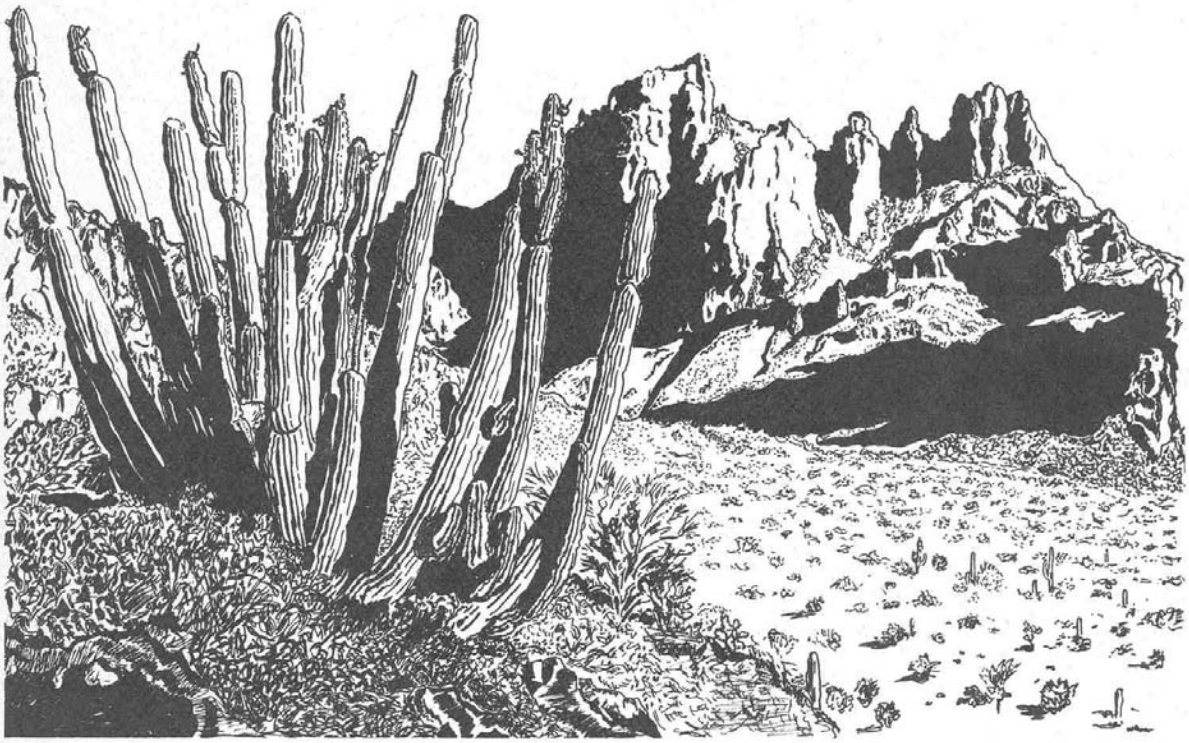
Invertebrates of Organ Pipe Cactus National Monument, Arizona

Kenneth J. Kingsley

Technical Report No. 60



United States Department of the Interior
United States Geological Survey
Cooperative Park Studies Unit
The University of Arizona

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National Park Service
Organ Pipe Cactus National Monument

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U.S. Geological Survey
Cooperative Park Studies Unit
School of Renewable Natural Resources
125 Biological Sciences East

The University of Arizona Tucson, Arizona 85721
National Park Service
Organ Pipe Cactus National Monument
Route 1, Box 100
Ajo, Arizona 85321

Author

Kenneth J. Kingsley
SWCA Inc.
343 S. Scott Ave.
Tucson, AZ 85701-1901

Unit Personnel
William L. Halvorson, Unit Leader
Cecil R. Schwalbe, Research Ecologist
Peter S. Bennett, Ecologist
Michael R. Kunzmann, Ecologist
Katherine L. Hiett, Biological Science Technician
Gloria J. Maender, Editor
Rene M. Tanner, Editorial Assistant
Daniel R. Morales, Jr., Editorial Assistant
Sandra K. Mosolf, Administrative Assistant
Brenda Carbajal, Secretary
(520) 670-6885; (520) 621-1174; FTS (520) 670-6885

Monument Resources Management personnel*
William Wellman, Superintendent
Peter G. Rowlands, Chief, Resources Management
Jim Petterson, Ecologist
Susan Rutman, Ecologist
Timothy J. Tibbitts, Wildlife Biologist
Nancy Favour, Geographer
Charles W. Conner, Biological Science Technician
Ami C. Pate, Biological Science Technician
Thomas N. Potter, Resource Management Specialist
Lara Dickson, Biological Science Technician
(520) 387-6849

The Cooperative Park Studies Unit at The University of Arizona (CPSU/UA) was established 16 August 1993 as a unit in the National Park Service (NPS). By action of Secretary of the Interior Bruce Babbitt, the research function of NPS and several other Interior agencies was transferred to a newly created agency, the National Biological Service (NBS), on 12 November 1993. At that time, the CPSU/UA and unit personnel were transferred to the new agency. On 1 October 1996, NBS became the Biological Resources Division of the U.S. Geological Survey.

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The CPSU/UA provides a multidisciplinary approach to studies in natural and cultural sciences. The unit conducts and coordinates research that is funded by various agencies. Principal Arizona cooperators include the School of Renewable Natural Resources and the Department of Ecology and Evolutionary Biology of The University of Arizona. The Western Archeological and Conservation Center (NPS) and the School of Renewable Natural Resources (UA) provide administrative assistance. Unit scientists hold faculty of research associate appointments at the university.

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*This list does not include personnel who contributed to the Ecological Monitoring Program in 1995 but no longer work at Organ Pipe Cactus National Monument: Harold J. Smith (Superintendent), James J. Barnett (Chief, Resources Management), Jonathan F. Arnold (Ecologist), and Dennis Casper (Biological Science Technician).

This report was printed on recycled paper.

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Abstract

A general study of the invertebrates of Organ Pipe Cactus National Monument was conducted between October 1987 and September 1990. This period was marked by drought and higher than normal temperatures. The most important factor influencing invertebrate populations appears to be weather. The effects of weather were apparently so profound as to override any other factors and limit conclusions that could be drawn from the data. This precluded derivation of conclusions about the importance of other population regulating factors and complicates development of a meaningful long-term monitoring plan.

This study examined the distribution and ecology of invertebrates in the monument and was part of a larger, multidisciplinary research program, the Sensitive Ecosystems Program (SENECPRO). The study focused primarily on 16 designated SENECPRO research sites. Macroinvertebrates, primarily arthropods, were collected and observed over a period of 3 years. Over 5,000 records and 4,200 specimens were made. More than 1,000 taxa were recorded. Most taxa were rare, with 439 being recorded only once. Only 50 taxa were recorded more than 10 times. Specific objectives of this study were to determine important species, indicator species, and invading exotic species; supplement the monument's invertebrate collection; and provide a methodology for long-term monitoring.

Lists of important, indicator, and invading species were made. The only significant problem involving invertebrates is the impending arrival of the strain of honey bee (*Apis mellifera)* known as the "Africanized" bee. This strain is expected to have important but unpredictable impacts on visitor safety, resource management, and aspects of plant and animal ecology. Methodology for long-term monitoring is presented in a separate document. Potential problems for implementing this methodology are discussed in this report.

Acknowledgments

Field work was conducted by the author and Richard A. Bailowitz, with the assistance of Erich A. Draeger, Laura Griffin-Austin, Mark Austin, Marian Chittenden, Kathryn Wilde, and Michael F. Wilson. Bailowitz and Draeger were responsible for Aguajita Wash, Alamo Canyon, Arch Canyon, Bull Pasture, Dripping Springs, and Neolloydia sites. Kingsley and assistants, primarily Wilson, were responsible for the remaining sites.

Members of the staff of Organ Pipe Cactus National Monument who accompanied and assisted us in the field were Jim Barnett, Marker Marshall, and Charles Conners. Laboratory preparation of specimens was done by the author and Richard A. Bailowitz, Erich A. Draeger, Laura Griffin-Austin, Kathryn Wilde, and Michael F. Wilson. Identification of specimens was done by the author, Richard A. Bailowitz, Michael F. Wilson, Carl A. Olson, Peter Jump, Ray Nagle, Frank Ramburg, and Stephen L. Buchman. Data entry, compilation, analysis, and report writing were the responsibility of the author. Richard A. Bailowitz, Michael F. Wilson, and several National Park Service employees reviewed the manuscript.

Introduction

The Sensitive Ecosystems Program (SENECPRO)

This project was 1 component of the Sensitive Ecosystems Program (SENECPRO), a multi-disciplinary program studying various aspects of the ecology of Organ Pipe Cactus National Monument (OPCNM). Research focused primarily on designated sites representative of ecosystems believed to be particularly vulnerable to change. The program began in September 1987 and continued for 3 years. Investigators working on each component met annually, or more often, to discuss their projects and develop new concepts in the approach of the overall program. Projects included studies of special-status plants, alien plants, annual plants, groundwater, land-use trends, grazing recovery, herpetofauna, terrestrial invertebrates, climate, political boundaries, birds, mammals, soils, and geology.

This study was undertaken in response to a request by the National Park Service (NPS) to conduct a study of the invertebrates of OPCNM. Objectives of this specific component of the SENECPRO were:

1. Determine which invertebrate species are important to monument ecosystems generally, but particularly in 15 designated research sites (a 16th site was added in the course of the program).

2. Identify any indicator species and explain how they relate to naturally functioning ecosystems in the monument or any deviations from natural processes.

3. Answer the question: Do any nonnative species pose a threat to the integrity of any native plants and animals in the monument?

4. Supplement the monument's museum collection of invertebrates.

5. Provide monument staff with a methodology for monitoring the "health" of the monument's invertebrate populations.

Products of This Study

This report summarizes research results and discusses the objectives in relation to the results. A list of the taxa recorded during the course of this study, a brief discussion of their role in the ecosystem, and the sites at which they were recorded are provided. In addition, this report discusses the concept of "important species" and the practicality of using invertebrate taxa for monitoring the "health" of the environment. The role of nonnative species and their impact and potential impact is also considered.

A collection of more than 4,000 specimens and a separately-bound catalog has been submitted to the staff of OPCNM, together with an electronic database (in dBase-III+) with data on all specimens. A separate database that incorporates all records of specimens and observations of invertebrates has also been submitted. Another separate database uses the monument's "Animal Abstracts" format to

compile information on selected species of special concern. Recommendations and protocols for a monitoring program for invertebrates are presented in a separate document.

A collection of photographic slides of invertebrates has been submitted for the monument's interpretive program. Interpreters may find information in the "Taxonomic Accounts" and "Discussion" sections of this report of particular interest. They may also want to reproduce the "Checklist of Butterflies" (Appendix) for distribution to visitors as part of the interpretive program.

Study Sites

The 15 original sites were designated by NPS personnel and described in the request for proposal (RFP) that initiated this project. An additional site, "Pozo Nuevo" was added after the annual investigators' meeting in 1989. The site descriptions below are based on those in the RFP. The digital system of vegetation classification was developed for OPCNM by Warren et al. (1981). Despite subsequent taxonomic revision of some of the plant names, the names used in this report for vegetation classifications remain as those used in Warren et al. (1981). Otherwise, plant names are those used in the Checklist of Vascular Plants of Organ Pipe Cactus National Monument, Arizona, 2nd printing, 1985, with a few exceptions of introduced species cited in Felger (1990). Plant lists in the following site descriptions are not inclusive of all taxa found on the sites, but represent only the most abundant taxa and/or those that are considered most important as habitat components for invertebrates.

Aguajita Wash and Spring (AG)

Vegetation Classification: *Prosopis glandulosa* Riparian Woodland (124.711) Association and *Prosopis glandulosa-Cercidium foridum* Subassociation (154.1215) (Warren et al. 1981).

Aguajita Wash is a large, shallow wash draining a large portion of the south half of the monument. The wash's course lies over a granitic sill, forcing subsurface water flow to the surface at Aguajita Spring. The aquatic habitat consists of a few small, quiet pools with rock and sand bottoms connected by shallow, slowly flowing streams. Elevation is 345 m. The 2 vegetation types lie adjacent to each other and are considered to be a single site. The site is approximately 100 ha in size, encompassing the riparian area from the international boundary fence to a vaguely defined end approximately 2 km upstream.

The plant community is developed on sandy soil with scattered cobbles. Dense thickets of shrubs and small trees grow along the riparian corridor. *Prosopis velutina, Cercidium microphyllum, C. floridum, Ambrosia ambrosioides, Zizyphus obtusifolia, Acacia greggii, Hymenoclea salsola,* and *Lycium* spp. are characteristic species. Associated species are *Larrea tridentata, Olneya tesota, Ambrosia deltoidea, Acacia constricta,* and *Opuntia versicolor.* Close to Aguajita Spring are small stands of *Typha domingensis, Cyperus* spp*., Baccharis salicifolia, B. sarothroides,* and *Tessaria sericea.* Small clusters of *Bebbia juncea, Wislizenia refracta, Nicotiana trigonophylla,* and *Datura discolor* appear in season and are important food sources for insects. Other annual grasses and forbs may also be important habitat components for invertebrates. *Tamarix ramosissima* and *Cynodon dactylon* are nonnative plants occurring in patches near the spring. A small population of *Atamisquea emarginata,* the only food plant for the rare butterfly *Ascia howarthi,* occurs on the site.

For purposes of this study, the site was usually examined by walking upstream from the road on 1 side of the wash for the length of the site, then downstream on the opposite side of the wash. More concentrated activity focused on the vicinity of the spring, between the road and the international boundary. Known *Atamisquea* plants were always checked for the presence of *Ascia.* The pools were checked for aquatic invertebrates, and plants in bloom were examined for flower-feeding insects. Collecting lights were usually set up in or near the old corral or in an open area of the wash.

Alamo Canyon, South Fork (AL)

Vegetation Classification: *Quercus ajoensis* Mixed Scrub Association (123.319) (Warren et al. 1981).

This is a narrow, southward-trending canyon dissecting the Ajo Mountains. Elevations range from 744 to 1,000 m. The designated site is approximately 25.5 ha in size.

The vegetation community is characterized by dense thickets of shrubs and small trees in the canyon bottom and extending a short distance up the canyon walls. Plant species recorded from the site- include *Quercus ajoensis, Vauquelinia californica, Acacia greggii, Simmondsia chinensis, Ambrosia ambrosiodes, A. cordifolia, Dodonea viscosa, Celtis reticulata, C. pallida, Prosopis vulutina, Rhamnus crocea, Eriogonum wrightii, Acalypha pringlei, Baccharis sarothroides, Ptelea trifoliata,* and *Forestiera shrevei.* Scattered along the canyon bottom are a variable number of rock pools providing temporary, although some quite longlasting, aquatic habitats.

The area sampled in this study includes the route from the Alamo Canyon campground to this site. For purposes of this study, the investigators hiked up the canyon from the campground, following the existing trail, but deviating from it irregularly to check plants in bloom or investigate microhabitats. Collecting lights were usually set up in the canyon bottom, and water sources were checked for aquatic invertebrates.

Arch Canyon (AC)

Vegetation Classification: *Ribes quercetorum-Ptelea trifoliata* Mixed Scrub Association (133.361) (Warren et al. 1981).

The site is a steep north-facing drainage in a rocky side-canyon tributary of Arch Canyon. Elevation is approximately 915 m. The designated site is approximately 6 ha in area.

Dense thickets of sclerophyllous shrubs 1-2 m tall characterize the vegetation community. This is the most mesic upland association in the monument, and has the most restricted distribution. Plant species recorded from the area include *Ribes quercetorum, Ptelea trifoliata, Rhamnus crocea, Berberis haematocarpa, Simmondsia chinensis, Celtis reticulata, C. pallida, Quercus ajoensis, Sapium biloculare,* and *Vauquelinia californica.* Small rock pools may hold water for brief periods following rains, but no long-lasting water source is located within the study area.

The area surveyed in this study includes the route from the parking area up to the designated site. Collecting-light setups were made in the most open, level spots available at the site.

Armenta Ranch (AR)

Vegetation Classification: *Larrea tridentata-Prosopis glandulosa* Flood plain Subassociation (154.1115) (Warren et al. 1981).

The site is located at the remains of a small family farm that operated from 1930 to 1935. A water well was present on the site, but was filled in with dirt in 1990. Much debris was scattered around the site during the period of this study. The site is on fine, silty soils of extreme lower bajadas on nearly level ground. Elevation is 480 m. The site encompasses approximately 32 ha. Standing dead mesquites and ironwoods are scattered in the area, suggesting a recent decrease in subsurface water availability. Severe erosion is creating deep gullies through much of the site.

Most of the area is open, bare ground with scattered trees and shrubs. Plants recorded from the area include *Prosopis velutina, Zizyphus obtusifolia, Acacia constricta, Lycium* spp.*, Atriplex canescens, Olneya tesota, Ferocactus wislizenii, Hymenoclea salsola pentalepis, Sphaeralcea coulterii, Amaranthus palmeri, Larrea tridentata, Ambrosia dumosa, Acacia greggii,* and *Kallstoemia grandiflora.* Several undetermined species of annual grasses and forbs are also present and may be important to insects in the area. The greatest density of annuals occurs along the road and several small drainage ways.

An intense microphytic bloom was observed here on 21 October 1989 following a rainstorm of 2-hour duration. The bare soil turned bright green over most of the area and remained so for a few hours. Numerous puddles were formed and held water into the following day. In July and September 1990, puddles containing larvae of the toad *Scaphiopus couchi* and the remains of dead adult toads were found scattered about the site. This suggests that standing water is available for periods of up to several weeks under the right conditions. Until 1990, the well also provided water accessible to insects.

The area sampled during this study included the entire designated site, but focused most closely on the large gullies, the smaller washes, patches of annual vegetation, and the area near the old building. Collecting-light setups were usually made on the flat open area north of the building.

Bull Pasture (BP)

Vegetation Classification: *Simmondsia chinensis-Viguiera deltoidea-Fouquieria splendens* Subassociation (154.1232) (Warren et al. 1981).

This site is on a mid-elevation bench below the higher peaks of the Ajo Mountains. The area is dissected by 2 drainages, 1 shallow and without permanent water, and the other deeper and watered by a spring, with shallow pools and a short stretch of flowing water. Soils are very shallow and rocky. Elevation is approximately 920 m. The site is 162 ha in size. The site includes a variety of microhabitats, slopes, exposures, moisture conditions, and soil depths.

Plant species recorded on the site include *Simmondsia chinensis, Viguiera deltoidea, Fouquieria splendens, Dodonaea viscosa, Gutierrezia sarothrae, Agave deserti, Opuntia acanthocarpa, O. chlorotica, Ephedra* spp.*, Jatropha cardiophylla, Cercidium microphyllum, Lemaireocereus thurberi, Carnegiea gigantea, Ferocactus covillei, Mammillaria microcarpa, Encelia farinosa,*

Ericameria laricifolia, Janusia gracilis, and *Juniperus monosperma.* Several species of annual and perennial grasses and forbs are also present.

For purposes of this study, sampling was done along the trail to the site, and throughout the site at all significant microhabitats. The water was checked for aquatic invertebrates. Collecting-light setups were made in fairly large, open areas near the center of the site.

Burn Site (BU)

Vegetation Classification: *Larrea tridentate-Ambrosia dumosa* Subassociation (154.1111); *Atriplex polycarpa-Atriplex linearis-Prosopis glandulosa* Subassociation (154.1763); *Larrea tridentata-Prosopis glandulosa* Flood Plain Subassociation (154.1115) (Warren et al. 1981).

This site is on 3 different deep, flood plain soils, each with a different type of vegetation. Portions of all 3 vegetation subassociations were burned by a fire in 1984. Elevation is 424 m. The site is 14 ha in size and lies between a dirt road and the international boundary fence. The site is very open and flat. Immediately across the fence is an agricultural operation with several irrigated crops.

Plant species recorded from the site include *Cercidium microphyllum, Hilaria rigida, Prosopis velutina, Carnegiea gigantea, Ambrosia deltoidea, A. dumosa, Opuntia fulgida, O. leptocaulis, Olneya tesota, Atriplex canescens, A. polycarpa, Krameria grayi, Lycium* spp*., Larrea tridentata,* and *Sphaeralcea* sp. Sparse annual grasses and forbs were present, particularly along the small drainage ways dissecting the site. No water is present on the site, but water is available in the agricultural area across the boundary. A swale of heavy soil is located near the south edge of the site, and may hold puddles for a few days following rainstorms.

Most of our activities on this site were focused on the *Larrea tridentate-Ambrosia dumosa* subassociation, which comprised approximately 60% of the site. Swales were examined a bit more intensively than the areas between them because most of the annual vegetation was in the swales. The general pattern of investigation was to walk across the area southward from the road in a zig-zag pattern to the boundary fence, then back to the road across another section of the site. No collecting-light setups were made on this site.

Dirt Tank (DT)

A man-made water catchment tank constructed by piling a dirt dam across a wash was found immediately north of the monument boundary, l km east of Armenta Ranch. The tank was examined only once, on 23 July 1988. Dense young mesquite trees circled the pond, which was about 0.5 ha in size. The catchment was filled with water and had more than 100 pairs of *Bufo alvarius* toads in amplexus. I walked around the pond, sampling for aquatic insects with a dip net, and caught dragonflies with an aerial net. This was the only visit to this site, which was not included in the list of SENECPRO sites to be studied. Other similar habitats are present within the monument boundaries, but were not sampled during this study.

Dos Lomitas Exclosure (DO)

Vegetation Classification: *Atriplex polycarpa-Atriplex linearis-Prosopis glandulosa* Subassociation (154.1763) (Warren et al. 1981).

The site is located adjacent to the international boundary on silty flood plain soil at an elevation of 487 m. The site is approximately 10 ha in size. Included is a 1.3-ha cattle closure and a control plot established in 1963 to study the effects of grazing. The site has apparently been severely impacted by cattle grazing in the past.

Plant species recorded on the site include *Atriplex polycarpa, Prosopis velutina, Ambrosia deltoidea, Opuntia fulgida, O. leptocaulis, Olneya tesota, Lycium* spp.*, Mammillaria thornberi,* and *Larrea tridentata.* Several undetermined species of annual weeds and grasses occur on the site and may be important as habitat components for insects. No water is available on the site, but water is available at agricultural sites south of the border.

The general pattern of investigation for this site was to walk from the road to the entrance to the closure and then walk around inside the closure in a large circle, checking all significant microhabitats. The return to the vehicle was generally along a slightly different route than the approach, so as to sample a larger portion of the area. No collecting-light setups were made on this site.

Dripping Springs (DR)

Vegetation Classification: *Simmondsia chinensis-Viguiera deltoidea-Fouquieria splendens* Subassociation (154.1232) (Warren et al. 1981).

This site is a steep, north-facing mountain slope with thin, rocky soil derived from lava and tuff. Subsurface moisture is abundant locally, especially on tuff deposits. Free water is found in several caves. Elevation is from 600 to 700 m. The site is approximately 5 ha in size.

Plant species recorded on the site include *Simmondsia chinensis, Viguiera deltoidea, Fouquieria splendens, Encelia farinosa, Eriogonum wrightii, Opuntia acanthocarpa, Agave deserti, Acacia greggii, Calliandra eriophylla, Lycium* spp.*, Cercidium microphyllum, Carnegiea gigantea, Lemaireocereus thurberi, Dodonea viscosa,* and *Aloysia wrightii.* Annual grasses and forbs may also be an important habitat component for invertebrates.

The usual approach to the site was to walk up to the springs, then climb the hills above the springs, and meander back to the road, sampling all habitats. Collecting-light setups were made in open, relatively flat areas within sight of the largest cave.

East of Armenta Ranch (EA)

Vegetation Classification: *Larrea tridentata-Prosopis glandulosa* Flood plain Subassociation (154.1115) (Warren et al. 1981).

This is a nearly level site on fine, silty soils. A few standing dead mesquites are scattered in the vicinity, suggesting a fairly recent decrease in subsurface water availability. Some soil erosion has

cut a few small gullies in the vicinity of the site. Elevation is 480 m. The site is approximately 10 ha in size. A small wash cuts across the south end of the site.

Vegetation consists of an open stand of microphyll shrubs, cacti, and small trees with stands of perennial grasses between the woody plants and cacti. Plant species recorded from the site include *Prosopis velutina, Zizyphus obtusifolia, Acacia constricta, Lycium* spp.*, Hilaria rigida, Olneya tesota, Cercidium microphyllum, C. floridum, Ferocactus wislizenii, Carnegiea gigantea, Echinocereus engelmannii, Opuntia acanthocarpa, O. arbuscula, O. fulgida, O. phaeacantha, Hymenoclea salsola pentalepis, Sphaeralcea coulterii, Larrea tridentata, Ambrosia dumosa,* and *Muhlenbergia porteri.* Numerous species of annual grasses and forbs are also an important habitat component for insects on the site. No standing water is present on the site or in the general vicinity. The general pattern for investigating this site was to walk south near 1 edge of the site from the road to the wash, then along the wash to the other edge of the site and back to the road along that edge, with deviations into the central section of the site. Collecting-light setups were made immediately adjacent to the wash and in an open area 30 m south of the road.

Growler Canyon (GC)

Vegetation Classification: *Prosopis glandulosa* Riparian Woodland Association (124.711 R) (Warren et al. 1981).

This site is in a wide, east-west trending canyon passing through the southern end of the Growler Mountains and extending west to the Bates Well area. Groundwater is close to the surface, and has been tapped by several wells. Soil is deep, silty, low in clay, and easily detached. Elevation is approximately 420 m. Boundaries of the site are poorly defined, but the site is approximately 122 ha in size. Large, open stands of trees 5-6 m tall grow on slightly dissected flats beside a fifth order wash. Tree density is greatest along the edges of the wash, and the understory of shrubs creates an almost impenetrable thicket in places. An understory of shrubs and smaller trees is also present. Islands in the wash support dense stands of shrubs. Many dead mesquites are present. Mistletoe *(Phoradendron californicum)* heavily infests most of the remaining large trees. The tree synusium appears to be in decline, and is being replaced by shrubs. No surface water is present. The area has been impacted by past overgrazing, woodcutting, and erosion.

Plant species recorded in the area include *Prosopis velutina, Cercidium floridum; C. microphyllum, Ambrosia ambrosioides, Zizyphus obtusifolia, Acacia greggii, Olneya tesota, Lycium* spp.*, Ambrosia deltoidea, Larrea tridentata, Sapium biloculare, Acacia constricta, Ferocactus wislizenii, Castela emoryi,* and *Baccharis sarothroides.* Annual grasses and forbs, including *Datura discolor,* are important habitat components for invertebrates, as are the dense clusters of *Phoradendron californicum.*

The usual procedure for sampling this site involved walking from Bates Well across the flats to the main wash, then heading eastward on 1 side of the wash to the confluence with Cherioni wash and returning along the opposite side of the wash. Collecting-light setups were made in small washes running into the main wash, on flats within sight of the wash, or in the main wash.

Lost Cabin (LO)

Vegetation Classification: *Cercidium microphyllum-Ambrosia deltoidea-Cercidium thurberi* with *Jatropha* spp. Subassociation (154.1272) (Warren et al. 1981).

This site is located on level ground surrounded by low hills. A small wash cuts through the site. Soils vary from deep sand to silty alluvium. Elevation is approximately 505-530 m. The designated site is approximately 5 ha in size. For unknown reasons, this site is unusually frost-free and supports exceptional populations of frost-sensitive plant species. Vegetation composition and topography are very similar to the Senita Basin site.

Plant species recorded from the site include *Cercidium mirocophyllum, C. floridum, Encelia farinosa, Lophocereus schottii, Lemaireocereus thurberi, Carnegiea gigantea, Jatropha cuneata, Ambrosia deltoidea, Fouquieria splendens, Opuntia bigelovii, O. fulgida, Larrea tridentata, Sapium biloculare, Olneya tesota, Lycium* spp. *Echinocereus engelmannii, Opuntia acanthocarpa, Ferocactus wislizenii, Hyptis emoryi, Calliandra eriophylla, Coursetia microphylla, Ditaxis lanceolata, Jatropha cardiophylla,* and *Acacia constricta.* No known aquatic habitats are present on or near the site.

The area sampled during this study includes the route from the Senita Basin road to the site. Investigations always included the upland and wash areas and usually went part way up the hills. No collecting lights were set up at this site.

Neolloydia (NE)

Vegetation Classification: *Ambrosia deltoidea-Cercidium microphyllum* Pediment Subassociation (154.1212) (Warren et al. 1981).

This site is a portion of a community developed on very thin, coarse soils and bedrock. The site lies on level to north- or south-facing slopes of several small hills near the north pediment of the Puerto Blanco Mountains at an elevation of 500 m. The study site is 2.4 ha in size.

The rare cactus *Echinomastus (= Neolloydia) erectocentra* var. *acunensis* is confined to a habitat nearly devoid of soil, and the plants prefer to grow in cracks in the fractured rhyolite bedrock. Vegetation is sparse on the site. Plant species recorded from the site include *Cercidium microphyllum, Ambrosia deltoidea, Larrea tridentata, Carnegiea gigantea, Lemaireocereus thurberi, Fouquieria splendens, Encelia farinosa, Opuntia fulgida, O. acanthocarpa, O. bigelovii, Olneya tesota, Krameria grayi, Jatropha cuneata, Lycium* spp., *Ferocactus covillei, Enchinocereus engelmannii, Ambrosia dumosa, Sapium biloculare, Mammillaria microcarpa, Ephedra nevadensis, Acacia constricta,* and *Calliandra eriophylla.* Annual grasses and forbs may also be important habitat components for invertebrates. No water is available at this site.

The usual method for sampling this site was to walk around within the area, attempting to cover as much ground as possible and visit all plants in bloom. The collecting-light setup was placed in an open area close to the road. An intensive study of the biology of *Echinomastus* was underway concurrent with this project. Investigators on the plant study collected insects associated with the plant, including pollinators and predators. Results of their study are included in their report (Johnson et al: 1993), and are not included herein.

Pozo Nuevo (PO)

This site was not included in the original SENECPRO sites, but was added following the annual investigators' meeting in 1989. The site is approximately 1 km south of the Pozo Nuevo Well site and is not clearly defined or described, but appears to be classifiable as *Larrea tridentate-Ambrosia dumosa* Association (154.111) and/or *Larrea tridentata-Ambrosia* spp. Association (154.1112). The site is on level, sandy and gravelly soil, with no water, no large rocks, and few trees. Boundaries of the site have not been set.

Plant species present on the site include *Larrea tridentata, Ambrosia dumosa, A. deltoidea, Fouquieria splendens, Krameria grayi, Prosopis glandulosa,* and *Ferocactus wislizeni.* Other plant species are undoubtedly present but were not recorded. Annual grasses and forbs may be important habitat components for invertebrates.

This site was first visited on 19 August 1989. The standard approach to investigating this site was to walk in zig-zag paths westward from the road for a distance of about 200-300 m, then return along different paths.. All species of plants in flower were checked for insects. The collecting-light setup was placed within 20 m of the road in a large, flat, open area.

Salsola (SA)

Vegetation Classification: Probably *Larrea tridentate-Ambrosia* spp. Subassociation (154.1112) and *Larrea tridentata-Prosopis velutina* Flood Plain Association (154.1115) (Warren et al. 1981).

This site is located adjacent to the international border on silty flood plain soil at an elevation of 500 m. The site extends 610 m along the boundary northward for 230 m. The site is 14, ha in size. The Salsola site has been highly impacted by grazing and flooding, and has had invasive weeds replace native vegetation on a large portion of the site.

Plant species recorded from the site include *Salsola australis, Amaranthus palmeri, Prosopis velutina, Ambrosia deltoidea, Opuntia fulgida, Hilaria rigida, Cercidium microphyllum, Ferocactus wislizenii, Lycium* spp*., Larrea tridentata,* and *Sarcostemma cynanchoides.* Annual grasses and forbs also may be important habitat components for invertebrates.

A mature nest of the Mexican leafcutter ant *(Atta mexicana)* was reported in the RFP, but was not found during the course of this study. The remains of a dead or inactive colony of this species, which I presume to be the one mentioned in the RFP, was found.

The site was often difficult to reach, especially during summer rainy seasons, because floods damaged the road leading to it. The usual pattern of investigating this site was to walk northward from the road along the wash, then return to the road in a zig-zag pattern across the upland portion of the site. The collecting-light setup was placed in an open, disturbed area immediately north of the road, close to the wash.

Senita Basin (SE)

Vegetation Classification: *Cercidium microphyllum-Encelia farinosa-Cereusthurberi-Jatropha cuneata* Hillside Subassociation (154.1261), *Cercidium microphyllum-Encelia farinosa-Cereus*

thruberi-Bursera microphylla Subassociation (154.1271), and *Cercidium microphyllum-Ambrosia deltoidea-Cereus thurberi* with *Jatropha* spp. Subassociation (154.1272) (Warren et al. 1981). This site is on a north-facing slope, a south-facing slope, and level ground. The area lies between the north end of the Sonoyta Mountains and the southeastern flank of the Puerto Blanco Mountains. For unknown reasons, the area has an unusually frost-free climate and supports frost-sensitive plant species. Soils vary from deep alluvium to bare rock. Elevation is approximately 505-530 m. The site is approximately 106 ha in size. A small wash runs through the area between steep rocky hills. There is no water available on the site.

Plant species recorded from the site include *Cercidium microphyllum, Encelia farinosa, Lemaireocereus thurberi, Carnegiea gigantea, Lophocereus schottii, Opuntia bigelovii, O. fulgida, O. acanthocarpa, Ferocactus covillei, F. wislizenii, Larrea tridentata, Bursera microphylla, Croton sonorae, Sapium biloculare, Olneya tesota, Krameria grayi, Lycium* spp. *Simmondsia chinensis, Agave deserti, Hyptis emoryi, Calliandra eriophylla, Coursetia microphylla, Ditaxis lanceolata, Echinocereus engelmannii, Phoradendron californicum, Jatropha cuneata, J. cinerea, J. cardiophylla,* and *Acacia constricta.* Annual grasses and forbs may also be important habitat components for invertebrates.

The standard procedure for sampling this site included walking from the parking lot through the wash eastward approximately 100 m, then climbing the hill north of the flat (the southfacing slope) and either climbing to the ridge top or traversing the slope and proceeding westward to cover most of the ridge. Then we descended to the wash and walked eastward along it to the parking lot, crossed the flat, and traversed the north-facing slope for 200-300 m. Sometimes the procedure was reversed. Attempts were made to sample all habitats within the site. Collecting-light setups were made in the widest sections of the wash, where the light would be visible from both slopes.

Vulture (VU)

Vegetation Classification: *Cercidium microphyllum-Ambrosia deltoidea* Middle Bajada Subassociation (154.1211) and *Ambrosia ambrosioides-Olneya tesota-Acacia* spp. Subassociation (154.1214) (Warren et al. 1981).

This site is adjacent to the international boundary on sandy, cobbley soil and coarse gravel at an elevation of 450 m. Vulture site is approximately 14 ha in area, and lies on the bajada of the Sonoyta Mountains and is dissected by 2 washes. The land slopes gently to the southwest. Many of the saguaros on the site are marked with whitewash droppings of the 100+ black vultures and turkey vultures that roost on the area. Old cattle trails cross the site, but there is no evidence of significant grazing impact.

Plants recorded from the site include *Cercidium microphyllum, Ambrosia deltoidea, A. ambrosioides, Larrea tridentata, Carnegiea gigantea, Lemaireocereus thurberi, Fouquieria splendens, Opuntia fulgida, O. acanthocarpa, Olneya tesota, Mammillaria microcarpa, Hyptis emoryi, Encelia farinosa, Acacia greggii, Lycium* spp.*, Zizyphus obtusifolia,* and *Bebbia juncea.* Annual grasses and forbs may be important habitat components for some invertebrates, especially on the relatively barren gravelly soil of the site. No water is available on the site, although water may be available across the international boundary.

For purposes of this study, the site was generally examined by traversing the bajada northwards from Puerto Blanco Drive and westward to the largest wash, then walking down the wash to the road. The area south of Puerto Blanco Drive and north of the international boundary was examined only cursorily twice. No collecting-light setups were made on this site.

Weather

Weather patterns are generally recognized as the primary driving force behind invertebrate population sizes and invertebrate activity in deserts (Crawford 1981). Individuals and populations respond to events of rainfall and temperature fluctuations by increasing their activity, reproduction rates, survival rates, and resource use. Sonoran Desert rainfall patterns are notoriously unpredictable and spotty. There was considerable variation between sites. The weather during the period of this study at the monument is summarized in Figures 1, 2, and 3 which are based on records from monument headquarters. Average temperatures (both minimum and maximum) were higher than the 46-year mean for both minimum and maximum temperature during the period of this study.

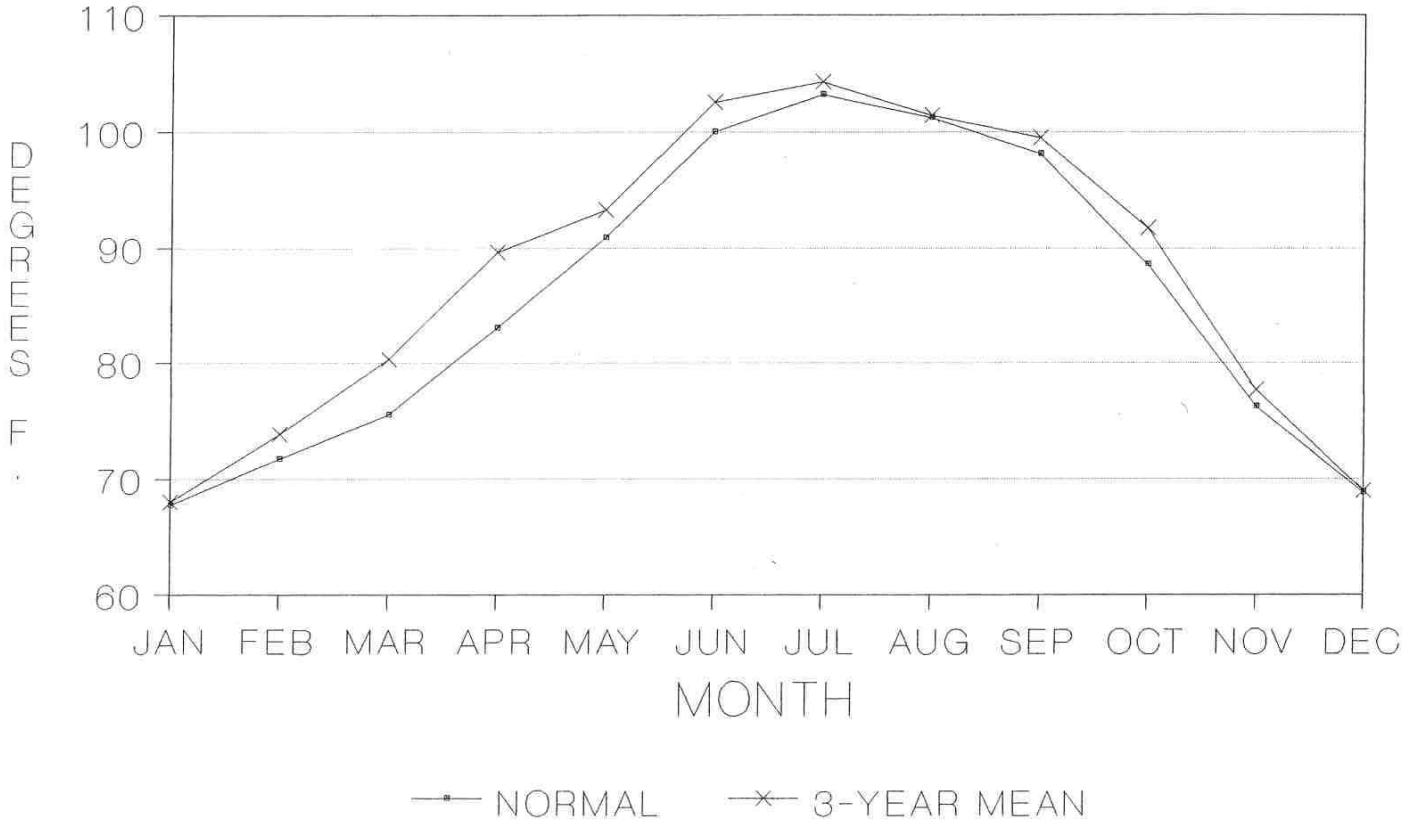
The graph of monthly precipitation (Figure 3) is deceptive, in that it shows that in 1988 rainfall exceeded the 46-year mean in several months. Indeed, the monthly totals did exceed normal in July, August, and October. However the majority of the rain came in a few widely separated, intense, 1-day storms that resulted in most of the water being lost as runoff, of little ecological value. Rainfall for 1989 was below normal, and approximately 25% of the total carne in a single storm. Ecological conditions reflected severe, prolonged drought, with very little annual plant production and general moisture stress during the period of this study. The summer rainy season of 1990 provided excellent conditions for annual plants and animals, with frequent storms bringing generally small amounts of rain. The general conditions of high temperatures and low moisture availability undoubtedly was stressful to invertebrate populations. Results of this study should be considered in the context of these weather conditions.

Previous Investigations

Investigations of invertebrates have been taking place at OPCNM since at least 1940. Most of these have focused on either specific taxonomic groups of invertebrates, or on specific locations, especially the Quitobaquito springs area. A bibliography on research at the monument has been prepared and includes all known written material available at the time (Bennett et al. 1990). The following is a brief overview of some of the more important work that has been done on invertebrates in or near OPCNM, including published works and a few unpublished manuscripts and a work in progress.

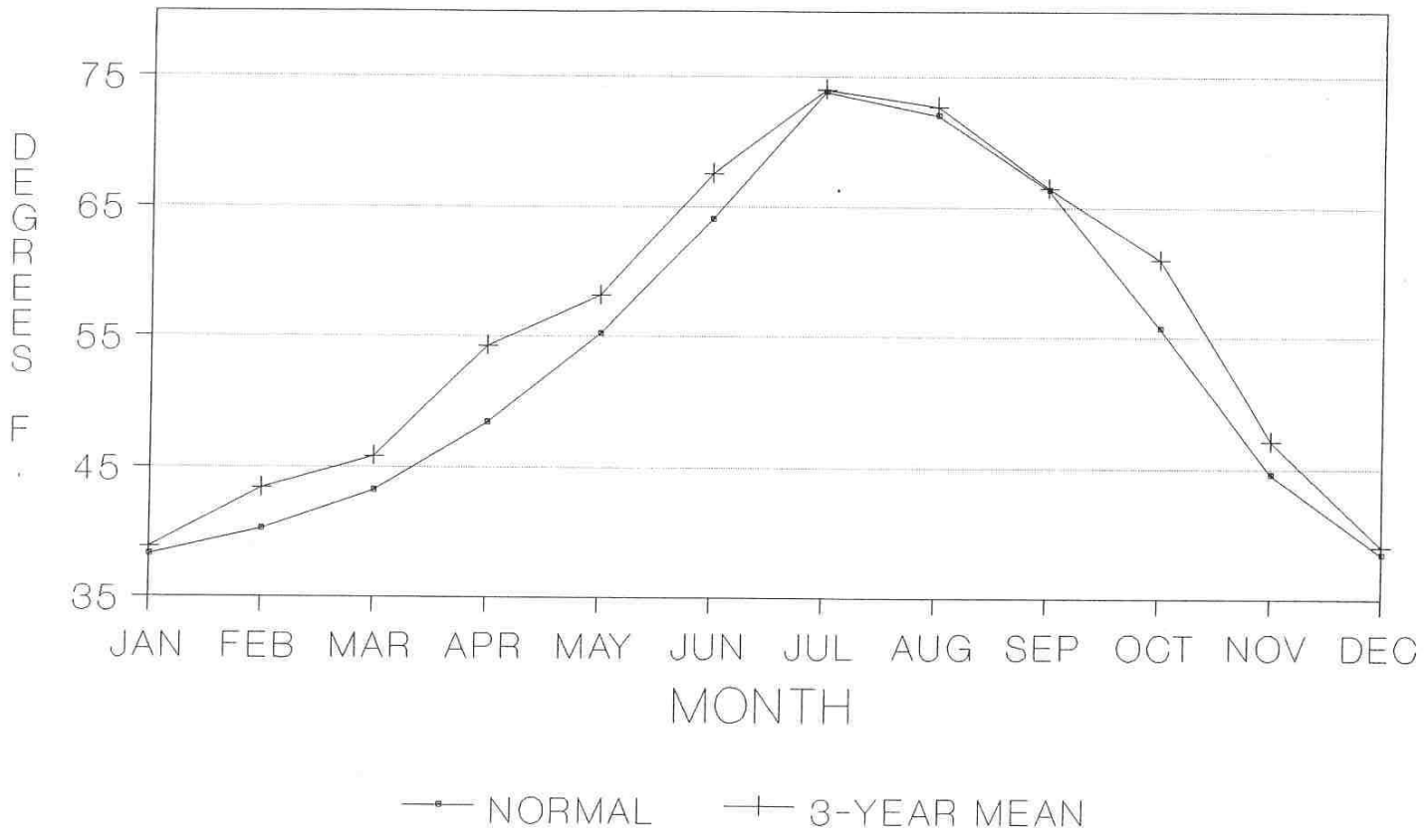
On 19 and 20 April 1942, a party of entomologists studying butterflies visited Alamo Canyon (Garth 1944). They listed 21 species present. Ball et al. (1942) cited specimens and records from the monument in their monograph on the Orthoptera of Arizona.

In 1949, Byars reported on the first known record of the Mexican leaf-cutting ant *(Atta mexicana* Hymenoptera: Formicidae) in the United States (Byars 1949). This ant has subsequently been studied in considerable depth by A. C. Mintzer (1997). In 1952, W. S. Creighton visited the monument from 12 to 30 March. He collected and observed ants throughout much of the monument, and wrote a report, which is in the monument's files.



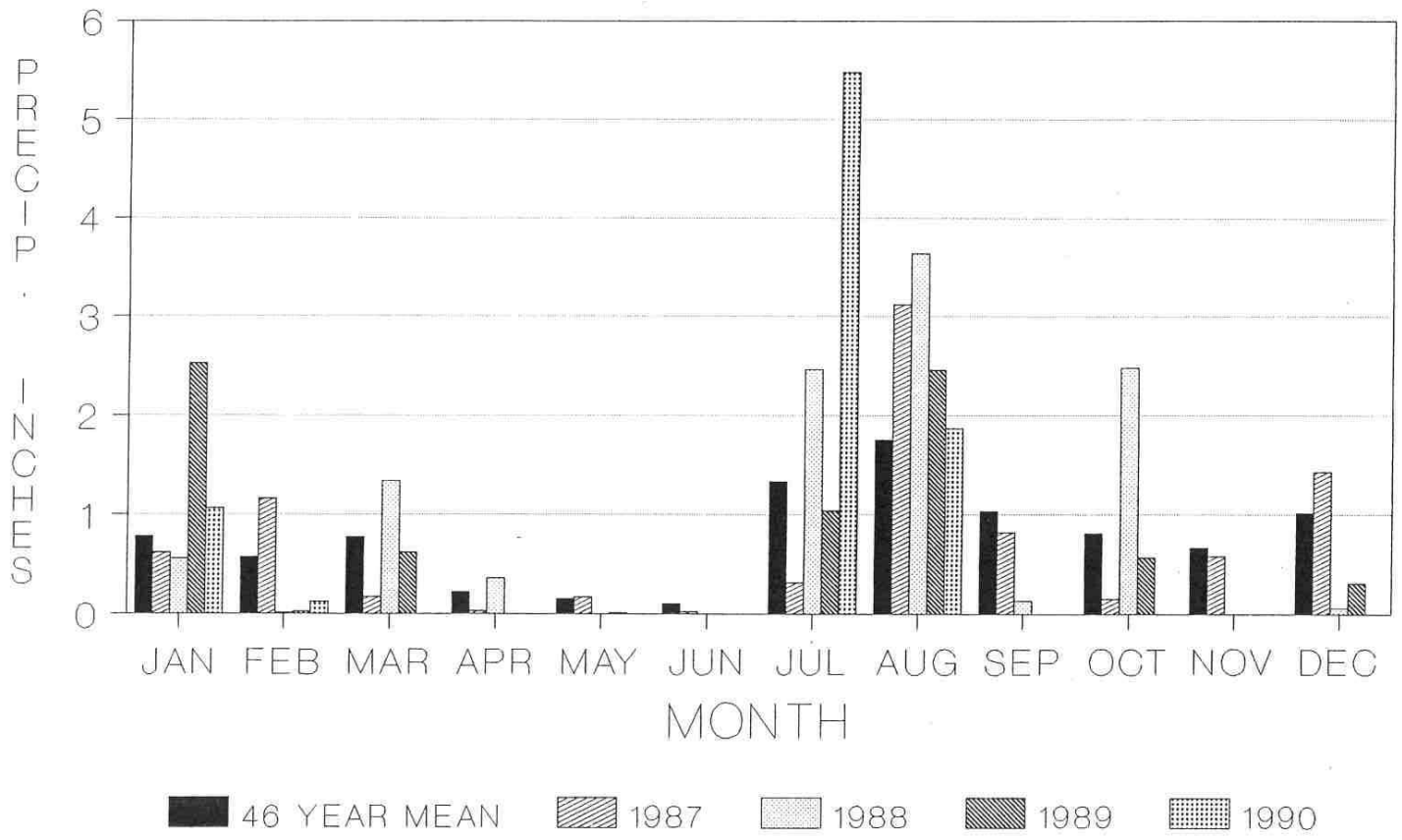
SOURCE: CLIMATOLOGICAL DATA (NOAA)

Figure 1. Average maximum temperatures for Organ Pipe Cactus National Monument.



SOURCE: CLIMATOLOGICAL DATA (NOAA)

Figure 2. Average minimum temperatures for Organ Pipe Cactus National Monument.



FROM CLIMATOLOGICAL DATA (NOAA)

Figure 3. Monthly precipitation for Organ Pipe Cactus National Monument.

Cole and Whiteside (1965) published an account of a study of the aquatic fauna of Quitobaquito pond. This included insects, crustaceans, and snails. Miller (1966) investigated snails in the monument and described a new subspecies *Sonorella baboquivariensis cossi* from the Ajo Mountains. His snail records from the monument were also incorporated into a book on the mollusks of Arizona (Bequaert and Miller 1973).

Werner et al. (1966) cites specimens of meloid beetles from the monument, but does not include information on when or where they were collected for most species. Fellows and Heed (1972) studied factors affecting host plant selection in *Drosophila* species (Diptera: Drosophilidae) in rotting cacti. They supplemented their field studies at the monument with laboratory studies. Kircher (1972) conducted chemical studies of organ pipe cactus and related them to the maturation of *Drosophila nigrospiracula.*

In 1977, Mehlhop and Scott studied seed-harvesting ants in Cabeza Prieta National Wildlife Refuge near the western boundary of the monument (Mehlhop and Scott 1983). Landye (1981) reported on a new species of snail from Quitobaquito. This snail has since been named *Tryonia quitobaquitae* Hershler and is listed by the U.S. Fish and Wildlife Service as a Category 2 endangered species. Kingsley et al. (1987) and Kingsley and Bailowitz (1987) reported on studies of arthropods -found at Quitobaquito in 1983 and 1984. Bailowitz (1985) reported on the biology of *Ascia howarthi* (Lepidoptera: Pieridae), which he found at Aguajita Wash and Quitobaquito.

Hall et al. (1988) reported on insects found in packrat middens from the late Quaternary period in the Ajo Mountains. These were contrasted with insects found in Alamo Canyon from March to November 1987. Larsen (n. d.) reported on aquatic bugs and beetles collected in the monument from 1980 through 1982. He included natural rock catchments, artificial ponds, Dripping Springs, Quitobaquito, and artificial stock tanks.

Simultaneous with the present study and continuing for an unknown period into the future, an investigation of honey bees (*Apis mellifera)* has been undertaken by scientists affiliated with the U.S. Department of Agriculture (USDA) Carl Hayden Bee Research Center. Results of their investigations have not yet been published.

The present study appears to be unique, not just for OPCNM but possibly the world. Ginsberg (1994), citing other researchers, pointed out that "no park had a systematic inventory of invertebrates." The only comparable study of which I am aware is by Proctor (1946).

Methods

Field investigations were conducted from 17 October 1987 through 11 September 1990. Table 1 lists the field trips by dates, with sites visited on each field trip. Table 2 lists the field trips by sites, showing the dates each site was visited. The general approach to each site is described in the introduction section of this report, in the site descriptions. Most field trips involved a senior investigator, either Kingsley or Bailowitz, and an assistant. National Park Service personnel often accompanied the investigators for part or all of the field trip, assisting with the work and receiving training in techniques. Persons involved are listed in the acknowledgments section of this report.

Most field trips occurred over weekends, the team arriving on Saturday morning, investigating 1 or 2 sites, then setting up and remaining on a site overnight. The following morning, the team finished study of the overnight site and generally moved on to 1 or more other sites before leaving the monument.

Sampling was restricted to easily visible macroinvertebrates. Sampling was done in a minimally disruptive manner, so as to limit environmental impact. On each site, the investigators did a walking reconnaissance, searching for the presence of invertebrates. Special efforts were made to examine representatives of plants in bloom and all microhabitats evident on the site. Occasionally sweep nets and beat sheets were used on stands of vegetation. Where appropriate, rocks and other objects were turned over to search for invertebrates and then carefully replaced. If standing water was available on the site, the investigators used dip nets to sample aquatic fauna and watched the water for variable lengths of time to observe and collect visiting fauna. When encountered, dead animals and rotting cacti were observed and probed to capture insects present in them. No major attempt was made to sample subterranean, wood-inhabiting, litter or soil invertebrates. No attempt was made to sample parasites. After dark, insects were attracted using portable, battery-operated black lights or a generator-operated mercury vapor light placed against a white sheet backdrop. Visual searches of the ground and plants were also made after dark. On several occasions, short-wave ultraviolet lights were used to search for fluorescing scorpions.

Invertebrates discovered by any of these methods were either collected or merely recorded if they were readily identifiable and had been previously collected. In a few cases (rare butterflies) specimens could not be caught, but positive identification was made in the field by Bailowitz. Specimens were killed by use of ethyl acetate killing jars or by plunging them into alcohol, or by pinching (butterflies). Notes were kept for each specimen or observation, recording the location and circumstances, including plant species at which the animal was feeding, if it could be identified.

At initial sorting of specimens, at least 1 or 2 of each recognizable taxon was selected for mounting. Occasionally duplicates were collected at lights. These were not mounted, but after initial inspection were placed in glassine envelopes with labels and packed in a plastic box with chlorocresol crystals. The box was submitted to monument staff along with the labeled collection. Specimens were mounted in the appropriate fashion (Borror et al. 1981) on pins or preserved in vials of alcohol. A reference number was assigned to each specimen to use as an anchor point throughout the process of identification and recording of data. These reference numbers followed no particular sequence and are meaningless except as a unique means of referring to each specimen. A small label bearing the

Table 1. List of invertebrate study field trips at Organ Pipe Cactus National Monument by date.

