Chapter 4

CENTRAL AMERICA AND CARIBBEAN ISLANDS

Overview

There are few reports of insect consumption by people in the Central American countries. This is surprising in view of the heavy use of edible insects in Mexico to the north and in Colombia to the south. There has been much research in E1 Salvador in recent years, however, on the use of dipterous larvae for recycling animal and other organic wastes into high-protein feed for animals, particularly poultry.

The use of insects as food was apparently widespread in the West Indies prior to the arrival of the Europeans. **Martyr (1612**: 121 f.) stated (vide Bodenheimer 1951: 25) that "in the houses of the inhabitants they found great chests and baskets made of twigs and leaves, which were full of grasshoppers, crickets, crabs, crayfish and snails, together with locusts which destroy the fields of corn, all dried and salted. The Indians explained that they kept these insects to sell to their inland neighbours." **Cowan (1865:** 98) provides a more literal translation of the above by Martyr. Martyr (p. 274; vide Bodenheimer, p. 301) mentioned that "young bees" [presumably larvae and/or pupae] are eaten "raw, roasted and sometimes soaked."

According to **Rouse (1948:** 524), the Arawak, who inhabited the West Indies before the European arrival, occasionally ate insects.

Regional Taxonomic Inventory

Taxa and life stages consumed	Countries
Coleoptera	
Cerambycidae (long-horned beetles)	
Macrodontia cervicornis (Linn.), larva	West Indies, Jamaica
Stenodontes damicornis Linn., larva	West Indies
Curculionidae (weevils, snout beetles)	
Rhynchophorus palmarum (Linn.), larva	West Indies, Barbados, Trinidad
Elateridae (click beetles)	
Pyrophorus sp., adult?	West Indies
Hymenoptera	
Apidae (honey bees)	
Bee brood (larva, pupa)	West Indies
Formicidae (ants)	
Atta cephalotes Linn., winged adults	Honduras, Nicaragua
Atta sp.	Nicaragua
Vespidae (wasps, hornets)	
Polistes spp., pupae	Guatemala
Lepidoptera	
Caterpillars	Central America
Orthoptera	
Acrididae (short-horned grasshoppers)	
Xanthippus (= Oedipoda?) corallipes (Haldeman),	West Indies
Grasshoppers, locusts	West Indies
Gryllidae (crickets)	
Gryllus campestris Mouffet	West Indies, Jamaica

The larva of the cerambycid beetle, *Stenodontes damicornis*, has drawn plaudits from Western observors as well as from local people in the West Indies for its elegant taste, as has the larva of the palm weevil, *Rhynchophorus palmarum* (Curculionidae). For a discussion of the possibility of greater production and marketing of the latter, combined with improved pest and disease control, the reader should consult Chapter 5. Also, Chapter 7 can be consulted for a discussion of the agricultural and ecological importance of the *Atta* (leafcutter) ants.

Protein deficiency is a problem in animal and poultry production in Central America as it is elsewhere in the tropics. Work in El Salvador by Lardé, aimed at alleviating this problem, and simultaneouly, an environmental problem, by using fly larvae to recycle coffee pulp, a noxious waste, has been summarized by DeFoliart (1997) in part as follows:

> Although up to 85% of the pulp is disposed of efficiently, the remainder produces flies and other insects and is thus a sanitation problem during the processing season. To avoid this, the pulp is covered with soil, lime, ash, or coffee shells (another byproduct of processing), or sprayed with insecticides or buried in excavations. The two most promising species are *Ornidia obesa* (Fabr.) [Diptera: Syrphidae] and *Hermetia illucens* (Linn.) [Diptera: Stratiomyidae], but so far, larval yields have been low, mainly because of the formation of anaerobic zones in the pulp beds. Better ventilation of the substrate will be necessary to prevent this problem. According to the author [Lardé], banana wastes are among other residues that might successfully be used for larviculture of these two species.

