Chapter 5

SOUTH AMERICA: OVERVIEW

At least 65 species of insects belonging to at least 38 genera, 26 families and 10 orders have been reported as human food in South America, as shown in the Regional Taxonomic Inventory below. Unfortunately, the specific taxonomic identity is known for only 43 of the species. The generic identity is known for another 14, only the family identity for another 6 and only the order for 2 species. For a number of reasons, including those discussed in Chapter 1, the number of species actually used is greatly under-reported. For example, Clastres stated that in Paraguay, the Guayaki eat the brood (larvae/pupae) of eight kinds of wasps, but Clastres provided the taxonomic identity for none of them. Similarly, Chagnon mentions that species of caterpillars are among the insect foods of the Yanomamo (Brazil/Venezuela) but gives no clue to their identity. In Colombia, Dufour found that informants could name many more edible insect species than were actually observed during her study. Informants could readily name 8 kinds of edible wasps and 10 kinds of edible ants, while only 3 species of each were observed during the study. Also, several kinds of caterpillars purportedly used were not observed by Dufour.

Regional Taxonomic Inventory (as of about 1996)

Taxa and stages consumed	Countries
COLEOPTERA	
Beetles/beetle grubs	Pan-regional
Bruchidae (seed beetles)	
Caryobruchus sp. (*scheelaea* Bridwell?), larva	Colombia
Bruchid (?) larvae	Brazil, Venezuela
Buprestidae (metallic woodborers)	
Euchroma gigantea Linnaeus, larva, adult	Colombia
Cerambycidae (long-horned beetles)	
Acrocinus longimanus (Linn.), larva	Colombia
Macrodontia cervicornis (Linn.), larva	Brazil, Guyana, Paraguay
Stenodontes damicornis Linn., larva	Brazil, Guyana
Curculionidae (weevils, snout beetles)	
Anthonomus spp., adults	Colombia
Rhynchophorus palmarum (Linn.), larva	Pan-regional
Elmidae (riffle beetles)	
Austrelmis chilensis (Germain), adult	Chile, Peru?
Austrelmis condimentarius (Philippi), adult	Peru, Chile?
Passalidae (bess beetles)	
Passalus interruptus Linn., larva	Suriname
Passalid beetles, larvae, adult	Colombia, Paraguay
Scarabaeidae (scarab beetles)	
Ancognatha sp., larva	Colombia
Megaceras crassum (author?), adult	Colombia
Megasoma hector Gory, larva	Brazil
Podischnus agenor Olivier, larva, adult	Colombia
June beetles, chafers, adults	Brazil, Ecuador
Family uncertain	
Lamia tribulus Fabr., larva	South America

DIPTERA

Aquatic larva	Bolivia
Simuliidae (black flies)	
Simulium rubrithorax Lutz, larva	Brazil
Stratiomyidae (soldier flies)	
Chrysochlorina spp., larvae	Colombia

HEMIPTERA

Stink bug adult	Ecuador

HOMOPTERA

Membracidae (treehoppers)	
Umbonia spinosa (Fabricius), adult	Brazil

HYMENOPTERA

Apidae (Meliponinae (stingless bees)	
Oxytrigona spp. (3), larvae, pupae	Brazil
Oxytrigona tataira (author?), larva, pupa	Brazil
Scaptotrigona nigro hirta Moure Ms, larva, pupa	Brazil
Tetragonisca a. angustula (Latreille), larva, pupa	Brazil
Trigona chanchamayoensis Schwarz, larva, pupa	Brazil
Trigona clavipes (author?), larva	Colombia
Trigona spinnipes (Fabr.), larva, pupa	Brazil
Trigona trinidadensis (author?), larva	Colombia
Bee brood	Nearly pan-regional
Formicidae (ants)	
Atta cephalotes Linn., alate female, soldier	Brazil, Colombia, Guyana
Atta laevigata Smith, alate female, soldier	Colombia
Atta sexdens Linn., alate female, soldier	Brazil, Colombia
Myrmecocystus spp., adults	South America
Ants, mainly leafcutter adult sexuals	Nearly pan-regional
Vespidae (wasps, hornets)	
Apoica thoracica du Buysson, pupa	Colombia
Mischocyttarus spp., (stage?)	Colombia
Polistes canadensis erythrocephalus Latreille, larva	Colombia
Polistes pacificus Fabr. (= *pacificus modestus* Smith), larva	Colombia
Polistes versicolor (Olivier) ssp., larva	Colombia
Polybia ignobilis (Haliday), larva	Colombia
Polybia rejecta (Fabr.), pupa	Colombia
Agelaia (= *Stelopolybia*) *angulata* (Fabr.), pupa	Colombia
Wasp brood	Brazil, Paraguay, Venezuela

