

## Chapter 27

## OCEANIA: OVERVIEW, PAPUA NEW GUINEA, OTHERS

Included in Oceania as treated here are Australia, New Zealand, Papua New Guinea and the Pacific Islands in Melanesia, Micronesia and Polynesia. The specific identity is known for 50 species used as food, but as indicated in the Regional Inventory, at least 84 species belonging to at least 68 genera, 35 families and 12 orders have been reported. As in other regions, the total number of species used is probably much greater than indicated in the Inventory.

## Regional Taxonomic Inventory

| Taxa and stages consumed   | Countries                |
|--|--------------------------|
| <b>Coleoptera</b>  |                          |
| <b>Carabidae (ground beetles)</b>                                      |                          |
| <i>Euryscaphus</i> sp., adult  | Australia                |
| <b>Cerambycidae (long-horned beetles)</b>                              |                          |
| <i>Agrianome spinicollis</i> (author?)                                 | Australia                |
| <i>Appectrogastra flavipilis</i> (author?)                             | Australia                |
| <i>Bardistus cibarius</i> Newman, larva                                | Australia                |
| <i>Batocera</i> sp., larva, adult?                                     | Papua New Guinea         |
| <i>Dihamnus</i> sp., adult?  | Papua New Guinea         |
| <i>Endoxyla eucalypti</i> (author?), larva                             | Australia                |
| <i>Endoxyla</i> sp., larva   | Australia                |
| <i>Eurynassa odewahni</i> Pascoe, larva                                | Australia                |
| <i>Hoplocerambyx severus</i> (author?), larva                          | Papua New Guinea         |
| <i>Mallodon costatus</i> (author?), larva                              | New Caledonia            |
| <i>Mnemopulis edulis</i> (author)                                      | Australia                |
| <i>Prionoplus reticularis</i> Wh., larva                               | New Zealand              |
| Cerambycid larvae/adults   | Australia, New Caledonia |
| <b>Curculionidae (snout beetles, weevils)</b>                          |                          |
| <i>Rhynchoporus bilineatus</i> (author?), larva, adult                 | Papua New Guinea         |
| <i>Rhynchoporus ferrugineus</i> (Oliv.), adult                         | Papua New Guinea         |
| <i>Rhynchoporus ferrugineus papuanus</i> (author?), larva, pupa, adult | Papua New Guinea         |
| Curculionid larvae   | Australia                |
| <b>Lucanidae (stag beetles)</b>  |                          |
| Lucanid grubs  | Papua New Guinea         |
| <b>Passalidae (bess beetles)</b>                                       |                          |
| Passalid grubs   | Papua New Guinea         |
| <b>Scarabaeidae (scarab beetles)</b>                                   |                          |
| <i>Anophlognathus viridiaeneus</i> Hope, larva                         | Australia                |
| <i>Lepidiota vogeli</i> Brenske, adult                                 | Papua New Guinea         |
| <i>Oryctes centaurus</i> (author?), larva, adult                       | Papua New Guinea         |
| <i>Oryctes rhinoceros</i> Linn., larva                                 | Solomon Islands          |
| <i>Oryctes</i> sp., larva  | Papua New Guinea         |
| <i>Scapanes</i> sp., larva   | Papua New Guinea         |
| <i>Xylotrupes gideon</i> (Linn.), larva                                | Papua New Guinea         |

## Diptera

Edible fly adult Australia

**Bibionidae (March flies)**  
"March flies" Australia

### Ephemeroptera

Mayfly adults Papua New Guinea

### Hemiptera

Leaf bugs of various families Australia

**Coreidae (leaf-footed bugs)**  
Leaf bugs Papua New Guinea

### Homoptera

**Cicadidae (cicadas)**  
*Baeturia* sp. Papua New Guinea  
*Cicadina* sp. Australia  
*Diceropyga* sp. Papua New Guinea  
Cicadas/cicada manna Australia

**Cicadellidae (leafhoppers)**  
Leafhopper Australia

**Coccoidea (scale insects)**  
*Apiomorpha pomiformis* Froggatt, gall Australia  
*Austrotachardia acaciae* (Frogg.), lerp sugar Australia

**Psyllidae (psyllids)**  
*Eucalyptolyma* sp., lerp sugar Australia  
*Spondylaspis eucalypti* Dobson, lerp manna Australia  
*Psylla* or lerp manna Australia  
*Psyllina* sp. Australia

### Hymenoptera

Galls (families unknown) Australia

**Apidae (honeybees)**  
*Trigona* spp., larvae, pupae Australia

**Formicidae (ants)**  
*Camponotus consobrinus* (author?), pupa Australia  
*Camponotus inflatus* (Lubb.), "honey-pot" Australia  
*Colobopsis grasseri* (author?), pupa Australia  
*Melophorus bagoti* Lubb., "honey-pot" Australia  
*Melophorus cowleyi* Frogg., "honey-pot" Australia  
*Melophorus midas* (author?), "honey-pot" Australia  
*Myrmecia pyriformis* (author?), pupa Australia  
*Myrmecia sanguinea* (author?), pupa Australia  
*Oecophylla smaragdina* (Fabr.), larva, adult Australia, Papua New Guinea  
*Oecophylla virescens* (author?) Australia  
Various ants/ant pupae Papua New Guinea

**Perilampidae**  
*Trachilogastir* sp., mulga apple (gall) Australia

**Vespidae (wasps, hornets)**

Wasp brood

Australia, Papua New Guinea

**Isoptera**

Termites

Australia, Papua New Guinea

**Lepidoptera**

Caterpillars/lepidopterous woodborers

Australia

Social caterpillars and their pupae

Papua New Guinea

**Cossidae (carpenter moths, leopard moths)***Catoxophylla cyanauges* Turner, adult

Australia

*Cossus* sp., larva

Australia

*Xyleutes amphiplecta* Turner, larva

Australia

*Xyleutes biarpiti* Tindale, larva

Australia

*Xyleutes boisduvali* Herrich-Schaeffer, larva

Australia

*Xyleutes eucalypti* Scott, larva

Australia

*Xyleutes leucomochla* Turner, larva

Australia

*Zeuzera citurata* (author?), larva

Australia

*Zeuzera eucalypti* (author?), larva

Australia

Additional cossid spp. larvae

Australia

**Hepialidae (ghost moths and swifts)***Abantiades marcidus* Tindale, larva, pupa, adult

Australia

*Oxycanus* spp., larvae, pupae, adults

Australia

*Trictena argentata* Herrich-Schaeffer, larva, pupa, adult

Australia

*Trictena argyrosticha* Turner, larva, pupa, adult

Australia

**Noctuidae (noctuids)***Agrotis infusa* (Boisd.), adult

Australia

**Psychidae (bagworm moths)***Panacela* sp., larva

Australia

**Sphingidae (hawk-moths)***Coenotes eremophilae* (author?)

Australia

*Hyles lineata livornicoides* (author?)

