

Chapter 24**SOUTHEASTERN ASIA: THAILAND****Taxonomic Inventory**

Taxa and life stages consumed

Coleoptera**Buprestidae (metallic woodborers)***Buprestis* sp., adult*Chrysobothris femorata* (author?), larva, adult*Sternocera aequisignata* Saund. (= *equisignata* and *acquisignata*), adult*Sternocera* sp., adult**Cerambycidae (long-horned beetles)***Apriona germari* Hope, larva, adult**Curculionidae (weevils, snout beetles)***Hypidisa talaca* Walk., adult*Hypomeces squamosus* (Fabr.), adult*Rhynchophorus schah* Fabr., larva, adult**Dytiscidae (predaceous diving beetles)***Cybister limbatus* Fabr., adult*Cybister* (= *Cybis*?) sp., adult*Cybister tripunctatus* (author?) (= *tripuncta*), larva, adult**Haliplidae (crawling water beetles)**

Haliplid sp., adult

Hydrophilidae (water scavenger beetles)*Hydrous* sp., adult**Scarabaeidae (scarab beetles)***Adoretus compressus* Web., adult*Adoretus convexus* Burm., adult*Anomala antiqua* Gyll.), adult*Apogonia* spp.*Copris* spp., adults*Exopatus* sp., adult*Helicopris* sp., adult*Holotrichia* sp., adult*Lepidiota* sp., larva, adult*Lepidiota stigma* (Fabr.), larva, adult*Leucopholis* (= *Leucophosis*?) sp., adult*Onitis* sp., adult*Onitis virens* Lansb., adult*Onthopagous* sp., adult*Oryctes rhinoceros* (Linn.), larva, pupa, adult*Psilophosis* sp., adult*Xylotrupes Gideon* Linn., larva, adult**Hemiptera****Belostomatidae (giant water bugs)***Lethocerus* (= *Belostoma*) *indicus* Lep. & Serv., adult**Naucoridae (creeping water bugs)**

Sphaerodema molestum (author?), adult
Sphaerodema rustica Fabr., adult

Nepidae (water scorpions)

Laccotrephes grisea Guer., adult
Nepa sp., adult

Notonectidae (back swimmers)

Notonecta undulata (author?) (? = *Notonita* ?; = *Notonica intermerata*), adult

Pentatomidae (stink bugs)

Tesseratoma (= *Teeseratama*) *javanica* Thunb., nymph, adult
Tesseratoma papillosa Drury, adult

Homoptera

Cicadidae (cicadas, psyllids, etc.)

Cosmopsatria sp., adult
Dundulia entemerata Walk. (? = *Dandubia*, ?; = *Dundubia*, ?; = *Dunduebia intermerata*), adult
Dundubia sp., adult
Magicicada spp., adults
Rihana sp., adult

Kerridae (lac scales)

Kerria (= *Laccifer*) *lacca* Kerr.

Hymenoptera

Anthophoridae (carpenter bees)

Xylocopa confusa Perez, adult
Xylocopa latipes Dr., adult

Apidae (honey bees)

Apis dorsata Fabr., larva, pupa
Apis florae Fabr., larva, comb/all stages
Apis indica (author?), larva, pupa
Apis sp., larva, pupa, comb/larva

Formicidae (ants)

Crematogaster sp., larva
Oecophylla smaragdina (Fabr.), all stages

Halictidae (halictids)

Nomia sp., larva, pupa

Vespidae (wasps, hornets)

Eumenes petiolata Fabr., larva
Vespa cincta Fabr., larva, adult
Vespa sp., larva

Isoptera

Rhinotermitidae

Reticulitermes flavipes Kollar, winged adult

Termitidae

Termes flavicole (author?), winged adult

Lepidoptera

Bombycidae (silkworm moths)

Bombyx mori (Linn.), pupa

Cossidae (carpenter moths, leopard moths)

Xyleutes leuconotus (author?), larva

Zeuzera coffeae (author?), larva

Pyralidae (snout and grass moths)

Pyralid sp.

Mantodea

Family uncertain

Hierdula sp., eggs, adults

Tenodera sinensis (author?)

Odonata

Aeshnidae (darners)

Anax (=Anax) *guttatus* Burm., adult

Aeschnidae spp., nymphs

Libellulidae (common skimmers)

Libellula (= *Libella*?; = *Ubellula*?) *pulchella* Drury

Libellulidae spp., nymphs

Macromiidae (belted skimmers, river skimmers)

Macromia sp., nymph

Family uncertain

Epophtholmia vittigera (author?), nymph

Rhyothemis sp., nymph

Orthoptera

Acrididae (short-horned grasshoppers)

Aelopus tamulus Fabr.

Cyrtacanthacris tatarica (author?), adult

Locusta migratoria Linn.

Locusta (= *Locustra*?) sp., adult

Oxya japonica japonica (author?)

Patanga succincta (author?)

Blattidae (roaches)

Blatta orientalis Linn., egg, adult

Stylophyga rhombifolia Stoll., egg adult

Gryllidae (crickets)

Brachytrupes (= *Brachytrypes*) *portentosus* Licht., adult

Brachytrupes sp.

Gryllus testaceus Walck.

Liogryllus bimaculatus De Geer (= *Gryllus*?; = *Acheta bimaculata*?; = *G. bimaculata*?; = *G. bimaculata*?)

Gryllotalpidae (mole crickets)

Gryllotalpa africana Beauv., adult

Tettigoniidae (long-horned grasshoppers)*Scudderia* sp., adult**Phasmida****Family uncertain***Eurycnema versirubra* Serville, frass

Bristowe (1932) published the first definitive paper on entomophagy in Thailand. Bristowe found that Thai and Lao peasants ate similar diets, consisting of rice with fish supplying the main protein constituent, but that the Lao, in addition, ate considerable numbers of insects, each in its particular season. Although the Laos are concentrated mainly in northern and eastern Thailand, their choice of insects and order of preference were found to be remarkably consistent throughout the country, the most popular being the giant waterbug, dung beetles and their larvae, grasshoppers and the larvae of Hymenoptera, beetles and moths. Up to 4d. may be paid for a single *Helicopriss* dung beetle or giant water-bug. Exceptions included dragonflies and their nymphs which are eaten only in the Ubon area and at Hua Hin, respectively, and cockroaches which are eaten at Korat and Hua Hin, but said in other areas to "stink." Cockroach eggs, however, are fried and eaten by children in all districts. Some species, such as the cicada, *Dundubia intemerata*, are restricted in range and therefore not known in other districts. Bristowe was impressed by the Lao knowledge of insect life-histories.

Bristowe states that, "As regards their reasons for eating insects, I found that without question the Laos like them. Some fetch high prices and the capture of others is fraught with considerable risk." Bristowe sampled most of the insects eaten by the Laos and "found none of them distasteful and a few quite palatable, notably the giant water-bug." Dung beetles were "by no means unpleasant." Salt is usually added to the insects, or sometimes chilli or the leaves of scented herbs, and sometimes they are eaten with rice or added to sauces or curry. Bristowe likened the flavor of termites, cicadas and crickets to that of lettuce.

Thais look askance at the Lao because of their insect-eating habits, particularly their liking for dung beetles and their larvae. The Thais themselves eat certain kinds of insects, however, although not making such a general practice of it. Bristowe states: "Giant water-bugs are added to royal sauces, Duang grubs (*Zeuzera coffeae*) were much prized by the late king, and certain kinds of ant and ant grub are pickled for the consumption of good family Siamese in Bangkok. Wasp grubs and honey, locusts, crickets and even big Mygalomorph spiders are occasionally eaten by some of the Siamese peasants."

Bristowe stated that his list of the insects eaten was probably far from complete, but he was confident that the major species were included. His findings are further reported below under the appropriate orders and families. Bristowe concluded his extremely valuable paper by listing some medicinal uses of insects in Thailand.

Bristowe (1953) rehashes his previous paper (1932) without adding any new information. **Nakao (1964;** vide Hirashima et al 1979) reported observations on human consumption of insects in Thailand [this paper, in Japanese, has not yet been seen].

Mungkorndin (1981; vide Watanabe and Satrawaha 1984) discusses the edible plants and animals throughout the whole of Thailand. [This paper has not yet been seen.]

In an important paper, **Sungpuag and Puwastien (1983)** provided the results of proximate, mineral and vitamin analyses on 12 species of insects that are consumed in the north and northeast of Thailand where insect consumption is common practice. Insects are the common source of protein and energy for the rural farmers of the region and therefore nutritionally important according to the authors, who also note that, despite this, there is no information on nutritive values of insects in the latest "Nutrient Composition Table of Thai Foods," published by the Nutrition Division, Department of Health.

The authors note that their analyses included only some of the species that are consumed in northeast Thailand. The insects for analysis were taken live (the majority of samples) by people in the villages or bought at markets in Ubon and Mahasarakam provinces. The insects were killed in boiling water and only the edible parts were retained. They were then sundried, baked at 50°C and ground to a powder. In a food consumption survey conducted during the insect consumption season in Ubon in the villages where samples were collected, it was found that 20-60 g of insects are consumed per day, providing 1-5 g of protein, 1-50 g of fat, 1-5 g of carbohydrate and 10-350 kcal of energy. The eight-month season of edible insect availability and consumption found by Sungpuag and Puwastien is shown in Thailand Table 1 (see authors' Table 1).

Although Sungpuag and Puwastien conducted analyses on baked and dried samples, the nutrient compositions are reported in grams or milligrams per 100 grams of live-weight (Thailand Tables 2 and 3; see

authors' Tables 2 and 3). Some vitamins were lost in the drying process, thus are underestimated in the tabular data. From the data, the authors conclude that the insects are a good source of protein and high in several minerals (calcium, phosphorus, sodium and potassium), but low in iron. Vitamin B₂ and niacin were higher than vitamin B₁. The authors conclude that there are enough nutrients in insects that they should be recommended to the rural people for consumption and information should be provided that would make their use as food as efficient as possible. Restraint should be exercised in the use of pesticides so that insects remain available as a food source. Finally, more studies should be conducted on the nutritive value of insects, especially on their amino acid content.

Sungpuag and Puwastien briefly discussed in tabular form the methods by which the various species are prepared for consumption. These are included below under the appropriate orders and families.

In an excellent paper, accompanied by numerous black-and-white photographs, **Watanabe and Satrawaha (1984)** provide data on 15 species of insects found in the public market in Khon Kaen in northeastern Thailand. The authors state that the insects are an important protein source for the people in this region, and that they are "saleable in urban areas, being quality food available in quantity." They also say, "To ensure a continued supply, however, collection methods will need to be improved and rearing methods established." In addition to the insects discussed, the authors note that insects are also sold unsorted in bulk.