ISOPTERA

Termites	Nearly pan-regional
Termitidae	
Cornitermes sp., winged adult, soldier, queen	Brazil

Macrotermes sp., soldier	Colombia
Syntermes parallelus (author?), soldier, alate female	Colombia
Syntermes snyderi (author?), soldier, alate female	Colombia
Termes flavicolle Perty, adult	Brazil
Termes destructor (Fabr.)	Guyana

LEPIDOPTERA

Caterpillars	Nearly pan-regional
Hepialidae (ghost moths, swifts)	
Species on bamboo, larva	Brazil
Hesperiidae (skippers)	
Genus?, larva	Colombia
Lacosomidae (sack-bearers)	
Genus?, larva	Colombia
Noctuidae (noctuids)	
Mocis repanda Fabr., larva	Colombia
Spodoptera frugiperda (J.E. Smith), larva	Colombia
Noctuid 1arvae (genera unknown)	Colombia, Venezuela
Notodontidae (prominents)	
Genus?, larva	Colombia
Saturniidae (giant silkworm moths)	
Genus?, larva	Colombia
Sphingidae (hawk-moths)	
Hawk-moth caterpillar	Guyana

NEUROPTERA

Corydalidae (dobsonflies, fishflies)	
Corydalus spp., larvae, adults	Colombia

ORTHOPTERA

Acrididae (short-horned grasshoppers)	
Aidemona azteca Saussure, nymph, adult	Colombia
Orphulella spp., nymphs, adults	Colombia
Osmilia flavolineata DeGeer	Colombia
Osmilia spp., nymphs, adults	Colombia
Schistocerca americana cancellata (Serville)	South America
Schistocerca americana paranensis (Burmeister)	South America
Schistocerca spp., nymphs, adults	Colombia
Grasshoppers, locusts	Brazil, Chile
Romaleidae (lubber grasshoppers)	
Tropidacris c. cristata (Linn.)(= *latreillei* (Perty)), nymph, adult	Colombia
Tettigoniidae (katydids, long-horned grasshoppers)	
Conocephalus angustifrons (Redt), nymph, adult	Colombia

TRICHOPTERA

Hydropsychidae (net-spinning caddiceflies)	
Leptonema spp., larvae	Colombia

Dufour cited several factors that help explain the discrepancy between numbers of species observed and the numbers enumerated by informants. Data were recorded only on insect collections brought back to the village, so insects typically consumed (usually raw) as they were collected in the fields or forests were under-recorded; especially prized foods such as palm weevil (*Rhynchophorus*) larvae were often successfully hidden from investigators; the limited duration of data gathering did not adequately sample seasonal differences in insect consumption; and some insects were probably missed that are harvested only opportunistically or only under certain social circumstances or outside the usual resource area exploited for insects. Posey (Brazil) also stresses the point that insects and other gathered foods are often eaten on the spot by Amerind groups, and "the importance of such foods may be grossly underestimated" unless researchers constantly follow and record data on the routine and continuous gathering activity.

The observations by Posey, Dufour and others suggest that a higher proportion of insects are consumed at the time of collection, fresh and uncooked, in South America than in Africa or Asia. In general, based on studies in Brazil (Lizot), Colombia (Ruddle, Dufour), Paraguay (Hurtado et al) and Peru (Denevan), women and children spend more time than men in foraging for insects. Insects also comprise a higher proportion of the diet of women and children than of men. Men are more likely to engage in the heavier work of insect collection such as felling trees to obtain honey and bee or wasp brood, or splitting logs for harvest of *Rhynchophorus* (palm weevil) larvae.

Numerous references provide ample evidence that many of the insects were (and are) considered great delicacies by indigenous populations. Roasting is the usual method of cooking. According to Ruddle, the Yukpa of Colombia prefer certain insect foods to fresh meat. The Yukpa are discriminating in their insect choices, however; although dobsonfly (*Corydalus*) adults are abundant, weak fliers and easily caught, they are only infrequently used as food. Leafcutter ants (*Atta*), palm weevil larvae (*Rhynchophorus*) and bee and wasp brood (Apidae and Vespidae) are among the insects that are most notable for their flavor and quality, not only among indigenous populations, but among Europeans and other Westerners who have sampled them. Contesti calls the leafcutter ants, which are known as *hormigas culonas* or big-bottomed ants, a national delicacy, equivalent in price and gastronomic value with Russian caviar or French truffles, and states that the toasted ants constitute the highest attainment of Colombian cookery. For a sampling of descriptions of how indigenes relish some of their insect foods, see Chagnon in Brazil (honey and bee brood); Dufour, Ruddle in Colombia (several species); Schomburgk in Guyana (leafcutter ants); Clastre, Homer and Vellard in Paraguay (palm weevil larvae); Bodenheimer in Peru (caterpillar); and Spruce in Venezuela (caterpillar). For a sampling of personal assessments of flavor and quality by Westerners, see McGovern, Noice and Rolfs in Brazil (leafcutter ants); Bancroft in Guyana (palm weevil larvae); Merian, Stedman in Suriname (palm weevil larvae); and Southey in Venezuela (palm weevil larvae).

