



BIG BEND NATIONAL PARK BIOSPHERE RESERVE: A HISTORY OF SCIENTIFIC STUDY

Volume I

A NARRATIVE DESCRIPTION OF SCIENTIFIC STUDY

U.S. MAN AND THE BIOSPHERE PROGRAM
U.S. MAB REPORT NO. 10



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Volume I

A Narrative Description of Scientific Study

U.S. Man and the Biosphere Program

U.S. MAB Report No. 10

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Bill Gregg, U.S. Man and the Biosphere Project - 8 Coordinator, and Nick Chura, former Desert Ecosystem Coordinator for the National Park Service were responsible for defining the scope of the project and for developing its initial funding. Administrative and additional financial support was received from Milford Fletcher, Chief Regional Scientist (SW Region NPS) and Gil Lusk, Superintendent of Big Bend National Park (BBNP), Texas. Mike Fleming, Vidal Davila, and Cynthia Vega, all of the BBNP Natural Resource Division, located many unpublished reports for us. Roy Johnson, of the Arizona Cooperative Programs Study Unit, NPS, provided insight to problems we might encounter in completing this project. Walter Wait, computer consultant at the Southwest Regional Office NPS, made our bibliography available on the NPS computers at the SW Region Office and at BBNP.

Citations for the bibliography (Volume 2) were contributed by many scientists working in the Chihuahuan Desert. Bibliographies received from Guillermo Mathus (Jefatura de Programa Forestal, Estado de Coahuila) and Antoine Cornet (Bolson de Mapimi Biosphere Reserve, Instituto de Ecologia) compose most of the Spanish language entries in the bibliography. Maria Maury and Monica Rojas, of the Instituto de Ecologia in Mexico City, proofread the Spanish citations from Antoine Cornet. Lisa Deal, Vidal Davila, and Raymond Olivas proofread the citations from Guillermo Mathus.

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19069 PERM " was not found.

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INTRODUCTION

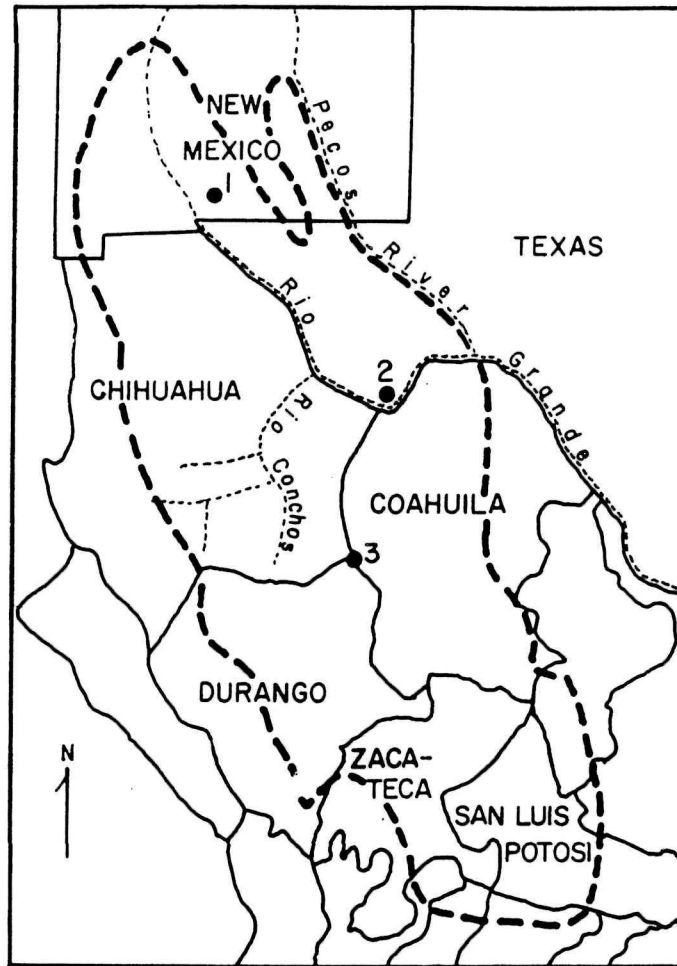
In 1971 the United Nations Educational, Scientific, and Cultural Organization (UNESCO) created the Man and the Biosphere (MAB) Program for the purpose of promoting rational use of the earth's resources. Formal involvement by the U.S. began in 1974. By 1976, 28 biosphere reserves had been selected in the U.S., including Big Bend National Park (BBNP) (Fig. 1). The purpose of this 2-volume report was to provide an interdisciplinary reference volume of literature citations for BBNP and the surrounding Chihuahuan Desert, and to provide a synopsis of research completed at BBNP.

Objectives of the biosphere reserve program are to: (1) preserve biological diversity, (2) provide areas for ecological and environmental research, and (3) provide facilities for education and training. Criteria for selecting biosphere reserves are suggested by UNESCO (1974) and Risser and Cornelison (1979). The kinds of data that should be collected at biosphere reserves are identified by the National Science Foundation (1978, 1979), Wiersma et al. (1978), and the U.S. Dep. of State (1979).

In 1984 an ACTION PLAN was developed for biosphere reserves (UNESCO 1984). Three areas of concern were identified for action: (1) improvement and expansion of the biosphere reserve system, (2) development of basic knowledge for conserving ecosystems and biological diversity, and (3) making biosphere reserves more effective in linking conservation and development. The minimum set of activities desirable at biosphere reserves are to: (1) obtain base-line inventories of flora and fauna, (2) establish an ecological monitoring plan, (3) prepare a history of research conducted at the reserve, (4) establish research facilities and programs, (5) establish training and education programs, and (6) address biosphere reserve functions in a management plan.

In 1976 Big Bend National Park and 27 other units of land in the U.S. were designated Biosphere Reserves. In an effort to determine the degree to which biosphere reserves in the U.S. were fulfilling their purpose, the U.S. MAB conducted a survey of biosphere reserve managers in July 1981 (Gregg and Goiguel 1981). Activities for which information was sought included: base-line information, environmental monitoring, and ecological research. There were significant gaps in base-line data at all biosphere

CHIHUAHUAN DESERT BIOSPHERE RESERVES



1 inch = 200 miles

LEGEND

- | | |
|--------------------------------|-----------------------|
| 1 - Jornado Experimental Range | --- Chihuahuan Desert |
| 2 - Big Bend National Park | — state boundary |
| 3 - Mapimi Reserve | ... rivers |

reserves; BBNP ranked 32nd of 36 biosphere reserves surveyed. Most reserves also reported substantial inadequacies for long-term environmental monitoring data; BBNP ranked 25th. Ecological programs at most reserves were not adequate to provide information needed to support management programs. BBNP ranked 32nd. Ninety-seven percent of the biosphere managers stated that guidance from MAB would be of value in meeting biosphere reserve objectives. A major impediment to the effective use of biosphere reserves was the lack of a reserve-specific source document listing scientific activities, data management capabilities, and institutional agreements.

At a workshop on biosphere reserves held in 1982 at Kalispell, Montana, participants suggested that on-site activity, awareness of MAB, and coordination were not adequate for an effective program (Parks Canada and U.S. Natl. Park Serv. 1982). Many reasons were given: e.g. (1) MAB is in a formative stage and not many people are familiar with the biosphere reserve program or its objectives, (2) most MAB work reflects the independent nature of park/biosphere reserve studies, and (3) despite NPS efforts to develop a common system of monitoring in a reserve-wide context, emphasis continues to be on park-specific needs that relate directly to resource management. What is required is a clear statement of management objectives and, in most instances, their reformulation to incorporate the MAB philosophy.

The National Park Service is addressing some of the needs of biosphere reserves by developing a "History of scientific studies" for individual reserves. In this history, prepared specifically for BBNP, we address all the minimum activities suggested for biosphere reserves (UNESCO 1984) and provide background information on MAB needed by on-site personnel. Similar reports have been published for the Great Smoky Mountains and Glacier National Park Biosphere Reserves (McCrone et al. 1982, Heywood et al. 1984).

Volume I of this report characterizes the research environment at BBNP and provides a synopsis of the kinds of data available for the Park.

Volume II is intended as a reference volume to the scientific activity conducted at Big Bend National Park and the Chihuahuan Desert. It was prepared in the form of an annotated bibliography. The disciplines we reviewed were: aquatic systems, archaeology, climate, geology/paleontology, history, soil, terrestrial fauna, use and effects, and vegetation. References were obtained from four sources: (1) commercial computer based literature searches, (2) a review of literature cited in published and unpublished reports, (3) replies to our requests for references from 125

scientists in the U.S., Mexico, and Canada, and (4) a bibliography provided by personnel at BBNP. A copy of the bibliography is available on computer tape at the NPS Southwest Region Office in Santa Fe, NM and at BBNP.

A separate report, based on Volumes 1 and 2, was prepared for BBNP. It provides an assessment of the research program at the Park and gives recommendations aimed at promoting the biosphere concept of resource management and research.

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UNESCO MAB. 1984. Action plan for biosphere reserves. Paper presented at the International co-ordinating council of the programme on Man and the Biosphere. Eighth session. 3-8 December 1984. Paris. 18pp.

U.S. Department of State. 1979. United States Man and the Biosphere Program (MAB): Long-term ecological monitoring in biosphere reserves. U.S. Dep. of State, U.S. Natl. Comm. for Man and the Biosphere. 31pp.

Wiersma, G. B., K. W. Brown, and A. B. Crockett. 1978. Development of a pollutant monitoring system for biosphere reserves. U.S. Environmental Protection Agency, Las Vegas, Nevada. 113pp.

RESEARCH FACILITIES

Cooperative agreements

Cooperative agreements between BBNP and individual researchers are common for short term (< 5 yr) research. Usually agreements are verbal and state only what the Park will provide to the scientist.

Assistance from Park personnel

The Resource Management Specialist can arrange lodging, provide access to data bases, and issue permits. Information for scientists conducting research in the Park are included in materials provided by the Resource Manager.

Housing

K-bar (Fig. 2) is the primary lodging facility for researchers. It is a four room structure with six single beds. Furnishings, appliances, electricity, water, and kitchen utensils are provided. Usually, people conducting long-term work reside at K-bar. Bedding must be supplied by the researcher. Rent at K-Bar, in 1984, was \$5.00/person/night.

Barker house (near Rio Grande Village) was designated as a MAB research station in 1980. Researchers on short-term visits usually stay here. The facilities are similar to those at K-Bar. Rent in 1984 was \$10.00/person/night.

Campgrounds are located near Castolon, Rio Grande Village, and the Basin. Rooms and a restaurant are available at the Chisos Mountains Lodge.

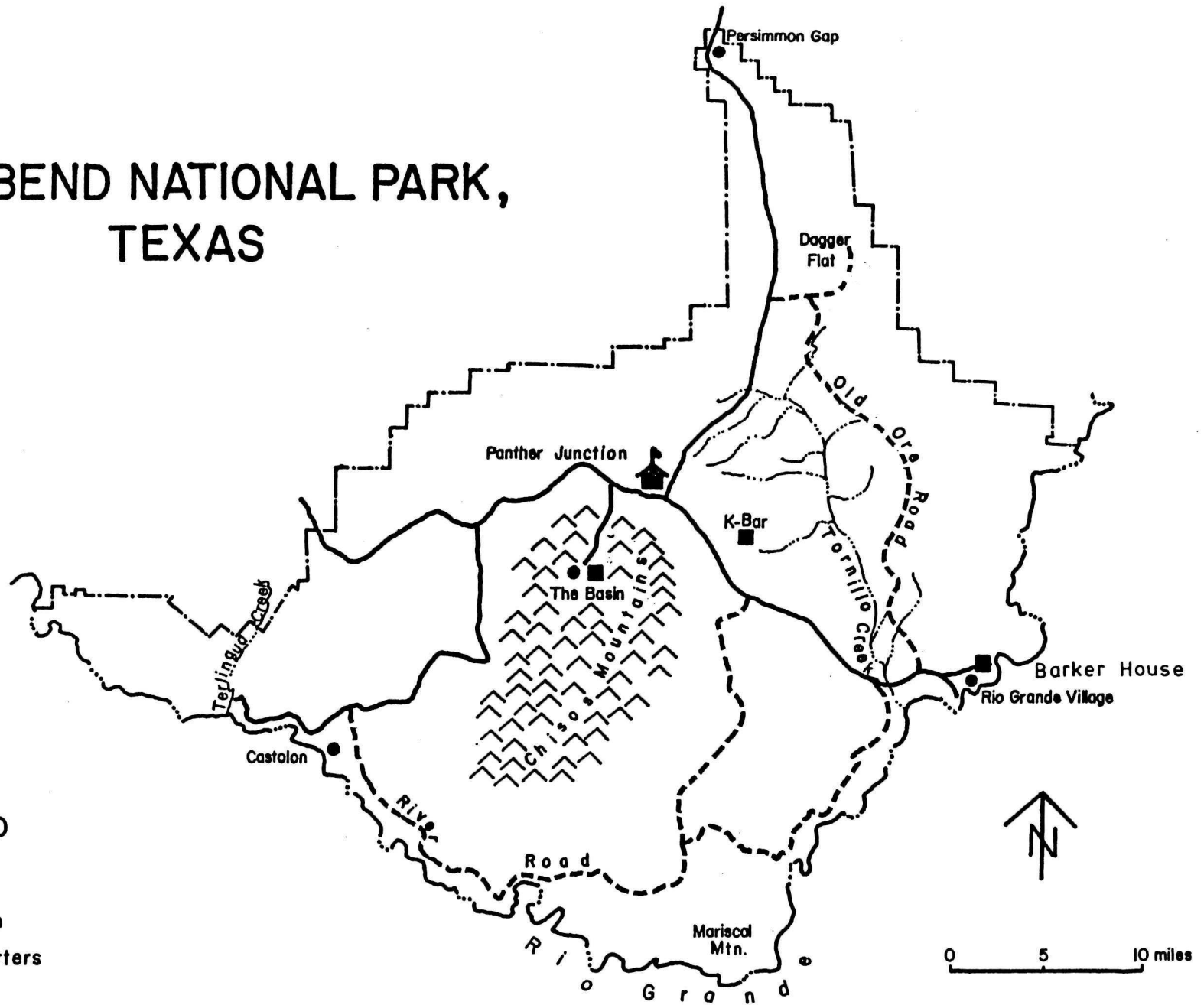
Office and lab space

Office space is not available; however, temporary work space is occasionally provided in the Naturalist's Workshop or conference room. A small wet lab and darkroom are located at Park headquarters.

