fields and gardens in Northeast Thailand. People who collect fruit from these volunteer trees consider them to be wild. Our classification of the cultivation status of species is based on statements of collectors and market vendors. This is a process that has been underway in Northeast Thailand for some time. Thus, a report on wild food species found in rural markets in the early 1990s states that a significant proportion of vendors indicated that the plant items they sold could be transplanted to make them more accessible and to conserve them, since much of the area is being rapidly deforested. Plant vendors were knowledgeable about a wide variety of management practices for the nurturance and maintenance of plants that were transplanted (Moreno-Black *et al*. 1996:113).

Quite a number of species are in transition, being sometimes collected from the wild and other times cultivated. Thus, species have been further classified according to whether they are only wild, mostly wild, mostly cultivated, or only cultivated. Moreno-Black *et al.* (1996:113) report that rural market vendors surveyed in the early 1990s raised some captured wild animal species in captivity, mostly fish, but that other than frogs, no one bred any animal species.

Interestingly, the domestication status of some species in urban markets is quite different from the general pattern. For example, most honey in Thailand is now obtained from domesticated honeybees, but in the urban market, only honey obtained from the hives of wild bees is sold.

Crickets sold in the market, on the other hand, were all raised by farmers, although it is still possible to collect them from nature. It may be that the heavy demand by urban consumers exceeds the supply of wild crickets so that people have to depend on the cultivated products.

Habitats of wild species in the rural ecosystem

A survey of wild species sold in nonurban markets in the early 1990s (Moreno-Black *et al.* 1996:113) reported that edible plants and fungi were obtained from several different habitats, including forests (28%); paddies (23%); upland gardens (23%); water sources such as ponds, canals, and swamps (22%); and home gardens in house areas and upland gardens (4%).

Although most species in this study are found living in two or more habitats, 17 plant species and 2 insect species are restricted to only a single habitat: 3 plant species occur only in paddy fields, 1 species only in upland fields, 5 species only in upland gardens, and 9 species only in house areas; 1 insect species is found only in paddy fields and 1 species only in home gardens in house areas. Species found in only a single habitat are likely to be at higher risk from human-induced changes in the rural environment, e.g., the conversion of upland crop fields to monocultural plantations of eucalyptus or rubber that is now occurring quite rapidly in many parts of Northeast Thailand.

Sources of supply of wild species to the urban market

Curiously, no species are obtained from Udon Thani and Nong Bua Lamphu, which are Khon Kaen's neighboring provinces to the north. It may be that urban markets in Udon Thani city can absorb the whole available supply of locally collected wild products. Similarly, only one species comes from Nakhon Ratchasima Province to the south. Again, it is likely that the urban markets in the provincial capital of Khorat, which is the largest city in Northeast Thailand, absorb almost all locally collected products.

Conclusions

This research has revealed the diversity of edible wild species that are sold in the main urban market in Khon Kaen Municipality. Despite undergoing many social and cultural changes associated with urbanization, urban people continue to desire many of the same wild foods as have been traditionally consumed by rural villagers. Urban demand for these species may have an important impact on rural biodiversity since species are obtained from many different habitats in an extensive supply-shed that covers eight provinces in Northeast Thailand.

The collection of wild species to supply urban markets can have both negative and positive effects on rural biodiversity in Northeast Thailand. In their desire to earn cash income, villagers may over-exploit some of these species, causing wild populations to decline in numbers or even become locally extinct. On the other hand, faced with a growing scarcity of wild species that bring a high price in urban markets, the villagers may intensify their efforts to cultivate them so as to allow more stable production, thus contributing to preservation of rural biodiversity. This has already begun to happen in the case of wild boar. Farmers living in the vicinity of Khon Kaen Municipality have recently begun to raise this formerly wild species in captivity in order to meet the heavy demand for wild game meat from urban restaurants (Shirai & Praweenwongwuthi 2007). However, understanding all of the ways in which urban demand for wild food species affects rural biodiversity will require much more research than it was possible to conduct as part of this study, which was explicitly focused on the place of these species in the urban markets.