Hugh-Jones reported that, for the Barasana of Colombia, a considerable portion of the diet comes from insects, while Milton (Brazil) and Dufour (Colombia) found that insect consumption is somewhat influenced by availability of fish and game. Milton considers insect foods to be particularly important to the Maku from July to September when game animals are hardest to find, but insects were collected even when fish and game were plentiful, and the fresh weight of insects collected exceeded that of both birds and reptiles. Dufour found inclusion of insects in the diet of Tukanoans to be frequent and inversely related to the consumption of fish and game. Although fish was by far the most frequently consumed animal food, appearing in 88% of the diet records of males and 78% of those of females, insects were second, appearing in 26% of the diet records of males and 32% of those of females. Fish also contributed most of the animal protein in the diet, but insects contributed 12% in men's diets and 26% in women's diets during the May-June study period. Dufour estimated that, over the entire year, insects probably contributed 5-7% of all the animal protein consumed. Dufour also notes that the amino acid composition of insects is complementary to that in the dietary staple, cassava, which is deficient in lysine and threonine. The most important insects in the Tukanoan diet were those which formed large, predictable aggregations in nature.

While insects are of recognized nutritional importance in South America, and many are held in high esteem as food, there is much less information available on their marketing and economic impact. It is well-known that roasted *Atta* ants are sold like popcorn in the movie theaters of Bogota, Colombia, and Bodenheimer stated that the ants are a "national dish" all over the Andean region. Contesti states that a campesino in Colombia, by collecting and selling *Atta* ants, can earn during the three-month season the equivalent of a year of day wages. A pound of ants sells for about US $20, the equivalent of six days of work at the minimum wage. In addition to local use, some are exported to Japan.

Other references to selling are few and some of them are old. Sampaio (1894, vide Lenko and Papavaro (1979)), in Brazil, mentioned that Ica ants go to the markets and although formerly cheap are now expensive. Stedman reported in 1796 that the palm weevil larva was regularly sold at Paramaribo, Suriname, and Philippi in 1864, speaking of riffle beetles (Elmidae) which are used as a food seasoning and known as *chiche* in Peru, stated that "their commercial value is not inconsiderable." More recently in Peru (1987), da Silva mentions "large, oily caterpillars" being sold on small plates in the market at Iquitos. Also in 1987, Herman reported from Ecuador that adult June beetles known as *catzos* are caught by the indigenous near Zuleta and transported live to Quito where they are sold as a delicacy for high prices in the market. From these scant records, it seems probable that fewer insects are sold in the village and urban markets of South America than in those of Africa and Asia.

Of the edible insects in South America, the palm weevil, *Rhynchophorus palmarum*, would appear to have the greatest mass-production and marketing potential. This insect has long been "semi-cultivated" by indigenous populations in Brazil (Chagnon), Colombia (Beckerman, Dufour), Paraguay (Clastres), and probably other countries. Harvest procedures vary slightly from one region to another, but, basically, palms are cut down and the logs left lying in the forest with the expectation that larvae will be ready to harvest from the decaying pith 2-3 months later. The 'heart of palm' is also an important food in many areas and is harvested at the same time the tree is felled. The Guayaki of Paraguay consider the felled trees to be private property with each man the owner of his larvae bed, and although the Guayaki are a nomadic people, they return to the cultivation area every 2-3 months to harvest the crop of larvae. As mentioned above, the flavor of palm larvae has been almost as universally admired by Westerners as by indigenous people, and not only in South America but throughout the Caribbean. Smeathman (1781), for example, wrote that the palm worm is "served up at all of the luxurious tables of West Indian epicures, particularly of the French, as the greatest dainty of the Western world."