Computer facilities

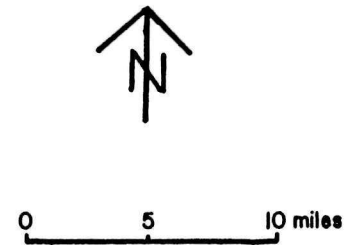
The Park has 15 terminals on a Data General S-140 system (16-bit AOS). These terminals may operate solely with the

BIG BEND NATIONAL PARK, TEXAS



LEGEND

- Lodging
- Ranger station
- 🏠 Park headquarters



Park's microcomputer or link with the Data General MV4000 super mini-computer at NPS Regional headquarters in Santa Fe, NM. A remote terminal in the Resource Manager's office is used to obtain fire weather from the Forest Fire Information Retrieval System.

DATA BASES

Documents

There are two sources of documents at Big Bend National Park; the Naturalist's library and files in the Resource Management Specialist's office. The Naturalist's library contains material used by Park Naturalists to develop interpretive programs for the general public. The files in the Resource Management Office contain journal articles, unpublished manuscripts, theses, reports, and other items related primarily to research and resource management. This report concerns the several hundred published and unpublished reports filed in the Resource Management Specialist's office. A list of these documents is available at the Park.

Unpublished data include:

1. Natural Resources Management Plan
2. Historic Resources Management Plan
3. Fire Management Plan
4. Backcountry Management Plan
5. River Management Plan (in progress)
6. Aquatic Resources Management Plan (in progress)
Water resources management profile (in progress)
7. Big Bend Gambusia Habitat Management Plan (1984)
8. Weather data
9. Data from environmental monitoring program
10. Plant list (1983) and card file; Denver Service Center
11. Event record (Card file of unusual sightings)
12. Species checklists
13. Soil map and description of soils (1984)
14. Spring survey: point water sources, 5 Vols.
15. Annual census data for peregrine falcon.
16. Data from IBWC for Rio Grande
17. Permit files for backcountry and river use
18. Historic Structure Survey: 6 Vols. (1983)

Maps

1. USDI Geological Survey
Terlingua-Chisos Mountains, Texas
Scale 1:130000 (for sale at the Park)

2. USDI Geological Survey
Big Bend National Park, Texas 1970
Scale 1:100000 (for sale at the Park)
3. USDI Geological Survey
7.5 minute series
Scale 1:24000 (for sale at the Park)
4. Flood plain elevation of Rio Grande within boundary of
the Park.
Southwest Region Office, NPS
Santa, NM (in prep.)
5. Geologic map
Scale 1:62500
6. Vegetation map
Warnock and Killan 1970
Scale
7. Vegetation map (foothills and desert)
Leopold 1983 (1 copy in RM office)
Scale 1:100000
8. Vegetation map (Nyquist)
Denver Service Center, Science Div.
Scale 1:125000 ?
9. Land status and boundary
Source - Big Bend National Park Files
10. Plat maps
County Assessor's Office, Alpine, TX
11. General soil map
Soil Conservation Service
12. Soils of Big Bend National Park
In progress

Collections

Collections at the Park are stored at Park Headquarters in the Naturalist's Workshop. The first entry in the accession catalogue is dated 8 July 1954. There are now 522 entries for 4732 catalogued items. Naturalists are the primary users of the collections.

The herbarium contains 2489 sheets, dating back to the 1930s. Geology and paleontology collections total 250 items; the archaeological collection 400 specimens and history 300 items. The zoology collection includes 50 mammals, 140 birds, 30 fish, and several hundred arthropods.

Photo file

Several hundred photos and slides are stored at BBNP; however, there is no master list. There are series for vegetation plots, historical structures, and point water sources. Aerial photographs (black and white, and 1:36000 color) and LANDSAT data are available for the Park.

Environmental monitoring stations

1. Five weather stations are located within the Park (Fig. 3). Data are collected by Park personnel. Temperature (high and low) and rain gauges are monitored daily at 8:00 AM. Fire weather is calculated each day for all stations except Persimmon Gap. Rainfall data is collected by the International Boundary and Water Commission (IBWC) at the two stream gauging stations on the Rio Grande.

2. Stream level gauges at Castolon and Rio Grande Village are read by Park personnel (Fig. 3).

3. The IBWC maintains 2 stream gauging stations within the Park boundary. One is 2.2 km upstream from the old Johnson Ranch headquarters on the Rio Grande; the other is on Terlingua Creek 4.2 km above its confluence with the Rio Grande. Data has been collected at both stations since 1936. At Johnson Ranch station discharge measurements are determined 27 times a year, data from an evaporimeter is also kept. Discharge measurements are recorded 29 times a year at the Terlingua gauge, water level is recorded continuously. The nearest sites for which water quality data of the Rio Grande are available are upstream at Presidio, Texas and Ojinaga, Chihuahua, Mexico. Downstream measurements are available for Foster Ranch near Langtry, Texas and Rancho Santa Rosa, Coahuila, Mexico.

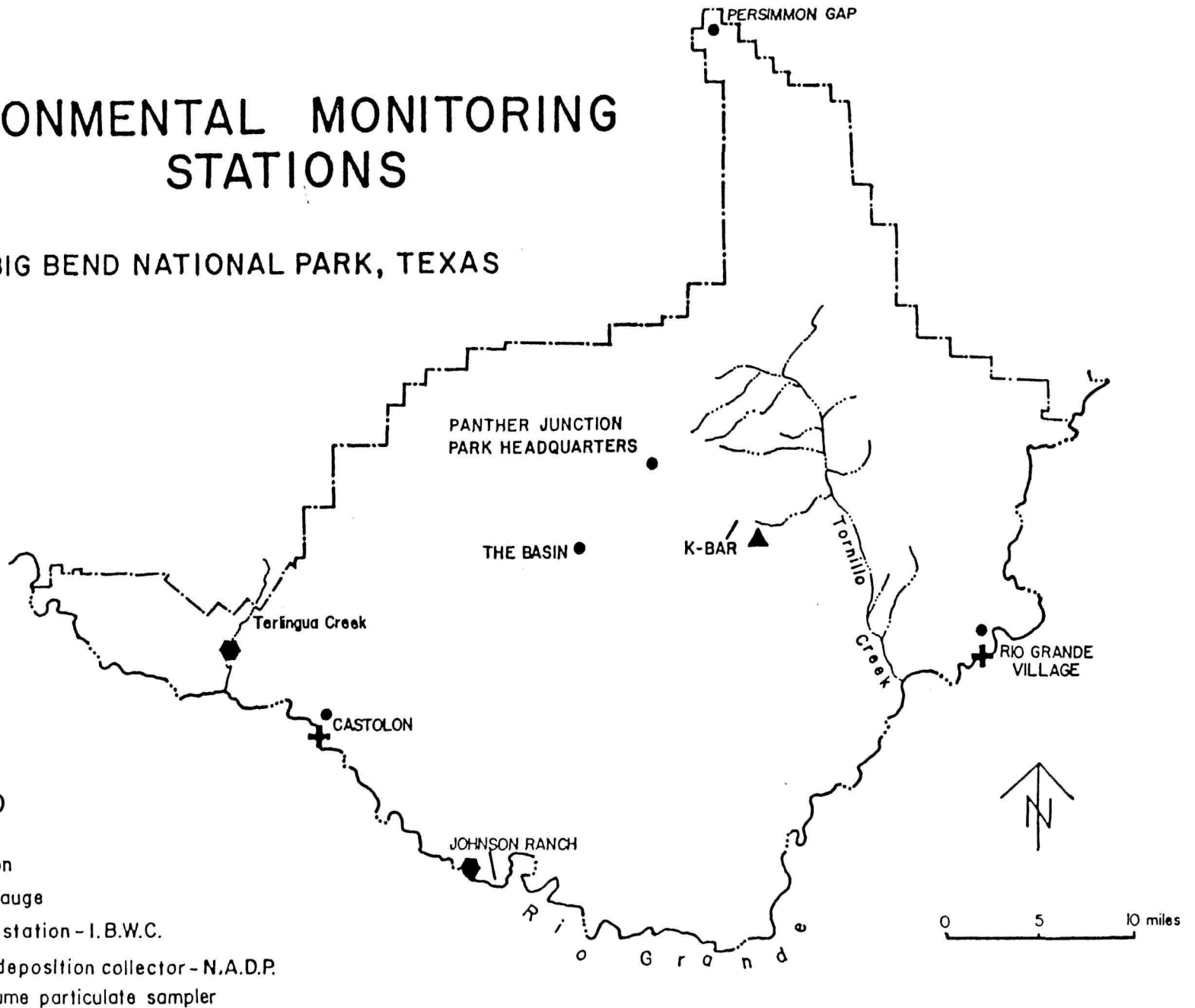
4. A Sierra high volume particulate sampler was installed near K-bar in April 1980 and a National Atmospheric Deposition (NADP) unit in May 1980. The Sierra unit was replaced with an SFS Fine Particulate Sampler in 1983. Telephotometer readings began in 1978. They are taken three times daily, 364 days per year. NADP samples are collected weekly. Raw data from the telephotometer is sent to Las Vegas, Nevada; data from the SFS Sampler to Crocker Nuclear Lab, U.C. Davis, California; and data from the NADP system to Champaign, Illinois.

Literature Cited:

Gregg, W. P., Jr., and M. M. Goigel. 1981. The Biosphere reserve project: The United States experience. International conference-exhibit, ecology in practice. Paris. 79pp.

ENVIRONMENTAL MONITORING STATIONS

BIG BEND NATIONAL PARK, TEXAS



SYNOPSIS OF DATA BASES

This section of the report provides a synopsis of the kinds of data available for BBNP. We summarized the information from nine disciplines: aquatic systems, archaeology, climate, geology and paleontology, history, soil, terrestrial fauna, use and effects, and vegetation. The objective of these sections was to provide an overview of the data available; detailed information is in the annotated bibliography. All citations in this section are of work done within the boundary of BBNP.

Following the summaries for each discipline is a subjective determination of the "level" of work. These levels were developed from "United States Man and the Biosphere Program (MAB): Long-term ecological monitoring in biosphere reserves." (U.S. Dep. of State 1979). Level "one" data is of the simplest kind, e.g. a breeding record for a species of bird. Level "two" data is more structured, e.g. an investigation of a specific problem. Most masters and PhD theses are examples of level two data. Ecosystem or community modeling are the best examples of level "3" data.

AQUATIC SYSTEMS

Inventory of Water Resources

Inventories and reconnaissance surveys of water resources of BBNP have been made by Twichell (1966), Leggat et al. (1968), and Howarth (1976). Howarth (1976) visited 181 springs and recorded several measurements for each. Limnological information has been collected for the Rio Grande (Lind 1976). Annual reports by the International Boundary and Water Commission (1931-1980) present data on water parameters for the Rio Grande from New Mexico to the Gulf of Mexico.

Gibson (1983) investigated hydrogeology and ground water sources in the Panther Junction area of BBNP. Abbott (1983) examined the geometry of shallow bedrock aquifers in the same region. Archer (1982) studied the characteristics of the Green Gulch alluvial fan.

Deal (1979) examined the Rio Conchos-Rio Grande drainage system and developed an historical explanation for low water levels in the lower Rio Grande. Elevations along the flood plain of the Rio Grande have been determined (Anon. No date.).

Geothermics

Henry (1977) and Bennack et al. (1978) collected geological, chemical, and biological information from Hot Spring sites to establish benchmark data. Hot springs and geothermic characteristics of water resources in the Park were studied by Henry (1977), Bennack et al. (1978), Cole and Bane (1978), Taylor et al. (1979), and Wilson (1983). Taylor et al. (1979) examined heat flow and temperature gradients between the river zone of Rio Grande Valley in BBNP and the high plains to the east of the valley.

