Chapter 2

INSECTS FORMERLY USED AS FOOD BY INDIGENOUS POPULATIONS OF NORTH AMERICA NORTH OF MEXICO

Taxonomic Inventory
Taxa and life stages consumed

Coleoptera

Bruchidae (seed beetles)
Algarobius (= Bruchus) spp., larvae, pupae
Neltumius (= Bruchus) spp., larvae, pupae

Cerambycidae (long-horned beetles)
Ergates spiculatus Leconte, larva
Monochamus maculosus Hald., larva
Monochamus scutellatus Leconte, larva
Neoclytus conjunctus Leconte, larva
Prionus californicus Mots., larva, adult
Rhagium lineatum Olivier, larva
Xylotrechus nauticus Mann., larva

Curculionidae (snout beetles, weevils)
Rhynchophorus cruentatus (Fabr.), larva

Dytiscidae (predaceous diving beetles)
Cybister explanatus (author?), adult

Scarabaeidae (scarab beetles)
Cyclocephala dimidiata Burmeister, adult
Cyclocephala villosa Burm., adult
Phyllophaga fusca Froelich, adult
Polyphylla crinita Leconte, adult

Miscellaneous Coleoptera
Scientific name(s) unrecorded

Diptera

Ephydridae (shore flies)
Ephydra cinerea Jones (= *E. gracilis* Packard), pupa
Ephydra macellaria Eggar *(= E. subopaca* Loew), pupa
Hydropyrus (= Ephydra) hians Say, pupa

Oestridae (warble flies, bot flies)
Hypoderma bovis Linn., larva
Oedemagena tarandi (Linn.), larva

Rhagionidae (snipe flies)
Atherix sp., egg masses with adult females

Tipulidae (crane flies)
Holorusia rubiginosa Loew, larva
Tipula derbyi Doane, larva
Tipula quaylii Doane, larva
Tipula simplex Doane, larva

Miscellaneous Diptera
Scientific name(s) unreported

Hemiptera

Belostomatidae (giant water bugs)
Lethocerus americanus Leidy, adult

Homoptera

Aphididae (aphids)
Hyalopterus pruni (Geoffroy) (= *H. arundinis* Fabr.), honeydew

Cicadidae (cicadas)
Diceroprocta apache (author?), nymph and adult?
Magicicada (= Cicada and Tibicen) septendecim Linn. complex, nymphs. Other periodical cicadas (*Magicicada)* in the complex include *M. cassini* Fisher, *M. septendecula* Alexander & Moore, *M. tredecim* Walsh & Riley, *M. tredecassini* A. & M., and *M. tredecula* A. & M.
Okanagana bella Davis, nymph and adult?
Okanagana cruentifera Uhler, nymph and adult?
Platypedia areolata Uhler, nymph and adult?

Hymenoptera

Anthophoridae (digger bees)
Anthophorid honey

Apidae (honey bees, bumble bees)
Bombus appositus Cresson, larva/pupa
Bombus nevadensis Cresson, larva/pupa
Bombus terricola occidentalis Greene, larva/pupa
Bombus vosnesenskii Radoszkowski, larva/pupa

Cynipidae (gall wasps, etc.)
Cynipid-produced oak galls

Formicidae (ants)
Camponotus sp., larva, adult
Formica rufa Linn., larva/pupa/adult?
Lasius niger Linn., larva/pupa/adult?
Myrmecocystus melliger Forel, honeypots
Myrmecocystus mexicanus hortideorum McCook, honeypots
Pogonomyrmex californicus Buckley, larva/pupa/adult?
Pogonomyrmex desertorum Wheeler, larva/pupa/adult?
Pogonomyrmex occidentalis Cresson, larva/pupa/adult?
Pogonomyrmex owyheei Cole, larva/pupa/adult?
Pogonomyrmex sp., adult

Vespidae (paper wasps, yellowjackets, hornets)
Vespula diabolica Saussure, larva/pupa
Vespula pennsylvanica Saussure, larva/pupa
Vespula spp., larvae/pupae

Isoptera

Rhinotermitidae (subterranean termites)
Reticulitermes tibialis Banks

Miscellaneous termites

Scientific name(s) unreported

Lepidoptera

Arctiidae (tiger moths, etc.)
Arctia caja americana Harris, larva

Lasiocampidae (tent caterpillars)
Malacosoma spp., larvae

Megathymidae (giant skippers)
Megathymus yuccae Boisduval & Leconte, larva

Noctuidae (noctuids)
Heliothis zea Boddie, larva
Homoncocnemis fortis Grote, larva
Spodoptera frugiperda Smith, larva

Saturniidae (giant silk moths)
Coloradia pandora Blake, larva, pupa
Hyalophora (= Platysamia; = Samia) euryalus Boisduval, larva (see Essig 1958, Arnett 1985)

Sphingidae (sphinx or hawk moths)
Hyles lineata Fabr., larva
Manduca sexta Johannsen (= *Macrosila carolina* (author?)), larva

Miscellaneous Lepidoptera
Scientific name(s) unreported

Odonata

Aeshnidae (darners)
Aeshna multicolor Hagen, nymph

Miscellaneous Odonata
Scientific name(s) unreported

Orthoptera

Acrididae (short-horned grasshoppers)
Arphia pseudonietana Thomas, adult
Camnula pellucida Scudder, adult
Melanoplus bivittatus Say, adult
Melanoplus devastator Scudder, adult
Melanoplus differentialis Thomas, adult
Melanoplus femurrubrum DeGeer, adult
Melanoplus sanguinipes Fabr. (= *M. mexicanus mexicanus* Suassure; reported as *M. atlanis* Riley by Essig 1931), adult
Melanoplus sp.
Oedaloenotus enigma Scudder, adult
Schistocerca Shoshone Thomas (= *S. venusta* Scudder), adult

Gryllacrididae (wingless long-horned grasshoppers)
Stenopelmatus fuscus Haldeman

Gryllidae (crickets)
Gryllus assimilis Fabr., complex

Tettigoniidae (long-horned grasshoppers)
Anabrus simplex Haldeman, nymph, adult

Plecoptera

Perlodidae
Isoperla sp., nymph, adult

Pteronarcidae (giant stoneflies)
Pteronarcys californica Newport, nymph, adult

As with indigenous populations nearly everywhere, North American Indian tribes made wide use of insects as food. Dozens of species have been recorded or are highly suspect on the basis of distribution, abundance and ecology. Data on the use of insects in aboriginal cultures are primarily of two types, ethnographic and archaeological, and it has been particularly necessary to draw upon the full range of methodology in North America where the original cultures have been so completely enveloped by a later European-derived culture. Ethnographic data are derived from direct observations by anthropologists, observations by non-anthropologists (e.g., ethnohistoric accounts), memory culture, continuation of practices into the present, and inferences from ethnographic data from neighboring groups. **Sutton** (**1988**: 1-10) points out pitfalls relative to the gathering and interpretation of each kind, and provides some insight as to why the importance of insect consumption in aboriginal societies has been under-reported and underestimated.

Sutton points out that few of the observers were trained in anthropology, and fewer yet in the natural sciences. Observers from European cultural backgrounds were often biased in their observations of insect consumption or disregarded it entirely. In addition, as insects were usually processed and fragmented, they often could not be recognized by ethnographers, and so were not recorded. As a result, Sutton concludes that it is probable that a much greater number and variety of insects were utilized by the Indians of the Great Basin than has been reported. In addition, misidentifications appear to have been frequent, e.g., the term "locust" used interchangeably for grasshoppers, crickets and cicadas. This affects conclusions as to seasonality, technology employed, and caloric return, and thus can lead to an underestimation of the importance of insects in the aboriginal diet and a corresponding overestimation of the importance of other dietary components.

Relative to archaeological data, poor preservation and inadequate field and laboratory methods result in a paucity of data. Sutton discusses reasons for this, and why even coprolite analysis is not as fruitful as might be expected. Coprolite evidence exists for the use of several kinds of insects. Sutton notes that insect remains are frequently encountered during flotation analyses of soil samples from features and hearths in archaeological sites, but they generally are not identified because they are considered unimportant. Coprolites could yield much more information than has been the case to date. "The recovery of archaeological evidence of insect use suffers most from indifference, disinterest, or ignorance on the part of archaeologists who are not attuned to the recovery of such data." Flotation samples must be given special attention and new data recovery techniques must be employed.

As far as known, insects never comprised *the* staple in any economy, but they were often critical resources that were more than an occasional addition to the diet. Sutton notes that Great Basin investigators are now beginning to study resources in view of their seasonal availability, nutritional content, and search and processing time, but, noting the usually cursory treatment of insect consumption by anthropologists, he states (p. 2): "From an ecological standpoint, an understanding of, or at least a delineation of, all parts of an economic system is necessary for an understanding of the system as a whole and of its interactions with other systems." Many components, including insects are poorly known. Anthropologists often consider that insects are "famine food and backup resources, usually taken on an individual encounter basis," yet, Sutton states (p. 3): "While it is probably true that insects were taken individually during the course of other activities, the overall procurement of insects appears to have been systematic and not confined to chance." He concludes that, "insects were commonly and extensively used and that they played an important part in fulfilling the nutritive requirements of the Great Basin Indians."

Sutton concluded that crickets, grasshoppers, shore flies, caterpillars, and ants were the most significant insect resources and they were utilized by almost every Great Basin group. Other insects, including bees,

yellowjackets, aphids, mesquite beetles, june beetles, stoneflies and lice were also eaten but in lesser quantity. Sutton disagrees with the view that insects were mostly obtained on an "encounter" basis, stating that, "the ethnohistoric and ethnographic data indicate that considerable planning, travel, and effort was often involved in insect procurement." Such effort suggests that aboriginal groups were knowledgeable about the seasonal and geographic availability of insects and that the insect resources were fully integrated into aboriginal economic systems. Although fresh insects were available primarily from April to October, many accounts specify that insect foods were stored for later use, often in large quantities. According to Sutton, "Stored insects, combined with stored plant products (with which insects were often mixed) may have formed a balanced diet providing for a comfortable winter."

Although cost/benefit ratios for collecting most insect resources have not been determined, Sutton notes that studies have shown high return rates for Mormon crickets and grasshoppers. Collecting and processing of insects in the Great Basin was conducted primarily by women, although in "drives" requiring the participation of many people, men, women and children probably participated.

In summary, Sutton concludes that insects probably constituted a major rather than a minor resource in the Great Basin, and states that "Anthropologists should continue to seek elucidation of the use of insect foods, both ethnographically and archaeologically, and should consider insect foods important resources that were fully integrated into the various economies of the aboriginal Great Basin."

The point made by Sutton that if the role of insects in North American aboriginal economies is underestimated, the role of other components is therefore overestimated and we lack an accurate understanding of the systems as a whole, is of particular interest and has wide implications. If this is true for North America, it is probably equally true for Africa, Asia and elsewhere inasmuch as most of the early information was furnished by Europeans. The historical record of insect consumption may be an excellent example of history distorted by being seen only through the eyes of those who wrote it.

Several points come into focus as one peruses the North American literature:

1. Insect consumption was widespread among tribes in western North America, but not in the eastern part of the continent. **Waugh** (**1916**) and **Carr** (**1951**) are among the few reports from east of the Mississippi River. On the other hand, not all western tribes used insects (see **Dorsey 1884**, **Ray 1933**, **Voegelin 1938**, and **Barnett 1939**, for example). **Hoffman** (**1896**) suggested that the Menomini did not eat insects and other "loathsome food" because they had "always lived in a country where game, fish, and small fruits were found in greater or lesser abundance," and **Skinner** (**1910**) suggests that "the universal practice of agriculture south of the Great Lakes" obviated any need for insects as food.

The reasons suggested by Hoffman and Skinner would seem to be discounted, however, by numerous reports from the West that the Indians relished insects in the midst of abundant food resources. **Dixon** (**1905**) states, regarding the Northern Maidu in the lower Sierra region, "Of animal food [deer, elk, rabbits, etc.] there was an abundance. . . . Yellow-jacket larvae were, however, eagerly sought, as were also angle-worms. Grasshoppers, locusts, and crickets were highly esteemed, and in their dried condition were much used in trade." **Muir** (**1911**), described a great variety and abundance of foods, then stated, "Strange to say, they seem to like the lake larvae [*Hydropyrus hians* pupae] best of all." According to **Ross** (**1956**), despite a profusion of salmon, buffalo and vegetables, the Snake Indians resort to "the most nauseous and disgusting articles of food," such as crickets, grasshoppers and ants.

2. Insects were an integral part of the seasonal rounds of food gathering. This is evident in many reports, but quick insight on the role of insects within the context of food gathering can be provided by quoting from the excellent and concise description by **Emma Lou Davis** (**1962**) of the seasonal activities and locations of the Mono Lake Paiute. Mono Lake is located at the base of the Sierra Nevada, within the Upper Sonoran Life Zone at an elevation of 6,400 feet. Davis states (p. 24):

> Due to this climatic variability and to the range in altitudes the area offered a wide range of seasonal foods which were attractive to hunter-gatherers. From April through October different natural food crops matured in turn throughout the territory. The activities of the Mono Lake Paiute, and of other aboriginal travelers and visitors, were geared to this cycle of food events. At each season the people had different sorts of camps, in different places and with significantly different artifact assemblages.
>
> The Kuzedika had only a stone-age tool kit, [but] their culture was characterized by a number of highly developed specialties which permitted them to cope successfully with their unpredictable environment. In common with other Basin-Plateau peoples they possessed a diversified complex of beautifully made baskets, permitting them to collect, toast and winnow tiny seeds and fine

meal.

They used metates and manos, mortars, stone bowls, and pestles. With this milling equipment they could reduce hard or tough foods to an edible consistency. They made warm fur robes by weaving twined strips of rabbit pelt into a fibre warp. They understood how to process and store protein foods. Most particularly, they had an encyclopedic knowledge of the ecology of which they formed a part. They were clever at devising ways of harvesting every seed, grub and rat in their habitat. They ate everything they could digest and knew precisely where and when it could be found and the best means of procuring it.

The staffs of life of the Kuzedika were greens, roots and fruits; seeds of grasses; fly larvae [actually *Hydropyrus hians* pupae], pine tree caterpillars [*Coloradia pandora* larvae], rodents, lizards, rabbits and occasional large game. The great winter staple was pine nuts. . . .

During an average year the Paiute schedule of camping and collecting ran as follows: In winter, the groups broke up into separate families. The families lived either in the pine nut groves, close to their caches of nuts, or else in sheltered coves around the warmer east end of the lake. Here they subsisted on rodents and stored foods. . . .

In March, when the sun and the deer returned, Kuzedika families moved to the west end of the lake and camped on sunny, well-drained knolls near streams with gallery forests of aspens. The first new food activities in spring were the hunting of deer and the collecting of fresh greens for which the people were starved. . . .

By June groups of people moved down to the summer grass sites. . . . These meadow camps served as a base for collecting grass seeds, berries, roots and tubers. They were also a point of departure for more distant and varied collecting activities. Each summer the whole population migrated to the lake shores in order to gather and process fly larvae, which piled up in windrows along the beaches. Open camps appear to have extended for miles along high strand lines at the west end of the lake, where fresh water was available. The wealth of food near the lake attracted other people from miles around. Even the unfriendly Washo paid regular visits to Mono Lake. The high percentage of projectile points (some of them very large spear points) at beach sites suggests defensiveness or an armed truce. . . .

In addition to its appeal as a food larder, Mono Lake basin was a cross-roads for trade and travel [and] many other people came and went through the home range of the Kuzedika. This situation was, of course, a potential source of inter-group friction but appears only occasionally to have caused outbreaks of armed hostility. The Paiute were not an aggressive people and territoriality was but weakly developed among these transient collectors.

On alternate summers, in the early part of July, the Kuzedika and scattered groups of visitors migrated 15 miles south to the Jeffrey pine forests near Indiana Summit. Here the caterpillars of a moth, *Coloradia pandora*, completed their biennial cycle and emerged to feed on the pine needles. Smudge fires were built; circular trenches (still faintly visible) were dug around the bases of selected trees. The trapped and stupified worms were then collected, sun-dried and stored in slab shelters, a few of which are still standing.

If the year were favorable, autumn brought in the most important of all food crops: the pine nuts. Families worked together to amass great piles of green cones, still tightly closed to protect the contained nuts. The cones were piled within retaining rings of stones, covered with grass, boughs and slabs of rock and left as winter stores. . . . If the harvest of pinyon nuts had been an adequate one, families built brush tipis with countersunk floors and wintered near their caches. In the scattered winter communities people trapped small game, gambled at Nayel'we, the popular Hand Game, told myths in endless song-recitive during the long evenings and waited for the returning sun to bring another cycle of collecting.

3. Some insects undoubtedly yielded a very high energy return for the energy expended in their harvest. Although few experimental data are available, this seems especially evident from the many vivid accounts of grasshopper and Mormon cricket "drives" (see under Orthoptera: Acrididae and Tettigoniidae) and the large-scale harvests of shore fly pupae (Diptera: Ephydridae) and pandora moth caterpillars (Lepidoptera:

Saturniidae). **Madsen and Kirkman** (**1988**) describe a special, but recurring, situation in which the return rate from collection of grasshoppers washed ashore at Great Salt Lake was at least 16 times that of any local seed resource. **Madsen** (**1989**) provides data suggesting that the return rates from Mormon crickets collected by hand exceeded those from all local plant resources and compared favorably with those from small and large game animals. It is likely that return rates from Mormon crickets collected during the large, organized drives described by early observors would have far exceeded those that can be obtained by hand-collecting. **Simms** (**1984**), although he makes no mention of edible insects, provides useful information on the kilocalories returned per hour of work for various Great Basin collected food resources, both plant and animal.

4. Insects, when dried, were storable for use in the future and were an important winter food. Grasshoppers, Mormon crickets, shore fly pupae, pandora moth caterpillars, cicadas and ants were among the insects stored (e.g., **Dixon 1905**, **Elliott 1909**, **Muir 1911**, **Steward 1941**, **Davis 1965**, and **Downs 1966**, among others).

5. Insects were important items of trade among tribes (e.g., **Dixon 1905**, **Steward 1933**, **J. Davis 1961**), with grasshoppers, pandora caterpillars and shore fly pupae among the insects most widely traded. Accounts of Indian attempts to trade their edible insect preparations to Whites, however, are frequently humorous (see, for example, **Bidwell 1890**). Disputes concerning insect collecting rights sometimes arose among Indian tribes or individual families. **Steward** (**1933**: 245-246), for example, cites Muir to the effect that families and tribes claimed sections of the shore at Mono Lake where the windrows of shore fly pupae washed up and disputes arose over encroachment into a neighbor's territory. Regarding pandora caterpillars, **Miller and Hutchinson** (**1928**: 158-160) related that "...the Monos, lured by the tempting collecting grounds, had crossed the range [the Sierra Nevada] and gathered caterpillars from areas that were considered exclusive worming grounds of another tribe. This caused a serious break in diplomatic relations between the two tribes and very nearly resulted in a great Pe-ag'gie war."

Conversely to most reports, **Heizer** (**1978**) shows only three recorded ethnographic instances of insects traded as food items from one tribe to another in California.

Essig's (**1931**) discussion is of particular interest because it is the first to provide the specific identity (scientific names) of many of the insects that were, or probably were, used as food in western North America. His information is incorporated under the appropriate insect orders below. **Essig** (**1934**), as did Davis (1962) and others later, extolled the intimate knowledge of the Indians about natural history, including the life cycles and habits of insects. He says (page 181):

> Indians probably knew a great deal more about certain facts concerning the natural instincts and habits of insects than the white race will ever know. The aborigines of California literally lived with their tiny six-legged brothers and liked them in more ways than one. Apparently there were no feelings of rivalry on the part of the red men as is so often expressed to-day by the entomological economists who class insects as man's greatest rivals on this earth. The Indians accepted nature as it was without carrying out any great schemes to replace the forests and the prairies with cultivated fields and great cities.

Finally, although our discussion here is limited to food, insects were much more than food in the lives of the Indians. **Hitchcock** (**1962**) has discussed a number of aspects in Indian culture, including the spiritual power of insects; insects as omens and symbols; their use in medicine, magic and witchcraft; influence on the growth and development of children; use of products for various purposes such as ornaments, artwork, dyes, not to mention honey and beeswax; domestication of insects of various kinds; use as food (briefly); and the Indian view of insect control. Hitchcock, as did Essig before him, suggests that the American Indian had a much more intimate view of himself in relation to nature than we do and insects were part of the world around him. Indians in general did not regard insects as pests in the same manner that we do. This was partly because the Indian economy was such that insects did not make such recognizable demands on it and partly because of their spiritual and other importance. A point made by both **Hitchcock** and **Essig** is that, in general, those groups that made the most use of insects or insect products had great knowledge about the biology and identification of their insects, a principle that we will see applies to indigenous people in other continents as well.

DeFoliart (**1991**) listed more than 70 species of insects known or presumed to have been used as food by North American tribes. Included were representatives of 12 insect orders and 28 families. **DeFoliart** (**1994**) described a number of insect foods of the American Indians and incidents showing how early whites reacted to them. The author concluded: "As might be expected from our European cultural heritage, some early American whites looked with open disgust at the insect foods of the American Indians. It is interesting, though, that so often . . . . these cross-cultural encounters relative to food seemed dominated by feelings of mutual tolerance,

curiosity and respect and were described with a sense of humor."

Ikeda et al (**1993**) reported that some 500 descendants of Miwok-speaking Native Americans live in Mariposa County, California, and that 50 percent of the families live below the federal poverty level and are unable to afford the kind of food that ensures an adequate diet. The authors report:

> Some families augmented their food supply in traditional ways: 47% gathered wild berries, nuts, mushrooms and other plants; 67% said their grandparents and parents traditionally used wild plants as foods, and 81% said this knowledge had been passed on to them by their elders. . .[22% gardened, 26% fished, 14% hunted] . . . Many Miwok recalled foods their grandparents ate that they do not eat: insects such as pine tree worms, Monarch butterfly larvae and grasshoppers; animals like squirrel, Mono Lake shrimp, quail, deer, rabbit, bear and hedge hog; and plant foods such as acorn mush, pine nuts, wild vegetables and berries. Some of these foods, particularly the insects, are not considered food by the dominant culture. This may have influenced these Native Americans to abandon them as food sources.

Sutton (**1995**) reiterates the importance of insects in prehistoric diet and technology and of their procurement in determining settlement/subsistence patterns. He also re-emphasizes and expands on his 1988 criticisms of "Western bias" on the part of anthropologists, ethnographers and archaeologists in assessing the role of insects, especially as food. In the interpretation of study results, there is an over-emphasis on male-oriented subsistence activities and "big ticket" economic animals, particularly mammals, while insects, which are not very mobile, are considered part of "gathering" which is done by women and children. The author discusses in detail the reasons for the low archaeological "visibility" of insects.

See also Lowie (1909b, insects as food of the Assiniboine) and Osborne (1923, insects in coprolites).

Coleoptera

Bruchidae (seed beetles)

Algarobius (= *Bruchus*) spp., larvae, pupae
Neltumius (= *Bruchus*) spp., larvae, pupae

Sutton (**1988**: 57-60) notes that bruchid beetles constituted an "automatic inclusion of animal protein in processed mesquite." Three genera of bruchids common in mesquite in North America are *Algarobius*, *Neltumius* and *Mimosestes* (**Kingsolver et al 1977**: 113, Table 6-3). There may be as many as three generations per year, and as many as 80% of the pods may be infested by the latter part of the season (**Glendening and Paulsen 1955**: 9; vide Sutton 1988), thus it was almost axiomatic that the bruchids would be a part of mesquite harvest. Regarding the harvest of mesquite pods, **Bell and Castetter** (**1937**: 22-23); vide Sutton 1988: 59) observed:

> When stored in the form of whole or dry pods, partially pulverized, they soon became a living mass, since an insect, a species of *Bruchus*, was present in almost every seed. To the Pima or any other tribe of Indians, this made little difference. The insects were not removed but accepted as an agreeable ingredient of the flour, subsequently made from the beans. If reduced to a fine flour soon after gathering, the larvae still remained within the beans and became a part of the meal, forming an homogenous mass of animal and vegetable matter.

Hooper (**1920**: 357) noted that the Desert Cahuilla ate mesquite beans that were "worm eaten in spots, but regardless of this, they are all pounded together."

Bye (**1972**: 94) gives the history of the botanical collections made by Edward Palmer and John Wesley Powell and reviews the ethnobiology of the southern Paiutes, which lived in southern Utah, adjacent northern Arizona, and southern Nevada. Relative to the mesquite, *Prosopis glandulosa* Torr. var. *torreyana*, and the screwbean, *P. pubescens* Benth., the fruits of which were important as food, especially the starchy inner portions and the seeds, often contained *Bruchus* larvae which were eaten along with the fruits. Now that bruchid-containing pods have become unacceptable to some tribes such as the Pima and Cahuilla, infestations can be controlled by heat-treatment as is the Seri custom in Mexico (**Felger 1977**: 163).

Mesquite seeds in a cached ceramic olla, or storage jar, recovered from CA-RIV-519 in southeastern California (ethnographic territory of the Desert Cahuilla, and radiocarbon dated to within the past several hundred years), showed evidence of insect activity within the bean matrix (**Swenson 1984**: 249). This was probably the result of bruchid beetles infesting the beans when they were still nutritionally viable.

Cerambycidae (long-horned beetles)

Ergates spiculatus Leconte, larva
Monochamus maculosus Hald., larva
Monochamus scutellatus Leconte, larva
Neoclytus conjunctus Leconte, larva
Prionus californicus Mots., larva, adult
Rhagium lineatum Olivier, larva
Xylotrechus nauticus Mann., larva

Essig (**1931**) states that the fat wood-boring cerambycid grubs, some of which measure up to 60 mm in length, were especially relished by the California Indians. Species mentioned include: *Ergates spiculatus* Leconte and *Prionus californicus* Mots. (obtained from old logs and stumps of coniferous trees, and the latter also from various deciduous trees); *Rhagium lineatum* Olivier (beneath the bark of dead pine trees in the foothills and lowlands during the winter and spring); *Xylotrechus nauticus* Mann., *Neoclytus conjunctus* Lec. and other species of these genera (under the bark of various deciduous trees); *Monochamus maculosus* Hald., and *M. scutellatus* Lec. (in fire-scorched, injured and dead coniferous trees). These and "countless" other kinds of cerambycid grubs from all kinds of vegetation were dug out and eaten, usually raw.

Roust (**1967**: 56, 82) reported adults of *Prionus* sp. (probably *californicus*) in prehistoric human coprolites from Lovelock Cave in western Nevada. The heads of the beetles were not found, "indicating that they were either bitten or torn off prior to ingestion, without chewing, of the whole beetle."

See also Powers (1877a, cerambycids as a food of the Nishinam of Pacer County, California) and Zigmond (1986, as a food of the Kawaiisu). It is surprising that, considering the extensive worldwide use of cerambycid grubs, and that hundreds of species occur in North America, there have been so few reports of their use as food here.

Curculionidae (snout beetles, weevils)
Rhynchophorus cruentatus (Fabr.), larva

Ghesquièré (**1947**) indicates by the following (translation) that this species was consumed: "In his interesting *History of Entomology*, Essig (1931) devoted a chapter to edible insects in North America; however, he neglects palmicoles in it and does not cite (cf. Bowdman, 1888, and Kunze, 1916) the boring *Rhynchophorus cruentatus* of the saw palmetto and the date tree, whose larvae are nevertheless eaten by the natives." The species occurs in Florida and nearby states in the southeastern United States, and southward through the Caribbean region.

Dytiscidae (predaceous diving beetles)
Cybister explanatus (author?), adult

Roust (**1967**) reported adults of *Cybister* sp. (*explanatus*?) (pp. 56, 60, 84) in prehistoric human coprolites from Lovelock Cave in western Nevada, and *C. explanatus* and unidentified insect parts in prehistoric human coprolites from nearby Hidden Cave (p. 66). As with the cerambycid adults mentioned above, the heads had been bitten or torn off prior to ingestion, without chewing, of the whole beetles.

Also see Hrdlicka (1908, dytiscids as a food of the Tarahumare, southwestern U.S.).

Scarabaeidae (scarab beetles).
Cyclocephala dimidiata Burmeister, adult
Cyclocephala villosa Burm., adult
Phyllophaga fusca Froelich, adult
Polyphylla crinita Leconte, adult

Indians in Madera County, California, were reported to have regularly eaten the adults of "the white-striped June beetle," *Polyphylla crinita* Leconte (**Essig 1931**). **Sutton** (**1988**:79) reports (via personal communication from Nancy Peterson Walter) that the Owens Valley and Mono Lake Paiute roasted June beetles (possibly *Phyllophaga fusca*) as late as 1981. These insects may have been used by other groups as well, but there are no other specific data. Sutton notes that other June beetles occurring in the desert areas of Arizona and California include *Cyclocephala villosa* and *C. dimidiata*.

Miscellaneous Coleoptera

White grubs from the soil and weevil grubs in nuts are mentioned by **Essig** (**1931**) as food in California,

but no specific observations are mentioned. Essig notes that the larvae of leaf beetles (Chrysomelidae) and ladybird beetles (Coccinellidae) were probably not eaten because of their offensive body secretions. According to **Ebeling** (**1986**: 368), the Cahuilla used as food an insect (probably a beetle larva) gathered from Australian saltbush (an introduced plant) when it bloomed.

Diptera

Ephydridae (shore flies)
Ephydra cinerea Jones (= *E. gracilis* Packard), pupa
Ephydra macellaria Egger (= *E. subopaca* Loew), pupa
Hydropyrus (= *Ephydra*) *hians* Say, pupa

There are numerous reports on the harvesting of shore flies, mainly the pupae of *Hydropyrus* (= *Ephydra*) *hians* Say, and their use was undoubtedly widespread. They were traded, and some groups traveled long distances to obtain them. They were available in great quantities and were storable enough to serve as winter provisions. **Sutton (1988:** 45) notes that other species of shore flies were probably also used, particularly *Ephydra cinerea* Jones (= *gracilis* Packard) which coexists with *H. hians* in the Great Salt Lake and elsewhere. The presence of two sizes is mentioned in one early ethnographic reference, and *E. cinerea* is much smaller than *H. hians.* Although the larvae were frequently mentioned as the stage consumed, **Ebeling** (**1986**: 103-104) and others have noted that it is primarily the pupae that wash up on shore where collection occurs.

Zenas Leonard, in his narrative of his travels written in 1839 (**Wagner 1904**: 166-167), writes of the Pai-utes (or Diggers) at Humboldt Lake: "When the wind rolls the waters onto the shore, these flies [shore flies] are left on the beach - the female Indians then carefully gather them into baskets made of willow branches, and lay them exposed to the sun until they become perfectly dry, when they are laid away for winter provender. These flies, together with grass seed, and a few rabbits, is their principal food during the winter season." (**Ebeling, 1986**: 104, citing **E. Strong, 1969**, identifies *Ephydra subopaca* Packard as the species, and Great Salt Lake as the locality referred to in this account.)

Fremont (**1845**: 154 [1988 reprint]) described [what lake?] a windrow 10-20 feet in breadth and 7-12 inches in depth, composed entirely of the "skins of worms, about the size of a grain of oats, which had been washed up by the waters of the lake." Alluding to this later, Fremont tells of an old hunter, Mr. Joseph Walker, who informed him that:

> . . . wandering with a party of men in a mountain country east of the great California range, he surprised a party of several Indian families encamped near a small salt lake, who abandoned their lodges at his approach, leaving everything behind them. Being in a starving condition, they were delighted to find in the abandoned lodges a number of skin bags, containing a quantity of what appeared to be fish, dried and pounded. On this they made a hearty supper; and were gathering around an abundant breakfast the next morning, when Mr. Walker discovered that it was with these, or a similar worm, that the bags had been filled. The stomachs of the stout trappers were not proof against their prejudices, and the repulsive food was suddenly rejected. Mr. Walker had further opportunities of seeing these worms used as an article of food; and I am inclined to think they are the same as those we saw, and appear to be a product of the salt lakes.