Australia

Hawk moth adults

Papua New Guinea

**Family unknown***Strigops grandis* (author?), larva

Australia

**Mantodea****Mantidae (mantids)***Hierodula sternosticta* (author?)

Papua New Guinea

*Tenodera* sp.

Papua New Guinea

**Odonata**

Zygopteran (damselfly) larvae

Papua New Guinea

**Libellulidae (common skimmers)**

Dragonfly larvae

Papua New Guinea

**Orthoptera**

**Acrididae (short-horned grasshoppers)***Chorticetes terminifera* (author?)

Australia

*Locusta migratoria* (Linn.)

Papua New Guinea

*Valanga irregularis* (Walk.)

Papua New Guinea

Grasshoppers/locusts

Australia, Papua New Guinea

**Blattidae (roaches)**

Cockroaches

Australia

**Gryllacrididae (wingless long-horned grasshoppers)**

Foliage crickets, tree-hole crickets

Papua New Guinea

**Gryllidae (crickets)***Teleogryllus commodus* (author?)

Australia, Papua New Guinea

**Gryllotalpidae (mole-crickets)***Gryllotalpa* sp.

Papua New Guinea

**Tettigoniidae (long-horned grasshoppers)***Caedicia* sp.

Papua New Guinea

*Valanga* sp.

Papua New Guinea

Edible small green grasshoppers

Papua New Guinea

**Phasmatodea****Phasmatidae (stick insects)***Eurycantha horrida* (author?)

Papua New Guinea

*Extatosoma tiaratum* (author?)

Papua New Guinea

Phasmatinae spp.

Papua New Guinea

**Phylliidae (leaf insects)***Mictis* sp.

Papua New Guinea

A great variety of insects is eaten in Papua New Guinea, one of which is the famous sago grub, *Rhynchophorus ferrugineus papuanus* which is not only widely eaten and widely marketed, but the center of annual "grub festivals." They are "tender and sweet with a slightly nutty flavor," and are bought by Europeans as well as Papua New Guineans. They are important nutritionally, making up 30% of the protein intake of some Sepik peoples (McQueen 1993), and are a good source of fat and other nutrients such as iron and zinc. The grubs breed in the rotting pith of sago palms, and Mercer (1994) has described in detail the production process. It is one of the better examples of environmentally efficient food production, and the grubs are a significant source of rural income. They are important not only in Papua New Guinea; according to Oliver (1989), sago grubs are among the wild biota most widely eaten by Pacific islanders.

Another environmentally efficient system, although on a smaller scale, is described by Mercer (1993). In the Gabensis logging area near Lae, PNG, villagers harvest large numbers of the cerambycid grub, *Hoplocerambyx severus*, from *Anisoptera polyandra* logs. To indicate abundance of the grubs, Mercer mentions that he was able to extract nearly 100 grubs from a single log in little more than 15 minutes.

Orsak (1993a) laments that New Guineans, to their economic and nutritional disadvantage, are coming to believe that eating insects is "bush behavior" and something to be discarded in their progress toward development. But it is obvious from the writings of researchers and educators who are familiar with the country that insects are an important part of the diet of Papua New Guineans. Mercer (1993) states that, "Nutritional programs in the future should recognise this fact."

In Australia, there is a voluminous literature on the insects used as food by the Aborigines. The use of insects was widespread if not universal (Waterhouse 1971), partly because, in the harsh environment of Australia, insects were at times almost the only available foodstuffs, and partly because some were regarded as special delicacies. Some of the edible species are represented on totems and in ceremony, myth, song and art (see Spencer and Gillen 1899, Bodenheimer 1951, Strehlow 1971, and Roheim 1974, among others). Among the most prized insects as food were witchety grubs (Cossidae), the bogong moth (Noctuidae), the bardee larva

(Cerambycidae), honeypot ants, honey and brood of the stingless bees and the sweet manna of various lerp insects.

Calvert (1894) noted that whereas intelligent, well-armed white people will die of hunger in the desert, the native will find a sufficiency of food. Tindale (1953) states that, "Aborigines with access to *witjuti* grubs usually are healthy and properly nourished . . . Women and children spend much time digging for them and a healthy baby seems often to have one dangling from its mouth in much the same way that one of our children would be satisfied with a baby comforter." Similarly, Mountford (1946) provided a photograph of a native baby, "fat and saucy," who "thrives on a diet of mother's milk, white grubs, and honey ants," and Mountford emphasizes that the child's home is in the Mann Range "where previous travelers' reports indicated that the country was too bad to support even aborigines." Nutrient analyses of witchetty grubs (James 1983) show a protein and fat content of 15.1% and 19.2%, respectively. The roasted grubs are delicate and nutty in flavor (Waterhouse 1971), similar to scrambled eggs, roast pork, or bone marrow. Several other grubs are also considered delicious, such as the "marrow-like" *bardi* (*Bardistus cibarius*) and other cerambycid species and hepialid grubs such as *Trictena argentata* which tastes like "the baked skin on roast pork."

The bogong moth was also very important nutritionally. The moths breed at lower elevations in New South Wales and southern Queensland, but moths of the spring generation migrate to the mountains where they aestivate for several months in vast assemblages on the granite outcroppings (Common 1954). They were a favorite food of upland Aborigines, who came from long distances and camped for two or three months each summer while collecting, cooking and feasting on the moths. Helms (1895), Jardine (1901), Flood (1980) and others have described how this moth diet rendered the Aborigines fat, sleek and in excellent condition, remindful of similar accounts from South Africa pertaining to the effect of termites or locusts on indigenous populations. The fat content of the summer-aestivating moths is high, abdomens of males averaging more than 61% and of females 51% on a dry weight basis (Common 1954). The flavor is described as like burnt almond or walnut.