Water Quality

Water quality characteristics have been measured throughout BBNP. Chemical analyses of water from 3 test wells at Castolon were reported by Rawson (1963). The International Boundary and Water Commission (1931-1980) and Leggat et al. (1968) included chemical analyses in their evaluations and survey of potential water sources in the Park.

Lind and Bane (1975) monitored 18 aquatic ecosystems between Hot Springs and Boquillas Canyon and examined biological and chemical indicators of water quality. More recently Lind (1980) reported findings for a similar but expanded investigation of water quality in the Park.

Fuchs (1976) analyzed pesticide levels in several springs in the Park. Environmental Consultants, Inc. (1976) measured pesticide and herbicides (silvex) levels in water samples from Oak Springs and McKinney Springs.

The level of mercury in water associated with old mining activities was determined along the Rio Grande from Alamito Creek to Terlingua Creek by Kettle (1972). Houston and Dumas (1974) studied mercury levels in the Rough Run - Terlingua Creek and Rio Grande areas of BBNP. Mattison and Nelson (1980) proposed the collection of water and mud samples from the Rio Grande between Presidio and Boquillas Canyon.

Fauna

Invertebrates

Lind and Bane (1975) analyzed species diversity in their limnological survey of the aquatic resources and collected invertebrates to be used as biological indicators (Bane and Lind 1978). Bane and Lind (1978) analyzed standing crop, biomass, and species diversity of the benthic invertebrates in Tornillo Creek. Cole and Bane (1978) identified a new species of invertebrate, Thermosphaeroma subequalum. Lind (1982) described the biogeographic affinities of the benthic communities from a sample of creeks in the Chihuahuan Desert.

Fish

Hubbs (1958) prepared a checklist of fish for BBNP. He identified 25 species as definitely occurring in the Park, and 13 other species that may occur.

Other studies of fish in the Park included an investigation of the seasonal changes in fish populations in Tornillo Creek (Hubbs and Wauer 1979). Burr (1976) collected specimens and reviewed the taxonomy of the Mexican stoneroller (Campostoma ornatum). Kettle (1972) determined the mercury concentrations in fish along the Rio Grande from Alamito Creek to Terlingua Creek.

Big Bend Gambusia

The endangered Big Bend Gambusia (Gambusia gaigei) is found only within the boundaries of the Park (Hubbs 1929). Several status reports and management plans have been prepared to help ensure the survival of this fish (Hubbs and Brodrick 1963, Hubbs et al. 1977, Moore 1980).

"Level" of data

Inventory

Level 2

Twichell 1966, Leggat et al. 1968, Howarth 1976, Lind 1976, Deal 1979, Archer 1982, Gibson 1983, International Boundary and Water Commission 1931-1980, Anon. no date

Geothermics

Level 2

Henry 1977, Bennack et al. 1978, Cole and Bane 1978, Taylor et al. 1979, Wilson 1983

Water Quality

Level 2

International Boundary and Water Commission 1931-1980, Rawson 1963, Leggat et al. 1968, Dumas 1974, Kettle 1972, Lind and Bane 1975, Environmental Consultants, Inc. 1976, Fuchs 1976, Lind 1980, Mattison and Nelson 1980

Fauna

Level 2

Invertebrates

Lind and Bane 1975, Bane and Lind 1978, Cole and Bane 1978, Lind and Bane 1980, Lind 1982

Fish

Hubbs 1958, Kettle 1972, Burr 1976, Hubbs and Wauer 1979, Gambusia gairdneri - Hubbs 1929, Hubbs and Brodrick 1963, Hubbs et al. 1977, Moore 1980

ARCHAEOLOGY

Sites

Surveys of archaeological sites in BBNP were reported by Peabody (1909), Smith (1923), Young (1929), Anon. (1937), Anon. (No date a), Cook (1937), Kelley et al. (1940), and Campbell (1967, 1970a). Campbell (1960) and Bousman and Rohrt (1974) reviewed archaeological literature for the area. Setzler (1943) discussed the association of archaeological materials with geological deposits in the region of the Park.

Shelters

Harrington (1928), Setzler (1932, 1935), Smith (1932, 1940) and Anon. (1937) described evidence of cave-dwelling people in BBNP. Information about rock constructions and other shelter materials used by early occupants in the region was reported by Smith (1932, 1951), Smith and Kelley (1933), Reed (1936), Anon. (1937), and Andretta (1979).

Textiles

The textile making activities of early inhabitants in the Big Bend area were discussed by Smith (1932, 1932, 1933, 1935, 1940, 1941, 1941), Anon. (1937), and Davenport (1938).

Artifacts

Harrington (1928), Setzler (1932), Smith (1932, 1933, 1945), Niebuhr (1936), and Anon. (1937) described artifacts found at archaeological sites in the Park. Kelley (1948) and Andretta (1979) discussed the early use of tools and weapons.

Reports of pictographs, petroglyphs, painted pebbles, and other rock art at Park sites were made by Smith (1923, 1932, 1946), Reed (1936), Jackson (1938), Davenport and Chelf (1941), Walker and Chelf (1941), Crowley (1980), and Lowrance (1982).

Preservation

Baskin (1978) and Panowski (1981) investigated potential effects of construction activities for a highway realignment project near archaeological sites within BBNP.

"Level" of Data

Sites and Shelters

Level 2

Peabody 1909; Smith 1923; Harrington 1928; Young 1929; Setzler 1932, 1935, 1943; Smith 1932, 1940, 1951; Smith and Kelley 1933; Reed 1936; Anon. 1937; Cook 1937; Kelley et al. 1940; Campbell 1960, 1967, 1970a, b; Bousman and Rohrt 1974; Andretta 1979

Textiles

Level 2

Smith 1932, 1933, 1935, 1940, 1941; Anon. 1937; Davenport 1938

Artifacts

Level 2

Tools and weapons

Harrington 1928; Setzler 1932; Smith 1932, 1933, 1945; Niebuhr 1936; Anon. 1937; Kelley 1948; Andretta 1979

Rock art

Smith 1923, 1932, 1946; Reed 1936, Jackson 1938, Davenport and Chelf 1941; Walker and Chelf 1941, Crowley 1980

Preservation

Level 2

Highway construction (Baskin 1978, Panowski 1981)

CLIMATE

Precipitation and temperature data for the Park are provided by Christensen (1981). The U.S. Dep. of Commerce (1968) summarized records for the Chisos Basin. The International Boundary and Water Commission (1931-1980) collect data at 2 gauging stations on the Rio Grande. Park Service personnel collect (and file) standard weather information from 5 stations in the Park.

Schulman (1952a) examined growth rings of Douglas firs to study past weather patterns of the region.

"Level" of Data

Long-term records

Level 2

International Boundary and Water Commission (1931-1980),
U.S. Dep. of Commerce (1968), Christensen (1981)

GEOLOGY/PALEONTOLOGY

Early surveys

Udden (1907) was the first to write about the geology of the area of the Big Bend that would become a National Park. Other early geological surveys of the Park were done by Baker (1934), Gould (1936), Wegemann (1936), and Maxwell (1941). Eley (1936, 1938) and Redfield (1937) prepared reports of the paleontology of the region.

Summaries of geology and paleontology

Reviews and summaries of the geology of the Park were prepared by Maxwell and Dietrich (1965), West Texas Geological Society (1965, 1972), Maxwell et al. (1967), and Maxwell (1968).

General Geology

Because of the great diversity of geological features at BBNP a large amount of research has been conducted. Poth (1979), Cobb (1980) and Cobb and Poth (1980) studied the Santiago Mt. range. The area around Mariscal Mt. was studied by Ullrich (1972), Bumgardner (1976), and Hill and Lindsey (1978). The Persimmon Gap region was investigated by Hazzard et al. (1958), Poth (1979), and Toelle (1981). Hopkins (1965, 1966) examined the Aquja Formation, Rigsby (1978), the Eocene formation, Schiebout (1974), the Black Peaks Paleocene formations, and Thurwachter (1983) sedimentology of Tornillo Creek. Other areas inspected were the Dead Horse Mountains (Eaves 1965, Moustafa 1983), Rattlesnake Mt. (Cameron 1969), Castolon (Stevens 1969), Grapevine Hills (Korshak 1973, 1976), and Mesa de Anquila (DeCamp 1981).

Volcanology

Winters (1967), Gilliland et al. (1969), Gilliland and Clark (1979), Walton and Henry (1979), and Wilson and Texas Memorial Museum (1980) studied volcanics of the Park and the Trans-Pecos. Ogley (1978, 1979) did an intensive study of the Pine Canyon caldera in the Chisos Mt.

Igneous

Petrology has been studied at Maverick Mt. (Cameron 1968), Rattlesnake Mt. (Carman et al. 1975), Burro Mesa (Becker 1976a, b), the Javelina Formation (Miller 1978), and Mariscal Mt. (Hill and Lindsley 1978).

Mineralogy and Mineral Resources

Several minerals of commercial value have been found in the region; old mines are numerous. Mercury has received much study (Phillips 1905, Udden 1913, Daugherty 1972, Ragsdale 1976, Sharpe 1980). Feldspar (Carmen and Cameron 1970), rhonite (Cameron et al. 1970), and anhydrite and basanite have also received some attention (Hill 1979). A search for uranium was conducted in the area (Union Carbide Corp. 1978).

Structure and Tectonics

Structural geology in BBNP was investigated by Lonsdale and Maxwell (1967), Maxwell (1967), and Maxwell and Marks (1971). The Santiago and Sierra del Carmens were examined by Poth (1979), Cobb and Poth (1980), and Moustafa (1983). Martino (1971) investigated the paleomagnetism of intrusives.

Aquifers and surface water

Ground water and hot springs have been investigated by Henry (1977), Taylor et al. (1979), Archer (1982), Abbott (1983), and Gibson (1983). Deal (1979) reviewed the geological history of the Rio Conchos - Rio Grande drainage system.

Maps

Maxwell (1968) provided the only complete geologic map for the Park. Maps of study areas are included in most of the references cited.

Paleobotany and micropaleontology

Chang (1973) studied the petrified wood of the Park, Meyer (1974, 1977) the pollen rain, and Wells (1966) the Pleistocene vegetation. Bostik (1960) and Huffman (1960) investigated micropaleontology of the Park.

Paleontology

Wilson (1964) and Langston (1971) provided a review of the paleontological work in BBNP. Colbert (1963) listed fossils collected.

Tertiary mammals were studied by Wilson et al. (1952) and Wilson (1967a). Tertiary vertebrates were studied by Gustafson (1979) and Wilson and Schiebout (1981). Miocene fauna was investigated by Stevens (1977) and Steven et al. (1969). Eocene vertebrates have been studied by many researchers (Hartnell 1970, Wood 1973, Schiebout and Miller 1978, Hartnell 1980a, 1980b).

Paleomagnetism has been investigated by Martino (1971), Lewis (1975, 1976), Rapp et al. (1983), and MacFadden (1984). Metcalfe and Clark (1978, 1979) took measurements of gravity.

Vertebrate biostratigraphy was examined by Wilson (1965, 1970), sedimentology by Schiebout (1970a, b, 1971, 1974), and paleoecology by Lawson (1972). Several noteworthy specimens have been collected in BBNP, including; California condor (Wetmore and Friedmann 1933), a giant crocodile (Colbert and Bird 1954), pterosaurs (Bedrossian 1975, Lawson 1975), hadrosaurs (1982, 1983), and a Chasmosaurus (Lehman 1982).

"Level" of Data

Early surveys

Level 1

Phillips 1905; Udden 1907, 1913; Baker 1934; Eley 1936, 1938; Gould 1936; Wegemann 1936; Redfield 1937; Maxwell 1944

General Geology

Level 2

Hazzard et al. 1958; Eaves 1965; Hopkins 1965, 1966; Lonsdale and Maxwell 1967; Maxwell 1967; Maxwell and Marks 1967; Cameron 1968, 1969; Stevens 1969; Cameron et al. 1970; Carmen and Cameron 1970; Martino 1971; Daugherty 1972; Ullrich 1972; Korshak 1973, 1976; Schiebout 1974; Carman et al. 1975; Becker 1976a, b; Bumgardner 1976; Ragsdale 1976; Hill and Lindsey 1978; Miller 1978; Riggsby 1978; Hill 1979; Poth 1979; Cobb 1980; Cobb and Poth 1980; Sharpe 1980; DeCamp 1981; Moustafa 1983; Thurwachter 1983;

Aquifers and surface water

Level 2

Henry 1977, Deal 1979, Taylor et al. 1979, Archer 1982, Abbott 1983, Gibson 1983

Paleontology

Level 2

Wetmore and Friedmann 1933; Wilson et al. 1952; Colber and Bird 1954; Bostik 1960; Huffman 1960; Colbert 1963; Wilson 1964, 1965, 1967a, 1970; Wells 1966; Steven et al. 1969; Hartnell 1970; Schiebout 1970a, b, 1971, 1974; Langston 1971; Martino 1971; Lawson 1972; Chang 1973; Wood 1973; Meyer 1974, 1977; Bedrossian 1975; Lawson 1975; Lewis 1975, 1976; Stevens 1977; Metcalfe and Clark 1978, 1979; Miller 1978; Gustafson 1979; Hartnell 1980a, b; Wilson and Schiebout 1981; Lehman 1982; Rapp et al. 1983; MacFadden 1984

HISTORY

Scott (1978b) prepared an overview of historical research at BBNP. Her report, along with a copy of Tyler's (1975a) book, provide a good background on the history of BBNP. Tyler (1975a) includes an extensive bibliography in his book.