There is another dimension to *R. palmarum.* It is a destructive pest of palms, mining the trunks of the trees and sometimes killing them. It also transmits the nematode, *Rhadinaphelenchus cocophilus*, the causal agent of red-ring disease (RRD) which may also kill the trees. Both insecticides and cultural control methods such as elimination of breeding sites by restricting physical injury to palms, control of *Oryctes* beetles, destruction of infested plants, and trapping the adult beetles, are used in efforts to control the insect. Morin et al (1986) described cultural procedures that have been used successfully in Para and Bahia, Brazil. As adult beetles are attracted for feeding and reproduction to the odor of fermentation emanating from wounds in healthy palms or from the decay of dead or diseased palms, all injured or decaying trees are removed and traps are constructed along the edge of a plantation from cut pieces of thinning, wild palms or uninfested parts of damaged or diseased trees. Trap heaps are renewed weekly, either by replacement with other palm pieces and burning of the old infested ones, or by spraying with palm sap to maintain attractiveness and also with 0.15% methomyl to prevent the piles from becoming a source of infection.

According to Schuiling and van Dinther (1981), at the Paricatuba oilpalm estate in Para, Brazil, palm losses from RRD were held to 1.14% of palms in the susceptible age group through a program of phytosanitation. The cultural program was considered much more effective than insecticides, the efficacy of which, according to the authors, is open to question.

The foregoing led the author (DeFoliart 1990) to propose the hypothesis described below:

> Palmworms would certainly seem worthy of wider publicizing as traditional cuisine of gourmet quality, the kind of delicacy that could be promoted as tourist and urban fare by the best restaurants throughout the tropics and subtropics, and eventually, maybe, even as an item for export. Could such wider promotion and use create more opportunities for employment and entrepreneurship in the rural countryside? Could, in fact, expanded markets provide a basis for attempting to combine increased palmworm production with more efficient recycling of dead and diseased palms, and as part of reduced-pesticide integrated pest management (IPM) programs and disease control on coconut and other palm species.
>
> Taking a cue from how indigenous populations have done it for centuries, could the trap logs recommended for pest and disease control, through a simple modification in procedure, be used simultaneously for palmworm production? The desired harvest stage is the late-instar larva. Studies in Trinidad (Hagley 1965), Brazil (Morin et al 1986) and Mexico (Gonzalez and Camino 1974) have shown that the egg and larval stages of *R. palmarum* last 2-4 days and 40-61 days, respectively, at essentially ambient temperatures. Instead of burning trap logs at the end of a week or spraying them with methomyl to kill the larvae, as suggested by Morin et al, if left in place for approximately 45-50 days, the larvae would be ready for harvest. All would be large-sized, few would have pupated and no adults would have yet emerged. Possibly, logs could be reused if desired by spraying with palm sap to renew attractiveness. If not, they could at that point be burned or otherwise disposed of.
>
> Greater efficiency might be achieved by additionally seeding new trap logs with eggs from adult weevils caught in traps baited with coconut tissue. This should exert additional control pressure within the plantation, while producing a higher density of developing larvae in the logs, thus

producing more larvae per unit of substrate, more efficient recycling of the logs and a reduced mass of material left for burning. Maharaj (1973), in Trinidad, described a simple aluminum trap that catches more than twice as many weevils as the conventional split-log trap and uses only about one-fifth as much coconut tissue as bait. To incorporate food production as part of weevil IPM as hypothesized, trap logs would have to remain in place about 7 weeks instead of one, and thus would occupy 7 times as much ground surface, but that should not be a huge problem in palm plantations.

Cowan (1865**:** 46), citing Simmonds (1859), states: "The Goliath-beetle, *Dynastes Goliathus*, is said to be roasted and eaten by the natives of South America and Africa." *Goliathus (= Dynastes) goliathus*, however, and *Goliathus* is an African genus, so this record as given is invalid for South America.

The *Atta* ants which vie with palm weevil larvae as a widely favored food in South America are also important agricultural pests, causing damage amounting to hundreds of millions of dollars annually. The ants exploit a wide range of species in stands of natural vegetation, and among cultivated crops, Hill (1983: 405-406) lists *Citrus*, cocoa, coffee and maize as main hosts, while alternative hosts include cotton, cassava, mango, beans, sweet potato, groundnut, banana, pineapple, rice and wheat among others. The ants cut pieces of living foliage which they carry back to the nest for construction of fungus gardens. Some trees, especially cultivated species, may be totally defoliated.