Coleoptera

Cerambycidae (long-horned beetles)
Macrodontia cervicornis Linn., larva
Stenodontes (= Prionus) damicornis Linn., larva

Sloane (1725, II, pp. 193-194) reported that the "cottontree worm" (*Stenodontes damicornis*) is sought after by both the blacks and Indians in Jamaica. The latter boil them in their soups, pottages, ollios, and pepper-pots and consider them "of admirable taste, like to, but much beyond, marrow." The blacks eat them with bread after slight roasting and consider them delicious. Sloane concluded his discussion of this insect by saying, "If these Worms are roasted on a wooden spit, and basted with Crums of Bread, grated with Salt and Nutmeg, it is a delicate and good Meat."

Bequaert (1921) wrote: "Thus we are informed some planters in the West Indies used to keep negroes whose sole duty it was to go into the woods in quest of the large larvae of [*Stenodontes (= Prionus) damicornis]*, chiefly found in the plum and silk-cotton trees."

Cowan (**1865**: 73) cites Shaw and Merian in writing of *S. damicornis* which is native to South America as well as the West Indies:

> . . . Its larva, a grub about three and a half inches in length, and of the thickness of the little finger, is in great request as an article of food, being considered by epicures as one of the greatest delicacies of the New World. We are informed by authors of the highest respectability, that some people of fortune in the West Indies keep negroes for the sole purpose of going into the woods in quest of these admired larvae, who scoop them out of the trees in which they reside. Dr. Browne, in his History of Jamaica, informs us that they are chiefly found in the plum and silk-cotton trees (*Bombax*). They are commonly called by the name of *Macauco* or *Macokkos*. The mode of dressing them is first to open and wash them, and then carefully broil them over a charcoal fire.

Bodenheimer (p. 301) indicates that *Macrodontia cervicornis*, another cerambycid, occurs in the West Indies although it is more common in South America. Of these cerambycid and *Rhynchophorus* grubs, Bodenheimer says they were "soon adopted as a rare delicacy by the new immigrant Europeans as well as Negroes."

Curculionidae (weevils, snout beetles)
Rhynchophorus (= Calandra) palmarum Linn., larva

Labat (1724: 100 [in French; awaiting translation]; vide Bodenheimer 1951: 302) tried the palmworm (*R. palmarum*, about two inches long and thick as a finger):

> They are placed in a row on a piece of wood and turned over the fire. When they begin to get hot, they are covered with powdered bread crust, some pepper and muscat. If they are boiled, they are served with a few drops of orange or lemon juice. They are good to eat and very delicate, once the natural repugnance at eating worms has been overcome. . . .

Either from hearsay or personal experience, Labat reported that the grubs, when left in the sun, exude an oil which is excellent against cold pains and especially against haemorrhoids.

Regarding the development of *Rhynchophorus palmarum* in palms, and its food quality, **Bodenheimer** (**1951**: 302-303) translated Merian (1771) as follows (this is not a literal translation; Merian's account is edited and shortened):

> The tree grows to the height of a man and is cut off when it begins to be tender, is cooked like cauliflower and tastes better than an artichoke. In the middle of these trees live innumerable quantities of grubs, which at first are as small as a maggot in a nut, but afterwards grow to a very large size, and feed on the marrow of the tree. These grubs are laid on the coals to roast and are considered as a highly agreeable food.

Schomburgk (1848: 646) writes of *Rhynchophorus (= Calandra) palmarum*, known in Barbados as the *grougrou-worm*: "The larva roasted is considered by some of the creoles a great delicacy: it resembles in taste the marrow of beef-bones." The eggs are laid in the trunks of palms, chiefly the maccaw tree (*Acrocomia fusiformis*) which has hence been known as the Grougrou palm.

Provancher (1890) visited several Caribbean islands in 1888 and related the following (as translated by **Starr [1993]**):

> While in Port of Spain, Trinidad in May 1888, we stopped by Laventille [now a poor section of the city] one morning in the company of some Dominican fathers. Laventille is a hill outside of town with a chapel dedicated to the Holy Virgin, to which there are usually weekly pilgrimages. Walking along a street that skirts the hill, we came upon a black man splitting a wooden log with his hatchet, and near him a little girl holding a teacup. 'This man is looking for palm grubs,' one of the fathers told us. 'Let us stop a moment if you would like to see them.' On approaching, we saw that the log was in fact the trunk of a palm, probably a coconut palm. It was about four or five feet long and in an advanced state of decomposition. Every blow of the hatchet exposed seven or eight big, very plump grubs, each about three inches long, which the little girl was eagerly gathering into the cup. These larvae were truly handsome animals, of a lovely yellowish white and with six dainty feet near the front end.
>
> 'And do the black people eat these grubs?' we asked. 'Oh no,' we were told, 'this food is too precious for the poor. They collect them for sale to the English gourmets, who relish them.'
>
> 'What price do they fetch?' 'A small cup such as you see there usually goes for a 'gourde', $1.' We estimated that this trunk would furnish at least two such cups of grubs. These grubs are . . . [the larva of a curculionid beetle, *Calandra palmarum* Fabr.].