As in other arid regions, sweets such as *Trigona* honey, lerp manna, and honey ants were much prized by the Aborigines. Of honey ants, Basedow (1904) stated, "The natives are passionately fond of these little luxuries of the bush and spend hours collecting the same." Considerable digging, often to a depth of 4-6 feet, is required to unearth the ants, and Spencer (1928 I) remarks that, "in some places the whole surface of the ground was turned over, just as if a small army of prospectors had been at work." The work is done mainly by women and children. Conway (1985b) reports that, in order to avoid destroying the colonies, the nests are only partially dug up, thereby preserving a valuable resource.

The influence of European intrusion is discussed by Macfarlane (1978) who says, "The overall picture of these [hunter/gatherers] as they made contact with European foods and culture, was that of well fed infants and adults." He mentions that social organization, the sharing with other members of the group anything that was caught, also tended to reduce malnutrition.

Finlayson (1943) was impressed by the generosity of the native people in matters of food distribution, all food obtained becoming the common property of the group. It seems probable that this admirable attitude of sharing was important for surviving under the harsh conditions in which these people lived. Cutter (1978) also discusses problems of assimilation and reasons why people are moving back to traditional areas, thus reinforcing traditional culture although most want to maintain a cash economy and 'white services.'

An interesting recent development in Australia is the explosion of interest in native, or "bush tucker," foods, including insects such as witchetti grubs. Scherer reported in the *Christian Science Monitor* (1991) that bush foods are "increasingly appealing to hotels and restaurants frequented by tourists," including the 19 motel Australian chain, the Country Comfort Inn which has made native foods the signature of its restaurants. "Bush food has also taken to the air on Australian Airlines, and the Australian Broadcasting Corporation," while, "book stores are well-stocked with books on bush tucker." Witchetty grubs are on the menu of the posh Rountrees on Sydney's North Shore, while Bush Tucker Supplies, in Sydney, supplies bush tucker to more than 40 restaurants across Australia (Pfeiff and Hutchison, *The Globe and Mail* [Canada], 1993) and exports bush tucker to Japan (Irvine 1989).

## PAPUA NEW GUINEA

**Von Miklucho-Maclay** (1875, p. 70; vide Bodenheimer 1951, p. 135) stated: "All insects without exception, especially big beetles, are eaten raw or cooked by the Papuans" [translation not yet available]. **Hagen** (1899; vide Bodenheimer, p. 135) also reported the consumption of insects by Papuans. According to **van der Sande** (1907, p. 4), the Papuan eats practically any animal that is harmless, "for the Papuan has no aversion to anything on account of outward appearance." Because, however, necklaces of chitinous exoskeletons were not observed, van der Sande presumed that beetles were not eaten. He was also unable to verify the use of hornets'

nests as a delicacy, as mentioned earlier by Biro.

According to **Pospisil (1963a: 244; vide Oliver 1989: 241)**, the Kapauku in the Wissel Lakes area identify and eat more than 50 species of insects, along with three species of amphibians, and the eggs of numerous species of birds. **Clarke (1971: 92; vide Oliver 1989: 241)** reports that insects are eaten by the Maring-speaking people in the Ndwinba Basin (Bismarck Range). The much-relished grub called *kima* is eaten only by the men.

**Meyer-Rochow (1973)** reported on the food habits of three groups of Melanesians, the Kiriwinians, the Chuave, and the Onabasulu, and tabulated the use of a wide variety of insects. The Kiriwinians inhabit the Trobriand Islands. They raise pigs and chickens, harvest primarily yam, taro, sweet potato, and coconut, and live on a balanced diet of fruits, vegetables, fish, and meat (mainly poultry). The inland people consume less fish than the coastal people. Kiriwinians living on the coast denied eating any insects and referred to the inland people as insect eaters. Meyer-Rochow noted, however, that the coastal people know well which insects are edible, and some were seen eating the yellow leaf ant, *Oecophylla smaragdina*.

The Chuave live in the central highlands of New Guinea and are part of the Chimbu people. Sweet potato is the principal food, followed by taro, yam and banana. Animals are eagerly hunted and pigs are raised, although slaughtered only infrequently. The population density is high (approximately 100/mile<sup>2</sup>) and malnutrition and starvation are fairly widespread. The Onabasulu live in the area north of Mt. Bosavi, and, until recently, were cannibalistic. The principal foods are sago, cooking bananas, and taro, and protein sources including mammals, marsupials, wild birds, fish and crustaceans are readily available. Pigs are raised and slaughtered when necessary.

Apparent differences that were found in food insect use by the three groups may or may not be related to differences in human population density and/or adequacy of total food supply available to each group. The Kiriwinians, with a population density that was intermediate, and who were in the best nutritional health of the three groups, used a variety of insects almost as great as that of the Chuave whose population density was highest and who were the poorest-off nutritionally. The Kiriwinians used a greater variety of insects than did the lower density Onabasulu who appeared to have an equally adequate conventional food supply. How closely "variety" of insect use can be equated with volume of insect use in this study, however, is not clear. Also, as mentioned by Meyer-Rochow, only three weeks or less were spent with each of the three ethnic groups, and it is possible that some insects that were not in season may have been missed in the survey.

Specific food insects used, as found by Meyer-Rochow, for the three ethnic groups are tabulated below under the appropriate orders and families. From this study, Meyer-Rochow concluded: "If the new Papua and New Guinea government can be persuaded not to accept the European attitude toward insects as human food, it would act to the benefit of vast numbers of natives. Instead of wasting resources in destroying certain insects often regarded as crop pests, the insects themselves should be used. Quite often they represent a higher nutritional value than the vegetable that they have been eating...."

**Meyer-Rochow (1975)** provides Kiriwina, Chuave, and Onabasulu terms for a number of insects, including some that are edible. These are applied below under the appropriate orders and families.

