

**BIODIVERSITY SURVEY OF THE
NORTH ROSILLOS AREA, BIG BEND NATIONAL PARK**

**A Final Report Submitted to the National Park Service,
Southwest Region, Santa Fe, New Mexico**

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CHAPTER 1

BACKGROUND AND OVERVIEW

David J. Schmidly, Project Coordinator

Introduction

Biological diversity is the Earth's most important and all-encompassing natural resource. Unfortunately, habitat destruction and overexploitation of natural resources are causing an abnormally high loss of biodiversity, and this has become a major environmental concern (Wilson, 1988). In the last 200 years, the rate of species extinction has greatly accelerated. What is equally important, if not more critical, is the loss of variety of entire ecosystems that are the natural repositories of biodiversity. For these reasons, loss of biological diversity has been identified as one of the greatest challenges to the integrity and future of the United States National Park System (Mott, 1986).

National Parks play a vital role in maintaining our country's biological heritage. Scattered throughout the units of the NPS are representatives of at least one-half of the plant species native to the United States and probably a higher percentage of mammals. Populations of some of America's most endangered or threatened bird species exist in several national parks. Yet, park inventories of other life forms are incomplete and little is known about natural variation in populations of many species of animals and plants. Leadership of the NPS has directed the service to initiate and support an intensive research and public awareness campaign regarding the biodiversity issue (NPS, 1988). Scientists and other consultants, both from within and outside the NPS, are conducting research in National Parks to gain a better understanding of all aspects of biological diversity.

In this report we document the results of an intensive three-year field study designed to inventory, monitor, and assess biological diversity within a recently purchased expanse of land, known as the North Rosillos Area, which has been added to Big Bend National Park (BBNP) in Brewster County, Texas. The products of this research and monitoring program were intended to provide: (1) state, federal, and private land resource managers with a better scientific base for understanding and preserving the fauna and flora of the Big Bend region; and (2) interpreters and decision-makers with the knowledge to promote in-service and public understanding of the importance and necessity of preserving biological diversity in the region.

An outstanding team of experts, representing some of the best scientific talent available at three Texas universities, was assembled as a "biodiversity research team" to accomplish this task. The linkages and networking derived from this "consortium approach" are intended to provide a shared data base, better utilization of facilities and university expertise, a better product for the financial cooperators, and linkages of data bases, expertise, and university resources.

Organization of the Study and the Report

The organization of the study dictated the design of the report which has been organized into chapters. Chapter 1 provides a background and overview with objectives, general methodology, schedule of activities, and a brief discussion about the team members. Chapter 2 presents a synthesis of the biological diversity for all floral and faunal components inventoried on the North Rosillos Area. This synthesis includes a discussion of the general factors governing biodiversity patterns for the various components inventoried, and a summary of overall diversity for the floral and faunal components in the 13 vegetative types recognized on the area. Chapter 2 also provides an assessment of the rare, threatened, endangered, and unusual resources discovered in the North Rosillos Area.

Chapters 3-7 of the report stand alone as complete descriptions of the background literature, methods, and results of the inventories for each of the major components of the study. This approach was taken to facilitate scientific publication of results and to insure that sufficient detail could be included to allow for future monitoring work in the North Rosillos Area. Each of the scientific disciplines has adopted unique standards for publishing inventory information which makes the use of a common format virtually impossible.

Finally, Chapter 8 provides some discussion about future management recommendations and options for consideration by the National Park Service with regard to the future of the North Rosillos component of the BBNP.

The Resource Inventory Team

A team of distinguished scientists, associated with two large state universities (Texas Tech and Texas A&M) and a regional university in the Trans-Pecos (Sul Ross) worked interactively to inventory the biological diversity of the North Rosillos Area. These scientists include some of the leading experts in their respective disciplinary fields in Texas and the United States. Disciplinary expertise of the scientists encompassed botanical, entomological, and wildlife (herpetology, ornithology, and mammalogy) components of the biodiversity in the region.

Project Coordinator. -- Dr. David J. Schmidly, Professor in the Department of Wildlife Fisheries Sciences at Texas A&M University (TAMU), coordinated the project. Dr. Schmidly has considerable experience in administering multidisciplinary research programs and is a recognized authority on the mammalian fauna of Texas and the southwest.

Botany. -- The botanical inventory was directed by Professor A. Michael Powell who has been associated with the Department of Biology at Sul Ross State University (SRSU) in Alpine, Texas, since 1963, and has served as Department Chair for 10 years. Dr. Powell has specialized in the study of plants from the southwestern United States and northern Mexico, and especially in plants of the Chihuahuan Desert region. He has been involved in a number of biodiversity surveys of specific areas in Trans-Pecos Texas, including BBNP and other nearby sites. His book Trees and Shrubs of Trans-Pecos Texas (1988) includes some 450 species and supposedly all of the woody plants that occur in the North Rosillos Area.

Parasitic Hymenoptera. -- This aspect of the inventory was directed by two faculty members in the Department of Entomology at TAMU. Dr. James Wooley, Associate Professor in the Department of Entomology at TAMU, has primary research interests in the systematics and biology of parasitic Hymenoptera in the superfamily Chalcidoidea. He has been actively surveying the chalcidoid fauna of Texas since 1983 and is coordinating a large collaborative, multi-national project to produce identification keys to genera of Chalcidoidea of North America. Dr. Robert Wharton is a Professor in the Department of Entomology at TAMU with research interests in the systematics of parasitic Hymenoptera in the superfamily Ichneumonoidea, particularly the large and important family Braconidae. Wharton is a coauthor of the manual for identification of North American Braconidae and is currently coordinating a cooperative project to characterize the Neotropical braconid fauna.

Herpetology. -- Dr. James F. Scudday, who has been teaching vertebrate biology at SRU since 1962 and is the President of the Board of Directors of the Chihuahuan Desert Research Institute, directed this component of the inventory. Dr. Scudday has authored or co-authored numerous publications and special reports, almost all of them on Chihuahuan Desert biota, and he has supervised numerous graduate students on their research programs in the Chihuahuan Desert.

Ornithology. -- Dr. Keith Arnold, Professor in the Department of Wildlife and Fisheries Sciences at TAMU, conducted this component of the project. Dr. Arnold has worked with Texas birds since 1966, serving as Curator of Birds in the Texas Cooperative Wildlife Collections (TCWC). As part of the TCWC, Dr. Arnold initiated the Texas Photo-Record File to preserve important photographic records of Texas birds, which includes a number of important records from the Big Bend region. Arnold organized the Texas Bird Records Committee of the Texas Ornithological Society in 1972 and has served as chairman of the committee since its inception. Arnold also edited the second edition of the T.O.S. Checklist of the Birds of Texas as part of his work with the Committee. He has authored numerous articles that relate to birds of Texas and adjacent parts of Mexico.

Mammalogy. -- This component of the project was directed by Dr. J. Knox Jones, Jr., and Dr. Clyde Jones of The Museum at Texas Tech University (TTU) with assistance of Dr. Richard W. Manning. Dr. J. K. Jones was Paul Whitefield Horn Professor of Biological Sciences and Museum Science at TTU. His research interests are in the systematics and natural history of mammals, particularly those distributed on the Great Plains, in the Southwest, and in Latin America, and in mammalian biogeography and evolution. Unfortunately, Dr. Jones died in November of 1992 before the completion of this project. Dr. Clyde Jones is Professor of Biological Sciences at TTU with more than 30 years of experience studying mammals. His research interests include systematics, ecology, natural history, and management and conservation of native mammals. Dr. Richard W. Manning is a lecturer at Southwest Texas State University. He joined the mammal research team while working on his Ph.D. at Texas Tech and continued on after completing that degree. His research interests are in systematics and biogeography of small mammals.

Description of the Study Region

The name Big Bend is somewhat loosely applied to all of the area in Brewster and Presidio counties, south of the Southern Pacific Railway, within the great curve of the Rio Grande in the southern Trans-Pecos of southwestern Texas. Physiographically, the area lies within the southern portion of the Basin and Range Province, and the northern edge of the Mexican Plateau forms its southeastern border. BBNP lies within the southernmost tip of the Big Bend region. The park was established in 1944 and is the sixth largest within the NPS, encompassing 732,163 acres. The North Rosillos Area is a 69,000 acre addition made in 1989 to BBNP along the northern boundary in the area of the Rosillos Mountains. This area encompasses both lowland and mountain environments, with elevation ranging from 2650' to 5450'. The average annual temperature at nearby Panther Junction is 65°F with an average high of 78.2° and an average low of 52.1°. Mean annual precipitation is 14.1". The desert climate of the Big Bend region provides a biological paradise with a fauna and flora unparalleled in Texas and among the richest in the southwestern United States.

Objectives of the Biodiversity Inventory

The flora and fauna of the North Rosillos Area, because it has not been part of BBNP and because it has been under private ownership, has received little attention, and no systematic study has examined the diversity of this region in relation to that of BBNP. Much additional biological information about the fauna and flora of the area was required to meet the present and projected demands for providing increased human access while also enhancing efforts to properly preserve and manage the rather fragile ecosystems of this important desert region.

The biodiversity inventory of the North Rosillos Area had the following objectives:

1. To compile a nearly complete list of plant species.
2. To identify the major plant associations.
3. To prepare a map of the North Rosillos Area indicating the major plant associations.
4. To conduct a detailed inventory of selected insects (the parasitic Hymenoptera) and the vertebrate fauna in each of the major plant associations.
5. To obtain and document information on the presence, distribution, and status of the plants, parasitic Hymenoptera, and terrestrial vertebrates, including any threatened, endangered, and protected species that may occur in the area.
6. To develop base-line data about the flora and fauna of the area in relation to the ecology and biogeography of the rest of BBNP.
7. To provide information, based both on the literature and recent data, in a suitable format to be incorporated into the NPS Geographic Information System.
8. To publish results of scientific research in appropriate professional outlets.

Much attention has been given recently to the identification of suitable indicator organisms for surveys of biological diversity, including both faunal and floral elements. The researchers involved with this study focused on five components of the biological resource base: plants, two families of parasitic Hymenoptera (Braconidae and Encyrtidae) among the insects, and all elements of the terrestrial vertebrate fauna (reptiles, amphibians, birds, and mammals). The rationale for including these particular components is based both on biological considerations and the existence of similar data bases from previous studies in the Big Bend region generally and BBNP specifically.

Any thorough biodiversity survey must include a list of plants that are known to occupy the particular area. Not only are plants the primary producers in an ecosystem, but plant communities form the basis for the existence of consumer organisms as well. Efficient zoological surveys must be planned in connection with an analysis of the major plant associations because of the correlations in community structure.

There are approximately three times more known insect species than all other animal species combined, and it is clear that serious attempts to chronicle the biological diversity of particular areas must attempt to characterize the insect fauna. However, in most areas of the world, including much of Texas, the overall insect fauna is poorly documented. Although some groups have attracted considerable attention (for example, butterflies, large and showy beetles, etc.), most groups are characterized by rather crude taxonomies and there are many undescribed genera and species.

Resources restrict complete inventories of all insect groups, and the best approach for inventory work is to rely on indicator groups. Butterflies, certain large beetles, and social insects often are cited as suitable indicators. However, these may represent relatively minor components of the total insect diversity. In this study we selected parasitic Hymenoptera as reliable indicators of overall insect diversity because they are parasites of a wide variety of other insects and their diversity is dependent upon diversity at a minimum of three trophic levels.

Amphibians and reptiles represent two groups of animals found at opposite ends of the moisture spectrum. Amphibians require water to insure their existence, whereas reptiles have evolved away from a dependence on water. Thus, reptiles represent a major component of desert communities because of their adaptive capabilities of survival where water is limited. Richness of reptilian species is a good indicator of overall species diversity found in desert habitats. Some amphibians, on the other hand, have evolved ways of maximum utility of little rainfall and sparse, isolated springs to become a part of the desert community. An inventory of amphibians and reptiles, therefore, was deemed important to understanding the total biotic community of the North Rosillos Area and its attendant terrain.

Mammals and birds are important and integral components of the ecosystems of the region. In addition, both are of great esthetic, economic, and biomedical importance to the constantly increasing numbers of people who pass through BBNP in particular, and the surrounding areas in general.

Botanical Investigations

Background and Previous Work:

The vegetation and flora of the southern Big Bend region of Texas have been discussed in several publications, but completed floristic investigations for the North Rosillos Area were lacking at the beginning of this study. Correll and Johnston (1970) have provided the most useful reference for the vascular plants of Texas, and this work along with the recent up-date by Johnston (1988) were the major sources of information about the vascular plants of the North Rosillos Area. Other useful botanical works included the older flora of Big Bend National Park (McDougall and Sperry, 1951), a recent treatment of the trees and shrubs of Trans-Pecos Texas (Powell, 1988), and a photographic treatment of some wildflowers of the Big Bend country (Warnock, 1970). In addition to published vegetation studies, BBNP over the years has accumulated reports from various plant investigations within the original park boundaries. Because the Rosillos Mountains are located just north of, and adjacent to, the original Park, botanical comparisons between the two areas are feasible. Limited and preliminary vegetative studies of the North Rosillos Area have been previously conducted. As an employee of the Texas Natural Heritage program (now in the Texas Parks and Wildlife Department), botanist Jackie Poole compiled "in house" reports concerning the vegetation in the North Rosillos Area when it belonged to the Nature Conservancy. Her work included a partial list of plants, some observations about plant associations, and consideration of possible rare or uncommon species. Graduate student Paul Whitefield, working under the supervision of Dr. Powell at SRSU, previously initiated vegetative studies to identify plant communities (after Henrickson and Johnston, 1986), and he compiled a plant list for the North Rosillos Area.

Methods:

Representative plant specimens were collected, pressed, and dried according to standard herbarium procedures. Voucher specimens were mounted and deposited in the herbarium at SRSU. The SRSU Herbarium already houses the most complete collection of plants from the northern Chihuahuan Desert region, and the most complete collection of plants from BBNP. Plant associations were determined by careful and repeated field observations and care was taken to abide by all NPS collecting rules. More detailed methodology about the botanical survey is contained in Chapter 3 of this report.

Schedule of Activities:

Whitefield completed a total of 43 plant collection and field mapping trips to the field area between August 1986 and May 1990. Dr. Powell and his students completed an additional 26 trips to the area after this study was formally initiated. All plant collections represent a total of 456 taxa in 272 genera within 82 plant families (see Plant List, pp 45-59). The authors are presently working with the Geographic Information Specialist at BBNP to enter all voucher specimen locales into the GIS database for the park.

Thirteen vegetation communities were delineated within the study area, with additional phases of vegetation discerned for two of the communities (see vegetation map in cover pocket). A description of the salient habitat features of each plant community, together with lists of plant

species observed within each of the vegetation communities is presented in Chapter 3. Each voucher collection is intended to represent the distribution of the taxon throughout the entire study area. However, many species with wider ecological tolerances are listed as occurring within more than one vegetation community. Since it is impossible to collect every species present in every community, some species might not be listed in communities it is extant in. This is because there are many species for which little is known about their distribution within the survey area, and their importance within the vegetation communities.

Parasitic Hymenoptera

Background and Previous Work:

Several researchers previously conducted surveys of insect taxa in BBNP. Because characterizing total insect diversity is an overwhelming task, most of these efforts surveyed families or smaller orders. Tinkham (1941, 1943, 1948) studied the dragonflies, cicadas, Orthoptera and some Lepidoptera of the Big Bend region. Kendall (1971) prepared a list of butterflies and skippers known from the park. Blanchard accumulated a list of some 387 species of moths in 17 families. Other researchers concentrated on beetles (e.g., Howden, 1960; Arnett, 1965; Triplehorn, 1968, 1971) and ants (Moody and Francke, 1982; Cokendolpher and Francke, 1990; and Cokendolpher, 1990). There have been no published works on the parasitic Hymenoptera of BBNP, although some collecting in these groups has been done. There are some specimens of parasitic Hymenoptera from BBNP in several museums including Texas A&M, U.S. National Museum, and the Canadian National Insect Collection.

Methods:

Specimens of Encyrtidae and Braconidae were collected by sweep nets, Malaise traps, pan traps and light traps. The sweep net was the most commonly used and most productive method. In general, sweep nets are the most effective way to sample insects from vegetation including grass and forbs, shrubs and trees. Modified nets with triangular collecting heads enabled us to sweep close to ground level, which is essential for sampling the diverse fauna of Encyrtidae, many of which are parasites of insects that occur at or below ground level. Malaise traps of a standard Townes design, shaped roughly like a pup tent, were particularly useful in long-term sampling of protected riparian habitats. Malaise traps were deployed in other habitat types during each visit to the study area. However, evaporation of the killing solution (70% ethanol) and exposure to wind made sampling in exposed habitats with malaise traps more difficult. Malaise traps are particularly effective at collecting flying insects. Plastic, rectangular pans (15x23 cm) were painted yellow, filled with water and a surfactant, and deployed in groups of 50-100 in various habitats. These were checked and emptied daily and were particularly productive for Encyrtidae and other insects close to ground level. Many of the Braconidae occurring in arid regions are nocturnal. To sample these, we ran a combination of mercury vapor lamps and black lights at various points along the main road and in the vicinity of Buttrill Springs. A drawback to this method is that insects coming to lights at night may be attracted from some distance, and consequently from a variety of vegetative communities. We have found that each method will produce insects not collected using other methods. By using

a combination of techniques we hoped to obtain a better overall sample of insect diversity. All insect specimens have been incorporated into the TAMU insect collection and all specimens bear a unique label indicating collection in BBNP.

Schedule of Activities:

Seven persons were involved in the collection of insects: Bob Wharton, Jim Wooley, Greg Zolnerowich, Darlene Judd, Reno Cecora, Roy Vogtsberger (all at the Department of Entomology, Texas A&M University) and Paul Whitefield (then in the Department of Biology, Sul Ross State University). A total of 15 trips were made to North Rosillos Area, the first in June 1990 and the last in March 1992, comprising some 43 days in the field. From 1 to 4 people participated in insect collections on each trip. Collections were made at 49 separate locations in 12 of the 13 vegetative communities. The mountain scrub community was not sampled due to lack of access. The terrain is mostly vertical, and technical rock climbing skills are necessary to sample the area. In total, 147 separate collections were made using one of the methods described above.

Herpetology

Background and Previous Studies:

Schmidt and Smith (1944) conducted the earliest comprehensive account of the amphibians and reptiles of the Big Bend area. There have been several herpetological inventories conducted within the southern Big Bend region since then, some of them near the North Rosillos Area area. These surveys contained lists and observations of amphibians and reptiles. Some were published, but with limited distribution, by Lyndon Johnson School of Public Affairs or the Texas Parks and Wildlife Department. The most pertinent surveys included Scudday (1975) for the Solitario area of Brewster and Presidio counties and Scudday (1975) for the Fresno Canyon and Colorado Canyon areas of Presidio county. Axtell (1952) surveyed the amphibians and reptiles of the Black Gap Wildlife Management area to the southeast, and Milstead (1953) reported on the ecological distribution of lizards of the La Mota Mountain area to the west of the Rosillos Mountains. Degenhardt (1975) and Scudday (1975) discussed factors effecting changes in reptile and amphibian populations in the Big Bend area. Numerous studies have been published on the systematics, behavior, and ecological relationships of taxa at all levels.

Methods:

Representative specimens were collected as voucher material from different plant communities and habitat types. Drift fences were used in appropriate areas. Some individuals were captured, marked, and released for ecological studies. Preserved specimens were deposited in the Vertebrate Collection at SRSU. All NPS rules for collecting were carefully followed.

Schedule of Activities:

Over the three year period, 14 field parties spent 59 days in the field. Field parties ranged from one person to as many as 10 persons. One person spent 120 days in the field over a two year period of time. Activity was confined to the warmer months of the year, from early March through mid-October, which is the period of time when amphibians and reptiles are most active. A total of 44 species of amphibians and reptiles were documented from the study area. This included 19 snakes, 17 lizards, and 1 turtle for a total of 37 reptilian species, and a total of 7 amphibians.

Ornithology

Background and Previous Work:

The bird fauna within the current boundaries of BBNP has received a moderate amount of attention beginning with the International Boundary Surveys. Birds formed a conspicuous part of the biological surveys done in the proposed park in 1901 by the United States Biological Survey (Bailey, 1905; Fuertes, 1903; Oberholser, 1902). For the next 20 years there was little research on birds in this region. The Gaige-Van Tyne expedition in 1928 represented the next organized survey of birds. Van Tyne's findings prompted several visits in the 1930s, including biologists sent by the NPS to explore the potential of the region for a national park. Van Tyne and Sutton (1937) combined their findings in a comprehensive analysis of the avifauna of Brewster County.

Taylor et al. (1944) completed a preliminary report on an ecological survey in the park, and by the mid-1950s TAMU had stationed a resident team within the park. This team collected a comprehensive series of birds during this period (Dixon, 1959; Dixon and Wallmo, 1956). Also in the mid-1950s park personnel began recording bird observations. Harold Brodrick (1960) published the first park checklist of birds which included 236 species. Phillip Allen and Anne LeSassier revised this checklist in 1966 and reported 241 species. Wauer established a systematic study of birds in the park, and he published a comprehensive account about them in 1973.

The first Christmas Bird Count occurred in 1961. Beginning in 1968, two Christmas Bird Counts, one in eastern BBNP and one in the Chisos Mountains, became more-or-less constant measurements of wintering bird populations in the park, and these were continued through the 1990s. Other limited studies and observations have taken place within the park, and these were added to subsequent versions of the park checklist.

Methods:

Species and populations of birds were inventoried using line transects and mist-netting. Population estimates for some species were derived through a banding program. Voucher specimens were obtained with nets. All collecting took place in accordance with permits issued by appropriate authorities. Voucher specimens were prepared as standard study skins, and deposited in the Texas Cooperative Wildlife Collection at TAMU. Distributional data and status on populations and species of birds were mapped and correlated with the 13 reactive community types on the North Rosillos Area.

Schedule of Activities:

Bird survey crews visited the North Rosillos Area area on 19 occasions between September 1990 and March 1992, for a total of 40 days in the field. The survey crew varied from two to four individuals on each visit.

Mammalogy

Background and Previous Work:

The mammalian fauna of what is now BBNP has received some general attention from biologists since the middle of the last century. Early interests undoubtedly were stimulated by the needs for information about the location of the boundary between the United States and Mexico (Baird, 1858, 1859; Allen, 1864; Mearns, 1907) and the efforts of the former United States Biological Survey to determine the kinds of organisms occurring in the country (Bailey, 1905). After early activities, there was a sizable gap in the research record with regard to our knowledge of the mammals of BBNP and adjacent areas because additional information did not appear in the literature for some time (Davis and Taylor, 1939; Blair, 1940; Borell and Bryant, 1942; Davis and Robertson, 1944; Davis and Buechner, 1946; Blair and Miller, 1949; Buechner, 1950; Tamsitt, 1954; Denyes, 1956).

Subsequent reports were based mostly on incidental observations or studies aimed at selected groups and site-specific issues (Porter, 1962; Judd, 1967; Baccus, 1971; Easterla, 1972, 1973, 1975; Easterla and Whitaker, 1972). In addition, some information about mammals of the area was included in general works, such as Davis (1974), Wauer (1973), and Schmidly (1974), or in systematic studies of specific taxa (for example, Lidicker, 1960, and Hollander, 1990). Prior to the research described in this report there had been no detailed study of the mammals occurring in the North Rosillos Area, and no studies concerning the preservation of the biodiversity of the areas adjacent to BBNP. The mammalian fauna of the area is rich and diverse, including insectivores, bats, lagomorphs, rodents, carnivores, and artiodactyles, many of which are important predators, fur bearers, and game species.

Methods:

Inventories of species and populations of mammals were conducted with the use of standard techniques, such as observations of signs (burrows, tracks, droppings, food caches); censuses along transects by either walking or driving during the day and night (with the use of spotlights); collecting with traps, nets, and guns; and salvaging animals found dead. Inventories were conducted in accordance with permits issued by the appropriate authorities. In order to document presence, distribution, and status of species and populations of mammals, voucher materials in the form of standard museum specimens, frozen living tissues, and related materials were prepared, as appropriate. These materials were deposited in the collections of mammals at TTU and TAMU. Comparisons of appropriate materials were made with specimens and information available from adjacent areas to resolve any problems with regard to systematic and biogeographic issues. Data on

presence, distribution, and status of species and populations of mammals were mapped and correlated with the 13 vegetative community types on the North Rosillos Area area.

Schedule of Activities:

Over the last three years mammalogists from Texas Tech University and elsewhere, usually working in groups of three or four, made over 20 trips to the North Rosillos Area during parts of nearly every month to collect specimens and study mammals. During those trips a total of 1000 specimens were collected, and most were prepared as standard skin and skulls. Field crews sampled 66 different localities and had in excess of 10,000 trap nights in the area. Collections made and observations recorded on these trips form the basis for our report (see Chapter 7).

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CHAPTER 2

BIODIVERSITY SYNTHESIS FOR THE NORTH ROSILLOS AREA

The total biodiversity for the component groups sampled in this study is summarized in this chapter. Vegetative communities, reflecting physiographic features, provide a natural framework for assessing patterns of overall biodiversity as well as for making comparisons among the various biodiversity components sampled. The faunal components of biodiversity have been integrated with the floristic components by arranging faunal and floral species lists by vegetative community. Factors other than vegetative community which influence faunal biodiversity also are discussed. Rare, endangered, threatened, and unusual species for each of the major component groups of the biodiversity survey are highlighted. Finally, methods for entering these inventory data into the National Park Service's Geographic Information System (GIS) are described separately for each component biodiversity group.

Overall Biodiversity Patterns

A total of 1,146 species/taxa of the five biodiversity component groups were recorded on the North Rosillos Area area during this study. These were distributed among the five major groups as follows: plants, 461 species/taxa (40% of the total); parasitic Hymenoptera, 496 (43%); herptiles, 44 (4%); birds, 103 (9%); and mammals, 42 (4%). These tabulations reveal that only 17% of the total biodiversity documented at the North Rosillos Area is represented by the "higher vertebrate groups."

Many undescribed taxa are represented in the collections made at the North Rosillos Area, especially among the plants and parasitic hymenopteran groups. Taxonomic work to describe these species and taxa will be on-going for years to come, and these aspects of the inventory data are discussed in the individual chapters describing the biodiversity for each of the major component groups.

Several significant records or observations of plants and animals that represent important additions to the flora and fauna of the Big Bend region were recorded during this study. These are discussed below in the section describing rare, threatened, endangered, and unusual species from the North Rosillos Area.

Floral Diversity

Plant species diversity may be expressed in three hierarchical levels (Whittaker, 1972): alpha diversity, the number of species within standard sized study plots; beta diversity, the variability of species composition between study plots; and gamma diversity, the number of species within a regional or local flora. Because this study was intended to be primarily a floristic inventory of the area, our comparisons have been limited to gamma diversity of relative species richness.

The botanical team identified 13 distinct plant communities in the North Rosillos Area. These are mapped and described in Chapter 3 of this report. The occurrence of plant species in each

of the 13 communities has been compiled and listed in Appendix 1. However, the number of plants shown for each of the 13 communities is in fact not the total number of plant species occurring in each community. The number of plants listed for each community should be regarded as the major visual components of that community. It was not considered feasible to construct a complete floral inventory for each community because of the large number of plant species (461 species/taxa), many of which were based upon one collection in one season in the North Rosillos Area.

The most appropriate comparison of species diversity for the study area is a direct comparison with the flora of BBNP before the annexation of the North Rosillos Area. The original park area encompassed 732,163 acres, with elevations ranging from 1700 to 7835 feet. The North Rosillos Area is approximately 69,000 acres, with elevations ranging from 2650 to 5450 feet. The flora of the study area includes 456 species as compared to more than 1100 species in the remainder of the park. Thus, the North Rosillos Area represents 7% of the total park, 45% of the topographical relief, and it has a flora which is about 40% of that known from the park. In addition, the known flora of BBNP has been increased by 32 species, or less than 3%, with the annexation of the new area. The rather close correspondence between the ratio of plant species and the ratio of vertical relief within the two areas is consistent with the findings of Bowers and McLaughlin (1982) who found that topographic relief explained most of the species diversity within selected floristic sample areas. Their regression equation $[47 + 0.349 * (\text{elevation range}) + 8.2 * (\text{collection years})]$ predicts that 402 species would be collected within the North Rosillos Area.

Bowers and McLaughlin (1982) also concluded that presence of a variety of vegetation types, canyons, and aquatic environments contributed greatly to the species richness of an area. In addition to each of these elements, the North Rosillos Area and BBNP both contain numerous features which contribute to overall diversity of habitats, and subsequently to species richness. Among these features are the presence of igneous intrusive bodies, limestone fault-blocks, sediment-filled grabbens, and springs. The common presence of these features at mid-elevational ranges accounts for the establishment of those species common to both floras.

The absence of floral elements from the North Rosillos Area that are found elsewhere in BBNP is attributable to the lack of appropriate habitat. Among those communities with poor representation within the study area are: (1) riparian species from the Rio Grande Corridor; (2) frost intolerant species limited to the lowest elevations of the park; and (3) species adapted to high elevation limestone fault-block ranges, such as the Mesa de Anguilla and Dead Horse Mountains. The absence of a large component of the BBNP flora within the study area is likely attributable to the limited area above 5000 feet elevation. This precludes establishment of additional vegetation components, such as oak-juniper-pinyon woodlands, high meadows, and coniferous forests, all of which are present at higher elevations in the Chisos Mountains. The North Rosillos Area can thus be viewed as a medium-sized igneous pluton which is in a metaphorical orbit around the Chisos Mountains. The Rosillos Mountains no doubt play an important role in the migration of wildlife and plant species between the Chisos Mountains, Christmas Mountains, Dead Horse Mountains, and other significant ranges to the north.

The plant species lists compiled in this report are by no means all inclusive. Plants may be continually added to the species list as more information becomes known about individual species distributions. However, these lists give some insights into relative species richness of each community. Perhaps the most evident observation from the lists is the repeated occurrence of several taxa within many of the vegetation communities. These species are obviously generalists, but may have varying degrees of importance within each of the communities for which they are shown (see Chapter 3 for lists of species which are characteristic of a particular community).

The most depauperate plant communities on the study area were the creosote scrub, alkaline grassland, mixed shrub and succulent scrub, and grama grassland. The first two occupy the harshest of habitats available. The latter two represent communities of relatively limited distribution. The number of species listed for the riparian corridor areas is quite short because only a few dominant tree species live there together with some species which occur only in standing water or permanently-saturated soil. Several other species occur in proximity to the springs. Most of these are located within canyon scrub and oak woodland community types.

The communities richest in plant species were the semidesert grassland (igneous phase), oak woodland, canyon scrub, and mariola scrub (alluvial phase). The semidesert grassland is widely distributed within the study area, and it also is evident at mid-elevations so that numerous generalist species from other communities overlap into the area. Oak woodland and canyon scrub contain impressive numbers of species, especially the latter for a community of such limited distribution. The vertical structure of these habitats provides diverse microhabitats, and their relatively cool, moist conditions harbor a number of unique elements in the flora. The alluvial phase of the mariola scrub also harbors a surprising number of species. The proximity of the mariola scrub community to the arroyos, canyons, and semidesert grasslands along the northern side of the Rosillos Mountains allows many herbaceous and ephemeral annual species from those areas to persist in years with adequate rainfall.

Mesquite scrub and mountain scrub displayed intermediate species richness. Mesquite scrub was the center of grazing activity before the National Park Service acquired the property. This community has expanded within the area at the expense of alkaline grassland. Indeed, most of the understory species are also distributed within alkaline grassland, which supports limited species richness. The mountain scrub community probably harbors many more species than presented in the list, but comprehensive sampling of much of the area occupied by the community is impossible without the use of technical climbing skills and equipment.

The mosaic plant community exhibits an artificially high species richness unless it is considered as three separate components - semidesert grassland limestone phase, mariola scrub limestone phase, and lechuguilla scrub. Of these, the majority of the species listed occur within the mariola scrub. The semidesert grassland limestone phase exhibits intermediate species richness, and the lechuguilla scrub is quite depauperate compared to the other components of the mosaic community.

Faunal Diversity

Plant community types were used as a basis for summarizing and quantifying the distribution of animal groups. The occurrence of faunal elements in each of the 13 vegetative community types is listed in Appendix 1. A summary of the number of taxa of each group for the 13 communities is presented in Table 1. The mean number of species/taxa recorded for all 13 communities was 132.8. Parasitic Hymenoptera accounted for 60% of the mean diversity, followed by birds and mammals (15% each), and herptiles (10%).

The riparian community had the most diverse fauna because of the high preponderance of parasitic Hymenoptera taxa in this community. Relatively low diversity was recorded among the other faunal components groups in the riparian community. Other communities with high overall biodiversity among the faunal components sampled include the arroyo scrub, canyon scrub, and mariola scrub. Communities with the lowest faunal biodiversity were the oak woodland (38 species/taxa recorded) and the alkaline grassland (49 species/taxa).

Considerable variation was evident among the parasitic Hymenoptera, and higher vertebrates (herptiles, birds, and mammals) with respect to patterns of diversity among the 13 vegetative community types. The greatest number of parasitic Hymenoptera was taken in the riparian, canyon scrub, and arroyo scrub communities. For the vertebrates, the greatest number of species was documented in the mariola scrub, arroyo scrub, and creosote scrub communities.

The percent contribution of the major biodiversity component groups (parasitic Hymenoptera and higher vertebrates) to the total diversity recorded in each community type varied considerably among the 13 communities. A summary of this is presented in Table 2. These numbers apply only to the North Rosillos Area, not to BBNP. The percentages were obtained by dividing the number of species of Hymenoptera or vertebrates by the total number of species found in that plant community. Parasitic Hymenoptera made up the highest percentage in six communities (riparian, canyon scrub, grama grassland, semidesert grassland, arroyo scrub, and mariola scrub), and vertebrates make up the highest percentage in six communities (oak woodland, mosaic, mixed/succulent scrub, mesquite scrub, alkaline grassland, and creosote scrub).

The percent of the total faunal biodiversity that was represented in each community type also varied substantially. A summary of this is presented in Table 3. These numbers apply only to the North Rosillos Area, not to BBNP. The percentages were obtained by dividing the number of species found in a plant community by the total number of species found in all communities. Vegetative communities with the highest percentage of parasitic Hymenoptera species were the riparian, canyon scrub, and arroyo scrub; those with the highest percentage of vertebrates were the mariola scrub, arroyo scrub, and creosote scrub.

Factors Affecting Biodiversity in the North Rosillos Area

A combination of abiotic factors (climate/microclimate and substrate/soil) combined with biotic factors (plant community composition and vegetative structure) determine the local diversity of floral and faunal elements in the North Rosillos Area. The relative importance of these various factors varies among the five biodiversity component groups, and these are discussed below.

Plants. A discussion of the environmental factors which affect the distribution of plant species populations is important to an understanding of species diversity within the study area. Of course the most important factor governing terrestrial species diversity is climate. Although many exceptions have been documented in the literature, growing season and moisture availability are no doubt the two limiting parameters governing plant establishment, growth, and competition. In the desert regions of southwestern North America, moisture availability is the single most limiting environmental factor.

Plant species diversity in desert communities is contingent upon localized edaphic conditions which control plant moisture stress and moisture availability. There is an array of habitat attributes within the study area which influence plant moisture stress and moisture availability. These attributes function to create a variety of microhabitats which in turn allow a wider variety of species to inhabit the area. The factors with the greatest influence upon the relative diversity of plant species within the study area include: (1) topographic relief; (2) physical/chemical substrate characteristics; and (3) plant species interactions. Grazing pressure and fire have also influenced the area in ways we cannot know without historic knowledge of the resource. A general discussion of these influences is presented below.

The presence of the main mass of the Rosillos Mountains greatly diversifies the microclimates of the study area, and affects precipitation patterns during both summer and winter storms. Cooler temperature regimes exist year-round as elevation increases. During summer months, as low pressure weather systems move across the region, thunderstorm cells develop when warm, moist air is forced up and over mountainous terrain. The presence of such terrain increases the probability of localized rainfall. To a lesser extent, mountain ranges also intercept winter stormfronts, which often experience precipitation in the form of frost, snow, and sleet. The effect of the Rosillos Mountains themselves within the study area allows the existence of several additional plant communities at higher elevations. The communities are somewhat stratified according to elevation, similar to the life zone concept of Merriam (1890, 1898). An exception to the traditional sequence of scrubland-grassland-woodland-forest exists within the study area with the superposition of grassland above woodland. Grassland is better developed at higher elevations within the Rosillos Mountains because the limited plateau above 5000 feet is subjected to more intense southerly-westerly exposure. This serves to increase moisture deficits of the plants occurring there. Oak woodland is instead best developed within canyons with a northerly-easterly orientation, where the ground is shaded for longer periods during morning and evening hours.

The presence of both igneous and sedimentary rock formations and their weathering products also greatly influences species richness within the study area. The physical resistance of solid rock formations to erosion provides mountain slopes, canyon walls, and cliff faces to which a number of species may have an adaptive advantage. In several areas within the study site, the rock is resistant enough to preclude the accumulation of sufficient amounts of soil within which plants can grow. This is a controlling habitat factor within the mixed shrub and succulent scrub communities, and also affects the presence/absence of plant species within the mountain and canyon scrub communities.

Resistant rock features also serve to physically channel precipitation into structural traps where it is more readily available to plant roots. The structural superposition of the Rosillos Laccolith upon the Aguja Sandstone Formation has created the localized aquifers which feed Buttrill Spring and numerous other springs around the base of the mountains (Christensen, 1981). This factor governs the presence of riparian corridor communities around springs.

The physical/chemical properties of soil-forming minerals which are derived from either igneous rock or sedimentary rock also greatly influence plant species distribution and community structure. In general, certain clays which are derived predominately from igneous (and to a lesser extent from limestone) rocks in the study area have active water-bonding sites, which may increase the availability of water to plant roots. Conversely, granular or porous soils, such as within the Rosillos Foothills and Rosillos Bajada may allow precipitation to rapidly percolate to soil depths where it becomes unavailable to plants. This largely influences the development of arroyo scrub, and to a lesser extent mariola scrub and creosote scrub. Additionally, soil color also influences the absorption of infrared solar radiation, and can affect local soil temperature regimes. The darker rock and soils derived from the Rosillos Laccolith are typically several degrees warmer than the lighter limestone mesas, hills, and canyons. It is suspected that these subtle features influence the flora to such a degree that separate igneous and limestone phases of semidesert grassland are recognized on the vegetation map.

Soil salinity also increases toward the lowest elevations within the alluvial Nine Point Draw and Chalk Draw basins. Here, saline and gypsiferous minerals accumulate under an intense soil evaporation regime. High soil salinities effectively limit moisture availability to plant roots by greatly increasing soil osmotic potential. This is perhaps the greatest factor limiting species diversity and vegetative cover within the basin areas, which are inhabited by depauperate communities such as alkaline grassland and creosote scrub. However, the presence of these marginal areas serves to increase the overall diversity of the study area by providing habitat for a number of plants which are adapted to saline environments.

Aside from the normal competition between plants for space, light, moisture, and nutrients, the effects of plant species interactions upon species diversity are perhaps the most difficult to discern. The most obvious effect of an established plant community in desert habitat is its synergistic influence upon soil moisture availability. Adequate ground cover by plants, and the commensurate increase in soil litter, serve to increase precipitation infiltration and retention. The near catastrophic loss of vegetative cover within basinal grasslands in the study area by poor livestock management practices over the last century has resulted in the encroachment of desert scrub and semidesert grassland at the expense of alkaline grassland and grama grassland communities. The effects of this change in floristic composition on species diversity cannot be estimated.

Other effects of plant species interaction involve the establishment of microhabitats by shrubs and trees which provide structural support for epiphytes and vines. These habitat attributes increase the species richness of scrubland and woodland communities. The presence of trees and shrubs provides shaded, moisture-retentive sites where other herbaceous species may become established.

Parasitic Hymenoptera. The distribution of parasitic wasps is intimately tied to that of the insect and arachnid hosts on which their immature forms develop. Some of these hosts are restricted to specific vegetative communities, while others cross community boundaries. Many of the Braconidae also require a nectar source for maintenance while searching for hosts or mates, and this nectar source does not have to be in the same habitat as the host.

Several of the species we collected are relatively host specific, often attacking hosts restricted to a single plant species or to a group of closely related species within the same plant community. Most of the Opius, Orgilus, and Apanteles species fall into this category. They often use cues emanating from the host plant to locate their hosts. While these wasps may be tied to a given plant species, they may also readily cross habitat types to locate widely dispersed plants (e. g. Yucca), or plants which occur in several different plant communities (e. g. mariola and certain grass species). Overlap was particularly noticeable where arroyos passed through mariola scrub, mosaic, semidesert grassland, and creosote scrub communities

Many groups of Encyrtidae are restricted to particular groups of hosts, which in turn may be restricted to particular habitats. Encyrtidae that attack armored scale, for example Ceraptoceroideus and Plagiomerus, and soft scale, for example Metaphycus and Microterys, are far more diverse in vegetative communities with large components of woody shrubs and trees such as riparian and canyon scrub. On the other hand, parasites of mealybugs, for example Tetracnemus, Anagyrus, and Apoanagyrus, are far more diverse in vegetative communities with a significant grass component, particularly grama grassland.

Other wasps species are more polyphagous, attacking a variety of arthropod hosts. However, these are often confined to the same habitat. Many of these species are found within the riparian vegetative community within the Rosillos Mountains. This community provides a mesic refuge for those species (such as Aleiodes scrutator (Say) and Meteorus laphygmae (Viereck)) which have a widespread distribution outside the national park. Of the 13 vegetative communities in the study area, the riparian contained the greatest diversity of both Braconidae and Encyrtidae. The alkaline grassland was clearly the most depauperate area.

The influence of the composition of the plant community on parasitic wasp diversity can be seen clearly by comparing the Encyrtidae collected in the grama grassland and semidesert grassland vegetative communities. Fifty-three species of Encyrtidae, representing 30 genera, were collected in grama grassland as compared to 22 species from 14 genera in semidesert grassland (igneous substrate). Semidesert grassland (limestone substrate) is found in a complex mosaic habitat with mariola and lechugulla scrub; however, this mosaic habitat did not contain a high diversity of Encyrtidae either. As noted in Chapter 3, the composition of these short grass prairie communities is quite different and the semidesert grassland areas in the North Rosillos Area have received intensive grazing pressure in the past, resulting in a substantial change in the species composition and diversity of species in these areas. This appears to be reflected in the encyrtid fauna as well; in fact, the difference in the Encyrtidae between the two vegetative communities is quite striking.

Vegetative structure, rather than specific plant species, is also an important factor explaining the distribution of parasitic wasp biodiversity. Grasslands (regardless of vegetative community) were very productive of Encyrtidae, providing a wealth of species. The braconid fauna of grasslands, while interesting, was very depauperate. Mesic communities (in particular riparian and, canyon) contained the greatest diversity of both Braconidae and Encyrtidae. For Braconidae, nearly half the species found in the riparian community were also found in other vegetative communities, particularly arroyos and canyons. For these species, vegetative structure (trees, shrubs, and shaded microhabitats) is more important than a specific vegetative community. Certain other patterns in wasp distributions can be linked to vegetative structure. For example, species that parasitize flies, e.g. Rhytidothorax (Encyrtidae) and the opiine and alysiine Braconidae, were more abundant in riparian or canyon communities where presumably more mesic conditions and accumulation of litter allow for development of their hosts.

Herptiles. The composition of the plant community quite often will set the stage for the kinds of amphibians and reptiles that can exist in an area. In some instances the composition of the substrate appears to be more important than plant composition. Tree lizards (Urosaurus ornatus), as the name implies, are usually associated with trees or large shrubs. In desert situations the species is commonly found on large boulders. If large boulders border a mesic canyon with trees present, individuals of tree lizards may be found on both the trees and the boulders. The canyon lizard, (Sceloporus merriami), will only be found on rocky bluffs and ledges regardless of the vegetative composition of the immediate area. Sandy substrates are a requisite for a number of desert lizards and snakes. The side-blotched lizard (Uta stansburiana) can be found in a number of plant communities providing the substrate is sandy.

The greatest diversity of reptiles and amphibians was found to occur in transitional areas where two or more plant communities overlapped. This has been referred to by ornithologists as the "edge effect". The plant community referred to herein as the Arroyo Scrub Community shows the highest biodiversity of herptiles for this reason. The arroyo scrub literally cuts through a number of other communities and serves as a pathway of dispersal for amphibians (water-dependent) as well as reptiles (water-independent). The beds of the arroyos are covered with sand, while the walls can be solid rock or clay-alluvium. Flash floods can carry montane species into low areas while drought can allow lowland species to move into higher elevations via dry streambeds. The marbled whiptail (Cnemidophorus marmoratus) is often found high off the desert floor only along arroyos.

The Canyon Scrub and Grama Grassland communities were the most depauperate in terms of herptile biodiversity with only two species of reptiles documented from each. These communities are found at the highest elevations of the Rosillos Mountains. Here the substrate was either covered densely with grasses or composed of steeply sloped rocky outcrops and cliff faces. Tall dense grass presents a habitat not usually frequented by most desert adapted herptiles, and easily conceals those that could be present. The high, rocky outcrops and cliffs definitely present a sampling bias. It is expected that more than two species actually inhabit these two communities.

Birds. Climate ultimately determines the avian diversity as this relates to species that breed in a region. However, the over-riding factor that determines diversity of birds in a region is vegetative structure. Other factors, including climatic variations, may affect the diversity of birds

in a given region. With their high mobility, birds rapidly respond to changes in vegetation and food supply. For example, unusually high rainfall in this desert region produces large seed crops which result in higher than usual numbers of seed-eaters such as the Lark Bunting (Calamospiza melanocorys) and the Spizella sparrows. Conversely, unusually dry weather may result in the absence of a species, such as the several waterbirds recorded in this study.

Given the widespread biotypes of desert grasslands and scrub vegetative communities, the other factor significantly affecting bird diversity is the presence of the mountain mass which has produced several "non-desert" vegetative communities. The presence of springs and these scrub and woodland communities provides the necessary habitat for a number of species. Examples include such species as the tanagers, warblers, flycatchers and the Crissal Thrasher (Toxostoma dorsale) in the riparian community. Other examples may be found in the avian species accounts.

Mammals. Three interrelated abiotic and biotic factors are the primary determinants influencing the distribution and relative abundance of mammals in the North Rosillos Area: 1) vegetative composition and structure of the plant communities; 2) type of soil or substrate upon which the vegetation is growing; and 3) amount of annual precipitation. Species composition of mammals was low in three of the vegetative community types (oak woodlands, limited distribution above 4000 feet; mountain scrub, inhomogeneous plant assemblage 4500 - 5000 feet; and canyon scrub, found on the north and east side of the Rosillos Mountains). These three communities are restricted to a small area (higher elevations) and represent a small percentage of the total habitat in the North Rosillos Area, and one would not expect to find high diversity of mammals in these areas. The vegetative community type with the highest mammalian diversity is the semidesert grassland mosaic unit which occupies a rather large portion of the study area and includes several distinct types of habitat representing a mixture of Chihuahuan flora. On some parts of this community type, desert plants grow on limestone caliche. Here one finds rodents like Chaetodipus nelsoni, Dipodomys merriami, and Perognathus flavus. Elsewhere, frequently in the same trapline, sandy soils dominate and one finds Chaetodipus penicillatus and Dipodomys ordii.

Our field study was conducted during a rather extended wet period for the desert. Vegetative growth and seed production were near a maximum. We noted a change in the relative abundance in several mammals (for example, both desert cottontails and black-tailed jackrabbits increased population numbers over time, as did mice of the genus Peromyscus). Presumably this increase in population size allowed for excess individuals to disperse (for example, we trapped cottons rat under creosote bushes with little or no ground cover) into adjacent habitats. Normally cotton rats inhabit areas with dense undercover. It would be valuable to return to some of these same areas while the desert is experiencing a dry period.

Rare, Endangered, Threatened, and Unusual Species

Knowledge about the occurrence and status of rare, endangered, threatened, and unusual species is of critical importance in developing long-range management plans for the North Rosillos Area of BBNP. The NPS is mandated to protect such floral and faunal elements. The status of the

critical species is summarized below for each of the major biodiversity components. Additional details are provided in the individual chapter reports for each of the major groups.

Plants. Thirty-two plant species were added to the list of confirmed plants for BBNP. Among the important records, a large fern, tentatively identified as Thelypteris ovata var. lindheimeri, was recorded at Buttrill Springs; a single Pinus cembroides, 18 ft. tall, was found at 5400 ft; and seven taxa of oaks (Quercus) were recognized, two of which may represent hybrids or new taxa.

Parasitic Hymenoptera. There are no Braconidae or Encyrtidae officially listed as threatened or endangered. Several rarely encountered or unusual taxa of each were collected, however, during the course of the project. At least three genera new to science were collected from the North Rosillos Area: two from the family Encyrtidae and one from Braconidae. The braconid is a member of a very small subfamily with only three known genera worldwide and whose biology is very poorly known. Two additional species of Encyrtidae have not at this time been placed in any genus previously described from the New World, and with further study these may prove to be new also. Many of the braconid and encyrtid species collected will undoubtedly be described as new to science with further study. At this time, two new species of Encyrtidae are being described from material collected in this study: a species of Copidosoma and a species of Paratetracnemoidea.

Among the more unusual and significant elements were a species of Agarwalencyrtus (Encyrtidae) and a species of Anapryxia (Braconidae). Agarwalencyrtus was described from India and is now known from North America primarily from material collected in Big Bend National Park. Likewise, the genus Neocharitopus (Encyrtidae) was not known to occur in North America before our work, but has proven to be common in the trans-Pecos region, including North Rosillos Mountains. The genera Shenahetla and Muerencyrtus (Encyrtidae) were described from the Neotropical region and have not been recorded in the literature as occurring in North America. However, Muscrenyrtus in particular is common in Texas and at least two of the species collected in North Rosillos Area are undescribed. Anapryxia was first described in 1991 on the basis of a few specimens from mesic woodlands in northern Florida and eastern Texas. The material from Rosillos Mountains represents not only a considerable range extension for this rarely encountered taxon, but also a significant shift in microhabitat. Similarly, the braconid genus Microptypus was not previously recorded from Texas, but we collected several specimens from cottonwood stands at Buttrill Springs. A great deal of the material collected is valuable. Many of the species listed have been represented in collections only by a few specimens or specimens of poor quality, but as a result of this project, numerous specimens of high quality will be available for future taxonomic work.

Herptiles. No federally protected species of reptile or amphibian was found within the study area and none would be expected. One State of Texas protected species was found, the Texas horned lizard (Phrynosoma cornutum). Three additional species of state protected reptiles should be expected within the study area but were not found during this survey. These are the reticulated gecko (Coleonyx reticulatus), the Big Bend blackheaded snake (Tantilla rubra), and the Texas lyre snake (Trimorphodon biscutatus vilkinsonii). All three of these species have been documented from

near the south end of the Rosillos Mountains. All three of these species are highly secretive, and when they are found it is usually on paved roads at night.

The leopard lizard (Gambelia wislizenii) is not a protected species, but it exists in low numbers in the Big Bend Region, and is rarely seen. The occurrence of this large lizard in the study area is significant. Three snake species once listed on the state protected species list in 1978 but since delisted are still on the "watch" list. These are the Trans-Pecos rat snake (Bogertophis subocularis), the Trans-Pecos copperhead (Agkistrodon contortrix pictigaster) and the mottled rock rattlesnake (Crotalus lepidus lepidus). All three of these snakes were found on the Rosillos Mountains study area, and remain much sought species by hobbyists and commercial collectors.

The presence of the large leopard lizard (Gambelia wislizenii) was the most significant record for BBNP recorded in this study. An unusual color morph of Cnemidophorus inornatus may represent a new taxon.

Birds. In categorizing birds as threatened, rare or endangered, we used the published lists of the U.S. Fish and Wildlife Service (1989), the Texas Parks and Wildlife Department (1987) and the Texas Organization of Endangered Species (1988). We encountered but one endangered species, a Peregrine Falcon (Falco peregrinus). A field party, while banding near the stock tank along the county road, observed a single adult fly over on 25 April 1991.

Several significant observations for BBNP were made. These include the first documentation of nesting Mexican Ducks, three records of Gambel's Quail, and one record of Costa's Hummingbird.

Mammals. It is possible that several rare species periodically wander through the study area. These species include the gray wolf (Canis lupus), thought to occur in Mexico. The spotted bat (Euderma maculatum) and the long-nosed bat (Leptonycteris nivalis) are both known from other areas of the park. Other species of concern and special interest include: the ghost-faced bat (Mormoops megalophylla) and the western red bat (Lasiurus blossevillii). Any information on these species would be helpful in our understanding of their biology.

The most significant record of a small mammal was the capture of the Plains Harvest Mouse (Reithrodontomys montanus) along the northern boundary of the North Rosillos Area. This is the only record of this species in the southern part of Brewster County. Among the larger species of mammals, a elk cow and calf were observed near the west end of the park boundary.

Biodiversity Summary

The biodiversity of the North Rosillos Area is less than to that found in BBNP, but typical for the Chihuahuan Desert region as a whole. A brief summary of the major trends for and of the biodiversity groups is provided below.

Plants. A total of 456 plant species were collected in the North Rosillos Area. Thirty-two of these were added to the list of confirmed plants for BBNP. More than 1200 species are on this list, so BBNP harbors far more plant species than does the North Rosillos Area. This is due to a

larger range in elevation and the more extensive riparian areas in BBNP. Even so, a few important records of specific plant species were documented in the North Rosillos Area.

When compared to the Chihuahuan Desert region, the North Rosillos Area does not contain any unique vegetative assemblages or plant species. It has about the same plant diversity as the Chihuahuan Desert region as a whole.

Parasitic hymenoptera. A total of 486 species of parasitic hymenoptera were collected in the North Rosillos Area. Since no work of this scope has been published on the parasitic hymenoptera of BBNP, direct numerical comparisons between the two areas is not possible. Among the specimens collected were a number of genera and species new to science. This is a common occurrence when insects are intensively collected in an area, and it is likely that new species would be discovered if the parasitic hymenoptera were studied elsewhere in the Big Bend region. It is possible that a few of the new species found in the North Rosillos Area are endemic to the area. However, most of the species described are common in the Big Bend region, and a third of the species described have a widespread distribution, ranging over the entire northern Chihuahuan Desert region.

Herptiles. A total of 41 herptiles were documented in the North Rosillos Area. Some species common in BBNP were not documented in the North Rosillos Area. The North Rosillos Area does not harbor any herptiles not found elsewhere in the Chihuahuan Desert region.

Birds. A total of 103 bird species were identified in the North Rosillos Area. No species new to BBNP were documented. In fact, a number of species common in BBNP were uncommon in the North Rosillos Area due to the lack of extensive riparian habitat. The diversity of birds in the North Rosillos Area is less than that of BBNP, but about equal to that seen in the Chihuahuan Desert region as a whole.

Mammals. A total of 42 species of mammals were documented in the North Rosillos Area. The most significant record of a small mammal was the capture of the Plains Harvest Mouse (Reithrodontomys montanus) along the northern boundary of the North Rosillos Area and the only record of this species in the southern part of Brewster County. Other than this record, no other mammals not already known to the area were found. Mammalian diversity is representative and typical of other parts of the Chihuahuan Desert region.

Geographic Information Systems (GIS)

The NPS now makes extensive use of GIS as a major tool for cataloging information and monitoring resource trends on its lands. One of the objectives of this project was to collect data in such a way that it could be input into the GIS system for BBNP. Below we describe how this is best accomplished for each of the major biodiversity component groups inventories during this study.

UTM coordinates recorded in this report are a single number, six digits long. To obtain the northing, take the first three digits of the UTM of interest, add 32 to the front and 00 to the back. To obtain the easting, take the second three digits of the UTM of interest, add 6 to the front and 00 to the back. For example, a UTM of 763761 equals a northing of 3276300 and an easting of 676100.

Parasitic Hymenoptera. Collections of all specimens of Braconidae and Encyrtidae have been recorded on National Park Service "Museum Catalog Record Worksheets", hard copies of which have been submitted to BBNP. Each worksheet corresponds to a single sample, and includes a list of the species of Braconidae or Encyrtidae taken in that sample, as well as the UTM coordinates corresponding to the location where that sample was collected.