Native Americans

Casey (1948) and Easterla (1968) wrote of Indians that lived in the Big Bend region. Smith (1946) presented evidence that Europeans influenced the Indian pictograph art of West Texas. A battle between the Indians and the Spanish has been described (Anon. No date "r"). Nelson (1935) and Townsend (1935) wrote of the conflicts between the Indians and the U.S. Army. Campbell and Field (1968) attempted to trace the Comanche raiding trails in the Big Bend.

Explorers

Cabeza de Vaca (1905 translation) was the first Spanish explorer to visit the region that is now the Park. Smith (1927, 1928) wrote of early Spanish travels. Bartlett (1854) reported his experiences along the U.S. - Mexico border while working with the boundary survey team. Tyler (1968) gave an account of Green's survey along the southern boundary of the Park. Hartz (1859) and Echols (1860) reported on the Army's camel expedition in the Big Bend.

Settlers

Casey (1948a, b, 1969b) wrote an detailed history of Big Bend's earliest inhabitants. Gillett (1933) wrote a first person account of his experiences on a ranch near the Chisos Mt. The attack on the Glenn Springs settlement has been well documented (Edwards 1951, Raborg 1954, Smithers 1963, Wood 1963, Tyler 1975b). Early settlers of the Big Bend region recounted their experiences on 105 "oral history" tapes stored in the Naturalist's Workshop at Park Headquarters.

Biographies of 25 women who lived in or visited the Big Bend are available (Anon. No date "p"). Langford and Gipson (1977) wrote a firsthand account of Langford's experiences of living at Hot Springs. The life of E. E. Townsend was written about by Burgess and Bently (1947) and Saxton and Casey (1958).

Early Industry

Early industry of the Big Bend region was described by Casey. He wrote about the candelilla wax industry (1970), ranching (1968), the Boquillas - Hot Springs area (1971), and Lajitas (1971). Utley (1962) wrote about the early cattle industry, and Ragsdale (1976) about the mining. Prewitt (1947) summarized the economic activities of the region prior to the establishment of BBNP.

Historical Structures

The most complete and up-to-date report of the historical structures at BBNP was prepared by Davila (1983). Brown and Evans (1964) provided an earlier inventory. Anon. (No date k, l) contains floor plans and other data on Park Service structures. Koue (1969) described the architecture of the Hot Springs complex, and Sheire and Simmons (1973) described the structures at Castolon. Weedin (1975) wrote of the ruins along Tornillo Creek. Baronial forts of the Big Bend region were discussed by Corning (1967).

Management Plans

Brown and Wauer (1968) wrote a "Historic Resources Management Plan" for BBNP. Scott (1978) summarized the relative value of seven planning documents.

Development of Big Bend National Park

The most complete accounts of the history and development of Big Bend National Park are provided by Anderson (1967) and Jameson (1974). Maier (1935), USDI (1935), Wirth (1935a, b), Morelock (1938), Brown and Olcott (1942), and Maxwell (No date a, b) provide first person perspectives at the time the events were occurring. Wagstaff (1968) wrote a more recent account of the legislative history.

"Level" of Data

Native Americans

Level 1

Easterla, P. 1968

Level 2

Anon. No date r, Nelson 1935, Townsend 1935, Smith 1946,
Casey 1948, Campbell and Field 1968, Easterla, P. 1968

Explorers

Level 1

Bartlett 1854, Cabez de Vaca 1905 translation

Level 2

Hartz 1859, Echols 1860, Smith 1927, 1928, Tyler 1968

Settlers

Level 1

Anon. No date p, Gillett 1933, Burgess and Bentley 1947

Level 2

Casey 1948a, b, 1969b, Edwards 1951, Raborq 1954, Saxton
and Casey 1958, Smithers 1963, Wood 1963, Tyler 1975b,
Langford and Gipson 1977

Early Industry

Level 2

Prewitt 1947, Utley 1962, Casey 1968, 1970a, b, 1971,
Ragsdale 1976

Historical Structures

Level 2

Corning 1967, Koue 1969, Brown and Evans 1964, Sheire and
Simmons 1973, Weedon 1975, Davila 1983

Management Plans

Level 2

Brown and Wauer 1968, Scott 1978

Development of Big Bend National Park

Level 1

Maxwell no date a, Morelock 1938, Brown and Olcott 1942

Level 2

Maier 1935, USDI 1935, Wirth 1935a, b, Anderson 1967,
Wagstaff 1968, Jameson 1974

SOIL

Early papers about the soils of Brewster County were written by Carter and Cory (1931) and Anon. (1949, 1973). Whitson (1970, 1974) provided data on soils in the Chisos Mt. Cochran (Early 1980s) wrote the most recent and complete paper about the soils of Big Bend National Park.

Kettle (1972) determined the concentration of mercury in the soil; Applegate (1970) did the same for insecticides.

"Level" of Data

Level 1

Carter and Cory 1931; Anon. 1949, 1973; Whitson 1970, 1974

TERRESTRIAL FAUNA

INVERTEBRATESEarly surveys

No invertebrate surveys conducted before 1900 were found.

Prepark surveys

Baker (1938) conducted a preliminary survey of insects. Kinsey (1935) identified gall wasps, Gertsch (1939) collected 22 species of Arachnids, and Gloyd (1958) surveyed the dragonfly fauna.

Contemporary checklists

There is no comprehensive checklist of invertebrates for Big Bend National Park. However, lists are available for some taxa. Pratt (1971b, 1971c, 1972) identified land snails in the Park. Clench (1963), Kendall (1971), Blanchard (1973), and Knudson (1984) provided checklists for groups of Lepidoptera. Van Pelt (1975, 1983) did the same for ants, and Loomis and Wrenn (1972) and Loomis et al. did so (1972) for the chiggers. Suter (1984) and Wellso (1984) are compiling lists of the Coleoptera in BBNP, and Anderson (1983) of the Curculionoidea. Arachnids were collected by Sabath (1967) and Smith (1972), Mantidae by Robinette (1969), and ectoparasites by Whitaker and Easterla (1975). Although most of the insect surveys conducted by Tinkham (1941, 1943, 1944, 1948) were done in Presidio County, they are useful for characterizing the invertebrate fauna of Big Bend National Park.

Taxonomy and distribution

New species and distribution have been described by Arnett (Oedemeridae) (1965), O'Conner et al. (Nycteriglyphus) (1977), and Pratt (snails) (1971a). Stahnke (1967) and Sissom (1984) identified scorpions found in the Park, and Sanderson (1939), Howden (1960a, b), and O'Brien (1973) identified the beetles. Knull (1944, 1946, 1952a, b, 1954, 1956, 1958a, b, 1959, 1960a, 1960b, 1962) identified new species of beetles in the Park. New species of Lepidoptera were identified by White (1944), Blanchard

(1966, 1968, 1971, 1972, 1973), Blanchard and Ferguson (1975), Blanchard and Knudson (1981a, b), and Ferguson et al. (1983).

Single species or taxon studies

Crawford (1973, 1974, 1976) and Wooton and Crawford (1975) conducted extensive ecological studies of Orthoporus (millipedes). Nunez and Crawford (1976) studied their digestive enzymes. Land snails were studied by Pratt (1971a, b, 1972, 1974) and ants by Van Pelt (1971, 1974, 1975, 1983) and Whitford (1978). Nelson and Crowell (1969) identified Vespidae (wasps) of the Park, and Hook (1981, 1982) investigated their nesting behavior. Gaumer (1973) studied the aestival tiger beetle fauna. Kendall (1966) studied the food and distribution of Hesperidae. Khan (1981) determined mercury levels in several species of arthropods.

AMPHIBIANS AND REPTILESEarly surveys

Strecker (1909) provided the first checklist of amphibians and reptiles for Brewster County. He identified 34 species of reptiles and four species of amphibians.

Prepark surveys

Smith (1936) identified four species of amphibians and 36 species of reptiles in the area of the Park. Murray (1939) listed 23 species of reptiles and three species of amphibians after a one month survey in the Chisos Mountains. Schmidt and Smith (1944) made extensive collections and identified four species of amphibians and 42 species of reptiles.

Contemporary checklists

Minton (1958) identified 69 species of amphibians and reptiles occurring in Big Bend National Park. Easterla (1975a) wrote the most recent checklist. The NPS (USDI 1982) listed 71 species for the Park.

Taxonomy and distribution

A new species of Coleonyx was described by Davis and Dixon (1958). Degenhardt and Milstead (1959) identified Tantilla cucullata and mapped its distribution.

Event record

Unusual sightings are recorded and placed in a card file in the Naturalist's office

Single species or taxon studies

The ecology of several genera has been well studied: Cnemidophorus (Lucchino 1970 Degenhardt 1960), Holbrookia (Degenhardt 1960), Coleonyx brevis and C. reticulatus (Dial 1975), Sceloporus and Urosaurus (Milstead 1970, 1971 Milstead and Smith 1970), Elaphe (Wallace and Hollander 1973), and Cophosaurus (Howland 1983). Trimorphodon vilkinsoni was studied by Degenhardt and Steele (1957), Hemidactylus turcicus by Easterla (1978), and Agkistrodon contortrix by McClung and Maxwell (1976). Natural history of the Big Bend slider was described by Leqler (1960).

Reproduction of the reticulated gecko was observed by Gallo (1978) and Loomis and Jahn (1973). Easterla (1975d) described the ecology and reproduction of Tantilla rubra. Campbell (1972) did the same for the Trans-Pecos ratsnake. The survival of Scaphiopus couchi larvae was investigated by Newan (1983). Food habits of Sceloporus poinsetti were identified by Smith and Milstead (1971).

Community ecology

Community ecology has been investigated for Sceloporus (Brown 1970 Dunham 1978, 1981), Holbrookia and Cnemidophorus (Degenhardt 1966), Urosaurus (Dunham 1978, 1981), and other groups of lizards (Degenhardt 1968, 1969, 1970).

Use and effects

The level of insecticides in vertebrates at campgrounds was determined by Applegate (1970); Gallagher (1974) measured the concentration of mercury in lizards.

BIRDSEarly surveys

Birds in the Big Bend region of Texas were first discussed by Baird (1859b). Beckham (1888) provided extensive notes on the birds of southwestern Texas. Bailey (1905) reported on birds throughout the state. The observations made by Oberholser (1902), Fuertes (1903), Montgomery (1905), and Maxon (1916a, b) were almost exclusively in the area that is now the Park.

Prepark surveys

During the 15 years before Big Bend National Park was created several surveys were conducted to obtain base-line information. The most comprehensive investigation of birds was by Van Tyne and Sutton (1937). The account by Brandt (1940) was also extensive. Observations of birds were reported by Van Tyne (1929), Thompson (1934), Sutton (1935, 1936), Quillin (1935), Borell (1936, 1938), Johnson (1937), Brandt (1938), and Stevenson and Smith (1938).

Contemporary checklists

Voluminous data and checklists are available on the occurrence of birds in Big Bend National Park. The most recent and comprehensive work is that of Wauer (1973a, the book was being updated in 1984). Oberholser (1974) gives excellent data on birds for the state of Texas.

Revised checklists have been published frequently since the mid 1930s. Observers used the checklist developed by Van Tyne and Sutton (1937) as a base on which to build. Cruickshank (1950) reported 119 species seen on a trip through Brewster County in 1949. Brodrick (1960) wrote the first complete update of birds of Big Bend National Park; in 1966 an official checklist of birds was published (Brodrick et al. 1966). Wauer (1967a, 1968a) rewrote the checklist and identified 358 species of birds occurring in the Park. In 1969 (Wauer 1969d) 357 species were listed for the Park. Easterla (1973a) listed 382 species in his revision of the bird checklist. Wauer (1973a) included 359 species on the regular list of birds in the Park and 26 on a list of hypothetical species; a total of 385 species. Scott's (1978b) summary of new records for the Park brought the total number of species of birds seen to 399.

Additional information on breeding birds can be found in Dixon (1966), Wauer (1968a), and Scott (1978a); wintering bird information in Wauer (1967d, 1969c); and general information in Wauer (1969a, 1973b, 1980) and Rylander (1968). A list of birds banded at the Park was compiled by Wauer (1967b). Christmas bird counts are conducted at Rio Grande Village and in the Chisos Mountains. The Rio Grande Village count began in 1965, and the Chisos Mountains count in 1966. Both counts have been conducted every year except for 1973, 1974, and 1975 (Aud. Field Notes 1966, 1967, 1968, 1969, 1970, 1971, Am. Birds 1972, 1973, 1976, 1977). Only the Rio Grande count was conducted in 1973.