Hearn (1923: 36-37)[in what country?] says of the ivory-colored head of the cabbage-palm, or palmiste: "Raw or cooked, it is eaten in a variety of ways,--in salads, stews, fritters, or *akras*. Soon after this compact cylinder of young germinating leaves has been removed, large worms begin to appear in the hollow of the dead tree,--the *vers-palmiste*. You may see these for sale in the market, crawling about in bowls or cans: they are said, when fried alive, to taste like almonds, and are esteemed as a great luxury."

Hearn (p. 377) again refers to the *ver-palmiste*, found in the heads of cabbage-palms, in Martinique: "These worms are sold in the Place du Fort at two sous each: they are spitted and roasted alive, and are said to taste like almonds. I have never tried to find out whether this be fact or fancy: and I am glad to say that few white creoles confess a liking for this barbarous food."

Wolcott, in 1933 (cited by **Ghesquièré 1947**), considering the infatuation of West Indian natives with the larva of *Rhynchophorus*, recommended the methodical raising of them.

Wilson (1963) mentions that it has long been known that *Rhynchophorus palmarum* is considered a delicacy by the South American Indians, and he states: "They were commonly eaten in Trinidad at the beginning of the century and are still looked upon as a succulent dish by some people."

Elateridae (click beetles)
Pyrophorus sp., adult (?)

Gilmore (1950: 418) cites as follows Ignacio de Armas in 1888 that: "The elaterid genus *Pyrophorus* is strongly luminescent and on Hispaniola was caged for lighting houses, tied to the big toe to aid in night hunting, fastened to body ornaments, and even eaten." According to Gilmore, its efficiency in lighting is high but power is low by modern standards.

Tenebrionidae (darkling beetles)

An article titled "Worms: Another Source," accompanied by two photographs, appeared in the September 17, 1987 edition of the El Salvadoran newspaper, El Diario de Hoy. The caption for the largest photo (in color) is:

> Diet of Worms. Worms of the 'Tenebrionidae' variety [larvae of *Tenebrio molitor*], a new source of protein for human and animal consumption. Ingestion of this food, or entomophagy, is common practice in Europe, Asia and America. They're delicious raw, fried or boiled. [Here], Dr. Ricardo Escobar enjoys a fistful of nutritious examples cultivated here.

The caption for the second photo reads: "Eating bugs isn't just for animals. In the National Zoo, animals like birds, amphibians and mammals (especially primates and wild rats) complement their diets with a certain type of worms. However, consumption of these coleopteras can be practiced by humans without risk." The article summarizes the life cycle of *T. molitor* and states that, "The nutritional value of this species comes from its high protein, fat, liquid and vitamin content . . ." The article then lists several orders of insects which serve as human food in various countries.

Hymenoptera

Apidae (honey bees, bumblebees)

Bee brood (see Martyr [1612] in Introduction).

Formicidae (ants)
Atta cephalotes Latreille, winged females

Conzemius (**1932**: 88) studied the Miskito and Sumu Indians, tribes which inhabit the Atlantic side of Honduras and Nicaragua, the Miskito being coastal and the Sumu inland. Together they inhabit most of the region known as the Mosquito Coast. Their food is obtained from agriculture, hunting, fishing and gathering the wild fruits of the forest. They care little for animals of foreign origin nor for eggs of domestic fowl, although Miskito on the edge of the savannah own cattle which they slaughter for meat. Both tribes like honey (all of which is from bees of the family Meloponidae), and the winged females of the leaf-cutter ants, *Atta cephalotes*, known as *wiwi* by the Miskito and as *isdan* by the Sumu. The abdomen is roasted before being eaten.