**Dornstreich (1977, p. 254; author's Table III)** tracked the number of *occasions* over a period of about 10 weeks in which the 18 members of one Gadio hamlet, classified by age and sex, engaged in various types of food-getting activity. The eight adult males engaged in a total of 341 occasions: gardening 168, sago making 27, gathering cultivated tree nuts and fruits 25, gathering wild tree nuts and fruits 8, gathering other plants 12, fishing 26, hunting and trapping 15, collecting grubs 33, and collecting other small animals and insects 25. The five adult females engaged in 320 occasions: gardening 186, sago making 33, gathering cultivated tree nuts and fruits 8, gathering wild tree nuts and fruits 16, gathering other plants 42, fishing 8, hunting and trapping 0, collecting grubs 10, collecting other small animals and insects 17.

**Apina (1979?)** discusses the need for extension work on edible insects as a source of protein in Papua New Guinea. [This paper not yet seen]

**Meyer-Rochow (1982)** notes that (translation): "In a state such as Papua New Guinea, where until very recently there had been no intrusion into either the culture or the traditions of the people, eating insects is still common practice in many places, even today."

**May (1984)** mentions that a variety of insects are collected and eaten, mostly by children. They include the larvae and adults of beetles, butterflies, moths, wasps, and dragonflies, and adult grasshoppers, crickets, stick insects, and cicadas. More detailed comment, when given, is included under the appropriate taxons below. May also mentions that the large orb weaving spiders of the genus *Nephila* are also considered a delicacy. They are plucked by the legs from their webs and lightly roasted over an open fire. Other species of spiders are also eaten.

**Meigs (1988, pp. 163-164)** lists "food rules" (taboos) for eating various kinds of insects among the Hua, located in the Eastern Highlands Province of Papua New Guinea. Unfortunately, only the Hua names are given for the insects.

The use of insects as food on the island of Bougainville is mentioned by **Oliver (1991, pp. 98-99)**:

The starch obtained from the pith of the trunk [sago palm] was a substitute food staple, fronds were the principal thatching material, the broad bases of branches were used as troughs, and rotting palm stumps crawled with choice edible grubs. . . Collecting edible insects was only an incidental activity. If people saw them they sometimes tried to catch them; there were no special implements involved. In addition to the sago grubs, which were regarded as a delicacy, the Siwai liked to eat beetles, white ants [termites?] - large and small - and certain kinds of spiders.

**Gillison (1993)**, pp. 125-126) describes how the Gimi in the Eastern Highlands Province use grubs or caterpillars in divination by cooking them with marsupials; the marsupials and insects are eaten after the ceremony.

**Orsak (1993a)** comments as follows:

Here in Papua New Guinea, we regularly eat insects, not necessarily cooked. The fare includes giant orb-weaving spiders, giant stinkbugs, and other exotica. The sad thing is, New Guinean villagers are coming to believe that this is 'bush kanaka' behavior, something to be discarded as they enter the developing world. More and more frequently, they are likely to forego this cheap source of protein in favor of expensive 'tinned fish' or corned beef. Status is a very important human need to be met in Melanesian culture, and buying, instead of collecting protein fits into the syndrome. But spending the little money they have on unnecessary things can be debilitating in a country where all school children must pay school fees, and thousands of villagers remain largely outside of the cash economy. Suffice it to say that I spend a lot of time lobbying people to stick to the bug-eating as one of their pathways to development!

**Mercer (1993)** states that, in PNG, many species are eaten in one locality or another. The species he discusses are included under the appropriate taxa below. He concludes that: "Insects are an important, but largely unrecognised part of the diet of Papua New Guineans. Nutritional programmes in [the] future should recognise this fact." In a broader context, he concludes that the predicted world protein shortage could be ameliorated by using insect protein, but that an education program would be necessary "to overcome the taboos currently held in the West."

**Dr. Mercer**, who, at the time was Senior Lecturer in Entomology at the PNG University of Technology, in Lae, commented (1995): "The majority of my students are keen consumers of a whole range of insects when they return to their villages during vacation time. I have come to the conclusion that it is the West which is out of step in its aversion to insects as food!"

**Meyer-Rochow and Changkija (1997)** report, without further elaboration, that additional research shows that the postulated correlation between number of insects consumed and human population density of the three ethnic groups studied by Meyer-Rochow (1973) is not valid.

## Coleoptera

See May (1984) in Introduction.

### Cerambycidae (long-horned beetles)

*Batocera* sp., larva, adult?

*Dihamnus* sp., adult?

*Hoplocerambyx severus* (author?), larva

Chuave: large longicorn beetles, e.g., *Batocera* sp. and *Dihamnus* sp. (**Meyer-Rochow 1973**). Chuave term for Cerambycidae and Curculionidae which are eaten (*emeiba*) (**Meyer-Rochow 1975**).

**Mercer (1993)** mentions that he, with a group of university students, was offered longicorn grubs (which appeared to be a species of *Batocera*) cooked in coconut milk as the centerpiece of a celebratory feast at Ahora, about 30 km from Gona. In the Gabensis logging area near Lae, he watched villagers collecting in large numbers grubs of *Hoplocerambyx severus* from under the bark of felled *Anisoptera polyandra* trees. If logs are left in the forest for any length of time they become riddled with holes and piles of frass (sawdust) surround them; he was able to extract nearly 100 grubs from a single log in little more than 15 minutes. The high regard for these grubs is indicated by the fact that villagers must climb 1000 meters to reach the logging area.

### Curculionidae (snout beetles, weevils)

*Rhynchophorus bilineatus* (author?), larva, adult

*Rhynchophorus ferrugineus* (Oliv.), adult

*Rhynchophorus ferrugineus papuanus* (author?), larva, pupa, adult

**Townsend (1970):** 54-55; vide Oliver 1989: 243-244), in her monograph on the Heve along the tributaries of the Upper Sepik River, describes what approaches "cultivation" or "domestication" of the sago grub:

When a sago log is cut and the pith left exposed, the sago beetle lays its eggs there. A month or so later the interior of the log is tunnelled by the plump white larvae eating their way through the sago pith. The pith can easily be broken apart with a digging stick and larvae readily picked out. The adult sago beetle (*ume*) and larvae in two stages (*asaye* and *tenive*) are all eaten.