Unusual or noteworthy sightings have been reported in the literature by Galley (1951 - Clark's nutcracker), Barlow (1967 - black-capped vireo), Wauer (1970c - black-vented oriole, 1970f - swallow-tailed kite, 1970g - upland plover, 1973d - bronzed cowbird), Barlow and Wauer (1971 - gray vireo), Wauer and Davis (1972 - cave swallow), Wauer and Scudday (1972 - Charadriiformes), and Wolf (1978 - Aztec thrush).

Taxonomy

The taxonomy of bushtits was reviewed by Raitt (1967) and that of Dendroica cornata by Hubbard (1969). Geographic variation in the blue-throated hummingbird was discussed by Van Tyne (1953). He also described a new subspecies of titmouse (Van Tyne 1954).

Event record

A card file in the Naturalist's office is used to record unusual events or sightings. Sight records for the goshawk and Aztec thrush are examples of the kinds of data recorded.

Single species and taxon studies

Ecology of hummingbirds (and other species) in relation to Agave havardiana was thoroughly investigated by Allen (1977), Allen and Neill (1979), and Neill and Allen (1979). Kuban (1977) identified niche overlap in 5 species of hummingbirds. The general ecology of six vireo species was reviewed by Barlow (1970, 1977). White-winged dove ecology was described by Gallucci (1978), roadrunner breeding behavior by Whitson (1971), and a reintroduction attempt of Montezuma quail by Wauer (1973c) and Brown (1977). Bushtit taxonomy was analyzed by Raitt (1967).

Peregrine falcon

In the mid 1970s and early 1980s several searches for the endangered peregrine falcon were conducted in BBNP and Trans-Pecos Texas. Eleven sites were located in 1975. Four canyon eyries failed to produce young; however, 6 of 7 sites in the mountains were successful (Hunt 1975). Surveys were continued in 1976 (Hunt 1976a, Johnson 1976), 1977 (Brownlee 1977, Hill and Schaetzer 1977), 1978 (Wesson et al. 1978), 1979 (Lawson and Falxa 1979), 1981 (Swepston 1981), and 1983 (Sharp 1983). Breeding in the Park was reported by Hill and Schaetzel (1977) and in Texas by Kowaleski and Wade (1977). In 1979 two of three eyries along the Rio Grande in BBNP produced young. Birds also fledged at a Chisos Mt. site (Scott 1979). Reports on the status of the peregrine falcon in west Texas were prepared by Hunt (1976b, 1977). Key (1980) reviewed the 1980 breeding status of falcons in Texas national parks. Critical habitat for peregrine falcons was identified by Netherton et al. (1978) and Key (1981). Breeding activity at each known peregrine nesting site in BBNP is recorded annually by Park personnel.

Colima warbler and Lucifer hummingbird

The Colima warbler and Lucifer hummingbird can be seen regularly (in the U.S.) only in BBNP. Van Tyne (1936) found the first nest of the Colima warbler in 1932. At that time Colima warblers were common and remained so until 1946. The population was estimated to be greater than 15 pairs (Blake 1949); however, no birds were reported from 1947-1949. Snyder (1957) found a nest with 4 young and counted 14 adults in the Boot Spring area. Gehlbach (1967) found a nest with young on 5 July 1964 (a late nesting date) near Boot Spring. The nesting behavior of the Colima warbler was described by Robinson (1973). Base-line population estimates and a monitoring program were established by Wauer (1967b, 1969b, 1970d); a summary of the results was published (Wauer 1979). Eleven "count units" were identified in the Chisos Mountains and the warblers censused in 1967, 1968, 1969, 1970, 1974, and 1976. Birds were seen only in pinyon-juniper-oak or cypress-pine-oak associations. The average number of warblers seen in the 6 years was 58 pairs (45-83 pairs). Populations were considered stable in 6 of the 11 count units. Precipitation may be positively correlated with number of pairs present the following year. The most recent census was conducted in 1982 (Griffen 1982). An excellent review of the status of the Colima warbler was conducted by Lanning (1983).

Lucifer hummingbirds are fairly common in all habitats of BBNP (Wauer 1973a). Their plumage and territorial behavior were described by Fox (1954). Characteristics of the nest were reported by Nelson (1970).

Community ecology

Dixon (1959) determined the density of desert birds on 33-acre plots. Wauer (1971b) identified the habitat preference of birds in relation to 6 plant associations. He also related changes in abundance and distribution to changes in the vegetation (Wauer 1974, 1977a) and identified birds dependent upon the riparian habitat (Wauer 1977b). Distribution, species diversity, and island biogeography were discussed using data from the Park (Wauer and Liqon 1977). Parker (1982) used regression and Bray-Curtis ordinations to determine that composition and vertical vegetation corresponded with complexity of bird communities.

Effects

The level of insecticides in some vertebrates at BBNP was determined by Applegate (1970). The level of DDT in the prey of peregrine falcons was identified by Hunt and Johnson (1977, 1982).

MAMMALS

Early surveys

The earliest accounts of mammals in the Trans-Pecos were in narratives of explorers and surveyors. Bartlett (1854) surveyed the U.S.-Mexico boundary and reported on his travels. Woodhouse (1854), Bailey (1859, 1902, 1905), Baird (1859a), and Mearns (1896b, 1897a, b, 1898c, 1907) accompanied the surveyors and wrote about the biology of the area. Comments from the years before 1900 were usually based on casual observations. Some of the information can be used to determine distribution, relative abundance, and habitat preferences.

Prepark surveys

During the decade before Big Bend National Park was established many surveys were conducted to obtain base line data. The most comprehensive investigation of mammals was by Borell and Bryant (1942); they prepared species accounts for 55 species. Johnson (1937) listed 30 species of mammals that occurred in the area of the proposed Park. Casual observations were reported by Thompson (1934), McDougall (1935b), Stevenson (1935), Wirth (1935b), Smith (1936b), and Taylor et al. (1944).

Contemporary checklists

Three recent checklists of mammals have been compiled for the Park. Wauer (1969b) identified 67 species, Easterla (1973c) 75 species, and NPS (USDI 1982) 74 species. Three publications, although not written solely for Big Bend National Park, are useful as checklists: Davis (1960, 1974) covers the state of Texas, Schmidly (1977) the Trans-Pecos, and Findley and Caire (1977) the northern Chihuahuan Desert.

Although not intended as checklists, work by Denyes (1956), Judd et al. (1966), Judd (1967), Baccus (1971), Wauer (1973b, 1980), Schmidly and Ditton (1976), and Boer (1977) may supplement them. Rodents were listed by Baccus (1971) and Boer and Schmidly (1977) and bats by Easterla (1967, 1968b, 1972).

Event record

A card file in the Naturalist's office is used to record unusual events or sightings. Sight records of black bear

and coati are examples of information in the files.

Bats

The ecology of bats in BBNP was studied by Easterla (1973b). He also provided observations of dead bats (Easterla 1969), species distribution (Easterla 1968a, 1970, 1975c), population trends of the long-tongued bat (Easterla 1972d), food habits (Easterla and Whitaker 1972), and notes on the spotted bat (Easterla 1970b, 1976; Easterla and Easterla 1969). Howell (1984) quantified the foraging behavior of Leptonycteris.

Predators

Movement patterns of coyotes (Stine 1975) and mountain lions (McBride 1976) in BBNP were identified using radio-telemetry. The mountain lion population in Trans-Pecos was estimated to be between 150-180 animals; deer are their preferred prey. Edwards (1950) and Wallmo (1959) wrote summaries of lion sightings. Waid (1984) used telemetry to determine movements of mountain lions in the Park.

Rodents

Three papers address taxonomy of rodents in the Park. Bryant (1939) identified a new race of Dipodomys ordii, D. o. attenatus. Warner and Warner (1964) prepared a key to the Peromyscus of the Park, and Avise et al. (1974) used electrophoresis to identify subspecies of Peromyscus boylii.

Beaver have been studied by Crowder (1969), Conner and Feeley (1976), Feeley and Conner (1977), Strong and Bissonette (1981), and Strong (1982). The population in the Park was estimated to be 94 by Conner and Feeley (1976) and 134 by Strong (1982). The distribution of beaver and vegetative communities were mapped; and habitat use and food habits investigated.

Rasp (1964) and Crowder (1970) studied the yellow-nosed cottonrat in the Chisos Mountains. General habitat use and food habits were identified. The density of the yellow-nosed cottonrat was 21/ac, density of deer mice was 53/ac. Rodents were trapped in five habitat types by Warner (1964).

Movements, populations, and habitat preferences of Perognathus were studied by Porter (1962). General ecology accounts of the silky pocket mouse (Forbes 1963), and rock squirrel (Layton 1973) are available.

Grassland, desert, and woodland rodent communities were discussed by Baccus (1971); grassland had the greatest species diversity and woodland the lowest. The effect of visitor use and grazing on riparian rodents was determined by Schmidly and Ditton (1976), Boer (1977), and Boer and Schmidly (1977).

Use and effects

Pesticide levels in rodents were determined by Applegate (1970).

Ungulates

White-tailed deer were studied by Mearns (1898a), Blackman (1970), Atkinson (1976), Krausman (1976, 1978a, b), Krausman and Ables (1976), and Krausman et al. (1978). Data are available on density, population size, relative abundance, sex ratios, predation pressure, habitat use, competition, food habits, and taxonomy. Similar data are available for mule deer (Kucera 1976, 1982; Leopold 1984) and peccary (Bissonette 1976, 1982). A summary of the status of bighorn sheep was prepared by Hailey (1977) and Leopold and Krausman (1983).

"Level" of Data

INVERTEBRATESSpecies Inventories

Level 1 - Pre 1900

No inventories found.

Prepark inventoryKinsey (1935), Baker (1938), Gertsch (1939), Gloyd (1956)

Contemporary observations

Robinette (1969), Wrenn (1971), Anderson (1983), Suter (1984)

Level 2 - Contemporary observations

Clench (1963); Sabath (1967); Smith (1967); Kendall (1971); Pratt (1971a, b, 1972); Loomis and Wrenn (1972); Loomis et al. (1972); Blanchard (1973), Van Pelt (1975, 1983); Knudson (1984), Willso (1984)

Taxonomy and distribution

Level 2

Sanderson (1939); Knull (1944, 1946, 1952a, b, 1954, 1956, 1958a, b, 1959, 1960a, b, 1962); White (1944); Howden (1960a, b); Arnett (1965); Blanchard (1966, 1968, 1972, 1973); Stahnke (1967); Pratt (1971); O'Brien (1973); Blanchard and Ferguson (1975); O'Conner et al. (1977); Blanchard and Knudson (1981a, b); Ferguson et al. (1983); Sisson (1984)

Populations and Abundance

Level 1

Tiger beetle (Gaumer 1973)

Level 2

Orthoporus (Crawford 1973, 1974, 1976; Wooten and Crawford 1975; Nunez and Crawford 1976)

Land snails (Pratt 1971a, b, 1972, 1974)

Ants (Van Pelt 1971, 1974, 1975, 1983; Whitford 1978)

Vespidae (Nelson and Crowell 1969; Hood 1981, 1982)

Hesperiidae (Kendall 1966)

Use and Effects

Level 2

Mercury in arthropods (Khan 1981)

AMPHIBIANS AND REPTILESSpecies Inventories

Level 1 - Pre 1900
Strecker (1909)

Prepard inventory
Murray (1939)

Contemporary observations
Wauer (1973b, 1980; NPS 1982)

Level 2

Prepark surveys
Smith (1936), Schmidt and Smith (1944)

Contemporary checklists

Minton (1958); Wauer (1970); Anon. (1971); Easterla (1975a)

Taxonomy

Level 2

Trimorphodon vilkinsoni (Degenhardt and Steele 1957)
Tantilla cucullata (Degenhardt and Milstead 1959)
Hemidactylus turcicus (Easterla 1978)
Akistrodon contortrix (McClung and Maxwell 1976)
Coleonyx (Davis and Dixon 1958)

Populations and Abundance

Level 2

Tantilla rubra (Easterla 1975b)
Reticulated Gecko (Gallo 1978; Loomis and Jahn 1973, Dial 1975)
Coleonyx brevis (Dial 1975)
Big Bend slider (Leqler 1960)
Cnemidophorus (Lucchino 1970)
Holbrookia (Degenhardt 1960)
Sceloporus and Urosaurus (Milstead 1970, 1971 Milstead and Smith 1970, Smith and Milstead 1971)
Elaphe (Wallace and Hollander 1973, Campbell 1972)
Cophosaurus texanus (Howland 1983)
Scaphiopus couchi (Newan 1983)

Use and Effects

Level 2

Mercury concentration in lizards (Gallagher 1974)

Insecticide levels in lizards (Applegate 1970)

Community Dynamics

Level 2

Sceloporus (Brown 1970, Dunham 1978)

Holbrookia and Cnemidoporus (Degenhardt 1966)

Urosaurus (Dunham 1978)