Insects reported by Watanabe and Satrawaha are discussed below under the appropriate orders and families. Relative to seasonal availability of the insect foods they discuss, the rainy season extends from May to October, the end of the rainy season refers to September-October, and the dry season extends from February to April. Prices are presumably those during the period 1979-1981.

In a study of natural food sources occurring in northeastern Thailand during the rainy season, **Somnasang et al (1984)**, pp. 59-60 report all of the species reported earlier by Sungpuag and Puwastien, plus the following: Coleoptera, *Chrysobothris femorata* (Buprestidae); Homoptera, *Magicicada* spp. (Cicadidae); Isoptera, *Reticulitermes flavipes* (Kollar); and Odonata, *Ubellula pulchella*. The authors say, in an introductory summation, that protein supplies are confined to animals and insects while vegetables are the source of minerals and vitamins. In years of abundant rainfall, the surplus of unconventional foods gathered from nature added to family income apart from the proportions consumed daily. The natural foods are gathered especially from paddy fields, from upland and forested areas, and from natural ponds and streams.

Somnasang et al state (p. 12, translation): "Insects are a very important source of protein for villagers in the Northeast, especially during the time that fish, prawn, and frogs are difficult to find. Besides providing protein insects also provide vitamins and minerals. It is safe to eat the insects because there is no pesticide. Most of the time people eat the insects cooked. Villagers said that nowadays insects are difficult to find." In one village in Chaiyapoom Province, villagers said that there are not many insects now because there are not many trees in the woods.

The authors mention that insects found in the rice paddies during the rainy season are water bugs, grasshoppers, true water beetles, winged termites, crickets and mole crickets (p. 26). Insects found in the woods and hills include the June beetles, crickets, true water beetles, cicadas, metallic wood-borers, and short-tailed crickets (p. 28). Insects found in water are the dragonfly naiads, true water beetles, and crickets (p. 29). While most insects are more plentiful when there have been good rains, there are more grasshoppers when it is dry (p. 8).

The giant water bugs are collected using nets or at lights. The whole bug except the wings is eaten. It is grilled and then put in sauce to lend the desired odor or essence. Female water bugs are sold two for one baht in the market, while male bugs, which have more of the preferred odor, sell for two baht each (p. 32). Grasshoppers and true water beetles are wrapped in banana leaf and grilled to put in soup. Grasshoppers are sold for one baht per bag. Winged termites are grilled or fried.

Somnasang et al (1985a) report that fewer insect foods are available during the cool season than during the rainy season in northeast Thailand (p. 29). Crickets are an exception, more being found in the cool season when as many as 10 may be collected from one cricket hole. Insects collected during the cool season include (p. 39): Coleoptera, *Cybister limbatus* (Dytiscidae); *Onitis* spp. and *Copris* spp. (Scarabaeidae); Hemiptera, *Notonita undurata* (Notonectidae); Homoptera, *Magicicada* spp. (Cicadidae); Odonata, *Libellula pulchella*; Orthoptera, *Gryllus bimaculatus* (Gryllidae), and *Gryllotalpa africana* (Gryllotalpidae); and an insect called mang-kha-noon. Cicadas are in season in February. They are fried and ground to powder in the same way as water bugs are prepared. A few other remarks are made regarding insect food preparation or seasonal abundance (pp. 19-22), but the information has been noted previously. Somnasang et al state that the main sources of food for family consumption in the cool season are crops and vegetables, and for meat, chicken. The forest remains a source of mushrooms at the onset of the cool season (November). Fish is the food most commonly purchased.

Somnasang et al (1985b) repeat information provided in the earlier report by this group (Somnasang et al 1984). **Somnasang et al (1986)** report several insects among the natural food resources in northeast

Thailand villages during the summer season. These include the buffalo dung beetles, *Onitis* spp. and *Copris* spp.; winged termites of *Reticulitermes flavipes*; the giant water-bug, *Lethocerus indicus*; the dragonfly naiad, *Ubellula pulchella* (known as noey); and red ant's eggs. The authors point out that summer natural food sources are limited compared to those in the rainy and cool seasons. Less wood is needed for fuel and more people are employed in the summer, so fewer trips are made to the forest.

The **Ministry of Public Health (1987)** provided an attractive booklet with colored illustrations called the "Manual for Using Food which Provides High Protein and Fat in Rural Areas." It is intended for selecting foods for malnourished infants and pre-school children. The Nutrition Division, based on research, developed nine "supplementary food" formulas that can be used to supplement the food of infants age 3 months and older. The formulas are based on locally produced foods; Formula 3, for example, consists of 650 g of rice, 250 g of mung bean, and 100 g of white sesame. The protein and energy value of this formula is shown in Thailand Table 4 (MPH manual p.4) along with values given in the booklet for several insects and selected other foods, a total of 60 foods (insect data shown on MPH pp. 14-15). The daily requirement of protein and calories for Thai children are also shown in Table 4 (on MPH p. 16).

Gorton (1989) states:

Drought, deforestation and overpopulation have left Northeast Thailand's poorest with even less than before. Still, 'Esarn' people, attuned to the weather and soil, have adapted in their own unusual, albeit practical, way. While swarms of insects have invaded precious rice and corn fields, villagers have fought back with their own appetites, instead of the more expensive and dangerous chemicals. At the same time, villagers have been able to increase their sagging protein intake.

Gorton notes that more than 19 varieties of insects are eaten by villagers and attributes to a leading Thai nutritionist the statement that "Insects are becoming an increasingly important protein supplement for the diets in the Northeast." Gorton mentions Oun Pachusoo, 40, who has a family of four to feed. She uses an old cloth to trap water bugs in ponds and paddies and lift them out of the water. Selling her water bugs at the Roi-Et open market, she estimates she earns 50 to 60 baht (U.S. \$1.90 to \$2.30) a day.

According to Gorton, villagers have been able to stem the damage to crops by "turning foe into food," a most notable example being the grasshoppers or "flying shrimp", which feed on corn seedlings, sugarcane, rice and banana leaves. Government spraying programs involving "massive amounts of chemicals" became less and less successful, while "being expensive and hazardous to health." Villagers sometimes ate insects dead from pesticides, and as recently as 1986, there were stories of villagers dying or being seriously injured by chemicals ingested along with the insects. "Large cross-province shipments of grasshoppers killed by pesticides, then fried to a crisp in cooking oil were a lucrative business for some."

Gorton reports that, as a result of information from news reports and health officials, some districts and villages gave up the spraying in favor of grasshopper catching competitions. Health and culinary experts gave demonstrations on the best way to clean and prepare the grasshoppers. Gorton notes that, "Those who can catch the insects in mass quantity are able to sell them on the village roadside or become involved with the lucrative 'export' trade to Bangkok."

Of red ant "eggs", which have long been considered a delicacy in northeast Thailand, Gorton says: "No fine restaurant in a provincial capital would be found without its supply of the foodstuff. The eggs are of great nutritional value because they are often eaten raw, mixed together with ants, chillies, chopped lemon grass, radishes and various other additives. On a good day, villagers can make a few dollars of marketable food, though the villagers often prefer to eat them at home as a kind of special treat for a successful walk in the wilderness."

Jonjuapsong (1996) discusses collection and preparation methods for several of the edible insects in Thailand (see under appropriate taxonomic groups below). He notes that children eagerly collect insects flying around the gas-powered lanterns and consider them delicious. Insects are a good source of protein for people in the countryside, and their taste is "not inferior to that of beef, pork, chicken, shrimp or fish in the least; for example the flesh of praying mantis is very similar to that of shrimp mixed with fresh mushrooms." Entomophagy also contributes to pest control, as many of the edible species are destructive to plants. More than 50 species are eaten (roasted, boiled, sautéed or pounded) by people from northeast Thailand, and it is part of the culture. The tabularized nutritional values presented are those published originally by Sungpuag and Puwastien.

Yhung-aree and Puwastien (1997) note that, because of transportation and other difficulties, "conventional protein" sources such as fish, poultry, pork, beef, eggs and milk, are not reliably available in some parts of Thailand, the north and northeast being two such regions. Insects have served since ancient times, however, as an alternative source of protein which helps to overcome the periodic or seasonal scarcity

of the conventional sources. In addition, some insects have long been important "cultural foods" and are widely used not only in the rural north and northeast but throughout the country. Two consumption patterns exist. In rural areas, insects serve as main dishes and are eaten with staple foods such as rice, while urban dwellers mainly use insects as snack foods, although some, such as the giant water bug, may be used as an ingredient in certain popular dishes.

To investigate consumption patterns in rural areas, Yhoun-aree and Puwastien conducted four dietary assessments representing different seasons among 140 school-aged children in northeast Thailand. The first assessment, in October (the transition month between the rainy and cool-dry seasons) revealed that 15% of the children ate insects and averaged 15 g/person/meal. In the second assessment, in December (the dry cool-season [and a period of low insect availability]), 2% ate insects and averaged 26 g/person/meal. In the third period, in February-March (late cool-dry season), 16% ate insects with an average consumption of 16 g/person/meal. In the fourth assessment, April to early May (the hot-dry season [and the period of greatest insect availability]), 32% of respondents consumed insect dishes and averaged 26 g/person/meal. Although volume of consumption was relatively low, the authors believe these data confirm that insects play a substantial role in household food security, "particularly since among the rural poor, insects can feed a sizable family at very little (if any) monetary cost."

In urban areas, although many are "squeamish" about eating them, insects are purchased and well-accepted by people of various economic levels and some insects, such as wasps, bamboo caterpillars, crickets, locusts and others, are sold as delicacies in the finest restaurants and food shops. The authors state that urbanites who like insect dishes may be mainly rural insect eaters who have migrated to the city. The authors mention also that the Thai government has played a role in promoting insect consumption, especially relative to locust plagues, and, as a result fried locusts and locust fritters appeared widely in city markets. Some people became wary, however, following reports that people had died after eating insects, possibly caused by insecticide contamination.

According to Yhoun-aree and Puwastien, cooking methods for insects are not different from those used for other foods, and they indicate which methods are most popular for the different insect groups. For example, they say, relative to *frying/frittering*:

Deep-frying is the main technique used to prepare bamboo caterpillars. This dish is delicious and tastes much like french fries. Hence, it becomes a popular dish even with urban dwellers of all economic classes. However the price is quite expensive compared to other insects (and some meat sources), reaching up to 150-200 Baht per kilogram of cooked bamboo caterpillars (Note: approx. 24 Baht = 1 US\$). Deep frying is also used for crickets, locusts, and beetles. Fried locusts or grasshoppers, known as "sky prawns," are a popular and expensive dish in urban areas as well as rural ones. Cricket and locust fritters are also one of the most common dishes sold in urban restaurants and as street foods in large markets such as the weekend market in Bangkok, the night market in the Patpong area, large markets in Chiangmai and so on. These dishes are normally served as a relish.