No.	Dates	Sites (*= black lighting)
1.	10/17–18/87	Alamo Canyon, Arch Canyon, Bull Pasture*
2.	10/30–11/1/87	Burn, Dos Lomitas, Lost Cabin, Salsola*, Senita Basin*, Vulture
3.	11/20–22/87	Aguajita Wash, Armenta Ranch*, Dripping Springs, East of Armenta, Growler Canyon*, Neolloydia
4.	2/26–29/88	Armenta Ranch*, East of Armenta, Growler Canyon
5.	3/5–6/88	Aguajita Wash, Dripping Springs, Neolloydia*
6.	4/9–10/88	Alamo Canyon, Arch Canyon*
7.	4/19–20/88	Burn, Lost Cabin, Senita Basin*, Vulture
8.	7/23–24/88	Armenta Ranch, Dirt Tank, East of Armenta*,
9.	7/23–24/88	Arch Canyon*, Bull Pasture
10.	8/27–28/88	Aguajita Wash, Dripping Springs, Neolloydia
11.	8/27–28/88	Burn, Dos Lomitas, Lost Cabin
12.	9/10–11/88	Alamo Canyon*, Armenta Ranch, Bull Pasture, East of Armenta Growler Canyon*
13.	10/8–9/88	Aguajita Wash*, Dripping Springs, Salsola, Senita Basin, Vulture, Bull Pasture
14.	1/28–29/89	Aguajita Wash, Arch Canyon*, Neolloydia
15.	2/18–19/89	Lost Cabin, Senita Basin*, Vulture
16.	3/11–12/89	Alamo Canyon, Dripping Springs*, Neolloydia
17.	4/8–9/89	Burn, Dos Lomitas, Growler Canyon*, Salsola
18.	4/29–30/89	Arch Canyon, Bull Pasture*

Table 1—continued.

No.	Dates	Sites (*= black lighting)
19.	5/27–28/89	Armenta Ranch*, East of Armenta, Senita Basin, Vulture
20.	7/22–24/89	Senita Basin*
21.	7/29–30/89	Alamo Canyon*, Arch Canyon
22.	8/18–19/89	Armenta Ranch, Burn, Dos Lomitas, East of Armenta, Pozo Nuevo, Salsola, Senita Basin*
23.	8/26–27/89	Alamo Canyon, Aguajita Wash*
24.	9/30–10/1/89	Arch Canyon*, Bull Pasture
25.	10/21–22/89	Armenta Ranch*, East of Armenta*
26.	2/24–25/90	Aguajita Wash, Armenta Ranch, East of Armenta, Growler Canyon*, Pozo Nuevo, Senita Basin, Vulture
27.	3/24–25/90	Arch Canyon, Bull Pasture*
28.	4/13–15/90	Aguajita Wash, Armenta Ranch*, Burn, Dos Lomitas, East of Armenta, Growler Canyon, Lost Cabin, Pozo Nuevo, Senita Basin*, Vulture
29.	5/5–6/90	Aguajita Wash*, Alamo Canyon
30.	7/10–11/90	Aguajita Wash, Alamo Canyon, Arch Canyon, Armenta Ranch, Bull Pasture, East of Armenta, Growler Canyon, Pozo Nuevo*, Senita Basin
31.	7/28–29/90	Alamo Canyon*, Aguajita Wash
32.	8/25–26/90	Aguajita Wash, Arch Canyon*, Bull Pasture
33.	9/9–11/90	Aguajita Wash, Armenta Ranch, Burn, Dos Lomitas, East of Armenta, Growler Canyon, Lost Cabin, Pozo Nuevo*, Senita Basin*, Vulture

Table 2. List of invertebrate study field trips at Organ Pipe Cactus National Monument by site.

Site	Dates (*= black lighting)
Aguajita Wash	11/21–22/87*, 3/5–6/88, 8/27–28/88, 10/8–9/88*, 1/28/89, 8/26–27/89*, 2/25/90, 4/14/90, 5/5–6/90*, 7/10/90, 7/28/90, 8/26/90, 9/10/90
Alamo Canyon	10/17–18/87, 4/9–10/88, 9/10–11/88*, 3/11/89, 7/29/89*, 8/26/89, 5/5/90, 7/10/90, 7/28/90*
Arch Canyon	10/17/87, 4/9–10/88*, 7/23/88*, 1/28/89*, 4/29/89, 7/29/89, 9/30/89*, 10/30/89, 3/24/90, 7/10/90, 8/25/90*
Armenta Ranch	11/20–21/87*, 2/26–29/88*, 7/23/88, 9/10/88, 5/27/89*, 8/18/89, 10/21/89*, 2/24–25/90, 4/13–14/90*, 7/10/90, 9/9/90
Bull Pasture	10/17/87*, 7/23/88, 9/10/88, 10/9/88, 4/29–30/89*, 9/30/89, 3/24/90*, 7/10/90, 8/25/90
Burn	10/30/87, 4/19/88, 8/27/88, 4/8/89, 8/18/89, 4/13/90, 9/9/90
Dirt Tank	7/23/88
Dos Lomitas	10/30/87, 8/27/88, 4/8/89, 8/18–19/89, 4/13/90, 9/9/90
Dripping Springs	11/21/87, 3/5/88, 8/27/88*, 10/8/88, 3/11–12/89*
East of Armenta	11/20/87, 2/26/88, 7/23/88*, 9/10/88, 5/27/89, 8/19/89, 10/21/89*, 2/24/90, 4/13/90, 7/10/90, 9/9/90
Growler Canyon	11/21–22/87*, 2/27/88, 10/10–11/88*, 4/8–9/89*, 2/24–25/90*, 4/13/90, 7/10/90, 9/9/90
Lost Cabin	10/30/87, 4/20/88, 8/27/88, 2/18/89, 4/13/90, 9/10/90
Neolloydia	11/20–21/87, 3/5–6/88*, 8/27/88, 1/28/89, 3/11–13/89
Pozo Nuevo	8/18/89, 2/24/90, 4/14/90, 7/10–11/90*, 9/10–11/90*
Salsola	10/30–31/87*, 10/9/88, 4/8/89, 8/18/89
Senita Basin	10/30–31/87*, 4/19–20/88*, 10/9–10/88*, 2/18–19/89*, 5/27/89, 7/22–23/89*, 8/18–19/89*, 2/24/90, 4/13–14/90*, 7/10/90, 9/9/90
Vulture	10/31–11/1/87, 4/19–21/88, 10/10/88, 2/18/89, 5/27/89, 2/24/90, 4/13/90, 9/9/90

reference number was placed on the pin or in the vial of each specimen. Locality and date labels were placed on each pin or in each vial. Specimens were then distributed for identification.

Taxonomic determinations were made to the lowest level of confidence of the identifier. The majority of taxonomic determinations were made by Michael F. Wilson, using published keys and by comparison with identified specimens in the collection of The University of Arizona Department of Entomology. Carl A. Olson made some of the determinations. Additional identifications of moths were made by Ray Nagle and Peter Jump, and of elaterid beetles by Frank Ramburg. Kenneth J. Kingsley made determinations of all specimens in alcohol, including spiders and other non-insect invertebrates, except mollusks. Walter B. Miller made determinations of mollusks. Richard A. Bailowitz made determinations of butterflies and some moths. Stephen L. Buchman made determinations on some hymenopterans.

A computerized database using dBase-III+ was used for recording data on all specimens and observations. This was then used to generate reports on the data. The entire database has been submitted to monument staff and may be accessed by investigators seeking additional or more detailed information. The entire collection is deposited in the natural history museum of. the monument, with the exception of a few specimens deposited with The University of Arizona Department of Entomology at the request of Carl A. Olson.

Results and Discussion

This section is divided into several subsections. The first subsection examines the data from a broad perspective, considering the numbers of taxa found during the study overall and at each site through the 3 years of the project.

The second subsection is a taxonomic account of all invertebrates found during this study. Included are all records of the distribution of each taxon from this study and records by previous investigators. Also included are observations and references to literature on the distribution, taxonomy, and ecology of many of the taxa.

The third subsection is a list of plants associated with invertebrates. This list is built from records obtained during this study and records in the literature, but is not to be considered an exhaustive literature search. It includes only invertebrates recorded during this study.

The fourth subsection deals with specific taxa, those that were considered of special concern because they were deemed important, interesting, or invaders. The fifth subsection deals with indicator species and the concept of monitoring and problems of putting it into practice.

General Observations

A total of 1,024 invertebrate taxa were recorded from OPCNM during the course of this study. It is impossible to know what portion of the actual number of invertebrate taxa present in the monument is represented by the number we have recorded. Figure 4 shows the year of first record of taxa. The great majority of taxa were first recorded in the first full year of the study, but new taxa continued to be discovered with each field trip. Figure 5 shows the number of taxa unique to each year, meaning that they were found only in the year indicated. Note that the scales are different between figures 4 and 5, but that the pattern remains. Undoubtedly, if sampling were to continue, new taxa would continue to be found. The rate of discovery of new taxa would inevitably decline, but that rate is unpredictable using current data. A large number of additional taxa could probably be obtained by expanding techniques used to include pitfall traps, specialized techniques for sampling parasites, soil, wood, carrion, dung, and so forth, and if microscopic taxa were to be included.

Most invertebrates are limited to the season or seasons during which they are active. Figure 6 combines data from all years to show the seasons at which taxa were first recorded. Seasons are here defined as solar seasons, with winter: 22 December-21 March; spring: 22 March-21 June; summer: 22 June-21 September; and fall: 22 September-21 December. The local summer rainy season and the period of ecological response to it are included in both summer and fall. A few invertebrate taxa are active throughout the year, or have bimodal peaks of activity.

Most of the taxa are considered rare. Figure 7 plots the number of times each taxon was recorded. There were 439 taxa recorded only once, and only 50 were recorded more than 10 times. No taxon, not even the seemingly ubiquitous *Apis mellifera* was recorded at every site on every field trip. This shows a very high degree of diversity, but makes meaningful conclusions on the importance, interest, or ecological role of most taxa impossible to obtain. For most of our taxa, all we can reliably state is that they came to black lights at certain sites on certain dates.

Figure 4. Year of first record of invertebrate taxa (all seasons combined) for Organ Pipe Cactus National Monument.

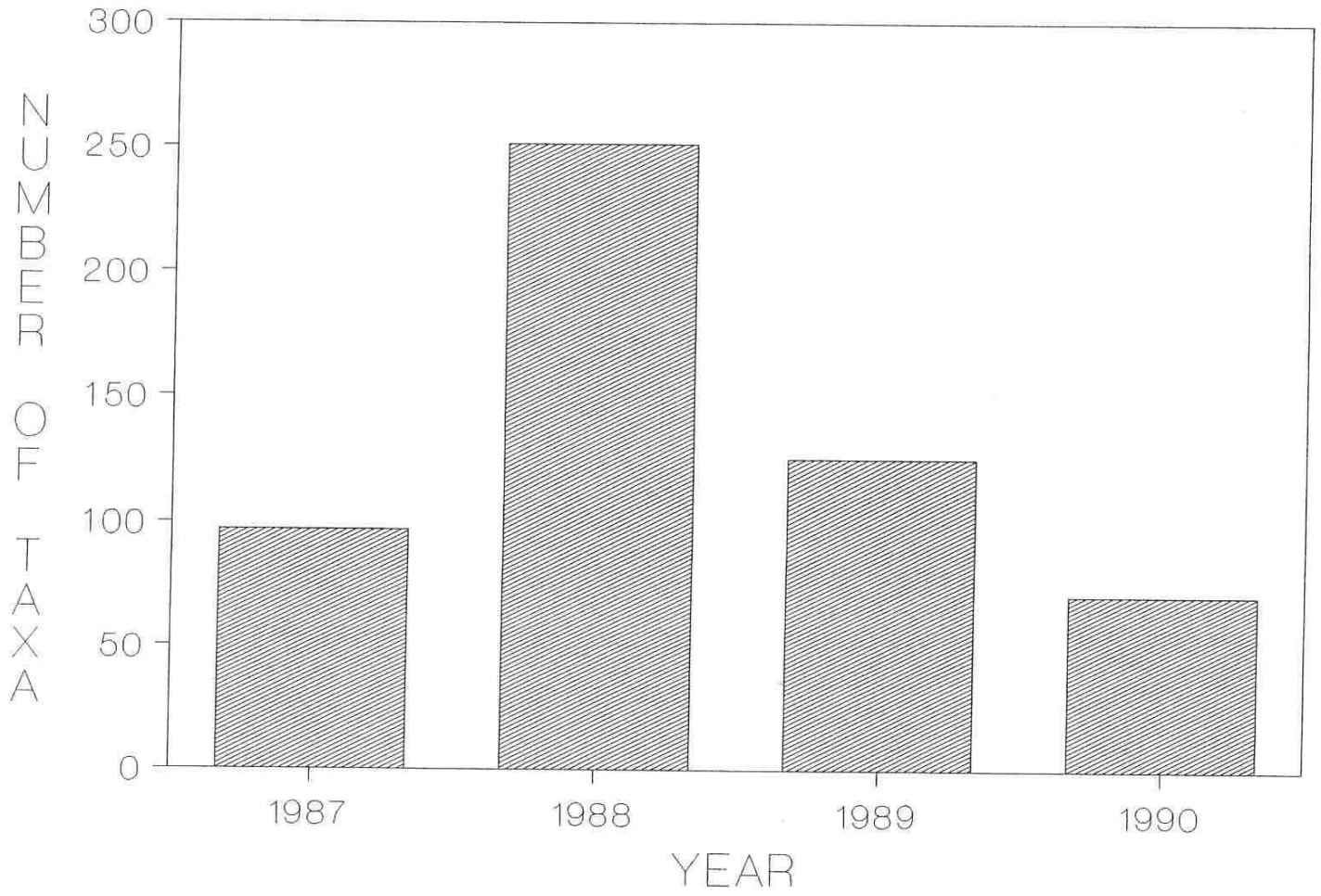


Figure 5. Invertebrate taxa unique to year for Organ Pipe Cactus National Monument.

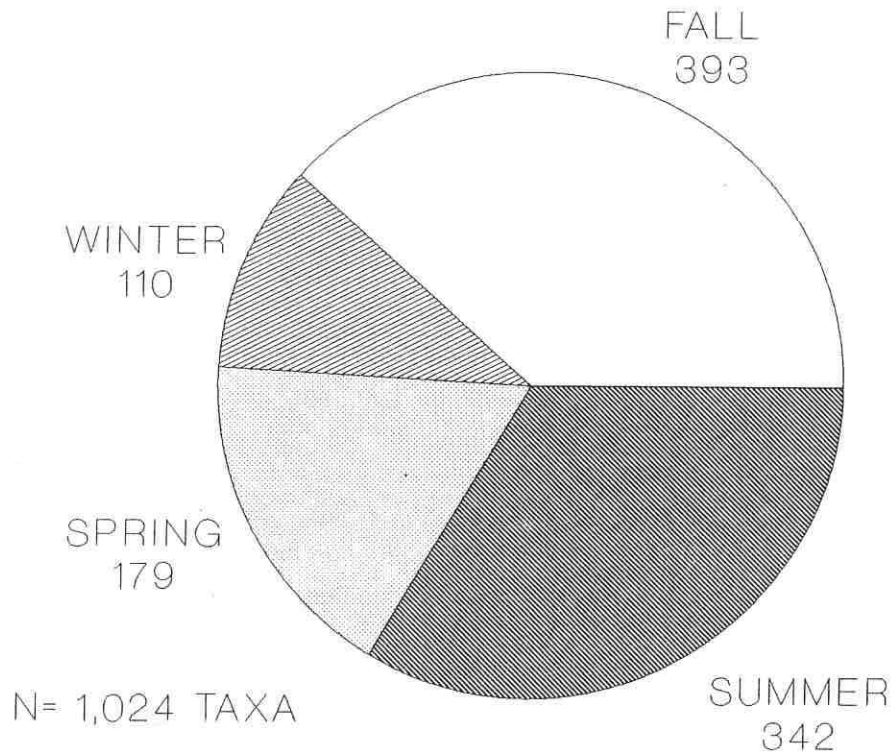


Figure 6. Season of first record of invertebrate taxa (all years combined) for Organ Pipe Cactus National Monument.

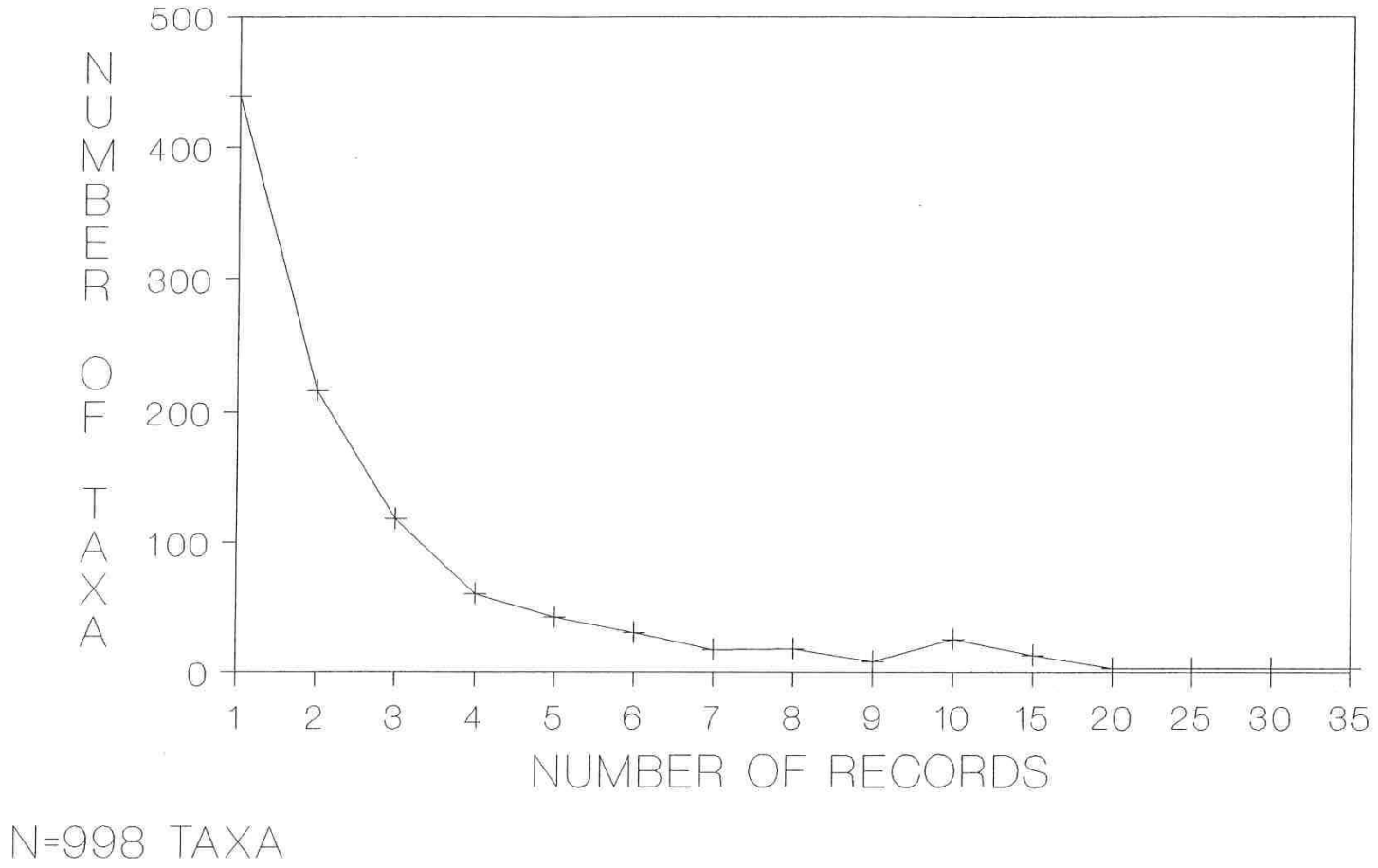


Figure 7. Number of times invertebrate taxa were recorded at Organ Pipe Cactus National Monument, October 1987 to September 1990.

There were considerable differences between the sites studied. Table 3 summarizes and contrasts data from all sites except the Dirt Tank site, which was such a specialized situation that it cannot be compared meaningfully with the other sites. It is crucial to note that sampling effort was not equal between sites, site size was not equal, and some sites were not sampled during seasons when species richness would be expected to be highest. However, general (and expected) trends are apparent. Sites with water and a diversity of habitats and micro habitats (generally large sites) had the highest invertebrate species richness. Small, disturbed sites low in plant and habitat diversity and without water had the lowest species richness. Also sites that were more intensively sampled had more taxa than sites that were less intensively sampled.

The Ajo Mountains sites (AC, AL, BP) had very high numbers of invertebrate taxa, which is to be expected considering the diversity of habitats and microhabitats present at these sites. Aguajita Wash had a very high number of taxa, part of which can be attributed to the presence of permanent water and part can be attributed to diversity of habitats and micro habitats. However, these may not fully account for the number of taxa found at this site. This site may also be an important corridor for migration and shelter during times of weather stress. Another explanation for an unknown part of the species richness of this site may be in the amount of effort that was expended here. This site was visited more times and sampled more intensively than any other.

Lowest invertebrate richness was found at the small, disturbed border sites (BU, DO, SA, VU), which was to be expected. The low number of taxa recorded from Lost Cabin site can only be explained by inadequate sampling. This site was not sampled very intensively, in part because access was not easy and in part because it appeared to resemble the Senita Basin site so closely that the additional effort required to sample Lost Cabin was not deemed worthwhile. In addition, weather conditions were not good for insect activity during some of the trips to Lost Cabin. The Pozo Nuevo site was under-sampled because it was not added to the site list until late in the study. More intensive sampling of the sites with low numbers of taxa would undoubtedly increase the numbers recorded there.

Table 4 lists the taxa recorded exclusively at each site. The proportion of unique taxa generally parallels the number of taxa found at each site, but this does not always hold true. Indeed, the highest proportions of unique taxa were at the sites with the lowest numbers of taxa. Dirt Tank, not included in the table, had 10 taxa, 6 of which were unique to it. This was a specialized habitat and had very limited sampling. The high proportion of unique taxa at Dos Lomitas may be partially due to sampling effects, considering the small total number of taxa that were found there and the fact that all unique taxa were collected in and around a small clump of *Sphaeralcea* sp. that was in bloom. Most likely additional sampling over a longer period of time would show that most of the taxa recorded as unique to certain sites were not, in fact, unique, but that this apparent uniqueness is due to limited sampling.

Table 3. Comparison of data between invertebrate study sites at Organ Pipe Cactus National Monument, October 1987 to September 1990.

Percent similarities between sites																
	AC	AG	AL	AR	BP	BU	DO	DR	EA	GC	LO	NE	PO	SA	SE	VU
AC	100	26	40	19	36	35	43	34	39	31	31	33	30	31	26	36
AG	29	100	33	37	26	45	64	35	39	40	31	43	45	56	41	55
AL	49	37	100	35	44	38	50	49	47	57	35	44	41	36	43	46
AR	7	13	11	100	10	35	36	13	33	21	38	20	15	43	19	35
BP	28	20	30	23	100	35	43	24	26	25	38	30	17	30	26	42
BU	3	4	3	9	4	100	43	4	9	6	17	7	4	20	4	21
DO	2	3	2	5	3	21	100	4	7	4	13	4	4	13	3	12
DR	22	21	26	21	18	24	50	100	26	35	28	39	28	33	27	32
EA	7	7	8	17	6	17	29	8	100	14	28	9	25	21	11	17
GC	17	20	25	30	16	31	43	30	40	100	31	25	45	36	18	30
LO	3	3	3	10	5	17	29	4	14	6	100	11	4	12	4	18
NE	11	13	12	18	12	24	29	21	16	16	38	100	8	21	16	27
PO	8	12	10	11	6	10	21	12	37	28	10	7	100	13	18	9
SA	6	11	6	23	7	41	57	11	23	14	24	13	10	100	12	30
SE	19	28	26	37	23	31	43	32	44	25	31	36	48	43	100	39
VU	8	11	8	21	12	48	57	11	19	12	41	18	7	33	12	100
Total 297	322	358	111	243	29	14	187	57	161	29	100	83	61	220	66	
Unique	77	86	75	28	63	3	4	37	6	17	2	19	9	8	36	6
% Unique	26	27	21	25	26	10	29	20	11	11	7	19	11	13	16	10

SITES: AC=Arch Canyon; AG=Aguajita Wash; AL=Alamo Canyon; AR=Armenta Ranch; BP=Bull Pasture; BU=Burn Site; DO=Dos Lomitas; DR=Dripping Springs; EA=East of Armenta; GC=Growler Canyon; LO=Lost Cabin Mine; NE= Neolloydia; PO=Pozo Nuevo; SE=Senita Basin; SA=Salsola; SE=Senita Basin; VU=Vulture.

To read the table, read X% of taxa found at (column site) were also found at (row site). For example, 40% of the taxa found at Alamo Canyon were also found at Arch Canyon; 358 taxa were found at Alamo Canyon, of which 75 (21%) were found nowhere else during this study. Note: effort was not equal at all sites.

Table 4. Invertebrate taxa unique to specific sites at Organ Pipe Cactus National Monument during study from October 1987 to September 1990.

Taxa Recorded Only from Arch Canyon

Araneae: Araneidae: *Neoscona arabesca*
Araneae: Thomisidae: *Coriarachne* sp.
Coleoptera: Carabidae: *Chlaenius* sp.
Coleoptera: Carabidae: *Pinacodera punctigera*
Coleoptera: Carabidae: *Pterostichus* sp.
Coleoptera: Cerambycidae: *Stenalaphus alienus*
Coleoptera: Cerambycidae: *Oncideres rhodosticta*
Coleoptera: Chrysomelidae: *Disonycha tenuicornis*
Coleoptera: Chrysomelidae: *Megalostomis pyropyga*
Coleoptera: Chrysomelidae: *Megalostomis subfasciata*
Coleoptera: Chrysomelidae: *Pachybrachys bullatus*
Coleoptera: Chrysomelidae: *Paria* sp.
Coleoptera: Chrysomelidae: *Odontota arizonicus*
Coleoptera: Cleridae: *Cymatodera aegra*
Coleoptera: Cryptophagidae: unidentifed taxon
Coleoptera: Cucujidae: *Ahasverus rectus*
Coleoptera: Derodontidae: undetermined taxon
Coleoptera: Elateridae: *Megapenthes* sp.
Coleoptera: Elateridae: *Conoderus cf. parallelus*
Coleoptera: Elateridae: *Lacon* sp.
Coleoptera: Lycidae: *Lycostomus* sp.
Coleoptera: Melandryidae: undetermined taxa.
Coleoptera: Meloidae: *Epicauta segmenta*
Coleoptera: Meloidae: *Epicauta* sp.
Coleoptera: Meloidae: *Epicauta tenebrosa*
Coleoptera: Mycetophagidae: undetermined taxon
Coleoptera: Oedemeridae: *Oxacis matthewi*
Coleoptera: Scarabaeidae: *Ataenius hirsutus*
Coleoptera: Scarabaeidae: *Ataenius* sp.
Coleoptera: Scarabaeidae: *Onthophagus velutinus*
Coleoptera: Scarabaeidae: *Trox suberosus*
Coleoptera: Trogossitidae: *Airora aequalis*
Dictyoptera: Polyphagidae: *Arenivaga grata*
Diptera: Asilidae: *Asilus compositus*
Diptera: Asilidae: *Cophura* sp.
Diptera: Bombyliidae: *Anthrax sereipunctatus*
Diptera: Bombyliidae: *Villa sagata*
Diptera: Bombyliidae: *Aphoebantus* spp. 2
Diptera: Conopidae: undetermined taxon
Diptera: Syrphidae: *Nausigaster geminata*
Diptera: Tachinidae: *Drino* sp.

Table 4--continued.

Taxa Recorded Only from Arch Canyon (cont.)
Diptera: Tachinidae: *Pseudeuantha indita*
Diptera: Tephritidae: *Eutreta augusta*
Hemiptera: Lygaeidae: *Lygaeus* sp.
Hemiptera: Miridae: *Spanagonicus albofasciatus*
Hemiptera: Reduviidae: *Apiomeris flaviventris*
Hemiptera: Reduviidae: *Triatoma protracts*
Hemiptera: Rhopalidae: *Sphyrocoris punctellus*
Homoptera: Membracidae: undetermined taxon
Hymenoptera: Formicidae: *Odontomachus clarus*
Hymenoptera: Pompilidae: *Hemipepsis mexicana*
Hymenoptera: Pompilidae: *Pompilus expulsus*
Hymenoptera: Tenthredinidae: *Stromboceridea nigricans*
Hymenoptera: Tiphiidae: *Tiphia* sp.
Hymenoptera: Vespidae: *Ancistrocerus tuberculocephalus*
Hymenoptera: Vespidae: *Maricopodynerus maricoporum*
Hymenoptera: Vespidae: *Stenodynerus lissolabus*
Lepidoptera: Arctiidae: *Ctenucha venosa*
Lepidoptera: Cossidae: *Givira theodori*
Lepidoptera: Noctuidae: *Ponometia sutrix*
Lepidoptera: Noctuidae: *Lythrodes venatus*
Lepidoptera: Noctuidae: *Bandelia angulata*
Lepidoptera: Noctuidae: *Catocala* sp. 1
Lepidoptera: Noctuidae: *Egira curialis*
Lepidoptera: Noctuidae: *Euxoa* sp.
Lepidoptera: Nymphalidae: *Occidryas chalcedona*
Lepidoptera: Nymphalidae: *Nymphalis antiopa*
Lepidoptera: Nymphalidae: *Vanessa virginiensis*
Lepidoptera: Sphingidae: *Sphinx istar*
Lepidoptera: Sphingidae: *Sphinx libocedrus*
Neuroptera: Myrmeleontidae: *Brachynemurus* sp.
Neuroptera: Myrmeleontidae: *Glenurus* sp.
Neuroptera: Myrmeleontidae: *Gnopholeon delicatulus*
Neuroptera: Myrmeleontidae: *Psammoleon sinuatus*
Orthoptera: Acrididae: *Schistocerca alutacea shoshone*
Orthoptera: Tettigoniidae: *Eremopedes ephippiatus*
Phasmatodea: Heteronemiidae: *Diapheromera arizonensis*

Taxa Recorded Only from Aguajita Wash
Coleoptera: Carabidae: *Goniotropis parca*
Coleoptera: Cerambycidae: *Enaphalodes seminitidus*
Coleoptera: Cerambycidae: *Stenodontes lobigenis*

Table 4-continued.

Taxa Recorded Only from Aguajita Wash (cont.)

Coleoptera: Chrysomelidae: *Cryptocephalus maccus*
Coleoptera: Cleridae: *Cymatodera horni*
Coleoptera: Cleridae: *Lecontella gnara*
Coleoptera: Coccinellidae: *Brachyacantha subfasciata*
Coleoptera: Dytiscidae: *Deronectes roffi*
Coleoptera: Dytiscidae: *Laccophilus pictus coccinelloides*
Coleoptera: Erotylidae: undetermined taxon
Coleoptera: Scarabaeidae: *Aphonides dunnianus*
Coleoptera: Tenebrionidae: *Lobometopon fusiforma fusiforma*
Coleoptera: Tenebrionidae: *Telabis* sp.
Coleoptera: Tenebrionidae: *Helops arizonensis*
Coleoptera: Tenebrionidae: *Ulus crassus*
Coleoptera: Tenebrionidae: *Zophobas subnitens*
Diptera: Asilidae: *Ospriocerus* sp.
Diptera: Asilidae: leptogastrinae: undetermined taxon
Diptera: Bombyliidae: *Bombylius major*
Diptera: Bombyliidae: *Exoprosopa* sp.
Diptera: Bombyliidae: *Epacmus* sp.
Diptera: Chamaemyiidae: undetermined taxon
Diptera: Chloropidae: *Oscinella fronto-orbitalis*
Diptera: Chloropidae: undetermined taxon
Diptera: Culicidae: *Culex coronator*
Diptera: Culicidae: *Culex tarsalis*
Diptera: Lauxaniidae: *Camptoprosopella ocellaris*
Diptera: Muscidae: *Musca domestica*
Diptera: Pipunculidae: undetermined taxon
Diptera: Stratiomyidae: *Adoxomyia regularis*
Diptera: Stratiomyidae: *Hedriodiscus currani*
Diptera: Tachinidae: *Microchaetina* sp.
Diptera: Tephritidae: *Ceroxys latiusculus*
Diptera: Tephritidae: undetermined taxon
Hemiptera: Miridae: *Lygus hesperus*
Hemiptera: Notonectidae: *Buenoa margaritacea*
Hemiptera: Pentatomidae: *Chlorochroa opuntiae*
Homoptera: Cicadellidae: *Draeculacephala minerva*
Homoptera: Membracidae: *Bajulata bajula*
Hymenoptera: Eulophidae: undetermined taxon
Hymenoptera: Formicidae: *Neivamyrmex pilosum mandibulare*
Hymenoptera: Leucospididae: undetermined taxon
Hymenoptera: Megachilidae: undetermined taxon
Hymenoptera: Mutillidae: *Acanthophotopsis* sp.
Hymenoptera: Mutillidae: *Sphaeropthalma (micromutilla)* sp.
Hymenoptera: Pompilidae: *Pepsis pallidolimbata*

Table 4-continued.

Taxa recorded only from Aguajita Wash (cont.)

Hymenoptera: Scoliidae: *Campsoscolia fammicoma*
Hymenoptera: Sphecidae: *Mellinus imperialis*
Hymenoptera: Sphecidae: *Philanthus gibbosus*
Hymenoptera: Tiphiidae: *Hadrocistis* sp.
Hymenoptera: Tiphiidae: *Paratiphia* sp.
Hymenoptera: Vespidae: *Euodynerus annulatus annulatus*
Hymenoptera: Vespidae: Eumeninae: undetermined taxon
Isoptera: Kalotermitidae: *Marginitermes hubbardi*
Isoptera: Rhinotermitidae: *Heterotermes aureus*
Isoptera: Termitidae: *Amitermes* sp.
Lepidoptera: Geometridae: *Semiothisa hypaethrata*
Lepidoptera: Geometridae: *Hydriomena* sp.
Lepidoptera: Geometridae: *Lobocleta plemyraria*
Lepidoptera: Noctuidae: *Fotella fragosa*
Lepidoptera: Noctuidae: *Heteranassa minor*
Lepidoptera: Noctuidae: *Pseudaletia unipuncta*
Lepidoptera: Noctuidae: *Tridepia nova*
Lepidoptera: Noctuidae: *Heliothis virescens*
Lepidoptera: Noctuidae: *Feltia annexa*
Lepidoptera: Nymphalidae: *Myscelia cyananthe*
Lepidoptera: Pieridae: *Appias drusilla*
Lepidoptera: Pieridae: *Ascia howarthi*
Lepidoptera: Pyralidae: *Ommatopteryx texana*
Lepidoptera: Pyralidae: Crambinae: undetermined taxon
Lepidoptera: Pyralidae: *Hellula* sp.
Lepidoptera: Pyralidae: *Mojavia achemonalis*
Lepidoptera: Pyralidae: *Noctueliopsis aridalis*
Lepidoptera: Pyralidae: *Plodia interpunctella*
Lepidoptera: Pyralidae: *Hymenia perspectalis*
Lepidoptera: Pyralidae: *Loxostege typhonalis*
Lepidoptera: Pyralidae: *Pyrausta napaealis*
Lepidoptera: Tortricidae: *Ofatulena duodecemstriata*
Odonata: Coenagrionidae: undetermined taxon
Odonata: Gomphidae: *Erpetogomphus compositus*
Odonata: Gomphidae: *Progomphus borealis*
Odonata: Libellulidae: *Orthemis ferruginea*
Odonata: Libellulidae: *Pantala flavescens*
Orthoptera: Acrididae: *Conozoa sulcifrons*
Orthoptera: Gryllidae: *Nemobius carolinus neomexicanus*
Trichoptera: undetermined taxon

Table 4-continued.

Taxa recorded only from Alamo Canyon

Scolopendromorpha: Scolopendridae: *Scolopendra heros*
Coleoptera: Alleculidae: *Isomira* sp.
Coleoptera: Buprestidae: *Acmaeodera chiricahuae*
Coleoptera: Cerambycidae: *Eburia ulkei*
Coleoptera: Cerambycidae: *Coenopoeus palmeri*
Coleoptera: Chrysomelidae: *Altica torquata*
Coleoptera: Chrysomelidae: clytrinae: undetermined taxon
Coleoptera: Cleridae: *Cymatodera fuscula*
Coleoptera: Cleridae: *Cymatodera* sp.
Coleoptera: Cleridae: *Thanasimus* sp.
Coleoptera: Cleridae: *Trichodes apachei*
Coleoptera: Cleridae: *Trichodes ornatus*
Coleoptera: Curculionidae: *Ericydeus lautus*
Coleoptera: Lagriidae: *Statira defecta*
Coleoptera: Pedilidae: undetermined taxon
Coleoptera: Rhipiphoridae: undetermined taxon
Coleoptera: Scarabaeidae: *Copris lecontei*
Coleoptera: Staphylinidae: *Homaeotarsus* sp.
Diptera: Anthomyiidae: *Scatophaga stercoraria*
Diptera: Asilidae: *Efferia argyrosoma*
Diptera: Asilidae: *Efferia spiniventris*
Diptera: Asilidae: *Leptogaster* sp.
Diptera: Bombyliidae: *Geminaria canalis*
Diptera: Bombyliidae: *Paravilla canicula*
Diptera: Bombyliidae: *Poecilanthrax effrenus*
Diptera: Syrphidae: *Volucella marginata*
Diptera: Syrphidae: *Syrphus opinator*
Homoptera: Coreidae: *Catorhintha selector*
Homoptera: Lygaeidae: *Nysius raphanus*
Homoptera: Phymatidae: *Phymata* sp.
Homoptera: Aleyrodidae: undetermined taxon
Hymenoptera: Braconidae: *Buccalatriplex bucculatricis*
Hymenoptera: Formicidae: *Paratrichina melanderi*
Hymenoptera: Formicidae: *Crematogaster arizonensis*
Hymenoptera: Gasteruptiidae: *Gasteruption* sp.
Hymenoptera: Ichneumonidae: *Barylypa apicalis*
Hymenoptera: Megachilidae: *Lithurge apicalis*
Hymenoptera: Pompilidae: *Anoplius* sp.
Hymenoptera: Pompilidae: *Episyron* sp.
Hymenoptera: Scoliidae: *Scolia* sp.
Hymenoptera: Sphecidae: *Bicyrtes viduata*

Table 4-continued.

Taxa recorded only from Alamo Canyon (cont.)
Hymenoptera: Sphecidae: *Cerceris californica*
Hymenoptera: Torymidae: *Podagrion mantis*
Hymenoptera: Vespidae: *Polistes major castaneicolor*
Lepidoptera: Geometridae: *Philtraea elegantaria*
Lepidoptera: Geometridae: *Semiothisa punctolineata*
Lepidoptera: Geometridae: synchlorini: undetermined taxon
Lepidoptera: Geometridae: *Idaea eremiata*
Lepidoptera: Geometridae: *Idaea gemmata*
Lepidoptera: Geometridae: *Idaea* sp.
Lepidoptera: Hesperiidae: *Cogia hippalus*
Lepidoptera: Hesperiidae: *Erynnis tristis*
Lepidoptera: Lasiocampidae: *Malacosoma* sp.
Lepidoptera: Lasiocampidae: *Tolype* sp.
Lepidoptera: Noctuidae: *Tripudia flavofasciata*
Lepidoptera: Noctuidae: *Tripudia luda*
Lepidoptera: Noctuidae: *Platysenta temecula*
Lepidoptera: Noctuidae: *Toxonprucha crudelis*
Lepidoptera: Noctuidae: *Hexorthodes accurate*
Lepidoptera: Noctuidae: *Ulolonche dilecta*
Lepidoptera: Nymphalidae: *Junonia coenia*
Lepidoptera: Pyralidae: epipaschinae: undetermined taxon
Lepidoptera: Pyralidae: *Heliothelopsis costipunctalis*
Lepidoptera: Pyralidae: *Jativa castanealis*
Lepidoptera: Pyralidae: *Microtheoris* sp.
Lepidoptera: Pyralidae: *Mimoschinia rufofascialis decorata*
Lepidoptera: Pyralidae: *Antigastra catalaunalis*
Lepidoptera: Pyralidae: *Diaphania quadristigmalis*
Lepidoptera: Pyralidae: *Hahncappsia jaralis*
Neuroptera: Chrysopidae: *Nodita* sp.
Odonata: Aeschnidae: *Aeschna multicolor*
Odonata: Aeschnidae: *Anax junius*
Odonata: Libellulidae: *Pseudoleon superbum*
Orthoptera: Acrididae: *Syrbula montezuma*
Orthoptera: Tettigoniidae: *Ateloplus schwarzi*

Taxa recorded only from Armenta Ranch
Araneae: Araneidae: *Metepeira* sp.
Araneae: Salticidae: *Corythalia* sp.
Solifugae: Ammotrechidae: *Branchia angustus*
Isopoda: Armadillidiidae: undetermined taxon
Coleoptera: Alleculidae: *Hymenorus spinifer*

Table 4-continued.

Taxa recorded only from Armenta Ranch (cont.)
Coleoptera: Cerambycidae: *Achryson surinamum*
Coleoptera: Cerambycidae: *Peranoplium simile*
Coleoptera: Cleridae: *Priocera* sp.
Coleoptera: Meloidae: *Linsleya suavissima*
Coleoptera: Tenebrionidae: *Aconobius laciniatus*
Coleoptera: Tenebrionidae: *Argoporis costipennis*
Coleoptera: Tenebrionidae: *Blapstinus* sp.
Coleoptera: Tenebrionidae: *Zopherodes tristis*
Diptera: Syrphidae: *Baccha* sp.
Hemiptera: Coreidae: undetermined taxon
Hemiptera: Pentatomidae: *Brochymena sulcata*
Hymenoptera: Formicidae: *Pheidole vasliti arizonica*
Hymenoptera: Formicidae: *Xiphomyrmex spinosus hispidus*
Hymenoptera: Halictidae: *Sphecodes* sp.
Hymenoptera: Ichneumonidae: *Enicospilus* sp.
Hymenoptera: Mutillidae: *Dasymutilla magna*
Hymenoptera: Mutillidae: *Dasymutilla magnifica*
Hymenoptera: Vespidae: *Euodynerus guerrero*
Hymenoptera: Vespidae: *Euodynerus* sp.
Isoptera: Kalotermitidae: *Paraneotermes simplicicomis*
Lepidoptera: Noctuidae: *Pseudaletia* sp.
Orthoptera: Gryllidae: *Nemobius* sp.
Mollusca: Succineidae: *Succinea califomica*

Taxa recorded only from Bull Pasture
Acari: Trombidiidae: *Dinothrobium magnificum*
Araneae: Salticidae: *Thiodina* sp.
Coleoptera: Buprestidae: *Acmaeodera quadrivittata*
Coleoptera: Buprestidae: *Hippomelas sphenicus*
Coleoptera: Cerambycidae: *Stenaspis solitaria*
Coleoptera: Cerambycidae: *Moneilema gigas*
Coleoptera: Cicindelidae: *Cicindela sedecimpunctata*
Coleoptera: Heteroceridae: undetermined taxon
Coleoptera: Lycidae: *Caenia amplicomis*
Coleoptera: Tenebrionidae: *Eusattus reticulatus*
Coleoptera: Tenebrionidae: *Eleodes longicollis*
Diptera: Asilidae: *Efferia anacapai*
Diptera: Asilidae: *Ospriocerus abdominalis*
Diptera: Asilidae: *Stichopogon catulus*
Diptera: Bombyliidae: *Lordotus diversus*
Diptera: Bombyliidae: *Villa curta*

Table 4-continued.

Taxa recorded only from Bull Pasture (cont.)

Diptera: Bombyliidae: *Geron albarius*
Diptera: Chloropidae: *Thaumatomyia glabra*
Diptera: Neriidae: *Odontoloxozus longicornis*
Diptera: Otitidae: *Diacrita costalis*
Diptera: Sciaridae: *Bradysia* sp.
Diptera: Stratiomyidae: *Hermetia subpellucida*
Diptera: Stratiomyidae: undetermined taxon
Diptera: Syrphidae: *Allograpta exotica*
Diptera: Syrphidae: *Mesograpta marginata*
Diptera: Syrphidae: undetermined taxon
Diptera: Tachinidae: *Archytas lateralis*
Hemiptera: Belostomatidae: *Lethocerus* sp.
Hemiptera: Coreidae: *Chelinidea vittiger*
Hemiptera: Coreidae: *Narnia femorata*
Hemiptera: Corixidae: undetermined taxon
Hemiptera: Corixidae: *Graptocorixa* sp.
Hemiptera: Gerridae: *Gerris remigis*
Hemiptera: Lygaeidae: *Lygaeus reclivatus*
Hemiptera: Lygaeidae: *Oncopeltus fasciatus*
Hemiptera: Miridae: *Taedia* sp.
Hemiptera: Notonectidae: *Buenoa arida*
Hemiptera: Pentatomidae: *Mecidea longula*
Hemiptera: Pentatomidae: *Murgantia histrionica*
Hemoptera: Cicadidae: *Tibicen* sp.
Hymenoptera: Anthophoridae: *Melissodes limbus*
Hymenoptera: Braconidae: *Chelonus cautus*
Hymenoptera: Chalcididae: *Spilochalcis* sp.
Hymenoptera: Formicidae: *Camponotus* sp.
Hymenoptera: Formicidae: Formicinae: undetermined taxon
Hymenoptera: Megachilidae: *Paranthidium* sp.
Hymenoptera: Vespidae: *Ancistrocerus neocallosus*
Hymenoptera: Vespidae: *Pachodynerus acuticarinatus*
Hymenoptera: Vespidae: *Stenodynerus ochrogonius*
Lepidoptera: Hesperiidae: *Pyrgus philetas*
Lepidoptera: Noctuidae: *Catocala* spp. 2
Lepidoptera: Noctuidae: *Toxonprucha strigalis*
Lepidoptera: Nymphalidae: *Euptoieta claudia*
Lepidoptera: Nymphalidae: *Junonia nigrosuffusa*
Lepidoptera: Pyralidae: chrysauginae: undetermined taxon
Lepidoptera: Pyralidae: *Decaturia pectinalis*
Mollusca: Physidae: *Physa virgata*

Table 4-continued.

Taxa recorded only from Bull Pasture (cont.)
Neuroptera: Ascalaphidae: *Neuroptynx furliger*
Orthoptera: Acrididae: *Acantherus piperatus*
Orthoptera: Acrididae: *Mermiria bivattata*
Orthoptera: Acrididae: *Opeia obscura*
Orthoptera: Romaleidae: *Taeniopoda eques*
Orthoptera: Tettigoniidae: *Eremopedes* sp.

Taxa recorded only from Burn Site
Diptera: Bombyliidae: *Paravilla* sp.
Diptera: Culicidae: *Psorophora coluinbiae*
Orthoptera: Acrididae: *Conozoa carinata*

Taxa recorded only from Dos Lomitas
Hymenoptera: Anthophoridae: *Diadasia diminuta*
Hymenoptera: Anthophoridae: *Diadasia lutzi*
Hymenoptera: Megachilidae: *Chalicodoma* sp.
Hymenoptera: Sphecidae: *Ammophila femurrubra*

Taxa recorded only from Dripping Springs
Acari: Ixodidae: undetermined taxon
Araneae: Salticidae: *Metacyrba* sp.
Spirobolida: undetermined taxon
Coleoptera: Buprestidae: *Acmaeodera parkeri*
Coleoptera: Cantharidae: undetermined taxon
Coleoptera: Cleridae: undetermined taxon
Coleoptera: Cleridae: *Cymatodera peninsularis*
Coleoptera: Lampyridae: *Microphotus dilatatus*
Diptera: Bombyliidae: *Heterostylum novum*
Diptera: Bombyliidae: *Paravilla emulata*
Diptera: Bombyliidae: *Aphoebantus* sp. 1
Diptera: Bombyliidae: *Phthiria* sp.
Diptera: Culicidae: *Aedes* sp.
Hemiptera: Lygaeidae: *Ligyrocoris* sp.
Hemiptera: Miridae: *Parthenicus aureosquamis*
Hemiptera: Miridae: *Atmoscelis modestus*
Hemiptera: Pentatomidae: *Podisus acutissimus*
Hemiptera: Reduviidae: *Triatoma recurva*
Homoptera: Cicadellidae: *Acinopterus* sp.
Hymenoptera: Formicidae: *Pogonomyrmex barbatus*
Hymenoptera: Ichneumonidae: *Trachysphyrus relativus nitschei*
Hymenoptera: Megachilidae: *Dianthidium* sp.

Table 4-continued.

Taxa recorded only from Dripping Springs (cont.)
Hymenoptera: Megachilidae: *Osmia* sp.
Hymenoptera: Sphecidae: *Ammophila californica*
Hymenoptera: Vespidae: *Leptochilus acolhuus*
Lepidoptera: Geometridae: *Stenoporpia,pulchella*
Lepidoptera: Geometridae: *Protoproutia rusticaria*
Lepidoptera: Noctuidae: *Cobubatha* sp.
Lepidoptera: Noctuidae: *Oncocnemis rosea*
Lepidoptera: Noctuidae: *Oxycnemis advena*
Lepidoptera: Noctuidae: *Grotella blanca*
Lepidoptera: Noctuidae: *Grotella tricolor*
Lepidoptera: Pyralidae: *Cymbopteryx fuvcimarginalis*
Lepidoptera: Pyralidae: *Mimoschinia rufofascialis novalis*
Lepidoptera: Papilionidae: *Papilio polyxenes*
Lepidoptera: Pyralidae: *Mutuuraia mysippusalis*
Orthoptera: Gryllidae: *Miogryllus lineatus*

Taxa recorded only from Dirt Tank
Coleoptera: Hydrophilidae: *Berosus* sp.
Coleoptera: Hydrophilidae: *Tropisternus lateralis*
Hemiptera: Belostomatidae: *Belostoma flumineum*
Hemiptera: Nepidae: *Ranatra quadridenxata*
Odonata: Libellulidae: *Perithemis intensa*
Mollusca: Planorbidae: *Heliosoma (pierosoma) tenue*

Taxa recorded only from east of Armenta
Coleoptera: Elateridae: *Melanotus longulus*
Coleoptera: Salpingidae: *Trimitromerus riversi*
Coleoptera: Scarabaeidae: *Phyllophaga* spp. 2
Homoptera: Cicadidae: *Diceroprocta semicincta*
Homoptera: Membracidae: *Stictopelta arizona*
Neuroptera: Myrmeleontidae: *Dendroleon* sp.

Taxa recorded only from Growler Canyon
Araneae: Lycosidae: *Pirata* sp.
Coleoptera: Cerambycidae: *Peranoplium* sp.
Coleoptera: Chrysomelidae: *Pachybrachys marmoratus*
Coleoptera: Chrysomelidae: *Pachybrachys xanti*
Coleoptera: Meloidae: *Tegrodera erosa aloga*
Coleoptera: Oedemeridae: *Oxacis nitidicollis*
Coleoptera: Scarabaeidae: *Phyllophaga* spp. 3
Coleoptera: Tenebrionidae: *Philolithus actuosus*

Table 4-continued.

Taxa recorded only from Growler Canyon (cont.)
Hemiptera: Miridae: *Lopidea eremita*
Hymenoptera: Formicidae: *Dorymyrmex pyramicus bicolor*
Lepidoptera: Geometridae: *Chlorochlamys phyllinaria*
Lepidoptera: Noctuidae: *Melipotis novanda*
Lepidoptera: Sphingidae: *Erinnyis obscura*
Lepidoptera: Yponomeutidae: *Atteva punctella*
Neuroptera: Myrmeleontidae: *Hesperoleon hubbardi*
Orthoptera: Acrididae: *Derotmema delicatulum*
Orthoptera: Acrididae: *Lactista aztecus*

Taxa recorded only from Lost Cabin Mine
Diptera: Asilidae: *Efferia tricella*
Hymenoptera: Formicidae: *Forelius foetida*

Taxa recorded only from Neolloydia
Araneae: Antrodiaetidae: *Antrodiaetus* sp.
Araneae: Lycosidae: *Lycosa* sp.
Araneae: Salticidae: *Pellenes* sp.
Araneae: Salticidae: *Phiddipus* sp.
Opiliones: Phalangiidae: undetermined taxon
Solifugae: Eremobatidae: undetermined taxon
Coleoptera: Carabidae: *Schizogenius* sp.
Diptera: Asilidae: *Efferia coquilletti*
Diptera: Conopidae: *Dalmannia pitta*
Hemiptera: Miridae: *Phytocoris stitti*
Hemiptera: Reduviidae: *Stenolemoides arizonensis*
Hymenoptera: Formicidae: *Camponotus vicinus*
Hymenoptera: Halictidae: *Dufourea vandykei*
Hymenoptera: Halictidae: *Lasioglossum sisymbrii*
Hymenoptera: Sphngdae: *Podalonia argentipilis*
Hymenoptera: Vespidae: *Pseudomasaris maculifrons*
Lepidoptera: Blastobasidae: undetermined taxon
Lepidoptera: Coleophoridae: undetermined taxon
Lepidoptera: Pyralidae: *Noctueliopsis bububattalis*

Taxa recorded only from Pozo
Nuevo Coleoptera: Carabidae: *Calosoma peregrinator*
Coleoptera: Cerambycidae: *Peritapnia fabra*
Coleoptera: Hydrophilidae: *Hydrophilus triangularis*
Coleoptera: Scarabaeidae: Aphodiinae: undetermined taxon
Hemiptera: Reduviidae: *Rasahus biguttatus*

Table 4-continued.

Taxa recorded only from Pozo Nuevo (cont.)
Hymenoptera: Pompilidae: *Cryptocheilus severini*
Lepidoptera: Arctiidae: *Euchaetias perlevis*
Lepidoptera: Noctuidae: *Conochares* sp.
Lepidoptera: Noctuidae: *Timora toralis*

Taxa recorded only from Salsola
Araneae: Araneidae: undetermined taxon
Coleoptera: Carabidae: *Bembidion* sp.
Diptera: Asilidae: *Efferia bicaudata*
Hemiptera: Alydidae: *Alydus* sp.
Hemiptera: Berytidae: *Aknisus multispinus*
Hemiptera: Reduviidae: *Zelus renardii*
Hymenoptera: Halictidae: *Nomia nevadensis arizonensis*
Orthoptera: Acrididae: *Derotmema laticinctum*

Taxa recorded only from Senita Basin
Coleoptera: Bostrichidae: *Prostephanus apax*
Coleoptera: Carabidae: *Bembidion nubiculosum*
Coleoptera: Carabidae: *Calosoma prominens*
Coleoptera: Carabidae: *Tachys* sp.
Coleoptera: Cerambycidae: *Acanthodes peninsularis*
Coleoptera: Cleridae: *Cymatodera sobara*
Coleoptera: Coccinellidae: *Chilocorus stigma*
Coleoptera: Dascillidae: *Anorus parvicollis*
Coleoptera: Melandryidae: *Anaspis* sp.
Coleoptera: Meloidae: *Epicauta brunnea*
Coleoptera: Staphylinidae: *Apocellus sphaericollis*
Coleoptera: Tenebrionidae: *Asbolus mexicanus*
Coleoptera: Tenebrionidae: *Stenomorpha convexa*
Dermaptera: Labiduridae: *Labidura riparia*
Diptera: Sarcophagidae: *Senotainia* sp.
Diptera: Syrphidae: *Baccha lemur*
Diptera: Therevidae: *Brachylinga* sp.
Hemiptera: Miridae: *Phytocoris squamosus*
Hemiptera: Miridae: *Parthenicus* sp.
Homoptera: Cicadellidae: *Norvellina pulchella*
Homoptera: Flatidae: *Mistharnophantia sonorana*
Hymenoptera: Braconidae: *Apanteles* sp.
Hymenoptera: Formicidae: *Neivamyrmex nigrescens*
Hymenoptera: Formicidae: *Camponotus fumidus festinatus*
Hymenoptera: Mutillidae: *Dasymutilla klugii*

Table 4--continued.

Taxa recorded only from Senita Basin (cont.)
Hymenoptera: Mutillidae: *Sphaeropthalma* (*photopsis)* sp.
Lepidoptera: Geometridae: *Semiothisa s-signata*
Lepidoptera: Geometridae: *Stenoporpia* sp.
Lepidoptera: Noctuidae: *Abagrotis* sp.
Lepidoptera: Noctuidae: *Euxoa segregata*
Lepidoptera: Pyralidae: *Melitara prodenialis*
Lepidoptera: Pyralidae: *Scoparia* sp.
Lepidoptera: Sphingidae: *Erinnyis ello*
Lepidoptera: Sphingidae: *Manduca rustica*
Neuroptera: Chrysopidae: *Meleoma* sp.
Neuroptera: Myrmeleontidae: *Hesperoleon* sp.