Lizards (Degenhardt 1968, 1969, 1970)

BIRDSSpecies Inventories

Level 1 - Pre 1900, 9 references

Bartlett 1854; Baird 1859; Beckham 1888; Oberholser 1902;
 Fuertes 1903; Bailey 1905; Montgomery 1905; Maxon 1916a, b

Prepark inventory, 10 references

Van Tyne 1929; Thompson 1934; Sutton 1935, 1936; Quillin
 1935; Borell 1936, 1938; Johnson 1937; Brandt 1938;
 Stevenson and Smith 1938

Contemporary observations

Galley 1951; Aud. Field Notes 1966, 1967, 1968, 1969,
 1970, 1971; Dixon 1966; Wauer 1967d, 1968a, 1969a, 1969c,
 1970a, 1970c, 1970d, 1973b, 1973c, 1980; Barlow 1967; Wauer
 and Rylander 1968; Barlow and Wauer 1971; Am. Birds 1972,
 1973, 1976, 1977; Wauer and Davis 1972; Wauer and Scudday
 1972; Scott 1978b; Wolf 1978

List of birds banded (Wauer 1968c)

Level 2 - Prepark inventories, 2 references

Van Tyne and Sutton 1937; Brant 1940

Contemporary regional checklists, 2 references

Wolfe 1956; Oberholser 1974

Recent Park checklists, 6 references

Brodrick 1960; Brodrick et al. 1966; Wauer 1967a, b,
 1969d, 1973a; Easterla 1973

Taxonomy

Level 2

Blue-throated hummingbird (Van Tyne 1953)

Black-crested titmouse (Van Tyne 1954)

Dendroica cornata (Hubbard 1968)

Bushtits (Raitt 1967)

Populations and Abundance

Level 1

Peregrine falcon (Hunt 1975; Hunt 1976a; Johnson 1976;
 Brownlee 1977; Hill and Schaetzel 1977; Kowlaleski and
 Wade 1977; Scott 1979; Key 1980)

Colima warbler (Van Tyne 1936; Blake 1949; Snyder 1957;
 Gehlbach 1967, Wauer 1967b)

Lucifer hummingbird (Fox 1954; Nelson 1970)

Level 2

Peregrine falcon (Hunt 1976b, 1977; Hill and Schaetzer 1977, Netherton et al. 1978; Wesson et al. 1978; Lawson and Falxa 1979; Key 1981; Swepston 1981; Griffen 1982; Lanning 1983; Sharp 1983)

Colima warbler (Robinson 1973; Wauer 1967c, 1969b, 1970b, 1979)

Hummingbirds (Allen 1977; Kuban 1977; Allen and Neill 1979; Neill and Allen 1979)

Vireos (Barlow 1970, 1977)

White-winged dove (Gallucci 1978)

Roadrunner (Whitson 1971)

Montezuma quail (Wauer 1973c, Brown 1977)

Community Dynamics

Level 2

Desert communities (Dixon 1959)

Habitat preference (Wauer 1971b)

Succession (Wauer 1974, 1977a; Parder 1982)

Riparian communities (Wauer 1977b)

Biogeography (Wauer and Ligon 1977)

Use and Effects

Level 2

Insecticides (Applegate 1970)

DDT/Peregrine falcons (Hunt and Johnson 1977, 1982)

MAMMALSSpecies Inventories

Level 1 - Pre 1900, 12 references

Bartlet 1854; Woodhouse 1854; Emory 1857; Bailey 1859, 1902, 1905; Baird 1859; Mearns 1897a, b, 1898c, 1907 .

Pre Park inventory, 7 references

Thompson 1934; McDougall 1935b, Stevenson 1935; Wirth 1935b; Smith 1936b; Johnson 1937; Taylor et al. 1944

Level 2 - Prepark inventories, 2 references

Johnson 1937; Borell and Bryant 1942

Contemporary regional checklists, 3 references

Davis 1960, 1974; Findley and Claire 1977; Schmidly 1977

Recent Park checklists, 4 references

Hammerstrom 1949; Wauer 1968b; Easterla 1973; NPS 1982

Additional data on species present in BBMP. 11 references.

Denyes 1956; Easterla 1967, 1968b, 1972; Judd 1967; Baccus 1971a, b; Wauer 1973b, 1980; Schmidly and Ditton 1976; Boer 1977; Boer and Schmidly 1977

Taxonomy

Level 2

Peromyscus (Awise et al. 1974)

White-tailed deer (Mearns 1898a, Krausman et al. 1978)

Populations and Abundance

Level 1

Bats (Easterla 1968, 1969, 1970a, b, 1971, 1975; Easterla and Easterla 1969; Easterla and Whitaker 1972)

Beaver (Crowder 1969, Feeley and Conner 1977)

Mule deer (Kucera 1982)

Mountain lion (Edwards 1950, Wallmo 1959, Van Pelt 1977)

Bighorn sheep (Hailey 1977, Leopold and Krausman 1983)

Level 2

Bats (Easterla 1972, 1973; Howell 1982)

Rock squirrel (Layton 1973)

Pocket mice (Porter 1962, Forbes 1963)

Beaver (Conner and Feeley 1976, Strong and Bissonette 1978, Strong 1982)

Yellow-nosed cottonrat (Rasp 1964, Crowder 1970)

Rodents (Warner 1964)
 Coyote (Stine 1975)
 Mountain lion (McBride 1977, Waid 1984)
 Peccary (Bissonette 1976, 1982)
 Mule deer (Kucera 1976, Leopold 1982)
 White-tailed deer (Blackman 1970, Atkinson 1976; Krausman
 1976, 1978; 1978; Krausman and Ables 1976; Krausman et al.
 1978)

Community Dynamics

Level 2

Rodent communities in grassland, desert, and woodland
 (Baccus 1971a)
 Riparian rodent communities (Schmidly and Ditton 1976,
 Boer 1977, Boer and Schmidly 1977, Schmidly et al. 1979)

Use and Effects

Level 2

Riparian rodent communities (Schmidly and Ditton 1976,
 Boer 1977, Boer and Schmidly 1977, Schmidly et al. 1979)
 Pesticide levels in rodents (Applegate 1970)

Models

Level 2

Peccary (Bissonette 1982)

USE AND EFFECTS

Early discussions of the Park's environment including geology, climate, flora, fauna, visitor accommodations and access, and park boundaries were provided by Shipman (1926), Toll (1934A), Winton (1936), Schoffelmayer (1937), Taylor et al. (1944), Taylor (1944), Tilden (1945), and Lassiter (1949). Scenic and potential recreational values in the park were described by Scott (1950) and Sprecher (1951). Jones and Harris (1959) identified 12 sites of possible interest to visitors. Evans (1964) developed a prospectus for interpretative activities in the Park.

Kenny (1968) provided a more recent visitor-oriented description of BBNP, and Madison (1968) discussed vegetation and wildlife found within the Park.

Floor plans, construction blueprints, survey sheets, benchmark information, and boundary proposals are available (Anon. No date k, Anon. No date q).

Park guides to trails (Anon. 1978), roads (Anon. 1980, Anon. 1980), and geothermal areas (Bennack et al. 1978) are also available. General tourist information about the Park was provided by Maxwell (1950) and Deckert (1981).

Land Use

The history of land uses by people inhabiting BBNP was reported by Madison (1968), Casey (1969, 1970), and Wauer (1970a, 1975a). Casey reviewed military, ranching, mining, railroad construction, candilla wax production, and farming activities in the area. Madison (1968) described livestock grazing and mining activities by people occupying the area from the time of Cabeza de Vaca to the 1960's. Wauer (1970a, 1975a) examined the ecological implications related to earliest hunting and food-gathering efforts in the Park to the more recent ranching, mining, and farming activities.

Livestock Grazing

The use of range lands in the BBNP area was reviewed by Gillett (1933), Russell (1935), Sperry (1938), Maxwell (1949), Utley (1962), Gehlbach (1965a), Warnock (1967a), Madison (1968), Casey (1968, 1969), Wauer (1975a), Howarth (1976), Schmidly and Ditton (1980). Sperry (1938), Maxwell (1949), McDougall (1953), Gehlbach (1965a), Warnock (1967a), Wauer (1970a, 1975a), and Schmidly and Ditton (1976, 1980) discussed deteriorating range conditions, shrub dominance over native grasses, and other adverse ecological effects resulting from cattle and sheep grazing in the area. Gillett (1933) described the natural environment along Terlingua Creek prior to the establishment of the G 4 ranch.

The use of horses in the Park for trail-riding and their effect on natural vegetation was examined by McDougall (1953) and USDI (1975). Whitson (1974) identified horse droppings on trails as the source of exotic plant species germinating in the Chisos Basin.

Mining

Reports of mining within the Park area were made by Schoffelmayer (1937), Madison (1968), Casey (1969), Csepregi (1973), and Sharpe (1980). Kettle (1972), Dumas (1974), Gallagher (1974), Houston and Dumas (1974), and Houston (1975) examined the effects of mercury mining in the BBNP area.

Recreation

Studies of recreational activities and visitor use patterns in BBNP include analyses of backcountry use permits (Schmidly and Ditton 1976, Ditton et al. 1981, Ditton and Bobbitt 1982), survey of river road campers (Ditton et al. 1977), examination of the motivations and satisfactions associated with a river float trip in the Park (Graefe 1977), and analyses of Santa Elena Canyon users (Ditton et al. 1981).

The effects of human activity, particularly camping and river-floating, on river resources and riparian habitats in BBNP were studied by Ditton et al. (1976, 1976, 1977) and Schmidly and Ditton (1976, 1978, 1979). Boer (1977) and Schmidly and Ditton (1976, 1979, 1979, 1980) inventoried small mammal populations in riparian zones to assess the influence of recreational activities on the fauna. Degenhardt (1969) discussed the effects of recreational development on the herpetofauna in BBNP.

Pesticides and Pollution

Reports of pesticide use and analyses of residues within BBNP were provided by Applegate (1970), Environmental Consultants, Inc. (1976), Fuchs (1976), Hunt (1961), and Schmidly and Ditton (1979).

Contaminant and pollution investigations in the Park were conducted by Lind and Bane (1980), Walther et al. (No date), Wetmore (1980, 1981), Yarborough and Meyers (1983, 1982), and Bennack et al. (1978).

Management

Management considerations and master plan proposals for the management of public uses and resources in BBNP are outlined in a series of USDI documents (1979, 1979a, 1979b, 1980c). Americans Backing Better Park Development (No date) proposed their own version of a master plan for the Park.

Brown et al. (1968) developed a management plan for BBNP's historical resources, and Liles (1982) developed a plan for river and backcountry use management. Plans for fire management and general development in the Park were outlined by the USDI (1980a, 1980b). Environmental assessments and environmental impact statements were also made by the USDI (1975, 1977, 1979b).

Wilderness proposals and management plans were presented by Americans Backing Better Park Development (No date), Anon. (1971), Anon. (1973), Liles (1982), and the USDI (1971, 1975, 1975B, 1979, 1979A). Wild and scenic river designations were discussed by the USDI (1975, 1980a).

Management and provision of Park facilities were outlined by Wear (1947) and the USDI (No date, 1975a, 1979). Alling (1978) and Ditton (1982) discussed the utility of visitor-use permits in BBNP. Baskin (1978), Gehlbach (1965a), and the USDI (1977, 1979) considered the effects of roads and trails throughout the Park.

"Level" of Data

Land Use

Level 2

Madison 1968; Casey 1969, 1970; Wauer 1970a, 1975a

Livestock Grazing

Level 1

Gillett 1933

Level 2

Russell 1935; Sperry 1938; Maxwell 1949; McDougall 1953; Utley 1962; Gehlbach 1965a; Warnock 1967a; Casey 1968, 1969; Madison 1968; Wauer 1970a, 1975a; Whitson 1974; USDI 1975; Howarth 1976; Schmidly and Ditton 1976, 1980

Mining

Level 2

Schoffelmayer 1937; Madison 1968; Casey 1969; Csepreqi 1973; Sharpe 1980

Recreation

Level 2

Boeer 1977; Schmidly and Ditton 1976, 1978, 1979, 1980; Ditton et al. 1976, 1977, 1981; Graefe 1977; Ditton and Bobbitt 1982

Pesticides and Pollution

Level 2

Applegate 1970; Environmental Consultants Inc. 1976; Fuchs 1976; Schmidly and Ditton 1979; Lind and Bane 1980; Wetmore 1980, 1981; Yarborough and Meyers 1982, 1983;

Management

Level 2

Wear 1947; Brown et al. 1968; Gehlbach 1965a; USDI 1975, 1977, 1979a, b, 1980a, b, c; Alling 1978; Baskin 1978; Ditton 1982

VEGETATION

Early surveys

Engelman (1859) wrote about the cacti of the U.S. Mexico border.

Prepark Surveys

Many expeditions visited the Big Bend region to determine the area's suitability as a National Park. McDougall (1935a) and Muller (1937) identified about 450 species of vascular plants. Sperry (1938, 1941) collected almost 900 species. Sperry and Warnock (1941) identified 1,139 species of plants. Roseberry and Dole (1938) prepared a vegetation map of the area. Casual observations were reported by Palmer (1928), Marsh (1937), Matthews (No date, 1937), and Taylor et al. (1944).