Herptiles. The Universal Transverse Mercator (UTM) Grid Coordinate System was used in plotting significant field collections or visual sighting localities. Coordinates were plotted on 7.5 minute USGS quad maps. Table 8 presents the UTM coordinates of important collections and sightings where identification was positive, as well as landmarks referred to in this report. The following quadrangle maps covered the study area: Bone Springs, Butterbowl, Twin Peaks, and Persimmon Gap.

Birds. Over 75 percent of the observations of birds resulted from the two transects which were established; collectively, the two transects encompass eight of the 13 vegetative communities. The beginning and end points for each transect have been fixed by Universal Transverse Mercator (UTM) coordinates: Bone Springs transect - 763761 to 767775; Buttrill Springs transect - 678709 to 673690. Each transect follows the road between these end points. However, the mosaic of the vegetative communities makes it difficult to establish boundaries of the vegetative communities along the transects.

All mist-netting took place at one of three locations and all banding and collection of specimens occurred at the same sites. UTM coordinates for each of these sites are: Tank No. 1 - 742754; Lodge - 674705; and Buttrill Springs jeep trail - 672698.

Mammals. One objective of the biodiversity survey was to provide information, in the appropriate format, so that records of locality for each species could be incorporated into the National Park Service Geographic Information System (GIS). Following each species account is a listing of specimens examined. In order to determine the Universal Trans-Mercator (UTM) coordinates refer to Table 13 (gazeteer of the mammal report, Chapter 7). The six digit number following the locality is the UTM coordinate for that locality.

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Table 1. A tabulation of the number of species/taxa of each of the four faunal diversity groups in the 13 vegetative community types in the North Rosillos Area.

Table 2. Percent contribution of the major biodiversity component groups to the total diversity recorded in each community type.

Table 3. Percent of total faunal biodiversity represented in each community type

CHAPTER 3

BOTANICAL INVESTIGATIONS

A. Michael Powell and M. Paul Whitefield

The vegetation and flora of the southern Big Bend region of Texas have been discussed in several publications, but completed floristic investigations for the North Rosillos Area are lacking. Correll and Johnston (1970) have provided the most useful reference for the vascular plants of Texas, and this work along with the recent up-date by Johnston (1990) has been a major source of information about the vascular plants of the North Rosillos Area. Other useful botanical works include the older flora of Big Bend National Park (McDougall and Sperry, 1951), a recent treatment of the trees and shrubs of Trans-Pecos Texas (Powell, 1988), and a photographic treatment of some wildflowers of the Big Bend country (Warnock, 1970). In addition to published vegetation studies, Big Bend National Park over the years has accumulated reports from various plant investigations within the original Park boundaries. The most recent and the most complete of these plant studies in the Park was accomplished in 1991 by Bonnie Amos (Angelo State University), and goes under the title Plants of Big Bend National Park.

A few other limited and preliminary vegetative studies of the North Rosillos Area have been conducted. As an employee of the Texas Natural Heritage Program (now in Texas Parks and Wildlife Department), botanist Jackie Poole compiled "in house" reports concerning the vegetation in the North Rosillos Area when it belonged to the Nature Conservancy. This work included a partial list of plants, some observations about plant associations, and considerations of possible rare or uncommon species. Graduate student Paul Whitefield, at Sul Ross State University, initiated vegetative studies of the North Rosillos Area that were aimed toward identifying plant communities (after Henrickson and Johnston, 1986) and compiling a plant list for the area. Much of the information contained in this report has resulted from the studies conducted by Whitefield.

Methods and Materials

A floristic survey of the North Rosillos Area was begun by graduate student Michael Paul Whitefield in 1986 as part of a thesis research project. In 1985 the Texas Nature Conservancy had established the area as a nature preserve after receiving the land as a gift from the Harte brothers. The vegetative studies were continued into the current Biodiversity Survey project by Whitefield and also by A. M. Powell who is a Principal Investigator (botany) in the biodiversity survey. Barry Hughes participated in the current survey as a graduate research assistant by making numerous plant collections in the North Rosillos Area.

The extensive vegetation studies by Whitefield led to his preparation of a vegetative map of the North Rosillos Area. The map was prepared by carrying a drawing board into the field area onto which were taped xerox portions of USGS 1:24,000 topographic quadrangles. Where possible high elevation points were selected from which to sketch the vegetative communities in color. Whitefield reported that the vegetation of the Chalk Basin was most difficult to map because of the absence of topographic relief. Much mapping was done in the Basin while walking or driving. The field

sketches were later copied onto a "rough out" topographic base map of the entire field area. A final topographic base map was prepared separately by tracing 100 and 200 foot contour lines onto a transparent mylar sheet with rapidograph pen. From the mylar, a paper diazo-blueline was made. A final copy showing vegetation in color pencil was produced on the diazo-blueline paper by tracing from the rough-out map on a light table. A system of color was adopted which was intended to convey the relative mesic/xeric nature of the environment. Blues, greens, and lavender are used for mesic vegetation, while red, orange, yellow, and white reflect xeric vegetation. A separate sheet of mylar with bordering and transfer-lettering was completed, and was designed to overlay the final color copy. They were photographed together in this manner, then reduced, and printed using a four-color-separation process. Additional recreations of the color map were produced by a computer graphics process and the maps were disseminated to the research team and the National Park Service.

A text designed to accompany the vegetation map of the North Rosillos Area was prepared by Whitefield. Thirteen plant communities were described for the area, together with descriptions of separate "phases" of vegetation for two of those communities. For each community shown on the map, gross features of the habitat were described, along with a compendium of important plant species. The characteristic species assemblages were termed communities. The community names were derived from the coupling of a noun that describes the plant formation (i.e., "woodland", "grassland", "scrub") together with a modifier which either provides information of an important floristic element (e.g., "grama", "oak", "mariola") or, since many communities contain diverse floristic assemblages, the modifier is often descriptive of habitat (e.g., "mountain", "canyon", "arroyo").

The map is intended to facilitate future vegetation analyses. By providing the researcher with gross vegetational features, one can more readily select representative vegetation "stands" for objective sampling. The map is also intended to demonstrate the relationships of the communities to their environment and to each other. Furthermore, the map should be useful in monitoring vegetational change through time. It is hoped that the map and community descriptions will also prove useful in faunal studies.

The plant lists were compiled from herbarium specimens and field notes. Specimens are deposited in the herbarium at Sul Ross State University (SRSU). Plants were collected during all seasons of the year and from all topographic and ecological regions of the North Rosillos Area. Field surveys continued through the spring of 1993 when plants new to the list were still being discovered. It is certain that we have not yet succeeded in finding all of the vascular plant species that ultimately will be discovered to occur in the area.

Results and Discussion

Major results of the botanical investigations in the North Rosillos Area include the production of a vegetation map (in color), a discussion of plant communities described for the area, and a list of plant species documented to occur in the area. No truly rare or endangered species were found to occur in the study site. Approximately 32 plant species were added to the list of plants previously confirmed for Big Bend National Park.

This text is designed to accompany the vegetation map (Fig. 1) of the North Rosillos Area prepared by Whitefield. Thirteen plant communities are described for the area, together with descriptions of separate "phases" of vegetation for two of those communities. For each community shown on the map, gross features of the habitat are described, plus a compendium of important plant species is provided. The system of communities presented here is largely derived from treatments for the Southwestern United States (Brown, 1982), and for the Chihuahuan Desert Region (Henrickson and Johnston, 1986). Plant species nomenclature follows that of Correll & Johnston (1970).

The geologic forces shaping the mapped area have created a diverse array of landforms and substrates, and their associated temperature and moisture gradients, to which an equally complex assemblage of plant species is adapted. There is no doubt that each species population is

distributed individualistically (Gleason, 1926). However, where geologic substrate, elevation, slope exposure, and moisture availability are similar there is usually a similar assemblage of overlapping plant species populations. These characteristic species assemblages are here termed communities. Where sharp contacts exist for the above listed habitat features, there are concordantly sharp changes in plant community composition. Indistinct environmental gradients are present as elevation is gained in the Rosillos Mountains and in the wash of sediments throughout the low-lying drainage basins. Here, boundaries between communities are necessarily arbitrary, and they are placed so as to reflect the relationships between the communities and their habitats.

The largest vegetation units revealed by the map are physiographic, and are evident in the pattern of communities about the igneous Rosillos Mountains, the block-faulted limestone Chalk Hills, and the sediment-filled basins and draws below them (see Bloomer 1946 and 1947; 1949; Maxwell, 1968, and Shepard, 1982 for descriptions of the geology of the area). Within these physiographic units are the plant communities shown in color on the map (enclosed). The smallest unit of vegetation is the association, which is widely recognized but defined differently in a variety of classification methods (see Whittaker, 1978 for a review). Numerous associations exist in microsites within the plant communities shown. Since it is impossible to map each microsite as a different plant community, objective vegetation analyses are necessary to discern them. The number of plant associations present in the field area would overwhelm any map of reasonable scale and size.

Making the Map. Kuchler (1967) provided much appreciated advice on the logistics and design of vegetation maps. It was deduced by Whitefield (who designed and drew the map) that the approach described in Methods and Materials allowed greater floristic detail than that of tracing vegetation from aerial stereophotograph pairs.

The Plant Communities. The following system is used for the vegetation map:

- A. Southwestern Riparian
 - 1. Riparian
- B. Madrean Woodland
 - 1. Oak Woodland
- C. Madrean Upland Scrub
 - 1. Canyon Scrub
 - 2. Mountain Scrub
 - (a) Rocky Bluff Phase
 - (b) Open Slope Phase
- D. Short Grass Prairie
 - 1. Grama Grassland
 - 2. Semidesert Grassland
 - (a) Igneous Substrate Phase
 - (b) Limestone Substrate Phase
- E. Chihuahuan Basinal Grassland
 - 1. Alkaline Grassland
- F. Chihuahuan Desert Scrub

1. Mesquite Scrub
2. Arroyo Scrub
3. Mariola Scrub
 - (a) Upland Limestone Phase
 - (b) Lowland Alluvial Phase
4. Lechuguilla Scrub
5. Mixed Shrub and Succulent Scrub
6. Creosote Scrub

All of these communities and phases are shown on the enclosed map, except for Semidesert Grassland (limestone phase), Mariola Scrub (limestone phase), and Lechuguilla Scrub, which exist together in a mosaic pattern in the Chalk Hills that is much too complex to be shown at the scale of the map. Instead, these are all mapped under the habitat entitled "Mosaic".

Riparian. Riparian vegetation is limited to the banks of a few springs and seeps in the study area. Except for Bone Spring, all are located in the foothills or lower canyons of the Rosillos Mountains. The plant species composition of each spring is usually unique, which probably reflects the limited ability of most riparian species to disperse. Common trees include Salix gooddingii (Goodding Willow) and Populus deltoides var. wislizenii (Rio Grande Cottonwood). At higher elevations Quercus grisea (Gray Oak) and Celtis reticulata (Netleaf Hackberry) occur.

Other riparian species are: Tamarix chinensis (Western Saltcedar), Baccharis salicifolia (Seepwillow), Cephalanthus occidentalis (Buttonbush), Hymenoclea monogyra (Burrobush), Typha latifolia (Cattail), Lobelia cardinalis (Cardinal Flower), Mimulus glabratus (Monkey-flower), Cynodon dactylon (Bermuda Grass), Juncus torreyi (Torrey's Rush), and Adiantum capillus-veneris (Maidenhair Fern). See also the descriptions for Oak Woodland and Canyon Scrub for other species associated with, but not limited to, riparian communities.

Buttrill Spring is the only source of perennial surface water which might be classifiable as a short stream. During the early part of the twentieth century the Buttrill family homesteaded and ranched from here (Wulfkuhle, 1986). At one time, the upper portion of the spring was terraced for a garden and orchard. Introduced species still surviving from that time are Carya illinoensis (Pecan), Quercus sinuata (Bastard Oak), and Prunus persica (Peach). Also unique to Buttrill Spring are Rhus toxicodendron (Poison Oak) and a species of large fern, Thelypteris ovata var. lindheimeri, as yet tentatively identified.

Oak Woodland. An Oak Woodland community is centered above 4000 feet elevation in north and east-facing canyons of the Rosillos Mountains. Because of its limited distribution, the community is somewhat depauperate compared with woodlands of larger Trans-Pecos mountain ranges. The community is best developed in Concha Canyon, where trees of Quercus grisea (Gray Oak) and Celtis reticulata (Netleaf Hackberry) line drainage bottoms in a dense gallery woodland. Quercus grisea is also scattered among rock outcrops and slopes to well above 5000 feet elevation. The small deciduous tree, Fraxinus cuspidata (Fragrant Ash), and Quercus pungens var. vaseyana (Vasey Shin Oak) are also frequent throughout the entire community. A single Pinus cembroides

(Mexican Pinyon Pine), 18 ft tall, was documented at 5400 feet elevation on a ridge running east of Rosillo Peak. Oak Woodland blends with Canyon Scrub at lower elevations, and with Grama Grassland at higher elevations.

Other species observed in the community include: Juniperus erythrocarpa (Red-Berry Juniper), Juniperus pinchotii (Pinchot Juniper), Nolina erumpens (Sacahuista), Opuntia imbricata (Cane Cholla), Bouvardia ternifolia (Scarlet Bouvardia), Mimosa biuncifera (Catclaw), Rhus virens (Evergreen Sumac), Brickellia cylindracea (Brickell Bush), Dasyllirion leiophyllum (Sotol), Prunus havardii (Harvard Plum), Zexmenia brevifolia (Shorthorn Zexmenia), Opuntia phaeacantha var. major (Prickly Pear), Rivina humilis (Rouge-Berry), Penstemon barbatus (Penstemon), Castilleja integra (Indian Paintbrush), Phlox mesoleuca (White-Eye Phlox), Cirsium texanum (Texas Thistle), Silene laciniata (Catchfly), Eriogonum tenellum (Wild Buckwheat), Eriogonum jamesii (James Buckwheat), Artemesia ludoviciana (Western Mugwort), Echeveria strictiflora, Phacelia congesta, Commelina erecta var. angustifolia (Widow's Tears), Selaginella peruviana (Resurrection Plant), Notholaena sinuata (Wavy Cloakfern), Bothriochloa laguroides var. torreyana (Silver Bluestem), Muhlenbergia emerslyi (Big Muhly Grass), Setaria leucopila (Plains Bristle Grass), Bouteloua curtipendula (Sideoats Grama), Bouteloua gracilis (Blue Grama), and Aristida purpurea (Purple Threeawn).

Canyon Scrub. Canyon scrub vegetation occupies most east and north-facing canyons about the base of the Rosillos Mountains, and also is found at the base of east and north-facing canyon walls in the Chalk Hills. The species with the highest fidelity to the community are Ungnadia speciosa (Mexican Buckeye), Diospyros texana (Texas Persimmon), Rhus virens (Evergreen Sumac), and Acacia roemeriana (Roemer's Acacia). Associated with them are a diverse assemblage of shrubs, succulents, and forbs, including: Juglans microcarpus (Little Walnut), Tecoma stans (Yellowbells), Bouvardia ternifolia, (Scarlet Bouvardia), Sapindus saponaria var. drummondii (Western Soapberry), Dalea frutescens (Black Dalea), Forestiera angustifolia (Desert Olive), Ferocactus hamatacanthus (Barrel Cactus), Echinocereus stramineus (Strawberry Pitaya), Opuntia leptocaulis (Pencil Cholla), Zexmenia brevifolia (Shorthorn Zexmania), Dasyllirion leiophyllum (Sotol), Senna lindheimeriana (Lindheimer Senna), Mimosa biuncifera (Catclaw), Maurandya antirrhyniflora (Snapdragon Vine), Clematis drummondii (Virgin's Bower), Carlowrightia linearifolia (Heath Carlowrightia), Penstemon havardii (Harvard Penstemon), Eriogonum jamesii (James Buckwheat), Eriogonum tenellum (Wild Buckwheat), Phaseolus angustissimus (Wild Bean), Castilleja nervata (Indian Paintbrush), Oenothera brachycarpa (Wild Primrose), Setcreasea brevifolia, Notholaena sinuata (Wavy Cloakfern), Notholaena standleyi (Standley Cloakfern), Pellaea intermedia (Cliff Brake), Cheilanthes tomentosa (Woolly Lipfern). The canyon scrub community intergrades with arroyo scrub at lower elevations and oak woodland at higher elevations.

Mountain Scrub. Mountain Scrub is a heterogenous assemblage of plant species that inhabit slopes and bluffs of the Rosillos Mountains between 4500 and 5000 feet elevation. The slopes typically have pitches greater than 45 degrees. There are two predominant phases of the community -- one occupying the rocky bluffs of the northern Rosillos Mountains, and another on the open slopes of the eastern and western sides of the range. The community is composed of populations of species "borrowed" from Oak Woodland, Canyon Scrub, Grama Grassland, and Semidesert Grassland which

have established themselves upon these rocky crevices and steep inclines with thin veneers of soil. Both phases are characterized by the presence of Prunus havardii (Havard Plum), Viguiera stenoloba (Skeletonleaf Goldeneye), Agave lechuguilla (Lechuguilla), Tecoma stans (Yellowbells), Bouvardia ternifolia (Scarlet Bouvardia), Nolina erumpens (Sacahuista), and Selaginella peruviana (Resurrection Plant).

The rocky-bluff phase includes more Oak Woodland and Canyon Scrub species, including Quercus pungens var. vaseyana (Vasey Shin Oak), Brickellia cylindracea (Bricklebush), Ungnadia speciosa (Mexican Buckeye), Dalea frutescens (Black Dalea), Cercocarpus montanus var. paucidentatus (Mountain Mahogany), Gymnosperma glutinosum (Nakedseed Weed), Hymenoxys scaposa (Bitterweed), Heterotheca fulcrata (Camphor Weed), Perityle parryi (Parry Rock-Daisy), Artemesia ludoviciana (Western Mugwort), Gnaphalium chilense (Cotton Batting Cudweed), Ipomoea cristulata (Scarlet Morning Glory), Eriogonum jamesii (James Buckwheat), Sedum wrightii (Wright Stonecrop), and Cheilanthes tomentosum (Woolly Lipfern).

The open slope phase borrows more heavily from Grama Grassland and Semidesert Grassland species. Frequently observed in the open slope phase are: Dasyilirion leiophyllum (Sotol), Fouquieria splendens (Ocotillo), Echinocereus stramineus (Strawberry Pitaya), Opuntia phaeacantha var. major (Prickly Pear), Echinocereus viridiflorus var. russanthus (Rusty Hedgehog), Coryphantha tuberculosa var. tuberculosa (Corncob Cactus), Mammillaria heyderi var. meiacantha (Pincushion Cactus), Acacia constricta (Whitethorn Acacia), Brickellia californica (California Bricklebush), Heteropogon contortus (Tanglehead Grass), Bouteloua curtipendula (Sideoats Grama), Bouteloua gracilis (Blue Grama), Machaeranthera scabrella, Polygala longa (Milkwort), and Bommeria hispida (Hairy Bommeria).

Grama Grassland. A Grama Grassland community dominates the highest elevations of the Rosillos Mountains. The community is well developed above 5000 feet elevation on gentle slopes, saddles, and ridgetops where deeper soil has accumulated. Grassland species also occupy the interstices between trees and shrubs of Oak Woodland at higher elevations. Important grasses in the assemblage are: Bouteloua gracilis (Blue Grama), Bouteloua curtipendula (Sideoats Grama), Bothriochloa laguroides var. torreyana (Silver Bluestem), Lycurus phleoides (Wolftail), Aristida adscensionis (Sixweeks Threeawn), Aristida purpurea (Purple Threeawn), and Heteropogon contortus (Tanglehead). Other important members of Grama Grassland are: Juniperus pinchotii (Pinchot Juniper), Dasyilirion leiophyllum (Sotol), Yucca elata (Soaptree Yucca), Nolina erumpens (Sacahuista), Echinocereus viridiflorus var. russanthus (Rusty Hedgehog), Mammillaria heyderi var. meiacantha (Pincushion Cactus), Opuntia imbricata (Cane Cholla), Opuntia phaeacantha var. major (Prickly Pear), Viguiera stenoloba (Skeletonleaf Goldeneye), Acacia constricta (Whitethorn Acacia), Machaeranthera scabrella (no common name), Iva ambrosiaefolia (Rag Sumpweed), Hymenoclea monogyra (Burro-Brush), Portulacca pilosa (Hairy Purslane), and Selaginella peruviana (Resurrection Plant).

Semidesert Grassland. Two phases of Semidesert Grassland occur in the study site. An igneous phase occurs between 3000 and 4200 feet elevation on the slopes and foothills about the Rosillos Mountains. The slopes are formed of massive accumulations of boulder piles and soil

which have been eroded away from the igneous parent rock of the main mass of the Rosillos Mountains. Scattered "islands" of the igneous phase also finger northward across Nine Point Draw and into the Chalk Hills, where the community occupies the eroded remnants of an igneous sill.

The community has likely been influenced by intensive grazing pressure at some time in the past, during which less palatable grasses, spinescent shrubs, and succulent cover increased at the expense of palatable grassland species. At one time the community may have resembled the Grama Grassland of the uppermost slopes of the Rosillos Mountains. Presently, the area occupied by the igneous phase of Semidesert Grassland shows little evidence of ranching activity in perhaps twenty years or more. Grass cover is good, but species composition is quite different from that of Grama Grassland.

Here the important grasses are Bouteloua trifida (Red Grama), Muhlenbergia porteri (Bush Muhly), Leptoloma cognatum (Fall Witchgrass), Cathastecum erectum (False Grama), Hilaria mutica (Tobosa Grass), Tridens muticus (Hairy Tridens), and Digitaria californica (California Cottontop). The grass species listed for Grama Grassland also occur in diminished importance.

Other important shrub and succulent species are: Prosopis glandulosa var. toreyana (Western Honey Mesquite), Koeberlinia spinosa (Allthorn), Adolphia infesta (Texas Adolphia), Parthenium incanum (Mariola), Guaiacum angustifolium (Guayacan), Mimosa biuncifera (Catclaw), Acacia neovernicosa (Viscid Acacia), Dalea formosa (Feather Dalea), Krameria grayi (White Ratany), Aloysia wrightii (Oreganillo), Berberis trifoliata (Algerita), Senna roemeriana (Two-leaved Senna), Yucca treculeana (Spanish Dagger), Yucca elata (Soaptree Yucca), Yucca rostrata (Beaked Yucca), Opuntia phaeacantha var. major (Prickly Pear), Opuntia phaeacantha var. discata (Prickly Pear), Opuntia violacea var. macrocentra (Purple Prickly Pear), Opuntia leptocaulis (Pencil Cholla), Opuntia schottii var. grahamii (Dog Cholla), Echinocereus viridiflorus var. russanthus (Rusty Hedgehog), Ephedra aspera (Mormon Tea), Croton dioicus (Grassland Croton), and Thymophylla acerosa (Prickleleaf Dogweed).

The igneous phase of Semidesert Grassland also includes a great diversity of forbs and annuals, including: Macrosiphonia lanuginosa (Rocktrumpet), Senecio douglassii var. longilobus (Threadleaf Groundsel), Astragalus mollisimus var. earlei (Woolly Locoweed), Astragalus nuttallianus, Verbena neomexicana (Hillside Vervain), Lupinus havardii (Rio Grande Bluebonnet), Hibiscus denudatus (Rose Mallow), Dalea jamesii (James Dalea), Dalea neomexicana (New Mexico Dalea), Thymophylla pentachaeta (Parallena Dogweed), Eriogonum tenellum (Wild Buckwheat), Froelichia arizonica (Snake Cotton), Lesquerella purpurea (Purple Bladderpod), Schoenocrambe linearifolium (Narrow-leaf Mustard), Boerhaavia gracillima (Slender Spiderling), and Euphorbia cinarescens (Spurge).

A limestone phase of Semidesert Grassland is present in the Chalk Hills and other small outlying outcrops of sedimentary rock. Because of the complexity of the eroded dendritic canyon system which penetrates the Chalk Hills, the limestone semidesert grassland phase cannot be clearly delineated at the scale of the map (Fig. 1). Instead, it is mapped as a single unit mosaic together with two other communities -- an upland phase of Mariola Scrub and Lechuguilla Scrub. In the mosaic,

Semidesert Grassland is prevalent upon hillsides and on steep-sided alluvial slopes of the drainage systems. On these slopes, good grass cover is present, together with a number of shrubs and succulents.

The grass cover is primarily Bouteloua gracilis (Blue Grama) and Bouteloua hirsuta (Hairy Grama). Other frequently observed species include: Hilaria mutica (Tobosa Grass), Bouteloua trifida, (Red Grama), Heteropogon contortus (Tanglehead Grass), Viguiera stenoloba (Skeletonleaf Goldeneye), Dasyilirion leiophyllum (Sotol), Larrea tridentata (Creosote Bush), Parthenium incanum (Mariola), Jatropha dioica (Leatherstem), Yucca treculeana (Spanish Dagger), Yucca elata (Soaptree Yucca), Yucca rostrata (Beaked Yucca), Calliandra conferta (False Mesquite), Ephedra aspera (Mormon Tea), Echinocereus dasyacanthus (Texas Rainbow Cactus), Echinocactus horizonthalonius (Horse-crippler Cactus), Ariocarpus fissuratus (Living-rock Cactus), Opuntia phaeacantha var. major (Prickly Pear), Macrosiphonia lanuginosa (Rocktrumpets), Hibiscus denudatus (Rose Mallow), Boerhaavia linearifolia (Narrowleaf Spiderling), Thymophylla acerosa (Prickleleaf Dogweed), and Selaginella lepidophylla (Resurrection Plant).

Mariola Scrub. The community is characterized by Parthenium incanum (Mariola) equaling or exceeding Larrea tridentata (Creosote Bush) in abundance. The shrubs occur as scattered individuals, or Parthenium incanum often occurs in small clusters together with Opuntia leptocaulis (Pencil Cholla) growing inside. The area between the shrubs is mostly bare ground, except for sparse grasses and forbs. Beyond these fundamental similarities, it is useful to recognize upland and lowland phases of Mariola Scrub. An upland phase occurs from 3000 to 3500 feet elevation upon the Chalk Hills, and is mapped as a single unit together with Limestone Semidesert Grassland and Lechuguilla Scrub. The lowland phase is distinguishable at the scale of the map (Fig. 1). It is best developed below 3000 feet elevation on alluvial fans derived from the Rosillos Mountains and Chalk Hills, and in the expansive basin about Nine Point Draw and Chalk Draw. Associated with each phase is a different assemblage of shrubs, forbs, and succulents.

The upland phase of Mariola Scrub is adapted to the thin veneer of calcareous soil overlying the limestone basement rock of the Chalk Hills. The community is prevalent upon the flat tops of hills and level saddles between hills. It also occupies portions of south and west-facing slopes. Numerous microhabitats exist for a diverse array of species, and the community is quite unhomogenous. Important members are: Tiquilia greggii (Plume Tiquilia), Tiquilia hispidissima, Tiquilia canescens, Guaiacum angustifolium (Guayacan), Dalea formosa (Feather Dalea), Calliandra conferta (Falsemesquite), Condalia ericoides (Javelina Bush), Dasyilirion leiophyllum (Sotol), Krameria grayi (White Ratany), and Krameria parvifolia (Range Ratany). The lowland phase of Mariola Scrub is adapted to sandy soils accumulated in drainage basins. The community occurs in a complex "braided" system together with Arroyo Scrub, Mesquite Scrub, and Creosote Scrub. Here it is best developed in sandy strips between drainages occupied by Arroyo Scrub and Mesquite Scrub, and upland "desert pavement" occupied by Creosote Scrub. Species diversity is richest nearest the base of the Rosillos Mountains foothills and Chalk Bluff, and diminishes as one passes farther into the drainage basins. In contrast to the upland phase of Mariola Scrub, the lowland phase has lower shrub and succulent diversity and higher forb and annual diversity.

In addition to Larrea tridentata and Opuntia leptocaulis, frequently observed species in the community include: Flourensia cernua (Tarbush), Krameria parvifolia (Range Ratany), Tiquilia canescens, Thymophylla acerosa (Dogweed), Ephedra trifurca (Mormon Tea), Melampodium leucanthum (Blackfoot Daisy), Yucca treculeana (Spanish Dagger), Yucca elata (Soaptree Yucca), Opuntia phaeacantha var. major (Prickly Pear), Opuntia violacea var. macrocentra (Purple Prickly Pear), Echinocereus dubius (Pitaya Cactus), Baileya multiradiata (Bailey Sand Daisy), Psilostrophe tagetina (Woolly Paper flower), Thelesperma megapotamicum (Green Thread), Cirsium texanum (Texas Thistle), Ratibida columnaris (Mexican Hat), Pectis papposa (Limoncillo), Senecio douglasii var. longilobus (Threadleaf Goundsel), Datura wrightii (Jimson Weed), Chamaesaracha coronopus (False Nightshade), Proboscidea louisianica (Devil's Claw), Ipomopsis havardii (Havard Ipomopsis), Verbena pumila (Pink Vervain), Nama hispidum (Sand-bell), Gaura parviflora (Lizard Tail), Cryptantha angustifolia (Cat's-eye), Cryptantha crassisepta (Cat's-eye), Heliotropium molle (Heliotrope), Heliotropium confertifolium (Heliotrope), Mentzelia multiflora, Lesquerella fendleri (Fendler Bladderpod), Selenia dissecta (Wild Mustard), Draba cuneifolia (Whitlow grass), Lepidium montanum (Pepper Grass), Dimorphocarpa wislizenii (Wislizenus Spectacle-pod), and Descurainia pinnata (Tansy-mustard).

Lechuguilla Scrub. Lechuguilla Scrub is the third community included in the mosaic mapped in the Chalk Hills. The community is best developed above 3300 feet elevation on a few hills along the northwestern boundary of the study area. It is characterized by dense mats of Agave lechuguilla with a small group of associated shrubs, succulents, and forbs.

Other members of the community are: Parthenium incanum (Mariola), Larrea tridentata (Creosotebush), Opuntia leptocaulis (Pencil Cholla), Dalea formosa (Feather Dalea), Yucca treculeana (Spanish Dagger), Dasyllirion leiophyllum (Sotol), Viguiera stenoloba (Skeletonleaf Goldeneye), Neolloydia conoidea (Texas Cactus), Echinocactus horizonthalonius (Horse-crippler Cactus), Ariocarpus fissuratus (Living Rock Cactus), Echinocereus dasyacanthus (Texas Rainbow Cactus), Opuntia phaeacantha var. major (Prickly Pear), Castilleja integra (Indian Paintbrush), Macrosiphonia lanuginosa (Rocktrumpets), Thamnosma texana (Dutchman's Breeches), and Menodora scabra var. scabra (Rough Menodora).

Mixed Shrub and Succulent Shrub. The Mixed Shrub and Succulent Scrub community might also be considered an extremely species-enriched phase of Lechuguilla Scrub. The community is of limited distribution upon a few ridgetops along Chalk Bluff. Here, a dense unit of limestone is exposed which does not erode into soil. The plants occurring here grow in fractures in the solid rock, or even appear to be growing directly upon the rock. In addition to Agave lechuguilla (Lechuguilla), a particularly rich assemblage of succulents distinguish the community, including: Neolloydia conoidea (Texas Cactus), Echinocereus stramineus (Strawberry Pitaya), Echinocereus dasyacanthus (Texas Rainbow Cactus), Coryphantha tuberculosa var. tuberculosa (Corncob Cactus), Opuntia rufida (Blind Prickly Pear), Opuntia phaeacantha var. major (Prickly Pear), Opuntia leptocaulis (Pencil Cholla), Opuntia schottii var. grahamii (Dog Cholla), Fouquieria splendens (Ocotillo), Jatropha dioica (Leatherstem), Dasyllirion leiophyllum (Sotol), and Yucca treculeana (Spanish Dagger).

In addition to the succulents listed above, a number of shrub species also occur in the assemblage. These are: Tiquilia greggii (Plume Tiquilia), Bernardia obovata (Desert Myrtlecroton), Tecoma stans (Yellowbells), Leucophyllum minus (Big Bend Silverleaf), and Chrysactinia mexicana (Damianita). Important forbs are: Thamnosma texana (Dutchman's Breeches), Oligomeris linifolia (no common name), Polygala macradenia (Milkwort), Houstonia nigricans (Bluet), Hedeoma nanum (False Pennyroyal), Hibiscus coulteri (Coulter Rose-Mallow), Castilleja integra (Indian Paintbrush), Menodora longiflora (Showy Menododra), and Selaginella lepidophylla (Resurrection Plant).

Arroyo Scrub. An Arroyo Scrub community occupies intermediate elevation drainages in the study area. The community is mapped as a dendritic pattern which penetrates nearly all other communities. Within the system of arroyos, sandy wash-bottoms and boulder piles provide a number of microhabitats for a large number of species. The species assemblage intergrades with Canyon Scrub above and Mesquite Scrub below.

Shrubs frequently observed lining the arroyos include: Parthenium incanum (Mariola), Acacia neovernicosa (Viscid Acacia), Acacia greggii (Catclaw Acacia), Mimosa biuncifera (Catclaw), Prosopis glandulosa var. torreyana (Western Honey Mesquite), Viguiera stenoloba (Skeletonleaf Goldeneye), Dasyllirion leiophyllum (Sotol), Chilopsis linearis (Desert Willow), Rhus microphylla (Littleleaf Sumac), Lycium puberulum (Downy Wolfberry), Berberis trifoliata (Algerita), Lycium berlandieri (Berlandier Wolfberry), Adolphia infesta (Texas Adolphia), Zizyphus obtusifolia (Lotebush), Dalea frutescens (Black Dalea), Dalea formosa (Feather Dalea), Fallugia paradoxa (Apache Plume), Trixis californica (American Trixis), and Nicotiana trigonophylla (Desert Tobacco).

A plethora of forbs and annuals was documented along the sandy wash bottoms. Some of these are: Kallstroemia grandiflora (Mexican Poppy), Psilostrophe tagetina (Woolly Paper Flower), Baileya multiradiata (Bailey Sand Daisy), Clematis drummondii (Virgin's Bower), Verbena neomexicana (Hillside Vervain), Astragalus mollissimus var. earlei (Woolly Locoweed), Penstemon barbatus (Penstemon), Penstemon havardii (Havard Penstemon), Phacelia congesta (Phacelia), Dalea neomexicana (New Mexico Dalea), Calylophus hartwegii (False Primrose), Eriogonum tenellum (Wild Buckwheat), Cryptantha crassiseppala (Cat's-eye), Gnaphalium chilense (Western Cudweed), Gaura suffulta var. nealleyi (Bee Blossom), Nerisyrenia camporum (Bicolor Mustard), Lepidium montanum (Pepper Grass), Schoenocrambe linearifolium (Narrow-leaf Mustard), Lesquerella purpurea (Purple Bladderpod), Cheilanthes wrightii (Wright Lipfern), and Notholaena sinuata (Wavy Cloakfern).

Mesquite Scrub. A community dominated by Prosopis glandulosa var. torreyana (Western Honey Mesquite) occurs in dense stands lining drainages at the lowest elevations of the study site. The drainages typically have steep-sided banks cut through deep deposits of sand and clay, and do experience flooding during heavy rains. Low-growing mesquite and other members of the community are scattered among the Alkaline Grassland community described below. The two communities together have been the site of most cattle-grazing continuing until recent time. Mesquite Scrub intergrades with Arroyo Scrub as elevation increases.

Important associates of Mesquite Scrub are: Atriplex canescens (Four-wing Saltbush), Buddleja scordioides (Escobilla Butterflybush), Lycium puberulum (Downy Wolfberry), Acacia neovernicosa (Viscid Acacia), Acacia greggii (Catclaw Acacia), Koeberlinia spinosa (Allthorn), Adolphia infesta (Texas Adolphia), Rhus microphylla (Littleleaf Sumac), Aloysia gratissima (Bee Brush), Yucca elata (Soaptree Yucca), Sorghum halapense (Johnson Grass), Chloris virgata (Showy Chloris), Leptoloma cognatum (Fall Witchgrass), Pappoporum bicolor (Pink Pappussgrass), Hilaria mutica (Tobosa Grass), Gutierrezia microcephala (Broomweed), Lantana macropoda (Desert Lantana), Salvia reflexa (Rocky Mountain Sage), Nyctaginia capitata (Scarlet Musk-flower), Xanthium spinosum (Cockle-burr), Machaeranthera tanacetifolia (Tahoka Daisy), Chenopodium album (Lamb's-quarters), Salsola kali (Tumbleweed), Verbena wrightii (Desert Verbena), Nerisyrenia camporum (Bicolor Mustard), Heliotropium glabriusculum (Cola de Alacran), Convolvulus equitans (Wild Morning Glory) and Euphorbia serpyllifolia (Spurge).

Alkaline Grassland. Shreve (1939; 1942) was the first author to distinguish a basinal grassland community in the Chihuahuan Desert Region that is floristically distinct from short grass prairie of the Great Plains. The Alkaline Grassland community of the study area occupies the flat bottoms of drainage basins where thick sequences of bentonitic clays have accumulated.

The community experiences occasional shallow flooding during periods of heavy rainfall. As mentioned above, Alkaline Grassland together with Mesquite Scrub have been the center of grazing activity until recent time. The result has been the depletion of grass cover from vast areas and subsequent arroyofication of these flats. Mesquite Scrub has invaded along the arroyos, and other assemblages of Chihuahuan Desert Scrub occupy margins of the basins. Also, some areas once occupied by Alkaline Grassland have been plowed and replanted with Sorghum halapense (Johnson Grass). Whether the grassland was once dominated by Hilaria mutica (Tobosa Grass) in an expansive "tobosa flat" or by Sporobolus spp. (Sacaton Grasses) cannot now be ascertained. The community may recover somewhat if soil stabilization begins to take effect as grass cover increases.

The community is quite depauperate, with the following species documented in the area: Hilaria mutica (Tobosa Grass), Erioneuron pulchellum (Fluffgrass), Sporobolus airoides (Alkali Sacaton), Sporobolus pyramidatus (Whorled Sacaton), Pappophorum vaginatum (Whiplash Pappussgrass), Bothriochloa laguroides var. torreyana (Silver Bluestem), Atriplex canescens (Four-wing Saltbush), Prosopis glandulosa var. torreyana (Western Honey Mesquite), Salsola kali (Tumbleweed), Verbena wrightii (Desert Verbena), Croton pottsii var. thermophilus (Leatherweed Croton), Opuntia phaeacantha var. major (Prickly Pear), Opuntia schottii var. grahamii (Dog Cholla), Solanum eleagnifolium (Silver Nightshade), Chamaesaracha coniodes (False Nightshade), Hoffmanseggia glauca (Rush-pea), Descurainia pinnata (Tansy-mustard), and Lesquerella fendleri (Fendler Bladderpod).

Creosote Scrub. Larrea tridentata (Creosote Bush) is present, if not subdominant in many communities below 3500 feet elevation, and circumscribable populations of the species exist to elevations above 5000 feet. The assemblage here described as Creosote Scrub is a community composed almost entirely of widely scattered Larrea, together with a paucity of associated species. The community is best developed on the Rosillos Mountains bajada, alluvial fans about the Chalk

Hills, and on a few outlying hilltops. Often a veneer of cobbles known as "desert pavement" is present in the interstices between shrubs.

Other members of the community are: Parthenium incanum (Mariola), Flourensia cernua (Tarbush), Coryphantha macromeris (Large-stem Coryphantha), Echinocereus dubius (Pitaya), Echinocactus horizonthalonius (Horse-crippler Cactus), Opuntia schottii var. grahamii (Dog Cholla), Opuntia leptocaulis (Pencil Cholla), Opuntia phaeacantha var. major (Prickly Pear), Opuntia violacea var. macrocentra (Purple Prickly Pear), Yucca treculeana (Spanish Dagger), Erioneuron pulchellus (Fluffgrass), Hilaria mutica (Tobosa Grass), Bouteloua trifida (Red Grama), Prosopis glandulosa var. torreyana (Western Honey Mesquite), Baileya multiradiata (Bailey Sand Daisy), Pectis papposa (Limoncillo), Thymophylla acerosa (Prickleleaf Dogweed), Hoffmanseggia glauca (Rush-pea), and Nerisyrenia camporum (Bicolor Mustard).

Plant List

Plant species documented to occur in the North Rosillos Area are listed below in alphabetical order by family. Approximately 461 taxa (ca. 456 spp.) are included. Some of the identifications are tentative because plant material sufficiently complete for positive determination was not always available.

Acanthaceae

- Carlowrightia linearifolia
- Ruellia parryi
- Stenandrium barbatum

Agaveaceae

- Agave havardiana
- Agave lechuguilla

Amaranthaceae

- Amaranthus palmeri
- Froelichia arizonica
- Tidestromia lanuginosa var. lanuginosa
- Tidestromia suffruticosa

Amaryllidaceae

- Zephyranthes longiflora

Anacardiaceae

- Rhus microphylla
- Rhus virens var. virens
- Rhus trilobata
- Toxicodendron radicans

Apocynaceae

Macrosiphonia lanuginosa

Aristolochiaceae

Aristolochia coryi

Asclepiadaceae

Asclepias asperula

Asclepias oenotheroides

Cynanchum pringlei

Matelea producta

Matelea reticulata

Sarcostemma cynanchoides var. *hartwegii*

Sarcostemma torreyi

Berberidaceae

Berberis trifoliolata

Bignoniaceae

Chilopsis linearis

Tecoma stans

Boraginaceae

Cryptantha angustifolia

Cryptantha crassiseppala var. *elachantha*

Cryptantha jamesii

Cryptantha mexicana

Cryptantha palmeri

Heliotropium confertifolium

Heliotropium glabriusculum

Heliotropium greggii

Heliotropium molle

Heliotropium torreyi

Lappula redowskii

Tiquilia canescens

Tiquilia greggii

Tiquilia hispidissima

Cactaceae

Ancistrocactus uncinatus

Ariocarpus fissuratus

Coryphantha echinus

Coryphantha macromeris

Coryphantha scheeri

Coryphantha tuberculosa var. varicolor
Coryphantha tuberculosa var. tuberculosa
Echinocactus horizonthalonius
Echinocactus texensis
Echinocereus dasyacanthus
Echinocereus dubius
Echinocereus stramineus
Echinocereus viridiflorus var. nova
Echinocereus viridiflorus var. russanthus
Ferocactus hamatacanthus
Mammillaria heyderi var. meiacantha
Mammillaria lasiacantha
Neolloydia conoidea
Opuntia engelmannii
(=O. phaeacantha var. discata)
Opuntia imbricata
Opuntia leptocaulis
Opuntia phaeacantha var. major
Opuntia schottii var. grahamii
Opuntia violaceae var. macrocentra

Campanulaceae

Lobelia berlandieri var. brachypoda
Lobelia cardinalis

Capparidaceae

Polanisia uniglandulosa

Caryophyllaceae

Drymaria pachyphylla
Silene laciniata
Silene laciniata var. greggii

Chenopodiaceae

Atriplex canescens
Chenopodium album
Chenopodium incanum
Salsola kali

Commelinaceae

Commelina erecta var. angustifolia
Setcreasea brevifolia

Compositae

Amphiachyris dracunculoides
Artemisia ludoviciana
Baccharis salicifolia
Bahia absinthifolia
Bahia pedata
Baileya multiradiata
Brickellia californica
Brickellia cylindracea
Brickellia laciniata
Centaurea americana
Centaurea melitensis
Chaetopappa bellioides
Chrysactinia mexicana
Cirsium texanum
Cirsium turneri
Conyza canadensis
Conyza coulteri
Erigeron modestus
Evax cf. verna
Flourensia cernua
Gaillardia pinnatifida
Gnaphalium stramineum
Gutierrezia microcephala
Gutierrezia sarothrae
Gymnosperma glutinosum
Helenium microcephalum
Helianthus annuus
Heterotheca cf. fulcrata
Heterotheca cf. villosa
Hymenoclea monogyra
Hymenoxys scaposa
Iva ambrosiaefolia
Leucelene ericoides
Machaeranthera pinnatifida
Machaeranthera scrabella
Machaeranthera tanacetifolia
Melampodium leucanthum
Melampodium leucanthum var. *leucanthum*
Parthenium argentatum
Parthenium confertum
Parthenium incanum
Pectis papposa
Perezia runcinata
Perezia wrightii

Perityle cf. aglossa
Perityle parryi
Perityle vaseyi
Porophyllum scoparium
Psilostrophe gnaphalodes
Psilostrophe tagetina
Ratibida columnaris
Senecio douglasii var. longilobus
Senecio millelobatus
Sonchus oleraceus
Stephanomeria pauciflora
Thelesperma longipes
Thelesperma megapotamicum
Thymophylla acerosa
Thymophylla micropoides
Thymophylla pentachaeta
Trixis californica
Verbesina encelioides
Viguiera dentata
Viguiera stenoloba
Xanthium spinosum
Xanthium strumarium
Zexmenia brevifolia
Zinnia acerosa

Convolvulaceae

Convolvulus arvensis
Convolvulus equitans
Cuscuta indecora
Evolvulus alsinoides
Ipomoea cf. cardiophylla
Ipomoea cristulata
Ipomoea cordatotriloba

Crassulaceae

Echeveria strictiflora
Sedum wrightii

Crossosomataceae

Forsellesia spinescens

Cruciferae

Descurainia pinnata
Dimorphocarpa wislizeni

Draba cuneifolia var. *integrifolia*
Draba cuneifolia
Lepidium cf. *lasiocarpum* var. *wrightii*
Lepidium oblongum
Lesquerella fendleri
Lesquerella purpurea
Nerisyrenia camporum
Schoenocrambe linearifolia
Selenia dissecta
Streptanthus carinatus
Streptanthus platycarpus
Synthlipsis greggii
cf. *Thelypodopsis purpusii*

Cucurbitaceae

Ibervillea cf. *lindheimeri*
Ibervillea tenuisecta

Cupressaceae

Juniperus cf. *erythrocarpa*
Juniperus pinchotii

Cyperaceae

Cyperus cf. *elegans*
Eleocharis macrostachya

Ebenaceae

Diospyros texana

Ephedraceae

Ephedra aspera
Ephedra trifurca

Euphorbiaceae

Argythamnia neomexicana
Bernardia obovata
Croton dioicus
Croton fruticulosus
Croton lindheimerianus
Croton pottsii var. *pottsii*
Croton pottsii var. *thermophilus*
Euphorbia albomarginata
Euphorbia brachycera
Euphorbia cinerascens

Euphorbia dentata
Euphorbia cf. *serpens*
Euphorbia serrula
Euphorbia serpyllifolia
Euphorbia theriaca
Jatropha dioica
Phyllanthus polygonoides
Tragia ramosa

Fagaceae

Quercus cf. *gambelii*
Quercus grisea
Quercus cf. *mohriana* X *Q. grisea*
Quercus pungens var. *pungens*
Quercus pungens var. *vaseyana*
Quercus sinuata var. *sinuata*
Quercus cf. *turbinella* (or *Q. turbinella* X *Q. grisea*)

Fouquieriaceae

Fouquieria splendens

Fumariaceae

Corydalis aurea var. *occidentalis*

Gentianaceae

Centaurium calycosum
Centaurium cf. *calycosum*

Geraniaceae

Erodium texanum

Gramineae

Agrostis semiverticillata
Aristida adscensionis
Aristida cf. *fendleriana*
Aristida glauca
Aristida purpurea
Aristida ternipes
Bothriochloa barbinodis
Bothriochloa laguroides var. *torreyana*
Bouteloua aristidoides
Bouteloua barbata
Bouteloua curtipendula
Bouteloua eriopoda

Bouteloua gracilis
Bouteloua ramosa
Bouteloua trifida
Cathestecum erectum
Cenchrus ciliaris
Chloris crinita
Chloris virgata
Cynodon dactylon
Digitaria californica
Diplachne (Leptochloa) fascicularis
Echinochloa muricata
Elymus longifolius
Enneapogon desvauxii
Eragrostis barrelieri
Eragrostis cilianensis
Eragrostis cf. pectinacea
Erioneuron pilosum
Erioneuron pulchellum
Heteropogon contortus
Hilaria mutica
Leptochloa dubia
Leptoloma cognatum
Lycurus phleoides
Muhlenbergia arenacea
Muhlenbergia emersleyi
Muhlenbergia porteri
Panicum arizonicum
Panicum bulbosum
Panicum fasciculatum
Panicum hirticaule
Panicum obtusum
Pappophorum bicolor
Pappophorum vaginatum
Poa bigelovii
Polypogon monspeliensis
Scleropogon brevifolius
Setaria leucopila
Sorghum halepense
Sporobolus airoides
Sporobolus pyramidatus
Tridens albescens
Tridens muticus

Hydrophyllaceae

Nama havardii
Nama hispidum
Phacelia coerulea
Phacelia congesta
Phacelia robusta

Juglandaceae
Carya illinoensis

Juncaceae
Juncus nodosus
Juncus torreyi

Koeberliniaceae
Koeberlinia spinosa

Krameriaceae
Krameria grayi
Krameria parvifolia (=K. erecta)

Labiatae
Hedeoma drummondii
Hedeoma nanum
Hedeoma nanum var. nanum
Marrubium vulgare
Salvia reflexa
Salvia roemeriana

Leguminosae
Acacia constricta
Acacia greggii
Acacia neovernicosa
Acacia roemeriana
Acacia schottii
Astragalus mollissimus var. earlei
Astragalus nuttallianus
Astragalus cf. nuttallianus
Caesalpinia parryi
Calliandra conferta
Dalea formosa
Dalea frutescens
Dalea greggii
Dalea jamesii

Dalea nana
Dalea neomexicana
Dalea cf. neomexicana
Dalea pogonathera
Dalea wrightii
Eysenhardtia texana
Hoffmanseggia glauca
Lotus oroboides
Lupinus havardii
Mimosa biuncifera
Mimosa borealis
Mimosa emoryana
Phaseolus acutifolius
Prosopis glandulosa var. torreyana
Senna bauhinoides
Senna durangensis
Senna lindheimeriana

Liliaceae

Dasyllirion leiophyllum
Nolina erumpens
Nolina cf. texana
Yucca elata
Yucca rostrata
Yucca treculeana

Linaceae

Linum sp.

Loasaceae

Cevallia sinuata
Eucnide bartonioides
Mentzelia multiflora

Loganiaceae

Buddleja scordioides

Malpighiaceae

Janusia gracilis

Malvaceae

Abutilon fruticosum
Abutilon parvulum
Gossypium hirsutum

Hibiscus coulteri
Hibiscus denudatus
Malvella leprosa
Sida abutifolia
Sphaeralcea angustifolia

Martyniaceae
 Proboscidea louisianica

Moraceae
 Morus microphylla

Nyctaginaceae
 Acleisanthes longiflora
 Allionia incarnata
 Ammocodon chenopodioides
 Boerhavia gracillima
 Boerhavia intermedia
 Boerhavia linearifolia
 Boerhavia wrightii
 Cyphomeris gypsophiloides
 Mirabilis coahuilensis
 Nyctginia capitata
 Selinocarpus angustifolius
 Selinocarpus parvifolius

Oleaceae
 Forestiera angustifolia
 Fraxinus cuspidata
 Fraxinus greggii
 Menodora longiflora
 Menodora scabra

Onagraceae
 Calylophus hartwegii var. hartwegii
 Gaura boquillensis
 Gaura coccinea
 Gaura parviflora
 Gaura suffulta var. nealleyi
 Oenothera brachycarpa
 Oenothera primiveris
 Oenothera tetraptera

Orobanchaceae

Orobanche cooperi

Papaveraceae

Argemone chisosensis

Phytolaccaceae

Rivina humilis

Pinaceae

Pinus cembroides

Plantaginaceae

Plantago cf. *hookeriana*

Plantago patagonica

Polemoniaceae

Gilia stewartii

Ipomopsis havardii

Polygalaceae

Polygala barbeyana

Polygala lindheimeri var. *parvifolia*

Polygala macradenia

Polygala scoparioides

Polygonaceae

Eriogonum abertianum

Eriogonum jamesii

Eriogonum rotundifolium

Eriogonum tenellum

Eriogonum wrightii

Polygonum sp.

Polypodiaceae

Adiantum capillus-veneris

Bommeria hispida

Cheilanthes feei

Cheilanthes horridula

Cheilanthes integerrima

Cheilanthes sinuata

Cheilanthes tomentosa

Cheilanthes wrightii

Notholaena parvifolia

Notholaena standleyi

Pellaea intermedia
Thelypteris ovata var. *lindheimeri*
Woodsia mexicana

Portulacaceae

Portulaca pilosa
Talinum aurantiacum

Ranunculaceae

Clematis drummondii

Resedaceae

Oligomeris linifolia

Rhamnaceae

Adolphia infesta
Condalia ericoides
Condalia viridis
Condalia warnockii
Ziziphus obtusifolia

Rosaceae

Amelanchier denticulata
Cercocarpus montanus var. *paucidentatus*
Fallugia paradoxa
Prunus havardii
Prunus persica

Rubiaceae

Bouvaridia ternifolia
Cephalanthus occidentalis
Galium cf. *proliferum*
Houstonia nigricans

Rutaceae

Thamnosma texana

Salicaceae

Populus X acuminata
Populus deltoides ssp. *wislizenii*
Populus fremontii subsp. *mesetae*
Salix gooddingii
Salix interior

Sapindaceae

- Sapindus saponaria* var. *drummondii*
- Ungnadia speciosa*

Saxifragaceae

- Fendlera rupicola*
- Ribes aureum*

Scrophulariaceae

- Castilleja integra*
- Castilleja nervata*
- Leucophyllum frutescens*
- Leucophyllum minus*
- Maurandya antirrhiniflora*
- Mimulus glabratus*
- Penstemon barbatus* var. *torreyi*
- Penstemon havardii*

Selaginellaceae

- Selaginella lepidophylla*
- Selaginella mutica* var. *texana*
- Selaginella peruviana*
- Selaginella underwoodii*

Solanaceae

- Chamaesaracha coniodes*
- Chamaesaracha coronopus*
- Chamaesaracha* cf. *sordida*
- Datura wrightii*
- Lycium berlandieri*
- Lycium puberulum* var. *puberulum*
- Lycium puberulum* var. *berberidoides*
- Lycium torreyi*
- Nicotiana trigonophylla*
- Physalis hederifolia*
- Quincula lobata*
- Solanum elaeagnifolium*

Tamaricaceae

- Tamarix chinensis*

Typhaceae

- Typha latifolia*

Ulmaceae

Celtis pallida
Celtis reticulata
Ulmus pumila

Urticaceae

Parietaria pensylvanica

Verbenaceae

Aloysia gratissima
Aloysia wrightii
Lantana macropoda
Tetraclea coulteri
Verbena neomexicana
Verbena neomexicana var. hirtella
Verbena pumila
Verbena cf. racemosa
Verbena scabra
Verbena wrightii

Viscaceae

Phoradendron tomentosum
Phoradendron coryae

Vitaceae

Cissus incisa
Vitis arizonica

Zygophyllaceae

Guaiacum angustifolium
Kallstroemia grandiflora
Kallstroemia parviflora
Larrea tridentata
Tribulus terrestris

Special Reports on Plants

There are only a few rare plants that are known to occur in the North Rosillos Area. One shrub species, Lycium puberulum var. berberidoides, is federally listed as Category 2. The rock-dwelling species Cirsium turneri is listed as Category 3C. It is possible that the Endangered cactus species Echinocereus lloydii and Echinomastus mariposensis could occur in the area, but these species were not located during the survey period. Another rare cactus, an undescribed variety of Ancistrocactus brevihamatus, is known to occur just a few miles to the north of the study area, but

it too was not found during the course of the current investigations. Yet other plant species that are considered to be rare eventually might be found in the study area.

Following is a list of 32 plant species identified in the North Rosillos Area that were not found on the 1991 plant list prepared for Big Bend National Park: Amphiachyris dracunculoides, Boerhavia linearifolia, Boerhavia wrightii, Buddleja scordioides, Calylophus hartwegii, Castilleja nervata, Centaurea melitensis, Cheilanthes feei, Cirsium texanum, Convolvulus arvensis, Corydalis aurea, Coryphantha scheeri, Cryptantha cinerea, Echinochloa muricata, Elymus longifolius, Evax verna, Gaura parviflora, Gaura suffulta var. nealleyi, Gossypium hirsutum, Ibervillea lindheimeri, Juniperus erythrocarpa, Juniperus pinchotii, Lepidium oblongum, Malvella leprosa, Muhlenbergia arenacea, Oenothera tetraptera, Opuntia macrocentra, Phaseolus acutifolius, Populus freemontii subsp. mesetae, Prunus persica, Synthlipsis greggii, Thelypteris ovata var. lindheimeri, Thymophylla micropoides, and Xanthium strumarium.