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Appendix A. Inventory of edible wild and semi-domesticated species sold in the Bang Lam Phu Market in 2006. **Seasonal availability**: Rainy (R), Dry (D). **Sources**: Wild only (W), Mostly (more than 50%) wild (MW), Mostly (more than 50%) cultivated (MC), Cultivated only (C). **Habitats**: Canals (C), Forests (F), Gardens (G), Ponds (P), Paddy fields (PF), Rivers (R), Swamps (S),Upland fields (U), Yards (Y). **References**: 1=Smitinand 2001; 2=Somnasang *et al*. 1988; 3=Agriculture Extension Department 2007; 4=Rice Department Thailand 2007; 5=Surathanee School 2007; 6=Vichakran.com 2007;7=Ubonrachathane University n.d.; 8=Mahasarakam University n.d.; 9=Wilkin & Thapyai 2009; 10=Hedge 1997; 11= Hedge & Lamond 1992; 12= Wong 1995; 13= The International Plant Names Index. n.d.; 14. Meyer 2011. Author-collected plant specimens (Yuko numbers) were deposited in the KKU (KKU numbers) herbarium.

Frequency	Names			Season		Source	Habitat	References	Specimens	
	Scientific	Thai	Isan	R	D				Yuko	KKU
	Plants									
167	*Ipomoea aquatica* Forssk.	**Pak bung na**	**Phak bung na**	X	X	W	PF	1	10	22586
106	*Spondias pinnata* (L.f.) Kurz	**Ma kok**	**Ma kok**	X	X	MW	U, Y	1	18	22587
66	*Azadirachta indica* A.Juss. var. *indica*	**Sa dao**	**Ka dao**	X	X	MW	F, U, Y	1	26	22588
40	*Sesbania grandiflora* (L.) Pers.	**Khae ban**	**Dok khae**	X	X	MC	Y	1	05	22589
39	*Barringtonia acutangula* (L.) Gaertn.	**Chik na**	**Phak ka doan**	X	X	MW	F, U, Y	1	22	22590
39	*Limnocharis flava* (L.) Buchenau	**Ta lapat ruesi**	**Phak kan jong**	X	X	MW	PF, S	1	06	22591
36	*Senna siamea* (Lam.) H.S.Irwin & Barneby	**Khi lek ban**	**Phak khi lek**	X	X	MW	F, U, Y	1	04	22592
35	*Bambusa nutans* Wall. ex Munro	**Pai bong**	**Pai wan**	X		MC	G	1	43	22593
34	*Cratoxylum formosum* (Jacq.) Benth. & Hook.f. ex Dyer	**Phak tiew kao**	**Phak tiew kao**	X	X	MW	F, U, Y	1	23	22594
33	*Nymphaea pubescens* Willd.	**Bua sai**	**Bua sai**	X	X	W	P, S R	1	27	22595
32	*Tiliacora triandra* (Colebr.) Diels	**Ya nang**	**Ya nang**	X	X	MW	G, Y	1	01	22596
27	*Bambusa multiplex* (Lour.) Raeusch. ex Schult.	**Pai liang**	**Pai liang**	X	X	MC	G	1	19	22597
26	*Piper sarmentosum* Roxb.	**Cha phlu**	**Phak e lerd**	X	X	MC	G, Y	1	07	22598
21	*Syzygium antisepticum* (Blume) Merr. & L.M.Perry	**Phak mek**	**Phak mek**	X	X	W	U	1	08	22599
20	*Limnophila aromatica* (Lam.) Merr.	**Phak kha yaeng**	**Phak ka ngieng**	X	X	MW	PF	1	03	22600
19	*Telosma cordata* (Burm.f.) Merr.	**Salit**	**Kik**	X	X	MC	G	1	29	22601
17	*Colocasia gigantea* Hook.f.	**Khun**	**Thun**	X	X	MC	Y	1	13	22602