In the account of the 1859 expedition of Capt. J.W. Davidson to Owens Valley (**Wilke and Lawton 1976**), it is stated (p. 30):

> Another very plentiful addition to their means of subsistence is the Larvae of dipterous insects. These are seen floating upon the surface of Owen's Lake in masses (agglomerated) about the size of a nutmeg, and the Indians gather them at this season as they are driven ashore by the winds. They then dry them and separate, by threshing and winnowing, the shells, or skeletons, of the Larva from the grub, which they pack away in cakes. I may safely say that I saw hundreds of bushels of this food, in process of preparation and prepared. The Indians inform me that these deposits are of yearly occurrence. . . .

Brewer (**1930**: 417), who visited Mono Lake in 1863 described it as follows:

> No fish or reptile lives in it, yet it swarms with millions of worms, which develop into flies. These rest on the surface and cover everything on the immediate shore. The number and quantity of these worms and flies is absolutely incredible. They drift up in heaps along the shore -- *hundreds*

> *of bushels* could be collected. They only grow at certain seasons of the year. The Indians come far and near to gather them. The worms are dried in the sun, the shell rubbed off, when a yellowish kernal remains, like a small yellow grain of rice. This is oily, very nutritious, and not unpleasant to the taste, and under the name of *koo-chah-bee* forms a very important article of food. The Indians gave me some; it does not taste bad, and if one were ignorant of its origin, it would make fine soup. Gulls, ducks, snipe, frogs, and Indians fatten on it.

Browne (**1865**: 111-113) described encountering a deposit of "worms" [actually the pupae of *Hydropyrus hians* Say], about two feet deep and three or four feet wide, which extended "like a vast rim" around the shores of Mono Lake, one of several highly alkaline lakes in the California-Nevada area:

> I saw no end to it during a walk of several miles along the beach. . . . It would appear that the worms, as soon as they attain the power of locomotion, creep up from the water, or are deposited on the beach by the waves during some of those violent gales which prevail in this region. The Mono Indians derive from them a fruitful source of subsistence. By drying them in the sun and mixing them with acorns, berries, grass-seeds, and other articles of food gathered up in the mountains, they make a conglomerate called *cuchaba*, which they use as a kind of bread. I am told it is very nutritious and not at all unpalatable. The worms are also eaten in their natural condition. It is considered a delicacy to fry them in their own grease. When properly prepared by a skillful cook they resemble pork 'cracklings.' I was not hungry enough to require one of these dishes during my sojourn, but would recommend any friend who may visit the lake to eat a pound or two and let me know the result at his earliest convenience. . . . There must be hundrds, perhaps thousands of tons of these oleaginous insects cast up on the beach every year. There is no danger of starvation on the shores of Mono. The inhabitants may be snowed in, flooded out, or cut off by aboriginal hordes, but they can always rely upon the beach for fat meat.

Palmer (**1871**: 426) states that the "ke-chah-re" from Mono Lake are dried and pulverized, then mixed with meal made from acorns, to be sun-dried or baked as bread, or mixed with water and boiled with hot stones for soup.

Loew (**1876**: 189) states, in describing Owens Lake: "Neither fish nor mollusks can exist, but some forms of lower animal life are plentiful, as infusoriae, copepoda, and larvae of insects." Loew continues:

> . . . one of the most striking phenomena is the occurrence of a singular fly, that covers the shore of the lake in a stratum 2 feet in width and 2 inches in thickness, and occurs nowhere else in the county; only at Mono Lake, another alkaline lake, it is seen again. The insect is inseparable from the alkaline water, and feeds upon the organic matter of the above-named alga [species not known] that is washed in masses upon the shore. In the larva state it inhabits the alkaline lake, in especially great numbers in August and September, and the squaws congregate here to fish with baskets for them. Dried in the sun and mixed with flour, they serve as a sort of bread of great delicacy for the Indians.

Hoffman (**1878**: 465-466) reported as follows, presumably in relation to *H. hians*:

> The Pah-Utes in the southwestern portion of Nevada, and even across the line into California, consume the larvae of flies found upon the borders of some 'alkali' lakes. The organic matter washed ashore is soon covered with flies, where they deposit their eggs; there being not sufficient nourishment for all the worms, some die, when more eggs are deposited, and so on *ad infinitum*, until there is a belt of swarming, writhing worms from 2 to 4 feet broad, and from an inch to 3 inches in depth. This was the exact condition on the shore of Owen's Lake, California, in August, which appears to be the favorable season. At such localities the Indians congregate, scoop up and pack all that can be transported for present and future use. When thoroughly dried, it is ground into meal, and prepared and eaten as by the Shoshonees.

Williston (**1883**) studied a sample of dipterous larvae and adults sent to him from the Soda Lakes near Ragtown, Nevada, and found them identical with material from Mono Lake. Williston described the adult of the Soda Lakes material under the name, *Ephydra californica* Packard (the adult of which was not previously described), while noting that differences are apparent in the larval stages and the Soda Lakes specimens may in fact represent *E. hians*. Williston quotes from an earlier source: "The water [Soda Lakes] appears to be wanting in animal life, with the exception of a minute fly, the larva of which is a small worm, accumulating in such large

quantities as to form a belt a foot wide along the shore. It is occasionally gathered by the Pah-Ute Indians, and, after drying and pulverizing, made into a sort of meal or flour." Williston also quotes extensively from correspondence with Prof. W.H. Brewer whose notes regarding Mono Lake were later published (see Brewer 1930).

Hutchings (**1888**: 427-428) describes the collection of fly larvae and pupae which occurs each summer along the western edge of Mono Lake:

> At such times every available native, young and old, and of both sexes, repairs to Mono Lake with baskets of all kinds and sizes, old coal-oil cans, and such articles; and, collecting this foam with its living tenants, repair to the nearest fresh water stream (Mono Lake water being impregnated with strong alkalies), and there wash away the foam, while retaining all the larvae and pupae. This is spread upon flat rocks to dry; and when cured, is called 'Kit-chavi,' and thenceforward forms one of the luxuries of Indian food, and becomes their substitute for fresh butter!

Hutchings continues: "Before participating therefore in the festivities of a morning or evening meal, this appetizing addition is made to their acorn mush-bread; when all sit, or kneel, around the unctuous viands, and with his or her two front fingers, converted for the time being into a spoon, help themselves to this unique repast, all eating from the same basket."

Kroeber (**1925**: 592; vide Sutton 1988: 47) reported that the Panamint exploited the flies from Owens Lake.

Essig (**1931**) discusses earlier reports on use of the larvae of *Ephydra hians* Say by the Mono and Koso (Shoshone) and Paiute tribes and known as *koo-tsabe* or *koo-chah-bee* by the latter.

Reagan (**1934a**: 54) states that the Goshutes (Shoshone)of Deep Creek country in Utah were alleged to have made soup of fly larvae, presumably *Hydropyrus.*

Heizer (**1950**), with his customary diligence in searching out the literature on a subject, cites a number of papers and articles which are not included here, on the use of *kutsavi* (*H. hians*) by the western Indians.

Lawton et al (**1976**) believe that probably the reason the Paiute did not develop irrigated agriculture in the southern part of their range was that they were able to obtain large quantities of *kutsavi* or *koochabie* from Owens Lake, thereby exploiting a more nutritive food source than the northern proto-agriculturists were able to exploit by irrigating their fields of *chufas* and grass nuts. They state (p. 42):

> One reason irrigation may not have been practiced near Owens Lake is because of the abundance of *kutsavi*, the larvae of a small fly, *Ephydra* (*Hydropyrus* =) *hians* Say, which formerly occurred in the alkaline waters of Owens Lake. . . . Irrigation was not practiced at Mono Lake either, according to Steward, nor was it recorded by Von Schmidt who surveyed that region in 1857. Mono Lake is located at about 7000 feet, perhaps too high for successful irrigation of yellow nut-grass and wild-hyacinth. However, here again, the fly larvae occur in abundance (see Heizer 1950) and would have provided a reliable winter staple that involved less effort to obtain than irrigating and harvesting wild plant foods. Steward (1933: 256) indicated that the larvae were also present in Walker Lake at the terminus of Walker River Valley. Thus, the Indians in all of these regions would have had a reliable winter food resource lacking in the northern and central Owens Valley.

According to **Irwin** (**1980**: 47), the Shoshoni called *Hydropyrus hians* larvae *Bishawa'da* and the flies (or pupae?) *ing ga'da* or *ing ga'ra*.

Sutton (**1988**: 49) reports (Nancy Peterson Walter, pers. comm. 1985) that *Hydropyrus* pupae were apparently collected from Mono Lake in numbers even as late as the late 1970s.

Also see Chalfant (1922, as food of the Eastern Monos [Owens Valley Piute]), E. Davis (1963, 1965, food of the Kuzedika Paiute of Mono Lake, Calif.), J. Davis (1961, as a food involved in trade among tribes), Downs (1966, *H. hians* as food of the Washo, who made long trips to collect them), Fowler (1986, as food of Great Basin tribes), Irwin (1980, food of the Inyo County, California Shoshoni), Kroeber (1925, food of the Koso or Panamint), Merriam (1979, food of the Mono Paiute and Panamint Shoshone), Muir (1911, food of the Mono Paiute), Powers (1877b, as food at Owens Lake), Steward (1933 as food at Owens Valley and Mono Lake; 1941, food of the Nevada Shoshoni), Stewart (1941, food of the Northern Paiute), and Strong (1969, food of the desert people).

Oestridae (warble flies, bot flies)
Hypoderma bovis Linn., larva
Oedemagena tarandi (Linn.), larva

Russell (**1898**: 228) noted that some Indian tribes in the far north depend almost entirely on the caribou for survival -- for food and for skins for lodges and clothing. Every part of the animal was utilized, including the grubs in its back (considered to be *Hypoderma lineatum* de Villers by Russell, but now known as *H. bovis*). The grubs were well-developed by the latter part of April. Russell states, "The Indians did not remove them from pieces of meat destined for the kettle," but cites an earlier report by Hearne that, "They are always eaten raw and alive out of the skin and are said by those who like them to be as fine as gooseberries." Children were particularly fond of them. **Felt (1918)** cites R.M. Anderson (1918) and says: "He states that the Eskimos pick out the grubs from the hides in the spring and eat them like cherries and adds, apparently from experience, that they are very watery and absolutely tasteless."

Harper (**1955**: 52, 57) reported that "the larvae of the warble fly (*Oedemagena tarandi*), found beneath the skin of the Caribou, are relished by the Eskimos, being eaten apparently while alive and raw." Harper cites a 1795 paper by Hearne reporting the Indians as eating the warbles in his day.

Rhagionidae (snipe flies)
Atherix sp., egg masses with adult females

Aldrich (**1912b**) relates two Indian accounts of harvesting a species of *Atherix*, a fly genus in which oviposition sites may become covered with a mass of both flies and eggs to a depth of several inches. In the first account, by a Modoc Indian, the flies were called *Ha-lib-wah*, and they were gathered early in the summer in the following manner:

> The Indians would place logs across the river in about the same manner that a present-day log or lumber boom is constructed. Then they would go up stream and shake the flies off the willow bushes growing along the banks of the river. The flies falling on the water would float down stream and lodge against the logs in great quantities. As many as a hundred bushels could be gathered in this way in a single day. The Indians used a kind of basket to dip the flies from the water and carry them to the place where they were to be prepared for food.

Aldrich describes in detail the method of preparing the flies in a pit lined with hot stones.

The account given to Aldrich by a Pit River Indian, also referring to Modoc County, California, was somewhat different:

> [The flies would gather] near the head of a small canyon through which flowed a small stream of water. . . some time in the month of May, and could be gathered by the tons. The trees, bushes and rocks were covered with them in places to the depth of five or six inches. Hence it was no trouble to gather them, for they could be scraped off the rocks and trees into great heaps. . . The time of gathering them was in the cool of the morning when they were all settled and too cold to fly. In the heat of the day the air would be so filled with them as to exclude the sun and one could see but a short distance.

The food was called "Why-hauts" by the Pit River Indians, and a great deal of it was used as part of the winter food supply. Their method of preparation, described by Aldrich, was somewhat different from that of the Modoc Indians.

Essig (**1931**) made several trips to the Pit River in an attempt to collect specimens and determine the identity of the *Atherix* species reported earlier as food by Aldrich, but he was not successful. Extensive power developments may have altered the habitat sufficiently that the insect is no longer abundant. He did find along the river, however, "the California salmon fly, *Pteronarcys californica* Newport, a plecopteran that emerges in enormous numbers during the month of May" and "fairly swarms on the bushes along the streams" in the area. "The adults could be shaken from the bushes and collected in bulk as they readily float on the water." This insect is used extensively for trout fishing in the region, but whether it might be the insect collected earlier as food can not be known with certainty.

Tipulidae (crane flies)
Holorusia rubiginosa Loew, larva
Tipula derbyi Doane, larva
Tipula quaylii Doane, larva
Tipula simplex Doane, larva

Essig (**1931**) reported that larvae of *Holorusia rubiginosa*, which occurs in freshwater streams, and several *Tipula* species, *T. simplex*, *T. derbyi* and *T. quaylii*, are abundant in the late winter and early spring in California and formed a ready supply of food when most other foods are scarce.

Crane fly remains comprised 25% of a human coprolite recovered from Bamert Cave in east-central California (**Nissen 1973**: 66-68).

Miscellaneous Diptera

Waugh (**1916**: 139) cites DuPerron (1638-1639) that the Hurons made a porridge of corn meal and water to which they sometimes added a handful of small gnat-like "waterflies"; this they esteemed highly and made "feasts of them."

Hemiptera

Belostomatidae (giant water bugs)
Lethocerus americanus Leidy, adult

Essig (**1949**), in addition to several species discussed in his earlier papers as food for the western Indians, mentions that the common waterbug, *Lethocerus americanus* (Leidy), was and is still eaten by man.

Homoptera

Aphididae (aphids)
Hyalopterus pruni (Geoffroy) (= *H. arundinis* Fabr.), honeydew

The sweet honeydew exudations of aphids and coccids were called "Indian honey" by the early whites in California (**Essig 1931**). It was particularly abundant on willows along streams and on and under shrubs in the arid regions. Although this crystallized excretion was widely used in the Great Basin, **Sutton** (**1988**: 73-76) considered it a minor resource. For many years, as shown by the earlier accounts following, the insect source of the honeydew was not known.

Palmer (**1871**: 423) discussed a sweet substance produced by or on bent grass (*Arundo phragmites*):

> This species of reed, which grows abundantly around St. Thomas, in Southern Utah, during the summer months, produces a kind of white, sweet gum. The Utah Indians cut down the reeds and lay them in piles on blankets or hides, and let them remain for a short time to wilt, when the bundles are beaten with rods to release the gum. The small particles so detached are pressed into balls, to be eaten at pleasure. It is a sweet, manna-like substance.

Powell (**1881**: 44) mentions "honey-dew" in discussing Indian mythology:

> The next day he met the elder brother and accosted him thus: 'Brother, your words were wise; let the *U-in-ka-rets* work for their food. But how shall they be furnished with honey-dew? I have thought all night about this, and when the dawn came into the sky I sat on the summit of the mountain and did think, and now I will tell you how to give them honey-dew: Let it fall like a great snow upon the rocks, and the women shall go early in the morning and gather all they may desire, and they shall be glad.' 'No,' replied the elder brother, 'it will not be good, my little brother, for them to have much and find it without toil; for they will deem it of no more value then dung, and what we give them for their pleasure will only be wasted. In the night it shall fall in small drops on the reeds, which they shall gather and beat with clubs, and then will it taste very sweet, and having but little they will prize it the more.' And the younger brother went away sorrowing, but returned the next day and said: 'My brother, your words are wise; let the women gather the honey-dew with much toil, by beating the reeds with flails.'

Orcutt (**1887**) was informed by a local rancher in northern Lower California that the sweet substance formerly used by the Indians (of which there were now few) was gathered from a low shrub which proved to be *Rhus ovata*. As described by Orcutt, "This curious substance when rolled together in the hand would form little balls of about the same consistency as the whitest of bees' wax; upon tasting, it was found to be as sweet and delicious in flavor as the best of refined sugar."

Witherspoon (1889) described the honey dew harvest by the Nevada Indians as follows:

> Early in the morning the squaws and children cut the tules and brought them to the shore in armfuls. They were then spread upon blankets, pieces of old canvas or calico, and exposed to the sun. In time the small drops of 'dew' crystallized by evaporation. When in the proper state the tules were beaten with willow wands from which the bark had been removed. This beating detached the particles of dew which fell on the cloth beneath from which it was removed with great care.

Witherspoon notes that the arduous labors of the Indians for such slight returns was evidence of the high value they placed on this product. He states that he was informed by white men living near Honey Lake that the lake derived its name from the honey dew.

Bidwell (**1890**: 126; also **1928**: 52), a pioneer in the Humboldt Sink area in 1841 stated:

> We saw many Indians on the Humboldt, especially towards the sink. There were many Tule marshes. The tule is a rush, large, but here not very tall. It was generally completely covered with honeydew, and this in turn was wholly covered with a pediculous-looking [louse-like] insect which fed upon it. The Indians gathered quantities of the honey and pressed it into balls about the size of one's fist, having the appearance of wet bran. At first we greatly relished this Indian food, but when we saw what it was made of -- that the insects pressed into the mass were the main ingredient -- we lost our appetites and bought no more of it.

Coville (**1892**: 355), in describing the customs and foods of the Panamint Indians of Inyo County, California (part of the Shoshonean family), provides the following:

> *Phragmites vulgaris*, the common reed, furnishes what is known as 'sugar.' In the early summer, commonly in June, when the plants have attained nearly their full size, they are cut and dried in the sun. When perfectly brittle the whole plant is ground and the finer portion separated by sifting. This moist, sticky flour is moulded by the hands into a thick gum-like mass. It is then set near a fire and roasted until it swells and browns slightly, and in this taffy-like state it is eaten.

Bolton (**1919**, II: 56), in the account of Father Kino in California, Arizona and Sonora, mentions honeydew:

> In order that sugar, which with so great artifice and toil is made over here, may not be lacking to the Californians, heaven provides them with it in abundance in the months of April, May, and June, in the dew which at that time falls upon the broad leaves, where it hardens and coagulates. They gather large quantities of it, and I have seen and eaten it. It is as sweet as sugar to the taste, and differs only in the refraction, which makes it dark.

Humorous to this writer is the following excerpt from Father Kino (pp. 58-60):

> All this fertility and wealth God placed in California only to be unappreciated by the natives, because they are of a race who live satisfied with merely eating. . . by nature they are very lively and alert, qualities which they show, among other ways, by ridiculing any barbarism in their language, as they did with us when we were preaching to them. When they have been domesticated they come after preaching to correct any slip in the use of their language. If one preaches to them any mysteries contrary to their ancient errors, the sermon ended, they come to the father, call him to account for what he has said to them, and argue and discuss with him in favor of their error with considerable plausibility; but through reason they submit with all docility.

Bolton (**1927**: 153, 219), from the diaries of missionary explorer Fray Juan Crespi in California, makes brief reference to receiving as gifts from the Indians the sweet dew that sticks to the reed grass.

Woodward (**1934**) draws from an 1859 newspaper article the information that the Chumash Indians of the Tulare country, who came once a year to the Mission Santa Barbara for trading, included among their wares "panoche, or thick sugar, made from what is now called honey dew, and the sweet carisa cane, and put up into small oblong sacks made of grass and swamp flags."

Concerning sources of sweets among the California Indians observed during expeditions in 1769 and 1770, **Fages** (**1937**: 79) writes: "The juice of the reed grass (*carrizo*) is obtained, after it has been harvested in season, by exposure to the sun for four or five days, when it can be shaken from the leaves, coagulated, and

dried, falling like the manna of the apothecary shops."

Woodward (**1938**) reviewed earlier literature relative to the "honey" used by California Indians and concludes that it "was not the product of bees, but was rather the exudations of sucking insects gathered by the tribesmen and formed into cakes or stored in woven bags for home consumption and trade."

Harrington (**1945**) cites correspondence with B.R. Stuart regarding honeydew:

> The Southern Paiute also had another secondary supply of sweets which I have never read anything about. In the spring this native cane, which grows in the river valleys and near springs, is attacked by a small white species of Aphis. This aphis brings the sap out of the cane-stalk and it hardens or crystallizes in small gobs in the air. The Paiute used to scrape these off, aphis and all -- the more aphis in the gob, the better.

During correspondence with Stuart, Harrington received a sample of the sugar (which was somewhat aged) and states that it looked like maple sugar and tasted something like malted milk. From Stuart, Harrington learned that the tribal elders used the term *pa gymph* for the sugar (literal translation, "water weed") which they took from carriso cane growing in wet or marshy spots in the Muddy River valley. As related by an elderly Paiute woman, the cane was cut and the bundles spread out to dry in the sun for a day. Then, while held over a hide, the canes were beaten with a short stick to dislodge the *pa gymph*, which was rolled into balls about the size of a turkey egg. Early May was usually the time for gathering the sugar. The balls were wrapped in cane leaves and stored in a basket for later use as needed.

Heizer (**1945**) provides a valuable review of the earlier literature on sugar gathering in the western United States, noting that the methods of gathering were similar even in widely separated localities. The common method was to cut the plants, allow them to dry in the sun, then beat or thresh them to shake off the tiny droplets which were then gathered and pressed into balls or cakes. According to Heizer's personal notes: "The Humboldt Lake Paviotso cut the cane off carefully at the base in order not to loosen the sugar grains. Cutting took place in September or October before the first rains which would dissolve and wash off the honey-dew. The cane was laid on tule mats and threshed. The sugar fell off and the resultant product was wind-winnowed to remove the small stem and leaf particles."

In researching early Mission records in California on the use of honey-dew by the Indians and its adoption by the Fathers, **Jones** (**1945**) cites Pere Picola who wrote in 1702: "In the months of April, May and June there falls with the dew a kind of manna, which solidifies and hardens on the leaves of reeds from which it is collected. I have tasted some. It is a little less white than sugar, but has all the sweetness of it." Jones mentions that some of the Fathers considered this "manna" as a special dispensation from Heaven and that explorers and missionaries of the time talked of cakes of sweet paste. Jones credits Woodward (1938) with showing that the manna was not from the sky and not from bees.

Jones was the first to report the specific identity of the insect, the aphid, *Hyalopterus pruni* (Geoffroy) (= *arundinis* (Fabr.)). It is called the mealy plum aphid because it spends its winter phase on plum trees and other species of *Prunus* (Jones cites Davidson [1919] for details on the life cycle of the aphid). In the spring and early summer it migrates to summer hosts, primarily reed grass, *Phragmites* (= *Arundo*) *communis*, from which it sucks sap and secretes the honeydew on stems and leaves where it crystallizes. Jones says that the reed grass is a tall reed or cane that grows along streams and in lake margins and other moist situations, and it is probable that all of the references to the host plant of the aphid producing the honeydew used by Indians, whether as "tule," "canes," "reeds," or "carrizo," actually refer to this species.

Jones summarizes the activity associated with honey-dew collection as follows:

> The gathering of the honey-dew seems to have been one of the annual seasonal rounds of activity of the Indians of the Great Basin. A family or band might camp for a short time near a stream or lake when the honey-dew was ready. Piecing together various accounts of the manner of collection gives a picture about as follows: The collection seems to have been primarily the work of women and children. The reeds were cut and carried away from the water. Stuart suggests that the mescal knife might have been used in the cutting. Cutting was done just after sunrise, and the reeds were spread out to dry during the warmer part of the day to dry the honey-dew and make it brittle. During the afternoon the reeds were held over a hide and beaten with a stick to dislodge the deposits of honey-dew which fell on the hide and could be collected. In recent times blankets and pieces of canvas cloth have been substituted for hides. The honey-dew was rolled into balls, wrapped in leaves, and stored in baskets until needed.

According to Jones, the practice of honey-dew collecting centered among the Paiute and was delimited

roughly by the boundary of the Shoshonean area of the Great Basin and southern California, although there are some records indicating the practice extended up the California coast among the Chumash, Salinan, and Costanoan Indians and also a short distance into the southern Yokuts area. There appear to be no records of its use by the Pueblos or their neighbors or by tribes of the Gila-Salt drainage. Some of the Yavapai and Cocopa are said to have used honey-dew from willows and other plants but not from reed grass. Jones notes that saccharine foods were rare in North America outside the maple-sugar region, and thus, when found, were eagerly exploited even at great labor. Thus, the energy exerted in collection of the honey-dew "suggests that the product was highly prized."

Bye (**1972**: 91) notes, relative to the Southern Paiutes and the reed, possibly *Phragmites communis* Trin., that the "brownish-sugary substance with various inclusions possibly represents accumulation of honeydew [earlier investigators are cited]...The sweet conglomeration was eaten whole and was mixed with water to make a beverage."

See also Bolton (1927, gifts of honeydew from southern California Indians, Chalfant (1922, honeydew as food of the Eastern Monos and Panamints), Drucker (1937, as food of southern California tribes), Fowler (1986, food of Great Basin tribes), Gifford (1940, as food of Apache Pueblo groups in southwestern U.S.), Harrington (1942, food of the Chumash and other groups along the central California coast), Landberg (1965, food of the Chumash in southern California), Steward (1933, food of the Owens Valley Paiute), and Voegelin (1938, food of the Tubatulabal of California).

Cicadidae (cicadas)
Diceroprocta apache (author?), nymph and adult?
Magicicada (= *Cicada* and *Tibicen septendecim* Linn. complex, nymphs. Other periodical cicadas (*Magicicada*) in the complex include *M. cassini* Fisher, *M. septendecula* Alexander & Moore, *M. tredecim* Walsh & Riley, *M. tredecassini* A. & M., and *M. tredecula* A. & M.
Okanagana bella Davis, nymph and adult?
Okanagana cruentifera Uhler, nymph and adult?
Platypedia areolata Uhler, nymph and adult?

Although there are numerous reports of the use of cicadas by groups in the Great Basin, **Sutton** (**1988**: 53-55) notes that cicada consumption may be underrepresented in the literature because of the confusion in terminology in which cicadas are often called locusts. Although specific species have not been identified in the ethnographic record, Sutton mentions that species that are sometimes common in the Great Basin include the bloody cicada (*Okanagana cruentifera*), the bella cicada (*O. bella*), the orchard cicada (*Platypedia areolata*), and possibly *P. lutea*. The largest of these is *O. cruentifera*, which measures about 32 mm in length. After emerging from the ground and molting it takes about a day before the adults are ready to fly. This is a vulnerable stage for easy harvest. Sutton concludes that cicadas were a minor resource because they didn't occur each year and rarely occurred in large concentrations. Cicadas are among the few insect groups reportedly used as food in the eastern part of the continent (e.g., see Collinson (1764), Waugh (1916) and Carr (1951)).

Sandel (**1715**: 71; vide Bodenheimer 1951: 285) reported on the cicada as a food of the Indians. **Collinson** (**1764**), in describing the emergence of the cicada in Pennsylvania, included among general remarks that they are a repast of the Indians, who, after plucking off the wings, boil and eat them.

Marlatt (**1907**: 102-104) quotes from correspondence to Dr. Asa Fitch from Mr. W.S. Robertson that, "the Indians make the different species of Cicada an article of diet, every year gathering quantities of them and preparing them for the table by roasting in a hot oven, stirring them until they are well browned." Marlatt also notes that Mr. T.A. Kelcher who sampled some of the cicada dishes described by Riley and Howard informed him "that he found the cicadas fried in batter to be most palatable, and that he much preferred them to oysters or shrimps." Marlatt concludes:

> The use of the newly emerged and succulent cicadas as an article of human diet has merely a theoretical interest, because, if for no other reason, they occur too rarely to have any real value. There is also the much stronger objection in the instinctive repugnance which all insects seem to inspire as an article of food to most civilized nations. Theoretically, the Cicada, collected at the proper time and suitably dressed and served, should be a rather attractive food. The larvae have lived solely on vegetable matter of the cleanest and most wholesome sort, and supposedly, therefore, would be much more palatable and suitable for food than the oyster, with its scavenger habit of living in the muddy ooze of river bottoms, or many other animals which are highly prized and which have not half so clean a record as the periodical Cicada.

Marlatt conducted biological studies on *Tibicen septendecim* (Linn.), having a 17-year cycle, and *T. tredecim*

(Walsh and Riley), with a 13-year cycle, but his discussion of cicadas as food does not necessarily pertain only to those two species.

According to **Wyman and Bailey** (**1964**: 42), cicadas were among the few insects used as medicine among the Navaho and the only insects that were ever used as food:

> Most informants said that cicadas were eaten only in 'the old days,' in their grandparents' time, perhaps when food was scarce, but that children sometimes eat them now, that adults might eat them because 'it is healthy' or 'for protection for being strong.' Usually the wings and the legs and sometimes the head were removed and the body roasted in hot ashes. Other methods mentioned were to burn off the wings and legs and salt the insects, to grind them with salt, to fry them, or to eat them raw. The taste was likened to peanuts, popcorn, or crackerjack; 'it has its own sugar.'

Wyman and Bailey (p. 43) provide the species identity of several Cicadidae of the genera *Beameria*, *Okanagana*, and *Tibicen* which were distinguished and named by the Navaho, but they do not indicate which of the species were used as food.

Park (cited in a 1986 presentation by C.S. Fowler; which is quoted here from **Sutton 1988**: 54) reported that the Northern Paiute at Pyramid Lake gathered "Kta" which Fowler identified as a cicada, probably *Okanagana bella*. They were gathered in the early morning or evening, cooked in a small pit, and stored whole (minus the legs and wings that had burned off) for winter use. It was stated that the cooked cicadas tasted like "cooked oysters" and would not spoil.

According to **Ebeling** (**1986**: 368), cicadas, *Diceroprocta apache*, were gathered in large quantities from saltbush by the Cahuilla, and were roasted and eaten.

See also Bean (1972, cicadas as food of the Cahuilla of southern California), Carr (1951, as food of the Cherokee in N. Carolina), Chalfant (1922, food of the Eastern Monos and the Panamints), Cowan (1865, food of North American Indians), Cushing (1920, cicadas possibly a food of the Zuni), Fowler (1986, food of Great Basin tribes),Lando and Modesto (1977, food of the Cahuilla), Malouf (1974, food of the Gosiute), Merriam (1979, food of the Paviotso (Northern Paiute)), Steward (1941, food of the Nevada Shoshoni; 1943, food of the Northern and Gosiute Shoshoni of eastern Idaho and northern Utah), Stewart (1941, food of Northern Paiute; 1942, food of the Ute-Southern Paiute) and Waugh (1916, as food of the Iroquois).

Hymenoptera

Sutton (**1988**: 61-67) concluded that consumption of at least several genera of ants was widespread in the Great Basin. Larvae, pupae and adults were used; references to "ant eggs" most likely refer to larvae and/or pupae. Ants were easily stored and undoubtedly formed an important portion of the winter diet of some groups. They also had medicinal and ritual uses (which Sutton describes).

Bee and yellowjacket larvae/pupae were fairly widely used in the Basin, but they appear to have been a minor resource that was gathered incidental to other activities (Sutton, pp. 69-72). Honey also was a minor resource because the native species of bees do not produce appreciable quantities.

Anthophoridae (digger bees)

See Hrdlicka (1908, anthophorid honey a food of Tarahumare children.)

Apidae (honey bees, bumblebees)

Bombus appositus Cresson, larva/pupa
Bombus nevadensis Cresson, larva/pupa
Bombus terricola occidentalis Greene, larva/pupa
Bombus vosnesenskii Radoszkowski, larva/pupa

Essig (**1931**) mentions that the larvae of wild bees were eaten raw by the Indians of northwestern California. According to **Palmer** (**1871**: 423), "The Winnebago and other tribes of the Indian Territory, near the borders of Texas, gather large supplies of wild honey, which is very abundant and much esteemed."