The use of sago grubs is comparable to pig husbandry in two significant ways. First, like pigs, grubs are to some extent regarded as a feast food. Second, sago grubs can also be seen as a means for converting abundant carbohydrates into needed fat and proteins. Young men cut sago palms a month or two before an anticipated feast and notch the logs so that the beetles can readily lay their eggs. Later they return to collect the grubs. Sago grubs are also an everyday food, however. Women get them from the unworked portions of sago palms they have cut a month or more earlier. It is especially significant that they serve as a rather efficient way of concentrating the food energy in low yield sago pith. The unworked portions of the sago log from which women get grubs are the stump and the section just below the crown. These parts of the log are relatively low in starch. For grubs the men cut *yapay* sago, also called *asaye naw*, 'grub sago.' This variety is explicitly said to be low in yield. The use of grubs thus exploits this sago as a food source while sparing the women the work of processing large amounts of low-yield sago pith.

Chuave: large weevils, e.g. *Rhynchophorus* sp. Onabasulu: the sago-palm beetle, *Rhynchophorus bilineatus*, and its larvae which are called "felili"; annual "grub festival" (**Meyer-Rochow 1973**). Meyer-Rochow describes an annual "grub festival" to which "hundreds of pounds" of sago grubs are brought, wrapped in banana leaves, like giant sausages up to 10 feet in length. According to **Meyer-Rochow (1975)**, Onabasulu terms include: sago palm beetle, *Rhynchophorus bilineatus* (*yagi*), and the "musical" weevil, *R. ferrugineus* (*hugu*).

**Kelly (1977, p. 34)**, who studied the Etoro from the Southern Highlands Western Provinces of Papua New Guinea, estimated the portion of protein obtained from grubs (weight consumed, for 1 year) to be 1.9%.

**May (1984)** states (p. 95): "Usually the grubs are either boiled or roasted over an open fire. In the Maprik and Angoram (East Sepik) markets, and probably elsewhere, they are often sold spitted and grilled like satay. They are tender and very sweet with a slightly nutty flavour. The adult beetle is also eaten." A recipe is offered (p. 144). Tabular data on nine animal foods summarized by the author from other sources show the sago grub second only to pork (medium fat) as a source of energy (760 kilojoules/100 grams), highest in calcium (461 mg/100 g; molluscs were second highest at 150 mg/100 g), and high in riboflavin at 0.43 mg/100 g. They were also a good source of iron (4.3 mg/100 g).

**Oliver (1989: 244)** concludes that sago grubs, rats, and coconut crabs are among the wild biota that are most widely eaten by the Pacific islanders.

The people of the Black Water River area of Middle Sepik are notoriously healthy and long-lived. **Malum Nalu** reports in a newspaper article, *Papua New Guinea Post-Courier* (October 12, 1993) that the river people attribute their long life to the clean, unpolluted river air and a diet of sago, grubs and fish.

**Orsak (1993b)** notes that insects have traditionally been an important source of protein in PNG, with sago grubs making up an estimated 30% of the protein intake of some Sepik peoples. **McQueen (1993)** observed bunches of sago grubs, skewered on small sticks and cooked in coconut milk, on sale in a PNG provincial market for about US 22 cents for six grubs. He states: "I have eaten these grubs and they are very tasty indeed, tho the head a bit crunchy. The bodies are a smooth texture, but I find it difficult to describe the taste. Suffice to say that I would eat them regularly [certainly once a week], but they are not generally available in Port Moresby . . ." McQueen suggests that commercial or semi-commercial production of sago grubs would be threatened by wild pigs.

**Mercer (1993)** notes that consumption of sago grubs, *R. ferrugineus papuanus*, is widespread in PNG and it is the only insect sold regularly in local food markets. "It is everywhere considered a delicacy." The grubs can cause injury to the stems and crowns of living palms, and eating the grub is a common biological control method. In some areas, palms are cut down in the knowledge that the grubs will breed in the rotting pith, and they are then harvested a month or two later. Ordinarily, however, the sago palm is harvested when the starch level is highest, usually between 12 and 15 years of age, just before flowering after which the palm dies. Mercer states that, in the Sepik and Fly river areas, the palm is cut down primarily for sago production (each palm produces

250 kg of sago starch, the food staple, enough to feed a man for a year), and the grubs are a by-product. The trunk is left covered with sago leaves to prevent oviposition by the adult weevils while the palm tops and butts are left exposed to oviposition.

At the market in Lae, the grubs, along with other collected wild food products, are sold mainly by women from villages along the seacoast. They are sold live in aerated plastic bags for one kina (about US \$1.05) per bag containing about 40 grubs weighing 250 grams. The author mentions that they are bought both by Papua New Guineans and foreigners, and usually sell out very quickly. Usually, the grubs are either boiled or roasted, and, according to the author, they "are tender and sweet with a slightly nutty flavour."

Mercer states that adult curculionid weevils are eaten raw in the Kokoda area of Oro Province.

**Mercer (1994)** reports the results of studies on the production of the sago grub at Labu swamp, about 10 km from Lae in PNG, and expands considerably on the information presented in his 1993 paper. In the Sepik floodplain where the smooth-trunked *Metroxylum sagu* is exploited, the trunk is used for sago production while the starch-rich "cabbage" (leaf bases and actively growing top) and stump are left for raising sago grubs as a by-product. The grubs are harvested about two months after the tree is felled. *Metroxylum rumphii*, the thorned-trunk sago palm, produces inferior sago starch and has lower yields than *M. sagu*, and, by the Labu people it is used almost exclusively for raising sago grubs.

In Labu swamp, *M. rumphii* is felled at between 12 and 15 years, just before flowering and when the starch level is highest. Mercer describes the process as follows:

The palm is felled using an axe so that the trunk falls across other vegetation and is thus above water level. A stump of about 1 metre in height is left, and this is also used for raising sago grubs. All along the upper surface of the trunk at intervals of about a metre, small squares of the very hard outer covering or cortex are removed by axe, exposing the soft fibrous interior. This is to facilitate oviposition by the sago weevil. Striations are also cut in the "cabbage" to make it more attractive to female weevils. Prepared trunks measured between 8 to 10 metres in length.