According to the authors, *roasting* is the most common method of cooking for all insects except bees and wasps which are automatically *smoked* during their collection. *Baking/barbecuing* may be used to cook crickets and giant water bugs. All kinds of insects, especially locusts, wasps, ant eggs and beetles, are suitable for preparing *spicy soup/curry*, and the authors mention that many kinds of insects are suitable for preparation as *homoke*, which entails mixing them with chilli-based ingredients, and wrapping the mixture in a banana leaf which is then either baked or steamed, resulting in a red custard-like dish. Minced insects (crickets, beetles, cicadas and giant water bugs are suitable) may be prepared as *jaew* (spicy chilli paste) or *pone* (watery chilli sauce), foods which are commonly eaten by indigenous people. Several less commonly used methods are mentioned, such as dipping the insects in eggs and frying or adding them as part of scrambled eggs or omelettes.

Noting that the protein content of conventional animal sources ranges from 3.5 g/100 g in milk to 18-20 g/100 g in meat, and comparing this to data from an earlier study on nutrient content of insects (see Thailand Tables 2 and 3), the authors consider insects to be quantitatively good sources of protein, but low in fat, except for young female red ants. They cite earlier studies on amino acid scores showing insects' protein quality ranging from 48 to 80% of the FAO/WHO reference protein. They note, from data on bamboo caterpillars, that frying results in a marked increase in protein and energy content. And, as shown in Thailand Table 3, insects are also good sources of certain minerals and vitamins, especially phosphorus, potassium, iron, riboflavin and niacin.

Yhoun-aree and Puwastien conclude by saying that although insects are not part of the staple diet of urbanites, they are significant sources of protein for rural inhabitants. Unfortunately, rapidly changing socio-economic factors such as people seeking off-farm employment and consequent reduction in rural collectors

and consumers and increasing environmental degradation may reduce the availability and consumption of insects. In the immediate future, however, because of their cheap availability and marketability, they should continue to play an important role in household food security.

Coleoptera

Buprestidae (metallic woodborers)

Buprestis sp., adult

Chrysobothris femorata (author?), larva, adult

Sternocera aequisignata Saund. (= *equisignata* and *acquisignata*), adult

Sternocera sp., adult

The woodboring buprestid, *Sternocera aequisignata* Saund. (Lao name: Mang Khup; Thai name: Mang Thup), is sought not only by the Laos for food but by the Chinese for decorative purposes, the metallic green and gold elytra being used in clothes, jewelry and ornaments (**Bristowe 1932**). The Chinese breed them for this purpose, and in Bangkok they sell for 1 satang or approximately 1/4d. each. They are picked off of shrubs by the Laos who roast them and squeeze out the feces before eating them.

Vara-asavapati et al (1975, pp. 13-50) discuss numerous insects used as food in northeast Thailand. Included among the Coleoptera are more than a dozen species of beetles representing seven families. In the family Buprestidae, the metallic woodborers, two species, *Buprestis* sp. and *Sternocera aequisignata*, are consumed, in the adult stage (p. 42). They are known as ma-langtap or ma-lang khap. They feed on tree leaves and are easily collected by shaking the trees; they do not fly away, but fall to the ground and feign death. They are fried and the head, wings and legs are removed before they are eaten.

Watanabe and Satrawaha (1984) summarize the *Sternocera* sp. (metallic wood borer) adult as follows: Malaeng Tub; 1 baht/2 adults; end of rainy season; live. The adults of *Buprestis* sp. and *S. aequisignata* feed on the leaves of tamarind trees, according to **Jonjuapsong (1996)**, who also mentions the ease of collecting them by shaking the branches because they do not try to escape when they fall to the ground. They are prepared by roasting or frying without oil, then removing the head, wings and legs.

See also Bristowe (1932) and Somnasang et al (1984) in the Introduction, and Ngamsomsuke et al (1987) under Miscellaneous.

Cerambycidae (long-horned beetles)

Apriona germari Hope, larva, adult

Among the beetles, **Bristowe (1932)** was unable to determine the specific identity of the larvae of a number of longicorns (Cerambycidae) and members of other families that are eaten by the Lao. The larvae, extracted from wood, are roasted.

Among the Cerambycidae or long-horned beetles, both the larvae and adults of *Apriona germari* Hope (known as ma-lang-kok or duang-nuatyao) are eaten (**Vara-asavapati et al 1975, p. 43**). This is a large species, the adults measuring 3-5 cm with the female the larger, and the larvae measuring 5-6 cm in length. It is a serious pest of mulberry and kapok trees among others. Eggs are laid from May to July and the life cycle takes about one year with 9-10 months in the larval stage. The adults are caught by hand, and the wings, head and legs are removed before they are grilled or fried. The larvae, and sometimes the pupae, are fried or cooked in banana leaves. When fried, larvae, pupae and adults are fried without oil (**Jonjuapsong 1996**).

See also Bristowe (1932) in the Introduction.

Curculionidae (weevils, snout beetles)

Hypodisa talaca Walk., adult

Hypomeces squamosus (Fabr.), adult

Rhynchophorus schah Fabr., larva, adult

Both the larvae and adults of the large curculionid weevil, *Rhynchophorus schah* F., are sought for food (**Bristow 1932**). The larvae are extracted from coconut palms, and roasted.

Adults of two species of snout beetles, *Hypomeces squamosus* and *Hypodisa talaca* Walk. (Curculionidae), are eaten after first removing the head (**Vara-asavapati et al 1975**). These are small greenish-bronze in color, and known as ma-lang-khom-tong or ma-lang-chang. Children catch them by hand and eat them raw, or if many are caught they are fried with a little salt.

Dytiscidae (predaceous diving beetles)

Cybister limbatus Fabr., adult
Cybister (= *Cybis*?) sp., adult
Cybister tripunctatus (author?) (= *tripuncta*), larva, adult

Only one dytiscid, *Cybister limbatus* F. (Lao name: Mang mee-eng), is reported by **Bristowe (1932)**. These black shiny water beetles are caught in nets (probably primarily during fishing) and roasted.

Graves and Launois (1973, p. 116) mention that in Bangkok's countless open-air stalls, "Vendors offer an enormous variety of foods, from rich confections and exotic fruits to a spicy paste made from mashed water beetles."

Vara-asavapati et al (1975) report the food use of water beetles representing three families. Villagers catch the "true water beetle," *Cybister tripunctatus* (Dytiscidae) (known as ma-langtap-tao or duang-ding) and its nymph (known as "mang-eed") in ponds, swamps, small rivers and rice paddies (p. 27). Bamboo nets or fishing nets are used to catch the beetles. The beetles and their nymphs are in season from the rainy season to winter, and the "mang-eed" are found in the markets everyday during the rainy season. "Mang-eed" is prepared in the same way as prawns; the wings of the adult beetles are removed before they are eaten.

Sungpuog and Puwastien (1983) state that the true water beetle, *Cybister limbatus* Fabr., known as ma-lang-tap-tao, is pounded into paste, roasted on a spit, pan roasted. See Thailand Table 1 for seasonal availability and Tables 2 and 3 for nutrient analyses. *Cybis* sp. (predaceous diving beetle) adult: Malaeng Tub Tow; 5 baht/3 scoops or 1 baht/2 scoops [both prices listed by authors]; rainy season; steamed (**Watanabe and Satrawaha 1984**).

Jonjuapsong (1996) states that these beetles, *Cybister tripuncta*, the "true water beetle," are "found in ponds, swamps and streams everywhere," and "are abundant from the rainy season until the cold season." They can be pounded and put in chili paste to be eaten with shrimp and other aquatic animals or fried without oil or put in stews, after first removing the wings.

See also Somnasang et al (1984, 1985a) in the Introduction.

Haliplidae (crawling water beetles)

An unidentified species of "crawling water beetle" (Haliplidae), known as ma-lang-khao-san or duang-nam, is caught and prepared in the same way as the other water beetles (**Vara-asavapati et al 1975, p. 45**). It is of medium size and is attracted to lights at night.

Hydrophilidae (water scavenger beetles)

Hydrous sp., adult

Adults of a *Hydrous* sp. (Hydrophilidae), known as ma-lang-niang, occur in the same types of habitat as the *Cybister* beetles, and are caught and prepared in the same way as the latter (**Vara-asavapati et al 1975, p. 29**)

Hydrous sp. (scavenger beetle [aquatic]) adult: Malaeng Nian; price same as *Cybis* sp. and often mixed with *Cybis*; steamed (**Watanabe and Satrawaha 1984**).

Scarabaeidae (scarab beetles)

Adoretus compressus Web., adult

Adoretus convexus Burm., adult

Anomala antiqua (Gyll.), adult

Apogonia spp.

Copris spp., adults

Exopotus sp., adult

Helicopris sp., adult

Holotrichia sp., adult

Lepidiota sp., larva, adult

Lepidiota stigma (Fabr.), larva, adult

Leucopholis (= *Leucophosis*?) sp., adult

Onitis sp., adult

Onitis virens Lansb., adult

Onthophagus sp., adult

Oryctes rhinoceros (Linn.), larva, pupa, adult

Psilophosis sp., adult

Xylotrupes gideon Linn., larva, adult

Annandale (1900, pp. 859-861) mentioned four species of melolonthid beetles, *Lepidiota stigma*, another species of *Lepidiota*, and two species of *Leucopholis*, which are sold in the markets of Patalung. Both the adults and their larvae, which are found in the soil or under fallen trees, are eaten. They, like the cicada, are either boiled or fried in coconut oil.

Numerous species of scarabaeid beetles are discussed by **Bristowe (1932)**. The small rose beetles, *Adoretus compressus* Web. and *A. convexus* Burm., known by the Lao as Mang ee noon, are very popular throughout the Ubon circle but are not found in the markets. They are caught at night when they swarm at lights; they are roasted and the wing covers removed. Larvae, pupae and adults of *Oryctes rhinoceros* L. (Lao name for larva: Mang bough; adult: Mang kwang) are searched for in cow and buffalo dung, especially in sheds that have housed either. The beetles, about 1 1/3 in. long, are usually roasted, but sometimes fried. They are also used in curries or eaten alone, after the elytra and other hard parts are removed. The larvae and pupae are soaked in coconut oil for 15 min. before roasting. The flavor is quite pleasant according to Bristowe, who states, "The beetles and grubs are highly prized, and it is due to their taste for these particular insects that the Laos rank so low in the Siamese estimation." Both adults and larvae of *Xylotrupes gideon* L. are eaten, but there is not as much enthusiasm for this species as for *O. rhinoceros*. The Lao name for it is Mang kwang, the same as for *O. rhinoceros*. Males of *X. gideon* are pitted against each other in beetle fights, but, says Bristowe, so much money changed hands that a law prohibiting beetle fights was passed. A *Helicopriss* species, possibly undescribed, but over two inches in length and proportionately broad, is found in northern Thailand where it is used both as food and medicine. These beetles were very expensive, fetching as much as 20 satangs (about 4d.) in Lampang, and Bristowe suggests that "a dung beetle farm might be a most profitable enterprise!" The Lao name is Mang chew chee. The beetle is roasted, pounded up and added to curry. Three other species of scarabaeids are eaten by the Lao. One is *Onitis virens* Lansb. (also known as Mang chew chee), which occurs in abundance in cattle dung, and is roasted with salt. The others are *Lepidiota stigma* F. (known as Mang ee noon, a name which at least some Lao seem to apply to all chafer and rose beetles) and a *Leucopholis* species, both of which are apparently eaten widely in northern and eastern Thailand.