Muir (**1911**) mentioned bumblebee larvae among the foods of the Digger Indians. **Gifford** (**1940**) mentions the use of bumblebee and black-bee honey. **Sutton** suggests several species of bumblebees that, on the basis of their abundance, might have been eaten: the western bumblebee, *Bombus occidentalis*, which is the most common species in the western United States; the Nevada bumblebee, *B. nevadensis*; the mountain bumblebee, *B. appositus*; and the yellow-faced bumblebee, *B. vosnesenskii*, which are also common.

See also Bean (1972, food of the Cahuilla), Downs (1966, food of the Washo in California and Nevada),

Fowler (1986, food of Great Basin tribes), Myers (1978, food of the Cato in northwestern California), Olmsted and Stewart (1978, food of the Achumawi in northeastern California), Steward (1933, food of the Owens Valley Paiute) and Stewart (1980, food of the Western Shoshone in Nevada).

Cynipidae (gall wasps, etc.)

According to **Carr** (**1951**), the Montauk Indians of Long Island considered the oak gall produced by a cynipid wasp a food delicacy. The spongy inside fiber was eaten under the name "sour jigs". **Essig** (**1931**) mentions that the galls of the cynipid wasp, *Disholcaspis eldoradensis* (Beutm.), which often occur abundantly on the stems of oak (*Quercus* spp.), secrete quantities of honeydew, but it is not known whether the Indians made use of it.

Formicidae (ants)
Camponotus sp., larva, adult
Formica rufa Linn., larva/pupa/adult?
Lasius niger Linn., larva/pupa/adult?
Myrmecocystus melliger Forel, honeypots
Myrmecocystus mexicanus hortideorum McCook, honeypots
Pogonomyrmex californicus Buckley, larva/pupa/adult?
Pogonomyrmex desertorum Wheeler, larva/pupa/adult?
Pogonomyrmex occidentalis Cresson, larva/pupa/adult?
Pogonomyrmex owyheei Cole, larva/pupa/adult?
Pogonomyrmex sp., adult

James (**1823**: 195-196) provided an account of the use of ants:

> A singular description of food is made use of by some tribes of Snake Indians, consisting chiefly, and sometimes wholly of a species of ant, (formica, Lin.) [possibly *Pogonomyrmex owyheei*, according to Sutton 1988] which is very abundant in the region in which they roam. The squaws go in the cool of the morning to the hillocks of these active insects, knowing that then they are together in the greatest numbers. Uncovering the little mounds to a certain depth, the squaws scoop them up in their hands, and put them into a bag prepared for the purpose. When a sufficient number are obtained, they repair to the water, and cleanse the mass from all the dirt and small pieces of wood collected with them. The ants are then placed upon a flat stone, and by the pressure of a rolling-pin, are crushed together into a dense mass, and rolled out like pastry. Of this substance a soup is prepared, which is relished by the Indians, but is not at all to the taste of white men.

In New Brunswick, some Malechites indulged in crushed black ants found in dead trees, and considered them a medicinally beneficial tidbit in the spring (**Carr 1951**).

Palmer (**1871**: 426-427) states that:

> This tribe [Diggers of California and the Plains] also feed upon ants, catching them by spreading a dampened skin or fresh-peeled bark over their hills, which immediately attracts the inhabitants to its surface. When filled, the cover is carefully removed and the adhering insects shaken into a tight sack, where they are confined until dead, and are then thoroughly sun-dried and laid away. Bushels are thus gathered annually, and are not more offensive than snakes, lizards, and crickets, which the tribe also eat.

McCook (**1882**: 30-33) sampled the flavor of the honey from honey ants while conducting biological studies on the species, *Myrmecocystus melliger*, in Colorado: "It is very pleasant, with a peculiar aromatic flavor, suggestive of bee-honey, and quite agreeable to me. Dr. Loew describes it as having 'an agreeable taste, slightly acid in summer from a trace of formic acid, but perfectly neutral in autumn and winter.'" McCook discusses the uses and commercial potential of the ants as follows:

> The uses to which the Mexicans and Indians put this ant-honey are various. That they eat it freely, and regard it as a delicate morsel is beyond doubt. Prof. Cope, when in New Mexico, had the ants offered to him upon a dish as a dainty relish. The Mexicans (Loew) press the insects, and use the gathered honey at their meals. They are also said to prepare from it by fermentation an

> alcoholic liquor. Again, they are said (Edwards) to apply the honey to bruised and swollen limbs, ascribing to it great healing properties. Dr. Loew's suggestion to bee-keepers to test the commercial value of these ants as honey-producers is wholly impractical. The difficulties of farming the colonies, gathering the supply, and the limited quantity of the product, would prevent a profitable industry. The greatest number of honey-bearers in a large colony, taking my observations as a standard, will not exceed six hundred, which counting six grains of honey to the ant, would be little more than one-half pound avoirdupois. Besides, the sentiment against the use of honey thus taken from living insects, which is worthy of all respect, would not be overcome. The Mexicans and Indians will therefore probably not be disturbed in their monopoly of the honey-product of the nests of Melliger.

McCook, in weighing six average-sized honey-bearers, found an average body weight (without honey) of 0.048 g and an average weight of honey per ant of 0.394 g, thus the weight of the honey was 8.2 times the weight of the body. Thus, it would require nearly 12 hundred (1,166) ants to yield a market or avoirdupois pound.

Wheeler (**1908**) quotes (pp. 371-372) from an 1875 publication by Saunders of observations made by a Mr. Krummeck on the biology of *Myrmecocystus mexicanus* var. *horti-deorum* McCook in the mountains around Santa Fe:

> He does not think that the honey is deposited by these honey ants in cells, as has been stated, but that they keep the fluid in their bodies, and the workers feed from them, and that when the honey in the sac of an individual is exhausted, it dies. In reference to the uses made of this honey in New Mexico, he says that the natives make a very pleasant drink of it, which is made in the proportion of three or four drachms of the honey to six ounces of water. It has not commercial value, is not brought to market, but simply made for their own use. They use this drink among themselves in the mountains in cases of fever, where medical attendance cannot be obtained. The honey is also used by them as a cure for eye diseases, especially for cataract.

Muir (**1911**: 45-46) describes how the Digger Indians of California are fond of both the larvae and adults of a large (about 3/4 inch long), jet-black, woodboring ant [*Camponotus sp.?*]. "They bite off and reject the head, and eat the tickly acid body with keen relish."

Egan (**1917**: 228-229) described how an Indian woman collected ants and ant "eggs" from a large ant-hill:

> . . . taking a large flat basket arrangement, pushed the top of the hill to one side and then scooped up about a peck of ants, gravel, dirt and all. Taking it to one side she spread on the ground a piece of flour sack, then taking the pan or basket in her hands, gave it an up and down motion at the side opposite from her. You ought to see those ants roll over the side and fall on the cloth! But not a bit of gravel or speck of dirt went with them. I have often seen the Squaws cleaning grass seed or wheat the same way, only the wheat or seed was left on the pan, and the chaff and dirt went over the edge.

In two or three trips to the ant-hill she had collected about a quart of ants and "eggs."

Essig (1934) mentions the use of ant larvae in California for food rather than for medicinal purposes.

Reagan (**1934a**: 54) states that "In the Deep Creek country there is a large red ant [possibly *Pogonomyrmex occidentalis*, according to Sutton 1988, p. 64] that makes a large bushy mound for a home. In the old times the Goshutes used to go to these ant hills and collect the ants and the ant eggs [larvae?] in a basket, take them home and boil them into a soup which the people assured the writer was a delicious dish."

Reagan (**1934b**: 60) reports that the Indians in Wintey River country (Utah) had been known, when pressed with hunger, to gather up crickets and ants, dry them in the sun, pound them and make bread of them.

Peter Skeene Ogden (**Rich and Johnson** (**1950**: 133, 139) observed ants being eaten by Northern Paiute in Idaho in February, 1826; the ants were collected early in the morning before thawing. According to Ogden, ants were preferred over locusts as food because they were fatter. In March, 1826, when 10 inches of snow covered the ground, Ogden encountered Northern Paiute who had nothing in their hut but a small stock of ants and a few wild prickly pears.

Euler (**1966**: 113), citing from Thomas Brown's unpublished journal, notes that Southern Paiute were observed eating matted and boiled ants in the mid-1800s. **Stewart** (**1966**:53) cites the earlier report by Father deSmet on the eating of ants and grasshoppers by the Ute.

Burgett and Young (1974) analyzed repletes of *Myrmecocystus mexicanus* and *M. mimicus* collected in Arizona and found sugars in the following proportions: fructose 47-49%, glucose 42-44%, and maltose 7-8%.

Blackburn (1976-1977) presents evidence that the Kitanemuk of California ingested ants (accompanied

with fasting) to produce hallucinogenic or mind-altering effects. Ants were apparently used similarly in some neighboring Indian groups, and a number of potentially mind-altering substances have been isolated from ant toxins.

Hall (**1977**) reported recovery of body parts of ants (probably *Formica* sp.) from two coprolite specimens from Zone One (p. 7, Table 1) at Dirty Shame Rockshelter, dated to between 400 B.P. and 1100 B.P.

Conway (1977) studied repletes of the honey ant *Myrmecocystus mexicanus hortideorum* McCook dug from nests in Colorado and found that color varies from clear to a very dark amber, with the latter forming about 96%. Analyses of crop fluid showed that the dark nectar contained more dissolved solids (53.6%) with glucose (18.7%) and fructose (11.9%) predominant among identifiable solids. Only a trace of sucrose was found. Clear repletes, on the other hand, contained only 1.0% of solids with sucrose (0.58%) predominant. The nectar from both clear and dark repletes was acidic, with a ph of 4.5 in the former and 3.6 in the latter. In weight, dark amber repletes averaged 0.19 g, while a single clear replete weighed only 0.07 g. Dark amber nectar has the taste, smell and coloration of cane molasses, according to Conway, while clear replete syrup has no detectable taste or smell. Considering the arid environment in which these ants live, it is a reasonable assumption that the clear repletes serve simply as water-storage vessels.

Honey ant repletes are modified workers with greatly distended abdomens that hang from specially constructed domed chambers. In the case of *M. mexicanus*, the "conventional" workers forage for nectar on summer evenings, return to the colony and regurgitate it to the repletes. Conway observed workers collecting nectar from reddish-brown galls on scrub oaks (*Quercus gambellii*) and from the surface of green yucca (*Yucca glauca*) capsules, and occasionally sipping honeydew from aphis on yuccas. The ants also brought dead arthropods to the nest. Conway found the first repletes in chambers 17-51 cm below the surface, but more commonly between 20 and 35 cm. The number of replete chambers per nest ranged from 7-21 and they were found at depths down to 1.8 m.

A species of honey ant that was probably eaten although there are no reports of it is *Myrmecocystus mimicus*. The abdomens of the repletes are "the size of blueberries," and there may be 2,000 repletes in a colony of 15,000 ants, according to **Holldobler** (**1984**; vide Ebeling 1986: 28-30), who studied the species in Arizona.

Ebeling (**1986**: 28-30) gives a brief summary of the life history of *Myrmecocystus* and amount of honey produced, and reports (p. 180) that the Atsugewi "ate the eggs of a red ant they called *sinosita*" which they dug from the anthills and shook into a basket.

Sutton (p. 61) speculates that genera and species which, from ecological considerations, were probably of importance as food in the Basin included the red harvester ants, *Pogonomyrmex occidentalis*, *P. owyheei*, *P. desertorum*, and *P. californicus*, the former two of which are much larger than the latter two. Other ants endemic to the Basin include the red ant, *Formica rufa*, carpenter ants, *Camponotus* spp., and the American black ant, *Lasius niger*. The honey ant, *Myrmecocystus mexicanus hortideorum* occurs throughout the Basin and may have been used as food.

The newspaper, *The Sunday Oregonion* of June 27, 1993, reported that Paiute-Shoshone tribal members were considering whether to let the government store its radioactive nuclear waste on their reservation, creating badly needed jobs and economic growth. The reservation is in a remote area along the Oregon-Nevada border. Ernestine Coble, 46, tribal council chairwoman, who was quoted at length, believes that the old values are slipping away and she would like to save the ones that remain. For instance, her grandmother would say, "Well, we're going to have ant pudding. You'd better get ready. We're going to have to leave when the sun comes up." Eight-year-old Ernestine's job was to put on warm clothing and to carry an empty coffee can. They would hike around the res (short for reservation). Her grandmother would spot a mound, lift the top like an old straw hat, and scoop out balls of cold-numbed ants. They were put into the coffee can and cooked on the old wood stove. Ernestine said that the ant pudding was not her favorite food, but it was a tradition and an anchor to a world of power and solidarity. From the article it can be calculated that the older generation of Paiutes in Oregon were still eating at least some of their insect foods as recently as about 1955.

From ethnographic accounts, it appears that adult ants consumed were primarily the workers (e.g., Kelly 1932, Reagan 1934, Steward 1941, 1943, Stewart 1942, Voegelin 1942). The author has seen no accounts from North America suggesting that winged males and females were harvested, which is the case with many of the ants harvested on other continents.

See also Bean (1972, ants as food of the Cahuilla of southern California), Bequaert (1922, food of N. American Indian tribes), Davis (1965, food of the Kuzedika Paiute), Downs (1966, food of the Washo of California and Nevada), Elliot (1909, food of the "Snake Indians" in Utah), Fladung (1924, food of Shoshones), Fowler (1986, food of Great Basin tribes), Frison (1971, *Pogonomyrmex* charred fragments in late prehistoric Shoshonean lodges), Harris (1940, food of the White Knife Shoshoni of Nevada), Heizer (1954, food of the Utah Utes), Kelly (1932, food of the Surprise Valley Paiute; 1938, Northern Paiute tale of ants), Lowie (1909a, food of northern Shoshone, 1924, food of the Lemhi Shoshone), Malouf (1974, food of the Gosiute), Olmsted and Stewart (1978, food of the Achumawi of northeastern California), Ray (1933, ants not eaten by the Southeast

Salish), Ross (1956, food of the Snake Indians), Shimkin (1947, food of the Wind River Shoshone), Steward (1933, food of the Owens Valley Paiute; 1941, food of the Nevada Shoshoni; 1943, food of the Northern and Gosiute Shoshoni), Stewart (1942, food of the Ute-Southern Paiute; 1980, food of the Western Shoshone in Nevada), Strong (1969, food of the desert people), Voegelin (1942, food of northeastern California Indians) and Waugh (1916, food of the Iroquois).

Vespidae (paper wasps, yellowjackets, hornets)
Vespula diabolica Saussure, larva/pupa
Vespula pennsylvanica Saussure, larva/pupa
Vespula spp., larvae/pupae

According to **Daguin** (**1900**: 14; vide Bodenheimer 1951: 292), wasp grubs and pupae were eaten in South Carolina.

According to **Essig (1931)**, the larvae of yellow jackets, hornets and other wasps were readily eaten raw by the Indians of northwestern California. To collect them, the nests were smoked to subdue the adults.

To obtain yellowjacket larvae, **Garth (1953)** reports, as summarized by Ebeling (1986: 182), that:

> The Atsugewi attached a white flower to the leg of a dismembered grasshopper and used the leg as a bait. The flower helped them follow the flight of any yellowjacket (*Vespula*) when it carried the bait away, thereby locating its nest, which was in the ground. The insects in the nest were killed by smoke from burning pine needles. The nest, with its thousands of larvae and pupae, was dug out and roasted over coals, first on one side and then the other.

Sutton (p. 71) notes that the most common yellowjacket in the Basin is *Vespula pennsylvanica*, with *V. diabolica* also common.

See also Barnett (1937, vespids as food of Indians on the Oregon coast), Beals (1933, food of the Nisenan), Callaghan (1978, food of the Lake Miwok in California), Carr (1951, food of the Cherokee in N. Carolina), Dixon (1905, food of the Northern Maidu in the southern Sierra region), Driver (1937, food in the southern Sierra Nevada; 1939, food of the Wiyot in northwestern California), Drucker (1937, food of southern California tribes; 1941, food of Yuman-Piman groups), Essene (1942, food of Round Valley, California groups), Fowler (1986, food of Great Basin tribes), Gifford (1940, food of the Apache-Pueblo), Gifford and Kroeber (1937, food of the Pomo in California), Harrington (1942, food of the Chumash), Heizer (1954, food of the Utah Utes), Landberg (1965, food of the Chumash), Levy (1978a, food of the Eastern Miwok; 1978b, food of the Coastanoan in California), Muir (1911, food of Digger Indians), Myers (1978, food of the Cahto in northwestern California), Olmsted and Stewart (1978, food of the Achumawi), Powers (1877a, food of the Yokuts of California), Riddell (1978, food of the Maidu and Konkow), Steward (1933, food of the Owens Valley Paiute; 1941, food of Nevada Shoshoni; 1943, food of Northern and Gosiute Shoshoni), Stewart (1942, food of the Ute-Southern Paiute) and Voegelin (1942, food of northeast California Indians).

Isoptera

Rhinotermitidae (subterranean termites)
Reticulitermes tibialis Banks

A coprolite from Zone III and one from Zone IV of Dirty Shame Rockshelter in southeast Oregon yielded parts of termites, possibly *Reticulitermes tibialis;* the termites made up 78.3% of the coprolite from Zone IV (**Hall 1977**; 7).

Miscellaneous termites

Essig (1934) mentions the use of termites from decaying wood in California.

Lepidoptera

The use of caterpillars as food has been widely reported throughout the great Basin, with the specific identity best established for two species of moths, the pandora moth, *Coloradia pandora* (Family Saturniidae), and the white-lined sphinx, *Hyles lineata* (Family Sphingidae). The food use of the pandora moth is well-documented in California and much is known about its ecology. Populations in Arizona have been estimated as high as 100,000 per hectare. The caterpillars were known as *piagi*, *Pe-ag'-gah* (big fat ones, good to eat), and

similar spellings, depending on the tribe, and they were widely traded. Several investigators have concluded that the pandora moth provided a significantly greater return for effort expended than did plant resources.

Arctiidae (tiger moths, etc.)
Arctia caja americana Harris, larva

See **Powers (1877a)**. Powers reported two species of "*Arctia*," but according to Arnett (1985: 605), *A. caja americana* is the only North American representative of the genus.

Lasiocampidae (tent caterpillars)
Malacosoma spp., larvae

According to **Essig (1949)**, the hairy tent caterpillars of North America, especially California, which were abundant in the spring, "were singed to remove the hairs and roasted before the fire by the Indians." These caterpillars belong to the genus *Malacosoma*.

Megathymidae (giant skippers)
Megathymus yuccae Boisduval & Leconte, larva

According to **Ebeling** (**1986**: 364-365), the fat larvae of giant skipper butterflies, which develop in agave and yucca and are up to 2 inches long, were often roasted and eaten as a delicacy. The best known California species is *Agathymus stephensi* which burrows in leaves of *Agave deserti* and pupates in a chamber near the base of the leaf, after constructing a "trap door" through which the adult can later escape. Throughout the Southwest, giant skipper larvae were roasted and eaten by the Indians, and Ebeling notes that one of the wide-ranging species in mountains and deserts is the Navajo giant skipper, *Megathymus yuccae navaho*. Ebeling cites one use of agave which, though not relevant to food, shows the intimate knowledge and ingenuity with which the Indians made use of their resources: "At the end of each agave leaf was a hard, needlelike thorn. If it was carefully detached, it came out of the leaf with several feet of fiber attached to it. This made a natural needle and thread. Set into wooden handles with asphaltum, the thorn could be used as an awl to facilitate basket making."

Noctuidae (noctuids)
Heliothis zea Boddie, larva
Homoncocnemis fortis Grote, larva
Spodoptera frugiperda Smith, larva

Barrett (1936) describes an "army worm" used as food by the Pomo of California. It's about 2 1/2 inches long, almost hairless, feeds exclusively on ash, and appears in vast numbers once every several years. The Indians harvest the caterpillars by digging an ingenious and intricate system of pits and trenches, the top edges of which they line with sand. The sand both helps to cause the caterpillars to tumble in and then prevents them from crawling back out. According to Barrett, "It was really a red-letter day in any Pomo community when this little caterpillar made his appearance, and the Indians made this the occasion not only for an immediate feast but they stored for winter use as large quantities as possible of the dried caterpillars." The caterpillars are killed by placing them in a vessel of cold water, where they quickly drown. They are then roasted in hot ashes or are boiled and are devoured on the spot or spread out to dry in the sun for winter use. The male caterpillars are called *li'baiya*, the females *li'mata*. Several hundred pounds could be gathered in a day. The Northern Pomo apparently collected this same species with great ceremony and solemnity, but that was not the case with the central Pomo studied by Barrett.

Swezey (**1978**) deduces that the armyworm reported earlier by Barrett (1936) was probably the noctuid, *Homoncocnemis fortis* (Grote). Swezey states, based on earlier accounts, that this species causes outbreaks with attendent defoliation of ash trees (*Fraxinus latifolia*) every 6-10 years. The Indians relished these almost hairless larvae which they dried and roasted. One Indian woman was quoted: "And when they were good and dry, I used to grab them and eat them. Gee, that was good."

Ebeling (**1986**: 26) includes the larvae of the corn earworm, *Heliothis zea*, and the fall armyworm, *Spodoptera frugiperda*, among the insects used as food by Indians of the arid areas of the West.

Saturniidae (giant silk moths)
Coloradia pandora Blake, larva, pupa
Hyalophora (= *Platysamia*; = *Samia*) *euryalus* Boisduval, larva (See Essig 1958, Arnett 1985)

Aldrich (**1912a**) was the first to call attention to the larva of *Coloradia pandora* as a food of the Paiute Indians of California (although the species had not been taxonomically described at that time). Aldrich spent several days at Mono Lake, California, and the following is extracted from his account:

> While I was at the Mono Lake post-office awaiting the departure of my stage, the postmaster, Mr. John Mattley, an old Swiss pioneer of the basin who had taken a very intelligent interest in my work, asked me, 'Have you seen the worms the Indians eat?' I replied that I had not, but very much wished to do so. . . . He had two Indian women working in his hay-field, both of them at the time standing about in the road by the residence. 'Come with me,' he exclaimed, and approached one of the women, asking her the question, 'Have you got any of those worms on hand?' The woman grinned rather sheepishly, as if expecting the subject to be a matter of ridicule, and said, 'No, all gone.' 'But you had a lot yesterday,' persisted Mr. Mattley. 'All gone,' was all she would reply, so Mr. Mattley took me along to the other woman. She began with the same reply, but finally admitted that there were some of the cooked ones still on hand. 'Show them to us,' demanded Mr. Mattley, and she led us to her camp near by, where she laid back an old cloth and disclosed a much-smoked three-quart tin bucket, nearly full of a yellowish, greasy-looking stew. Considerably excited by the prospect, I picked up a little stick and began to fish in the stew. It was half full of large caterpillars, blackened by drying, resembling dried and stewed prunes as much as anything. One of them I pulled in two and thrust a half in my mouth to see what sort of food it was. I found it tough and flavorless, with an insipidity beyond expectation on account of the absence of salt in the stew. . . .

Aldrich was informed to the effect, regarding harvest, that:

> The caterpillars feed on the leaves of the yellow pine (*Pinus ponderosa*), but not on the one-leafed pinon (*Pinus monophylla*) which is much more abundant about Mono Lake. The Indians collect the caterpillars by making a smudge under the tree, for which purpose they make a trench rather close about the base of the tree; this is presumably to guard against the spread of the fire. As the thick smoke rises and envelopes the caterpillars, it causes them to let go and drop to the ground, where they are collected by the Indians, killed and dried. The preserved material is called Papaia.

A Forest Service official in the San Francisco office later informed Aldrich that, while inspecting a national forest at some distance southeast of Mono Lake, he had observed a considerable area of hillside in which every pine was surrounded by a trench in which there had been a fire. From these observations, Aldrich concluded that "the collection of this caterpillar for food is an industry of considerable importance in the territory along the Nevada-California line."

Aldrich (**1921**) identifies the food called *Pe-aggie* by the Indians around Mono Lake, California, as the caterpillar of *Coloradia pandora* Blake. The caterpillars are regarded as a great delicacy by the Indians, and Aldrich reports (pers. comm. from G.S. Way) that one multifamily group put up 1.5 tons of cured caterpillars during the summer of 1920. Collection and preservation is described as follows:

> The first step in the collection of the caterpillars is to make a trench about the base of each tree, the outer edge of the trench as nearly vertical as possible. This is to keep the caterpillars from straying away when they come down the tree. The Indians go from tree to tree in the collecting season and pick them up out of these trenches. The next process is to kill and dry them. A large mound of dry earth is made and a fire built about it. When it is thoroughly heated, the fire is removed, the mound opened, the caterpillars thrown in and mixed with the hot dirt. Here they remain an hour, until partly cooked and dried. The Indians then sift them out of the mixture with a specially made, cone-shaped sieve, so that the insects are free from dirt. The drying is finished by spreading them on the ground in bark huts for two days, after which they are sacked and keep indefinitely in a cool, dry place.

The life cycle of *C. pandora* requires two years, according to Aldrich, so *pe-aggie* can be collected only every other year. The foodplant is *Pinus jeffreyi*. The eggs are laid in sheltered places in the bark in the latter part of April. The larvae overwinter as "balls" of caterpillars among the pine needles in the tops of the trees. In the following summer, feeding is completed by late June; the larvae descend the tree trunks, and, if they escape the Indians, pupate in the soil.

In describing serious injury to the yellow pine forests of eastern Oregon by the larvae of *Coloradia*

pandora, **Engelhardt** (**1924**) mentions reports that "parties of Indians [Klamath] were assembling in parts of the infested regions for the purpose of harvesting the living pupae which is done by women and children armed with hoes and rakes." He continues: "After gathering the pupae by bushels they are roasted and pulverized and in that shape represent a welcome addition to the menu of Indian food."

Engelhardt reports that the lumberjacks were well-acquainted with the "pine-tree worms," and "they related that during the feeding period in June and early July the constant dropping of excrement made a noise like a sleet storm and that a few weeks previous the tree trunks were literally alive with the worms descending to enter the ground." Ordinarily, the caterpillars are fairly common only every other year, while large outbreaks occur at about 20-year intervals. Engelhardt continues:

> Being too late to search for larvae, we began to look for pupae in the ground below the trees and soon discovered that these could be found easily and in untold numbers by simply combing with one's fingers the loose, volcanic ash of which the soil was composed just below the cover of pine needle mould. A scoop of the hand was likely to produce 3 or 4 and in a short time we had an ample supply. About 50 percent of the pupae had been killed by parasites and bacterial diseases. A large mortality among the fully-grown larvae was also indicated by the windrows of shrivelled-up specimens around the base of trees. Chipmunks and other small rodents and insectivores also no doubt account for a large amount of the pupae, for their shallow excavations could be observed everywhere under the trees.

Engelhardt describes a life cycle that is somewhat at variance with that described by Aldrich:

> The moths are not due to emerge until August or early September of the next year following pupation; the eggs are laid in masses, usually encircling twigs; the young larvae, hatching in September, construct a slight webb, one for each colony, from which they issue to feed but return daily and remain in it for hibernation when frost sets in; this communal life is continued in the spring until the larvae are about half-grown, when they scatter and become vagabonds; pupation takes place in late June and during July.

Miller and Hutchinson (**1928**: 158-160), described harvest and processing of pandora caterpillars by the Monos and Paiutes, relying mainly (as did Aldrich earlier) on first-hand observations made by Forest Ranger G.S Way of the Inyo National Forest, California. The authors state: "The Indians use them in stews, mixing them with potatoes [a late introduction, as noted by Sutton] well seasoned with salt and pepper [also a late addition], and serving them with bread made from pine nuts [*Pinus* spp.] and sunflower [*Helianthus* sp.] seed." Note is made by the authors that, although the practice has almost disappeared, it is the pandora pupae, not the larvae, that are harvested by the Klamath and Modoc in southern Oregon. The pupae are known as "bull-quanch."

Keen (**1929**: 78) describes the use of *C. pandora* as follows:

> The Pai-Ute Indians of the Mono Lake region encircle the infested trees with a trench in which the caterpillars are caught when they descend from the trees. The caterpillars are then collected by the Indians, dried and ground into a paste which is called Pe-aggie and is used as food. The pupae are egg shaped, over an inch in length and of a dark red color; they are called "Bull Quanch" by the Klamath Indians, who dig them out of the ground and relish them as food. During years of bountiful harvest, the young Indians often become ill from a too hearty indulgence in the rich diet. Fortunately for the Indians and for the pine trees as well, the heavy epidemics only occur at intervals of about thirty years.

Spier (**1930**: 160, 227) states that insects are probably not a regular item of diet among the Klamath, but that Gatschet records that women gather moth chrysalids [probably *C. pandora*] in late August and September. The ground is scraped up with a paddle to gather the chrysalids and they are pit-roasted between layers of grass, with a covering of bits of bark and earth.

Essig (**1931**) states that many caterpillars were used as food by the California Indians, but those of *Coloradia pandora* were the most extensively used. The moth occurs throughout the yellow and Jeffrey pine belts of the West. Essig confirms the two-year life-cycle reported by earlier writers. Eggs are laid in clusters on the bark in May, June and July, and the young caterpillars appear in August, feeding on the needles and often defoliating large areas of standing timber. They do not attain full growth until the following June or July when they crawl or drop to the ground to pupate in the soil. The adult moths emerge the following spring. Harvest methods described by Essig are similar to those described earlier, and Essig mentions that the reservation Indians are still using this food.

Gifford (1932: 22-23) notes that the acorns used by the Northfork Mono were more than 50% wormy, but the wormy meats were not thrown out. Earlier workers are cited relative to chrysalids (piagi) of the pandora moth (*Coloradia pandora*) being eaten, after parching with coals in a winnowing basket. Gifford states that the Eastern Mono are reported to eat the caterpillars, while the Klamath Lake Indians and Western Mono eat the chrysalids.

Regarding the taste of *pe-ag-gie*, the stew made from larvae of *C. pandora*, **Essig** (**1934**) says that hungry whites who tasted the food claimed that boarding with the early Californians on the "American plan was not so good."

Emma Davis (**1964**: 261; vide Sutton 1988: 38-39) suggested that small structures for drying and storage were used to dry roasted *piagi* (pandora moth larvae), although this interpretation has been questioned (see Weaver and Basgall 1986: 169).

Carolin and Knopf (**1968**) mention that, in collecting pandora moth larvae (the Paiute tribe) and pupae (the Modoc and Klamath), the Indians must have effected some direct control of this damaging pest in localized areas. The Paiute smoked the larvae out of trees with smudge fires and caught them in trenches. They were dried and cooked with vegetables in a stew called "peage". The pupae were called "bull quanch" and considered a delicacy.

Furniss and Carolin (**1977**: 195), in discussing the biology and outbreaks of the pandora moth, note its sporadic abundance limits its use as a food staple.

Bettinger (**1982**: 55) discusses the nature of archaeological evidence of pandora moth harvesting sites. **Bettinger** (**1985**: 43) states that insects were a useful supplementary source of food for the Owens Valley Paiute and illustrated a loosely twined basket for caterpillar collecting.