The female weevils are attracted by the odor given off from damaged parts. The majority arrive at night and upwards of 100 weevils were observed on freshly felled trunks in the early morning. Females continue to visit a trunk for several weeks after it is felled. Each female lays 200-500 eggs; the eggs hatch in 3 days. The larvae, up to 6 cm long at maturity, make tunnels up to 1 meter in length. The larval period lasts 2-4 months, but may be as short as 24 days when they feed on the more nutritious "cabbage." The pupal stage lasts 14-28 days, and the young adult stays in the cocoon for 8-14 days before emerging.

As females continue to visit the felled (and prepared) palm trunk for a number of weeks, and the speed of larval development varies with richness of the food supply, grubs at all stages of development are found in any one trunk. Trunks were visited about 10 times beginning about one month after the tree was felled, with 50-60 grubs collected each visit and between 500 and 600 grubs collected totally per tree. Later on, when pupae and young adults were found, they were eaten raw by collectors or taken home for cooking, but they were not sold in the market at Lae. Grubs were sold in the Lae market either alive or grilled on a bamboo skewer; live grubs were one kina (approximately US \$1) for 40, while grilled grubs were approximately 15 for fifty toea (US \$0.50). This represents a significant source of rural income, according to the author.

Mercer cites other studies for results of nutritional analyses of the grubs: 760.2 kilojoules/100 g, protein 6.1%, fat 13.1%, carbohydrate 9%, iron 4.3 mg/100 g, thiamine 0.08 mg/100 g, riboflavin 0.43 mg/100 g, niacin 2.4 mg/100 g, and calcium 461 mg/100 g. The calcium is four times as high as that for any other meat tested. The grubs are also an important source of zinc. Mercer concludes that in the areas of PNG where sago is the staple food, the eating of sago grubs may help to alleviate protein deficiency.

**Mercer (1997)** briefly covers some of the points made in his earlier papers and concludes, relative to maintaining biodiversity: "The production system at Lae appears sustainable in that only mature palms are felled, just before they flower and die. The sago palms regenerate vigorously, and as the swamps are not used for agriculture, the palm forests are left to grow to maturity." Relative to biodiversity, Mercer also discusses commercial butterfly ranching in PNG. Ranchers are dependent on butterflies from the surrounding rainforest to lay eggs, and this has played a major role in rainforest conservation. Although the butterflies are not among the edible species, it seems that similar principles might be found applicable in some situations involving edible insects.

Also see Oliver (1991) in the Introduction.

## Lucanidae (stag beetles)

Chuave: Lucanidae, stag beetle grubs (*gomuna*) are eaten (**Meyer-Rochow 1975**).

## Passalidae (bess beetles)

Chuave: Passalidae, sugar beetle grubs (*gomuna*) are eaten (**Meyer-Rochow 1975**).

## Scarabaeidae (scarab beetles)

*Lepidiota vogeli* Brenske, adult

*Oryctes centaurus* (author?), larva, adult

*Oryctes* sp., larva

*Scapanes* sp., larva

*Xylotrupes gideon* (Linn.), larva

**Jolivet (1971)** mentions that in the mountains of the central range of New Guinea (the region of Goroka/Mt. Hagen), the rainy season in August provokes a massive hatch of the June bug (*Lepidiota vogeli* Brenski). Although, according to Jolivet, the beetles, fried, have a turpentine aftertaste that "discourages Europeans from eating them in great numbers," the Papous throughout New Guinea and its coastal islands beat the twilight and eat them in enormous numbers.

Kiriwinians: woodboring grubs, especially those of the rhinoceros beetle, *Scapanes* sp. Chuave: various woodboring grubs and root feeders. Onabasulu: rhinoceros beetle, *Oryctes centaurus*, adults and larvae. The Chuave roast grubs and other large insects in hot ashes or stewed over hot stones wrapped in banana leaves, while other insects are eaten raw or roasted. The Onabasulu usually roast beetles, while the grubs are wrapped in banana leaves and stewed over hot stones for 45-60 minutes (**Meyer-Rochow 1973**). Kiriwina term: Scarabaeidae, the grubs of some of which are eaten (*kim*); Chuave term: rhinoceros beetles, *Xylotrupes gideon* and *Oryctes* sp. (*wawe*), grubs eaten; coleopteran wood-boring grubs (*omun*), some of which are eaten (**Meyer-Rochow 1975**).

In the Kaianantu/Goroka area of Eastern Highlands Province, "whole clans go out catching smooth brown cockchafer beetles (Scarabaeidae: Cetoniinae) which appear in some numbers after the onset of the rainy season" (**Mercer 1993**).

## Ephemeroptera

**Lea (1972;** vide Mercer 1993) reported that mayflies often occur in large clouds along the Sepik River. Villagers skim them from the water when they fall, and they are either eaten raw or put into sago pancakes.

## Hemiptera

### Coreidae (leaf-footed bugs)

Kiriwinians: brown leaf bugs, or "stink bugs," said to have a strong aromatic flavor. Coreoidea and Lygaeoidea. Chuave: leaf bugs (**Meyer-Rochow 1973**).

## Homoptera

### Cicadidae (cicadas)

*Baeturia* sp.

*Diceropyga* sp.

Chuave: cicadas, e.g. *Diceropyga* sp. and *Baeturia* sp. (**Meyer-Rochow 1973**). Chuave term for Cicadidae, cicadas (*giuro*) (**Meyer-Rochow 1975**).

In the Gulf Province young boys catch cicadas which are then eaten raw (**Mercer 1993**). See also May (1984) in the Introduction.

## Hymenoptera

### Formicidae (ants)

*Oecophylla smaragdina* (Fabr.)

Kiriwinians: the yellow leaf ant, *Oecophylla smaragdina*, and a sweet-tasting species (identity unknown); the little yellow leaf ants, called "siboyeki," are used as spices for the starchy yam and taro meals and resemble fresh lime in taste. Chuave: various ants (species not determined) and their pupae. Onabasulu: the

yellow leaf ant, *O. smaragdina* (**Meyer-Rochow 1973**). See also Meyer-Rochow (1973) in the Introduction.