Vara-asavapati et al (1975) describe the use of species in five genera of the beetle family Scarabaeidae. The June beetle complex includes *Holotrichia* sp., *Psilophosis* sp., *Leucophosis* sp., and *Exopotus* sp. (p. 13). Common names are grey June beetle, white-stomach June beetle, red June beetle and green June beetle, and they are known collectively as ma-lang-kee-noon. The white-stomach June beetle is found in all markets in April and May. It is about 1.5-2.0 cm in length; the red and the grey June beetles are somewhat larger, about 3-4 cm long. The beetles feed at night on the young leaves of trees such as tamarind, zizyphus, mango and custard apple. During the day, they hide underground which is also where the larvae or "white grubs" develop. The beetles are collected at night using a lantern or flashlight and a bamboo stick about 1.5 m long. The bamboo is hollowed out except at one end. When beetles are found, using the light, the stick is positioned below, and the beetles either fall into the open end or fly to the light. Sometimes a mat is placed under a tree and when it is shaken the beetles either fall to the ground and feign death or fly to the light. Captured beetles are placed in a bucket of water or in a plastic bag. The authors note that some villagers are expert at knowing which trees have the most beetles. Sometimes a shovel is used to dig the beetles from the ground during the daytime. For eating, the beetles are fried and then the wings are removed. Or, sometimes they are ground to make a spicy sauce, or put into bamboo shoot soup or red ant egg soup, both of which are considered as "very good."

Buffalo dung beetles of the genus *Copris* (several species), about 1.0-1.5 cm in length, are active at night, and are collected from animal dung piles early in the morning, using a shovel and a bucket of water (Vara-asavapati et al, p. 31). In some villages, signs are placed on certain dung piles to indicate that they are already "reserved." After collection the beetles are left overnight in the bucket of water to rid themselves of the ingested dung. They are also soaked in water for two or three hours before cooking. The beetles sold in markets are cooked with a little salt. Some people eat the beetles whole while others remove the wings first. They are prepared in the same way as June beetles.

Sungpuag and Puwastien (1983) state that the June beetle, *Anomala antiqua* Gyll., known as ma-lang-gi-noon, is pounded into paste, pan-roasted, raw (chopped and seasoned) and buffalo dung beetles, *Copris* sp. and *Onitis* sp., known as malang-gudjee, are pounded into paste, deep-fried, pan roasted. See Thailand Table 1 for seasonal availability and Tables 2 and 3 for nutrient analyses.

Watanabe and Satrawaha (1984) summarize several scarabaeids as follows: *Copris* sp. and *Onthophagus* sp. (dung beetles) adult; Kood Chi (Good Gi); 5 baht/5 small scoops; rainy season; steamed. *Holotrichia* sp. and *Exopotus* sp. (June beetle or May beetle) adult: Malaeng Kinoon Daeng and Malaeng Kinoon Mone, respectively; Daeng has metallic-colored elytra, Mone has dark elytra; 1

baht/scoop; rainy season; steamed. *Xylotrupes gideon* (Hercules beetle) adult: Malaeng Krarm or Duang Ma Prao; 1 baht/2 adults; end of rainy season; live. Females are preferred because they are not pets, but food.

Xylotrupes gideon has been reported damaging the bark of apple (*Malus pumila*) and oriental pear (*Pyrus lindleyi*) trees in Thailand (**Sirinthip and Black 1987**). Attacks begin with the first rains and continue through August. The Lahu people consider *X. gideon* a delicacy to be eaten with chili sauce, and, as a first step in limiting tree damage, they were encouraged to search their orchards early in the morning for the beetles.

Copris dung beetles are soaked in water for 2-3 hours to clean them, then fried without oil with a little salt or added to other dishes along with June beetles (**Jonjuapsong 1996**). The popular way to prepare June beetles (*Holotrichia* and *Leucophosis*) is to fry them without oil, then remove the wings and eat them with chili paste, or to eat them in bamboo shoot stew ("gaeng noremai") or in stew ("gaeng pa") mixed with red ant eggs.

See **Ministry of Public Health (1987)** in the Introduction and Table 4 for proximate analyses in relation to nutritive requirements of Thai children. See also Bristowe (1932) and Somnasang et al (1985a, 1986) in the Introduction, and Ngamsomsuke et al (1987) under Miscellaneous.

Hemiptera

Belostomatidae (giant water bugs)

Lethocerus (= *Belostoma*) *indicus* Lep. & Serv., adult

Four species of hemipterans were reported by **Bristowe (1932)**, one being the well-known giant water-bug, *Lethocerus* (= *Belostoma*) *indicus* Lep. & Serv., which is about two inches long and preys on large insects, frogs and fish. It is caught in water nets. Bristowe states that, "It is a great delicacy which is shared by Laos and Siamese alike; it reaches the tables of princes in Bangkok." The usual methods of preparing it are described as follows: "1. Steam thoroughly and then soak in shrimp sauce. The insect is then served up and picked to pieces, each piece yielding a little meat from its inner side. The flavour is strong and reminiscent of Gorgonzola cheese. 2. After cooking, pound it up and use it for flavouring sauces or curries. A popular sauce called Namphla is made by mixing shrimps, lime juice, garlic, and pepper and then adding Mang daar [Mang daar nah is the Lao name] to finish up with. Vegetables are dipped into this sauce." The price in Bangkok varies according to season from 5 to 20 satangs each (1d. to 4d.). In the cold season, from December to February, it is unobtainable. Bristowe suggests that, at these prices, it might be worth breeding *Lethocerus*, like *Helicopris*, for the market.

Jolivet (1971) states that the giant waterbug, *Lethocerus indicus*, is made into a much-prized sauce to accompany meat and fish, particularly in the northern region of Chiang Mai. The male *Lethocerus* secretes a fragrant liquid from two abdominal glands, and it is this liquid according to Jolivet that is used to flavor sauces. The males with this penetrating odor sell for 1 baht at the Chiang Mai and Bangkok markets, while the females fetch only 50 satangs. Jolivet gives the details for preparing the sauce, which contains the following ingredients: 1 or 2 male *Lethocerus*, shrimp pasta (10 g), crushed garlic (3-5 g), lemon, soybean or fish sauce, and pepper. Of the flavor, Jolivet says (translation), "Well, let us say that it's not bad, that one gets used to it and that gourmets appreciate it!"

Vara-asavapati et al (1975) mention hemipterans of four families that are used as food. The giant water bug, *Lethocerus* (= *Belostoma*) *indicus* (known as ma-lang-da-na)(Belostomatidae) is consumed in almost all parts of Thailand (p. 19). The bugs are about three inches long, although the males are smaller and have a stronger odor. They live in swamps and rice paddies. Eggs are laid on branches and grass close to the water and are cared for by the mother bug. The authors mention the fierceness of these insects in catching prey, other insects and larger animals such as frogs and prawn. During the rainy season they come out of the water and are attracted to lights, especially to blue neon lights. One method of catching them is to set a blue light in a field and this may yield 200 to 300 bugs per day. Fishing nets are also used to harvest them from swamps and ponds. In the dry season the bugs hide in tree cavities where 10 or more may be collected from a single cavity. There are many methods of preparation including roasting, steaming and grilling and then soaking in fish sauce. Water bug eggs are difficult to find, but if found are eaten raw by some people. The bugs are found widely in the markets during the rainy season, when the price ranges from ½ to 1 baht. They are more expensive in the dry season, costing 2 baht or more. The authors note that artificial water bug flavoring is now produced, but people still prefer to eat the real bugs.

Hirashima et al (1979) describe as follows the marketing of the giant water bug in Bangkok:

Tourists were curious to see the giant water bug, *Lethocerus indicus*, which was displayed for sale at the Sunday market in Bangkok. Shopkeepers display many of bugs, which were boiled

in hot water, in a large bamboo basket, some were beautifully arranged in rows, for sale....We learned that the bugs are consumed in two ways. They are eaten after fried in oil or used as one of seasonings for a sauce which is served for fried fish, especially the catfish. One of us tried this dish at Chiang Mai and he liked it because of a rich taste. Shoppers were used to stick a toothpick, which was served by the shopkeeper, in the abdomen of the bug and then smell it in order to buy a good one. Good one means the bug which has a stronger and better flavor. Usually the male bug is more attractive, but the female bug is also sold. The price was 1 baht for 1 bug in 1973, while it was 5 baht in 1977.

Sungpuag and Puwastien (1983) state that the giant water bug, *Lethocerus indicus* Lep. & Serv., known as mang-da-na, is pounded into paste. See Table 1 for seasonal availability and Tables 2 and 3 for nutrient analyses.

Watanabe and Satrawaha (1984) summarize *Lethocerus indicus*, the giant water bug adult, as follows: Thai name, Malaeng Da Na (Maeng Da Na); very popular food; 3-5 baht per male, 2 baht/female; available most of the year; sold steamed or live. Usually used to flavor Nam Prik Malaeng Da. The mature eggs in the ovary are eaten during the late rainy season.

The 63-page book, Malaeng Daa Naa (Of Edible Insects) by Chaiya Uisoognern, published by the Centre for Agricultural Texts, was reviewed by **Clutterbuck (1992)** who opened by saying, "Blissfully unaware of the revulsion experienced by those from other cultures, Chaiya Uisoognern uses this book to tell us everything we could possibly want to know about Thailand's favourite edible insect [the giant water bug]." Aspects are then discussed pertaining to biology, harvesting, market prices, recipes and other culinary uses. The selling season for *malaeng daa* is usually October-March. Male *malaeng daa* can be sold wholesale for Bt3-5 apiece (25 baht = US \$1), while females fetch only 50-75 satang (1 baht = 100 satang). This is because the male has the distinctive odor.

