

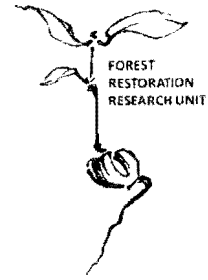
**EDIBLE
FOREST
INSECTS
HUMANS
BITE
BACK!!**

A Workshop Focused on Asia-Pacific Resources
and Their Potential for Development

19-21 FEBRUARY 2008

CHIANG MAI, THAILAND





**A Workshop Focused on Asia-Pacific Resources
and Their Potential for Development**

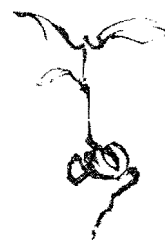
Forest Insects as Food: Humans Bite Back

Centara Duangtawan Hotel
19-21 February 2008
Chiang Mai, Thailand

Programme Guide

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Forest Insects as Food: Humans Bite Back

A Workshop Focused on Asia-Pacific Resources and Their Potential for Development

**19-21 February 2008
Chiang Mai, Thailand**

Background

Humans have consumed insects for thousands of years – in some cases as emergency food, in other cases as a staple, and in still other cases as delicacies. In modern times, consumption of insects has declined in many societies, and has often been shunned as old-fashioned, dirty, or unhealthy. Yet, among various cultures scattered throughout the world, insects remain a vital and preferred food and an essential source of protein, fat, minerals and vitamins. For some members of the rapidly growing upper and middle classes of urban society, insects are “nostalgia food,” reminding them of earlier, simpler days in the rural countryside.

Worldwide, over 1,400 insect species are reportedly eaten as human food. Most are harvested from natural forests. Yet, while insects account for the greatest amount of biodiversity in forests, they are the least studied of all fauna. Surprisingly little is known, for example, about the life cycles, population dynamics, and management potential of many edible forest insects. Similarly, little is known of the impacts that over-harvesting of forest insects might have on forest vegetation or other forest fauna.

Among forest managers, there is little knowledge or appreciation of the potential for managing and harvesting insects sustainably. There is almost no knowledge or experience in manipulating forest vegetation or harvest practices to increase, maximize, or sustain insect populations. Indeed, as many insects cause massive damage and mortality to valuable commercial trees, virtually all insects are considered undesirable by many forest managers. What knowledge does exist in these respects is often held by traditional forest dwellers and forest-dependent people.

The capturing, processing, transporting, and marketing of edible forest insects provide interesting income and livelihood opportunities for an undetermined number of people around the world. Traditionally, these activities were all locally based and largely under-recognized. Recently, however, more sophisticated and wide-reaching marketing and commercialization of edible forest insects have been advanced, including attractive packaging and advertising. Some advocates believe that creating a wider market for food insects could provide an economic incentive for conserving insect habitat.

To further promote forest insects as human food, six major areas need to be addressed:

- geographic information gaps;
- improved insect identification;
- better understanding of the ecological roles of edible forest insects;
- assessment of the potential for rearing insects for food and other purposes;
- post-harvest handling of insects and improved processing and storage; and
- economic and marketing data and information.

The Chiang Mai workshop will attempt to address these issues and discuss strategies to promote edible forest insects for enhancing human nutrition and forest management.

Workshop scope

The workshop will focus on all aspects of edible forest insects, including management, collection, harvest, processing, marketing, and consumption. Social, environmental, and economic aspects will be explored, including opportunities and issues related to income and livelihoods. The focus of the workshop will be on knowledge and experiences from Asia and the Pacific, but the workshop will also draw on resource persons from other regions of the world as well. Consideration will be given to insects and their edible relatives, such as spiders and scorpions.

Workshop objectives

The objectives of the workshop are:

- raise awareness of the potential of edible forest insects as human food source;
- document the significance of food insects to people's livelihoods and assess their linkages to sustainable forest management and conservation;
- identify key challenges to promoting edible forest insects in wider markets and possible solutions to address those challenges;
- develop working relationships and contacts with colleagues from other countries on edible forest insects;
- share existing knowledge on the collection/capture, processing, marketing and consumption of edible forest insects in the Asia-Pacific region and fill gaps where information is insufficient; and
- develop recommendations and strategies for promoting forest insects as food on a regional scale.

Workshop themes and subjects:

Edible forest insects as a natural resource. Overview of current status of forest insect exploitation for food in Asia and the Pacific. Insect conservation issues. Thematic presentations by participants, with particular attention to the identified geographic gaps (i.e., Vietnam, Cambodia, Myanmar, Peninsular Malaysia, and the Pacific Islands).

Models of insect management for food and other products. Examples from beekeeping, silk worm farming and palm grub harvesting. Complementary and competing economic non-food insect products and uses (i.e., medicine, livestock feed, ritual, ornamental, IPM). The relationship of insect exploitation to the extraction of common non-wood forest products (NWFPs) and linkages to forest management.

Development potential for edible forest insects. The role of edible forest insects in food security. Insect protein as a contribution to better nutrition. Economics of collecting edible forest insects. Harvesting, processing and marketing of edible forest insects. Promoting insect eating: snacks, dishes, condiments, recipes, etc.

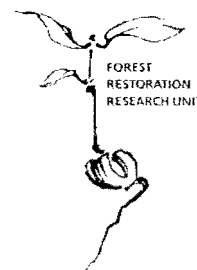
Working groups. One half-day session to develop recommendations and present to plenary final session.

Field trip: Tour of an insect museum, local insect farm and a market where edible insects are being sold.

Proceedings: Edited by one or more of participants and published by FAO.

The workshop is co-organized by the Food and Agriculture Organization on the United Nations (FAO) and Chiang Mai University. Local support is provided by the Forest Restoration Research Unit (FORRU), Chiang Mai University.