A few exotic species are present in the study area. Cynodon dactylon is considered naturalized in Texas and was common in the study area. Sorghum halepense and Salsola iberica are common throughout the North Rosillos Area, but these species are common all over Texas. Tamerix sp. was very sparse and was located near springs.

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CHAPTER 4

PARASITIC WASPS OF THE FAMILIES ENCYRTIDAE AND BRACONIDAE

James B. Woolley and Robert A. Wharton

FAMILY ENCYRTIDAE

The Encyrtidae are one of the largest families in the order Hymenoptera, the order of insects that includes bees, wasps and ants. The family is one of the largest in the superfamily Chalcidoidea, and one of the most diverse in terms of host relationships. All known Encyrtidae are parasitic on other insects and their larvae develop by feeding on the immature or rarely the adult stages of other insects. Although hosts are known in most orders of insects, the majority of encyrtids are parasites of insects in the order Homoptera including scale insects and mealybugs and more rarely aphids and whitefly. Some species parasitize spiders and ticks. The majority of encyrtidae collected at Big Bend National Park are parasites of mealybugs and scale insects. Many of these insects exist below the crown level in desert plants, particularly in grasses. As a group, Encyrtidae seem well adapted to xeric habitats worldwide and are common and diverse elements of the fauna of micro-Hymenoptera in desert regions.

Approximately 400 described species of Encyrtidae are known from North America, however, a great many undescribed species are known. The majority of taxonomic research on this family has focused on species of agricultural importance because encyrtids are commonly used as biological control agents of pest insects. As a result, a great deal of descriptive work remains to be done on the fauna of non-agricultural areas, such as desert regions. It is clear that only a fraction of the fauna from North America, certainly less than 50%, has been described. Woolley's laboratory at Texas A&M University has concentrated on the taxonomy of Encyrtidae of North America for approximately ten years.

During this project, 2459 specimens of Encyrtidae were collected. Following collection in ethanol, specimens were critical-point dried, point-mounted and labelled using standard methods. Material was then sorted to species. One hundred fifty-four species in 65 genera were found in the material from the North Rosillos Area (Table 4). As expected, many of these species are clearly undescribed, and many more have not yet been associated with type material for North American species. Therefore, we report the majority of these species as numbered morphospecies. The numbers used are consistent with numbers we are using in other work in progress, therefore, the sequences of numbers for species may not be consecutive: for example, *Avetianella* sp. 2 and sp. 4 were found in the survey, but not species 1 and 3 which are known from elsewhere. Encyrtidae are very highly sexually dimorphic and definite association of male and female individuals of a species is often a difficult task without rearing samples, access to live material or long series of specimens. We have followed a conservative approach. Males were assumed to belong to same species as females unless there was evidence to the contrary. Therefore, if species were collected only from male specimens they may not be included in the totals reported and they are therefore certainly underestimates of the number of species present.

Species that are definitely new to science are indicated as such, as are at least two new genera that are found in material from Big Bend National Park. Description of these taxa is underway in the context of other projects. Two additional species could not be placed in any known genus, but we have not conclusively determined at this time that they represent new genera. It is possible that they belong in genera described from other parts of the world but unreported as yet from North America, as has been the case with many other species of Encyrtidae. Discovery of species and genera not known to occur in North America, particularly Neotropical species, is rather common as might be expected, but nevertheless such discoveries have been an especially valuable aspect of the survey work in Big Bend National Park. All Encyrtidae collected during this project are labelled with distinctive blue labels that state "Natl. Park Serv., Big Bend N.P., Accession #650" and all are deposited in the Insect Collection, Department of Entomology, Texas A&M University.

Encyrtidae were collected from most of the vegetative communities in the North Rosillos Area using a variety of methods. The sweep net is the most common and productive method used to collect Encyrtidae, particularly modified nets with triangular collecting heads that allow one to sweep close to the ground level. Rectangular, yellow pan traps filled with water and a surfactant are also productive. From 50-100 such pans (15x23 cm) were deployed and checked daily. Malaise traps of a standard Townes design were the third collecting method used. Up to a dozen such Malaise traps were deployed in various vegetative communities during each visit to North Rosillos Area. Obviously, each of these methods also resulted in the collection of many species of Braconidae. In all, 147 different lots of material were collected during the project. Ninety-two of these collections yielded Encyrtidae, 121 yielded Braconidae and 134 collections yielded either Braconidae or Encyrtidae.

Patterns by Vegetative Community

Encyrtidae were found in 12 of the 13 vegetative communities identified by Powell and Whitefield in this project. Because many of the collections were made before detailed maps of vegetative communities were available, not all collections were restricted to a single vegetative community. For example, a few collections from riparian communities also included material from arroyo scrub, some collections from semidesert grassland also contained material from arroyo scrub, etc.

Table 6 contains lists of genera and species of Encyrtidae collected in each vegetative community. Repeated occurrences of species names in Table 3 indicates that the species occurred in that number of samples. These repetitions therefore provide a rough indication of the relative commonness of each species. We provide lists only for collections that could be definitely associated with single vegetative communities, although in general the results would not be significantly different if the mixed samples were included.

Riparian. This vegetative community was by far the most productive of any sampled in the North Rosillos Area. Several riparian habitats in the North Rosillos Area were sampled, but the vicinity of Buttrill Springs was by far the most commonly collected. Twenty-four collections made in riparian habitats contained Encyrtidae, however, one of these collections overlapped arroyo scrub

habitat also. In the 23 remaining samples, 107 species were collected in 49 different genera. Numerous species collected in riparian habitat were not found in other plant habitat types even though canyon scrub, mariola scrub, arroyo scrub, semidesert grassland, grama grassland, mesquite scrub and creosote scrub habitats received extensive attention. In part, the mesic conditions found in riparian habitats provide excellent conditions for the hosts of encyrtids. These habitats are also more stable over time and not as subject to seasonal fluctuations in soil moisture available for plant growth, presumably providing more stable conditions for populations of Homoptera and other encyrtid hosts. Also, encyrtids predominantly associated with trees and shrubs were much more diverse in this habitat. For example, seven species of *Metaphycus* were collected in riparian habitat, far more than any other plant association (four species were collected in canyon scrub). *Metaphycus* species are parasites of soft scale insects (family Coccidae) that are much more commonly found on large shrubs and trees.

Oak Woodlands. Oak woodlands were not extensively sampled in the survey, due to limited distribution and inaccessability of the habitat. Only one sample was taken in an area determined to be oak woodlands and unfortunately this sample overlapped a canyon scrub area. In any case, the sample produced only limited Encyrtidae: 2 species in 2 genera. Both of these species were present in other habitats, for example, in riparian areas, although one of them, *Agarwalencyrtus* sp. 3, is uncommon and otherwise occurred only in two riparian samples. This genus was described from India and is known from North America primarily from material collected in Big Bend National Park. In addition to the species we encountered in the North Rosillos Area, another species has been collected by other workers in the main area of the park. The hosts of these species are unknown, although other *Agarwalencyrtus* are parasites of mealybugs or larvae of Pipunculid flies. Apparently, this genus also is associated with host insects that occur in large shrubs or trees.

Canyon Scrub. This habitat was reasonably productive and contained the second most diverse group of Encyrtidae. Eighteen samples from canyon scrub produced Encyrtidae, although as noted above, one of these collections overlapped an oak woodland area. However, due to the low number of species found in this particular sample it is not a complicating factor. Canyon scrub was second only to riparian habitat in terms of encyrtid diversity: 78 species in 42 genera were encountered. Some of these species were found only in this habitat. For example, the genus *Cerapetroceroideus* was found only in samples from either riparian or canyon scrub, however, the former contained a single species while canyon scrub produced three species. These species are almost certainly parasites of armored scale insects which would be expected to be most diverse in shrub and tree species typically found only in these habitats.

Grama Grassland. This habitat was third most diverse in terms of Encyrtidae. Ten collections were made in grama grassland, although one also included elements of mariola scrub. The remaining nine collections produced 53 species in 30 genera. In addition, several species collected in grama grassland, for example, *Anagyrus* sp. 30, *Discodes* sp. 1 and *Tetracnemus* sp. 7, were not found in any of the other habitats. These species are almost certainly undescribed. Collections from high elevation meadows near the summit of Rosillos Mountains were particularly productive for Encyrtidae. The encyrtids collected in grama grassland are predominantly associated with Homopteran hosts such as mealybugs and scale insects, many of which develop on grasses. The

high diversity of encyrtids in this habitat is no doubt associated with a high diversity of host insects and grass species in these relatively undisturbed locations.

Semidesert Grassland (Igneous Substrate). Semidesert grassland was also extensively sampled, but it appears to be substantially less diverse with respect to Encyrtidae than the grama grassland. However, many of the more productive samples from semidesert grassland overlapped arroyo scrub habitat, mostly in the vicinity of Buttrill Springs. Twenty-two species from 14 genera were found in the five samples restricted to semidesert grassland. However, when the four samples that also included elements of arroyo scrub are included, the totals become 36 species in 24 genera. Many of these samples produced long series of relatively few common species, such as *Apoanagyrus* sp. 24 and *Meromyzobia* sp. 1. In any case, grama grassland was by any measure more diverse with respect to Encyrtidae than was the semidesert grassland community, no doubt this is due to differences in plant composition, and perhaps grazing history.

Mosaic: Semidesert Grassland (Limestone Substrate), Mariola Scrub and Lechugilla Scrub. Even though this habitat produced only three samples with Encyrtidae, the collections were reasonably diverse: 26 species in 18 genera were found. Two species of *Anagyrus*, sp. 8 and sp. 29, were collected only in this habitat type. *Anagyrus* species are parasites of mealybugs which in desert areas are primarily associated with the roots and crowns of grasses. Given that this habitat is essentially composed of faunal elements found elsewhere, it is likely that these two species also would be collected in other habitats, for example, in semidesert grassland, with continued sampling.

Arroyo Scrub. As noted above, many of the samples from arroyo scrub contained elements of other plant habitats, specifically riparian, semidesert grassland and creosote scrub. In the 6 samples from arroyo scrub habitat that contained encyrtids, we found 19 species in 12 genera. However, when all 13 of the samples that contain elements of this habitat are included the totals become 33 species in 24 genera. One species of *Gyranusoidea*, sp. 10, was found only in samples from arroyo scrub. This species is almost certainly undescribed. Although its biology is unknown other species in the genus are parasites of mealybugs. The plant host of this species is unknown.

Mixed Shrub and Succulent Scrub. This habitat was not particularly productive of Encyrtidae, only 12 species in 11 genera were encountered, all of which occur in other habitats. We cannot entirely explain this, perhaps more samples would have produced more. One species found in this habitat, *Metaphycus* sp. 40, was not encountered in samples from any other habitat. Again, this genus contains parasites of soft scale insects (Coccidae) that would be expected to occur on shrubs in this habitat.

Mariola Scrub. Surprisingly, this habitat produced far more samples containing Braconidae (15 collections) than Encyrtidae (4 collections). Of the four samples containing encyrtids, one overlapped a Grama Grassland area, leaving three samples. Given the low number of samples they were reasonably diverse: 22 species in 15 genera were represented. One species, *Metaphycus* sp. 36 was found only in a single sample from Mariola scrub. Again, it would be unwise to draw too many conclusions from these limited data, but *Metaphycus* species are parasites of soft scale insects, probably associated with shrubs or small trees.

Mesquite Scrub. This habitat was sampled largely using Malaise traps in Nine Point Draw and vicinity. Encyrtid diversity in general is rather low: only 3 of these samples contained encyrtids and only 9 species in 8 genera are represented. All of these species are common elements in the other habitats sampled.

Alkaline Grassland. This habitat was almost devoid of insect diversity during the several occasions we attempted to sample it. One sample from alkaline grassland contained Encyrtidae but this sample also overlapped mesquite scrub habitat. In any case, only two species of Encyrtidae were present, both common species in samples from virtually every plant association.

Creosote Scrub. Despite a fair amount of attention to this habitat (8 samples produced Encyrtidae, one of which overlapped arroyo scrub), encyrtid diversity was low. Only 7 species in 5 genera were encountered, all of which were common in samples from other habitats.

Summary

During this project, 154 species of Encyrtidae in some 65 genera were collected. The riparian and canyon scrub vegetative communities were the most diverse for Encyrtidae, presumably because the higher plant diversity and more stable, mesic conditions allow for more sustained development of their hosts. Because many mealybugs and other Homoptera are associated with the roots and crowns of grasses in desert habitats, we expected to find encyrtid diversity in vegetative communities containing high grass diversity. This was certainly the case in the grama grassland, but clearly not not the case in the semidesert grassland (igneous substrate). Semidesert grassland (limestone substrate) is found in a complex mosaic habitat with mariola and lechugilla scrub, however, this mosaic habitat did not contain a high diversity of Encyrtidae either. As noted in Chapter 3, the composition of these short grass prairie communities is quite different and the semidesert grassland areas in the North Rosillos Area have received intensive grazing pressure in the past, resulting in a substantial change in the species composition and diversity of species in these areas. This appears to be reflected in the encyrtid fauna as well, in fact, the difference in the Encyrtidae between the two vegetative communities is quite striking.

FAMILY BRACONIDAE

The Braconidae are the second largest family of Hymenoptera, the order of insects which includes bees, wasps, and ants. With the exception of a few recently discovered phytophagous tropical species, all known braconid wasps develop as parasitoids. Parasitoid adults are free living, but the females lay their eggs in or on other invertebrates which then serve as hosts for the developing immature stages. The immature stages of braconids develop at the expense of other insects, killing their host. Immature Lepidoptera (caterpillars) and adult and immature Coleoptera (beetles) are among the most common hosts of the Braconidae, but many other insect groups are attacked as well.

There are approximately 2000 different species of Braconidae which have been described from America north of Mexico. Although braconids are fairly well-known because many species attack pests of agricultural crops, there are still many undescribed species which await detailed study. This is particularly true for areas such as Big Bend National Park, where little prior collecting has been done. Van Pelt, for example, in a recent compendium of the Hymenoptera of Big Bend National Park, lists only six species of Braconidae. We collected 332 species in 73 genera during our biodiversity survey of the North Rosillos Area (Table 5). As expected, many of these are clearly undescribed species, and many others cannot be assigned species names without more detailed taxonomic research. The material we have collected will be used for such taxonomic studies for years to come.

The Braconidae from North Rosillos Area can be conveniently divided into 18 subfamily groups, which are discussed individually below. A species list, arranged by subfamily, is provided at the end of the report, with morphospecies designated simply by consecutive numbers within a genus. Thirteen habitat types have been described for the North Rosillos Area Division, and we have also provided a discussion of the species by habitat type. At least one-third of the species from our samples are fairly widespread in distribution, ranging well outside the Big Bend Region. Based on collections made in nearby Big Bend State Natural Area, most of the remaining species do not appear to be endemic to the North Rosillos Area.

Taxonomic Treatment

Subfamily Rogadinae. This subfamily (treated here in the broad sense to include the exothecines and related groups) is represented by 56 species in eight genera. Most of these species are nocturnal, and are either external or internal parasitoids of Lepidoptera. Many of the species attack exposed or weakly concealed foliage-feeding caterpillars while others attack leaf-miners. At least half of the species collected during this survey are undescribed, and some of this material is currently being used in taxonomic revisions. *Aleiodes* is particularly speciose in the North Rosillos Area, and this is typical of arid regions throughout the world. At least one new species of *Aleiodes* will be described based on material from the National Park and the nearby State Natural Area. This new species has not been collected outside these areas. Collections of *Aleiodes ferrugineus* from both the National Park and the State Natural Area represent a significant northern range extension for this species. *Hormius* and *Parahormius*, both of which are species-rich, are very poorly known genera with few described species in North America. The diversity of *Clinocentrus* species was unexpected, since they are not well-known from arid regions. It is probable that three of the four species are undescribed.

Subfamily Doryctinae. The doryctines are represented by 42 species in 12 genera, and all North American species are external parasitoids. The vast majority of the specimens are assignable to either *Heterospilus* or *Rhaconotus*, the hosts of which are stem-boring Lepidoptera and Coleoptera. The species richness of *Heterospilus* was expected as it is a huge genus, and its species are some of the most commonly encountered braconids in all habitats in the New World. The genus has not been recently revised, and only seven species had previously been recorded from Texas. For *Rhaconotus*, we collected nearly twice the number of species previously recorded for North America. Included

in our samples are some very unusual brachypterous forms from grasslands. Brachyptery has never been recorded for North American *Rhaconotus* prior to our surveys of the Big Bend Region. Remaining doryctines are somewhat under-represented in our samples, and, based on our experiences elsewhere, we would expect to find at least an equal number of other species with more intensive sampling. However, this would probably require the removal of considerable amounts of beetle-infested vegetation for rearing since these species occur within dense, thorny vegetation and are otherwise difficult to sample. Three specimens appear to represent an undescribed genus, and these will be studied in the near future to determine their exact status.

Subfamily Braconinae. The braconines are represented by 34 species in seven genera. At least one additional genus, *Cyanopterus*, should occur in this part of the park, but was not collected during our survey. Numerous specimens of both *Digonogastra* species 1 and species 2 were collected from various yucca pods. They attack the lepidopteran pollinators which feed as caterpillars within the pods. *Habrobracon gelechiae* and several of the *Bracon* species are widespread, highly polyphagous, and attack a wide variety of insects hosts. Many of these hosts feed on flowers. All North American species are external parasitoids, but members of all remaining subfamilies discussed here develop from eggs laid inside their host, and are therefore internal parasitoids.

Subfamily Gnamptodontinae. This is a small subfamily with only two North American genera, both of which are present in the North Rosillos Area. Known species are parasitic on leaf-mining Lepidoptera of the family Nepticulidae, and this almost certainly applies to the four species recorded during our survey.

Subfamily Opiinae. This subfamily is represented in our samples by a single genus with approximately 34 species, nearly all of them undescribed. Most of these are parasitoids of leaf-mining Diptera of the family Agromyzidae. *Opius* is one of the largest genera of the Braconidae, and thus the species richness recorded here is not entirely surprising. However, this level of diversity has not been previously recorded for arid regions.

Subfamily Alysiinae. Although represented by only 16 species in four genera, the diversity of alysiines in the North Rosillos Area is unexpectedly high. Alysiines are primarily a mesic group, with greatest diversity in cool, wet habitats. Nearly all of the species recorded here are undescribed, and all are parasitic on Diptera. The species of *Aspilota* are restricted in their hosts to members of the family Phoridae, while the group to which our three species of *Chorebus* belong are known primarily as parasitoids of members of the family Ephydriidae.

Subfamily Aphidiinae. This small subfamily is represented by five species in four genera. As the name suggests, all aphidiines are parasitoids of aphids. Three of these species are widespread in North America, attacking a number of different aphid species in a wide variety of habitats. The other two may represent undescribed species, but the sample size is too small to be certain.

Subfamily Agathidinae. This subfamily is represented by nine species in four genera, and is almost certainly under-represented in our samples. Agathidines are most commonly collected at flowers during the summer months, and we were unable to obtain adequate samples during our survey in part

because of the drought conditions prevailing during the first portion of sampling period. We would normally expect to find at least twice as many species in similar habitats in western United States, and at least one additional genus (*Bassus*). The *Coccygidium* we collected is unusually color-variable, and represents a species not previously recorded from Texas. Only two species of *Coccygidium* have previously been known from the United States. All agathidines attack caterpillars, often those concealed in flower heads and shoots or buds.

Subfamily Macrocentrinae. This subfamily is represented in our samples by a single species, which is somewhat surprising since the species are normally crepuscular to nocturnal and often found in arid regions. They are exclusively parasitic on lepidopteran larvae.

Subfamily Homolobinae. This small subfamily is represented in our samples by the very common and widespread species *Homolobus truncator*, which attacks a wide diversity of caterpillars.

Subfamilies Blacinae and Helconinae. Subfamily limits are currently a matter of some debate, and these groups are lumped together here in a broad sense to include both microtypines and orgilines. We collected 20 species in six genera. Hosts include both lepidopterans and coleopterans, and the known species of *Urosigalphus* and *Nealiolus* are exclusively parasitic on weevils. *Microtypus* is represented in our samples by more species than have previously been recorded from all of North America. The species of *Orgilus* (parasitic on concealed lepidopteran larvae) are currently being revised taxonomically, and we expect that several of our species are undescribed.

Subfamily Neoneurinae. This is a very small subfamily with only two genera described from North America. We have collected a single species, but it represents a third genus, new to science. This is the most significant finding of our survey of North Rosillos Area Braconidae. Members of this subfamily are presumed to be parasitic on ants.

Subfamily Ichneutinae. This is another small subfamily represented in our samples by two species in two genera. The genus *Anapryxia* was recently described from material collected in Florida and central Texas, and our material represents both a considerable range extension and the first records of the genus from an arid region. The ichneutines which we have collected are apparently parasitic on small lepidopteran larvae, but little is actually known of this group.

Subfamily Euphorinae. For the sake of convenience, we are also including the meteorines under this subfamily. This group is represented by 21 species in five genera. The material at hand is dominated by members of the genus *Microctonus*, parasitoids of adult beetles. They commonly attack weevils and tenebrionid beetles in arid environments, but almost all of our information on the biology of this genus comes from work in agricultural crops in more mesic habitats. Members of the genus *Meteorus* encountered in our survey are parasitoids of caterpillars, and *M. laphygmae* was one of the most abundant braconids collected during the period of our investigation.

Subfamily Cheloninae. *Adelius* is included here because of its close relationship to *Chelonus*, even though this genus is usually placed in a different subfamily. This group is represented by 26 species in two genera. Most if not all of our *Adelius* represent undescribed species, and many of the

Chelonus are similarly undescribed. All *Chelonus* are egg-larval parasitoids of Lepidoptera. The genus *Phanerotoma* was not represented in any of our samples. The species are nocturnal, and typical of arid regions. We found four species of *Phanerotoma* in Big Bend State Natural Area, and I would expect at least two of those to occur in the North Rosillos Area.

Subfamily Cardiochilinae. There is a single genus in North America, and it is represented by six species in our samples. These species typically attack exposed or weakly concealed caterpillars, usually in the herbaceous stratum. Members of this genus are commonly encountered in arid regions, and we would expect to find a few more species with more intensive sampling of flowers. Included among our material is a long series of an exceptionally small species which we have not previously encountered, and which may represent a new species in this otherwise well-studied group.

Subfamily Miracinae. This is a small subfamily with one genus in North America. We collected four species, most of which appear to be undescribed. The species attack small lepidopteran larvae, often those mining leaves.

Subfamily Microgastrinae. One of the largest subfamilies of the Braconidae, it is represented in our material by 50 species in 11 genera. At least one additional, relatively rare species associated with yuccas should also occur in the North Rosillos Area, but we did not see it even though we specifically looked for it. Male microgastrines are especially difficult to identify, and localities on the data sheets are based almost exclusively on females. Thus some of the species may be more widespread across habitats than is indicated in our report. All microgastrines are parasitic on larval lepidopterans, and many of the species we collected are undescribed.

Patterns by Vegetative Community

Braconids were found in all 13 habitat types identified by Powell and Whitefield in their vegetation survey of the North Rosillos Area (Table 6). However, the mountain scrub was sampled intensively on only one occasion, and only a single individual (a widespread species of *Aleiodes*) was observed in the field. All other habitats were represented by at least four species, and voucher specimens of all of these species are maintained in the Insect Collection of the Department of Entomology, Texas A&M University.

Riparian. The riparian habitat was clearly the most productive for Braconidae, with 33 samples containing 194 different species. More than half of these species were confined to the riparian habitat within the North Rosillos Area of the park, with the remainder being found in other habitat types, primarily canyon and arroyo. More species were restricted to the riparian habitat than to all other habitats combined. Nearly all of our samples were taken from Buttrill Springs, but several other riparian habitats were also sampled, and found to be similar in species composition. Several common, widespread species range into the desert and semidesert areas of the Big Bend region by using the riparian habitat as a refugium. Trees, shrubs, and streamside forbs provide more mesic conditions and abundant host material for parasitoids, even during periods of drought. Seven other habitat types (mariola scrub, mosaic, canyon scrub, arroyo scrub, grama grassland, semidesert

grassland, and creosote scrub) were sampled with equal intensity during the study period. However, many of the samples from these other habitats were devoid of Braconidae.

Canyon Scrub. The canyon scrub produced 61 species of Braconidae from 28 samples. Only 14 of these species were confined to the canyon scrub habitat. Most of the canyon scrub samples came from the vicinity of Buttrill Springs, and many of the species collected from the canyon scrub were also found in the adjacent riparian habitat. At higher elevations, the canyon scrub was intermingled with the oak woodland habitat to some extent. The oak woodland habitat was specifically sampled only once, due to difficulty of access and small size of the habitat type, and at this site the oak woodland was not readily separable from canyon scrub. Nevertheless, sweep net samples taken specifically from oaks were among the most productive samples taken anywhere in the North Rosillos Area outside of Buttrill Springs. Fifteen species were collected from the oak woodland/canyon scrub mixed habitat in approximately one hour. Two of the species were specific to this sample site, and one of these represents an undescribed genus.

Mariola Scrub. Mariola scrub increased notably in productivity following the end of the drought. We recovered 45 species from 15 samples, but as noted above, several other samples were taken which proved unproductive. Most of the 12 species collected only in this habitat type have been found elsewhere in Texas, and several of these occur outside the Big Bend Region.

Mosaic. The mosaic habitat produced 33 species, but only seven of these were unique to this habitat type. Of the eight habitats sampled on a regular basis, the mosaic and creosote scrub produced the lowest percentages of unique species. This is not unexpected for the mosaic given the mixed nature of the habitat.

Arroyo Scrub. Arroyo scrub intersected many of the other habitat types, and it was often difficult to segregate the samples by habitat. Thus we took braconids from 10 samples exclusively within the arroyo habitat and another 10 samples representing an arroyo and its adjacent habitat type. Seventy species were collected within the arroyo alone, giving the arroyo scrub the highest species-to-sample ratio of the 13 habitat types. Twenty-five of these species were found only in the arroyos. The grama grassland is also represented by 10 samples containing Braconidae. In the grama grassland, however, only 22 species were recovered, nine of which were unique to this habitat type.

Mesquite Scrub. The mesquite habitat was represented largely by Malaise trap samples from nine-point draw. Malaise traps are usually one of the best methods for collecting Braconidae, but do not work well in most desert habitats. The mesquite trees along Nine-Point Draw, however, provided one of the few places outside the riparian habitat and deeper arroyos where Malaise traps could be operated efficiently. Almost all samples taken in the mesquite habitat produced braconids, with 36 species recovered from seven collections.

Creosote Scrub. The creosote scrub also produced only seven samples containing braconids. Many additional samples were taken from this habitat, but these lacked braconids. Twenty four species

were collected from creosote bushes, but only three of these were unique to this habitat. All three were species of *Apanteles*, the members of which are host-specific on certain caterpillars.

Semidesert Grassland. The semidesert grassland was largely unproductive for Braconidae during the first portion of our sampling period, when drought conditions still prevailed. Six of the samples taken following the end of the drought contained braconids, though these were few in number. Only 11 species were collected, with three of these unique to this grassland habitat.

Alkaline Grassland. The alkaline grassland habitat, though fairly extensive, was also relatively unproductive. Only two of several samples taken in this habitat contained braconids. Two of the six species recovered from these samples were collected only in the alkaline grassland within the North Rosillos Area, but both species are well-known elsewhere in Texas. Vegetation in this habitat was sparse and dry during the first part of our study, and largely weedy during the remainder of our sampling program.

Summary

The Braconidae of the North Rosillos Area of Big Bend National Park are represented by 332 species in 73 genera. Many of these species are undescribed, and specific names are therefore available for only a few of the taxa on our list. The remainder have been identified to morphospecies. Revisions of several of the genera reported here are currently in progress by a number of specialists, and material from our collections will be used in these revisions.

Van Pelt, in a recent compendium of the Hymenoptera of Big Bend National Park, lists only six species of Braconidae. All of these are found in the North Rosillos Area, but names used in the original sources need to be re-evaluated pending revision of the genera *Digonogastra*, *Hormius*, and *Orgilus*. The *Bracon gelechiae* listed by Van Pelt is now in the genus *Habrobracon*, and is one of the more common and widespread braconids in the U.S.

At least one-third of the species from our samples are fairly widespread in distribution, and range well outside the Big Bend region. Based on collections made in nearby Big Bend State Natural Area, most of the remaining species do not appear to be endemic to the North Rosillos Area and probably occur throughout the Big Bend region. A few of the species, most notably the undescribed genus of Neoneurinae, may be endemic but more extensive collecting in Big Bend Park outside the North Rosillos Area will be needed to determine the status of this and other potential endemics.

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Table 4. Species of Encyrtidae collected in the North Rosillos Area, Big Bend National Park.

Subfamily Encyrtinae:

TribeSpecies

Aphycini?	Metaphycus sp. 1
Aphycini	Acerophagus sp. 2
Aphycini	Aphycus sp. 7
Aphycini	Blastothrix sp. nr. longipennis
Aphycini	Metaphycus sp. 1
Aphycini	Metaphycus sp. 3
Aphycini	Metaphycus sp. 6
Aphycini	Metaphycus sp. 8
Aphycini	Metaphycus sp. 21
Aphycini	Metaphycus sp. 34
Aphycini	Metaphycus sp. 35
Aphycini	Metaphycus sp. 36
Aphycini	Metaphycus sp. 38
Aphycini	Metaphycus sp. 39
Aphycini	Metaphycus sp. 40
Aphycini?	Metaphycus sp. 1
Aphycini	Pseudaphycus sp. 1
Aphycini	Pseudaphycus sp. 3
Aphycini	Pseudaphycus sp. 5
Aphycini	Pseudaphycus sp. 6
Aphycini	Pseudaphycus sp. 7
Aphycini	Pseudaphycus sp. 11
Aphycini	Pseudaphycus sp. 12
Aphycini	Pseudectroma sp. 1
Aphycini	Stemmatosteres sp. 2
Aphycini	Tachardiobius sp. 1
Bothriothoracini	Bothriothorax sp. 4
Bothriothoracini	Pentelicus sp. 1
Bothriothoracini	Rhytidothorax sp. 8
Cerapterocerini	Cerapterocerus sp. 2
Cerapterocerini	Cerapterocerus sp. 4
Cerapterocerini	Ceraptrroceroideus sp 5
Cerapterocerini	Ceraptrroceroideus sp 6
Cerapterocerini	Ceraptrroceroideus sp. 3
Cheiloneurini	Achalcerinys ?
Cheiloneurini	Cheiloneurus sp. 6
Cheiloneurini	Cheiloneurus sp. 7
Cheiloneurini	Cheiloneurus sp. 9

Microterryini
 Microterryini
 Microterryini
 Microterryini
 Trechnitini
 Trechnitini
 Trechnitini
 Trechnitini
 Trechnitini
 Unplaced
 Unplaced
 Unplaced
 Unplaced
 Unplaced
 Unplaced
 Unplaced
 Unplaced
 Unplaced
 Unplaced

Ooencyrtus sp. 27
 Ooencyrtus sp. 28
 Shenahetia sp. 2
 Syrphophagus
 Trjapitzinellus sp. 1
 Psyllaephagus nr. yaseeni
 Psyllaephagus sp. 1
 Psyllaephagus sp. 2
 Psyllaephagus sp. 12
 Psyllaephagus sp. 13
 Americencyrtus sp.
 Forcipestricis sp. 1
 Ginsiana sp. 3
 Ginsiana sp. 4
 Habrolepopteryx sp. 1
 Habrolepopteryx sp. 2
 Lamennasia sp. 1
 Lamennasia sp. 2
 New Genus 5, sp. 2
 New Genus 45, sp. 1

Subfamily Tetracneminae:

TribeSpecies

Acroaspidiini
 Acroaspidiini
 Acroaspidiini
 Aenasiini
 Aenasiini
 Aenasiini
 Aenasiini
 Aenasiini
 Aenasiini
 Aenasiini
 Anagyrini
 Anagyrini
 Anagyrini
 Anagyrini
 Anagyrini
 Anagyrini
 Anagyrini
 Anagyrini

Pheidoloxenus sp. 1
 Pheidoloxenus sp. 2
 Pheidoloxenus sp. 3
 Aenasius sp. 1
 Aenasius sp. 3
 Aenasius sp. 7
 Aenasius sp. 12
 Aenasius sp. 13
 Blepyrus sp. 1
 Blepyrus sp. 5
 Anagyrus sp. 2
 Anagyrus sp. 6
 Anagyrus sp. 8
 Anagyrus sp. 10
 Anagyrus sp. 21
 Anagyrus sp. 24
 Anagyrus sp. 29
 Anagyrus sp. 30
 Anagyrus sp. 31

Anagyrini	Apoanagyrus sp. 4
Anagyrini	Apoanagyrus sp. 5
Anagyrini	Apoanagyrus sp. 8
Anagyrini	Apoanagyrus sp. 10
Anagyrini	Apoanagyrus sp. 11
Anagyrini	Apoanagyrus sp. 12
Anagyrini	Apoanagyrus sp. 18
Anagyrini	Apoanagyrus sp. 20
Anagyrini	Apoanagyrus sp. 21
Anagyrini	Apoanagyrus sp. 22
Anagyrini	Apoanagyrus sp. 24
Anagyrini	Apoanagyrus sp. 25
Anagyrini	Ectromatopsis sp. 1
Anagyrini	Epanusia xerophila
Anagyrini	Formicencyrtus sp. 1
Anagyrini	Formicencyrtus thoreauini Gir.
Anagyrini	Gyranusoidea sp. 7
Anagyrini	Gyranusoidea sp. 8
Anagyrini	Gyranusoidea sp. 10
Anagyrini	Pseudleptomastix sp. 3
Anagyrini	Pseudleptomastix sp. 5
Anagyrini	Pseudleptomastix sp. 6
Anagyrini	Rhopus sp. 2
Anagyrini	Rhopus sp. 4
Miraini	Charitopus sp. 1
Miraini	Neocharitopus sp. 1
Tetracnemini	Tetracnemus sp. 4
Tetracnemini	Tetracnemus sp. 5
Tetracnemini	Tetracnemus sp. 6
Tetracnemini	Tetracnemus sp. 7
Tetracnemini	Tetracnemus sp. 8
Unplaced	Zarhopalus sp. 2
Unplaced	Unknown Genus 1
Unplaced	Unknown Genus 2

Table 5. Species of Braconidae collected in the North Rosillos Area, Big Bend National Park.

ROGADINAE

Aleiodes 1	Hormius 5
Aleiodes 2	Hormius 6
Aleiodes 3	Hormius 7
Aleiodes 4	Hormius 8
Aleiodes 5	Hormius 9
Aleiodes 6	Hormius 10
Aleiodes 7	Hormius 11
Aleiodes 8	Parahormius 1
Aleiodes 9	Parahormius 2
Aleiodes 10	Parahormius 3
Aleiodes 11	Parahormius 4
Aleiodes 12	Parahormius 5
Aleiodes 13	Parahormius 6
Aleiodes 14	Parahormius 7
Aleiodes carinatus (Ashmead)	Parahormius 8
Aleiodes ferrugineus Enderlein	Parahormius 9
Aleiodes graphicus (Cresson)	Pambolus 1
Aleiodes molestus (Cresson)	Pambolus 2
Aleiodes ms name	Pambolus 3
Aleiodes scrutator (Say)	Polystenidea 1
Clinocentrus 1	Polystenidea 2
Clinocentrus 2	Polystenidea 3
Clinocentrus 3	Polystenidea 4
Clinocentrus 4	Stiropius 1
Hormius 1	Stiropius 2
Hormius 2	Stiropius 3
Hormius 3	Tetrasphaeropyx 1
Hormius 4	Tetrasphaeropyx 2

DORYCTINAE

Acrophasmus 1	Heterospilus 5
Allorhogas 1	Heterospilus 6
Ecphylus 1	Heterospilus 7
Ecphylus 2	Heterospilus 9
Glyptocolastes 1	Heterospilus 10
Heterospilus 1	Heterospilus 11
Heterospilus 2	Heterospilus 12
Heterospilus 3	Heterospilus 13
Heterospilus 4	Heterospilus 14

Heterospilus prosopidis Viereck
 Hecabolus 1
 Leluthia 1
 Monolexis 1
 Odontocolon 1
 Rhaconotus 1
 Rhaconotus 2
 Rhaconotus 3
 Rhaconotus 4
 Rhaconotus 5
 Rhaconotus 6
 Rhaconotus 7
 Rhaconotus 8
 Rhaconotus 9
 Rhaconotus 10
 Rhaconotus 11
 Rhaconotus 12
 Rhaconotus 13
 Rhaconotus 14
 Rhaconotus 15
 Rhaconotus 16
 Rhaconotus 17
 Stenocorse 1
 Undetermined genus

BRACONINAE

Bracon 1
 Bracon 2
 Bracon 3
 Bracon 4
 Bracon 5
 Bracon 6
 Bracon 7
 Bracon 8
 Bracon 9
 Bracon 10
 Bracon 11
 Bracon 12
 Bracon 13
 Bracon 14
 Bracon 15
 Bracon 16
 Digonogastra 1
 Digonogastra 2

Digonogastra 3
 Digonogastra 4
 Digonogastra 5
 Digonogastra 6
 Digonogastra 7
 Digonogastra 8
 Digonogastra 9
 Digonogastra 10
 Habrobracon gelechiae (Ashmead)
 Habrobracon 2
 Habrobracon 3
 Myosoma 1
 Myosoma 2
 Vipio 1
 Vipio 2

GNAMPTODONTINAE

Pseudognaptodon 1

Pseudognaptodon 3

Gnamptodon 1

Gnamptodon 2

ALYSIINAE

Aphaereta pallipes (Say)

Aspilota 1

Aspilota 2

Aspilota 3

Aspilota 4

Aspilota 5

Aspilota 6

Aspilota 7

Aspilota 8

Aspilota 9

Aspilota 10

Aspilota 11

Chorebus 1

Chorebus 2

Chorebus 3

Dacnusa n. sp. 1

OPIINAE

Opius 1

Opius 2

Opius 3

Opius 4

Opius 5

Opius 6

Opius 7

Opius 8

Opius 9

Opius 10

Opius 11

Opius 12

Opius 13

Opius 14

Opius 15

Opius 16

Opius 17

Opius 18

Opius 19
Opius 20
Opius 21
Opius 22
Opius 23
Opius 24
Opius 25
Opius 26
Opius 27
Opius 28
Opius 29
Opius 30
Opius 31
Opius 32
Opius 33
Opius 34

APHIDIINAE

Diaeretiella rapae (M'Intosh)
Lysiphlebus testaceipes (Cresson)
Aphidius 1
Aphidius 2
Praon 1

AGATHIDINAE

Agathirsia testacea (Muesebeck)
Agathirsia nigricauda (Viereck)
Coccygidium 1
Agathis discolor (Cresson)
Agathis gibbosus (Say)
Cremnops vulgaris (Cresson)
Cremnops 1
Cremnops 2
Cremnops 3

MACROCENTRINAE

Macrocentrus 1

HOMOLOBINAE

Homolobus truncator (Say)

BLACINAE/HELCONINAE

Blacus 1
 Blacus 2
 Blacus 3
 Diospilus 1
 Microtypus 1
 Microtypus 2
 Microtypus 3
 Nealiolus 1
 Nealiolus 2
 Orgilus 1
 Orgilus 2
 Orgilus 3
 Orgilus 4
 Orgilus 5
 Orgilus 6
 Orgilus 7
 Orgilus 8
 Urosigalphus 1
 Urosigalphus 2

NEONEURINAE

New Genus

ICHNEUTINAE

Anapryxia 1
 Paroligoneurus 1

EUPHORINAE

Meteorus laphygmae (Viereck)
 Meteorus versicolor (Wesmael)
 Meteorus 3
 Meteorus 4
 Meteorus 5
 Euphoriella 1
 Leiophron 1
 Microctonus 1
 Microctonus 2
 Microctonus 3
 Microctonus 4
 Microctonus 5
 Microctonus 6
 Microctonus 7
 Microctonus 8
 Microctonus 9

Microctonus 10
 Microctonus 11
 Microctonus 12
 Microctonus 13
 Syntretus 1

CHELONINAE

Adelius 1	Chelonus 11
Adelius 2	Chelonus 12
Adelius 3	Chelonus 13
Chelonus 1	Chelonus 14
Chelonus 2	Chelonus 15
Chelonus 3	Chelonus 16
Chelonus 4	Chelonus 17
Chelonus 5	Chelonus 18
Chelonus 6	Chelonus 19
Chelonus 7	Chelonus 20
Chelonus 8	Chelonus 21
Chelonus 9	Chelonus 22
Chelonus 10	Chelonus 23

CARDIOCHILINAE

Cardiochiles 1
Cardiochiles 2
Cardiochiles 3
Cardiochiles 4
Cardiochiles 5
Cardiochiles 6

MIRACINAE

Mirax 1
Mirax 2
Mirax 3
Mirax 4

MICROGASTRINAE

Apanteles 1	Apanteles 12
Apanteles 2	Apanteles 13
Apanteles 3	Apanteles 14
Apanteles 4	Apanteles 15
Apanteles 5	Apanteles 16
Apanteles 6	Apanteles 17
Apanteles 7	Apanteles 18
Apanteles 8	Apanteles 19
Apanteles 9	Apanteles 20
Apanteles 10	Apanteles 21
Apanteles 11	Apanteles 22

Apanteles 23
Apanteles 24
Cotesia 1
Cotesia 2
Cotesia 3
Cotesia 4
Glyptapanteles 1
Glyptapanteles 2
Glyptapanteles 3
Glyptapanteles 4
Microplitis 1
Microplitis 2
Microplitis 3
Microplitis 4
Microplitis 5
Microplitis 6
Microplitis 7
Microplitis 8
Microplitis 9
Microplitis 10
Microplitis 11
Microplitis 12
Illidops 1
Pholetesor 1
Protomicroplitis 1
Pseudapanteles 1
Rasivalva 1
Venanides 1

Table 6. Species of Braconidae and Encyrtidae collected in each vegetative community. Table 3 contains lists of the species of Braconidae and Encyrtidae collected in each vegetative community. Numbers following generic names of Braconidae represent different morphospecies. Duplications in the lists indicate the number of separate collections in which a particular species was found. For example, *Adelius* species 3 (Braconidae) was collected three different times from the riparian habitat. Collections representing mixtures of habitat types have not been included in this list, except for the single sample from oak woodland/canyon scrub.

Braconidae collected in riparian vegetative community:

Acrophasmus 1	Apanteles 1
Adelius 2	Apanteles 1
Adelius 3	Apanteles 1
Adelius 3	Apanteles 1
Adelius 3	Apanteles 2
Adelius sp. 1	Apanteles 2
Agathis discolor (Cresson)	Apanteles 3
Aleiodes ms name	Apanteles 5
Aleiodes ms name	Apanteles 5
Aleiodes scrutator (Say)	Apanteles 6
Aleiodes scrutator (Say)	Apanteles 6
Aleiodes scrutator (Say)	Apanteles 6
Aleiodes scrutator (Say)	Apanteles 6
Aleiodes scrutator (Say)	Apanteles 6
Aleiodes scrutator (Say)	Apanteles 6
Aleiodes scrutator (Say)	Apanteles 9
Aleiodes scrutator (Say)	Apanteles 10
Aleiodes 1	Apanteles 10
Aleiodes 1	Apanteles 11
Aleiodes 1	Apanteles 16
Aleiodes 1	Apanteles 16
Aleiodes 2	Apanteles 16
Aleiodes 2	Apanteles 17
Aleiodes 4	Apanteles 19
Aleiodes 7	Apanteles 22
Aleiodes 7	Apanteles 22
Aleiodes 9	Apanteles 24
Aleiodes 9	Aphaereta pallipes (Say)
Aleiodes 9	Aphidius 1
Aleiodes 13	Aspilota 1
Anapryxia 1	Aspilota 2
Apanteles 1	Aspilota 4
Apanteles 1	Aspilota 7
Apanteles 1	Aspilota 8

Glyptapanteles 4
 Glyptapanteles 4
 Glyptapanteles 4
 Glyptocolastes 1
 Gnamptodon 2
 Habrobracon gelechia (Ashmead)
 Habrobracon gelechia (Ashmead)
 Habrobracon gelechia (Ashmead)
 Habrobracon 2
 Hecabolus 1
 Heterospilus 1
 Heterospilus 1
 Heterospilus 3
 Heterospilus 5
 Heterospilus 7
 Heterospilus 9
 Heterospilus 9
 Heterospilus 11
 Heterospilus 12
 Heterospilus 14
 Heterospilus 14
 Heterospilus prosopidis Viereck
 Heterospilus prosopidis Viereck
 Heterospilus prosopidis Viereck
 Heterospilus prosopidis Viereck
 Heterospilus prosopidis Viereck
 Heterospilus prosopidis Viereck
 Homolobus truncator (Say)
 Hormius 2
 Hormius 3
 Hormius 3
 Hormius 3
 Hormius 3
 Hormius 3
 Hormius 3
 Hormius 3
 Hormius 3
 Hormius 3
 Hormius 3
 Hormius 9
 Hormius 10
 Hormius 11
 Leiophron 1
 Leiophron 1
 Leluthia 1
 Lysiphlebus testaceipes (Cresson)

Lysiphlebus testaceipes (Cresson)
 Macrocentrus 1
 Macrocentrus 1
 Macrocentrus 1
 Macrocentrus 1
 Meteorus 4
 Meteorus 5
 Meteorus laphygmae (Viereck)
 Meteorus laphygmae (Viereck)
 Meteorus laphygmae (Viereck)
 Meteorus laphygmae (Viereck)
 Meteorus laphygmae (Viereck)
 Meteorus laphygmae (Viereck)
 Meteorus laphygmae (Viereck)
 Meteorus laphygmae (Viereck)
 Meteorus laphygmae (Viereck)
 Meteorus laphygmae (Viereck)
 Meteorus laphygmae (Viereck)
 Meteorus versicolor (Wesmael)
 Microctonus 2
 Microctonus 3
 Microctonus 4
 Microctonus 6
 Microctonus 7
 Microctonus 8
 Microctonus 8
 Microctonus 9
 Microctonus 9
 Microctonus 10
 Microctonus 11
 Microctonus 12
 Microctonus 13
 Microplitis 1
 Microplitis 1
 Microplitis 1
 Microplitis 2
 Microplitis 2
 Microplitis 3
 Microplitis 3
 Microplitis 3
 Microplitis 4
 Microplitis 4
 Microplitis 4

Microplitis 5
 Microplitis 9
 Microplitis 10
 Microplitis 11
 Microplitis 12
 Microtypus 1
 Microtypus 1
 Microtypus 3
 Microtypus 3
 Microtypus 3
 Mirax 1
 Mirax 2
 Mirax 2
 Mirax 3
 Mirax 3
 Mirax 3
 Mirax 4
 Monolexis 1
 Myosoma 2
 Odontocolon 1
 Opius 1
 Opius 5
 Opius 7
 Opius 10
 Opius 11
 Opius 12
 Opius 12
 Opius 13
 Opius 13
 Opius 13
 Opius 13
 Opius 13
 Opius 13
 Opius 16
 Opius 17
 Opius 19
 Opius 20
 Opius 24
 Opius 26
 Opius 27
 Opius 29
 Opius 29
 Opius 30
 Opius 30
 Opius 31

Opius 31
 Opius 32
 Opius 32
 Orgilus 1
 Orgilus 3
 Orgilus 5
 Orgilus 5
 Orgilus 8
 Orgilus 8
 Orgilus 8
 Pambolus 1
 Pambolus 3
 Pambolus 3
 Parahormius 1
 Parahormius 1
 Parahormius 2
 Parahormius 2
 Parahormius 3
 Parahormius 3
 Parahormius 3
 Parahormius 3
 Parahormius 4
 Parahormius 5
 Parahormius 6
 Parahormius 7
 Parahormius 9
 Paroligoneurus 1
 Paroligoneurus 1
 Paroligoneurus 1
 Paroligoneurus 1
 Paroligoneurus 1
 Polystenidea 2
 Polystenidea 4
 Protomicroplitis
 Pseudapanteles
 Pseudognaptodon 3
 Pseudognaptodon 3
 Pseudognaptodon 3
 Pseudognaptodon 3
 Rasivalva 1
 Rhaconotus 3
 Rhaconotus 4
 Rhaconotus 5
 Rhaconotus 9
 Rhaconotus 10

Rhaconotus 17
 Stenocorse 1
 Stenocorse 1
 Stenocorse 1
 Stenocorse 1
 Stiropius 1
 Stiropius 2
 Stiropius 3
 Stiropius 3
 Stiropius 3
 Syntretus 1
 Undetermined genus
 Urosigalphus 2
 Urosigalphus 2
 Urosigalphus 2
 Urosigalphus 2
 Urosigalphus 2

Encyrtidae collected in riparian vegetative community:

Achalcerinys ?	Anagyrus sp. 6
Aenasius sp. 1	Anagyrus sp. 10
Aenasius sp. 1	Anagyrus sp. 10
Aenasius sp. 3	Anagyrus sp. 24
Aenasius sp. 3	Anagyrus sp. 31
Aenasius sp. 3	Anagyrus sp. 31
Aenasius sp. 3	Aphycus sp. 7
Aenasius sp. 3	Aphycus sp. 7
Aenasius sp. 3	Aphycus sp. 7
Aenasius sp. 3	Aphycus sp. 7
Aenasius sp. 3	Apoanagyrus sp. 4
Aenasius sp. 7	Apoanagyrus sp. 5
Aenasius sp. 12	Apoanagyrus sp. 10
Aenasius sp. 12	Apoanagyrus sp. 18
Aenasius sp. 12	Apoanagyrus sp. 18
Aenasius sp. 12	Apoanagyrus sp. 18
Aenasius sp. 13	Apoanagyrus sp. 21
Aenasius sp. 13	Apoanagyrus sp. 22
Agarwalencyrtus	Apoanagyrus sp. 22
Agarwalencyrtus	Apoanagyrus sp. 22
Agarwalencyrtus sp. 3	Apoanagyrus sp. 22
Agarwalencyrtus sp. 3	Apoanagyrus sp. 24
Anagyrus sp. 2	Apoanagyrus sp. 25

Meromyzobia sp. 1	Ooencyrtus sp. 4
Meromyzobia sp. 1	Ooencyrtus sp. 4
Meromyzobia sp. 1	Ooencyrtus sp. 4
Meromyzobia sp. 1	Ooencyrtus sp. 7
Meromyzobia sp. 2	Ooencyrtus sp. 7
Meromyzobia sp. 2	Ooencyrtus sp. 7
Metaphycus sp. 1	Ooencyrtus sp. 7
Metaphycus sp. 1	Ooencyrtus sp. 7
Metaphycus sp. 1	Ooencyrtus sp. 7
Metaphycus sp. 1	Ooencyrtus sp. 7
Metaphycus sp. 3	Ooencyrtus sp. 7
Metaphycus sp. 6	Ooencyrtus sp. 7
Metaphycus sp. 8	Ooencyrtus sp. 26
Metaphycus sp. 8	Ooencyrtus sp. 26
Metaphycus sp. 8	Ooencyrtus sp. 27
Metaphycus sp. 8	Ooencyrtus sp. 27
Metaphycus sp. 8	Ooencyrtus sp. 28
Metaphycus sp. 8	Ooencyrtus sp. 28
Metaphycus sp. 35	Ooencyrtus sp. 28
Metaphycus sp. 35	Parablastothrix
Metaphycus sp. 35	Parablastothrix
Metaphycus sp. 38	Parablastothrix n. sp. 1
Metaphycus sp. 38	Parablastothrix n. sp. 1
Metaphycus sp. 39	Paratetracnemoidea
Metaphycus sp. 39	Pentelicus sp. 1
Metaphycus sp. 39	Pheidoloxenus sp. 2
? Metaphycus sp. 1	Pheidoloxenus sp. 3
Microterys sp. 4	Plagiomerus sp. 1
Microterys sp. 4	Plagiomerus sp. 1
Microterys sp. 4	Plagiomerus sp. 1
Microterys sp. 4	Plagiomerus sp. 1
Microterys sp. 4	Prochiloneurus sp. 1
Mucencyrtus sp. 3	Prochiloneurus sp. 2
Mucencyrtus sp. 3	Prochiloneurus sp. 2
Mucencyrtus sp. 3	Prochiloneurus sp. 2
Neocharitopus sp. 1	Prochiloneurus sp. 2
Neocharitopus sp. 1	Prochiloneurus sp. 2
Neocharitopus sp. 1	Pseudaphycus sp. 1
Neocharitopus sp. 1	Pseudaphycus sp. 1
Ooencyrtus sp. 3	Pseudaphycus sp. 5
Ooencyrtus sp. 3	Pseudaphycus sp. 5
Ooencyrtus sp. 3	Pseudaphycus sp. 6
Ooencyrtus sp. 3	Pseudaphycus sp. 6
Ooencyrtus sp. 3	Pseudaphycus sp. 7
Ooencyrtus sp. 3	Pseudaphycus sp. 12

Pseudectroma sp. 1
 Pseudleptomastix sp. 3
 Pseudleptomastix sp. 3
 Pseudleptomastix sp. 5
 Pseudleptomastix sp. 6
 Pseudleptomastix sp. 6
 Pseudleptomastix sp. 6
 Psyllaephagus nr. yaseeni
 Psyllaephagus sp. 1
 Psyllaephagus sp. 2
 Psyllaephagus sp. 12
 Rhopus sp. 2
 Rhopus sp. 4
 Rhytidothorax
 Rhytidothorax
 Rhytidothorax
 Rhytidothorax sp. 8
 Rhytidothorax sp. 8
 Rhytidothorax sp. 8
 Rhytidothorax sp. 8
 Rhytidothorax sp. 8
 Rhytidothorax sp. 8
 Syrphophagus
 Tetracnemus sp. 4
 Tetracnemus sp. 4
 Tetracnemus sp. 4
 Tetracnemus sp. 4
 Tetracnemus sp. 4
 Tetracnemus sp. 5
 Tetracnemus sp. 6
 Trjapitzinellus sp. 1
 Unknown Genus 2
 Zaomma sp. 5
 Zarhopalus sp. 2
 Zarhopalus sp. 2

Braconidae collected in oak woodland vegetative community:

Allorhogas 1
 Apanteles 2
 Apanteles 5
 Apanteles 7
 Chelonus 21
 Digonogastra 8

Digonogastra 9
 Digonogastra 10
 Gnampodon 1
 Hormius 7
 New Genus
 Parahormius 1
 Parahormius 6
 Rhaconotus 8
 Urosigalphus 2

Encyrtidae collected in oak woodland vegetative community:

Agarwalencyrtus sp. 3
 Ooencyrtus sp. 3

Braconidae collected in canyon scrub vegetative community:

Agathis gibbosus (Say)	Chelonus 12
Aleiodes ms name	Chelonus 16
Aleiodes scrutator (Say)	Chelonus 17
Aleiodes 14	Chelonus 18
Apanteles 4	Chelonus 21
Apanteles 4	Chelonus 21
Apanteles 10	Chelonus 21
Atanycolus 1	Chelonus 21
Bracon 4	Chelonus 23
Bracon 4	Clinocentrus 2
Bracon 4	Coccygidium 1
Bracon 5	Cotesia 4
Bracon 5	Cotesia 4
Bracon 6	Cotesia 4
Bracon 6	Cotesia 4
Bracon 6	Cotesia 4
Bracon 6	Glyptapanteles 2
Bracon 15	Glyptapanteles 4
Bracon 2	Glyptapanteles 4
Bracon 3	Habrobracon gelechiae (Ashmead)
Cardiochiles 2	Habrobracon gelechiae (Ashmead)
Cardiochiles 5	Heterospilus 1
Chelonus 1	Homolobus truncator (Say)
Chelonus 6	Homolobus truncator (Say)
Chelonus 7	Hormius 3
Chelonus 10	Meteorus laphygmae (Viereck)
Chelonus 10	Microplitis 11