Clutterbuck continues:

The eggs can be eaten on their own, raw or grilled, the result 'yet another form of deliciousness.' The rather tasteless female is best deep fried in batter and dipped in *nam jim*. Alternately she can be stuffed in pork and fried, or she can make a nice roast *malaeng daa* curry. The male, after a grilling to increase his flavour and removing his wings, is best crushed in a mortar to make *nam phrik* chili sauce. Chaiya recommends adding fish, prawn sauce (*kapi*), the aubergine relative *makheua* or the fermented *plaa raa* for 'tastiness you shouldn't tell anybody' about (*aroi yaa bork khrai*).

Clutterbuck confirms that, as a dip for grilled chicken, *nam phrik malaeng daa* "is indeed tasty and distinctive." He concludes: "For the adventurous, another world of flavour is waiting, once they discard their conditioning, " and offers a final useful hint, "When buying, the best way to sex a *malaeng daa* (and avoid being tricked by market women) is to look for the female's egg-laying apparatus."

Yhoun-aree and Puwastien (1997) mention that giant water bugs "are eaten by people living all over the country." See also Bristowe (1932), Somnasang et al (1984, 1986) and Gorton (1989) in the Introduction, and Ngamsomsuke et al (1987) under Miscellaneous. Jonjuapsong mentions *B. indicus*, but adds nothing new to the above discussion.

Naucoridae (creeping water bugs)

Sphaerodema molestum (author?), adult

Sphaerodema rustica Fabr., adult

Among hemipterans that are eaten are *Sphaerodema rustica* F. and *S. molestum*, two small greenish water-bugs that are common in Thailand (**Bristowe 1932**). The Lao name for both is Mang kharn. Sticks are used to knock them from bushes in which they rest during the day. They are roasted in a dish and eaten with the fingers like shrimps.

Nepidae (water scorpions)

Laccotrephes grisea Guer., adult

Nepa sp., adult

The water scorpion, *Laccotrephes grisea* Guer. (Lao name: Mang dah), is said to have a good flavor after being toasted on a bamboo skewer (**Bristowe 1932**).

A species of water scorpion, *Nepa* sp. (known as ma-lang-see-siad or ma-lang-khan-so) (Nepidae), is reported as food by **Vara-asavapati et al (1975, p. 36)**. It lives in and near ponds, wells and rivers, and although it has fully-developed wings, it flies very little. The bite is painful. It is often included in catches of other aquatic insects and fish and is usually cooked along with other insects collected from water.

Notonectidae (back swimmers)

Notonecta undulata (author?) (?= *Notonita*; ?= *Notonica intermerata*), adult

An aquatic bug that is used as food is the back-swimmer, *Notonita undulata* (known as ma-lang-hua-kwai or muan-won)(Notonectidae)(**Vara-asavapati et al, p. 35**). These are found in ponds, swamps and rivers, and they are attracted to lights during the rainy season and the beginning of the cool season (October-December). They are collected at neon lights at night or with fish nets directly from the water. They are eaten raw, stir-fried or in curry. If enough are collected they are preserved with salt and cooked in sticky rice which is known as "jom." It can be kept for many days, and "jom" made from back-swimmers is as famous as "jom" made from prawn and small fish.

Watanabe and Satrawaha (1984) give the following summary: Notonectidae (swimmer) adult: Malaeng Muan Won or Manghua Qai; 3 baht/small bag or 2 baht/3 small spoonsful (usually, several other aquatic insects such as water boatmen are intermixed); dry season?; live.

See also Somnasang et al (1985a) in the Introduction and Ngamsomsuke et al (1987) under Miscellaneous.

Pentatomidae (stink bugs)

Tesseratoma (= *Teeseratama*) *javanica* Thunb., nymph, adult

Tesseratoma papillosa Drury, adult

Both adults and nymphs of the stink bug, *Tesseratoma javanica* Thumb (known as ma-lang-khang-khiaw or muan-lam-yai) (Pentatomidae) are used as food (**Vara-asavapati et al, p. 50**), despite the presence of the odor gland, the secretion from which can irritate human skin. The bugs are present during March and April when the new leaves are on Longan trees, orange trees and others. Trees with heavy infestations are felled in order to collect the bugs. They are soaked in water for 1-2 hours to rid them of the poisonous secretion and then they are fried before consumption.

See also Ngamsomsuke et al (1987) under Miscellaneous.

Homoptera

Cicadidae (cicadas, psyllids, etc.)

Cosmopsatria sp., adult

Dundulia entemerata Walk. (? = *Dandubia*; ? = *Dundubia*; ? = *Dunduebia intermerata*), adult

Dundubia sp., adult

Magicicada spp., adults

Rihana sp., adult

Annandale (1900, pp. 859-861) reported that the cicada, *Dundubia intemerata*, forms a regular article of diet among the Thai inhabitants of Patalung. He described their capture at the village of Ban Nah as follows:

Immediately after the sun has set several of the natives gathered in an open space, round a fire of brushwood or a number of torches fastened to stakes stuck into the ground, and commenced to clap their hands in unison, observing a regular time and rhythm. Very soon, if they were fortunate, the Cicadae flew out from the undergrowth of the surrounding orchards and jungle, and alighted on the persons of their captors, who had no difficulty in picking off the insects with their fingers and securing them, still alive, in a fold of their draperies. The clapping only continued for about half an hour every evening...The voiceless females [females don't stridulate], as might be expected, were in great preponderance over the males among the specimens taken.

The cicadas were collected in early April, and appeared to Annadale to be very local. According to Annandale, the cicadas have little flavor.

Pendlebury (1923, p. 11; vide Bodenheimer 1951, p. 259) apparently described the collecting of

Dundubia intemerata, similarly to the account given by Annandale. Of the homopteran, *Dundubia intemerata* (Lao name: Tua chuck-a-chun), **Bristowe (1932)** states that it is the only species of cicada that is highly prized by the Laos, but except in southern Thailand it is absent or rare.

Vara-asavapati et al (1975) report (p. 40) three species of cicadas (Homoptera: Cicadidae) that are harvested as food, i.e., *Rihana* sp., *Dundulia* (*Dundubia*?) sp., and *Cosmopsatria* sp. They are searched for during March and April and three methods are used to collect them. The most common practice makes use of a mixture of tree resin with "nam-man-yang" which is called "tang" and is sticky. "Tang" is applied to the end of a small stick attached to a long pole. When a cicada's wing is touched by the sticky point, it cannot fly and is captured and put into a container. A second method is to hunt for cicadas at night. Trees are shaken until the cicadas fall to the ground. They will not fly at night, according to the authors, and a lantern is used to help find them on the ground. Another method involves the use of a fishing net although the authors do not explain how the net is used. After collection the wings are removed and the cicadas used to make a spicy sauce, or they may be fried or deep-fried.

Jonjuapson also mentions collection of cicadas (*Rihana*, *Dundulia* and *Cosmopsatria*) with rubber cement on the end of a short stick, or searching for them with a light at night. If there are cicadas in a tree when a lamp is held under it, a fine mist will fall which villagers call 'cicada piss.' They are easily collected by shaking the tree as they do not try to escape at night. They are eaten fried or pounded and added to mango chili paste.

See also Bristowe (1932) and Somnasang et al (1984, 1985a) in the Introduction, and Ngamsomsuke et al (1987) under Miscellaneous.

Kerridae (lac scales)

Kerria (= *Laccifer*) *lacca* Kerr.

See Ngamsomsuke et al (1987) under Miscellaneous.

Hymenoptera

Anthophoridae (carpenter bees)

Xylocopa confusa Perez, adult

Xylocopa latipes Dr., adult

Bristowe (1932) reports that there are no domesticated bees in Thailand, but a quantity of wild honey and wax appears in the markets. Adults of *Xylocopa confusa* Perez (Lao name: Mang poo) and *X. latipes* Dr. are eaten by first crushing the head, pulling off the head and wings, and eating the underside of the abdomen raw. Both of these species are considered pests, the latter because it bores through the lead encasing cables.

Apidae (honey bees)

Apis dorsata Fabr., larva, pupa

Apis florea Fabr., larva, comb/all stages

Apis indica (author?), larva, pupa

Apis sp., larva, pupa, comb/larva

Both the honey and grubs of *Apis mellifica indica* (Lao name: Mangpeung koh) are eaten (**Bristowe 1932**). Near Hua Hin, the nests, which are made of mud and are about 1 foot in diameter, are taken by smoking the bees with burning coconut fiber. The grubs, honey and wax of a species, probably *Apis dorsata* (Lao name: Mang peung), are collected in the northern forest districts of Thailand. The nests, which are 5-6 feet in diameter, are found high in the branches of *Ficus* trees, and there may be several nests on a single tree. These bees sting severely. The method of collecting, which involves prayers, ceremonies and incantations, is described by Bristowe. Bristowe states regarding the wax of this species: "In the forest it fetches a price of about 1 tical per cattie, but by the time it has passed through the hands of several Chinese middlemen and, as often as not, been adulterated with pumpkin juice and paraffin wax, it costs a purchaser in Bangkok no less than 5 or 6 ticals per cattie (say 7s. 2d. to 8s. 2d. per lb.)." Grubs of an *Apis* species (possibly *indica*) are eaten all over northern Thailand. The Lao name is Mang non when; the Thai name is Mang non won. The nests, as large as a football, are made of mud and cow-dung. The bees are smoked out and the nest knocked down with a long pole. The grubs are picked out and fried or eaten in curry. A favorite dish according to Bristowe: "In coconut milk put onion, pepper, Takrie (a lemon grass, *Cymbogon citratus*) and Bai Makrut leaves (*Citrus hystrix*). Wrap them in linen, steam them, and then add them to rice."

Among Hymenoptera, **Vara-asavapati et al (1975)** mention three species of wild bees (Apidae) which are important honey producers in Thailand (pp. 15-16). They are known as peung and include *Apis dorsata*, a very large bee that builds its hives on large trees and cliffs; *A. indica* which builds hives in cavities in tree trunks; and *A. florea* a smaller species that builds its hives in the woods on small tree branches and bamboo. Honey from *A. dorsata* is the most expensive, but that from *A. florea* is the most commonly found in the markets. Honey is sold the year-round, and is considered "a wonderful medicine and dessert." People like to eat the bee grubs uncooked, but they are also sometimes fried or put into soup.

Hirashima et al (1979) also discuss the sale of honey and bee's wax in Chiang Mai, some of the honey, probably produced by *Apis indica*, being very expensive: "A bottle of honey, about 720 ml, of good quality having beautiful color and good taste, was a little more expensive than a bottle of the same size of Jonnie Walker Red Label, the imported Scotch whiskey which was sold at the department store in Chiang Mai." Honey of ordinary quality was much cheaper, about 70 baht for a 720 ml bottle. Bee's wax sold for 42 baht per 550 grams. Also, *Apis florea* comb was seen on the Sunday market in Bangkok. "It contained many of the larvae and pupae and also a few of adults of *florea* in addition to honey. This is also served for dish."