For more information, contact: Patrick B. Durst, Senior Forestry Officer, FAO Regional Office for Asia and the Pacific, 39 Phra Atit Road, Bangkok, Thailand 10200. Telephone: (66-2) 697-4139; Fax: (66-2) 697-4445; E-mail: Patrick.Durst@fao.org



Forest Insects as Food: Humans Bite Back

A Workshop Focused on Asia-Pacific Resources and Their Potential for Development

19-21 February 2008
Chiang Mai, Thailand

Day 1: Tuesday, 19 February

Time	Activity	Resource person
08:00-08.45	Registration	FORRU
08.45-09.15	Opening ceremony	
08.45-08.50	<ul style="list-style-type: none"> Opening remarks – Head of biology department , Faculty of science , Chiang Mai University 	Assist. Prof Dr.Narit-Sritasuwan
08.50-08.55		
08.55-09.15	<ul style="list-style-type: none"> Welcome address – FAO Introduction to the workshop 	P.B. Durst D. Johnson
09.15-09.45	Keynote address: "Forest insects as food: humans bite back"	Hans Schabel
09.45-10.15	Coffee/tea break	
10.15-12.00	Overview session:	
10.15-10.35	<ul style="list-style-type: none"> Edible insects and other invertebrates in Australia: future prospects 	A.L. Yen
10.35-10.55	<ul style="list-style-type: none"> The future use of insects as human food 	J. Mitsuhashi
10.55-11.15	<ul style="list-style-type: none"> Entomophagy: its past and its future 	V.B. Meyer Rochow
11.15-11.35	<ul style="list-style-type: none"> The future of edible insects in Africa 	A. van Huis
11.35-12.00	Questions/Discussion	
12.00-13.00	Lunch	

Time	Activity	Resource person
13.00-15.00	General Session I	
13.00-13.15	• Edible insects and associated food habits in Thailand	Y. Hanboonsong
13.15-13.30	• Nutritional value of edible insects in Thailand	J. Yhoun area
13.30-13.45	• Some edible insects in the upper northern part of Thailand	P. Leksawasdi
13.45-14.00	• Edible bee products of the Thai forest, other than honey	S. Boongird
14.00-14.30	<i>Questions/Discussion</i>	
14.30-15.00	Coffee/tea break	
15.00-17.45	General Session II	
15.00-15.15	• The common edible species of wasps in Yunnan, China and their value as food	Y. Feng
15.15-15.30	• A review of the nutritive value of edible insects	X. Chen
15.30-15.45	• Insect eating among tribal peoples in India	G. T. Gujar
15.45-16.00	• Edible products from mulberry silkworm and wild silkworm (<i>Samia ricini</i> D)	S. Sirmungkarat
	<i>Questions/Discussion</i>	
16.00-16.15	• An overview of ethnoentomological practices in Borneo	A.Y.C. Chung
16.15-16.30	• Edible insects in Papua, Indonesia, from delicious snack to basic need	E. Ramandey
16.45-17.00	• Gathering non-timber forest products in a market economy: a case study of Sahakone Dan Xang fresh food makret, Xaithany District, Vientiane Capital, Lao PDR	S. Boulidam
	<i>Questions/ Discussion</i>	
1700-1730		
19.00-21.00	Welcome dinner	

Day 2: Wednesday, 20 February

Time	Activity	Resource person
08.00-16.00	Field trip (insect markets and Siam Insect Zoo)	FORRU
18.00-19.00	Video: "Minilivestock in the Tropical Forest Habitat"	

Day 3: Thursday, 21 February

Time	Activity	Resource person						
8.30-09.45	General Session III							
08.30-08.45	<ul style="list-style-type: none"> The cultural and commercial roles of edible wasps in Japan 	K. Nonaka						
08.45-09.00	<ul style="list-style-type: none"> Philippine edible insects: a new opportunity to manage pests and bridge the protein gap of resource poor families 	C. B. Adalla						
09.00-09.15	<ul style="list-style-type: none"> Filling the plates: serving insects in the USA 	D. Gracer						
09.15-09.45	Questions/Discussion							
09.45-10.00	<p>Formation of three concurrent working groups</p> <p>Each group to address three questions within their topics:</p> <ol style="list-style-type: none"> 1. Current status of edible forest insects in Asia-Pacific 2. Key bottlenecks to future development 3. Recommended short- and long term actions 							
10.00-10.30	Coffee/tea break							
10.30-12.30	<table border="1"> <thead> <tr> <th>WG I</th> <th>WG II</th> <th>WG III</th> </tr> </thead> <tbody> <tr> <td>Taxonomy and ecology</td> <td>Harvest practices and management implications</td> <td>Post-harvest processing, shipping and marketing</td> </tr> </tbody> </table>	WG I	WG II	WG III	Taxonomy and ecology	Harvest practices and management implications	Post-harvest processing, shipping and marketing	
WG I	WG II	WG III						
Taxonomy and ecology	Harvest practices and management implications	Post-harvest processing, shipping and marketing						
12.30-13.30	Lunch							
13.30-15.00	<p>Plenary session:</p> <p>Working group reports and finalization of recommendations</p>	Panelists						
15.00-15.15	Closing ceremony	FAO/CMU						

8.00 Lobby

Presentation Abstracts

Philippine Edible Insects: A New Opportunity to Manage Pests and Bridge the Protein Gap of Resource Poor Families

Candida B. Abdalla and Cleofas R. Cervancia

College of Agriculture; Institute of Biological Sciences, College of Arts and Sciences University of the Philippines, Los Baños, College Laguna, 4031 Philippines

Email: aydsadalla@yahoo.com

Abstract

The Philippines has a rich tropical flora and fauna, with arthropods representing the greatest diversity. The most popular edible insects are honey bees, *Apis dorsata* Fab and *Apis cerana* Fab, both indigenous species. Bees are popular not only for the prized honey and related products, but local people also enjoy the larvae as a delicacy. Apiculture is popular and has been contributing significantly to higher agricultural productivity and biodiversity. Among other forest insects eaten by the rural folks are the migratory locust (popular nationwide, particularly in swampy and grassy areas where outbreaks occasionally occur); field crickets, mole crickets, carpenter ants (eggs particularly), coconut beetles (particularly the grubs), June beetles and some katydid species. Edible arachnids are not common, but some farmers reported having eaten the larger-sized scorpions and centipedes. Korean bugs (*Palembus* sp.) were also popularly eaten in the early 1970s. Descriptions, bionomics and folk recipes of the aforementioned species are presented. Currently, edible insects are underutilized as a general food resource in the Philippines. A deliberate effort is needed to educate Filipinos about this alternative food resource which may yet offer a significant breakthrough, not only in nutrition but also have a positive impact on pest management.