In June, 1981, at Bishop, California, **Fowler and Walter** (**1985**) observed elderly Paiute harvesting and processing pandora moth larvae, *Coloradia pandora lindseyi*, or *piagi*. The larvae were harvested by hand that season rather than by the frequently described trenching method. The authors accompany their report with a series of excellent photographs. Their description of the two-year life cycle is similar to the summary by Blake and Wagner (1987) (see below). Their description of harvesting and processing is the most detailed available and is quoted nearly in full below:

> Caterpillars are ordinarily collected in trenches (*odiabi*) dug around the bases of trees selected for their accumulations of caterpillar frass (Fig. 2). According to the elders, old trenches were cleaned and new ones dug when the people first arrived at the harvesting grounds. Old trenches take a person roughly ten minutes to clean, 'if you get right at it.' The trenches were approximately one-third meter deep and roughly one-third to one-half meter from the tree, and totally encircled it. Cleaning takes the trenches to the level of the old soil or just below. All litter such as pine needles and twigs...was removed. The elders noted that trenches had either vertical or back-cut walls to prevent the caterpillars from climbing out.
>
> New trenches were made in the same manner [as the old]. In former times a wooden digging stick (*woobi*) was used for excavating the trenches. . . The only social restriction placed on excavation of new trenches was that they must be located in one's own family area. Trenches were private property, usually inherited through the female line.
>
> None of the Owens Valley elders felt that building fires around the bases of trees, as reported by [earlier investigators] to smoke the caterpillars would necessarily bring them down faster. 'They come down on their own,' the elders said, and indeed in June, 1981, they were observed descending the trees in large numbers.
>
> Trenches were cleaned of caterpillars twice daily and processing took place coincidently. During the 1981 harvest, caterpillars were merely gathered from the ground at a rate of roughly 100 per 30 minutes (Fig. 3). In the past, the caterpillars were kept in the shade in open-twined globular baskets (Fig. 4) or in a 'large pit'. . . while awaiting processing. Today, plastic buckets serve as well, as the caterpillars are prevented from climbing out by the slick sides.
>
> Processing begins in a sandy area with the construction of a roasting pit about one meter in diameter. In the past, larger pits may have been used depending on the catch. A conical mound of sand is first made and then hollowed in the center. A fire is built to heat the surrounding sand. The coals are removed and the live caterpillars are then placed in the hollowed center of the pit (Fig. 5). They are mixed with the hot sand at the bottom of the pit, covered, and left to roast for 30 minutes to one hour, depending on what additional processing is planned.

> After roasting, the caterpillars are removed from the pit and sifted to remove the sand. An open-twined parching basket (*paco*) was formerly used, now replaced by the ingenious device of willow, reinforcing rod, and hardware cloth. . . (Fig. 6). The roasted caterpillars are then washed and sorted. Any 'flat' (possibly diseased), overcooked, or discolored caterpillars are discarded, in favor of nice, plump, yellow ones (Fig. 7). *Piagi* to be eaten immediately are boiled for roughly one hour in either salted or unsalted water, depending on individual taste. Boiled caterpillars are taken from the water and their heads removed. The results are enjoyed by all (Fig. 8). Caterpillars are eaten plain or made into a stew with other meat and/or vegetable products. The skins of the caterpillars are rather tough and they retain their shape when cooked.
>
> Caterpillars to be dried for storage are placed in the shade for two or three days to two weeks. In former times, pole-and-bark drying sheds were used, at least in some areas. According to the elders, if the caterpillars are sun-dried they will rapidly become rancid. In the opinion of one individual, caterpillars boiled in salted water also would taste 'old' by sometimes being cached at the harvesting grounds in the pole-and-bark sheds or in pits. They kept well through the winter, and with care into the spring and early summer.

The authors conducted a proximate analysis of prepared *piuga* (roasted, washed, boiled with non-iodized salt): moisture 71.8%, protein 11.8%, fat 10.9%, ash 1.1%, and carbohydrates 4.3%. Calories/100 grams was estimated at 163, and cal/hour worked at 1,848 - 2,753. The authors consider the estimates of cal/hour returned for collecting and processing to be probably low, but still nearly twice those of pinyon nuts and considerably above values reported for most plant foods studied by Simms (1984).

Data by **Schmid** (**1984**) indicate the great abundance of the *C. pandora* food resource. Schmid studied the emergence and post-emergence behavior of the moth in Arizona, and estimated that more than 100,000 adults emerged per infected hectare in 8,000 hectares that had been moderately to severely defoliated by the preceding generation of larvae. **Miller and Wagner** (**1984**) reported that pandora moth larvae pupate beyond the dripline of the tree, where the litter or duff layer is thinner. The investigators speculate that pupation under open canopies where fuel loads are light may be an adaptation that permitted higher survival during the frequent low-intensity fires that were typical of the presettlement ponderosa pine forest.

Ebeling (**1986**: 155-157) identifies several insects used or probably used by Indians. He notes that large outbreaks of pandora moths occur only in areas of loose mineral soils, and gives a tip on how to find pupae: "Likely areas for digging for Pandora moth pupae are where one sees little tufts of pine needles at the ends of otherwise defoliated twigs high in the larger trees. The larvae devour the needles and presumably the tufts are growth that develops subsequent to their departure."

Noting that many accounts of pandora caterpillar collecting and processing were not based on firsthand observation and that misleading and often conflicting information has accumulated, **Weaver and Basgall** (**1986**) present a critical evaluation of discrepancies relating to collection trenches, roasting hearths, storage structures, and smudge fires. Relative to the latter, the authors point out that none of the first-hand accounts mentioned the use of smudge fires; furthermore, modern collectors consistently express the opinion that smoke would be of no help in bringing the caterpillars down. The authors conclude that systematic use of smudge fires was unlikely.

Weaver and Basgall also assessed the importance of pandora caterpillars relative to regional subsistence strategies. It is apparent that both the Mono Lake and Owens Valley Paiute regarded *piagi* as a highly prized foodstuff. Based on the fact that *piagi* has been shown to be fully competitive with virtually all vegetal resources from the standpoint of energy (compare the data of Fowler and Walter [1985] with those of Simms [1984]), *piagi* were more predictable in terms of availability than originally thought (see discussion by the authors), timing of caterpillar availability did not conflict with scheduling of other important subsistence resources, they were storable and collection territories were owned by particular family groups, the authors conclude that *piagi* meet the criteria of a significant dietary component. Finally, the authors discuss temporal dimensions of *piagi* use and conclude that caterpillar exploitation has considerable antiquity.

Blake and Wagner (**1987**) state that, "There are modern Indian people in the United States, living within walking distance of major grocery and fast-food chains, who choose to collect and eat larvae of the pandora moth, *Coloradia pandora lindseyi* Barnes & Benjamin." *Piuga* is the Paiute name for the larvae. The moth has a two-year life cycle in east-central California, summarized as follows by Blake and Wagner:

> Adults emerge from late July to early August, mate, and the females lay their pale blue eggs indiscriminately on bark surfaces, needles, and undergrowth. Tiny first instars emerge from the eggs in late August and immediately crawl to the tips of the branches and begin to feed in colonies. They overwinter at the base of the needles, feeding only on warm days. Larvae resume

> full-time feeding on the needles of their hosts in the spring when temperatures are consistently warmer. The larvae grow rapidly and consume an enormous quantity of needles (Carolin and Knopf 1968) of all ages and can defoliate their hosts completely during an outbreak. Mature larvae are ca. 5.5 - 6 cm in length and as big around as an adult's finger.

Blake and Wagner cite recent research in saying: "Pandora moth larvae pupate in the loose mineral soil beyond the dripline of the tree...though pupae are sometimes found beneath the litter or duff layer near the base of the tree. . . . Larvae crawl down the trees in late June to early July and seek pupation sites. Pupae remain in the soil until the following July, when adults emerge and begin the cycle anew."

Piuga is regarded by the Paiute Indians "as a tasty, nutritious food that is especially good for sick people, much like our chicken soup," according to Blake and Wagner, and many Paiutes said they "would eat *piuga* every day if it were available." The authors also describe collecting and processing, drawing largely, however, from Fowler and Walter and Weaver and Basgall (see above).

Peigler (**1994**) doubts that pupae of *Hyalophora euryalus* were eaten, at least routinely (as reported earlier by Essig) "because of the power most groups associated with the rattle made from these cocoons."

See also Chalfant (1922, food of the Eastern Monos and the Panamint), E. Davis (1963, 1965, food of the Kuzedika Paiute), J. Davis (1961, Eastern Mono trade in *C. pandora*), Fowler (1986, food of Great Basin tribes), Johnston (1995, harvest and preparation of "peaggies"), Merriam (1979), Muir (1911), Steward (1933, 1941), Stewart (1941), Strong (1969, food of the desert people) and Zigmond (1986, food of the Kawaiisu). For *Hyalophora euryalus* see Powers (1877a).

Sphingidae (sphinx or hawk moths)
Hyles lineata Fabr., larva
Manduca sexta Johannsen (= *Macrosila carolina* (author?)), larva

Among the Pimos Indians, tobacco worms, which are the caterpillars of *Macrosila carolina*, are gathered and made into soup, or fried until crisp and brown (**Palmer 1871**: 426-427). Vegetables, meal, or seeds are usually added if made into pottage. Palmer says that he has seen this tribe gather bushels of the worms for immediate consumption, or to be dried and pounded up for winter stores.

Wright (**1884**: 238; vide Sutton 1988: 39) observed "vast armies of caterpillars. . . huge worms three and four inches long," which according to Feninga and Fisher (1978) were the white-lined sphinx moth, *Hyles lineata*. Wright describes their use as follows:

> [A] small army of Indians [men, women, and children] are out gathering them as though they were huckleberries, for use as food. Seizing a fat worm, they pull off its head, and by a dexterous jerk the viscera are ejected, and the wriggling carcass is put into a small basket or bag, or strung in strings upon the arm or about the neck, till occasion is found to put them into a large receptacle. At night, these Indians carry their prey home, where they have a great feast. Indians from a long distance came to these worm feasts, and it is a time of great rejoicing among them. The larvae that are not consumed at the time (and they eat incredible quantities), are put upon ground previously heated by a fire, and thoroughly dried, when they are packed away whole, or pulverized into a meal.

Simmonds (**1885**: 355-356, 360-366, 370) discusses a number of insects used as food by North American Indians, for only some of which he cites sources of information. The only insect use mentioned by Simmonds that is not referred to under the appropriate authors in this chapter is the use of what he called "tobacco worms," *Macrosila carolina*, by the Pimos Indians. According to Simmonds (p. 355), the caterpillars "are gathered and made into soup, or fried until crisp and brown. Vegetables, meal, or seeds are usually added to the composition when made into pottage. A writer in the official agricultural reports of the United States records having seen this tribe gather bushels of the worms for immediate consumption, or to be dried and pounded for winter use."

Russell (**1908**: 81) states that the Pima (southern Arizona) gather large quantities of a "worm" called *ma'kum*. After removing the head and intestines, the worms are put into cooking pots lined with saltbush branches and boiled. The skins are braided together while soft, and allowed to dry for a day or two in the sun. These dry, brittle "sticks" can then be eaten at any time without further preparation. Pima women claim that their hands become swollen and sore if they come into contact with the skin of the worms.

Spier (**1933**: 65, 73) mentions honey and caterpillars among the foods of the Maricopa, one of the Yuman tribes of the Gila River. The following is excerpted from page 73:

> A worm, called 'ame' (more probably a caterpillar, since it was said to have a horn on each end)

> was caught, boiled, dried, and eaten. They caught them in their hands in the spring and late autumn. There was a peculiar way of catching them: with one hand they caught the beast, broke off the end with the thumb nail, squeezed it out, and inserted it between the other fingers of the same hand. In some fashion they braided long strings of these, perhaps because the 'worm' coiled around its fellows. Then they boiled and dried them. They were eaten dried or boiled. Dried 'worms' were also heated in warm water and fried. The finger tips got sore gathering them.

Spier mentions that the caterpillars are said to travel rapidly. He considered this to be the same as the Pima ma'kum.

Feninga and Fisher (**1978**), by analyzing earlier reports, confirm the identity of one of the insects used by the Cahuilla as the caterpillar of the white-lined sphinx moth, *Hyles lineata*. These authors state that, "In researching this subject, it has become apparent to us that the relatively uncharted field of ethnoentomology has considerable potential for adding to existing knowledge of California Indian life."

See also Fowler (1986, food of Great Basin tribes), Kelly (1964, food of the southern Paiute), Lando and Modesto (1977, *H. lineata*), Powers (1877a, food of California Indians).

Miscellaneous Lepidoptera

Childs (**1953**: 35) mentioned that in living with and around the Sand Papago (along the U.S. -- Mexican boundary toward the Gulf of Mexico) and eating what they had to give, there were two kinds of grubs which he "could not go." He describes only one: "One is those large army worms with a large horn on their hind end. They get very fat just before they bury up to become a butterfly. They roast them between two ollas, and cover them with hot coals. They have a beautiful smell as they are very fat when eaten, and there is considerable oil that comes out of them. But to swallow one I could not. . . ."

For miscellaneous "caterpillars," see also Aginsky (1943, food of Central Sierra Indians), Barnett (1937, food of Indians along the Oregon coast), Bean and Theodoratus (1978, food of Western and Northeastern Pomo), Downs (1966, food of the Washo), Driver (1937, food in the southern Sierra Nevada; 1939, food in northwestern California), Drucker (1937, food of southern California tribes; 1941, food of the Yuman-Piman), Essene (1942, food of Round Valley, California groups), Fladung (1924, as food of Pai-Ute Indians), Fowler (1986, food of Great Basin tribes), Gifford (1940, food of the Apache Pueblo groups), Gifford and Kroeber (1937, food of the Pomo), Harrington (1942, food of groups along the central California coast), Kelly (1932, food of the Surprise Valley Paiute; 1964, food of Southern Paiute), Landberg (1965, food of the Chumash), Levy (1978b, food of the Castanoan), Merriam (1979, food of Western Mono), Myers (1978, food of the Cahto), Olmsted and Stewart (1978, food of the Achumawi), Powers (1877a, food of California tribes), Steward (1943, food of Northern and Gosiute Shoshoni), Stewart (1942, food of Ute-Southern Paiute), and Voegelin (1942, food of the Modoc).

Odonata

Aeshnidae (darners)
Aeshna multicolor Hagen, nymph

Ebeling (**1986**: 26) lists the nymph of the common blue darner, *Aeshna multicolor*, among the insects used as food by the Indians of the arid regions of the West.

Miscellaneous Odonata

See Hrdlicka (1908, food of the Tarahumare).

Orthoptera

Acrididae (short-horned grasshoppers)
Arphia pseudonietana Thomas, adult
Camnula pellucida Scudder, adult
Melanoplus bivittatus Say, adult
Melanoplus devastator Scudder, adult
Melanoplus differentialis Thomas, adult
Melanoplus femurrubrum DeGeer, adult
Melanoplus sanguinipes Fabr. (= *M. mexicanus mexicanus* Saussure; reported as *M. atlanis* Riley by Essig 1931), adult

Melanoplus sp.
Oedaloenotus enigma Scudder, adult
Schistocerca shoshone Thomas (= *S. venusta* Scudder), adult

One needs only to briefly scan the numerous reports to concur with **Sutton's** conclusion (**1988**: 11-22) that grasshoppers and locusts were widely used throughout the Great Basin and were a very important resource.

Pattie (**1831**: 100) encountered a group of "Grasshopper Indians" [apparently Ute, according to Sutton] at the headwaters of the Arkansas River in east-central Colorado. The Indians were said to "derive their name from gathering grasshoppers, drying them, and pulverizing them, with the meal of which they make mush and bread; and this is their chief article of food."

Taylor (**1859**: 205-206) states:

> The Indians take the grasshoppers in great numbers by sweeping them into holes or piles, or by surrounding them with fire and driving them into the centre, and afterwards roasting and pounding them for food. But this is always found to sicken the Indians -- a fact which has been noted by the pioneer settlers and natives of old, as also by many travellers and voyagers who have visited California and the Rocky Mountain country, and also by the Jesuits of Lower California.

Taylor mentions (p. 209) "But the good counsels of the missionaries, after their appearance in 1722, when this species of food occasioned among them a great sickness, caused them to leave off using them, though some of the neophytes still would eat them in the years when food became scarce from their ravages in the sowings." Essig (1931, p. 24) says, "There seems to be no foundation for the supposition that grasshoppers sickened the Indians as related above, because not only the American Indians but many other primitive races regularly consumed quantities of these insects."

When **Peter Simmonds** (**1859**; vide Ebeling 1986: 28) sampled grasshoppers that had been prepared by "Digger" Indians by dipping them in salt water and then pit-baking them for 15 minutes, he concluded, ". . . if one could divest himself of the idea of eating an insect as we do an oyster or shrimp, without other preparation than simple roasting, they would not be considered very bad eating, even by more refined epicures then the Digger Indians."

Palmer (**1871**: 426-427) describes the collection of grasshoppers as follows:

> By the Diggers of California and the Plains grasshoppers are caught in great numbers. When the insect attains its best condition, the Indians select some favorable locality and dig several little pits, in shape somewhat like inverted funnels, the aperture being narrower at the surface than at the base, the object being to prevent the insect which chances to tumble in from hopping out again. The pits being ready, an immense circle is formed, the surrounding grass is set on fire, and the Indians, men, women, and children, station themselves at proper intervals around the fiery belt, keeping up a continual ring of flame, until the luckless grasshoppers are corraled in the pits or roasted at the brink. They are eaten after being mixed with pounded acorns, and constitute one of the national dishes. Grasshoppers are sometimes gathered into sacks saturated with salt, and placed in a heated trench, covered with hot stones, for fifteen minutes, and are then eaten as shrimps, or they are ground and put into soup or mush. . . . Grasshoppers are pounded up with service, hawthorn, or other berries. The mixture is made into small cakes, pressed hard, and dried in the sun for future use.

Powell (**1875**; vide Fowler and Fowler 1971: 48; vide Sutton 1988: 18-19) noted that grasshoppers and crickets [probably *Anabrus*] were very important foods of the Utes:

> Soon after they [grasshoppers] were fledged and before their wings were sufficiently developed for them to fly [late spring or summer], or later in the season when they are chilled with cold, great quantities are collected by sweeping them up with brush brooms, or they are driven into pits, by beating the ground with sticks. When thus collected they are roasted in trays like seeds and ground into meal and eaten as mush or cakes. Another method of preparing them is to roast great quantities of them in pits filled with embers and hot ashes, much in the same manner as *yant* [*Agave deserti* or *A. utahensis*, according to Sutton] is prepared for consumption. When these insects are abundant, the season is one of many festivities. When prepared in this way these insects are considered very great delicacies.

Powell (**1875**: 133 [1957 abridged edition]), referring to the Shivwits on the Rio Virgen, a tributary of the

Colorado River, wrote:

> During the autumn, grasshoppers are very abundant. When cold weather sets in, these insects are numbed, and can be gathered by the bushel. At such a time, they dig a hole in the sand, heat stones in a fire near by, put some in the bottom of the hole, put on a layer of grasshoppers, then a layer of hot stones, and continue this, until they put bushels on to roast. There they are left until cool, when they are taken out, thoroughly dried, and ground into meal. Grasshopper gruel, or grasshopper cake, is a great treat.

Several of the men with Edward Kern in 1845 near the headwaters of the Kern River in the southern Owens Valley, after putting three Indians to flight, returned with a small sack containing a dark chocolate-colored substance, which was "very palatable with coffee." **Kern** (**1876**: 483) states: "I have seen the same dish among the Indians of California; it is prepared from roasted grasshoppers and large crickets, pounded up, and mixed with, when procurable, some kind of animal grease."

Hoffman (**1878**: 465-466) states:

> Some of the tribes will adhere to the most disgusting varieties of food, in spite of the partial advantages of civilization with which they come in contact. . . . Some of the Shoshonees obtain some food from settlements, but subsist chiefly upon what game and fish they can secure in addition to lizards, grasshoppers, etc....Their mode of preparing grasshoppers is in this wise: a fire is built covering an area of from 20 to 30 feet square, and as the material is consumed to coals and ashes, all the Indians start out and form an extensive circle, driving the grasshoppers with blankets or bunches of brush toward the centre, where they are scorched or disabled, when they are collected, dried, and ground into meal. With the addition of a small quantity of water this is worked and kneaded into dough, formed into small cakes, and baked in the sand under a fire. Generally ground grass seed is mixed with water, baked, and eaten alone, but frequently it is mixed with this insect flour, giving it a better consistence. The Pah-Utes on the banks of the Colorado River use this sort of food more generally than the Shoshonees. The latter raise some corn, melons, and musk-melons, and store great quantities of pinon nuts, when in season. . . .

Of the Seviches and Hualpais, who "are as filthy in their tastes as the Pah-Utes," Hoffman says: "The fruit of several species of Opuntia, grass-seed, gophers, dried lizards, grasshoppers, and other large insects are eaten with apparent relish."

Hutchings (**1888**: 428-429) states that grasshoppers were considered a great food luxury by the Indians: "These are eaten as meat and cooked in various ways. Sometimes they are caught, threaded on a string, and hung over a fire until they are slightly roasted, then eaten from the string. At others the grass is set on fire, which both disables and cooks them; when they are picked up and eaten, or stored for future use." Hutchings continues:

> The most effectual method for securing grasshoppers, when they are abundant, is to dig a hole sufficiently deep to prevent their jumping out; then to form a circle of Indians, both old and young, with a bush in each hand, and commence driving them towards it until they fall in, and are there caught. They are thence gathered into a sack, and saturated with salt water [doubtful, according to Essig (1931), except near saline lakes]; after which a trench is dug, in which a good fire is built, and when it is sufficiently heated, the ashes are cleaned out, a little grass put upon the bottom, when the grasshoppers are put in, and covered with hot rocks and earth until they are sufficiently cooked. They are then eaten in the same manner as we eat shrimps; or are put away to mix with acorn or seed mush, when they are ground into a kind of paste.

Mooney (**1890**: 259-260) reported that the Cosumnes tribe of California gathered grasshoppers and cooked them in pits.

> The grasshopper hunt was a great event in Digger society, and was conducted in a very systematic manner. A whole settlement would turn out and begin operations by starting a number of small fires at regular intervals in a circle through the woods, guiding the flame by raking up the pine needles, and stamping out the fire when it spread too far. When the fires burned out there was left a narrow strip of bare ground enclosing a circular area of several acres, within which the game was confined. A large fire was then kindled at a point inside of the circle, taking advantage of the direction of the wind, and allowed to spread unchecked. The men, armed with bows and arrows

> and accompanied by their dogs, kept to the windward in front of the fire and shot down the rabbits and other small animals as the heat drove them from cover, while the women, with their conical baskets on their backs, followed up the fire to gather up the grasshoppers, which merely had their wings singed by the fire, but were not killed. As a squaw picked up a hopper she crushed its head between her thumb and finger to kill it, and then tossed it over her shoulder into the basket.
>
> When the hunt was over, a hole about two feet deep was dug in the earth and filled with bark, which was then set on fire. When the heat was most intense the coals were raked out and the grasshoppers thrown in and thus roasted. . . .

The Indians sometimes ate grasshoppers alive, but first pulled off the legs.

From **Chittenden and Richardson's** account (**1905**, III: 1032-1033), the famous French missionary, Father Pierre-Jean De Smet did not regard the grasshopper-eating Soshocos too highly:

> The Soshocos are the most degraded of the races of this vast continent...They roam over the desert and barren districts of Utah and California, and that portion of the Rocky Mountains which branches into Oregon. I have sometimes met with families of these wretched Soshocos; they are really worthy of pity. . . . While the Indians of the plains, who live on the flesh of animals, are tall, robust, active and generally well-clad with skins, the Soshoco, who subsists chiefly on grasshoppers and ants, is miserable, lean, weak and badly clothed; he inspires sentiments of compassion in the minds of those who traverse the unproductive region which he occupies.

Chittenden and Richardson describe the Soshoco grasshopper hunt (circa 1850) as follows:

> The principal portion of the Soshoco territory is covered with wormwood [sagebrush], and other species of artemisia, in which the grasshoppers swarm by myriads; these parts are consequently most frequented by this tribe. When they are sufficiently numerous, they hunt together. They begin by digging a hole, ten or twelve feet in diameter by four or five deep; then, armed with long branches of artemisia, they surround a field of four or five acres, more or less, according to the number of persons who are engaged in it. They stand about twenty feet apart, and their whole work is to beat the ground, so as to frighten up the grasshoppers and make them bound forward. They chase them toward the centre by degrees -- that is, into the hole prepared for their reception. Their number is so considerable that frequently three or four acres furnish grasshoppers sufficient to fill the resevoir or hole.
>
> The Soshocos stay in that place as long as this sort of provision lasts. They, as well as other mortals, have their tastes. Some eat grasshoppers in soup, or boiled; others crush them, and make a kind of paste from them, which they dry in the sun or before the fire: others eat them *en appalas* -- that is, they take pointed rods and string the largest ones on them; afterward these rods are fixed in the ground before the fire, and, as they become roasted, the poor Soshocos regale themselves until the whole are devoured.
>
> As they rove from place to place, they sometimes meet with a few rabbits, and take some grouse, but seldom kill deer or other large animals.
>
> The contrast between the Indian of the plain and the destitute Soshoco is very striking; but poor as he is, like the Hottentot, he loves devotedly his native soil.

Lewis (**1905-1907**?: 181), cites De Smet in saying, "The Shoshone of the more arid regions lived largely on grasshoppers and other insects, with a few rabbits, grouse, and deer, and do not seem to have been averse to eating any kind of animal that came their way."

Fynn (**1907**: 87) makes passing reference to locusts as among the foods of the American Indian.

Fladung (**1924**: 6) states that some North American tribes were in the habit of eating large quantities of Rocky Mountain locusts.

In a letter to the 1924 *Pathfinder* weekly paper, **A.L. Gillis** of Mt. Pleasant, Iowa, wrote:

> I saw an article in your magazine about Indians eating grasshoppers. About 70 years ago my grandfather was agent for the Pawnee Indians on their reservation in what is now western

> Nebraska. I have often heard my father, who was then a boy, tell of those Indians eating grasshoppers and the interesting way in which they caught them. They would dig a deep hole in the ground and then, choosing a time when there was no wind and when a fire would burn on the prairie slowly and could be kept under control, they would encircle several acres around this hole with a ring of fire and drive the hoppers into the hole and capture them by the bushel. They were then dried and ground into meal to be mixed with their corn meal and made into bread.

Jensen (**1930**; vide Madsen and Kirkman 1988) makes no reference to insects as food, but relative to the Great Salt Lake, he states, "at times shifts of the wind blew clouds of the grasshoppers out upon the lake, where they were drowned and washed in upon the shores in great windrows, in some cases, pickled by the brine, remaining several years" (see below under Madsen and Kirkman).

Essig (**1931**) states that: "Grasshoppers were held in the greatest and most universal favor. They were always abundant in many parts of the state every year. They constituted a clean, nutritious, and healthy food. The common method of preparation was to roast them in the hot coals and ashes and then grind them into a meal which could be made into a gruel or mixed with acorn meal into a combination mush-gruel, or baked into a bread." According to Essig, the most abundant species in the high mountain meadows throughout California is "the yellow-winged" or "pellucid grasshopper," *Camnula pellucida* (Scudder), and associated with it in northern California and the Sacramento Valley in large numbers, were "the lesser migratory locust," *Melanoplus atlanis* (Riley); "the red-legged locust," *M. femur-rubrum* (DeGeer); "the two-striped locust," *M. bivittatus* (Say); and "the valley grasshopper," *Oedaloenotus enigma* (Scudder). The dominant species in the western Sierra foothills and the Sacramento Valley was "the devastating grasshopper," *Melanoplus devastator* Scudder, while in the lower San Joaquin Valley "the differential grasshopper," *M. differentialis* (Thomas), occurred in abundance along the rivers and in marsh areas. In the more arid areas of southern California and the foothills, "the large green valley grasshopper," *Schistocerca venusta* Scudder, was abundant. According to Essig, all of these species, and, probably, others, were consumed.

Essig relates as follows the observations of a relative of his who lived in the Sacramento Valley during the early 1850s:

> The method then used in that place was to build a large fire which was reduced to a bed of coals. The Indians then formed a large circle and drove the grasshoppers into the coals where they were soon roasted, removed and eaten at once or preserved for the future. In other places pits were dug in which the fire was built and into which the grasshoppers were driven or deposited. At times the insects were captured and killed and dried in the sun, after which they were ground into a meal.

According to **Reagan** (**1934a**: 54) it was alleged that the Goshute of Deep Creek country in Utah "dried grasshoppers for eating."

Steward (**1938**: 34), in his study of the Basin-Plateau tribes of eastern California, Nevada, Idaho and Utah, mentions that grasshoppers and Mormon crickets were extremely abundant in some years and could be taken in quantities that would last for months.

Lowie (**1939**: 327) reported the Washo boiled grasshoppers in baskets, and also cooked locusts in the ground and dried them. A long-legged insect also served as food. Lowie gives the Washo terms for these insects.

Morgan (**1947**: 255; vide Sutton 1988: 13) described repeated grasshopper infestations in the Salt Lake area in the 1850s and 1860s, many of the grasshoppers falling into the lake and being washed up in long windrows on the shore (see Madsen and Kirkman 1988 for the food relevance of this).

Volney H. Jones, in **Burgh and Scoggin** (**1948**: 94-99) reported that insect remains recovered from a storage cist along the Yampa River on the Utah-Colorado border were grasshoppers. The material, from a cache recovered during excavations of Mantles Cave in northwestern Colorado, and dated to roughly post-A.D. 650, were analyzed and found to be partly sand and partly insect remains in a fairly comminuted state with a few scattered parts of leaves and plant stems. Jones reports:

> The insect remains are almost wholly composed of grasshoppers of the first, second, third and fourth instars. All of those that could be identified belong to the genus *Melanoplus*, and appear to be mostly of one species, though there may be more than one. Most of them are adult, and the majority are in the second and fourth instars. The bodies are finely divided, and the parts are jammed together in the greatest confusion, legs sticking into heads, legs clumped together, etc., as if they had been mashed or chopped or ground up into a solid mass.

Other types of insects in the sample included unidentified fly pupae, an ant, and a few beetles that were

considered intrusive. Jones concluded that the material from the cache was a stored food supply.

Ogden (**Rich and Johnson 1950**: 133-134), in February of 1826, observed Northern Paiute in Idaho with grasshoppers and ants gathered and stored the preceding summer, and which provide food for nearly four months of the year.

Orr (**1952**; vide Madsen and Kirkman 1988) described a cache of grasshoppers that was recovered from Crypt Cave along the lower Humboldt River.

Garth's (**1953**) account is summarized as follows by Ebeling (1986: 182):

> To gather grasshoppers, the Atsugewi tied willows together to make a strip 30-40 feet long and tied dry grass to it at intervals. They then set the dry grass on fire, and two men ran across a grasshopper-infested field, carrying the flaming line of willows between them. Grasshoppers jumped into the flames and died; they were then easily gathered. In the early morning when grasshoppers were inactive because of the low temperature, they were knocked off bushes into a burden basket with a stick. Whichever way they were captured, the Atsugewi prepared them for eating by cooking them in an earth oven for about an hour, then putting them away to dry for two days. If stored, the dried insects were ground up to prepare them for eating.

Gudde and Gudde (**1961**) furnish a translation of Heinrich Lienhard's 1846 account of his westward trek from St. Louis to Sutter's Fort, including an encounter with an Indian on the South Fork of the Humboldt River. Leinhard had requested the Indian to dig some edible roots for him and he thoroughly enjoyed the yellowish parsnip-tasting roots that were presented (pp. 132-133):

> The Indian seemed to be pleased with my confidence in him, especially since I seemed to enjoy the roots which he had dug for me. Taking my stick away from me again, he walked away quickly and dug diligently for more roots. As soon as he had a small quantity, he jumped eagerly after some big grasshoppers, a few of which he brought back with him. He pressed one of the largest with its long, leaping legs against a piece of root, opened his mouth, and moved his jaws as though he were eating, although he wasn't. Then he offered both grasshopper and root to me, just as one would offer a piece of bread and butter to a child. The Indian seemed surprised that this time I did not want to accept what he offered. To convince me that he wasn't expecting anything unusual of me, he himself bit off a piece of the upper body of the forked grasshopper together with the head and a part of the root. He chewed this meat vigorously with the vegetable side dish, gesturing to show me how good it tasted. When he thought he had convinced me entirely, he again offered this marvelous delicacy to me. But in spite of his persuasive words without the use of words, I couldn't be induced to follow his good example. The expression on his face seemed to show that he felt sorry for me, and I should not be at all surprised if he thought to himself that these white men were quite stupid and didn't know what was really good. The remaining roots, however, I enjoyed thoroughly, and since Thomen, who had just joined us, also found them good, the Indian walked off once more and brought back quite a supply of them.