Checklists

Checklists of plants have been frequently prepared for BBNP. McDougall and Sperry (1951) wrote a key to over 800 species of vascular plants occurring in the Park. Warnock and Koch (1970) prepared the most recent checklist. About 750 specimens are stored in the Park herbarium (Warnock 1967b). Powell (1984) continues to collect plants and deposit them at Sul Ross State University in Alpine.

Anthony (1952) and Smith (1972, 1973) listed the cacti that occur in BBNP; Kurtz (1979) wrote a key. Wauer (No date) identified 58 forms of cacti in BBNP.

Keys and lists are also available for other groups of plants. Cummins (1964, 1965) wrote about the Uredinales, Wetmore (1969, 1976) the lichens, Magill (1972, 1975, 1976) the mosses, and Wauer (1971) the oaks.

Physiology/Anatomy

Chemical properties of locoweed, cacti, and nectar of the century have been studied (Pease 1940, Neill and Allen 1979). Eickmeier investigated crassulacean acid metabolism (1976, 1978, 1979).

Ruth (1972) studied the stomata of agaves in the Park.

Single Species or Taxon Studies

Burr (1966) wrote a brief account of an aspen survey, and Wauer (1971e) a key to the oaks. Walter and Lucht (1977) discussed diseases that might affect cottonwood trees in the Park. Liles (1983) wrote about the "Big" trees of the Park.

The status of several species of plants in the Park has been investigated: Opuntia (Anthony 1951), night-blooming cereus (Davis 1969), Giant dagger (Yucca carnerosana, O'Neil 1971), Hechtia scariosa (Green 1973, Smith 1978), salt cedar (Howarth 1976), Leucaena retusa (Brewbaker 1979), Aquilegia spp. (Lott 1979), and Ancistrocactus tobushii (Heil and Brack 1984).

The rehydration of the resurrection plant was investigated by Eickmeier (1984), pollination of Agave harvardiana by Kuban (1983), and ontogeny of legumes by Derstine (1982).

Plots, Transects, and Succession

Long-term changes in the vegetation of the Park were reviewed by Wauer (1970a). Moir (1982) reviewed the effects of fire on the vegetation in the Chisos Mt. Warnock (1967a) compared a series of photos taken in the early 1900s to a series taken in 1966-67.

Quantitative data on the vegetation of the Park was first collected in 1936-37 when exclosures were built at Green Gulch, Burnham's Trap, and Tornillo Flat (Sperry 1938). "Raw" data on recovery of the vegetation is available for 1944-51 (Anon. 1944-51). The Soil Conservation Service, in cooperation with the NPS, established 11 vegetation transects in Big Bend National Park in 1948 (Leithead 1948). These plots were remeasured by Warnock (1970b) in 1969. Wallmo (1955) described the location of 5 transects between Panther Junction and Persimmon Gap. Warnock (1955) provided photos and plot maps for 6 belt transects. Summaries of the data from the belt transects in 1955 and 1967 were given by Warnock (1967d). Wondzell and Ludwig (1983) remeasured 51 transects in 1981. The Texas A&M circular plots, established in 1955, were read again in 1968 (Warnock 1970a). Fifty-one desert plots were read again in 1981 (Wondzell 1984). Data is available only for selected plots, not all were remeasured (Warnock and Kittams 1967).

Permanent plots (4) were established in Boot Canyon in 1964 (Whitson 1965a). Eleven sites, each with 5 100 ft lines, were established by Warnock (1970c). Moir (1980)

established plots in the Chisos Mt. in 1978. The most recent permanent plots were established by Ludwig (1984) as part of an MAB project. Ten 30-m transects were established at Paint Gap hills in 1981.

Dick-Peddie and Alberico (1977) began a 3-phase study of fire ecology in the Park. Meents and Moir (1981) established plots, near Paint Gap Hills and Nugent Mt., in the Spring of 1981 and remeasured them in the fall. In 1982 6 additional plots were established (Meents and Moir 1982). Comparisons of burned and unburned areas were made by Moir and Meents (1981) and Griese and Warren (1980).

Baccus (1971) studied the ecology rodents but also collected vegetation data in the grassland, desert shrub, and woodland. Degenhardt (1960) studied relationships between lizards and vegetation quadrats between 2,800 and 5,250 ft elevation. Vegetation data is also available for the riparian zone (Schmidly 1976, Schmidly et al. 1979). Wauer (1977a) discussed changes in birdlife associated with changes in the vegetation.

Vegetation Maps

Several maps of the vegetation of BBNP have been prepared. Warnock and Kittams (1970) defined plant communities of the Park. Strong and Bissonette (1981) plotted cottonwood and willow stands along the Rio Grande. Leopold (1983) identified 15 vegetation associations in the Park and plotted them on a 1:100000 scale map. Nyquist (1984) is working on a color vegetation map, based on high altitude photography, for BBNP.

"Level" of Data

Species Inventories

Level 1 - Prepark inventory

Palmer 1928; Marsh 1937; Matthews n.d., 1937; Taylor et al. 1944

Level 2 - Prepark inventory

Vascular plants (McDougall 1935a; Muller 1937; Sperry 1938, 1941; Sperry and Warnock 1941) Vegetation map (Roseberry and Dole 1938)

Contemporary observations

Vascular plants (McDougall and Sperry 1951; Warnock 1967b; Warnock and Koch 1970)

Cacti (Anthony 1952; Smith 1972, 1973; Kurtz 1979; Wauer n.d.)

Uredinales (Cummins 1964, 1965)

Lichens (Wetmore 1969, 1976)

Moses (Magill 1972, 1975, 1976)

Oaks (Wauer 1971)

Physiology/Anatomy

Level 2

Locoweed (Pease 1940)

Century plant (Neill and Allen 1979)

Crassulacean acid metabolism (Eickmeier 1976, 1978, 1979)

Agave (Ruth 1972)

Taxonomy and Single Species Studies

Level 2

Aspen (Burr 1966)

Cottonwood (Walter and Lucht 1977, Strong 1982)

Opuntia (Anthony 1951)

Cereus (Davis 1969)

Giant dagger (O'Neill 1971)

Hechtia scariosa (Green 1973, Smith 1978)

Tamarix (Howarth 1976)

Leucaena retusa (Brewbaker 1979)

Aquilegia spp. (Lott 1979)

Ancistrocactus tobushii (Heil and Brack 1984)

Agave harvardiana (Kuban 1983)

Resurrection plant (Eickmeier 1984)

Legumes (Derstine 1982)

Plots, Transects, and Succession

Level 2

Long-term reviews (Warnock 1967a, Wauer 1970a)

Exclosures (Sperry 1938)

Vegetation plots and transects (Leithead 1948; Wallmo 1955; Warnock 1955, 1967d, 1970a, b, c; Whitson 1965a; Warnock and Kittams 1967; Moir 1980; Wondzell and Ludwig 1983; Ludwig 1984)

Fire ecology (Dick-Peddie and Alberico 1977, Griese and Warren 1980, Meents and Moir 1981, Moir and Meents 1981, Meents and Moir 1982)

Vegetation maps**Level 1**

Warnock and Kittams 1970, Strong and Bissonette 1982, Leopold 1983

TABLES

These tables are intended as a "quick reference" to the kinds of research conducted at BBNP. When there is no entry in a column we were unable to determine what the author intended, e.g. many geologists did not give dates their field work was conducted, therefore the "DATE" column in the table is blank. Entries are ordered chronologically by date of work.

AQUATIC REFERENCES

<u>OBJECTIVE/SUBJECT</u>	<u>SAMPLING METHOD/REMARKS</u>	<u>LOCATION</u>	<u>DATE</u>	<u>REFERENCE</u>
Differentiation of species of <u>Gambusia nobilis</u> group, and description of <u>G. gaigei</u>	Collection and analyses of specimens	Fort Stockton and Boquillas, Texas	1927-28	Hubbs et al. 1929
History and status of <u>Gambusia gaigei</u>	Literature review	BBNP, TX	1928-76	Clark and Williams 1979
Rio Grande: flow rate, chemistry, biochemistry, specific conductance, sewer outfalls, diversions, water use, reservoirs, rainfall	Discharge measurements, gauge height records, chemical and biochemical analysis, specific conductance and silt determination	Rio Grande River and Rio Grande watershed, TX	1931-80	International Boundary and Water Comm. 1931-80
Survey of fish in the Big Bend area	Collection	BBNP, TX	1940	Hubbs 1940
Status of <u>Gambusia gaigei</u>	Observation	BBNP, TX	1957-62	Hubbs and Brodrick 1963
Water quality from test wells near Castolon	Drilling, chemical analysis, bailing, pumping tests	Castolon, BBNP, TX	1963	Rawson 1963?
Seasonal changes in the fish fauna of Tornillo Creek	Sampled 15 ^m segment of stream; fishes were counted and conditions noted	Tornillo Creek, BBNP, TX	1967-70	Hubbs and Wauer 1973
Quantitative description of the benthic community of Tornillo Creek	91 sq. ft. Surber samples were taken on 5 dates	BBNP, TX	1973-74	Rang and Lind 1978
Preliminary evaluation of benthic dispersion	Hand picking, dip net, Surber sampler, and drift net	BBNP, and GBNP, TX and SE AZ	1973-74	Lind 1982

AQUATIC REFERENCES

OBJECTIVE/SUBJECT	SAMPLING METHOD/REMARKS	LOCATION	DATE	REFERENCE
Limnological survey of some aquatic resources	Chemical analysis of water samples from 18 sites, 31 samples of invertebrates	BBNP, TX	1973-74	Lind and Bane 1978
Provide baseline limnological data for water quality evaluation	Water samples collected from 18 sites, 3 samples at each site: (1) N and P analysis (2) Metal analysis, (3) pH, alkalinity, hardness, sulfates, and turbidity. Quantitative samples of inverts obtained by handpicking and/or dip net. Surber samples used to a small extent.	BBNP, TX	1973-74	Lind and Bane 1980
Description of new species of Crustacea: Isopoda	Collection	BBNP, TX	1974	Cole and Bane 1978
Springs and tinajas in BBNP	Observation; measurement of flow rate	BBNP, TX	1975-76	Howarth 1976
Analyses of fishes between El Paso and the Pecos River-Rio Grande confluence	Collection in channelized and wild river segments	Rio Grande, Big Bend area, TX	1977	Hubbs et al. 1977
Distribution of Texas fish	Observation, literature review	BBNP, TX and Texas		Hubbs 1957
List of fishes at BBNP	Observation, literature review	BBNP, TX		Hubbs 1958
Water resources surrounding the Chisos Mt.	Drilling, chemical analysis, pumping tests	BBNP, TX		Twichell 1966

AQUATIC REFERENCES

OBJECTIVE/SUBJECT	SAMPLING METHOD/REMARKS	LOCATION	DATE	REFERENCE
Water resources investigation in BBNP	Chemical analysis, test drilling, pumping tests	BBNP, TX		Leggat et al. 1988
Morphological study of the Mexican stone roller	Collection of specimens, measurements	West-central Mexico		Burr 1976
History of and management plan for <u>Gambusia gaigei</u>	Review of available data, personal experience	BBNP, TX		Hubbs et al. 1977
Aquifer test of geothermal spring #4	Test wells	BBNP, TX		Moore 1980
Systematics, distribution and life history of the Chihuahuan shiner	Measurements, sex determination			Burr and Hayden 1981
Ground water hydrology	Testing wells, measurement of precipitation	Panther Junction, BBNP, TX		Gibson 1983
Site for a thermal flowing well	Search	Rio Grande Village, BBNP, TX		Wilson 1983

ARCHAEOLOGICAL REFERENCES

<u>OBJECTIVE/SUBJECT</u>	<u>SAMPLING METHOD/REMARKS</u>	<u>LOCATION</u>	<u>DATE</u>	<u>REFERENCE</u>
Painted pebbles	Literature review	Trans-Pecos	Historic	Davenport and Chelf 1941
Synthesis of known literature	Literature search	BBNP, TX	Historic	Bousman and Rohrt 1974
Findings of 4 excavations	Excavation of 3 caves in Chisos Mt. and 1 rock shelter in Chalk Draw	Chisos Mt., BBNP, TX	1928	Harrington 1928
Findings of E. P. Coffin at 2 archaeological sites	Excavation	Newman, NM Bee Cave Canyon in Chalk Draw	1929	Anon. 1929
Report of archaeological expeditions into Santa Elena Canyon and Chisos Mountains	Exploration of Doric cave, and testing of caves in Chisos Mt.	Doric Cave, Santa Elena Canyon, and Smoky Canyon Cave in Chisos Mt.	1929	Young 1929
Big Bend basket- makers	Observation, collection	Big Bend area, TX	1931	Martin 1932
Painted pebbles of Big Bend area	Archaeological exploration of caves	Shumla Cave, Texas	1931	Martin and Woolford 1932
Description of results of investigation	Archaeological investigation	Knight Cave, Texas	1931	Setzler 1931
Description of findings in 4 cave excavations	Excavation of 4 caves	Mule Ears Peaks, Cartledge Cave, Sunny	1932	Setzler 1932