Edible Bee Products of the Thai Forest Other than Honey

Somnuk Boongird

Department of Agriculture, Faculty of Science, Ramkhamhaeng University

Hua mark, Bungkhum, Bangkok 10240 Thailand

Email: somnuk_b@yahoo.com

Abstract

Thai nonwood forest products are mainly derived from secondary forests, because very little primary forest still exists. Primary forest degradation has led to a reduction of bee populations necessary for forest tree pollination and natural regeneration. Stingless bees have distinctive forest habitats. Large stingless bees, *Trigona* spp., prefer tree tops; those of medium size feed on flowers at lower canopy levels; the smallest on flowering bushes and ground covers. Stingless bees nest in tree cavities forming permanent colonies. Arboreal honey bees, *Apis* spp., usually migrate among forest types as nectar sources are exhausted. Collectors typically take the entire nest, rather than only the honeycomb portion, as a result adult nurse and guard bees die within 1 week; occasionally the queen and worker bees attempt to rebuild the nest nearby but it is seldom successful. Bee nests are collected in forests open for such activities, as well as in restricted forests where legally prohibited. In general, collected bee products are sold at local markets for cash, not consumed for subsistence. Nests are displayed to attract buyers of bottled honey, which is often adulterated. Nonhoney food uses include capped brood mixed with pollen which is cut into pieces and macerated in alcohol to produce a liquid medicine with some food value. Capped brood may also be roasted and eaten directly, except for the pollen. Eating pollen, especially from stingless bees, generally is avoided because of the fear of allergic reactions. Because wild honey production itself is low, sales of brood comb, pollen comb and propolis represent income sources to collectors. Actions are needed to discourage honey collecting in restricted forests and the collection of entire nests, to assure sustainable harvest of bee products and natural forest regeneration.

Gathering Non-timber Forest Products in a Market Economy: A Case Study of Sahakone Dan Xang Fresh Food Market, Xaithany District, Vientiane Capital, Lao PDR

Somkhit Boulidam

Department of Geography, Faculty of Social Sciences

National University of Laos, Dong Dok Campus

Vientiane, Lao PDR

Email: kkkhith@yahoo.com

Abstract

This study describes the gathering of non-timber forest products (NTFPs) in Dong Makkhai village and their trading at the Sahakone Dan Xang market. A key objective was to understand NTFP activities and changes over the past decade, by identifying the major species collected and traded in the village, and the demand for the products in the market. An attempt was made, over the 10 year period, to determine any changes in the abundance of NTFPs in this forest dependent village, to investigate the local knowledge of natural resources management and to assess the sustainability of the NTFP resources. Individual surveys were conducted in the village and in the local market with the Yamane method used to select sampling size. Using only simple tools, all of the villagers surveyed gathered NTFPs, composed of 27 species of wild vegetables, 22 species of insects, and 10 species of wildlife. Wildlife species numbers are rapidly decreasing, while the number of species of wild vegetables and insects are stable. However, the abundance of wild vegetables and insects has declined, particularly of the wild vegetable phak van. Most species of NTFPs found in the market come from many locations: 31 species of wild vegetables from 17 locations, 21 species of insects from 23 locations and 4 wildlife species from 10 locations. The majority of NTFPs delivered to Sahakone Dan Xang market are from Xaithany district, particularly Dong Makkhai village. Of the insects, the best sellers in the market are ant eggs, grasshoppers, crickets, and honeycomb. Market demand for wildlife NTFPs typically is greater than the supply. Local people have a keen interest in sustaining sources of NTFPs. They believe they should practice forest conservation, avoiding the harvest of NTFPs during the full moon and on moonless days, supplementing crop planting, avoiding trade of rare species, stopping poaching, and reducing overall NTFP gathering. However, in reality, local people expand and intensify their NTFP gathering to meet the growing market demand.

A Review of the Nutritive Value of Edible Insects

Chen xiaoming, Feng ying and Zhang hong
The Research Institute of Resource Insects
Chinese Academy of Forestry
Kunming 650224 P.R. China
Email: xmchen@vip.km169.com.cn

Abstract

As an important biological resource, insect resources have not been fully used and developed. Based on analysis and study, the nutritive value of edible insects was reviewed. The results showed that insects have rich protein (20-70%), amino acid (30-60%), fat (10-50%), fatty acid, carbohydrate (2-10%), mineral elements, vitamins and other activated elements which promote human health. As protein resources, the nutritive value of edible insects is as good as other animal or plant resources. Insects are characterized by rich species diversity and large populations, therefore as nutritive resources, edible insects can be widely used and have great development potential. In promoting insects as human food, the relative nutritive values should be taken into consideration to provide the maximum benefit to human consumers.

An Overview of Ethnoentomological Practices in Borneo

Arthur Y. C. Chung

P.O. Box 1407, Forest Research Centre, Forestry Department

90715 Sandakan, Sabah, Malaysia

Email: arthur.chung@sabah.gov.my

Abstract

Procurement of insects and insect products for food, medicine and other uses by the local people, known as ethnoentomology, is still practiced in some rural areas in Borneo although it is getting less common nowadays. This also includes uses of insects in myths, beliefs and ritual ceremonies in the tradition and culture of the local people. Unlike urban areas, food in the interior is sometimes scarce, thus some local people take insects as an alternative source of protein. Insects are abundant in the forest and can be easily available compared to other animals. Various stages of insects are procured for food. It could be the eggs, larvae or nymphs, pupae or adults. Insect products, such as honey and pollen are sought after as nutritional food. The local people also use certain insects and insect products as medicine since it is difficult to seek treatment from a doctor in very remote areas. In Borneo, more than 50 species of edible insects were documented from various villages throughout Sabah, mainly taken by the Kadazandusun and Murut people. The most common insect groups taken as food are the honeybee brood, grasshoppers and sago grubs. Others include crickets, rice bugs, cicadas, termites, ants and beetles. Insects are often procured for food when they are abundant and easily obtainable in the field. The methods of preparing the insects as food are highlighted. More than 25 species of edible insects were also documented from the Dayak Lundayeh community adjacent to the Kayan Mentarang National Park in Kalimantan during a two-week transboundary expedition in 2003. Information on common edible insects from Sarawak is also compiled. Insects and insect products with medicinal values, as well as other ethnoentomological uses are also discussed. Recommendations are made regarding expanded utilization of insect species for food and nonfood uses.

The Common Edible Species of Wasps in Yunnan, China and Their Value as Food

Feng ying and Sun long
The Research Institute of Resource Insects
Chinese Academy of Forestry
Kunming 650224 P.R. China
Email: yingf@263.net

Abstract

Wasps belong to the Hymenoptera and feed on other insects. Wasps have been used as food insects for a long time both in China and abroad. They are common edible insects in Yunnan. Investigation and research results show that there are 12 species of edible wasps in Yunnan: *Vespa velutina auraria* Smith, *V. tropica ducalis* Smith, *V. analis* Buysson, *V. variblis* Buysson, *V. sorror* Buysson, *V. basalis* Smith, *V. ducalis* Smith, *V. mandarinia mandarinia* Smith, *V. bicolor bicolor* Fabricius, *Provespa barthelemyi* Buysson, *Polistes sagittarius* Saussure, and *P. sulcatus* Smith. The larvae and pupae of wasps are nutritious, rich in protein and amino acids. The average amount of protein is 52.96% and the average amount of amino acids is 44.77%. The average amount of 7 types of necessary amino acids for human nutrition is 16.62%, occupying 37.12% of total amino acids. Among the edible insects, wasps can play an important future role in human nutrition.