Bodenheimer (**1951**: 301) makes brief reference to the Rama-Indians of Nicaragua, stating that their food is primarily obtained from primitive agriculture (especially manioc tubers), some fishing, and hunting for tortoises and mammals. Honey is collected from nests of *Melipona* species. "In earlier times," females of an *Atta* ant were collected as food.

Vespidae (wasps, hornets)
Polistes spp., pupae

Lenko and Papavero (**1979**: 173) cited Evans and Eberhard in 1970 that the Chuh Indians, a small group of Mayans in Guatemala collect nests of *Polistes* in order to eat the pupae. These Indians believe that the eyes of the pupae (black colored) give great reproductive powers, allowing them to have children with big eyes.

Lepidoptera

A caterpillar called *maquara*, which is found in a certain aquatic reed and measures 8-10 cm in length, is "joyously" collected by the Mundracos (Daguin 1900, cited by **Bodenheimer 1951**: 307). Although "excellent" of flavor, "intoxication" results unless the head is removed before the larva is ingested.

Gilmore (1950: 418), though not specific, indicates that large lepidopterous larvae may be used as food in

Central America.

Orthoptera

Acrididae (short-horned grasshoppers)
Oedipoda corallipes Haldeman [*Xanthippus* = *Oedipoda*?]

Pinkerton (1808-14, II, p. 525; vide Bodenheimer 1951: 301) referred to an earlier report that a grasshopper, *Oedipoda corallipes*, is consumed in great quantities in the West Indies.
See also Martyr (1612) in Introduction.

Gryllidae (crickets)
Gryllus campestris Mouffet

Sloane (1725: 204) identified as *Gryllus campestris* the cricket reported earlier from Jamaica by Lopez de Gomara as "found in baskets amongst the other provisions of the Indians."
See also Martyr (1612) in Introduction.

Insects as Animal Feed

Bankiva (**1904**), in El Salvador, notes that there has been much talk in the past few years of establishing "wormeries" as a source of animal protein for laying hens and young chickens. He concludes for several reasons that it is very inefficient to feed meat, grain and flour to fly larvae which in turn are fed to poultry and he states that it has not worked out in practice. He suggests instead that (translation):

> There is only one method of procuring worms with which to feed our poultry: it is the most natural, the simplest and the most economical . . . If we find, near a large population of animals, a well-kept garden fertilized with chicken manure . . . let our birds run through it at dawn, before the sun is out if possible, they will find a large quantity of insects that will form an important part of their diet. One can also get this class of feed by having the children spend 6 hours a day looking for snails and other types of insects in neighbors' gardens. You can pay for this work with eggs, resulting in an insignificant price.

Bankiva continues:

> If the poultry farmer can create permanent meadows of a size in proportion to the number of birds, this is also a good method for insects, because in these meadows live a prodigious quantity of larvae and insects of all types that are not seen at first glance but that can easily be found by the birds. The cultivation of potatoes to feed chickens and other birds, if done under the proper conditions, can be highly advantageous . . . The conclusion is that to raise chickens on a grand scale it is best to have a lot of animals, especially horses, who will provide enough manure to produce plenty of insects.

Lardé (1984) conducted the first in a series of studies on the use of fly larvae to recycle coffee pulp, which is a noxious waste product with an offensive odor from October to January in El Salvador. Although up to 85% of the pulp is disposed of efficiently, the remainder produces flies and other insects and is thus a sanitation problem during the processing season. To avoid this, the pulp is covered with soil, lime, ash, or coffee shells (another byproduct of processing), or sprayed with insecticides, or buried in excavations. The author cites an earlier study in which 929 insects were found in a liter of pulp.