Graham (**1965**: 167) reported that grasshopper parts were recovered from a human coprolite from Wetherill Mesa in Colorado.

Bryant (**1967** [1848]: 162-163, 168) describes, among encounters with the Utah Indians, an occasion when three women appeared,

> . . . bringing baskets containing a substance, which, upon examination, we ascertained to be service-berries, crushed to a *jam* and mixed with pulverized grasshoppers. This composition being dried in the sun until it becomes hard, is what may be called the 'fruitcake' of these poor children of the desert. No doubt these women regarded it as one of the most acceptable offerings they could make to us. We purchased all they brought with them, paying them in darning needles and other small articles, with which they were much pleased. The prejudice against the grasshopper 'fruitcake' was strong at first, but it soon wore off, and none of the delicacy was thrown away or lost.

At the nearby Indian encampment, Bryant's party saw large numbers of the grasshoppers, or crickets, being prepared for pulverization.

Bryant continues:

> The Indians of this region, in order to capture this insect with greater facility, dig a pit in the

> ground. They then make what hunters call a *surround*; - that is, they form a circle at a distance around this pit, and drive the grasshoppers or crickets into it, when they are easily secured and taken. After being killed, they are baked before the fire or dried in the sun, and then pulverized between smooth stones. Prejudice aside, I have tasted what are called delicacies, less agreeable to the palate. Although the Utahs are a powerful and warlike tribe, these Indians appeared to be wretchedly destitute.

Further on, Bryant mentions that the Digger Indians had a mixture of parched sunflower seeds and grasshoppers for exchange.

John Wesley Powell (**Fowler and Fowler 1971**) provided a description of insect collecting by the Ute/Southern Paiute:

> Grasshoppers and crickets form a very important part of the food of these people. Soon after they are fledged and before their wings are sufficiently developed for them to fly, or later in the season when they are chilled with cold, great quantities are collected by sweeping them up with brush brooms, or they are driven into pits, by beating the ground with sticks. When thus collected they are roasted in trays like seeds and ground into meal and eaten as mush or cakes. Another method of preparing them is to roast great quantities of them in pits filled with embers and hot ashes. . . . When these insects are abundant, the season is one of many festivities. When prepared in this way these insects are considered very great delicacies.

Smith (**1974**: 50-51) reported that the Uintahs, but not the White River or Uncompaghres, ate grasshoppers, using willow sticks to knock them to the ground after which they were put into a basket or sack. The legs were removed and the grasshoppers were baked in a fire on the sand. After being cooked and cooled they were ground on a flat rock. "They were so rich they would just eat a little bit at a time. Take a pinch between your fingers and eat it. It was good." Another method was to cook them in a pit with hot stones.

Bitten and Wilcox (**1978**), in summarizing grasshopper outbreaks in territorial Utah make no mention of insects as human food, but they cite early reports of grasshoppers being washed ashore in huge numbers along the shores of the Great Salt Lake (pp. 344, 348). These windrows, sometimes reported as two to six feet high, were in fact tapped as a food resource by the Indians (see Madsen 1989 below). Bitten and Wilcox also mention (p. 347) that chickens were helpful in eliminating pest insects in gardens and to a limited extent on the farmlands.

Goldschmidt (**1978**) mentions (p. 347) that the Nomlaki harvested grasshoppers by driving them into a concentrated area and firing the grass.

Riddell (**1978**) gives an excellent account of the foods of the Wadatkut Paiute in the Honey Lake region of Lassen County, California, including their use of insects (pp. 51-52):

> Late in the summer nishu (apparently Mormon crickets) and kua (locusts), when they occurred in great numbers, were gathered for food. Good places to collect nishu were Secret Valley and in the vicinity of Doyle. They were collected by being scraped into a container with the hands, or by being picked from sagebrush where they would be clustered in great numbers. The gathering had to be done early in the morning before the insects became warm and active. After they had been gathered a pit would be dug into the ground and a fire built in the pit. When the fire was reduced to a quantity of hot coals, the insects were dumped into the pit and immediately covered with earth. From time to time they were sampled to see if they were done. When cooked, the insects were uncovered and removed from the pit, and laid in the sun to get perfectly dry. After drying they were sacked for future use. Before they were eaten, however, their heads and legs were pulled off and discarded. The body was ground into a flour with a mano and metate and eaten dry, or made into a soup which had a flavor somewhat like that of dried deer meat (deer meat also could be ground into a flour coarser than acorn flour, and made into soup). Flour made from nishu could be salted to taste when eaten.
>
> Kua were caught and their legs torn off immediately, and then prepared in the same manner as nishu. The kua were caught wherever they were found in sufficient quantities, and were simply picked from the brush, apparently while cold and inactive in the morning.

Bryan (**1979**: 228), working in Smith Creek Cave in eastern Nevada, found grasshopper parts (*Melanoplus* sp.) in dung layers dating back to about 2,100 years.

Noting that Southern Paiute informants had told Kelley (1971) that they gathered grasshoppers from rabbit brush (*Chrysothamnus nauseosus*), **Ebeling** captured three species resting on this plant in October near

Bishop in Owens Valley, i.e., *Melanoplus femurrubrum*, *M. devastator* and *Arphia pseudonietana*. Although these seemed to be the only species readily evident at the time, Ebeling notes that there is a seasonal succession that would have been available to the Paiute. Rabbit brush is abundant there, covering miles of the valley floor.

Madsen and Kirkman (**1988**) reported evidence from Lakeside Cave on the shore of Great Salt Lake, that salted, sun-dried grasshoppers (*Melanoplus sanguinipes*) that had washed up on the beaches were collected, then winnowed in the cave to remove the sand before consumption. Grasshopper parts, estimated from samples to be in the millions, were concentrated in the lower five cultural units, strata deposited about 4500 years ago. Human fecal deposits were associated with all strata where grasshopper parts were found and contained oolitic sand and hopper parts as their principal components.

According to the authors, the connection between beach and cave became obvious in the summer of 1985, a grasshopper plague year, when they investigated a report of "millions" of grasshoppers washed up on a nearby beach:

> Windrows of grasshoppers that had flown or been blown into the lake and which had been formed by wave action of varying intensity into lines of salted and sun-dried grasshoppers stretched for tens of kilometers along the beach. Up to five separate windrows were identified in any one place and ranged in size from a few centimeters wide to over 1.5m wide by 20 cm thick. Based on counts of two 1-liter samples, the number of individual hoppers in these windrows ranged from an estimated 1,800 to 34,000 per meter. The windrows were well sorted and contained virtually nothing but grasshoppers coated with a thin veneer of oolitic sand. . . .

The authors conducted several tests to determine the caloric return rate of collecting grasshoppers from the windrows compared to collecting other local food resources, principally plant resources. Proximate analysis showed the sun-dried grasshoppers to contain 3,010 kcal/kg. The authors state:

> Based on these figures, we believe the return rates for grasshopper procurement around the Great Salt Lake greatly exceed any other known 'collected' resource. Return rates ranged from 41,598 kcal/hour for the smallest sample to 714,409 kcal/hour for the largest sample, with an average of 272,649 kcal/hour for the five samples. Put more descriptively and assuming a daily caloric requirement of 2,000 kcal, this means that, on the average, one person, in one hour, could feed four people for more than a month. . . .

In view of several uncertainties, to be conservative in comparing the caloric return from collected grasshoppers to other collected Great Basin resources, Madsen and Kirkman used only 1/10th the experimental grasshopper return; even at this reduced rate, the grasshopper return for labor expended (27,265 kcal/hr of work) was 16 times higher than the highest-ranking seed resource, 1,699 kcal/hr for bulrush seeds.

Many other observers have described the use of grasshoppers: see Aginsky (1943, food of the Central Sierra tribes), Barnett (1937, food of Oregon coastal Indians), Beals (1933, food of the Nisenan), Bean (1972, food of the Cahuilla), Bean and Theodoratus (1978, food of the Pomo), Callaghan (1978, food of the Lake Miwok), Camp (1923, food of the Paiute in southwestern Utah), Carr (1951, food of the Cherokee), Cowan (1865, food of the California Digger Indians), E. Davis (1965, food of the Kuzedika), J. Davis (1961, Chumash involved in grasshopper trade), DeFoliart (1989, acridid species used), De Quille (1877, food of Northern Paiute), Dixon (1905, food of the Northern Maidu), Downs (1966, food of the Washo), Driver (1937, food in the southern Sierra Nevada; 1939, food in northwestern California), Drucker (1937, food of southern California tribes), Elliot (1909, food of the "Snake Indians"), Essene (1942, food of the Round Valley, California groups), Fowler (1986, food of Great Basin tribes), Gifford (1940, food of the Apache-Pueblo), Gifford and Kroeber (1937, food of the Pomo), Harrington (1942, food of the Chumash), Heizer (1954, food of the Utah Utes), Hrdlicka (1908, food of the Tarahumare), Johnson (1978, food of the Yani), Kelly (1932, food of the Surprise Valley Paiute; 1964, food of the southern Paiute), Landberg (1965, food of the Chumash), Lando and Modesto (1977, food of the Cahuilla), Lapena (1978, food of the Wintu), Levy (1978a, food of Eastern Miwok; 1978b, food of the Costanoan), Lowie (1909a, food of the Northern Shoshone), Malouf (1974, food of the Gosiute), Muir (1911, food of the Digger Indians), Myers (1978, food of the Cahto), Olmsted and Stewart (1978, food of the Achumawi), Powers (1877a, food of the Yokut and Konkau; 1877b, food of the Northern Paiute), Ray (1933, not eaten by the Southeast Salish), Riddell (1978, food of the Maidu and Konkow), Ross (1956, food of the "Snake Indians"), Shimkin (1947, food of the Wind River Shoshone), Silver (1978, food in Shasta territory), Steward (1933, food of Owens Valley Paiute; 1941, food of Nevada Shoshoni; 1943, food of Northern and Gosiute Shoshoni), Stewart (1941, food of Northern Paiute; 1942, food of Ute-Southern Paiute), Strong (1969, food of the desert people), and Voegelin (1942, food in northeast California).

Gryllacrididae (wingless long-horned grasshoppers)
Stenopelmatus fuscus Haldeman

Ebeling (**1986**: 26) lists the Jerusalem cricket, *Stenopelmatus fuscus* Haldeman, among the insects used as food by the Indians of the arid areas of the West.

Gryllidae (crickets)
Gryllus assimilis Fabr., complex

Essig (**1931**) believes that Power's statement in 1877 that *hallih* or crickets were used as food by the Nishinam of Placer County was in error as crickets are scarce there while grasshoppers are abundant. According to Essig, the black field cricket, *Gryllus assimilis* Fabr., is very abundant, however, along the Sacramento and San Joaquin Rivers.

Sutton (**1988**: 23) notes that winged gryllid crickets of the genera *Nemobius*, *Miogryllus* and *Gryllus* (= *Acheta assimilis*) are common in the Great Basin and probably were used although none have been mentioned in the ethnographic literature.

See also De Quille (1877, food of Northern Paiute), Fladung (1924, food of Shoshones), Lowie (1909a, food of northern Shoshone).

Tettigoniidae (long-horned grasshoppers)
Anabrus simplex Haldeman, nymph, adult

The Mormon cricket, *Anabrus simplex* (actually a wingless tettigoniid grasshopper), was a resource of major importance and was probably used by virtually every group in the Basin (**Sutton**, pp. 23-32). Sutton cites historical accounts of the plague proportions of this insect, frequently lasting for years on end, notes the organized manner by which they were harvested (involving large numbers of people), and concludes that it provided huge returns for the labor invested. Ethnographic accounts of groups (men, women and children) spending days and considerable labor in the harvest preparation certainly suggest that crickets were not an ephemeral resource taken on an "encounter basis." The crickets probably constituted a formal part of the seasonal round, and Sutton states, "Hundreds or thousands of pounds of very high quality food for a few days of labor would have been a wise investment, especially since the resulting food was storable."

A number of early writers make it evident that the Mormon cricket, *Anabrus simplex* Haldeman (Orthoptera: Tettigoniidae), was widely used as food by Indian tribes in the western states. **Domenech** (**1860**, 2: 64; vide Sutton 1988: 30) noted collection and preparation of [Mormon] crickets by the Ute Indians. **Palmer** (**1871**: 426-427) reported that various berries collected by the tribes in Oregon are sometimes mixed, for variety, with the dried eggs of salmon or with crickets [probably *Anabrus*], dried and pulverized. **Glover** (**1872**: 75) reported that the Indians in Utah eat the crickets, generally roasted and pounded into a course-grained meal. **Parkman** (**1873**: 208) stated that the "Root-Diggers" turn the crickets "to good account by making them into a sort of soup, pronounced by certain unscrupulous trappers to be extremely rich." **Thomas** (**1875**: 904) reported that, "This is the species eaten by the Indians. Not only do they eat them after roasting, but often without any other preparation than simply pulling off their legs and head."

Gottfredson (**1874**: 15), in Thistle Valley (August, 1864) in the Sevier River drainage in the east central Basin, described a relatively labor-efficient method of collecting Mormon crickets by driving them into a stream: "The squaws [placed] baskets in the ditch for the crickets to float into. The male Indians with long willows strung along about twenty feet apart whipping the ground behind the crickets driving them towards the ditch. . . . [The crickets] tumbled into the ditch and floated down into the baskets. . . .They got more than fifty bushels." The crickets were prepared as follows:

> They had a lot of berries that they had gathered before which they crushed with the crickets and made into loaves the size of a persons head. They then dug holes in the ground about eighteen inches deep and buried the loaves and left them for about a month. . . . The berries they used were service berries which were plentyful in the hills, and wild currants, both black and red that grew along the creek, and some squaw berries and chokecherries.

(These cakes were widely known as "desert fruitcake" according to Madsen and Kirkman [1988: 595].)

Around the Great Salt Lake, about the time the first settlements were constructed in 1847, **Lorenzo Young** reported: "The ground was black with black crickets; millions of them. . . . an unusual number of Indians . . . gathered together . . . . were harvesting them. . . . [they depended upon this food as one of their principle [sic] supplies for winter use.]" (**Anonymous 1884**: 3-4; vide Madsen and Kirkman 1988).

In Utah, **Bancroft** (**1889**: 262) states that: "The ground was covered with millions of black crickets [*Anabrus simplex*] which the Indians were harvesting for their winter food. An unusual number of natives had assembled for this purpose." Bancroft quotes from a manuscript (1847) by Lorenzo Young to describe how the crickets were harvested:

> The Indians made a corral twelve or fifteen feet square, fenced about with sage brush and grease-wood, and with branches of the same drove them into the enclosure. Then they set fire to the brush fence, and going amongst them, drove them into the fire. Afterward they took them up by the thousands, rubbed off their wings [?] and legs, and after two or three days separated the meat, which was, I should think, an ounce or half an ounce of fat to each cricket.

Young slightly overestimated the amount of fat per cricket, as a whole dried Mormon cricket weighs only a little more than 1.0 gram, which is 1/28th of an ounce.

Coville (**1897**: 104) reported that: "One curious use of the plant [blueberry elder, *Sambucus glauca*], now rarely resorted to, but formerly common among the Snake [Northern Paiute] Indians, consists of punching out the pith from sections of the stem, ramming them full of large crickets, *Anabrus simplex* Hald., and plugging the ends. The contents of the stems were used for food in the winter."

Dried crickets were observed as food in the Humboldt Sink in 1846 by **Aram** (**1907**: 628): "We came to an Indian village, they came out in strong force but finding us friendly, they treated us kindly. They were digging roots on a creek bottom. They looked like a small red carrot. They gave us some that were cooked, they tasted like a sweet potato. They also offered us some dried crickets but those we declined, thinking they would not relish well with us."

Egan (**1917**: 228-233), in delightfully written first-person accounts of experiences in the early West, confirms the use of ants by the Indians, and describes in detail a Mormon cricket drive. The procedure was basically to dig a series of trenches, each about 30 to 40 feet long and in the shape of a new moon, cover the trenches with a thin layer of stiff wheat grass straw, drive the crickets into the grass covering the trenches, and then set fire to the grass. Egan mentions that he thought they were going to a great deal of trouble for a few crickets. As the drive began, "We followed them on horseback and I noticed that there were but very few crickets left behind. As they went down, the line of crickets grew thicker and thicker till the ground ahead of the drivers [men, women and children] was black as coal with the excited, tumbling mass of crickets." After the grass had been fired, Egan observed that in some places the trenches were more than half full of dead crickets. "I went down below the trenches and I venture to say there were not one out of a thousand crickets that passed those trenches."

Once the drive was over, the men and children had done their part and were sitting around while the women gathered the catch into large baskets which could be carried on their backs. Egan says, in obvious admiration:

> Now here is what I saw a squaw doing that had a small baby strapped to a board or a willow frame, which she carried on her back with a strap over her forehead: When at work she would stand or lay the frame and kid where she could see it at any time. She soon had a large basket as full as she could crowd with crickets. Laying it down near the kid, she took a smaller basket and filled it. I should judge she had over four bushels of the catch. But wait, the Indians were leaving for their camp about three or four miles away. This squaw sat down beside the larger basket, put the band over her shoulders, got on her feet with it, then took the strapped kid and placed him on top, face up, picked up the other basket and followed her lord and master, who tramped ahead with nothing to carry except his own lazy carcass. There were bushels of crickets left in the trenches, which I suppose they would gather later in the day.

Egan learned that the crickets were used to make a bread that was decidedly black in color. They were dried, then ground on the same mill used to grind pine nuts or grass seed, "making a fine flour that will keep a long time, if kept dry." His Indian companion said "the crickets make the bread good, the same as sugar used by the white woman in her cakes."

Clayton (**1921**: 335) reported that Brigham Young advised the company against giving guns and ammunition to the Indians [the Utes?] because they would be used to shoot the cattle, advising them instead to "let them eat crickets, there's a plenty of them."

Henderson (**1931**: 13-14), in Utah, quoted from several earlier references to the Mormon cricket as food, including from John Young who reported: "They (the Indians) kept on hand baskets made purposely to put in the creeks to catch the loathsome insects as they floated down the streams, and they caught them by the tons, sun-dried them, then roasted them and made them into a silage that would keep for months." Several authors are

quoted relative to the use of crickets and grasshoppers by the tribes in the Salt Lake Valley. Henderson also quotes from an article titled "Feasting on Crickets" in the September 1904 issue of "The Improvement Era":

> An echo of early times is reported from Rush Valley. It appears that millions of black crickets have appeared, coming from Death Canyon and Skull Valley. Near Harker's Canyon the mountains for miles about have been denuded of every vestige of green. The pests are headed towards Vernon. The Indians are gathering them to eat, preserving them for winter use, while the coyotes have stopped killing sheep and are feasting on crickets upon which, like the prairie chicken, they are growing sleek and fat.

Leechman (**1944**: 451), drawing on an earlier report by Coville (1897), suggests that the tubes described by Drews were used as receptacles for Mormon crickets or other food stored for winter use.

Chamberlin (**1950**: 8-9) gives a description by John R. Young of how the Indians collected Mormon crickets when they were attacking Mormon farms in 1848 and the irrigation ditches were often full of the insects: "Baskets purposely made to put in the creeks to catch the loathsome insects as they floated down the streams, and they caught them by the tons, sun-dried them, then roasted them and made them into a silage that would keep for months. Their skill in this convinces me that the coming of the crickets had been continuous for ages."

Whiting (**1950**: 17-19) reported that the Harney Valley, Oregon, Paiute gathered crickets: "About the fifteenth of July, families began to congregate at Cow Creek, about five miles east of Harney. Families from all over the valley and from the Hunibui Eater band to the north came to gather crickets. The women went out early in the morning and caught them, were back by sunrise, and spent the rest of the day roasting, drying, and pounding them and putting them in bags to be cached for the winter." Whiting continues: "In the fall some of the families went up to Canyon City, the men to hunt elk and the women to pick huckleberries. During these wanderings they were technically within the terrain of the Hunibui Eaters and Elk Eaters, but inasmuch as these people wandered to the south to get crickets and sometimes to get *wada* there was reciprocal exchange."

Wakeland (**1959**: 4) relates that in 1890, northwest of Reno, Nevada, S.B. Doten (pers. comm. to Wakeland, 1952) "stumbled onto a number of burlap bags filled with dried Mormon crickets. He later saw Indians grind these with dried grass seed in stone grinders and then make a paste which they baked and ate."

Dillon (**1966**: 40) mentions that the Indians near Mary's River (later called the Humboldt) brought dried crickets into the camp, which they tried to trade for food.

Frison and Huseas (**1968**: 22) found evidence of insect utilization in Leigh Cave on the west flank of the Bighorn Mountains in Wyoming. Charcoal from a hearth or roasting pit produced a radiocarbon date of about 2220 B.C. The authors state: "In and near this fire were the cooked remains of several hundred large insects of the order Orthoptera and more commonly known as the Mormon cricket (*Anabrus simplex*). The context suggests that the cave occupants were roasting these insects for food."

Olmsted and Stewart (**1978**) reported that in northern California the Achumawi Indians remembered the periodic plagues of Mormon crickets as times of plenty. They roasted the insects and formed them into cakes for storage.

Lanner (**1981**: 148) quoted a Northern Shoshoni consultant on the historical collection of unidentified crickets: "In the spring we would collect lots of young crickets when they are young. We used to mash them and dry them between stones and eat them in pine-nut soup. That's very rich food."

Madsen (**1989**: 22-25) gives a more popular account of the grasshopper studies reported by Madsen and Kirkman, and adds information from studies on the rate of return per unit of effort expended in collecting Mormon crickets in the same area: Crickets were collected from bushes, grass, etc., at rates of 600 to 1,452 per hour, an average of nearly two and one-third pounds or, at 1,270 calories per pound, an average of 2,959 calories per hour. The crickets often reached greatest densities along the margins of streams or other bodies of water which lie in their line of march and which they will attempt to cross. In two such situations, they were collected at the rates of 5,652 and 9,876 per hour, an average of nearly 18 1/2 pounds of crickets or 23,479 calories per hour. The first number (2,959 calories per hour) surpasses the return rate from all local resources except small and large game animals, while the latter compares favorably even with deer and other large game.

Madsen places cricket collecting in a modern context by saying, "One person collecting crickets from the water margin for one hour, yielding 18 and one-half pounds, therefore accomplishes as much as one collecting 87 chili dogs, 49 slices of pizza, or 43 Big Macs." He concludes, "Our findings thus showed that the use of insects as a food resource made a great deal of economic sense."

According to **Jones and Madsen** (**1991**), ethnographic and ethnohistoric data suggest that *A. simplex* was the most commonly collected insect resource in the eastern Great Basin. Collection strategies varied, but included driving the crickets into trenches, brush corrals, or streams, or less efficiently, picking them by hand. To determine the range in return rates that might apply to the Mormon cricket, Jones and Madsen conducted

experiments in which two collecting methods were compared, picking them from the ground and vegetation in mid-day when they were most active, and collecting them in shallow water where they had concentrated in a 3 m wide band of low *Juncus* along the margin of a small reservoir. The crickets were in a "near-adult instar" and migrating in bands. Average weight per cricket was found to be 2.77 g, and analyses yielded energy values of 1212 cal/kg (live weight) and 3450 cal/kg (dry wt.). The lower energy value was used in subsequent calculations.

In the experiment involving picking crickets from the ground and vegetation, the average return rate was 2245 cal/hour; in picking crickets from the water's edge, the average return rate was 20,869 cal/hr. In applying their experimental data to published reports pertaining to quantities of crickets, the authors estimate that return rates sometimes may have exceeded 100,000 cal/hr when mass-collection techniques were used. The above return rates did not include processing time for consumption or storage, but they still place Mormon crickets well above most other gathered food resources.

Many other observers have also described the use of *Anabrus*: see E. Davis (1965, food of the Kuzedika Paiute), Dixon (1905, food of the Northern Maidu), Fowler (1986, food of Great Basin tribes), Frison (1971, food of the late prehistoric Shoshoni), Harris (1940, food of the White Knife Shoshoni), Kelly (1932, food of the Surprise Valley Paiute), Lowie (1909, food of northern Shoshone), Malouf (1974, food of the Gosiute), Napton and Heizer (1970, in human coprolites, Nevada), Olmsted and Stewart (1978, food of the Achumawi), Powers (1877a, food of the Nishinam; 1877b, food of the Northern Paiute), Ray (1933, not eaten by the Southeast Salish), Reagan (1934b, food of the Utes in Utah), Riddell (1978, see under Acrididae), Ross (1956, food of the "Snake Indians"), Shimkin (1947, food of the Wind River Shoshone), Silver (1978, food in the Shasta territory), Steward (1933, food of the Owens Valley Paiute; 1941, food of the Nevada Shoshone; 1943, food of the Northern and Gosiute Shoshoni), Stewart (1941, food of the Northern Paiute; 1942, food of the Ute-Southern Paiute), Strong (1969, food of the desert people), and Voegelin (1942, food of northeast California Indians).

Plecoptera

Ebeling (**1986**: 182-183) notes that some Indians used adult and nymphal salmonflies or stoneflies as food: "In the spring the Atsugewi picked up adult salmonflies from the banks of streams in the early morning, before the wind arose. They removed the wings and boiled the insects for eating. . . ."

Perlodidae

Isoperla sp., nymph, adult

Ebeling (**1986**: 26) lists *Isoperla* (= *Isoperia*) sp. nymphs and adults among the insects used by Indians in the arid regions of the West. The nymphs are aquatic, living in rivers, and are omnivores or predatory.

Pteronarcidae (giant stoneflies)

Pteronarcys californica Newport, nymph, adult

Sutton (**1985, 1988**: 50-51) suggests that the California salmonfly, *Pteronarcys californica* Newport, may have been an important food resource for the Modoc, Wintu, and Achumawi Indians along the Pit River in Northeastern California (see also Aldrich [1912b] and Essig [1931] under Diptera: Rhagionidae). **Ebeling** (**1986**: 26) indicates that *P. californicus* was eaten in both the nymph and adult stages. Other species of the genus may also have been eaten, such as the giant stonefly, *P. dorsata* Say, which, according to Arnett (1985: 109) has a wing expanse of 70-106 mm. The eggs are laid in water, and the nymphs are found in small brooks, streams and rivers where they live under stones or other debris and feed on plant material for as long as three years. They then ascend emergent vegetation where the molt to the adult stage occurs. The adults are nocturnal, poor fliers, and do not feed. Sutton provides references to the biology and distribution of the group.

DuBois (**1935**; vide Sutton 1985) reported that the Wintu gathered salmonflies in the morning before their wings were strong enough to permit flight. They were either boiled, or if plentiful enough, dried for winter use. **Sapir and Spier** (**1943**; vide Sutton 1985) reported that salmonflies were washed up in great numbers from the river onto the willows along the bank, where the Yana gathered, cooked and used them as food. **Garth** (**1953**; vide Sutton 1985) reported that salmonflies were plentiful along the Pit River and Lost Creek, and the Atsugewi obtained them in the spring, picking them by hand from the banks in the early morning before the wind arose. The wings were removed, and the body was boiled and eaten.

See also Johnson (1978, food of the Yani), Lapena (1978, food of the Wintu), and Olmsted and Stewart (1978, food of the Achumawi).

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Aginsky studied the Central Sierra Indians including the Miwok, and more northerly Yokut and Mono settlements. Grasshoppers and caterpillars were widely used (pp. 397, 452). Methods used on grasshoppers by different groups included: "Large basket, sometimes more than 1, placed in clearing. People circle and close in on basket, making noise and stamping on ground to cause grasshoppers to jump into basket. Also build fence, toward which women chase grasshoppers. Also soak in warm water and eat"; "Driven into creek, picked up with basket and placed in hot water"; "Catch by putting water in trench"; "Just burned over ground and picked them up." Caterpillars were: "Knocked off of branches with sticks, and caught in baskets"; "Caught in trench"; "Picked off tree"; "Placed in hot water, boiled and, after water squeezed out, eaten."

Aldrich, J.M. 1912a. Larvae of a saturniid moth used as food by California Indians. *J. New York Entomol. Soc.* 20: 28-31. (See under Saturniidae)

Aldrich, J.M. 1912b. Flies of the leptid genus *Atherix* used as food by California Indians (Dipt.). *Entomol. News* 23: 159-163. (Rhagionidae)

Aldrich, J.M. 1921. *Coloradia pandora* Blake, a moth of which the caterpillar is used as food by Mono Lake Indians. *Ann. Entomol. Soc. Am.* 14: 36-38. (Saturniidae)

Ambro, R.D. 1967. Dietary-technological-ecological aspects of Lovelock Cave coprolites. Berkeley: *Univ. Calif. Archaeol. Surv. Rpts.* No. 70: 37-47.

The author makes brief reference (pp. 39, 45) to insects in coprolite studies related to those of Roust (1967) and suggests that insects were probably rarely eaten in the vicinity of Lovelock Cave and Hidden Cave which are located in western Nevada.

Aram, J. 1907. Reminiscences of Captain Joseph Aram. *J. Am. Hist.* 1: 623-632. (Tettigoniidae)

Arnett, R.H. 1985. American Insects: A Handbook of the Insects of America North of Mexico. Florence, Kentucky: Van Nostrand Reinhold, 850 pp. (Arctiidae, Pteronarcyidae)

Bancroft, H.H. 1889. The works of Hubert Howe Bancroft. Vol. XXVI. History of Utah, pp. 262, 279-281. San Francisco: The History Co., Publ. (Tettigoniidae)

Barnett, H.G. 1937. Culture element distributions: VII - Oregon Coast. *Univ. Calif. Pubs. Anthropol. Rec.* 1(3): 155-219.

Barnett reports (pp. 165-166) the use of parched grasshoppers, parched yellow-jacket larvae, boiled caterpillars, and honey.

Barnett, H.G. 1939. Culture element distributions: IX - Gulf of Georgia Salish. *Univ. Calif. Pubs. Anthropol. Records* 1(5): 221-295.

The author reports (pp. 236, 277) no use of insects as food by the Gulf of Georgia Salish in British Columbia. All informants denied the use of caterpillars or yellowjacket larvae as food. The latter were used, however, as a "salve" and to "train" warriors.

Barrett, S.A. 1936. The army worm: a food of the Pomo Indians. *In* R.H. Lowie (ed.), Essays in Anthropology Presented to A.L. Kroeber, pp. 1-5. Berkeley: Univ. Calif. Press. (Noctuidae)

Beals, R.L. 1933. Ethnology of the Nisenan. Univ. Calif. Publ. in Am. Arch. and Ethnol. 31: 346-347. [What is the total pagination of this article?]

Beals (pp. 346-347) reports that the Nisenan ate nearly all available foods, but, although some mammals, birds and reptiles were avoided, no insect or invertebrate was mentioned as having been avoided, nor any edible plant. Beals summarized invertebrate use as follows:

All classes eaten, including grubs, earthworms. Latter brought to surface of damp spots at certain seasons by pounding ground with club. Roasted by shaking on trays with hot rocks.

Yellowjacket (Epen, P) larvae roasted similarly. Nests found by men or boys with unusually keen eyesight who followed insects on clear, cloudless days. Lizard meat exposed to attract yellowjackets and leg of grasshopper, colored white, inserted in their jaws while eating to make it easier to follow them to nests. Hunter waited until all insects in nest at twilight, placed ignited tuft of pine needles in hole, blowing smoke down. When insects stupified, nest dug up. Sometimes whole nest roasted over coals, eaten with acorn soup. Some specialized in this work.

Hornet nests burned at night with pine-needle brush on stick. Man near Forest Hill attempted by daylight; died of stings.