Pseudaphycus sp. 7
 Pseudaphycus sp. 12
 Pseudectroma sp. 1
 Pseudleptomastix sp. 3
 Pseudleptomastix sp. 3
 Pseudleptomastix sp. 6
 Psyllaephagus sp. 1
 Psyllaephagus sp. 13
 Rhopus sp. 2
 Rhopus sp. 2
 Rhopus sp. 4
 Rhytidothorax sp. 8
 Rhytidothorax sp. 8
 Stenmatosteres
 Syrphophagus
 Tachardiobius sp. 1
 Tetracnemus sp. 4
 Tetracnemus sp. 4
 Tetracnemus sp. 4
 Tetracnemus sp. 4
 Tetracnemus sp. 4
 Tetracnemus sp. 4
 Tetracnemus sp. 4
 Tetracnemus sp. 4
 Tetracnemus sp. 4
 Tetracnemus sp. 5
 Tetracnemus sp. 7
 Tetracnemus sp. 7
 Tetracnemus sp. 8
 Unknown Genus 1
 Zaomma sp. 5
 Zaomma sp. 5
 Zarhopalus sp. 2

Braconidae collected in grama grassland vegetative community:

Agathis gibbosus (Say)
 Agathis gibbosus (Say)
 Agathis gibbosus (Say)
 Aleiodes ferrugineus Enderlein
 Apanteles 11
 Apanteles 15
 Aspilota 3
 Aspilota 4
 Bracon 2

Bracon 3
 Bracon 3
 Bracon 3
 Chelonus 2
 Chelonus 2
 Chelonus 2
 Chelonus 3
 Chelonus 9
 Chelonus 9
 Chelonus 11
 Chelonus 22
 Habrobracon gelechia (Ashmead)
 Habrobracon 2
 Microctonus 5
 Microplitis 2
 Opius 3
 Opius 25
 Opius 34
 Parahormius 2
 Praon 1

Encyrtidae collected in grama grassland vegetative community:

Aenasius sp. 1	Blepyrus sp. 1
Anagyrus sp. 2	Bothriothorax sp. 4
Anagyrus sp. 2	Cerapterocerus sp. 2
Anagyrus sp. 2	Cerapterocerus sp. 2
Anagyrus sp. 2	Cerapterocerus sp. 4
Anagyrus sp. 2	Cerchysius sp. 1
Anagyrus sp. 2	Charitopus sp. 1
Anagyrus sp. 2	Charitopus sp. 1
Anagyrus sp. 30	Charitopus sp. 1
Apoanagyrus sp. 4	Cheiloneurus sp. 6
Apoanagyrus sp. 8	Cheiloneurus sp. 9
Apoanagyrus sp. 8	Cheiloneurus sp. 9
Apoanagyrus sp. 11	Copidosoma floridanum
Apoanagyrus sp. 21	Discodes sp. 1
Apoanagyrus sp. 21	Discodes sp. 2
Apoanagyrus sp. 21	Discodes sp. 2
Apoanagyrus sp. 21	Discodes sp. 2
Apoanagyrus sp. 21	Discodes sp. 2
Apoanagyrus sp. 21	Discodes sp. 2
Apoanagyrus sp. 24	Ginsiana sp. 5
Apoanagyrus sp. 24	Gyranusoidea sp. 7

Hydranusoidea sp. 7	Ooencyrtus sp. 4
Habrolepopteryx sp. 2	Ooencyrtus sp. 4
Habrolepopteryx sp. 2	Ooencyrtus sp. 7
Habrolepopteryx sp. 2	Ooencyrtus sp. 7
Mahencyrtus sp. 1	Pheidoloxenus sp. 1
Meromyzobia sp. 1	Pheidoloxenus sp. 1
Meromyzobia sp. 1	Pheidoloxenus sp. 1
Meromyzobia sp. 1	Pheidoloxenus sp. 1
Meromyzobia sp. 1	Pheidoloxenus sp. 1
Meromyzobia sp. 1	Pseudaphycus sp. 1
Meromyzobia sp. 1	Pseudaphycus sp. 1
Meromyzobia sp. 1	Pseudaphycus sp. 1
Metaphycus sp. 1	Pseudaphycus sp. 3
Metaphycus sp. 1	Pseudaphycus sp. 6
Metaphycus sp. 1	Pseudaphycus sp. 7
Metaphycus sp. 1	Pseudaphycus sp. 7
Metaphycus sp. 8	Pseudaphycus sp. 11
Metaphycus sp. 8	Psyllaephagus nr. yaseeni
Metaphycus sp. 8	Rhopus sp. 2
Metaphycus sp. 34	Rhopus sp. 2
Metaphycus sp. 34	Rhytidothorax sp. 8
Metaphycus sp. 34	Rhytidothorax sp. 8
Metaphycus sp. 34	Shenahetia sp. 2
Metaphycus sp. 35	Syrphophagus
Metaphycus sp. 38	Tetracnemus sp. 4
Metaphycus sp. 39	Tetracnemus sp. 4
Metaphycus sp. 39	Tetracnemus sp. 4
Metaphycus sp. 39	Tetracnemus sp. 4
Microterys sp. 4	Tetracnemus sp. 4
Mucencyrtus sp. 1	Tetracnemus sp. 4
Mucencyrtus sp. 3	Tetracnemus sp. 4
Mucencyrtus sp. 4	Tetracnemus sp. 4
Neocharitopus sp. 1	Tetracnemus sp. 4
Neocharitopus sp. 1	Tetracnemus sp. 5
Neocharitopus sp. 1	Tetracnemus sp. 6
Neocharitopus sp. 1	Tetracnemus sp. 6
Neocharitopus sp. 1	Tetracnemus sp. 6
New Genus 45, sp. 1	Tetracnemus sp. 6
New Genus 45, sp. 1	Tetracnemus sp. 6
Ooencyrtus sp. 3	Tetracnemus sp. 7
Ooencyrtus sp. 4	Tetracnemus sp. 7
Ooencyrtus sp. 4	Tetracnemus sp. 7
Ooencyrtus sp. 4	Tetracnemus sp. 7
Ooencyrtus sp. 4	Tetracnemus sp. 7

Braconidae collected in semidesert grassland (igneous substrate) vegetative community:

Aphidius 2
Bracon 4
Bracon 6
Chelonus 4
Habrobracon 3
Habrobracon gelechia (Ashmead)
Heterospilus 2
Parahormius 4
Polystenidea 1
Rhaconotus 12
Vipio 2

Encyrtidae collected in semidesert grassland (igneous substrate) vegetative community:

Aenasius sp. 3
Apoanagyrus sp. 21
Apoanagyrus sp. 24
Apoanagyrus sp. 24
Cerapterocerus sp. 2
Cerapterocerus sp. 2
Cerapterocerus sp. 4
Copidosoma floridanum
Copidosoma lymani
Discodes sp. 2
Epanusia xerophila
Gyranusoidea sp. 7
Habrolepopteryx sp. 1
Habrolepopteryx sp. 2
Habrolepopteryx sp. 2
Homalotylus sp. 11
Meromyzobia sp. 1
Meromyzobia sp. 1
Meromyzobia sp. 2
Meromyzobia sp. 9
Mucronocryptus sp. 3
Pseudaphycus sp. 6
Pseudaphycus sp. 6
Psyllaephagus sp. 1
Psyllaephagus sp. 2
Psyllaephagus sp. 2
Tetraneura sp. 4

Tetracnemus sp. 4
Tetracnemus sp. 5

Braconidae collected in mosaic of semidesert grassland (limestone substrate), mariola scrub, lechugilla scrub vegetative community:

Apanteles 1	Opius 12
Apanteles 2	Opius 20
Apanteles 3	Opius 21
Apanteles 3	Opius 29
Apanteles 9	Opius 29
Apanteles 23	Opius 29
Bracon 4	Opius 29
Bracon 4	Parahormius 1
Bracon 4	Parahormius 1
Bracon 6	Parahormius 6
Bracon 11	Pholetesor 1
Bracon 2	Pholetesor 1
Bracon 2	Polystenidea 3
Cardiochiles 5	Polystenidea 4
Cremnops 3	Polystenidea 4
Habrobracon 3	Rhaconotus 6
Habrobracon gelechia (Ashmead)	Rhaconotus 7
Heterospilus 1	Rhaconotus 10
Heterospilus 1	Rhaconotus 16
Hormius 3	Urosigalphus 1
Hormius 4	Urosigalphus 1
Microplitis 1	Urosigalphus 1
Microplitis 1	Urosigalphus 1
Microplitis 2	Vipio 2

Encyrtidae collected in mosaic of semidesert grassland (limestone substrate), mariola scrub, lechugilla scrub vegetative community:

Aenasius sp. 1	Apoanagyrus sp. 21
Aenasius sp. 3	Apoanagyrus sp. 22
Anagyrus sp. 2	Apoanagyrus sp. 24
Anagyrus sp. 2	Apoanagyrus sp. 24
Anagyrus sp. 8	Apoanagyrus sp. 24
Anagyrus sp. 29	Apoanagyrus sp. 24
Aphycus sp. 7	Blepyrus sp. 5
Aphycus sp. 7	Cheiloneurus sp. 9
Apoanagyrus sp. 21	Cheiloneurus sp. 9

Cheiloneurus sp. 9
 Copidosoma floridanum
 Copidosoma floridanum
 Copidosoma floridanum
 Habrolepopteryx sp. 2
 Homalotyloidea sp. 3
 Homalotylus sp. 11
 Lamennasia sp. 1
 Lamennasia sp. 1
 Lamennasia sp. 1
 Lamennasia sp. 1
 Lamennasia sp. 1
 Meromyzobia sp. 1
 Meromyzobia sp. 1
 Metaphycus sp. 8
 Ooencyrtus sp. 4
 Ooencyrtus sp. 7
 Ooencyrtus sp. 7
 Ooencyrtus sp. 26
 Pseudaphycus sp. 1
 Pseudaphycus sp. 6
 Rhopus sp. 4
 Stenmatosteres sp. 2
 Tetracnemus sp. 4
 Tetracnemus sp. 4
 Tetracnemus sp. 4
 Tetracnemus sp. 4

Braconidae collected in arroyo scrub vegetative community:

Agathirsia nigricauda (Viereck)	Apanteles 5
Agathis gibbosus (Say)	Apanteles 7
Aleiodes 1	Apanteles 9
Aleiodes 1	Apanteles 14
Aleiodes 3	Aspilota 6
Aleiodes 8	Aspilota 9
Apanteles 1	Bracon 4
Apanteles 2	Bracon 6
Apanteles 2	Bracon 16
Apanteles 2	Bracon 1
Apanteles 2	Bracon 2
Apanteles 3	Cardiochiles 1
Apanteles 3	Cardiochiles 2

Cardiochiles 3
 Cardiochiles 4
 Cardiochiles 5
 Cardiochiles 5
 Chelonus 1
 Chelonus 1
 Chelonus 10
 Chelonus 10
 Chelonus 10
 Chelonus 12
 Chorebus 3
 Chorebus 3
 Cotesia 1
 Cotesia 3
 Cotesia 4
 Cotesia 4
 Cremnops 1
 Cremnops 2
 Cremnops vulgaris (Cresson)
 Cremnops vulgaris (Cresson)
 Diospilus 1
 Ecphylus 2
 Euphoriella 1
 Euphoriella 1
 Genus Unknown
 Glyptapanteles 4
 Habrobracon gelechia (Ashmead)
 Heterospilus 2
 Heterospilus 10
 Heterospilus 13
 Homolobus truncator (Say)
 Homolobus truncator (Say)
 Homolobus truncator (Say)
 Illidops 1
 Microctonus 1
 Microctonus 8
 Microplitis 1
 Microplitis 2
 Microplitis 2
 Microplitis 2
 Microplitis 3
 Microplitis 3
 Microplitis 3
 Microplitis 3

Microplitis 3
 Microplitis 6
 Microplitis 7
 Microplitis 8
 Nealiolus 1
 Nealiolus 2
 Opius 6
 Opius 8
 Opius 12
 Opius 13

Opius 23
Opius 29
Opius 29
Opius 29
Opius 33
Opius 33
Orgilus 2
Orgilus 5
Orgilus 7
Parahormius 2
Rasivalva 1
Rasivalva 1
Tetrasphaeropyx 1
Tetrasphaeropyx 2
Urosigalphus 1
Urosigalphus 1

Encyrtidae collected in arroyo scrub vegetative community:

Aenasius sp. 3
Aenasius sp. 12
Apoanagyrus sp. 4
Apoanagyrus sp. 4
Apoanagyrus sp. 18
Apoanagyrus sp. 22
Charitopus sp. 1
Copidosoma floridanum
Discodes sp. 2
Habrolepopteryx sp. 2
Habrolepopteryx sp. 2
Lamennasia sp. 1
Lamennasia sp. 1
Lamennasia sp. 1
Lamennasia sp. 1
Meromyzobia sp. 1
Ooencyrtus sp. 3
Ooencyrtus sp. 4
Ooencyrtus sp. 7
Ooencyrtus sp. 26
Ooencyrtus sp. 27
Prochiloneurus sp. 2
Pseudleptomastix sp. 6
Psyllaephagus sp. 2

Braconidae collected in mixed shrub and succulent scrub vegetative community:

Apanteles 9
Apanteles 21
Apanteles 23
Bracon sp. 2
Cardiochiles 5
Habrobracon gelechia (Ashmead)
Opius 2
Opius 29
Opius 29
Parahormius 1
Rhaconotus 17
Urosigalphus 1
Vipio 2

Encyrtidae collected in mixed shrub and succulent scrub vegetative community:

Apoanagyrus sp. 4
Apoanagyrus sp. 21
Apoanagyrus sp. 21
Cheiloneurus sp. 9
Cheiloneurus sp. 9
Cheiloneurus sp. 9
Copidosoma floridanum
Formicencyrtus sp. 1
Gyranusoidea sp. 7
Homalotyloidea sp. 3
Lamennasia sp. 1
Metaphycus sp. 1
Metaphycus sp. 40
Ooencyrtus sp. 7
Prochiloneurus sp. 2
Pseudaphycus sp. 1

Braconidae collected in mariola scrub vegetative community:

Agathirsia testacea (Muesebeck)	Aleiodes scrutator (Say)
Aleiodes carinatus (Ashmead)	Aleiodes 1
Aleiodes carinatus (Ashmead)	Aleiodes 6
Aleiodes ferrugineus Enderlein	Aleiodes 6
Aleiodes ferrugineus Enderlein	Aleiodes 7
Aleiodes molestus (Cresson)	Aleiodes 10
Aleiodes scrutator (Say)	Aleiodes 11

Apanteles 2
 Apanteles 3
 Apanteles 9
 Apanteles 11
 Aphidius 2
 Aspilota 5
 Bracon 4
 Cardiochiles 5
 Chelonus 1
 Chelonus 5
 Chelonus 10
 Coccygidium 1
 Coccygidium 1
 Cotesia 4
 Dacnusa n. sp. 1
 Digonogastra 2
 Digonogastra 7
 Digonogastra 8
 Glyptapanteles 1
 Heterospilus 13
 Homolobus truncator (Say)
 Homolobus truncator (Say)
 Hormius 10
 Meteorus 3
 Meteorus 4
 Meteorus 4
 Meteorus laphygmae (Viereck)
 Microctonus 8
 Microplitis 1
 Microplitis 2
 Microplitis 2
 Microtypus 2
 Nealiolus 2
 Opius 9
 Opius 29
 Orgilus 8
 Parahormius 1
 Urosigalphus 1
 Urosigalphus 1
 Venanides sp.

Encyrtidae collected in mariola scrub vegetative community:

Acerophagus sp. 2
 Anagyrus sp. 2
 Aphycus sp. 7
 Apoanagyrus sp. 4
 Apoanagyrus sp. 22
 Cheiloneurus sp. 7
 Cheiloneurus sp. 9
 Cheiloneurus sp. 9
 Cheiloneurus sp. 9
 Copidosoma floridanum
 Copidosoma floridanum
 Habroleptopteryx sp. 2
 Meromyzobia sp. 2
 Metaphycus sp. 1
 Metaphycus sp. 34
 Metaphycus sp. 35
 Metaphycus sp. 36
 New Genus 5, sp. 2
 Ooencyrtus sp. 4
 Ooencyrtus sp. 7
 Prochiloneurus sp. 2
 Pseudaphycus sp. 1
 Pseudaphycus sp. 3
 Rhopus sp. 4
 Tetracnemus sp. 4
 Tetracnemus sp. 4

Braconidae collected in mesquite scrub vegetative community:

Aleiodes ferrugineus Enderlein	Chelonus 14
Aleiodes 1	Clinocentrus 2
Aleiodes 12	Cotesia 2
Apanteles 1	Cotesia 4
Apanteles 6	Cotesia 4
Apanteles 6	Cremnops 1
Apanteles 9	Glyptapanteles 1
Aspilota 9	Glyptapanteles 2
Bracon 6	Heterospilus 6
Bracon 2	Heterospilus 10
Cardiochiles 2	Heterospilus prosopidis Viereck
Cardiochiles 2	Hormius 3
Cardiochiles 3	Hormius 3
Cardiochiles 5	Meteorus laphygmae (Viereck)
Chelonus 1	Microplitis 2

Microplitis 4
Microplitis 4
Opius 12
Opius 22
Opius 29
Opius 29
Orgilus 4
Orgilus 6
Parahormius 1
Parahormius 1
Rasivalva sp.

Urosigalphus 1
Vipio 1

Encyrtidae collected in mesquite scrub vegetative community:

Aenasius sp. 3
Anagyrus sp. 6
Anagyrus sp. 24
Copidosoma floridanum
Lamennasia sp. 1
Lamennasia sp. 1
Lamennasia sp. 1
Meromyzobia sp. 9
Prochiloneurus sp. 2
Pseudleptomastix sp. 6
Psyllaephagus sp. 2
Psyllaephagus sp. 2

Braconidae collected in alkaline grassland vegetative community:

Aleiodes graphicus (Cresson)
Bracon 2
Heterospilus 4
Opius 29

Encyrtidae collected in alkaline grassland vegetative community:

Lamennasia sp. 1
Copidosoma floridanum

Braconidae collected in creosote scrub vegetative community:

Aleiodes ferrugineus Enderlein
Aleiodes scrutator (Say)
Aleiodes 1
Aleiodes 3
Aleiodes 3
Apanteles 12
Apanteles 13
Apanteles 18
Apanteles 20
Bracon 4
Chelonus 1
Chelonus 21
Chorebus 3
Chorebus 3
Glyptapanteles 4

Glyptapanteles 4
Habrobracon gelechia (Ashmead)
Habrobracon gelechia (Ashmead)
Habrobracon 2
Homolobus truncator (Say)
Homolobus truncator (Say)
Meteorus laphygmae (Viereck)
Microplitis 3
Microtypus 3
Opius 20
Opius 29
Rasivalva 1
Rhaconotus 17
Urosigalphus 1

Encyrtidae collected in creosote scrub vegetative community:

Apoanagyrus sp. 22
Copidosoma floridanum
Copidosoma floridanum
Lamennasia sp. 1
Lamennasia sp. 1
Lamennasia sp. 1
Ooencyrtus sp. 4
Ooencyrtus sp. 7
Ooencyrtus sp. 7
Ooencyrtus sp. 8
Psyllaephagus sp. 2

CHAPTER 5 HERPETOLOGY

James F. Scudday

The earliest comprehensive account of the amphibians and reptiles of the Big Bend area was that of Schmidt and Smith (1944). Minton (1959) reported on his extensive collections in Big Bend National Park and from the Rosillos Mountains in 1955. His are probably the only published herpetological records from the Rosillos Mountains. Minton lived with his family on the Rosillos Ranch from 16 February to 8 August 1955. Axtell (1952) surveyed the amphibians and reptiles of the Black Gap Wildlife Management area to the southeast and Milstead (1953) reported on the ecological distribution of lizards of the La Mota Mountain area to the west of the Rosillos Mountains. Wauer and Burdick (1974) documented the first record of the Mediterranean gecko in Boquillas, Mexico, just across the river from Big Bend National Park. Degenhardt (1975) and Scudday (1975) touched on factors effecting changes in reptile and amphibian populations in the Big Bend area. Numerous studies have been published on the systematics, behavior, and ecological relationships of taxa at all levels.

There have been a number of biodiversity surveys conducted within the southern Big Bend region, some of them very close to the present study area. These surveys contain lists and observations of amphibians and reptiles. Some of these surveys were published, but with limited distribution, by the Lyndon Johnson School of Public Affairs or the Texas Parks and Wildlife Department. The most pertinent ones include Scudday (1975) on the Solitario area of Brewster-Presidio Counties and Scudday (1975) on the Fresno Canyon and Colorado Canyon areas of Presidio County.

Amphibians and reptiles represent two groups of animals found at opposite ends of the moisture spectrum. Amphibians require water to insure their existence, while reptilian evolution has trended toward a survival strategy in xeric environments. Thus reptiles represent a major component of desert communities because of their adaptive capabilities of survival where water is limited. Richness of reptilian species is a good indicator of overall species diversity in desert habitats. Some amphibians, on the other hand, have evolved ways of maximum utility of little rainfall and sparse, isolated springs to become a part of the desert community. An inventory of amphibians and reptiles, both in the domain of herpetology, is an essential part of our understanding the total biotic community of the Rosillos Mountains and its attendant terrain.

Field work for the present herpetofaunal study was conducted over a three year period, commencing in June 1990 and terminating in September 1993. Because of the vagaries of climatological conditions three years is a minimum length of time to adequately conduct a thorough survey of such a large desert area. Hopefully, during that period of time at least one good wet season should (but may not) occur, creating ideal conditions for even desert-adapted reptiles to become more abundant. Milstead (1975) discussed the value of long-term field studies in order to fully understand what occurs with natural populations under fluctuating environmental conditions. He

found at Black Gap Wildlife Management Area that even the best drought-adapted lizards produced population explosions in wet years. The chance of catching a wet season is absolutely essential for some amphibian species. The small, secretive madrean cliff frog (Syrrhophus guttilatus) is never found under drought conditions, yet in some areas it appears plentiful during prolonged wet periods. As it turned out the time frame in which this study was conducted was most propitious in terms of abundant desert rain storms. In fact field work at times was seriously hampered by too much rain.

METHODS AND MATERIALS

Representative specimens of Amphibia and Reptilia were collected as voucher material from different plant communities and habitat types. Field collecting of diurnal lizards was done by stunning the specimen with two number 105 Plymouth rubber bands tied together. Drift fences were constructed by using four 50-foot (15.2 m) length X 12 inch (30.2 cm) high 30 ga galvanized flashing as a barrier. Fences were usually placed in an X pattern with four 50-foot (15.2 m) wings converging at the center. Plastic buckets were buried at each end and at the center to form a pit trap. Plywood covers were placed over each pit and propped up with rocks to a height of about 2-3 inches (5 - 7.6 cm) to imitate a shelter. The plywood covers were then covered with a 1 inch (2.7 cm) layer of sand or dirt. Drift fences were used to passively sample areas in flat, deep soil sites. In a few instances two 50-foot (15.2 m) lengths of galvanized metal were placed end-to-end below a rocky ledge or cliff where enough soil existed to efficiently bury pit traps (drift fence numbers 5, 6 and 7).

Driving the passable dirt roads at night proved to be an efficient method of observing nocturnal snakes. Searching specific areas such as ledges, springs and the perimeters of ponds at night was accomplished with the use of Coleman lanterns and battery-powered spotlights.

Only one pond held water throughout the three year study period. This pond (turtle pond #1) is located at UTM coordinates 742754. Another pond, (turtle pond #2) located at coordinates 767748, usually held water throughout the summer and fall months, but remained dry during the winter and spring months. Turtles were trapped in these two ponds using wire mesh traps baited with sardines. The pond at 742754 was the larger of the two ponds and much deeper in the center. Most turtles trapped over the three year study were from this pond. Trapped turtles were marked by notching the marginal scutes and released in hopes that mark-recapture techniques could be employed to estimate the population size of turtles utilizing the pond.

Representative individuals of each species encountered at different study sites were preserved as voucher specimens and to help plot the general distribution of each species on the entire study area. Redundant captures in drift fences were released within 100 yards of the fence location. Serial collections of some species were preserved as specimens if a taxonomic problem was thought to exist. Specimens were preserved in 10% formalin and tagged in the field. They were left to harden in the formalin solution for as few as two days for amphibians and up to 14 days for larger snakes and turtles. Specimens were then placed in clean water to soak for several days depending on body mass. Water was changed at least twice during the soaking process for lizards, small snakes and amphibians, more often for larger snakes and turtles. The specimens then were placed in 70% ethyl alcohol for permanent preservation. All voucher specimens have been cataloged into the Sul Ross State University's Vertebrate Collection (SRSU). A list of all specimens preserved and cataloged appears in Table 7.

The Universal Transverse Mercator (UTM) Grid Coordinate System was used in plotting significant collections or visual sighting localities. Coordinates were plotted on 7.5 minute USGS quad maps. Table 8 presents the UTM coordinates of important collections and sightings where identification was positive, as well as landmarks referred to in this report. The following USGS

quadrangle maps covered the study area: Bone Springs, Butterbowl, Twin Peaks, and Persimmon Gap. The distributional pattern of each species was then plotted on the vegetation map prepared by Paul Whitefield. Plant community names are those of Whitefield (1990). Common names of amphibians and reptiles are those of Conant and Collins (1991).

RESULTS AND DISCUSSION

Seven species of amphibians, all anurans, and 34 reptiles (16 lizards, 17 snakes, 1 turtle) were documented as occurring in the North Rosillos Area during the present study. Minton (1959) collected two snakes and one lizard not found by us in the same study area. The snakes he collected were the desert patch-nosed snake (Salvadora deserticola) 1.8 mi NE Rosillos Peak, and the blacknecked garter snake (Thamnophis cyrtopsis) from the base of north Rosillos Mountains. He collected the short-lined skink (Eumeces tetragrammus brevilineatus) from Goat Spring. Minton's Rosillos specimens are deposited at the Chicago Natural History Museum (CNHM) and the University of Michigan Museum of Natural History (MMNH). Additionally the mammal study group from Texas Tech University (TTU) collected a specimen of Thamnophis cyrtopsis 1.75 mi W hwy. 385 on the unpaved county road in 1991, and captured a Great Plains skink in a mammal trap in the Chalk Hills area. These records add two snakes and two lizards with specimen documentation from the study area for a total of 17 lizards, 19 snakes, and 1 turtle, for a total of 37 reptilian species.

No federally protected species of reptile or amphibian was found within the study area and none would be expected. One state of Texas protected species was found, the Texas horned lizard (Phrynosoma cornutum). Three additional species of state protected reptiles should be expected within the study area but were not found during this survey. These are the reticulated gecko (Coleonyx reticulatus), Big Bend blackheaded snake (Tantilla rubra) and the Texas lyre snake (Trimorphodon biscutatus vilkinsonii). All three of these species have been documented near the south end of the Rosillos Mountains in Big Bend National Park. The three are highly secretive, and when they are found it is usually only on paved highways at night.

Surprisingly, not a person of all the research teams working in the study area for three years came across an ornate box turtle (Terrapene ornata). It was fully expected that this common terrestrial turtle of the northern Chihuahuan Desert would be encountered at least several times throughout the three seasons spent in the field. Perhaps the extreme drought conditions in the preceeding years had extirpated the species locally, and recolonization from annectent populations has not reached the area.

SPECIES ACCOUNTS

UTM coordinates recorded in this report are a single number, six digits long. To obtain the northing, take the first three digits of the UTM of interest, add 32 to the front and 00 to the back. To obtain the easting, take the second three digits of the UTM of interest, add 6 to the front and 00 to the back. For example, a UTM of 763761 equals a northing of 3276300 and an easting of 676100.

Amphibia

A total of seven amphibian species were documented from the study area. Amphibians were mostly collected while driving the roads at night and in the drift fence traps. All amphibians were found in the lower elevation plant communities.

Scaphiopus couchi (Couch's spadefoot) - This spadefoot toad was the most widely distributed and the most numerous amphibian found. Its loud bleating call is the first to be heard following a spring or summer rain. The species was most prevalent in the Alkali Grassland, but ranged through all the plant communities below 3,500 feet where the substrate is relatively soft. It generally avoids rocky substrates where it would have difficulty burrowing following mating.

Scaphiopus multiplicatus (New Mexico spadefoot) - This spadefoot was found in only one locality (UTM 683729). The site from which it was found borders Nine Point Draw which carries a great amount of water during heavy rains. The New Mexico spadefoot is not as desert adapted as Couch's spadefoot, and generally prefers more moist grassland valleys. It is probably confined to the Alkaline Grassland Community of Whitefield (1990).

Bufo punctatus (red-spotted toad) - This common little toad was found in every plant community below 3,500 feet. It was most commonly found along the county road and in the Arroyo Scrub community as well as other plant communities with a rocky substrate. The red-spotted toad was caught in pit traps at every drift fence. Most of these toads were young (less than 30 mm snout-vent length). Very few large adults were seen (greater than 40 mm snout-vent length) indicating a high reproductive success for the season.

Bufo debilis (western green toad) - Green toads were found only east of a line running northwest by southeast along the Chalk Hills. The westernmost specimens came from drift fence number 5 (UTM 672722) just beneath a rocky ledge of the Chalk Hills and from the county road where it passes through the gap of the Chalk Hills (UTM 681730). Most individuals are from the Alkaline Grassland Community and were taken in pit traps at the drift fences. Many were collected in one night at drift fence number 4 (UTM 691759) set in a tobosa grass flat.

Bufo speciosus (Texas toad) - This large toad was found on a regular basis along the county road between UTM coordinates 686728 - 681730. This site is where the road runs parallel and very close to a chalk hill on one side and Nine Point Draw on the other side. The substrate here at road level is sandy. The Texas toad was also found in the Mariola Scrub Community at the lodge field headquarters and in the Arroyo Scrub community, both very rocky substrates. It was not seen anywhere west of the lodge headquarters, but was fairly common between the lodge and the eastern boundary of the study area.

Gastrophryne olivacea (Great Plains narrowmouth toad) - The little narrowmouth toad is especially secretive, but its presence can be determined by its voice which is a high-pitched buzz. Some of these little amphibians were taken in pit traps at drift fence number 9 (UTM 767748) and on the county road at UTM 697733. Both of these sites are within the Creosote Scrub Community.

Rana berlandieri (Rio Grande leopard frog) - True frogs are generally adapted to living in and immediately near permanent water sources. This is true of the Rio Grande leopard frog most of the time. During wet periods this species may move away from its permanent water source and show up almost anywhere. We found this frog at every body of permanent water on the study area. It was found also in temporary pools along Nine Point Draw following heavy rains and seen on the county road at night far from any known permanent water. The frog is especially abundant at Buttrill and Alamo Springs. It was less common at Borracho Springs (No-Name Springs), where there were no deep pools to afford protection from predators. Leopard frogs were not present in either of the turtle tanks during 1990, the first year the tanks held water, but were commonly seen at both tanks in 1991 and 1992. It is the only amphibian in the study area that is mostly confined to the Riparian Community.

Reptilia

Thirty-seven species of reptiles have been documented from the study area. The number of snake species (19) slightly outnumber the lizard species (17), but the lizards are the most visible component of the herpetofauna. Two lizards, Cophosaurus texanus and Cnemidophorus marmoratus, are by far the most commonly encountered lizards on the study area. These two

lizards occur in every plant community below 3,500 feet (1,068 m) elevation. Both species are well adapted for the area, and active individuals can often be found during the hottest part of the day.

Nearly all the snakes of the area are primarily nocturnal, the exception being the two species of racers, Masticophis taeniatus and M. flagellum testaceus. The first year of field work produced very few snakes from the area. By the second year snakes were slightly more common, and by the summer of 1992, some species of snakes, primarily Crotalus atrox, were common. The abundant rainfall of 1990 and 1991 undoubtedly produced conditions ideal for increasing the prey base of snakes in general. Some snake species were recorded on the basis of a single record. A number of snake species have been documented on adjacent lands but were not found in the North Rosillos Area. These species should be expected to occur there: Tantilla rubra, Gyalopion canum, Thamnophis cyrtopsis (recorded at San Juan Spring in the south Rosillos Mountains by Minton) and Trimorphodon biscutatus vilkinsoni.

Chelonia

Kinosternon flavescens (yellow mud turtle) - Although this was the only turtle documented for the study area, the species was fairly common during all three seasons of field work. This turtle was especially abundant in the pond designated as turtle pond number 1 (UTM 742754). The pond site held no water prior to 17 July 1990 when a thunderstorm filled it. The pond was created by earlier ranchers of the area who constructed a large berm of soil across a drainage system from the nearby low hills. This kind of structure is commonly referred to locally as a spreader dam, and they only collect water from local rainstorms that are sufficient to produce some flooding of the arroyos. Sporadic heavy rainfall from 17 July 1990 until the end of field work in September 1992 maintained some water at the site, although it did get very low in the summer of 1992.

A total of 12 mud turtles were trapped there in April of 1991 and marked by notching numbered marginal scutes. A retrapping of the pond in June 1991 caught 17 turtles, none of which were marked. This indicates either a large population of turtles living in the pond or a high turn-over of turtles in the pond. The latter is likely the case. Yellow mud turtles are known to leave ponds and move overland during wet periods. We generally encountered mud turtles in various situations following heavy rains. They most often were seen along the county road that crosses the area from east to west. We sometimes found them in small drying mud puddles in various places. None of the marked turtles were ever found. Therefore, no estimation of the population could be calculated.

Turtle pond number 2 (UTM 767748) was a shallow pond that dried completely during the winter months. It too was formed by a spreader dam, however its location did not allow it to trap as much water as pond number 1. This pond was located in the Alkaline Grassland Community. Turtles were trapped here only a few times to monitor their occurrence.

Lacertilia

Coleonyx brevis (Texas banded gecko) - The only strictly nocturnal lizard of the Chihuahuan Desert, this species is only found active at night by lantern or car lights. It is easily found during the

day by turning flat rocks, boards, or other suitable debris. The species was most often found in the Mariola and Lechuguilla Scrub Community with a limestone substrate. It was trapped in drift fence traps in the Semidesert Grassland. One specimen was found beneath a dead yucca trunk on a very sandy substrate.

Crotaphytus collaris baileyi (western collared lizard) - An inhabitant of rocky substrates, the collared lizard is often seen basking on the tops of boulders by midmorning. It is easily identifiable by its large size, greenish coloration, and its bipedal running style. This lizard was recorded from the Mosaic of Semidesert Grassland - Mariola and Lechuguilla Scrub, the Arroyo Scrub, and Mixed Shrub and Succulent Scrub communities. The lizard was not found above 3,500 feet (1069 m) in elevation. It could almost always be seen on warm spring days along the county road between the lodge field headquarters and the Chalk Hills eastern escarpment.

Gambelia wislizenii (longnose leopard lizard) - Probably the rarest of the lizards, this large lizard was found only in bajada habitat with sandy to gravelly soil as a substrate. This species has a scattered, disjunct distribution in Trans-Pecos Texas. It is strongly carnivorous on smaller lizards. The leopard lizard is known to consume Uta stansburiana and Cnemidophorus inornatus, both small species found in the same habitat with it at the base of the Rosillos Mountains. The two collection sites for this species was near the old tin barn (UTM 692724) and on the east lower slope of the Rosillos Mountains (UTM 734711). The tin barn site is in the Creosote Scrub Community while the eastern slope site is in the Mariola Scrub Community. No leopard lizards were found on the west side of the mountains.

Cophosaurus texanus scitula (Texas earless lizard) - One of the most commonly seen lizards in the study area, this lizard was found in almost every plant community below 3,500 feet (1,069 m). It was missing only from the Alkaline Grassland Community. The Texas earless lizard prefers a substrate with some rock rubble present, and generally is not found in totally sandy soils. Bajada type habitat at the base of hills and mountains as it occurs in the Rosillos area are ideal for this species. It was also common in the Chalk Hills to the north of the Rosillos and the low-lying limestone hills to the east of Chalk Draw to Bone Spring. Texas earless lizards are most at home in the Arroyo Scrub Community. These lizards commonly use rocky arroyos to extend their populations into deeper soil types. Howland (1992) studied the life history of this species in the Grapevine Hills of Big Bend National Park and onto the South Rosillos Mountains. He commented on the proclivity of C. texanus to occupy creek beds and wash bottoms. Although his study population experienced two flooding periods, he found no effect on the lizard population.

Sceloporus poinsetti (crevice spiny lizard) - An interesting enigma was presented with this species. Only three specimens were collected and all three were juvenile lizards. Two of the three came from the lodge field headquarters in 1992 and one from near Buttrill Springs in 1991. Although the habitat in the Rosillos Mountains with its high bluffs and huge boulder beds is ideal habitat for this species, not a single adult lizard was found through the three seasons of field work. The adult lizards are large, heavy-bodied individuals up to 12 inches (30 cm) long and are easy to see as they rest on rocks. The pattern we found suggests a possible introduction at the lodge. This species is somewhat rare in the southern Big Bend country, but it is common only a short distance

to the north. Another possibility is there are very few adult S. poinsetti, but they have been successful in producing some young. Certainly a major collecting bias exists at the lodge site in the increased amount of time spent there.

Sceloporus magister bimaculosus (twin-spotted spiny lizard) - A large lizard of lowland desert environments, this species was found primarily in the Mesquite Scrub and Arroyo Scrub communities. These lizards rival the spiny crevice lizards in size. In contrast the twin-spotted spiny lizards prefer sandy to alluvial soils with large mesquites or other shrubs to which they retreat, climbing the trunk opposite the side danger is perceived. All our specimens were captured in drift fence traps (drift fences number 1 and 10) near Nine Point Draw.

Sceloporus undulatus consobrinus (southern prairie lizard) - A smaller species of Sceloporus, this species grows to nearly 7 inches (18 cm) in total length. It is a rather ubiquitous lizard in its habitat preference providing there is a structure upon which to climb. It was found in every plant community except the Grama Grassland and Oak Woodland. Every building, wooden windmill, and cement structure had its resident prairie lizard. When approached while they are foraging on the ground they were often seen to retreat into small desert shrubs or escape by running up the trunk of larger shrubs. Yuccas, if present, always provided an effective escape route up the trunk and beneath the shaggy dead leaves that point downward from the crown.

Sceloporus merriami annulatus (Big Bend canyon lizard) - The canyon lizards are one of the smallest of the spiny lizards reaching a maximum total length of a 6.2 inches (15.8 cm). Our specimens averaged less than 5 inches (12.7 cm). Three subspecies of S. merriami have been described and all three subspecies occur in the Big Bend Region of Texas along the Rio Grande. Sceloporus m. annulatus is the race occurring throughout Big Bend National Park. The species is confined to rocky bluffs and outcrops throughout its range. It is a common lizard within its range, but its restricted range in Texas was once grounds to list it as a protected species in the state (TPWD 1978). It is no longer listed as such.

This species was found in most plant communities where bluffs and rocky outcrops were adequate. Many of the disjunct igneous outcrops in the Rosillos Mountains, such as those above Buttrill Springs, supported demes of canyon lizards. However, the lizard appeared much more common along the scarp of the Chalk Hills. Perhaps the long continuity of the limestone scarp has allowed for a larger contiguous population to develop. This scarp is included in the Mixed Shrub and Succulent Scrub Community.

Canyon lizards were not found above 4,700 feet (1,432.5 m) elevation in the Rosillos Mountains although adequate habitat was present. Large boulder beds characterized much of the Grama Grassland and Oak Woodland communities above 4,700 feet (1,423.5 m). This area was the least sampled of all areas, so it is possible that collection bias simply missed finding the lizard.

Urosaurus ornatus schmidtii (Big Bend tree lizard) - This species of lizard normally is found scampering around tree trunks and lower limbs as the common name implies. The Big Bend race is normally seen on boulders and rocky ledges, the same habitat preferred by the canyon lizard. In

the North Rosillos Area this species was found more often on the basaltic outcrops of the Rosillos Mountains proper. It was always found on the trees and the rock ledges near the various springs in the Riparian Community. It was seldom seen in the Chalk Hills. The tree lizard was the only reptilian species found on and near the top of the Rosillos Mountains, generally above 4,700 feet (1,432 m). The species was found to be somewhat common on Rosillo Peak. The absence of Sceloporus merriami from the higher elevations of the Rosillos Mountains suggests Urosaurus displaces it at these elevations. The near absence of tree lizards in the Chalk Hills may be due to canyon lizards out-competing them at lower elevations. The two species are found in about equal numbers among isolated rocky outcrops in the lower Rosillos Mountains.

Tree lizards of the study area are brightly colored in the gular and belly regions. The dorsum of males shows a series of squarish black patches while the venter is bright blue to turquoise. Color variation among isolated populations of tree lizards is well known.

Uta stansburiana stejnegeri (side-blotched lizard) - A common species on sandy to gravel-sandy soils. This small lizard occurs throughout much of the same range as the leopard lizard, and is a major dietary item of the latter. This species was abundant anywhere sandy soil predominated as a substrate. It was most abundant in the Alkaline Grassland Community where grass was sparse such as at Bone Spring, or at the transitional edges of this community where it blended into other communities (UTM 667738). It was also found in the Arroyo Scrub Community if the substrate was sandy (UTM 638699).

Phrynosoma cornutum (Texas horned lizard) - This species was found in two localities. One locality was a transitional zone between a Mariola Scrub and a Creosote Scrub community. This site was near the old ranch trash dump (UTM 688761). Texas horned lizards were seen a number of times within a half mile (792. m) of this site. The other sightings of this species was at the old ranch headquarters (UTM 688751) where one was seen several times around the pens. The trash dump provides good hiding spaces for this species as does the old boards and other debris around the ranch house.

Phrynosoma modestum (roundtail horned lizard) - This little horned lizard was recorded from only two widely spaced localities. One was caught in a trap at drift fence number 1 in the Creosote Scrub Community, and the other was found to the north near Chalk Draw (UTM 667806) in the Mariola Scrub Community. The roundtail horned lizard is a master at background color matching making these small lizards almost impossible to see unless they are moving. I would expect this species to be better represented in the area than my field data shows. It is probably much more numerous than the Texas horned lizard.

Cnemidophorus inornatus heptagrammus (Trans-Pecos striped whiptail) - This species, one of the smallest of the whiptail lizards, was commonly seen in the Arroyo Scrub, Mariola Scrub, and Moosaic of Semidesert Grassland and Mariola & Lechuguilla Scrub communities. Individuals of this taxon are normally characterized by having seven pale stripes on a dark groundcolor. Of 18 specimens collected from the study area, 72% display the normal 7-stripe pattern while 28% display only 6 pale stripes. Most of the 6-striped individuals are from the east side of the Rosillos, but two

individuals are from the northwest side. Both forms have been collected at the same sites. Preliminary analysis supports the 6-striped form being referable to C. inornatus. Further analysis of this problem will be done in the future.

Cnemidophorus marmoratus (marbled whiptail) - The marbled whiptail is the signature reptile of the North Rosillos Area. It was found in every plant community below 3,500 feet (1,066 m) elevation, and sometimes as high as 4,000 feet (1,219 m) where it followed arroyos higher into the mountains. This was the only species of lizard that was active during mid-day when the temperature was 100 degrees F (37.8 C). It has been recorded as being active at temperatures of 105 degrees F (40.5 C). Marbled whiptails were found on every substrate except bluffs and rocky outcrops. This lizard is extremely wary and ordinarily cannot be closely approached. It was successfully captured in drift fence traps.

Cnemidophorus septemvittatus (Plateau spotted whiptail) - The largest of Texas whiptails, this species is easily identifiable by its rusty colored rump and dark lines, some complete, others broken into dark squarish blotches. Juveniles may be more difficult to identify. This large lizard prefers rocky hillsides, valleys, and arroyos. It was commonly found in the Rosillos Mountains up to 5,200 feet (1,585 m) elevation in the Grama Grassland Community, and as low as 3,200 feet (975 m) around the base of the Rosillos and the Chalk Hills in mixed communities. In the Chalk Hills it was most numerous in the Mixed Shrub and Succulent Scrub Community. Young plateau spotted whiptails in the Chalk Hills displayed a pattern of markings that was not typical, but the adults looked like typical individuals. This is the most common whiptail in the Chisos Mountains, and occurs there in elevations in excess of 5,500 feet (1,678 m). Why it was not found on the very top of the Rosillos Mountains cannot be explained except to say the grass was so dense on the top that it made seeing a lizard on the ground almost impossible. The only ones seen on the sides of the mountain at high elevations were found foraging around rocky outcrops where grass was less dense to absent.

Eumeces tetragrammus brevilineatus (short-lined skink) - This species was not found during the present study, but it was collected by Minton at Goat Spring in 1955 (Minton 1959). This little skink should be expected around any of the permanent springs on the ranch. Although not confined to the Riparian Community it is most likely to be found there.

Eumeces obsoletus (Great Plains skink) - This species, the largest of the skinks, was inadvertently trapped in a Sherman live trap by the mammalogy team at a site in the Chalk Hills (UTM 665760). A large lizard was briefly seen at Unnamed Spring in June 1991, but the observer only tentatively identified it as a Great Plains skink. This large skink is relatively common throughout the Trans-Pecos region.

Serpentes

Thamnophis marcianus marcianus (checkered garter snake) - Usually found in or near water this garter snake may disperse down arroyos and other low places during wet periods. Garter snakes were sometimes seen in and around all the permanent springs, but because the vegetation was so

dense it was almost impossible to identify or capture them. The only specimen captured from the study site is from a limestone ridge on the western boundary of the study area and but a short distance from Corazones Draw (UTM 629679).

Thamnophis cyrtopsis cyrtopsis - (western blackneck garter snake) - This species is difficult to distinguish from the checkered garter snake discussed above unless one gets a good look at them. At least one individual at Buttrill Springs was positively identified as a western blackneck garter snake. The only documented record of the species is from Minton's collection in the area in 1955 (Minton 1959). His specimen is from San Juan Spring, just to the south of the present study area. This species tends to be even more terrestrial than the checkered garter snake, and is more likely to be encountered in more arid habitats. The favored habitat for both species would be in the Riparian Community.

Diadophis punctatus regalis (regal ringsnake snake) - A single specimen of this colorful little snake was collected from underneath a rock in the bottom of an arroyo only one-quarter mi (396 m) NE the lodge headquarters (UTM 679706), placing it in the Arroyo Scrub Community. They are rather ubiquitous in their habitat choice, and could be found almost anywhere except in very sandy desert substrates.

Masticophis flagellum testaceus (western coachwhip) - A rather common species found throughout the study area. This species was found from the floor of the valley (UTM 669796) to 3,700 feet in the Rosillos Mountains (UTM 699697). This is one of two species of diurnal snakes that can be found active in all but the hottest part of the day. All the individuals found during the study were unicolored light to dark brown in coloration. None of the pinkish to dark red colored individuals often found in the Trans-Pecos Region were seen. Minton (1959) remarked that most of the adult individuals he found in the Big Bend were pinkish tan to bright vermilion in color.

Masticophis taeniatus girardi (central Texas whipsnake) - A fast moving, dark colored, slender snake often seen but rarely caught, this species is active throughout daylight hours. A single specimen was taken for a voucher from near Goat Spring (UTM 657684). There has been considerable debate over the subspecific status of this snake in Trans-Pecos Texas. Conant and Collins (1991) presently include all Trans-Pecos populations with girardi. The diet of this snake is predominantly lizards.

Salvadora deserticola (Big Bend patchnose snake) - This species was not found during the present study. Minton (1959) collected this species from "east base Rosillos Mtns." in 1955. He found his specimens in lower arroyo and sandy desert situations. It, like the western whipsnake, is more often seen than caught. Patchnose snakes feed primarily on lizards.

Bogertophis subocularis (Trans-Pecos rat snake) - This species is considered by many to be the most beautiful snake in the United States. It was listed as a protected species by the Texas Parks and Wildlife Department in 1978 because of the heavy commercial collecting that was occurring. It has since been removed from the list, but its populations are being monitored. The known range of this snake is restricted to southwestern Texas and southeastern New Mexico. It also occurs across

the Rio Grande in northern Chihuahua and Coahuila, but its status there is unknown. All the individuals we observed in the study area were found while driving the county road at night. It was found most often in the Arroyo Scrub Community where the road followed an arroyo, or where an arroyo draining Semidesert Grassland communities crossed the road.

Elaphe guttata emoryi (Great Plains rat snake) - A single specimen of this species was collected at UTM 676717. The mammal team from Texas Tech reported collecting one at UTM 681730. Both of these sites are in the low limestone hills through which the county road passes after it leaves the flats on the way to the lodge. This would be in the Arroyo Scrub Community. The UTM 681730 site is bordered to the north by a Creosote Scrub Community that quickly drops into Nine Point Draw, while on the south it is bordered by a hard, lowlying, limestone hill covered with Mixed Shrub and Succulent Scrub Community. This is a singular area in which more species were collected than any other. The high herpetological diversity at this point undoubtedly reflects the high diversity of plant communities concentrated over such a small distance.

Arizona elegans elegans (Kansas glossy snake) - Glossy snakes are most often found on sandy substrates. We saw only four individuals of this species, all on sandy segments of the county road at night. These localities were in the Creosote Scrub Community and the Mariola Scrub Community. Two specimens were taken, one at UTM 705732, and the other at UTM 718732.

Pituophis melanoleucus affinis (Sonoran gopher snake) - This species was found only four times during the three years of field work. This was unexpected since it is one of the most common snakes in the Big Bend Region. This form of the bullsnake is the largest snake in the region. It is active in the daylight as well as at night. Although there is a paucity of records from the North Rosillos Area, all four sightings were in different plant communities. This snake was found at a much higher elevation than any other species of snake. One sighting was at UTM 699681, near Rosillo Peak at an elevation of 5,200 feet (1,585 m) in the Oak Woodland - Grama Grassland communities.

Rhinocheilus lecontei tessellatus (Texas longnose snake) - Another snake represented by a single occurrence, this species was collected in the Creosote Scrub Community on the county road where it crosses low chalky hills (UTM 771766) just before the road drops into the deeper-soiled flats. The longnose snake is found throughout Brewster County except in the mountains above 4,000 feet (1,219 m). It is typically found in gravelly to rocky substrates in the lower Chihuahuan Desert. Snakes of this species are quite variable in color, but usually have varying amounts of red, black, and yellow or white. It is sometimes mistaken for a kingsnake or even a coral snake by people unfamiliar with snakes.

Sonora semiannulata (ground snake) - Individuals of this species are quite variable, ranging from plain pale tan to dark brown with a reddish line down the back, to tan, brown, or gray ground color with dark crossbands around the body. Some have a blackish head or a partial dark band just behind the head. The one specimen we obtained was uniformly brown in color. This specimen was in a trap at drift fence number 2 (UTM 731743) in the Creosote Scrub Community. These little snakes average about 8.5 inches (21 mm) in length in southwestern Texas.

Tantilla hobartsmithi (southwestern blackheaded snake) - This species is another of the small, highly secretive snakes of the Big Bend area, averaging about 8 inches (20 mm) in length. Our one specimen came from the far western edge of the study area next to a rocky ledge (UTM 614684). No other individuals of this species were seen. Blackheaded snakes are too small to be seen by car headlights on dirt roads at night, and mostly spend daylight hours secreted under rocks or dead vegetation, or in holes and crevices. The taxonomy of the blackheaded snakes is still perplexing. This particular taxon was long considered to represent T. atriceps in southwest Texas. Cole and Hardy (1981) determined that T. atriceps is confined to Mexico and specimens considered to be atriceps from southwest Texas and northern Coahuila and Chihuahua represented T. hobartsmithi.

Hypsiglena torquata jani (Texas night snake) - A common and widespread species of the lower elevations throughout the Big Bend area, this species is a rear-fanged snake that feeds mostly on lizards. The venom is not dangerous to man, but does help this small snake subdue its lizard prey. As the name suggests it is primarily a nocturnal species that is very effective in surprising sleeping lizards. This species was found in only one locality (UTM 716716) but it was abundant there. We discovered three individuals within 200 feet (61 m) of each other. All three were discovered beneath old boards and metal lying on the ground near a windmill that was still pumping water. The area is somewhat transitional between the Arroyo Scrub Community and the Semidesert Grassland Community. At least seven individuals of Crotalus atrox were also found within 300 yards (274 m) of the same site at various times. An overflow of water from the tank into which the windmill was pumping had established a small marshy area down hill from the tank, creating a little oasis for wildlife of the area. Three species of lizards also were collected at this site.

Agkistrodon contortrix pictigaster (Trans-Pecos copperhead) - Milstead (1960) recognized the Trans-Pecos race of copperheads as representing a relict species in the Chihuahuan Desert. The species is found only where there is permanent water. Thereby the species tends to be more commonly found in areas of higher elevations where springs and running streams are more prevalent. In the lower Chihuahuan Desert copperheads are found around isolated desert springs that seldom run streams more than a few meters from their source, fragmenting the populations even more. Milstead (1968) commented on their precarious existence with extinction from two sources, too much water from flash floods and too little water from extreme drought. Minton (1959) collected this species from Alamo Spring in the Rosillos Mountains in 1955. We found the species to be abundant at Buttrill Springs. Searching the spring area during daylight hours was mostly futile, but using lanterns at night was very effective in finding relative high numbers of copperheads. A single juvenile copperhead was found at 12:20 PM on 14 July 1992 at the base of the large pecan tree, the only time the species was found during daylight hours. Trans-Pecos copperheads also were found at night on the county road where it passed around a large igneous mass UTM 638706 and 642711. These localities are about two miles and just down hill from Buttrill Springs. These specimens from the Creosote Scrub Community most likely dispersed there from Buttrill Springs, or perhaps were carried there by summer flash floods from the springs above.

Night time searches around No Name (Borracho) Spring failed to find copperheads at that locale. No Name Spring is an isolated, low-volume spring on the east side of the Rosillos Mountains away from the other flowing springs on the northwest and west side of the mountains. If

copperheads in fact are not there it could be that copperheads never reached the east side, or possibly No Name Spring ceases to flow during drought periods. Unusually abundant rainfall occurred during all three seasons of the present study, and the springs were flowing, although not a great amount. Riparian vegetation is not extensive at this site suggesting that spring flow is very localized.

The Trans-Pecos copperhead was listed as a protected species by Texas Parks and Wildlife in 1978, but it has since been delisted. It is on the watch list.

Crotalus atrox (Western diamondback rattlesnake) - The western diamondback rattlesnake was one of the most difficult snakes to find in 1990, but became the most often encountered snake in the study area by 1992. This common rattlesnake of the Trans-Pecos was found in every plant community below 4,000 feet (1,211 m) elevation. Seven individuals were found within 300 yards (274 m) of each other around UTM 714717 on the evening of 24 April 1992. This is the locality of a pumping windmill where overflow water from a tank has created a small marsh-like situation. Conditions here are ideal for various forms of wildlife that might be attracted to free surface water. Rattlesnakes probably find an abundance of prey here in the form of small mammals and birds.

Crotalus scutulatus scutulatus (Mojave rattlesnake) - The Mojave rattlesnake was recorded only from the east side of the Rosillos Mountains. All Mojave rattlesnakes were found on the county road at night, except for two specimens that were found dead on the road. This species is the most toxic of all rattlesnakes in the United States. All specimens were in the Creosote Scrub, Arroyo Scrub, or Mariola Scrub communities at elevations below 3,000 feet (914 m). Mojave rattlesnakes are usually associated with the Sonoran Desert of Arizona, but a disjunct population is found in the lower Chihuahuan Desert in Trans-Pecos Texas southward to Coahuila, Mexico. Records show the species is expanding northward in the Trans-Pecos and into areas of higher elevations.

Crotalus molossus molossus (Blacktail Rattlesnake) - Often locally referred to as the velvet-tail rattlesnake, this is primarily a species of highland grasslands, but it has been recorded from sandy desert soils along the Rio Grande. In the Rosillos Mountains the blacktail rattler was seldom seen in the higher elevations, but it was found more often where the Semidesert Grassland Community blended into other communities at lower elevations. Most of these rattlesnakes were seen in the area where the county road parallels a small chalky hill before crossing the hill, then follows an arroyo westward to the lodge. Nine Point Draw with its broad flood plain and sandy substrate supports a dense stand of introduced grass only a few meters from the road (UTM 684729). Numerous rodents were almost always seen along this segment of the road at night. The blacktail rattlesnakes could have been attracted to this, and other lower elevational levels, by the abundance of prey created by the unusually wet years of 1990-1992. One of our specimens is from Buttrill Springs. The blacktail rattlesnake rivals the western diamond back in size, but it tends to have a much better disposition. We found these beautiful green and black patterned rattlesnakes were more likely to retreat than to stand their ground.