Taxa recorded only from Vulture
Coleoptera: Buprestidae: *Acmaeodera gibbula*
Coleoptera: Curculionidae: *Ophryastes* sp.
Hymenoptera: Anthophoridae: *Anthophora forbesi*
Hymenoptera: Halictidae: *Agapostemon* sp.
Hymenoptera: Megachilidae: *Megachile parallela*
Hymenoptera: Vespidae: *Leptochilus periallis*

Taxonomic Accounts

In this section, results of our collections and observations are presented for each taxon. More than 5,000 records are condensed and included here. A taxon is defined, for our purposes, as the lowest level to which we were able to identify an organism. In many cases, this level is species. In a very few cases, the level was order. The nomenclature of the higher groups (orders, families, subfamilies, and genera) generally follows Arnett (1985) for insects, Roth (1985) for spiders, Borror et al. (1981) for other arthropods, and Bequaert and Miller (1973) for mollusks. Determination and nomenclature at the specific (and in a few cases subspecific) level is based on the use of monographs on the taxa, consultation with experts, and comparison of our specimens to identified specimens in the collection of The University of Arizona Entomology Department. Identification was generally done conservatively. That is, identification was stopped at the level at which we could be fairly certain of being correct, using our best judgement and the resources available to us (including time). For the most part, dissection and microscopic examination of genitalia and other body parts, often necessary for species determination of some groups of invertebrates, was not done.

For convenience, the taxa are listed in alphabetical, rather than taxonomic, order. Within the list, classes, orders, and families are in capital letters and boldface. Subfamilies are in capitals, and genera and species are in lower case with the first letter of the genus name capitalized. Genus and species names are in italics. When the species has been determined, the name of the author or first describer of the species follows the specific epithet. When an author's name appears in parentheses, it means that the original description had the species assigned to another genus and revisionary work has reassigned it. Common names appear in (parentheses) after the author's name, when either an official common name has been assigned (Stoetzel 1989), or the insect is a butterfly given a common name in Tilden and Smith (1986). Other common names appear in "quotation marks," and should not be considered official. Advances are continuously being made in invertebrate taxonomy and identification, so names change with some frequency.

Many specimens were not identified to the genus and species level. This means only that we were unable to identify them, for any one of a number of reasons. Identification is a complex science, even an art. Specialists on particular groups may not be able to readily identify all specimens in that group. Lack of a name in this list does not mean that the specimen represents an undescribed species, although such may be possible. Where we have identified a specimen to genus but not to species, the genus name is followed by the abbreviation "sp.". In some cases, it was evident that we had specimens representing; more than 1 species of a genus, but we could not positively identify them to species. Then the lowest level to which we could identify them is given, followed by "sp." and a number (l, 2, 3, etc.).

Unless otherwise stated, at least 1 specimen was collected for each taxon. A collection of more than 4,200 specimens is deposited with OPCNM. Arrangement of pinned specimens follows that of this list, alphabetical by taxon. However, some specimens are preserved in alcohol, and are not arranged alphabetically by taxon. Computer disk files, using a dBase III+ format, have been submitted to monument staff. These disks contain all of the information in the catalog and all of the information needed to print catalog cards.

Information on distribution of taxa within OPCNM is included in this section. Sites at which taxa were recorded are listed by a 2-letter code followed by dates on which the taxa was recorded at that site. The site codes are:

AC: Arch Canyon
AG: Aguajita Wash
AL: Alamo Canyon
AR: Armenta Ranch
BP: Bull Pasture
BU: Burn Site
DO: Dos Lomitas
DR: Dripping Springs
DT: Dirt Tank, 0.8 km E of Armenta Ranch
EA: East of Armenta
GC: Growler Canyon
LO: Lost Cabin mine
NE: Neolloydia
PO: Pozo Nuevo
SA: Salsola
SE: Senita Basin
VU: Vulture

Phylum: Arthropoda
Class: Arachnida
Order: Acari (Mites and Ticks)
Family: Ixodidae (Ticks)
Undetermined species. One specimen found on ground, DR 3/12/89. Ticks are probably quite plentiful as parasites of vertebrates, but it would require a separate, extensive study to gather data on them.

Family: Trombidiidae (Mites, Velvet Mites)
Dinothrobium magnificum (Leconte). Common to abundant in patches after summer rains. This large red "velvet mite" may be active for only a few hours each year, and not every year. It emerges from underground on mornings following rain when winged termites are flying (Tevis and Newell 1962). Eats winged termites that have fallen to the ground or are emerging. Two specimens, both from BP 7/23/88. Found in Arizona, New Mexico, and Texas (Essig 1958).

Dinothrombium superbum (Banks). Probably less common than *D. magnificum.* Little is known of its biology, but it is probably similar to *D. magnificum.* Characterized by white markings on body. One specimen at AC 7/29/89. Observed at AR. 7/23/88. Found in Arizona, New Mexico, and Texas (Essig 1958).

Order: Araneae (Spiders)
Family: Agelenidae (Grass and Funnel-Web Spiders)
Agelenopsis sp. Common to abundant funnel-web spider, with conspicuous webs on ground, often under shrubs. Probably found throughout the monument, although recorded only from AR, EA, DO, GC, LO, SA, SE, and VU. Identification to genus is tentative, based on web structure. There may be several genera and species of related spiders present. No specimens-very difficult to collect. Genus widespread, with 14 species (Roth 1985).

Family: Antrodiaetidae (Folding Trapdoor Spiders)
Antrodiaetus sp. *A* burrowing spider that lives in a well-hidden burrow with a trap-door. May wander after rains or when burrow is disturbed. One specimen, NE 11/21/87, an immature. There are 11 species in the genus, widespread in North America (Roth 1985).

Family: Araneidae (Orb-weavers)
Undetermined subfamily. One specimen, from SA 10/09/88, an immature.

Subfamily: Araneinae (Typical Orb Weavers)
Metepeira sp. Probably more common than our 1 specimen would indicate. One specimen, AR 11/21/87 from web in mesquite. There are 9 species described from this genus which is distributed from southern Canada and throughout the United States (Roth 1985)

Neoscona arabesca (Walckenaer). Common to abundant under right conditions. Colorful, conspicuous large spider in large web. Seen throughout the monument in September 1990.

Specimens from AC 10/17/87. Found throughout the United States (Kaston 1972). There may be other spiders that superficially resemble this one, but we have no specimens.

Family: Diguetidae (Diguetid Six-eyed Spiders)
Diguetia sp. Common to abundant spider, usually builds webs in creosote bush with a conspicuous retreat in which the spider spends most of its time. There are 6 species in the genus, which are distributed throughout the southwestern United States (Roth 1985). Collected specimens from: AR 11/21/87 and PO 8/18/89. Observed throughout the monument.

Family: Lycosidae (Wolf or Ground Spiders)
Common to abundant spiders, of which there may be several genera and species. Some make holes in the ground and build little turrets above the holes. The family has 15 genera and 234 described species (Roth 1985). Identification is based on minute genitalic structure and is a job for experts only.

Lycosa sp. One specimen, believed to be of this genus, NE 1/28/89, an immature. Holes believed to have been made by *Lycosa carolinensis* Walkenauer, based on descriptions in Shook (1978), were observed throughout the monument. Widespread (Roth 1985).

Pirata sp. Distribution and abundance in monument unknown, but probably more common than our 1 specimen, from GC 11/21/87 would indicate. A widespread genus, with 27 species (Roth 1985). A hunting spider, without a permanent home.

Family: Salticidae (Jumping Spiders)
There are probably several to many more genera and species present in the monument than we have found. These are generally small, often cryptic, fast-moving jumping spiders that easily evade observation and capture. The family contains 45 or 46 genera and 288 species in North America. Those collected were:

Corythalia sp. One specimen, AR 11/21/87. This genus is distributed in the southern United States and has 3 species (Roth 1985).

Metacyrba sp. One specimen, DR 11/21/87.

Pellenes (Habronattus) sp. One specimen, NE 3/5/88. This is a widespread genus with 62 species, 20 undescribed (Roth 1985).

Phiddipus sp. One specimen, NE 3/13/89. This is a widespread genus with at least 39 species and 20 undescribed (Roth 1985).

Thiodina sp. One specimen, BP 7/23/88. This species has apparently not been described (Roth 1985) but is distributed in California and Arizona.

Family: Theraphosidae (Tarantulas)
Aphonopelma sp. Common tarantula found throughout the monument. Not collected. This genus has 26 species, found in the southwestern United States (Roth 1985). Individuals may live up to 35 years (Kaston 1972). It is possible that more than 1 species occurs in the monument. Also reported by Hall et al. (1988) from AL.

Family: Theridiidae (Comb-footed Spiders)
Latrodectus hesperus "Black Widow." A common spider in sheltered locations throughout the monument. Most often observed in small caves along washes, in old rodent burrows, or in woodrat nests. Not collected. Venomous and potentially dangerous to people, it is difficult to get bit by one (Smith 1982). Distributed throughout the western United States (Kaston 1972).

Family: Thomisidae (Crab Spiders)
There are probably several more genera and species than we have collected. Typically, crab spiders hide in flowers and catch insects that come for nectar or pollen. The family has 10 genera and 128 species in North America (Roth 1985).

Coriarachne sp. One specimen, AC 1/29/89. A widespread genus with 4 species.

Order: Opiliones (Harvestmen)
Family: Phalangidae (Daddy-longlegs)
Undetermined species. One specimen, NE 3/5/88. Approximately 150 species of daddylonglegs occur in North America. Most are predacious or scavengers (Borror et al. 1981). I have found them in woodrat nests and rodent burrows in other Sonoran desert locations, but our records from OPCNM are insufficient to say anything about them.

Order: Scorpiones (Scorpions)
Positive identification of scorpion species is difficult because there are no adequate keys available, to my knowledge. All 3 taxa found are probably distributed throughout the monument. Scorpions spend most of the time hiding and are seldom active above ground (Crawford 1981), so they may be much more common than our records indicate. All can sting if molested, but only *Centruroides sculpturatus* is likely to be dangerous to people. All prey upon insects and other small creatures. All of our species are native North Americans, with distributions in Arizona and other southwestern states.

Family: Buthidae
Centruroides sculpturatus Ewing. Two specimens and made an observation: AL 4/9/88; DR 11/21/87; SE 10/10/88.

Family: Vejovidae
Hadrurus sp. "Giant Hairy Scorpion," probably *H. arizonensis* Ewing, but needs confirmation. Probably found throughout the monument. Records from: AR 5/27/89; GC 4/08/89; SE 10/30/87 (specimen), 10/9/88, 8/19/89.

Vejovis sp. "Striped-tailed Scorpion," probably V. *spinigeris* (Wood), but needs confirmation. Probably found throughout the monument. Records from: AR 2/27/88, 5/27/89; DR 11/21/87 (specimen); GC 4/8/89; LO 10/30/87 (specimen); NE 11/21/87 (specimen); SE 10/30/87 (specimen), 10/31/87 (specimen), 10/9/88, 8/18/89. Also reported by Hall et al. (1988) from AL.

Order: Solifugae (Windscorpions, Sunspiders, Solpugids)
These are generally secretive, cursorial predators on insects. Most often they are found under rocks in the daytime or running about at night. They are ferocious in appearance and can bite if handled,

but are not venomous. The order is worldwide in distribution. A total of 156 species are known from North America and Central America (Muma 1970). There are probably several species present in the monument that we have not recorded.

Family: Ammotrechidae
Subfamily: Saronominae
Branchia angustus Muma. Distributed in Arizona and California. One specimen, AR 11/21/87.

Family: Eremobatidae
Undetermined species. A juvenile collected at NE 1/28/89.

Class: Chilopoda
Order: Scolopendomorpha (Tropical Centipedes)
There may be several species present in the monument. They are probably found throughout the monument, in all habitats. Good taxonomic keys are not known to me. All species are venomous, but are not dangerous to people (Smith 1982). They are predacious on insects, and spend most of the time in hiding. Most often, they are found under rocks, but occasionally may be found wandering about, even in daylight.

Family: Scolopendridae
Undetermined species, probably juveniles, specimens from SA 10/31/87; SE 10/31/87; DR 11/21/87; NE 11/21/87, 1/28/89.

Scolopendra heros "Giant Desert Centipede." Observed in AL, 9/11/88. Probably distributed throughout the monument. Also reported by Hall et al. (1988) from AL.

Class: Crustacea
Order: Isopoda
Family: Armadillidiidae (Pillbugs)
Undetermined species, specimens from AR 2/28/88 from beneath bark of a dead mesquite tree. Probably cosmopolitan in distribution. Feed on fungus in moist locations.

Order: Concostraca
Family: Limnadiidae
Eulimnadia texana Packard "clam shrimp." One specimen, BP 9/10/88, observed at AC 7/10/90. Clam shrimp remain as dry eggs until flooded with water at the right temperature and oxygen tension, then hatch and live brief lives in puddles. Probably widespread in the monument, in rock pools and temporary ponds.

Class: Diplopoda (Millipedes)
Order: Spirobolida
Undetermined species. One specimen, DR 11/21/87.

Order: Spirostreptida
Family: Spirostreptidae
Orthoporus omatus (Girard). Abundant large millipede, found throughout the monument and the southwestern United States, only active during the summer rainy season and most active during or immediately following rainstorms. Observed eating lichens and seedlings, recorded (Crawford 1981) as also consuming detritus and bark. May live for 10 years or more (Crawford 1981). Recorded from: AC 7/29/89; BP 7/23/88, 7/10/90; PO 7/11/90 (specimen); SE 8/18/89,7/10/90. Also reported by Hall et al. (1988) from AL.

Class: Insecta (= Hexapoda) (Insects)
Order: Coleoptera (Beetles)
Family: Alleculidae (Comb-clawed Bark Beetles)
There are 18 genera and 185 species in North America (Arnett 1985). Adults are found on flowers and come to lights at night, adults and larvae are found under bark, in plant litter, and in fungi (Arnett 1985).

Subfamily: Alleculinae
Hymenorus sp. There are 100 species which have been described in this genus (Arnett 1985). There may be several species that have only been identified to this genus in our collection. Specimens were collected at: AL 4/9/88, 7/23/88; AG 8/26/89, 5/5/90; BP 4/29/89; DR 8/27/88; GC 9/10/88; PO 7/11/90; SE 4/19/88,10/9/88.

Hymenorus spinifer Horn. One specimen, from AR 4/14/90. Some or all of the specimens identified as *Hymenorus* sp. may be this species.

Isomira sp. There are 16 species known from North America (Arnett 1985). More than 1 species may be present in the monument. Specimens were collected at AL 4/9/88, at light.

Family: Anobiidae (Drug Store and Death Watch Beetles)
Larvae bore into bark and wood. Adults came to lights, where all of our specimens were collected. There are 53 genera and 299 species in North America (Arnett 1985).

Subfamily: Dorcatominae
Tricorynus sp. There are 82 species known from North America (Arnett 1985). Specimens were collected at AL 4/9/88; BP 3/24/90.

Family: Anthicidae (Ant-like Flower Beetles)
Adults feed in flowers, larvae are found in decaying vegetation. There are 157 species in 17 genera in North America (Arnett 1985).

Undetermined specimens were collected in *Datura* flowers at AG 10/9/88 and GC 9/10/88. Other species (*Ischyropalpus* sp.) reported by Hall et al. (1988) from AL.

Family: Bostrichidae (Horned Powder-post Beetles)
Larvae bore in wood, especially twigs. Adults are attracted to lights, and may be found under bark or on dead branches of trees. There are 64 species found in North America (Arnett 1985). Other species not listed here were reported by Hall et al. (1988) from AL.

Undetermined taxa: specimens collected at lights at BP 10/17/87 and SE 10/30/87, 4/13/90 were not identified beyond family.

Subfamily: Bostrichidae
Amphicerus cornutus (Pallas) powderpost bostrichid. This species is an occasional pest, burrowing in wood products and causing some damage. It is distributed throughout the southern United States (Arnett 1985). Specimens were collected at lights at AL 8/25/90 and PO 7/11/90, 9/10/90.

Amphicerus sp. Specimens identified only to genus were collected at AG 10/8/88 and PO 7/11/90, at lights.

Apatides fortis (LeConte). Specimens from EA 7/23/88; SE 9,19/90.

Subfamily: Dinoderinae
Prostephanus apax Lesne. One specimen, SE 10/30/87, at light.

Family: Bruchidae (Pea and Bean Weevils)
Small beetles, the larvae develop in seeds, usually those of legumes. Adults sometimes come to lights, and may occasionally be found in flowers. There are 20 genera and 134 described species in the United States (Arnett 1985).

Undetermined species. Two specimens, 1 from AG 10/8/88, 1 from AL 4/9/88.

Subfamily: Bruchinae
Mimosestes amicus (Horn). Larvae of a closely related species develop in seeds of *Cercidium microphyllum* (McAuliffe 1990), and I suspect that this species does also. Species probably also infests seeds of other legumes such as *Prosopis* and *Acacia.* Adults were found in flowers of *Opuntia phaeacantha* and *Vauquelinia californica.* Collected at AG 11/22/87, 5/5/90; AL 4/9/88, 5/5/90; BP 7/23/88; EA 7/23/88; GC 9/10/88, 10/10/88. Also reported by Hall et al. (1988) from AL.

Stator limbatus (Horn). Collected at light, AG 8/28/88; GC 10/10/88. Also reported by Hall et al. (1988) from AL. Found by McAuliffe (1990) emerging from seeds of *Cercidium microphyllum,* this species also probably infests seeds of other legumes.

Family: Buprestidae (Metallic Wood-boring Beetles)
There are 40 genera with 675 species of these usually colorful and conspicuous beetles described from the United States and Canada (Arnett 1985). Larvae bore in wood or stems of plants, often dead and decaying trunks and roots of trees. Adults feed on flowers or foliage. Other species not listed here were reported by Hall et al. (1988) from AL.

Subfamily: Acmaeoderinae
Acmaeodera chiricahuae Barr. Adults found on flowers of *Gymnosperma glutinosum,* AL 8/26/89.

Acmaeodera cuneata Fall. Adults found on flowers of Erigeron *divergens, Eriogonum fasciculatum,* and *Opuntia phaeacantha.* AL 4/9/88, 5/5/90; BP 3/24/90.

Acmaeodera gibbula LeConte. Adults found at *Bebbia juncea, VU 10/10/88.*

Acmaeodera parkeri Cazier. Adult found on *Lycium* sp., DR 8/27,188.

Acmaeodera quadrivittata Horn. Adult found in flower of *Ferocactus covillei,* BP 7/23/88.

Subfamily: Buprestinae
Agaeocera scintillans Waterh. Adults collected at lights, AL *7/30/89;* DR 8/27/88.

Chrysobothris octocola LeConte. Adults collected at flowers of *Acacia greggii* and *Cercidium microphyllum.* LO *4/20/88;* NE 11/21/87.

Hippomelas sphenicus LeConte. Adult collected at light, BP 10/17/87.

Family: Cantharidae (Soldier Beetles)
Adults feed at flowers and may be attracted to lights. Larvae are found under bark and in plant litter and are predacious. There are *20* genera and 468 described species in the United States and Canada.

Undetermined species. A single individual, at light, DR 8/27/88.

Subfamily: Chauliognathinae
Chauliognathus obscurus Schaeffer. Adults were found at flowers of *Acacia constricta* or at lights. AL 10/18/87, 8/26/89*;* BP 9/10/88. Also reported by Hall et al. (1988) from AL.

Family: Carabidae (Ground Beetles)
A very large family of beetles, most of which are cursorial predators on other insects. Most are very difficult to identify to species. There are 168 genera and 2,271 species described from the United States and Canada (Arnett 1985).

Undetermined taxa. There were 2 or 3 taxa which could not be identified beyond family. Individuals collected at AC 7/23/88 and BP 10/17/87.

Subfamily: Carabinae
Agonum sp. Individuals, probably all of 1 species, collected at AL 7/29/89; BP 10/17/87; DR 8/27/88. The genus has 115 U.S. species (Arnett *1985).*

Amara sp. Individuals, probably all of 1 species, collected at AC 7/23/88 and PO 7/11/90, all at light. There are 132 described species in the United States and Canada (Arnett 1985). Also reported by Hall et al. (1988) from AL.

Bembidion flavopictum Mots. Individuals found at lights, AC 7/23/88; SE 10/30/87.

Bembidion nubiculosum Chd. Collected l individual at light, SE 10/30/87.

Bembidion sp. Collected 1 individual at light, SA 10/31/87. The genus has 255 species in the United States and Canada (Arnett 1985).

Calosoma (Camegonia) prominens LeConte. One specimen at light, SE 9/9/90.

Calosoma (Cameoula) peregrinator G.-M. One specimen at light, PO 9/10/90.

Chlaenius sp. One specimen at light, AC 8/26/90. There are 50 species described for this genus in the United States and Canada (Arnett 1985).

Colliuris pennsylvanica (L.). Collected at lights. AC 7/23/88; AG 8/26/89; AL 7/29/89. Also reported by Hall et al. (1988) from AL.

Lebia sp. Collected at lights: AC 9/30/89; AL 4/9/88, 7/29/89; BP 4/29/89, 3/24/90; DR 3/11/89; GC 4/8/89; NE 3/5/88; SE 10/9/88, 4/13/90, 9/9/90. Probably all the same species. There are 51 species described for this genus in the United States and Canada (Arnett 1985). *L. arizonica* Shaeffer was reported by Hall et al. (1988) from AL.

Pasimachus californicus Chd. Two specimens, both at lights, AC 7/23/88; AL 7/30/89.

Pinacodera punctigera (LeConte). Collected at light, AC 7/23/88. Also reported by Hall et al. (1988) from AL.

Pterostichus sp. One specimen collected at light, AC 7/23/88. There are 234 species described for this genus in the United States and Canada (Arnett 1985). *P. arizonicus* Schaeffer was reported by Hall et al. (1988) from AL.

Schizogenius sp. One specimen collected at light, NE 3/5/88. There are 24 species described for this genus in the United States and Canada (Arnett 1985).

Tachys sp. One specimen, SE 10/30/87. There are 12 species described for this genus in the United States and Canada (Arnett 1985).

Tetragonoderus fasciatus Haldeman. Collected at lights, AC 7/23/88; AG 8/26/89, 5/5/90; AL 7/29/89. Also reported by Hall et al. (1988) from AL.

Subfamily: Paussinae
Goniotropis parca LeConte. Collected 1 specimen at light, AG 8/26/89.

Family: Cerambycidae (Long-horned Beetles)
Generally our species are fairly large beetles, with a distinctive shape and long antennae. Adults feed on wood, roots, leaves, pollen, and some are predacious on other insects (Arnett 1985). Larvae are

wood, bark, or stem borers. This is a large, worldwide family. There are 303 genera and 956 species described for the United States and Canada (Arnett 1985). Other species not listed here were reported by Hall et al. (1988) from AL.

Subfamily: Cerambycinae
Achryson surinamum (L.). This species is found primarily in the southeastern United States (Arnett 1985). Collected 1 specimen at light, AR 4/14/90.

Aneflomorpha sp. There are 20 species described for this genus in the United States and Canada (Arnett 1985). Specimens, probably all of 1 species, were collected at lights, AC 7/23/88; AL 7/29/89; PO 7/11/90. Also reported by Hall et al. (1988) from AL.

Aneflus calvatus Horn. Collected at lights, AC 8/25/90; SE 9/9/90.

Anelaphus brevidens (Schaeffer). Collected at lights, BP 4/29/89; SE 4/13/90.

Anelaphus submoestus Linsley. Collected at lights, AL 7/28/90; EA 7/23/88; PO 7/11/90.

Anoplocurius canotiae Fisher. Collected at lights, AC 7/23/88; A.G 8/26/89; AL 7/28/90; EA 7/23/88.

Dendrobias mandibularis Audinet-Serville. Collected while feeding at *Baccharis sarothroides* and at fruit of *Opuntia phaeacantha.* DR 8/27/88; GC 11/22/87.

Eburia ulkei Bland. Collected 1 specimen at light, AL 7/29/89.

Enaphalodes seminitidus (Horn). Collected 1 specimen at light, AG 8/26/89.

Peranoplium simile (Schaeffer). Collected 1 specimen at light, AR 4/14/90.

Peranoplium sp. Collected 2 specimens at light, GC 4/8/89. May be *P. simile,* but cannot be determined with certainty. There are 5 species described for this genus in California and Arizona (Arnett 1985).

Stenalaphus alienus (LeConte). Collected 1 specimen at light, AC 7/23/88. Also reported by Hall et al. (1988) from AL.

Stenaspis solitaria (Say). Collected 1 specimen on flowers of *Cercidium microphyllum* at BP 9/10/88.

Taranomis bivittata cylindricollis Casey. Collected feeding at flowers of *Baccharis sarothroides* and at lights. AG 10/8/88; AL 10/18/87.

Undetermined genera. Several specimens could not be identified beyond subfamily. They appear to be of at least 4 different species. All were collected at lights.

Subfamily: Lamiinae
Coenopoeus palmeri (LeConte). Collected 1 specimen at light, AL 7/29/89.

Moneilema gigas LeConte. Occasionally seen feeding on chollas and prickly pears. Larvae bore into cacti, which may be killed or injured. Specimens collected on *Opuntia versicolor,* BP 10/17/87, 4/29/89, 3/24/90. Also reported by Hall et al. (1988) from AL.

Oncideres rhodosticta Bates. Adults chew "girdles" (circles around twigs and limbs) on mesquite, killing the portion of the tree beyond the girdle. Eggs are laid under the bark of the section that will die, and larvae feed on the wood. Probably more common than our 2 specimens would indicate. Collected 2 specimens at light, AC 9/30/89.

Peritapnia fabra Horn. Collected at light, PO 7/11/90.

Subfamily: Lepturinae
Acanthodes peninsularis Horn. Collected at light, SE 9/9/90.

Subfamily: Prioninae
Derobrachus forreri Bates. This large brown beetle is the smaller of the 2 species often called "palo verde beetle." Adults probably do not feed. Information is uncertain, but the biology of this species is probably similar to that of its congener *D. geminatus.* Adults come to lights. Specimens: AC 7/23/88; AL 7/28/90; GC 10/10/88.

Derobrachus geminatus LeConte. This large brown beetle is the larger of the 2 species often called "palo verde beetle." Adults probably do not feed. Eggs are laid in soil at base of trees, usually palo verdes. Larvae eat tree roots and may take several years to mature. Adults come to lights. Specimens: AC 7/23/88; AL 7/28/90; EA 7/23/88. Also reported by Hall et al. (1988) from AL.

Stenodontes lobigenis (Bates). Collected 1 specimen at light, AG 8/26/89.

Family: Chrysomelidae (Leaf Beetles)
A large family of small beetles, with 188 genera and 1,481 species in the United States and Canada (Arnett 1985). Larvae and adults feed on leaves, stems, and roots. Many species feed on only 1 host plant. Adults may come to lights. Other species, not listed here, were reported by Hall et al. (1988) from AL.

Subfamily: Alticinae
Altica torquata LeConte. Collected 1 specimen at light, AL 4/9/88.

Disonycha tenuicomis Horn. Collected 1 specimen on *Vaquelinia califomica,* AC 7/23/88.

Phyllotreta sp. Collected at lights, AC 7/23/88; AG 11/22/87. There are 38 species described for this genus in the United States and Canada (Arnett 1985).

Undetermined taxa. There were 4 specimens which could not be identified beyond subfamily. They appear to be of 3 different genera.

Subfamily: Clytrinae
Megalostomis pyropyga Lacord. Collected 2 specimens at light, AC 7/29/89.

Megalostomis subfasciata (LeConte). Collected 1 specimen, from *Ambrosia deltoidea,* AC 7/29/89.

Saxinis deserticola Mold. Collected from *Cercidium microphyllum,* BP 4/30/89 and NE 8/27/88.

Undetermined taxa. Collected 1 unidentified specimen of this subfamily at light, AL 7/28/90.

Subfamily: Cryptocephalinae
Cryptocephalus cowaniae Schffr. Collected at lights, DR 10/8/88 and GC 10/10/88.

Cryptocephalus maccus White. Collected only at AG 10/8/88 on unidentified plant.

Genus *Pachybrachys.* This genus contains 151 species in the United States and Canada (Arnett 1985). Larvae live in camouflaging cases composed of excreta and feed on leaves. Adults feed on leaves and at least some come to lights.

Pachybrachys bullatus Fall. Collected 1 specimen at light, AC 7/23/88.

Pachybrachys laetus Bowditch. Collected on Lycium sp. and at lights, AC 7/23/88; AL 4/9/88; DR 3/5/88; GC 4/8/89.

Pachybrachys marmoratus Jacoby. Collected at light, GC 4/8/89.

Pachybrachys signatus Bowditch. Collected at lights, AC 7/23/88; AL 9/10/88; DR 8/27/88.

Pachybrachys snowi Bowditch. Collected at lights, AC 7/23/88; .AL, 7/28/90. Also reported by Hall et al. (1988) from AL.

Pachybrachys sp. Collected at lights, AC 7/23/88; SE 10/30/87. May be 2 different species.

Pachybrachys wickhami Bowditch. Collected at lights, AC 7/23/88; AG 8/27/88; DR 8/27/88.

Pachybrachys xanti Crotch. Collected 1 specimen at light, GC 11./22/87. Also reported by Hall et al. (1988) from AL.

Subfamily: Eumolpinae
Paria sp. Collected at light, AC 7/24/88.

Subfamily: Galerucinae
Pseudoluperus sp. Collected at lights, AC 7/23/88; AL 9/10/88.

Subfamily: Hispinae
Odontota arizonicus Uhmann. Collected at light, AC 10/1/89. Larvae are probably leaf miners.

Family: Cicindelidae (Tiger Beetles)
Adults and larvae are predacious on other insects. Larvae live in vertical holes in sandy soil and await the passing of potential prey. They leap out of the hole and grab the prey animal when it comes near. Adults are cursorial and generally quite colorful. They are active both day and night, run very rapidly, and come to lights, where they catch prey. Arnett (1985) cites 185 species in the United States and Canada. At least 2 species have been found in the monument.

Cicindela lemniscata LeConte. An abundant, spectacularly colorful beetle, 1 cm long, iridescent red, blue, and green with white stripes. Probably found throughout the monument, active as adults during and after the summer rains. Specimens from AC 7/23/88; EA 7/23/88; GC 9/10/88; PO 7/11/90, 9/10/90; SE 9/9/90. Also reported by Hall et al. (1988) from AL.

Cicindela sedecimpunctata Klug. Collected only at BP 7/23/88. This is a spotted tiger beetle, slightly larger than the above species.

Family: Cleridae (Checkered Beetles)
These are generally small beetles marked by contrasting colors (usually black and a light color) and hairy bodies. Larvae and adults of most species are. predacious on other insects. Adults may also feed do pollen, and a few species are pests of stored products and are carrion feeders. Some are attracted to lights. There are 33 genera and 266 species described for the United States and Canada (Arnett 1985). Other species, not listed here, were,reported by Hall et al. (1988) from AL.

Undetermined taxa. Collected 2 individuals of an unidentified taxon in this family on *Lycium* flowers at DR 3/5/88.

Subfamily: Clerinae
Cymatodera aegra Wolcott. Collected at light, AC 9/30/89.

Cymatodera antennata Schaeffer. Collected at lights, AC 7/23/88; AL 4/9/88. Also reported by Hall et al. (1988) from AL.

Cymatodera fuscula LeConte. Collected at light, AL 4/9/88. 55

Cymatodera horni Wolcott. Collected at light, AG 8/26/89.

Cymatodera latefascia Schffr. Collected at lights, AC 7/23/88; AL 7/29/89.

Cymatodera oblita Horn. Collected at lights, AC 9/30/89; AG 5/:i/90; AL 4/9/88; GC 10/10/88; SE 4/13/90.

Cymatodera peninsularis Schffr. Collected at lights, DR 8/27/88.

Cymatodera serena Barr. Collected at lights, AC 7/23/88, 9/30/89; AL 7/29/89; DR 8/27/88; EA 7/23/88.

Cymatodera sobara Barr. Collected at lights, SE 10/30/87.

Cymatodera sp. Collected 3 specimens, apparently all 1 species, AL 4/9/88, 7/28/90.

Cymatodera xaviera Knull. Collected at lights, AC 7/23/88; EA 7/23/88.

Enoclerus quadrisignatus Say. Collected at lights, AC 7/23/88, 9/30/89; AL 4/9/88; AR 11/20/87.

Lecontella gnara Wolcott. Collected at lights, AG 8/26/89.

Priocera sp. Collected at lights, AR 11/20/87.

Thanasimus sp. Collected at lights, AL 4/9/88.

Trichodes apachei Barr & Foster. Collected at lights, AL 7/29/90.

Trichodes omatus Say. Collected at lights, AL 4/9/88.

Family: Coccinellidae (Ladybird Beetles)
A common, widespread family of beetles. Most, both as larvae and adults, are predators on plant-feeding insects. A few are phytophagous. Most species are marked with red or orange and black. Despite the distinctive color patterns, species are difficult to identify. There are 53 genera and 399 species in the United States and Canada (Arnett 1985).

Brachyacantha subfasciata Mulsant. Collected 1 specimen at light, AG 11/22/87.

Chilocorus stigma (Say) (twicestabbed lady beetle). A predator of aphids and other softbodied insects. Collected 1 specimen at light, SE 9/9/90.

Hippodamia convergens G.-M. (convergent lady beetle). Our most common and conspicuous lady beetle. Often found on leaves or flowers where it feeds on insects. Found all year, throughout the monument. We collected it on *Amsinckia tessalata, Cercidium microphyllum,* and *Encelia farinosa* flowers, but it probably comes to almost any blooming plant that is attracting other insects. AL 10/18/87; AR 2/27/88; AC 4/10/88; BU 4/30/89; LO 4/20/88.

Rhyzobius lophantae (Blais.). Found on *Sphaeralcea* sp. flowers, and probably other flowers that are attracting insects. It also comes to lights. AG 11/22/87, 1/28/89', SA 10/31/87; SE 10/30/87.

Undetermined taxa. Collected 3 specimens, perhaps all the same species, 1 at light, 2 at a rotten saguaro. AC 7/24/88; AG 3/6/88.

Family: Cryptophagidae (Silken Fungus Beetles)
Small beetles, often associated with fungi. There are 16 genera and 152 species described for the United States and Canada (Arnett 1985).

Undetermined taxon. Collected 1 specimen at light, AC 7/23/88.

Family: Cucujidae (Flat Bark Beetles)
There are 85 species of this family known from the United States and Canada (Arnett 1985). Most live under bark or in decaying plant materials, but some are pests of stored grain. May come to lights.

Subfamily: Silvaninae
Ahasverus rectus (LeConte). Collected at light AC 7/23/88.

Family: Curculionidae (Snout Beetles and Weevils)
This is the largest family in the animal kingdom. Although over 40,000 specie's have been described from the world, it is likely that these represent only a fraction of the undescribed species. Very few species were found during this study, a fact for which I have no explanation. Most have elongated snouts with tiny mouthparts at the end. They are almost all phytophagous as adults. Eggs are deposited within a host plant tissue. In 1985, there were 2,614 species in 401 genera described for the United States and Canada (Arnett 1985). Identification is extremely difficult. Several other species, not listed here, were reported by Hall et al. (1988) from AL.

Undetermined taxa. Collected 5 specimens, probably representing 5 different taxa, which were not identified.

Subfamily: Brachyderinae
Ericydeus lautus (LeC.) Collected 2 specimens, AL 10/18/87, 8/26/89.

Subfamily: Leptiinae
Ophryastes sp. Collected 1 specimen, found on ground, VU 11/01/87. *O. varius* LeConte was reported by Hall et al. (1988) from AL. Members of this genus are thought to feed on *Larrea* (Crawford 1981).

Family: Dascillidae (Soft-bodied Plant Beetles)
Subfamily: Dascillinae
Anorus parvicollis Horn. All we know about it is that adults were, collected at light, SE 4/19/88.

Family: Dermestidae (Skin and Larder Beetles)
Most species of this family feed on dead animals or plants, but a few also feed on pollen. There are 129 described species in the United States and Canada (Arnett 1985).

Undetermined taxa. Collected 2 specimens of unidentified dermestids at lights, AC 7/23/88, SE 10/30/87.

Family: Derodontidae (Tooth-necked Fungus Beetles)
A small family of small beetles, about which little is known. Our 1 specimen remains unidentified beyond family. It was collected at light, AC 7/24/88.,

Family: Dytiscidae (Predacious Diving Beetles)
These are aquatic beetles, capable of long-range flight to get from 1 aquatic habitat to another. Larvae and adults are predators of aquatic insects and other small animals.

Subfamily: Hydaticinae
Eretes sticticus (Linnaeus). A cosmopolitan aquatic beetle, thrives in short-lived ponds. The biology of this species was described by Kingsley (1985). Adults migrate to ponds, often arriving shortly after a pond has filled. Larvae are voracious predators and have the fastest growth rates known for aquatic beetles. Adults were observed in synchronous mass migration from a drying pond. Specimens from AG 8/28/88, 8/26/89 in water; GC 9/10/88 at light; PO 7/11/90 at light; SA 10/31/87 at light; SE 9/9/90 at light.

Subfamily Hydroporinae
Deronectes roffi (Clark). Collected in water, AG 1/28/89.

Subfamily Laccophilinae
Laccophilus fasciatus terminalis Sharp. Collected in water AC 7/23/88, BP 9/10/88; at light SE 10/9/88.

Laccophilus sp. Collected in water, BP 7/23/88; DT 7/23/88.

Laccophilus coccinelloides Regimbart. Collected in water, AG 1/28/89.

Family: Elateridae (Click Beetles)
Fairly common beetles, mostly taken at lights. Most are brown or black. Larvae are called "wireworms," and are hard-bodied, slender inhabitants of soil. Many species feed on roots and tubers, some are carnivorous. A very difficult family to identify to species. There were 73 genera and 885 species known from the United States and Canada (Arnett 1985).

Subfamily: Cardiophorinae
Horistonotus sp. There are 53 species of this genus known (Arnett 1985). More than 1 species may be present in the monument. Collected at lights: AC 7/23/88; AL 9/10/88; AR 4/14/90; DR 8/27/88; EA 7/23/88; GC 9/10/88.

Subfamily: Elaterinae
Diplostethus sp. Collected at lights: AG 8/26/89; AL 7/29/89, 7/28/90; GC 9/10/88, 10/10/88.

Megapenthes sp. Collected at light, AC 7/23/88.

Neotrichophorus sp. Collected at lights: AC 7/23/88; AL 7/29/89; DR 8/27/88; GC 10/10/88; SE 9/9/90.

Subfamily: Melanotinae
Melanotus sp. Collected at light, EA 7/23/88.

Subfamily: Pyrophorinae
Conoderus sp. Collected at light, AC 7/29/89.

Lacon sp. Collected at light, AC 7/23/88.

Family: Erotylidae (Pleasing Fungus Beetles)
A small family with 65 species in 10 genera in the United States and Canada (Arnett 1985). Larvae are found on fungi or in decaying wood. Adults are sometimes found walking on the ground, especially after rains.

Undetermined taxon. Collected 1 specimen, on ground, AG 3/6/88.

Family: Heteroceridae (Variegated Mud-loving Beetles)
A small family of beetles, with only 30 species known from the United States and Canada (Arnett 1985). Unfortunately, the genera and species are difficult to identify. Most are burrowers in damp sand or mud.

Undetermined taxon. Collected 1 specimen, on ground, BP 10/17/87.

Family: Histeridae (Clown Beetles)
A family of 499 known U.S. species (Arnett 1985), which are difficult to identify. Most species are found on carrion, in fungus, under bark, or in ants' nests.

Subfamily: Saprininae
Aphelostemus interstitialis (LeConte). A common carrion feeder, occasionally attracted to lights. Collected at lights, AG 3/6/88; AL 4/9/88.

Family: Hydrophilidae (Water Scavenger Beetles)
Aquatic beetles, generally black or dark brown and active swimmers. There were 284 species known for the United States and Canada (Arnett 1985). Some species may occasionally come to lights a considerable distance from water. Adults are scavengers and predators, larvae are predacious.

Subfamily: Berosinae
Berosus sp. Three specimens collected from water, DT 7/23/88.

Subfamily: Hydrobiinae
Enochrus pygmaeus pectoralis (LeConte). Collected from water, AC 7/23/88; AG 1/28/89.

Subfamily: Hydrophilinae
Hydrophilus triangularis Say. Collected only once, at light, miles from the nearest known water. PO 7/11/90.

Tropistemus ellipticus (LeConte). Collected from water, AG 1/28/89; BP 9/10/88.

Tropisternus lateralis (Fabricius). Collected from water, DT 7/23/88.

Family: Lagriidae (Long jointed Beetles)
A small family of colorful, metallic beetles, with 33 species in the United States and Canada (Arnett 1985). Adults are leaf-feeders, larvae live under bark or plant litter.

Subfamily: Statirinae
Statira defecta Schffr. Collected at light, AG 5/5/90; AL 7/29/89.

Statira pluripunctata Horn. Collected at light, AG 8/26/89; DR 8/27/88.

Family: Lampyridae (Firefly Beetles)
Most species of this family have light-producing organs, which they use in signaling to attract mates. There are 124 species known for the United States and Canada (Arnett 1985). Larvae and adults are predacious. Firefly beetles are rare in the desert and are not seen flashing as they do in moister climates.

Subfamily: Lampyrinae
Microphotus dilatatus LeConte. Collected only once, DR 8/27/88.

Family: Lycidae (Net-winged Beetles)
Uncommon beetles, usually found at flowers. Adults and larvae are predacious. Most species are marked with red, orange, or yellow and black warning colors and are protected from predators by noxious chemicals. There are 83 species known from the United States and Canada (Arnett 1985).

Subfamily: Lycinae
Caenia amplicomis LeConte. A rare species, collected only once, BP 4/30/89.

Lycostomus sp. A rare species, 2 specimens, AC 4/29/89.

Family: Melandryidae (False Darkling Beetles)
These are small, generally dark-colored, uncommon beetles, found on ground, bark, flowers or fungi. There are 142 species known for the United States and Canada (Arnett 1985).

Subfamily: Anaspidinae
Anaspis sp. Collected only once, SE 4/19/88.

Pentaria pallida (Lilj.). Collected at AC 7/24/88 and AG 8/28/88.

Undetermined taxa. Probably all the same species, 5 specimens collected at AC 7/23/88.

Family: Meloidae (Blister Beetles)
A fairly large family, with 310 species known for the United :States and Canada (Arnett 1985). Adults are phytophagous, often found on the ground or on flowers, and come to lights. Larvae are parasitic on wild bees and the eggs of grasshoppers. The blood of adults contains an irritating substance that causes blisters on contact with human skin, and can be deadly if consumed. There are 143 species known from Arizona (Werner et al. 1966).

Subfamily: Lyttinae
Tegrodera erosa aloga (Skinner). A large, conspicuous yellow, red, and black beetle. Adults are known to feed on *Eriastrum diffusum,* larvae on eggs and stores of bees (Werner et al. 1966). On occasion, large numbers of these beetles may be seen, but such was not the case during the period of this study. Only 1 specimen was found, GC 4/15/88.

Epicauta arizonica Werner. Collected at light, AL 7/29/89; BP 10/17/87; GC 10/10/88.

Epicauta brunnea Werner. Collected at light, SE 9/9/90.

Epicauta lauta (Horn). Collected at light, AG 8/26/89; AL 7/29/89; GC 10/10/88; PO 9/10/90; SE 10/9/88, 9/9/90.

Epicauta segmenta Say. Collected at light, AC 8/25/90.

Epicauta sp. Collected at light, AC 8/25/90.

Epicauta tenebrosa Werner. Collected at light, AC 7/23/88.

Epicauta tenella (LeConte). Collected at light, AL 7/29/89; AL 7/29/89; EA 7/23/88; PO 7/11/90.

Epicauta tenuilineata (Horn). Collected at light, AC 7/23/88, 8/25/90; AG 8/26/89; AL 9/10/88, 7/29/89; DR 8/27/88; GC 9/10/88, 10/10/88; SE 9/9/90.

Epicauta virgulata LeConte. Collected at light, GC 9/10/88; PO 9/10/90.

Linsleya sp. Collected at light, AR 2/27/88.

Pyrota concinna Casey. Collected at light, AG 8/26/89; PO 9/10/90.

Pyrota trochanterica Horn. Collected at light, AC 8/25/90; PO 9/10/90.

Subfamily: Nemognathinae
Nernognatha nigripennis LeConte. Collected at light, AC 4/10/88',; SA 10/31/87.

Family: Melyridae (Soft-winged Flower Beetles)
Small beetles, feeding on pollen and insects, there are 520 species in 48 genera in the United States and Canada (Arnett 1985).

Subfamily: Dasytinae
Trichorous indutus Casey. Widespread and common in the monument, often found at lights. Collected at AC 4/10/88, 4/29/89; AL 4/9/88; DR 3/5/88; LO 4/20/88; NE 3/12/89.

Family: Mycetophagidae (Hairy Fungus Beetles)
A small family of obscure little beetles that feed on fungus and pollen. There are 26 species found in the United States and Canada (Arnett 1985).

Undetermined taxon. Collected 1 specimen, AC 7/23/88.

Family: Nitidulidae (Sap-feeding Beetles)
Usually small beetles, occasionally marked with red or yellow spots. Food of adults is nectar, plant juices, decaying fruit and pollen. There are 183 species known from the United States and Canada (Arnett 1985).

Subfamily: Carpophilinae
Carpophilus pallidipennis (Say). Collected from prickly pear flowers and fruits. AC 4/10/88; AL 5/5/90; LO 4/20/88.

Family: Oedemeridae (Pollen Feeding Beetles)
All adults of this family feed on pollen, larvae live in soil. Some species can cause blisters if squashed on human skin. There are 86 species in 16 genera known from the United States and Canada (Arnett 1985).

Subfamily: Oedemerinae
Oxacis laevicollis Horn. Collected at AG 5/5/90; BP 4/29/89.

Oxacis matthewi Arnett. Collected at AC 7/23/88.

Oxacis nitidicollis Champion. Collected at AL 7/28/90; GC 10/10/88.

Oxacis sp. Collected at DR 8/27/88; AL 7/28/90.

Family: Pedilidae (False Antlike Flower Beetles)
This is a poorly known group of small, brownish beetles, with 77 species in the United States and Canada (Arnett 1985).

Duboisius arizonensis (Champion). Collected at light, AC 7/23/88; AG 8/26/89; EA 7/23/88.

Undetermined taxon. Collected at AL 7/28/90.

Family: Phenogodidae (Glowworm Beetles)
Females are wingless and luminous. Males have complex, plu.mose antennae. Larvae are predators on myriapods, including the large millipede *Orthoporus ornatus.* These beetles are very rare in our experience in the monument. There are 25 species known from the United States and Canada (Arnett 1985).

Zarhipis sp. Males collected at lights, AL 4/9/88; BP 4/29/89.

Family: Ptinidae (Spider Beetles)
Small, dark beetles that usually live in dried plant and animal material. There are 47 species known from the United States and Canada (Arnett 1985).

Subfamily: Ptininae
Ptinus sp. Collected at AC 7/29/89; NE 3/5/88.

Family: Rhipiphoridae (Wedge-shaped Beetles)
A small family of beetles that, as adults, feed on flowers. Larvae are internal parasites of wasps. There are 44 species known from the United States and Canada (Arnett 1985).

Undetermined taxon. Collected 1 specimen, AL 5/5/90, in *Opuntia phaecantha* flower.

Family: Salpingidae (Narrow-waisted Bark Beetles)
A small family of 33 U.S. species, found in a wide variety of environments (Arnett 1985).

Subfamily: Salpinginae
Trimitromerus riversi Horn. Collected only once, EA 7/23/88.

Family: Scarabaeidae (Lamellicorn Beetles)
This is a very large family of beetles, with over 12,000 species worldwide and 1,395 species in 135 genera in the United States and Canada (Arnett 1985). Larvae are white grubs, most often found in soil where they feed on roots, but are also found in dung, carrion, ant nests, rodent burrows and many other situations. Adults are mostly leaf-feeders. They frequently come to lights, and are most abundant during and after the summer rainy season.

Subfamily: Aphodiinae
Ataenius hirsutus Horn. A small dung beetle, both adults and larvae feed on dung. Collected at light AC 7/23/88.

Ataenius sp. Probably the same as the above species, but not positively identified. Collected 5 specimens at AC 7/23/88.

Undetermined taxon. Collected 2 specimens at light, PO 7/11/90.

Subfamily: Centoniinae
Cremastocheilus sp. The 32 known species of this genus inhabit ant nests, where the larvae apparently feed on organic debris (Arnett 1985). Adults are attractive to ants and are carried by them into their nests. We may have more than 1 species. Specimens collected at AG 3/6/88; AR 2/27/88.

Subfamily: Dynastinae
Aphonides dunnianus (Rivers). AG 7/28/90 at light.

Ligyrus gibbosus (DeG.) carrot beetle. A fairly large, common beetle, the larvae may be pests on carrots and a number of other crops, but they also feed on native vegetation. Adults are often seen at lights. Specimens collected at AC 7/23/88; AG 10/8/88; EA 7/23/88;
PO 7/11/90, 9/10/90; SA 10/31/87; SE 9/9/90.

Oxygrilus ruginasus (LeConte). A fairly large, common beetle, collected at lights. AC 7/23/88; PO 7/11/90; SE 10/30/87, 10/9/88.

Phileurus illatus LeConte. A fairly large, common beetle, collected at lights. AC 7/23/88; AG 8/26/89; AL 9/10/88, 7/29/89, 7/28/90; EA 7/23/88.

Subfamily: Melolonthinae
Diplotaxis spp. At least 4 species appear to be among our specimens, but they are difficult to distinguish. There are 104 species known for the United States and Canada (Arnett 1985). Our specimens were all collected at lights or under rocks. AC 7/23/88, 9/30/89; AG 8/26/89, 5/5/90; AL 4/9/88, 9/10/88, 7/29/89; BP 10/17/87; DR 8/27/88, 3/11/89; EA 7/23/88; GC 9/10/88; PO 7/11/90; 9/10/90; SA 10/31/87; SE 10/30/87, 10/9/88>, 4/13/90, 9/9/90.

Phyllophaga latidens (Schaeffer). Collected at lights: AC 7/23/88; AL 7/29/89.

Phyllophaga scoparia (LeConte). Collected at lights: AG 5/5/90; AR 4/14/90; EA 7/23/88.

Phyllophaga spp. At least 3 additional species, which could not be determined. The genus has 217 species in the United States and Canada (Arnett 1985). Collected at lights: AG 8/26/89, 5/5/90; EA 7/23/88; GC 9/10/88, 10/10/88; PO 7/11/90, 9/10/90; SE 9/9/90.

Phyllophaga timida (Horn). Collected at lights: AG 8/26/89; AL 7/29/89; DR 8/27/88; EA 7/23/88; GC 10/10/88.

Undetermined taxa. There were 3 specimens, which were determined only to subfamily. They may be the same species. Collected at light: AC 7/23/88; EA 7/23/88.

Subfamily: Rutelinae
Cotalpa consobrina Horn. Collected at light: EA 7/23/88; PO 7/11/90.

Pelidnota lugubris Leconte. Collected at light: AL 7/29/89; GC 10/10/88.

Subfamily: Scarabaeinae
Copris lecontei Matheson. A rare dung beetle, collected only once, AL 7/29/89.

Onthophagus velutinus Horn. A rare dung beetle, collected only once, AC 7/23/88.

Subfamily: Troginae
Trox punctatus Germar. Collected at AC 7/23/88; AL 9/10/88, 7/29/89.

Trox suberosus Fabricius. Collected at AC 7/23/88.

Family: Staphylinidae (Rove Beetles)
A very large family of beetles, with 3,187 species in 315 genera in the United States and Canada (Arnett 1985). Most are found in carrion, but species :may be found in a variety of situations, including under rocks and in decaying cacti, and some come to lights.

Subfamily: Oxytelinae
Apocellus sphaericollis (Say). Collected at SE 10/30/87.

Subfamily: Xantholininae
Homaeotarsus sp. Collected at AL 9/10/88.

Undetermined taxa. There were 8 specimens, identified only to family. AC 7/23/88, 8/25/90; AG 3/6/88.

Family: Telegeusidae (Long-lipped Beetles)
Rare, poorly known, rather drab little brown beetles. Only 3 species are known from the United States and Canada (Arnett 1985).

Telegeusis sp. Although there are only 2 species known for this genus, both are found in Arizona, and we cannot distinguish them. Collected at lights, AC 7/23/88; AL 4/9/88; DR 8/27/88.

Family: Tenebrionidae (Darkling Beetles)
A large family, with 176 genera and 1,008 species known from the United States and Canada (Arnett 1985). Most are dark (black or brown), hard beetles that are most often found on the ground and under rocks. Abundant in the arid Southwest. Identification may be very difficult.

Subfamily: Pimeliinae
Asbolus mexicanus. A rare species, apparently Mexican in origin. Collected at SE 10/31/87. The only specimen is deposited with The University of Arizona Department of Entomology.

Asidina parallela (LeConte). Found on ground, collected at DR 11/21/87; NE 1/28/89.

Cryptoglossa variolosa (Horn). Found on ground, collected at DIE, 11/21/87, 8/27/88; LO 4/20/88.

Eupsophulus castaneus Horn. Collected at lights and under rocks, AG 5/5/90; AL 4/9/88; SE 4/19/88; VU 4/20/88.

Eupsophulus sp. (probably also *castaneus,* but not positively identified to species). At lights and under rocks. AG 5/5/90; AR 4/14/90; GC 4/8/89; SE 4/19/88, 4/13/90.

Eusattus reticulatus (Say). Found drowned in tinaja, BP 8/25/90.

Lobometopon fusiforma fusifonna (Casey). Collected 1 specimen at light, AG 8/26/89.

Lobometopon sp. Apparently not the preceding species. Collected at lights, AG 10/8/88; AL 9/10/88; EA 7/23/88; SE 10/9/88.

Metoponium sp. Mostly collected at lights, AR 4/14/90; DT 7/23/88 (drowned in water); EA 7/23/88; GC 4/8/89.

Pechalius dentiger (Horn). Collected at lights, AG 10/8/88; AL 4/9/88.

Philolithus actuosus (Horn). Collected 1 specimen from ground, GC 9/10/88.

Stenomorpha convexa (LeConte). Collected 1 specimen from ground near our light SE 10/9/88.

Stenomorpha marginata (LeConte). Collected 1 specimen from ground at each location, AL 7/30/89; BP 10/17/87.

Telabis sp. Collected 1 specimen at light, AG 5/5/90.

Triorophus histrio Casey. Collected on ground and at lights, DR 11/21/87, 3/11/89; NE 1/28/89.

Subfamily: Tenebrioninae
Aconobius laciniatus (Casey). Collected 1 specimen, from under a rock, AR 2/27/88.

Argoporis costipennis (LeConte). Collected 1 specimen, from under a rock, AR 2/28/88.

Argoporis sp. Some or all of these may be the same species, and they may be *A*. *costipennis.* Collected under rocks, AC 10/17/87, 1/29/89; AL 10/18/87; DR 11/21/87.

Blapstinus sp. Collected 2 specimens, both from under a rock, AR 2/27/88.

Eleodes armatus LeConte. A fairly common, large, slow-moving beetle that stands on its head when disturbed. If disturbed enough, the beetle will release a noxious chemical mixture that is irritating to skin and mucous membranes (Smith 1982). Other species in the genus (50 known from Arizona) defend themselves in the same way. Food is vegetation and detritus. Found on the ground and under rocks, AR 11/21/87, 2/26/88; SA 10/31/87; SE 10/30/87; VU 11/1/87.