Apis sp. (honey bee) comb: Pung (Rueng Pung); 5-10 baht/comb, depending on size and maturity of larvae; live (**Watanabe and Satrawaha 1984**).

Yhiong-aree and Puwastien (1997) mention that, as fire and smoke are used to drive away the adult bees during collection of the hive with its honey and bee pupae, the pupae are automatically smoked, precooked and ready to eat following collection, or they can be sold 'ready-to-eat' in markets.

See also Ngamsomsuke et al (1987) under Miscellaneous.

Formicidae (ants)

Crematogaster sp., larva

Oecophylla smaragdina (Fabr.), all stages

Cowan (1865, pp. 159-160) cited earlier references to the consumption of a species of red ant, both adults and their pupae, the pupae being a costly luxury that is brought to the table curried, or rolled in green leaves, mingled with shreds or very fine slices of fat pork.

Bingham (1903, p. 311) mentions that in India, Burma and Thailand, a paste is made of the ant, *Oecophylla smaragdina* F., and eaten as a condiment with curry.

Eggs of the yellow ant, *Oecophylla smaragdina* F. (Lao name: Mottdaang), are eaten by the Thais, while the Laos eat the adult ants as well (**Bristowe 1932**). They are said to have sour taste. This species is abundant. The nest is built in shrubs by binding together a number of leaves, and it may be as large as a football. The ants can bite, so the nest is collected by bringing a jar of water underneath it and pushing it upward until the nest is submerged. The ants from about 20 nests make a meal for a family. According to Bristowe, an undetermined species of ant, brown and medium-sized, is much more popular among the Thais and Laos. The nests are subterranean and as large as a big basket. The ants, their larvae and pupae are pickled in salt water, tamarind juice, ginger, onion, a little sugar and the leaf of Bai Makfut (*Citrus hystrix*). The grubs of a species of *Crematogaster* (called Mott dam) are eaten in curry in the Hua Hin district.

Brygoo (1946), cited by **Bodenheimer (1951, p. 233)** mentions that ant larvae mixed with pork ragout are much appreciated in Thailand.

According to **Vara-asavapati et al (1975)**, people like all stages of the red, or yellow, ant, *Oecophylla smaragdina* (Formicidae), known as mod-dang and khai-mod-dang (p. 21). The eggs, "young ants," and adults are eaten cooked and uncooked. They can be made into salad, fried with eggs, or put into bamboo shoot soup, etc. The worker ants are also consumed by the people who like the sour taste of the formic acid. The workers build the nest in large-leaved trees such as mango by pulling the leaves together and gluing them. Eggs are produced from February to April and villagers sell red ants and their eggs daily during this period. When collected the nest is placed in a bucket of water. The worker ants float while the eggs, "young ants," and adults sink to the bottom. To remove the workers, a piece of cloth to which they adhere is stirred through the water. Nests in high trees are dislodged first, using a long bamboo pole.

Sungpuag and Puwastien (1983) state that the red ant, *Oecophylla smaragdina* Fabr., and the young female, both known as tua-peng, and the red ant's egg known as kai-mod-dang; are in spicy salads boiled, pan-roasted. See Table 1 for seasonal availability and Tables 2 and 3 for nutrient analyses.

The 1984 edition of the "Nutrient Composition Table of Thai Foods" (**Ministry of Public Health 1984**) includes one insect, the red ant, presumably *Oecophylla smaragdina*. The analytical results recorded are as follows, per 100 g of insect: kcal 493, moisture 22%, protein 24.1 g, fat 42.2 g, carbohydrate 4.3 g, fiber 4.6 g, ash 2.8 g, calcium 40 mg, phosphorus 230 mg, iron 10.4 mg, vitamin A 710 I.U., B₁ 0.22 mg, B₂ 1.13 mg, and niacin 5.7 mg.

Oecophylla smaragdina (weaving ant) larva, pupa: Khai Mot Daeng or Mae Peng; 2-5 baht/2 scoops

or 10 baht/one handful (prices depend on quality, being cheaper with a higher proportion of adults); dry season; steamed (**Watanabe and Satrawaha 1984**).

Red ants, *O. smaragdina*, are popularly used to give foods a sour flavor, for example, boiled fish, boiled chicken or shellfish (**Jonjuapsong 1996**). The eggs and larvae are often eaten raw, but sometimes they are cooked and put in Thai salad ("yam"), fried with eggs, put in bamboo shoot stew ("gaeng noremai") or curried fish wrapped in banana leaves ("hore mohk").

See **Ministry of Public Health (1987)** in the Introduction and Table 4 for proximate analyses in relation to nutritive requirements of Thai children. See also Bristowe (1932), Somnasang et al (1986) and Gorton (1989) in the Introduction, Ngamsomsuke et al (1987) under Miscellaneous.

Halictidae (halictids)

Nomia sp., larva, pupa

A *Nomia* species is collected for its grubs as well as for the honey and wax. The Lao name is Mang mim (**Bristowe 1932**).

Vespidae (wasps, hornets)

Eumenes petiolata Fabr., larva

Vespa cincta Fabr., larva, adult

Vespa sp., larva

Two species of wasps are used as food (**Bristowe 1932**). The grubs of the euminid, *Eumenes petiolata* F. are called Mang taan at Hua Hin where they are fried for food. The grubs of the hornet, *Vespa cincta* F. (Lao name: Tua thor), are apparently eaten throughout Thailand, and, at least at Hua Hin, by the Thai as well as the Lao. According to Bristowe, the belief that a few stings may cause death may be authentic (the Laos of northern Thailand say that to be stung by one of these wasps makes one's hair go white). The nests are in hollow trees and the wasps are killed with fire and smoke. Both the grubs and the adults are fried with a little salt, the latter after the legs and head have been removed.

Wasp grubs (Vespidae) are eaten in the same way as bees, being fried, or put in soup or curry, boiled or stir-fried (**Vara-asavapati et al 1975**, p. 24). There are many kinds of wasps, but the kind eaten in the northeast are hive-wasps which are called "toh-loom" (*Vespa* sp.). To find the nests, which are in the ground, the authors say that people wait near ponds, and wasps that come to drink water are followed back to the nest. Smoke is used to deactivate the wasps so that the nest and grubs can be collected.

The main collecting method is using a quick flame to burn down the nest (**Yhoun-aree and Puwastien 1997**). This leaves the wasps half-cooked and ready to eat, or the nests can be sold 'ready-to-eat' in the markets. As wasps are very tasty and considered delicacies, they are expensive to buy in the markets, and "many people are tempted to gather them as an income-generating activity.

See also Bristowe (1932) in the Introduction, and Ngamsomsuke et al (1987) under Miscellaneous.

Isoptera

Rhinotermitidae

Reticulitermes flavipes Kollar, winged adult

Termitidae

Termes flavicole (author?), winged adult

Flying termites, known as Mang mauw, are captured in large numbers when they are attracted to candles surrounded by water during swarming periods (**Bristowe 1932**). They are roasted with salt. This is by no means a bad dish, according to Bristowe, but eaten raw they are insipid. The queen termite is also a delicacy.

In the northeast, termites of the species *Termes flavicole*, known as ma-lang-mao, are collected at the beginning of the rainy season when the swarms of winged individuals emerge to mate (**Vara-asavapati et al 1975**, p. 37). They emerge in the evening and are attracted to lights, especially neon lights. One method of collecting is to place a bucket of water under a light. Another is to place mosquito netting over a termite mound when emergence is expected. The de-winged termites are fried over low heat with a little salt. According to the authors, some people believe that a headache may result if too many are eaten. Termites are sometimes preserved by frying and then drying them in the sun. **Jonjuapsong** adds that the "flavor is nutty and delicious, although some people believe that if you eat too many they can make you groggy."

See also Bristowe (1932) and Somnasang et al (1984, 1986) in the Introduction, and Ngamsomsuke et

al (1987) under Miscellaneous.

Lepidoptera

Bristowe (1932) notes that a number of the larger lepidopterous larvae are eaten, but they have not been reared to determine their identity.

Bombycidae (silkworm moths)

Bombyx mori (Linn.), pupa

Vara-asavapati et al (1975) state that silk worm pupae, *Bombyx mori* (Bombycidae), are a popular food and quite expensive in the markets (p. 23). They are known as dak-dae-mai. They are raised in every province in the Northeast, but especially in Korat, Roi-et, Nakorn Panom and Ubon. Silk worm culture is government-supported. They can be prepared in many ways, one of which is to fry and then grind them. The ground pupae may then be included in soup, curry, or other kinds of food. The authors briefly describe the life cycle and also the early history of silk worm culture.

Sungpuag and Puwastien (1983) state that the silk worm pupa, *Bombyx mori*, known as dak-dae-mai is pounded into paste, pan-roasted. See Table 1 for seasonal availability and Tables 2 and 3 for nutrient analyses. **Watanabe and Satrawaha (1984)** summarize the *Bombyx mori* pupa: Duck Dae Tua Mai; very popular; 5 baht/5 scoops, or 25 baht/kg; available throughout the year; sold steamed.

According to **Jonjuapsong**, the pupae are mixed with salt for use in chili paste for stews and other dishes. They are popular in the northeast and fetch a good price when sold in the market. People in the northeast raise silkworms at home both for consumption and small-scale silk production (**Yhung-aree and Puwastien**). They are very tasty and some households earn part of their living by selling the pupae.

Cossidae (carpenter moths, leopard moths)

Xyleutes leuconotus (author?), larva

Zeuzera coffeae (author?), larva

Kerr (1931, p. 217; vide Bodenheimer 1951, p. 261) reported that the larvae of *Zeuzera coffeae*, the coffee borer, are known as *Duang sano* and are collected for eating. The larvae tunnel in the branches of *Sesbania roxburghii* and various other trees and shrubs and are specially plentiful in the Province of Aynthia. There is some trade in the larvae which are sent down to Bangkok, alive, during September and October. They are prepared for the table by frying.

The Laos apparently extract the boring larvae of *Xyleutes leuconotus* from *Casuarina* trees. **Bristowe (1932)** mentions, "His Serene Highness Prince Sithiporn told me that his cousin, the late King of Siam, was very fond of the caterpillar of *Zeuzera* which the Siamese call Duang and which feeds on *Sesbania aculeata*. The larva is roasted and eaten with salt and rice."

See **Ministry of Public Health (1987)** in the Introduction and Table 4 for proximate analyses in relation to nutritive requirements of Thai children.

Pyralidae (snout and grass moths)

Pyralid sp.