Lardé reports that the dominant species found in the exposed experimental coffee beds was the large green fly, *Ornidia obesa* (Fabr.) (Syrphidae). The first pupae were observed after 24 days while the maximum larval population occurred on the 31st day. The total live weight was slightly more than 1.6% of the initial wet weight of the coffee pulp. The mean length and live weight of larvae was 20 mm and 247 mg, respectively, that of pupae 12 mm and 205 mg, respectively, making them similar in size to the soldier fly, *Hermetia illucens*, and much larger than the house fly, *Musca domestica*. Larvae moved to whole pulp leaves prior to pupation making manual collection of either life stage difficult, and suggesting the need to homogenize the pulp. Because of the shorter time to harvest size and crude protein content (44.1% dry weight basis) equivalent to that of pupae, the larvae are considered the more practical for harvest. The larvae also contained 4.8% water, 12.1% ash (2.5% calcium), and 30% ether extract. Other mineral values are given in a table. As the pulp material became

biologically stabilized over a 50-day period, the proportion of N and the majority of minerals increased as would be expected. The author considers *O. obesa* of interest as an animal feed because of its high protein content.

Lardé (1986) reports that two species of Diptera which live in coffee pulp, *Ornidia obesa* and *Hermetia illucens* (Linn.) (Stratiomyidae), would be suitable for larviculture as animal feed. *O. obesa* is found more frequently in the main coffee-growing area of El Salvador. Interestingly, chickens have been observed eating larvae from channels used to retain coffee water residues. To study these two species, a tile and cement bed has been constructed and covered with bamboo and plastic screen to protect the larvae from their natural enemies. Other residues that could be used for larviculture are banana wastes, animal feces, solids from water residues from sugar plants, and domestic trash. Lardé cites five potential advantages of larviculture: 1) Uses *local* biological resources; 2) Recycles agroindustrial residues such as coffee pulp which are wastes; 3) Stabilizes and concentrates nutrients in these organic residues, increasing their value as fertilizer; 4) Controls domestic flies produced in the residues, which otherwise must be treated with insecticides, rendering the residue unusable for other purposes; and 5) Produces an alternative source of protein for animal feed. Biological studies on the flies will be necessary, however, to develop feasible systems.

Lardé's thesis of using larvae for recycling appears particularly valid for a substance such as coffee pulp which extensive studies have shown to contain "antiphysiological compounds" which limit its utilization as feed for livestock. Other possiblities for larval recycling include *Ptecticus nigrifrons* Enderlein (Diptera: Stratiomyidae), a species similar to *H. illucens*, which has been found developing in domestic wastes (fruit and vegetable peels) in El Salvador, and *H. illucens* which, according to the author, has been considered as a recycler of banana wastes in Panama.

In a third paper, **Lardé (1987)** confirms much of the information in the preceding papers and adds details regarding cost of constructing the beds for larviculture in coffee pulp and additional biological details. In addition to *Ornidia obesa* and *Hermetia illucens*, other species found in coffee wastes are the dipteran larvae, *Musca domestica* (Muscidae), *Copostylum* sp. (group *"lanei"*) (Syrphidae), *Copostylum* sp. (group *"trivittatum"*), and an unidentified adult coleopteran (Staphylinidae). Lardé notes that adult *O. obesa* are commonly seen flying over trash accumulations in public markets and in the streets, as well as over the crusts formed on residual coffee water. Relative to larviculture, the size of *O. obesa* and *H. illucens* larvae relative to that of *M. domestlca* is again emphasized, i.e., 247 mg, 204 mg, and 11 mg, respectively, on a dry weight basis. The author cites unpublished data (from H.A. Lemus Castro, 1985) estimating that 1,800 *M. domestica* larvae are produced per 454 g of fresh coffee pulp. Another unpublished study in El Salvador (by J.F. Godinez, 1986) is cited in which pig manure is placed in a special basket above fish ponds; larvae, mainly *M. domestica*, are eaten by the fish when they fall into the water. Finally, Lardé notes that the coffee pulp substrate becomes less capable of supporting larvae as time passes, becoming stabilized after about 48 days, at which time N and mineral elements are greatly concentrated (data tabularized by the author).

Lardé (1989) studied factors affecting the practical mass-production and harvest of fly larvae (as a protein source for domestic animals) developing in an open coffee-pulp (CP) bed, contained in a rectangular concrete tank 2.67 m long, 1.0 m wide and 0.51 m deep. The depth of the CP bed varied from 20 to 50 cm during the larval observation period of approximately 120 days. One-day-old CP was added periodically in amounts ranging from 4-13 kg wet matter per loading, the total weight loaded being 44.8 kg. Inoculation of eggs was by wild flies of the species, *Ornidia obesa* (green hover fly), *Hermetia illucens* (soldier fly) and *Musca domestica* (house fly). Larvae migrating out of the tank dropped into a water-filled pit from which they were collected for weighing.