Grasshoppers, E.ni (P) caught by driving toward narrow-mouthed pits dug in open place. Each man dug own. Around each, straw or pine needles scattered for 6-8 ft. Grasshoppers driven by beating up brush; hide in grass and pine needles. These ignited. Some grasshoppers killed and roasted by fire; others fly in holes, removed in fine mesh bags, each handful squeezed to kill insects. When roasted at home in basket with hot rocks, turn red. Dried, usually saved until winter when pounded fine, mixed with acorn soup.

In mountains large area sometimes covered with about 3 in. pine needles in which insects hid, which then fired, killing, cooking them.

Grasshoppers considered healthful food, acquiring virtues of medicinal plants eaten. As more plentiful in valley and foothills, traded to mountain people for black oak acorns.

Bean, L.J. 1972. Mukat's People: The Cahuilla Indians of Southern California. Berkeley: Univ. Calif. Press, 201 pp.

Bean (pp. 61-62), without referencing earlier literature, states that a large number of insect and "worm" species were important foods of the Cahuilla of southeastern California. Ant (*?anet*) hills were dug up and the swarming ants were pushed into pits where they roasted instantly on very hot rocks. They were also boiled or parched. Grasshopper (*wi?it*) swarms were common, and to harvest them, the Cahuilla dug long trenches which they filled with heated rocks and sand. The grasshoppers were then scooped up and pushed into the trenches. "Cricket pupae [?] and cicadas (*taciqal*) also came in large numbers at times, and were eagerly gathered and roasted as they, too, were considered delicacies. After roasting they were dried and stored for future use, to be eaten without further preparation or as a condiment with other foods like acorn mush."

Bean also mentions a worm called *piyatem*, "possibly an army worm," as a favorite treat of the Cahuilla. The worms "appeared at the surface of the ground in abundance after warm spring rains, and were collected in large quantities, prepared by parching, and stored for future use." Their arrival was celebrated by a first-fruit ritual as were those of other insects and worms. Bean mentions that: "Wild bee larvae and honey were eaten in historic times. The beehives of imported honey bees were tended by the men and were individually owned. The honey was collected regularly, some always being left for the continuation of normal beehive activity."

Bean, L.J.; Theodoratus, D. 1978. Western Pomo and Northeastern Pomo. *In* W.C. Sturtevant (Ed.), Handbook of North American Indians (R.F. Heizer, Vol. Ed.), 1978, pp. 289-305.

Grasshoppers, caterpillars and larvae were among the animal foods of these Indian groups (pp. 290-291).

Bell, W.H.; Castetter, E.F. 1937. The utilization of mesquite and screwbean by the aborigines in the American Southwest. *Univ. New Mex. Ethnobiol. Studies in the Am. Southwest Bull.* 5, pp. 22-23.* (Bruchidae)

Bequaert, J.C. 1922. The predaceous enemies of ants. *In*: Ants of the American Museum Congo Expedition. A contribution to the myrmecology of Africa, W.M. Wheeler. *Bull. Am. Mus. Nat. Hist.* 45: 271-331.

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George Yount noted (Camp, p. 39) that the Paiute in southwestern Utah ate "grasshoppers and insects such as flies, spiders and worms of every kind."

Carolin, V.M.; Knopf, J.A.E. 1968. The pandora moth. U.S. Dept. Agric. For. Surv. Pest Leafl. 114, pp. 1-7. (Saturniidae)

Carr, L.G. 1951. Interesting animal foods, medicines and omens of the eastern Indians, with comparisons to ancient European practices. *J. Wash. Acad. Sci*. 41: 229-235.

Carr reports that Cherokees living in the shadows of the Great Smoky Mountains of North Carolina have a high regard for a number of animal foods including locusts, grubs and other insects. Lottie Jenkins provided the information that grubworms were formerly employed and that they can be made into a delicious thick soup: "She told that her husband once sat down to a meal of grubworm soup, but had no knowledge of what he was eating. He thought the soup very good until his Indian host advised him to 'dig deep and get grubs.' When he pulled up a fat grub, the thought of it was too much; he was unable to finish the meal." The cicada, *Tibicen septendecim*, also was a "choice delicacy" among the Cherokee who dug them up just when they were ready to emerge from the ground. The legs were removed, then they were fried in hot fat. They were so highly prized that during years of abundance they were salted down and pickled for canning. The Cherokee even made pies from them. Roasted cornworms were another insect delicacy of the Cherokee. "Young" wasps and yellowjackets [grubs] were also eaten.

Also see under Hymenoptera: Cynipidae.

Chalfant, W.A. 1922 [1933]. The Story of Inyo. Copyright W.A. Chalfant, pp. 80-84.

Chalfant's discussion refers primarily to the Eastern Monos (Owens Valley Piutes) and to a lesser extent to the Panamints which were desert Indians. Among the foods of the latter:

> Sugar substitute was secured from a common reed, either by scraping a parasitic covering from the stems and leaves and using it in crude form, or by cutting the plants, drying them in the sun, crushing the material and sifting out the finer product. This was ground into a gum-like mass and partially roasted. White men who saw it say that the crude sugar was filled with small green bugs, a detail not objectionable to the aborginal user.

According to Chalfant:

> . . . animals of all edible kinds and some insects helped the larder, and very little of each was wasted. . . . A favorite food was a large caterpillar known as pe-ag-ge. This delicacy is the larva of the Pandora moth, *Coloradia pandora*. The moth is brownish gray, each wing bearing a small black spot. Its eggs are laid in early summer in tree bark; while the yellow pine is sometimes used for the purpose, forest men who have observed the point say that the Jeffrey pine is almost exclusively chosen, usually in a stand of its own species and not in a mixed collection of trees. Egg laying is on the sunny side of the tree, or on the side away from prevailing winds. Hatching occurs in August or September. The young caterpillars feed on leaves, moving upward until in October they gather in clusters like bees on the higher branches. Remaining dormant during cold weather, they continue to grow when spring comes, and move earthward. They are from 1 1/2 to 3 inches long, and half an inch or more in diameter. When not destined to become food for Indians, birds or animals, they reach the ground, burrow into it and there produce hard cocoons, and in the second year of the life cycle they become moths.
>
> The Indians prepare to receive the caterpillars by surrounding each tree with a trench ten to sixteen inches deep and approximately two feet wide, with an almost vertical outer wall. The caterpillars collect in quantities and are scooped up, a single camp sometimes gathering a ton or more. The harvest was sometimes hastened by building a fire under the tree, the smoke causing

the caterpilalrs to drop.

> Fires were made and earth and peagges mixed with the coals in a mound. When the mass cooled off, the caterpillars were sifted out and stored in cool places for later use. When not eaten in this baked condition, they were mixed in stews and eaten with pinenuts and sunflower seeds.
>
> . . . It is said that one of the wars between Indians east of the Sierras and those on the western slope arose from an expedition made by Piutes to secure breeding stock from worm orchards across the summit. This credits them with a foresight unusual in their affairs.
>
> Some of the inland lakes, notably Mono and formerly Owens, contain countless millions of the pupa of a fly, *Ephydra hians*. The small shells cling to rocks under water until they loosen and are driven ashore in great windrows, where the women gathered them. They were dried in the sun and the shells rubbed off, leaving a small yellowish kernal of worm, which was used as food. This is termed "cozaby" by Indians with whom the author has talked. . . .

Chalfant also notes that, "Occasional invasions of the seventeen-year locust were not unwelcomed, for plenty of quick-lunch material was thus made available."

Chamberlin, R.V. 1911. The ethno-botany of the Gosiute Indians. *Memoirs Am. Anthropol. Assoc.* Vol. 2, Part 5 (1964): 331-405.

Writing of the Gosiute Indians of Utah, Chamberlin states (pp. 336-337):

> An abundance of food was furnished at times by the black cricket (*Anabrus simplex*), several species of locusts, and the cicada. The crickets often occurred in vast swarms, or 'armies.' They were not only eaten in season, but were dried and preserved for winter use in baskets or other receptacles covered in pits. A favorite method of cooking fresh crickets was to place them in pits lined with hot stones in which they were covered and left until thoroughly roasted. This dish is really very palatable and is compared by the Indians to the shrimp, which they accordingly term the 'fish cricket.' Locusts were similarly prepared and preserved for winter use. The cicada was eaten not only after cooking, but also fresh. Indian children may still often be seen catching these insects, deftly removing head and appendages, and eating them at once with evident relish.

Chamberlin, R.V. 1950. Life Sciences at the University of Utah. Background and History. Salt Lake City: Univ. Utah, pp. 8-9. (Tettigoniidae)

Childs, T. 1953. Sketch of the "Sand Indians." *The Kiva* 19(2-4): 27-39. (Miscellaneous Lepidoptera)

Chittenden, H.M.; Richardson, A.D. 1905. Life, Letters and Travels of Father Pierre-Jean De Smet, S.J., 1801-1873. New York: Harper, pp. 1032-1033. (Acrididae)

Clayton, W. 1921. [1973 reprint]. William Clayton's Journal. A Daily Record of the Journey of the Original Company of "Mormon" Pioneers from Nauvoo, Illinois, to the Valley of the Great Salt Lake. New York: Arno Press, p. 335. (Tettigoniidae)

Collinson, P. 1764. Some observations on the cicada of North America. *Philosoph. Trans.* 54: 65-68. (Cicadidae)

Conway, J.R. 1977. Analysis of clear and dark amber repletes of the honey ant, *Myrmecocystus mexicanus hortideorum*. *Ann. Entomol. Soc. Am.* 70: 367-369. (Formicidae)

Coon, C.S. 1948. A Reader in General Anthropology. New York: Henry Holt and Co., pp. 46-49, 58-59, 267.

Contains reprints in part of Dixon (1905), Egan (1917) and Steward (1938).

Coville, F.V. 1892. The Panamint Indians of California. *Am. Anthropologist* 5 (o.s.): 351-361 (New York: Kraus Reprint Corp., 1964 reprint). (Aphididae)

Coville, F.V. 1897. Notes on the plants used by the Klamath Indians of Oregon. *Contrib. U.S. Nat. Herbar.* 5(2), p. 104. (Tettigoniidae)

Cowan, F. 1865. Curious Facts in the History of Insects; Including Spiders and Scorpions. Philadelphia: J.B. Lippincott & Co., pp. 99, 255.

Cowan quotes (p. 99) Simmond's *Curios of Food,* p. 304, which quoted the *Empire County Argus* regarding the harvest and preparation of grasshoppers as food by the California Digger Indians. Cowan cites (p. 255) Collinson regarding the use of *Cicada septendecim* by North American Indians "who plucked off the wings and boiled them."

Cowan, R.A. 1967. Lake-margin ecologic exploitation in the Great Basin as demonstrated by an analysis of coprolites from Lovelock Cave, Nevada. *Rpts. Univ. Calif. Archaeol. Surv.* No. 70: 21-35.

Cowan reports (pp. 24, 31, 33) that prehistoric dried human feces in Lovelock Cave contained "insects," but they were of less importance in the diet than in post-contact times.

Cushing, F.H. 1920. Zuni Breadstuff. Indian Notes and Monogr. 8, pp. 562-563.

Cushing, who lived with the Zuni for five years and is sometimes quite euphoric in his descriptions of Zuni foods and their preparation, mentions insects as follows:

> Finally, most curious of all the eatables of these motley meals, are parched locust-chry, or *chum'-al-li*. These insipient, though active insects are industriously dug in great numbers from the sandy soil of the canon woodlands, by the women, who go forth to their lowly chase, like berry-pickers, in merry shoals. They are then confined in little lobe-shaped cages of wicker, brought home toward evening, and at once both cleaned and 'fattened,' by immersion over night in warmish water, of which, if they be a lively lot, they absorb so much as to increase in individual bulk before morning to more than twice their natural size. Then they are taken out and treated to a hot bath in melted tallow, which causes them to roll up and die, after which they are salted and parched as corn is, in an earthen toasting-pot, over a hot - very hot - fire.

Cushing continues: "Such a meal as this, eaten as promiscuously as it has been described, is not to be seen every day; but if one eliminate from it the locusts and other fancy dishes, retaining the meat and bean-stews, *he'-we*, and some other varieties of breadstuff, he will have the representative dinner, or evening meal, of every well-to-do Zuni household almost every day (except during melon and green-corn time) throughout the year." The mention of digging by Cushing suggests that these "locusts" may actually have been cicadas.

Daguin, E. 1900. Les insectes comestibles dans l'antiquite et de nos jours. *Les Naturaliste* (reprint), 27 pp.* (Vespidae)

Davidson, W.M. 1919. Life history and habits of the mealy plum aphis. U.S. Dept. Agric., Professional Paper, Bull. No. 774.* (Aphididae)

Davis, E.L. 1962. Hunter-gatherers of Mono Lake. *The Masterkey* 36(1): 23-28. (Introduction)

Davis, E.L. 1963. The desert culture of the western Great Basin: a lifeway of seasonal transhumance. *Am. Antiquity* 29(2): 202-212.

Davis emphasizes that "each local enclave exploited the full range of available food products, hunting when possible, but concentrating on collecting and processing of more reliable vegetal and insect crops. . . . Paiute who lived near Mono Lake relied on pinyon nuts, on biennial harvests of pine-tree caterpillars, and particularly on lake-fly larvae which washed ashore in windrows along the margins of the lake." Davis continues: "The Mono Lake families took their group name, the Kuzedika or Fly-larva-eaters, from this particular crop." She notes that, in a good season, hundreds of pounds of caterpillars of *Coloradia pandora* were collected, dried, and stored. After the fly larvae, called *kutsavi*, had been collected, they were sun-dried, husked, and stored in baskets.

According to Davis, before the coming of the Europeans disturbed the varied ecosystems of the highland area in the vicinity of Mono Lake, a great variety of animals was found in meadow, wood and grassland,

including rodents, hares and rabbits, deer, antelope and mountain sheep. Although the Paiute hunted, big game was not their staff of life. Relative to ethnological confusion occasioned by the fact that different types of artifact assemblages occur at different types of sites, Davis notes that: "Projectile points are numerous on pinyon-grove sites where the game moved seasonally, but are seldom found in the climax Jeffrey-pine forest where caterpillar harvesting was a brief but full-time activity."

Davis, E.L. 1965. An ethnography of the Kuzedika Paiute of Mono Lake, Mono County, California. Misc. Papers No. 8, Univ. Utah Anthropol. Papers No. 75, pp. 1-55.

Davis (pp. 12, 26, 29-33, 35) reiterates many of the points covered in her 1962 and 1963 papers, and adds more detailed information. She states, regarding the harvesting of *Coloradia pandora* (p. 32):

> When the 'hatch' began, families went into concerted action. Trenches were dug in circles around the bases of selected trees. . . to trap the caterpillars, and the families worked together very much like Vermonters sugaring off in a maple grove.
>
> After the caterpillars started migrating down the trunks, smudge fires were built under the trees to stupify the larvae remaining in the branches. These were picked up as they fell to the ground. Meantime, the trenches, which had under-cut sides, filled with caterpillars, which were also collected from time to time. Some were barbecued on willow sticks and eaten at once. The rest were tossed into hot ashes to kill them, then sun-dried and stored in fiber bags in the shade of bark shelters. . . where they kept cool and dry. The caterpillars, being the feeding instar of the creature, were very rich and greasy and therefore subject to spoilage. If the weather was favorable and the gathering went well, a hard-working family could garner bushels of sun-dried worms, shriveled and hard as twigs. Later on, these were added to soups and stews, where the hot water plumped them out again. . .

Regarding the harvest of the shore fly, *Ephydra hians*, Davis says (p. 33):

> These *kutsavi* were a staple, a delicacy and an important item of trade. We were able to observe some of the process of preparing this food. The larvae, which are about the size of grains of brown rice, had been dried on a canvas, the husks rubbed off between the palms and then winnowed out by tossing in a tray in the breeze. The *kutsavi* were then more thoroughly sun dried and stored in bags or baskets. They have a novel but not unpleasant taste, like shrimp flavored with Epsom Salts (the flavor of the lake water). Like the caterpillars, they are extremely rich and required similar care (and good luck) to prevent spoiling. They were added to all manner of dishes -- berries, *pa:pi* or pinenut gruel, soups and stews. Whether the supply of this staple fluctuated in the past is impossible to say. Today, the flies have disappeared almost entirely from the shores and only a scraping of larvae are to be found.

Other insects mentioned by Davis as foods of the Mono Lake Paiute include locusts, [Mormon] crickets and ant brood.

Davis, J.T. 1961. Trade routes and economic exchange among the Indians of California. Berkeley: *Univ. Calif. Archaeol. Surv. Rpts.* No. 54, pp. 21, 28. (Need several pages prior to p. 21 and also the first page of Table 1)

Davis reports that the Chumash received grasshoppers from the "Interior" (possibly the Mojave Desert or the San Joaquin Valley, according to Sutton (1988), suggesting that these insects were involved in trade. Also, the Eastern Mono apparently conducted a lively trade in pandora moth caterpillars and pupae, trading them to the Central Miwok, the Tubatulabal, and the Western Mono. According to Davis, the Eastern Mono also traded *kutsavi* (*Hydropyrus hians*) to the Central Miwok, the Tubatulabal, the Western Mono, and the Washo.

DeFoliart, G.R. 1989. The identity of grasshoppers used as food by Native American tribes. *Food Insects Newslet*. 2(3): 3, 5, 8.

Drawing from the literature, primarily Essig (1931), the author lists eight species in four genera.

DeFoliart, G.R. 1991. Toward a recipe file and manuals on "How to Collect" edible wild insects in North America. *Food Insects Newslet.* 4(3): 1, 3-4, 9. (Acrididae)

DeFoliart, G.R. 1994. Some insect foods of the American Indians: and how the early Whites reacted to them. *Food Insects Newslet.* 7(3): 1-2, 10-11. (Acrididae)

De Quille, D. 1877. History of the Big Bonanza: An Authentic Account of the Discovery, History, and Working of the World Renown Comstock Silver Lode of Nevada. . . . Hartford, Conn.: American; San Francisco: Bancroft, p. 284.

De Quille describes an encounter with a Northern Paiute in Virginia City who opined that grasshoppers and crickets are pretty good food but stated that scorpions make him sick.

Dillon, R. (ed.). 1966. California Caravan: The 1846 Overland Memoir of Margaret M. Hecox. San Jose, Calif.: Harlan-Young, p. 40. (Tettigoniidae)

Dixon, R.B. 1905. The Huntington California Expedition. The Northern Maidu. *Bull. Am. Mus. Nat. Hist.* 17 (part III): 183-184, 190. (Reprinted by Coon 1948).

Dixon, reporting the results of ethnological studies on the Northern Maidu in the lower Sierra region, says of their food habits:

> Of animal food there was an abundance. In the mountains, deer, elk, mountain-sheep, and bear were plenty; while in the Sacramento Valley there were great herds of antelope. Of smaller game, rabbits, racoons, and squirrels were numerous. In addition to the animals mentioned, nearly all others known in the region, such as the badger, skunk, wildcat, and mountain-lion, were eaten. Only the wolf, coyote, and dog were not used as food, and in the southern section the grisly bear was also exempt. All birds practically, except the buzzard, were eaten, ducks and geese in particular being caught in hundreds at the proper seasons. Lizards, snakes, and frogs were not eaten. Yellow-jacket larvae were, however, eagerly sought, as were also angle-worms. Grasshoppers, locusts, and crickets were highly esteemed, and in their dried condition were much used in trade. Fish of many kinds were to be had, salmon being caught in considerable quantities in the early days. Eels were a favorite food, and, dried, formed an indispensable part of the winter's food-supply for the foot-hill and valley people. Shell-fish, such as mussels, were to be had in some abundance, particularly in the Sacramento River. Salmon-bones and deer vertebrae were pounded up and used for food; the salmon-bones being eaten raw, whereas the deer-vertebrae, after pounding, were made into little cakes and baked.

The above-described animal food abundance in the land of the Northern Maidu, coupled with their esteem for insect foods, does little to support Hoffman's suggestion that the Menomini did not use insects because of the food abundance in which they lived. Dixon says further of the insect foods:

> Grasshoppers and locusts were eaten eagerly when they were to be had. The usual method of gathering them was to dig a large, shallow pit in some meadow or flat, and then, by setting fire to the grass on all sides, to drive the insects into the pit. Their wings being burned off by the flames, they were helpless, and were thus collected by the bushel. They were then dried as they were. Thus prepared, they were kept for winter food, and were eaten either dry and uncooked or slightly roasted.

Domenech, E. 1860. Seven Years Residence in the Great Deserts of North America, 2 vols. London, Vol. II, p. 64.* (Tettigoniidae)

Dorsey, J.O. 1884. Omaha sociology. Bur. Ethnol., Smithson. Inst., 3rd Ann. Rpt., pp. 303-304.

Dried fish, slugs, dried fish-spawn, dried crickets, grasshoppers and other insects, among other things, were not eaten by the Omaha. If, however, "worms" infested the corn they would be collected and pounded up with a small quantity of corn that had been heated and the mixture used as a soup to drink.

Downs, J.F. 1966. The Two Worlds of the Washo. An Indian Tribe of California and Nevada. New York: Holt, Rinehart and Winston, Inc., p. 35.

Downs mentions several kinds of insects in his discussion of the animal foods of the Washo, a tribe centered around Lake Tahoe in California and Nevada. Periodically, when the locusts swarmed, "The Washo always rallied to gather as many of them as possible. Sometimes the insects would be gathered in baskets and roasted in the coals of a camp fire. At other times brush and grass was set on fire and the insects driven by the flames into a ditch where they could be gathered more easily. Dried and ground, they produced a nutritious and long lasting flour to be mixed with other foods." Also, Downs says, "At certain times of the year the common grasshopper appeared in great numbers. If a gatherer began early in the morning before the hoppers became active in the growing warmth of the day, he could pick them from the grass and bushes with ease. These were usually roasted in pits. The grasshopper could also be dried and ground into flour to be stored against the winter."

According to Downs, caterpillars were eaten whenever they appeared in sufficient numbers to justify gathering them, and bee larvae were cooked and eaten. The Washo also often made long trips to Mono Lake to collect the *matsibabesha* (the larvae of *Hydropyrus hians*). Although ants and "ant eggs" were eaten by all of the neighboring tribes, the Washo stubbornly insisted that they never used ants as food.

Drews, R. 1940. Peculiar wooden tubes from southeastern Oregon. *Am. Antiquity* 6(1): 75-76.

Drews describes hollow wooden tubes found during excavations. The tubes ranged up to 10 cm in length and up to 1.2 cm in diameter, but most were smaller. Leechman (1944) offers a possible explanation as to their use.

Driver, H.E. 1937. Culture element distributions: VI - southern Sierra Nevada. *Univ. Calif. Pubs. Anthropol. Rec.* 1(2): 53-154.

Driver (p. 62), working in the San Joaquin Valley region, found grasshoppers and caterpillars "collected in trenches," yellowjacket larvae and caterpillar pupae mentioned, but less frequently than in the area worked by Drucker (1937).

Driver, H.E. 1939. Culture element distributions: X - northwest California. *Univ. Calif. Pubs. Anthropol. Rec.* 1(6): 297-433.

Driver (pp. 310, 376) records several insect foods from northwestern California, including caterpillars (widespread), grasshoppers and yellow-jacket larvae (somewhat less widespread), and caterpillars caught in trench. The Wiyot also ate wild-bee honey. The Matt smoked yellow-jackets out of the nest with wormwood.

Drucker, P. 1937. Culture element distributions: V - southern California. *Univ. Calif. Pubs. Anthropol. Rec.* 1(1): 1-52.

Drucker, using the cultural elements method of questioning (originated by Gifford in 1934), reports (pp. 9-10) widespread consumption of yellow-jacket larvae, grasshoppers, dried caterpillars, and honey dew among southern California tribes.

Drucker, P. 1941. Culture element distributions: XVII - Yuman-Piman. *Univ. Calif. Pubs. Anthropol. Rec.* 6(3): 91-230.

Drucker (pp. 99, 165, 171) reported caterpillars and yellowjacket eggs as eaten by several of 11 Yuman-Piman groups in western Arizona, extreme southern California, and northwestern Mexico. All informants denied that grasshoppers were eaten. Drucker says of the Pima, "The ritual name of the caterpillars means 'Shaman's ornaments,' suggesting some ritual importance of the creatures." Said of the Yavapai, "Big caterpillars were not so plentiful as in the regions in the west of the Verde Valley," and of the Shivwits Paiute, "The people of the tacai district got more caterpillars than other Shivwits."

Dubois, Cora. 1935. Wintu ethnography, *Univ. Calif. Pubs. Am. Archaeol. Ethnol.* 36(1): 15.* (Pteronarcyidae)

Ebeling, W. 1986. Handbook of Indian Foods and Fibers of Arid America. Berkeley: Univ. Calif. Press, pp. 5, 25-30, 79, 98-105, 154-157, 179-183, 364-368, 400. (Miscellaneous Coleoptera, Cicadidae, Megathymidae, Saturniidae, Acrididae and Tettigoniidae)

Egan, W.M. (ed). 1917. Pioneering the West 1846-1878: Major Howard Egan's Diary. Richmond, Utah:

Howard Egan Estate, pp. 228-233. (Formicidae, Tettigoniidae). The account of a Mormon cricket drive is reprinted in Coon (1948: 46-49).

Elliott, T.C. (ed.). 1909. The Peter Skene Ogden Journals. *Quart. Oregon Hist. Soc.* 10(4): 331-365.

In an entry dated February 1826 (Elliott, pp. 354-355), Ogden refers to the "Snake Indians" from north of the Great Salt Lake:

> I had often heard these wretches subsisted on ants, locusts and small fish, not larger than minnies, and I wanted to find out if it was not an exaggeration of late travelers, but to my surprise, I found it was the case; for in one of their dishes, not of small size, was filled with ants. They collected them in the morning early before the thaw commences. The locusts they collect in Summer and store up for their Winter; in eating they give the preference to the former, being oily; the latter not, on this food these poor wretches drag out an existence for nearly 4 months of the year; they live contented and happy; this is all they require. . . . [This account can also be found in Rich and Johnson 1950: 133-134.]

Engelhardt, G.P. 1924. The saturniid moth, *Coloradia pandora*, a menace to pine forests and a source of food to Indians in eastern Oregon. *Bull. Brooklyn Entomol. Soc.* 19: 35-37. (Saturniidae)

Essene, F. 1942. Culture element distributions: XXI - Round Valley. *Univ. Calif. Pubs. Anthropol. Rec.* 8(1): 1-97.

Essene (p. 4) studied the Round Valley, California groups, but his results regarding insects are not clear. Caterpillars, yellowjacket larvae, and grasshoppers are included in the list of animal foods not eaten by anyone, but under the section of various hunting methods Essene shows positive responses to the following categories: Caterpillar caught in trench; Leaves tied around tree, which caterpillars feed on, and from which they are picked off by hand; Caterpillars knocked off tree with stick; Only small hairless caterpillars that feed on 'ash' trees are eaten; Yellowjackets smoked to stun them; Grasshoppers killed by burning grass.

Essig, E.O. 1931. A History of Entomology. New York: Macmillan, pp. 23-41. (Most orders and families)

Essig, E.O. 1934. The value of insects to the California Indians. *Sci. Month.* 38: 181-186.

Essig mainly repeats in more general terms the information provided in his 1931 paper, although there is mention of the use of termites from decaying wood and of ant larvae for food rather than for medicinal purposes. Also see Essig under the Introduction, and under Saturniidae.

Essig, E.O. 1949. Man's six-legged competitors. *Sci. Month.* 69: 15-19. (Belostomatidae and Lasiocampidae)

Euler, R.C. 1966. Southern Paiute Ethnohistory. *Univ. Utah Anthropol. Papers*, No. 78, pp. 112-113.

Euler summarizes a long list of Southern Paiute foodstuffs reported in the previous literature (including several insect references not consulted by this bibliographer. Insects included "cane grass candy" or honeydew from *Phragmites communis*, grasshoppers, ants, fly larvae, and honey. The Southern Paiutes also engaged in agriculture in some areas, growing corn, squash, beans and potatoes. Also see Euler under Formicidae.

Fages, P. 1775 [1937]. A Historical, Political and Natural Description of California. Transl. by H.I. Priestley. Berkeley: Univ. Calif. Press, pp. 22, 60, 79. (Aphididae)

Felger, R.S. 1977. Mesquite in Indian cultures of southwestern North America. *In* Simpson, B.B. (ed.), Mesquite. Its Biology in Two Desert Scrub Ecosystems. Stroudsburg, Pa.: Dowden, Hutchinson & Ross, Inc., p. 163. (Bruchidae)

Felt, E.P. 1918. Caribou warble grubs edible. *J. Econ. Entomol.* 11: 482. (Oestridae)

Fenenga, G.L.; Fisher, E.M. 1978. The Cahuilla use of *Piyatem*, larvae of the white-lined sphinx moth (*Hyles lineata*), as food. *J. Calif. Anthropol.* 5(1): 84-90. (Sphingidae)

Fladung, E.B. 1924. Insects as food. Maryland Acad. Sci. Bull., Oct. 1924, pp. 5-8.

Fladung mentions insects used as food by a number of North American tribes, including grasshoppers, crickets, ants and miscellaneous caterpillars.

Fowler, Catharine S. 1986. Subsistence. *In* Handbook of North American Indians. Vol. 11, Great Basin (W.L. d'Azevedo, ed.), pp. 64-97 (Table 5).

Fowler (pp. 88, 90-91) reported that among insects, the most widespread use was of caterpillars, cicadas, Mormon crickets and "ant eggs"; specific technologies were developed for harvesting some of the insects. Fowler (p. 92, Table 5) lists tribes known to use the different insects or insect groups:

Mormon cricket (*Anabrus simplex)*: Washoe, Nev. Northern Paiute,Western Shoshone, Northern Shoshone, Bannock, Utah Southern Paiute, Western Ute, Southern Ute, Northern Ute
Grasshoppers: Washoe, Western Shoshone, Northern Ute, Southern Ute
Pandora moth larvae (*Coloradia Pandora*): Owens Valley Paiute, Nev. Northern Paiute
White-lined sphinx moth larvae (*Hyles lineata):* Washoe, Nev. Northern Paiute, Nev. and Utah Southern Paiute, Western Shoshone, Western Ute
Caterpillars: Nev. Northern Paiute, Washoe, Western Shoshone, Northern Shoshone?, Utah Southern Paiute,Western Ute, Northern Ute, Southern Ute
Bee larvae, often *Vespula diabolica* (yellow jacket [a wasp actually]): Washoe, Nev. Northern Paiute, Western Shoshone, Northern Shoshone, Southern Ute
Ants and ant larvae: Nev. Northern Paiute, Western Shoshone, Nev. Southern Paiute, Northern Shoshone, Bannock, Northern Ute, Western Ute
Cicada (*Diceroprocta* spp.): Panamint, Nev. Southern Paiute, Chemehuevi
Cicada (*Okanagodes* spp.): Washoe, Nev. Northern Paiute, Owens Valley Paiute, Panamint, Western Shoshone, Nothern Shoshone, Bannock, Nev. and Utah Southern Paiute, Northern Ute, Western Ute, Southern Ute
Mealy plum aphis honeydew (*Hyalopterus pruni*): Washoe, Nev. Northern Paiute, Owens Valley Paiute, Panamint, Western Shoshone, Nev. and Utah Southern Paiute, Western Ute
Brine fly larvae (*Ephydra hians*): Washoe, Nev. Northern Paiute, Owens Valley Paiute, Panamint

Fowler, C.S.; Walter, N.P. 1985. Harvesting pandora moth larvae with the Owens Valley Paiute. *J. Calif. & Great Basin Anthropol.* 7(2): 155-165. (Saturniidae)

Fowler, D.D.; Fowler, C.S. 1971. Anthropology of the Numa: John Wesley Powell's Manuscripts on the Numic Peoples of Western North America, 1868-1880. Contrib. to Anthropol. No. 14. Smithson. Inst., Washington, D.C., p. 48. (Acrididae)

Fremont, J.C. 1845 [1988 reprint]. The Exploring Expedition to the Rocky Mountains, Washington, D.C.: Smithsonian Inst. Press, p. 154. (Ephydridae)

Frison, G.C. 1971. Shoshonean antelope procurement in the upper Green River Basin, Wyoming. *Plains Anthropologist* 16: 258-284.