Frequency	Names			Season		Source	Habitat	References	Specimens	
	Scientific	Thai	Isan	R	D				Yuko	KKU
16	*Vietnamosasa ciliata* (A.Camus) T.Q.Nguyen	**Pai chot**	**Chot**	X		W	F, U	1	44	22603
13	*Glinus oppositifolius* (L.) Aug.DC.	**Sadao din**	**Phak kaeng khom**		X	MW	Y	1, 13	17	22604
12	*Garcinia cowa* Roxb. ex Choisy	**Chamuang**	**Phak som mong**	X	X	W	F, U, Y	1	50	22605
12	*Tamarindus indica* L.	**Ma kham**	**Mak kham**	X	X	MC	PF, U, G, Y	1	09	22606
10	*Sauropus androgynus* (L.) Merr.	**Phak waan ban**	**Phak waan ban**	X	X	MW	PF, P	1	02	22607
10	*Schleichera oleosa* (Lour.) Merr.	**Ta kho**	**Mak kho**	X		MW	F, U	1	45	22608
9	*Calamus* sp.	**Wai**	**Wai**	X		MC	G	1	24	22609
7	*Cyclea barbata* Miers	**Bai kon pit**	**Ked ma noi**		X	W	F, U, Y	1	12	22610
6	*Amaranthus viridis* L.	**Phak kom**	**Phak kom**	X	X	W	Y	1	21	22611
6	*Basella alba* L.	**Phak plang**	**Phak pang**	X		MC	Y	1	28	22612
4	*Adenia viridiflora* Craib	**Phak sab**	**Phak sab**	X	X	W	Y	1	32	22613
3	*Colocasia esculenta* (L.) Schott	**Bon**	**Bon**	X	X	C	Y	1	25	22614
3	*Oenanthe javanica* (Blume.) DC.	**Phak chi lom**	**Phak chi nam**		X	W	PF, G, Y	1	33	22615
3	*Phyllanthus emblica* L.	**Ma kam pom**	**Mak kam pom**	X	X	MW	F, PF, U	1	34	22616
3	*Spirogyra* sp.	**Thao**	**Thao**		X	W	C, R	1	35	22617
3	*Terminalia chebula* Retz.	**Samo thai**	**Samo**	X	X	MW	F, U	1	16	22619
3	Unknown	**Phak phai**	**Phak phai**	X		MW	PF, P	-	11	22618
2	*Aegle marmelos* (L.) Corrêa ex Roxb.	**Ma tum**	**Mak tum**	X	X	C	F, U, Y	1	30	22620
2	*Diospyros decandra* Lour.	**Chan**	**Mak chan**	X		C	U, Y	1	42	22622
2	*Emilia sonchifolia* (L.) DC. ex DC.	**Hang pla chon**	**Phak lin pii**	X		MW	Y	1	15	22623
2	*Feroniella lucida* (Scheff.) Swingle	**Ma sang**	**Dok sang**		X	W	F, PF, U, G	1	36	22624
2	*Maranta arundinacea* L.	**Sakhu**	**Sakhu**		X	C	F, G, Y	1	46	22621
2	*Marsilea crenata* C.Presl	**Phak waen**	**Phak waen**	X		W	PF, R	1	31	22625
1	*Acmella oleracea* (L.) R.K.Jansen	**Phak Khrat**	**Phak kaad**	X		W	G, Y	1	52	22634
1	*Averrhoa carambola* L.	**Ma fueang**	**Mak fueang**	X		W	G	1	20	22626
1	*Azadirachta indica* A.Juss. var. *siamensis* Valeton	**Phak khi nin**	**Phak khi nin**		X	W	F, U, Y	1	37	22628