Eleodes caudatus (Horn). Collected at lights, AG 11/22/87, 8/26/89; SE 9/9/90.

Eleodes longicollis LeConte. Collected 1 specimen, BP 10/17/87.

Eleodes spp. Collected 4 specimens, of at least 2 species, which could not be identified beyond genus. Collected at BP 3/24/90; DR 3/5/88; NE 11/21/87, 3/5/88. Hall et al. (1988) reported 4 species, not found in this study from AL.

Helops arizonensis Horn. Collected at light AG 5/5/90.

Nocibiotes granulatus (LeConte). Found under rocks, AC 7/24/88; DR 11/21/87. Also reported by Hall et al. (1988) from AL.

Ulus crassus (LeConte). Collected 1 specimen at light, AG 8/26/89.

Zopherodes tristis (LeConte). Found under rocks, AR 2/28/88. *Zophobas subnitens* (Horn). Collected 1 specimen at light, AG 8/26/89.

Family: Trogossitidae (= Ostomatidae) (no common name)
Larvae are predacious, living in galleries of wood-boring insects. Adults may come to lights. There are 64 species known from the United States and Canada (Arnett 1985). Apparently they are quite rare at OPCNM.

Subfamily: Trogossitinae
Airora aequalis Reitter. Collected 1 specimen at light, AC 7/23/88.

Temnochila aerea (LeConte). A large, shiny green beetle that can bite if handled. Collected at lights, AC 7/23/88; PO 7/11/90; SE 4/13/90. Also reported by Hall et al. (1988) from AL.

Order: Dermaptera (Earwigs)
Only 2 species of earwigs were found during this study. Both are rare, and our information about them is scanty.

Family: Labiduridae (Long-horned Earwigs)
This family has only 1 species, cosmopolitan in distribution (Arnett 1985).

Labidura riparia (Pallas) striped earwig. Believed to have been introduced to Arizona. The first Arizona specimens are from Yuma in 1952. It is now widely distributed in the southern part of the state. It is a predator on other insects, especially fly larvae. It was found at Quitobaquito (Kingsley et al. 1987). During this study, 1 specimen was found at the light at SE 10/30/87. Apparently this is a very rare insect in OPCNM. Although it may be considered an introduced species, there is probably no reason to be especially concerned about it.

Family: Labiidae (Little Earwigs)
Subfamily: Spongiphorinae
Spongovostox apicidentatus (Caudell). An uncommon insect, taken only at AC 7/23/88 and SE 9/9/90, at lights. A native species, usually found in plant debris including dead cacti (Helfer 1972).

Order: Dictyoptera (Mantids and Cockroaches)
Family: Blattellidae (German Cockroaches)
This family includes several introduced, now almost cosmopolitan household pest species. However, our species are native, rare, and harmless.

Subfamily: Blatellinae
Parcoblatta notha (Rehn & Hebard). Collected 3 specimens at lights, NE 3/5/88; SE 10/30/87. Also said to live under bark (Helfer 1972).

Family: Mantidae (Mantids)
There were 3 species of mantids found in this study. Another species, *Yersiniops solitarium* (Scudder), was reported by Hall et al. (1988) from AL, but not found by us. Mantids typically station themselves on plants that are attracting insects and use their superb camouflage to ambush visitors to the plants. They overwinter as eggs, in tough cases containing a dozen or more eggs, and emerge in spring. Mantids frequently come to lights, where most of our specimens were caught.

Subfamily: Amelinae
Litaneutria minor Scudder. A small, fast-running, common species often seen running on the ground. Comes to lights. Records from AC 9/30/89; AL 10/18/87, 9/10/88; AR 11/20/87, 2/26/88; BP 10/17/87, 7/23/88; EA 7/23/88; GC 9/10/88, 4/8/89; PO 9/10/90; SE 10/30/87, 10/9/88, 9/9/90.

Subfamily: Mantinae
Stagmomantis californica Rehn and Hebard. A large green or brown mantid. Found at GC 9/10/88; SE 10/9/88, 9/9/90; VU 9/9/90. Found on *Bebbia juncea* that was attracting many insects. Also recorded as hiding on leaves of *Larrea* (Schultz et al. 1977). We found egg cases, believed to be this species, on mesquite at many locations in OPCNM.

Stagmomantis limbata (Hahn). Another large green or brown mantid. Apparently this is less common than the previous species. Our specimens were all collected at lights. BP 9/10/88; GC 10/10/88. Recorded as ambushing prey on *Larrea* (Schultz et al. 1977).

Family: Polyphagidae (Desert Cockroaches)
This is a small family of 12 species of native cockroaches. Most live in sandy areas, and live much of their lives buried in sand or soil. Some also inhabit woodrat nests and rodent burrows, or can be found under rocks and logs. Females are wingless, males sometimes fly to lights at night. At least 2 species are found in the monument.

Subfamily: Polyphaginae
Arenivaga erratica (Rehn). Males collected at lights, AG 8/26/89; DR 8/27/88, 3/11/89; GC 10/10/88; PO 7/11/90; SA 10/31/87; SE 10/30/87.

Arenivaga grata Hebard. Collected 1 specimen at light, AC 9/30/89.

Order: Diptera (Flies)
Family: Anthomyiidae (Anthomyiid Flies)
These flies superficially resemble common houseflies. Adults of some species are predators on other insects. Larvae live in plant stems or as parasites of caterpillars or in decaying plant material. A few are aquatic as larvae, and some live in seeds or roots. There are 412 species known from the United States and Canada (Arnett 1985). Many are difficult to identify.

Subfamily: Anthomyiinae
Hylemya platura (Meigen). Most of our specimens were collected at lights. Records from AC 4/10/88; AG 11/21/87; AL 4/9/88, 3/11/89; AR 11/20/87; DR 11/21/87; SA 10/31/87.

Subfamily: Scatophaginae (considered a separate family by Arnett [1985])
Scatophaga stercoraria (L.). Adults are attracted to fresh manure, and sometimes to lights. Larvae feed in manure. Collected at AL 4/9/88.

Family: Asilidae (Robber Flies)
Predacious flies that catch other insects in flight. The larvae are also predacious and live under bark, in soil, or in debris. Typically, adults have regularly used perches in or on the edges of clearings where they wait for insects to fly close by. They dart out and catch the prey, then often return to the perch to consume their food. There are 883 species known from the United States and Canada (Arnett 1985).

Subfamily: Asilinae
Asilus compositus Hine. Collected 1 specimen, at light, AC 7/23/88.

Efferia anacapai (Wilcox & Martin). Collected 1 specimen, BP 7/23/88.

Efferia argyrosoma (Hine). Collected 1 specimen, AL 4/9/88.

Efferia arida (Will.). Collected at AG 1/28/89 and VU 10/10/88. At VU, the individual was perched on *Bebbia juncea* that was attracting many insects.

Efferia bicaudata (Hine). Collected 1 specimen, SA 10/31/87, perched on *Larrea* in bloom.

Efferia coquilletti (Hine). Collected 1 specimen, NE 3/5/88.

Efferia costalis (Will.). Collected 2 specimens, GC 2/27/88 and VU 4/20/88.

Efferia sp. We identified 12 specimens to genus only, some of which may be of the species listed here and some may be other species. Superficially it appears that at least 3 species are represented. The genus has 100 species known from the United States and Canada (Arnett 1985). AC 10/17/87, 7/29/89, 10/1/89; AG 8/28/88; AL 10/18/87, 4/9/88; AR 11/21/87; NE 11/21/87; SE 4/19/88; VU 4/19/88. Also reported by Hall et al. (1988) from AL.

Efferia spiniventris Hine. Collected 1 specimen, AL 7/29/89.

Efferia tricella (Bromley). Collected 1 specimen, LO 4/20/88.

Promachus sp. Collected 3 specimens, apparently of 2 species. AL 10/18/87; BP 7/23/88; SA 10/9/88.

Subfamily: Leptogastrinae
Cophura sp. Collected only at AC 7/29/89

Leptogaster sp. Collected 1 individual, at AL 4/9/88. The specimen is in the collection of The University of Arizona Entomology Department, at the department's request.

Lestomyia atripes Wilcox. Collected at AL 7/30/89; AR 11/21/87; DR 11/21/87, 3/5/88. Perched on *Lycium sp.*

Ospriocerus abdominalis (Say). Collected 1 specimen, BP 9/110/88.

Ospriocerus sp. Apparently not *abdominalis,* but 1 of the other 21 species known from North America (Arnett 1985). Collected 1 specimen, AG 10/8/88, perched on *Atriplex canescens.*
Stichopogon catulus Osten-Sacken. Collected only once, BP-3/24/90.

Unidentified taxon. Collected 1 specimen, AG 7/28/90.

Family: Bombyliidae (Bee Flies)
Hairy flies that generally are found in or around flowers. The adults feed on nectar and pollen, often hovering at flowers. Larvae are predacious on eggs or young of many species of insects. There are 797 species known from the United States and Canada (Arnett 1985). Plant records listed below are probably not exclusive food sources for the species, but are plants at which specimens were collected.

Undetermined taxa. There were 3 specimens, of apparently 2 species, which were not identified beyond family.

Subfamily: Anthracinae
Anthrax irroratus Say. Common and widespread in the monument. Variable in size. Found feeding at *Enceha farinosa.* Specimens from AC 4/10/88,4/29/89; AL 10/18/87, 4/9/88; 5/5/90; BP 7/23/88, 3/4/90; DR 3/5/88.

Anthrax limatulus larrea Marston. Collected at AL 4/9/88; BP 9/10/88.

Anthrax sereipunctatus (Osten-Sacken). Collected only once, at AC 4/29/89.

Anthrax sp. There were 2 specimens, which could not be identified to species; they appear to be different from each other. AC 4/10/88; AG 10/8/88. There are 37 species known from the United States and Canada (Arnett 1985).

Anthrax xylocopae Marston. Found feeding on *Simmondsia chinensis.* AC 7/29/89, 10/1/89; AL 10/18/87.

Subfamily: Bombyliinae
Bombylius albicapillus Painter. Found feeding on *Lycium* sp. flowers. AL 3/11/89; GC 2/27/88.

Bombylius major Linne. Found feeding on *Baccharis sarothoides* flowers. AG 3/6/88.

Geminaria canalis (Coquillett). Found only once, AL 4/9/88.

Heterostylum novum (Will.). Collected at DR 3/12/89.

Lordotus diversus Coquillett. Collected only once, at BP 9/10/88.

Lordotus gibbus striatus Painter. Collected at AG 10/8/88, and VIU 10/10/88 at *Bebbia juncea.*

Lordotus pulchrissimus Williston. Collected at BP 9/10/88, BU 4/8/89, and NE 3/12/89.

Subfamily: Exoprosopinae
Chrysanthrax lepidota (Osten-Sacken). Collected at *Ambrosia deltoidea.* AC 7/29/89; AG 7/28/90.

Exoprosopa divisa (Coquillett). Collected at *Bebbia juncea.* AG 10/8/88; BP 8/25/90; VU 10/10/88.

Exoprosopa pardus Osten-Sacken. Collected at BP 9/10/88; DR 8/27/88.

Exoprosopa pueblensis Jeannicke. Collected at *Acacia angustissima* and *Sapium biloculare.* AC 7/29/89; AL 8/26/89; BP 7/23/88.

Exoprosopa sp. Collected 2 specimens, apparently different species, both from AG 10/8/88, 1 at *Bebbia juncea,* the other at an unidentified yellow composite.

Paravilla canicula (Osten-Sacken). Collected at *Acacia greggii.* ALL 5/5/90.

Paravilla emulata (Painter). Collected only once, DR 10/8/88.

Paravilla sp. Collected 1 specimen, BU 4/8/89.

Poecilanthrax effrenus (Coquillett). Collected only once, AL 7/29/89, at *Baccharis sarothroides.*

Rhynchanthrax rex (Osten-Sacken). Common and widespread in the monument, feeding on many species of flowers. Collected from *Bebbia juncea,* but also observed at other species. AC 4/10/88; AG 10/8/88; AL 3/11/89; BP 3/24/90; BU 4/8/89; SA 4/8/89; VU 10/10/88.

Villa curta (Loew). Collected only once, BP 7/23/88, on *Selaginella arizonica.*

Villa eumenes (Osten-Sacken). Common and widespread. Collected at *Baccharis sarothroides, Encelia farinosa,* and *Lycium* sp. AC 4/10/88; AG 3/6/88; AL 4/9/88; DR 3/5/88; NE 3/12/89.

Villa sagata (Loew). Collected only once, AC 7/29/89.

Villa sp. At least 3 species.

Subfamily: Geroninae
Geron albarius Painter. Collected only once, BP 4/30/89.

Geron sp. Possibly more than 1 species.

Subfamily: Lomatiinae
Aphoebantus desertus Coquillett. Collected at *Baccharis sarothroides.* AG 3/6/88; DR 3/12/89.

Aphoebantus sp. 1. Collected at *Cercidium microrphyllum* and *Lycium* sp. DR 3/5/88, 8/27/88.

Aphoebantus spp. 2. Collected only once, AC 4/29/89.

Epacmus sp. Collected only once, AG 8/27/88.

Ogcodocera analis Williston. Collected at AC 7/29/89 and 131? 7/23/88.

Subfamily: Phthiriinae
Phthiria sp. Collected only once, at *Lycium* sp. flowers. DR 3/5/88. Also reported by Hall et al. (1988) from AL.

Family: Calliphoridae (Blow Fly Family)
Generally shiny, metallic blue, green, or black flies. Adults often come to food, but usually feed on nectar, pollen, and decaying plant or animal material. Larvae are maggots in dung or carrion or decaying vegetation. Some live in wounds of animals. A few species are intestinal parasites of invertebrates. There are 78 species known from the United States and Canada (Arnett 1985).

Subfamily: Calliphorinae
Calliphora coloradensis Hough. Collected at AG 11/22/87; B-P 10/17/87.

Phaenicia sp. Common, shiny green flies, found feeding at *Baccharis sarothroides, Sapium biloculare,* and tuna fish cans. Larvae feed in carrion. One of the first flies to come to fresh meat. Specimens from AC 7/29/89; AG 3/6/88; AL 4/9/88, 9/11/88; BP 10/17/87.

Subfamily: Chrysomyinae
Cochliomyia macellaria (Fabricius) (secondary screwworm). A shiny bluish-green fly. Taken from *Lemaireocereus thurberi* flowers. Larvae feed primarily on carrion, but may enter wounds on animals. Collected at AG 11/22/87; AL 9/11/88; BP 7/23/88, 9/10/88.

Phormia regina (Meigen) (black blow fly). A dark shiny blue fly. Larvae live in carrion or bloody wounds of animals. Adults were collected at *Baccharis sarothroides* flowers and on *Quercus ajoensis.* AC 4/10/88; AG 3/6/88; AL 4/9/88, 3/11/89.

Family: Cecidomyiidae (Gall Midges)
At least 1,059 species are known from the United States and Canada (Arnett 1985). Many species make galls on various plants, at least 16 on *Larrea* alone (Waring and Price 1990). Other species inhabit decaying organic material including some that feed on fungi and others that are predacious; some live in ant and termite nests; a few are agricultural pests. These are tiny, delicate flies that are very difficult to identify. We were unable to identify our specimens beyond family. Also, we did not collect galls. Waring has collected gall midges on *Larrea* at OPCNM, and is preparing descriptions of the species.

Undetermined taxa belonging to this family were collected by us at AG 11/21/87, 3/6/88, 10/8/88; AL 4/9/88; DR 8/27/88, 3/11/89; NE 1/28/89; SE 4/19/!38.

Family: Chamaemyiidae (Chamaemyiid Flies)
Tiny, delicate flies that are very difficult to identify and poorly known. Larvae of some are predacious. There are 36 species known from the United States and Canada (Arnett 1985). We have only 2 specimens, unidentified beyond family, from AG 11/21/87.

Family: Chironomidae (Midge Family)
A group of tiny, delicate flies. Most larvae are aquatic. Classification is difficult, and many species are probably undescribed. There are 139 genera and 817 species known from the United States and Canada (Arnett 1985). Adults superficially resemble mosquitoes. Swarms can sometimes be seen hovering over water or in clearings. Adults sometimes come to lights. Our specimens, unidentified beyond family, were collected at ACS 11/21/87; AL 4/9/88; AR 11/20/87; NE 3/5/88; SE 10/30/87. Some of these locations are at considerable distance from known water sources.

Family: Chloropidae (Fruit Flies)
These are tiny black flies that (in our species) are most frequently seen flying around human faces. They are attracted to eyes and mucous membranes, where they feed on liquids. They may spread infections and cause abrasions of the eyes (Smith 1982). Larvae live in decaying vegetation or dung, usually in moist microhabitats. "Eye gnats" can be very annoying during brief periods in spring. Nothing that is very effective can be done about them. Insect repellent may help reduce the number landing on one's face. There are 27a species known from the United States and Canada (Arnett 1985). Not all species are eye gnats, some are gall-formers, some are predacious, and some are nectar feeders. Although our species are abundant and may be found throughout the monument, they are very difficult to catch, so we have few specimens.

Oscinella fronto-orbitalis Sabrosky. Collected 1 specimen, AG 11/22/87.

Thaumatomyia glabra (Meigen). Collected 1 specimen, BP 10/17/87.

Undetermined taxa. Collected 1 specimen, AG 11/22/87.

Family: Conopidae (Thick-headed Flies)
Small to middle-sized dark flies, the adults feed on nectar and pollen. Larvae are parasites of bees, wasps, and grasshoppers. There are 67 species known from the United States and Canada (Arnett 1985).

Dalmannia picta Will. Collected only once, NE 3/6/88.

Undetermined specimen. Collected only once, AC 4/29/89, at *Acacia greggii* flowers.

Family: Culicidae (Mosquitoes)
Larvae of all species are aquatic. Some are capable of rapid growth in small pools of water, including saguaro holes. Adult females of most species must obtain a blood meal in order to reproduce. Many species bite people, but many are more selective, biting only birds or reptiles.

Some species are capable of flights of several miles from water. There are 13 genera and 150 species known from the United States and Canada (Arnett 1985).

Subfamily: Culicinae
Aedes sp. An unidentifiable specimen was collected, biting the collector, at DR 3/11/89. Damage to the specimen in the process of collecting it precluded identification of species.

Culex coronator Dyar and Knab. Larvae were collected from a pool, AG 1/28/89.

Culex tarsalis (Coq.). An adult was collected, biting the collector, AG 11/22/87.

Culiseta incidens (Thomson). Adults were collected at lights, AC 1/28/89; AG 11/21/87. Larvae were collected from a pool, AG 1/28/89.

Culiseta inornata (Williston). Adults collected at lights, AG 1:1/21/87; AR 11/20/87.

Psorophora columbiae Dyar and Knab. Adults collected, biting collector, BU 8/27/88.

Undetermined taxa. Specimens of males, which we could not identify, were collected at AG 11/21/87; AL 4/9/88; BP 4/29/89.

Family: Cuterebridae (= Oestidae in Arnett [1985])
Generally large, heavy bodied, hairy flies, generally resembling bees. Adults lack developed mouthparts and do not feed. They are very rarely seen. Larvae are endoparasites of mammals. They are commonly found beneath the skin of rabbits and large rodents such as *Neotoma.* There are 41 species known from the United States and Canada (Arnett 1985).

Cuterebra sp. Collected 3 specimens, perched on dead branches, AC 10/1/89; DR 3/5/88, 3/12/89. They appear to be the same species.

Family: Ephydridae (Shore Flies)
Most species are aquatic or semi-aquatic as larvae, and adults are generally found near water. There were 3 specimens, unidentified beyond family, which were collected during this study. AC 10/17/87; AL 9/10/88, 10/17/87.

Family: Lauxaniidae (Lauxaniid Flies)
Small flies, usually found in shaded areas near water. Rare in deserts. There are 135 species known from the United States and Canada (Arnett 1985).

Camptoprosopella ocellaris Townsend. Collected 1 specimen at AG 8/28/88, deposited with The University of Arizona Entomology Department.

Family: Muscidae (House Flies)
A large family with 622 species known from the United States arid Canada (Arnett 1985). Identification is very difficult. Many species are attracted to food, animal excrement, or decaying vegetation.

Undetermined taxa. There were 8 unidentified specimens that appear to be of the same species.

Subfamily: Muscinae
Musca domestica Linnaeus house fly. A cosmopolitan species, it may be considered a pest under some circumstances. Collected 1 specimen, AG 11/22/87.

Family: Mydidae (Mydas Flies)
A small family of fairly large flies, 45 species are known from the United States and Canada (Arnett 1985). They are predacious as adults. Larvae, as far as is known, live in decaying wood or soil and are predacious. Generally considered rare in any habitat.
Messiasia pertenuis John. Collected 2 specimens, 1 from AC 7/29/89, the other from AL 8/26/89. Taken on *Dodonaea viscosa* flowers, probably awaiting prey.

Family: Neriidae (Neriid Flies)
Uncommon or rare flies, the larvae live in decaying cactus tissues. Adults are apparently attracted by yeasts found in the decaying cactus, as they also come to beer. Only 2 species are known from the United States and Canada (Arnett 1985).

Odontoloxozus longicomis (Coquillett). Collected only once, BP 9/30/89.

Family: Otitidae (Picture-winged Flies)
Wings of most species are "pictured," marked with dark patterns. Larvae feed on decaying vegetation or roots. There are 127 species known from the United States and Canada (Arnett 1985).
Diacrita costalis Gerst. Collected only once, BP 4/30/89.

Family: Pipunculidae (Big-headed Flies)
Tiny flies (our species), that are thought to parasitize Homoptera. There are 105 species known from the United States and Canada (Arnett 1985). We have 2 specimens, unidentified beyond family, both collected at AG 3/6/88 and 10/9/88. They may be the same species.

Family: Sarcophagidae (Flesh Flies)
Larvae feed on animal flesh, usually carrion, but some are parasites and others are predators. Adults feed on nectar and plant juices (Arnett 1985). Sarcophagids, in our experience at OPCNM, have the habit of following people around, perhaps hoping that we will die or kill something. They often land on humans, usually after flying around one's face. They are very swift moving, and adept at avoiding nets or swats. We have an undetermined number of species. Most of them are plain black or gray flies that are very difficult to distinguish from each other. They superficially resemble house flies, although most of them are larger than house flies. There are 327 species known from the United States and Canada (Arnett 1985).

Undetermined taxa. Most of our Sarcophagid specimens are unidentified beyond family. They appear to be of several genera and species. They have been collected throughout the year and at almost all sites.

Subfamily: Miltogramminae
Senotainia sp. Collected only once, SE 10/9/88. Known relatives are nest parasites of larval wasps (Arnett 1985).

Family: Sciaridae (Dark-winged Fungus Flies)
Larvae live on fungi. Adults are tiny black flies. There are 20 genera and 137 species known from the United States and Canada (Arnett 1985).

Bradysia sp. Collected only once, BP 3/24/90, 2 specimens. We deposited 1 specimen with The University of Arizona Entomology Department. There are 65 species known from the United States and Canada (Arnett 1985).

Family: Sepsidae (Black Scavenger Flies)
The common name well describes most of the members of this family. They are small black flies that feed on decaying materials, both plant and animal, and manure. There are 34 species known from the United States and Canada (Arnett 1985).

Undetermined taxa. Our 5 specimens may all be of the same species. Collected at *Baccharis sarothroides.* AG 11/22/87, 3/6/88; AL 3/11/89; DR 11/21/87.

Family: Sphaeroceridae (Small Dung Flies)
Larvae feed in manure and rotting vegetation, adults are usually nearby. There are 117 species in the United States and Canada (Arnett 1985).

Leptocera sp. The genus has 27 species described (Arnett 1985). Ours may be all of 1 species. Collected at lights, AG 11/21/87; DR 10/8/88; SE 10/30/87.

Family: Stratiomyidae (Soldier Flies)
A family with very diverse habits. Most are forest species. Adults feed on nectar and pollen. Larvae include some that are aquatic, some that inhabit dung, others live under rocks, in tree sap, in decaying wood or vegetation, and some are carnivorous. There are 254 species known from the United States and Canada (Arnett 1985). We know very little about our species, except that they are rare and some come to lights at night.

Subfamily: Clitellarinae
Adoxomyia regularis James. Collected only once, AG 11/21/87.

Dieuryneura obscura (Coq.). Collected at lights, AG 8/26/89; DR 8/27/88.

Hermetia subpellucida James & Wirth. Collected at *Jatropha cardiophylla,* BP 8/25/90.

Subfamily: Stratiomyinae
Hedriodiscus currani (James). Collected at *Bebbia juncea,* AG 10/8/88.

Undetermined taxon. Collected only once, BP 3/24/90, at *Opuntia phaeacantha* flower.

Family: Syrphidae (Flower Flies)
A common and diverse family in OPCNM. Many species resemble bees in general appearance and in feeding habits, often being found at flowers. Most species hover while they are feeding. Larvae either feed on decaying vegetation or are predators on aphids and other soft-bodied insects. A few feed on plants, and a very few are aquatic. There are 91 genera and 874 species known from the United States and Canada (Arnett 1985). Identification, especially of species of some of the larger genera, is difficult. Recent revisionary work has been done, and names of some of the genera and species listed below may have changed, but I do not have current information.

Subfamily: Eristalinae
Eristalis latifrons Loew. Collected at *Baccharis sarothroides* and *Wislizenia refracta,* it probably feeds at many other species as well. AG 10/9/88; BP 7/23/88, 9/30/89.

Eristalis vinetorum (Fabricius). Collected at AG 8/27/89, 7/28/90; AL 8/26/89. Observed feeding on flowers of *Baccharis sarothroides* and *Gymnosperma glutinosum.*

Volucella fornax Tns. Collected at AG 10/8-9/88; NE 1/28/89. Observed feeding on flowers of *Bebbia juncea* and *Hyptis emoryi.*

Volucella isabellina Will. Observed feeding in flowers of *Acacia greggii* and *Bebbia juncea.* Collected at AG 10/9/88; AL 3/11/89; BP 4/30/89; NE 3/6/88; SE 9/9/90.

Volucella marginata Say. Collected only once, AL 3/11/89.

Volucella nigra Greene. Observed at flowers of *Bebbia juncea* and *Cercidium microphyllum.* BP 4/30/89; VU 10/10/88.

Volucella sp. There were 2, possibly 3, species which were not identified beyond genus. Observed feeding at flowers of *Bebbia juncea; Baccharis sarotroides;* and *Eriogonum wrightii.* AL 3/11/89; BP 10/17/87, 9/30/89, 3/24/90; VU 10/10/88.

Subfamily: Syrphinae
Allograpta exotica (Wied.). Collected only once, BP 10/17/87.

Allograpta obliqua (Say). Collected at AC 10/1/89; AL 10/18/87; BP 10/17/87.

Baccha lemur Osten-Sacken. SE 2/18/89, collected at light.

Baccha sp. Collected only once, AR 4/13/90 in *Prosopis* flowers.

Eupeodes volucris Osten-Sacken. Collected at AC 4/10/88; AG 5/5/90; AL 4/9/88, 5/5/90; NE 1/28/89.

Mesograpta marginata (Say). Collected at *Eriogonum wrightii,* BP 9/30/89.

Nausigaster geminata Townsend. Collected only once, AC 4/29/89.

Scaeva pyrastri (L.). At *Encelia farinosa,* AC 4/10/88; AL 3/11/89.

Syrphus opinator Osten-Sacken. AL 8/26/89.

Undetermined taxa. Collected 1 specimen of a syrphid fly, Bl? 10/17/87, remains unidentified beyond family.

Family: Tabanidae (Horse Flies and Deer Flies)
Adult females of most species inflict painful bites on people. Males feed on nectar. Larvae are aquatic or inhabit mud. These flies are quite rare, but widely distributed at OPCNM. Apparently only 1 species is present.

Apatolestes sp. Collected at light or attempting to bite collectors. AC 4/10/88, 4/29/89; AG 5/5/90; GC 4/13/90.

Family: Tachinidae (Parasitic Flies)
Most tachinids are stout, bristly flies usually seen at flowers, and occasionally collected at lights. All larvae are internal parasites of other insects, especially caterpillars. They are considered to be very important as biological control agents of phytophagous insects. Many species are undescribed, and 1,277 species are known from the United States and Canada (Arnett 1985).

Undetermined taxa. Most of our specimens could not be identified beyond family. They appear to represent at least 4 species. Specimens collected at AC 4/10/88; AG 11/22/87; AL 3/11/89; AR 4/14/90; BP 9/10/88; SA 4/8/89; SE 10/9/88,4/13/90.

Subfamily: Goniinae
Drino sp. Observed at *Eriogonum fasciculatum* flowers. Collected only at AC 4/10/88, 4/29/89.

Spoggosia gelida (Coquillett). Probably our most common and widespread species in the family. Larvae parasitize lepidopteran caterpillars, adults feed at flowers (Arnett 1985). Collected at AG 11/22/87, 3/6/88; AL 9/10/88; BP 7/23/88,3/24/90; DR 8/27/88; GC 10/10/88.

Subfamily: Dexiinae
Pseudeuantha indita (Walker). Collected only once, AC 8/25/90.

Subfamily: Proseninae
Euphasiopteryx ochracea (Bigot). Collected at AG 11/21/87; AR 11/20/87.

Microchaetina sp. Collected only once, AG 11/22/87.

Microphthalma disjuncta (Wied.). Collected at AC 4/29/89; BP 1.0/17/87.

Ptilodexia sp. Collected at AL 3/11/89; BP 10/17/87.

Subfamily: Tachininae
Archytas lateralis (MacQuart). Collected only once, BP 10/17/87.

Peleteria bryand Cn. Collected at AG 11/22/87; AL 4/9/88.

Family: Tephritidae (Fruit Flies)
Adults generally have distinctive markings on their wings, which they use in courtship displays. Adults may feed on nectar or fruit juices. Larvae feed in fruit, seeds, leaves, or galls. Sometimes small clouds of adults may fly around ripe fruits, feeding and depositing eggs. There are 280 species known from the United States and Canada (Arnett 1985).

Ceroxys latiusculus (Loew). Collected only once, AG 11/22/8,7.

Euaresta bellula Snow. Collected at fruit of *Opuntia phaeacantha.* AG 11/22/87; AL 5/5/90; BP 10/17/87.

Eutreta augusta Banks. Collected only once, AC 7/24/88.

Tomoplagia cressoni Aczel. Collected at fruit of *Opuntia phaeacantha.* AC 10/17/87; AL 5/5/90.

Trupanea sp. Collected circling over and resting on *Ambrosia. ambrosiodes.* AG 11/22/87; AR 11/20/87; DR 11/21/87, 3/5/88; SE 4/19/88.

Undetermined taxa. Collected 2 specimens, possibly the same: species, from AG 3/6/88, 10/9/88.

Family: Therevidae (Stiletto Flies)
These uncommon flies were collected at lights or at flowers. Adults apparently feed at flowers and larvae are predacious, living in sand or decaying wood. There are 145 species known from the United States and Canada (Arnett 1985).

Arenigena sp. Collected at lights, AR 4/14/90; SE 4/13/90.

Brachylinga sp. Collected only once, at light, SE 4/19/88.

Psilocephala sp. Collected at *Amsinckia tesselata* and *Baccharis sarothroides* flowers. AG 3/6/88; AL 3/11/89; AR 2/26/88.

Family: Tipulidae (Crane Flies)
Large, slender, long-legged flies that resemble giant mosquitoes. They are most often found at lights, and do not bite. Larvae are aquatic, semi-aquatic or live in rotting vegetation, with a few species living in other terrestrial situations. This is the lw-gest family in the order Diptera, with 64 genera and 1,517 species known from the United States and Canada (Arnett 1985). They are very difficult to distinguish from each other. Specimens are very delicate, and legs break off easily, which further complicates identification.

Undetermined taxa. All of our specimens are identified only to family. It appears superficially that we may have 2 or 3 species. Collected at light, AG 3/6/88; AL 4/9/88; SE 4/19/88.

Family: Undetermined (Mystery Flies)
We collected 17 specimens, from many different sites, that we were unable to identify readily to family. Some of them may be duplicates of specimens we had identified, others may be new.

Order: Hemiptera (Bugs)
Family: Alydidae (Broad-headed Bugs)
Small, uncommon, plant-feeding bugs. There are 11 genera and 29 species known from the United States and Canada (Arnett 1985).

Subfamily: Alydinae
Alydus sp. Collected only once, SA 8/19/89.

Family: Belostomatidae (Giant Water Bugs)
Large, aquatic bugs, usually found in the muddy bottoms of tinajas or pools. Predacious on insects, tadpoles, and fish. Capable of inflicting a sharp bite if handled. Adults may come to lights, but our 2 specimens were collected in water. There are 3 genera and 20 species known from the United States and Canada (Arnett 1985).

Subfamily: Belostomatinae
Belostoma flumineum Say. Collected 1 specimen, from DT 7/23/88. Larsen (n.d.) collected *Belostoma* sp. at Quitobaquito.

Subfamily: Lethocerinae
Lethocerus sp. Collected 1 specimen, from a tinaja at BP 4/30/89. Larsen (n.d.) collected *Lethocerus medius* in Ajo Mountains and wells. Our specimen may be this species.

Family: Berytidae (Stilt Bugs)
Long, thin antennae and legs and slender bodies characterize this, plant-feeding family of 14 U.S. species. May come to lights.

Subfamily: Metacanthinae

Aknisus multispinus (Ashmead). Collected only once, 3 specimens, at light SA 8/19/89.

Family: Coreidae (Squash Bugs)
This is a large family of plant-feeding bugs. There are 33 genera and 120 species known from the United States and Canada (Arnett 1985). Most are brown and inconspicuous. All have scent glands that are capable of secreting chemical defenses against predators. Some come to lights at night. Probably more abundant and diverse in OPCNM than our records suggest.

Undetermined taxon. Collected at AR 11/21/87; identified to family only.

Subfamily: Coreinae
Catorhintha selector Stal. Collected on flowers of *Boerhaavia* sp., AL 8/26/89.

Chelinidea vittiger Uhler. Collected on *Opuntia phaeacantha* at BP 7/23/88.

Leptoglossus oppositus (Say). Collected on *Opuntia phaeacantha* at SA 8/19/89 and VU 4/21/88. L. *brevirostis* Barber was reported by Hall et al. (1988) from AL.

Narnia femorata Stal. Collected only once, on *Opuntia phaeacantha,* BP 8/25/90. *Narnia* sp. was reported by Hall et al. (1988) from AL.

Family: Corixidae (Water Boatman Bugs)
Brown, rapidly-swimming aquatic bugs, these are generally seen swimming in tinajas. Some species are vegetarians, feeding on algae, while others feed on smaller insects. Some may come to lights at night. There are 19 genera and 122 species known from the United States and Canada (Arnett 1985). Identification is difficult, and is based largely on characteristics of adult male genitalia.

Undetermined nymphs. Several specimens, probably all the same species, were too young to identify even to genus. BP 10/17/87.

Subfamily: Corixinae
Graptocorixa sp. Collected at BP 9/10-11/88. Larsen (n.d.) collected 2 species of this genus.

Trichocorixa sp. Collected at AG 5/5/90; DT 7/23/88. Larsen (n.d.) collected an unidentified species of this genus at Quitobaquito.

Family: Cydnidae (Burrower Bugs)
Black or dark brown bugs with the front legs flattened and used for burrowing in soil. They climb on plants to feed, and may come to lights at night. There are 36 species known from the United States and Canada (Arnett 1985).

Subfamily: Cydninae
Dallasiellus californicus (Blatchley). Collected at lights, AC 7/23/88 and AL 7/29/89. Reported by Hall et al. (1988) from AL.

Pangaeus bilineatus (Say). Collected at lights, AC 7/23/88; AL 7/29/89. Also reported by Hall et al. (1988) from AL.

Family: Gerridae (Water Strider Bugs)
Aquatic bugs that skate on the surface film of still water. These predators catch insects that come to the water and are trapped in the film or that fall into the water. There are 80 genera and 45 species known from the United States and Canada (Arnett 1985).

Subfamily: Gerrinae
Gerris remigis Say. Collected from water, BP 9/10/88, 4/30/89. Also listed by Larsen (n.d.).

Family: Largidae (Red Bugs and Ant Mimic Bugs)
A small family of plant feeding bugs, most are usually marked with red or yellow. Generally uncommon and/or overlooked. There are 5 genera and 17 species known from the United States and Canada (Arnett 1985).

Subfamily: Largidae
Largus cinctus (Herrich-Schaeffer). Collected on *Baccharis sarothroides* and *Sapium biloculare.* AC 7/29/89; DR 3/11/89; GC 11/22/87. Also reported by Hall et al. (1988) from AL.

Family: Lygaeidae (Seed Bugs)
A large family of often colorful and sometimes pestiferous bugs. Many are a combination of red and black, which may be aposematic, warning of noxious chemical defenses against predation. Most are seed feeders, but some feed on plant juices. Most of our species were either found on food plants or came to lights. There are 295 species known from the United States and Canada (Arnett 1985).

Subfamily: Lygaeinae
Lygaeus belfrage Stal. Found on *Baccharis sarothroides,* BP 9/30/89; GC 11/22/87.

Lygaeus kalmii Stal (small milkweed bug). Known to feed on *Asclepias* species (Arnett 1985), but also found on other plants including *Erodium cicutarium,* and collected at lights. AR 2/27/88; BP 10/17/87.

Lygaeus lateralis Dallas. Occasionally builds up enormous populations after a good spring bloom and may invade houses because it is attracted to lights. Although capable of biting, its bite is not painful. Collected at AL 4/9/88, 7/29/89; PO 9/10/90. Also observed around and in visitor center, 4/20/88.

Lygaeus reclivatus Say. Collected only at BP 7/23/88, on milkweed.

Lygaeus rubricollis (Uhler). Widespread and common in the monument, often collected at lights. AC 7/23/88; AG 10/8/88; SE 10/31/87, 9/9/90. Also reported by Hall et al. (1988) from AL.

Lygaeus sp. Collected 1 specimen at light which could not be identified to species with certainty, AC 9/30/89.

Oncopeltus fasciatus (Dallas) (large milkweed bug). Collected on. *Asclepias* sp. and *Baccharis sarothroides.* BP 4/30/89, 9/30/89.

Subfamily: Orsillinae
Nysius raphanus Howard (false chinch bug). Collected only once, at AL 4/9/88, 5 specimens on *Erigeron divergens.*

Subfamily: Rhyparochrominae
Ligyrocoris nitidulus Uhler. Collected at lights, AG 10/8/88; GC 11/21/87, 4/8/89. Also reported by Hall et al. (1988) from AL.

Ligyrocoris sp. Collected only once, DR 3/11/89, at light.

Family: Miridae (Plant Bugs)
A large family of bugs that may be very difficult to identify with 207 genera and 1,777 species known from the United States and Canada (Arnett 1985). Most feed on plant juices, some are predacious. Many are agricultural pests. Some come to lights.

Undetermined taxa. Collected 10 specimens which were identified only to family. They probably represent several different species.

Subfamily: Mirinae
Lygus hesperus Knight. Often a pest on a variety of agricultural crops. Our only specimen was collected at light AG 11/22/87.

Lygus sp. The genus has 34 species known from the United States and Canada (Arnett 1985). Our specimens may represent more than 1 species. Collected on *Cucurbita digitata,* and at lights. AR 9/9/90; BP 10/17/87; PO 9/10/90.

Neurocolpus sp. Collected at lights, BP 4/29/89; GC 4/8/89. There are 14 species known from the United States and Canada (Arnett 1985).

Phytocoris ramosus Uhler. Widespread and abundant. Collected on *Larrea* and at lights: AL 4/9/88; AR 4/14/90; DR 3/11/89; NE 3/5/88; SE 10/30/87, 4/19/88, 4/13/90; VU 4/21/88.

Phytocoris sp. Perhaps several species, the genus has 198 species in the United States and Canada (Arnett 1985). Collected at lights, AG 11/21/87, 10/8188, 5/5/90; DR 8/27/88, 3/11/89; GC 4/8/89; SA 10/31/87; SE 10/30/87.

Phytocoris squamosus Knight. Collected at light, SE 4/19/88.

Phytocoris stitti Knight. Collected at light, NE 3/5/88.

Taedia sp. Collected at light BP 10/17/87.

Subfamily: Orthotylinae
Lopidea eremita VanDuzee. Collected at light, GC 9/10/88.

Parthenicus aureosquamis Knight. Collected only once, DR 8/27/88.

Parthenicus nicholi Knight. Collected only once, SE 4/19/88.

Parthenicus sp. Collected only once, SE 4/19/88.

Subfamily: Phylinae
Atomoscelis modestus (Van Duzee). Collected only once, DR 8/27/88.

Spanagonicus albofasciatus (Reuter) (white-marked fleahopper). An occasional pest of grass, especially golf courses and lawns. Collected only once, AC 7/23/88.

Family: Nabidae (Damsel Bugs)
A small family of predacious bugs, usually found hiding on flowers awaiting prey. There are 48 species known from the United States and Canada (Arnett 1985).

Subfamily: Nabinae
Nabis alternatus Parshley (western damsel bug). Collected on *Sphaeralcea* and at lights. BU 4/8/89; SA 10/31/87. Probably more abundant than our records indicate.

Family: Nepidae (Waterscorpions)
A small family of aquatic bugs with breathing tubes at the posterior. The bugs tend to be sedentary, lying in wait on submerged objects until suitable prey swims by, then grabbing with raptorial front legs. Capable of biting people if handled. There are 13 species known from the United States and Canada (Arnett 1985).

Subfamily: Ranatrinae
Ranatra quadridentata Stal. Collected only once, in water at DT 7/23/88. Also reported by Hall et al. (1988) from AL, and Larsen (n.d.) from several locations.

Family: Notonectidae (Backswimmers)
Often abundant bugs in small water sources, they actively swim about in search of prey that usually consists of insects that visit or fall into the water. They are highly migratory, and reach new water sources within a matter of days after rains. Capable of biting if handled. There are 3 genera and 35 species known from the United States and Canada (Arnett 1985). Larsen (n.d.) listed 7 species for OPCNM, only 3 of which we found.

Buenoa arida Truxel. Collected at BP 10/17/87 and 7/23/88.

Buenoa arizonis Bare. Collected at BP 9/10/88; DT 7/23/88.

Buenoa margaritacea Torre Bueno. Collected only once, AG 8/28/88.

Family: Pentatomidae (Stink Bugs)
A family of primarily plant-feeding bugs, some of which are agricultural pests. Some species are predacious. All have scent glands that may have defensive; roles. There are 76 genera and 247 species known from the United States and Canada (Arnett 1985).

Subfamily: Asopinae
Podisus acutissimus Stal. Predacious on other insects. Collected only once, DR 8/27/88.

Subfamily: Pentatominae
Acrostemum hilare (Say) (green stink bug). An occasional pest of fruit orchards and soybeans, found throughout the United States. Collected at lights, AC 9/30/89; AL 9/10/88.

Brochymena sulcata Van Duzee. Collected only once, at light AR 11/21/87.

Chlorochroa opuntiae Esselbach. Collected only once, AG 10/8/88.

Mecidea longula Stal. Collected only once, BP 10/17/87.

Murgantia histrionica (Hahn). Collected only once, BP 8/25/90.

Thyanta pallidoventris Stal. Abundant and widespread, known to feed on *Larrea* (Schultz et al. 1977). Collected on *Larrea, Cucurbita digitata,* and *Cirsium neomexicanum* as well as at lights. AC 7/23/88, 9/30/89; AL 9/10/88; AR 9/9/90; BP 4/30/89; DR 3/5/88, 3/11/89; EA 7/23/88; GC 9/10/88, 10/10/88, 4/8/89; PO 7/11/90, 9/10/90; SE 10/9/88; 9/9/90. Probably can be found at all locations in the monument. Also reported by Hall et al. (1988) from AL. May be an agricultural pest on a variety of crops.

Family: Phymatidae (Ambush Bugs)
Often colorful, these predacious bugs usually hide in flowers awaiting insects. Colors often match flowers well, with shades of yellow predominant. Ambush bugs may remain motionless for hours, then move with amazing speed to grasp their prey in raptorial front legs so it can stab the prey with a sharp, short beak. Some may have toxic saliva, and some may be resistant to stings of wasps and bees. May inflict a small bite if handled by people. There are 2 genera and 22 species known from the United States and Canada (Arnett 1985).

Subfamily: Phymatinae
Phymata sp. Collected only once, AL 10/18/87, 2 specimens.

Family: Reduviidae (Assassin and Thread-legged Bugs)
A family of 39 genera and 106 species in the United States and Canada (Arnett 1985). Species are either predacious, and resemble Phymatidae in behavior, or blood-sucking and live in rodent, especially *Neotoma,* nests. All can bite if handled.

Subfamily: Apiomerinae
Apiomeris flaviventris Herrich-Schaeffer. Collected only once, AC 7/30/89.

Apiomeris longispinis Champion. Collected at AL 7/28/90; BP 9/10/88, 8/25/90. Known to feed on honey bees. Also reported by Hall et al. (1988) from AL,

Subfamily: Ectrichodiinae
Rhiginia cictiventris Stal. Collected at AL 7/29/89; SE 9/9/90, at lights. Also reported by Hall et al. (1988) from AL.

Subfamily: Emesinae
Stenolemoides arizonensis (Banks). Collected only once, NE 3/5/88, 3 specimens.

Subfamily: Harpactorinae
Sinea confusa Caudell. Collected on *Baccharis sarothroides, Bebbia juncea,* and *Spharalcea* sp., also at lights. AG 7/28/90; BU 4/8/89; SA 8/19/89; VU 10/10/88.

Zelus renardii Kolenati (leafhopper assassin bug). Collected only once, SA 8/19/89. Also found at Quitobaquito (Kingsley et al. 1987).

Zelus socius (Uhler). Collected at lights, AG 10/8/88; DR 3/11/89. Also reported by Hall et al. (1988) from AL. Also found at Quitobaquito (Kingsley et al. 1987).

Subfamily: Piratinae
Rasahus biguttatus (Say). Collected at lights, PO 7/11/90, 9/10/90. Also found at Quitobaquito (Kingsley et al. 1987).

Subfamily: Triatominae
Triatoma protracta (Uhler) (western bloodsucking conenose). Collected only once, at light, AC 7/23/88, 2 specimens.

Triatoma recurva (Stal). DR 8/27/88, 2 specimens, at light.

Triatoma rubida (Uhler). Our most common and widespread "kissing bug," collected at lights, AC 7/23/88; AL 7/29/89; EA 7/23/88. Also reported by Hall et al. (1988) from AL, and at Quitobaquito (Kingsley et al. 1987). Capable of inflicting a very painful bite, it attacks sleeping or sedentary people at night. Severe reactions may occur (Smith 1982).

Family: Rhopalidae (Scentless Plant Bugs)
Plant-feeding bugs that are generally unobtrusive and not destructive, these may be quite numerous at times. Most feed on sap, but a few species feed on seeds. There are 36 species known from the United States and Canada (Arnett 1985).

Subfamily: Rhopalinae
Liorhyssus hyalinus (Fabricius) (hyaline grass bug). Found throughout the United States, usually on weeds or grass. May come to lights. Collected at AG 11/22/87; BU 4/8/89, on *Sphaeralcea* sp. Also found at Quitobaquito (Kingsley et al. :1987).

Stictopleuris crassicornis (L.). Collected at AG 10/8/88; BU 4/8/89, on *Bebbia juncea* and *Sphaeralcea* sp.

Family: Scutelleridae (included by Arnett [1985] in Pentatomidae)
Our species are quite rare, half-inch long, dark bugs, with the scutellum covering the wings. Plant feeders.

Sphyrocoris punctellus (Stal). *AC* 7/29/89, on *Ambrosia deltoidea.*

Order: Homoptera (Cicadas, Leafhoppers, Aphids, Scale Insects, and Allies)
This is a large, diverse, and difficult to identify order, with 894 genera and 6,329 species known from the United States and Canada (Arnett 1985). New species are described each year. Distribution, habits, and basic biology are known only for a few species. All are plant feeders, and some lose all recognizable body parts when they settle down on their food plants. Many are agricultural pests. Most of our specimens were collected at lights.

Undetermined families. There were 8 specimens which were identified to order only. They probably represent several species from a few different families.

Family: Aleyrodidae (Whiteflies)
The tiny adults of most species are seldom seen. Nymphs and. pupae are sedentary on leaves and are easily overlooked. We probably have many more species than the one we found. Some species may be agricultural pests, especially those that are vectors for plant diseases. There are 99 species known from the United States and Canada (Arnett 1985).

Undetermined taxon. Collected only once, on *Quercus ajoensis.* AL 3/11/89.

Family: Cicadellidae (Leafhoppers)
Often common or abundant, sometimes quite colorful, this is the largest family of Homoptera, with 2,507 species known from the United States and Canada (Arnett 1985). Many are difficult for specialists to identify. Many species are agricultural pests of considerable importance. Leafhoppers feed on plant juices and lay their eggs in plant tissues.

Undetermined taxa. There were 33 specimens, collected at many sites, which were not identified beyond family.

Subfamily: Deltocephalinae
Acinopterus sp. Collected only once, DR 8/27/88.

Norvellina pulchella (Baker). Collected only once, SE 4/19/88, 2 specimens at light.

Spathanus acuminatus (Baker). Widespread and common, collected on *Larrea* and at lights. AR 4/14/90; DR 8/27/88; NE 3/5/88; SA 10/31/87; SE 10/30/87, 4/19/88, 10/9/88.

Texananus incuavatus (Osb. & Lath.). Widespread and common, collected at lights, BP 4/29/89; DR 8/27/88, 3/11/89; EA 7/23/88; SE 4/19/88, 10/9/88.

Texananus sp. This appears to be different from the above, and may be 1 or more of the other 37 described species. Collected at lights, AC 7/23/88; AL 9/10/88; SE 10/30/87.

Subfamily: Iassinae
Hamana sp. Collected at AC 8/25/90; AL 9/10/88; GC 9/10/88.

Subfamily: Tettigellinae
Draeculacephala minerva Ball (grass sharpshooter). Collected only once, on *Cyperus* sp. AG 1/28/89.

Homalodisca lacerta (Fowler). Uncommon, collected at lights and on *Castela emoryi.* DR 11/21/87; GC 9/10/88, 9/9/90.

Family: Cicadidae (Cicadas)
Noisy, conspicuous but well camouflaged and difficult to catch, common summer insects. Adults feed in trees, the males making a loud droning buzz. Buzzing may be a territorial signal or mating call. A special loud buzz is used as a defense if a male is captured. The calls cease as a collector approaches, and the insect blends with its environment so well it is often impossible to find. Indian children are said to catch and eat cicadas as delicacies. Nymphs feed on roots underground. Nymphs emerge from underground and climb trees or other vertical surfaces, then shed their skins. The empty nymphal skins remain in place for days or weeks following emergence. All species have long life cycles, lasting 2-17 years. Our specimens may not reflect the diversity of the group, and we may lack specimens of our most common species. There are 22 genera and 166 species known from the United States and Canada (Arnett 1985).

Subfamily: Tibiceninae
Diceroprocta semicincta Davis. Collected only once, but probably quite common and widespread. EA 7/23/88 on *Cercidium microphyllum.*

Tibicen sp. Collected only once, but probably quite common and widespread. BP 7/23/88 on *Dodonaea viscosa.*

Family: Cixiidae (Cixiid Planthoppers)
Adults feed on trees and shrubs, nymphs feed on roots. There are 13 genera and 172 species known from the United States and Canada (Arnett 1985).

Oecleus sp. Collected on *Acacia greggii.* AC 7/23/88, 1/28/8!), 4/29/89; AL 4/9/88, 9/10/88. Also reported by Hall et al. (1988) from AL.

Family: Flatidae (Flatid Planthoppers)
Curiously constructed, wedge-shaped brownish or greenish insects, Flatids feed on trees and shrubs. They are not common in the United States, where 33 species are found (Arnett 1985), but are much more common and colorful in the tropics. Some species are agricultural pests.

Subfamily: Flatinae
Mistharnophantia sonorana Kirkaldy. SE 10/30/87, collected at light.

Ormenis sp. Widespread and fairly common in OPCNM. Found on *Lycium* spp. and probably other plants and collected at lights. AC 9/30/89; AG 8/26/89; AL 9/10/88; DR 8/27/88; EA 7/23/88; GC 9/10/88; NE 8/27/88; SE 10/30/87, 10/9/88. Probably all 1 species.

Subfamily: Flatoidinae
Flatoidinus fuscus (VanDuzee). Fairly widespread, collected at lights in spring and fall. AC 9/30/89; AL 4/9/88, 9/10/88; DR 3/11/89.

Family: Fulgoridae (Fulgorid Planthoppers)
Uncommon plant-feeding insects, only 15 species are known :from the United States and Canada (Arnett 1985).

Subfamily: Amyclinae
Scolopsella reticulata Ball. Collected at lights, AG 5/5/90; AL 9/10/88; GC 10/10/88; SE 10/9/88, 9/9/90.

Family: Issidae (Weevillike Planthoppers)
Small, dark, uncommon planthoppers, living on trees or grasses. There are 23 genera and 127 species known from the United States and Canada (Arnett 1985).

Undetermined taxa. Our specimens may represent more than I species. All were collected at lights. AG 11/21/87, 5/5/90; SE 10/30/87.

Family: Kerridae (= Tachardiidae in Arnett [1985]) (Lac Scales)
These seldom look like insects, but resemble strange waxy or resinous growths on twigs. Only 6 species are known from the United States and Canada (Arnett 1985).

Subfamily: Tachardiinae
Tachardiella larreae (Comstock). Found on *Larrea* as a reddish-brown cluster of resinous material on outer twigs. Often attended by ants of the genus *Crematogaster.* Observed throughout the monument, but apparently most abundant at the north end sites during the period of this study.

Family: Membracidae (Treehoppers)
A large family, with over 2,400 species in the world and 56 genera and 258 species known from the United States and Canada (Arnett 1985). Most species are said to be host-specific, on trees and shrubs. Nymphs secrete honeydew and may be attended by ants.

Subfamily: Smiliinae
Bajulata bajula Goding. Collected only once, AG 5/5/90.

Subfamily: Daminae

Stictopelta arizona Goding. Collected only once, EA 7/23/88.

Undetermined taxon. Collected only once, AC 7/23/88.

Order: Hymenoptera (Ants, Bees, and Wasps)
Family: Andrenidae (Andrenid Bees)
This is the largest family of bees, with 1,199 species known from the United States and Canada (Arnett 1985). They nest in tunnels in soil, sometimes many individuals in a small area.

Identification to species is very difficult, and only a few specialists will attempt it. These bees may be important pollinators of many plant species. Some bee species may be fairly selective in their choice of plants, others may be very broad in their choice.

Subfamily: Andreninae
Andrena sp. Possibly more than 1 species. Collected at *Calliandra eriophylla* and *Sphaeralcea* sp. NE 3/5/88, 3/12/89; VU 2/18/89. Likely to be more widespread and several species. There are 38 subgenera and 529 species known from the United States and Canada (Arnett 1985).

Subfamily: Panurginae
Perdita sp. Possibly more than 1 species. Collected at *Prosopis velutina* and *Wislizenia refracta.* AG 10/9/88; AR 4/13/90. Likely to be more widespread'. and comprise several species. There are 20 subgenera and 614 species known from the United States and Canada (Arnett 1985).

Family: Anthophoridae (Cuckoo Bees, Digger Bees, & Carpenter Bees)
Common and diverse, there are 920 species known from the United States and Canada (Arnett 1985). Most live in tunnels in soil that they excavate. Adults feed on nectar and pollen, and females provision nests with nectar and pollen on which larvae feed. These are solitary bees, although some may occur in concentrated patches with suitable conditions.

Subfamily: Anthophorinae
Anthophora coptognatha (Timberlake). Collected at DR 3/5/88; 'VU 2/18/89; in *Larrea* flowers.