Frison (p. 261) reported charred fragements of the Mormon cricket, *Anabrus simplex*, and large red ants, *Pogonomyrmex* sp., in late prehistoric or protohistoric Shoshonean lodges at the Eden-Farson Site in the upper Green River Basin.

Frison, G.C.; Huseas, M. 1968. Leigh Cave, Wyoming, Site 48 WA 304. *The Wyo. Archaeol.* 11(3): 21-33. (Tettigoniidae)

Fry, G.F. 1976. Analysis of prehistoric coprolites from Utah. Anthropol. Papers No. 97. Salt Lake City: Univ. Utah Press, pp. 1-45.

Fry reported "insect parts" in coprolites.

Furniss, R.L.; Carolin, V.M. 1977. Western forest insects. U.S. Dept. Agric. For. Serv. Misc. Publ. No. 1339, pp. 193-197. (Saturniidae)

Fynn, A.J. 1907. The American Indian as a Product of Environment. Boston: Little, Brown & Co., p. 87. (Acrididae)

Garth, T.R. 1953. Atsugewi ethnography. Univ. Calif. *Anthropol. Recs.* 14(2): 129-212.* (Acrididae, Pteronarcyidae)

Ghesquièré, J. 1947. Les insectes palmicoles comestibles. *In*: Les Insectes des Palmiers, P. Lepesme, pp. 791-793. Paris: Lechevalier. (Curculionidae)

Gifford, E.W. 1932. The Northfork Mono. *Univ. Calif. Publs. Am. Archaeol. and Ethnol.* 31(2): 15-65. (Saturniidae)

Gifford, E.W. 1940. Culture element distributions: XII - Apache-Pueblo. *Univ. Calif. Pubs. Anthropol. Rec.* 4(1): 1-208.

Gifford (pp. 10, 90) found little use of insects as food among the Apache Pueblo groups in the Southwest, mainly Arizona and New Mexico. Of 20 groups studied, positive responses were obtained in only two for caterpillars, one for yellowjacket grubs, one for parched grasshoppers, (surprisingly) from 15 for bumble-bee honey from the ground, seven for black-bee honey from (split) sotol stalks, 5-8 for white man's bee honey, and three for honeydew. One informant, when asked about insects as food, contemptuously replied, "Why ask foolish questions?" Yellowjacket grubs and roasted grasshoppers were primarily consumed by children. Caterpillars are described as follows: "brown caterpillar with black stripes, about 4 in. long, in summer after heavy rains. Head pinched off, entrails pulled out; bodies 'braided,' boiled in pot, dried on sun or branch or timber to preserve for short time; or ate at once." Also, "black and green caterpillars."

Gifford, E.W.; Kroeber, A.L. 1937. Culture element distributions: IV Pomo. *Univ. Calif. Pubs. Am. Archaeol. Ethnol.* 37: 117-254.

Information is furnished on 20 autonomous communities of the Pomo in California, with data on 16 of them obtained in this study. Supplementary comments from the different communities are given for each of the four insect groups consumed (pp. 137-138, 176, 178). Grasshoppers were eaten in at least 12 of the communities: "Grass burned to kill grasshoppers."; "Taken by burning grass."; "Not pulverized."; "Grasshoppers taken by burning grass. Eaten without further cooking." Yellowjacket larvae were eaten in all 20 communities: "Yellowjackets killed in burrow by fanning smoke. Nest then dug out."; "Yellowjacket called go'o."; "To force smoke into yellowjackets' burrow they blew or fanned with pepperwood leaves."; "after sundown." Caterpillar chrysalids were eaten in at least eight communities: "Smooth caterpillar (li), brown color, found on maple trees; eaten.; Hairy species (tsimeli) not eaten."; "Caterpillars from 'ash trees' (prob. *Fraxinus oregona*, possibly *dipetala*) eaten whole, raw or boiled. Went to Ukiah region for them as no ash trees near Cloverdale."; "Black and green caterpillars taken when came down from 'ash trees.' Available for 4 days only. Cooked in earth oven." Honeydew (from leaves) was eaten in only two communities: "From white-oak leaves; made into ball and eaten." In addition, angleworm soup was eaten in at least 11 of the Pomo communities: "Worms driven to surface of ground by inserting and churning a stick."

Glendening, G.E.; Paulsen, H.A. 1955. Reproduction and establishment of velvet mesquite. USDA Tech. Bul. 1127. Washington: Govt. Print. Off.* (Bruchidae)

Glover, T. 1872. Entomological record. U.S. Dept. Agric. Monthly Rpt. (Febr.), pp. 74-76. (Tettigoniidae)

Goldschmidt, W. 1978. Nomlaki. *In*: W.C. Sturtevant (Ed.), Handbook of North American Indians (R.F. Heizer, Vol. Ed.), Vol. 8., 1978, pp. 341-349. (Acrididae)

Gottfredson, P. 1874. Journal of Perter Gottfredson, From the Gottfredson Family History. Ms. on file, Utah State Hist. Soc., Salt Lake City, pp. 15-16. (Tettigoniidae)

Graham, S.A. 1965. Entomology: an aid in archaeological studies. *In* Contrib. of the Wetherill Mesa Archeological Project, D. Osborne, Assembler, pp. 167-174. *Mems. Soc. Am. Archaeol.*, No. 19, p. 167. (Acrididae)

Gudde, E.G.; Gudde, E.K. (eds.). 1961. From St. Louis to Sutter's Fort, 1846. [by Heinrich Lienhard] Norman: Univ. Okla. Press, p. 133. (Acrididae)

Hall, H.J. 1977. A paleoscatological study of diet and disease at Dirty Shame Rockshelter, southeast Oregon. Tebiwa: Misc. Papers Idaho State Univ. Mus. Nat. Hist., No. 8: 1-14, Table 1. (Formicidae, Rhinotermitidae)

Harper, F. 1955. The Barren Ground Caribou of Keewatin. *Univ. Kansas Mus. Nat. Hist. Misc. Pub. No. 6,* pp. 1-164. (Oestridae)

Harrington, J.P. 1942. Culture element distributions: XIX - central California coast. *Univ. Calif. Pubs. Anthropol. Rec.* 7(1): 1-46.

Harrington reported (pp. 8-9) several insects used as food by the Chumash and other groups along the central California coast. These included yellowjacket larvae, grasshoppers, caterpillar pupae, and the collection of honeydew.

Harrington, J.P. 1986. Ethnographic Field Notes, Vol. 3, Southern California/Basin. Washington: Smithson. Inst., Nat. Anthropol. Arch. (Microfilm edition, Millwood, N.Y.: Kraus Internat. Publs.*

Harrington, M.R. 1945. Bug sugar. *The Masterkey* (Southwest Mus.) 19: 95-96. (Aphididae)

Harris, J.S. 1940. The White Knife Shoshoni of Nevada. *In* Acculturation in Seven American Indian Tribes (R. Linton, ed.), pp. 39-118. New York: D. Appleton-Century Co, Inc. Reprinted by permission, 1963, Gloucester, Mass.: Peter Smith.

Harris (pp. 40-41), in discussing the White Knife Shoshoni, states that: "Insects such as crickets and ants formed a substantial item of the diet, but the bulk of the food consisted of numerous roots, seeds, plants and berries." Women gathered the insects, and dried insects were cached. Harris states (p. 80): "Always poor in the meat of the larger animals, they were forced now more than ever [because of activities of the Whites] to live on rats, ants, crickets, grubworms and other insects."

Heizer, R.F. 1945. Honey-dew sugar in western North America. *The Masterkey* 19: 140-145. (Aphididae)

Heizer, R.F. 1950. Kutsavi, a Great Basin Indian food. *Kroeber Anthropol. Papers* 2: 35-41. (Ephydridae)

Heizer, R.F. 1954. Notes on the Utah Utes by Edward Palmer, 1866-1877. Univ. Utah Anthropol. Papers, No. 17.

Heizer (pp. 7, 8) cites Palmer that the Utes ate "ants eggs." Pah Ute boys fastened small lighted straws to wasps so as to follow them to their holes; with a bundle of lighted straw, they smoked out the adult wasps, then cooked the nest with the eggs and ate them. During autumn when grasshoppers were numbed with cold, they could be gathered by the bushel. A hole was dug in the sand while stones were heated in a nearby fire. Hot stones were placed in the bottom of the hole, covered with a layer of grasshoppers, then another layer of hot stones, another layer of grasshoppers, etc., until bushels could be roasted at one time. When cooled, the grasshoppers were removed, thoroughly dried and ground into meal.

Heizer, R.F. 1967. I. Analysis of human coprolites from a dry Nevada cave. *Univ. Calif. Archaeol. Surv. Rpts.* No. 70: 1-20.

Heizer (pp. 5, 6) makes brief reference to insects in coprolite studies related to those of Roust (1967) and suggests that insects were probably rarely eaten in the vicinity of Lovelock Cave and Hidden Cave in western Nevada.

Heizer, R.F. 1978. Trade and Trails. *In:* W.C. Sturtevant 1978, pp. 690-693. (Introduction)

Heizer, R.F.; Napton, L.K. 1969. Biological and cultural evidence from prehistoric human coprolites. *Science* 165 (3893): 563-568.

The authors report body parts of *Anthrenus* sp. (Dermestidae) and *Ptinus* sp. (Ptinidae) from human

coprolites in Lovelock Cave in west-central Nevada. As both of these genera are scavengers on plant and animal products, it is doubtful that their presence in the coprolites suggests ingestion, or at least intentional ingestion. The authors state that "coprolite analysis is the most precise method available to archeologists for determining ancient dietary patterns and food-preparation practices," and briefly mention coprolite rehydration techniques that improve analysis for delicate remains such as those of insects.

Henderson, W.W. 1931. Crickets and grasshoppers in Utah. Utah Agric. Expt. Sta. Circ. 96, 38 pp. (Tettigoniidae)

Hevly, H.C.; Johnson, C.D. 1974. Insect remains from a prehistoric pueblo in Arizona. *Pan-Pac. Entomol.* 50: 307-308.

The authors report the identity of four species of insects from a 13th Century pueblo in Arizona, but consider the insects to have been intrusive and not used as food.

Hitchcock, S.W. 1962. Insects and Indians of the Americas. *Bull. Entomol. Soc. Am.* 8: 181-187. (Introduction)

Hoffman, W.J. 1878. Miscellaneous ethnographic observations on Indians inhabiting Nevada, California, and Arizona. *In* Tenth Annual Report of the United States Geological and Geographical Survey of the Territories, Embracing Colorado and Parts of Adjacent Territories, being a Report of Progress of the Exploration for the Year 1876. Washington: Govt. Print. Off., pp. 465-466. (Ephydridae)

Hoffman, W.J. 1896. The Menomini Indians. 145th Ann. Rpt., Bur. Ethnol., Part I, p. 287.

Hoffman reveals some of his own feelings about eating insects as well as providing some information on the Menomini:

> The Menomini Indians are not addicted to eating all kinds of reptiles, insects, and other loathsome food, as was common to many of the tribes of the Great Basin and of California. This form of diet may result from having always lived in a country where game, fish, and small fruits were found in greater or lesser abundance, and the evident relish with which the so called Diggers, the Walapai, and others, devour grasshoppers, dried lizards, beef entrails, and bread made of grass-seed meal mixed with crushed larvae of flies, would appear as disgusting to the Menomini as to a Caucasian.

Hooper, Lucile. 1920. The Cahuilla Indians. *Univ. Calif. Publs. Am. Archaeol. Ethnol.* 16(6): 315-380. (Bruchidae)

Hrdlicka, A. 1908. Physiological and medical observations among the Indians of southwestern United States and northern Mexico. *Smithson. Inst., Bur. Am. Ethnol. Bull.* 34, pp. 25, 264-265.

Hrdlicka mentions (p. 25) that locusts, grasshoppers, water beetles, dragonfly nymphs and certain kinds of larvae are among the "small animal" food occasionally eaten by the Tarahumare in the Southwest. Mentioned also (pp. 264-265) is that a favorite sweet of the Pima children is honey deposited by a small solitary bee, probably *Anthophora* or *Melisodes* (Anthophoridae), in underground clay cells. These cells or clay "jars" are dug up by the children. The honey is called *mo-wa-li chuh-nie*, or "fly syrup."

Hutchings, J.M. 1888. In the Heart of the Sierras, the Yo Semite Valley, etc. Oakland, Calif.: Pacific Press, pp. 427-429. (Ephydridae and Acrididae)

Ikeda, J.; Dugan, S.; Feldman, N.; Mitchell, R. 1993. Native Americans in California surveyed on diets, nutrition needs. *Calif. Agric.* 47(3): 8-10. (Introduction)

Irwin, C.N. (ed.). 1980. The Shoshoni Indians of Inyo County, California: The Kerr Manuscript. Ballena Press Publs Archaeol., Ethnol, Hist., No. 15, pp. XVII + 1-92.

Irwin provides the following footnote on p. 47: "*Bishawa'da* a yellowish or cream colored larva measuring approximately one-quarter-inch long. The species proliferated in Owens Lake. This food should not be

confused with *ing ga'da, ing ga'ra*, the lake flies, which were also collected and eaten. However, the two foods are derived from the same species, *Hydropyrus hians* Say, one being comprised of larvae and the other of pupae, representing two life phases of the insect (Wilke and Lawton 1976: 30, 48; Fenenga and Fisher 1978: 87)."

James, E. 1823. Account of an Expedition from Pittsburgh to the Rocky Mountains, Performed in the Years 1819, 1820. 3 vols. London. Vol. I, pp. 195-196. (Formicidae)

Jensen, A. 1930. History of Tooele Stake. Ms. on file, Church of Jesus Christ of Latter Day Saints, Historian's Office. Salt Lake City.* (Acrididae)

Johnson, J.J. 1978. Yana. *In*: W.C. Sturtevant 1978, pp. 361-369.

Among the animal foods of the Yani in north-central California were grasshoppers, salmon fly (Plecoptera), and earthworms.

Johnston, Verna R. 1995. Pinyon pine - juniper woodland. *Fremontia* 23(2): ?

The author provides (p. 19) a brief account of the harvest and preparation of "peaggies" (*Coloradia pandora*). Tribes prepared them in different ways; "the Paiutes cooked and dried them and mixed them with vegetables in a stew." The larvae were regarded as choice morsels.

Jones, K.T.; Madsen, D.B. 1991. Further experiments in native food procurement. *Utah Archaeol*. 1991: 68-77. (Tettigoniidae)

Jones, V.H. 1945. The use of honey-dew as food by Indians. *The Masterkey* 19: 145-149. (Aphididae)

Jones, V.H. 1948. Prehistoric plant materials from Castle Park. *In* The Archaeology of Castle Park, Dinosaur National Monument, by R.F. Burgh and C.R. Scoggin, Appendix III, pp. 94-99. Boulder: Univ. Colo. Ser. Anthropol., No. 2. (Acrididae)

Keen, F.P. 1929. Insect enemies of California pines and their control. Calif. St. Dept. Nat. Res., Div. Forestry, Bull. No. 7, pp. 76-78. (Saturniidae)

Kelly, Isabel T. 1932. The ethnography of the Surprise Valley Paiute. Univ. Calif. *Publs. Am. Archaeol. Ethnol.* 31(3): 67-210.

Kelly (pp. 90-91, 93) reported as follows on the insects eaten by the Surprise Valley Paiute:

> Crickets (ni su) [Mormon crickets] were found in late summer on the slopes of hills. They were collected early in the morning when cold and bunched. Women usually did the gathering, but men occasionally assisted. The insects were picked up in the hand and dumped into the carrying basket. All informants explicitly denied beating the brush and driving the crickets into a pit. One informant stated that 'the whites did that when they wanted to kill them.' Grasshoppers (hu adada) were never eaten, but an unidentified insect similar to the grasshopper was considered edible. Ants (a ni) were gathered early in the morning when they were bunched on the top of the hill. Ant eggs (a ninoho) were also gathered. 'Worms' or larvae of some sort, probably caterpillars (called biu gu) [they were described as black with yellow stripes and about 4 inches long], were gathered early in the morning. They did not come every year and nowadays are never found in this vicinity. My interpreter saw some this summer near Gerlach, Nevada.

On page 93, Kelly states:

> Crickets were gathered early in the morning. A fire was built in a hole some three feet in diameter and two feet deep. If many women participated in the gathering, the hole might be five or six feet in diameter with the piles belonging to different individuals separated in the pit by a few handfuls of grass. The live crickets were dumped on the coals and roasted from a few minutes to several hours, time varying with informants. After cooking they could be dried. Biu gu (caterpillars, larvae?) were poured on the coals and covered for two or three minutes, then eaten immediately. Ants were gathered, parched, and ground on the metate. Ant eggs were likewise parched.

Kelly, I.T. 1938. Northern Paiute tales. *J. Am. Folk-lore* 51: 364-468.

The tale about "Coyote and Bear" begins as follows (p. 420):
"Coyote was living with his wife and son. Coyote went rabbit hunting. His wife and little boy were hunting ants. They found an ant nest, and Coyote's wife was gathering those ants. She sent her little boy to hunt more nests. Bear was in an ants' [*sic*] nest. He was cleaning it. When the ants got on his paw, he licked them off. The little boy came to the spot where Bear was standing, and that Bear killed the little boy." The story continues.

Kelly, I. 1964. Southern Paiute ethnography. *Univ. Utah Anthropol. Papers* No. 69, Glen Canyon Ser. No. 21, pp. 37, 54, 158, 182,

Using informants, Kelly studied the Southern Paiute, who live in southern Utah and adjacent Arizona and southern Nevada. Among the Kaibob, one of the included groups, locusts and "green caterpillars" were, according to Kelly, "welcome, but certainly not basic in the diet": "In spring ate locusts (?) (kivi) and 'green caterpillars' (probably what is known locally as tomato worm). Formerly gathered in baskets by both sexes; picked from *Chrysothamnus nauseosus*. Dry rabbit-brush stacked; locusts poured on top; pile fired, stirred; locusts eaten when blaze died down (Sapir: locusts parched in tray). 'Caterpillars' found in desert and along hills. Gathered in basket; head twisted off; body squeezed between fingers to clean. Twisted into sort of braid, bodies crossing one another, with new caterpillar inserted each time. Roasted between 2 flat stones that were 'red hot.'" The Kaiparowits used yellow caterpillars (piiagi) that were found "everywhere." They were pulled, head down, between thumb and first finger to clean, then "braided" into "rope" two to three feet long and roasted between two heated stone slabs. Grasshoppers, ants and ant larvae were among the game not eaten by the Kaiparowits. Kelly doesn't mention any insects eaten by the Panguitch, but states that ant larvae were not eaten.

Kern, E.M. 1876 [1983 reprint]. Journal of Mr. Edward M. Kern of an exploration of the Mary's or Humboldt River, Carson Lake, and Owens River and Lake, in 1845. *In* Report of Explorations Across the Great Basin of the Territory of Utah...in 1859, by Capt. J.H. Simpson, pp. 477-486. Washington: Govt. Print. Off. [reprint Reno: Univ. Nevada Press]. (Acrididae and Tettigoniidae)

Kingsolver, J.M.; Johnson, C.D.; Swier, S.R.; Teran, A. 1977. *Prosopis* fruits as a resource for invertebrates. *In*: Simpson, B.B. (ed.), Mesquite. Its Biology in Two Desert Scrub Ecosystems. Stroudsburg, Pa.: Dowden, Hutchinson & Ross, Inc. pp. 108-122. (Bruchidae)

Kroeber, A.L. 1925. Handbook of the Indians of California. Bur. Am. Ethnol. Bull. 78, 995 pp.

Kroeber writes regarding the Koso or Panamint (p. 592), “On the shores of Owens Lake countless grubs of a fly [*Hydropyrus*] were scooped out of the shallow water and dried for food.”

Landberg, L.C.W. 1965. The Chumash Indians of southern California. Southwest Mus. No. 19: 11-157.

According to Landberg (p. 81), insects were probably used mainly as condiments by the Chumash. They were probably collected by the women when they were out collecting plants. Grasshoppers, yellowjacket larvae, "caterpillar chrysalids," and honeydew were used alone as condiments or as ingredients in *pinole*.

Lando, R.; Modesto, R.E. 1977. *Temal Wakhish*: a desert Cahuilla village. *J. Calif. Anthropol.* 4(1): 95-112.

The authors corroborate (p. 110) the earlier report by Bean of use by the Cahuilla of a worm called *piyatem* (Ruby E. Modesto was the granddaughter of an earlier Desert Cahuilla informant):

> She remembered that her grandmother went out in the spring towards the hills, and they would gather these worms [white-lined sphinx moth, *Hyles lineata*], killing them by pinching off the heads. The worms were roasted on a *comal* "griddle" and either immediately eaten or stored. Sometimes they were parched over hot coals, which dried them out and allowed them to be stored longer without turning rancid. Grasshoppers, locusts, and cicadas were also roasted and eaten. They were also stored for future use like prepared meat in small net bags. Another type of worm or caterpillar called *ewinchem* was taken in November or December. It was found among the roots of the saltbush, (*Atriplex lentiformis*?) and was a pinkish insect larva approximately two to three inches long. This larva was prepared like army worms and also parched or sun dried for

storage.

Lanner, Harriette. 1981. Pine-nut cookery. *In* The Pinyon Pine: A Natural and Cultural History, by R.M. Lanner, pp. 148-167. Reno: Univ. Nevada Press. (Tettigoniidae)

Lapena, F.R. 1978. Wintu. *In*: W.C. Sturtevant (Ed.), Handbook of North American Indians, Vol. 8, California (R.F. Heizer, Vol. Ed.), 1978, pp. 324-340.

Lapena (p. 337) cites Du Bois (1935: 14-15) for the following relative to the Wintu in northern California:

> Grasshoppers were obtained by encircling grassy area. The people sang and danced as they drove the grasshoppers into the center area. The grass in the center was then set afire with wormwood torches. After the blaze had subsided, the now wingless insects were gathered by both men and women. The grasshoppers were boiled in baskets, put on basket trays to dry, and then either eaten at once or mashed in a hopper and stored. Salmon flies [Plecoptera], which swarmed on the river edge for a few days in April, were gathered early in the morning before their wings were strong enough to permit flight. They were boiled, or, if great in number, dried and saved for winter use.

Lawton, H.W.; Wilke, P.J.; DeDecker, M.; Mason, W.M. 1976 (?). Agriculture among the Paiute of Owens Valley. *J. Calif. Anthropol.* [Vol.?]: 13-49. (Ephydridae)

Leechman, D. 1944. Further light on "wooden tubes" from Oregon. *Am. Antiquity* 9(4): 451. (Tettigoniidae)

Leonard, Z. 1904. Adventures of Zenas Leonard, Fur Trader and Trapper, 1831-1836. W.F. Wagner (ed.). Cleveland: Burrows Bros. Co., p. 166.* [see under Wagner]

Levy, R. 1978a. Eastern Miwok. *In*: W.C. Sturtevant 1978, pp. 398-413.

Most prominent among the insects eaten by the Eastern Miwok in California were grasshoppers and yellow jacket larvae (p. 403).

Levy, R. 1978b. Costanoan. *In*: W.C. Sturtevant 1978, pp. 485-495.

Levy cites Harrington (1921) in saying (p. 492) that insects eaten by these California Indians included yellow jacket larvae, grasshoppers and caterpillars. Honey and wasp larvae were collected by blowing smoke (using a fan of hawk feathers) into the nests to kill the bees or wasps.

Lewis, A.B. 1905-1907? Tribes of the Columbia Valley and the coast of Washington and Oregon. *Memoirs Am. Anthropol. Assoc.* 1 (part 2): 149-209. (Acrididae)

Loew, O. 1876. Report on the alkaline lakes, thermal springs, mineral springs, and brackish waters of southern California and adjacent country. Ann. Rpt. Upon the Geograph. Surveys West of the 100th Meridian, Appendix H3, pp. 188-199. (Ephydridae)

Lowie, R.H. 1909a. The northern Shoshone. Anthropol. Papers Am. Mus. Nat. Hist. Vol. II, Part II, p. 188.

Lowie mentions grasshoppers, crickets, and ants among the small animal foods of the tribe, some portions of which were known as "Diggers," because they depended primarily on vegetable food. The insects were prepared by throwing them into a large tray with burning cinders and tossing them to and fro until roasted. Roasted ants were stored in bags for future use.

Lowie, R.H. 1909b. The Assiniboine. Anthropol. Papers Am. Mus. Nat. Hist. Vol. IV, Part I, p. 12.

The porcupine was an important food item in the forest, and “in case of necessity, pulverized insects dried in the sun, roots, seeds, and the inner bark of the cypress served to eke out their fare.”

Lowie, R.H. 1924. Notes on Shoshonean ethnography. *Anthropol. Papers Am. Mus. Nat. Hist.* 20(3): 185-324.

Lowie reports (pp. 195, 199) that the Lemhi, although largely vegetarians, "did not disdain such small game as grasshoppers and ants," while the Wind River Shoshone "deny having eaten roasted ants, but they did not scorn small game."

Lowie, R.H. 1939. Ethnographic notes on the Washo. *Univ. Calif. Publs. Am. Archaeol. Ethnol.* 36(5), p. 327. (Acrididae)

Luomala, Katharine. 1978. Tipai-Ipai. *In*: W.C. Sturtevant 1978, pp. 592-609.

Most meat came from rodents, but lizards, some snakes, insects, and larvae were eaten (p. 601).

Madsen, D.B. 1989. A grasshopper in every pot. *Nat. Hist.*, July 1989, pp. 22-25. (Tettigoniidae)

Madsen, D.B.; Kirkman, J.E. 1988. Hunting hoppers. *Am. Antiquity* 53: 593-604.

These authors emphasize that there is a substantial amount of ethnographic and ethnohistorical data revealing the importance of insects as a food resource for Great Basin groups. "Not only did every identified group use them, but many were dependent on one or more species as a primary resource and principal winter-storage food."

See Madsen and Kirkman also under Acrididae.

Malouf, C. 1951 [1974]. The Gosiute Indians. *In* Shoshone Indians (D.A. Horr, ed.), 1974, pp. 25-172. New York: Garland Publ. Inc.

Malouf begins his discussion of insects (pp. 52-54) by commenting: "It is difficult for Europeans to appreciate insect life as a source of food. Yet, when viewed objectively, 'bugs' contain many of the necessary vitamins, proteins, and carbohydrates that modern advertising has proclaimed so necessary for nourishment." He continues: "Rodents, 'Mormon crickets' (*Anabrus simplex*), cicadas, and grasshoppers were most often consumed. In preparing the ants for eating, the women would scoop up an ant hill into a winnowing basket. Tossing this mass up and down, she would allow the ants to roll to one side into another basket or onto a blanket. About a quart of ants and ant eggs [larvae/pupae] could be collected in this way. These were then mixed with water and a flour made of ground seeds, and then it was placed on a fire to cook." Methods of harvesting and preparing crickets and locusts are described from earlier accounts by Chamberlin and Egan. Crickets and locusts were not only eaten in season, but were dried and preserved for winter use. Although usually roasted, crickets were also eaten raw, after removing the legs. Cicadas were eaten fresh or roasted, or ground in a metate for storage and future use. Malouf notes: "The primary source of sustenance for the Gosiute was not animal life, but a variety of plants, roots, berries, nuts, seeds, and greens."

McCook, H.C. 1882. The Honey Ants of the Garden of the Gods and the Occident Ants of the American Plains. Philadelphia: J.B. Lippincott & Co., pp. 30-33. (Formicidae)

Merriam, C. Hart. 1979. Indian names for plants and animals among Californian and other western North American tribes. Assembled and annotated by Robert F. Heizer. Ballena Press Publs. Archaeol., Ethnol, Hist. No. 14, 296 pp. (pp. 260-261, 263-264, 271-272.).

Merriam reported as follows on the insects eaten: Mono Paiute, (p. 260), Mono Lake (*Ephedra*) [*Hydropyrus* =] (informant remarked: "Give me lots to eat"): E-wah-kw-ma-ga/E-wah'-mah-kah'; Sphynx (pine tree worm; boil to eat): Pe-ap'-pe/Pe-ag'-gah; Larvae in Mono Lake of fly: Koo-cha'-be/Koo-za'-be. Monache (Western Mono) at North Fork, San Joaquin River (p. 260), Tree worm (big fat ones, good to eat): Pe-ag'-gah; Hairy caterpillar (eaten): U-ah'-be. Monache at Pine Ridge, east of Sycamore Creek, Fresno Co. (p. 261), Sphynx moth, it's larvae: Pe-ag'-gah (good to eat). Bridgeport Paiute (p. 263), Sphynx moth ("Pine tree worm"; boil larvae to eat): Pe-ag'-gah (the larvae). Panamint Shoshone, Panamint Valley and several other locations (p. 264), Larvae in lake; good to eat: Pish-sha-war'-rah; Fly larvae in Owens Lake (used for food): E-yar'-rah/E-yad'-dah/Eng-ar'-rah. Southern Shoshone (southern Nevada) (p. 271), Sphynx moth; worms good to eat: Pe-ag'-gah; Cicada ("fat, good to eat"): Ku-ah/Ga'. Paviotso (Northern Paiute at Walker Lake) (p. 272), Sphynx moth, the worms best food"; Cicada ("good to eat"): Ku-ah'.

Miller, J.; Hutchinson, W. 1928. Where Pe-ag'gie manna falls. *Nat. Mag.* 12(1): 158-160. (Saturniidae)

Miller, K.K.; Wagner, M.R. 1984. Factors influencing pupal distribution of the pandora moth (Lepidoptera: Saturniidae) and their relationship to prescribed burning. *Environ. Entomol.* 13: 430-431. (Saturniidae)

Mooney, J. 1890. Notes on the Cosumnes tribes of California. *Am. Anthropologist*, o.s. 3 (No. 3, July 1890): 259-262. (Acrididae)

Moore, J.G.; Fry, G.F.; Englert, E., Jr. 1969. Thorny-headed worm infection in North American prehistoric man. *Science* 163: 1324-1325.

Moore et al reported recovery of Acanthocephala eggs, probably *Moniliformis clarki*, from coprolites of probable human origin found in Danger Cave in Utah. This constitutes possible indirect evidence of insect consumption, as the camel cricket, *Ceuthophilus uthahensis* (and probably other insects), are the intermediate hosts of this parasite. Definitive hosts include a variety of small rodents. Human infestation by *M. clarki* has not been reported, but Moore et al conclude that "aboriginal people could have served as a definitive host by ingesting the arthropod intermediate host, or they may have been victims of false parasitism as a result of eating parasitized rodents." Another possibility is the congeneric and cosmopolitan *M. dubius*, the definitive host of which is primarily the rat; beetles and cockroaches serve as the intermediate hosts.

Morgan, D. 1947. The Great Salt Lake. New York: The Bobbs-Merrill Co., p. 255.* (Acrididae)

Muir, J. 1911. My First Summer in the Sierra. Boston: Houghton Mifflin Co., pp. 45-46, 119, 206, 227.

Muir, in a general statement regarding Digger Indian fare (p. 119), says: "When food is scarce, he can live on whatever comes his way, -- a few berries, roots, bird eggs, grasshoppers, black ants, fat wasp or bumblebee larvae, without feeling that he is doing anything worth mention, so I have been told." On page 206, Muir says, "Their food is mostly good berries, pine nuts, clover, lily bulbs, wild sheep, antelope, deer, grouse, sage hens, and the larvae of ants, wasps, bees, and other insects."