Frequency	Names			Season		Source	Habitat	References	Specimens	
	Scientific	Thai	Isan	R	D				Yuko	KKU
1	*Bambusa bambos* (L.) Voss	**Pai paa**	**Pai paa**	X		W	F, U	12	47	22627
1	*Dialium cochinchinense* Pierre	**Khleng**	**Kheng**	X		W	F, U	1	51	22629
1	*Dioscorea* sp.	**-**	**Man mak heb**		X	W	F, U	9	53	22638
1	*Diplazium esculentum* (Retz.) Sw.	**Phak kut khao**	**Phak kut**		X	C	G, Y	1	48	22630
1	*Flacourtia rukam* Zoll. & Moritzi	**Ta khp thai**	**Mak ben**	X		W	F, U	1	38	22631
1	*Lasia spinosa* (L.) Thwaites	**Phak nam**	**Phak nam**	X		W	Y	1	39	22632
1	*Monochoria hastata* (L.) Solms	**Phak top thai**	**Phak top**	X		W	P, S, R	1	49	22633
1	*Raphanus sativus* L.	**Hua phak kat khao**	**Phak pong**	X		W	PF	10	40	22636
1	*Schinus terebinthifolia* Raddi	**Phak tum sa u**	**Phak tum sa u**	X		C	Y	14	41	22639
1	*Trachyspermum roxburghianum* (DC.) H.Wolff	**Phak sa ngea**	**Phak sa ngea**		X	C	Y	11	14	22637
1	*Wolffia globosa* (Roxb.) Hartog & Plas	**Khai name**	**Khai phlam**	X		W	P, S	1	54	22635
	Fungi									
2	*Amanita* sp.	**Hed ra ngok**	**Hed la ngok**	X		W	F, U	2		
1	*Lentinula edodes* (Berk.) Pegler	**Hed kho**	**Hed kho**	X		W	F, U	2		
1	*Russula delica* Fr.	**Hed kai**	**Hed kai**	X		W	F, U	2		
1	*Russula nigricans* Fr.	**Hed than**	**Hed than**	X		W	F, U	2		
1	*Russula rosea* Pers.	**Hed na dang**	**Hed na dang**	X		W	F, U	8		
1	*Russula* sp.	**Hed na lae**	**Hed na lae**	X		W	F, U	8		
	Amphibians									
14	*Occidozyga* spp.	**Keyad**	**Keyad**	X	X	W	PF, S, R	7		
11	*Hoplobatrachus tigerinus* Daudin, 1803	**Kob**	**Kob**	X		MC	PF, S, R	6		
	Birds									
1	*Coturnix chinensis* L., 1766	**Nok kum see**	**Nok kum**	X		W	PF, U	5		
	Crustaceans									
73	*Somanniathelpusa* spp.	**Pu naa**	**Ka puu**	X	X	W	PF, S	2		

Frequency	Names			Season		Source	Habitat	References	Specimens	
	Scientific	Thai	Isan	R	D				Yuko	KKU
4	*Macrobrachium lanchesteri* de Man, 1911	**Kung foi**	**Kung**	X	X	W	C, P, S, R	2		
	Fish									
2	*Channa striata* Bloch, 1793	**Pla chon**	**Pla kor**	X	X	W	PF, C, P, S, R	2		
1	*Esomus* spp.	**Pla siew**	**Pla siew**	X		W	PF, C, P, S, R	2		
1	*Monopterus albus* Zuiew, 1793	**Pla lai**	**Ien**	X		W	PF, C, P, S, R	2		
	Insects									
43	*Oecophylla smaragdina* Fabricius, 1775	**Mod dang**	**Mod dang**		X	W	F, U	2		
14	*Gryllus* sp.	**Jing lid**	**Jii lid**	X	X	C	Y	2		
11	*Lethocerus indicus* Lepeletier & Serville, 1825	**Mang daa**	**Mang daa**	X	X	W	PF, P, S, R	2		
2	*Apis florea* Fabricius, 1787	**Peung**	**Peung**		X	W	F, U	8		
2	*Cyrtacanthacris tatarica* L., 1766	**Taka taen (Panangka)**	**Taka taen (Panangka)**	X		W	PF, U	2		
1	*Gryllotalpa africana* Palisot de Beauvois, 1805	**Malang kra chon**	**Meng ki son**	X		W	PF	2		
	Mammals									
1	*Rattus argentiventer* Robinson & Kloss, 1916	**Nu tong kaow**	**Nu na**		X	W	F, PF, U	4		
1	*Rattus losea* Swinhoe, 1871	**Nu puk**	**Nu puk**		X	W	F, PF, U	4		
	Mollusks									
17	*Filopaludina martensi* Frauenfeld, 1864	**Hoi kom**	**Hoi juub**	X	X	W	PF, C, P, S, R	2		
16	*Pomacea canaliculata* Lamarck, 1819	**Hoi chery**	**Hoi chery**	X	X	W	PF, C, P, S, R	3		
	Reptiles									
3	*Liolepis reevesii* Gray, 1831	**Yea**	**Yea**		X	W	F, PF, U	2		
3	*Malayemys subtrijuga* Schlegel & Müller, 1845	**Tao**	**Tao**	X		W	PF, P, S, R	7		
1	*Calotes versicolor* Daudin, 1802	**Jing kaa**	**Ka pom**		X	W	F, U	2		