Anthophora forbesi (Cock.). Collected only once, VU 2/18/89.

Anthophora lesquerellae (Cockerell). Collected at AL 3/11/8!9; DR 3/5/88; in *Larrea* flowers.

Anthophora sp. Collected at AC 3/25/90 at *Dichelostemma pulchellum;* BP 3/24/90 at *Viguiera deltoidea.* These may be different species.

Anthophora urbana urbana (Cresson). Collected at AC 4/10/88, 3/25/90; AG 11/22/87; BP 4/30/89; LO 4/20/88. At *Cercidium microphyllum, Coursetia microphylla,* and *Rhamnus betulaefolia.*

Centris lanosa (Cress.). Collected at LO 4/20/88; SA 4/8/89. At *Acacia greggii, Cercidium microphyllum, Coursetia microphylla,* and *Larrea tridentata.*

Centris pallida (Fox). Collected at AC 3/25/90; BU 4/8/89; VU 4/21/88. At *Echinocereus engelmannii; Opuntia phaeacantha; Rhamnus betulaefolia.*

Diadasia diminuta (Cr.). Collected only once, DO 4/8/89 at *Sphaeralcea* sp.

Diadasia lutzi Ckll. Collected only once, DO 4/8/89 at *Sphaeralcea.*

Eriocris lata (Cress.). Collected at BU and SA, both on 4/8/89.

Melissodes limbus LaBerge. Collected at BP 9/10/88; 4/30/89.

Undetermined taxa. We identified 11 specimens to subfamily only; they may represent several genera and species.

Subfamily: Xylocopinae
Xylocopa californica arizonensis Cress. These are large black carpenter bees that burrow into wood or woody stems and make nests which are provisioned with balls of nectar and pollen. Most common near *Agave.* Observed feeding at *Beloperone californica* flowers. Collected at AC 3/25/90; AL 4/9/88; BP 7/23/88, 9/10/88, 9/30/89; DR 3/5/88; NE 8/27/88.

Family: Apidae
Subfamily: Apinae
Apis mellifera Linnaeus (honey bee). Common to abundant, introduced and important. See discussion in separate section of this report. Records: AC 10/17/87, 3/25/90; AG 10/8/88, 8/26/89, 2/24/90; 4/14/90; AL 10/18/87, 8/26/89; AR 11/21/87, 2/29/88; BP 10/17/87, 3/24/90; DR 11/21/87, 3/5/88, 10/8/88; EA 11/20/87; GC 11/'22/87, 2/27/88, 9/10/88, 4/8/89, 2/25/90, 4/14/90; LO 10/30/87, 4/20/88, 4/13/90; NE 11/21/87, 3/5/88, 8/27/88; SA 10/31/87; SE 4/19/88, 10/10/88, 8/18/89; VU 10/10/88,2/18/89, 2/24/90. No records from PO, DO, BU, DT, but this insect undoubtedly occurs at these sites occasionally. A hive is present in the rocks immediately north of the Dos Lomitas exclosure (established May 1990), but bees were not observed foraging on the DO site during our visits to it. Honey bees were recorded feeding at: *Ambrosia ambosiodes, Bebbia juncea, Calliandra eriophylla, Cercidium foridum, Cercidium microphyllum, Larrea tridentata, Lesquerella gordoni, Lycium* sp.*, Opuntia phaeacantha; Phoradendron californicum, Prosopis velutina, Rhamnus betulaefolia,* and *Sapium biloculare.* It undoubtedly feeds on many other plants as well. Also abundant at water.

Family: Braconidae (Braconids)
A large family of generally small to 15 mm wasps, solitary in nature. Adults feed at flowers and come to lights. Larvae are internal parasites of Lepidoptera larvae. There are 1,937 species known from the United States and Canada (Arnett 1985)., Identification is extremely difficult, and many species may be undescribed.

Undetermined taxa. There were 32 specimens, representing several different species identified only to family.

Subfamily: Cheloninae
Chelonus cautus Cresson. Collected only once, at *Calliandra eriophylla* flowers, BP 9/10/88.

Subfamily: Euphorinae
Meteorus leviventris (Wesmael). Collected at AL 9/10/88; SE 4/19/88.

Subfamily: Microgastrinae
Apanteles sp. Collected only once, SE 4/19/88. There are 197 species known from the United States and Canada (Arnett 1985).

Subfamily: Rogadinae
Buccalatriplex bucculatricis (Ashmead). Collected only once, AL 4/9/88.

Rogas sp. Collected at AG 11/21/87; GC 11/21/87.

Family: Chalcididae (Chalcidid Wasps)
Generally tiny wasps that are parasites of Lepidoptera, Coleoptera, and Diptera. They are probably much more common than our records indicate. The best way to sample for them is to rear them from parasitized insects, which we did not do.

Subfamily: Chalcidinae
Spilochalcis sp. Collected only at BP 7/23/88 and 9/10/88.

Family: Colletidae (Yellow-faced and Plasterer Bees)
Small black bees, some with yellow markings on the face. Colletids nest in the ground, rock crevices, or plant stalks. They gather nectar and pollen to feed their larvae. There are 153 species known from the United States and Canada (Arnett 1985).

Subfamily: Colletinae
Colletes louisae Ckll. Collected at AC 4/10/88; AG 11/22/87. Feeding at flowers of *Coursetia microphylla.*

Colletes sp. Collected at AR 4/13/90; DR 3/12/89. Feeding at flowers of Prosopis velutina. There are 114 species in this genus known from the United States and Canada (Arnett 1985).

Subfamily: Hylaeinae
Hylaeus sp. Collected at AC 10/17/87; AL 10/18/87.

Family: Eulophidae (Eulophid Wasps)
A small family of 507 U.S. species of tiny parasitic wasps. May parasitize scale insects, beetles, moths, and other orders. Some are egg parasites, laying their eggs in those of other insects.

Undetermined taxon. Collected only once, AG 11/22/87, 2 specimens.

Family: Formicidae (Ants)
A large, diverse, and easily recognized family (in most cases). Ants are extremely important in desert ecosystems. They turn over and aerate soil, harvest and (inadvertently) plant seeds, are major predators and scavengers, and are important food for many wildlife species.

One of the great myrmecologists, William S. Creighton, visited OPCNM from 12 March to 30 March 1952. He sampled ants at Alamo Canyon (AL), the Headquarters Campground (CG), Dripping Springs (DS), Abra Wash (AW) (foot of the Growler Mountains, location uncertain to me), and Quitobaquito (Q). He collected 29 species, some of which were not found by us. A copy of his report is on file in monument records. Since his visit, there has been active taxonomic revision of some groups of ants. In this report, generic names are those found in Arnett (1985), specific names

are those found in Creighton (1950), with the exception of the genus *Pogonomyrmex* for which names are those of Cole (1968).

Subfamily: Dolichoderinae
Dorymyrmex pyramicus (Roger). Collected at AG 11/22/87; SE 10/30/87. Also found by Creighton (1952) at AL, CG, AW. Probably widespread and abundant in the monument. It is quite tiny and inconspicuous. It feeds primarily on honeydew, plant juices, and dead insects.

Dorymyrmex pyramicus bicolor Wheeler. Not reported by Creighton (1952). This subspecies is distinctly different from the above, at least in coloration and behavior. Creighton (1950) considers it a subspecies. Wheeler and Wheeler (1973) list it as a separate species. Both authors point out that this form is active at hotter temperatures, nests in hotter places, and seems to be better adapted for desert life. Collected only once, GC 11/22/87.

Forelius foetida (Buckley). Collected only once, in fruit of *Lophocereus schottii* at LO 8/28/88. Also found by Creighton (1952) at AW. This is a tiny, obscure ant, easily overlooked, so it may be much more common than our records indicate.

Forelius pruinosus Andre (Formerly *Iridomynnex pruinosum analis* Andre). Collected at AC 7/24/88; AL 4/9/88; BP 7/23/88; BU 4/8/89; GC 11/21/87; NE 8/27/88. Also found by Creighton (1952) at AL, CG, Q, AW. An abundant, widespread ant, found throughout the monument. Eats insects and honeydew.

Subfamily: Dorylinae
Neivamyrmex nigrescens (Cresson). Collected only once, SE 4/14/90 in combat with *Camponotus fumidus festinatus.* Not listed by Creighton (1952). Reported by Hall et al. (1988) from AL. This is an army ant, forming highly nomadic colonies that raid other ant colonies and carry off eggs and larvae for food, as well as feeding on any other insects that can be caught.

Neivamyrmex pilosum mandibulare (MR Smith). Another army ant, this was collected at AG 3/6/88 (workers on ground), 8/26/89 (alates at light). Not reported by Creighton (1952).

Subfamily: Formicinae
Camponotus fumidus festinatus (Buckley). Collected only once, at SE 4/14/90, in combat with *Neivamyrmex nigrescens.* Not listed by Creighton (1952).

Camponotus sp. The genus *Camponotus* is the largest in the ant family, and species are very difficult to distinguish. Identification is based on characteristics of the major worker, which may not be available in all samples. Creighton (1952) found 2 species (*C. vafer* and *C. sayi)* that we did not find, or could not identify with certainty. Hall et al. (1988) reported unidentified species of *Camponotus* from AL. Our only unidentified specimen came from BP 10/17/87.

Camponotus vicinus Mayr. Collected only once, NE 1/28/89, under rock. Not reported previously from the monument.

Myrmecocystis melliger Forel. Widespread and abundant in the monument. Collected at AR 2/27/88; NE 8/27/88, 3/12/89; BP 3/24/90; EA 11/20/87; SA 10/31/87. Also found by Creighton (1952) at CG and AW. Collected on *Euphorbia* sp., and *Sapium biloculare.* This ant feeds primarily on nectar and honeydew. Workers forage for food, then store it as honey in the living bodies of ants (called "repletes") underground. The colony taps the repletes for food during times of scarcity. Indians are said to have used the repletes as a source of honey.

Paratrichina melanderi (Wheeler). Collected only once, AL 4/9/88 in *Anisicanthus thurberi.* Also found by Creighton (1952) at AL.

Undetermined taxon. A winged specimen, collected at light, BP 7/23/88, was identified to subfamily only.

Subfamily: Myrmicinae
Acromyrmex versicolor (Pergande). Widespread and abundant, this is the common leaf-cutter ant found throughout the monument lowlands in deep alluvial soil. Collected or observed at AR 11/20/87, 2/26/88, 10/21/89, 7/10/90; EA 11/20/87, 7/23/88, 9/10/88, 5/27/89, 10/21/89, 2/25/90, 4/15/90; GC 11/21/87, 9/10/88; LO 10/30/87, 4/14/90; SE 10/30/87; VU 11/1/87, 2/24/90. Recorded by Creighton (1952) at AW only ("abundant in the Abra Valley"). Not reported for highland areas or rocky soils. Builds symmetrical large craters which are thought to be ventilation shafts. Harvests green vegetation to use as compost for fungus gardens. The fungus is the only food of these ants.

Aphaenogaster cockerelli Andre. (Formerly called *Novomessor cockerelli*.) Possibly the most abundant and widespread ant in the monument. A slender, long-legged, black or reddish large ant, usually seen foraging individually. Entrances to nests are large enough to resemble rodent burrows. Primary food is insects. Observed feeding on termites. These ants frequently raided our light traps in large numbers, carrying off hapless prey with amazing speed. Also came to peanut butter baits. This is a gentle ant, as far as people are concerned, and does not bite or sting. The literature says that this ant is not a harvester, but I have observed it removing hundreds of mesquite seeds from its nest immediately after a rain, which suggests that at least these seeds may be harvested. Observed or collected at AG 11/22/87, 1/28/89, 8/26/89, 4/14/90; AL 7/29/89; AR 11/20/87; 2/26/88, 5/27/89, 10/21/89, 2/25/90, 4/14/90, 7/10/90; EA 11/20/87, 10/21/89, 4/15/90; GC 11/21/87, 2/27/88, 9/10/88, 4/8/89, 2/25/90; LO 10/30/87, 2/18/89; NE 11/21/87, 3/5/88; PO 8/18/89, 9/10/90; SA 10/31/87; SE 10/30/87, 4/19/88, 9/9/90; VU 11/01/87, 4/21/88, 10/10/88. Recorded by Creighton (1952) at CG, DS, AW, and Q. Also reported by Hall et al. (1988) from AL. Also found at Quitobaquito by Kingsley et al. (1987). Not recorded for AC or BP, but probably occurs there.

Atta mexicana (F. Smith). Not found at any of the SENECPRO sites during this study, although a dead colony was reported from SA. This large Mexican ant occurs only at a few locations in the monument as the only sites in the United States. Distribution and behavior have been studied by Mintzer for several years, information on which is in monument files.

Crematogaster arizonensis Wheeler. Collected only once, AL 4/9/88: Not reported by Creighton (1952).

Crematogaster coarctata vermiculata Emery. Collected at AL 3/11/89 on Quercus ajoensis; DR 3/5/88. Also found by Creighton (1952) at AL and AW.

Crematogaster depilis Wheeler. Collected at AR 11/21/87; SE 10/30/87; VU 11/01/87. Usually in company with the creosote bush lac insect *Tachardiella larreae*, from which it may derive some nourishment. Also found by Creighton (1952) at AL and CG.

Crematogaster sp. Specimens identifiable only to genus, either because they were winged males collected at lights or field observations without specimens. Collections: AC 7/29/89; PO 7/11/90. Observations: EA 5/27/89, 2/25/90; PO 8/18/89; VU 2/24/90. These may represent several species, some of which are listed above, others may have escaped collection and remain unknown to us.

Pheidole hyatti Emery. Collected at AG 11/21/87 and AR 2/27/88. Also found by Creighton (1952) at AL.

Pheidole sp. Identification of *Pheidole* is challenging and is based on details of the major workers, which are not always collected because they may be rare or inactive. Specimens identifiable only to genus were collected or observed at AR 11/21/87, 10/21/89; GC 4/8/89; SA 10/31/87; SE 8/18/89; VU 11/01/87. Creighton (1952) lists 5 species from the monument. Hall et al. (1988) listed *P. vistana* Forel from AL, a species that was not collected by us or by Creighton. *Pheidole* is a genus of small harvester ants, usually with 2 distinct morphs, a minor, which is abundant, and a much larger major, which generally remains in or near the nest and functions as a seed husker and defender of the nest. Their primary foods appear to be seeds of annual grasses and annual forbs.

Pheidole vasliti arizonica Santschi. Collected only once, AR 11/21/87. Also found by Creighton (1952) at AL and Q., and Kingsley et al. (1987) at Quitobaquito.

Pheidole xerophila tucsonica Wheeler. Collected at SA 10/31/87; SE 10/30/87. Also observed by Creighton (1952) at CG and AW.

Pogonomyrmex spp. The several species in the genus are harvester ants that harvest seeds from grasses and other plants. Seeds are stored in chambers of the underground nests. Harvester ants are also scavengers, eating insects and some other dead animals. Most harvester ants are equipped with potent stings, which protect the nest and the ant against marauders and can be very painful to people. Their venoms are especially toxic to vertebrates (Schmidt 1989). Identification of species is difficult, and a taxonomic revision by Cole (1968) was done after Creighton's visit to the monument. Some of the identifications made by Creighton, based on Cole's work, are questionable. Our identifications are the best we can do, using Cole as a reference, but we are not 100% certain of all of our determinations. Color is not generally a particularly useful way to distinguish the species, because most are variations of red. There are considerable variations of characters within each species, and much overlap between species. Creighton (1952) listed *P. imbericulus townsendi,* from AL, but we did not find this species, and the map in Cole (1968) shows no records near the monument.

Pogonomyrmex barbatus (F. Smith) (red harvester ant). Collected only once, but undoubtedly more common, DR 10/8/88. Creighton (1952) listed this species as from AL, 750-850 m elevation, but not lower.

Pogonomyrmex californicus (Buckley) (California harvester ant). Collected at BU 8/27/88; GC 11/21/87. Creighton (1952) reported it from AW.

Pogonomyrmex maricopa Wheeler (Maricopa harvester ant). This is probably our most abundant and widespread species of Pogonomyrmex. We collected or observed it at AL 4/9/88; AR 11/21/87, 9/10/88, 5/27/89, 10/21/89, 7/10/90; BP 10/17/87; EA 5/27/89; SA 10/31/87. The species was not listed in Creighton (1952), but may have been 1 of the varieties of "*P. californicus*" that he observed.

Pogonomyrmex pima Wheeler. Recorded from AR 10/21/87 and BU 8/27/88. Creighton (1952) listed this species from CG, DS, AW, and Q, and stated that it was "abundant in all parts of the monument up to elevation of 2,000 feet" (p. 2). Also found at Quitobaquito by Kingsley et al. (1987).

Pogonomyrmex rugosus Emery (rough harvester ant). Recorded from AR 2/27/88, 9/10/88, 5/27/89, 7/10/90; EA 5/27/89. Easiest to identify of our *Pogonomyrmex* species, this is a large, stout, and very dark ant, usually appearing black. It is most abundant on the north and west sides of the monument, in flat land with annual grasses. The sting is very painful. Nests are flattened circles of gravel, often with a ring of chaff or dense annual plants at the outer edge.

Solenopsis aurea Wheeler. A tiny, golden ant that is insectivorous and feeds on nectar and fruit. Has a sting that is not very potent. Collected at BP 10/17/87; NE 11/21/87. Also listed by Creighton at AL, "2200-2800 feet but not lower." Also reported by Hall et al. (1988) from AL.

Solenopsis xyloni McCook (southern fire ant). A tiny, red-and-black ant with habits like its congener, above, but with a slightly more potent sting. May be a pest in houses and other situations. Identifiable in the field by its red and black color, small size, and sting that has a distinctive feeling like fire. Collected from BP 10/17/87, 4/29/89; BU 4/8/89; EA 5/27/89; SE 5/27/89. Probably more common and widespread than our records indicate. Creighton (1952) listed it from AL, CG, and AW, "1,300-2,200 feet but not higher."

Undetermined taxa. Seven specimens of alate males belonging to this subfamily were not identified to genus.

Veromessor pergandei (Mayr). A widespread and abundant harvester ant, this shiny black ant is easy to recognize because it is always found in groups consisting of several sizes. It makes small craters that are usually surrounded by low chaff piles or sprouts of annual grasses. Creighton (1952) described it as "abundant throughout the monument at elevations below 2,000 feet" (p. 3). We recorded it from AR 11/21/87; EA 11/20/87, 7/23/88, 4/15/90; GC 11/21/87, 2/27/88; SA 10/31/87; VU 11/01/87, 4/21/88, 10/10/88.

Xiphomyrmex spinosus hispidus Wheeler. Collected only once, AR 11/21/87. Creighton (1952) listed it from AL and AW.

Subfamily: Ponerinae
Cerapachys augustae Wheeler. Collected at lights, alates only, AC 7/23/88; AL 9/10/88; SE 10/30/87. Rare. Not listed by Creighton (1952).

Odontomachus clarus Roger. A rare ant, collected only once, AC 10/17/87. Also reported by Hall et al. (1988) from AL.

Subfamily: Pseudomyrmicinae
Pseudomyrmex apache Creighton. A slender orange ant usually found in trees (oaks and mesquites). Collected at BP 10/17/87; LO 10/30/87. Creighton listed *"Pseudomyrma decipiens"* in his notes on ants of the monument, but does not list it in his monograph on ants of North America. Our determination is based on Wheeler and Wheeler (1973). Also reported by Hall et al. (1988) from AL.

Family: Gasteruptiidae (Gasteruptiid Wasps)
A small, little-known family of 1 genus and 15 species known from the United States and Canada (Arnett 1985). Adults feed at flowers, larvae develop as predators or live in nests of bees and wasps that nest in wood.

Gasteruption sp. Collected only at AL 10/18/87, 4/9/88, 5/5/90. Feeding at *Baccharis sarothroides* and *Eriogonum fasciculatum.*

Family: Halictidae (Sweat Bees)
This family gets its common name from a few species that are attracted to human perspiration. Sweat bees can sting if they are roughly handled or trapped, but the sting is not particularly painful. Most are brown or black, but some species are beautifully marked with shiny greens, blues, and yellows. Many species are very small. Sweat bees nest in the ground. There are 22 genera and 502 species known from the United States and Canada (Arnett 1985).

Undetermined taxa. We identified 2 specimens only to family. They appear to be different species.

Subfamily: Dufoureinae
Dufourea vandykei (Bohart). Collected only once, NE 3/5/88, 2 specimens, feeding at *Calliandra eriophylla.*

Subfamily: Halictinae
Agapostemon melliventris Cr. Collected at AG 10/9/88, 1/28/89; AL 9/10/88; VU 2/18/89. Feeding at *Malva parviflora, Sphaeralcea* sp., and *Wislizenia refracta.*

Agapostemon sp. We collected 1 specimen, VU 10/10/88 at *Bebbia juncea,* that appears to be a different species from the above.

Augochlorella neglectula (Ckll.). Collected at AC 4/10/88, 4/29/89; AG 11/22/87. At *Acacia greggii* and *Encelia farinosa.*

Dialictus sp. Collected at AC 4/10/88; AG 8/28/88; AL 10/18/87; NE 8/27/88. Probably all the same species. Feeding at *Sapium biloculare.*

Halictus ligatus (Say). Collected at AL 10/18/87; AR 2/29/88; NE 3/5/88. At *Calliandra eriophylla* and *Lesquerella gordoni.*

Lasioglossum sisymbrii (Cockerell). Collected only once, NE 3/5/88, at *Calliandra eriophylla.*
Sphecodes sp. Collected only once, AR 4/13/90 at *Prosopis velutina* flowers.

Subfamily: Nomiinae
Nomia nevadensis arizonensis Cockerell. Collected only once, at SA 4/8/89 at *Bebbia juncea* flowers.

Family: Ichneumonidae (Ichneumon Wasps)
The largest family of Hymenoptera, there are 3,322 described species and at least 5,000 undescribed species in the United States (Arnett 1985). Identification is very difficult at best, with a few exceptions. All species are parasites, the adults laying their eggs in the bodies of the hosts. Some species are host specific, but most are not. Adults may be found at flowers or coming to lights.

Trachysphyrus relativus nitschei (Dalla Torre). Not placed in a subfamily. Collected only once, DR 3/11/89, at light.

Undetermined taxa. We identified 23 specimens only to family. They represent several species from a variety of locations.

Subfamily: Anomaloninae
Barylypa apicalis Cresson. Collected only once, AL 4/9/88 at *Baccharis sarothroides.*

Subfamily: Campopleginae
Campoletis sp. Apparently only 1 species, collected at AC 1/29/89; NE 3/5/88.

Dusona sp. May represent more than 1 species. AC 4/10/88; AG 3/6/88; DR 3/5/88; NE 11/21/87. At flowers of *Cercidium microphyllum, Encelia farinosa,* and *Larrea tridentata.*

Subfamily: Cryptinae
Compsocryptus calipterus (Say). Collected at AC 10/17/87, 4/29/89; AG 11/22/87, 3/6/88; AL 3/11/89; BP 10/17/87. At *Baccharis sarothroides.*

Subfamily: Ophioninae
Enicospilus sp. Collected only once, AR 4/14/90, 2 specimens at light.

Undetermined taxa. We identified 8 specimens from 4 different locations to subfamily only. They may represent more than 1 species.

Subfamily: Tryphoninae
Netelia sp. Abundant, large brown ichneumons that are attracted to lights throughout the year. These all appear to be the same species, but the genus is very difficult, with 6 subgenera and 85 described species and probably many undescribed. The genus is important as a biological control agent of

caterpillars on some crops. AL 4/9/88; DR 8/27/88; GC 4/8/89; SE 4/19/88, 10/09/88, 2/18/89,9/9/90; VU 4/20/88.

Family: Leucospididae
Undetermined taxa. Collected only once, AG 11/22/87, 2 specimens at *Baccharis sarothroides.*

Family: Megachilidae (Leaf-cutting and Mason Bees)
A large family with 682 species known from the United States and Canada (Arnett 1985). Most species cut leaves and use them in constructing cells within underground nests or wood cavities. In the cells, the adults provide stores of pollen as food for larvae. A few species are parasitic in the nests of other leaf-cutting bees. Some species are important pollinators of agricultural crops and native plants, but may be considered minor pests because of the damage they do to leaves.

Subfamily: Lithurginae
Lithurge apicalis (Cress.). Collected at flowers of *Opuntia phaeacantha,* AL 5/5/90.

Subfamily: Megachilinae
Ashmeadiella sp. Collected at flowers of *Larrea tridentata, Penstemon* sp., and *Prosopis velutina.* May be more than 1 species. There are 54 species known from the United States and Canada (Arnett 1985). AR 4/13/90; BP 3/24/90; SA 4/8/89.

Chalicodoma discorhina (Ckll.). Collected at flowers of *Cercidium microphyllum.* BP 4/30/89; LO 4/20/88.

Chalicodoma sp. Apparently a different species than the above. Collected only once, DO 4/8/89.

Dianthidium sp. Collected only once, DR 3/12/89.

Heteranthidium larreae (Ckll.). Collected at flowers of *Bebbia juncea* and *Larrea tridentata.* AG 10/08/88; SA 4/8/89.

Megachile parallela Sm. Collected only once, VU 10/10/88, at *Bebbia juncea* flowers.

Osmia coloradensis (Cress.). Collected at flowers of *Enceha farinosa* and *Penstemon* sp. AC 4/10/88; AL 3/11/89; BP 3/24/90.

Osmia sp. Collected only once, at flowers of *Cercidium microphyllum,* DR 3/5/88.

Osmia texana (Cress.). Collected at flowers of *Baccharis sarothroides* and *Cirsium neomexicana.* AL 4/9/88; BP 4/30/89.

Paranthidium sp. Collected only once, BP 4/30/89.

Undetermined taxa. We collected 1 specimen at *Bebbia juncea,* AG 8/27/89, and identified it to subfamily only.

Family: Mutillidae (Velvet Ants)
Females are wingless and resemble large, hairy ants. They are usually found running over the ground. Most of our conspicuous species are brightly colored with red, white, or orange hairs. They are capable of inflicting a severe sting if handled, and squeak if pinched. Males are winged and are very different from females in appearance. They are most often found at flowers or at lights. Larvae are parasites of the larvae and food stores of ground-nesting bees and wasps. There are 483 species known from the United States and Canada (Arnett 1985).

Subfamily: Apterogyninae
Chyphotes attenuatus (Blake). Collected from AG 5/5/90; AR 11/20/87; BP 10/17/87; SE 10/30/87, 10/9/88; VU 4/20/88.

Chyphotes sp. Probably not the above species. There are 47 species known from the United States and Canada (Arnett 1985). Collected at AG 11/21/87; SE 10/30/87.

Subfamily: Sphaeropthalminae
Acanthophotopsis sp. Collected only once, AG 11/21/87.

Dasymutilla klugii (Gray). Collected only once, SE 9/9/90.

Dasymutilla magna (Cress.). Collected only once, AR 7/10/90.

Dasymutilla magnifica Mickel. Collected only once, AR 2/29/88. Also reported by Hall et al. (1988) from AL.

Dasymutilla zelaya (Blake). Our most abundant species of this genus. Collected at BP 10/17/87; EA 7/23/88; LO 10/30/87.

Dilophotopsis sp. Collected at AC 7/23/88; BP 10/17/87; SE 10/9/88.

Dilophotopsis stenognatha Schuster. Collected at AC 7/23/88; AG 5/5/90; SA 10/31/87; SE 10/30/87, 4/19/88, 10/9/88; VU 4/21/88.

Odontophotopsis acmaea Vierick. Collected at AG 11/21/87 and AR 4/14/90.

Odontophotopsis anomala Schuster. Collected at AG 5/5/90; BP 10/17/87; SE 10/30/87, 4/19/88.

Odontophotopsis brunnea Schuster. Collected at AC 7/23/88; AG 11/21/87; BP 10/17/87; SE 10/30/87.

Odontophotopsis sp. We collected 6 specimens, which may represent more than 1 species. AC 7/23/88; AL 9/10/88; BP 10/17/87; GC 4/8/89; SE 9/9/90.

Photomorphus hebes (Melander). Collected at GC 4/8/89; SE 4/19/88.

Sphaeropthalma (Micromutilla) sp. Collected only once, AG 5/5/90.

Sphaeropthalma (Photopsis) sp. Possibly more than 1 species. SE 10/30/87, 4/19/88, 10/9/88. There are 68 species known from the United States and Canada (Arnett 1985) for this subgenus.

Undetermined taxa. Collected 6 specimens, identified only to family.

Family: Pompilidae (Spider Wasps)
Most of our species are large, conspicuous black wasps with orange or black wings. They are usually seen at flowers or cruising over the ground in search of spiders. Spiders are stung, paralyzed, and stored underground. On each spider, the wasp lays an egg. The larva eats the spider. Several of our largest species in the genera *Hemipepsis* and *Pepsis* prey on tarantulas, and are called "tarantula hawks." They run about on the ground, exploring all holes of suitable size. If a tarantula of the right size is at home, it will emerge and battle with the wasp. Usually the wasp wins and stings the tarantula to paralyze it. Then the wasp drags its heavy prey to another (possibly previously prepared) burrow and seals it underground. The larva consumes the spider slowly and emerges about a year later. Apparently spiders are not the only prey, as I once saw a tarantula hawk carry a *Schistocerca vaga* (one of our largest grasshoppers). The wasp does not always fight to the finish, as I have seen one give up in mid-fight with a tarantula, then continue its search and capture another tarantula. The sting, at least of our larger species, can be excruciatingly painful (Schmidt 1989) to people, but it is very difficult to get stung by one.

Subfamily: Ceropalinae
Notocyphus dorsalis arizonicus Townes. We collected 2 specimens BP 4/30/89; DR 10/8/88.

Subfamily: Pepsinae
Cryptocheilus severini Banks. Collected only once, PO 9/11/90.

Hemipepsis mexicana (Cresson). Collected only once, AC 4/29/89.

Hemipepsis ustulata Stal. Collected at AC 4/29/89; AG 11/22/87, 1/28/89; GC 11/21/87.

Pepsis chrysothemis Lucas. Collected at BP 10/17/87, 9/10/88; LO 4/20/88.

Pepsis formosa pattoni Banks. Collected at AL 8/26/89; BP 7/23/88.

Pepsis mildei Stal. Collected at *Baccharis sarothroides* flowers. AG 10/9/88; AL 10/18/87; SA 10/31/87.

Pepsis pallidolimbata Lucas. AG 10/9/88, at *Wislizenia refracta*.

Pepsis sp. We collected 2 specimens, which may be different species, AR 10/21/89; SE 8/18/89.

Subfamily: Pompilinae
Anoplius sp. Collected only once, AL 10/18/87.

Episyron sp. Collected only once, AL 10/18/87.

Pompilus expulsus Schulz. AC 7/29/89, collected at *Sapium biloculare*.

Family: Scoliidae (Scoliid Wasps)
Fairly large (20-50 mm) brightly colored, furry wasps. Larvae are parasites of beetle grubs, especially Phyllophaga spp. (Scarabaeidae). Females dig in soil to find the grubs, then lay 1 egg on each grub found. Adults feed at flowers. They are rarely seen. There are 22 species known from the United States and Canada (Arnett 1985).

Subfamily: Scoliinae
Campsoscolia flammicoma (Bradley). Collected only once, AG 10/8/88. Apparently a Mexican genus, not listed in Arnett (1985). Feeding at *Wislizenia refracta* flowers.

Scolia ardens Smith. Collected while feeding at *Hyptis emoryi* flowers. AC 10/1/89; AL 10/18/87.

Scolia otomita Sauss. Collected while feeding at *Acacia angustissima* and *Kallstroemia grandifora*, AC 10/1/89; AG 8/28/88; AL 8/26/89; BP 8/25/90.

Scolia sp. We collected 3 specimens at AL 8/26/89 feeding on *Acacia angustissima* and' *Baccharis sarothroides,* appeared to be different from the above species but were not identified.

Family: Sphecidae (Digger Wasps)
A large and diverse family, with 1,139 species known from the United States and Canada (Arnett 1985). All are solitary. At least 9 distinctive subfamilies are recognized. Most nest in burrows that they dig in soil, but some use ready-made burrows and some make mud shelters. All species capture insects or spiders and use them as provision for their larvae in the nest. Adults may feed at flowers.

Subfamily: Larrinae
Trypoxylon califomicum Saussure. Collected at AG 7/28/90; BP 10/17/87, 9/30/89; DR 8/27/88. Seen feeding at *Gymnosperma glutinosum* flowers.

Subfamily: Nyssoninae
Bicyrtes viduata (Handlirsch). Collected only once, AL 7/30/89 at *Baccharis sarothroides* flowers.
Glenostictia scitula Fox. Collected at *Prosopis velutina* and *Sphaeralcea* sp. flowers. AR 4/13/90; BU 4/8/89.

Mellinus imperialis Bohart. Collected only once, AG 11/22/87.

Steniolia duplicata Provancher. Observed feeding at *Bebbia juncea* flowers. Collected at AG 11/22/87, 10/8/88; AL 5/5/90; VU 10/10/88.

Subfamily: Philanthinae
Cerceris californica Cresson. Collected only once, AL 4/9/88, at *Eriogonum fasciculatum* flowers.

Philanthus gibbosus (Fabricius). Collected only at AG 11/22/87, 8/28/88.

Subfamily: Sphecinae
Ammophila breviceps Smith. Observed feeding at *Calliandra eriophylla* flowers. AG 11/22/87, 8/28/88; NE 3/5/88.

Ammophila califonica Menke. Observed feeding at *Eriogonum wrightii* flowers. Collected only once, DR 10/8/88.

Ammophila femurrubra Fox. Collected only once, DO, 4/8/89.

Fernaldina lucae (Saussure). Observed feeding at *Acacia greggii, Eriogonum fasciculatum,* grasses, *Gymnosperma glutinosum,* and *Wislizenia refracta* flowers. AG 10/9/88; AL 9/11/88; BP 4/30/89.

Isodontia elegans (Smith). Observed feeding at *Acacia greggii* and *Baccharis sarothroides* flowers. AC 4/29/89; AL 4/9/88.

Podalonia argentipilis (Prov.). Collected only once, NE 3/5/88 at *Calliandra eriophylla* flowers.
Podalonia melaena Murray. Observed feeding at *Bebbia juncea* flowers. AG 11/22/87; BU 4/8/89; VU 10/10/88.

Family: Tenthredinidae (Common Sawflies)
This is a large family of 731 species in the United States and Canada (Arnett 1985), most of which are found in woodland. Desert species are very rare, and only 1 specimen was found during this study. Larvae resemble caterpillars and feed on leaves. Adults visit flowers. Some species cause damage to cultivated plants and forest trees.

Subfamily: Selandriinae
Stromboceridea nigricans (Norton). Collected only once, AC 7/24/88. The specimen was deposited at The University of Arizona Entomology Department.

Family: Tiphiidae (Tiphiid Wasps)
Generally small brown wasps that are commonly attracted to lights and occasionally found at flowers. There are 225 species known from the United States and Canada (Arnett 1985). Identification is difficult, especially for some subfamilies and the larger genera. Larvae are parasites of beetle larvae and some other Hymenoptera.

Undetermined taxa. We collected 5 specimens, identified only to family. They may represent several different species.

Subfamily: Brachycistidinae
Brachycistis alcanor (Blake). Collected at lights, AR 11/20/87, 4/14/90; GC 11/21/87; SA 10/31/87; SE 10/30/87.

Brachycistis glabrella (Cresson). Collected at lights, AC 7/23/88; AG 5/5/90; GC 9/10/88, 10/10/88; PO 9/10/90.

Brachycistis ioachinensis Bradley. Collected at lights, AR 11/20/87; SE 10/30/87.

Colocistis sp. Our specimens may represent more than 1 species. Collected at lights, AC 7/23/88; AL 7/29/89; BP 4/29/89; PO 9/10/90; SE 4/19/88.

Hadrocistis sp. Collected only once, 2 specimens, at light AG 5/5/90.

Undetermined taxa. We collected 11 specimens from a variety of locations, identified to subfamily only.

Subfamily: Tiphiinae
Paratiphia sp. Collected only once, at light, AG 11/22/87, 2 specimens.

Tiphia sp. Collected only once, at *Cirsium neomexicanum* flower, AC 4/10/88.

Family: Torymidae (Torymid Wasps)
These tiny wasps are parasites of gall-inhabiting insects, nest parasites of bees and wasps, internal parasites of caterpillars and beetle larvae, a few are phytophagous, and some are parasites on insect eggs. There are 175 species known from the United States and Canada (Arnett 1985).

Subfamily: Podagioninae
Podagrion mantis Ashmead. Collected at flowers of *Erigeron divergens,* AL 4/9/88. This wasp is an egg parasite of the larger mantids *(Stagmomantis* spp.). It lays its eggs in the egg case of the mantid, and the wasp larvae consumes the developing mantid. Tiny holes in the mantid's egg case are chewed for exit holes by the mature wasps (personal observation). Although we only collected the wasp once, most of the mantid egg cases we examined had wasp exit holes, so the wasp must be quite common.

Family: Vespidae (True Wasps)
A diverse family that is split into 3 families by some authors. All species are capable of stinging people if provoked. If the family is considered as only 1 family, then 31 genera and 415 species are known from the United States and Canada (Arnett 1985). Adults may be found at flowers or water. Nests, either solitary or social, are constructed of individual cells provisioned with pollen, nectar, or insects as food for larvae.

Subfamily: Eumeninae. Members of this subfamily are solitary and make nests of mud as pots attached to vegetation or rocks or in burrows. Adults capture caterpillars as food for larvae.
Ancistrocerus neocallosus Beq. Collected only once, BP 10/17/87, at water.

Ancistrocerus tuberculocephalus (Saussure). Collected only once, AC 10/17/87.

Eumenes bolli Cresson. Observed feeding on flowers of *Gymnosperma glutinosum* and at water. AC 4/29/89, 10/1/89; AL 9/11/88; DR 11/21/87, 8/27/88.

Euodynerus annulatus annulatus (Say). Collected only once, at *Wislizenia refracta* flowers, AG 7/28/90.

Euodynerus annulatus imperialis (Bohart). Collected only once, 2 specimens, at water AR 9/9/90.

Euodynerus guerrero (Saussure). Collected only once, at water, BP 8/25/90.

Euodynerus pratensis (Saussure). Observed feeding at flowers of *Gymnosperma glutinosum* and *Acacia greggii,* and at water. AC 4/29/89; AL 10/18/87, 9/11/88; AR 9/9/90; BP 4/30/89, 9/30/89.

Euodynerus sp. Collected only once, AR 9/9/90 at water. Not one of the above species. There are 58 species in the genus in the United States and Canada (Arnett 1985).

Leptochilus acolhuus (Sauss.). Collected at *Eriogonum wrightii* flowers, DR 10/8/88.

Leptochilus periallis Parker. Collected at *Sphaeralcea* sp. flowers, VU 2/18/89.

Leptochilus polius Parker. Collected at AC 7/24/88; NE 11/21/87.

Maricopodynerus maricoporum (Viereck). Collected at AC 10/17/87.

Pachodynerus acuticarinatus (Cameron). BP 9/10/88 collected at water.
Stenodynerus lissolabus Bohart. Collected at *Acacia greggii* flowers, AC 4/9/88.

Stenodynerus ochrogonius (Viereck). Collected only at BP 7/23/88, 9/10/88. Observed feeding at fruit of *Lemaireocereus thurberi.*

Stenodynerus toltecus (Sauss.). Collected at AG 11/22/87; DR 8/27/88.

Undetermined taxa. Collected 1 specimen at AG 7/28/90, identified to subfamily only.

Subfamily: Masarinae. Members of this subfamily make nests of mud attached to twigs or rocks and provision them with pollen and nectar rather than insects. They are solitary wasps (Arnett 1985).

Pseudomasaris maculifrons (Fox). Collected only once, at *Calliandra eriophylla* flowers, NE 3/5/88.
Subfamily: Polistinae. Members of this subfamily build nests of paper-like material made of chewed plant material. They are social, living in small groups consisting of the offspring of 1 female. They provision the nest with insects. Adults are often found at water or flowers.

Polistes flavus Cresson. A large, common yellow wasp, often found at water. Collected from AC 10/17/87; AL 10/18/87; BP 10/17/87, 9/10/88; DO 4/8/89; DR 11/21/87, 8/27/88; 10/8/88.

Polistes major castaneicolor Bequaert. Collected at water, AL 10/18/87.

Order: Isoptera (Termites)
Termites are abundant and important in desert ecosystems. They break down dead plant material and recycle it. They also tunnel through soil, turning, aerating, and enriching it. Additionally, termites may be important as food for many other animals. Jones and Nutting (1989) give a general review of the role of Sonoran Desert termites. Some 1,900 species of termites are known for the world, but only 44 are found in the United States (Arnett 1985), and 20 are known for the Sonoran Desert

(Jones and Nutting 1989). Identification of termites is most often based on the structure of the soldier caste. Soldiers are always in the minority in a termite colony, and sometimes cannot be found, making identification impossible.

Family: Kalotermitidae (Powder-post Termites)
May excavate nests in dry wood, damp wood, and wood not contacting soil. Usually these termites inhabit dead trees or standing dead wood, but they may attack living trees on occasion (Jones and Nutting 1989). The nests are difficult to find and require specialized techniques to excavate, so our records bear no relation to the relative abundance of this family in the monument. Winged adults (alates) may come to lights during the very brief period when they are active above ground.

Marginitermes hubbardi (Banks). Collected only once, at light, AG 8/26/89. Probably much more abundant than our records indicate. Nests exclusively within dead wood (Jones and Nutting 1989).

Paraneotermes simplicicornis (Banks). Collected only once, in a dead mesquite, AR 2/26/88. Probably much more abundant than our records indicate. Builds nests underground and feeds on roots, stumps and buried wood. May also damage living plants (Jones and Nutting 1989).

Family: Rhinotermitidae
The 9 North American species all nest in soil (Jones and Nutting 1989). Some may be serious structural pests.

Heterotermes aureus (Snyder). Collected only once, AG 11/22/87, under rock. This is supposed to be the most common Sonoran Desert termite (Jones and Nutting 1989), so our records undoubtedly underestimate its abundance. It is very effective at recycling dead wood, which makes it a pest under some circumstances. It tunnels up from underground inside wood, so it is seldom seen.

Family: Termitidae
Subfamily: Amitermitinae
Amitermes sp. Several species of *Amitermes* probably occur in the monument, but we have not found them. Our only specimen is a winged male that we could not identify to species. All species are subterranean and tunnel into wood, especially that of legumes. May also eat the remains of dead cholla (Jones and Nutting 1989). Our only specimen is from AG 1/28/89 at light.

Gnathamitermes perplexus (Banks). Our most obvious and possibly most abundant termite, this species builds cases of mud and feces over wood, so its workings are visible. Inside the casings, the termites consume the surface layers of wood (and sometimes softer plant material). The nest is underground, and foragers travel through underground tunnels to reach their food. This species is very important in recycling our annual plants and the droppings of large animals. Found throughout the monument, most visibly active during and shortly after rainy seasons. Specimens or recorded observations from AR 11/21/87, 2/26/88, 9/10/88; BU 8/27/88; EA 7/23/88, 9/10/88; LO 10/30/87; SA 10/31/87, 10/9/88; SE 10/10/88; VU 10/10/88.

Undetermined taxa. The 5 collections that contained only workers could not be identified, but are probably 1 of the species listed above.

Order: Lepidoptera (Moths, Butterflies, and Skippers)
The multitude of members of this order in our collection may reflect their abundance in the environment, but may also, at least in part, indicate their susceptibility to our collection technique of using ultraviolet lights to lure night-flying insects. Larvae of all of our species are herbivores feeding on leaves, flowers, fruit, stems, roots, and detritus. Adults either feed on nectar or plant fluids or do not feed at all. Food plants for many of our species are not known. Those that are known are listed below for each species. Names, both scientific and common, for butterflies are taken from Tilden and Smith (1986). Most of the butterflies and some of the larger moths are easily identified in the field, so many of our records are sight records rather than specimens.

Family: Apaturidae (Leaf-wings and Emperors)
Medium-sized, brown, orange, black, and white butterflies with eyespots. There are 17 species known from the United States and Canada (Arnett 1985). The species may be difficult to distinguish, but we have only 1.

Subfamily: Apaturinae
Asterocampa ledia (W. H. Edwards) (Empress Leilia). Larvae feed on *Celtis* spp. Records from AC 10/17/87, 4/29/89, 7/29/89, 10/30/89, 3/25/90, 8/25/90; AL 10/18/87, 4/9/88, 9/11/88, 3/11/89, 7/29/89, 8/26/89, 5/5/90, 7/28/90; BP 10/17/87, 9/10/88, 4/29/89, 9/30/89, 8/25/90; DR 10/8/88, 3/11/89; GC 4/8/89. Garth (1944) misidentified this as *A. celtis*. Also found at Quitobaquito (Kingsley and Bailowitz 1987).

Family: Arctiidae (Tiger Moths)
Many species in this family are brightly colored with red, orange, yellow, white, and black markings including stripes. There are 89 genera and 264 species known from the United States and Canada (Arnett 1985).

Subfamily: Arctiinae
Ectypia clio (Packard). Collected at lights, GC 4/8/89, SE 10/9/88.

Euchaetias perlevis Grote. Collected only once, PO 9/10/90.

Euchaetias zella Dyar. Larval food is *Asclepias* spp. Collected at lights, AL 7/29/88, 9/10/88; DR 8/27/88; GC 9/10/88.

Pygarctia castella Grt. Larval food is *Asclepias* spp. At lights, AC 7/23/88; AG 8/26/89; AL 9/10/88; GC 9/10/88, 10/10/88.

Subfamily: Ctenuchinae
Ctenucha venosa Walker. A diurnal, colorful moth. AC 7/23/88.

Subfamily: Lithosiinae
Cisthene angelus (Dyar). Common at lights AL 4/9/88, 9/10/88; BP 10/17/87; GC 10/10/88, 4/8/89; SE 10/30/87,4/19/88,10/9/88,4/13/90.

Family: Blastobasidae (Blastobasid Moths)
Larvae mostly live in nuts or seeds, buds, and galls. There are 21 genera and 121 species known from the United States and Canada (Arnett 1985).

Undetermined taxon. Collected at lights, AG 11/21/87; NE 3/5/88. May be the same species.

Family: Coleophoridae (Casebearer Moths)
Larvae of most species make cases from their food plants. Young larvae are leaf miners. There are 169 species known from the United States and Canada (Arnett 1985).

Undetermined taxon. Collected only once, at light, NE 3/5/88.

Family: Cossidae (Carpenter Moths and Goat Moths)
Larvae of these moths are wood borers. There are 46 species known from the United States and Canada (Arnett 1985).

Givira theodori Dyar. Collected only once, at light, AC 8/25/90.

Undetermined taxa. Possibly 2 different species. AG 8/25/90; AL 7/29/89.

Family: Danaidae (Milkweed Butterflies)
Large orange-and-black butterflies, conspicuous and well-known. Larvae feed on several species of milkweeds (Asclepiadaceae). Migratory.

Danaus gilippus (Cramer) (queen). One of our most abundant and conspicuous butterflies. Feeds on *Sarcostemma cynanchoides,* both as larva and adult. Probably distributed throughout the monument, our records are from AC 10/30/89, 8/25/90; AG 8/28/88, 10/8/88, 8/26/89, 4/14/90, 5/6/90, 7/28/90, 8/26/90, 9/10/90; AL 10/18/87, 9/11/88, 7/29/89, 8/26/89, 5/5/90, 7/28/90; AR 9/10/88, 5/27/89; BP 7/23/88, 9/10/88, 4/29/89, 9/30/89, 3/24/90, 8/25/90; DR 8/27/88; GC 9/10/88, 4/8/89, 9/10/90; LO 4/20/88; NE 8/27/88; VU 10/10/88, 2/18/89. Also found at Quitobaquito (Kingsley and Bailowitz 1987), and at AL by Garth (1944).

Danaus plexippus (Linnaeus) (monarch). Probably does not breed in the monument. Adults recorded from AC 10/30/89; AG 4/14/90, 5/6/90; AL 7/28/90; BP 9/30/89, 3/24/90, 8/25/90. Also found at Quitobaquito (Kingsley and Bailowitz 1987).

Family: Gelechiidae (Gelechid Moths)
A large family with 91 genera and 630 species known from the United States and Canada (Arnett 1985). Identification is difficult, and many species may be undescribed. Larvae may feed on leaves, grain, be leafminers, mine pine needles, live in galls, eat stored food, consume fruits and seeds of native plants, or be found in flowers. Many species are pests of economic importance.

Undetermined taxa. We identified 60 specimens, representing an undetermined number of species, to family only.

Subfamily: Gelechiinae
Bryotropha inaequalis (Busck). Common at lights. Larval food plant: *Cercidium microphyllum.* Collected at AG 11/21/87, 8/26/89; AL 4/9/88; DR 3/11/89; NE 3/5/88; SE 4/19/88.

Family: Geometridae (Geometer Moths)
A large, diverse family with 254 genera and 1,404 species known from the United States and Canada (Arnett 1985). Larvae are "inchworms," with characteristic movement patterns of looping and stretching the body. Most feed on leaves, and many are very specific as to host plant selection. Larvae of most species are very well camouflaged. Most adults are dullcolored brown or gray moths. Identification of subfamilies, genera, and species is very difficult. Unless specified differently below, all of our specimens were collected at lights.

Subfamily: Ennominae
Anacamptodes obliquaria (Grote). AC 9/30/89; AG 5/5/90; AL 4/9/88, 9/10/88; AR 11/20/87; BP 3/24/90; GC 11/21/87, 4/8/89; SE 10/30/87, 4/19/88. Also at Quitobaquito (Kingsley et al. 1987).

Anacamptodes sp. AG 5/5/90; AL 9/10/88; GC 4/8/89; SE 4/19/88, 2/18/89.

Animomyia smithii (Pears.). BP 3/24/90; SE 10/30/87, 4/19/88, 4/13/90.

Chloraspilates bicoloraria Packard. AL 4/9/88; GC 4/8/89.

Elpiste metanemaria (Hulst.). Larval food plant: *Baccharis sarothroides.* AG 11/21/87; AL 4/9/88.

Eubarnesia ritaria (Grossb.). Food plant: *Fouquieria splendens.* AC 7/23/88; AG 10/8/88; AL 9/10/88, 7/29/89; BP 4/29/89; SE 10/30/87, 4/19/88. Also at Quitobaquito (Kingsley et al. 1987).

Eusarca detractaria (B. & McD.). BP 4/29/89; DR 3/11/89.

Glaucina erroraria Dyar. AL 4/9/88; AR 2/26/88; BP 10/17/87; GC 10/10/88; NE 3/5/88.

Glaucina sp. Possibly only 1 species, appearing to be different from the above. DR 8/27/88; GC 9/10/88, 4/8/89; PO 9/10/90; SE 4/19/88, 2/18/89, 4/13/90, 9/9/90.

Itame sobriaria B. & McD. AG 11/21/87, 5/5/90; AL 4/9/88, 9/10/88; GC 4/8/89.

Ourapterygini Undetermined taxa. Possibly more than 1 species, identified to tribe only. AC 7/23/88; AL 9/10/88; BP 4/29/89.

Pero flavisaria (Grossb.). AL 4/9/88; BP 4/29/89; SE 4/19/88.

Pero meskaria (Pack.). AG 11/21/87; AL 7/29/89; SE 2/18/89.

Philtraea elegantaria Hy.Edw. AL 4/9/88.

Plataea sp. Probably only 1 species, AG 8/26/89; NE 3/5/88.

Pterospoda nigrescens (Hulst.). AG 11/21/87, 8/26/89; AR 11/20/87, 4/14/90; NE 3/5/88.

Semiothisa colorata (Grote). Abundant and widespread, food plant: *Larrea.* AG 11/21/87, 10/8/88; AL 4/9/88; AR 2/26/88, 4/14/90; DR 11/21/87, 8/27/88; GC 11/21/87, 9/10/88, 4/8/89; SA 10/31/87; SE 10/30/87, 4/19/88, 10/9/88, 4/13/90, 9/9/90.

Semiothisa cyda (Druce). Uncommon, larval food plant *Penstemon* spp. AG 11/21/87; GC 4/8/89; SE 4/19/88.

Semiothisa excurvata (Pack.). Larval food plant unknown. Uncommon. AL 9/10/88; BP 4/29/89; SE 2/18/89.,

Semiothisa hypaethrata Grote. At light, AG 10/8/88. Also found at Quitobaquito (Kingsley et al. 1987).

Semiothisa parcata (Grossb.). Common at lights. Larval food plant: *Acacia constricta. AG* 11/21/87; AR 4/14/90; BP 10/17/87; DR 3/5/88; *GC* 4/8/89; NE 3/5/88; SA 10/31/87; SE 10/30/87, 2/18/89.

Semiothisa punctolineata (Pack.). Collected twice, only at AL 4/9/88 and 9/10/88.

Semiothisa s-signata (Pack.). Collected only once, at light, 3 specimens SE 4/19/88. Also found at Quitobaquito (Kingsley et al. 1987).

Semiothisa sp. Collected 30 specimens at lights, probably several species.

Stenoporpia pulchella (Grossb.). DR 8/27/88, 3 specimens.

Stenoporpia sp. Collected only at SE 10/30/87, 2/18/89.

Synglochis perumbraria Hulst. Common and widespread. Larval food plant: *Larrea.*
AG 10/8/88; AL 9/10/88; AR 2/26/88; 4/14/90; DR 8/27/88, 3/11/89; GC 9/10/88, 4/8/89; PO 9/10/90; SA 10/31/87; SE 10/30/87, 4/19/88, 10/9/88, 2/18/89.

Tornos erectarias Grossb. Uncommon at lights, AG 11/21/87, 5/5/90; AL 9/10/88; SE 4/19/88.
Undetermined taxa. We identified 3 specimens, probably of different species, to this subfamily only.

Subfamily: Geometrinae
Chlorochlamys apellaria Pears. Uncommon at lights, AL 4/9/88; DR 3/11/89; GC 4/8/89.

Chlorochlamys phyllinaria (Zell). GC 4/9/89, 5 specimens. Also at Quitobaquito (Kingsley et al. 1987).

Nemoria obliqua (Hulst). Scarce but widespread. AL 4/9/88; BP 4/29/89; SE 4/19/88, 1 specimen from each location and date.

Synchlorini unidentified. Collected 1 specimen, at AL 9/10/88, which was identified to this tribe only.

Synchlora frondaria (Gn.). Scarce but widespread, collected at AG 11/21/87; AL 4/9/88; GC 4/8/89, 1 specimen from each location and date.

Subfamily: Larentiinae
Archirhoe neomexicana (Hulst). Scarce in Spring, and rare in Fall. AC 1/28/89; AG 10/8/88; AL 4/9/88; GC 4/8/89; NE 3/5/88; SE 4/19/88, 9/9/90. We collected 1 or 2 specimens from each location and date.

Hydriomena sp. AG 11/21/87.

Mesoleuca sp. AC 9/30/89; AG 11/21/87.

Stamnodes fervifactaria (Grt.). AC 9/30/89, 8/25/90; AL 9/10/88.

Subfamily: Sterrhinae
Cyclophora nanaria (Wlk.). AC 9/30/89; BP 3/24/90.

Idaea eremiata (Hulst.). Collected only at AL, 4/9/88, 9/10/88.

Idaea gemmata (Pack.). Collected only at AL, 4/9/88, 9/10/88.

Idaea sp. Collected only at AL, 9/10/88. This appears to be different from the above 2 species.

Lobocleta plemyraria (Gn.). AG 11/21/87.

Lobocleta quaesitata (Hulst.). AC 7/23/88; AL 9/10/88; BP 10/17/87.

Lobocleta sp. Apparently a different species than either of the above. Collected at AG 8/26/89, 5/5/90; AL 3/11/89; DR 8/27/88.