Filling the Plates: Serving Insects in the USA

David M. Gracer
Sunrise Land Shrimp
401 Exeter St.
Providence RI 02906 USA
Email: Dave@SLShrimp.com

Abstract

It is most interesting to watch an American eat his or her first insect: emotions crowd the moment. Although entomophagy is shunned by the majority of the people, quite a few Americans are happy to sample cooked insects in a variety of ways – usually without hiding the food in chocolate or similar coverings. In fact, entomophagy is a slowly growing presence in the general culture: insects are eaten on television shows; insect dishes are on the menus at a few fine restaurants; and many children are able to recognize the facts regarding the environmental impact related to food production. While it is clear that advocating for entomophagy means fighting the momentum of American food practices, there are good reasons to be optimistic about the future. The changes and the opportunities for insects as food are discussed.

Edible Insects and Associated Food Habits in Thailand

Yupa Hanboonsong

Entomology Division, Faculty of Agriculture

Khon Kaen University, Khon Kaen 40002 Thailand

Email: yupa_han@kku.ac.th

Abstract

The practice of insect eating has a long history in Thailand and takes place throughout the country. More than 150 species in 8 families of edible insects have reportedly been consumed. Of these, beetles represent the largest group of edible insects. A wide range of insects at various stages of their life cycles are consumed. The preferences of local people in terms of insects as food vary from region to region of Thailand. Having an agreeable taste is the main reason for eating insects. Most edible insects are cooked in some way before being eaten; for example deep fried, fried with spices or roasted. Among local Thai people, traditional knowledge of insect eating represents an important aspect of this food resource in the past and in the present day, and provides indicators of future development potential.

Some Edible Insects in the Upper Northern Part of Thailand

Paitoon Leksawasdi
Biology Department, Faculty of Science,
Chiang Mai University
Chiang Mai, Thailand
Email: scboi014@chiangmai.ac.th

Abstract

A survey of edible insects was conducted through randomized interviews of residents in Jaehom District, Lampang province in 1992. The basic background information of the population was correlated to the consumption of insects, principle cooking method and edible insect lists within the area of interest. Some edible insects were studied in detail, including three species of ants. The first two species, namely, Malang Mun and weaver ant were considered the favorite while the acrobat ant was occasionally consumed during the research in 1983, 1988 and 2005, respectively. Another group of edible insect was beetles in the chafer group, some scarabaeids and a species of buffalo or elephant dung beetles as indicated in the studies during 1990, 2002, and 2006, respectively. In addition, the data obtained from the joint research project in 2007 on mosquitoes and black flies revealed that a Karen hilltribe population considers the larvae of black flies as one of their delicacies. The last edible insect species to be described here is the bamboo borer moth. This insect was studied in 1995 and is generally considered as one of the preferred insects for consumption among Thai people. The outcome of this research has led to the development of several training workshops supported by Chiang Mai University, with the objective of educating farmers in the 8 provinces of the upper Northern region of Thailand who collect and sell insects as a part-time activity. The training of an estimated 760 farmers during 2005-2008 was accomplished through 38 small workshops of approximately 20 participants each. The life histories of the insects were recorded in detail to obtain an accurate understanding of each species, with additional information on the respective consumption methods.

Entomophagy: It's Past and it's Future

V.B. Meyer-Rocha
Faculty of Engineering and Sciences
Jacobs University
P.O. Box 750561, D-28725 Bremen, Germany
Email: b.meyer-rochow@ju-bremen.de

Abstract

Ever since Bodenheimer (1951) published his seminal tome *Insects as Human Food*, considerable progress in mapping food insects around the globe has been made. Yet, some regions and ethnic groups have hardly been studied: to name but a few, Pacific Islands and their inhabitants, including the tribal peoples of Taiwan, or the Moluccan Island of Ceram and its Melanesian populations, many northern Australian tribes; even for most Amerindian cultures of South America today we only have scant information. Existing qualitative studies need supplementing by quantitative data and checking against seasonal, even annual, fluctuations; further investigations into the nutritional value of food insects have to be carried out; economic as well as ecological aspects of entomophagy have to be addressed; insect folk medicinal uses must be documented and ultimately ways to commercially breed important species ought to be sought. But most of all we have to encourage those still practicing entomophagy not to give up the habit and to convince those able to fund our research to support us, because once entomophagy has been given up, information on this certainly not negligible aspect of human culture will be irretrievably lost.

The Future Use of Insects as Human Food

Jun Mitsuhashi
Koishikawa 1-28-13
Bunkyo-ku, Tokyo 112-0002 Japan
Email: junmths@nifty.com

Abstract

In the twenty-first century, shortages of food, especially animal protein, are foreseen. It will be necessary to look for new sources of animal protein. For this, insects are suitable sources, although most people in the developed countries dislike or hesitate to consume insects. It is probably that people are repulsed by the shape of insects, but not by their flesh or protein. Through processing insects and mixing them with other foodstuffs, insects can be accepted favorably in the future. For the more distant future, one of the uses of edible insects may be as space food. For long voyages to other planets, cell culture of insects will provide animal protein in a space craft, within which the area for the production of foodstuffs will be limited. When humans are living in huge airtight domes built on other planets such as Mars, food production will have to be developed within the confines of the domes. Breeding of large livestock will not be practicable because of space limitations. The alternative is to use insects to provide a good source of animal protein. For such purposes, use of species such as silkworms, termites and flies have been suggested, taking into account the effective recycling of organic substances.