Jordan (1993), in a *Wall Street Journal* article datelined Chiang Mai, describes the Kaithong Restaurant which touts itself as the purveyor of "authentic jungle food." For the famished, there's the house favorite, a "mixed jungle steak" of three meats - cobra, python and croc - with a heap of steaming corkscrew-shaped bamboo worms on the side. The menu also lists mountain frog, ground lizzard and soft-shelled turtle, in curry, stewed in lemon-grass soup or simply fried. "Some days we get so many people, there aren't enough seats," says manager Sayan Uphaphar. "Most are Americans, Europeans, Chinese and Japanese. Only 5% are Thais." The Thais, he said, like their cobra local-style, sizzling with garlic and pepper.

Bamboo caterpillars (scientific name not yet determined) are called *rot duan* in northern Thailand where they are found in large numbers in deep bamboo jungles (**Yhung-aree and Puwastien 1997**). They feed on the inside of the bamboo stem, and stems with caterpillars will have yellow leaves; they also make a characteristic noise which helps hunters know where they are. A bamboo section (internode) may contain a thousand caterpillars. The caterpillars die quickly once the internode is opened, so collectors harvest the entire internode. After the internode is opened, the caterpillars are preserved by boiling them for a short time. The caterpillars are expensive, and many native people gather and sell them as an additional source of income (see also under these authors in the Introduction).

Mantodea

Family uncertain

Hierodula sp.

Tenodera sinensis (author?)

Both eggs and adults of the mantid genus, *Hierodula* (Lao name: Mang naap), of which there are several species in Thailand, are eaten by the Laos at Hua Hin, and probably elsewhere (**Bristowe 1932**).

Vara-asavapati et al (1975) mention the mantid, *Tenodera sinensis*, as a food in northeastern Thailand, where it is known as takka-tan-tam-khao (p. 49). The authors include the Mantidae as a family of Orthoptera and they are apparently prepared and eaten in the same way as described by the authors for grasshoppers. See also Jonjuapsong (1996) in the Introduction.

Odonata

Aeshnidae (darners)

Anax (= *Anaz*) *guttatus* Burm., adult

Aeshnidae spp., nymphs

Libellulidae (common skimmers)

Libellula pulchella Drury (?= *Libella*; ?= *Ubellela*)

Libellulidae spp., nymphs

Macromiidae (belted skimmers, river skimmers)

Macromia sp., nymph

Family uncertain

Epophtholmia vittigera (author?), nymph

Rhyothemis sp., nymph

The dragonfly, *Anax guttatus* Burm. (adults) are eaten in the Ubon district where it is roasted in a dish, and the nymphs of a fat-bodied species are eaten at Hua Hin (**Bristowe 1932**). They are boiled and said to taste like crayfish. Dragonflies do not appear to be taken in other districts. Mang por appears to be a general name for all dragonflies.

Dragonfly nymphs of three species are eaten in northeast Thailand, *Rhyothemis* sp., *Epophtholmia vittigera*, and *Macromia* sp. (**Vara-asavapati et al 1975**, p. 33). They represent three families, the Libellulidae, Coruliidae and Macromiidae. Vara-asavapati et al state that the nymphs known as ma-lang-ngam are about 1.5 cm long and are much smaller than the nymphs known as ma-lang-pong-peng which are about 4 cm long, but the authors do not say which species is known by which name. Both kinds are apparently equally liked as food and both apparently are sold in the markets. The nymphs are harvested by using fishing nets or by draining the water from swamps and ponds if they are not too large. The bodies of water where nymphs are found are in or near wooded areas which are the habitats of the adult dragonflies. They are prepared fried, boiled, stir-fried and as part of salads. The "most famous dish," according to the authors, is spiced nymphs with onion, garlic, lemon grass, basil and fish sauce.

Watanabe and Satrawaha (1984) summarize Aeshnidae and Libellulidae (dragonflies) larvae: Pong Peng and Malaeng Ngum, respectively); only large larvae are sold, 2 baht/scoop or 5 baht/3 scoops; end of rainy season; live.

See also Bristowe (1932) and Somnasang et al (1984, 1985a, 1986) in the Introduction.

Orthoptera

Acrididae (short-horned grasshoppers)

Aelopus tamulus Fabr.

Cyrtacanthacris tatarica (author?), adult

Locusta migratoria Linn.

Locusta sp., adult

Locustra spp.

Oxya japonica japonica (author?)

Patanga succincta

Both Laos and Thais eat grasshoppers and locusts (**Bristowe 1932**). Species include *Patanga*

succincta, *Locusta migratoria* L., and other large short-horned grasshoppers (called Took-ah-tanne by the Laos) which are eaten everywhere in Thailand. A much smaller species, *Aeolopus tamulus* F., is also eaten. They are roasted or toasted and eaten like shrimps.

Vara-asavapati et al (1975) report that orthopterans of three families are eaten, including many species in addition to the three they mention specifically. Among the Acrididae, they mention specifically only *Cyrtacanthacris tatarica*, known as tak-ka-tan (p. 49). They are caught in the hands, or by using a net, or a stick or a piece of cloth. According to the authors they can also be attracted by lights, but this probably refers only to the Tettigoniidae. Before being eaten, the head is removed [and probably also the wings and legs, although not so stated by the authors]. They can then be stir-fried, used in curry as a meat-substitute, or made into a spicy sauce. "Deep-fried, crispy grasshoppers are very well-liked by a lot of people" (translation).

Sungpuag and Puwastien (1983) state that the big locust, *Cyrtacanthacris tatarica*, known as tak-ka-tan-yai, and the small locust, *Oxya japonica japonica* (Thunb.), known as tak-ka-tan-lek, are pounded into paste, pan-roasted, deep-fried. See Table 1 for seasonal availability and Tables 2 and 3 for nutrient analyses.

The November 13, 1983 edition of the National Review, published in Bangkok, described a campaign launched by local officials in which villagers in the Province of Prachinburi collected more than 10 tons of pest grasshoppers for use as food. According to **Saengrungruang (1983)**, the campaign was launched because control efforts had been unsuccessful. The article stated:

Fried and crispy grasshoppers are, according to many people, delicious snacks and many food shops in Prachinburi and other provinces served them for their customers. For beer and whiskey drinkers, fried grasshoppers are marvelous. Grasshoppers have now become one of the exporting items of Prachinburi which has a long list of orders from traders who buy them at six baht a kilo...Grasshoppers have become a favorite dish for many people who said the cooking method is also simple - merely taking out their wings, heads and tails and cleaning them before throwing them into the frying pan.

Locusta sp. (locust) adult: Tukkatan (Tucka Tan); popular food, sometimes mixed with grasshoppers, mantises or green hoppers; 1 baht/scoop or 3 baht/100 grams; rainy season; steamed or sometimes live (**Watanabe and Satrawaha 1984**).

In 1983, Thai farmers began collecting grasshoppers as food as an alternative to government-sponsored insecticide spraying efforts that were ineffective (**Anon. 1992**). Grasshoppers, once the scourge of Thai corn fields have risen in price from 12 US cents per kilogram in 1983 to US \$2.80 per kg in 1992. At local restaurants, once deep fried, they cost about US \$6.00 per kg. A small farmer can earn up to US \$120 per half-acre, twice as much as he can from corn. The trade in grasshoppers now averages about US \$6 million per year. Because of the obvious benefits in containing the grasshopper population, the Thai government has publicized a number of grasshopper recipes.

Jonjuapsong (1996) states that there are many kinds of grasshoppers, large and small, and Thai people from the northeast eat them all. "Grasshoppers are prepared for eating by roasting them over a fire or frying them without oil or adding them to stews or in chili paste. Crispy fried grasshoppers are sold everywhere at a relatively high price."

See **Ministry of Public Health (1987)** in the Introduction and Table 4 for proximate analyses in relation to the nutritive requirements of Thai children. See also Bristowe (1932), Somnasang et al (1984), Gorton (1989) and Yhoun-aree and Puwastien (1997) in the Introduction, and Ngamsomsuke et al (1987) under Miscellaneous.

Blattidae (roaches)

Blatta orientalis Linn., egg, adult

Stylophyga rhombifolia Stoll., egg, adult

Cockroaches, *Blatta orientalis* L. and the apterous *Stylophyga rhombifolia* St., were collected in **Bristowe's** presence at Hua Hin, and Laos in that district and in Korat will eat the roaches, but they are not eaten in other districts. In all districts, however, children collect their eggs for frying.

Choovivathanavanich et al (1970) make no reference to the direct ingestion of cockroaches, but note that cockroaches provoke allergic symptoms in susceptible individuals as a contactant, injectant, inhalant, or ingestant. They describe their skin test results using cockroach extracts from samples blended from several species obtained in allergic patients' dwellings in different locations in Bangkok.

See also Bristowe (1932) in the Introduction.

Gryllidae (crickets)

Brachytrupes (= *Brachytrypes*) *portentosus* Licht., adult

Brachytrupes sp.

Gryllus testaceus Walck.

Liogryllus bimaculatus De Geer (= *Gryllus* ?; = *Acheta bimaculata* ?; = *G. bimaculata* ?; = *G. bimaculata* ?)

Bristowe (1932) states that three species of crickets are among other orthopterans that are eaten: *Gryllus testaceus* Walck. (Lao name: Ching-reep-sigh), *Brachytrupes portentosus* Licht. (Lao name: Ching-reep-ong), and *Liogryllus bimaculatus* De Geer. These crickets are considered to have a rich flavor, but Bristowe found them insipid. After the head is removed, the insects are roasted on sticks over a fire. Thais as well as Laos were observed by Bristowe to eat *Brachytrupes* at Patani and Hua Hin.

According to **Vara-asavapati et al (1975)**, people in the Northeast eat several kinds of crickets (Gryllidae), but the most widely liked is the short-tailed cricket, *Brachytrupes portentosus*, known as jee-pom or jing-kong or jing-reed-hua-to (p. 39). The season for crickets is the middle of the rainy season and the beginning of winter, and between July and December villagers sell short-tailed crickets in the markets. The crickets stay in their tunnels, which are about one foot deep, during the day and come out at night. They feed on young plants and are an agricultural pest. Vara-asavapati et al state that the crickets do not like lights, but that is contrary to reports from elsewhere. Villagers use shovels to dig the crickets from the ground. There is usually one cricket per hole. Children sometimes collect them by pouring water into the holes to force them out or will catch them in traps at night [the traps are not described]. The crickets may be eaten whole or cut into small pieces. They are fried, grilled or put into curry as a substitute for meat. The other species of edible crickets are harvested either by digging or at night at lights.

Hirashima et al (1979) describe how the cricket, *Brachytrupes portentosus* Lichtenstein, is sold in the market at Chiang Mai. The shopkeeper takes the crickets from a plastic bag, in which they are kept alive, and spits them longitudinally from head to abdomen on a bamboo stick, 3 or 4 crickets per stick. They are then fried in oil in front of shoppers. According to the authors, although somewhat lacking in flavor, "It was well edible, having a taste somewhat similar to shrimp."