Odontoptila obrimo (Druce). DR 3/11/89; NE 3/5/88; SE 2/18/89.

Pigia multilineata Hulst. BP 4/29/89; SE 2/18/89.

Protoproutia rusticaria MeD. DR 8/27/88.

Semaeopus ella (Hulst.). AL 4/9/88; BP 10/17/87.

Undetermined taxa. We identified 4 specimens to subfamily only. They probably represent several species.

Family: Heliconiidae (Long-wings)
Some authors, including Arnett (1985) consider this a subfamily of Nymphalidae. This is a primarily tropical group of butterflies, with only a few species reaching into the United States.

Agraulis vanillae (Linnaeus) (gulf fritillary). Larvae feed on *Passiflora,* which does not occur in the monument. Adults migrate widely and have been recorded from AC 4/29/89; AG 10/8/88; AL 3/11/89; 7/28/90; BP 4/29/89, 8/25/90. Usually seen 1 at a time, fluttering along or investigating flowers. Observed feeding on *Bebbia juncea.* Also found at Quitobaquito (Kingsley and Bailowitz 1987).

Family: Hesperiidae (Skippers)
A fairly large family, with 89 genera and 290 species known from the United States and Canada (Arnett 1985). Taxonomy is still debated by experts, and some "species" may be "subspecies" and vice versa. Also, identification of some is very difficult, requiring genitalic dissection, which cannot be done casually in the field.

Subfamily: Hesperiinae
Amblyscirtes nysa WH Edwards (Nysa roadside skipper). Larval food plant: grasses, species not known for the monument. Uncommon, records from AC 7/29/89; AL 9/11/88, 7/29/89, 7/28/90.

Amblyscirtes prenda Evans (Prenda roadside skipper). Larval food plant: not known. Uncommon. AL 9/11/88, 8/26/89; BP 8/25/90.

Copaeodes aurantiacus (Hewitson) (orange skipperling). Fairly common in Ajo Mountains and Quitobaquito (Kingsley and Bailowitz 1987), not recorded from elsewhere, larvae feed on *Cynodon dactylon,* adult observed feeding on *Acacia angustissima* flowers. AC 4/29/89, 10/17/87, 7/29/89, 10/30/89, 3/25/90; AG 10/8/88; AL 10/18/87, 9/11/88, 3/11/89, 8/26/89, 5/5/90, 7/28/90; BP 10/17/87, 7/23/88, 9/10/88, 4/29/89, 9/30/89, 8/25/90; Also observed by Garth (1944) at AL.

Hylephila phyleus (Drury) (fiery skipper). Rare, 2 records: AG 10/9/88; NE 3/12/89. Larval food plant: grasses, especially *Cynodon dactylon.* Adults fed at flowers of *Bebbia juncea* and *Calliandra eriophylla.* Also found at Quitobaquito (Kingsley and Bailowitz 1987).

Lerodea arabus (W. H. Edwards) (Arabus skipper). Scarce in Ajo Mountains. Larval food plant: unknown. Records from AC 9/30/89. 10/30/89, 8/25/90; AL 4/9/88. Also found at Quitobaquito (Kingsley and Bailowitz 1987).

Lerodea eufala (W. H. Edwards) (Eufala skipper, rice leaf roller). Scarce but widespread. Larval food plant: grasses, a pest of rice. Adults fed at *Bebbia juncea.* Records from AC 8/25/90; AG 10/8/88; BP 8/25/90; VU 10/10/88. Also found at Quitobaquito (Kingsley and Bailowitz 1987).

Subfamily: Pyrginae
Cogia hippalus (W. H. Edwards) (Hippalus skipper). Rare, recorded only from AL 7/29/89, 8/26/89, 7/28/90. Larval food plant: unknown. Adults observed feeding at *Acacia angustissima.*

Erynnis funeralis (Scud. & Burg.) (funereal dusky-wing). Common and widespread. Larval food plant: various legumes, including ironwood (*Olneya tesota*). Adults observed feeding at flowers of *Amsinckia tessalata* and *Bebbia juncea.* Recorded from AC 4/29/89, 10/30/89, 3/25/90, 8/25/90; AG 8/28/88, 10/8/88, 5/6/90, 8/26/90; AL 4/9/88, 9/11/88, 3/11/89, 8/26/89, 5/5/90, 7/28/90; AR 9/10/88; BP 9/10/88, 4/29/89, 9/30/89, 3/24/90, 8/25/90; DR 8/27/88 3/11/89; EA 2/25/90; GC 9/10/88; NE 8/27/88, 3/12/89; SA 4/8/89; VU 10/10/88, 2/18/89. Also found at Quitobaquito (Kingsley and Bailowitz 1987).

Erynnis tristis (Boisduval). Rare, collected and observed only in AL. Larval food plant is *Quercus ajoensis* (and other oaks where they occur). AL 9/11/88.

Heliopetes domicella (Erichson) (Erichson's skipper). Uncommon but widespread. Larval food plant is unknown, adults were recorded feeding at *Erigeron divergens.* AC 7/29/89, 10/30/89; AL 10/18/87, 4/9/88, 3/11/89, 7/29/89, 8/26/89, 5/5/90, 7/28/90; BP 9/10/88, 9/30/89, 8/25/90. Also found at Quitobaquito (Kingsley and Bailowitz 1987).

Pholisora catullus (Fabricius) (common sooty-wing). Rare, and only seen in the Ajo Mountains. Larval food plant: *Amaranthus graecizans.* Records from AC 8/25/90; AL 7/28-29/90.

Pholisora libya (Scudder) (Mohave sooty-wing). Uncommon and recorded only from AW. Larval food plant is *Atriplex* species. Adults observed feeding at *Nicotiana trigonophylla* flowers. Date of records: 3/6/88, 8/28/88, 10/8/88, 4/14/90, 5/6/90, 7/28/90, 8/26/90. Also found at Quitobaquito (Kingsley and Bailowitz 1987).

Polygonus leo (Gmelin) (hammock skipper). Rare. Larval food plant unknown. AL 8/26/89, BP 8/25/90.

Pyrgus communis albescens Ploetz (southern checkered skipper). Uncommon but widespread in the monument. Larval food plants are several members of Malvaceae. Adults recorded feeding at *Bebbia juncea.* Recorded from: AC 4/29/89; AG 8/28/88, 10/8/88, 1/28/89, 5/6/90, 8/26/90; AL 3/11/89; BP 4/29/89, 8/25/90; BU 4/8/89; DO 4/8/89; DR 3/11/89; NE 3/12/89; SA 4/8/89; VU 10/10/88, 2/18/89. Also found at Quitobaquito (Kingsley and Bailowitz 1987), and at AL by Garth (1944).

Pyrgus philetas W. H. Edwards (philetas skipper). Collected only once, BP 9/30/89. Also found at Quitobaquito (Kingsley and Bailowitz 1987).

Staphylus ceos (W. H. Edwards) (ceos sooty-wing). Rare. Larval food plant is unknown, adults were recorded feeding at *Asclepias linaria.* Records from AC 3/25/90; BP 7/23/88, 9/10/88, 8/25/90; GC 9/10/88, 9/9/90. Recorded at AL by Garth (1944).

Systasea zampa (W. H. Edwards) (Edwards's powdered skipper). Common and widespread. Larval food plants not known, but expected to be Malvaceae. Adults recorded as feeding at *Abutilon* sp. Recorded from AC 4/29/89, 10/30/89, 3/25/90; AL 4/9/88, 9/11/88, 3/11/89, 7/29/89, 8/26/89, 5/5/90, 7/28/90; BP 10/17/87, 7/23/88, 9/10/88, 3/24/90, 8/25/90; DR 3/5/88. Also found at Quitobaquito (Kingsley and Bailowitz 1987) and at AL by Garth (1944) as *"Antigonus pulverulenta* Feld."

Urbanus dorantes (Stoll) (dorantes skipper). Rare, recorded only on 1 day, in 2 nearby locations AC and BP, 8/25/90.

Family: Lasiocampidae (Lappet Moths)
In our area, these are rare moths. Larvae feed on leaves of trees, and some are "tent caterpillars," living colonially inside webs. Adults may have nonfunctional mouthparts.

Subfamily: Lasiocampinae
Malacosoma sp. Collected only once, at light AL 7/29/89.

Subfamily: Macromphaliinae
Tolype sp. Collected only once, AL 9/10/88.

Family: Libytheidae (Snout Butterflies)
A small family with 1 genus and 3 species found in the United States (Arnett 1985). Only 1 species occurs in our area.

Libythedna bachmanii (Kirtland) (snout butterfly). Populations are extremely variable. On rare occasions enormous numbers of these butterflies migrate in swarms of thousands. A large migration was witnessed by Kingsley and Bailowitz at OPCNM in September 1983. Most of the time, however, the butterflies are found by ones and twos. Larval food plant is *Celtis* spp., adults are found at many species of flowers including *Bebbia juncea.* Records from: AC 10/17/87,4/29/89, 10/30/89, 8/25/90; AG 8/28/88, 10/8/88, 8/26/90; AL 10/17/87, 9/11/88, 3/11/89, 8/26/89, 7/28/90; AR 9/10/88; BP 10/17/87, 9/10/88, 4/29/89, 9/30/89, 8/25/90; BU 8/27/88; DR 11/21/87, 8/27/88, 10/8/88; GC 9/10/88, 4/8/89; SA 10/9/88; SE 10/10/88; VU 10/10/88, 2/18/89. Also found at Quitobaquito (Kingsley and Bailowitz 1987), and by Garth (1944) in AL.

Family: Lycaeinidae (Hairstreak, Copper, and Blue Butterflies)
Most of the members of this family are small butterflies, marked with blue or coppery-color on the wings. The undersides of the wings are often very different in color and pattern from the uppersides. Many species have eyespots and tails that function to deceive predators. There are 52 genera and 136 species known from the United States and Canada (Arnett 1985).

Subfamily: Eumaeinae
Atlites halesus (Cramer) (great purple hairstreak). Uncommon. Larval food plant is mistletoe *(Phoradendron californicum).* Adults have been seen feeding in mesquite flowers. Recorded from AC 4/29/89, 3/25/90; AG 3/6/88,10/8/88, 8/26/90; AL 10/18/87, 3/11/89; BP 4/29/89;
DR 3/11/89. Also found at Quitobaquito (Kingsley and Bailowitz 1987), and in AL by Garth (1944).

Ministrymon leda (WH Edwards) (Leda hairstreak). Uncommon to common. Larval food plant is mesquite flowers. Adults have been recorded feeding at *Prosopis, Baccharis,* and *Bebbia* flowers. Recorded at AG 8/28/88, 10/9/88, 8/26/89, 5/6/90, 8/26/90; AL 10/18/87, 8/26/89, BP 9/30/89, 8/25/90, VU 10/10/88. Also found at Quitobaquito (Kingsley and Bailowitz 1987).

Strymon melinus Huebner (common hairstreak, cotton square borer). Common at most sites. Uses a wide variety of larval food plants. A minor pest of cotton. Adults were recorded at *Bebbia juncea, Baccharis sarothroides, Prosopis velutina.* Records from AC 4/29/89; AG 8/28/88, 10/8/88, 8/26/90; AL 3/11/89; BP 4/29/89, 9/30/89, 8/25/90; SE 2/18/89; VU 10/10/88. Also found at Quitobaquito (Kingsley and Bailowitz 1987).

Xamia xami (Reakirt) (xami hairstreak). Rare. Adults were recorded feeding at *Eriogonum fasciculatum.* Larval food plants are not known for OPCNM. AC 10/30/89; BP 9/10/88, 4/30/89.

Subfamily: Polyommatinae
Brephidium exile (Boisduval) (pygmy blue). Generally common, this tiny blue butterfly is easily overlooked. Larvae feed on plants in the family Chenopodiaceae, adults have been recorded feeding at mesquite flowers and flying around *Amaranthus palmeri.* Records from AC 4/29/89, AG 11/22/87, 8/28/88, 10/8/88, 5/6/90, 7/28/90, 8/26/90; AR 9/9/90; BP 4/29/89, 8/25/90; BU 4/8/89; DO 4/8/89; DR 11/21/87, 10/8/88; NE 11/21/87; SA 4/8/89; VU 10/10/88. Also found at Quitobaquito (Kingsley and Bailowitz 1987).

Celastrina ladon (Cramer) (spring azure). Rare Spring butterfly in the Ajo Mountains. Recorded only twice, AC 4/29/89; AL 3/11/89. Also recorded by Garth (1944) for AL as *"Lycaenopsis pseudargiolus* Bdv. & Lec."

Hemiargus ceraunus (Fabricius) (ceraunus blue). Uncommon but widespread, this blue butterfly feeds on a wide variety of legumes both as larva and adult. Records from AC 8/25/90; AG 8/28/88, 10/8/88, 5/6/90, 7/28/90, 8/26/90; AL 8/26/89, 5/5/90; BP 4/29/89, 9/30/89, 8/25/90; NE 3/12/89; SE 9/9/90; VU 10/10/88. Also at Quitobaquito (Kingsley and Bailowitz 1987).

Hemiargus isola (Reakirt) (Reakirt's blue). Uncommon but widespread, this blue butterfly also feeds on a wide variety of legumes. Records from AC 4/29/89; AG 10/8/88, 1/28/89; BP 10/17/87, 9/10/88, 4/29/89, 9/30/89, 8/25/90; DR 3/11/89; SE 8/18/89. Also at Quitobaquito (Kingsley and Bailowitz 1987).

Euphilotes battoides martini (Mattoni) (Martin's blue). Recorded by Garth (1944) as *"Philotes rita* B. & McD." from *Eriogonum fasciculatum* in the Ajo Mountains. Bailowitz searched for this species in 1988, 1989, and 1990, but was unable to find it. It may no longer occur in the monument, or it may come back if conditions are right. If present, this would be the easternmost distributional record.

Leptotes marina (Reakirt) (marine blue). Common to abundant blue butterfly, feeds on various legumes both as larva and adult. Records from AC 4/29/89, 10/30/89, 3/25/90; AG 5/6/90; AL 10/18/87,4/9/88,9/11/88, 8/26/89,5/5/90,7/28/90; AR 5/27/89; BP 10/17/87, 7/23/88, 9/10/88, 4/29/89, 9/30/89, 3/24/90, 8/25/90; BU 8/27/88; DR 3/11/89; GC 4/8/89; NE 8/27/88, 3/12/89; SE 4/19/88, 4/19/90; VU 4/21/88. Also at Quitobaquito (Kingsley and Bailowitz 1987), and found in AL by Garth (1944).

Family: Noctuidae (Noctuid Moths)
This is a very large family of moths, with 607 genera and 2,925 species known from the United States and Canada (Arnett 1985). New species are being discovered constantly. Little is known about

most species except that they are attracted to lights. Larvae of some species are serious agricultural pests. The range of larval foods is enormous, but often little known. The group is divided into 16 subfamilies, but identification of subfamilies is sometimes very difficult. Identification of species often depends on genitalic dissection. Unless specified below, all of our specimens were collected at lights.

Subfamily: Acontiinae
Acontia arida Sm. AL 4/9/88; DR 3/11/89.

Acontia cretata (Grote). AC 9/30/89; AL 9/11/88; DR 3/11/89.

Acontia expolita Grote. AC 7/23/88; AL 9/10/88; DR 8/27/88.

Acontia sp. Possibly more than 1 species. DR 8/27/88; NE 3/5/88; SE 9/9/90.

Aleptina inca Dyar. AG 8/26/89; AL 9/10/88; DR 8/27/88.

Bagisara buxea (Grote). AG 8/26/89; AL 7/28/90.

Characoma nilotica Rogenhofer. AG 11/21/87; AL 4/9/88.

Cobubatha dividua (Grote). DR 8/27/88; GC 4/8/89; SE 4/19/88, 10/9/88.

Cobubatha orthozona (Ramp.). AL 4/9/88; BP 10/17/87; NE 3/5/88; SE 2/18/89.

Cobubatha sp. DR 8/27/88.

Conochares acutus Sm. GC 9/10/88, 4/8/89; NE 3/5/88; SE 4/19/88, 2/18/89. Also found at Quitobaquito (Kingsley et al. 1987).

Conochares arizonae (Hy Edw.). AG 10/8/88; AL 9/10/88; DR 8/27/88; NE 3/5/88; PO 9/10/90; SE 4/19/88. Also found at Quitobaquito (Kingsley et al. 1987).

Conochares elegantulus (Harv.). AC 8/25/90; AG 8/26/89; AL 4/9/88; NE 3/5/88; SE 4/19/88.
Conochares sp. PO 9/10/90.

Fotella fragosa (Grote). AG 10/8/88.

Fruva fasciatella (Grote). AC 7/23/88; AG 8/26/89; AL 9/10/88, 7/29/89; DR 8/27/88.

Metaponpneumata rogenhoferi Mosch. AC 7/23/88; AL 9/10/88; GC 9/10/88

Ponometia megocula (Sm.). AG 11/21/87; AR 11/20/87.

Ponometia sutrix Grote. AC 8/25/90.

Spragueia magnifica Grote. AG 8/26/89; PO 9/10/90. Also found at Quitobaquito (Kingsley et al. 1987).

Tarachidia clausula Grote. AC 7/23/88; DR 8/27/88; GC 10/10/88. Also reported by Hall et al. (1988) from AL.

Tarachidia cuta Sm. AC 7/23/88, 9/30/89; AG 11/21/87; AL 7/29/89; BP 10/17/87; GC 9/10/88; SE 9/9/90.

Tarachidia venustula Walker. AC 7/23/88; DR 8/27/88.

Tripudia balteata (Sm.). BP 4/29/89; SE 4/19/88.

Tripudia dimidata (Sm.). AL 4/9/88, 9/10/88; BP 4/29/89; DR 8/27/88.

Tripudia flavofasciata (Grote). AL 4/9/88.

Tripudia luda (Druce). AL 4/9/88.

Undetermined taxa. We collected 3 specimens, apparently representing more than 1 species. AL 9/10/88; DR 8/27/88, 3/11/89.

Subfamily: Agaristinae
Misa cosyra (Druce). AC 7/23/88; AL 7/29/89; EA 7/23/88; GC 9/10/88, 10/10/88; SE 9/9/90.

Subfamily: Amphipyrinae
Aseptis catalina (Sm.). AG 11/21/87; AL 4/9/88; BP 3/24/90; DR 3/11/89; GC 4/8/89; NE 3/5/88; PO 9/10/90; SE 4/19/88,4/13/90. Also found at Quitobaquito (Kingsley et al. 1987).

Azenia implora Grote. DR 8/27/88; PO 9/10/90. Also found at Quitobaquito (Kingsley et al. 1987).

Draudtia lunata (B. & McD.). AG 11/21/87; AR 11/20/87.

Emarginea dulcinea Dyar. AL 4/9/88, 9/10/88; GC 4/8/89; SE 4/19/88.

Hoplolythra discistriga (Sm.). DR 3/11/89; NE 3/5/88.

Lythrodes venatus Sm. AC 8/25/90.

Magusa orbifera (Wlk.). AL 9/10/88, 7/28/90; DR 8/27/88; GC 9/10/88.

Osalaria pura (B. & McD.). DR 8/27/88; PO 9/10/90; SE 9/9/90.

Oslaria viridifera (Grote). AG 8/26/89; GC 9/10/88; PO 9/10/90.

Platysenta temecula Barnes. AL 9/10/88.

Properigea continens (Hy. Edw.). AL 4/9/88; BP 10/17/87.

Prothrinax luteomedia Sm. AL 9/10/88; SE 9/9/90.

Pseudohadera vulnerea (Grote). AL 4/9/88; AR 4/14/90; GC 4/8/89; SE 4/19/88, 4/13/90.

Spodoptera exigua (Huebner) (beet armyworm). AG 8/26/89; AL 9/10/88; DR 8/27/88; GC 11/21/87, 9/10/88; PO 9/10/90; SE 10/30/87, 2/18/89. Also at Quitobaquito (Kingsley et al. 1987).

Stiria consuela Stkr. BP 3/24/90; DR 3/11/89.

Timora toralis Grote. PO 9/10/90. Also found at Quitobaquito (Kingsley et al. 1987).

Walterella ocellata (B. & McD.). AG 11/21/87; AR 2/26/88; GC 11/21/87; SE 2/18/89.

Subfamily: Catocalinae
Ascalapha odorata (Linnaeus) (black witch). AC 10/30/89; AL 7/28/90; BP 9/10/88. Also found at Quitobaquito (Kingsley et al. 1987) under the name *"Erebus odora. "*

Bandelia angulata (B & L). AC 7/23/88.

Bulia deducta Morrison. AC 7/23/88, 9/30/89; AG 10/8/88; DR 8/27/88; PO 7/11/90. Also at Quitobaquito (Kingsley et al. 1987).

Bulia similaris Richards. AL 4/9/88; GC 9/10/88; PO 7/11/90.

Catocala sp. 1. AC 9/30/89

Catocala spp. 2. BP 4/29/89.

Forsebia perlaeta (Hy. Edw.). AG 8/26/89; DR 3/5/88, 8/27/88, 3/11/89; EA 7/23/88; GC 9/10/88, 4/8/89; PO 7/11/90, 9/10/90; SE 10/30/87, 4/19/88, 2/18/89, 4/13/90, 9/9/90. Also found at Quitobaquito (Kingsley et al. 1987).

Heteranassa mima (Harv.). AG 11/21/87; AL 4/9/88; DR 8/27/88; GC 4/8/89; SE 4/19/88, 9/9/90. Also found at Quitobaquito (Kingsley et al. 1987).

Heteranassa minor (Sm.). AG 11/21/87.

Matigramma rubrosuffusa (Grote). Larval food plant: *Acacia constricta.* AC 7/23/88; AG 11/21/87; AL 4/9/88, 9/10/88; DR 8/27/88; EA 7/23/88; GC 9/10/88, 10/10/88, 4/8/89; NE 3/5/88; PO 9/10/90; SE 10/30/87, 4/19/88, 10/9/88,4/13/90, 9/9/90. Also found at Quitobaquito (Kingsley et al. 1987).

Melipotis indomita Wlk. AC 9/30/89; AG 10/8/88. Also reported by Hall et al. (1988) from AL.

Melipotis jucunda Huebner. Larval food plant: *Calliandra eriophylla.* AC 9/30/89; AG 10/8/88; AL 4/9/88; AR 4/14/90; DR 3/11/89; GC 4/8/89; NE 3/12/89; SE 10/9/88.

Melipotis novanda (Gn.). GC 4/8/89.

Melipotis sp. Possibly more than 1 species. AL 4/9/88; BP 10/17/87; PO 7/11/90; SE 10/9/88.

Synedoida tejonica (Beu.). BP 10/17/87; DR 3/11/89.

Toxonprucha crudelis (Grote). AL 4/9/88.

Toxonprucha repentris (Grote). AC 7/23/88; AG 8/26/89; AL 4/9/88; DR 8/27/88; GC 4/8/89; SE 4/19/88.

Toxonprucha strigalis (Grote). BP 10/17/87.

Undetermined taxa. We identified 4 specimens, representing several species, to this subfamily only.

Zaleops umbrina Grote. AC 7/23/88; AL 4/9/88; EA 7/23/88; GC 10/10/88, 4/8/89; PO 9/10/90; SE 10/9/88, 9/9/90.

Subfamily: Cucullinae
Catabena vitrina (Wlk.). AC 7/23/88; DR 8/27/88.

Copanarta nigerrima Sm. AC 7/23/88; AL 4/9/88; GC 9/10/88; NE 3/5/88.
Oncocnemis angustus Harv. Larval food plant: *Penstemon* spp. AG 11/21/87; GC 11/21/87; SA 10/31/87.

Oncocnemis occata (Grote). Larval food plant: *Penstemon* spp. AG 11/21/87; NE 3/5/88. Also found at Quitobaquito (Kingsley et al. 1987).

Oncocnemis rosea Sm. DR 3/11/89

Oxycnemis acuna Barnes. AL 4/9/88, 7/28/90; DR 8/27/88; GC 4/8/89; PO 9/10/90.

Oxycnemis advena Grote. DR 8/27/88.

Oxycnemis fusimacula Sm. AL 4/9/88; GC 4/8/89; NE 3/5/88.

Undetermined taxa. We identified 4 specimens possibly representing 2 different species, to this subfamily only.

Subfamily: Hadeninae
Egira curialis Grote. AC 1/28/89.

Hexorthodes accurata (Hy. Edw.). AL 7/29/89.

Hemorthodes furfurata (Grote). AG 11/21/87; BP 10/17/87.

Lacinipolia illaudabilis (Grote). AC 9/30/89; AL 4/9/88; BP 10/17/87, 4/29/89; SE 10/30/87, 4/19/88,10/9/88.

Polia nipana (Sm.). AG 11/21/87; AL 10/17/87,4/9/88; BP 10/17/87.

Protorthodes alfkeni (Grote). AG 11/21/87; BP 10/17/87; GC 4/8/89; SE 10/30/87, 4/19/88, 10/9/88.
Pseudaletia sp. AR 11/20/87.

Pseudaletia unipuncta (Harv.) (armyworm). AG 11/21/87.

Scotogramma orida (Sm.). AC 7/23/88; AG 11/21/87; BP 10/17/87.

Scotogramma ptilodonta (Grote). AG 11/21/87; SE 10/9/88.

Trichopolia dentatella Grote. BP 10/17/87; SE 10/9/88.

Tridepia nova Sm. AG 10/8/88.

Undetermined taxa. We identified 4 specimens, apparently representing 4 different species, to subfamily only.

Ulolonche dilecta (Hy. Edw.). AL 4/9/88.
Subfamily: Heliothinae
Grotella binda Barnes. DR 8/27/88; GC 9/10/88, 10/10/88; PO 9/10/90. Also found at Quitobaquito (Kingsley et al. 1987).

Grotella blanca Barnes. DR 8/27/88.

Grotella tricolor Barnes. DR 8/27/88.

Heliothis virescens (Fabricius). AG 10/8/88.

Subfamily: Hypeninae
Hemeroplanis incusalis (Grote). An abundant and widespread moth. Depending on wear-and-tear, this species may appear to be extremely variable. AC 7/23/88; AG 11/21/87; AL 4/9/88; DR 8/27/88; GC 9/10/88,4/8/89; NE 3/5/88; PO 9/10/90; SE 4/19/88,10/9/88,4/13/90, 9/9/90. Also reported by Hall et al. (1988).

Subfamily: Noctuinae
Abagrotis alampeta (Franc.). AL 4/9/88; BP 4/29/89.

Abagrotis barnesi (Benj.). AG 11/21/87; AR 11/20/87. *Abagrotis*
sp. SE 10/9/88.

Agrotis ipsilon Hufnagel (black cutworm). AG 10/8/88; GC 9/10/88, 3/5/88; SE 2/18/89.

Copablepharon album (Harv.). GC 9/10/88; SE 9/9/90.

Euxoa brevipennis (Sm.). AG 11/21/87; BP 10/17/87; SE 10/9/88.

Euxoa medialis Smith. AG 11/21/87; AL 4/9/88; SE 4/19/88.

Euxoa quadridentata G & R. AG 11/21/87; SE 10/9/88.

Euxoa segregata Sm. SE 4/19/88.

Euxoa sp. AC 1/28/89.

Feltia annexa Treitschke. AG 11/21/87.

Hemieuxoa rudens (Harv.). AC 1/28/89; AG 11/21/87,10/8/88; AL 9/10/88; BP 4/29/89; DR 8/27/88, 3/11/89; NE 3/5/88.

Hemieuxoa rudens pellucidalis (Grote). AC 1/28/89; AG 10/8/88.

Peridroma saucia (Hbn.) (variegated cutworm). AC 1/28/89, 9/30/89; AG 11/21/87; AL 9/10/88; DR 3/11/89; GC 9/10/88, 10/10/88; PO 9/10/90; SE 10/9/88, 2/18/89, 9/9/90.

Subfamily: Plusiinae
Trichoplusia ni (Huebner) (cabbage looper). AG 11/21/87,10/9/88; PO 9/10/90.
Undetermined taxa. We identified 11 specimens to family only. They represent at least 5 species.

Family: Notodontidae (Prominent Moths)
Members of this family resemble Noctuids but differ in the branching of wing veins. "Classification of the family is confused." (Arnett 1985, p. 599). There are 41 genera and 136 species known from the United States and Canada (Arnett 1985).

Undetermined taxa. We collected 5 specimens, possibly 3 species, 1 from AC 9/30/89, another from AL 7/29/89, and 1 from DR 8/27/88.

Family: Nymphalidae (Brush-footed Butterflies)
The largest family of butterflies, all are characterized by reduced front legs. Many species are strong fliers and stray outside their breeding range.

Subfamily: Argynninae
Euptoieta claudia (Cramer) (variegated fritillary). Rare, probably a stray. Adults observed feeding at *Baccharis sarothroides.* BP 7/23/88, 9/30/89. Also found at Quitobaquito (Kingsley and Bailowitz 1987).

Subfamily: Limenitidinae
Adelpha bredowii (Geyer) (sister). Rare, possibly breeds in the monument, but may be a stray. Feeds on oaks. AC 4/29/89, 10/30/89; AL 4/9/88.

Subfamily: Melitaeinae
Anathanassa texana (WH Edwards) (Texas crescent). Uncommon, may breed in the monument. AC 4/29/89, 10/30/89; AL 3/11/89; BP 4/29/89. Also found at Quitobaquito (Kingsley and Bailowitz 1987), and AL (Garth 1944).

Chlosyne californica (WG Wright) (California patch). The larval food plant, *Viguiera deltoidea,* is widespread in the monument, but this butterfly is rather rare. AC 8/25/90; AL 8/26/89; BP 8/25/90. Also found at Quitobaquito (Kingsley and Bailowitz 1987) and in AL by Garth (1944).

Chlosyne lacinia (Geyer) (bordered patch). Rare, but may occasionally be more common. Records from AC 10/30/89; AL 8/26/89, 7/28/90; BP 9/30/89, 8/25/90. Also at Quitobaquito (Kingsley and Bailowitz 1987). Adults recorded at *Baccharis.*

Dymasia dymas (W. H. Edwards) (dymas checker-spot). Uncommon. Larval food plant: *Siphonoglossa.* Records from AC 7/29/89, 3/25/90, 8/25/90; AL 4/9/88; BP 9/10/88, 4/29/89, 9/30/89, 3/24/90, 8/25/90.

Occidryas chalcedona (Doubleday) (chalcedon checker-spot). Rare, apparently strays, but suitable food plants do occur in the monument. Recorded only once, several individuals, AC 4/10/88. Adults feeding at *Encelia farinosa.* Also recorded by Garth (1944) in AL.
Texola elada (Hewitson) (elada checker-spot). Uncommon. Food plant may be *Anisacanthus thurberi.* AC 7/29/89, 10/30/89, 3/25/90; AL 4/9/88, 9/11/88, 7/29/89, 8/26/89; BP 4/29/89, 8/25/90.

Thessalia fulvia (W. H. Edwards) (fulvous checker-spot). Rare, recorded only from AL 4/9/88 and BP 3/24/90. Also recorded by Garth (1944). Adults recorded (Garth 1944) feeding at flowers of *Eriogonum fasciculatum.* Larval food plant: *Castilleja.*

Subfamily: Nymphalinae
Junonia (= *Precis*) *coenia* (Huebner) (buckeye or peacock butterfly). A rare butterfly that utilizes a variety of larval food plants and habitats. Only 1 record, no specimen, AL 3/11/89. Also found at Quitobaquito (Kingsley and Bailowitz 1987).

Junonia (= *Precis*) *nigrosuffusa* B. & McD. (dark peacock). A rare butterfly, recorded only once from BP 8/25/90. Also found at Quitobaquito (Kingsley and Bailowitz 1987).

Myscelia cyananthe Felder. A rare stray, recorded only once. AG 8/28/88.

Nymphalis antiopa (Linnaeus) (mourning cloak). A rare stray, recorded only once. AC 4/29/89. Also found at Quitobaquito (Kingsley and Bailowitz 1987).

Vanessa annabella (Field) (west coast lady). A rare stray, recorded from AC 3/25/90; AG 10/8/88, 1/28/89. Also found at Quitobaquito (Kingsley and Bailowitz 1987). Adults were recorded feeding at *Bebbia juncea* flowers.

Vanessa atalanta (Linnaeus) (red admiral). A rare stray, recorded from AC 4/29/89; AL 3/11/89; BP 8/25/90. Also found at Quitobaquito (Kingsley and Bailowitz 1987). Adults were recorded feeding at *Baccharis sarothroides* flowers.

Vanessa cardui (Linnaeus) (painted lady). Common and widespread throughout the monument. Utilizes a variety of larval food plants. Adults were recorded feeding at *Bebbia juncea* flowers, but feed at practically any flowers in bloom. AC 10/17/87, 7/29/89, 10/30/89, 3/25/90; AG 10/8/88, 1/28/89, 2/24/90, 5/6/90, 8/26/90; AL 9/11/88, 3/11/89, 7/29/89, 8/26/89; AR 9/10/88; BP 9/10/88, 4/29/89, 9/30/89, 3/24/90, 8/25/90; DO 4/8/89; DR 3/11/89; EA 2/25/90; GC 4/8/89, 2/25/90; NE 8/27/88, 3/12/89; PO 2/24/90; SA 4/8/89; SE 2/24/90; VU 10/10/88, 2/24/90. Also found at Quitobaquito (Kingsley and Bailowitz 1987).

Vanessa virginensis (Drury) (American painted lady). Rare, stray recorded only from AC 11/1/89.

Family: Papilionidae (Swallowtail Butterflies)
Large, showy butterflies, these are strong fliers and may range widely. Most are very specific in larval food plant selection.

Subfamily: Papilioninae
Battus philenor (Linnaeus) (pipevine swallowtail). Common to abundant, and distributed throughout the monument. The larval food plant is *Aristolochia watsoni.* Adults feed at many flowers. Records from AC 10/30/89; AG 3/6/88, 10/8/88, 8/26/90; AL 9/11/88, 7/29/89; AR 9/10/88, 5/27/89; BP 10/17/87, 9/10/88, 4/29/89, 9/30/89, 8/25/90; DR 3/11/89; EA 9/10/88; GC 2/27/88, 9/10/88,4/8/89,9/9/90; NE 3/12/89; SA 10/9/88,4/8/89; VU 10/10/88. Also found at Quitobaquito (Kingsley and Bailowitz 1987) and by Garth (1944) in AL.

Papilio cresphontes Cramer (giant swallowtail, orange dog). Rare, primarily a citrus feeder and a minor pest of cultivated citrus. Records from AC 4/29/89; BP 4/29/89, 8/25/90; SA 4/8/89.

Papilio multicaudatus Kirby (two-tailed swallowtail). Uncommon, a large, strong-flying butterfly that may breed in the monument. *Ptelea trifoliata* is the only 1 of several known larval food plants known to grow in the monument. Records from: AC 4/10/88, 4/29/89, 7/29/89, 10/30/89, 3/25/90; AL 4/9/88, 3/11/89, 7/29/89, 5/5/90, 7/28/90. Also recorded by Garth (1944) in AL.

Papilio polyxenes Fabricius (black swallowtail). Rare, seen only twice at DR, 8/27/88, 3/11/89. No specimens. Probably a stray.

Family: Pieridae (Whites and Sulfurs)
A worldwide family of butterflies, most of which are white or yellow. Most species feed on members of the large plant family Cruciferae, and some species are pests on cruciferous and other crops.

Subfamily: Anthocharinae
Anthocharis pima Edwards (Pima orange-tip). A rare butterfly, the food plant is not known, but is probably 1 or more species of wild mustards. Records from DR 3/5/88, 3/11/89; LO 2/18/89; SE 2/18/89; VU 2/24/90. Also found at Quitobaquito (Kingsley and Bailowitz 1987).

Anthocharis sara Lucas (Sara orange-tip). An uncommon or rare butterfly, the larval food plants are several species of mustards. Records from AL 3/11/89; GC 2/25/90; NE 1/28/89; SE 2/18/89.

Subfamily: Coliadinae
Colias eurytheme Boisduval (orange sulfur, alfalfa caterpillar). A common and conspicuous butterfly. A pest of alfalfa, this species feeds on many other legumes. Records from AC 1/28/89; AG 10/8/88, 8/27/89, 8/26/90; AL 3/11/89; AR 2/26/88, 9/10/88; BP 8/25/90; DR 3/5/88; LO 4/20/88; SE 8/18/89; VU 10/10/88. Also found at Quitobaquito (Kingsley and Bailowitz 1987).

Eurema mexicana (Boisduval) (Mexican sulfur). Ranging in abundance from common to rare, depending on site and season. Food plant for larvae is *Cassia* species (Tilden and Smith 1986). Records from AC 4/29/89, 10/30/89; AG 11/22/87; AL 4/9/88, 3/11/89, 5/5/90; BP 9/10/88, 4/29/89, 3/24/90, 8/25/90. Also found at Quitobaquito (Kingsley and Bailowitz 1987), and in AL by Garth (1944).

Eurema nicippe (Cramer) (sleepy orange). Common to abundant, larval food plants are *Cassia covesii* and other legumes. Records from AC 10/17/87, 4/29/89, 10/30/89, 3/25/90, 8/25/90; AG 8/28/88, 10/8/88, 4/14/90, 5/6/90, 8/26/90; AL 10/18/87, 4/9/88, 9/11/88, 3/11/89, 8/26/89, 5/5/90, 7/28/90; BP 10/17/87, 9/10/88, 4/29/89, 9/30/89, 3/24/90, 8/25/90; BU 4/8/89; DR 11/21/87, 3/5/88, 8/27/88, 10/8/88, 3/11/89; GC 9/10/88, 4/9/88; NE 11/21/87, 3/12/89; SA 10/10/88, 4/8/89; SE 10/10/88; VU 10/10/88, 2/18/89. Also found at Quitobaquito (Kingsley and Bailowitz 1987), and at AL by Garth (1944).

Eurema proterpia (Fabricius) (proterpia orange). A rare butterfly, its larvae and food plants are unknown. Adults were seen feeding at *Zauschneria californica.* Records from AC 10/30/89; BP 9/30/89; VU 2/18/89.

Kricogonia lyside (Godart) (Lyside). A rare butterfly, its larval food plant is not found in the monument. Individuals may be found cruising along and feeding at whatever is in bloom, including *Bebbia juncea.* Records from AG 10/8/88, 8/26/89, 7/28/90, 8/26/90; AL 8/26/89; SE 8/18/89. Also found at Quitobaquito (Kingsley and Bailowitz 1987).

Nathalis iole Boisduval (dainty sulfur). An uncommon, widely distributed small butterfly, it may be easily overlooked because of its size and its habit of flying low to the ground. Feeds on a wide variety of plants. Records from AC 4/29/89; AG 8/28/88, 10/8/88, 5/6/90; AL 4/9/88, 3/11/89; BP 9/30/89; DO 4/8/89; DR 3/11/89; GC 9/9/90; LO 4/20/88, 2/18/89; NE 3/12/89; SA 4/8/89; VU 2/18/89. Also found at Quitobaquito (Kingsley and Bailowitz 1987) and at AL by Garth (1944).

Phoebis sennae (Linnaeus) (cloudless sulfur). An uncommon or rare butterfly, its larval food plant is *Cassia covesii.* Adults were seen feeding at *Ipomoea hirsutula.* Records from AC 4/29/89, 10/30/89,

8/25/90; AG 10/8/88, 7/28/90, 8/26/90; AL 10/18/87, 9/11/88, 8/26/89, 7/28/90; AR 9/10/88; BP 9/30/89, 8/25/90; DO 8/19/89; GC 9/10/88; SE 8/18/89; VU 10/10/88. Also found at Quitobaquito (Kingsley and Bailowitz 1987).

Zerene cesonia (Stoll) (southern dogface). An uncommon to common and conspicuous butterfly. Uses several legumes as a larval food plant. Records from AG 10/8/88, 8/26/90; AL 10/18/87, 4/9/88, 9/11/88, 3/11/89, 8/26/89; BP 10/17/87, 4/29/89, 9/30/89, 8/25/90; DR 11/21/87; GC 4/8/89; SE 9/9/90; VU 2/18/89. Also found at Quitobaquito (Kingsley and Bailowitz 1987), and at AL by Garth (1944).

Subfamily: Pierinae
Appias drusilla Cramer (Florida white). Rare, 1 record only. AG 8/28/88, no specimen.

Ascia howarthi (Dixey) (Howarth's white). The only known localities for this butterfly in the United States are the AW and Quitobaquito area of OPCNM (Bailowitz 1985). The only known food plant is *Atamisquea emarginata,* which is found in the United States only at these locations. This is a rare butterfly, and is of some interest for its rarity and the fact that it is unique to the monument (for the United States), but it is not especially rare or endangered where the plant is more common, and is not especially interesting for any other reason. Adults are not always present, or at least not always active. Dates during the course of this study when adults were seen were 11/22/87, 3/6/88, 8/28/88, 10/8/88, 4/14/90, 5/6/90, and 7/28/90. No records are from 1989, despite 2 searches for this insect in its habitat. Several possible explanations might apply:

1. The observers missed a butterfly that was, in fact, present, but inactive or inconspicuous due to weather conditions.
2. The butterfly was not present as an adult but was in an earlier, more difficult to detect stage of development.

3. The butterfly was not present, in any stage of development, during this period but has reestablished itself with more favorable weather conditions.

Pontia protodice (Bsdvl. & LeC.) (checkered white, southern cabbageworm). Common to abundant, widespread. Feeds on many members of the mustard family. Adults feed on almost any flower in bloom. Records from AG 8/28/88, 10/8/88, 1/28/89, 5/6/90, 8/26/90; AL 9/11/88; AR 2/26/88; BU 8/27/88; DR 8/27/88, 3/11/89; GC 9/10/88; 4/8/89; SA 4/8/89; SE 5/27/89, 8/18/89, VU 10/10/88. Also found at Quitobaquito (Kingsley and Bailowitz 1987).

Family: Plutellidae (Diamondback Moths)
A "poorly defined" family with 52 species known from the United States and Canada (Arnett 1985). Small, obscure moths, all of our specimens were collected at lights.

Plutella xylostella Linnaeus (diamondback moth). A cosmopolitan pest of cruciferous crops. Specimens from BP 10/17/87; SE 4/19/88.

Undetermined taxa. We identified 4 specimens, possibly representing 2 species, to family only. AL 9/10/88; SE 4/19/88.

Family: Psychidae (Bagworm Moths)
An unusual group of 26 U.S. species of moths. Adult males are winged, females are wingless and live in cases that are built by larvae from silk and plant material (Arnett 1985).

Thyridopteryx meadi (Hy. Edw.). This bagworm lives on *Larrea.* Bags are found hanging from branches. The bags are made of silk and covered with leaves. Although this is probably an abundant insect, and bags are present throughout the year, it is easily overlooked. No males were collected. Observations from AR 11/20/87, 5/27/89, 10/21/89, 4/14/90; NE 1/28/89. It is likely that the insect is found throughout the monument, but has been overlooked at most sites.

Family: Pterophoridae (Plume Moths)
Adults show up occasionally at lights. They are very difficult to identify beyond family. There are 146 species known from the United States and Canada (Arnett 1985).

Undetermined taxa. We identified 9 specimens, which may represent more than 1 species, to family only.

Family: Pyralidae (Snout Moths)
A large family of 423 genera and 1,374 species recorded from the United States and Canada (Arnett 1985). Taxonomy is complex, difficult, and constantly changing. All we can say about most of our species is they come to lights. Many species are pests in a variety of situations.

Subfamily: Chrysauginae

Undetermined taxa. Only 1 specimen. BP 10/17/87.

Subfamily: Crambinae
Ommatopteryx texana Roc. AG 8/26/89.

Undetermined taxa. We identified 1 specimen to subfamily only. AG 5/5/90.

Subfamily: Epipaschinae

Undetermined taxa. We identified 1 specimen to subfamily only. AL 4/9/88.

Subfamily: Evergestinae
Evergestis nolentis Heinr. AG 11/21/87, 8/26/89; AL 9/10/88; DR 3/11/89; NE 3/5/88; SE 2/18/89. Also found at Quitobaquito (Kingsley et al. 1987).

Subfamily: Glaphyriinae
Abegesta reluctalis (Hulst). AG 8/26/89; AL 4/9/88.

Hellula rogatalis (Hulst) (cabbage webworm). AG 11/21/87; AL 9/10/88.

Hellula sp. AG 8/27/89.

Soybalistodes sp. May be more than 1 species. AG 5/5/90; AL 4/9/88; BP 4/29/89; SE 4/19/88.

Stegea salutalis (Hulst). AL 4/9/88; GC 4/9/89.

Subfamily: Odontiinae
Cymbopteryx fuscimarginalis Mun. DR 3/11/89.

Cymbopteryx unilinealis B. & McD. AG 11/21/87,10/8/88; DR 8/27/88; NE 3/5/88; SE 10/30/87.

Decaturia pectinalis B. & McD. BP 4/29/89.

Heliothelopsis costipunctalis B. & McD. AL 4/9/88.

Jativa castanealis (Hulst). AL 4/9/88, 9/10/88.

Microtheoris sp. AL 9/10/88.

Mimoschinia rufofascialis decorata (Druce) (barberpole caterpillar). AL 4/9/88, 9/10/88.

Mimoschinia rufofascialis novalis (Grote) (barberpole caterpillar). DR 3/11/89. *Mojavia achemonalis* (B. & Mc.D.). AG 8/26/89.

Noctueliopsis aridalis (B. & Benj.). AG 8/26/89.

Noctueliopsis bububattalis Hulst. NE 3/5/88.

Pseudoschinia elautalis (Grote). AL 4/9/88; SE 4/19/88.

Undetermined taxa. We identified 6 specimens, apparently representing 2 or 3 species, only to this subfamily.

Subfamily: Phycitinae
Cactobrosis fernaldialis (Hulst). At one time, this moth was implicated as a vector in the mysterious "bacterial necrosis disease" of saguaros. When the condition was proved to be normal decay of dead cacti, the moth's reputation improved. It is possible that the moth carries bacteria and or yeasts that contribute to rotting. Specimens collected at lights AC 7/23/88; AL 9/10/88; BP 10/17/87; GC 4/9/89; PO 9/10/90; SE 10/9/88,.4/13/90, 9/9/90. Also found at Quitobaquito (Kingsley et al. 1987). Also reported by Hall et al. (1988) from AL.

Eteilla zinckenella Treitschke (limabean pod borer). AL 4/9/88; DR 3/11/89.

Heterographis morrisonella Ragonot. AG 11/21/87; NE 3/5/88.

Melitara prodenialis Wlk. SE 10/30/87.

Passadena flavidorsella Ragonot. DR 8/27/88; NE 3/5/88; SE 4/19/88.

Plodia interpunctella Huebner. AG 11/21/87.

Selga arizonella Hulst. AG 11/21/87; AL 4/9/88; AR 4/14/90; SE 4/19/88.

Undetermined taxa. We identified 20 specimens, probably representing several species, only to this subfamily.

Subfamily: Pyraustinae
Antigastra catalaunalis (Dup.). AL 4/9/88.

Diaphania quadristigmalis Gn. AL 7/29/89.

Hahncappsia jaralis (Schaus). AL 9/10/88.

Hymenia perspectalis (Huebner) (spotted beet webworm). AG 10/8/88. Also found at Quitobaquito (Kingsley et al. 1987).

Loxostege albiceralis Grote. AC 7/23/88; AL 9/10/88, 9/10/90. Also found at Quitobaquito (Kingsley et al. 1987).

Loxostege allectalis (Grote). BP 3/24/90; GC 4/8/89; SE 4/19/88, 4/13/90.

Loxostege sp. We identified 18 specimens to genus only. They may represent more than 1 species. There are 25 species known from the United States and Canada (Arnett 1985).

Loxostege typhonalis (B. & McD.). AG 8/26/89.

Mutuuraia mysippusalis (Wlk.). DR 3/11/89.
Nomophila nearctica Munroe. BP 3/24/90; GC 4/8/89; NE 3/5/88.

Pyrausta napaealis Hulst. AG 11/21/87.

Pyrausta onythesalis Walker. AC 7/23/88; AL 9/10/88, DR 3/11/89.

Pyrausta signatalis (Wlk.). AC 9/30/89; AL 9/10/88.

Sameodes sp. Possibly more than 1 species. AL 4/9/88, 9/10/88; BP 4/29/89; GC 4/8/89.

Undetermined taxa. We identified 7 specimens to this subfamily only. They evidently represent several species.

Subfamily: Scopariinae
Scoparia sp. SE 2/18/89.

Undetermined subfamilies. We identified 28 specimens to family only. They undoubtedly represent several species.

Family: Riodinidae (Metalmark Butterflies)
There are 25 species of this family found in the United States (Arnett 1985).

Subfamily: Riodininae
Apodemia mormo (C. & R. Felder) (Mormon metalmark). A fairly common butterfly. The larval food plant is *Eriogonum wrightii.* Adults were observed feeding at *Bebbia juncea, Eriogonum fasciculatum,* and *E. wrightii.* Records from AC 4/29/89; AG 11/22/87; AL 10/18/87, 8/26/89, 5/5/90, 7/28/90; BP 4/29/89; DR 11/21/87, 8/27/88; NE 11/21/87, 8/27/88; VU 10/10/88. Also found at Quitobaquito (Kingsley and Bailowitz 1987).

Apodemia palmerii (W. H. Edwards) (Palmer's metalmark). *Prosopis* is the larval food plant for this rare butterfly. Prefers riparian areas. Adults were recorded feeding at flowers of *Acacia greggii.* Records from AL 8/26/89; BP 4/29/89. Also found at Quitobaquito (Kingsley and Bailowitz 1987).

Calephelis nemesis (W. H. Edwards) (fatal metalmark). An uncommon butterfly, except at Quitobaquito and Aguajita Spring, where it is fairly common. Larvae feed on shrub composites, probably *Baccharis salicifolia.* Adults were seen feeding at *Gymnosperma glutinosum* flowers. Records from AG 10/8/88, 5/6/90, 7/28/90, 8/26/90; AL 9/10/88. Also found at Quitobaquito (Kingsley and Bailowitz 1987).

Family: Saturniidae (Giant Silkworm Moths)
Members of this family are large, often brightly colored, distinctive moths. All are rather rare. There are 69 species known from the United States and Canada (Arnett 1985).

Subfamily: Ceratocampinae
Syssphinx (= Sphingicampa) hubbardi (Dyar). Larval food plants: *Prosopis* and *Cercidium* spp., possibly other legumes. Uncommon. AL 7/29/89; GC 9/10/88, 10/10/88; PO 9/10/90; SE 10/10/88 (caterpillar on *Cercidium microphyllum),* 9/9/90.

Subfamily: Hemileucinae
Hemileuca juno Packard. Larval food plant: *Prosopis* spp. Rare. AG 11/21/87; AR 11/20/87.

Subfamily: Saturniinae
Agapema galbina anona (Ottolengui). Larval food plant: *Condalia globosa.* Our only records are of larvae and cocoons, GC 4/9/89; LO 4/20/88.

Eupackardia calleta (Westwood). Larval food plant: *Sapium biloculare.* Our records include larvae and old cocoons at NE 1/28/89; larvae collected at LO 2/18/89 (4 larvae collected and reared to pupae, none emerged, all were parasitized by the time they were second instar); 1 adult found dead at the visitor center, approximately 1/1/89, and passed on to us.

Family: Sesiidae (Clear-winged Moths)
Diurnal moths, many of which have transparent wings. Larvae are borers in stems and roots. Adults of some species are quite colorful and actively feed at flowers. There are 115 species known from the United States and Canada (Arnett 1985). Some are agricultural pests.

Hymenoclea palmii Beutenmuller. The known food plant is *Hymenoclea monogyra,* which is not listed as occurring in the monument. The moth may feed on *H. salsola.* Adults collected at AC 9/30/89; BP 10/17/87.

Family: Sphingidae (Hawk Moths)
Large, often colorful moths. Some species may be very abundant, and some are agricultural pests. Adults may be active by day and at twilight, as well as at night. The long proboscis is well-adapted for feeding in tubular flowers such as *Datura* and many cactus flowers.

Subfamily: Macroglossinae
Erinnyis ello Linnaeus. Rare, probably a stray. This is a tropical moth, known to wander as far north as Canada (Holland 1903). Only 1 record: SE 10/9/88 at light.

Erinnyis obscura Fabricius. Rare, a stray. This is a tropical moth, known to wander into this country occasionally. Only 1 record: GC 10/10/88 at light.

Hyles lineata (Fabricius) (whitelined sphinx). Abundant and ubiquitous. Larvae feed on many species of plants, mostly annuals. Occasionally huge numbers of the yellow-and-black striped larvae may be found in a small area, crawling over the ground and sampling all lowgrowing vegetation. Adults are often abundant at lights. On some occasions more than 50 were visible at any given moment. Sometimes the adults are active by day, feeding at flowers. Records from AL 4/9/88; AR 9/10/88, 10/21/89, 4/14/90; BP 9/10/88; GC 9/10/88, 10/10/88; PO 7/11/90, 9/10/90; SE 4/19/88, 2/18/89,4/13/90. Also found at Quitobaquito (Kingsley et al. 1987).

Subfamily: Sphinginae
Manduca quinquemaculata (Haworth) (tomato hornworm). Both larvae and adults have been observed feeding on *Datura* spp., larvae on the leaves and adults at the flowers. Occasionally the large adults may be very abundant, coming to lights and zooming around the heads of collectors. Records from AL 9/10/88; GC 10/10/88; PO 7/11/90, 9/10/90. Also found at Quitobaquito (Kingsley et al. 1987).

Manduca rustica (Fabricius). Rare, stray. A tropical moth that occasionally strays northward, it is more at home in the southeastern United States SE 9/9/90, at light.

Manduca sexta (Linnaeus). (tobacco hornworm). Both larvae and adults have been observed feeding on *Datura* spp., larvae on the leaves and adults at the flowers. Occasionally the large adults may be very abundant, coming to lights and zooming around the heads of collectors. Apparently more abundant than *M. quinquemaculata,* but it is difficult to tell the 2 apart in the field, so our records may not accurately reflect conditions. Records from AG 8/26/89; AL 7/29/89, 7/28/90; EA 7/23/88; GC 9/10/88, 10/10/88; PO 7/11/90; SE 9/9/90. Also found at Quitobaquito (Kingsley et al. 1987). Also reported by Hall et al. (1988) from AL.

Sphinx istar Rothschild & Jordan. Rare, a stray, collected twice at AC 7/23/88, 8/25/90.

Sphinx libocedrus H. Edwards. Rare, a stray, collected once. AC 7/23/88.

Family: Tineidae (Clothes Moths)
Some members of this family use wool, hair, and dead skin as larval food, so are considered pests of clothing and fabrics. Larvae also feed on fungi, rotten wood, and detritus. There are 175 species known from the United States and Canada (Arnett 1985). Most of the adults are little brown or gray moths that are very difficult to identify.

Acrolophus sp. There are 49 species known for this genus in the United States (Arnett 1985). Our specimens may represent more than 1 species. Collected at lights, AC 7/23/88; AG 10/8/88, 8/26/89; AL 9/10/88, 7/29/89; DR 8/27/88, 3/11/89. Also found at Quitobaquito (Kingsley et al. 1987).

Dyotospasta yumaella Kearfott. Common and widespread. Collected at lights, AL 4/9/88, 9/10/88; BP 10/17/87, 4/29/89; DR 8/27/88; NE 3/5/88; SE 10/30/87.

Undetermined taxa. We identified 9 specimens, representing several species, only to family.

Family: Tortricidae (Tortricid Moths)
Larvae of these obscure moths bore into fruits, seeds, or leaves. Some are leaf-rollers. Many species are pests in agriculture and forestry. Identification of the genera is based on genitalic dissection, which is a task for specialists.

Subfamily: Olethreutinae
Cydia deshaisiana (Luc.). Reared from fruits of *Sapium biloculare.* Locations and dates of fruit collection: AC 1/29/89; DR 3/11/89. Movements of the larvae inside the fruits give the plant the common name "Mexican jumping bean."