Sri Lanka as a Potential Gene Pool of Edible Insects

M. R. M. P. Nandassena, D.M.S.K. Disanayake, and L. Weeratunga
Entomology Division, Department of National Museum
Colombo 07, Sri Lanka
Email: manorim@sltnet.lk

Abstract

Sri Lanka is a tropical island with unique geo-climatic features, supporting a very rich biological diversity. The number of insect species names recorded from Sri Lanka totals 11,144, belonging to 30 insect orders. Calculations are based only on museum specimens and limited catalogs. Sri Lanka supports habitats for 28 species of worldwide edible insects, within six orders. The majority represent the Coleoptera (9 spp) and Lepidoptera (7 spp). Four species of aquatic bugs and beetles occur in large numbers in hundreds of ancient reservoirs (tanks), extensive rice paddies and in natural marsh lands. Terrestrial insects are found in the natural forests (protected and unprotected) and also in native home gardens which resemble in structure the natural rainforest. The actual number of edible insect species may be much higher than current data suggest. In Sri Lanka, insect eating is a practice only found among the Vedda tribal people. The Vedda history on the island goes back about 37,000 years; they are descended from Sri Lankan Mesolithic prehistoric man. The Vedda customarily eat bee brood and larvae of *Apis dorsata* (giant honey bee), *A. cerana* (common honey bee) and *A. florea* (dwarf honey bee). Insects are not eaten by other ethnic groups (e.g. Sinhalese ca. 75%, Tamils 12%, Muslims 8%) for two major reasons: 1) the two major religious groups (Buddhist and Hindu) are vegetarian and do not kill animals for food; 2) marine and inland fisheries, along with livestock, provide adequate supplies of protein for the meat eating portion of the population. Sri Lanka is a clear example of religious factors presenting an insurmountable obstacle to promoting insects as human food; such factors need to be taken into account when making an assessment of the global potential for edible insects. Forest fragmentation and habitat loss are increasing as a consequence of development projects, reducing insect diversity along with populations of other fauna and of flora. A recognition of the island's unique insect biodiversity, coupled with the creation of a program to protect and conserve the edible insect gene pool, could give Sri Lanka a potential role in the maintenance of an edible insect gene pool for the rest of the world.

The Cultural and Commercial Roles of Edible Wasps in Japan

Kenichi Nonaka
Department of Geography
Rikkyo University
3-34-1 Nishi-ikebukuro
Toshima, Tokyo, Japan 171-8501
Email: k-nonaka@za2.so-net.ne.jp

Abstract

Insects such as long-horned beetle caterpillars and wasps are consumed as a traditional food resource in the mountainous forested areas of Japan. Although the practice of insect eating has declined in the mountains, the collecting and eating of wasps (*Vespula* spp. and *Vespa* spp.) can still be found. In particular, yellow-jacket wasp larvae and pupae (*Vespula* spp.) are preferred in the mountainous areas of Central Japan, where they are treasured as an autumn season delicacy. Men enjoy going out in groups to collect them and it is also common for people to raise them near their houses. Each household prepares the insects in different ways, with each bringing its own unique flavor to the autumn dinner table. The larvae and pupae are also available commercially at high prices. Insect materials used in canned foods are imported from other countries to satisfy the expanding demand. Communal management has begun to maintain the populations and habitat of *Vespula* spp. as a food resource. *Vespa* spp. are also eaten in the mountains. They are collected for subsistence use and for commercial sale by local people who must use special protective gear against the dangerous wasps. The cultural and commercial roles of wasps are regarded as an essential food resource for the sustainable development of rural mountain villages.

Edible Insects in Papua, Indonesia: From Delicious Snack to Basic Need

Euniche Ramandey and Henk van Mastrigt
Komplex Puspenka GK1 No. 12A
Sentani, Jayapura, Papua 99352 Indonesia
Email: icka_ramday@yahoo.com

Abstract

The Indonesian Province of Papua occupies the western portion of the island of New Guinea, is equatorial in latitude and consists of lowland, hill and mountain habitats up to 2,300 m. About 60-100 insect species, representing 10 insect orders, are eaten by indigenous people. The choice of edible insects is focused on larger insects which do not need special equipment to capture and which are edible raw or after some roasting. Among large insects, preferences are variable from tribe to tribe, probably based upon taste, abundance and custom. Among lowland people, *Rhyncophorus bilineatus* commonly associated with sago palms is the most common edible insect, its larvae used as subsistence food and sold in local markets. In mountainous areas a greater diversity of insects are consumed, but their collection is more incidental and exclusively for subsistence purposes. In Papua, there is broad indigenous knowledge of edible insects, reflected in local language insect names, traditions and insect habitats. In the lowlands, edible insect populations are being reduced because of loss of sago forests, but there is the prospect of rearing sago grubs. In the mountainous areas, economic development is providing alternative animal protein sources, but incidental food insect collecting is expected to continue and could be promoted as additional scientific information becomes known.

Forest Insects as Food: Humans Bite Back

Hans Schabel

College of Natural Resources

University of Wisconsin, Stevens Point WI 54881 USA

Email: hschabel@uwsp.edu

Abstract

Many forest insects decried as “pests” also happen to be useful per se, or as the source of products that can serve for subsistence, as well as in trade and commerce. One such forest-based industry relies on insects as a source of human food (entomophagy). After a period of cultural estrangement in parts of the world, the age-old practice of eating insects may now be on the verge of recapturing its former respectability and broadening its significance in the tropics. As a nutrient-rich food source, certain insects can contribute to a balanced diet, and thus have the potential to promote human health, while improving food and income security especially of economically disadvantaged populations. At the same time, these once-abundant, free-for-all food insect resources may be in jeopardy due to habitat destruction/deterioration and non-sustainable rates or modes of extraction, unless managed either in the wild, or ranched or raised as (semi)domesticated mini-livestock. Hopefully, dependence on, and appreciation of insects as valuable food will enhance nature awareness and help foster positive conservation attitudes. A brief global review of traditional and contemporary aspects and trends associated with entomophagy will highlight the merits of this practice, while pointing out its limitations and challenges. Several case studies make an argument for “entomoforestry,” i.e., deliberate interventions to manipulate trees for the sake of insects, especially multi-purpose insects, and their integration with other land use management schemes.

Edible Products from Mulberry Silkworm and Wild Silkmoth (*Samia ricini* D.)

Sivilai Sirimungkararat^{1*}, Weerasak Saksirirat², Tassanee Nopparat²
and Anchalee Natongkam¹

¹ Entomology Section, ² Plant Pathology Section, Department of Plant
Science and Agricultural Resources, Faculty of Agriculture,
Khon Kaen University, Khon Kaen 40002 Thailand

*Email: sivilai@kku.ac.th

Abstract

Among edible insects with nutritional value, 194 species are reported in Thailand. There are 81 species of edible forest insects. In general, insect foods are well-known as a protein source in the country, especially in the north and northeast. Of those, beetles are the major group (61 species), followed by Lepidopteran (47 species), cricket and grasshopper (22 species), Hymenopteran (16 species), Hemipteran (11 species), Homopteran (11 species) and dragon fly (4 species). Cooking methods and recipe development derive from indigenous knowledge of the insect consumers in the regions. Mulberry silk pupa is a popular edible insect as a by-product derived from silk yarn reeling. Recently, a cultivated wild silkmoth (eri silkworm, *Samia ricini* D.) was introduced into the northeast, where cassava (*Manihot esculenta*), its host plant, is grown in the largest planting area of Thailand. This silkworm has diverse host plants found generally over the entire region such as castor (*Ricinus communis*), cassava, ceara rubber tree (*Manihot glaziovii*), variegated cassava (*Manihot esculenta* var. *variegata*) etc. It is reared easily under northeast conditions. Because of its high protein content (66%), erifood products were developed using more than 8 recipes, which were registered as intellectual property. The erifoods are safe, based on nonchemical usage in the rearing process and yielding a so-called "green product." Moreover, eri products could generate subsidiary income for farmers. This erifood product should be rapidly publicized by providing more information to consumers. This indicates the potential of eri silkworm in supporting the government safety food policy and supplying edible insects as a commodity in Thailand.