An undesirable feature was the formation of an anaerobic zone that constituted 49% of the total volume of the CP bed. Larvae developed only in the aerobic zones extending about 12 cm deep from the top of the bed and 8 cm inward from the tank walls. Young fly larvae of all three species were found in the bed within the first week after initial loading. Larvae of *M. domestica*, which has the shortest life cycle, were pupating within a few days after the initial loading, and 815 larvae of this species migrated out of the bed on day 9. Heavy migrations from the bed occurred on days 36 and 50 after initial loading as the result of a heavy addition of coffee-pulp the preceding day in each case. These migrations presumably were caused by increased temperatures resulting from the heat generated by the rapid aerobic fermentation of the large volumes of substrate added. Such migrations did not occur when smaller lots of CP were added. The only rain, on day 82, also initiated a major migration. Turning of the CP, beginning on day 90, was expected to increase migrations, but that did not happen, probably because of the smaller numbers of larvae in the bed at that time.

Larvae of *O. obesa* and *H. illucens* were found to tolerate temperatures from 22.5°C to 35°C in the medium and the latter was found in zones up to 40°C. *O. obesa* larvae were more migratory than *H. illucens* larvae, and this clearly contributed to the greater weight of the former that migrated out of the bed (ll.8 kg wet matter or 0.3 kg wet matter kg^{-1} wet matter total CP loaded, compared to 2.2 kg and 0.05 kg, respectively, for *H. illucens*. The author recommends emphasis on harvest of these two species because the larvae are about 20 times heavier than *M. domestica* larvae. Some larvae of at least two of the species, *H. illucens* and *M. domestica*, were

lost because of pupation within the medium, but there was apparently no attempt to determine the proportions lost in this manner.

The author states that under the management conditions of the experiment, it would not be possible to achieve a constant daily level of larval production. A mass recovery can probably be accomplished, however, within 3-5 weeks after the initial loading by flooding the bed or by heat. Also, a better ventilation of the substrate is needed to prevent formation of anaerobic zones. Data on minerals analyses of one-day-old CP and at 104 days and 145 days after initial loading are presented in tabular form.

Lardé (1990) reports a small-scale experiment to obtain preliminary data on digestion of coffee pulp by larvae of *Hermetia illucens* (Linn.). After 13 days the coffee pulp was converted into a slurry-like material and lost 29.8% of the initial dry matter, the pH increased from 7.6 to 8.85, the odor was reduced significantly, and the total weight of larvae was 6.2 times that at the beginning. It was concluded that *H. illucens* larvae could be used in recycling coffee pulp under controlled conditions. The gain in weight as related to the initial dry matter was low, as shown in tabularized data. Lardé notes that low yields were also the result in an earlier test under more practical conditions because of difficulties in separating larvae from substrate (Lardé 1989), and he cautions that this should be taken into account if the use of larvae as feedstuff is to be considered.

References Cited (An * denotes reference not seen in the original)

Bankiva, G. 1904. Los insectos en la alimentacion de las gallinas. *Bol. Agricultura* (El Salvador) 4(11): 363-366. (See under insects as animal feed, El Salvador)

Bequaert, J. 1921. Insects as food. How they have augmented the food supply of mankind in early and recent times. *J. Am. Mus. Nat. Hist.* 21: 191-200. (Cerambycidae, W. Indies)

Bodenheimer, F.S. 1951. Insects as Human Food. The Hague: W. Junk, 352 pp. (Cerambycidae and Curculionidae, W. Indies; Formicidae, Nicaragua; Lepidoptera, C. America)

Conzemius, E. 1932. Ethnographical survey of the Miskito and Sumu Indians of Honduras and Nicaragua. Smithson. Inst. Bur. Am. Ethnol. Bull. 106. Washington DC: U.S. Govt. Print. Off. (Formicidae, Honduras and Nicaragua)

Cowan, F. 1865. Curious facts in the history of insects; including spiders and scorpions. Philadephia: Lippincott, 396 pp. (Overview, Cerambycidae, W. Indies)