Ofatulena duodecemstriata (Wlsm.) At light, AG 5/5/90.

Undetermined taxa. We identified 12 specimens, apparently representing several species, to this family only.

Family: Undetermined
We collected 30 specimens of Lepidoptera (1 of which was a caterpillar), not identified to family. Reasons include damage or wear to specimen, obscure or ambiguous characters made keying difficult, specimen could not be run through the keys easily. Most of these specimens are the only members of their species found, or there are 2 or 3 specimens of 1 species.

Family: Yponomeutidae (Ermine Moths)
Pretty, rare, small moths. Larvae feed on leaves under webbing or mine in stems or leaves. Adults come to lights. There are 32 species known from the United States and Canada (Arnett 1985).

Atteva punctella (Cramer) (ailanthus webworm). Only 1 record, from GC 10/10/88. Also found at Quitobaquito (Kingsley et al. 1987).

Order: Neuroptera (Dobsonflies, Lacewings, Antlions, and Allies)
Most species are predators as larvae, actively pursuing prey, lying in wait and pouncing, or constructing traps. As adults, some species are predators, others eat nectar, and some do not eat as adults (Arnett 1985).

Family: Ascalaphidae (Owlflies)
A small family with only 6 species in the United States (Arnett 1985). Larvae hide under debris and pounce on insects. Adults are active by day or in early evening, and are among the first insects to come to lights as darkness descends.

Subfamily: Ascalaphinae
Ululodes arizonensis Banks. AL 9/10/88, 8/26/89; DR 8/27/88.

Subfamily: Haplogleniinae
Neuroptynx furliger (MacLachlan). BP 7/23/88.

Family: Berothidae (Beaded Lacewings)
Rare and poorly known, 10 species, all in the same genus, are known from the United States (Arnett 1985).

Lomamyia sp. We collected 2 specimens, probably the same species, at lights. AL 4/9/88; DR 3/11/89.

Family: Chrysopidae (Green Lacewings)
Members of this family are important biological control agents in agriculture, feeding on aphids and other soft-bodied insects. Larvae and adults may be predacious, although adults of some species are nectar feeders only. There are 87 species known from the United States and Canada (Arnett 1985). Identification of some genera and most species is very difficult.

Chrysopa spp. Probably more than 1 species. There are 34 species known from the United States and Canada (Arnett 1985). Collected at lights and on vegetation. AG 11/21/87; AL 4/9/88; AR 4/14/90; DR 11/21/87, 3/11/89; GC 9/10/88; 10/10/88; PO 9/10/90; SE 4/19/88, 9/9/90. Several unidentified species were also found at Quitobaquito (Kingsley et al. 1987).

Eremochrysa sp. Possibly more than 1 species. There are 13 species known from the United States and Canada (Arnett 1985). One, identified as *E. punctinervis* McLachlan, was found at Quitobaquito (Kingsley et al. 1987). Our unidentified specimens may include this species. Specimens from DR 8/27/88; SE 4/19/88, 9/9/90.

Leucochrysa sp. Probably only 1 species. DR 11/21/87 and GC 11/21/87.

Meleoma sp. Collected only once, SE 4/19/88.

Nodita sp. Collected only once, AL 4/9/88. .

Family: Hemerobiidae (Brown Lacewings)
There are 50 species known from the United States and Canada (Arnett 1985). Most of them live in trees. Adults come to lights. They are rather rare.

Hemerobius pacificus (Banks). Collected at lights, AG 11/21/87; AL 4/9/88.

Hemerobius sp. Collected at lights, probably 1 species, AC 1/28/89; AL 4/9/88.

Family: Mantispidae (mantislike lacewings)
Larvae are parasitic in spider egg cases and predators on subterranean insect larvae. Adults are predacious, with their front legs raptorial, like those of mantids. They come to lights, but are generally rare.

Subfamily: Platymantispinae
Plega banksi Rehn. Collected at lights, AC 7/23/88; BP 7/23/88; DR 8/27/88.

Plega sp. Possibly more than 1 species, apparently different from *banksi.* Collected at lights, AC 7/23/88, 9/30/89, 8/25/90; BP 4/29/89; DR 8/27/88, 3/11/89.

Family: Myrmeleontidae (Ant Lions)
A rather diverse family, well adapted for desert life. Larvae of some species construct little conical pits in sand or dust, most often in shade or under rock overhangs. Ants, and probably other small cursorial insects, slide; into the pits and are grabbed by the ferocious jaws of the predators. Larvae of most species in the family do not make pitfalls but lie in wait under debris or sand. Adults commonly come to lights. They are generally weak fliers. Adults may eat nectar or may not eat at all (Arnett 1985).

Subfamily: Dendroleontinae
Brachynemurus sp. There are 50 species known for this genus (Arnett 1985). We collected 1 specimen, at light, AC 7/23/88. It. may be *B*. *yavapai* Currie, which was recorded from AL by Hall et al. (1988).

Chaetoleon pusillus (Currie). Fairly common at lights. AC 7/23/88; AG 8/26/89; AL 9/10/88; GC 9/10/88; SE 4/13/90, 9/9/90.

Dendroleon sp. Collected only once, EA 7/23/88.

Eremoleon nigribasis Banks. AC 7/23/88; DR 8/27/88. Also at Quitobaquito (Kingsley et al. 1987), and AL (Hall et al. 1988).

Glenurus snowi Banks. AC 7/23/88.

Gnopholeon delicatulus (Currie). AC 7/23/88.

Hesperoleon douglasi Banks. GC 9/10/88, 10/10/88; PO 9/10/90.

Hesperoleon hubbardi (Currie). GC 9/10/88.

Hesperoleon niger (Currie). AL 9/10/88; DR 8/27/88; GC 9/10/88.

Hesperoleon sackeni (Hagen). AL 4/9/88; AR 4/14/90; GC 4/8/89; SE 4/19/88, 4/13/90.

Hesperoleon sp. SE 9/9/90.

Psammoleon sinuatus Currie. AC 9/30/89.

Scotoleon longipalpus Hagen. EA 7/23/88; PO 7/11/90.

Undetermined taxa. Possibly more than 1 genus and species. PO 7/11/90; SE 10/9/88, 9/9/90.

Subfamily: Acanthaclisinae
Vella hesperus Banks. AC 7/23/88; AG 10/8/88; GC 10/10/88; PO 9/10/90. Also found at Quitobaquito (Kingsley et al. 1987) and reported by Hall et al.. (1988) from AL.

Order: Odonata (Dragonflies and Damselflies)
Larvae of all species are aquatic predators. Some may require several years to mature, others may mature in only a short time, but all require standing or running water for the duration of their larval lives. The pond at Quitobaquito, Aguajita Spring and the Rio Sonoita are probably the best breeding sites for dragonflies in the area. Adult dragonflies are strong fliers, voracious predators, and may range far from water. Adult damselflies are not strong fliers and are usually found near breeding sites (Arnett 1985).

Family: Aeschnidne (Darners)
Large, swift-flying dragonflies that are quite challenging to catch. There are 34 species known from the United States and Canada (Arnett 1985).

Aeschna multicolor Hagen. Collected only once, AL 8/26/89. :May breed in the larger tinajas or the spring at BP, but may just be an immigrant from larger, permanent water.

Anax junius Drury. Collected only once, AL 8/26/89. May breed in the larger tinajas or the spring at BP, but may just be an immigrant from larger, permanent water. Also found at Quitobaquito (Kingsley et al. 1987).

Family: Coenagrionidae (Narrow-winged Damselflies)
The 92 species known for this family are almost impossible to distinguish, except by a few experts.

Undetermined taxon. Collected 1 specimen, AG 11/22/87. Several species were recorded from Quitobaquito (Kingsley et al. 1987) and this is probably 1 of them.

Family: Gomphidae (Clubtails)

Uncommon dragonflies in our area. There are 86 species known from the United States and Canada (Amett 1985). They are not known as especially strong fliers.

Erpetogomphus compositus Hagen. Collected only once, AG 8/28/88. Also found at Quitobaquito (Kingsley et al. 1987).

Progomphus borealis McLachla:n. Collected only once, AG 8/27/88. Also found at Quitobaquito (Kingsley et al. 1987).

Family: Libellulidae (Common Skimmers)
Often these are strong fliers and can be found miles from the nearest water. There are 91 species known from the United States and Canada (Arnett 1985).

Libellula saturata Uhler. Records from AC 9/30/89; AG 8/28/88, 9/10/90 (usually there are some present here); AL 8/26/89; BP 7/23/88, 9/30/89; VU 11/1/87, 5/27/89. Also found at Quitobaquito (Kingsley et al. 1987), and at AL by Hall et al. (1988).

Orthemis ferruginea Fabricius. Collected only once, AG 8/28/88. Also found at Quitobaquito (Kingsley et al. 1987).

Pantala flavescens Fabricius. Collected only once, AG 8/28/88. This species is worldwide in distribution. Adults are attracted to fires and have also been found far out at sea (Arnett 1985).

Pantala hymenea Say. Observed or collected at GC 4/8/89; AL 7/29/89; BP 7/23/88. Also at Quitobaquito (Kingsley et al. 1987).

Perithemis intensa Kirby. Collected only once, DT 7/23/88.

Pseudoleon superbum Hagen. Collected only once, AL 7/29/90. Also reported by Hall et al. (1988) from AL.

Sympetrum corruptum Hagen. Widespread, a strong flier often seven far from water. Recorded from AG 11/22/87; BP 7/23/88; LO 10/30/87; NE 11/21/87; VU 11/1/87. Also reported by Hall et al. (1988) from AL.

Order: Orthoptera (Grasshoppers, Crickets, and Katydids)
Family: Acrididae (Short-horned Grasshoppers)
A large, worldwide family, with 114 genera and 548 species known for the United States (Arnett 1985). All are herbivorous, feeding on a wide variety of plants. Some are highly food-specific, others are generalists. Some are habitat-specific, others range more broadly. Many species are considered pests under some circumstances. Taxonomy is well-developed for North American species with the publication of Otte's monographs (Otte 1981, 1984). Nomenclature herein follows that work.

Subfamily: Cyrtacanthacridinae

Schistocerca alutacea albolineata (Thomas). A large, colorful and conspicuous grasshopper that is uncommon but widespread in the monument. It prefers wash riparian habitat over open desert. It feeds on a variety of plant species, mostly shrubs, and comes to lights. Records from AC 10/17/87, 7/29/89; BP 9/10/88, 9/30/89; DR 11/21/87,10/8/88; GC 10/10/88; PO 9/10/90; SE 9/9/90.

Schistocerca alutacea shoshone (Thomas). Rare, found only at AC 10/17/87. This species is not as conspicuous as the former subspecies, and prefers dense, shaded vegetation, so it may be easily overlooked despite its large size. It is generally considered an Upper Sonoran species, only occasionally reaching into mesic areas in the Lower Sonoran zone (Ball et al. 1942).

Schistocerca vaga (Scudder).. Fairly common and widespread. This grasshopper is wellcamouflaged and does not flush until approached closely, so it is easily overlooked. It feeds on a wide variety of vegetation and is probably found in every habitat in the monument. Most specimens were collected at lights. Records from AC 7/23/88, 9/9/90; DR 10/8/88; EA 7/23/88; PO 7/11/90, 9/10/90; SE 8/18/89, 9/9/90. Also found at Quitobaquito (Kingsley and Bailowitz 1987) and at AL by Hall et al. (1988).

Subfamily: Gomphocerinae
Acantherus piperatus Scudder & Cockerell. Rare, 1 record BP 10/17/87. Lives on tall grasses under shrubs and trees (Ball et al. 1942).

Bootettix argentatus Bruner. Common to abundant, living on *Larrea* and blending extremely well with the foliage. Comes to lights. Probably found throughout the monument. Records from AR 11/21/87; DR 8/27/88; EA 9/10/88; GC 11/21/87; SE 10/30/87,10/9/88, 5/27/89, 8/18/89; VU 10/10/88, 5/27/89.

Cibolacris parviceps Walker,, Common to abundant, generally in open lowland areas where it blends in well with gravel. Records from AG 8/28/88; BU 4/19/88, 8/27/88, 4/8/89; DO 4/8/89; EA 7/23/88; L04/20/88; PO 7/11/90; SE 4/19/88, 10/9/88; VU 4/21/88, 5/27/89. Also at Quitobaquito (Kingsley and Bailowitz 1987).

Ligurotettix coquilletti McNeill. Common to abundant, living; primarily on *Larrea* and blending in extremely well with twigs. Feeds on *Larrea* leaves, other shrubs, and annual plants. Calls a conspicuous "clicking" sound from bushes, but is extremely difficult to locate. Comes to lights occasionally,. Records from AC 7/29/89; AL 7/30/89, 7/28/90; AR 11/21/87, 9/10/88, 7/10/90; BU 8/27/88; 9/9/90; EA 11/20/87, 7/23/88, 9/10/88, 7/10/90, 9/9/90; GC 9/10/88; LO 10/30/87; NE 8/27/88; PO 8/18/89; SA 10/9/88; SE 10/10/88, 8/18/89; VU 10/10/88, 9/9/90. Also reported by Hall et al. (1988) from AL, and Quitobaquito (Kingsley and Bailowitz 1987).

Mermiria bivittata (Serville). Rare, recorded only once, BP 9/10/88. Inhabits tall grasses and is very difficult to catch (Ball et al. 1942).

Opeia obscura (Thomas). Uncommon, collected only from BP l1)/17/87,7/23/88,9/10/88. Also found at Quitobaquito (Kingsley and Bailowitz 1987), where it was considered common.

Parapomala pallida (Bruner). Apparently rare, this grasshopper lives in bunch grasses and is difficult to catch, but it comes to lights. Collected only at AG 10/8/88 and PO 9/10/90.

Psoloessa texana Scudder. Apparently uncommon, this grasshopper is well-camouflaged against soil and is easily overlooked. It feeds on seedlings (Ball et al 1942). Records from AG 8/28/88; NE 8/27/88; SA 8/18/89. Also reported by Hall et al: (1988) from AL.

Syrbula montezuma (Saussure). Rare, collected only from AL 9/10/88, 7/30/89. Found on taller grasses of desert grasslands (Otte 1981).

Subfamily: Melanoplinae
Barytettix humphreysii (Thomas),. Uncommon, characteristically found in the Upper Sonoran zone and high grassland of Lower Sonoran zone (Ball et al. 1942). AC 10/17/87; AL 10/18/87; AR 9/10/88; BP 10/17/87.

Clematodes larreae Scudder. Apparently rare, this grasshopper spends most of its time on creosote bush twigs and blends with them perfectly. It occasionally comes to lights. Records from AG 11/21/87; SE 10/9/88, 9/9/90.

Melanoplus aridus (Scudder). Fairly common to locally abundant. on rank growth of annual weeds. Records from AR 9/10/88; SA 10/31/87; SE 10/31/87, 10/9/88, 9/9/90; VU 10/10/88.

Melanoplus pictus Scudder. Fairly common to locally abundant on rank growth of annual weeds. Records from AG 11/22/87; AL 10/18/87; AR 9/10/88, 9/'9/90; GC 11/22/87; SA 8/19/89.

Poecilotettix pantherinus (Walker). Rare, we never found more than 1 on any given field trip. It is typically found among oaks in the Upper Sonoran zone in the central part of Arizona. AL 10/18/87, 9/11/88; BP 9/30/89. Also reported by Hall et al. (1988) from AL.

Subfamily: Oedipodinae
Anconia integra Scudder. Common to abundant, usually on *Atriplex* spp. Recorded from AG 11/22/87, 3/6/88, 8/28/88, 10/8/88, 5/5/90; DO 8/19/89; DR 3/5/88; SA 8/18/89; SE 5/27/89. Also found at Quitobaquito (King;sley and Bailowitz 1987).

Conozoa carinata Rehn. Apparently rare, this grasshopper is easily overlooked or mistaken in the field for *Trimerotropis pallidipennis,* an abundant grasshopper that this one superficially resembles. Our only record is from BU 9/9/90.

Conozoa sulcifrons (Scudder). Apparently rare, this grasshopper is easily overlooked or mistaken in the field for *Trimerotropis pallidipennis,* an abundant grasshopper that this one superficially resembles. Our only record is from AG 8/28/88.

Conozoa texana (Bruner). Apparently rare, this grasshopper is easily overlooked or mistaken in the field for *Trimerotropis,pallidipennis* or *Anconia integra,* 2 common grasshoppers that this one superficially resembles. Taken only twice, SA 10/31/87 and SE 10/9/88.

Derotmema delicatulum Scudder. Apparently rare, this grasshopper is easily overlooked or mistaken in the field for *Trimerotropis pallidipennis* or *Ancortia integra,* 2 common grasshoppers that this one superficially resembles. Only 1 record: GC 9/9/90.

Derotmema laticinctum Scudder. Apparently rare, this grasshopper is easily overlooked or mistaken in the field for *Trimerotropis pallidipennis,* an abundant grasshopper that this one superficially resembles. Only 1 record: SA 10/9/88.

Encoptolophus subgracilis Caudell. Uncommon but widespread, it may be more common than our records suggest. This grasshopper is easily overlooked or mistaken in the field for *Trimerotropis pallidipennis,* an abundant grasshopper that this one superficially resembles. Records from AG 11/22/87, 10/8/88; PO 7/11/90, 9/10/90: Also reported by Hall et al. (1988) from AL.

Lactista aztecus (Saussure). Apparently rare, only 1 record: GC 11/21/87. This grasshopper is easily overlooked or mistaken in the field for *Trimerotropis pallidipennis,* an abundant grasshopper which this one superficially resembles. Also found at Quitobaquito (Kingsley and Bailowitz 1987).

Lactista gibbosus Saussure. Apparently rare, 2 records only: AL. 7/30/89; SE 10/9/88. This grasshopper is easily overlooked or mistaken in the field for *Trimerotropis pallidipennis,* an abundant grasshopper that this one superficially resembles.

Leprus intermedius Saussure. An uncommon but unmistakable species, this is our only large grasshopper with blue hind wrings. Records from AC 4/10/88, 4/29/89; AL 4/9/88; BP 10/17/87; DR 3/5/88, 10/8/88; NE 3/12/89; SE 9/9/90. Also reported by Hall et al. (1988) from AL.

Trepidulus rosaceus Scudder. An uncommon, unmistakable species, this is our only small grasshopper with red hind wings. Records from AL 7/29/89; l3U 9/9/90; DO 8/19/89; GC 9/10/88, 10/10/88; SA 8/19/89.

Trimerotropis pallidipennis (Burmeister). Our most abundant and widespread grasshopper, it tends to prefer open ground with little vegetation. The hind wings are pale yellow. The sitting grasshopper blends perfectly with gravel and soil. Several other species (mentioned above) superficially resemble this species and may have been mistaken for it in the field. Records from AG 11/22/87, 3/6/88, 10/8/88; AL 4/9/88; AR 11/21/87, 2/29/88, 9/10/88, 7/10/90; BP 10/17/87; BU 8/27/88, 4/8/89,4/13/90; DO 8/19/89; DR 11/21/87; EA 11/20/87,7/23/88; GC 11/21/87, 9/10/88; LO 10/30/87, 4/20/88; PO 8/18/89, 7/11/90, 9/10/90; SA 10/31/87, 10/9/88, 4/8/89, 8/19/89; SE 10/31/87, 4/19/88, 10/9/88, 5/27/89; VU 11/01/87,4/21/88, 10/10/88, 2/18/89, 5/27/89. Also found at Quitobaquito (Kingsley and Bailowitz 1987) and reported by Hall et al. (1988) from AL.
Undetermined nymphs. We collected 14 specimens of immature grasshoppers which could not be identified with certainty. They are almost certainly young of some of the above species.

Family: Gryllidae (Crickets)
Primarily nocturnal and secretive, crickets are usually found under objects on the ground or coming to lights. Their calls make them conspicuous, but they become quiet when approached. Identification of species is a challenge, still being worked on by specialists.

Subfamily: Gryllinae
Gryllus sp. (May be "*assimilis* (Fabricius)"). Arnett (1985) cites 14 described species and many that are yet undescribed. Identification of species is extremely difficult and probably questionable. According to Arnett, G. *assimilis* occurs only in south Florida, but erroneous records of it appear from all over the world, because many species key out to this in the published literature. Our species are 2 very differently appearing insects, 1 brown the other black, which may (or may not) be 2 (or more) different species. Records from AG 8/26/89; GC 4/8/89; PO 7/11/90, 9/10/90; SE 10/9/88, 9/9/90. Also reported by Hall et al. (1988) from AL.

Miogryllus lineatus (Scudder). Rare, recorded only once, from DIZ 11/21/87.

Subfamily: Mogoplistinae
Cycloptilum comprehendens Hebard. Rare, records from AC 7/29/89; SE 10/30/87.

Subfamily: Nemobiinae
Identification is tentative, the subfamily has been revised since the keys I used were published.

Nemobius cubensis mormonius Scudder. Rare, records from AG 1/28/89 and PO 9/10/90.

Nemobius sp. Rare, collected only once, AR 2/28/88.

Nemobius carolinus neomexicanus Scudder. Rare, collected only once, AG 8/26/89.

Subfamily: Oecanthinae
Oecanthus sp. Arnett (1985) cites 15 described species and many undescribed. Known to be a predator on aphids and other insects, as well as phytophagous. We may have more than 1 species. These insects are common and their sound is heard all summer long, but they are very difficult to locate. Fortunately, they occasionally come to lights. Our only specimens are from AG 8/26/89 and PO 7/1:1/90, 9/10/90.

Family: Romaleidae (Lubber Grasshoppers)
Large, conspicuous, and appearing clumsy, there is only 1 species in the monument.
Taeniopoda eques (Burmeister). One of our most strikingly colorful. grasshoppers; the body is shiny black with orange and yellow markings. The hind wings are rosy red. This species is sometimes exceedingly abundant in Upper Sonoran and Chihuahuan Desert grassland but rare in the monument, where it has been found only in the Ajo Mountains. This is probably the western-most location for the species, which ranges eastward into Texas and southward through Mexico to Costa Rica. It would appear to be a prime target for many predators because of its large size and abundance. However, it has multiple defenses, including secretion of irritating chemicals, production of defensive noises, aposematic coloration, and the habit of spending the night hours perched on the outer branches of shrubs and trees where it may be difficult to catch (Heske 1990). It consumes a wide variety of desert plants (Ball et al. 1942). Our population may be a relic, similar in status to our white-tailed deer. Individuals were observed on the highway between Why and Kitt Peak on 9/9/90. Our records from the monument are all from BP: 10/17/87, 9/10/88, 9/30/89, 8/25/90. This may be considered 1 of our "interesting" species for its colors, behavior, and isolation.

Family: Tettigoniidae
Subfamily: Decticinae
Ateloplus schwarzi Caudell. An uncommon (or secretive) large insect. Bali et al. (1942) cite the Baboquivari Mountains as the western limit of this species' range, and state that it is an inhabitant of pack rat dens. Collected only at AL 7/29/89 and 8/26/89. Also reported by Hall et al. (1988) from AL.

Eremopedes ephippiatus (Scudder). A rare (or secretive) large insect. Ball et al. (1942) cite the Baboquivari Mountains as the western limit to this species' range. Collected only once, AC 8/26/90.

Eremopedes sp. Only 1 specimen, apparently immature and probably the above species, could not be identified to species with certainty. BP 4/30/89.

Subfamily: Phaneropterinae
Arethaea gracilipes papago Hebard. A slender, graceful, delicate insect that blends well with the grasses on which it feeds. The type locality is "Growler Valley." It is probably more abundant than our 2 records would suggest. AL 9/10/88; BP 10/17/87. Also reported by Hall et al. (1988) from AL.

Insara covilleae Rehn & Hebard. This insect is probably common, but it is rarely seen because it blends so perfectly with the creosote bush, on which it spends most of its life. Occasionally it is attracted to lights. Our records are from AG 10/8/88; PO 9/10/90; SE 9/9/90, but it is probably found throughout the monument. It was found at Quitobaquito (Kingsley and Bailowitz 1987).

Insara elegans elegans Scudder. Like its congener, this species is probably much more abundant than our records indicate. It feeds on *Prosopis* and *Acacia,* and is well-camouflaged on them. Our records are of specimens that came to lights. AL 9/10/88; GC 10/10/88; SE 10/9/88, 9/9/90. Also found at Quitobaquito (Kingsley and Bailowitz 1987) and reported by Hall et al. (1988) from AL.

Scudderia mexicana (Saussure). Described by Ball et al. (1942) as "very common ... west to the Ajo Mountains." We have only 3 specimens, from AC 10/17/!37 and AL 10/18/87. This species was also found at Quitobaquito (Kingsley and Bailowitz 1987).

Order: Phasmatodea (Walkingsticks)
These insects are very difficult to find because they are so well camouflaged. There are 29 species known from the United States and Canada (Arnett 1985). Some authors classify this as a family of Orthoptera. Our species do not fly, and spend most of their lives on the trees and shrubs on which they feed. Only 1 specimen was collected during this study. Hall et al (1988) found another species *Pseudosermyle straminea* Scudder in AL. There may be 1 or more other species in the monument also.

Family: Heteronemiidae
Subfamily: Heteronemiinae
Diapheromera arizonensis Caudell. This species feeds on a variety of desert plants, but is most abundant on *Prosopis* and Acacia. Our 1 specimen is from AC 10/1/89.

Order: Thysanura (Silverfish and Allies)
Most of the 18 U.S. species live in leaf litter or under bark, rocks, or debris and are rarely seen (Arnett 1985). Identification of species is difficult, and was not attempted.

Family: Lepismatidae
Undetermined taxa. There were 4 specimens, possibly all the same species. Recorded from AR 2/28/88; LO 10/30/87; NE 3/.5/88, 1/28/89.

Order: Trichoptera (Caddisflies)
Larvae of nearly all of the 1,261 North American species are aquatic. Many make distinctive cases that they carry with them as they wander across the bottom of their aquatic habitat. Identification is difficult and was not attempted.

Undetermined taxa. We collected 2 specimens, apparently the same species. AG 11/21/87 and 5/5/90.

Phylum: Mollusca (Mollusks)
A surprising number of snails can be found in the Sonoran Desert. Bequaert and Miller (1973) reviewed the mollusks of Arizona, including records from the monument. Miller (1966) described the subspecies *Sonorella baboquivariensis cossi* from the Ajo Mountains. Our searches for this species were unsuccessful, but that fact may mean only that we did not turn over enough rocks.

The following list was compiled from Bequaert and Miller (1973) and reviewed by W. B. Miller, with additions made by Miller from specimens collected during this study. It lists the known and probable snails from the monument.

Family: Helminthoglyptidae
Sonorella meadi Miller. "Dead shells, possibly of this species, were seen from nearby Bates Mts..." (p. 114).

Sonorella baboquivariensis cossi Miller. "Type locality: Ajo Mountains, Organ Pipe Cactus National Monument, at S left side of Arch Canyon, ca 1 mi above the Arch, 2,900 ft, Pima County. Also at nearby Stations in same Range, 3,500 to 4,000 ft." (p. 119).

Family: Hydrobiidae (Trunicatellidae)
Tryonia quitobaquitae Herschler. Landye (1981), in the report Current Status of Endangered, Threatened, and/or Rare Mollusks of New Mexico and Arizona stated that this was a previously undescribed species, "Father Kino's Tryonia," endemic to the Quitobaquito Spring complex, and of "extreme limited distribution." In 1990, a new channel was constructed to carry water from the spring to the pond (personal observation). It is unknown what effect this had on the population of this rare snail. A cursory examination of the new channel on 10 September 1990 found no snails.

Family: Physidae
Physa virgata Gould. Found throughout Arizona from 1,000 to 8,700 ft (Bequaert and Miller 1973), but not previously recorded from ORPI; this may be the *"Physa* sp." recorded at Quitobaquito by Cole and Whiteside (1965). Specimens collected from water at BP 9/10/88.

Biomphalaria havanensis (Pfeiffer) (formerly *Planorbis).* "Not native in Arizona ... only an occasional, perhaps temporary adventive in artificial bodies of water" (p. 206). Found in pond at Quitobaquito Springs in 1969 by Bequaert. We do not know whether or not it is still present.

Family: Planorbidae
Heliosoma (Pierosoma) tenue (Dunker) (formerly *Planorbis).* "One of the most widely distributed snails of Arizona...all counties except Mohave, Yavapai, Apache, and Greenlee...usually at low elevations, below 6,000 ft." (p. 207). Recorded from the dirt pond 1 km E of AR 7/23/88.

Family: Pupillidae
Gastrocopta ashmuni (Sterki). "Pima Co. Ajo Mts, Arch Canyon, 3,500 ft ...southwesternmost Station of species" (p. 160).

Gastrocopta dalliana bilamellata (Sterki & Clapp). "Pima Co. Ajo Mts: Arch Canyon, 3,500 ft and Dripping Springs, 2.,000 ft" (p. 168).

Gastrocopta pellucida (Pfeiffer). "Common in Arizona, 1,100 to 6,500 ft; known from all counties" (p. 171). Not definitely recorded from the monument, but may occur there.

Chaenaxis tuba (Pilsbry & Ferriss). "litter in Ajo Mts, on W slope in Arch Canyon, 2,800 to 3,500 ft ... drift of Cuerda de Lena. Wash, 13 mi SE of Ajo" (p. 174).

Pupoides albilabris (Adams). "Ajo Mts" (p. 176).

Family: Succineidae
Succinea califomica Fisher & Cross. Shells found on the ground at AR, 10/21/89.
Family: Thysanophoridae

Thysanophora hornii (Gabb). "Pima Co. Ajo Mts, Arch Canyon, 3,500 ft" (p. 136).

Family: Vallonfdae
Vallonia perspectiva (Sterki). "Ajo Mts, Arch Canyon, 3,500 ft, westernmost Station of species" (p. 191).

Family: Zonitidae
Retinella indentata paucilirata (Morelet). "Recent in most Arizona highlands at 3,500 ft (in Ajo Mts)..." (p. 145).

Hawaiia minuscula (Binney). "widespread...at 2,500 to 8,500 ft ... perhaps (Arizona's) most common snail" (p. 145). Not known if present in the monument, but it is possible.

Plants Associated with Invertebrates
Plants in bloom were usually inspected for insects and other invertebrates. Often, plants that were attracting insects were observed for an hour or more, so as to collect most of the insects coming to the plants. Also, when convenient, plants were checked at intervals throughout the day and

occasionally at night, so as to increase the sample. In addition, casual search of plants not in bloom was part of the normal procedure at each site. The following list contains all taxa found associated with plants, including nectar and pollen-feeding, phytophagous, and predators that ambush plant-feeding species at plants. In addition, known food plants of monophagous larval forms of Lepidoptera are included, even when no adults or larvae were found on plants but when the plants are known to occur in OPCNM. Plant order and nomenclature follows the Checklist of Vascular Plants of Organ Pipe Cactus National Monument, Arizona, published by Southwest Parks and Monuments Association (1985).

Selaginellaceae: *Selaginella arizonica* Maxon (Club Moss)
Diptera Bombyliidae *Villa curta* (Loew)

Gramineae: *Cynodon dactylon* (L.) Pers. (Bermuda Grass)
Lepidoptera Hesperiidae *Copaeodes aurantiacus* (Hewitson)

Gramineae: (Unidentified Grasses)
Hymenoptera Sphecidae *Femaldina* lucae (Saussure)
Neuroptera Chrysopidae *Chrysopa* sp.

Cyperaceae: *Cyperus* sp. (Flat Sedge)
Homoptera Cicadellidae *Draeculacephala minerva* Ball

Liliaceae: *Dichelostemma pulchellum* (Salisb.) Heller (Bluedicks)
Hymenoptera Anthophoridae *Anthophora* sp.

Fagaceae: *Quercus ajoensis* C.H. Muell. (Ajo Oak)
Diptera Bombyliidae *Villa* sp.
Diptera Calliphoridae *Phormia regina* (Meigen)
Homoptera Aleyrodidae unidentified
Hymenoptera Formicidae *Crematogaster coarctata vermiculata* Emery
Lepidoptera Hesperiidae *Erynnis tristis* (Boisduval)
Lepidoptera Nymphalidae *Adelpha bredowii* (Geyer)

Ulmaceae: *Celtis* spp. (Hackberry)
Lepidoptera Apaturidae *Asterocampa leilia* (WH Edwards)
Lepidoptera Nymphalidae *Nymphalis antiopa* (Linnaeus)

Urticaceae: *Parietaria hesperia* Hinton (Pellitory)
Lepidoptera Nymphalidae *Vanessa atalanta* (Linnaeus)

Loranthaceae: *Phoradendron californicum* Nutt. (Desert Mistletoe)
Hymenoptera Apidae *Apis mellifera* Linnaeus
Lepidoptera Lycaenidae *Atlides halesus* (Cramer)

Aristolochiaceae: *Aristolochia watsoni* Woot. & Standl. (Indian Root)
Lepidoptera Papilionidae *Battus philenor* (Linnaeus)

Polygonaceae: *Eriogonum fasciculatum* Benth. (Flat-top Buckwheat, California Buckwheat)
Coleoptera Bruchidae unidentified
Coleoptera Buprestidae *Acmaeodera cuneata* Fall
Coleoptera Cleridae *Thanasimus* sp.
Coleoptera Cleridae *Trichodes omatus Say*
Diptera Tachinidae *Drino* sp.
Hymenoptera Gasteruptiidae unidentified
Hymenoptera Sphecidae *Cerceris californica* Cresson
Hymenoptera Sphecidae *Fernaldina lucae* (Saussure)
Lepidoptera Lycaenidae *Xamia xami* (Reakirt)
Lepidoptera Riodinidae *Apodemia mormo* (C.&R. Felder)

Polygonaceae: *Eriogonum wrightii* Torr. (Wright Buckwheat)
Diptera Syrphidae *Volucella* sp.
Diptera Syrphidae *Mesograpta marginata (Say)*
Hymenoptera Halictidae unidentified
Hymenoptera Sphecidae *Ammophila californica* Menke
Hymenoptera Tiphiidae unidentified
Hymenoptera Vespidae *Leptochilus acolhuus* (Sauss.)
Lepidoptera Riodinidae *Apodemia mormo* Felder

Chenopodiaceae: *Atriplex canescens* (Pursh.) Nutt. (Four-wing Saltbush)
Lepidoptera Hesperiidae Pyrginae *Pholisora libya* (Scudder)
Orthoptera Acrididae *Anconia integra* Scudder
Orthoptera Acrididae *Trepidulus rosaceus* Scudder

Amaranthaceae: *Amaranthus palmeri* Wats. (Careless Weed)
Coleoptera Chrysomelidae Alticinae unidentified
Lepidoptera Lycaenidae *Brephidium exile* (Boisduval)
Orthoptera Acrididae *Barytettix humphreysii* (Thomas)
Orthoptera Acrididae *Melanoplus aridus* (Scudder)
Orthoptera Acrididae *Melanoplus pictus* Scudder

Nyctaginaceae: *Boerhaavia* sp. (Spiderling)
Hemiptera Coreidae *Catorhintha selector* Stal

Cruciferae: *Lesquerella gordoni* (Gray) Wats. (Bladder Pod)
Hymenoptera Apidae *Apis mellifera* Linnaeus
Hymenoptera Halictidae *Halictus ligatus* (Say)

Capparidaceae: *Atamisquea emarginata* Miers
Lepidoptera Pieridae *Ascia howarthi* (Dixey)

Capparidaceae: *Wislizenia refracta* Englem. (Jackass Clover)
Diptera Syrphidae *Eristalis latifrons* Loew

Hymenoptera Andrenidae *Perdita* sp.
Hymenoptera Halictidae *Agapostemon melliventris Cr.*
Hymenoptera Pompilidae *Pepsis pallidolimbata* Lucas
Hymenoptera Scoliidae *Campsoscolia flammicoma* (Bradley)
Hymenoptera Sphecidae *Femaldina lucae* (Saussure)
Hymenoptera Vespidae *Euodynerus annulatus annulatus* (Say)

Rosaceae: Vauquelinia californica (Tory.) Sarg. (Arizona Rosewood)
Coleoptera Bruchidae *Mimosestes amicus* (Horn)
Coleoptera Chrysomelidae *Disonycha tenuicomis* Horn

Leguminosae: Acacia angustissima (Mill.) Kuntze (White-ball Acacia)
Diptera Bombyliidae *Exoprosopa pueblensis* Jeannicke
Hymenoptera Scoliidae *Scolia otomita* Sauss.
Hymenoptera Scoliidae *Scolia* sp.
Hymenoptera Tiphiidae unidentified
Lepidoptera Hesperiidae *Copaeodes aurantiacus* (Hew.)
Lepidoptera Hesperiidae *Cogia hippalus* (WH Edwards)

Leguminosae: Acacia constricta Benth. (White-thorn Acacia)
Coleoptera Cantharidae *Chauliognathus obscurus* Schaeffer
Lepidoptera Geometridae *Semiothisa parcata* (Grossb.)
Lepidoptera Noctuidae *Matigramma rubrosuffusa* (Grote)

Leguminosae: *Acacia greggii* Gray (Catclaw Acacia)
Coleoptera Buprestidae *Chrysobothris octocola* LeConte
Coleoptera Lycidae *Lycostomus* sp.
Coleoptera Melyridae *Trichochrous indutus* Casey
Diptera Bombyliidae *Paravilla canicula* (Osten-Sacken)
Diptera Conopidae unidentified
Diptera Syrphidae *Volucella isabellina* Will.
Homoptera Cixiidae *Oecleus* sp.
Hymenoptera Anthophoridae *Centris lanosa* (Cress.)
Hymenoptera Halictidae *Augochlorella neglectula* (Ckll.)
Hymenoptera Sphecidae *Femaldina lucae* (Saussure)
Hymenoptera Sphecidae *Isodontia elegans* (Smith)
Hymenoptera Vespidae *Euodynerus pratensis* (Saussure)
Hymenoptera Vespidae *Stenodynerus lissolabus* Bohart
Lepidoptera Lycaenidae *Hemiargus isola* (Reakirt)
Lepidoptera Riodinidae *Apodemia palmerii* (W.H. Edwards)

Leguminosae: *Calliandra eriophylla* Benth. (Fairy Duster)
Hymenoptera Andrenidae *Andrena* sp.
Hymenoptera Apidae Apis *mellifera*
Linnaeus Hymenoptera Braconidae *Chelonus cautus* Cresson
Hymenoptera Halictidae *Dufourea vandykei* (Bohart)

Hymenoptera Halictidae *Halictus ligatus* (Say)
Hymenoptera Halictidae *Lasioglossum sisymbrii* (Cockerell)
Hymenoptera Sphecidae *Ammophila breviceps* Smith
Hymenoptera Sphecidae *Podalonia argentipilis* (Prov.)
Hymenoptera Vespidae *Pseudomasaris maculifrons (Fox)*
Lepidoptera Hesperiidae *Hylephila phyleus* (Drury)
Lepidoptera Noctuidae *Melipotis jucunda* Huebner

Leguminosae: *Cassia covesii* Gray (Desert Senna)
Lepidoptera Pieridae *Eurema mexicana* (Boisduval)
Lepidoptera Pieridae *Eurema nicippe* (Cramer)
Lepidoptera Pieridae *Phoebis sennae* (Linnaeus)

Leguminosae: Cercidium floridum Benth. (Blue Palo Verde)
Hymenoptera Apidae *Apis mellifera* Linnaeus

Leguminosae: *Cercidium microphyllum* (Tory.) Rose & Johnst. (Foothill Palo Verde)
Coleoptera Bruchidae *Mimosestes amicus* (Horn)
Coleoptera Bruchidae *Stator limbatus* (Horn)
Coleoptera Buprestidae *Chrysobothris octocola* LeConte
Coleoptera Cerambycidae *Derobrachus forreri* Bates
Coleoptera Cerambycidae *Derobrachus,geminatus* LeConte
Coleoptera Cerambycidae *Stenaspis solitaria* (Say)
Coleoptera Chrysomelidae *Saxinis deserticola* Mold.
Coleoptera Coccinellidae *Hippodamia convergens G.-M.* Diptera
Bombyliidae *Aphoebantus* sp. 1
Diptera Syrphidae *Volucella nigra* Greene
Hymenoptera Anthophoridae *Anthophora urbana urbana* (Cresson)
Hymenoptera Anthophoridae *Centris lanosa* (Cresson) Hymenoptera
Anthophoridae unidentified
Hymenoptera Apidae *Apis mellifera* Linnaeus
Hymenoptera Braconidae unidentified
Hymenoptera Ichneumonidae *Dusona* sp.
Hymenoptera Megachilidae *Chalicodoma discorhina* (Ckll.)
Hymenoptera Megachilidae *Osmia* sp.
Lepidoptera Gelechiidae *Bryotropha inaequalis* (Busck.)
Lepidoptera Saturniidae *Syssphinx hubbardi (Dyar)*

Leguminosae: *Coursetia microphylla* Gray
Hymenoptera Anthophoridae *Anthophora urbana urbana* (Cresson) Hymenoptera Anthophoridae
Centris lanosa (Cress.) Hymenoptera Colletidae *Colletes louisae* Ckll.
Lepidoptera Pyralidae *Heliothelopsis costipunctalis* B. & McD.

Leguminosae: *Prosopis velutina* Woot. (Mesquite)
Arachnida Araneae Araneidae *Metepeira* sp.
Coleoptera Cerambycidae *Oncideres rhodosticta* Bates

Diptera Syrphidae *Baccha* sp.
Hymenoptera Andrenidae *Perdita* sp.
Hymenoptera Apidae *Apis mellifera*
Linnaeus Hymenoptera Colletidae *Colletes* sp.
Hymenoptera Halictidae *Sphecodes* sp.
Hymenoptera Megachilidae *Ashmeadiella* sp.
Hymenoptera Sphecidae *Glenostictia scitula Fox*
Hymenoptera Tiphiidae unidentified
Isoptera Kalotermitidae *Paraneotermes simplicicornis* (Banks)
Lepidoptera Riodinidae *Apodemia palmeri* (W. H. Edwards)
Lepidoptera Lycaenidae *Leptotes marina* (Reakirt)
Lepidoptera Lycaenidae *Ministrymon leda* (W. H. Edwards)
Orthoptera Tettigoniidae *Insara elegans elegans* Scudder

Geraniaceae: *Erodium cicularium (L.)* L'Her. (Filaree)
Hemiptera Lygaeidae *Lygaeus kalmii* Stal

Zygophyllaceae: *Kallsroemia grandiflora* Torr. (Mexican Poppy, Summer Poppy)
Hymenoptera Scoliidae *Scolia otomita* Sauss.

Zygophyllaceae: *Larrea tridentata* (DC.) Coville (Creosote Bush)
Arachnida Araneae Diguetidae *Diguetia* sp.
Diptera Asilidae *Efferia bicaudata* (Hine)
Hemiptera Miridae *Phytocoris ramosus* Uhler
Hemiptera Pentatomidae *Thyanta pallidoventris* Stal
Homoptera Cicadellidae *Spathanus acuminatus* (Baker)
Homoptera Kerridae *Tachardiella larreae* (Comstock)
Hymenoptera Anthophoridae *Anthophora coptognatha* (Timberlake)
Hymenoptera Anthophoridae *Anthophora lesquerellae* (Cockerell)
Hymenoptera Anthophoridae *Centris lanosa* (Cress.)
Hymenoptera Apidae *Apis mellifera* Linnaeus
Hymenoptera Formicidae *Crematogaster depilis* Wheeler
Hymenoptera Formicidae *Crematogaster* sp.
Hymenoptera Ichneumonidae. *Dusona* sp.
Hymenoptera Megachilidae *Ashmeadiella* sp.
Hymenoptera Megachilidae *Heteranthidium larreae* (Ckll.)
Lepidoptera Geometridae *Semiothisa colorata* (Grote)
Lepidoptera Psychidae *Thyridopteryx meadi* Hy. Edw.
Orthoptera Acrididae *Bootetfx argentatus* Bruner
Orthoptera Acrididae *Ligurotettix coquilletti* McNeil
Orthoptera Tettigoniidae *Insara covilleae* Rehn & Hebard

Simaroubaceae: Castela emoryi (A. Gray) Moran & Felger (Crucifixion Thorn)
Homoptera Cicadellidae *Homalodisca lacerta* (Fowler)

Euphorbiaceae*: Euphorbia* *sp*.
Hymenoptera Formicidae *Myrmecocystis melliger* Forel

Euphorbiaceae: *Jatropha cardiophylla* (Torr.) Meull. Arg. (Limber Bush, Sangre-deCristo)
Diptera Stratiomyidae *Hermetia subpellucida* James & Wirth

Euphorbiaceae: *Sapium biloculare* (Wats.) Pax (Mexican Jumping Bean)
Diptera Bombyliidae *Exoprosopa pueblensis* Jeannicke
Diptera Bombyliidae *Villa* sp.
Diptera Calliphoridae *Phaenia* sp.
Hemiptera Largidae *Largus cinctus* (Herrich-Schaeffer)
Hymenoptera Apidae *Apis mellifera* Linnaeus
Hymenoptera Formicidae *Mynnecocystis melliger* Forel
Hymenoptera Halictidae *Dialictus* sp.
Hymenoptera Pompilidae *Pompilus expulsus* Schulz
Lepidoptera Saturniidae *Eupackardia calleta* (Westwood)
Lepidoptera Tortricidae *Cydia deshaisiana* (Luc.)

Buxaceae: *Simmondsia chinensis* (Link.) Schneid. (Jojoba)
Diptera Bombyliidae *Anthrax xylocopae* Marston

Sapindaceae: *Dodonaea viscosa* Jacq. var. *angustifolia (L.L)* Benth. (Hop Bush)
Diptera Mydidae *Messiasia pertenuis* John.
Homoptera Cicadidae *Tibicen* sp.
Neuroptera Ascalaphidae *Ululodes arizonensis* Banks

Rhamnaceae: *Condalia globosa* Johnston (Bitter Condalia)
Lepidoptera Saturniidae *Agapema galbina anona* (Ottolengui)

Rhamnaceae: *Rhamnus betulaefolia* Greene (Birchleaf Buckthorn)
Hymenoptera Anthophoridae *Anthophora urbana urbana* (Cresson)
Hymenoptera Anthophoridae *Centris pallida* (Fox)
Hymenoptera Apidae *Apis mellifera* Linnaeus

Malvaceae: *Abutilon* sp.
Lepidoptera Hesperiidae *Systasea zampa* (WH Edwards)

Malvaceae: *Malva parviflora* L. (Cheeseweed, Little Mallow)
Hymenoptera Halictidae *Agapostemon melliventris* Cr. Lepidoptera
Nymphalidae *Vanessa annabella* (Field)

Malvaceae: *Sphaeralcea* sp.
Coleoptera Coccinellidae *Rhyzobius lophantae* (Blais.)
Hemiptera Nabidae *Nabis altematus* Parshley
Hemiptera Reduviidae *Sinea confusa* Caudell
Hemiptera Rhopalidae *Liorhyssus hyalinus* (Fabricius)

Hemiptera Rhopalidae *Stictopleuris crassicomis* (Linnaeus)
Hymenoptera Andrenidae *Andrena* sp.
Hymenoptera Anthophoridae *Diadasia diminuta (Cr.)*
Hymenoptera Anthophoridae *Diadasia lutzi* Ckll.
Hymenoptera Halictidae Agapostemon *melliventris* Cr.
Hymenoptera Sphecidae *Glenostictia scitula* Fox
Hymenoptera Vespidae *Leptachilus periallis* Parker
Lepidoptera Nymphalidae *Vanessa annabella* (Field)

Cactaceae: *Carnegiea gigantea* (Engelm.) Britt. & Rose (Saguaro, flowers)
Hymenoptera Apidae Apis *mellifera* Linnaeus

Cactaceae: *Carnegiea gigantea* (Engelm.) Britt. & Rose (Saguaro, rotting dead plant)
Coleoptera Coccinellidae unidentified
Coleoptera Erotylidae unidentified
Coleoptera Histeridae *Aphelostemus interstitialis* (LeConte)
Coleoptera Staphylinidae unidentified

Cactaceae: *Echinocereus engelmannii* (Parry) Lemaire var. *nicholii* L. Benson (Hedgehog Cactus)
Hymenoptera Anthophoridae *Centris* pallida (Fox)
Hymenoptera Anthophoridae Anthophorinae unidentified

Cactaceae: *Ferocactus covillei* Britt. & Rose (Coville Barrel Cactus)
Coleoptera Buprestidae *Acmaeodera quadrivittata* Horn

Cactaceae: *Lemaireocereus thurberi* (Engel.) Britt. & Rose (Organ Pipe Cactus)
Diptera Calliphoridae *Cochliomyia macellaria* (Fabricius)
Neuroptera Mantispidae Plega *banksi* Rehn
Hymenoptera Vespidae *Stenodynerus ochrogonius* (Viereck)

Cactaceae: *Lophocereus schottii* (Engelm.) Britt. & Rose (Senita)
Hymenoptera Formicidae *Forelius foetida* (Buckley)

Cactaceae: *Opuntia phaeacantha* Engelm. (Engelmann Prickly Pear)
Coleoptera Bruchidae *Mimosestes amicus* (Horn)
Coleoptera Buprestidae *Acmaeodera cuneata* Fall
Coleoptera Cerambycidae *Dendrobias mandibularis* Audinet-Serville
Coleoptera Melyridae *Trichochrous indutus* Casey
Coleoptera Nitidulidae *Carpophilus pallidipennis* (Say)
Coleoptera Rhipiphoridae unidentified
Diptera Stratiomyidae unidentified
Diptera Tephritidae *Euaresta bellula* Snow
Diptera Tephritidae *Tomoplagia cressoni* Aczel
Herniptera Coreidae *Chelinidea vittiger* Uhler
Hemiptera Coreidae *Leptoglossus oppositus (Say)*

Hemiptera Coreidae *Narnia femorata* Stal
Hymenoptera Anthophoridae *Centris pallida* (Fox)
Hymenoptera Anthophoridae unidentified
Hymenoptera Apidae Apis *mellifera* Linnaeus
Hymenoptera Megachilidae *Lithurge apicalis* (Cress.)

Cactaceae: *Opuntia versicolor* Engelm. (Deerhorn Cholla, Staghorn)
Coleoptera Cerambycidae *Monedema gigas* LeConte

Onagraceae: *Zauschneria californica* Presl. (Hummingbird Trumpet)
Lepidoptera Pieridae *Eurema proterpia* (Fabricius)

Fouquieriaceae: *Fouquieria splendens* Engelm. (Ocotillo, Coach Whip)
Lepidoptera Geometridae *Eubarnesia ritaria* (Grossb.)

Asclepiadaceae: *Asclepias linaria* Cav.
Hemiptera Lygaeidae *Lygaeus reclivatus* Say
Hemiptera Lygaeidae *Oncopeltus fasciatus* (Dallas)
Lepidoptera Hesperiidae *Staphylos ceos* (W. H. Edwards)

Asclepiadaceae: *Asclepias* spp.
Lepidoptera Arctiidae *Euchaetias zella* Dyar
Lepidoptera Arctiidae *Pygarctia castella* Grt.
Lepidoptera Danaidae *Danaus plexippus* (Linnaeus)
Lepidoptera Danaidae *Danaus gilippus* (Cramer)

Convolvulaceae: *Ipomaea hirsutula* Jacq. F. (Morning Glory)
Lepidoptera Pieridae *Phoebis sennae* (Linnaeus)
Hymenoptera Halictidae unidentified

Boraginaceae: *Amsinckia tesselata* Gray (Fiddle Neck)
Coleoptera Coccinellidae *Hippodamia convergens* G.-M.
Coleoptera Meloidae *Linsleya* sp.
Diptera Therevidae *Psilocephala* sp.
Lepidoptera Hesperiidae *Erynnis funeralis* (Scud. & Burg.)
Lepidoptera Nymphalidae *Vanessa cardui* (Linnaeus)

Verbenaceae: *Aloysia wrightii* (Gray) Heller (Wright Lippia)
Orthoptera Romaleidae *Taeniopoda eques* (Burmeister)

Labiatae: *Hyptis emoryi* Torr. (Desert Lavender)
Diptera Syrphidae *Volucella fomax* Tns.
Hymenoptera Braconidae unidentified
Hymenoptera Scoliidae *Scolia ardens* Smith

Solanaceae: *Datura discolor* Bernh. (Desert Thorn Apple)
Coleoptera Anthicidae unidentified
Hymenoptera Apidae *Apis mellifera* Linnaeus
Lepidoptera Sphingidae *Manduca quinquemaculata* (Haworth)
Lepidoptera Sphingidae *Manduca sexta* (Linnaeus)

Solanaceae: *Lycium* spp. (Wolfberry)
Coleoptera Buprestidae *Acmaeodera parkeri* Cazier
Coleoptera Chrysomelidae *Pachybrachys laetus* Bowditch
Coleoptera Cleridae unidentified
Coleoptera Curculionidae unidentified
Coleoptera Melyridae *Trichochrous inndutus* Casey
Diptera Asilidae *Lestomyia atripes Wilcox*
Diptera Bombyliidae *Bombylius albicapillus* Painter
Diptera Bombyliidae *Villa eumenes* (Osten-Sacken)
Diptera Bombyliidae *Geron* sp.
Diptera Bombyliidae *Aphoebantus* sp. 1
Diptera Bombyliidae *Phthiria* sp.
Homoptera Flatidae *Ormenis* sp.
Hymenoptera Apidae *Apis mellifera* Linnaeus

Solanaceae: *Nicotiana trigonophylla* Dunal
Lepidoptera Hesperiidae *Pholisora libya* (Scudder)

Scrophulariaceae: *Castilleja lanata* Gray (Indian Paintbrush)
Lepidoptera Nymphalidae *Thessaha fulvia* (WH Edwards)
Scrophulariaceae: *Penstemon antirrhinoides* Benth.
Hymenoptera Megachilidae *Ashmeadiella* sp.
Hymenoptera Megachilidae *Osmia coloradensis* (Cress.)
Lepidoptera Geometridae *Semiothisa cyda* (Druce)
Lepidoptera Noctuidae *Oncocnemis angustus* Harv.
Lepidoptera Noctuidae *Oncocnemis occata* (Grote)

Acanthaceae: *Anisicanthus thurberi* (Tory.) Gray (Desert Honeysuckle)
Hymenoptera Formicidae *Paratrichina melanderi* (Wheeler)

Acanthaceae: *Beloperone californica* Benth. (Chuparosa)
Hymenoptera Anthophoridae *Xylocopa califonica arizonensis* Cress.
Lepidoptera Nymphalidae *Anathanassa texana* (W. H. Edwards)

Acanthaceae: *Siphonoglassa longiflora* (Torr.) Gray
Lepidoptera Nymphalidae *Dymasia dymas* (WH Edwards)
Lepidoptera Nymphalidae *Texola elada* (Hewitson)

Cucurbitacea: *Cucurbita digitala* Gray (Finger-leaved Gourd)
Hemiptera Miridae *Lygus* sp.