The Future of Edible Insects in Africa

Arnold van Huis

Laboratory of Entomology, Wageningen University P.O. Box 8031

6700 EH Wageningen, The Netherlands

Email: arnold.vanhuis@wur.nl

Abstract

Human development in Africa is hampered by under-nutrition, especially micronutrient deficiency. Food based approaches are the preferred long-term solution. Many programs promote home gardening but bioconversion of important pro-vitamins from vegetables is much less than previously thought. Animal foods contain more bio-efficacious micronutrients. One opportunity of promoting animal protein consumption in low income situations are edible insects. African culture itself recognizes the value of insects as food, and insects are eaten all over the continent, particularly in Central and Southern Africa, where they are an important protein and micronutrient source for the rural poor, and a delicacy for urban dwellers. About 250 edible insect species occur in Africa. Of these, 30% belong to the Lepidoptera, 29% to the Orthoptera and 6% to the Isoptera. The other 35% are Coleoptera (19%), Homoptera (7%), Hymenoptera (5%), Heteroptera (3%), Diptera and Odonota (1%). Compared to other continents, caterpillars and grasshoppers are more represented in Africa, while Hymenoptera are less represented. Edible insects as a food in Africa are limited because insects can only be harvested during short periods of the year. In Africa, edible insects were never domesticated so rearing does not occur. Insect consumption by different groups is under pressure due to Western influences and poor ecological and social management of open wild areas where insects are collected. Collecting practices depend on insects' behavior. For example, inactivity at low temperatures enables easy catching of locusts and grasshoppers in the morning. Some hemipterous species mass in aestivation sites. Night flyers (termites, some grasshoppers) can be lured into traps by light. Some species (crickets, cicadas) can be located by sound. A number of tools are used to facilitate capturing such as glue, sticks, nets and baskets. Breeding sites are sometimes created by cutting palms such as for the weevil *Rynchophorus*. Insects are an excellent food source and have important advantages over usual livestock, including a high content of essential amino-acids, vitamins and minerals, a unique taste, available free in wild vegetation, and simple and cheap on-farm rearing is possible and would provide a small,

steady flow of animal protein. Insects have high food conversion efficiency and a high fecundity, and they accept relatively low quality food substrates of various kinds. To explore the potential of insects as animal food source in Africa, an interdisciplinary research effort will be necessary that will study:

- 1) The role of edible insects in rural food consumption and ways to promote their use;
- 2) Ways to sustainably exploit wild populations of edible insects in open accessory areas, including improved harvesting techniques;
- 3) Ways to rear insects using low-cost and simple techniques for on-farm production;
- 4) The potential of insect collection and insect rearing to improve the livelihood of poor rural communities;
- 5) Post-harvest activities in the use and commercialization of edible insects, and opportunities for improvement.

Edible Insects and Other Invertebrates in Australia: Future Prospects

Alan L. Yen

Biosciences Research Division, Department of Primary Industries

621 Burwood Highway

Knoxfield, Victoria, Australia 3156

Email: alan.yen@dpi.vic.gov.au

Abstract

At the time of European settlement, the relative importance of insects in the diets of Australian Aborigines varied across the continent, reflecting both the availability of edible insects and of other plants and animals as food. The hunter-gatherer life style adopted by the Australian Aborigines, as well as their understanding of the dangers of over-exploitation, meant that entomophagy was a sustainable source of food. Over the last 200 years, entomophagy amongst Australian Aborigines has decreased because of the increasing adoption of European diets, changed social structures, and changes in demography. Entomophagy has not been readily adopted by non-indigenous Australians, although there is an increased interest because of tourism and the development of a boutique cuisine based on indigenous foods (bush tucker). Tourism has adopted the hunter-gatherer model of exploitation in a manner that is probably unsustainable and may result in long-term environmental damage. The need for large number of edible insects (not only for the restaurant trade but also as fish bait) has seen feasibility studies on the commercialization of edible Australian insects. Emphasis has been on the four major groups of edible insects: witjuti grubs (larvae of the moth family Cossidae), bardi grubs (beetle larvae), Bogong moths, and honey ants. Many of the edible moth and beetle larvae are slow growing and their larval stages last for two or more years. Attempts at commercialization have been hampered by taxonomic uncertainty of some of the species and the lack of information on their biologies. This has made it difficult to establish rearing facilities that can raise large numbers in a short time.

Nutritional Values of Edible Insects in Thailand

Jintana Yhoung-aree
Institute of Nutrition, Mahidol University
Nakhon Pathom 73130, Thailand
Email: nujya@mahidol.ac.th

Abstract

Edible insects should be viewed not only for their nutrient content but also for their nostalgic value to consumers. A few decades ago, insects were commonly eaten among people in the north and northeast of Thailand. Nowadays, they have wriggled onto menus of urban dwellers throughout the country. In general, there are three main groups of insect eaters: first, indigenous eaters who originate from the northern and northeastern provinces no matter where they now live. In this case, they currently work outside their native area, and the food insects have an emotional value added as nostalgia foods. Second, consumers in urban areas who learn and later develop a taste for the delicacy of insect foods. This group may include partners of the indigenous consumers as well as the new consumers. Third, foreign tourists are observed to be attracted by different insects prepared and sold in tourist spots. Although over 50 species of the insects are reported to be eaten in Thailand, not all of them have had their nutritive values determined, because food analysis is expensive. Therefore, the Institute of Nutrition at Mahidol University has analyzed the nutrient contents of only those insects that are most commonly eaten. These include groups of ants, bees, beetles, bugs, cicadas, crickets, locust, moths and termites. Edible insects are good sources of protein, fat, calories and micronutrients. However, methods of their preparation play a part in determining the nutritional values to the consumers. In Thai cuisine, there is cultural knowledge of 13 techniques for cooking insects. These techniques are grouped into singeing (precooking), cooking in oil (frying, sautéing) and oil free cooking (paste, soup, curry, poaching, steaming, and hot-salad). Cooked in oil, 100 gr of raw insects may absorb approximately 13-17 gr of the cooking oil. Recently, frittering, prepared burgers and sandwiches have become in high demand among non-indigenous consumers, especially in urban and tourist places. These new methods possibly increase the caloric intake to the consumers.