The *Atta* nest is a slightly raised bare mound measuring up to 10-15 meters in diameter and with numerous entry holes (Hill 1983). Depth extends to 4 m underground. Queens live up to 20 years, and nests may contain up to two million ants. There are many interlinked underground chambers in which the fungus gardens, made of chewed leaf fragments and saliva, are located. The fungus mycelium develops on this organic base. More than 50% of the dry weight of the fungus is available as soluble nutrient and provides the metabolic capability of converting cellulose into carbohydrates which can be metabolized by the ants (Martin and Weber 1969). As commented by Hodgson (1955), feeding on a cultured fungus has achieved for *Atta* a preeminent position among rain forest fauna by allowing it to tap the virtually inexhaustible supply of cellulose in its environment.

Atta species produce sexual adults for a short period once annually, and the nuptial/dispersal flights occur usually soon after the beginning to the middle of the rainy season. After founding a new colony, sexuals are not produced until after the third year. The worker ants forage for distances up to 150 m from the nest, using a number of semipermanent trails leading from the immediate vicinity of the nest. Cherrett (1968) proposes, from studies on *A. cephalotes*, that a "conservational grazing system" is practiced, evening out the grazing pressure around the nest and preventing over-exploitation of the plant resources by providing periods of relief from intense grazing during which vegetation can recover. The abandonment of established trails and development of new ones, as was observed, eventually results in a fairly general coverage of the area surrounding a nest.

The clearing of tropical rain forest for agriculture upsets this conservational foraging strategy, Cherrett concludes. Citrus or cocoa, which are commonly planted in newly-cleared forest areas, present a greatly reduced availability of forage, thus increasing the grazing pressure per plant. As leaf-cutters keep returning to a particular tree until it is defoliated, in orchards an individual tree is more likely to be defoliated repeatedly and killed, whereas an individual tree in the forest can recover during the considerable periods between defoliations.

Atta species can be reared in the laboratory (e.g. Littledyke and Cherrett 1976), but their expansive nests and extensive foraging behavior suggest that they cannot be mass-produced economically under controlled or semi-controlled conditions. Also, as they are such serious pests of many cultivated trees and other crops, nests at the edges of forests adjacent to cultivated areas probably cannot be tolerated. Their presence within the forest, however, and their preservation as a source of food and income for rural people appears to be another matter.

Their ecological role in forests is also important. Lugo et al (1973) studied the impact of *Atta colombica* on energy flow of a tropical wet forest in Costa Rica, and calculated that the leaf-cutting activity reduced the gross production of the forest by 1.76 Kcal/m^2 per day but accelerated net production by at least 1.80 Kcal/m^2 per day through the return of ash rich in calcium to the forest floor. Nest refuse composed of old fungus parts, dead ants, soil particles and debris is deposited outside the nest by maintenance ants and has three roles: 1) food source for many species of insects in their early developmental stages (also visited by birds and mammals), 2) habitat for these associated fauna, some of which eat ants, and 3) a mechanism for fast mineralization of the forest. The authors cite an earlier study in which a refuse pile was found to contain 200 ppm of available phosphorus compared to less than 0.05 ppm in the forest floor away from the nest. The authors calculated that their study colony consumed 2.6% of the total grazing or 0.2% of the total gross productivity of the forest, and they comment that, "It is significant for a single species such as *Atta colombica* to control so much energy in a system as diverse as this tropical wet forest." Moffett (1995) stated that leafcutters remove about 15% of leaf production in rainforests, but they turn over and aerate large quantities of soil. And DeFoliart (1997) notes that many edible insect species enhance local environments in one way or another, but probably none on a more massive scale than the leafcutter ants.

In closing this overview chapter, it should be mentioned that the near absence, except in Colombia, of references to grasshopper and locust consumption in South America is surprising considering the importance of these insects as food in Africa and Asia. There is no dearth of species, and even the migratory locusts of the genus *Schistocerca* are well-represented. Gilmore mentioned that *S. paranensis* and *S. cancellata* periodically invade the Guiana-Brazilia region from the southwest and are "probably among the species that have been eaten." These are considered by Dirsh (1974) to be subspecies of *S. americana* (Drury), and both occur widely in South America. The typical form of *paranensis* breeds in Argentina, Bolivia, Paraguay and Uruguay, and it is one of the species in this genus that sometimes multiplies to great numbers, forming bands in the nymphal stage and swarms in the adult stage (Dirsh 1974: 12). Dirsh mentions (p. 12) that the labels on several specimens of *S. paranensis* in the Bruner collection, collected in Uruguay on February 20th, 1909, bore the following inscription: "By the billions a great pest in all Central Southern S. America, this year -- eats everything except leaves of coffee plant." Considering the avid use of grasshoppers/locusts in Colombia (reported by Ruddle) and in Mexico, it seems probable that there is wider use in South America than is now known.

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