Hemiptera Pentatomidae *Thyanta pallidoventris* Stal

Compositae: *Ambrosia ambrosioides* (Cav.) Payne (Canyon Ragweed)
Coleoptera Cleridae *Trichodes abachei* Barr & Foster
Diptera Tephritidae *Trupanea* sp.
Hymenoptera Apidae *Apis mellifera* Linnaeus

Compositae: *Ambrosia deltoidea (Torr.)* Payne (Triangle-leaf Bursage)
Coleoptera Chrysomelidae *Megalostomis subfasciata* (LeConte)
Diptera Asilidae *Cophura* sp.
Diptera Bombyliidae *Chrysanthrax lepidota* (Osten-Sacken)
Hemiptera Scutelleridae *Sphyrocoris punctellus* (Stal)

Compositae: *Baccharis sarothroides (Ruiz &* Pavon) Pers. (Desert Broom)
Coleoptera Cerambycidae *Dendrobias mandibularis* Aud.-Ser.
Coleoptera Cerambycidae *Taranomis bivittata cylindricollis* Casey
Diptera Bombyliidae *Bombylius major* linne
Diptera Bombyliidae *Poecilanthrax effrenus* (Coquillett)
Diptera Bombyliidae *Villa eumenes* (Osten-sacken)
Diptera Bombyliidae *Aphoebantus desertus* (Coquillett)
Diptera Calliphoridae *Phaenia* sp.
Diptera Calliphoridae *Phormia regina* (Meigen)
Diptera Pipunculidae unidentified.
Diptera Sarcophagidae unidentified
Diptera Sarcophagidae *Spoggosia gelida* (Coquillett)
Diptera Sepsidae unidentified
Diptera Syrphidae *Eristalis latifrons* Loew
Diptera Syrphidae *Eristalis vinetorum* (Fabricius)
Diptera Syrphidae *Volucella* sp.
Diptera Tephritidae unidentified
Diptera Therevidae *Psilocephala* sp.
Hemiptera Largidae *Largus cinctus* (Herrich-Schaeffer)
Hemiptera Lygaeidae *Lygaeus belfrage* Stal
Hemiptera Lygaeidae *Oncopeltus fasciatus* (Dallas)
Hemiptera Reduviidae *Sinea confusa* Caudell
Hymenoptera Gasteruptiidae unidentified
Hymenoptera Ichneumonidae *Barylypa apicalis* Cresson
Hymenoptera Ichneumonidae *Compsocryptus calipterus* (Say)
Hymenoptera Leucospididae unidentified
Hymenoptera Megachilidae *Osmia texana* (Cress.)
Hymenoptera Pompilidae *Pepsis mildei* Stal.
Hymenoptera Scoliidae *Scolia* sp.
Hymenoptera Sphecidae *Bicyrtes viduata* (Handlirsch)
Hymenoptera Sphecidae *Isodontia elegans* (Smith)
Lepidoptera Geometridae *Elpiste metanemaria* (Hulst.)
Lepidoptera Lycaenidae *Ministrymon leda* (WH Edwards)

Lepidoptera Nymphalidae *Euptoieta claudia* (Cramer)
Lepidoptera Nymphalidae *Chlosyne lacinia* (Geyer)
Lepidoptera Nymphalidae *Vanessa atalanta* (Linnaeus)
Lepidoptera Pieridae *Appias drusilla* Cramer

Compositae: *Bebbia juncea* (Benth.) Greene (Sweet Bush)
Coleoptera Buprestidae *Acmaeodera gibbula* LeConte
Dictyoptera Mantidae *Stagmo mantis californica* Rehn & Hebard
Diptera Asilidae *Efferia arida (Will.)*
Diptera Bombyliidae *Anthrax* sp.
Diptera Bombyliidae *Lordotus gibbus striatus* Painter
Diptera Bombyliidae *Exoprosopa divisa* (Coquillett)
Diptera Bombyliidae *Exoprosopa* sp.
Diptera Bombyliidae *Rhynchanthrax rex* (Osten-Sacken)
Diptera Bombyliidae *Villa sp,.*
Diptera Stratiomyidae *Hedriodiscus currani* (James)
Diptera Syrphidae *Volucella jomax* Tns.
Diptera Syrphidae *Volucella isabellina Will.*
Diptera Syrphidae *Volucella nigra* Greene
Diptera Syrphidae *Volucella* sp.
Hemiptera Miridae unidentified
Hemiptera Reduviidae *Sinea confusa* Caudell
Hemiptera Rhopalidae *Stictopleuris crassicornis* (Linnaeus)
Hymenoptera Anthophoridae unidentified
Hymenoptera Apidae *Apis mellifera* Linnaeus
Hymenoptera Halictidae *Agapostemon* sp.
Hymenoptera Halictidae *Nornia nevadensis arizonensis* Ckrl.
Hymenoptera Megachilidae *Ileteranthidium larreae* (Ckll.)
Hymenoptera Megachilidae *Megachile parallela* Sm.
Hymenoptera Megachilidae unidentified
Hymenoptera Sphecidae *Steniolia duplicate* Provancher
Hymenoptera Sphecidae *Podalonia melaena* Murray
Lepidoptera Danaidae *Danaus gilippus* (Cramer)
Lepidoptera Heliconiidae *Agraulis vanillae* (Linnaeus)
Lepidoptera Hesperiidae *Hylephila phyleus* (Drury)
Lepidoptera Hesperiidae *Lerodea eufala* (WH Edwards)
Lepidoptera Hesperiidae *Erynnis funeralis* (Scud. & Burg.)
Lepidoptera Hesperiidae *Pyrgus communis albescens* Ploetz
Lepidoptera Libytheidae *Libythedna bachmanii* (Kirtland)
Lepidoptera Lycaenidae *Ministrymon leda* (W. H. Edwards)
Lepidoptera Lycaenidae *Strymon melinus* Hubner
Lepidoptera Noctuidae *Trichoplusia ni* (Hubner)
Lepidoptera Nymphalidae *Vanessa annabella* (Field)
Lepidoptera Nymphalidae *Vanessa cardui* (Linnaeus)
Lepidoptera Pieridae *Eurema nicippe* (Cramer)
Lepidoptera Pieridae *Kricogonia lyside* (Godart)

Lepidoptera Pieridae *Pontia protodice* Boisduval & Leconte
Lepidoptera Riodinidae *Apodemia mormo* (C.& R. Felder)
Orthoptera Acrididae *Melanoplus aridus* (Scudder)

Compositae: *Cirsium neomexicanum* Gray (Thistle)
Coleoptera Melyridae *Trichochrous indutus* Casey
oleoptera Nitidulidae *Carpophilus pallidipennis* (Say)
Homoptera Pentatomidae *Thyanta pallidoventris* Stal
Hymenoptera Megachilidae *Osmia texana* (Cress.)
Hymenoptera Tiphiidae *Tiphia* sp.
Lepidoptera Nymphalidae *Vanessa cardui* (Linnaeus)

Compositae: *Encelia farinosa* Gray (Brittlebush, Incienso)
Coleoptera Chrysomelidae Alticinae unidentified
Coleoptera Coccinellidae *Hippodamia convergens* G.-M.
Coleoptera Meloidae *Nemognatha nigripennis* LeConte
Diptera Bombyliidae *Anthrax irroratus* Say
Diptera Bombyliidae *Anthrax* sp.
Diptera Bombyliidae *Villa eumenes* (Osten-Sacken)
Diptera Sarcophagidae unidentified
Diptera Syrphidae *Scaeva pyrastri* (Linnaeus)
Diptera unidentified
Homoptera Cicadellidae unidentified
Hymenoptera Halictidae *Augochlorella neglectula (Ckll.)*
Hymenoptera Ichneumonidae *Dusona* sp.
Hymenoptera Megachilidae *Osmia coloradensis* (Cress.)
Lepidoptera Nymphalidae *Occidryas chalcedona* (Doubleday)

Compositae: *Erigeron divergens* Torr. & Gray (Spreading Fleabane)
Coleoptera Buprestidae *Acmaeodera cuneata* Fall
Hemiptera Lygaeidae Nysius *raphanus* Howard
Hymenoptera Halictidae unidentified
Hymenoptera Torymidae *Podagrion mantis* Ashmead
Lepidoptera Hesperiidae *Heliopetes domicella* (Erichson)

Compositae: *Gymnosperma glutinosum* (Spreng.) Less.
Hymenoptera Braconidae unidentified
Coleoptera Buprestidae *Acmaeodera chiricahuae* Barr
Diptera Bombyliidae *Geron* sp.
Diptera Syrphidae *Eristalis vinetorum* (Fabricius)
Hymenoptera Sphecidae *Trypoxylon californicum* Saussure
Hymenoptera Sphecidae *Fernaldina lucae* (Saussure)
Hymenoptera Vespidae *Eumenes* bolli Cresson
Hymenoptera Vespidae *Euod'ynerus pratensis* (Saussure)
Lepidoptera Nymphalidae *Vanessa virginiensis* (Drury)
Lepidoptera Riodinidae *Calephelis nemesis* (WH Edwards)

Compositae: *Hymenoclea salsola Torr. &* Gray var. *pentalepis* (Rydb.) Benson (Burro Bush)
Lepidoptera Sesiidae *Hymenoclea palmii* Beutenmuller

Compositae: *Pectis papposa* Harv. & Gray (Chinchweed)
Coleoptera Meloidae *Nemognatha nigripennis* LeConte

Compositae: *Porophyllum gracile* Benth. (Yerba del Venado)
Lepidoptera Pieridae *Zerene cesonia* (Stoll)
Compositae: *Viguiera deltoidea* Gray
Hymenoptera Anthophoridae *Anthophora* sp.
Lepidoptera Nymphalidae *Chlosyne californica* (W. G. Wright)

Species of Special Concern
At the inception of this project, a major stated objective was to determine which invertebrate species are important to monument ecosystems generally but particularly in the designated research sites. Importance was not clearly defined. It was proposed that a list of important species be derived from the total list of species found during this study. Factors to be considered in developing the concept of importance were:

1. relationship to special.-status plants;

2. relationship to the process of recovery of ecosystems from the effects of cattle grazing;

3. potential for the invasion by nonnative species that might: have significant impact on other elements of the ecosystems or visitor use;

4. potential interest to or effects on park visitors, this would include heroic species, potentially dangerous species, endemic species, and endangered species;

5. relative ease (and/or value) with which species can be used as indicators of environmental conditions by subsequent investigators in a monitoring program.

A goal for the list of "important" species was the development of a monitoring plan that could be used by monument staff in a long-term program for monitoring the relative "health" of the environment. This will be treated in the next section of this report and in a separate document.

Species Associated with Special-Status Plants

All insect-plant associations recorded by members of our team are listed in a previous section of this report, arranged by plant. This includes those special-status plants that we were able to locate and at which we found invertebrates. Some of the special-status plants were so rare that they were not encountered by our research team during the course of this study.

Insects associated with *Echinomastus (= Neolloydia) erectocentra* were studied intensively by the team working on special-status plants, and will be reported on by that team. They found at least 20 species of pollinating insects visiting flowers (R. Johnson, personal communication). Among the

pollinators was *Apis mellifera,* an introduced species. It appears that availability of pollinators is not a problem for the plant. One beetle, tentatively identified as *Moneilema gigas* (Coleoptera: Cerambycidae), was found to bore into and damage or kill some plants, but it is considered of minor importance to the plant: population (R. Johnson, personal communication). A lepidopteran seed predator was found and reared but has not been identified at this time. Specimens have been sent to experts for determination. The impact of this seed predator is believed to be minor.

In general, our limited data suggest that no invertebrates are creating important adverse impacts on any special-status plant species, and that no plants are limited by lack of availability of pollinators or seed. dispersers, or by predation by invertebrates. Our observations suggest that most, if not all, species of pollinators and seed dispersers are generalists, including special-status plants in their diets, but not specializing on them. There is no evidence that any of our special-status plants are exclusively dependent upon single species of insects in any way. However, it must be recognized that our data is very sparse, because we did not focus intensively on special-status plants. A specific project, dealing only with such invertebrate-plant interactions may be warranted as the only way to obtain detailed information.

Relationship to the Process of Recovery from Grazing

Insects that may be related to the process of recovery from grazing include those that:

a) consume plants or seeds of plants to such a degree that they prevent establishment,

b) have beneficial impacts resulting from dispersal or nurturing of desired plants (including the reduction of unwanted plants), or

c) prefer conditions associated with stages in the recovery process but have no important impact.

Such relationships are poorly understood in general, and specific information from the monument and the Sonoran Desert is lacking. Detailed, highly specific studies over a long period of time would be needed to determine the existence and importance of such relationships. The present study is inadequate to reveal significant relationships. Lists of taxa found at the various study sites could be related to the degree of recovery of those sites from grazing but would be of little value because so many other factors are involved.

A few invertebrate taxa encountered during this study may be related to the process of recovery from grazing. Among them are a complex of grasshoppers, most notable being *Trimerotropis pallidipennis* (Orthoptera: Acrididae). These insects are known to consume grasses and forbs and tend to be more abundant in disturbed and overgrazed areas than in pristine areas. They are usually associated with barren spots of sandy or gravelly soil. However, no data strongly implicate them in retarding recovery from grazing in the Sonoran Desert, and their role in the ecosystem is not well understood.

Another complex of insects that may have an impact on recovery from grazing are the harvester ants, particularly of the genera *Pogonomyrmex* and *Veromessor.* Numerous studies have shown that these ants harvest many species of seeds and reduce the availability of seeds in the environment. Some

Pogonomyrmex species clear areas of all plants in the immediate vicinity of their nests. Other studies suggest that the ants may have a beneficial effect by dispersing seeds, aerating soil., or enriching soil. The general impact of ants on recovery from grazing in the Sonoran Desert: is unknown and would require a specific, complex study over many years to determine. It is my opinion that, if such a study were done, the conclusions would be ambiguous.

The value to management of knowing the relationship between invertebrates and recovery from grazing may be very lirnited. Studies that would conclusively demonstrate significant relationships would need to include removal of selected taxa and prevention of their reestablishment over a period of several years. If strong adverse; impacts of invertebrate species were shown to occur, that would suggest the obvious technique of large-scale control of such species as a management tool in hastening the recovery process. No control technique is without impact on non-target organisms, and it is doubtful that any technique would be approved for use in the monument.

Observation suggests that some insect taxa may be associated with disturbed and overgrazed land. These may be considered as indicators of degree of recovery from grazing. However, simple visual observation of plants and soil conditions would be an easier and probably more meaningful way to assess recovery than any method of monitoring insect populations.

Potential for Invasion by Nonnative Species

The potential for invasion by nonnative species is a concept that is difficult or impossible to measure or ascertain in any meaningful way. It is possible, though unlikely, that some agricultural pests from Mexico may occasionally come across the line and become established in native plants in the monument. This is unlikely, however. Most pests show decided preferences for an abundance of preferred food-the crop in which they are pests. I know of no instance in history in which an agricultural pest became a problem on native plants under natural conditions. The reverse, however, has occurred numerous times. Agricultural pests usually become pests because they thrive in monocultures and in the absence of a full complement of predators and parasitoids, diseases, and weather fluctuations. They do not thrive well in native complex ecosystems. The possibility, however remote, may exist that some Mexican agricultural pest might make this exceptional transfer. There is no way this possibility can be predicted, and it cannot be measured until, or unless, it actually happens.

Only 2 nonnative species were encountered during this study. A third, which was found in a previous study, was not found and was not searched for during our study but may be present.

1. *Labidura riparia* (Pallas), the striped earwig, is believed to have been introduced to Arizona. The first Arizona specimens are from Yuma in 1952. It is now widely distributed in the southern part of the state. It is a predator on other insects, especially fly larvae. It was found at Quitobaquito (Kingsley et al. 1987). During this study, 1 specimen was found at SE on 10/30/87 at light. Apparently this is a very rare insect in OPCNM. Although it may be considered an introduced species, there is probably no reason to be especially concerned about it. It is not expected to have any significant impact on ecosystems or visitors.

2. The honey bee, *Apis mellifera* Linnaeus is an extremely important introduced insect. Honey bees were brought from Europe in the 1500s by the Spanish and have become thoroughly

naturalized throughout the western hemisphere; in suitable habitats. They are generally common to abundant throughout the monument but are most prevalent near (and require) standing water. The ecological role of the honey bee and the impacts of its establishment are poorly understood. Studies on the ecology of honey bees in OPCNM are currently being undertaken by scientists of the USDA Carl Hayden Bee Research Center (Schmidt and Edwards 1998). Honey bees are major consumers of nectar and pollen and may have significant impacts on the biology of desert plants (Schmidt and Buchmann 1986) and on other flower-feeding insects. However, they have been established in the Sonoran Desert for so long that it is impossible to ascertain their impact on populations of native plants and animals.

Honey bees were observed at most of the SENECPRO sites and were recorded feeding at a wide variety of plants. Records of their distribution and plant selection are included in the previous section on taxonomic accounts.

Of primary concern is the impending invasion of a new genetic strain, the "Africanized Bee," also known as the "Killer Bee" and the "African Bee." This is a highly aggressive and defensive strain that is known for its penchant for stinging people and animals that approach hives. This strain is expected to arrive in the monument in the next few years and to become established, eventually replacing the current strain. Africanized bees are likely to have adverse impacts on native plant populations, native flower-feeding insect populations, native wildlife populations, visitor health and safety, and safety of NPS personnel. The magnitude of these effects is unpredictable. The opportunity to develop a good baseline for the study of the impact of this insect has passed untaken. For the future, it will be necessary to develop strategic plans for coping with the most obvious problems of visitor safety. Continued cooperation with the ongoing research of the Carl Hayden Bee Research Center will be of value, and the advice of these scientists should be followed in developing a management plan.

3. The snail, *Biomphalaria havanensis* (Pfeiffer) (formerly *Planorbis)* is not native in Arizona (Bequaert and Miller 1973). It was found in the pond at Quitobaquito in 1969, but we do not know if it is still present. It is considered only an occasional, perhaps temporary, resident in artificial bodies of water. Its ecological role and impact are not known. If it is still present, there is probably no reason for concern.

Species of Potential Interest to or Effects on Visitors

Criteria for inclusion in this category are nebulous. Factors for consideration might include:

1. "heroic" species (those that are near their range limits, are large, colorful, or dramatic in behavior, or have stories that might illustrate ideas considered socially desirable);

2. species that are potentially dangerous or annoying to visitors; or

3. rare, endemic, threatened, and endangered species.

Visitor interest is difficult to judge. To some people, all creatures are inherently interesting. Other people are only vaguely interested, if at all, in invertebrates. If rarity is a criterion for inclusion in this category, then the majority of our taxa should be included. No officially listed threatened or endangered taxa, except the Quitobaquito snail, were found during this study, and none are expected from the monument. Taxa that axe potentially dangerous or annoying to visitors are well-covered in Smith (1982), which is on sale in the monument bookstore. Candidates for consideration as species of interest to visitors are listed below. See taxonomic accounts for more information on each taxon.

Arachnida: Scorpiones. All species may be of interest to visitors. All can sting, so are potentially dangerous or annoying, but visitor stings are rare.

Arachnida: Theraphosidae. Tarantulas are usually of some interest to visitors. They are not rare or dangerous, but are of striking appearance.

Arachnida: Trombidiidae. Both species of velvet mites may be of interest to visitors, if any visitors are fortunate enough to see them.

Chilopoda: Scolopendromorpha: *Scolopendra heros.* Although rarely seen, this is a striking creature that is of minor potential danger to visitors.

Diplopoda: Spirostreptida *Orthoporus ornatus*. This large millipede may be very abundant and conspicuous during the summer rainy season. Shed skins or remains of dead millipedes may also attract visitor interest.

Diptera: Mosquitoes are uncommon or rare in the monument. They are, however, of potential interest to visitors because they bite and they are not expected in desert environments. None of the species encountered during this study are of any real danger to visitors. Other diptera, including Chloropids and Tabanids, may also be of interest to visitors because they can be annoying. Cuterebrids may be of interest to some visitors for their subcutaneous parasitism of mammals, but they are rarely seen.

Coleoptera: Cerambycidae: *Derobrachus* species. These large "Palo Verde Beetles" may attract visitor attention during the brief period of adult activity in summer.

Coleoptera: Tenebrionidae: *Eleodes* species. These large beetles may attract visitor attention because they are conspicuous, fairly common, and have interesting defensive behavior.

Hemiptera: Reduviidae: *Triatoma* species. "Kissing bugs" may be of interest because they are capable of inflicting serious, painful bites.

Hymenoptera: Apidae: *Apis mellifera*. See above discussion under "Potential for Invasion by Nonnative Species." Honey bees are always interesting to visitors and will become more so as the potential threat of serious injury by bees increases.

Hymenoptera: Formicidae: *Atta mexicana*. OPCNM is the only known U.S. location for this Mexican ant. It is interesting in its habits because it is a fungus-growing ant. It is large, can bite

painfully if molested, and illustrates (as almost all ants do) social behavior. It has been well studied in the monument by Mintzer, who has contributed interpretive materials on it.

Other ants that may be of interest are *Acromyrmex versicolor, Pogonomyrmex* species, *Neivamyrmex* species, and *Myrmecocystus melliger*. See accounts on them in the Taxonomic Accounts section of this report.

Hymenoptera: Mutillidae: *Dasymutilla* species. These are large, colorful "velvet ants." Although rarely seen, they are conspicuous when active above ground. They are capable of inflicting severe stings and also vocalize under duress.

Hymenoptera: Pompilidae: *Pepsis* and *Hemipepsis* species. These are large, colorful wasps with gruesomely interesting life histories. They are also potentially dangerous to visitors, in that they have very potent stings.

Lepidoptera: Butterflies. More people are interested in these colorful insects than in any other group of invertebrates. The monument has many species, some of which are quite common and colorful. A checklist of butterflies of OPCNM is included as an appendix to this report. The interpretive staff may wish to reproduce this list for distribution to visitors. A display of butterflies found in the monument may also interest visitors. Submitted separately from this report is a collection of almost all the species known from the monument, which can easily be adapted for an interpretive display.

Lepidoptera: Lycaenidae: *Euphilotes battoides martini* (Martin's blue). This butterfly was recorded once in 1944 by Garth (1944) (as *"Philotes rita* B. & McD.") from Alamo Canyon but has not been seen since then. It may no longer occur in the monument, or it may come back if conditions are right. It is of interest as an eastern range limit of the subspecies.

Lepidoptera: Pieridae *Ascia howarthi.* This rare butterfly has the monument as its only known U.S. location.

Lepidoptera: Saturniidae: *Eupackardia calleta, Rothschildia cincta* (not found during this study), and others. These are large, colorful, poorly-known moths. They may attract visitor interest for aesthetic reasons.

Orthoptera: Romaleidae: *Taeniopoda eques.* One of our most strikingly colorful grasshoppers, this species is likely to attract visitors' attention if it is seen. It is rare in the monument, where it has been found only in the Ajo Mountains. This is probably the westernmost location for the species, which ranges eastward into Texas and southward through Mexico to Costa Rica.

Mollusca: The very existence of snails in the desert may be of interest to some visitors. The variety of snails present in the monument may also be of interest. Two taxa, *Sonorella baboquivariensis cossi* and *Tryonia quitobaquitae* are endemic to the monument. Walter Miller has offered to contribute specimens and collaborate in the creation of an interpretive display on desert snails.

Indicator Species and the Concept of Monitoring

This project began with the idea that monitoring selected invertebrate species might be a useful way to measure changes in environmental conditions. It was believed that invertebrates, being numerous, reproducing quickly, and being sensitive to a wide spectrum of environmental conditions, might be useful as indicators of events and changes in the general environment and in the selected ecosystems or habitat types represented by the study sites. One of the purposes of our broad approach to sampling invertebrates was to obtain enough knowledge of species roles and populations so that we might develop a list of indicator species and a monitoring program. Most of the other SENECPRO projects had the same assignment, selecting taxa for long-term monitoring. The monitoring was to be carried out periodically by monument staff, who would not necessarily be invertebrate experts but would receive minimal training in the recognition of taxa.

Criteria listed in the RFP for selection of indicator species were:

1. Special-status species covered by legislation.

2. Endemics.

3. Species that are harvested by hunting, poaching, and collecting for commercial or domestic purposes.

4. Species that occupy different trophic levels, feeding guilds, and so forth, so that all levels are represented.

5. Species that are common or dominant.

6. Species that are of special interest to the public, managers, interpreters, and/or scientists, including "heroic species."

7. Species that occupy sites that are subject to dramatic change such as precipitant loss or alteration of habitat.

To this list, common sense calls for the addition of 2 more criteria:

8. Species that are consistently and easily identifiable by monument staff in the context of a larger monitoring program.

9. Species for which population fluctuations meaningfully indicate environmental conditions that cannot be measured in an easier, more efficient, and more consistent way.

A tentative list of taxa for monitoring and a monitoring protocol were developed in 1989 and field tested in 1989 and 1990. Species selected and the reasons for their selection were:

Trimerotropis pallidipennis (Orthoptera: Acrididae). A common, fairly conspicuous grasshopper, most prevalent on disturbed, barren soil. Numbers may indicate degree of disturbance of habitat or,

inversely, degree of recovery from disturbance. Population size may indicate abundance of rainfall and annual plant growth (personal observation).

Ligurotettix coquilletti (Orthoptera: Acrididae). An abundant grasshopper, generally distributed and detectable by its calls. Only grasshopper known to defend territories, population levels may be independent of rainfall (Otte and Joem 1975). May indicate habitat quality in some way. Easy to count.

Taeniopoda eques (Orthoptera: Romaleidae). Species of interest because of its isolation, appearance, and behavior (a "heroic" species). Easily detectable and identifiable.

Battus philenor (Lepidoptera: Papilionidae). A common and conspicuous, easily recognizable species. Population numbers may indicate general environmental conditions. It is a monophagous herbivore as a larva and multiphagous nectar feeder as an adult (Tilden and Smith 1986).

Danaus gilippus (Lepidoptera: Danaidae). A common and conspicuous, easily recognizable species. Population numbers may indicate general environmental conditions. It is a polyphagous herbivore as a larva and multiphagous nectar feeder as an adult (Tilden and Smith 1986).

Strymon melinus (Lepidoptera: Lycaenidae). A common and conspicuous, easily recognizable species. Population numbers may indicate general environmental conditions. It is a multiphagous herbivore as a larva and multiphagous nectar feeder as an adult (Tilden and Smith 1986).

Eurema nicippe (Lepidoptera: Pieridae). A common and conspicuous, easily recognizable species. Population numbers may indicate general environmental conditions. It is a polyphagous herbivore as a larva and multiphagous nectar feeder as an adult (Tilden and Smith 1986).

Leptotes marina (Lepidoptera: Lycaenidae). A common and conspicuous, easily recognizable species. Population numbers may indicate general environmental conditions. It is a polyphagous herbivore as a larva and multiphagous nectar feeder as an adult (Tilden and Smith 1986).

Ascia howarthi (Lepidoptera: Pieridae). Selected as a species of special interest, its distribution in the United States is limited to a small portion of the monument. It is dependent on a special-status plant *(Atamisquea emarginata)* for its larval food (Bailowitz 1985).

Euphilotes battoides martini (Lepidoptera: Lycaenidae). Selected as a species of special interest, it was recorded in 1942 (Garth 1944) but not since, and it would be an eastern distribution record if it still occurred in the monument.

Apis mellifera (Hymenoptera: Apidae). Selected because it is introduced, important as a pollinator and potential danger to visitors, is generally abundant, conspicuous, and identifiable. Its population size may indicate general environmental conditions.

Pogonomyrmex spp. (Hymenoptera: Formicidae). Selected because they are conspicuous and the genus is easily identifiable (although the species are not easily identifiable). They are seed harvesters

(Cole 1968), and their population size may be indicative of general environmental conditions. There may also be a relationship between populations and degree of recovery from grazing.

Aphaenogaster (= *Novomessor*) *cockerelli* (Hymenoptera: Formicidae). An abundant, widespread, and easily identifiable ant. This species is primarily a predator on insects (Creighton 1950). Its population size may be indicative of general environmental conditions and the abundance of prey species.

Acromyrmex versicolor (Hymenoptera: Formicidae). An abundant ant in deep soils, this species was selected because it may be of interest to visitors, is easy to identify and to count its colonies, and may indicate general environmental conditions.

Atta mexicana (Hymenoptera: Formicidae). Selected because the only known U.S. population is found in the monument (Byars 1949).

Agelenopsis spp. (Araneae: Agelenidae). Selected because they are easily detectable predators and may be indicative of prey population sizes and general environmental conditions.

Lycosa "carolinensis" (Araneae: Lycosidae). Selected because they are easily detectable predators and may be indicative of prey population sizes and general environmental conditions.

The sampling protocol involved walking 5 transects (100 X 2 m) across each site and recording numbers of all of the listed taxa encountered. The protocol proved practical on the level, open sites but impractical in canyon sites. Numbers of each taxon encountered were generally very low, most often zero, during the period of field testing. Repeated testing showed little or no value in continuing this protocol because it proved inadequate for sampling very low populations or activity levels encountered and for the reasons discussed below. Any simpler protocol would be meaningless. Only a more complex protocol, as described in a separate document, might yield meaningful information.

The problems associated with monitoring invertebrate species are many. For example, only 1 species, the Quitobaquito snail, is currently or likely to be covered by legislation as a special-status species. The small size and cryptic nature of this snail make monitoring difficult. Lack of knowledge of the basic biology of this species prevents development of a meaningful monitoring plan, short of an intensive study of the biology of the snail. A detailed study of the basic biology of this species must be performed before a monitoring program can be developed. The habitat of this snail is very restricted and carefully managed but may be subject to unforseen perturbation that would impact the snail. The Ajo Mountain's snail *(Sonorella baboquivariensis cossi*) might conceivably meet criteria for listing as a restricted, habitat-endemic snail. However, current knowledge of this cryptic species is too limited to enable us to develop even the most rudimentary monitoring program that would have any meaning. Again, an intensive study of the biology of this snail may lead to the development of a useful monitoring plan. No other known invertebrate species found during this study is likely to meet criteria for listing.

A few species, i.e., *Ascia howarthi* and *Atta mexicana* may be considered "special" in that they are separated by a political boundary from the major concentration of their species. Others, such as *Taeniopoda eques* may represent distributional extremes. The value of developing monitoring

programs for them is questionable, at best and may be a waste of time and money, since we have no idea what fluctuations in their populations mean. Intensive studies of the biology of each species are necessary as a foundation for developing a monitoring plan.

No known species are likely to be harvested by hunting, poaching, and collecting for commercial or domestic purposes. A few species, such as some of our rare Saturniid moths and some beetles and butterflies, may be of interest to some collectors, including some commercial collectors. However, most, if not all collectors are unlikely to risk legal prosecution for collecting species in the protected area of the monument when these same species are obtainable elsewhere with no risk. None of our rare species are truly endemic to the monument (with the exception of those mentioned above), so impact by collectors should not be an important consideration. Some value may come from welcoming collectors and issuing permits for collection of limited numbers of certain rare species as a way of increasing the knowledge of their biology.

Consideration of species that represent different trophic levels and the few species that meet the criteria of being common or dominant encounters other practical problems.

1. Too little is known about even the most common or dominant species to enable us to draw any meaningful conclusion from the observation of fluctuations in their numbers.

2. Fluctuations in numbers of observed individuals may have little or nothing to do with actual population sizes. All species are sensitive to weather conditions and have seasonal and daily activity patterns that make monitoring difficult. They simply may not be visible during periods when weather conditions are not to their liking or in the wrong season or time of day, even though they may be abundant in cryptic resting stages. Our knowledge is inadequate to enable us to recommend optimal conditions for monitoring any species or to interpret changes in observed populations.

3. Rainfall patterns are the most important driving force for invertebrate populations in this environment and complicate or cancel out our understanding of any other factors. Fluctuations in invertebrate populations may only tell us, indirectly, the relative amount of rainfall. If we want to measure rainfall, there are easier ways than to monitor invertebrate populations.

4. Many of the most common species are not easily and consistently identifiable under field conditions. For example, the common grasshopper *Trimerotropis pallidipennis,* is quite cryptic in coloration and behavior and closely resembles several other species. Other examples could be given, which would eliminate many of the common species. Only a few species are unmistakable, but then we have the other problems mentioned above. Even expert insect taxonomists working under the best laboratory conditions make mistakes in identification of species. Minimally trained resource management personnel, who are not entomologists and are not familiar with the taxonomic complexities involved, will produce data that are questionable at best.

The same problems discussed above, apply to species that are of special interest or that occupy sites subject to dramatic changes, such as precipitant loss or alteration of habitat. Knowledge of the

biology of the species is insufficient to enable population data to be used as indicators of anything except weather conditions or radical habitat alteration, which are more efficiently measured in other ways.

As an example of the kinds of problems that are encountered in monitoring and interpreting population levels and presence or absence of invertebrate species, comparison of butterfly species present in selected areas in the same season in different years may be useful. Table 5 shows records of spring butterflies observed at Bull Pasture and Arch Canyon by Richard A. Bailowitz, an expert lepidopterist. The major differences between years are almost certainly a result of weather. Although inherently interesting to some people, these kinds of data are of no value to resource managers. The

Table 5. Spring butterflies observed at Bull Pasture and Arch Canyon, Organ Pipe Cactus National Monument, 1989–1990.

Abundance: R= rare, S= scarce, U= uncommon, C= common, A= abundant
Food: 1= monophagous, 2= polyphagous (within 1 plant family), 3= multiphagous (several plant families)

		Abundance			
		Bull Pasture		Arch Canyon	
Species	Food	1989	1990	1989	1990
Copaeodes aurantiacus	1	R		U	R
Pyrgus albescens	2	R		R	
Erynnis funeralis	2	U	U	U	U
Staphylos ceos	2				R
Systasea zampa	2		R	R	R
Battus philenor	1	U			
Papilio multicaudatus	3		U	U	U
Papilio cresphontes	2	R		R	
Colias cesonia	2	C		C	
Phoebis sennae	2			S	
Eurema mexicana	2	C	U	C	
Eurema nicippe	2	C	U	C	U
Nathalis iole	3			S	
Atlides halesus	1	U		U	R
Xamia xami	3	S			
Brephidium exile	2	S		S	
Leptotes marina	2	A	A	A	A
Hemiargus isola	2	R		R	
Hemiargus ceraunus	2	U			
Strymon melinus	3	U		U	
Celastrina argiolus	3			R	
Apodemia mormo	2	S		S	
Apodemia palmeri	1	S			
Libytheana bachmanii	2	R		R	
Asterocampa leilia	2	U		C	U
Adelpha bredowii	2			R	
Nymphalis antiopa	3			S	
Vanessa cardui	3	S	S		S
Vanessa annabella	2				R
Vanessa atalanta	2			S	
Anthanassa texana	2	U		C	
Dymasia dymas	1	S	R		R
Thesallia fulvia	1		R		
Texola elada	1	S			S
Agraulis vanillae	1	R		U	
Danaus plexippus	2		R		
Danaus gilippus	2	S	R		
Totals		25	11	25	13

most obvious conclusion, that Spring 1990 was drier than spring 1989, could have been arrived at by easier means than by observing butterflies.

In conclusion, present knowledge of the biology of invertebrates is insufficient to permit meaningful interpretation of data on their population fluctuations or to develop a useful, inexpensive monitoring program. We do not even know enough to develop a complete list of questions for further research toward developing a knowledge base from which to develop a monitoring program. The period of study of this project was too short and impacted by drought conditions, to enable drawing any more useful conclusion. Continued research, including widespread sampling of all invertebrates and concentration on developing basic understanding of some of the species present, is warranted as a way of better understanding all components of our environment. But the utility of data on invertebrate populations in resource management or prediction of environmental changes is not apparent and is not likely, in itself, to justify further work. However, NPS officials insist on a monitoring program. Therefore, the monitoring program described in the separate document is presented as a foundation for developing a meaningful, long-term monitoring program. Although the program presented is complex and expensive, it is anticipated that it can be reduced in complexity and cost after 10 or 20 years of research has answered basic questions about methods for sampling.

General Conclusions

As far as possible, the objectives of this study have been met. A list of invertebrate species of special concern has been made, following several criteria. "Important" and "indicator" species have been identified and discussed. The question, "Do any nonnative species pose a threat..." has been answered affirmatively in the case of the "Africanized" bee. The monument's collection of invertebrates has been supplemented. A methodology for monitoring the "health" of the monument's invertebrate populations has been provided as a separate document.

This project has resulted in a major increase in the knowledge of invertebrate taxa in OPCNM. Over 1,000 taxa were recorded, together with data on their distribution in time, space, and habitats; their relative abundance; and their associations with plants. OPCNM now has one of the largest, most complete, and best-identified invertebrate collections to be found in the National Park system. Still, only an unknown fraction of the invertebrate taxa that reside in the monument were encountered during the period of this study. Continued study would probably result in a greatly increased number of taxa, especially if additional, more time-consuming techniques were used to examine specialized microhabitats. Many taxa could not be identified to species, and some of these may be previously undescribed. Involvement of taxonomic specialists would be necessary to describe "new" species.

No detectable problems affecting the populations of invertebrates, other than weather, were found. No problems caused by invertebrates were found. It is unlikely that further research will discover any major problems of either sort, with the exception of the impending arrival of the "Africanized" bee. The invertebrates of OPCNM appear to be doing the best they can under the circumstances imposed by weather. Taken as a whole, the invertebrates of the monument are not likely to be impacted by anthropogenic factors, other than significant climate change. A few species of highly localized distribution may be impacted by management activities at Aguajita Wash and Quitobaquito, if their welfare is not considered.

The concept of developing a simple monitoring program for selected invertebrate populations is attractive on the surface. That concept is rendered difficult because of the severe limitations in knowledge of the basic biology of even the most common species, several practical considerations, and the confounding effects of weather. A meaningful monitoring program can only be based on much more information than could be obtained by this study. The monitoring program, presented as a separate document, is in my opinion, the minimum program that would lead to meaningful conclusions. Further research of the type reported on here, with the addition of intensive studies of the biology of selected species over a long period of time, may possibly result in the gathering of sufficient knowledge to enable the development of simpler monitoring techniques and protocols.

Recommendations for Management

This study examined the distribution and ecology of invertebrates in OPCNM. The period of study was predominately a very hot, dry period. Many species that may be found in the monument during years of more favorable weather may be absent or overlooked by this study. Population sizes observed during the period of study might not be indicative of population sizes under other weather conditions. Impacts of invertebrate predation on specialstatus plants, observed to be minimal during the period of this study, might increase either under more favorable weather conditions for invertebrates or prolongation of unfavorable conditions for plants. Visitor annoyance by pest insects was also minimal during the period of study but might increase during periods of weather more favorable for potential pests.

Despite the volume of data obtained in the course of this study, our knowledge of the biology of invertebrates of OPCNM remains very limited. Any long-term management or monitoring plan must begin with detailed studies of individual taxa and the complex of factors that might influence their populations. Current knowledge is insufficient to permit drawing conclusions about any taxon, other than it was or was not present at a particular time and place in observed numbers doing some particular behavior. A very small amount of work has been done in the monument on a few species. This work has not provided sufficient information over a long enough period of time and variety of weather conditions to permit meaningful conclusions to be drawn that would be useful to management. Continued research, both broad-scale studies of all invertebrates and concentrated studies of the biology of selected species, would be necessary to develop the knowledge needed to be useful to management. I recommend that every effort be made to enlist the cooperation of researchers, both professional and amateur, in expanding knowledge of the invertebrate fauna of the monument. Specifically, I recommend that:

1. The collection of specimens be adequately maintained and accessible to all interested persons.

2. Collecting and research permits be easily obtainable by researchers, both professional and amateur. Requirements on the disposition of specimens should be relaxed, if possible, to include disposition in private collections.

3. Cooperative agreements with researchers from other governmental organizations, such as the USDA Carl Hayden Bee Research Center and The University of Arizona, be maintained and enhanced if possible. Provision of even minimal funding and field support may enhance such cooperation.

4. Creation of a scholarship fund for support of students interested in studying aspects of invertebrate biology in the monument may be of value in attracting additional highquality research, especially concentrated studies on the biology of selected species and insect-plant relationships. Such a scholarship fund, if created, should be adequately publicized to attract investigators.

5. The monitoring program, presented as a separate document (Kingsley 1995), be implemented. This includes continuation and expansion of broad-scale sampling of the invertebrate fauna using the methods and sites used in this study and specific studies of individual species.

Full cooperation with the USDA researchers in their investigation of "Africanized" bees is considered imperative. A plan for dealing with these insects should be developed immediately, following the advice of the bee specialists. The potential impact of these insects on visitor safety and the workings of monument ecosystems should not be underestimated.

The presence of 2 invertebrate species, *Ascia howarthi* (dependent on a special-status plant) and *Tryonia quitobaquitae* (nonnative) should be considered in any management plans for Aguajita Wash and Quitobaquito. Also, sampling for the introduced snail *Biomphalaria havanensis* at Quitobaquito may be justified. If deemed appropriate, Walter B. Miller may be a good source for advice and specimens to facilitate identification.

Additional informative displays may be of value as part of the monument's interpretive program. Specifically, displays featuring aspects of the biology of invertebrates might be considered for the visitor center. These might include a display on butterflies, a display on ants, and a display on snails. The submitted collection might serve as a nucleus for a display on butterflies. Also, the checklist of butterflies of the monument, included as an appendix of this report, might be published for distribution to visitors. It would be more difficult to create a display on ants featuring the variety of species found, since many are small, and specimens are difficult to appreciate. A display on snails may be created with the cooperation of Walter B. Miller, who has offered to submit specimens and advice. Additional displays might be created to feature the variety of insects that feed on specific plants, such as *Baccharis sarothroides, Bebbia juncea, Prosopis velutina,* or *Larrea tridentata.* Serious consideration should be given to appropriate ways of informing visitors about the possible danger of honey bees, once the "Africanized" bee becomes a part of our fauna.

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Appendix
Checklist of Butterflies

Butterflies of Organ Pipe Cactus National Monument (including Quitobaquito)
Nomenclature follows *A Field Guide to Western Butterflies* (Tilden and Smith 1986).

Food: 1 = monophagous, 2 = polyphagous (within 1 plant family), 3 = multiphagous (within several plant families), ? = not known

Abundance: R = rare, S = scarce, U = uncommon, C = common, A = abundant

Where alternatives are given (C/U), occurrence is either highly seasonal or varies locally within the monument.

Scientific name	Common name	Food	Abundance
Danaidae	**Milkweed Butterflies**		
Danaus plexippus (Linnaeus)	Monarch	2	R
Danaus gilippus (Cramer)	Queen	2	C
Heliconiidae	**Long-wings**		
Agraulis vanillae (Linnaeus)	Gulf fritillary	1	R
Apaturidae	**Leaf-wings and Emperors**		
Subfamily Apaturinae	**Emperors**		
Asterocampa leilia (W. H. Edwards)	Empress Leilia	2	U/C
Nymphalidae	**Brush-footed Butterflies**		
Subfamily Marpesiinae	**Dagger-wings**		
Marpesia petreus (Cramer)	Ruddy dagger-wing	1	R
Subfamily Limenitidinae	**Admirals and Relatives**		
Adelpha bredowii (Geyer)	Sister	2	R
Subfamily Nymphalinae	**Tortoise-shells, Angle-wings, etc.**		
Nymphalis antiopa (Linnaeus)	Mourning cloak	3	R
Vanessa atalanta (Linnaeus)	Red admiral	2	R
Vanessa cardui (Linnaeus)	Painted lady	3	C
Vanessa virginiensis (Drury)	American painted lady	2	R
Vanessa annabella (Field)	West coast lady	2	R
Junonia coenia (Huebner)	Buckeye or peacock butterfly	3	R

Appendix—continued.

Scientific name	Common name	Food	Abundance
Junonia nigrosuffusa (B. & McD.)	Dark peacock	3	R
Myscelia cyananthe Felder	no common name	?	R
Subfamily Argynninae	**Fritillaries**		
Euptoieta claudia (Cramer)	Variegated fritillary	3	R
Subfamily Melitaeinae	**Checker-spots, Patches, and Crescents**		
Anthanassa texana (W. H. Edwards)	Texas crescent	2	U
Chlosyne lacinia (Geyer)	Bordered patch	2	R
Chlosyne californica	California patch	1	R
Thessalia fulvia (W. H. Edwards)	Fulvous checker-spot	1	R
Dymasia dymas (W. H. Edwards)	Dymas checker-spot	1	U
Texola elada (Hewitson)	Elada checker-spot	1	U
Occidryas chalcedona (Doubleday)	Chalcedon checker-spot	2	R
Papilionidae	**Swallowtails and Parnassians**		
Subfamily Papilioninae	**Swallowtails**		
Battus philenor (Linnaeus)	Pipe-vine swallowtail	1	C/U
Papilio polyxenes Fabricius	Black swallowtail	3	R
Papilio cresphontes Cramer	Giant swallowtail	2	R
Papilio multicaudatus Kirby	Two-tailed swallowtail	3	U
Pieridae	**Whites and Sulfurs**		
Subfamily Pierinae	**Whites**		
Pontia protodice (Bsdvl. & LeC.)	Checkered white	3	C/U
Ascia howarthi (Dixey)	Howarth's white	1	R
Appias drusilla Cramer	Florida white	?	R
Subfamily Coliadinae	**Sulfurs and Yellows**		
Colias eurytheme Boisduval	Orange sulfur	2	U
Zerene cesonia (Stoll)	Southern dogface	2	C/U
Phoebis sennae (Linnaeus)	Cloudless sulfur	1	U/R
Kricogonia lyside (Godart)	Lyside	1	R
Eurema mexicana (Boisduval)	Mexican sulfur	2	C/R
Eurema proterpia (Fabricius)	Proterpia orange	?	R
Eurema nicippe (Cramer)	Sleepy orange	2	C
Nathalis iole Boisduval	Dainty sulfur	3	U

Appendix—continued.

Scientific name	Common name	Food	Abundance
Subfamily Anthocharinae	**Orange-tips and Marbles**		
Anthocharis pima W. H. Edwards	Pima orange-tip	?	R
Anthocharis sara Lucas	Sara orange-tip	2	U
Libytheidae	**Snout Butterflies**		
Libytheana bachmanii (Kirtland)	Snout butterfly	2	C
Riodinidae	**Metalmarks**		
Apodemia mormo (C. & R. Felder)	Mormon metalmark	2	C
Apodemia palmerii (W. H. Edwards)	Palmer's metalmark	1	U
Calephelis nemesis (W. H. Edwards)	Fatal metalmark	?	U
Lycaenidae	**Gossamer-winged Butterflies**		
Subfamily Eumaeinae	**Hairstreaks**		
Atlides halesus (Cramer)	Great purple hairstreak	1	U
Chlorostrymon simaethis (Drury)	Simaethis hairstreak	1	R
Ministrymon leda (W. H. Edwards)	Leda hairstreak	1	U
Xamia xami (Reakirt)	Xami hairstreak	2	R
Strymon melinus Huebner	Common hairstreak	3	C
Strymon columella (Fabricius)	Columella hairstreak	1	R
Subfamily Polyommatinae	**Blues**		
Brephidium exile (Boisduval)	Pygmy blue	2	C/S
Leptotes marina (Reakirt)	Marine blue	2	C
Hemiargus ceraunus (Fabricius)	Ceraunus blue	2	U
Hemiargus isola (Reakirt)	Reakirt's blue	2	U
Celastrina ladon (Cramer)	Spring azure	3	S
Hesperiidae	**True Skippers**		
Subfamily Hesperiinae	**Branded Skippers**		
Lerodea eufala (W. H. Edwards)	Eufala skipper	2	R
Lerodea arabus (W. H. Edwards)	Arabus skipper	?	R
Amblyscirtes prenda Evans	Prenda roadside skipper	?	R
Amblyscirtes nysa W. H. Edwards	Nysa roadside skipper	2	R
Hylephila phyleus (Drury)	Fiery skipper	2	R
Copaeodes aurantiacus (Hewitson)	Orange skipperling	1	C/R
Nyctelius nyctelius (Latreille)	Nyctelius skipper	?	R

Appendix—continued.

Scientific name	Common name	Food	Abundance
Subfamily Pyrginae	**Dusky-wings, Checkered Skippers, etc.**		
Pholisora catullus (F.)	Common sooty-wing	2	R
Pholisora libya (Scudder)	Mojave sooty-wing	1?	U
Heliopetes domicella (Erichson)	Erichson's skipper	2	U
Pyrgus scriptura (Boisduval)	Small checkered skipper	2	R
Pyrgus communis albescens Ploetz	Southern checkered skipper	2	U
Pyrgus philetas WH Edwards	Philetas skipper	2	R
Erynnis funeralis (Scud. & Burg.)	Funereal dusky-wing	2	C
Erynnis tristis (Boisduval)	Mournful dusky-wing	?	R
Systasea zampa (W. H. Edwards)	Edwards's powdered skipper	2	C/R
Staphylos ceos (W. H. Edwards)	Ceos sooty-wing	2	R
Cogia hippalus (W. H. Edwards)	Hippalus skipper	?	R
Urbanus dorantes (Stoll)	Dorantes skipper	2	R
Polygonus leo (Gmelin)	Hammock skipper	?	R

The cover art was rendered by Ami Pate, a biological technician at Organ Pipe Cactus National Monument.

As the nation's principal conservation agency, the U.S. Department of the Interior has responsibility for most of our nationally owned public lands and natural and cultural resources. This includes fostering wise use of our land and water resources, protecting fish, wildlife and plants, preserving the environmental and cultural values of national parks and historic places, and providing for enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

Appendix

Checklist of Butterflies

Butterflies of Organ Pipe Cactus National Monument (including Quitobaquito) Nomenclature follows *A Field Guide to Western Butterflies* (Tilden and Smith 1986).
Food: 1 = monophagous, 2 = polyphagous (within 1 plant family), 3 = multiphagous (within several plant families), ? = not known
Abundance: R = rare, S = scarce, U = uncommon, C = common, A = abundant
Where alternatives are given (C/U), occurrence is either highly seasonal or varies locally within the monument.

Scientific name Common name	Food	Abundance
Danaidae Milkweed Butterflies		
Danaus plexippus (Linnaeus) Monarch	*2*	R
Danaus gilippus (Cramer) Queen	*2*	*C*
Heliconiidae Long-wings		
Agraulis vanillae (Linnaeus) Gulf fritillary	*1*	*R*
Apaturidae Leaf-wings and Emperors		
Subfamily Apaturinae Emperors		
Asterocampa leilia (W. H. Edwards) Empress Leilia	2	U/C
Nymphalidae Brush-footed Butterflies		
Subfamily Marpesiinae Dagger-wings		
Marpesia petreus (Cramer) Ruddy dagger-wing	*1*	R
Subfamily Limenitidinae Admirals and Relatives		
Adelpha bredowii (Geyer) Sister	2	R
Subfamily Nymphalinae Tortoise-shells, Angle-wings, etc.		
Nymphalis antiopa (Linnaeus) Mourning cloak	3	R
Vanessa atalanta (Linnaeus) Red admiral	2	R
Vanessa cardui (Linnaeus) Painted lady	3	C
Vanessa virginiensis (Drury) American painted lady	2	R
Vanessa annabella (Field) West coast lady	2	R
Junonia coenia (Huebner) Buckeye or peacock butterfly	*3*	*R*

Appendix--continued.

Scientific name	Common name	Food	Abundance
Junonia nigrosuffusa (B. & McD.)	Dark peacock	3	R
Myscelia cyananthe Felder	no common name	?	R
Subfamily Argynninae	Fritillaries		
Euptoieta claudia (Cramer)	Variegated fritillary	3	R

Subfamily Melitaeinae	Checker-spots, Patches, and Crescents		
Anthanassa texana (W. H.	Texas crescent	2	U
Chlosyne lacinia (Geyer)	Bordered patch	2	R
Chlosyne califomica	California patch	1	R
Thessaha fulvia (W. H. Edwards)	Fulvous checker-spot	1	R
Dymasia dymas (W. H. Edwards)	Dymas checker-spot	1	U
Texola elada (Hewitson)	Elada checker-spot	1	U
Occidryas chalcedona (Doubleday)	Chalcedon checker-spot	2	R
Papilionidae	Swallowtails and Parnassians		
Subfamily Papilioninae	Swallowtails		
Battus philenor (Linnaeus)	Pipe-vine swallowtail	1	C/U
Papilio polyxenes Fabricius	Black swallowtail	3	R
Papilio cresphontes Cramer	Giant swallowtail	2	R
Papilio multicaudatus Kirby	Two-tailed swallowtail	3	U
Pieridae	Whites and Sulfurs		
Subfamily Pierinae	Whites		
Pontia protodice (Bsdvl. & LeC.)	Checkered white	3	C/U
Ascia howarthi (Dixey)	Howarth's white	1	R
Appias drusilla Cramer	Florida white	?	R
Subfamily Coliadinae	Sulfurs and Yellows		
Colias eurytheme Boisduval	Orange sulfur	2	U
Zerene cesonia (Stoll)	Southern dogface	2	C/U
Phoebis sennae (Linnaeus)	Cloudless sulfur	1	U/R
Kricogonia lyside (Godart)	Lyside	1	R
Eurema mexicana (Boisduval)	Mexican sulfur	2	C/R
Eurema proterpia (Fabricius)	Proterpia orange	?	R
Eurema nicippe (Cramer)	Sleepy orange	2	C
Nathalis iole Boisduval	Dainty sulfur	3	U

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Appendix-continued.

Scientific name Common name	Food	Abundance
Subfamily Anthocharinae Orange-tips and Marbles		
Anthocharis pima W. H. Edwards Pima orange-tip	?	R
Anthocharis sara Lucas Sara orange-tip	*2*	*U*
Libytheidae Snout Butterflies		
Libytheana bachmanii (Kirtland) Snout butterfly	*2*	*C*
Riodinidae Metalmarks		
Apodemia mormo (C. & R. Felder) Mormon metalmark	*2*	*C*

Apodemia palmerii (W. H. Edwards) Palmer's metalmark	*1*	*U*
Calephelis nemesis (W. H. Edwards) Fatal metalmark	?	U
Lycaenidae Gossamer-winged Butterflies		
Subfamily Eumaeinae Hairstreaks		
Atlides halesus (Cramer) Great purple hairstreak	*1*	*U*
Chlorostrymon simaethis (Drury) Simaethis hairstreak	*1*	R
Ministrymon leda (W. H. Edwards) Leda hairstreak	*1*	*U*
Xamia xami (Reakirt) Xami hairstreak	*2*	R
Strymon melinus Huebner Common hairstreak	*3*	*C*
Strymon columella (Fabricius) Columella hairstreak	*1*	R
Subfamily Polyommatinae Blues		
Brephidium exile (Boisduval) Pygmy blue	*2*	*C/S*
Leptotes marina (Reakirt) Marine blue	*2*	*C*
Hemiargus ceraunus (Fabricius) Ceraunus blue	*2*	*U*
Hemiargus isola (Reakirt) Reakirt's blue	*2*	*U*
Celastrina ladon (Cramer) Spring azure	*3*	*S*
Hesperiidae True Skippers		
Subfamily Hesperiinae Branded Skippers		
Lerodea eufala (W. H. Edwards) Eufala skipper	*2*	R
Lerodea arabus (W. H. Edwards) Arabus skipper	?	R
Amblyscirtes prenda Evans Prenda roadside skipper	?	*R*
Amblyscirtes nysa W. H. Edwards Nysa roadside skipper	*2*	R
Hylephila phyleus (Drury) Fiery skipper	*2*	R
Copaeodes aurantiacus (Hewitson) Orange skipperling	*1*	C/R
Nyctelius nyctelius (Latreille) Nyctelius skipper	?	R

Appendix--continued.

Scientific name	Common name	Food	Abundance
Subfamily Pyrginae	Dusky-wings, Checkered Skippers, etc.		
Pholisora catullus (F.)	Common sooty-wing	2	R
Pholisora libya (Scudder)	Mojave sooty-wing	1?	U
Heliopetes domicella (Erichson)	Erichson's skipper	2	U
Pyrgus scriptura (Boisduval)	Small checkered skipper	2	R
Pyrgus communis albescens Ploetz	Southern checkered skipper	2	U
Pyrgus philetas WH Edwards	Philetas skipper	2	R
Erynnis funeralis (Scud. & Burg.)	Funereal dusky-wing	2	C
Erynnis tristis (Boisduval)	Mournful dusky-wing	?	R
Systasea zampa (W. H. Edwards)	Edwards's powdered skipper	2	OR
Staphylos ceos (W. H. Edwards)	Ceos sooty-wing	2	R
Cogia hippalus (W. H. Edwards)	Hippalus skipper	?	R

Urbanus dorantes (Stoll)	Dorantes skipper	2	R
Polygonus leo (Gmelin)	Hammock skipper.		