Crotalus lepidus lepidus (mottled rock rattlesnake) - This little rattlesnake was seen only twice during the three year study. It too was never found where they are traditionally located in

other areas of the Trans-Pecos. Long searches around talus slopes and rocky outcrops by personnel accustomed to finding rock rattlesnakes failed to turn up a single record of one in these typical rock rattler habitats. A specimen was located in a rocky arroyo bed just downhill from Alamo Spring (UTM 657651) on 19 June 1991 at an elevation of 3,400 feet (1,036 m) in the Arroyo Scrub Community. The other was found on a small hill 1.3 mi (2 km) northwest of Bone Spring (UTM 751792) in the fall (18 Sept. 1992), at an elevation of only 2,927 feet (892 m) in the Creosote Scrub Community. This latter locality is one of the last places this species was expected to be found. The mottled rock rattlesnake was listed as a protected species by Texas Parks and Wildlife in 1978, but it has since been delisted. It is still a favorite species sought by hobby and commercial collectors.

Summary

The species of amphibians and reptiles documented for the North Rosillos Area of Big Bend National Park are characteristic herpetofauna of the northern portion of the Chihuahuan Desert. The elevational gradients in which some species were found did present some surprises. It was unusual to find Crotalus molossus and C. lepidus in scrub communities of the lower elevations rather than in the higher Oak Woodland and Grama Grass communities in the rougher terrain. The dominance of Urosaurus ornatus on top of the Rosillos, and the absence of other snake and lizard species from the higher elevations of the mountains was unusual. Most species of desert dwelling reptiles are not well adapted to dense grassland habitats. The unusually wet years that occurred during the present study produced thick vegetative cover over almost the entire study area. The grassland communities, especially at higher elevations, produced a tall and heavy growth of grass that obscured the ground. This dense grass growth may have acted to conceal reptiles from us, or it could have driven montane reptiles to lower elevations where they could forage more efficiently.

The paucity of snake records from the area the first year of the study, and the increased occurrences of snakes the other two years, especially of Crotalus atrox, seem to indicate that snake populations had responded positively to increased rainfall. This supposition would be based upon the enlargement of their prey base as plant communities flourished. Lizard populations also responded positively in that the dominant lizards became much more numerous. It is interesting to note that many of the snake species and two of the lizard species feed on lizards.

The two pattern morphs of Cnemidophorus inornatus found in the Rosillos Mountains is of interest. Individuals of this species have been examined from all over west Texas and northern Mexico, but a 6-lined morph has never been encountered before. This problem will hopefully be examined in the future.

The three years of the study could not have come at a better time to determine the amphibians of the area. It is likely that time will add one or two more amphibians to the list, but it is likely that we found most of the species that occur there.

A number of reptilian species will likely be added to the herpetofauna. It is very likely that at least a dozen snakes and lizards occur there that we did not document. No federally protected species are likely to be present, but several species listed as protected by the Texas Parks and

Wildlife Department should be present. It is also likely that additional species, some once protected by state regulations but now delisted, may be returned to protected status if monitoring of their populations indicate a decline is occurring. Species such as Bogertophis subocularis, Agkistrodon contortrix pictigaster, and Crotalus lepidus lepidus remain much sought species by hobbyist and commercial collectors.

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Table 7. List of the herptiles collected during the study.

REPTILES

IGUANIDAE CROTAPHYTUS COLLARIS	06/12/1991	ROSILLOS MTNS. NEAR OLD TIN BARN OFF RD. BREWSTER TEXAS
IGUANIDAE PHRYNOSOMA MODESTUM	J 09/08/1990	ROSILLOS STUDY AREA TRAP AT DRIFT FENCE BREWSTER TEXAS JFS 5168
VIPERIDAE CROTALUS SCUTULATUS	08/30/1990	ROSILLOS 3.2 MI W HWY 385 DOR CITY ROAD BREWSTER TEXAS JFS 5150
TEIIDAE CNEMIDOPHORUS MARMORATUS	08/30/1990	ROSILLOS 1ST DRIFT FENCE TRAP BREWSTER TEXAS JFS 5151
TEIIDAE CNEMIDOPHORUS MARMORATUS	08/30/1990	ROSILLOS 1ST DRIFT FENCE TRAP BREWSTER TEXAS JFS 5152
TEIIDAE CNEMIDOPHORUS MARMORATUS	09/01/1990	ROSILLOS 1ST DRIFT FENCE TRAP BREWSTER TEXAS JFS 5155
TEIIDAE CNEMIDOPHORUS MARMORATUS	09/01/1990	ROSILLOS 1ST DRIFT FENCE TRAP BREWSTER TEXAS JFS 5154
GEKKONIDAE COLEONYX BREVIS	09/01/1990	ROSILLOS 1ST HILLS AFTER 9PT DRAW BREWSTER TX JFS 5153
IGUANIDAE SCELOPORUS MAGISTER	08/27/1990	ROSILLOS FLATS NEAR 9PT DRAW BREWSTER TEXAS JFS 5146
IGUANIDAE SCELOPORUS MAGISTER	08/21/1990	ROSILLOS FLATS NEAR 9PT DRAW BREWSTER TEXAS JFS 5145
IGUANIDAE UTA STANSBURIANA	08/27/1990	ROSILLOS FLATS NEAR 9PT DRAW BREWSTER TEXAS JFS 5147
IGUANIDAE UTA STANSBURIANA	09/08/1990	ROSILLOS PIT TRAP NOLL DRIFT FENCE BREWSTER TEXAS JFS 5169
KINOSTERNIDAE KINOSTERNON FLAVESCENS	07/24/1990	ROSILLOS 3.8 MI FROM HWY 385 BREWSTER TEXAS LRB 007

KINOSTERNIDAE KINOSTERNON FLAVESCENS 09/16/1990
 ROSILLOS 3.9 MI FROM HWY 385 IN POND BREWSTER TEXAS JFS 5194

KINOSTERNON FLAVESCENS 09/16/1990
 ROSILLOS 3.9 MI FROM HWY 385 IN POND BREWSTER TEXAS JFS 5197

KINOSTERNIDAE KINOSTERNON FLAVESCENS 09/16/1990
 ROSILLOS 3.9 MI FROM HWY 385 IN POND BREWSTER TEXAS JFS 5195

KINOSTERNIDAE KINOSTERNON FLAVESCENS 09/16/1990
 ROSILLOS 3.9 MI FROM HWY 385 IN POND BREWSTER TEXAS JFS 5196

KINOSTERNIDAE KINOSTERNON FLAVESCENS 09/16/1990
 ROSILLOS 3.9 MI FROM HWY 385 IN POND BREWSTER TEXAS JFS 5198

TEIIDAE CNEMIDOPHORUS INORNATUS 09/08/1990
 ROSILLOS 1ST RKY HILL BY CTY RD 9PT DRAW BREWSTER TX JFS 5170

KINOSTERNIDAE KINOSTERNON FLAVESCENS 09/23/1990
 ROSILLOS 8.5 MI FROM HWY 385 IN SHLW POND BREWSTER TEXAS JFS 5230

IGUANIDAE CROTAPHYTUS COLLARIS 09/23/1990
 ROSILLOS BREWSTER TEXAS JFS 5229

IGUANIDAE SCELOPORUS MAGISTER 09/25/1990
 ROSILLOS TRAP @ DRIFT FENCE 7.2 MI ON RD BREWSTER TEXAS JFS 5228

COLUBRIDAE SONORA SEMIANNULATA 09/25/1990
 ROSILLOS DRIFT FENCE 6.2 MI FROM HWY 385 BREWSTER TEXAS JFS 5226

IGUANIDAE COPHOSAURUS TEXANUS 09/19/1990
 ROSILLOS DRIFT FENCE 6.2 MI W HWY 385 BREWSTER TEXAS JFS 5224

IGUANIDAE UTA STANSBURIANA 09/19/1990
 ROSILLOS DRIFT FENCE 6.1 MI W HWY 385 BREWSTER TEXAS JFS 5223

TEIIDAE CNEMIDOPHORUS MARMORATUS 09/23/1990
 ROSILLOS 4TH DRIFT FENCE 9.3 MI HWY 385 BREWSTER TEXAS JFS 5231

VIPERIDAE CROTALUS ATROX 09/28/1990
 ROSILLOS 2.1 MI FROM HWY 385 BREWSTER TEXAS LRB 005

IGUANIDAE CROTAPHYTUS COLLARIS 09/01/1990
 ROSILLOS 13.3 MI W HWY 385 BREWSTER TEXAS JFS 5239

IGUANIDAE SCELOPORUS MERRIAMII 06/19/1991
 ROSILLOS EAST BANK BUTTRILL SPRINGS BREWSTER TEXAS JFS 5275

TEIIDAE CNEMIDOPHORUS MARMORATUS 06/19/1991
 ROSILLOS UNNAMED SPRING BREWSTER TEXAS JFS 5290

IGUANIDAE PHRYNOSOMA CORNUTUM 05/06/1991
 ROSILLOS ALPINE BREWSTER TEXAS JFS 5251

TEIIDAE CNEMIDOPHORUS SEPTEMVITTATUS 06/19/1991
 ROSILLOS 3RD DRAW E BUTTRILL SPRINGS BREWSTER TEXAS JFS 5282

IGUANIDAE SCELOPORUS MERRIAMII 06/19/1991
 ROSILLOS HEAD 3RD DRAW BUTTRILL SPRINGS BREWSTER TEXAS JFS 5283

TEIIDAE CNEMIDOPHORUS MARMORATUS 06/20/1991
 ROSILLOS RED ROCK MTS 4.6 MI N HDQTRS BREWSTER TEXAS JFS 5288

TEIIDAE CNEMIDOPHORUS MARMORATUS 06/20/1991
 ROSILLOS RED ROCK MTS. 4.6 MI N OF HDQTR BREWSTER TEXAS JFS 5289

TEIIDAE CNEMIDOPHORUS SEPTEMVITTATUS 06/20/1991
 ROSILLOS CAUGHT MID-SPRG BUTTRILL SPRING BREWSTER TEXAS JFS 5287

SCELOPORUS MERRIAMII 06/19/1991
 ROSILLOS BOULDER BED E BUTTRILL SPRING BREWSTER TEXAS JFS 5279

IGUANIDAE SCELOPORUS MERRIAMII 06/19/1991
 ROSILLOS 3RD DRAW E BUTTRILL SPRINGS BREWSTER TEXAS JFS 5274

IGUANIDAE UROSAURUS ORNATUS 06/19/1991
 ROSILLOS E BANK OF BUTTRILL SPRINGS BREWSTER TEXAS JFS 5286

TEIIDAE CNEMIDOPHORUS INORNATUS 06/19/1991
 ROSILLOS NEAR TANK BELOW UNNAMED SPRING BREWSTER TEXAS JFS 5254

IGUANIDAE SCELOPORUS MERRIAMII 06/19/1991
 ROSILLOS ARROYO JUNC E BUTTRILL SPRINGS BREWSTER TEXAS JFS 5271

IGUANIDAE UROSAURUS ORNATUS 06/19/1991
 ROSILLOS 3RD DRAW TO E BUTTRILL SPRINGS BREWSTER TEXAS JFS 5285

TEIIDAE CNEMIDOPHORUS INORNATUS 06/19/1991
 ROSILLOS BELOW KNOLL S BUTTRILL SPRINGS BREWSTER TEXAS JFS 5253

IGUANIDAE SCELOPORUS MAGISTER 06/19/1991
ROSILLOS DRIFT FENCE NEAR ARROYO BREWSTER TEXAS JFS 5291

UROSAURUS ORNATUS 06/19/1991
ROSILLOS ABOVE E BANK BUTTRILL SPRINGS BREWSTER TEXAS JFS 5284

UROSAURUS ORNATUS 06/19/1991
ROSILLOS 2ND DRAW E BANK BUTTRILL SPRING BREWSTER TEXAS JFS 5281

SCELOPORUS MERRIAMII 06/19/1991
ROSILLOS E BANK BUTTRILL SPRINGS BREWSTER TEXAS JFS 5280

SCELOPORUS POINSETTI 06/20/1991
ROSILLOS W BANK BUTTRILL SPRINGS BREWSTER TEXAS JFS 5280

UROSAURUS ORNATUS 06/19/1991
ROSILLOS 3RD DRAW E BUTTRILL SPRINGS BREWSTER TEXAS JFS 5292

SCELOPORUS MERRIAMII 06/19/1991
ROSILLOS E BANK BUTTRILL SPRINGS BREWSTER TEXAS JFS 5276

UTA STANSBURIANA 06/19/1991
ROSILLOS 2.7 MI N HDQTRS SANDY AREA BREWSTER TEXAS JFS 5293

SCELOPORUS MERRIAMII 06/19/1991
ROSILLOS 3RD DRAW E BUTTRILL SPRINGS BREWSTER TEXAS JFS 5273

CNEMIDOPHORUS SEPTEMVITTATUS 04/27/1991
ROSILLOS LEDGE AT END OF LANDING STRIP BREWSTER TEXAS JFS 5245

CNEMIDOPHORUS SEPTEMVITTATUS 04/27/1991
ROSILLOS E FROM LODGE AT END OF RUNWAY BREWSTER TEXAS JFS 5243

IGUANIDAE COPHOSAURUS TEXANUS 04/27/1991
ROSILLOS SSW OF LODGE AT LANDING STRIP BREWSTER TEXAS JFS 5244

SCELOPORUS MERRIAMII 04/28/1991
ROSILLOS ON WALL OF INDIAN CAVE BREWSTER TEXAS JFS 5246

COLUBRIDAE ELAPHE GUTTATA EMORYI 05/06/1991
ROSILLOS 0.5 MI NE LODGE ON COUNTY ROAD BREWSTER TEXAS JFS

UROSAURUS ORNATUS 06/13/1991
ROSILLOS ROCKY RIDGE W OF ROSILLOS PEAK BREWSTER TEXAS JFS 5370

CNEMIDOPHORUS SEPTEMVITTATUS 06/12/1991
ROSILLOS W END OF AIRSTRIP CHALK HILLS BREWSTER TEXAS JFS 5332

CNEMIDOPHORUS SEPTEMVITTATUS 06/11/1991
ROSILLOS 0.5 MI S LODGE BREWSTER TEXAS JFS 5338

IGUANIDAE COPHOSAURUS TEXANUS 06/11/1991
ROSILLOS 0.5 MI LODGE BUTTRILL SPRINGS BREWSTER TEXAS JFS 5330

GAMBELIA WISLIZENII 06/11/1991
ROSILLOS OLD RANCH HOUSE TO E OF LODGE BREWSTER TEXAS JFS 5333

CNEMIDOPHORUS SEPTEMVITTATUS 06/12/1991
ROSILLOS 0.5 MI S LODGE ABOVE LEDGE BREWSTER TEXAS JFS 5321

IGUANIDAE COPHOSAURUS TEXANUS 06/12/1991
ROSILLOS 2 MI E OF LODGE ALOND COUNTY RD BREWSTER TEXAS JFS 5325

CNEMIDOPHORUS SEPTEMVITTATUS 06/12/1991
ROSILLOS 1 MI SSW OF LODGE BREWSTER TEXAS JFS 5329

SCELOPORUS MERRIAMII 06/11/1991
ROSILLOS OUTCROP ABOVE BUTTRILL SPRINGS BREWSTER TEXAS JFS 5324

CNEMIDOPHORUS INORNATUS 06/11/1991
ROSILLOS DRIFT FENCE IN TOBOSA FLAT BREWSTER TEXAS JFS 5322

IGUANIDAE COPHOSAURUS TEXANUS 06/10/1991
ROSILLOS 1ST ROCKY AREA BY E COUNTY RD BREWSTER TEXAS JFS 5335

UROSAURUS ORNATUS 06/13/1991
ROSILLOS FAR E PT E OF ROSILLOS PEAK BREWSTER TEXAS JFS 5340

CNEMIDOPHORUS INORNATUS 06/20/1991
ROSILLOS 0.9 MI N OF OLD RANCH HDQTRS BREWSTER TEXAS JFS 5312

IGUANIDAE COPHOSAURUS TEXANUS 06/19/1991
ROSILLOS JUST BELOW HDQTRS BREWSTER TEXAS JFS 5301

UROSAURUS ORNATUS 05/16/1991
ROSILLOS AROUND ALAMO SPRINGS BREWSTER TEXAS JFS 5318

UROSAURUS ORNATUS 06/13/1991
ROSILLOS 1ST PEAK UP FROM OLD TIN BARN BREWSTER TEXAS JFS 5337

CNEMIDOPHORUS SEPTEMVITTATUS 06/12/1991
ROSILLOS 1 MI SSW OF LODGE BELOW TUFF BREWSTER TEXAS JFS 5331

CEMIDOPHORUS INORNATUS 06/12/1991
ROSILLOS 1 MI SSW OF LODGE BREWSTER TEXAS JFS 5323

CNEMIDOPHORUS SEPTEMVITTATUS 06/12/1991
ROSILLOS 0.75 MI SW LODGE LOW HILLS BREWSTER TEXAS JFS 5336

TEIIDAE CNEMIDOPHORUS MARMORATUS 06/12/1991
ROSILLOS OLD ROSILLOS RANCH 2 MI N LODGE BREWSTER TEXAS JFS 5327

UTA STANSBURIANA 06/20/1991
ROSILLOS 0.6 MI SE BONE BONE SPRING BREWSTER TEXAS JFS 5303

CNEMIDOPHORUS INORNATUS 06/12/1991
ROSILLOS RANGER LODGE AT CHALK HILLS BREWSTER TEXAS JFS 5339

TEIIDAE CNEMIDOPHORUS MARMORATUS 06/20/1991
ROSILLOS RED ROCK MT. CA. 4.6 MI N HDQRT BREWSTER TEXAS JFS 5297

IGUANIDAE COPHOSAURUS TEXANUS 06/20/1991
ROSILLOS OUTCROP ABOVE BUTTRILL SPRINGS BREWSTER TEXAS JFS 5317

UROSAURUS ORNATUS 06/10/1991
ROSILLOS OUTCROP ABOVE BUTTRILL SPRING BREWSTER TEXAS JFS 5328

CNEMIDOPHORUS INORNATUS 06/20/1991
ROSILLOS 1.8 MI N HDQTRS BREWSTER TEXAS JFS 5307

CNEMIDOPHORUS SEPTEMVITTATUS 06/18/1991
ROSILLOS CA 500 YDS. E OF HDQTRS BREWSTER TEXAS JFS 5298

UROSAURUS ORNATUS 05/16/1991
ROSILLOS ROCKY LEDGE ABOVE ALAMO SPRING BREWSTER TEXAS JFS 5320

UROSAURUS ORNATUS 05/16/1991
ROSILLOS ROCKY LEDGE ABOVE ALAMO SPRING BREWSTER TEXAS JFS 5319

SCELOPORUS MERRIAM 06/10/1991
ROSILLOS OUTCROP E BANK BUTTRILL SPRINGS BREWSTER TEXAS JFS 5326

UROSAURUS ORNATUS 06/12/1991
ROSILLOS 2.7 MI N HDQTRS BREWSTER TEXAS JFS 5334

UTA STANSBURIANA 06/20/1991
ROSILLOS 2.7 MI N HDQTRS BREWSTER TEXAS JFS 5309

CNEMIDOPHORUS INORNATUS 06/19/1991
ROSILLOS SLOPE JUST E BUTTRILL SPRINGS BREWSTER TEXAS JFS 5302

CNEMIDOPHORUS INORNATUS 06/18/1991
ROSILLOS CA. 500 YDS. E OF LODGE BREWSTER TEXAS JFS 5300

UROSAURUS ORNATUS 06/19/1991
ROSILLOS 4200FT. UP ARROYO BUTTRILL SPR BREWSTER TEXAS JFS 5313

TEIIDAE CNEMIDOPHORUS MARMORATUS 06/20/1991
ROSILLOS RED ROCK MT. CA 4.6 MI N HDQTR BREWSTER TEXAS JFS 5296

TEIIDAE CNEMIDOPHORUS MARMORATUS 06/20/1991
ROSILLOS 2.7 MI N OF OLD RANCH HDQTRS BREWSTER TEXAS JFS 5315

TEIIDAE CNEMIDOPHORUS MARMORATUS 06/19/1991
ROSILLOS DRIFT FENCE E OF OLD RANCH BREWSTER TEXAS JFS 5314

CNEMIDOPHORUS INORNATUS 06/19/1991
ROSILLOS CA 1/4MI.W GOAT SPRINGS BREWSTER TEXAS JFS 5304

UROSAURUS ORNATUS 06/13/1991
ROSILLOS ROSILLOS PEAK BREWSTER TEXAS JFS 5341

SCELOPORUS UNDULATUS 06/18/1991
ROSILLOS OLD HOUSE AT BONE SPRINGS BREWSTER TEXAS JFS 5299

UROSAURUS ORNATUS 06/19/1991
ROSILLOS UNNAMED SPRING E OF MTN BREWSTER TEXAS JFS 5295

IGUANIDAE COPHOSAURUS TEXANUS 06/19/1991
ROSILLOS NEAR UNNAMED SPRING BREWSTER TEXAS JFS 5306

VIPERIDAE CROTALUS MOLOSSUS 06/13/1991
ROSILLOS WATERCOURSE BELOW BUTTRILL SPR BREWSTER TEXAS JFS 5241

CNEMIDOPHORUS INORNATUS 06/18/1991
ROSILLOS DRIFT FENCE IN TABOSA FLAT BREWSTER TEXAS JFS 5294

VIPERIDAE CROTALUS SCUTULATUS 05/18/1991
VALENTINE, 9.3 MI N ON US 90 JEFF DAVIS TEXAS JFS 5252

MASTICOPHIS TAENIATUS 06/11/1991
ROSILLOS, CA 0.25 MI BELOW W GOAT SPRING BREWSTER TEXAS JFS 5345

MASTICOPHIS FLAGELLUM 06/13/1991
ROSILLOS 4 MI E LODGE ON COUNTY ROAD BREWSTER TEXAS JFS 5344

MASTICOPHIS FLAGELLUM 06/20/1991
ROSILLOS 2.7 MI N OLD RANCH HDQTRS BREWSTER TEXAS JFS 5343

UROSAURUS ORNATUS 06/13/1991
ROSILLOS E FORK BUTTRILL SPRING CANYON BREWSTER TEXAS JFS 5359

IGUANIDAE COPHOSAURUS TEXANUS 06/12/1991
ROSILLOS 1 MI E LODGE ON COUNTY ROAD BREWSTER TEXAS JFS 5347

CNEMIDOPHORUS INORNATUS 06/13/1991
ROSILLOS JUST BELOW BUTTRILL SPRINGS BREWSTER TEXAS JFS 5351

SCELOPORUS MERRIAMII 06/10/1991
ROSILLOS ABOVE PECAN TREE BUTTRILL SPR BREWSTER TEXAS JFS 5358

SCELOPORUS POISETTI 06/12/1991
ROSILLOS ON FOUNDATION OF THE LODGE BREWSTER TEXAS JFS 5357

UROSAURUS ORNATUS 06/13/1991
ROSILLOS 4700FT ABOVE PASS TO ROSI PEAK BREWSTER TEXAS JFS 5362

UROSAURUS ORNATUS 06/13/1991
ROSILLOS PEAK N OF ROSILLOS PEAK BREWSTER TEXAS JFS 5353

UROSAURUS ORNATUS 06/13/1991
ROSILLOS ABOVE PASS TO OLD TIN BARN BREWSTER TEXAS JFS 5355

UROSAURUS ORNATUS 06/12/1991
ROSILLOS BLUFF ABOVE BUTTRILL SPRINGS BREWSTER TEXAS JFS 5352

UROSAURUS ORNATUS 06/13/1991
ROSILLOS N PEAK ABOVE TIN BARN BREWSTER TEXAS JFS 5350

SCELOPORUS UNDULATUS 06/13/1991
ROSILLOS CA 4000FT. BUTTRILL SPRINGS BREWSTER TEXAS JFS 5360

SCELOPORUS UNDULATUS 06/13/1991
ROSILLOS CA 4500FT ABOVE TIN BARN BREWSTER TEXAS JFS 5349

SCELOPORUS MERRIAMII 06/10/1991
ROSILLOS ROCKY OUTCROP BUTTRILL SPRINGS BREWSTER TEXAS JFS 5348

SCELOPORUS MERRIAMII 06/12/1991
ROSILLOS E BLUFF OF BUTTRILL SPRINGS BREWSTER TEXAS JFS 5361

IGUANIDAE COPHOSAURUS TEXANUS
ROSILLOS 1 MI E OF LODGE BREWSTER TEXAS JFS 5346

VIPERIDAE AGKISTRODON CONTORTRIX 06/20/1991
ROSILLOS BUTTRILL SPRINGS 50 YDS N TREE BREWSTER TEXAS JFS 5342

VIPERIDAE CROTALUS LEPIDUS 06/19/1991
ROSILLOS ARROYO CA 0.25 MI NW ALAMO SPRGS BREWSTER TEXAS JFS 5277

VIPERIDAE CROTALUS MOLOSSUS 10/20/1991
ROSILLOS 1 MI E OF LODGE AT RD BREWSTER TEXAS JFS 5387

IGUANIDAE COPHOSARUS TEXANUS M 04/24/1992
ROSILLOS - WEST SIDE WHERE DRIFT FENCE W BREWSTER TEX

TEIIDAE CNEMIDOPHORUS MARMORATUS M 04/24/1992
ROSILLOS-WEST SIDE WHERE DRIFT FENCE WAS BREWSTER TEX

COLUBRIDAE HYP SIGLENA TORQUATA 04/24/1992
ROSILLOS- CANYON ON NE SIDE NEAR WINDMIL BREWSTER TEX

UROSAURUS ORNATUS M 04/24/1992
PILE OF LARGE BOULDERS 400YDS S. ABOVE BREWSTER TES

VIPERIDAE CROTALUS ATROX 04/24/1992
ROSILLOS: 100 YDS S. WINDMILL AS ABOVE BREWSTER TEX

HYP SIGLENA TORQUATA 04/24/1992
ROSILLOS; CA. 80 YDS NE WINDMILL AS ABOV BREWSTER TES

CNEMIDOPHORUS INORNATUS 04/24/1992
ROSILLOS; IN CANYON WHERE WINDMILL WORKS BREWSTER TES

COPHOSAURUS TEXANUS M 04/24/1992
ROSILLOS; SAME AS ABOVE BREWSTER TEX

SCELOPORUS UNDULATUS F 04/24/1992
ROSILLOS; ON TANK AT WINDMILL AS ABOVE BREWSTER TEXAS

VIPERIDAE CROTALUS ATROX 04/24/1992
 ROSILLOS; 300 YDS EAST OF MILL AS ABOVE BREWSTER TEXAS

CNEMIDOPHORUS SEPTEMVITTATUS 04/24/1992
 ROSILLOS; INSIDE GARAGE AT MOUNTAIN LODG BREWSTER TEX

VIPERIDAE CROTALUS ATROX 04/24/1992
 ROSILLOS; CO. ROAD 0.7 MI N PITCOCK GATE BREWSTER TEXAS

VIPERIDAE AGKISTRODON CONTORTRIX 04/24/1992
 ROSILLOS; CO. ROAD W. SIDE, BREWSTER TEXAS JFS 5405

VIPERIDAE CROTALUS ATROX 04/24/1992
 ROSILLOS; BREWSTER TEXAS

ARIZONA ELEGANS 04/25/1992
 ROSILLOS; CA 6 MI FROM HWY385 ON CO. ROAD BREWSTER TEXAS

BOGERTOPHIS SUBOCULARIS 04/25/1992
 ROSILLOS; 2 MI W JCT CO. ROAD & LODGE RD BREWSTER TEXAS

CNEMIDOPHORUS MARMORATUS F 05/03/1992
 ROSILLOS; 1.6 MI W LODGE GATE BY CO.RD. BREWATER TEXAS JFS 5410

GEKKONIDAE COLEONYX BREVIS F 05/03/1992
 ROSILLOS: 1.6 MI W LODGE GATE ON CO.RD. BREWSTER TEXAS JFS 5411

UROSAURUS ORNATUS 05/03/1992
 MOUNTAIN LODGE FIELD HDQTRS BREWSTER TEXAS 5412

CNEMIDOPHORUS MARMORATUS M 05/04/1992
 ROSILLOS: 1.6 MI W LODGE GATE ON CO. RD. BREWSTER TEXAS JFS 5413

GEKKONIDAE COLEONYX BREVIS F 05/04/1992
 ROSILLOS: 1.6 MI W LODGE GATE ON CO. RD. BREWSTER TEXAS JFS 5414

CNEMIDOPHORUS MARMORATUS M 05/08/1992
 ROSILLOS: 4.1 MI W LODGE GATE OM CO. RD. BREWSTER TEXAS 5415

COPHOSAURUS TEXANUS M 05/09/1992
 ROSILLOS: 4.1 W LODGE GATE ON CO. RD. BREWSTER TEXAS JFS 5417

VIPERIDAE CROTALUS SCUTULATUS M 05/09/1992
 ROSILLOS: 0.9 MI W LODGE GATE ON CO. RD. BREWSTER TEXAS JFS 5419

UROSAURUS ORNATUS M 05/09/1992
ROSILLOS: AT MOUNTAIN LODGE FIELD HDQTRS BREWSTER TEXAS JFS 5422

UROSAURUS ORNATUS M 05/09/1992
ROSILLOS: AT MOUNTAIN LODGE HDQTRS. BREWSTER TEXAS JFS5423

SCELOPORUS UNDULATUS M 05/10/1992
ROSILLOS: MOUNTAIN LODGE HDQTRS. BREWSTER TEXAS JFS 5424

SCELOPORUS UNDULATUS F 06/07/1992
ROSILLOS: MOUNTAIN LODGE FIELD HDQTRS. BREWSTER TEXAS JFS 5427

COLUBRIDAE RHINOCHEILUS LECONTEI 06/10/1992
ROSILLOS: 8.8 MI E LODGE GATE ON CO. RD. BREWSTER TEXAS JFS 5429

SCELOPORUS POINSETTI J 06/14/1992
ROSILLOS: MOUNTAIN LODGE FIELD HDQTRS. BREWSTER TEXAS JFS

IGUANIDAE SCELOPORUS UNDULATUS M 06/15/1992
ROSILLOS: MOUNTAIN LODGE FIELD HDQTRS. BREWSTER TEXAS JFS 5434

VIPERIDAE CROTALUS SCUTULATUS F 06/15/1992
ROSILLOS: 7.8 MI W LODGE GATE ON CO. RD. BREWSTER TEXAS JFS 5435

VIPERIDAE CROTALUS ATROX F 06/15/1992
ROSILLOS: 3.5 MI W LODGE GATE ON CO. RD. BREWSTER TEXAS JFS 5436

KINOSTERNIDAE KINOSTERNON FLAVESCENS F 06/15/1992
ROSILLOS: 9-POINT DRAW AT CO. RD. XING BREWSTER TEXAS JFS 5437

IGUANIDA SCELOPORUS UNDULATUS 06/16/1992
ROSILLOS: MOUNTAIN LODGE FIELD HDQTRS. BREWSTER TEXAS JFS 5438

COLUBRIDAE BOGERTOPHIS SUBOCULARIS 06/15/1992
ROSILLOS: 3.7 MI W LODGE GATE ON CO. RD BREWSTER TEXAS JFS 5439

VIPERIDAE AGKISTRODON CONTORTRIX F 06/21/1992
ROSILLOS: 1.9 MI W LODGE GATE ON CO. RD. BREWSTER TEXAS JFS 5441

TEIIDAE CNEMIDOPHORUS MARMORATUS 06/22/1992
ROSILLOS: 7.8 MI E LODGE GATE, 0.7 MI S. BREWSTER TEXAS JFS 5445

VIPERIDAE CROTALUS ATROX 06/25/1992
ROSILLOS: 0.2 MI W LODGE GATE ON CO. RD. BREWSTER TEXAS JFS 5446

VIPERIDAE CROTALUS SCUTULATUS 06/25/1992
 ROSILLOS: 7.5 MI W LODGE GATE ON CO.RD. BREWSTER TEXAS JFS 5447

KINOSTERNIDAE KINOSTERNON FLAVESCENS 06/25/1992
 ROSILLOS: 7.8 MI E LODGE GATE, 0.7 MI S. BREWSTER TEXAS JFS 5450

VIPERIDAE CROTALUS SCUTULATUS M 06/26/1992
 ROSILLOS: 5.8 MI E LODGE GATE ON CO.RD. BREWSTER TEXAS JFS 5460

TEIIDAE CNEMIDOPHORUS INORNATUS F 06/26/1992
 ROSILLOS: 0.5 MI E LODGE NEAR BUTTRILL SP BREWSTER TEXAS JFS

COLUBRIDAE PITUOPHIS MELANOLEUCUS M 06/29/1992
 ROSILLOS: 4.8 MI E LODGE GATE ON CO. RD. BREWSTER TEXAS JFS 5462

TEIIDAE CNEMIDOPHORUS MARMORATUS 06/29/1992
 ROSILLOS: W SIDE 9-PT DRAW DRIFT FENCE BREWSTER TEXAS JFS 5463

IGUANIDAE SCELOPORUS MERRIAM 06/29/1992
 ROSILLOS: 1.8 MI NNE LODGE, LSTONE HILLS BREWSTER TEXAS JFS 5465

UTA STANSBURIANA 06/29/1992
 ROSILLOS: 1.8 MI NNE LODGE BASE OF LHILL BREWSTER TEXAS JFS 5466

TEIIDAE CNEMIDOPHORUS SEPTEMVITTATUS M 06/29/1992
 ROSILLOS: 1.8 MI NNE LODGE, LSTONE HILLS BREWSTER TEXAS JFS 5467

TEIIDAE CNEMIDOPHORUS SEPTEMVITTATUS F 06/29/1992
 ROSILLOS; 1.8 MI NNE LODGE, LSTONE HILLS BREWSTER TEXAS JFS 5468

TEIIDAE CNEMIDOPHORUS MARMORATUS F 06/30/1992
 ROSILLOS: AT CRAZY WINDMILL BREWSTER TEXAS JFS 5469

IGUANIDAE UROSAURUS ORNATUS 06/30/1992
 ROSILLOS: UNNAMED SPRING, IGNEOUS BOULDE BREWSTER TEXAS JFS 5470

IGUANIDAE UROSAURUS ORNATUS 06/30/1992
 ROSILLOS: UNNAMED SPRING, ON IGNEOUS BOU BREWSTER TEXAS JFS 5471

UROSAURUS ORNATUS 06/30/1992
 ROSILLOS; UNNAMED SPRING, IGNEOUS BOULDE BREWSTER TEXAS JFS 5472

UROSAURUS ORNATUS 06/30/1992
 ROSILLOS: UNNAMED SPRING AREA BREWSTER TEXAS JFS 5473

COLUBRIDAE ARIZONA ELEGANS 06/30/1992
ROSILLOS: 3.1 MI E LODGE GATE ON CO. RD. BREWSTER TEXAS JFS 5474

IGUANIDAE SCELOPORUS MERRIAM M 07/01/1992
ROSILLOS: 1.5 MI NNW LANDING STRIP BREWSTER TEXAS JFS 5477

IGUANIDAE SCELOPORUS MERRIAM M 07/01/1992
ROSILLOS: 1.5 MI NNW LANDING STRIP BREWSTER TEXAS JFS 5478

TEIIDAE CNEMIDOPHORUS INORNATUS M 07/01/1992
ROSILLOS: 1.5 MI NNW LANDING STRIP BREWSTER TEXAS JFS 5479

IGUANIDAE SCELOPORUS POINSETTI 07/14/1992
ROSILLOS: MOUNTAIN LODGE ON WOODEN BLDG. BREWSTER TEXAS JFS

VIPERIDAE CROTALUS SCUTULATUS M 07/14/1992
ROSILLOS: 7.3 MI E LODGE GATE ON CO. RD. BREWSTER TEXAS JFS

CNEMIDOPHORUS INORNATUS M 07/15/1992
ROSILLOS: AT BUTTRILL SPRINGS BREWSTER TEXAS

CNEMIDOPHORUS SEPTEMVITTATUS M 07/15/1992
ROSILLOS: NEAR GOAT SPRINGS BREWSTER TEXAS JFS 5483

IGUANIDAE UTA STANSBURIANA 07/16/1992
ROSILLOS: NEAR GOAT SPRINGS BREWSTER TEXAS JFS 5484

IGUANIDAE UTA STANSBURIANA 07/16/1992
ROSILLOS: 1.5 MI N LODGE GATE LSTONE HIL BREWSTER TEXAS JFS 5484

IGUANIDAE UTA STANSBURIANA 07/16/1992
ROSILLOS: 1.5 MI N LODGE GATE LSTONE HIL BREWSTER TEXAS JFS 5485

TEIIDAE CNEMIDOPHORUS MARMORATUS 07/16/1992
ROSILLOS: 1.5 MI N LODGE GATE LSTONE HIL BREWSTER TEXAS JFS 5486

TEIIDAE CNEMIDOPHORUS MARMORATUS M 07/16/1992
ROSILLOS: 1.5 MI N LODGE GATE LSTONE HIL BREWSTER TEXAS JFS 5487

VIPERIDAE CROTALUS SCUTULATUS F 07/21/1992
ROSILLOS: 4.4 MI E LODGE GATE ON CO. RD. BREWSTER TEXAS JFS 5488

TEIIDAE CNEMIDOPHORUS SEPTEMVITTATUS M 07/22/1992
ROSILLOS: NEAR BUTTRILL SPRINGS BREWSTER TEXAS JFS 5489

TEIIDAE CNEMIDOPHORUS INORNATUS F 07/22/1992
 ROSILLOS: NEAR BUTTRILL SPRINGS BREWSTER TEXAS JFS 5490

TEIIDAE CNEMIDOPHORUS INORNATUS F 07/22/1992
 ROSILLOS: NEAR BUTTRILL SPRINGS BREWSTER TEXAS JFS 5491

IGUANIDAE COPHOSAURUS TEXANUS 07/22/1992
 ROSILLOS BETWEEN LODGE AND BUTTRILL SPR. BREWSTER TEXAS

TEIIDAE CNEMIDOPHORUS SEPTEMVITTATUS F 07/22/1992
 ROSILLOS: AT MOUNTAIN LODGE FIELD HDQTRS BREWSTER TEXAS JFS 5493

COLUBRIDAE THAMNOPHIS MARCIANUS 07/22/1992
 ROSILLOS: 4.3 M. W LODGE; 3 M. N IN FENCE BREWSTER TEXAS JFS 5494

COLUBRIDAE MASTICOPHIS FLAGELLUM 07/14/1992
 ROSILLOS: 1.2 MI W HWY 385 ON CO. RD. BREWSTER TEXAS JFS 5495

TEIIDAE CNEMIDOPHORUS MARMORATUS 07/22/1992
 ROSILLOS: 4.3 MI W 1 MI N BOUNDARY WEST BREWSTER TEXAS JFS 5496

COLUBRIDAE TANTILLA HOBARTSMITHII 07/22/1992
 ROSILLOS: 4.3 M. W LODGE; 5M N BOUND FENCE BREWSTER TEXAS JFS 5497

TEIIDAE CNEMIDOPHORUS INORNATUS 07/30/1992
 ROSILLOS: NEAR GOAT SPRING BREWSTER TEXAS JFS 5498

TEIIDAE CNEMIDOPHORUS INORNATUS 07/30/1992
 ROSILLOS: NEAR GOAT SPRING BREWSTER TEXAS JFS 5499

TEIIDAE CNEMIDOPHORUS INORNATUS 07/30/1992
 ROSILLOS; NEAR GOAT SPRING BREWSTER TEXAS JFS 5500

IGUANIDAE COPHOSAURUS TEXANUS 07/30/1992
 ROSILLOS: NEAR GOAT SPRING BREWSTER TEXAS JFS 5501

TEIIDAE CNEMIDOPHORUS MARMORATUS 07/30/1992
 ROSILLOS; NEAR GOAT SPRING BREWSTER TEXAS JFS 5502

TEIIDAE CNEMIDOPHORUS SEPTEMVITTATUS F 06/29/1992
 1.7 MI NNW LODGE BASE OF LIMESTONE HILLS BREWSTER TEXAS JFS 5503

COLUBRIDAE DIADOPHIS PUNCTATUS 06/30/1992
 ROSILLOS: 0.25 MI S LODGE IN ARROYO BREWSTER TEXAS JFS 5504

IGUANIDAE GAMBELIA WIZLIZENII 07/01/1992
ROSILLOS: CA. 2 MI DOWN ROAD TO UNNAMED BREWSTER TEXAS JFS 5505

VIPERIDAE CROTALUS LEPIDUS 09/18/1992
ROSILLOS 1.3 M NW BONE SPRING TOP OF HIL BREWSTER TEXAS JFS 5511

VIPERIDAE CROTALUS LEPIDUS M 09/18/1992
ROSILLOS 1.3 M NW BONE SPRING TOP OF HIL BREWSTER TEXAS JFS 5511

AMPHIBIANS

SCAPHIOPUS COUCHI 09/15/1990
ROSILLOS 6.1 MI FROM HWY 385 IN PIT TRAP BREWSTER TEXAS JFS 5192

BUFO SPECIOSUS 09/15/1990
ROSILLOS 3.9 MI W HWY 385 AT TANK BREWSTER TEXAS JFS 5190

BUFO SPECIOSUS 09/11/1990
ROSILLOS 8.6 MI W HWY 385 ON COUNTY ROAD BREWSTER TEXAS JFS 5185

BUFO DEBILIS 09/11/1990
ROSILLOS 8.6 MI W HWY 385 ON COUNTY ROAD BREWSTER TEXAS JFS 5182

GASTROPHRYNE OLIVACEA 09/16/1990
ROSILLOS TRAP BY POND 3.9 MI ON CTY RD BREWSTER TEXAS JFS 5200

BUFO SPECIOSUS 09/11/1990
ROSILLOS 8.6 MI W HWY 385 ON COUNTY ROAD BREWSTER TEXAS JFS 5184

BUFO DEBILIS 09/11/1990
ROSILLOS 8.6 MI W HWY 385 ON COUNTY ROAD BREWSTER TEXAS JFS 5173

BUFO DEBILIS 09/11/1990
ROSILLOS 8.6 MI W HWY 385 ON COUNTY ROAD BREWSTER TEXAS JFS 5181

BUFO SPECIOSUS 09/11/1990
ROSILLOS 8.6 MI W HWY 385 TO TERLINGUA BREWSTER TEXAS JFS 5183

BUFO DEBILIS 09/11/1990
ROSILLOS 8.6 MI W HWY 385 ON COUNTY ROAD BREWSTER TEXAS JFS 5180

BUFO SPECIOSUS 09/11/1990
ROSILLOS 8.6 MI W HWY 385 TO TERLINGUA BREWSTER TEXAS JFS 5186

BUFO DEBILIS 09/11/1990
 ROSILLOS 8.6 MI W HWY 385 ON COUNTY ROAD BREWSTER TEXAS JFS 5177

C BUFO DEBILIS 09/11/1990
 ROSILLOS 8.6 MI W HWY 385 ON COUNTY ROAD BREWSTER TEXAS JFS 5174

SCAPHIOPUS COUCHI 08/23/1990
 ROSILLOS CA 1.2 MI SE TANK 2712 NEAR 9PT BREWSTER TEXAS JFS 5143

SCAPHIOPUS COUCHI 09/23/1990
 ROSILLOS CA 1.2 MI SE TANK 2712 NEAR 9PT BREWSTER TEXAS JFS 5144

BUFO DEBILIS 09/11/1990
 ROSILLOS 8.6 MI W HWY 385 ON COUNTY ROAD BREWSTER TEXAS JFS 5179

BUFO DEBILIS 09/11/1990
 ROSILLOS 8.6 MI W HWY 385 ON COUNTY ROAD BREWSTER TEXAS JFS 5175

BUFO SPECIOSUS 09/14/1990
 ROSILLOS 8.6 MI W HWY 385 ON COUNTY ROAD BREWSTER TEXAS JFS 5191

BUFO SPECIOSUS 09/08/1990
 ROSILLOS 8.6 MI W HWY 385 ON COUNTY ROAD BREWSTER TEXAS JFS 5161

SCAPHIOPUS MULTIPLICATUS 09/08/1990
 ROSILLOS 8.6 MI W HWY 385 ON COUNTY ROAD BREWSTER TEXAS JFS 5157

SCAPHIOPUS MULTIPLICATUS 09/08/1990
 ROSILLOS 8.6 MI W HWY 385 ON COUNTY ROAD BREWSTER TEXAS JFS 5158

BUFO DEBILIS 09/11/1990
 ROSILLOS 8.6 MI W HWY 385 ON COUNTY ROAD BREWSTER TEXAS JFS 5176

PELOBATIDAE SCAPHIOPUS MULTIPLICATUS 09/08/1990
 ROSILLOS 8.6 MI W HWY 385 ON COUNTY ROAD BREWSTER TEXAS JFS 5156

BOFONIDAE BUFO SPECIOSUS 09/08/1990
 ROSILLOS 8.6 MI W HWY 385 ON COUNTY ROAD BREWSTER TEXAS JFS 5164

PELOBATIDAE SCAPHIOPUS MULTIPLICATUS 09/08/1990
 ROSILLOS 8.6 MI W HWY 385 ON COUNTY ROAD BREWSTER TEXAS JFS 5159

BUFO SPECIOSUS 09/08/1990
 ROSILLOS 8.6 MI W HWY 385 ON COUNTY ROAD BREWSTER TEXAS JFS 5162

SCAPHIOPUS COUCHI 08/27/1990
ROSILLOS FLATS NEAR 9 PT DRAW BREWSTER TEXAS JFS 5148

BUFO DEBILIS 09/08/1990
ROSILLOS 8.6 MI W HWY 385 ON COUNTY ROAD BREWSTER TEXAS JFS 5167

GASTROPHRYNE OLIVACEA 09/16/1990
ROSILLOS TRAP NEAR POND 3.9 MI ON CTY RD BREWSTER TEXAS JFS 5199

BUFO DEBILIS 09/08/1990
ROSILLOS 8.6 MI W HWY 385 ON COUNTY ROAD BREWSTER TEXAS JFS 5156

SCAPHIOPUS COUCHI 08/27/1990
ROSILLOS 8.6 MI W HWY 385 ON COUNTY ROAD BREWSTER TEXAS JFS 5149

BUFONIDAE BUFO DEBILIS 09/11/1990
ROSILLOS 8.6 MI W HWY 385 ON COUNTY ROAD BREWSTER TEXAS JFS 5178

GASTROPHRYNE OLIVACEA 09/16/1990
ROSILLOS TRAP NEAR POND 3.9 MI ON CTY RD BREWSTER TEXAS JFS 5202

BUFO SPECIOSUS 09/16/1990
ROSILLOS 8.6 MI W HWY 385 ON COUNTY ROAD BREWSTER TEXAS JFS 5163

GASTROPHRYNE OLIVACEA 09/16/1990
ROSILLOS TRAP NEAR POND 3.9 MI ON CTY RD BREWSTER TEXAS JFS 5201

BUFO DEBILIS 09/08/1990
ROSILLOS 8.6 MI W HWY 385 ON COUNTY ROAD BREWSTER TEXAS JFS 5166

RANA BERLANDIERI 09/16/1990
ROSILLOS 3.9 MI W HWY 385 ON COUNTY ROAD BREWSTER TEXAS JFS 5222

RANA BERLANDIERI 09/28/1990
ROSILLOS BUTTRILL SPRINGS CEMENT TANK BREWSTER TEXAS LRB 010

BUFO SPECIOSUS 09/19/1990
ROSILLOS 7.1 MI W HWY 385 ON COUNTY ROAD BREWSTER TEXAS JFS 5217

BUFO SPECIOSUS 09/16/1990
ROSILLOS 6.1 MI FROM HWY 385 IN TRAP BREWSTER TEXAS JFS 5214

SCAPHIOPUS COUCHI 09/19/1990
ROSILLOS 7.1 W HWY 385 ON COUNTY ROAD BREWSTER TEXAS JFS 5218

C SCAPHIOPUS COUCHI 09/19/1990
ROSILLOS 7.1 MI W HWY 385 ON COUNTY TOAD BREWSTER TEXAS JFS 5220

SCAPHIOPUS COUCHI 09/19/1990
ROSILLOS 7.1 MI W HWY 385 ON COUNTY ROAD BREWSTER TEXAS JFS 5219

SCAPHIOPUS COUCHI 09/19/1990
ROSILLOS 7.1 MI HWY 385 ON COUNTY ROAD BREWSTER TEXAS JFS 5221

BUFO SPECIOSUS 09/28/1990
ROSILLOS 8 MI W HWY 385 ON COUNTY ROAD BREWSTER TEXAS LRB 006

BUFO SPECIOSUS 09/28/1990
ROSILLOS 9.4 MI W HWY 385 ON COUNTY ROAD BREWSTER TEXAS LRB 008

BUFO PUNCTATUS 09/28/1990
ROSILLOS 9.4 MI W HWY 385 ON COUNTY ROAD BREWSTER TEXAS LRB 009

RANA BERLANDIERI 09/15/1990
ROSILLOS IN POND 3.9 MI W HWY 385 CTY RD BREWSTER TEXAS JFS 5205

RANA BERLANDIERI 09/16/1990
ROSILLOS AROUND 3.9 POND (TANK) BREWSTER TEXAS JFS 5207

BUFO SPECIOSUS 09/16/1990
ROSILLOS 3.9 MI FROM HWY 385 AT TANK BREWSTER TEXAS JFS 5203

RANA BERLANDIERI 09/16/1990
ROSILLOS 3.9 MI FROM HWY 385 AT TANK BREWSTER TEXAS JFS 5208

RANA BERLANDIERI 09/15/1990
ROSILLOS 3.9 MI FROM HWY 385 AT TANK BREWSTER TEXAS JFS 5206

BUFO SPECIOSUS 09/25/1990
ROSILLOS FENCE 6.2 MI FROM HWY 385 BREWSTER TEXAS JFS 5227

SCAPHIOPUS COUCHI 09/16/1990
ROSILLOS 7.1 MI W HWY 385, DRYING POOL BREWSTER TEXAS JFS 5209

BUFO SPECIOSUS 09/23/1990
ROSILLOS DRIFT FENCE 9.3 MI W HWY 385 BREWSTER TEXAS JFS 5232

SCAPHIOPUS COUCHI 09/16/1990
ROSILLOS 7.1 MI W HWY 385, DRYING POOLS BREWSTER TEXAS JFS 5210

BUFO DEBILIS 09/16/1990
ROSILLOS 7.1 MI W HWY 385, DRYING POOLS BREWSTER TEXAS JFS 5211

BUFO DEBILIS 09/16/1990
ROSILLOS 7.1 MI W HWY 385, DRYING POOLS BREWSTER TEXAS JFS 5212

BUFONIDAE BUFO PUNCTATUS 09/16/1990
ROSILLOS ON ROAD NEAR TANK 3.9 MI W 385 BREWSTER TEXAS JFS 5204

BUFO DEBILIS 09/16/1990
ROSILLOS 7.1 MI W M HWY 385, DRYING POOL BREWSTER TEXAS JFS 5213

RANA BERLANDIERI 06/10/1991
ROSILLOS BUTTRILL SPRINGS AT HEAD BREWSTER TEXAS JFS 5374

RANA BERLANDIERI 06/13/1991
ROSILLOS UNNAMED SPRING BASE OF E SLOPE BREWSTER TEXAS JFS 5366

BUFO SPECIOSUS 06/10/1991
ROSILLOS AT LODGE HDQTRS BREWSTER TEXAS JFS 5377

BUFO DEBILIS 06/11/1991
ROSILLOS FENCE IN TOBOSA FLAT NEAR HILL BREWSTER TEXAS JFS 5371

RANA BERLANDIERI 06/11/1991
ROSILLOS ALAMO SPRINGS BREWSTER TEXAS JFS 5369

BUFO DEBILIS 06/11/1991
ROSILLOS FENCE IN TOBOSA FLAT NEAR HILL BREWSTER TEXAS JFS 5368

RANA BERLANDIERI 06/10/1991
ROSILLOS AT LODGE NEAR WATER TANK BREWSTER TEXAS JFS 5365

BUFO DEBILIS 06/12/1991
ROSILLOS FENCE AT END OF LANDING STRIP BREWSTER TEXAS JFS 5365

BUFONIDAE BUFO PUNCTATUS 06/11/1991
ROSILLOS TOBOSA FLAT AREA NEAR HILL BREWSTER TEXAS JFS 5364

RANA BERLANIERI 06/10/1991
ROSILLOS HEAD OF BUTTRILL SPRINGS BREWSTER TEXAS JFS 5378

RANA BERLANDIERI 06/11/1991
ROSILLOS ALAMO SPRINGS BREWSTER TEXAS JFS 5372

BUFO SPECIOSUS 06/10/1991
ROSILLOS AT LODGE HDQTRS BREWSTER TEXAS JFS 5377

BUFO DEBILIS 06/11/1991
ROSILLOS DRIFT FENCE IN TOBOSA FLAT BREWSTER TEXAS JFS 5367

BUFO PUNCTATUS 06/18/1991
ROSILLOS CA 40 YDS BELOW TANK AT LODGE BREWSTER TEXAS JFS 5305

BUFO DEBILIS 06/18/1991
ROSILLOS DRIFT FENCE IN TOBOSA FLAT BREWSTER TEXAS JFS 5316

BUFO DEBILIS 06/18/1991
ROSILLOS DRIFT FENCE IN TOBOSA FLAT BREWSTER TEXAS JFS 5311

BUFO DEBILIS 06/18/1991
ROSILLOS FENCE IN TOBOSA FLAT NEAR HILL BREWSTER TEXAS JFS 1510

BUFO PUNCTATUS 06/10/1991
ROSILLOS CA 1.5 MI E OF LODGE BREWSTER TEXAS JFS 5363

PELOBATIDAE SCAPHIOPUS COUCHI 05/08/1992
ROSILLOS: 0.9 MI W LODGE GATE ON CO. RD. BREWSTER TEXAS JFS 5416

GASTROPHRYNE OLIVACEA 05/09/1992
ROSILLOS BREWSTER TEXAS JFS 5418

BUFONIDAE BUFO PUNCTATUS 05/09/1992
ROSILLOS: 2.6 MI W LODGE GATE ON CO. RD. BREWSTER TEXAS JFS 5420

BUFO PUNCTATUS 05/09/1992
ROSILLOS: 4 MI W LODGE GATE ON CO. RD. BREWSTER TEXAS JFS 5421

PELOBATIDAE SCAPHIOPUS COUCHI 06/07/1992
ROSILLOS: 2.1 MI E LODGE GATE ON CO. RD. BREWSTER TEXAS JFS 5425

BUFONIDAE BUFO PUNCTATUS 06/09/1992
ROSILLOS: 3.5 MI W LODGE GATE ON CO. RD. BREWSTER TEXAS JFS 5426

RANIDAE RANA BERLANDIERI 06/10/1992
ROSILLOS: 9-PT DRAW AT CO. RD. XING BREWSTER TEXAS JFS 5428

BUFONIDAE BUFO PUNCTATUS 06/10/1992
ROSILLOS: 3.5 MI W LODGE GATE ON CO. RD. BREWSTER TEXAS JFS 5430

RANIDAE RANA BERLANDIERI 06/14/1992
ROSILLOS: 9-PT DRAW AT CO. RD. XING BREWSTER TEXAS JFS 5432

BUFONIDAE BUFO PUNCTATUS 06/14/1992
ROSILLOS: 9-PT DRAW AT CO. RD. XING BREWSTER TEXAS JFS 5433

BUFO DEBILIS 06/21/1992
ROSILLOS: 7.8 MI E LODGE GATE, 0.7 MI S BREWSTER TEXAS JFS 5440

BUFONIDAE BUFO DEBILIS 06/22/1992
ROSILLOS: 7.8 MI E LODGE GATE; 0.7 MI S BREWSTER TEXAS JFS 5442

BUFO DEBILIS 06/22/1992
ROSILLOS: 7.8 MI E LODGE GATE; 0.7 MI S BREWSTER TEXAS JFS 5443

GASTROPHRYNE OLIVACEAE 06/22/1992
ROSILLOS: 7.8 MI E LODGE GATE; 0.7 MI S BREWSTER TEXAS JFS 5444

RANIDAE RANA BERLANDIERI 06/25/1992
ROSILLOS: 7.8 MI E LODGE GATE; 0.7 MI S BREWSTER TEXAS JFS 5448

RANIDAE RANA BERLANDIERI 06/25/1992
ROSILLOS: 7.8 MI E OF LODGE; 0.7 MI S BREWSTER TEXAS JFS 5449

MICROHYLIDAE GASTROPHRYNE OLIVACEAE 06/26/1992
ROSILLOS: 2.8 MI E LODGE GATE ON CO. RD. BREWSTER TEXAS JFS 5451

MICROHYLIDAE GASTROPHRYNE OLIVACEAE 06/26/1992
ROSILLOS: 2.8 MI E LODGE GATE ON CO. RD. BREWSTER TEXAS JFS 5452

MICROHYLIDAE GASTROPHRYNE OLIVACEAE 06/26/1992
ROSILLOS: 2.8 MI E LODGE GATE ON CO. RD. BREWSTER TEXAS JFS 5453

MICROHYLIDAE GASTROPHRYNE OLIVACEAE 06/26/1992
ROSILLOS: 2.8 MI E LODGE GATE ON CO. RD. BREWSTER TEXAS JFS 5454

BUFO PUNCTATUS 06/26/1992
ROSILLOS: 3.9 MI E LODGE GATE ON CO. RD. BREWSTER TEXAS JFS 5455

PELOBATIDAE SCAPHIOPUS COUCHI 06/26/1992
ROSILLOS: 4.2 MI E LODGE GATE ON CO. RD. BREWSTER TEXAS JFS 5456

PELOBATIDAE SCAPHIOPUS COUCHI 06/26/1992
ROSILLOS: 4.3 MI E LODGE GATE ON CO. RD. BREWSTER TEXAS JFS 5457

BUFONIDAE BUFO SPECIOSUS 06/26/1992
ROSILLOS: 6.6 MI E LODGE GATE ON CO. RD. BREWSTER TEXAS JFS 5458

BUFONIDAE BUFO SPECIOSUS 06/26/1992
ROSILLOS: 6.6 MI E LODGE GATE ON CO. RD. BREWSTER TEXAS JFS 5459

BUFONIDAE BUFO SPECIOSUS 06/29/1992
ROSILLOS: W SIDE 9-PT DRAW, CO. RD. XING BREWSTER TEXAS JFS 5464

RANIDAE RANA BERLANDIERI 06/30/1992
ROSILLOS: BORACHO (UNNAMED SPRING) BREWSTER TEXAS JFS 5475

RANIDAE RANA BERLANDIERI 06/30/1992
ROSILLOS: BORACHO (UNNAMED SPRING) BREWSTER TEXAS JFS 5476

TABLE 8. Important UTM coordinates of reptiles and amphibians collected and verifiable sightings. Also included are important landmarks of the North Rossillos Area. UTM coordinates recorded in this report are a single number, six digits long. To obtain the northing, take the first three digits of the UTM of interest, add 32 to the front and 00 to the back. To obtain the easting, take the second three digits of the UTM of interest, add 6 to the front and 00 to the back. For example, a UTM of 763761 equals a northing of 3276300 and an easting of 676100.