Kiriwina term for weaver ant, *Oecophylla smaragdina (siboyeki)*; Chuave terms for ants (*sin*) and ant pupae (*sin morena*), some eaten; Onabasulu term for weaver ant, *O. smaragdina (yesi)* (**Meyer-Rochow 1975**).

### Vespidae (wasps, hornets)

**Biro (1899**, p. 96; vide Bodenheimer, p. 135) reported that hornets' nests are consumed as a delicacy. According to **May (1984)**, wasp nests are cut down over open fires "providing an earth oven in which the larvae are baked."

## Isoptera

Termites are present but not eaten by any of the groups (**Meyer-Rochow 1973**). **Mercer (1993)**, however, reports that many people in PNG eat termites, including the Kote people in Morobe Province and the Wipim people in Western Province. Also see Oliver (1991) in the Introduction.

## Lepidoptera

The Chuave utilize unspecified butterfly pupae and "colonial caterpillars"; blackish caterpillars called "monumuna" are stuffed into a bamboo stick and cooked (**Meyer-Rochow 1973**). Chuave term for social caterpillars in a sort of nest (*monsumuna*); Onabasulu term for Lepidoptera larvae and pupae (*kegab(i)*), some of which are eaten (**Meyer-Rochow 1975**).

### Sphingidae (hawk-moths, sphinx moths)

The adults of a hawk moth and another large unidentified moth are scorched and eaten, or in the Sepik, wrapped in sago leaves and smoked (**May 1984**).

## Mantodea

### Mantidae (mantids)

*Hierodula sternosticta* (author?)

*Hierodula* sp.

*Tenodera* sp.

Kiriwinians: praying mantis (*Hierodula sternosticta*). Chuave: praying mantids, *Hierodula* sp. (**Meyer-Rochow 1973**). Large insects such as praying mantis and stick insects are usually fried by Kiriwinians. The praying mantis, according to Meyer-Rochow, "tastes like a mixture of shrimp and raw mushrooms." Kiriwina term for Mantodea: *Tenodera* sp., *Hierodula sternosticta (tataya)*; Chuave term for praying mantis, *H. sternosticta (keikabu)* (**Meyer-Rochow 1975**).

## Odonata

Libellulidae. Onabasulu: utilize dragonfly larvae (**Meyer-Rochow 1973**). Zygopteran (damselfly) sp. (*wodien*), larvae are considered small crayfish by the Onabasulu and are eaten (**Meyer-Rochow 1975**). See also May (1984) in Introduction.

## Orthoptera

### Acrididae (short-horned grasshoppers)

*Locusta migratoria* Linn.

*Valanga irregularis* (Walk.)

*Valanga* sp.

Kiriwinians: nonchirping, female large locusts. Chuave: unspecified locusts. The Kiriwinians eat locusts and crickets raw or cooked (**Meyer-Rochow 1973**). Kiriwina: Acrididae, large forms, some of which are eaten (*nipawa*), and small forms, some of which are eaten (*gagata*) (**Meyer-Rochow 1975**). See Meyer-Rochow's discussion of *Valanga* under Tettigoniidae. **May (1984)** gives tabular data from other sources showing the locust, compared to most other animal foods, to be high in protein (20%) and riboflavin (0.5 mg/100 g).

**Mercer (1993)** refers to a serious locust outbreak (*Locusta migratoria*) in 1988 in the Markham valley near Lae: "The locusts devastated the pastures and maize crops of the commercial farmers, and equally hard hit were the food gardens of the villagers. The villagers made up partially for their crop losses by consuming large quantities of the locust." See also May (1984) in the Introduction.

### Gryllacrididae (wingless long-horned grasshoppers)

Kiriwinians: foliage crickets. Chuave: unspecified tree-hole crickets (**Meyer-Rochow 1973**).

### Gryllidae (crickets)

*Teleogryllus commodus* (Walk.)

Chuave: brown cricket, *Teleogryllus* sp. (**Meyer-Rochow 1973**). Kiriwina: Grylloidea, bush-crickets, some of which are eaten (*sigwa*), *Teleogryllus commodus* (*sigwapolu*); Chuave: Grylloidea, *T. commodus* (*keko*) (**Meyer-Rochow 1975**). See also May (1984) in the Introduction.

### Gryllotalpidae (mole crickets)

*Gryllotalpa* sp.

Chuave: mole-crickets (**Meyer-Rochow 1973**). Chuave: mole cricket, *Gryllotalpa* sp. (*wiwi*) (**Meyer-Rochow 1975**).

### Tettigoniidae (long-horned grasshoppers)

*Caedicia* sp.

*Valanga* sp.

Kiriwinians: small green grasshoppers called "kilili." Chuave: unspecified grasshoppers (**Meyer-Rochow 1973**). Kiriwina: Tettigoniidae, long-horned grasshoppers, *Caedicia* sp., *Valanga* sp., eaten if it doesn't chirp (*pwewesa*); all edible small green grasshoppers (*kilili*); Chuave: *Valanga* sp. (*giba*); long-horned grasshoppers (*weriwawa*); Onabasulu: *Valanga* sp. (*sak(g)e*) (**Meyer-Rochow 1975**).

## Phasmatodea

### Phasmatidae (stick insects)

*Eurycantha horrida* Boisd.

*Extatosoma tiaratum* (author?)

Kiriwinians: stick insects of several species (Podacanthinae and *Eurycantha horrida*) (**Meyer-Rochow 1973**). Phasmatodea, stick insects, *Eurycantha horrida* (*kidoka*), Phasmatinae (*kwapu*), some of which are eaten (**Meyer-Rochow 1975**).

**Stone (1992)** describes the use of the spiny stick insect, *Extatosoma tiaratum*, as food in PNG. Leaves of the sago palm are the main food of the insect; the leaves are also used for roof thatching and house roofs need rethatching several times a year. According to Stone (pp. 157-158):

The women prepare a thatching feast and the men move off into the rain forest to collect large bundles of sago palm leaves. On their return, the leaves are cleaned up, dead leaves are brushed out, and at this stage many Giant Spiny Stick Insects are usually found and promptly handed over to the women for cooking. They are skewered with fine-pointed sticks pushed from the abdomen tip up through the head and spit roasted over an open fire until the legs fall off; at this stage they are ready to eat. The flesh of these large insects is pink in colour, in fact, very meaty-looking, but what it tastes like I can only guess. I have actually seen this thatching feast on film which was taken about 20 years ago. The natives also ate large spiders cooked in the same way. Whether this practice still exists today I do not know.