Teak Caterpillars as a Food Source and Selected other Edible Insects

Dwi Retno Lukiwati

Faculty of Animal Agriculture

Diponegoro University, Semarang Central Java, Indonesia

E-mail: drlukiwati_07@yahoo.com

Abstract

Teak (*Tectona grandis*) is a wonderfully versatile wood that is good for building, furniture making and also fine carving. In Javanese, the name for teak, "kayu jati", also means real wood. Most of the teak could find growing now is in villager's forest-gardens called "kebun", especially in traditional teak producing country, such as in Wonogiri, Blora, Cepu (Central Java), Bojonegoro, Lamongan and Ngawi (East Java) in Java island. Amongst the defoliators frequently encountered in the plantations is teak caterpillar cocoon or "enthung jati" of *Hyblaea puera* Cramer (common name : teak defoliator) from phylum Arthropoda, class Hexapoda, order Lepidoptera, family Hyblaeidae and the sole genus in this family is *Hyblaea*. Last year was a good year for teak caterpillar cocoons, because there was rain in October, which allowed the leaves of the deciduous teak to bud early. As soon as the teak has a full cover of leaves the caterpillars attack and as soon as the cocoons appear, and the cocoon collectors descend on to the teak grove floor. The whole neighborhood was here, young and old, men and women, children still in their schools uniform, everyone was scraping the ground and picking up every bit of curled teak leaf to open it and a tiny cocoon inside. Some people love teak caterpillar cocoons, but others burst out into an allergic rash when they eat this seasonal delicacy. Frequently, and especially if large quantities of the teak caterpillar cocoons harvested, they brought some of them and sold in the local markets, the price was Rp.30,000.-/kg or \$US 3.-/kg. The teak caterpillar cocoons is believed could increasing the vitality of man.

An estimated 2,000 insect species are consumed around the world, and people do not just eat insects, they relish them as delicacies. Quantities actually harvested from an area of forest or agricultural vary greatly according to species and the prevalence of their food plants. Many species of insects are lower in fat, higher in protein compared to beef, lamb, pork, or chicken. Crickets (*Brachytrupes portentosus* Lichtenstein), grasshoppers (*Valanga nigricornis* Burmeister, *Patanga succincta* Linnaeus), dragonflies (order Odonata, species *Pantala flavescens* Fabricius), palm weevil

(*Rhynchophorus ferrugineus* Fabricius, *Chalcosoma atlas* Linnaeus), bee/wasp (*Xylocopa latipes* Drury), and termites are selected other edible insects one that are especially palatable, nutritious, and easily obtained in Indonesia. Those who are accustomed to eating animals probably know that most animals must be killed, cleaned, and cooked before one can eat them. The case is similar with edible insects. Normally the edible insects are taken and can either be eaten after roasting or frying with coconut oil, mixed with cassava leaves, cooked with salt and few hot peppers, or simply fried with salt and onion. Some pictures of the edible insects and recipes to cook them can be found in the poster.

Edible insects are generally abundant, nutrient-dense, marketable, and contributed significantly to the livelihoods of many rural families in Indonesia, although the organization has not historically kept data on insects as food. No research has been done on them so far, but they may have considerable development potential.

Poster Abstracts

The Cultural and Commercial Roles of Edible Insects in Lao PDR.

Kenichi Nonaka

Department of Geography, Rikkyo University,
3-34-1 Nishi-ikebukuro, Toshima, Tokyo, Japan 171-8501.

Email: k-nonaka@za7.so-net.jp

Abstract

A case study is presented that seeks to clarify the cultural and commercial roles of edible insects in the Vientiane Plain area of Lao PDR. Characteristics of insect used are examined in relation to rice cultivation and commercialization arising from economic development. Insects represent one of the most important natural resources in Lao PDR. Large numbers of many species of insects are used as food. They are cooked in various ways and served as side dishes eaten with sticky rice. Activities associated with collecting insects, and their habitats, are related to subsistence farming, which mainly consists of rice cultivation in the rural area, where land use patterns are a combination of paddy fields and surrounding forests. Marketing of edible insects has increased since the 1990s, along with urban development and the introduction of a cash economy into rural areas. Many people, including children, have become involved in the collecting of insects as resources to provide cash income. Insects are regarded as both bio-resources and cultural resources, reflecting a rich biodiversity. If more people become engaged in collecting insects, however, this could lead to competition for this resource and overexploitation. Insect forest habitats will decline as further urban development takes place in the Vientiane Plain. Management strategies need to be designated to assure that wild insect populations are sustainable and can continue to contribute to human nutrition in the future.

Studies on Alkaline Solution Extraction of Polysaccharide from Silkworm Pupa and Its Immunomodulating Activities

Sun Long, Feng Ying, He Zhao, Ma Tao & Zhang Xin

Research Institute of Resources Insects

CAF, Key Laboratory of Cultivation and Utilization of Resource Insects,

State Forestry Administration, Kunming 650224, Yunnan, China

Email: Sunlong1818@126.com

Abstract

The extraction of polysaccharide from silkworm pupa by alkaline solution was studied. Optimum conditions were obtained by using orthogonal design $L_9 3^4$. The result shows the optimum conditions are as follows: concentration of alkaline solution $0.02 \text{ mol} \cdot \text{L}^{-1}$, temperature 80 C , time 3 hours. Under these conditions, the content of total polysaccharide, protein and amino acids in extractives is 27.9%, 38.1% and 35.85%, respectively. The immunological test in mice shows the polysaccharide of silkworm pupa (PSP) can increase significantly macrophage phagocytosis, enhance remarkably hemolysin antibody and lymphocyte transformation, which indicates PSP has evident nonspecific, cellular and humoral immunity.