<u>SPECIES</u>	<u>UTM COORDINATES</u>
Amphibia	
<u>Scaphiopus couchi</u>	728741 764746 755749 752751
<u>Scaphiopus multiplicatus</u>	683729
<u>Bufo punctatus</u>	629680 630685 696732 691759 741754 687720 633684 643698
<u>Bufo debilis</u>	677741 691759 741754 683729 728741 726741 681730 707731
<u>Bufo speciosus</u>	741754 683729 741743 674705 726741 681730
<u>Gastrophryne olivacea</u>	74175 697733
<u>Rana berlandieri</u>	741754 743693 742754 66167 767748
Reptilia	
<u>Kinosternon flavescens</u>	686728 767775 744754 742375
<u>Coleonyx brevis</u>	681728 650713
<u>Crotaphytus collaris</u>	676715 681727
<u>Gambelia wislizenii</u>	734711 692724
<u>Cophosaurus texanus</u>	625705 738747 675742 764691 667668 658686 718717 744702

<u>Sceloporus poinsetti</u>	674705 673694
<u>Sceloporus magister</u>	693723 732743 741707
<u>Sceloporus undulatus</u>	677685 767775 673694 674705
<u>Sceloporus merriami</u>	676692 679693 694701 658686 675746 663740 667741
<u>Urosaurus ornatus</u>	648696 718711 699679 745692 747697 649703 650709 686677 690679 673692 717715 747698 698684 699680 700671 696689 704693 725681 701689 660673 664665 638699
<u>Uta stansburiana</u>	732743 738747 769763 717766 666738
<u>Phrynosoma cornutum</u>	688759 690756
<u>Phrynosoma modestum</u>	738747 667806
<u>Cnemidophorus inornatus</u>	658667 663697 672696 693700 719719 737696 661762 666766 667758
<u>Cnemidophorus septemvittatus</u>	658668 639701 661696 672694 674744 667755 678686 680680 683677 687680 674701 694693 692699 667738
<u>Cnemidophorus marmoratus</u>	647719 684725 746702 725740 740706 631698 738747 763692 623693 660820 674784 664800
<u>Eumeces tetragrammus</u>	668683 (By Minton 1959)
<u>Eumeces obsoletus</u>	665760
<u>Thamnophis marcianus</u>	629679
<u>Thamnophis cyrtopsis</u>	673693 734656 (By Minton 1959)
<u>Diadophis punctatus</u>	679706

<u>Masticophis flagellum</u>	712731 669796
<u>Masticophis taeniatus</u>	657684 699695
<u>Salvadora deserticola</u>	East side Rosillos (by Minton 1959)
<u>Bogertophis subocularis</u>	669700 630684
<u>Elaphe guttata</u>	681730
<u>Arizona elegans</u>	705732 718732
<u>Pituophis melanoleucus</u>	720734 714718
<u>Rhinocheilus lecontei</u>	776769
<u>Sonora semiannulata</u>	732743
<u>Tantilla hobartsmithi</u>	614684
<u>Hypsiglena torquata</u>	716716 716717
<u>Agkistrodon contortrix</u>	673695 638706 64711
<u>Crotalus atrox</u>	630686 715713 714716 728741 668743 717718 680819
<u>Crotalus scutulatus</u>	749755 764759 736748 757756
<u>Crotalus molossus</u>	674695 684729 675724
<u>Crotalus lepidus</u>	657651 751792

LANDMARKS

Alamo Springs	661667
Lost Spring	625661
Buttrill Springs	673693-5
Goat Spring	668683

No Name Spring (Borracho)	743693
Bone Spring	767775
Lodge (field headquarters)	674705
Ranch trash dump	688761
Crazy Windmill	623693
Working windmill	716715
Turtle Tank No. 1	742754
Turtle Tank No. 2	767748
Drift fence No. 1	738747
Drift Fence No. 2	732743
Drift Fence No. 3	741743
Drift Fence No. 4	691759
Drift Fence No. 5	677741
Drift Fence No. 6	672722
Drift Fence No. 7	647698
Drift Fence No. 8	644701
Drift Fence No. 9	767748
Drift Fence No. 10	726741
Drift Fence No. 11	655710
Drift Fence No. 12	633684

CHAPTER 6 ORNITHOLOGY

Keith A. Arnold

The Big Bend region of Texas lies within the Chihuahuan Desert Biome. The avifauna of this biome has a number of distinct features that reflect the vegetative associations and the topography of this area, including the mountain masses that provide great altitudinal relief. Nonetheless, the total avifauna of the biome also reflects the general motility of birds: avian species are, for the most part, more affected by the landscape and the physiognomy of the vegetation than by the actual plant species. Birds respond more to the presence or absence of brush, the presence of water, or the type of ground cover. The amount of vegetative cover in this biome depends heavily upon availability of water.

The North Rosillos Area includes large areas of desert flatlands and a modest mountain massive; the latter does not greatly affect the distribution of birds in the region except for the vegetational changes resulting from the canyons associated with the mountains. The 19 plant communities and sub-communities which Whitefield (1991) recognized in the North Rosillos Area (later condensed into 13 types) have little effect on bird distributions, although the six major associations [southwestern riparian, Madrean upland scrub, short grass prairie, Chihuahuan basinal grassland, and Chihuahuan desert scrub] approach the physiognomy effect mentioned above. The several stock ponds in the North Rosillos Area serve as foci for not only water birds, but also as concentration areas for land birds which depend upon "free" water sources during extended dry periods. Brush species grow thickest along the several drainages or draws that dissect the flatlands on this area.

This report will emphasize the distributions of avian species in relation to plant associations and to seasons.

Methods

Teams visited the North Rosillos Area at intervals to allow sampling for seasonal changes in the vegetation and the avifauna. To maximize the ability to sample the different plant associations, a 1-mile transect was established in October 1990 along the jeep trail leading to Buttrill Spring; this transect crossed five of the plant associations. In January 1991 a second 1-mile transect was established along the road to Bone Spring; this transect also transversed five plant associations. The two transects only shared two plant associations; hence, the transects collectively sampled eight of the 13 vegetation types (Table 9). The remaining five plant associations were sampled by walking or driving through portions of each association for one to two hours on any one day. Each transect was walked at sunrise, alternating which transect was visited first; weather permitting, these were censused for two days on each visit. Birds were identified by visual observation and by vocalizations. Species and numbers of individuals were recorded in the field on a micro-cassette tape recorder. Over the course of the study, 16 censuses were made on the Buttrill Spring transect and 15 on the Bone Spring transect.

Since birds have differing degrees of detectability, related to behavior or habitat preference, mist-nets were utilized to sample birds at three sites of noted concentrations. UTM coordinates for each of these sites are: Tank No. 1 - 742754; Lodge - 674705; and Buttrill Springs jeep trail - 672698. This process permitted better assessment of relative numbers of similar-looking species and helped in detecting species that often elude transect counts. Of the three mist-netting sites, only the Buttrill Springs jeep trail sampled a vegetative community (riparian) not covered by the line transects. However, several species were captured with the nets at all three sites that were not recorded on the transects. Weather and other time commitments dictated the amount of time spent with nets, but an attempt was made to have at least six nets in operation at two sites on each visit for a minimum of six hours each day, usually immediately after completion of the transects and the two hours before sunset. High winds frequently influenced the ability to use mist-nets.

The four remaining vegetative communities (oak woodland, canyon scrub, mountain scrub and alkaline grassland) were sampled by selecting sites within each community and walking through those sites to record observations along the route. Due to a skewed use of time, these communities have the poorest representation within the sampling effort.

A limited number of birds were collected to document presence of unusual species or to examine them for taxonomic or systematic studies. Any obvious species were noted in travels around the ranch, and a few observations were received from personnel of the entomology and mammalogy crews.

Results

From the first field trip in September 1990 through the last field trip in March 1992, we made a total 10 visits to the study area. Eight of those visits included censuses of the transects. Our total efforts resulted in a composite list of 103 species (see Table 10 and Checklist below). These included 21 permanent residents, 3 migrants or transients, 15 summer residents, 28 winter residents and 35 species where we could not determine a status from the evidence available; several species listed here as summer residents are also migrants and winter visitors. We found evidence of nesting for 12 species. We banded a total of 116 individual birds of 29 species (Table 11), and collected seven birds representing six species. Banding took place mostly at three locations: around a stock tank 1 km east of the road to the headquarters; at the mountain lodge; and on a jeep trail approximately 0.5 km below Buttrill Spring.

During the more than two years of study in the North Rosillos Area, the area experienced periods of very high rainfall which greatly affected the herbaceous vegetation and resulted in large seed crops in both winters. These food "patches" produced very large concentrations of seed-eating birds the first winter, but smaller numbers the second winter. This proved especially noteworthy in the different numbers of Lark Buntings (Calamospiza melanocorys), White-crowned Sparrows (Zonotrichia leucophrys) and Spizella sparrows. The Lark Buntings were often seen in flocks of hundreds (and occasionally thousands) in January 1991, but in small flocks, usually 20 - 40 or fewer in January 1992. In a similar manner, the White-crowned Sparrows and the Spizella sparrows were also significantly reduced in those same time frames. Interestingly, the ratio of Clay-colored and

Brewer's Sparrows were reversed in the two years of our banding efforts: Brewer's out-numbered Clay-colored 5 or 6 to 1 in 1991, but Clay-colored out-numbered Brewer's 3 or 4 to 1 in 1992.

Threatened, Rare or Endangered Birds.--In categorizing birds as threatened, rare or endangered, we used the published lists of the U.S. Fish and Wildlife Service (1989), the Texas Parks and Wildlife Department (1987) and the Texas Organization of Endangered Species (1988). We encountered but one endangered species, a Peregrine Falcon (Falco peregrinus). A field party, while banding near the stock tank along the county road, observed a single adult fly over on 25 April 1991.

Discussion

For the most part, the individual vegetation associations had little effect on bird distribution per se: the vegetation structure played a much more important role. The amount of ground cover, the density and height of brush and the proximity to water played major roles in bird distribution. Thus, those open areas that might be termed grasslands tended to hold similar types of birds, as did "scrub" habitats. The more structured wooded areas around springs and in the mountain canyons also had a vegetation profile that attracted some bird species not found elsewhere.

Dixon (1959) examined the relationships of desert scrub birds in west Texas. Raitt and Maze (1968) and Raitt and Pimm (1976) also examined the species composition and dynamics of bird communities in the Chihuahuan Desert. Austin (1970) pointed out the importance of riparian habitat in desert environments. He demonstrated that riparian woodlands add significantly to the scrub layers in desert environments.

Naranjo and Raitt (1993) demonstrated a relationship between breeding bird distributions and the vegetation physiognomy in the Chihuahuan desert of southern New Mexico. They reported a positive correlation between numbers of grassland species and an increase of plant cover in open areas and between scrub birds and an increase in diversity of plant life-forms. In their study, Naranjo and Raitt also reported similar relationships between the multivariate axes of their principle component analysis and both bird species diversity and richness.

Impoundments served two primary avian clientele: water birds such as ducks and grebes, and land birds which needed a source of "free" water periodically. The diverse vegetation usually found around these impoundments also provided cover and food sources for a variety of birds. For example, a large majority of our observations of Say's Phoebe (Sayornis saya) took place at such impoundments.

For most diurnal raptors the availability of suitable perches in an area determined their presence. Such perches usually consisted of utility poles and wires and large trees around the ranch buildings. The owls also used such perches, but also require sufficient cover for daytime

concealment. This latter need may be met by buildings (for barn owls), thickets in the draws and around stock tanks, and cuts in the walls of draws and canyons.

Annotated Checklist

Please note that residency is only for the North Rossillos Area, not for BBNP as a whole.

PODICIPEDIFORMES: PODICIPEDIDAE

Pied-billed Grebe, Podilymbus p. podiceps. Uncommon migrant and winter resident. Recorded only once: February 1991. This bird will occur only on the deeper stock tanks. Wauer (1973) lists the species as a rare summer and winter resident and a common migrant.

ANSERIFORMES: ANATIDAE

Green-winged Teal, Anas crecca carolinensis. Common migrant and winter resident. Found only on stock tanks. Wauer (1973) lists this as the park's most numerous waterfowl.

Mexican Duck, Anas platyrhynchos novamexicanus. Uncommon permanent resident. Found only on stock tanks. Clyde Jones (pers. comm.) reported sighting a brood on a stock tank in the northern part of the North Rosillos Area in June 1991. Wauer (1973) knew of no evidence for breeding within the park.

Gadwall, Anas strepera. Uncommon migrant and winter resident. Found only on stock tanks.

Ring-necked Duck, Aythya collaris. Uncommon migrant and winter resident. Found only on stock tanks.

Lesser Scaup, Aythya affinis. Rare migrant and winter resident. Found only on stock tanks.

FALCONIFORMES: CATHARTIDAE

Turkey Vulture, Cathartes a. aura. Common permanent resident. We found no evidence of breeding, but Wauer (1973) records a few records for the park.

ACCIPITRIDAE

Northern Harrier, Circus cyaneus hudsonicus. Uncommon migrant and winter resident. Usually encountered over open areas, especially grasslands.

Sharp-shinned Hawk, Accipiter striatus velox. Status uncertain: one record in March 1991. Wauer (1973) reported this species as a casual breeder in Big Bend National Park.

Cooper's Hawk, Accipiter cooperii. Uncommon migrant. Found in wooded habitats, including thick brush of the scrub habitats.

Harris' Hawk, Parabuteo unicinctus harrisi. Rare permanent resident. Found in all of the open scrub habitats. We found no evidence of breeding. Wauer (1973) reported several nesting records for the Big Bend region; he considered the species as a rare summer and winter visitor and migrant.

Swainson's Hawk, Buteo swainsoni. Status uncertain. Recorded only once. Wauer (1973) considered this species as an uncommon summer visitor and common migrant. It prefers open scrub habitats.

Red-tailed Hawk, Buteo jamaicensis. Uncommon summer resident and common migrant and winter visitor. The most abundant diurnal raptor, the Red-tail usually perched on utility poles and lines in all grassland and scrub habitats. We found no evidence of breeding.

Rough-legged Hawk, Buteo lagopus sanctijohannis. Status uncertain. The one record, October 1991, likely represents an early migrant. Wauer (1973) lists only a single record within the park, but notes it's more common appearance north of the park.

FALCONIDAE

American Kestrel, Falco sparverius. Common migrant and winter visitor. Often seen on utility poles and lines in open scrub and grassland habitats. Wauer (1973) reports nesting for this species in the park.

Peregrine Falcon, Falco peregrinus. Status uncertain. Recorded only once. F. p. anatum is an uncommon summer resident in the river canyons of Big Bend National Park (T.O.S. 1984).

GALLIFORMES: PHASIANIDAE

Scaled Quail, Callipepla squamata pallida. Common permanent resident. Although we did not document nesting, we did encounter covies of 10-15 birds on several occasions. Found in open scrub habitats.

Gambel's Quail, Callipepla gambelii ignoscens. Rare permanent resident. Recorded on three occasions, always in or near canyon or riparian woodlands. This species is more frequently associated with riverine lowlands in the Trans-Pecos region (Wauer 1973).

GRUIFORMES: GRUIDAE

Sandhill Crane, Grus canadensis. Sporadic migrant. As a flock of this species appeared on a single day in March 1991, in flight overhead, the bird probably passes through the area in migration every year. However, only the two larger tanks on the area could possibly attract this crane, and then only as a brief stop-over. Wauer (1973) lists the species as an uncommon fall migrant and rare winter visitor; he reports most sightings as birds flying overhead.

COLUMBIFORMES: COLUMBIDAE

White-winged Dove, Zenaida asiatica. Rare summer resident. Usually encountered in the riparian and canyon scrub habitats. The subspecific identity of Big Bend White-wings remains uncertain until more material becomes available; currently, the T.O.S. places Big Bend birds in Z. a. mearnsi.

Mourning Dove, Zenaida macroura marginella. Common permanent resident. This species may be seen in almost every habitat. Even though we documented nesting only in April, it likely has a much more extended breeding season.

CUCULIFORMES: CUCULIDAE

Greater Roadrunner, Geococcyx californianus. Common permanent resident. We found no evidence of nesting; however, we encountered several individuals along the roads in scrub habitats on every trip as well as recorded them on both of the census lines on several occasions.

STRIGIFORMES: TYTONIDAE

Barn Owl, Tyto alba pratincola. Rare permanent resident. This owl was recorded on only two occasions, but the presence of pellets at one of the sites and the extensive fecal material at the other site suggest long-time occupancy of those sites.

STRIGIDAE

Great Horned Owl, Bubo virginianus. Status uncertain. Although we heard this owl on only one occasion, it likely is a permanent resident of the wooded draws and canyons. The resident subspecies for the Big Bend region is B. v. pallescens.

Elf Owl, Micrathene whitneyi. Status uncertain. We encountered this tiny owl on but one occasion, 14 June 1991. Wauer (1973) lists this species as a "fairly common summer resident and migrant below 5,600 feet elevation." The T.O.S. (1984) lists the nominate subspecies as a "common local summer resident in the mountains of Brewster, Jeff Davis and Culberson counties; uncommon at the lower elevations."

Burrowing Owl, Speotyto canicularia hypugaea. Status uncertain. The single record from April 1991 could represent a migrant or a summer resident. Wauer (1973) considers this species as a rare summer resident and migrant.

Long-eared Owl, Asio otus. Status uncertain. Our single record in April 1991 likely represents a lingering winter resident. However, Wauer (1973) records the species as a rare summer resident, as well as a migrant and winter visitor; he suggests that this owl may nest at Boot Springs in Big Bend National Park.

Short-eared Owl, Asio flammeus. Status uncertain. We encountered this owl on one occasion, 9 January 1992. Wauer (1973) considers this species as a rare winter visitor, while the T.O.S. (1984) considers it as an uncommon to locally common migrant and winter resident in all parts of Texas.

CAPRIMULGIFORMES: CAPRIMULGIDAE

Lesser Nighthawk, Chordeiles acutipennis texensis. Common summer resident. Although we recorded the species in April, June and August, we found no evidence of breeding; Wauer (1973) lists breeding within the park.

Common Nighthawk, Chordeiles minor. Status uncertain. The one record for August 1991 likely represents an early fall migrant. Wauer (1973) records this species as an uncommon spring and rare fall migrant.

Common Poorwill, Phaenoptilus nuttallii nuttallii. Common summer resident. The bird is most frequently encountered on the roads at night or heard in the twilight hours of early morning and evening.

APODIFORMES: TROCHILIDAE

Black-chinned Hummingbird, Arcilochus alexandri. Status uncertain. Our single April record suggests other than a common summer resident listed by Wauer (1973) and T.O.S. (1984) for the Big Bend region.

Costa's Hummingbird, Calypte costae. Status uncertain. The single record is not expected. T.O.S. lists this species as a casual migrant and winter visitor in the western half of Texas, while Wauer (1973) lists but two records for the park.

PICIFORMES: PICIDAE

Ladder-backed Woodpecker, Picoides scalaris cactophilus. Uncommon permanent resident. The four months for which we recorded this bird likely do not truly represent its status. We saw numerous workings of this bird in fence posts and utility poles. The T.O.S. (1984) lists this woodpecker as a common resident in the Trans-Pecos.

PASSERIFORMES: TYRANNIDAE

Western Wood-pewee, Contopus sordidulus. Status uncertain. The single observation from August 1991 could represent a migrant or a lingering summer resident. Wauer (1973) lists the species as a common migrant.

Empidonax species. The single observation in March 1992 will remain an enigma. Several species of this genus have been recorded as migrants and winter visitors in the Big Bend area, and two species have been recorded breeding in the park: E. traillii and E. occidentalis (Wauer 1973). Confusion reigns in regards the status of this genus in migration and as winter visitors in west Texas.

Say's Phoebe, Sayornis saya saya. Common permanent resident. We recorded this species on all but one visit to the study area, and found evidence of nesting in April and June of 1991. While frequently encountered around stock tanks, the species also occurs in open scrub habitats.

Ash-throated Flycatcher, Myiarchus cinerascens cinerascens. Common summer resident (Wauer 1973, T.O.S. 1984). Although recorded only in April and June of 1991, a juvenile that we banded in June, documents breeding of this secondary hole-nesting species on the area. The bird prefers open desert scrub habitats.

Cassin's Kingbird, Tyrannus vociferus. Status uncertain. The single April record could be a summer visitor or a migrant; this species has been recorded breeding in the park (Wauer 1973). The species prefers open habitats with tall perch sites.

ALAUDIDAE

Horned Lark, Eremophila alpestris. Sporadic winter visitor. We found this in small flocks on grasslands only in 1992. Wauer (1973) states that it is an uncommon migrant and rare winter visitor in the park, but that it is more common in northern Brewster county.

HIRUNDINIDAE

Cliff Swallow, Hirundo pyrrhonota. Common summer resident and migrant. The species nested at the mountain lodge each summer. The likely subspecies for the area is H. p. minima; lack of specimens precludes confirmation.

Cave Swallow, Hirundo fulva pallida. Uncommon summer resident and migrant. We found a few pairs nesting at mountain lodge with the Cliff Swallows in June 1991.

Barn Swallow, Hirundo rustica erythrogaster. Status uncertain. Although we found the species present in April, June and August of 1991, we did not find any nests. Wauer (1973) states that the species is a summer resident at a few localized places in the park.

CORVIDAE

Chihuahuan Raven, Corvus cryptoleucus. Rare migrant. Wauer (1973) also considers this as a rare summer visitor in the lower parts of the park; he states that the bird becomes more common in the mesquite flats of northern Brewster county.

Common Raven, Corvus corax sinuatus. Uncommon permanent resident. We failed to record this species during the winter months and it may move out of the area during that time. We did not document breeding by the species. Wauer (1973) lists this as the common raven in all parts of the park.

REMEZIDAE

Verdin, Auriparus flaviceps ornatus. Status uncertain. We only recorded the species on the study area in March 1992, yet Wauer (1973) lists the species as a fairly common resident in the desert lowlands.

TROGLODYTIDAE

Cactus Wren, Campylorhynchus brunneicapillus couesi. Common permanent resident in all scrub communities. However, we failed to encounter evidence of breeding. Wauer (1973) indicates breeding within the park.

Rock Wren, Salpinctes obsoletus obsoletus. Common migrant and winter visitor in draws and rocky hillsides; we had no observations for the summer months, although both Wauer (1973) and the T.O.S. (1984) list this species as a common summer resident in this area.

Bewick's Wren, Thryomanes bewickii erempophilus. Uncommon migrant and winter visitor. Although we recorded this species only in January and March 1992 and in October 1991, the T.O.S. (1984) considers this species as a common resident throughout the Trans-Pecos.

House Wren, Troglodytes aedon. Status uncertain. Our single observation could represent either a migrant or a winter visitor. Wauer (1973) lists this species as a common migrant and uncommon winter visitor in the park. The species prefers thick brush and often is found in piles of cut brush.

MUSCICAPIDAE

Ruby-crowned Kinglet, Regulus calendula. Common migrant and winter visitor. This ubiquitous species will occur almost anywhere that a scrub or two exists.

Blue-gray Gnatcatcher, Poliophtila caerulea caerulea. Uncommon migrant and winter visitor. Scrub and woodland habitats draw this species. Wauer (1973) reports the bird as a common migrant and an uncommon and sporadic winter visitor; he also reports breeding in the mountains of the park.

Black-tailed Gnatcatcher, Polioptila melanura melanura. Uncommon permanent resident. We recorded this species on all but two trips to the area. Wauer (1973) and the T.O.S. (1984) list the bird as a common resident in the desert lowlands. We recorded evidence of breeding in June 1991. Like the preceding species, it prefers open scrub and woodland habitats.

Hermit Thrush, Catharus guttatus. Uncommon migrant and winter visitor. We found this thrush in thick scrub around the stock tanks and in the riparian and canyon woodlands.
MIMIDAE

Northern Mockingbird, Mimus polyglottus leucopterus. Common resident. Recorded on every trip to the study area, this species appeared in almost every habitat. We recorded evidence of breeding in June 1991.

Sage Thrasher, Oreoscoptes montanus. Status uncertain. The single record for March 1991 could be a lingering winter visitor. Wauer (1973) records this species as an uncommon spring migrant and a sporadic fall migrant and winter visitor. The T.O.S. (1973) lists the species as rare to uncommon and irregular in most parts of the state.

Brown/Long-billed Thrasher, Toxostoma rufum/longirostre. Status uncertain. We have three sightings in which the species was not distinguished between these two thrashers; Wauer (1973) lists the Brown Thrasher as the more common of the two, but either species is possible in the thick brush where these sightings occurred.

Curve-billed Thrasher, Toxostoma curvirostre celsum. Uncommon permanent resident. Even though we recorded the species only on three trips, the distribution of those records supports a resident status. It prefers open scrub lands. In the park, Wauer (1973) has noted a declining status for this bird.

Crissal Thrasher, Toxostoma dorsale dorsale. Status uncertain. We only recorded the bird on two trips: June 1991 and January 1992, but we netted two birds on the latter trip, each from a different locale. Wauer (1973) reports increasing numbers of this thrasher in the park from an ever-increasing array of habitats; elsewhere, the bird prefers fairly thick brush, especially riparian woodlands.

MOTACILLIDAE

American Pipit, Anthus spinoletta. Uncommon migrant and winter visitor. Recorded only in January and March of 1992, undoubtedly we overlooked this species. It uses open areas near water.

Sprague's Pipit, Anthus spragueii. Rare migrant and winter visitor. Also recorded only in January and March of 1992, this species occurred only on the alkaline grasslands. Wauer (1973) lists this only as a rare migrant in the park.

PTILOGONATIDAE

Phainopepla, Phainopepla nitens. Status uncertain. The single record from April 1991 could be a lingering winter visitor or a migrant. This species prefers open scrub lands. Wauer (1973) lists this species as rare in summer and uncommon as a migrant and winter visitor.

LANIIDAE

Loggerhead Shrike, Lanius ludovicianus. Uncommon summer resident and common migrant and winter visitor. The bird hunts in open scrub habitats and on grasslands where sufficient perch sites exist. It often sits on utility wires and fences.

VIREONIDAE

Warbling Vireo, Vireo gilvus. Rare summer resident. Nesting was documented at Alamo Springs. This vireo prefers riparian woodlands. Wauer (1973) considers this bird as a rare summer resident that nests in the park only in wet years.

EMBERIZIDAE

Orange-crowned Warbler, Vermivora celata. Uncommon winter visitor. This plainly-marked, small bird can often be overlooked in winter flocks. It occurs in all types of scrub and woodlands.

Yellow-rumped Warbler, Dendroica coronata. Common migrant and winter visitor. The common winter warbler, this bird forages in all types of scrub and woodlands.

Townsend's Warbler, Dendroica townsendi. Status uncertain. We have a single record for this species: April 1991. This likely is a migrant, as the species is not known to nest in Texas (T.O.S. 1984).

MacGillivray's Warbler, Oporornis tolmiei monticola. Status uncertain. T.O.S. (1984) lists this as an uncommon to common migrant in the western two-thirds of Texas, while Wauer (1973) records it as common in spring and rare in fall in the park.

Wilson's Warbler, Wilsonia pusilla. Status uncertain. The single record from April 1991 likely represents a migrant. Wauer (1973) lists this species as the most common migrant, but makes no reference to it as a winter visitor.

Yellow-breasted Chat, Icteria virens. Common summer resident. Although we found no evidence of breeding, Wauer (1973) reports it as a common summer resident in the park. The species prefers brush along rivers, streams and other water sources.

Summer Tanager, Piranga rubra. Status uncertain. We have but one record: August 1991. The species nests in most parts of Texas (T.O.S. 1993) and it likely nests in the woodlands associated with the permanent springs on the area.

Western Tanager, Piranga ludoviciana. Status uncertain. The single record for April 1991 could be a migrant or a summer resident. Wauer (1973) considers the species as rare in summer, but fairly common as a migrant.

Northern Cardinal, Cardinalis cardinalis. Status uncertain. We have but one record, March 1992, but several records of "Cardinalis sp." could be this species [vocalizations only]. The species is a common, local summer and winter resident and an uncommon migrant in the park (Wauer 1973).

Pyrrhuloxia, Cardinalis sinuatus sinuatus. Common permanent resident. We recorded the species on every trip but March 1992; we did not find evidence for breeding. The bird prefers open or patchy brush. Wauer (1973) lists this as a common summer and winter resident and uncommon migrant.

Blue Grosbeak, Guiraca caerulea interfus. Uncommon summer resident. We encountered this inhabitant of open scrub and brushy patches in spring and summer, but found no evidence of breeding. The T.O.S. (1984) lists this as a rare to locally common summer resident.

Lazuli Bunting, Passerina amoena. Status uncertain. The lone bird collected in April 1991 would support the statement by Wauer (1973) that the species is a rare spring migrant.

Varied Bunting, Passerina versicolor versicolor. Uncommon summer resident. Both of our sightings occurred in scrub habitat in the draw below Buttrell springs. Wauer (1973) suggests that the species has a wider distribution in the park, especially in "weedy places along the roads."

Painted Bunting, Passerina ciris. Status uncertain. The single record for August 1991 could be a summer resident or a wandering post-breeding bird (Wauer 1973). This is a species which should have appeared more frequently in our records.

Green-tailed Towhee, Pipilo chlorurus. Uncommon migrant and winter visitor. We found the species concentrated around water with abundant brush.

Canyon Towhee, Pipilo fuscus texanus. Status uncertain. The two records, January and June, suggest that the species may be a permanent resident, as our studies at Big Bend Ranch State Natural Area confirm. Wauer (1973) lists the species as an abundant resident in the sotol grasslands in the park, less common in the lower arroyos and higher mountains.

Cassin's Sparrow, Aimophila cassinii. Status uncertain. The bird was certainly an uncommon winter resident, but a singing male in March 1991 suggests that it may also occasionally nest in the area. Wauer (1973) suggests that nesting in the park depends upon the amount of rainfall received. This sparrow prefers open areas with scattered brush.

Rufous-crowned Sparrow, Aimophila ruficeps eremoeca. Uncommon permanent resident. Even though we do not have records for every visit, the spread of our observations for this sparrow will support this status. The bird prefers rocky slopes with scattered brush.

Chipping Sparrow, Spizella passerina arizonae. Common migrant and winter visitor. Like the following two species, this one prefers open scrub habitats. The T.O.S. (1984) lists the species as a common resident in the Trans-Pecos, but we had no evidence of breeding and no observations between April and October.

Clay-colored Sparrow, Spizella pallida. Common winter visitor and migrant. Because of the difficulty in distinguishing this species and the next in the field, we cannot comment with certainty on the relative abundance of the two species. Our banding efforts, however, suggest that this species was in much lower numbers in the winter of 1990-1991, but reversed that situation in 1991-1992. Like the preceeding species, Clay-coloreds prefer open scrub habitats.

Brewer's Sparrow, Spizella breweri. Common winter visitor and migrant. See comments for previous species.

Field Sparrow, Spizella pusilla. Status uncertain. We did not record this species until March 1992, our last trip to the area. It is likely a regular migrant and winter visitor to the area that we simply overlooked.

Vesper Sparrow, Pooecetes gramineus. Uncommon winter visitor and migrant. This bird prefers "weedy" roadside patches of brush.

Black-throated Sparrow, Amphispiza bilineata opuntia. Common permanent resident. We recorded the bird on every trip, indeed, on every census, in the open scrub habitats. Other than when we encountered a flock of Spizella sparrows or the time when Lark Bunting were so abundant, this was the most numerous bird on the area.

Lark Bunting, Calamospiza melanocorys. Uncommon to common winter visitor and migrant. In the winter of 1990-1991, this bird appeared in flocks of hundreds and even thousands; the next year it was present, but in greatly reduced numbers. The species occurs wherever sufficient annuals provide the necessary seeds.

Grasshopper Sparrow, Ammodramus savannarum. Status uncertain. We banded two individuals in January 1991, but never recorded the species again. Although the T.O.S. lists the species as a summer resident in all parts of the state, and a migrant and winter resident throughout most of the state (including Trans-Pecos), Wauer (1973) only lists it as an uncommon migrant and a sporadic winter visitor.

Song Sparrow, Melospiza melodia. Rare migrant and winter visitor. We encountered the species in brush near water. Wauer (1973) considers this as an uncommon migrant and rare winter visitor.

Lincoln's Sparrow, Melospiza lincolni. Uncommon migrant and winter visitor. This bird likes brush near water.

White-crowned Sparrow, Zonotrichia leucophrys gambelli. Common migrant and winter visitor. We found the bird especially abundant in brush along water courses and around stock tanks. The subspecies is easily identified in the hand.

McCown's Longspur, Calcarius mccownii. Status uncertain. We found this bird only once, a small flock on the alkaline grassland. Very likely, it is a sporadic migrant and winter visitor, absent in some years.

Eastern Meadowlark, Sturnella magna. Status uncertain. We only identified the species once by vocalization [in June 1991], but had "unidentified" meadowlarks in January, March and October. The form of this "species," S. m. lilianae, may represent a third species in Texas.

Western Meadowlark, Sturnella neglecta. Status uncertain. Our two records are for February and March, but the presence of the unidentified meadowlarks confuses the issue. Wauer (1973) lists the species as a fairly common migrant and winter resident in the park. All meadowlarks will occur in open areas, either with grass or bare ground.

Brown-headed Cowbird, Molothrus ater. Common summer resident. A female collected in June 1991 had developing eggs in her oviduct. The breeding subspecies for the Big Bend area is M. a. obscurus, but other subspecies occur in the area as migrants and winter visitors (T.O.S. 1984). Usually found in scrub and woodland habitats where it parasitizes the nests of small passerines.

Orchard Oriole, Icterus spurius spurius. Uncommon summer resident. A pair nested in the woodland below Buttrill Springs in June 1991. This species prefers patchy scrub and open woodland habitats.

Scott's Oriole, Icterus parisorum. Uncommon summer resident. Although recorded in three consecutive trips in spring and summer of 1991, we found no evidence for breeding. Wauer (1973) considers this as a common summer resident in the yucca-Sotol-grasslands, and a common migrant in other parts of the park. This species occurs in open desert scrub habitats.

FRINGILLIDAE

House Finch, Carpodacus mexicanus frontalis. Common permanent resident. We recorded the species on every trip except October 1991. The bird nested at the mountain lodge in both 1991 and 1992, using old Cliff Swallow nests. Generally, we encountered the bird only near human habitations.

Lesser Goldfinch, Carduelis psaltria psaltria. Status uncertain. We encountered the species only in June 1991 and March 1992, but the T.O.S. lists this as uncommon to common summer resident in the Trans-Pecos region, while Wauer (1973) lists it as a fairly common summer and

winter resident. The species may occur in any habitat with an abundant seed supply and some brush for cover.

PASSERIDAE

House Sparrow, Passer domesticus domesticus. Status uncertain. We recorded the bird only in June 1991. Given it's status elsewhere in Big Bend and the Trans-Pecos as a common resident (Wauer 1973, T.O.S. 1984), the lack of records for this area may reflect the "abandonment" of the area by humans and the concomitant lack of livestock on the area.

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Table 9. Percentage vegetation types for the two line transects.

Table 10. Birds recorded by month of observation.

Species	JAN	FEB	MAR	APR	JUN	AUG	OCT
Pied-billed Grebe		1					
Green-winged Teal	1						1
Mexican Duck	1				1		1
Gadwall	1						
Ring-necked Duck	1	1					
Lesser Scaup		1					
Duck sp.	1						
Turkey Vulture				1	1	1	1
Northern Harrier	1	1	1	1		1	1
Sharp-shinned Hawk			1				
Cooper's Hawk			1				1
<u>Accipiter</u> sp.		1					
Harris' Hawk	1	1		1			1
Swainson's Hawk					1		
Red-tailed Hawk	1	1	1	1	1	1	1
Ferruginous Hawk							1
Rough-legged Hawk							1
American Kestrel	1	1		1			1
Peregrine Falcon				1			
Scaled Quail		1	1	1	1	1	1
Gambel's Quail	1		1	1			
Sandhill Crane				1			
Killdeer							
1							
White-winged Dove					1	1	
Mourning Dove	1	1		2	1	1	1
Greater Roadrunner	1	1	1	1	1	1	1
Barn Owl		1				1	
Great Horned Owl		1					
Elf Owl					1		
Burrowing Owl				1			
Long-eared Owl				1			
Short-eared Owl	1						
Lesser Nighthawk				1	1	1	
Common Nighthawk						1	
Common Poorwill				2	1	1	1
Black-chinned Hummingbird				1			
Costa's Hummingbird				1			
Ladder-backed Woodpecker		1		1		1	1

Western Wood-pewee
Empidonax sp.

1

1

Species	JAN	FEB	MAR	APR	JUN	AUG	OCT
Say's Phoebe	1	1	1	4	4		1
Ash-throated Flycatcher				1	2,4		
Cassin's Kingbird				1			
Horned Lark	1	1	1				
Cliff Swallow				1	4	1	
Cave Swallow					4		
Barn Swallow				1	1	1	
Chihuahuan Raven				1		1	
Common Raven				1	1	1	1
Verdin				1			
Cactus Wren	1	1	1	1	1	1	1
Rock Wren	2	1	1				1
Bewick's Wren			1		1		
House Wren							1
Ruby-crowned Kinglet	2	1	2				1
Blue-gray Gnatcatcher	1	1	2				
Black-tailed Gnatcatcher	1		1	1	2,4	1	1
Hermit Thrush	2		2				2
Northern Mockingbird	1	1	1	1	2,4	1	1
Sage Thrasher				1			
Long-billed/Brown Thrasher	1		1	1			1
Curved-billed Thrasher	1		1		1		1
Crissal Thrasher	3				1		
American Pipit	1		1				
Sprague's Pipit	1		1				
Phainopepla				1			
Loggerhead Shrike	1	1			1	1	1
Warbling Vireo				4	1	1	
Orange-crowned Warbler	2		1				
Yellow-rumped Warbler	1	1	1	1			1
Townsend's Warbler							1
MacGillivray's Warbler				1			
Wilson's Warbler				1			
Yellow-breasted Chat				1	1	1	
Summer Tanager						1	
Western Tanager				1			
Northern Cardinal				1			
Pyrrhuloxia	2	2		2,4	1	1	1
<u>Cardinalis</u> sp.			1				
Blue Grosbeak				3,4		2	1
Lazuli Bunting				3			
Varied Bunting				1		1	

Species	JAN	FEB	MAR	APR	JUN	AUG	OCT
Painted Bunting						1	1
Green-tailed Towhee	1	2	1	2			1
Canyon Towhee	1				1		
Cassin's Sparrow	2	2	1	1			
Rufous-crowned Sparrow	1	1		2			2
Chipping Sparrow		1		1			1
Clay-colored Sparrow	2	2,3	1	2			
Brewer's Sparrow	2	2,3	1	1			
Field Sparrow			1				
<u>Spizella</u> sp.	1	1	1				1
Vesper Sparrow	1	2	1	2			
Black-throated Sparrow	1	1	2	1	1	1	1
Lark Bunting	1	2	1			1	1
Grasshopper Sparrow	2						
Song Sparrow	3		2				
Lincoln's Sparrow	2	2	2	2			
Swamp Sparrow	2						
White-crowned Sparrow	2	2	2	2			1
McCown's Longspur			1				
Eastern Meadowlark					1		
Western Meadowlark		1	1				
<u>Sturnella</u> sp.	1		1				1
Brewer's Blackbird				1			
Brown-headed Cowbird				1	3,4	1	
Orchard Oriole					4	1	
Scott's Oriole				1	1	1	1
<u>Icterus</u> sp.							1
House Finch	1	1	2,4	1	2,4	1	
Lesser Goldfinch			1		2		
House Sparrow					1		

1 = Seen or heard only

2 = Banded

3 = Collected

4 = Evidence of nesting

Table 11. Birds Banded in the North Rosillos Area.

Species	JAN	FEB	MAR	APR	JUN	AUG	OCT
Mourning Dove				1			
Common Poorwill				1			
Ash-throated Flycatcher					1		
Rock Wren	1						
Ruby-crowned Kinglet	1			1			
Blue-gray Gnatcatcher			1				
Black-tailed Gnatcatcher					1		
Hermit Thrush	1						1
Northern Mockingbird					3		
Orange-crowned Warbler	1						
Pyrhuloxia		2	1		1		
Green-tailed Towhee	1	1		1			
Blue Grosbeak					1		
Cassin's Sparrow			1				
Rufous-crowned Sparrow							1
Chipping Sparrow		2		1			
Clay-colored Sparrow		8		7			1
Brewer's Sparrow		28		2			
Vesper Sparrow		6		1			
Black-throated Sparrow			1				
Lark Bunting		3					
Song Sparrow			1				
Lincoln's Sparrow	2	1		2			
Swamp Sparrow	2						
White-crowned Sparrow	1	7	3	5			
Scott's Oriole					1		
House Finch		2	1	1	1		
Lesser Goldfinch				2			
Totals	10	60	9	25	9	0	3

CHAPTER 7 MAMMALS

Clyde Jones, Richard W. Manning, and
Franklin D. Yancey, II

Introduction and Methods

For a total of almost three years, we have been conducting studies on the biodiversity of the mammals that occur in the North Rosillos Area addition to Big Bend National Park. This survey of the mammals of the area was carried out in accordance with the work of a unique research consortium organized by Dr. Milford Fletcher (National Park Service) and Dr. David Schmidly (Texas A&M University). We have made every effort to coordinate our field activities with those of the other members of the research consortium.

Our major goals were to attempt to determine the kinds of living mammals that are extant in the North Rosillos Area, and to attempt to sample and observe mammals in as many of the habitats throughout the geographic area as possible. We employed mostly traditional methods (a total of more than 10,000 trap-nights) in carrying out our observations and sampling efforts. However, we used Sherman live traps almost exclusively in our sampling efforts in order to be able to release those animals captured that were not needed as voucher specimens. All field research activities were conducted in the most discrete manner possible in consideration of the sensitivities of the local human population in the region.

Accounts of Species

In the accounts that follow, 42 species of mammals that are known to occur in the North Rosillos Area of Big Bend National Park are treated. Although ordinal and familial headings are not utilized here (Table 12), accounts are in the currently accepted phylogenetic sequence through genera; species are arranged alphabetically within each genus. The names of taxa, as well as vernacular names, are in accordance with the names for the species of mammals of Texas listed by Jones and Jones (1992). Measurements provided below are in millimeters. Specimens listed are deposited in the Collection of Recent Mammals of The Museum, Texas Tech University.

Myotis yumanensis yumanensis (H. Allen, 1864)

Only two specimens of the Yuma myotis were obtained during this study. Both bats were captured in mist nets placed over water. According to Schmidly (1991), this bat usually forages near open water in lowland habitats. Testes of these bats, captured on 8 and 10 November, measured 1 x 1 and 3 x 1, respectively.

Specimens examined (2). -- Mountain Lodge, North Rosillos Area, 1; 0.6 mi. S, 1.5 mi. E Key Place, North Rosillos Area, 1.

Pipistrellus hesperus maximus Hatfield, 1936

The western pipistrelle was the most common bat encountered during this study. Although specimens were obtained by use of mist nets set over water at only two localities, these mammals were observed flying about at dusk and dawn at numerous places in the study area, especially along roads and adjacent to Chalk Ridge. A female examined on 19 May contained two embryos (crown-rump length, 11); lactating females were collected on 19-21 July. Measurements of testes of males obtained in July and August ranged from 2 x 2 to 4 x 4; in October and November, testes of males measured from 1 x 1 to 3 x 2. Volant young of the year were captured on 19-21 July.

Specimens examined (49).--Mountain Lodge, North Rosillos Area, 48; Cedar Creek, 0.75 mi. E Twin Peaks, North Rosillos Area, 1.

Eptesicus fuscus pallidus Young, 1908

A lactating female was captured on 20 July in a mist net placed over water. In the Big Bend of Texas, female big brown bats inhabit lowland areas during the summer (Schmidly, 1991).

Specimens examined (1).--Mountain Lodge, North Rosillos Area, 1.

Lasiurus cinereus cinereus (Palisot de Beauvois, 1796)

On two occasions during the night of 10 November, a hoary bat was observed in a mist net set over water at Buttrill Springs; the bat escaped before it could be retrieved. According to Schmidly (1991) this species is restricted mostly to wooded, montane areas of the Big Bend. No specimens of this taxa were collected or examined.

Plecotus townsendii pallescens (Miller, 1897)

Two specimens of Townsend's big-eared bat were obtained during this study. A male, taken from inside a building on 8 November, had testes that measured 4 x 2. A non-gravid female was netted over water on 8 November.

Specimens examined (2).--Key Place, North Rosillos Area, 1; 0.6 mi. S, 1.5 mi. E Key Place, North Rosillos Area, 1.

Antrozous pallidus pallidus (Le Conte, 1856)

The pallid bat was found commonly from March through September during this study, especially in association with man-made structures and open water. Before the collapse of the structure, the old adobe house at the former headquarters of the North Rosillos Area was a very important night roost for these bats. Pregnant females (crown-rump length, 23-26) were obtained on 19 and 22 May, respectively. Lactating females were present on 19-21 July. Testes of a male captured in March measured 5 x 3; bats obtained in May had testes that ranged in size from 2 x 1 to 6 x 2. A male examined in August had testes that measured 9 x 5. Volant young of the year were present in July and August.

Specimens examined (22).--Mountain Lodge, North Rosillos Area, 17; Key Place, North Rosillos Area, 2; Headquarters, North Rosillos Area, 3.

Tadarida brasiliensis mexicana (Saussure, 1860)

Brazilian free-tailed bats were captured in mist nets set over water from March through November. As a result of the well-known segregation of sexes in these bats, females were obtained only in March (3), October (2), and November (1). Measurements of testes of males ranged from 2 x 1 to 6 x 3; animals with the larger testes were obtained in September, October, and November.

Specimens examined (59).--Mountain Lodge, North Rosillos Area, 59.

Sylvilagus audubonii minor (Mearns, 1896)

In the North Rosillos Area, the desert cottontail is found primarily in lowlands, especially in Nine Point Draw and its tributaries. It seems that these mammals are especially wary in the area; they are not found far from cover. Desert cottontails were rare during the first two years of this study. However, in May and June of 1992, they were abundant, and many young animals were observed. Lactating females were taken in March, May, and August. A female with six fetuses (crown-rump length, 35), one with three fetuses (crown-rump length, 12), and a female with two fetuses (crown-rump length, 55) were collected in March, May, and August, respectively. Testes of males collected in March through November measured from 27 x 17 to 50 x 20. A male taken on 8 November exhibited fresh winter pelage.

Specimens examined (12).--Mountain Lodge, North Rosillos Area, 2; 1 mi. N Mountain Lodge, North Rosillos Area, 2; 1.3 mi. N Mountain Lodge, North Rosillos Area, 1; 0.5 mi. N, 1.5 mi. W Mountain Lodge, North Rosillos Area, 1; 1.25 mi. N, 1 mi. E Mountain Lodge, HNorth Rosillos Area, 1; 1.5 mi. N, 0.4 mi. E Mountain Lodge, North Rosillos Area, 1; 1.5 mi. N, 0.5 mi. E Mountain Lodge, North Rosillos Area, 1; 1.75 mi. N, 1.5 mi. E Mountain Lodge, North Rosillos Area, 1; 0.25 mi. N Key Place, North Rosillos Area, 1; 4 mi. S Persimmon Gap Ranger Station, North Rosillos Area, 1.

Lepus californicus texianus Waterhouse, 1848

The black-tailed jackrabbit is a widespread and often common inhabitant of the study area, especially in open creosote bush and mesquite grasslands. Although no precise census data are available, it seems that this hare has been increasing in numbers in the area during each of the last three years. Reproductive data gathered on L. californicus included a female with one fetus (crown-rump length, 28) collected in July, one with three fetuses (crown-rump length, 40) obtained in August, and a female containing two fetuses (crown-rump length, 38) examined in September. Lactating females were found in March, July, and August. Testes of adult males measured in June were 42 x 19, whereas males collected in August had testes that were 25 x 10, 28 x 8, and 50 x 18, respectively.

Specimens examined (18).--Mountain Lodge, North Rosillos Area, 1; 1 mi. N Mountain Lodge, North Rosillos Area, 2; 0.25 mi. N, 2.25 mi. W Mountain Lodge, North Rosillos Area, 1; 1.5 mi. S, 2.75 mi. W Mountain Lodge, North Rosillos Area, 1; 1.5 mi. N, 2 mi. E Mountain Lodge, North Rosillos Area, 1; 1.75 mi. N, 2.75 mi. E Mountain Lodge, North Rosillos Area, 1; 0.5 mi. S, 1.5 mi. E Key Place, North Rosillos Area, 1; 0.25 mi. N Key Place, North Rosillos Area, 1; 1.5 mi. N, 2.6 mi. E Key Place, North Rosillos Area, 1; Headquarters, North Rosillos Area, 3; 0.7 mi. N Headquarters, North Rosillos Area, 1; 4.25 mi. S, 1.25 mi. W Persimmon Gap Ranger Station, North Rosillos Area, 1; 4 mi. S, 2 mi. W Persimmon Gap Ranger Station, HNorth Rosillos Area, 1; 4 mi. S Persimmon Gap Ranger Station, North Rosillos Area, 1; 4 mi. S, 0.5 mi. E Persimmon Gap Ranger Station, North Rosillos Area, 1.

Ammospermophilus interpres interpres (Merriam, 1890)

It seems apparent that the Texas antelope squirrel is not common in the North Rosillos Area. Animals were observed on several occasions along the road in the vicinity of Key Place, as well as near the western boundary of the area. As with several other kinds of mammals in the area, we were impressed with the wariness exhibited by this species. No specimens of this taxa were collected or examined.

Spermophilus spilosoma marginatus Bailey, 1890

The spotted ground squirrel occurs predominantly in habitats on coarse, sandy-gravelly soils in the area. These animal are wary; it seems that they seldom venture far from cover of shrubs and grasses. Information obtained on reproduction in this species includes females collected in September with four and seven placental scars, respectively. A male obtained in May had testes that measured 22 x 13; measurements of testes of an animal collected in September were 13 x 7. A male examined on 21 May exhibited molting of the pelage. Some of these ground squirrels taken in September and October had extensive deposits of fat.

Specimens examined (8).--0.5 mi. S, 2.5 mi. W Mountain Lodge, North Rosillos Area, 1; 2.1 mi. N, 3.2 mi. E Mountain Lodge, North Rosillos Area, 1; 0.25 mi. N, 0.25 mi. E Key Place, North Rosillos Area, 3; 0.4 mi. N, 0.2 mi. E Key Place, North Rosillos Area, 1; 0.4 mi. N, 0.8 mi. E Key Place, North Rosillos Area, 1; 0.4 mi. N, 1.2 mi. E Key Place, North Rosillos Area, 1.

Spermophilus variegatus grammurus (Say, 1823)

Rock squirrels were observed in the vicinity of Buttrill Spring, as well as on rocky outcrops on the western slopes of the Rosillos Mountains. In addition to being uncommon in the area, these squirrels seem extremely wary also. No specimens of this taxa were collected or examined.

Cratogeomys castanops clarkii (Baird, 1855)

Yellow-faced pocket gophers were found in deep, sandy soils of the lowlands in the western portion of the study area. In addition these animals were located in shallow, rocky soils in the vicinity of Mountain Lodge. Schmidly (1977) reported that these gophers require topsoils of a depth of seven to eight inches. It seems apparent that C. castanops should be distributed more widely in the area than our records indicate. A female obtained in September contained three fetuses (crown-rump length, 49). Measurements of testes of a male collected in November were 7 x 5. Animals taken in May, September, and November exhibited evidence of molting.

Specimens examined (5).--Mountain Lodge, North Rosillos Area, 2; 0.75 mi. N Mountain Lodge, North Rosillos Area, 1; 1 mi. S, 2.5 mi. W Mountain Lodge, North Rosillos Area, 1; 1.25 mi. S, 2.5 mi. W Mountain Lodge, North Rosillos Area, 1.

Perognathus flavus gilvus Osgood, 1900

The silky pocket mouse was one of the more common small rodents that was encountered throughout the study area. Although not especially abundant in any given place at any given time, this heteromyid was obtained in numerous habitats on both sandy and rocky substrates during the course of this study. Our perceptions of the habitat preferences of this rodent coincide with those determined by Porter (1962). Pregnant females were taken in March (4 fetuses, crown-rump length, 7), July (3 fetuses, crown-rump length, 4), August (6 fetuses, crown-rump length, 3; 3 fetuses, crown-rump length, 5; 4 fetuses, crown-rump length, 10; 3 fetuses, crown-rump length, 11; 4 fetuses, crown-rump length, 12; 2 fetuses, crown-rump length, 18). Also, lactating females were collected in August. Measurements of testes of males taken in various months were recorded as follows: March, 4 x 2; May, 6 x 3; July, 2 x 2, 3 x 2, 5 x 4, 7 x 4; August, 2 x 1, 2 x 2, 4 x 2, 4 x 3; November, 2 x 1. Animals with pelage undergoing molt were examined in July and August.