On page 227, Muir writes: "In the season they in like manner depend chiefly on the fat larvae of a fly that breeds in the salt water of the lake [Mono Lake], or on the big fat corrugated caterpillars of a species of silkworm that feeds on the leaves of the yellow pine [*Coloradia pandora*]." After describing a great variety of plant and animal foods used by the Indians "to vary their wild diet of worms," including rabbits and deer which were abundant, antelope, sage hen, grouse, squirrels, pine nuts, acorns, wild rye, and an occasional wild sheep from the high peaks, Muir states that: "Strange to say, they seem to like the lake larvae best of all. Long windrows are washed up on the shore, which they gather and dry like grain for winter use. It is said that wars, on account of encroachments on each other's worm-grounds, are of common occurrence among the various tribes and families. Each claims a certain marked portion of the shore."

See Muir also under Formicidae.

Myers, J.E. 1978. Cahto. *In*: W.C. Sturtevant (Ed.), Handbook of North American Indians, Vol. 8. California (R.F. Heizer, Vol. Ed.), 1978, pp. 244-248.

Deer were the chief meat source of the Cahto in northwestern California, supplemented with fish and other animals. Caterpillars, grasshoppers, bees and hornets were also eaten (p. 246).

Napton, L.K.; Heizer, R.F. 1970. Analysis of human coprolites from archaeological contexts, with primary reference to Lovelock Cave, Nevada. Contrib. Univ. Calif. Archaeol. Res. Facility, No. 10, Part II: 87-130.

The authors report (pp. 118-120) coprolites from Lovelock Cave containing "insects," including "crickets."

Nissen, Karen. 1973. Analysis of human coprolites from Bamert Cave, Amador County, California. *In* The Archaeology of Bamert Cave, Amador County, California, by R.F. Heizer and T.R. Hester, Appendix V. Berkeley: Univ. of Calif. Archaeol. Res. Facility, pp. 66-68. (Tipulidae)

Olmsted, D.L.; Stewart, O.C. 1978. Achumawi. *In*: W.C. Sturtevant 1978, pp. 225-235.

The authors describe the invertebrate foods of the Achumawi or Pit River Indians in northeastern California as follows (p. 228):

> Digging for roots, bulbs, and tubers exposed angleworms that were collected and added to the soup pot. The underground nests of the yellowjacket wasp were sought and exposed so that the larvae could be procured for eating. The larvae of ants, bees, and hornets were also eaten. Crickets, grasshoppers, caterpillars, and salmonflies were also used as food. The periodic plagues of Mormon crickets were remembered as times of plenty, for the crickets were roasted and formed into cakes for storage. Fields might be encircled with fire to drive grasshoppers together and be roasted in the process of capture. They were then ready for winter when placed in sacks of vegetable fiber.

The authors note, citing others (p. 225), that: "The Indians burned fields and forests to drive game, stimulate growth of seed and berry plants, collect insects, and, at times, as an aid in warfare."

Orcutt, C.R. 1887. A lemonade and sugar tree. *West Am. Scientist,* 3: 45-47. (Aphididae)

Orr, P.C. 1952. Preliminary excavation of Pershing County Caves. Bull. 1, Nevada St. Mus., Carson City.* (Acrididae)

Osborne, P.J. 1973. Insects in archaeological deposits. *Sci. and Archaeol.* 10: 4-6.

In archaeological deposits, assessment of the use of insects as human food apparently depends on the finding of coprolites containing their remains. In humid climates, faecal masses do not preserve well, but Osborne cites Callen (1963) regarding coprolites from Peru and Mexico found to contain insects and other invertebrates.

Palmer, E. 1871. Food products of the North American Indians. *In* Rpt. Commissioner Agric. for 1870, Washington, D.C.: Govt. Print. Off., pp. 404-428. (Ephydridae, Aphididae, Apidae, Formicidae, Sphingidae, Acrididae and Tettigoniidae)

Parkman, F. 1873. The Oregon Trail. Boston: Little, Brown & Co., pp. 208-209. (Tettigoniidae)

Pattie, J.O. 1831. The Personal Narrative of James O. Pattie, of Kentucky. Cincinnati: John H. Wood, p. 100. (Acrididae)

Peigler, R.S. 1994. Non-sericultural uses of moth cocoons in diverse cultures. *Proc. Denver Mus. Nat. Hist.* Ser. 3, No. 5: 1-20. (Saturniidae)

Powell, J.W. 1875 [1957 reprint]. Exploration of the Colorado River of the West. Washington: Smithson. Inst., p. 133. [The reprint deletes some parts of the original.] (Acrididae and Tettigoniidae)

Powell, J.W. 1881. Sketch of the mythology of the North American Indians. Smithson. Inst., Bur. Ethnol. First Ann. Rpt., pp. 19-56. (Aphididae)

Powers, S. 1877a. Tribes of California. Contributions to North American Ethnology, Vol. III. U.S. Geograph. & Geol. Surv. of Rocky Mtn. Region, Dept. Interior, pp. 379, 430-431.

Powers (p. 379) says of the Yokuts of California:

> In the mountains they used to fire the forests, and thereby catch great quantities of grasshoppers and caterpillars already roasted, which they devoured with relish, and this practice kept the underbrush burned out, and the woods much more open and park-like than at present. This was the case all along the Sierra. But since about 1862, for some reason or other, the yield of grasshoppers has been limited. They are fond of a huge succulent worm, resembling the tobacco-worm, which is roasted; also the larvae of yellow-jackets, which they pick out and eat raw.

Powers lists (pp. 430-431) a number of insects among the animal foods of the Nishinam of Pacer County, California: Shek (*Saturnia caeanothi* [*Hyalophora euryalis* =]), caterpillar; Shek (two species of *Arctia*), caterpillar; Hol'-lih, crickets, roasted (formerly they were often roasted in large numbers by firing the woods); Pan'-nak, grubs found in decayed oak trees; Kut (*Sphinx ludoviciana*), a horned black worm (the Indian name denotes "a buck," so-called because of the horn). En'neh, or grasshoppers, are eaten by the Konkau. They catch

them with nets, or by driving them into pits, then roast them and reduce them to powder for preservation.

Powers, S. 1877b [1975]. Centennial Mission to the Indians of Western Nevada and California. Smithson. Inst. Ann. Rpt. 1876, pp. 449-460. Washington: Govt. Print. Off. (R.F. Heizer, The Friends of the Bancroft Library, Berkeley: Univ. Calif., 1975.)

Powers (pp. 24) reported that the Northern Paiute at Pyramid Lake ate grasshoppers, crickets and other species of insects. He also mentioned (p. 29) *Ephydra* larvae, saying "Some are eaten raw, and are of a rank and oleaginous taste; others are made into soup."

Ray, V.F. 1933. The Sanpoil and Nespelem: Salishan peoples of northeastern Washington. *Univ. Wash. Publ. Anthropol.* 5: 1-237.

According to Ray (p. 90), the Southeast Salish looked with repugnance on eating insects: "Certain animals were never used as food. Among these were the snake, gopher, mouse, wood rat, all frogs, and the dog. Grasshoppers, crickets, ants and ant pupae were not eaten, though all were abundant. In fact, all insects were looked upon as unfit for food."

Reagan, A.B. 1934a. The Gosiute (Goshute), or Shoshoni-Goship Indians of the Deep Creek Region, in western Utah. *Proc. Utah Acad. Sci., Arts, Lett.* XI: 43-54. (Ephydridae, Formicidae, Acrididae)

Reagan, A.B. 1934b. Some notes on the history of the Uintah Basin, in northeastern Utah, to 1850. *Proc. Utah Acad. Sci., Arts Lett.* XI: 55-64. (Formicidae, Tettigoniidae)

Rich, E.E.; Johnson, A.M. 1950. Peter Skene Ogden's Snake Country Journals, 1824-25 and 1825-26. London: The Hudson's Bay Record Society, pp. 133, 139.* (Formicidae, Acrididae)

Riddell, F.A. 1978a. Honey Lake Paiute ethnography. *Occas. Papers, Nev. St. Mus.* 3(1): 51-52. (Orthoptera: Acrididae and Tettigoniidae)

Riddell, F.A. 1978b. Maidu and Konkow. *In*: W.C. Sturtevant 1978, pp. 370-386.

Riddell (p. 374) cites Dixon (1905) in saying that yellowjacket larvae, angleworms, locusts, grasshoppers, and crickets were caught and eaten.

Ross, A. 1956. The Fur Hunters of the Far West. Edited by K.A. Spaulding. Norman: Univ. Oklahoma Press, pp. 179-180. [Sutton 1988 notes that this edition is of Ross' original manuscript, unlike the 1855 edition, published in London and which was heavily edited.]

Ross reported, regarding the Snake Indians (probably Northern Paiute or Bannock, according to Sutton 1988) in the early 1800s, that despite a profusion of salmon, buffalo and vegetables, they often resorted to "the most nauseous and disgusting articles of food.":

> Beneath the shade of the bushes is found an enormous kind of cricket. Skipping in the sun is a good-sized grasshopper, and gigantic mounds of pismires [ants] of enormous growth are likewise very frequent: all these insects are made subservient to the palate of the Snake Indian. These delicacies are easily collected in quantity and when brought to the camp, they are thrown into a spacious dish along with a heap of burning cinders, then tossed to and fro for some time, until they are roasted to death. Under this operation they make a crackling noise like grains of gun powder dropped into a hot frying pan. They are then either eaten dry or kept for future use, as circumstances may require. In the latter case, a few handfuls of them are frequently thrown into a boiling kettle to thicken the soup.

Ross continues: "One of our men had the curiosity to taste this mixture and said that he found it most delicious! Every reptile or insect that the country produces is after the same manner turned economically to account to suit the palate of the Snake Indian...."

Roust, N.L. 1967. Preliminary examination of prehistoric human coprolites from four western Nevada Caves. *Rpts. Univ. Calif. Archaeol. Surv.* No. 70: 49-88. (Cerambycidae and Dytiscidae)

Russell, F. 1898. Explorations in the Far North. Iowa City: Univ. Iowa Press, p. 228. (Hypodermatidae)

Russell, F. 1908. The Pima Indians. 26th Ann. Rpt., Bur. Am. Ethnol., p. 81. (Sphingidae)

Sandel, A. 1715. (Note.) Mitchell and Millers Medical Repository 4: 71.* (Cicadidae)

Sapir, E.; Spier, L. 1943. Notes on the culture of the Yana. Univ. Calif. *Anthropol. Recs.* 3(3): 239-298.* (Pteronarcyidae)

Schmid, J.M. 1984. Emergence of adult pandora moths in Arizona. *Great Basin Nat.* 44: 161-165. (Saturniidae)

Shimkin, D.B. 1947. Wind River Shoshone ethnogeography. *Univ. Calif. Anthropol. Recs.* 5(4), p. 265.

Insects were not a food staple, but a few people, particularly in the Green River country, ate locusts, crickets and ants.

Silver, Shirley. 1978. Shastan Peoples. *In*: W.C. Sturtevant 1978, pp. 211-224.

Shasta territory was rich in food resources (p. 216), and grasshoppers and crickets were among the significant non-vegetal foods. If people from other divisions were visiting in the Shasta Valley at the right time, they also gathered and ate crickets. "Men hunted and fished; women gathered seeds, bulbs, roots, insects, and grubs and caught fish in baskets."

Simms, S.R. 1984. Aboriginal Great Basin Foraging Strategies: An Evolutionary Analysis. Ph.D. Diss., Dept. Anthropol, Univ. Utah, Salt Lake City. (Introduction)

Simpson, J.H. 1876. Report of explorations across the Great Basin of the Territory of Utah for a direct wagon-route from Camp Floyd to Genoa, in Carson Valley, in 1859. U.S. Army, Engineer Dept., U.S. Govt. Print. Off., Washington, D.C., pp. 35, 36, 53.

Simpson (p. 35) mentions that: "Some of the weaker bands both of the Snakes and Utahs are almost continually in a state of starvation, and are compelled to resort almost exclusively to small animals, roots, grass, seed, and insects for subsistence." Relative to the Go-shoots, an offshoot of the Ute Indians, Simpson mentions specifically as foods (pp. 36, 53) rabbits, rats, lizards, snakes, insects, rushes, roots, and grass-seeds. He states that rabbits are their largest game and it is seldom they kill an antelope.

Skinner, A. 1910. The use of insects and other invertebrates as food by the North American Indians. *J. New York Entomol. Soc.* 18: 264-267.

The author reviews some of the earlier literature and states that, west of the Mississippi River insects are used as food by tribes of the Algonkian, Siouan, Shoshonean, Athabasca, Pujunan, Pinan, and Shastan stocks, "at least." He says that records of food insect use by tribes east of the Mississippi are lacking, and suggests that the "universal practice of agriculture south of the Great Lakes" obviated any need for insects as food, thus explaining the absence of such customs.

Smith, Anne M. 1974. Ethnography of the northern Utes. Mus. N. Mex. Papers Anthropol. No. 17, pp. 1-288, 30 pls. (Acrididae)

Smith, J.S. 1977. The Southwest Expedition of Jedediah S. Smith. His Personal Account of the Journey to California, 1826-1827. (Edited by G.R. Brooks 1977.) Glendale, Calif.: The Arthur H. Clark Co.

Smith mentions "Sugar Candy" (pp. 90-91), which, on enquiry he found was made from cane grass. The editor of this work, George R. Brooks, quotes from a report by Lt. Robert S. Williamson, who, during the course of work on the railroad surveys reported cane at the same location in 1853. Williamson wrote: "[The Indians] seemed at this season of the year [August] to be principally employed in collecting a kind of bulrush or cane, upon the leaves of which is found a substance very like sugar, which to them is a not unimportant article of food. They cut the cane and spread it in the sun to dry, and afterwards, by threshing, separate the sugar from the leaf.

The cane itself had no sweet taste."

Spier, L. 1930. Klamath ethnography. *Univ. Calif. Publs. Am. Archaeol. Ethnography* 30, pp. 160, 227. (Saturniidae)

Spier, L. 1933. Yuman Tribes of the Gila River. Chicago: Univ. Chicago Press, pp. 65, 73. (Sphingidae)

Spier, R.F.G. 1978. Monache. *In*: W.C. Sturtevant (Ed.), Handbook of North American Indians, Vol. 8, California (R.F. Heizer, vol. ed.), 1978, pp. 426-436.

The author states, relative to the Monache in central California (p. 429): "Insects, grubs, and seeds were parched with hot coals in a winnowing basket before being eaten. Yucca and other roots were collected and roasted. Honey was relished when found."

Steward, J.H. 1933. Ethnography of the Owens Valley Paiute. *Univ. Calif. Publ. Am. Archaeol. Ethnol.* 33(3): 233-256.

Steward, in discussing the sweets and candies of the Owens Valley Paiute, based on visits to Owens Valley and Mono Lake in 1927 and 1928, describes (pp. 245-246) hau've (*Phragmites communis* Trin.), a cane or reed as most important: "Sugar, called hauva-hauva, the dried sap brought to surface by small green insects, gathered by beating into baskets; many insects remained in sugar. Made into balls. Later softened by fire and eaten like sugar. Much less sweet than commercial cane sugar. Formerly popular." Steward describes a second process: "Green cane gathered in summer when leaves are thick. Entire plant cut up; dried until sap is on surface in lumps; cane piled on canvas, beaten with sticks to loosen sugar; sugar gathered up, cleaned by winnowing, and stored in shallow baskets, about sixteen inches diameter, made of tule. Tule preferred to willow, believing it preserves the sugar but does not give it taste nor change its color. Now ready to eat as candy."

Steward (pp. 255-256) draws mainly from the earlier literature in discussing several other Owens Valley and Mono Lake foods. Several Indians denied eating grasshoppers (a takica) and crickets (tsu nutugi'), although Muir had seen Mono Lake Paiute, in 1870, eating larvae of ants, wasps, bees, and other insects, and "Diggers," probably Miwok, eating ants after biting off their heads. According to Steward, piuga, the larvae of *Coloradia pandora*, and cuza vi (Owens Valley) or cu-tza or cutza (Mono Lake), the pupae of *Ephydra hians*, were traded widely. Muir is cited to the effect that families and tribes claim sections of the shore at Mono Lake where the windrows of pupae wash up and disputes arise over encroachment into a neighbor's territory.

Steward, J.H. 1938. Basin-plateau aboriginal sociopolitical groups. Smithson. Inst. Bur. Am. Ethnol. Bull. 120, pp. 27, 34. (Partially reprinted in Coon 1948.) (Acrididae and Tettigoniidae)

Steward, J.H. 1941. Culture element distributions: XIII - Nevada Shoshoni. *Univ. Calif. Pubs. Anthropol. Rec.* 4(2): 209-359.

Steward (pp. 228, 277, 331) found food insect use widespread among the Nevada Shoshoni. Ants, ant "eggs," larvae, crickets and locusts were delicacies. The Mormon cricket, occasionally in incredibly large swarms in eastern Nevada, was an important food when plentiful. Among caterpillars, *Coloradia pandora* and at least two other species were used. One of the latter was called "tsagwano"; they were roasted in coals after removing the heads. Pupae of *Ephydra hians* from Owens Lake were called "cuija'vi" or i*n*ada, and Shoshoni said pupae of at least two other species were procured from the lake. A large black ant called "ani'" was "dug from nest in early morning while still cold; dirt winnowed out in basket; killed with coals in parching tray; entire ants ground on metate; boiled into mush." Red ants were eaten as a tonic when a person was thin. Yellowjacket eggs were called "pena."

Steward's notes continue: "cicadas gathered from bushes in early morning into conical basket; parched in coals which burned off legs and wings; dried and ground on metate; could be stored for winter." They were called "kua" or "gua" by different Shoshoni groups. The cricket, called "maico," is "scooped into conical basket in early morning; thrown into pit from which fire has been removed; covered with grass; when roasted, insides removed by pulling off head; legs pulled off; dried; ground; stored in buckskin bags for winter use." Another group drove them into the fire and then dried and ground them. Grasshoppers, called "a:ti*n*," were eaten only when the people were hungry; they were thrown into a grass fire and eaten when they turned red.

Steward, J.H. 1943. Culture element distributions: XXIII - Northern and Gosiute Shoshoni. *Univ. Calif. Pubs. Anthropol. Rec.* 8(3): 263-392.

Steward (pp. 270-271, 299-300, 362) reported widespread use of insects as food among the Northern and Gosiute Shoshoni of eastern Idaho and northern Utah. Steward says: "Except among groups having access to bison, rodents and insects were of outstanding importance....Most often, informants said crickets were picked up in the early morning when they were cold and dumped into the fire." Other insects that were widely used included caterpillars, ants (as food, and by one group as medicine), ant and yellowjacket "eggs," and cicadas. Grasshoppers were eaten by the Idaho Shoshoni; of two kinds, only the large yellowish variety was edible. Cicadas, Mormon crickets, and grasshoppers were frequently stored.

Stewart, O.C. 1941. Culture element distributions: XIV - Northern Paiute. *Univ. Calif. Pubs. Anthropol. Rec.* 4(3): 361-446.

Stewart reported (pp. 373, 419, 426-427) numerous insects used as food by the Northern Paiute, who occupied a region including northeastern California, eastern Oregon, southwestern Idaho and Nevada excepting its southern tip. Stewart discusses in detail, in relation to earlier accounts, the location of lakes where kutsavi [*H. hians*] pupae were found and which groups used them. Other insect foods included "piuga" (caterpillars of *C. pandora*), cicadas ("kua"), crickets ("miju" or "niju"). Grasshoppers were used by only two of the 14 groups studied.

Stewart, O.C. 1942. Culture element distributions: XVIII - Ute-Southern Paiute. Univ. Calif. Pubs. Anthropol. Rec. 6(4): 231-354.

Stewart (pp. 245, 337) reported widespread use of insects by the Ute-Southern Paiute Indians of Colorado, Utah and northern Arizona. These included caterpillars, ants, ant and wasp "eggs," cicadas, crickets and grasshoppers. The latter three were gathered in baskets in the morning before they became active. Cicadas were called "kovi," crickets were called "arcupits."

Stewart, O.C. 1966. Ute Indians: before and after white contact. Utah Hist. Quart. 34(1): 38-61.

The only mention of insects is quoted from Father Pierre Jean deSmet regarding the Sampeetches (p. 53): "Two, three, or at most four of them may be seen in company, roving over their sterile plains in quest of ants and grasshoppers, on which they feed."

Stewart, O.C. 1980. Temoke Band of Shoshone and the Oasis Concept. *Nev. Hist. Quart.* 23(4): 246-261.*

Stewart reports (p. 250) the use of ants and bee eggs by the Western Shoshone in Ruby Valley, Nevada.

Strong, E. 1969. Stone Age in the Great Basin. Portland, Ore.: Binfords & Mort, pp. 125-129.

The author draws mainly on earlier accounts (Leonard, Fremont, Ogden) in briefly discussing the use of the shore flies, *Ephydra hians* and *E. subopaca*, crickets, locusts, ants, and the caterpillar, *Coloradia pandora*. He notes that: "Insects formed a small but important portion of the diet of the desert people, important because they offered a variety in the menu not less desirable to a primitive race than to ourselves, and because no food source could be overlooked. . . . Our culture generally revolts at the use of insects for food, and relegates those who do to an inferior status in the same manner as any other native trait differing from our beliefs, yet edible insects may have cleaner habits and be as tasty as some delicacies considered by us a luxury; for instance the oyster."

Sturtevant, W.C. (Ed.). 1978 -1998. Handbook of North American Indians. Smithson. Inst., Washington, D.C.

Contains numerous articles cited in this bibliography.

Sutton, M.Q. 1985. The California salmon fly as a food source in northeastern California. *J. Calif. & Great Basin Anthropol.* 7(2): 176-182. (Plecoptera: Pteronarcyidae)

Sutton, M.Q. 1988. Insects as food: aboriginal entomophagy in the Great Basin. Ballena Press Anthropol. Papers No. 33, 115 pp. (See under Introduction and most insect orders.)

Sutton, M.Q. 1995. Archaeological aspects of insect use. *J. Archaeol. Method Theory* 2: 253-298.

(Introduction)

Swenson, J.D. 1984. A cache of mesquite beans from the Mecca Hills, Salton Basin, California. *J. Calif. & Great Basin Anthropol*. 6(2): 246-252. (Bruchidae)

Swezey, S.L. 1978. Barrett's armyworm: a curious ethnographic problem. *J. Calif. Anthropol*. 5(2): 256-262. (Noctuidae)

Taylor, A.S. 1859. An account of the grasshoppers and locusts of America, condensed from an article written and furnished by Alexander S. Taylor, Esq. of Monterey, California. Smithson. Inst. Ann. Rpt. 1858, pp. 205-206, 209. (Acrididae)

Thomas, C. 1875. Report upon the collections of Orthoptera made in portions of Nevada, Utah, California, Colorado, New Mexico, and Arizona during the years 1871, 1872, 1873, and 1874. U.S. Geol. Surv. West of the 100th Meridian 5(2): 843-908. (Tettigoniidae)

Thomas, D.H. 1983. The archaeology of Monitor Valley. 1. Epistemology. *Am. Mus. Nat. Hist. Anthropol. Papers* 58(1), pp. 82-83.

The author cites earlier papers relative to the use of *piuga* (*Coloradia pandora*) and *kutsavi* (*Hydropyrus hians*).

Voegelin, E.W. 1938. Tubatulabal ethnography. *Anthropol. Rec* 2(1): 1-90.

Voegelin (p. 12) reports that the Tubatulabal of California rejected insects as food even though caterpillars, grasshoppers, grubs and other insects were available to them. They did use honeydew, however, as described on page 19:

> Honey dew, which produced in summer by aphids on stalks, leaves of cane (paha·bil), *Phragmites communis* Trin., utilized as sweet (ha·bist). Canes cut in July, August, spread out in hot sun to dry; then heaped on bearskin, 'because bearskins are good and thick for beating,' and flayed vigorously with hardwood stick beaters. Beating caused saccharine crystals on canes to adhere to bearskin; these crystals scraped off skin, winnowed on flat tray, put into small cooking basket, and made into stiff dough with cold water. Doughy mass removed from basket with hands, spread on twined tule tray; end of tray folded over wet sweets, and tray put away for 6-7 days to allow sugary substance to dry. When dry, lumps of sweet broken off the hard brown loaf with rock and eaten dry with chia gruel. . . .

Voegelin, E.W. 1942. Culture element distributions: XX - northeast California. *Univ. Calif. Pubs. Anthropol. Rec*. 7(2): 47-251.

Voegelin (pp. 53, 56, 59, 177-178) reported widespread use of insects as food among northeast California Indians. People of the Shasta Valley and elsewhere where they were available ate crickets; some others made trips to gather them. The insects were pounded into meal and stored. Not many grasshoppers were eaten; those that were were boiled. The Modoc ate four varieties of caterpillars. Ants were roasted; "eggs" of red ants also used. Yellowjacket larvae were used by 13 of the 16 tribal groups. Grasshoppers were used also as bait.

Wagner, W.F. (ed.). 1839 [1904]. Leonard's Narrative. Adventures of Zenas Leonard, Fur Trader and Trapper 1831-1836. Cleveland: The Burrows Bros. Co., pp. 166-167. (Ephydridae)

Wakefield, E.G.; Dellinger, S.C. 1936. Diet of the bluff dwellers of the Ozark Mountains and its skeletal effects. Ann. Intern. Med. 9: 1412-1418.

These authors reported insect and mite fragments in coprolytic material from an ancient race of bluff-dwellers in the Ozarks of Arkansas and Missouri. Identifications included two early stage coleopterous larvae tentatively of the family Nitidulidae (genus *Steliodite*), an ant, and a number of lice and mites, the mites including several specimens of a species of *Cheyletus* and a species of the family Tyroglyphidae. The fact that Nitidulidae and Tyroglyphidae are largely associated with stored products or decaying materials suggests that most of these arthropods may have been ingested accidentally. The authors note that many primitive peoples have been known

to deliberately ingest their own lice.

Wakeland, C. 1959. Mormon crickets in North America. U.S. Dept. Agric. Tech. Bull. No. 1202, p. 4. (Tettigoniidae)

Wallace, Edith. 1978. Sexual status and role differences. *In*: W.C. Sturtevant 1978, pp. 683-689.

The author states (p. 683):

> All California Indian tribes distinguished between the statuses and roles of men and women, assigning to each sex special tasks, duties, and prerogatives. . . . Shellfish and crustaceans were regularly procured by women and girls as were insects, larvae, and grubs, supplementary foods for many Californians. Communal insect hunts, in which everyone participated, were undertaken too; and now and then men went out to search for a particular species.

Waugh, F.W. 1916. Iroquois foods and food preparation. Can. Dept. Mines, Geol. Surv., Mem. 86, No. 12, Anthropol. Ser. Ottawa: Govt. Print. Bur., 235 pp.

Waugh (pp. 138-139) credits an Onondaga informant for the information that ants of various species were eaten raw -- because of the acid flavor, and more as a luxury than as a staple. From another informant, Waugh reports: "At Onondaga Castle, N.Y., the larvae of the seventeen-year locust (*Cicada septendecim*) were formerly ploughed or dug up and roasted in a pot, without water. They were stirred while cooking and, when they were thoroughly done, a little grease was added. Some of the older people are said to make use of them still. They are considered to be 'good for the health.' An Onondaga name given was 'ogwayu"da'." Waugh cites earlier authors for the use of either locusts or cicadas (the use of the popular name, "locust," leaves doubt as to which) by the Iroquois and the Delaware, and for the use of "young wasps" among the tribes of North Carolina.

See also under Miscellaneous Diptera.

Weaver, R.A.; Basgall, M.E. 1986. Aboriginal exploitation of pandora moth larvae in east-central California. *J. Calif. Great Basin Anthropol.* 8(2): 161-179. (Saturniidae)

Wheeler, W.M. 1908. Honey ants, with a revision of the American Myrmecosysti. *Bull. Am. Mus. Nat. Hist.* 24: 345-397. (Formicidae)

Whiting, Beatrice B. 1950. Paiute sorcery. Viking Fund Publs. Anthropol. No. 15, New York, pp. 17-19. (Tettigoniidae)

Wilke, P.J. 1978. Late prehistoric human ecology at Lake Cahuilla, Coachella Valley, California. Berkeley: Contrib. Univ. Calif. Archaeol. Res. Facility No. 38.*

Wilke (p. ? ; vide Sutton 1988: 81) reported unidentified insect remains in coprolites from the northern Coachella Valley in southeastern California, but generally attributed these to post-depositional intrusions rather than as indications of diet.

Wilke, P.J.; Lawton, H.W. (eds.). 1976. The Expedition of Capt. J.W. Davidson From Fort Tejon to the Owens Valley in 1859. Soccoro, N. Mex.: Ballena Press, p. 30. (Ephydridae)

Williston, S.W. 1883. Dipterous larvae from the western alkaline lakes and their use as human food. *Trans. Conn. Acad. Arts & Sci.* (New Haven) 6: 87-90. (Ephydridae)

Wilson, N.L.; Towne, A.H. 1978. Nisenan. *In*: W.C. Sturtevant 1978, pp. 387-397.

Citing earlier papers by Wilson, the authors state (p. 390):

> Grasshoppers were gathered in meadows in the summer. They were chased into conical pits by drivers beating the grass. A smoking grass bundle was thrown into the pits for killing. They were soaked in water and baked in an earth oven. A light crushing with a handstone on a basketry tray broke off the wings and legs, which were winnowed away. They were eaten whole, crushed into a meal, cooked like a mush, or stored. A ring of fire was also built to creep through the

underbrush roasting the grasshoppers and other insects.

It is mentioned that larvae, pupae, ants and other insects were eaten, and some of them were gathered for medicinal use or for poisons.

Witherspoon, W.W. 1889. Collection of honey dew by the Nevada Indians. *Am. Anthropologist*, o.s., Vol. 2, p. 380. Washington. (Aphididae)

Woodward, A. 1934. An early account of the Chumash. *The Masterkey* 8: 118-123. (Aphididae)

Woodward, A. 1938. The "honey" of the early California Indians - a strange ethnological error. *The Masterkey* 12: 175-180. (Aphididae)

Wright, W.G. 1884. A naturalist in the desert. *Overland Monthly* 4(21): 279-284.* (Sphingidae)

Wyman, L.C.; Bailey, F.L. 1964. Navaho Indian ethnoentomology. Univ. *N. Mex. Publs. Anthropol.* No. 12, pp. 1-158. (Cicadidae)

Zigmond, M. 1980. Kawaiisu mythology: an oral tradition of south-central California. Ballena Press Anthropol. Papers No. 18, p. 55.*

Zigmond (vide Sutton 1988: 49) relates the Kawaiisu myth, "The Origin of the *Pagazozi*," which tells how the *Pagazozi*, a people to the north of the Kawaiisu, were created from the worms of the lake [Owens?] when they reached land.

Zigmond, M.L. 1986. Kawaiisu. *In* Handbook of North American Indians, Vol. 11, Great Basin (W. d'Azevedo, ed.), pp. 398-411. Washington: Smithson. Inst.

"Invariably, deer meat was mentioned as the favorite animal food [of the Kawaiisu], but a large number of faunal species, including large and small game, rodents, birds, and insects, were considered edible. . . The caterpillar of the Pandora moth and a white 'worm' found in dead trees [probably a cerambycid grub] were commonly eaten, the latter fed to children to 'fatten' them." (p. 400)

The Kawaiisu denied eating grasshoppers (p. 400).

Chapter 2 of The Human Use of Insects as a Food Resource: A Bibiliographic Account in Progress, by Gene R. DeFoliart, posted on website September, 2002

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Items Needing Attention

Pp. 13, 72. Fremont (1845), name of lake?

Pp. 45, 80. Lewis (1905-1907?), correct date?

P. 58. Beals (1933), total pagination?

P. 66. Davis, J.T. (1961), need several pages prior to p. 21 and also the first page of Table 1.

P. 77. Johnston (1995), pagination?

P. 80. Lawton et al (1976) (?), J. Calif. Anthropol., volume number?

P. 93. Wilke (1978), page cited?