Teak Caterpillars as a Food Source and Selected other Edible Insects

Dwi Retno Lukiwati

Faculty of Animal Agriculture

Diponegoro University, Semarang Central Java, Indonesia

E-mail: drlukiwati_07@yahoo.com

Abstract

Teak (*Tectona grandis*) is a wonderfully versatile wood that is good for building, furniture making and also fine carving. In Javanese, the name for teak, "kayu jati," also means "real wood." Most of the teak can be found growing now in villagers' forest-gardens called "kebun," especially in traditional teak producing areas, such as in Wonogiri, Blora, Cepu (Central Java), Bojonegoro, Lamongan and Ngawi (East Java) on Java island. Among the defoliating insects frequently encountered in the plantations is the teak caterpillar cocoon or "enthung jati" (*Hyblaea puera* Cramer; (common name: teak defoliator) which represents the sole genus of the family Hyblaeidae. Last year was a good year for teak caterpillar cocoons, because there was rain in October, which allowed the leaves of the deciduous teak to bud early. As soon as the teak has a full cover of leaves the caterpillars attack and as soon as the cocoons appear the cocoon collectors come into the forest. The entire neighborhood takes part, young and old; men, women and children, everyone scavenging the ground and picking up every bit of curled teak leaf containing the tiny cocoon. Some people love teak caterpillar cocoons, but others break out with an allergic rash when they eat this seasonal delicacy. Frequently, and especially if large quantities are harvested, some are sold at local markets for a price of Rp.30,000.-/kg or \$US 3.-/kg. Consuming teak caterpillar cocoons is believed to increase human vitality.

An estimated 2,000 insect species are consumed around the world, and people do not just eat insects, they relish them as delicacies. Quantities actually harvested from an area of forest or agriculture varies greatly according to species and the prevalence of their food plants. Many species of insects are lower in fat, higher in protein compared to beef, lamb, pork, or chicken. Crickets (*Brachytrupes portentosus* Lichtenstein), grasshoppers (*Valanga nigricornis* Burmeister, *Patanga succincta* Linnaeus), dragonflies (order Odonata, species *Pantala flavescens* Fabricius), palm weevil (*Rhynchophorus ferrugineus* Fabricius, *Chalcosoma atlas* Linnaeus),

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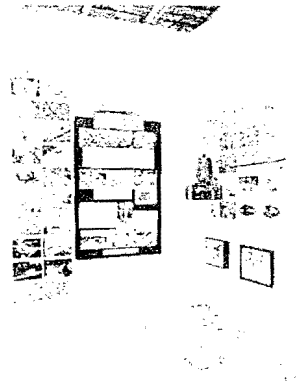
Field Trip Programme

Edible Insects Field Trip – 20 February 2008

Schedule

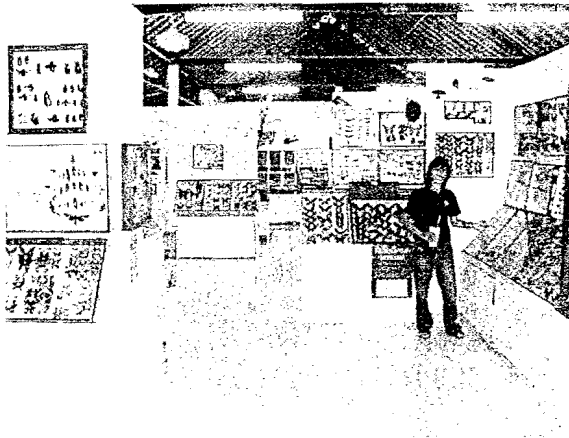
- 08:30 Depart from hotel to Siam Insect Farm
- 09:00 Visit to Siam Insect Farm , Presentation and tour, question time, own discussions, own exploration of the exhibits
- 10:45 Visit to Supha Bee Farm , Presentation by manager about: Supha bee farm cooperative, the industry and market in Thailand , equipment in the museum, live hives, products, factory, distribution centre. Includes taste testing and a visit to the gift shop.

- 12:00 Travel to Orchid Farm
- 12.30 Lunch in Orchid Farm Restaurant
- 13:30 Travel to Cricket Farm
- 13:45 Cricket Farm viewing and interview with farmer
- 14:30 Travel back to Chiang Mai on canal road.



Edible Insect exhibits corner

- 15:00 Visit to Huay Kaew Waterfall, look at edible insect stalls, interview vendors.
- 15:45 Return to Centana Duangtawan Hotel



Siam Insect Farm



Raw Insects stalls at Huay Kaew Waterfall

Forest Insects as Food: Humans Bite Back
19-21 February 2008, Chiang Mai, Thailand

TIPS TO BE HAPPY HERE IN CHIANG MAI, THAILAND

Hotel Email saledc@chr.co.th

Website:

<http://www.chiangmaibooking.com/hotelchiangmai/duangtawan/>

Hotel Phone **(66) 53 905000** **Fax: (66) 53 275429**

Currency – **Thai “Baht”** (US\$ 1 is about 30 Baht)
(Please check again)

Electricity - Voltage in Thailand is 220-240AC, 50 Hertz.

Climate – Now is winter, it can be cooler in the morning and late night.

Religions – Most Thais are Buddhists. Chiang Mai has >200 temples.

Tradition – **“Wai”** (palms close to each other and put it in front of your chest) is the way to present the greeting/respects/excuse/thank you. Please try to use “Wai” as much as possible.

Magic words – SAWASDEE (Ka or Krub) – Hello
– KHOB KHUN (Ka or Krub) – Thank you
– KHOR TOD (Ka or Krub) – Sorry / Excuse me
(Note: Ending of words or sentences – if you are female use “Ka”, “Krub” for male.)

Laws & Regs – Most public areas such as department store, cinema, public transportation, restaurant, and etc. are **NON-SMOKING AREA**. However, some places they provide customers the smoking area. Please check the sign before you smoke.

Transportation – Main public transportation in Chiang Mai is “**ROD DAENG**” or “Red Taxi” which you have to tell your destination to the driver before you get in. The fare started from 20 Baht and depends on distance. The late night taxi may charge you more. The red taxi is available until midnight. “**Tuk-tuk**” is also common here in Chiang Mai, the fare (mostly started from 60 Baht) is also varying upon destination and time. Tuk-tuk is available all night.

Shopping Places – Most popular places in Chiang Mai are as list:
“KAD LUANG” means big market. Open daily.
Till late night
“NIGHT BAZAR” Open daily. From 6 pm till midnight.
“CENTRAL Kad Suan Kaew” Department Store with cinemas (on Huay Kaew Road).
“AIRPORT PLAZA” with cinemas (near Airport).
“THA PAE GATE” Walking Street (Sunday market) Best place for souvenir shopping!!
“Lotus Tesco Megastore”, “BigC”, “Carrfour”
– all mega stores

Accomodation: – You are staying at **Centara hotel**. Please pick up the hotel Address Card, in case that you would like to wonder around by yourself.