Specimens examined (64).--Mountain Lodge, North Rosillos Area, 7; 2.5 mi. N, 4 mi. W Mountain Lodge, North Rosillos Area, 2; 1.3 mi. N, 4 mi. W Mountain Lodge, North Rosillos Area, 1; 1.25 mi. S, 2.75 mi. W Mountain Lodge, North Rosillos Area, 9; 1.5 mi. S, 2.75 mi. W Mountain Lodge, North Rosillos Area, 1; 1.1 mi. S, 3.8 mi. W Mountain Lodge, North Rosillos Area, 6; 1 mi.

N, 0.5 mi. E Mountain Lodge, North Rosillos Area, 4; 0.5 mi. S, 1.5 mi. E Key Place, North Rosillos Area, 2; Headquarters, North Rosillos Area, 1; 0.25 mi. N, 1 mi. E Headquarters, North Rosillos Area, 1; 0.5 mi. N, 1.4 mi. W Headquarters, North Rosillos Area, 1; 4 mi. S Persimmon Gap Ranger Station, North Rosillos Area, 1; 4 mi. S, 1 mi. E Persimmon Gap Ranger Station, North Rosillos Area, 2; 4 mi. S, 0.5 mi. E Persimmon Gap Ranger Station, North Rosillos Area, 1; 4.25 mi. S, 1.25 mi. E Persimmon Gap Ranger Station, North Rosillos Area, 9; Southeast Windmill, 5 mi. S, 0.5 mi. E Persimmon Gap Ranger Station, North Rosillos Area, 1; 0.1 mi. N, 1.5 mi. E Twin Peaks, North Rosillos Area, 4; Cedar Creek, 0.75 mi. E Twin Peaks, North Rosillos Area, 10; Cedar Creek, 0.8 mi. S, 0.4 mi. E Twin Peaks, North Rosillos Area, 1.

Chaetodipus nelsoni canescens (Merriam, 1904)

Nelson's pocket mouse occurs in habitats on gravelly and rocky substrates within the study area. Precise habitats of this heteromyid in the Big Bend area were described in detail by Porter (1962). We found pregnant females of this species only in June (3 fetuses, crown-rump length, 5; 4 fetuses, crown-rump length, 8) and August (5 fetuses, crown-rump length, 8). Testes of males taken through the year were measured as follows: March, 8 x 4; May, 12 x 6; June, 8 x 4; July, 11 x 4, 9 x 4, 8 x 3; August, 3 x 1, 4 x 2, 5 x 2; September, 5 x 2; November, 4 x 2, 6 x 3, 6 x 4. Young animals were collected in July and August. Based on examination of specimens obtained, molting of pelage seemingly takes place in late summer (July, August).

Specimens examined (121).--Mountain Lodge, North Rosillos Area, 25; 0.5 mi. N, 0.1 mi. W Mountain Lodge, North Rosillos Area, 10; 0.3 mi. N, 2 mi. W Mountain Lodge, North Rosillos Area, 7; 1 mi. N Mountain Lodge, North Rosillos Area, 1; 2.5 mi. N, 4 mi. W Mountain Lodge, North Rosillos Area, 1; 2 mi. S, 0.5 mi. E Mountain Lodge, North Rosillos Area, 7; Buttrill Spring, North Rosillos Area, 33; 0.5 mi. S, 1.5 mi. E Key Place, North Rosillos Area, 11; 1.4 mi. S, 3.4 mi. E Key Place, North Rosillos Area, 5; 0.5 mi. N, 1.5 mi. W Headquarters, North Rosillos Area, 7; 4.25 mi. S, 1.25 mi. W Persimmon Gap Ranger Station, North Rosillos Area, 1; 4 mi. S, 0.5 mi. E Persimmon Gap Ranger Station, North Rosillos Area, 1; 4 mi. S, 1 mi. E Persimmon Gap Ranger Station, 1; 0.1 mi. N, 1.5 mi. E Twin Peaks, North Rosillos Area, 4; Cedar Creek, 0.75 mi. E Twin Peaks, North Rosillos Area, 3; Cedar Creek, 0.8 mi. E, 0.4 mi. S Twin Peaks, North Rosillos Area, 4.

Chaetodipus penicillatus eremicus (Mearns, 1898)

In accordance with the preferences of habitats of these pocket mice determined by Porter (1962), we found the desert pocket mouse in all kinds of vegetation in habitats on rock-free, sandy soils (and occasionally on gravel) where we sampled mammals during this study. This mouse was the most abundant heteromyid collected during our field work in the North Rosillos Area. Females carrying fetuses were obtained in March (3 fetuses, crown-rump length, 1.5; 5 fetuses, crown-rump length, 6), May (6 fetuses, crown-rump length, 4), June (8 fetuses, crown-rump length, 2; 6 fetuses, crown-rump length, 7), July (2 fetuses, crown-rump length, 3), August (4 fetuses, crown-rump

length, 5; 4 fetuses, crown-rump length, 12; 3 fetuses, crown-rump length, 21), September (4 fetuses, crown-rump length, 10), and November (3 fetuses, crown-rump length, 13). Ranges of measurements of testes of males were recorded as follows: March, 7 x 4 - 11 x 6; June, 3 x 2 - 8 x 4; July, 3 x 1 - 7 x 3; August, 6 x 4 - 10 x 4; September, 4 x 2 - 6 x 3; November, 3 x 1, 4 x 1. Molting of pelage was noted in specimens obtained during July and August.

Specimens examined (179).--Mountain Lodge, North Rosillos Area, 5; 1.5 mi. S, 2.75 mi. W Mountain Lodge, North Rosillos Area, 51; 0.5 mi. N, 2 mi. W Mountain Lodge, North Rosillos Area, 1; 2.5 mi. N, 4 mi. W Mountain Lodge, North Rosillos Area, 2; 1.3 mi. N, 4 mi. W Mountain Lodge, North Rosillos Area, 4; 2.5 mi. W Mountain Lodge, North Rosillos Area, 3; Crazy Windmill, 0.7 mi. S, 3.2 mi. W Mountain Lodge, North Rosillos Area, 2; 1 mi. N, 0.5 mi. E Mountain Lodge, North Rosillos Area, 2; 1.5 mi. N, 0.5 mi. E Mountain Lodge, North Rosillos Area, 1; 1 mi. N, 0.5 mi. E Mountain Lodge, North Rosillos Area, 3; Headquarters, North Rosillos Area, 4; 0.25 mi. N Headquarters, North Rosillos Area, 2; 0.75 mi. N Headquarters, North Rosillos Area, 6; 1.25 mi. E Headquarters, North Rosillos Area, 14; 2.5 mi. N, 1 mi. W Headquarters, North Rosillos Area, 6; Buttrill Spring, North Rosillos Area, 3; 0.1 mi. W Airstrip Lodge, North Rosillos Area, 1; Key Place, North Rosillos Area, 1; 0.5 mi. S, 1.5 mi. E Key Place, North Rosillos Area, 7; 1.4 mi. S, 3.4 mi. E Key Place, North Rosillos Area, 5; Bone Spring, North Rosillos Area, 1; 4 mi. S Persimmon Gap Ranger Station, North Rosillos Area, 6; 4 mi. S, 0.5 mi. W Persimmon Gap Ranger Station, North Rosillos Area, 1; 4.25 mi. S, 1.25 mi. W Persimmon Gap Ranger Station, North Rosillos Area, 1; 4.25 mi. S, 1.75 mi. W Persimmon Gap Ranger Station, North Rosillos Area, 8; 5 mi. S, 2.5 mi. W Persimmon Gap Ranger Station, North Rosillos Area, 8; 2.2 mi. N, 7.25 mi. W Persimmon Gap Ranger Station, North Rosillos Area, 6; North Windmill, 1 mi. N, 7 mi. W Persimmon Gap Ranger Station, North Rosillos Area, 2; 2.2 mi. N, 6.3 mi. W Persimmon Gap Ranger Station, North Rosillos Area, 4; Coyote Tank, 0.25 mi. N, 6.6 mi. W Persimmon Gap Ranger Station, North Rosillos Area, 7; 4 mi. S, 0.5 mi. E Persimmon Gap Ranger Station, North Rosillos Area, 2; 4 mi. S, 1 mi. E Persimmon Gap Ranger Station, North Rosillos Area, 5; Southeast Windmill, 5.1 mi. S, 0.5 mi. E Persimmon Gap Ranger Station, North Rosillos Area, 3; Cedar Creek, 0.8 mi. S, 0.4 mi. E Twin Peaks, North Rosillos Area, 2.

Dipodomys merriami ambiguus Merriam, 1890

Merriam's kangaroo rat was associated most commonly with gravelly and rocky soils, but with a wide array of types of vegetation. Reproductive data gathered on this species included pregnant females taken in March (3 fetuses, crown-rump length, 12), May (2 fetuses, crown-rump length, 6), July (2 fetuses, crown-rump length, 15), August (2 fetuses, crown-rump length, 29; 4 fetuses, crown-rump length, 4; 3 fetuses, crown-rump length, 3), September (3 fetuses, crown-rump length, 17), October (2 fetuses, crown-rump length, 6), November (3 fetuses, crown-rump length, 10; 2 fetuses, crown-rump length, 14). Like females, males exhibited reproductive activity throughout most of the year; some measurements of testes ranged as follows: March (15 x 8; 10 x 4), July (11 x 6; 12 x 6), August (11 x 6), September (14 x 7; 10 x 5), October (16 x 8), November (11 x 6; 15 x 5). Young animals were collected in August. It is of interest that one of the young D.

merriami obtained in August had cheeks and the entire venter covered with yellow pollen. Seeds, as well as insects and green vegetation, are the major food items of this rat (Schmidly, 1977).

Specimens examined (88).--Mountain Lodge, North Rosillos Area, 5; 1.5 mi. S, 2.75 mi. W Mountain Lodge, North Rosillos Area, 18; 0.25 mi. N, 2.25 mi. W Mountain Lodge, HNorth Rosillos Area, 2; 1.3 mi. N, 4 mi. W Mountain Lodge, North Rosillos Area, 2; 2.5 mi. N, 4 mi. W Mountain Lodge, North Rosillos Area, 3; 0.3 mi. N, 2 mi. W Mountain Lodge, North Rosillos Area, 1; 1.1 mi. S, 3.8 mi. W Mountain Lodge, North Rosillos Area, 5; 1 mi. N, 0.5 mi. E Mountain Lodge, North Rosillos Area, 2; Headquarters, North Rosillos Area, 1; 2.5 mi. N, 1 mi. W Headquarters, North Rosillos Area, 2; 0.25 mi. N, 1 mi. E Headquarters, North Rosillos Area, 2; 1.25 mi E Headquarters, North Rosillos Area, 2; 0.5 mi. S, 1.5 mi. E Key Place, North Rosillos Area, 2; 1.4 mi. S, 3.4 mi. E Key Place, North Rosillos Area, 1; 4 mi. S Persimmon Gap Ranger Station, North Rosillos Area, 7; 4 mi. S, 0.5 mi. E Persimmon Gap Ranger Station, North Rosillos Area, 9; 4 mi. S, 1 mi. E Persimmon Gap Ranger Station, North Rosillos Area, 4; 4.25 mi. S, 1.25 mi. W Persimmon Gap Ranger Station, North Rosillos Area, 1; 5 mi. S, 2.5 mi. W Persimmon Gap Ranger Station, North Rosillos Area, 4; 4 mi. S, 0.5 mi. W Persimmon Gap Ranger Station, North Rosillos Area, 1; 2.2 mi. N, 7.25 mi. W Persimmon Gap Ranger Station, North Rosillos Area, 2; Coyote Tank, 0.25 mi. N, 6.6 mi. W Persimmon Gap Ranger Station, North Rosillos Area, 3; 2.2 mi. N, 6.3 mi. W Persimmon Gap Ranger Station, North Rosillos Area, 3; 0.1 mi. N, 1.5 mi. E Twin Peaks, North Rosillos Area, 2; Cedar Creek, 0.75 mi. E Twin Peaks, North Rosillos Area, 4.

Dipodomys ordii obscurus (J. A. Allen, 1903)

Ord's kangaroo rat was not common during the tenure of our work in the North Rosillos Area. This rat was encountered only on sandy soils associated with arroyos and roads. Females carrying fetuses were obtained only in August (3 fetuses, crown-rump length, 5; 3 fetuses, crown-rump length, 6; 2 fetuses, crown-rump length, 28). Ranges of measurements of testes of males taken were recorded as follows: May, 10 x 6; August, 6 x 4 - 12 x 7; September, 9 x 3 - 16 x 10. A young animal was taken in July. Some animals examined in August exhibited molting of pelage.

Specimens examined (20).--1.25 mi. S, 2.75 mi. W Mountain Lodge, North Rosillos Area, 10; 1.5 mi. S, 2.75 mi. W Mountain Lodge, North Rosillos Area, 3; 1.1 mi. S, 3.8 mi. W Mountain Lodge, North Rosillos Area, 2; 0.3 mi. N, 2 mi. W Mountain Lodge, North Rosillos Area, 1; 1.3 mi. N, 4 mi. W Mountain Lodge, North Rosillos Area, 2; 0.4 mi. N, 1.2 mi. E Key Place, North Rosillos Area, 1; Southeast Windmill, 5.1 mi. S, 0.5 mi. E Persimmon Gap Ranger Station, North Rosillos Area, 1.

Reithrodontomys megalotis megalotis (Baird, 1858)

The western harvest mouse was encountered rather sporadically in the area during this study. This rodent seems to prefer habitats in lowlands, with rank vegetation that provides a rather thick thatch of ground cover. Harvest mice were most common in areas adjacent to earthen tanks and catch basins where water accumulated periodically. Gravid females were recorded in March (3 fetuses, crown-rump length, 20), September (4 fetuses, crown-rump length, 4; 7 fetuses, crown-rump length, 3), and October (4 fetuses, crown-rump length, 4). Some measurements of testes of males were recorded as follows: March, 6 x 3, 8 x 3, 7 x 3, 4 x 2; June, 7 x 3, 7 x 4, 5 x 3; September, 10 x 5, 9 x 5, 5 x 2; October, 3 x 2, 4 x 2.

Specimens examined (30).--Buttrill Spring, North Rosillos Area, 1; Crazy Windmill, 0.7 mi. S, 3.2 mi. W Mountain Lodge, North Rosillos Area, 2; 0.25 mi. N, 1 mi. E Headquarters, North Rosillos Area, 3; 1.25 mi. E Headquarters, North Rosillos Area, 2; 0.75 mi. S Headquarters, North Rosillos Area, 1; North Windmill, 1 mi. N, 7 mi. W Persimmon Gap Ranger Station, North Rosillos Area, 4; 4.25 mi. S, 1.75 mi. W Persimmon Gap Ranger Station, HNorth Rosillos Area, 5; 2.2 mi. N, 6.3 mi. W Persimmon Gap Ranger Station, North Rosillos Area, 7; Coyote Tank, 0.25 mi. N, 6.6 mi. W Persimmon Gap Ranger Station, North Rosillos Area, 5.

Peromyscus boylii rowleyi (J. A. Allen, 1893)

The brush mouse was the most uncommon member of the genus Peromyscus that was encountered during this study. This species was found only in dense, brushy vegetation in the bottom of the ravine adjacent to the outflow from Buttrill Spring. An adult female had 3 fetuses (crown-rump length, 21). An adult male had testes that measured 13 x 7. One subadult exhibited molting of the pelage.

Specimens examined (5).--Buttrill Spring, North Rosillos Area, 5.

Peromyscus eremicus eremicus (Baird, 1858)

The cactus mouse was the most common of all members of the genus Peromyscus present in the study area. It seemed that the most preferred habitats of this species were slopes with large rocks, cacti, shrubs, and grasses. It is of interest to note that a large number of these mice were taken from within the man-made structure at Mountain Lodge. Information on reproduction of cactus mice includes the following: females collected in March contained from 2 to 4 fetuses (crown-rump length, 3 - 12); May, 3 fetuses (crown-rump length, 5); July, 2 fetuses (crown-rump length, 5 - 18); August, 2 to 4 fetuses (crown-rump length, 3 - 18); September, 2 to 3 fetuses (crown-rump length, 3 - 13); November, 3 to 4 fetuses (crown-rump length, 6 - 9). It seems that males were active reproductively in all months of the year; measurements of testes ranged from 8 x 3 to 10 x 6. Neonates were found in nests in March and August. Molting of pelage was observed in specimens obtained from August through October.

Specimens examined (106).--Mountain Lodge, North Rosillos Area, 39; 0.5 mi. N, 2 mi. W Mountain Lodge, North Rosillos Area, 1; 0.3 mi. N, 2 mi. W Mountain Lodge, North Rosillos Area, 6; 2.5 mi. N, 4 mi. W Mountain Lodge, North Rosillos Area, 5; 1.1 mi. S, 3.8 mi. W Mountain Lodge, North Rosillos Area, 3; 2 mi. S, 0.5 mi. W Mountain Lodge, North Rosillos Area, 3; Buttrill Spring, North Rosillos Area, 2; 0.1 mi. W Airport Lodge, North Rosillos Area, 7; Headquarters, North Rosillos Area, 1; 2.5 mi. N, 1 mi. W Headquarters, North Rosillos Area, 2; 0.5 mi. N, 1.4 mi. W Headquarters, North Rosillos Area, 2; 0.25 mi. N, 1 mi. E Headquarters, North Rosillos Area, 1; 0.5 mi. S, 1.5 mi. E Key Place, North Rosillos Area, 5; 4 mi. S Persimmon Gap Ranger Station, North Rosillos Area, 3; 4 mi. S, 0.5 mi. E Persimmon Gap Ranger Station, North Rosillos Area, 2; 4.25 mi. S, 1.25 mi. W Persimmon Gap Ranger Station, North Rosillos Area, 4; 2.2 mi. N, 7.25 mi. W Persimmon Gap Ranger Station, North Rosillos Area, 3; 2.2 mi. N, 6.3 mi. W Persimmon Gap Ranger Station, North Rosillos Area, 7; 0.1 mi. N, 1.5 mi. E Twin Peaks, North Rosillos Area, 7; Cedar Creek, 0.75 mi. E Twin Peaks, North Rosillos Area, 2; Cedar Creek, 0.8 mi. S, 0.4 mi. E Twin Peaks, North Rosillos Area, 1.

Peromyscus leucopus texanus (Woodhouse, 1853)

The white-footed mouse seems to occur most abundantly in lowland areas of creosote scrub, especially in places where vegetation (grasses, forbs) occurs among the creosote bushes. Pregnant females were examined in March (4 - 6 fetuses, crown-rump length, 3 - 19), May (3 - 6 fetuses, crown-rump length, 10 - 12), September (3 - 5 fetuses, crown-rump length, 11 - 16), and October (4 fetuses, crown-rump length, 4). Lactating females were taken in each of these months also. Males exhibited evidence of reproductive activity in all months of the year; measurements of testes ranged from 6 x 3 to 18 x 7.

Specimens examined (97).--0.3 mi. N, 2 mi. W Mountain Lodge, North Rosillos Area, 1; 1.25 mi. S, 2.75 mi. W Mountain Lodge, North Rosillos Area, 7; Crazy Windmill, 0.7 mi. S, 3.2 mi. W Mountain Lodge, North Rosillos Area, 8; 1.5 mi. S, 2.75 mi. W Mountain Lodge, HNorth Rosillos Area, 7; 1.1 mi. S, 3.8 mi. W Mountain Lodge, North Rosillos Area, 1; 1 mi. N, 0.5 mi. E Mountain Lodge, North Rosillos Area, 1; Buttrill Spring, North Rosillos Area, 6; 0.25 mi. N, 0.25 mi. E Key Place, North Rosillos Area, 1; 0.4 mi. N, 0.8 mi. E Key Place, North Rosillos Area, 2; 0.5 mi. S, 1.5 mi. E Key Place, North Rosillos Area, 3; 0.25 mi. N, 1 mi. E Headquarters, North Rosillos Area, 15; 1.25 mi. W Headquarters, North Rosillos Area, 1; 0.75 mi. S Headquarters, North Rosillos Area, 1; 1.25 mi. E Headquarters, North Rosillos Area, 7; 2.5 mi. N, 1 mi. W Headquarters, North Rosillos Area, 2; 4.25 mi. S, 1.75 mi. W Persimmon Gap Ranger Station, North Rosillos Area, 3; Southeast Windmill, 5.1 mi. S, 0.5 mi. E Persimmon Gap Ranger Station, North Rosillos Area, 2; 2.2 mi. N, 7.25 mi. W Persimmon Gap Ranger Station, North Rosillos Area, 5; North Windmill, 1 mi. N, 7 mi. W Persimmon Gap Ranger Station, HNorth Rosillos Area, 11; 2.2 mi. N, 6.3 mi. W Persimmon Gap Ranger Station, North Rosillos Area, 4; Coyote Tank, 0.25 mi. N, 6.6 mi. W Persimmon Gap Ranger Station, North Rosillos Area, 9.

Peromyscus maniculatus blandus Osgood, 1904

This deer mouse was taken in lowland habitats, usually in areas that were relatively open with regard to vegetation. Pregnant females were collected in March (4 fetuses, crown-rump length, 4), August (4 fetuses, crown-rump length, 5; 3 fetuses, crown-rump length, 8), and September (5 fetuses, crown-rump length, 6; 6 fetuses, crown-rump length, 4). Measurements of testes of males obtained in several months were as follows: March, 10 x 6, 9 x 4; June, 8 x 5; August, 11 x 4; October, 10 x 5.

Specimens examined (26).--2.5 mi. N, 4 mi. W Mountain Lodge, North Rosillos Area, 1; 0.7 mi. S, 3.2 mi. W Mountain Lodge, North Rosillos Area, 2; 1.25 mi. S, 2.75 mi. W Mountain Lodge, North Rosillos Area, 3; 1.1 mi. S, 3.8 mi. W Mountain Lodge, North Rosillos Area, 1; 1.4 mi. N, 3.4 mi. E Key Place, North Rosillos Area, 1; 0.25 mi. N, 1 mi. E Headquarters, HN North Rosillos Area, 1; 1.25 mi. E Headquarters, North Rosillos Area, 1; North Windmill, 1 mi. N, 7 mi. W Persimmon Gap Ranger Station, North Rosillos Area, 2; Coyote Tank, 0.25 mi. N, 6.6 mi. W Persimmon Gap Ranger Station, North Rosillos Area, 8; 2.2 mi. N, 6.3 mi. W Persimmon Gap Ranger Station, North Rosillos Area, 6.

Peromyscus pectoralis laceianus Bailey, 1906

The white-ankled mouse was collected on a rocky slope with fairly open vegetation above the outflow from Buttrill Spring, as well as on a rock-strewn area on Rosillos Peak. A female obtained in October contained 4 fetuses (crown-rump length, 4). Measurements of testes of males taken in May ranged from 6 x 3 to 11 x 5; animals examined in August had testes that ranged in measurements from 10 x 5 to 14 x 8.

Specimens examined (17).--Buttrill Spring, North Rosillos Area, 11; Rosillos Peak, North Rosillos Area, 6.

Onychomys arenicola arenicola Mearns, 1896

Schmidly (1977) reported that Mearns's grasshopper mouse was extremely rare in the Big Bend region, based, in part, on only a single specimen known at that time from Big Bend National Park. This mouse was reported to occur in lowland habitats in association with D. merriami (Schmidly, 1977). However, we also found this grasshopper mouse on sandy substrates, with open vegetation, in association with D. ordii. Pregnant females were captured in March (4 fetuses, crown-rump length, 6; 4 fetuses, crown-rump length, 12), July (4 fetuses, crown-rump length, 12), and August (4 fetuses, crown-rump length, 10). A lactating female was taken in September. Measurements of testes of males were recorded as follows: May, 9 x 5, 20 x 9; July, 11 x 6; September, 10 x 3, 7 x 3; November, 8 x 3. Young animals were observed in May, June, September, and November.

Specimens examined (13).--Mountain Lodge, North Rosillos Area, 1; 1.3 mi. N, 4 mi. W Mountain Lodge, North Rosillos Area, 1; 0.3 mi. N, 2 mi. W Mountain Lodge, North Rosillos Area, 2; 2.5 mi. N, 4 mi. W Mountain Lodge, North Rosillos Area, 1; 1.25 mi. S, 2.75 mi. W Mountain Lodge, North Rosillos Area, 1; 1.5 mi. S, 2.75 mi. W Mountain Lodge, North Rosillos Area, 3; Crazy Windmill, 0.7 mi. S, 3.2 mi. W Mountain Lodge, North Rosillos Area, 2; Coyote Tank, 2.5 mi. N, 4 mi. W Persimmon Gap Ranger Station, North Rosillos Area, 1; 0.1 mi. N, 1.5 mi. E Twin Peaks, North Rosillos Area, 1.

Sigmodon hispidus berlandieri Baird, 1855

The hispid cotton rat was found commonly in thick vegetation in lowland areas, especially in the vicinity of earthen tanks and catch basins where water accumulated periodically. However, this mammal also was taken occasionally in open creosote shrub areas, as well as in rocky habitats, such as at the base of Chalk Ridge. Gravid females were observed in March (7 fetuses, crown-rump length, 3), August (8 fetuses, crown-rump length, 10), and September (6 fetuses, crown-rump length, 15). It seems that males were reproductively active throughout most of the year; measurements of testes ranged from 8 x 4 in March to 30 x 12 in September.

Specimens examined (40).--Mountain Lodge, North Rosillos Area, 1; 1.25 mi. S, 2.75 mi. W Mountain Lodge, North Rosillos Area, 1; Crazy Windmill, 0.7 mi. S, 3.2 mi. W Mountain Lodge, 5; Buttrill Spring, North Rosillos Area, 4; 0.4 mi. N, 0.8 mi. E Key Place, North Rosillos Area, 1; 0.25 mi. N, 0.25 mi. E Key Place, North Rosillos Area, 2; 0.5 mi. S, 1.5 mi. E Key Place, North Rosillos Area, 1; 0.1 mi. W Airport Lodge, North Rosillos Area, 1; 0.75 mi. S Headquarters, North Rosillos Area, 1; 0.25 mi. S, 1 mi. E Headquarters, North Rosillos Area, 1; Coyote Tank, 0.25 mi. N, 6.6 mi. W Persimmon Gap Ranger Station, North Rosillos Area, 4; 1.4 mi. N, 4.6 mi. W Persimmon Gap Ranger Station, North Rosillos Area, 5; 2.2 mi. N, 7.25 mi. W Persimmon Gap Ranger Station, North Rosillos Area, 5; 4.25 mi. S, 1.75 mi. W Persimmon Gap Ranger Station, North Rosillos Area, 4; 5.1 mi. S, 0.5 mi. E Persimmon Gap Ranger Station, North Rosillos Area, 2; 2.2 mi. N, 6.3 mi. W Persimmon Gap Ranger Station, North Rosillos Area, 2.

Neotoma mexicana mexicana Baird, 1855

Only one specimen of the Mexican woodrat was obtained during this study. The animal was collected from among large rocks on Rosillos Peak.

Specimens examined (1).--Rosillos Peak, North Rosillos Area, 1.

Neotoma micropus canescens J. A. Allen, 1891

The southern plains woodrat is well known for its habits of constructing "houses" of piles of sticks, cacti, and debris (Schmidly, 1977). However, we did not observe any such "houses" during

our work in the area studied, although we searched constantly for these structures. These woodrats were associated mostly with creosote scrub-grassland habitats. Pregnant females were obtained in March (3 fetuses, crown-rump length, 30), May (3 fetuses, crown-rump length, 50), July (2 fetuses, crown-rump length, 25), and August (3 fetuses, crown-rump length, 40). A lactating female was taken in September. Some measurements of testes of adult males were recorded as follows: June, 18 x 8; July, 15 x 8, 15 x 10; August, 19 x 14, 17 x 8; September, 12 x 6; October, 15 x 6.

Specimens examined (26).--Mountain Lodge, North Rosillos Area, 1; 1.3 mi. N, 4 mi. W Mountain Lodge, North Rosillos Area, 7; 0.4 mi. N, 1 mi. W Mountain Lodge, North Rosillos Area, 1; 1.5 mi. S, 2.75 mi. W Mountain Lodge, North Rosillos Area, 3; 1.1 mi. S, 3.8 mi. W Mountain Lodge, North Rosillos Area, 2; 0.25 mi. N, 1 mi. E Headquarters, North Rosillos Area, 1; 0.25 mi. N, 0.25 mi. E Key Place, North Rosillos Area, 2; North Windmill, 1 mi. N, 7 mi. W Persimmon Gap Ranger Station, North Rosillos Area, 1; Coyote Tank, 0.25 mi. N, 6.6 mi. W Persimmon Gap Ranger Station, North Rosillos Area, 1; 2.2 mi. N, 6.3 mi. W Persimmon Gap Ranger Station, North Rosillos Area, 3; 4 mi. S Persimmon Gap Ranger Station, North Rosillos Area, 1; 4 mi. S, 0.5 mi. E Persimmon Gap Ranger Station, North Rosillos Area, 2; Southeast Windmill, 5.1 mi. S, 0.5 mi. E Persimmon Gap Ranger Station, North Rosillos Area, 1.

Erethizon dorsatum epixanthum Brandt, 1835

Schmidly (1977) thought that the porcupine was increasing in both geographic range and numbers of animals in the Trans-Pecos area. In December, we observed a porcupine along the road at a place near an earthen tank about 0.4 mi. N, 0.8 mi. E Key Place in the North Rosillos Area. No specimens of this taxa were collected or examined.

Canis latrans texensis Bailey, 1905

It seems apparent that coyotes are common in a variety of habitats throughout the study area. These carnivores seem abundant especially in the northern portion of North Rosillos Area, such as in the vicinity of North Windmill. However, these mammals can be heard almost nightly also from Mountain Lodge and along Chalk Ridge. No specimens of this taxa were collected or examined.

Urocyon cinereoargenteus scottii Mearns, 1891

Based on our observations of animals, it seems that common gray foxes are most abundant on the lower slopes north of the Rosillos Mountains. For example, animals were seen several times in the vicinity of Key Place and near Mountain Lodge. No specimens of this taxa were collected or examined.

Bassariscus astutus flavus Rhoads, 1894

Sign (feces) was noted in numerous areas, especially in the vicinity of Buttrill Spring and along Chalk Ridge. It is assumed that the ringtail is present throughout the study area in rocky habitats.

Specimens examined (1).--Mountain Lodge, North Rosillos Area, 1.

Procyon lotor mexicanus Baird, 1858

The unmistakable tracks of the common raccoon were seen in mud and sand along Cedar Creek at a place 0.75 mi. E Twin Peaks at the western boundary of the study area. It seems that this mammal may be more common along watersheds in the region than our observations indicate. No specimens of this taxa were collected or examined.

Mustela frenata neomexicana (Barber and Cockerell, 1898)

The long-tailed weasel is rare in the Trans-Pecos region of Texas (Schmidly, 1977); it occurs mostly in areas close to permanent water.

Specimens examined (1).--0.75 mi. N Mountain Lodge, North Rosillos Area, 1.

Mephitis mephitis varians Gray, 1837

Although it probably is the most common mustelid in Texas, the striped skunk is less numerous in parts of the Trans-Pecos region than elsewhere (Schmidly, 1977; Jones and Jones, 1992). It occurs usually in association with agricultural areas and in the vicinity of human habitations. We observed striped skunks only on two occasions during this study.

Specimens examined (1).--Key Place, North Rosillos Area, 1.

Felis concolor stanleyana Goldman, 1938

The mountain lion is common in some parts of Big Bend National Park and the Trans-Pecos area (Waid, 1990), as well as in some other parts of Texas (Bigony, 1993). We observed fresh tracks of a large and small animal (perhaps a female and cub) in mud of a temporary pond at a place 4.25 mi. S and 1.75 mi. W Persimmon Gap Ranger Station. No specimens of this taxa were collected or examined.

Lynx rufus texensis J. A. Allen, 1895

Bobcats are fairly common in the Trans-Pecos region (Schmidly, 1977), especially in the vicinity of rocky areas. We observed only two of these mammals during this study; both were seen along the road, one about 3 mi. E Mountain Lodge, and the other near the western boundary of the North Rosillos Area. No specimens of this taxa were collected or examined.

Tayassu tajacu angulatus (Cope, 1889)

Herds of the collared peccary are common in the study area. Signs (tracks, feces, rooted areas) and animals have been seen throughout the lowland portions of the North Rosillos Area. It seems that these animals are concentrated especially in arroyos and near sources of water in the area.

Specimens examined (1).--1.5 mi. N, 0.75 mi. E Mountain Lodge, North Rosillos Area, 1.

Cervus elaphus nelsoni Bailey, 1935

An antlered male was observed in the area just to the northwest of Mountain Lodge. In addition, a cow and calf were seen in Nine Point Draw just outside of the western boundary of the study area. It seems that the elk observed in the North Rosillos Area may have wandered from the groups of these animals that have been introduced into either the Guadalupe or Davis mountains in recent times. No specimens of this taxa were collected or examined.

Odocoileus hemionus crooki (Mearns, 1897)

It seems that mule deer are common in the North Rosillos Area. Animals (bucks, does, fawns) have been observed on numerous occasions in all habitats of the area, especially on the lower slopes and lowlands adjacent to the Rosillos Mountains. Signs (tracks, feces) and these animals seem common especially adjacent to sources of water. No specimens of this taxa were collected or examined.

Antilocapra americana mexicana Merriam, 1901

The creosote bush-grassland flats in the eastern portion of the study area seemingly are the preferred habitats of pronghorn in the North Rosillos Area. Pairs and small groups of up to six animals have been seen occasionally in this region. No specimens of this taxa were collected or examined.

Ammotragus lervia

A male Barbary sheep has been observed in the high country south of Mountain Lodge and in the vicinity of Rosillos Peak. Signs (tracks, feces) of this introduced species (native of North Africa) have been observed above Buttrill Spring. According to Traweek (1985), the total population of Barbary sheep in the wild in Texas exceeds 5000 animals. No specimens of this taxa were collected or examined.

Discussion

Because of some earlier reports on the bats of Big Bend National Park (Easterla, 1973) and adjacent areas (Schmidly, 1977; 1991) we originally thought that the bat fauna of the North Rosillos Area might be more diverse than we found it to be during this study. However, we are well aware that the presence and abundance of bats are influenced by the availability of roosting sites (day, night), abundance of food items, and permanent sources of water (Findley, 1993). We have observed that some roosting places for bats, especially man-made structures, in the area have been impacted greatly by human disturbances. Vandalism and collapse of some of these structures have reduced the numbers of roosting sites available for these important species of mammals.

Based on some previous reports of mammals in the Trans-Pecos area in general and in Big Bend National Park in particular (Schmidly, 1977), we were pleased to find a considerable diversity in the overall mammalian fauna of the North Rosillos Area. Schmidly (1977) listed a total of 96 species of mammals that may have inhabited the Trans-Pecos area within the past 100 years. We found a total of 42 species that occur currently in the North Rosillos Area area of Big Bend National Park. It is certain that more field research in the area will result in the discovery of additional species of mammals that inhabit the North Rosillos Area addition to Big Bend National Park. Although elk and Barbary sheep were observed in the area, the paucity of introduced mammals is rather interesting. For example, it is noteworthy that no examples of either Mus or Rattus were obtained during the time of our intensive sampling of mammals in the area.

Some interesting trends in the composition of the mammalian fauna of the North Rosillos Area area were noted during the course of our study. For example, during the first year of field work, specimens of Sigmodon and Peromyscus were difficult to obtain anywhere. However, these particular kinds of small mammals seemed relatively abundant in appropriate habitats during subsequent years of sampling. Incidentally, it is our perception that many species of mammals have become more abundant and widespread during the tenure of our studies in the North Rosillos Area.

Based on some of the aforementioned comments in the accounts of species, we were impressed with the levels of wariness exhibited by some mammals, such as desert cottontails and members of the family Sciuridae, for example. These habits of wariness by these mammals could be the results of pressures from predators, such as hawks, owls, and snakes. Also, we noted throughout our study that casings of expended cartridges were common along the main road through the North Rosillos Area.

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Table 12. Checklist of Mammals of the North Rosillos Area, Big Bend National Park.

Order Chiroptera -- Bats

Family Vespertilionidae (vespertilionid bats)

Myotis yumanensis (Yuma myotis)
Pipistrellus hesperus (western pipistrelle)
Eptesicus fuscus (big brown bat)
Lasiurus cinereus (hoary bat)
Plecotus townsendii (Townsend's big-eared bat)
Antrozous pallidus (pallid bat)

Family Molossidae (free-tailed bats)

Tadarida brasiliensis (Brazilian free-tailed bat)

Order Lagomorpha -- Lagomorphs

Family Leporidae (hares and rabbits)

Sylvilagus audubonii (desert cottontail)
Lepus californicus (black-tailed jackrabbit)

Order Rodentia -- Rodents

Family Sciuridae (squirrels and allies)

Ammospermophilus interpres (Texas antelope squirrel)
Spermophilus spilosoma (spotted ground squirrel)
Spermophilus variegatus (rock squirrel)

Family Geomyidae (pocket gophers)

Cratogeomys castanops (yellow-faced pocket gopher)

Family Heteromyidae (pocket mice and kangaroo rats)

Perognathus flavus (silky pocket mouse)
Chaetodipus nelsoni (Nelson's pocket mouse)
Chaetodipus penicillatus (desert pocket mouse)
Dipodomys merriami (Merriam's kangaroo rat)
Dipodomys ordii (Ord's kangaroo rat)

Family Muridae (mice and rats)

Reithrodontomys megalotis (western harvest mouse)

Peromyscus boylii (brush mouse)

Peromyscus eremicus (cactus mouse)

Peromyscus leucopus (white-footed mouse)

Peromyscus maniculatus (deer mouse)

Peromyscus pectoralis (white-ankled mouse)

Onychomys arenicola (Mearns' grasshopper mouse)

Sigmodon hispidus (hispid cotton rat)

Neotoma mexicana (Mexican woodrat)

Neotoma micropus (southern plains woodrat)

Family Erethizontidae (New World porcupines)

Erethizon dorsatum (porcupine)

Order Carnivora -- Carnivores

Family Canidae (canids)

Canis latrans (coyote)

Urocyon cinereoargenteus (common gray fox)

Family Procyonidae (procyonids)

Bassariscus astutus (ringtail)

Procyon lotor (common raccoon)

Family Mustelidae (mustelids)

Mustela frenata (long-tailed weasel)

Mephitis mephitis (striped skunk)

Family Felidae (cats)

Felis concolor (mountain lion)

Lynx rufus (bobcat)

Order Artiodactyla -- Even-toed Ungulates

Family Dicotylidae (peccaries)

Tayassu tajacu (collared peccary)

Family Cervidae (cervids)

Cervus elaphus (elk)

Odocoileus hemionus (mule deer)

Family Antilocapridae (pronghorn)

Antilocapra americana (pronghorn)

Family Bovidae (bovids)

Ammotragus lervia (Barbary sheep)

Table 13. Gazetteer of Geographic Localities, North Rosillos Area, Big Bend National Park (UTM coordinates). UTM coordinates recorded in this report are a single number, six digits long. To obtain the northing, take the first three digits of the UTM of interest, add 32 to the front and 00 to the back. To obtain the easting, take the second three digits of the UTM of interest, add 6 to the front and 00 to the back. For example, a UTM of 763761 equals a northing of 3276300 and an easting of 676100.

1. Mountain Lodge, North Rosillos Area (674705)
2. 1 mi. N Mountain Lodge, North Rosillos Area (677722)
3. 0.75 mi. N Mountain Lodge, North Rosillos Area (676717)
4. 0.25 mi. N, 2.25 mi. W Mountain Lodge, North Rosillos Area (638711)
5. 0.5 mi. N, 2 mi. W Mountain Lodge, North Rosillos Area (642714)
6. 0.3 mi. N, 2 mi. W Mountain Lodge, North Rosillos Area (642711)
7. 0.5 mi. N, 1.5 mi. W Mountain Lodge, North Rosillos Area (651713)
8. 0.5 mi. N, 0.1 mi. W Mountain Lodge, North Rosillos Area (674714)
9. 1.75 mi. N, 2.75 mi. E Mountain Lodge, North Rosillos Area (718735)
10. 2.1 mi. N, 3.2 mi. E Mountain Lodge, North Rosillos Area (725739)
11. 1.75 mi. N, 1.5 mi. E Mountain Lodge, North Rosillos Area (698734)
12. 1.5 mi. N, 2 mi. E Mountain Lodge, North Rosillos Area (706731)
13. 1.5 mi. N, 0.5 mi. E Mountain Lodge, North Rosillos Area (680730)
14. 1.5 mi. N, 0.75 mi. E Mountain Lodge, North Rosillos Area (687729)
15. 1.25 mi. N, 1 mi. E Mountain Lodge, North Rosillos Area (691726)
16. 1 mi. N, 0.5 mi. E Mountain Lodge, North Rosillos Area (683722)
17. 2.5 mi. W Mountain Lodge, North Rosillos Area (634705)
18. 0.5 mi. S Mountain Lodge, North Rosillos Area (677697)
19. 0.5 mi. S, 2.5 mi. W Mountain Lodge, North Rosillos Area (634696)
20. 1 mi. S, 2.5 mi. W Mountain Lodge, North Rosillos Area (633689)
21. 1.25 mi. S, 2.5 mi. W Mountain Lodge, North Rosillos Area (631685)
22. 1.25 mi. S, 2.75 mi. W Mountain Lodge, North Rosillos Area (629685)
23. 1.5 mi. S, 2.75 mi. W Mountain Lodge, North Rosillos Area (629681)
24. 2 mi. S, 0.5 mi. E Mountain Lodge, North Rosillos Area (682672)
25. 1.3 mi. N Mountain Lodge, North Rosillos Area (676727)
26. 1.5 mi. N, 0.4 mi. E Mountain Lodge, North Rosillos Area (681731)
27. 0.4 mi. N, 1 mi. W Mountain Lodge, North Rosillos Area (685712)
28. 2.5 mi. N, 4 mi. W Mountain Lodge, North Rosillos Area (611744)
29. 1.3 mi. N, 4 mi. W Mountain Lodge, North Rosillos Area (612724)
30. 1.1 mi. S, 3.8 mi. W Mountain Lodge, North Rosillos Area (611687)
31. Key Place, North Rosillos Area (692724)
32. 1.5 mi. N, 2.6 mi. E Key Place, North Rosillos Area (739749)
33. 0.4 mi. N, 0.8 mi. E Key Place, North Rosillos Area (705733)
34. 0.4 mi. N, 1.2 mi. E Key Place, North Rosillos Area (712731)
35. 0.25 mi. N Key Place, North Rosillos Area (692729)
36. 0.25 mi. N, 0.25 mi. E Key Place, North Rosillos Area (694731)

37. 0.5 mi. S, 1.5 mi. E Key Place, North Rosillos Area (716718)
38. 0.6 mi. S, 1.5 mi. E Key Place, North Rosillos Area (716716)
39. Headquarters, North Rosillos Area (689751)
40. 2.5 mi. N, 1 mi. W Headquarters, North Rosillos Area (673792)
41. 0.25 mi. N, 1 mi. W Headquarters, North Rosillos Area (672755)
42. 0.25 mi. N, 1 mi. E Headquarters, North Rosillos Area (704755)
43. 1.25 mi. W Headquarters, North Rosillos Area (668751)
44. 1.25 mi. E Headquarters, North Rosillos Area (709751)
45. 0.75 mi. S Headquarters, North Rosillos Area (688739)
46. 0.5 mi. N, 1.4 mi. W Headquarters, North Rosillos Area (665760)
47. 0.1 mi. W Airstrip Lodge, North Rosillos Area (677745)
48. 2.2 mi. N, 7.25 mi. W Persimmon Gap Ranger Station, North Rosillos Area (651856)
49. 4 mi. S Persimmon Gap Ranger Station, North Rosillos Area (768759)
50. 4 mi. S, 0.5 mi. E Persimmon Gap Ranger Station, North Rosillos Area (776758)
51. 4 mi. S, 1 mi. E Persimmon Gap Ranger Station, North Rosillos Area (783763)
52. 4 mi. S, 2 mi. W Persimmon Gap Ranger Station, North Rosillos Area (738749)
53. 4 mi. S, 0.5 mi. W Persimmon Gap Ranger Station, North Rosillos Area (759758)
54. 4.25 mi. S, 1.75 mi W Persimmon Gap Ranger Station, North Rosillos Area (741753)
55. 4.25 mi. S, 1.25 mi. W Persimmon Gap Ranger Station, North Rosillos Area (748754)
56. 5 mi. S, 2.5 mi. W Persimmon Gap Ranger Station, North Rosillos Area (728741)
57. 2.2 mi. N, 6.3 mi. W Persimmon Gap Ranger Station, North Rosillos Area (664857)
58. Coyote Tank, 0.25 mi. N, 6.6 mi. W Persimmon Gap Ranger Station, North Rosillos Area (662827)
59. Northwest Windmill, 1 mi. N, 7 mi. W Persimmon Gap Ranger Station, North Rosillos Area (656840)
60. Crazy Windmill, 0.7 mi. S, 3.2 mi. W Mountain Lodge, North Rosillos Area (623693)
61. Southeast Windmill, 5.1 mi S, 0.5 mi. E Persimmon Gap Ranger Station, North Rosillos Area (779741)
62. Buttrill Spring, North Rosillos Area (673693-5)
63. 0.1 mi. N, 1.5 mi. E Twin Peaks, North Rosillos Area (625777)
64. Cedar Creek, 0.75 mi. E Twin Peaks, North Rosillos Area (612776)
65. Cedar Creek, 0.8 mi. S, 0.4 mi. E Twin Peaks, North Rosillos Area (606763)
66. Rosillos Peak, North Rosillos Area (701678)

CHAPTER 9

MANAGEMENT RECOMMENDATIONS

1. The present high biodiversity of the North Rosillos Area of Big Bend National Park is due to the availability of permanent water from springs and windmills, and seasonal water from spreader dams constructed across drainages by the previous landowners. Although we recognize that windmills and spreader dams are not natural components to the area, it is our suggestion that at least one windmill and a spreader dam be maintained in good working order. The working windmill in the lower end of Concha Canyon (UTM 716716), and the spreader dam at UTM 742754 already represent important water sources for many species that require the presence of open water. Having these two sources of open water available will allow for better spacing of the avifauna and of the larger mammals. The open tanks formed by the spreader dams in wet years and seasons undoubtedly are very important breeding localities for the yellow mud turtle. Both these localities, in conjunction with No Name Spring (or Boracho Spring, a very low volume spring) are located on the east side of the Rosillos Mountains. Buttrill and Alamo springs are sufficient watering sources for the western side of the Rosillos Mountains.

2. Restrict visitation to the North Rosillos Area, especially to Buttrill Springs. We all agree that the Buttrill Springs area is very fragile and could be adversely impacted by too many visitors over a period of time. Perhaps this could be modeled after the plan in which Guadalupe Mountains National Park handles visitation to McKittrick Canyon.

3. Build and maintain a trail into the Buttrill Springs area to confine visitors to a designated path. Without a designated trail each visitor must find his own way through the dense growth to reach the springs. This will ultimately result in many trails criss-crossing the area.

4. If visitation to Buttrill Springs is to be permitted there should be a designated parking area well below the springs. An area just off the county road might be considered.

5. Maintain at least one of the old ranch buildings as a research station for visiting scientists working in the northern end of Big Bend National Park. The present hunting lodge would be in an ideal location in terms of water availability, but it would require considerable investment in repair to bring it to a really usable facility.

6. Oppose the creation of a paved Farm-to-Market road that would follow the present county road around the northern end of the Rosillos Mountains. There has been a suggestion of such by residents in southern Brewster County to connect U. S. highway 385 to Texas highway 118 by a paved road. Such a highway, if built, could be constructed further north to make a southern connection between the two present highways.

7. Establish presence of authority by either regular patrols or preferably by the establishment of a management position at the North Rosillos Area in order to develop some controls over the presence of people and corresponding numerous unauthorized uses in the area.

8. Ultimately develop a trail to the top of the Rosillos Mountains. It is a rigorous climb by any route. Many visitors to the area are going to want to climb the mountain and a single, safe route should be available. This will lessen the impact on other canyons, springs, and natural resources in the montane habitat.

9. Develop a comprehensive, long-term management plan for the North Rosillos Area addition to Big Bend National Park. Make this information available in order to establish enhanced public relations with the local community.

10. Develop a comprehensive, long-term plan for continued field research and monitoring of the biological diversity of the wildlife that exists in the North Rosillos Area and adjacent areas of the Park.

Appendix 1. List of plants, parasitic hymenopter, herptiles, birds, and mammals recorded in each of 13 vegetative community types of the North Rosillos Area Expansion Area.