Sungpuag and Puwastien (1983) state that the short-tail cricket, *Brachytrupes* sp., known as jee-pom, and the cricket, *Gryllus bimaculatus* Degeer, known as jing-riid, are pounded into paste, deep-fried, roasted. See Table 1 for seasonal availability and Tables 2 and 3 for nutrient analyses. *Acheta bimaculata* and *Brachytrupes portentosus* (crickets) adult: Ching Reed (Chi Reed) and Ching Klong or Chi Pom, respectively; 5 baht/25 adults: end of rainy season; steamed (**Watanabe and Satrawaha 1984**).

Jonjuapsong, mentioning *Gryllus bimaculatus* and *Brachytrypes portentosus*, states that crickets are caught by digging around their tunnel entrances to a depth not greater than one foot, driving them out by filling the holes with water, or collecting them as they fly around lights at night. They are barbecued on sticks after the wings are removed and they have been eviscerated. "Fried without oil, crickets also serve as food to be eaten while drinking alcohol."

See also Bristowe (1932), Somnasang et al (1984, 1985a), and Yyoung-aree and Puwastien (1997) in the Introduction, and Ngamsomsuke et al (1987) under Miscellaneous.

Gryllotalpidae (mole crickets)

Gryllotalpa africana Beauv., adult

Bristowe (1932) states that the mole cricket, *Gryllotalpa africana* Beav. (Lao name: Kin-ni; Thai name: Mang-ka-chan), is dug from its burrows by Laos in all districts of Thailand. It occasionally flies into houses at night.

Sungpuag and Puwastien (1983) state that the mole cricket, *Gryllotalpa africana*, known as ma-lang-gra-chawn, is boiled, pan-roasted. See Table 1 for seasonal availability and Tables 2 and 3 for nutrient analyses. **Watanabe and Satrawaha (1984)** summarize the *Gryllotalpa africana* adult as follows: Malaeng Krachorn; 2 baht per shallow scoop (about 5 cm in diameter); rainy season; sold live.

See also Somnasang et al (1984, 1985a) in the Introduction and Ngamsomsuke et al (1987) under Miscellaneous.

Tettigoniidae (long-horned grasshoppers)

Scudderia sp., adult

From among the Tettigoniidae **Vara-asavapati et al (1975, p. 49)** mention *Scudderia* sp., known as tak-ka-tan-nuat-yao. They are caught and prepared similarly to grasshoppers.

Phasmida

Family uncertain

Eurycnema versirubra Serville, frass

Excrement of the giant phasmid, *Eurycnema versirubra* Serville, is used to make a very acceptable and flavorful tea (Jolivet 1971). The phasmid feeds on the guava tree (*Psidium quajava* L.) (the myrtle family) although other host plants may be used in Thailand. The excrement is very fragrant and somewhat resembles the odor of Chinese jasmine tea. After drying, hot water is poured on the excrements. According to Jolivet, the flavor is excellent. It is sold in Chinese stores, especially in the central parts of Thailand.

Miscellaneous

As part of the United Nations-Government of Thailand project, "Integrated Development of the Phu Wiang Watershed," Ngamsomsuke et al (1987) reported on farmers' attitudes toward forest, plantation and conservation farming. The study was based on the assumption that in order to protect the existing forest reserve and improve the living conditions of the rural population, "good mutual understanding between the project and the watershed population is...crucial for sustained success." The watershed is located in the Phu Wiang valley in the Phu Wiang district of Khon Kaen province, about 70 km northwest of Khon Kaen City. The forest still occupies about 63 percent of the watershed and is a source of many natural foods: 49 spp. of wild vegetables, 52 spp. of fruits, 29 spp. of mushrooms, 27 spp. of mammals and birds, and 28 spp. of insects. There are 160 spp. of medicinal plants. It was found that more than 80 percent of households surveyed consume or make other use of these forest products, and cash income from sale of these products accounts for about 10 percent of annual household income. Logging by most people is for home use only, but poorer people, with little or no paddy land, are more likely to be involved in lumbering for cash.

Ngamsomsuke et al summarized farmers' attitudes as follows:

Farmers with less than 3.2 ha of paddy make up 86 percent of those who use the uplands and almost all report the land as their own. The local population feels disadvantaged by the reduced cropping area due to forest plantations. The farmers would rather obtain legal permission to continue cropping cassava inside the forest reserve. They said if such permission could be obtained they would protect the forest, but the researchers did not determine exactly how. Although farmers recognize the environmental benefits of forest cover, they place a higher value on short-term financial benefits, such as from cassava cropping. Problems of erosion and reduced productivity from upland soils are acknowledged by most people, but little action is being undertaken to reverse this trend. If farmers were to plant trees for their own benefit, they would prefer fruit trees. The main benefit they see from the reforestation project is the possibility of employment.

Forest clearing accelerated as cassava became more widely adopted in the mid-1970's, and, as a percentage of total land area declined from 76.5% in 1976 to 68.4% in 1982 and to 62.7% in 1984. Demographic data indicate that population pressure will strongly increase in the next 10 years, with an increase in illegal logging when legal access to the forest is prohibited. More than 60% of the villagers are farmers. Rice production is a major activity, but it is for home consumption, not a source of cash income. Some villages import rice. Major upland crops are cassava and kenaf which are produced for cash income. Vegetables, legumes, and perennial fruit trees are also planted, and short-duration fruit trees such as banana and papaya, and also mung beans are produced as additional cash crops. Poor families, young families, and young members (particularly daughters) of large families are more likely to engage in off-farm employment when opportunities arise.

The investigators noted that, "the villagers did not refer to livestock production as an occupation although they raise poultry for home consumption and sell them when cash is needed in emergency." Cattle are not numerous, but buffalo raising is important for land preparation. Fish and certain other small game animals are of considerable importance in the diet. Relatively little time is spent fishing but fish, crabs, etc. are readily gathered and when there is a surplus, they are sold. Some villagers have recently started fish culture.

With the preceding background on the agriculture, demographics and economy of the Phu Wiang valley, we can now turn to a consideration of the forest as a source of natural foods as reported by Ngamsomsuke et al. They found that, similar to the earlier report by Somnasang et al (1986) in northeastern Thailand, the three main sources of natural foods are paddy fields, forest, and water sources; however,

because of the greater extent of forest cover in Phu Wiang, the forest is of greater importance as a source of natural foods. While villagers do collect natural foods from the paddy fields and water sources more often than from the forest, the amount collected per unit of time from these sources is less than that from the forest.

The total species found by Ngamsomsuke et al to be gathered and percentage of households that gather forest products, including insects, are shown in Thailand Table 5 (see authors' Tables 2.4 and 2.5, pp. 34 and 35), which is condensed from more detailed data presented by the researchers. Relative to their more extensive data on number of species, the authors state:

The number of species sold is usually smaller than those for consumption in all product groups [indicating] that the majority of the types of forest products gathered are consumed in the homes. More valuable things are sold when there is enough of other less valuable products for consumption. The study has not found any single forest product collected solely for commercial purpose nor is there any single household involved in selling purpose only without using the product themselves. In addition, there are only small variations in number of species collected for home consumption among different groups of farmers (including those outside the valley). Comparison between the villagers inside and outside the valley showed the total number of species gathered for sale to be about the same.

Relative to the number of households that participate in gathering forest products (Table 5), Ngamsomsuke et al state: "More than 80 percent of the households in each group on the average are involved in the consumption and use of forest products. There are variations among the product groups due to availability and need, but there is little difference among types of people participating (leaders [village headmen, etc.], non-leaders [ordinary villagers], farm-size [large, medium, small, or very small farms], etc.) in terms of the *number* and *types* of products used." This point is illustrated in Thailand Table 6 (authors' Table 2.5, p. 35) which breaks down the "Insects group" in Table 5. [This doesn't seem to square with the authors' statement (p. 30) that: "Findings showed that a larger percentage of smaller farmers collected forest products for home consumption and sale. This confirms RRA finding that the poorer groups have higher dependency on the forest."]

Ngamsomsuke et al (p. 72) report 28 species of edible insects in the Phu Wiang valley, some of which are reported only by the local name. At least two species are first reports from Thailand: a scale insect, *Laccifer lacca* Kerr, known as krang (Homoptera) and a stink bug, *Tessaratoma papillosa*, known as maeng kaeng (Hemiptera). Because of the species reported by local name and differences in spelling of local names from previous reports in some cases and some variance in taxonomic names used, we duplicate the entire list below:

Coleoptera: June beetle (*Apogonia* spp., maeng ghi-noon; buffalo dung beetle (family Histeridae, maeng gkoot-gchji); rhinoceros beetle (*Oryctes rhinoceros*, maeng karm); metallic woodborer beetle (*Sternocera acquisignata*, maeng tup); true water beetle (*Cybister limbatus*, maeng dtup-dtow).

Hemiptera: giant water bug (*Lethocerus indicus*, maeng dah); back swimmer (*Notonica underata*, maeng hoo-ah-kwooie).

Homoptera: cicada (*Dundubia intermerata*, chjuk-chjan).

Hymenoptera: red ant's egg (kai-mot-daeng, or mot-daeng); bees, wasps (beung or dtaw or dtaen).

Isoptera: winged termite (*Reticulitermes flavipes*, maeng mow); termites (bpluak).

Odonata: dragonfly nymph (maeng ra-ngum).

Orthoptera: a kind of cricket (chji-nai); short tail cricket (*Brachytrupes* spp., chji-bpom); mole cricket (family Tridactylidae, maeng gkra-chorn); locust (*Locustra* spp., dtuk-dtaen).

Order unknown, given only as local names: maeng now-mai, mim, maeng gkawk, maeng e, maeng kow-sarn, maeng chjoo-chjee.

As part of the joint project on "Integrated Development of the Phu Wiang Watershed," aimed at diversifying the rural economy through creation of new sources of income based on sound use of natural resources, **Sterk (1988)** presents a financial analysis of traditional and improved sericulture. Although use of

the byproduct pupae is not mentioned in the report, they of course represent a source of food and animal feed. The author briefly outlines the sericulture production process (pp. 3-8), describes traditional sericulture (pp. 9-14), and modern ways of sericulture (pp. 15-24). Other aspects are addressed in subsequent chapters and appendices. The author states (p. 41) that: "raising the income of poor farmers from 3000 to 4000 baht means little, because they will remain poor farmers, but increasing their incomes substantially - to 15,000 or even 23,000 baht - means development." The report describes and analyzes the requirements for accomplishing this.

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Chapter 24 in, *The Human Use of Insects as a Food Resource: A Bibliographic Account in Progress*, by Gene R. DeFoliart, placed on website, August, 2002.

Items Needing Attention

P. 29. Mungkorndin (1981), copy needed.

P. 29. Nakao (1964), in Japanese, translated copy needed.