**Mercer (1993)** reports that the Orokaivan people near Kokoda eat a large spiny stick insect, and that the Wau Ecology Institute in Morobe Province raises stick insects on guava leaves, then collects the excretory pellets and sells them to China where they are used to make a herbal tea with medicinal properties. See also May (1984) in the Introduction.

**Phylliidae (leaf insects)***Mictis* sp.

Kiriwinians: leaf insects (**Meyer-Rochow 1973**). Kiriwina term for leaf bugs, *Mictis* sp. (*pwadu kula*); Chuave term for leaf bugs, *Mictis* sp. (*ga(d)raniba*) (**Meyer-Rochow 1975**).

**NEW ZEALAND****Coleoptera****Cerambycidae (long-horned beetles)***Prionoplus reticularis* Wh., larva

**Tillyard (1926, p. 232)** mentions that the larva of *Prionoplus reticularis* Wh. (Prioninae), called "Hu-hu" by the Maoris, is eaten as a delicacy. This is the largest of all New Zealand beetles, the adults measuring up to two inches in length and the larvae to more than 2 1/2 inches. It is very common and is attracted to lights. The larva bores into fallen forest timber, mainly white pine or kahikatea (*Podocarpus dacrydioides*) and also into the introduced *Pinus radiata*.

**Bodenheimer (1951, p. 101)** mentions that the larva of the cerambycid, *Prionoplus reticularis* Wh., known as *hu-hu* was collected by the Maoris from felled or fallen *Podocarpus* and *Pinus* trees and esteemed a great delicacy. The adult beetle is about 5 cm in length, according to Bodenheimer, but only about 1 1/2 inches in length according to **Miller (1971, p. 77)**, who gives the length of the grub as 2 1/2 inches. Miller (p. 78) says that *huhu* was the general Maori name for the grub, but when it was fully grown and had ceased to feed (i.e. the pre-pupal stage when the gut was fully evacuated), it was called *tataka* and considered a great delicacy. The Maori had other names for the other life stages. Miller provides information on the life cycle of the insect.

**Ramsay and Singh (1982, p. 6)** make brief reference to the *huhu* saying it was one of "certain insects" eaten and enjoyed as a delicacy by the Maori.

**Sharell (1971)** presents a color page (plates 147-151) showing the life cycle of the huhu beetle (*P. reticularis*); one plate shows a non-Maori woman holding a handful of grubs with the caption, "A handful of fat huhus - a delicacy of the Maori. Fried quickly, with a sprinkling of salt, they taste good."

**Scarabaeidae (scarab beetles)**

**Hyatt Verrill (1938, p. 162; vide Bodenheimer 1951, p. 134)** states that entomophagous fungi developing in large scarabaeid beetle grubs is eaten by the Maoris with great delight.

**PACIFIC ISLANDS**

**Failla Tedaldi (1882, I, pp. 232-240; vide Bodenheimer 1951, p. 135)** cites an earlier source that the Kanaks of New Caledonia collect roots, "worms" and grubs of beetles as part of their diet.

**Bernatzik (1936, pp. 71, 73, 91; vide Bodenheimer 1951, p. 136)** describes a great variety of animal foods, including insects, that are consumed by the natives of Owa Raha, one of the Solomon Islands. Among the beetle grubs, those of *Oryctes rhinoceros* Linn. are particularly attractive. Adult beetles, cicadas, praying mantis and butterflies are among the animals that are not eaten. Before consumption, fish and insects are roasted on an open fire. The main vegetable foods are yam and taro.

**Oliver (1989: 240)** reported infrequent and opportunistic collection of edible berries and insects by the Siuai, a horticultural people of Bougainville, while engaged in other pursuits. They were eaten only as snacks or as occasional relishes with regular meals.

Noting that many Hawaiian traditions about insects have been lost, **Howarth and Mull (1992, p. 13)** mention:

One that did survive involves the existence of a large cricket-like animal, called the '*hini pa'awela*, in the Ka' District of the Big Island; it was a favorite food among the Hawaiians there until the late 1800s. A few of these animals roasted on a skewer provided a full meal. No specimens of the '*hini pa'awela* survived, and we can only speculate that it may have been a

giant weta-like *Banza* katydid or a *Thaumtogryllus* cricket.

### Coleoptera

#### Cerambycidae (long-horned beetles)

*Mallodon costatus* (author?), larva

**Simmonds (1885, p. 355)** states that the larvae of *Mallodon costatus* are eaten by the natives of New Caledonia. **Williams (1944: 121)** mentions a longicorn beetle which inhabits decaying trees (e.g. *Aleurites moluccana* Wild.) in New Caledonia; the larva and pupa are considered a delicacy.

#### Scarabaeidae (scarab beetles)

*Oryctes rhinoceros* Linn., larva

See Bernatzik (1936) in the Introduction.

### Orthoptera

#### Acrididae (short-horned grasshoppers)

According to **Handy and Handy (1972: 259; vide Oliver 1989: 242)**, pre-European Hawaiians ate many kinds of birds, but apparently only one kind of insect, a grasshopper.

#### Gryllidae (crickets)

See Howarth and Mull in the Introduction.

#### Tettigoniidae (long-horned grasshoppers)

See Howarth and Mull in the Introduction.

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Coventry, N. 1996? Worms & westcargots: Some New Zealand festivals offer the best of wines or beers; others, the epitome of culinary delights. . . *Horizon* [Vol.?]: 26-29.

### Items Needing Attention

Pp. 8, 17. Apina (1979?), need copy, is date correct?

P. 12. Jolivet (1971) cited, but not listed under References Cited. Need title, etc.

Pp. 7, 19. Pospisil (1963) (vide Oliver 1989: 241) is cited, but reference lacks title, etc.