RIPARIAN

a. Plants

Adiantum capillus-veneris
Baccharis salicifolia
Carya illinoensis
Celtis reticulata
Cephalanthus occidentalis
Chilopsis linearis
Cynodon dactylon
Cyperus elegans
Eleocharis macrostachya
Fallugia paradoxa
Hymenoclea monogyra
Juncus nodosus
Juncus torreyi
Lobelia cardinalis
Mimulus glabratus
Populus X acuminata
 ssp. mesetae
Populus deltoides
 ssp. wislizenii
Populus fremontii
Prosopis glandulosa
 var. torreyana
Prunus persica
Quercus grisea
Quercus sinuata
 var. sinuata
Salix gooddingii
Salix interior
Setaria leucopila
Tamarix chinensis
Thelypteris ovata
 var. lindheimeri
Toxicodendron radicans
Typha latifolia
Ungnadia speciosa
Verbena racemosa
Vitis arizonica

Xanthium strumarium
Xanthium spinosum

b. Insects

Family Braconidae:

Acrophasmus 1
Adelius 2
Adelius 3
Adelius sp. 1
Agathis discolor (Cresson)
Aleiodes ms name
Aleiodes scrutator (Say)
Aleiodes sp. 1
Aleiodes sp. 2
Aleiodes sp. 4
Aleiodes sp. 7
Aleiodes sp. 9
Aleiodes sp. 13
Anapryxia 1
Apanteles 1
Apanteles 2
Apanteles 3
Apanteles 5
Apanteles 6
Apanteles 7
Apanteles 8
Apanteles 9
Apanteles 10
Apanteles 11
Apanteles 16
Apanteles 17
Apanteles 19
Apanteles 22
Apanteles 24
Aphaereta pallipes (Say)
Aphidius 1
Aspilota 1
Aspilota 2
Aspilota 4
Aspilota 7
Aspilota 8
Aspilota 9

Aspilota 10
Aspilota 11
Blacus 2
Blacus 3
Blacus 4
Bracon 5
Bracon 6
Bracon 7
Bracon 8
Bracon 9
Bracon 12
Bracon 13
Bracon 14
Bracon sp. 1
Bracon sp. 2
Bracon sp. 3
Bracon 10
Cardiochiles 5
Cardiochiles 6
Chelonus 1
Chelonus 7
Chelonus 8
Chelonus 10
Chelonus 12
Chelonus 13
Chelonus 15
Chelonus 17
Chelonus 18
Chelonus 19
Chelonus 20
Chelonus 21
Chorebus 1
Chorebus 2
Chorebus 3
Clinocentrus 2
Clinocentrus 3
Clinocentrus 4
Coccygidium sp. 1
Cotesia 1
Cotesia 4
Cremnops vulgaris (Cresson)
Diaeretiella rapae (M' Intosh)
Digonogastra 6
Digonogastra 8

Digonogastra sp. 1
Digonogastra sp. 3
Digonogastra sp. 5
Digonogastra 10
Diospilus sp. 1
Ecphylus 1
Glyptapanteles 1
Glyptapanteles 3
Glyptapanteles 4
Glyptocolastes 1
Gnamptodon 2
Habrobracon gelechiae (Ashmead)
Habrobracon sp. 2
Hecabolus 1
Heterospilus 1
Heterospilus 3
Heterospilus 5
Heterospilus 7
Heterospilus 9
Heterospilus 11
Heterospilus 12
Heterospilus 14
Heterospilus prosopidis Viereck
Homolobus truncator (Say)
Hormius 2
Hormius 3
Hormius 5
Hormius 9
Hormius 10
Hormius 11
Leiophron sp. 1
Leluthia sp. 1
Lysiphlebus testaceipes (Cresson)
Macrocentrus 1
Meteorus 4
Meteorus 5
Meteorus laphygmae (Viereck)
Meteorus versicolor
Microctonus 2
Microctonus 3
Microctonus 4
Microctonus 6
Microctonus 7
Microctonus 8

Microctonus 9
Microctonus 10
Microctonus 11
Microctonus 12
Microctonus 13
Microplitis 1
Microplitis 2
Microplitis 3
Microplitis 4
Microplitis 5
Microplitis 9
Microplitis 10
Microplitis 11
Microplitis 12
Microtypus 1
Microtypus 3
Mirax 2
Mirax 3
Mirax 4
Mirax sp. 1
Monolexis 1
Myosoma sp. 1
Myosoma sp. 2
Odontocolon 1
Opius 1
Opius 5
Opius 7
Opius 10
Opius 11
Opius 12
Opius 13
Opius 16
Opius 17
Opius 19
Opius 20
Opius 24
Opius 26
Opius 27
Opius 29
Opius 30
Opius 30
Opius 31
Opius 32
Orgilus 1

Orgilus 3
 Orgilus 5
 Orgilus 8
 Pambolus 1
 Pambolus 3
 Pambolus 3
 Parahormius 1
 Parahormius 2
 Parahormius 3
 Parahormius 4
 Parahormius 5
 Parahormius 6
 Parahormius 7
 Parahormius 9
 Paroligoneurus 1
 Polystenidea 2
 Polystenidea 4
 Protomicroplitis sp.
 Pseudapanteles sp.
 Pseudognaptodon 3
 Rasivalva sp.
 Rhaconotus 3
 Rhaconotus 4
 Rhaconotus 5
 Rhaconotus 9
 Rhaconotus 10
 Rhaconotus 17
 Stenocorse sp. 1
 Stiropius 1
 Stiropius 2
 Stiropius 3
 Syntretus sp.
 Undetermined genus
 Urosigalphus 2

Family Encyrtidae:

Achalcerinys ?
 Aenasius sp. 1
 Aenasius sp. 3
 Aenasius sp. 7
 Aenasius sp. 12
 Aenasius sp. 13
 Agarwalencyrtus sp. 3

Anagyrus sp. 2
Anagyrus sp. 6
Anagyrus sp. 10
Anagyrus sp. 24
Anagyrus sp. 31
Aphycus sp. 7
Apoanagyrus sp. 4
Apoanagyrus sp. 5
Apoanagyrus sp. 10
Apoanagyrus sp. 18
Apoanagyrus sp. 21
Apoanagyrus sp. 22
Apoanagyrus sp. 24
Apoanagyrus sp. 25
Avetianella sp. 2
Avetianella sp. 4
Blastothrix sp. nr. *longipennis*
Blepyrus sp. 1
Blepyrus sp. 5
Bothriothorax sp. 4
Cerapterocerus sp. 2
Ceraproceroideus sp. 5
Ceraproceroideus sp. 5
Cerchysius sp. 1
Cheiloneurus sp. 7
Cheiloneurus sp. 9
Cheiloneurus sp. 15
Cheiloneurus sp. 27
Copidosoma celaenae
Copidosoma floridanum
Copidosoma lymani
Copidosoma n. sp. 18
Discodes sp. 2
Epiencyrtus sp. 1
Forcipestricis sp. 1
Formicencyrtus thoreauini Gir.
Ginsiana sp. 3
Gyranusoidea sp. 7
Homalotyloidea sp. 2
Homalotyloidea sp. 3
Homalotyloidea sp. 4
Homalotylus sp. 1
Homalotylus sp. 4
Homalotylus sp. 9

Isodromus iceryae
Lamennasia sp. 1
Lamennasia sp. 2
Meromyzobia sp. 1
Meromyzobia sp. 2
Metaphycus sp. 1
Metaphycus sp. 3
Metaphycus sp. 6
Metaphycus sp. 8
Metaphycus sp. 35
Metaphycus sp. 38
Metaphycus sp. 39
Metaphycus ? sp. 1
Microterys sp. 4
Mucrencyrtus sp. 3
Neocharitopus sp. 1
Ooencyrtus sp. 3
Ooencyrtus sp. 4
Ooencyrtus sp. 7
Ooencyrtus sp. 26
Ooencyrtus sp. 27
Ooencyrtus sp. 28
Parablastothrix
Parablastothrix n. sp. 1
Paratetracnemoidea
Pentelicus sp. 1
Pheidoloxenus sp. 2
Plagiomerus sp. 1
Prochiloneurus sp. 1
Prochiloneurus sp. 2
Pseudaphycus sp. 1
Pseudaphycus sp. 5
Pseudaphycus sp. 6
Pseudaphycus sp. 7
Pseudaphycus sp. 12
Pseudectroma sp. 1
Pseudleptomastix sp. 3
Pseudleptomastix sp. 5
Pseudleptomastix sp. 6
Psyllaephagus nr. yaseeni
Psyllaephagus sp. 1
Psyllaephagus sp. 2
Psyllaephagus sp. 12
Rhopus sp. 2

Rhopus sp. 4
Rhytidothorax sp. 8
Syrphophagus
Tetracnemus sp. 4
Tetracnemus sp. 5
Tetracnemus sp. 6
Trjapitzinellus sp. 1
Unknown Genus 2
Zaomma sp. 5
Zarhopalus sp. 2

c. Herptiles

Rana berlandieri
Eumeces tetragrammus
Bufo punctatus
Thamnophis marcianus
Kinosternon flavescens
Thamnophis cyrtopsis
Sceloporus undulatus
Agkistrodon contortrix
Urosaurus ornatus
Kinosternon flavescens

d. Birds

Accipiter striatus
Callipepla gambelii
Zenaida asiatica
Zenaida macroura
Regulus calendula
Polioptila caerulea
Catharus guttatus
Mimus polyglottus
Toxostoma dorsale
Vireo gilvus
Vermivora celata
Dendroica coronata
Dendroica townsendi
Icteria virens
Piranga rubra
Piranga ludoviciana
Icterus spurius

e. Mammals

Chaetodipus penicillatus
Reithrodontomys megalotis
Peromyscus boylii
Peromyscus leucopus
Sigmodon hispidus
Neotoma micropus
Erethizon dorsatum
Canis latrans
Urocyon cinereoargenteus
Procyon lotor
Mustela frenata
Mephitis mephitis
Felis concolor
Lynx rufus
Tayassu tajacu

OAK WOODLAND

a. Plants

Agave havardiana
Agave lechuguilla
Aloysia wrightii
Aristida purpurea
Aristida ternipes
Artemisia ludoviciana
Astragalus mollissimus
 var. earlii
Berberis trifoliolata
Bothriochloa barbinodis
Bouteloua curtipendula
Bouteloua gracilis
Bouvaridia ternifolia
Bothriochloa laguroides
 var. torreyana
Brickellia cylindracea
Castilleja integra
Celtis reticulata
Centaurea americana
Cheilanthes sinuata
Cheilanthes tomentosum Commelina erecta
 var. angustifolia

Coryphantha tuberculosa
 var. *varicolor*
Dalea frutescens
Dasyilirion leiophyllum
Digitaria californica
Echeveria strictiflora
Echinocereus viridiflorus
 var. *russanthus*
Eriogonum tenellum
Eriogonum jamesii
Fallugia paradoxa
Fraxinus cuspidata
Juniperus erythrocarpa
Juniperus pinchotii
Lycurus phleoides
Machaeranthera scrabella
Mimosa biuncifera
Muhlenbergia emersleyi
Nicotiana trigonophylla
Nolina erumpens
Opuntia imbricata
Opuntia engelmannii (=O. *phaeacantha* var. *discata*)
Orobanche cooperi
Panicum bulbosum
Panicum obtusum
Penstemon barbatus
 var. *torreyi*
Phacelia congesta
Phlox mesoleuca
Phoradendron tomentosum
Phoradendron coryae
Pinus cembroides
Prunus havardii
Rhus virens
 var. *virens*
Quercus cf. *gambelii*
Quercus grisea
Quercus mohriana X *Q. grisea*
Quercus pungens
 var. *pungens*
Quercus pungens
 var. *vaseyana*
Quercus turbinella
 (or *Q. turbinella* X *Q. grisea*)

Selaginella peruviana
Senecio douglasii
 var. longilobus
Senna durangensis
Setaria leucopila
Setcreasea brevifolia
Silene laciniata
Viguiera stenoloba
Yucca treculeana
Zexmenia brevifolia

b. Insects

Family Braconidae:

Allorhogas 1
Apanteles 2
Apanteles 5
Apanteles 7
Chelonus 21
Digonogastra 8
Digonogastra 9
Digonogastra 10
Gnamptodon 1
Hormius 7
New Genus
Parahormius 1
Parahormius 6
Rhaconotus 8
Urosigalphus 2

Family Encyrtidae:

Agarwalencyrtus sp. 3
Ooencyrtus sp. 3

c. Herptiles

Urosaurus ornatus
Pituophis melanoleucus

d. Birds

Tyrannus vociferus

Salpinctes obsoletus
Regulus calendula
Polioptila caerulea
Mimus polyglottus
Vermivora celata
Dendroica coronata
Pipilo fuscus

e. Mammals

Spermophilus variegatus
Chaetodipus nelsoni
Peromyscus boylii
Peromyscus eremicus
Peromyscus pectoralis
Neotoma mexicana
Erethizon dorsatum
Urocyon cinereoargenteus
Bassariscus astutus
Mustela frenata
Mephitis mephitis
Felis concolor
Lynx rufus

CANYON SCRUB

a. Plants

Acacia roemeriana
Acleisanthes longiflora
Amelanchier denticulata
Bouvardia ternifolia
Carlowrightia linearifolia
Castilleja nervata
Celtis pallida
Cheilanthes sinuata
Cheilanthes tomentosa
Cheilanthes wrightii
Chilopsis linearis
Cissus incisa
Clematis drummondii
Dalea frutescens
Dasyilirion leiophyllum
Diospyros texana

Echinocereus stramineus
Eriogonum jamesii
Eriogonum tenellum
Eysenhardtia texana
Fallugia paradoxa
Fendlera rupicola
Ferocactus hamatacanthus
Forestiera angustifolia
Fraxinus greggii
Guaiacum angustifolium
Janusia gracilis
Juglans microcarpa
Matelea producta
Matelea reticulata
Maurandya antirrhyniflora
Mimosa biuncifera
Morus microphylla
Notholaena standleyi
Oenothera brachycarpa
Opuntia leptocaulis
Pellea intermedia
Penstemon havardii
Phaseolus angustissimus
Portulacca pilosa
Rhus virens
Rhus trilobata
Rivina humilis
Pellea intermedia
Perityle aglossa
Perityle parryi
Perityle vaseyi
Prunus havardii
Sapindus saponaria
 var. drummondii
Senna lindheimeriana
Setcreasea brevifolia
Silene laciniata
Tecoma stans
Ungnadia speciosa
Zexmania brevifolia

b. Insects

Family Braconidae:

Agathis gibbosus (Say)
Aleiodes ms name
Aleiodes scrutator (Say)
Aleiodes sp. 14
Allorhogas 1
Apanteles 2
Apanteles 4
Apanteles 5
Apanteles 7
Apanteles 10
Atanycolus sp. 1
Bracon 4
Bracon 5
Bracon 6
Bracon 15
Bracon sp. 2
Bracon sp. 3
Cardiochiles 2
Cardiochiles 5
Chelonus 1
Chelonus 6
Chelonus 7
Chelonus 10
Chelonus 12
Chelonus 16
Chelonus 17
Chelonus 18
Chelonus 21
Chelonus 23
Clinocentrus 2
Coccygidium sp. 1
Cotesia 4
Digonogastra 8
Digonogastra 9
Digonogastra 10
Glyptapanteles 2
Glyptapanteles 4
Gnamptodon 1
Habrobracon gelechia (Ashmead)
Heterospilus 1

Homolobus truncator (Say)
Hormius 3
Hormius 7
Meteorus laphygmae (Viereck)
Microplitis 11
Microplitis 12
Mirax sp. 1
New Genus
Opius 3
Opius 4
Opius 9
Opius 18
Opius 20
Opius 28
Opius 29
Opius 30
Opius 31
Parahormius 1
Parahormius 2
Parahormius 3
Parahormius 6
Parahormius 8
Parahormius 9
Polystenidea 2
Polystenidea 4
Pseudognaptodon 1
Rhaconotus 8
Rhaconotus 9
Rhaconotus 12
Rhaconotus 16
Rhaconotus sp. 2
Undetermined genus
Urosigalphus 2

Family Encyrtidae:

Aenasius sp. 1
Aenasius sp. 3
Aenasius sp. 12
Agarwalencyrtus sp. 3
Ageniaspis
Anagyrus sp. 2
Anagyrus sp. 10
Anagyrus sp. 21

Apoanagyrus sp. 4
Apoanagyrus sp. 12
Apoanagyrus sp. 18
Apoanagyrus sp. 20
Apoanagyrus sp. 21
Apoanagyrus sp. 22
Apoanagyrus sp. 24
Cerapterocerus sp. 2
Ceraptroceroideus sp 3
Ceraptroceroideus sp 5
Ceraptroceroideus sp 6
Ceraptroceroideus sp. 3
Charitopus sp. 1
Cheiloneurus sp. 6
Cheiloneurus sp. 9
Copidosoma floridanum
Discodes sp. 2
Ectromatopsis sp. 1
Epanusia xerophila
Formicencyrtus sp. 1
Formicencyrtus thoreauini Gir.
Gyranusoidea sp. 7
Gyranusoidea sp. 8
Homalotyloidea sp. 3
Homalotylus sp. 4
Homalotylus sp. 11
Iceromyia sp 1
Lamennasia sp. 1
Lamennasia sp. 2
Mahencyrtus sp. 1
Mayridia sp. 1
Meromyzobia sp. 1
Metaphycus sp. 1
Metaphycus sp. 8
Metaphycus sp. 34
Metaphycus sp. 39
Microterys sp. 4
Microterys sp. 7
Mucencyrtus sp. 1
Mucencyrtus sp. 3
Neocharitopus sp. 1
Ooencyrtus sp. 3
Ooencyrtus sp. 4
Ooencyrtus sp. 7

Parablatticida
Prochiloneurus sp. 2
Pseudaphycus sp. 1
Pseudaphycus sp. 6
Pseudaphycus sp. 7
Pseudaphycus sp. 12
Pseudectroma sp. 1
Pseudleptomastix sp. 3
Pseudleptomastix sp. 6
Psyllaephagus sp. 1
Psyllaephagus sp. 13
Rhopus sp. 2
Rhopus sp. 4
Rhytidothorax sp. 8
Stemmatosteres
Syrphophagus
Tachardiobius sp. 1
Tetracnemus sp. 4
Tetracnemus sp. 4
Tetracnemus sp. 5
Tetracnemus sp. 7
Tetracnemus sp. 8
Unknown Genus 1
Zaomma sp. 5
Zarhopalus sp. 2

c. Herptiles

Sceloporus undulatus
Crotalus atrox
Sceloporus merriami
Cnemidophorus septemvittatus
Crotalus molossus
Crotalus lepidus
Masticophis flagellum

d. Birds

Accipiter cooperii
Buteo jamaicensis
Callipepla gambelii
Zenaida asiatica
Zenaida macroura
Bubo virginianus

Micrathene whitneyi
Contopus sordidulus
Salpinctes obsoletus
Regulus calendula
Polioptila caerulea
Catharus guttatus
Mimus polyglottus
Toxostoma dorsale
Vermivora celata
Dendroica coronata
Icteria virens
Pipilo fuscus
Melospiza melodia
Melospiza lincolnii
Zonotrichia leucophrys

e. Mammals

Spermophilus variegatus
Chaetodipus nelsoni
Peromyscus boylii
Peromyscus eremicus
Peromyscus pectoralis
Neotoma mexicana
Erethizon dorsatum
Urocyon cinereoargenteus
Bassariscus astutus
Mustela frenata
Mephitis mephitis
Felis concolor
Lynx rufus

MOUNTAIN SCRUB

a. Plants

Acacia constricta
Agave lechuguilla
Artemisia ludoviciana
Bouteloua barbata
Bouteloua curtipendula
Bouteloua gracilis
Brickellia californica
Bommeria hispida

Bouvardia ternifolia
Cercocarpus montanus
 var. paucidentatus
Cheilanthes sinuata
Cheilanthes tomentosum
Cheilanthes wrightii
Cissus incisa
Convovulus arvensis
Coryphantha tuberculosa
 var. tuberculosa
Dalea frutescens
Dasylirion leiophyllum
Echinocereus viridiflorus
 var. russanthus
Eriogonum jamesii
Fallugia paradoxa
Fendlera rupicola
Forestiera angustifolia
Fouquieria splendens
Gnaphalium chilense
Guaiacum angustifolium
Gymnosperma glutinosum
Heteropogon contortus
Heterotheca fulcrata
Hymenoxys scaposa
Ibervillea lindheimeri
Ibervillea tenuisecta
Ipomoea cristulata
Machaeranthera scabrella
Mammalaria heyderi
 var. meiacantha
Nolina erumpens
Polygala longa
Polygala macradenia
Portulacca pilosa
Prunus havardii
Quercus pungens
 var. pungens
Quercus pungens
 var. vaseyana
Ribes aureum
Sedum wrightii
Selaginella peruviana
Tecoma stans

Tragia ramosa
Ungnadia speciosa
Viguiera stenoloba

c. Herptiles

Bufo punctatus
Sceloporus undulatus
Sceloporus merriami
Urosaurus ornatus
Cnemidophorus septemvittatus
Masticophis flagellum
Pituophis melanoleucus
Crotalus atrox
Crotalus molossus
Crotalus lepidus

d. Birds

Buteo jamaicensis
Zenaida macroura
Bubo virginianus
Regulus calendula
Dendroica coronata

e. Mammals

Spermophilus variegatus
Chaetodipus nelsoni
Peromyscus boylii
Peromyscus pectoralis
Neotoma mexicana
Erethizon dorsatum
Urocyon cinereoargenteus
Bassariscus astutus
Mustela frenata
Mephitis mephitis
Felis concolor
Lynx rufus
Ammotragus lervia

GRAMA GRASSLAND

a. Plants

Agave lechuguilla
Acacia constricta
Aristida adscensionis
Aristida purpurea
Bothriochloa laguroides
 var. torreyana
Bouteloua curtipendula
Bouteloua gracilis
Cheilanthes sinuata
Cheilanthes tomentosum
Dasylirion leiophyllum
Echinocereus viridiflorus
 var. russanthus
Fallugia paradoxa
Heteropogon contortus
Hymenoclea monogyra
Iva ambrosiaefolia
Juniperus pinchotii
Larrea tridentata
Lycurus phleoides
Machaeranthera scabrella
Mammillaria heyderi
 var. meiacantha
Nolina erumpens
Opuntia imbricata
Opuntia phaeacantha
 var. major
Portulacca pilosa
Selaginella peruviana
Verbena neomexicana
Viguiera stenoloba
Yucca elata

b. Insects

Family Braconidae:

Agathis gibbosus (Say)
Aleiodes ferrugineus Enderlein
Apanteles 11

Apanteles 12
Apanteles 15
Aspilota 3
Aspilota 4
Bracon sp. 2
Bracon sp. 3
Chelonus 2
Chelonus 3
Chelonus 9
Chelonus 10
Chelonus 11
Chelonus 22
Habrobracon gelechia (Ashmead)
Habrobracon sp. 2
Hormius 8
Microctonus 5
Microplitis 2
Opius 3
Opius 25
Opius 34
Parahormius 2
Praon sp.

Family Encyrtidae:

Aenasius sp. 1
Anagyrus sp. 2
Anagyrus sp. 30
Apoanagyrus sp. 4
Apoanagyrus sp. 8
Apoanagyrus sp. 11
Apoanagyrus sp. 21
Apoanagyrus sp. 24
Blepyrus sp. 1
Bothriothorax sp. 4
Cerapterocerus sp. 2
Cerapterocerus sp. 4
Cerchysius sp. 1
Charitopus sp. 1
Cheiloneurus sp. 6
Cheiloneurus sp. 9
Copidosoma floridanum
Discodes sp. 1
Discodes sp. 2

Ginsiana sp. 5
 Gyranusoidea sp. 7
 Habrolepopteryx sp. 2
 Mahencyrtus sp. 1
 Meromyzobia sp. 1
 Metaphycus sp. 1
 Metaphycus sp. 8
 Metaphycus sp. 34
 Metaphycus sp. 35
 Metaphycus sp. 38
 Metaphycus sp. 39
 Microterys sp. 4
 Mucrencyrtus sp. 1
 Mucrencyrtus sp. 3
 Mucrencyrtus sp. 4
 Neocharitopus sp. 1
 New Genus 45, sp. 1
 Ooencyrtus sp. 3
 Ooencyrtus sp. 4
 Ooencyrtus sp. 7
 Pheidoloxenus sp. 1
 Pseudaphycus sp. 1
 Pseudaphycus sp. 3
 Pseudaphycus sp. 6
 Pseudaphycus sp. 7
 Pseudaphycus sp. 11
 Psyllaephagus nr. yaseeni
 Rhopus sp. 2
 Rhytidothorax sp. 8
 Shenahetia sp. 2
 Syrphophagus
 Tetracnemus sp. 4
 Tetracnemus sp. 5
 Tetracnemus sp. 6
 Tetracnemus sp. 7

c. **Herptiles**

Cnemidophorus septemvittatus
 Pituophis melanoleucus

d. Birds

Circus cyaneus
Regulus calendula

e. Mammals

Sylvilagus audubonii
Lepus californicus
Spermophilus variegatus
Chaetodipus nelsoni
Chaetodipus penicillatus
Reithrodontomys megalotis
Peromyscus leucopus
Peromyscus maniculatus
Sigmodon hispidus
Neotoma micropus
Urocyon cinereoargenteus
Mustela frenata
Mephitis mephitis
Felis concolor
Lynx rufus
Odocoileus hemionus
Antilocapra americana

SEMIDESERT GRASSLAND (IGNEOUS PHASE)

a. Plants

Acacia neovernicosa
Adolphia infesta
Agave lechuguilla
Aloysia gratissima
Aloysia wrightii
Amaranthus palmeri
Aristida glauca
Aristida ternipes
Aristida adensionis
Asclepias asperula
Astragalus mollissimus
 var. *earlii*
Astragalus nuttallianus
Atriplex canescens
Berberis trifoliata

Boerhaavia gracillima
Bouteloua curtipendula
Bouteloua eriopoda
Bouteloua ramosa
Bouteloua trifida
Calliandra conferta
Cathastecum erectum
Convolvulus arvensis
Croton dioicus
Dalea formosa
Dalea neomexicana
Dalea jamesii
Digitaria californica
Diospyros texana
Echinocactus horizonthalonius
Echinocereus dubius
Echinocereus stramineus
Echinocereus viridiflorus
 var. novum
Echinocereus viridiflorus
 var. russanthus
Eneapogon desvauxii
Ephedra aspera
Erigeron modestus
Eriogonum tenellum
Euphorbia cinerescens
Fallugia paradoxa
Ferocactus hamatacanthus
Flourensia cernua
Froelichia arizonica
Gallardia pinnatifida
Gilia stewartii
Guaiacum angustifolium
Hibiscus denudatus
Hilaria mutica
Houstonia nigricans
Koeberlinia spinosa
Krameria grayii
Lappula redzowskii
Larrea tridentata
Leptoloma cognatum
Lesquerella purpurea
Lotus oroboides
Lupinus havardii

Lycurus phleoides
 Machaeranthera pinnatifida
 Macrosiphonia lanuginosa
 Melampodium leucanthum
 Mimosa biuncifera
 Mimosa borealis
 Muhlenbergia porteri
 Muhlenbergia arenacea
 Opuntia imbricata
 Opuntia leptocaulis
 Opuntia phaeacantha
 var. discata
 Opuntia phaeacantha
 var. major
 Opuntia schottii
 var. grahamii
 Opuntia violacea
 var. macrocentra
 Parthenium confertum
 Parthenium incanum
 Plantago patagonica
 Prosopos glandulosa
 var. toreyana
 Rhus microphylla
 Schoenocrambe linearifolium
 Senecio douglassii
 var. longilobus
 Senna durangensis
 Sida abutifolia
 Spharalcea angustifolia
 Thymophylla acerosa
 Thymophylla pentachaeta
 Tidestromia lanuginosa
 Tiquilia canescens
 Tiquilia greggii
 Tragia ramosa
 Tridens muticus
 Verbena neomexicana
 Verbena wrightii
 Yucca elata
 Yucca rostrata
 Yucca treculeana
 Zinnia acerosa

b. Insects

Family Braconidae:

Aphidius 2
Bracon 4
Bracon 6
Chelonus 4
Chelonus 21
Habrobracon 3
Habrobracon gelechia (Ashmead)
Heterospilus 2
Parahormius 4
Polystenidea 1
Rhaconotus 12
Rhaconotus 13
Rhaconotus 15
Rhaconotus 16
Rhaconotus sp. 1
Vipio 2

Family Encyrtidae:

Aenasius sp. 3
Anagyrus sp. 2
Apoanagyrus sp. 18
Apoanagyrus sp. 21
Apoanagyrus sp. 22
Apoanagyrus sp. 24
Cerapterocerus sp. 2
Cerapterocerus sp. 4
Charitopus sp. 1
Cheiloneurus sp. 9
Copidosoma floridanum
Copidosoma lymani
Discodes sp. 2
Epanusia xerophila
Gyranusoidea sp. 7
Gyranusoidea sp. 10
Habrolepopteryx sp. 1
Habrolepopteryx sp. 2
Homalotyloidea sp. 3
Homalotylus sp. 11
Meromyzobia sp. 1

Meromyzobia sp. 2
Meromyzobia sp. 9
Mucroncyrtus sp. 3
Neocharitopus sp. 1
New Genus 5, sp. 2
Ooencyrtus sp. 3
Ooencyrtus sp. 7
Pheidoloxenus sp. 2
Pseudaphycus sp. 6
Psyllaephagus sp. 1
Psyllaephagus sp. 2
Rhopus sp. 4
Tetracnemus sp. 4
Tetracnemus sp. 5
Zarhopalus sp. 2

c. Herptiles

Scaphiopus couchi
Cnemidophorus septemvittatus
Bufo punctatus
Coleonyx brevis
Sceloporus undulatus
Sceloporus merriami
Urosaurus ornatus
Cnemidophorus inornatus
Masticophis flagellum
Bogertophis subocularis
Hypsiglena torquata
Agkistrodon contortrix
Crotalus atrox
Crotalus molossus

d. Birds

Circus cyaneus
Buteo jamaicensis
Falco sparverius
Callipepla squamata
Zenaida macroura
Geococcyx californianus
Asio flammeus
Chordeiles acutipennis
Chordeiles minor

Phaenoptilus nuttallii
Regulus calendula
Mimus polyglottus
Anthus spinoletta
Lanius ludovicianus
Vermivora celata
Dendroica coronata
Sturnella magna
Sturnella neglecta

e. Mammals

Sylvilagus audubonii
Lepus californicus
Ammospermophilus interpres
Spermophilus variegatus
Perognathus flavus
Chaetodipus nelsoni
Dipodomys merriami
Peromyscus eremicus
Peromyscus maniculatus
Peromyscus pectoralis
Neotoma micropus
Canis latrans
Urocyon cinereoargenteus
Bassariscus astutus
Mustela frenata
Mephitis mephitis
Felis concolor
Lynx rufus

MOSAIC

a. Plants

Abutilon parvulum
Agave lechuguilla
Ancistrocactus uncinatus
Ariocarpus fissuratus
Baileya multiradiata
Boerhaavia intermedia
Boerhaavia linearifolia
Bouteloua gracilis
Bouteloua ramosa

Bouteloua trifida
Caesalpinia parryi
Calliandra conferta
Castilleja integra
Cathestecum erectum
Cheilanthes integerrima
Cheilanthes sinuata
Cheilanthes tomentosa
Condalia ericoides
Condalia viridis
Cyphomeris gypsophiloides
Dalea formosa
Dasylirion leiophyllum
Dimorphocarpa wislizenii
Echinocactus horizonthilonius
Echinocereus dasyacanthus
Echinocereus stramineus
Echinocereus dubius
Ephedra aspera
Ephedra trifurca
Erigeron modestus
Eriogonum rotundifolium
Erodium texanum
Eucnide bartonioides
Fallugia paradoxa
Flourensia cernua
Fouquieria splendens
Galium proliferum
Gaura boquillensis
Gaura suffulta
 var. nealleyi
Guaiacum angustifolium
Heteropogon contortus
Hibiscus denudatus
Hilaria mutica
Houstonia nigricans
Jatropha dioica
Kraymeria grayii
Kraymeria parvifolia
Larrea tridentata
Leucophyllum frutescens
Macrosiphonia lanuginosa
Mammillaria lasiacantha
Melampodium leucanthum

Menodora scabra
 var. longiflora
Menodora scabra
 var. scabra
Mirabilis coahuilensis
Nama hispidum
Neolloydia conoidea
Opuntia leptocaulis
Opuntia phaeacantha
 var. major
Opuntia phaeacantha
 var. discata
Opuntia schottii
 var. grahammii
Opuntia violacea
 var. macrocentra
Parthenium argentatum
Parthenium confertum
Parthenium incanum
Pectis papposa
Polygala scoparioides
Psilostrophe tagetina
Selaginella lepidophylla
Selinocarpus angustifolius
Stenandrium barbatum
Streptanthus carinatus
Streptanthus platycarpus
Tecoma stans
Thamnosia texana
Thelesperma megapotamicum
Thymophylla acerosa
Tiquilia canascens
Tiquilia greggii
Tiquilia hispidissima
Verbena pumila
Viguiera stenoloba
Yucca elata
Yucca rostrata
Yucca treculeana

b. Insects

Family Braconidae:

Apanteles 1
Apanteles 2
Apanteles 3
Apanteles 9
Apanteles 23
Bracon 4
Bracon 6
Bracon 11
Bracon sp. 2
Cardiochiles 5
Cremnops 3
Habrobracon 3
Habrobracon gelechia (Ashmead)
Heterospilus 1
Hormius 3
Hormius 4
Microplitis 1
Microplitis 2
Opius 12
Opius 20
Opius 21
Opius 29
Parahormius 1
Parahormius 6
Pholetesor sp.
Polystenidea 3
Polystenidea 4
Rhaconotus 6
Rhaconotus 7
Rhaconotus 10
Rhaconotus 16
Urosigalphus 1
Vipio 2

Family Encyrtidae:

Aenasius sp. 1
Aenasius sp. 3
Anagyrus sp. 2
Anagyrus sp. 8

Anagyrus sp. 29
Aphycus sp. 7
Apoanagyrus sp. 21
Apoanagyrus sp. 22
Apoanagyrus sp. 24
Blepyrus sp. 5
Cheiloneurus sp. 9
Copidosoma floridanum
Habrolepopteryx sp. 2
Homalotyloidea sp. 3
Homalotylus sp. 11
Lamennasia sp. 1
Meromyzobia sp. 1
Metaphycus sp. 8
Ooencyrtus sp. 4
Ooencyrtus sp. 7
Ooencyrtus sp. 26
Pseudaphycus sp. 1
Pseudaphycus sp. 6
Rhopus sp. 4
Stemmatosteres sp. 2
Tetracnemus sp. 4

c. Herptiles

Scaphiopus couchi
Bufo punctatus
Bufo speciosus
Kinosternon flavescens
Coleonyx brevis
Crotaphytus collaris
Cophosaurus texanus
Uta stansburiana
Cnemidophorus inornatus
Cnemidophorus marmoratus
Masticophis flagellum
Bogertophis subocularis
Crotalus atrox
Crotalus scutulatus
Crotalus molossus

d. Birds

Buteo jamaicensis

Falco sparverius
Callipepla squamata
Zenaida macroura
Geococcyx californianus
Phaenoptilus nuttallii
Picoides scalaris
Corvus corax
Campylorhynchus brunneicapillus
Regulus calendula
Polioptila caerulea
Polioptila melanura
Mimus polyglottus
Toxostoma curvirostre
Lanius ludovicianus
Vermivora celata
Dendroica coronata
Cardinalis sinuatus
Guiraca caerulea
Aimophila cassinii
Spizella passerina
Spizella pallida
Spizella breweri
Pooecetes gramineus
Amphispiza bilineata
Calamospiza melanocorys
Molothrus ater
Carduelis psaltria

e. Mammals

Sylvilagus audubonii
Lepus californicus
Ammospermophilus interpres
Spermophilus spilosoma
Spermophilus variegatus
Cratogeomys catanops
Perognathus flavus
Chaetodipus nelsoni
Chaetodipus penicillatus
Dipodomys merriami
Dipodomys ordii
Reithrodontomys megalotis
Peromyscus eremicus
Peromyscus leucopus

Peromyscus maniculatus
Onychomys arenicola
Sigmodon hispidus
Neotoma micropus
Erethizon dorsatum
Canis latrans
Urocyon cinereoargenteus
Bassariscus astutus
Mustela frenata
Mephitis mephitis
Felis concolor
Lynx rufus
Tayassu tajacu
Odocoileus hemionus
Antilocapra americana

MIXED SHRUB AND SUCCULENT SCRUB

a. Plants

Agave lechuguilla
Berberis trifoliata
Bernardia obovata
Castilleja integra
Chrysactinia mexicana
Coryphantha tuberculosa
 var. *tuberculosa*
Dasyilirion leiophyllum
Echinocereus dasyacanthus
Echinocereus stramineus
Fallugia paradoxa
Fouquieria splendens
Galium proliferum
Guaiacum angustifolium
Hedeoma nanum
Hibiscus coulteri
Houstonia nigricans
Jatropha dioica
Lappula redzowskii
Larrea tridentata
Leucophyllum minus
Menodora longiflora
Neolloydea conoidea
Oligomeris linifolia

Opuntia leptocaulis
Opuntia phaeacantha
 var. *major*
Opuntia rufida
Opuntia schottii
 var. *grahammii*
Opuntia violacea
 var. *macrocentra*
Polygala macradenia
Polygala scoparioides
Selaginella lepidophylla
Tecoma stans
Thamnosia texana
Tiquilia greggii
Tiquilia hispidissima
Yucca elata
Yucca rostrata
Yucca treculeana

b. Insects

Family Braconidae:

Apanteles 9
Apanteles 21
Apanteles 23
Bracon sp. 2
Cardiochiles 5
Habrobracon gelechia (Ashmead)
Opius 2
Opius 29
Parahormius 1
Rhaconotus 17
Urosigalphus 1
Vipio 2

Family Encyrtidae:

Apoanagyrus sp. 4
Apoanagyrus sp. 21
Cheiloneurus sp. 9
Copidosoma floridanum
Formicencyrtus sp. 1
Gyranusoidea sp. 7

Homalotyloidea sp. 3
Lamennasia sp. 1
Metaphycus sp. 1
Metaphycus sp. 40
Ooencyrtus sp. 7
Prochiloneurus sp. 2
Pseudaphycus sp. 1

c. Herptiles

Scaphiopus couchi
Bufo punctatus
Bufo debilis
Coleonyx brevis
Crotaphytus collaris
Cophosaurus texanus
Sceloporus undulatus
Sceloporus merriami
Cnemidophorus inornatus
Cnemidophorus marmoratus
Cnemidophorus septemvittatus
Eumeces obsoletus
Masticophis flagellum
Bogertophis subocularis
Elaphe guttata
Pituophis melanoleucus
Hypsiglena torquata
Crotalus atrox
Crotalis lepidus

d. Birds

Buteo jamaicensis
Falco sparverius
Callipepla squamata
Zenaida macroura
Geococcyx californianus
Tyto alba
Phaenoptilus nuttallii
Campylorhynchus
 brunneicapillus
Salpinctes obsoletus
Polioptila caerulea
Polioptila melanura

Mimus polyglottus
Dendroica coronata
Aimophila ruficeps
Amphispiza bilineata

e. Mammals

Sylvilagus audubonii
Lepus californicus
Ammospermophilus interpres
Spermophilus variegatus
Perognathus flavus
Chaetodipus nelsoni
Chaetodipus penicillatus
Dipodomys merriami
Reithrodontomys megalotis
Peromyscus eremicus
Peromyscus leucopus
Peromyscus maniculatus
Onychomys arenicola
Neotoma micropus
Canis latrans
Urocyon cinereoargenteus
Bassariscus astutus
Mephitis mephitis
Mustela frenata
Felis concolor
Lynx rufus
Tayassu tajacu
Odocoileus hemionus

ARROYO SCRUB

a. Plants

Acacia neovernicosa
Acacia schottii
Acacia greggii
Adolphia infesta
Argemone chisosensis
Astragalus mollissmus
 var. earlii
Bahia absinthifolia
Baileya multiradiata

Berberis trifoliata
Calylophus hartwegii
Centaurea americana
Cevallia sinuata
Clematis drummondii
Chamaesaracha coronopis
Chamaesaracha sordida
Cheilanthes wrightii
Chilopsis linearis
Clematis drummondii
Corydalis aurea
 var. occidentalis
Cryptantha crassisepala
Dalea formosa
Dalea frutescens
Dalea neomexicana
Dasylirion leiophyllum
Diospyros texana
Eriogonum tenellum
Fallugia paradoxa
Gallardia pinnatifida
Gaura suffulta
 var. nealleyi
Gnaphalium chilense
Guaiacum angustifolium
Kallstroemia grandiflora
Koeberlinia spinosa
Larrea tridentata
Lepidium montanum
Lesquerella purpurea
Lupinus havardii
Lycium berlandieri
Lycium puberulum
Maurandya antirrhiniflora
Mimosa biuncifera
Mimosa emoryana
Nama havardii
Nama hispidum
Nerisyrenia camporum
Notholaena sinuata
Nicotiana trigonophylla
Oenothera tetraptera
Parthenium incanum
Penstemon havardii

Phacelia congesta
Phacelia coerulea
Phaseolus acutifolius
Plantago hookeriana
Plantago patagonica
Prosopis glandulosa
 var. torreyana
Psilostrophe tagetina
Rhus microphylla
Senna lindheimeriana
Solanum eleagnifolium
Trixis californica
Verbena neomexicana
Verbena pumila
Verbena wrightii
Viguiera stenoloba
Ziziphus obtusifolia

b. Insects

Family Braconidae:

Agathirsia nigricauda (Viereck)
Agathis gibbosus (Say)
Aleiodes ferrugineus Enderlein
Aleiodes ms name
Aleiodes scrutator (Say)
Aleiodes sp. 1
Aleiodes sp. 3
Aleiodes sp. 5
Aleiodes sp. 7
Aleiodes sp. 8
Aleiodes sp. 12
Apanteles 1
Apanteles 2
Apanteles 3
Apanteles 5
Apanteles 7
Apanteles 8
Apanteles 9
Apanteles 14
Aspilota 6
Aspilota 9
Blacus 1

Blacus 4
 Bracon 4
 Bracon 6
 Bracon 13
 Bracon 16
 Bracon sp. 1
 Bracon sp. 2
 Cardiochiles 2
 Cardiochiles 3
 Cardiochiles 4
 Cardiochiles 5
 Cardiochiles sp. 1
 Chelonus 1
 Chelonus 10
 Chelonus 12
 Chelonus 21
 Chorebus 3
 Clinocentrus 1
 Clinocentrus 2
 Coccygidium sp. 1
 Cotesia 1
 Cotesia 3
 Cotesia 4
 Cremnops 1
 Cremnops 2
 Cremnops vulgaris (Cresson)
 Digonogastra 6
 Digonogastra 8
 Digonogastra sp. 1
 Digonogastra sp. 2
 Digonogastra sp. 3
 Diospilus sp. 1
 Ecphylus 2
 Euphoriella sp.
 Genus Unknown
 Glyptapanteles 4
 Habrobracon gelechia (Ashmead)
 Heterospilus 1
 Heterospilus 2
 Heterospilus 10
 Heterospilus 13
 Homolobus truncator (Say)
 Hormius 1
 Hormius 2

Hormius 3
Hormius 5
Hormius 6
Illidops sp.
Macrocentrus 1
Meteorus 3
Microctonus 1
Microctonus 8
Microplitis 1
Microplitis 2
Microplitis 3
Microplitis 6
Microplitis 7
Microplitis 8
Microtypus 1
Mirax 3
Myosoma sp. 1
Nealiolus 1
Nealiolus 2
Opius 6
Opius 8
Opius 12
Opius 13
Opius 23
Opius 29
Opius 33
Orgilus 2
Orgilus 5
Orgilus 7
Pambolus 2
Parahormius 1
Parahormius 2
Parahormius 3
Parahormius 6
Polystenidea 4
Rasivalva sp.
Rhaconotus 10
Rhaconotus 13
Rhaconotus 14
Rhaconotus 15
Rhaconotus 16
Rhaconotus sp. 1
Stenocorse sp. 1
Tetrasphaeropyx 1

Tetrasphaeropyx 2
Urosigalphus

Family Encyrtidae:

Aenasius sp. 3
Aenasius sp. 12
Anagyrus sp. 2
Apoanagyrus sp. 4
Apoanagyrus sp. 18
Apoanagyrus sp. 22
Apoanagyrus sp. 24
Charitopus sp. 1
Cheiloneurus sp. 9
Copidosoma floridanum
Discodes sp. 2
Gyranusoidea sp. 10
Habrolepopteryx sp. 2
Homalotyloidea sp. 3
Lamennasia sp. 1
Lamennasia sp. 2
Meromyzobia sp. 1
Metaphycus sp. 8
Neocharitopus sp. 1
New Genus 5, sp. 2
Ooencyrtus sp. 3
Ooencyrtus sp. 4
Ooencyrtus sp. 7
Ooencyrtus sp. 26
Ooencyrtus sp. 27
Pheidoloxenus sp. 2
Prochiloneurus sp. 2
Pseudleptomastix sp. 6
Psyllaephagus sp. 2
Rhopus sp. 4
Rhytidothorax sp. 8
Tetracnemus sp. 4
Tetracnemus sp. 5
Zarhopalus sp. 2

c. Herptiles

Scaphiopus couchi
Bufo punctatus

Bufo speciosus
Kinosternon flavescens
Coleonyx brevis
Crotaphytus collaris
Cophosaurus texanus
Sceloporus magister
Sceloporus merriami
Sceloporus undulatus
Urosaurus ornatus
Uta stansburiana
Cnemidophorus inornatus
Cnemidophorus marmoratus
Cnemidophorus septemvittatus
Diadophis punctatus
Masticophis flagellum
Masticophis taeniatus
Salvadora deserticola
Bogertophis subocularis
Elaphe guttata
Rhinocheilus lecontei
Hypsiglena torquata
Agkistrodon contortrix
Crotalus atrox
Crotalus scutulatus
Crotalis molossus
Crotalis lepidus

d. Birds

Buteo jamaicensis
Falco sparverius
Zenaida macroura
Geococcyx californianus
Bubo virginianus
Picoides scalaris
Sayornis saya
Myiarchus cinerascens
Auriparus flaviceps
Campylorhynchus
 brunneicapillus
Regulus calendula
Polioptila caerulea
Polioptila melanura
Catharus guttatus

Mimus polyglottus
Lanius ludovicianus
Vermivora celata
Dendroica coronata
Oporornis tolmei
Wilsonia pusilla
Icteria virens
Cardinalis sinuatus
Guiraca caerulea
Passerina versicolor
Pooecetes gramineus
Calamospiza melanocorys
Melospiza lincolni
Zonotrichia leucophrys
Molothrus ater
Carduelis psaltria

e. Mammals

Sylvilagus audubonii
Lepus californicus
Spermophilus spilosoma
Cratogeomys catanops
Perognathus flavus
Chaetodipus penicillatus
Dipodomys merriami
Dipodomys ordii
Reithrodontomys megalotis
Peromyscus eremicus
Peromyscus leucopus
Peromyscus maniculatus
Onychomys arenicola
Sigmodon hispidus
Neotoma micropus
Canis latrans
Urocyon cinereoargenteus
Mustela frenata
Mephitis mephitis
Felis concolor
Lynx rufus
Tayassu tajacu

MESQUITE SCRUB

a. Plants

Acacia neovernicosa
Acacia greggii
Adolphia infesta
Aloysia gratissima
Aloysia wrightii
Atriplex canescens
Buddleja scordioides
Celtis pallida
Chamaesaracha coronopus
Chamaesaracha sordida
Chenopodium album
Chloris virgata
Convovulus equitans
Euphorbia serpyllifolia
Guaiacum angustifolium
Gutierrezia microcephala
Gutierrezia sarothrae
Helianthus annuus
Heliotropium glabriusculum
Hilaria mutica
Kalstroemia grandiflora
Koeberlinia spinosa
Larrea tridentata
Lantana macropoda
Leptoloma cognatum
Lycium puberulum
Machaeranthera tanacetifolia
Maurandya antirrhiniflora
Nama havardii
Nerisyrenia camporum
Nyctaginia capitata
Pappophorum bicolor
Prosopis glandulosa
 var. *torreyana*
Rhus microphylla
Salsola kali
Salvia reflexa
Solanum eleagnifolium
Sorghum halapense
Verbena wrightii

Xanthium spinosum
Yucca elata
Yucca treculeana

b. Insects

Family Braconidae:

Aleiodes ferrugineus Enderlein
Aleiodes sp. 1
Aleiodes sp. 12
Apanteles 1
Apanteles 6
Apanteles 9
Aspilota 9
Bracon 6
Bracon sp. 2
Cardiochiles 2
Cardiochiles 3
Cardiochiles 5
Chelonus 1
Chelonus 14
Clinocentrus 2
Cotesia 2
Cotesia 4
Cremnops 1
Glyptapanteles 1
Glyptapanteles 2
Heterospilus 6
Heterospilus 10
Heterospilus prosopidis Viereck
Hormius 3
Meteorus laphygmae (Viereck)
Microplitis 2
Microplitis 4
Microplitis 6
Opius 12
Opius 22
Opius 29
Opius 29
Orgilus 4
Orgilus 6
Parahormius 1
Rasivalva sp.

Rhaconotus 6
Urosigalphus 1
Vipio 1

Family Encyrtidae:

Aenasius sp. 3
Anagyrus sp. 6
Anagyrus sp. 24
Copidosoma floridanum
Lamennasia sp. 1
Meromyzobia sp. 9
Prochiloneurus sp. 2
Pseudleptomastix sp. 6
Psyllaephagus sp. 2

c. Herptiles

Scaphiopus couchi
Scaphiopus multiplicatus
Bufo punctatus
Rana berlandieri
Kinosternon flavescens
Sceloporus magister
Sceloporus undulatus
Urosaurus ornatus
Uta stansburiana
Cnemidophorus inornatus
Cnemidophorus marmoratus
Masticophis flagellum
Pituophis melanoleucus
Crotalus atrox

d. Birds

Buteo jamaicensis
Falco peregrinus
Falco sparverius
Callipepla squamata
Zenaida macroura
Geococcyx californianus
Phaenoptilus nuttallii
Picoides scalaris
Sayornis saya

Myiarchus cinerascens
Corvus corax
Corvus cryptoleucus
Campylorhynchus brunneicapillus
Regulus calendula
Polioptila caerulea
Polioptila melanura
Mimus polyglottus
Toxostoma curvirostre
Lanius ludovicianus
Vermivora celata
Dendroica coronata
Cardinalis sinuatus
Aimophila cassinii
Spizella passerina
Spizella pallida
Spizella breweri
Pooecetes gramineus
Amphispiza bilineata
Calamospiza melanocorys
Molothrus ater
Icterus parisorum
Carduelis psaltria
Passer domesticus

e. Mammals

Sylvilagus audubonii
Lepus californicus
Spermophilus spilosoma
Cratogeomys catanops
Perognathus flavus
Chaetodipus penicillatus
Dipodomys merriami
Dipodomys ordii
Reithrodontomys megalotis
Peromyscus eremicus
Peromyscus leucopus
Peromyscus maniculatus
Sigmodon hispidus
Neotoma micropus
Canis latrans
Urocyon cinereoargenteus
Mustela frenata

Mephitis mephitis
Felis concolor
Lynx rufus
Tayassu tajacu
Cervus elaphas
Odocoileus hemionus

ALKALINE GRASSLAND

a. Plants

Atriplex canescens
Bothriochloa laguroides
 var. torreyana
Chamaesaracha conoides
Chamaesaracha sordida
Croton pottsii
 var. thermophilus
Descuriana pinnata
Erionueron pulchellum
Hilaria mutica
Hoffmanseggia glauca
Lesquerella fendleri
Nama havardii
Opuntia phaeacantha
 var. major
Opuntia schottii
 var. grahammii
Pappaphorum vaginatum
Prosopis glandulosa
 var. torreyana
Salsola kali
Solanum eleagnifolium
Sorghum halapense
Sporobolus. airoides
Sporobolus pyramidatus
Verbena wrightii

b. Insects:

Family Braconidae:

Aleiodes graphicus (Cresson)
Bracon sp. 2

Heterospilus 4
Microplitis 6
Opius 29
Rhaconotus 6

Family Encyrtidae:

Copidosoma floridanum
Lamennasia sp. 1

c. Herptiles

Scaphiopus couchi
Scaphiopus multiplicatus
Bufo punctatus
Bufo debilis
Kinosternon flavescens
Uta stansburiana
Cnemidophorus marmoratus

d. Birds

Falco sparverius
Eremophila alpestris
Mimus polyglottus
Anthus spinoletta
Anthus spragueii
Calcarius mccownii
Sturnella magna
Sturnella neglecta

e. Mammals

Sylvilagus audubonii
Lepus californicus
Spermophilus spilosoma
Cratogeomys catanops
Perognathus flavus
Chaetodipus nelsoni
Chaetodipus penicillatus
Dipodomys merriami
Dipodomys ordii
Reithrodontomys megalotis
Peromyscus leucopus

Peromyscus maniculatus
Onychomys arenicola
Sigmodon hispidus
Neotoma micropus
Canis latrans
Urocyon cinereoargenteus
Mustela frenata
Mephitis mephitis
Felis concolor
Lynx rufus
Tayassu tajacu
Cervus elaphas
Odocoileus hemionus
Antilocapra americana

MARIOLA SCRUB (ALLUVIAL PHASE)

a. Plants

Abutilon parvulum
Baileya multiradiata
Chamaesaracha coronopus
Cirsium texanum
Corydalis aurea
 var. *occidentalis*
Cryptantha crassisepala
Dalea nana
Dalea pogonathera
Datura wrightii
Descuriana pinnata
Dimorphocarpa wislizenii
Draba cuneifolia
Echinocereus dubius
Ephedra trifurca
Fallugia paradoxa
Flourensia cernua
Gaura parviflora
Guaiaacum angustifolium
Heliotropium molle
Heliotropium confertifolium
Ipomopsis havardii
Kallstroemia parviflora
Krameria grayi
Krameria parvifolia

Larrea tridentata
Lepidium montanum
Lesquerella fendleri
Lupinus havardii
Melampodium leucanthum
Mentzelia multiflora
Nama havardii
Nama hispidum
Opuntia leptocaulis
Opuntia phaeacantha
 var. major
Opuntia violacea
 var. macrocentra
Opuntia schottii
 var. grahammii
Parthenium incanum
Pectis papposa
Phacelia coerulea
Plantago patagonica
Polanisia uniglandulosa
Proboscoidea louisianica
Psilostrophe tagetina
Ratibida columnaris
Selenia dissecta
Senecio douglassii
 var. longilobus
Senna bauhinioides
Spharalcea angustifolia
Thelesperma megapotamicum
Thymnophylla acerosa
Tiquilia canescens
Tiquilia greggii
Tiquilia hispidissima
Verbena neomexicana
Verbena pumila
Verbena wrightii
Yucca elata
Yucca treculeana

b. Insects

Family Braconidae:

Agathirsia testacea (Muesebeck)

Aleiodes carinatus (Ashmead)
Aleiodes ferrugineus Enderlein
Aleiodes molestus (Cresson)
Aleiodes scrutator (Say)
Aleiodes sp. 1
Aleiodes sp. 6
Aleiodes sp. 7
Aleiodes sp. 10
Aleiodes sp. 11
Apanteles 2
Apanteles 3
Apanteles 9
Apanteles 11
Apanteles 12
Aphidius 2
Aspilota 5
Bracon 4
Cardiochiles 5
Chelonus 1
Chelonus 3
Chelonus 5
Chelonus 10
Chelonus 11
Coccygidium sp. 1
Cotesia 4
Dacnusa n. sp. 1
Digonogastra 7
Digonogastra 8
Digonogastra sp. 1
Digonogastra sp. 2
Digonogastra sp. 3
Glyptapanteles 1
Heterospilus 13
Homolobus truncator (Say)
Hormius 8
Hormius 10
Meteorus 3
Meteorus 4
Meteorus laphygmae (Viereck)
Microctonus 8
Microplitis 1
Microplitis 2
Microtypus 2
Nealiolus 2

Opius 9
Opius 29
Orgilus 8
Parahormius 1
Urosigalphus 1
Urosigalphus 1
Venanides sp.

Family Encyrtidae:

Acerophagus sp. 2
Aenasius sp. 1
Anagyrus sp. 2
Aphycus sp. 7
Apoanagyrus sp. 4
Apoanagyrus sp. 21
Apoanagyrus sp. 22
Apoanagyrus sp. 24
Cheiloneurus sp. 7
Cheiloneurus sp. 9
Copidosoma floridanum
Discodes sp. 2
Habrolepopteryx sp. 2
Mahencyrtus sp. 1
Meromyzobia sp. 1
Meromyzobia sp. 2
Metaphycus sp. 1
Metaphycus sp. 34
Metaphycus sp. 35
Metaphycus sp. 36
Mucencyrtus sp. 4
New Genus 5, sp. 2
New Genus 45, sp. 1
Ooencyrtus sp. 4
Ooencyrtus sp. 7
Pheidoloxenus sp. 1
Prochiloneurus sp. 2
Pseudaphycus sp. 1
Pseudaphycus sp. 3
Pseudaphycus sp. 7
Pseudaphycus sp. 11
Rhopus sp. 4
Syrphophagus
Tetracnemus sp. 4

Tetracnemus sp. 6
Tetracnemus sp. 7

c. Herptiles

Bufo punctatus
Bufo debilis
Bufo speciosus
Coleonyx brevis
Gambelia wislizenii
Crotaphytus collaris
Cophosaurus texanus
Sceloporus poinsetti
Sceloporus undulatus
Phrynosoma cornutum
Phrynosoma modestum
Cnemidophorus inonatus
Cnemidophorus marmoratus
Cnemidophorus septemvittatus
Masticophis flagellum
Salvadora deserticola
Arizona elegans
Tantilla hobartsmithii
Agkistrodon contortrix
Crotalus atrox
Crotalus molossus

d. Birds

Buteo swainsonii
Buteo jamaicensis
Falco sparverius
Callipepla squamata
Zenaida macroura
Geococcyx californianus
Asio otus
Chordeiles acutipennis
Phaenoptilus nuttallii
Picoides scalaris
Sayornis saya
Myiarchus cinerascens
Corvus corax
Campylorhynchus
 brunneicapillus

Regulus calendula
Polioptila caerulea
Polioptila melanura
Mimus polyglottus
Toxostoma curvirostre
Lanius ludovicianus
Vermivora celata
Dendroica coronata
Cardinalis sinuatus
Guiraca caerulea
Passerina amoena
Passerina ciris
Pipilo chlorurus
Aimophila cassinii
Aimophila ruficeps
Spizella passerina
Spizella pallida
Spizella breweri
Pooecetes gramineus
Amphispiza bilineata
Calamospiza melanocorys
Molothrus ater
Icterus parisorum
Carpodacus mexicanus
Carduelis psaltria

e. Mammals

Sylvilagus audubonii
Lepus californicus
Spermophilus spilosoma
Cratogeomys catanops
Perognathus flavus
Chaetodipus nelsoni
Chaetodipus penicillatus
Dipodomys merriami
Reithrodontomys megalotis
Peromyscus eremicus
Peromyscus leucopus
Peromyscus maniculatus
Onychomys arenicola
Sigmodon hispidus
Neotoma micropus
Canis latrans

Urocyon cinereoargenteus
Mustela frenata
Mephitis mephitis
Felis concolor
Lynx rufus
Tayassu tajacu
Odocoileus hemionus
Antilocapra americana

CREOSOTE SCRUB

a. Plants

Agave lechuguilla
Baileya multiradiata
Bouteloua trifida
Coryphantha macromeris
Echinocactus horizonthalonius
Echinocactus texensis
Echinocereus dubius
Erionueron pulchellus
Flourensia cernua
Hilaria mutica
Hoffmanseggia glauca
Melampodium leucanthum
Larrea tridentata
Nama havardii
Nerisyrenia camporum
Opuntia leptocaulis
Opuntia phaeacantha
 var. major
Opuntia schottii
 var. grahammii
Opuntia violacea
 var. macrocentra
Parthenium incanum
Pectis papposa
Prosopis glandulosa
 var. torreyana
Psilostrophe tagetina
Salsola kali
Tiquilia canescens
Tiquilia greggii
Tiquilia hispidissima

Thymnophylla acerosa
Thymophylla micropoides
Yucca treculeana
Zinnia acerosa

b. Insects

Family Braconidae:

Aleiodes ferrugineus Enderlein
Aleiodes ms name
Aleiodes scrutator (Say)
Aleiodes sp. 1
Aleiodes sp. 3
Aleiodes sp. 5
Aleiodes sp. 7
Aleiodes sp. 12
Apanteles 12
Apanteles 13
Apanteles 18
Apanteles 20
Blacus 1
Bracon 4
Chelonus 1
Chelonus 10
Chelonus 21
Chorebus 3
Clinocentrus 1
Coccygidium sp. 1
Digonogastra sp. 2
Glyptapanteles 4
Habrobracon gelechia (Ashmead)
Habrobracon sp. 2
Homolobus truncator (Say)
Hormius 1
Hormius 2
Hormius 3
Hormius 6
Macrocentrus 1
Meteorus 3
Meteorus laphygmae (Viereck)
Microplitis 3
Microtypus 1
Microtypus 3

Opius 13
Opius 20
Opius 29
Pambolus 2
Parahormius 1
Parahormius 6
Polystenidea 4
Rasivalva sp.
Rhaconotus 14
Rhaconotus 17
Tetrasphaeropyx 2
Urosigalphus 1

Family Encyrtidae:

Aenasius sp. 3
Apoanagyrus sp. 22
Copidosoma floridanum
Lamennasia sp. 1
Ooencyrtus sp. 4
Ooencyrtus sp. 7
Ooencyrtus sp. 8
Psyllaephagus sp. 2

c. Herptiles

Scaphiopus couchi
Bufo punctatus
Gastrophryne olivacea
Kinosternon flavescens
Gambelia wislizenii
Cophosaurus texanus
Sceloporus undulatus
Uta stansburiana
Phrynosoma cornutum
Phrynosoma modestum
Cnemidophorus inornatus
Cnemidophorus marmoratus
Arizona elegans
Rhinocheilus lecontei
Sonora semiannulata
Crotalus atrox
Crotalus scutulatus

d. Birds

Buteo jamaicensis
Falco sparverius
Callipepla squamata
Zenaida macroura
Geococcyx californianus
Tyto alba
Picoides scalaris
Hirundo pyrrhonota
Hirundo fulva
Hirundo rustica
Campylorhynchus brunneicapillus
Regulus calendula
Polioptila caerulea
Polioptila melanura
Catharus guttatus
Mimus polyglottus
Sayornis saya
Toxostoma curvirostre
Phainopepla nitens
Lanius ludovicianus
Vermivora celata
Dendroica coronata
Cardinalis sinuatus
Guiraca caerulea
Pipilo chlorurus
Aimophila cassinii
Spizella passerina
Spizella pallida
Spizella breweri
Poocetes gramineus
Amphispiza bilineata
Calamospiza melanocorys
Ammodramus savannarum
Melospiza lincolnii
Zonotrichia leucophrys
Molothrus ater
Icterus parisorum
Carpodacus mexicanus

e. Mammals

Sylvilagus audubonii

Lepus californicus
Ammospermophilus interpres
Spermophilus spilosoma
Cratogeomys catanops
Perognathus flavus
Chaetodipus nelsoni
Chaetodipus penicillatus
Dipodomys merriami
Dipodomys ordii
Reithrodontomys megalotis
Peromyscus eremicus
Peromyscus leucopus
Peromyscus maniculatus
Onychomys arenicola
Sigmodon hispidus
Neotoma micropus
Canis latrans
Urocyon cinereoargenteus
Mustela frenata
Mephitis mephitis
Felis concolor
Lynx rufus
Tayassu tajacu
Antilocapra americana