DeFoliart, G.R. 1997. An overview of the role of edible insects in preserving biodiversity. *Ecol. Food Nutr.* 36: 109-132. (Overview)

Ghesquièré, J. 1947. Les insectes palmicoles comestibles. In: Les Insectes des Palmiers, P. Lepesme, pp. 791-793. Paris: Lechevalier. (Curculionidae, W. Indies, source of a reference)

Gilmore, R.M. 1950. Fauna and ethnozoology of South America. In: Handbook of South American Indians, J.H. Steward, ed., 6: 345-464. U.S. Smithson. Inst. Bull. 143. (Elateridae, Hispaniola; Lepidoptera, C. America)

Hearn, L. 1923. Two Years in the French West Indies. New York: Harper & Bros. Publishers, pp. 36-37, 377. (Curculionidae, W. Indies)

Labat, J.B. 1724. Nouveau Voyage aux Isles de l'Amerique. I. Paris. [Awaiting translation from the French.] (Curculionidae, W. Indies)

Lardé, G. 1984. Conversion de la pulpa de cafe a proteina de larvas y pupas. In: Congreso Nacional de Ingenieria "Ingenieria... Fuerzo de Progresso," San Salvador 1: 63-79. (Insects as animal feed, El Salvador)

Lardé, G. 1986. Larvicultura, cultivos alimenticios y produccion animal. In: CENTA Ann. Progr. Coop. CentroAmer. para mejoramiento cult. aliment. 19: 1-8. (Insects as animal feed, El Salvador)

Lardé, G. 1987. Crianza de larvas en lechos de pulpa de cafe. In: Utilizacion integral de los subproductos del cafe (C. Porres et al, Eds.), Memoria del Tercer Simposio Internacional Guatemala, 16 a 18 de Febrero, pp. 29-36. (Insects as animal feed, El Salvador)

Lardé, G. 1989. Investigation on some factors affecting larval growth in a coffee-pulp bed. *Biol. Wastes* 30: 11-19. (Insects as animal feed, El Salvador)

Lardé, G. 1990. Recycling of coffee pulp by *Hermetia illucens* (Diptera: Stratiomyidae) larvae. *Biol. Wastes* 33: 307-310. (Insects as animal feed, El Salvador)

Lenko, K.; Papavero, N. 1979. Insetos no Folclore. Sao Paulo: Conselho Estadual de Artes e Ciencias Humanas, p. 173. (Vespidae, Guatemala)

Martyr, P. 1612. De Novo Orbe; or, The History of the West Indies.* (Translation by Eden and Lok, London.) (Overview)

Pinkerton, J. 1808-1814. General Collection of Voyages and Travels in all parts of the World. Vol. II (of 17). London.* (Acrididae, W. Indies)

Provancher, L. 1890. Des insectes comme aliment. *Naturaliste Canadien* 20: 114-127. (Curculionidae, Trinidad)

Rouse, I. 1948. The Arawak. In: Handbook of South American Indians, J.H. Steward, ed., 4: 507-546. New York: Cooper Square Publ., Inc. (Overview)

Schomburgk, R.H. 1848. The History of Barbados, p. 646. London: Longman et al. (Curculionidae, Barbados)

Sloane, H. 1725. A Voyage to the Islands of Madeira, Barbados, Nieves, St. Christophers, and Jamaica; with the Natual History... [of Jamaica]. Vol. II. London. (Cerambycidae, Gryllidae, Jamaica)

Starr, C.K. 1993. Eating palm-weevil larvae in Trinidad (an extract from Leon Provancher). *Food Insects Newslet.* 6(2): 3. (Curculionidae, Trinidad)

Wilson, M.E. 1963. Investigations into the development of the palm weevil *Rhynchophorus palmarum* (L.). *Ann. Entomol. Soc. Am. Trop. Aqric.* 40: 185-196. (Curculionidae, Trinidad)

Chapter 4 of The Human Use of Insects as a Food Resource: A Bibliographic Account in Progress, by Gene R. De Foliart, posted on website July, 2002.

Items Needing Attention

Pp. 3, 10. Labat (1724, p.100) awaiting translation
Pp. 4, 10. Hearn (1923), in what country?