ARCHAEOLOGICAL REFERENCES

OBJECTIVE/SUBJECT	SAMPLING METHOD/REMARKS	LOCATION	DATE	REFERENCE
Findings of excavations	Excavation of 67 archaeological sites	Madera Valley, Chihuahuan Desert	1933	Kelley 1933
First archaeological survey of BBNP	Location of 184 sites, excavation of 4 sites	BBNP, TX	1936	Reed 1936
Archaeological survey of BBNP	Compilation	BBNP, TX	1936-37 1966-67	Campbell 1970
Survey of 184 sites in Big Bend	Observation, excavation	Big Bend area, TX	1937	Cook 1937
Rock wall construction by Indians of Big Bend	Observation	Big Bend area, TX	1938	Smith 1951
Identification of bones associated with use of caves by humans	Excavation	Cuatro-Ciencas, MX	1940-41	Gilmore 1947
Findings of 4 excavations	Excavated 4 of 49 previously unreported sites	Western TX	1948	Kelley 1949
Bibliography of archaeological literature	Literature review	Texas	1960	Campbell 1960
Results of excavation of a cave	Excavation	Roark Cave, Brevster Co., Texas	1961	Kelley 1963
Results of excavation and test pits in 4 rock shelters	Excavation	Brevster Co., Texas	1961	Kelley and Smith 1963

ARCHAEOLOGICAL REFERENCES

<u>OBJECTIVE/SUBJECT</u>	<u>SAMPLING METHOD/REMARKS</u>	<u>LOCATION</u>	<u>DATE</u>	<u>REFERENCE</u>
Archaeology of La Cueva de La Zona de Derrumbes	Archaeological survey and investigation	Cueva de La Zona de Derrumbes, valley of Rio Santa Rosa, SE Nuevo Leon, MX Nuevo Leon, MX	1963	McClarkan 1980
Archaeological survey of BBMP	Recorded 132 archaeological sites in a 6-week survey	BBMP, TX	1966	Campbell 1967
Raiding trails in Trans-Pecos Texas	Review of records and survey of area	Trans-Pecos Texas	1966-67	Campbell and Field 1968
Nature and origin of the lithic tradition in in WE Mexico	Excavation, surface collections	WE Mexico	1960-67	Epstein 1980
Pollen record for WE Mexico	Analysis of pollen records	Nueva Leon, Coahuila, MX West and SW Texas	1968	Bryant and Riskind 1980
Evolution of basketry in WE Mexico and lower and Trans-Pecos TX	Collection	Coahuila, Tamaulipas, Lower and Trans-Pecos, Texas	1970-75	Adovasio 1980
Findings of excavation at Fort Leaton site	Excavation site	Fort Leaton, Presidio Co. TX	1971	Jgg, and Kedley 1971
Spanish missions at Guerrero, Coahuila	Archaeological survey and investigation	Guerrero, Coahuila, MX	1975-76	Adams 1980

ARCHAEOLOGICAL REFERENCES

OBJECTIVE/SUBJECT	SAMPLING METHOD/REMARKS	LOCATION	DATE	REFERENCE
Excavation of site threatened by highway realignment	Excavation	BBNP, TX	1977	Baskin 1978
Archaeological survey of Tornillo Creek drainage	Observation, excavation	Tornillo BBNP, TX	1979	Andretta 1979
Climate, geology, paleontology, and archaeology of Big Bend	Observation	Big Bend area, TX		Peabody 1909
Pictographs in Big Bend	Archaeological exploration, review of available data	Big Bend area		Smith 1923
Notes on dry rock shelters in W. Texas	Discussion of artifacts found in over 100 sites	Alpine, TX		Smith 1927
Early Spanish explorations in the Big Bend area of Texas	Summarizes historical data of early European expeditions in Big Bend area	Big Bend area, TX		Smith 1928
Human remains from 2 sites	Discussion of remains from Chalk Draw and Satan Canyon Rockshelter	Chalk Draw, Brevster Co. and Satan Canyon Valverdi Co., TX		Oetteking 1930
Findings in a rock shelter excavation	Excavation	Bee Cave Canyon, TX		Coffin 1932
Basket-making culture in Big Bend Area	Observation	Big Bend area, TX		Smith 1932

ARCHAEOLOGICAL REFERENCES

OBJECTIVE/SUBJECT	SAMPLING METHOD/REMARKS	LOCATION	DATE	REFERENCE
Archaeological findings in Big Bend area	Review of available data	Big Bend area, TX		Smith 1932
Sandals of the Big Bend culture	Discussion of types of sandals	Big Bend area, TX		Smith 1933
Results of excavation of rock shelter in Sunny Glen Canyon	Excavation	Sunny Glen, TX		Smith 1934
Archaeological survey of Texas	Divides and relates five broad areas of Texas archaeology	Texas		Sayles 1935
Prehistoric cave, culture in SW Texas	Analysis of differences in results of previous excavations	BBMP, TX Trans-Pecos Texas		Setzler 1935
Split stitch basket	Discussion of split stitch basket	Big Bend area, TX		Smith 1935
Discussion of Big Bend cave dwellers	Review of available data	West Texas		Anon. 1937
Rock art sites in Texas	Survey of literature on rock art sites in Texas	Texas		Jackson 1938
Results of excavation of rockshelter	Excavation	Sunny Glen Canyon, TX		Smith 1938

ARCHAEOLOGICAL REFERENCES

<u>OBJECTIVE/SUBJECT</u>	<u>SAMPLING METHOD/REMARKS</u>	<u>LOCATION</u>	<u>DATE</u>	<u>REFERENCE</u>
Cordage of caves	Studied 3,721 pieces of cord made from rough grass and stranded fiber cord	Big Bend area, TX		Smith 1940
Basketry in the Big Bend	Discussion of range of variations in basket manufacturing	Big Bend area, TX		Smith 1941
Evidence of European influence in the pictographs of West Texas	Observation, discussion of rock art sites	Brewster Co. Chalk Draw, Ajuá Prió Bluff, Texas		Smith 1942
Evidence of European influence in the pictographs of West Texas	Documentation of pictographs	West Texas		Smith 1946
Arrow or dart shaft, tools and problematical incised stones	Describes tools, their function and their relation to ancient culture	Western Texas		Kelley 1949
Description and findings of house structure excavation	Excavation	Iowa Seca, Chihuahua, Mexico		Kelley 1951
Description of findings in mass burial cave	Exploration	Candelaria, Coahuila, MX		Martinez del Rio 1953
Implications of the C-14 dates from a cave in Coahuila, Mexico	Discussion of excavation	Coahuila, Mexico		Taylor 1956

ARCHAEOLOGICAL REFERENCES

OBJECTIVE/SUBJECT	SAMPLING METHOD/REMARKS	LOCATION	DATE	REFERENCE
Defense of classification of Livermore Pecos	Review of available data			Kelley 1957
Review of Trans-Pecos Texas archaeology	Review of available data	Trans-Pecos Texas		Lehmer 1958
Desert cultures and the Balcones phase	Summary of available data			Kelley 1959
Prehistoric cultures and their reliance on water nomadism	Discussion	Northern Coahuila, MX		Taylor 1962
Archaic cultures adjacent to the Northeastern frontiers of Meso America	Analysis of available data			Taylor 1966
Pollen as an indicator of prehistoric diets	Pollen analysis of 47 human coprolite specimens	Prigntful Cave, Coahuila, Mexico		Bryant 1975
The need for fuller understanding of why Trans-Pecos peoples never adopted agriculture despite available knowledge	Review of data on changes in environmental conditions, projectile points, settlement systems, subsistence data through time, and external cultural factors	Trans-Pecos area		Martindale 1979
Functional interpretations of lower Pecos art	Personal experience, literature review	Lower Pecos area, TX		Snafer 1980

ARCHAEOLOGICAL REFERENCES

<u>OBJECTIVE/SUBJECT</u>	<u>SAMPLING METHOD/REMARKS</u>	<u>LOCATION</u>	<u>DATE</u>	<u>REFERENCE</u>
Test excavations at prehistoric campsite	Excavations	BBNP, TX		Panowski 1981

CLIMATE REFERENCES

<u>OBJECTIVE/SUBJECT</u>	<u>SAMPLING METHOD/REMARKS</u>	<u>LOCATION</u>	<u>DATE</u>	<u>REFERENCE</u>
Rainfall patterns of northern Mexico	Rainfall readings from 49 stations in northern Mexico	Mexico	1921-40	Shreve 1944
Boundary of Chihuahuan Desert based on climatic data	Temperature and precipitation values from about 800 weather stations in Mexico and U.S.	Chihuahuan Desert	1978	Schmidt 1979
Climate of Chihuahua, Mexico	Analysis of data from 130 meteorological stations	Chihuahua, Mexico		Schmidt 1975
Identification of sources of weather data for Mexico	Literature and personal experience, 94 citations	Mexico		Schmidt 1980

GEOLOGICAL REFERENCES

<u>OBJECTIVE/SUBJECT</u>	<u>SAMPLING METHOD/REMARKS</u>	<u>LOCATION</u>	<u>DATE</u>	<u>REFERENCE</u>
Geology of Big Bend	Observation, field trip	Big Bend area, TX	1936	Wegeemann 1936
Geology of BBNP	Collection, observation, chemical analysis, analysis of thin sections, paleomagnetic studies, mapping	BBNP, TX	1936, 37, 40 11, 46-63 intermittently	Maxwell et al. 1967
Geology of Wildhorse Mountain intrusion	1) Chemical analysis of samples from Wildhorse Mt., wet chemical analyses, X-ray fluorescence technique for major elements and atomic absorption for Na and K 2) Petrographic analysis, detailed study of 110 thin sections made from 85 samples taken from the Wildhorse Mt. 3) Electron microprobe analysis, detailed electron microprobe analysis of 20 feldspar phenocrysts, 3 Pyroxene phenocrysts and 13 feldspar groundmass grains	Wildhorse Mountain Intrusion Brewster Co., TX	1940, 76, 77	Indest 1978
Geology of the Christmas and Rosillos Mountains	Geologic survey	Christmas and Rosillos Mt., TX	1946-47	Bloomer 1949
Road log, BBNP	Observation	BBNP, TX	1949	Maxwell et al. 1949
Glaciation	Field survey	BBNP, TX	1958	Jenkins 1958
Description of agate collecting trip	Collection	Ceedle peak, south of Terlingua, TX	1960-61	Zeitner 1962

GEOLOGICAL REFERENCES

OBJECTIVE/SUBJECT	SAMPLING METHOD/REMARKS	LOCATION	DATE	REFERENCE
Foundation of Chisos Mt. Lodge	volumetric changes in bentonitic clay foundation material is causing cracks in the lodge	BBNP, TX	1969	Maxwell 1969
Mode of origin and emplacement of the Grapevine Hills laccolith of BBNP	10 sample cores collected from northern half of laccolith; Lab work: thin sections (85 samples), electron microprobe analyses, Na ₂ O and K ₂ O whole rock analyses, /448 (29 samples)	Grapevine Hills, BBNP, TX	1972	Kovschak 1973
Discovery of new mercury mineral, pinchite	Observation, X-ray fluorescence scan, neutron analysis	Terlingua, TX	1973	Sturman and Mandarino
Geochemical and petrographic survey of area and analysis of trends differentiating this from adjacent areas	Representative samples of various rock types were collected at 17 localities. Samples for geochemical study were taken near the margins of the exposed intrusions, 67 thin sections were studied petrographically. 20 whole rock samples were analyzed chemically.	Mariscal Mt., BBNP, TX Texas	1974	Myers 1978
Geology of Gabbro Sill surrounding Mariscal Mt.	Electron microprobe analysis, point-counting, thin section measuring	Gabbro Sill surrounding Mariscal Mt., BBNP, TX	1975	Runggardner 1976

GEOLOGICAL REFERENCES

<u>OBJECTIVE/SUBJECT</u>	<u>SAMPLING METHOD/REMARKS</u>	<u>LOCATION</u>	<u>DATE</u>	<u>REFERENCE</u>
Burro Mesa, riebeckite and rhyolite	Mapped study area, collected samples, lab work: whole rock chemical analyses of major-element oxides, selected trace elements were obtained by X-ray fluorescence, and mineral chemistry was determined by electron microprobe analyses.	Burro Mesa, BBNP, TX	1979	Becker 1976
Petrology of the Christmas Mt.	Chemical analyses, electron microprobe analyses, studied temperature of crystallization and oxygen fugacity	Christmas Mt., TX	1976	Junqlusuk 1977
Geothermal areas of the Big Bend	Visited 14 thermal springs and wells; measured temperature, pH, discharge; analyzed water chemistry (cations by atomic absorption spectrophotometry). Studied 3 springs for life forms included: bacteria (isolated for pure cultures, then tested) algae, vascular plants, invertebrates, vertebrates	West Texas along Rio Grande	1976 1978	Bennack et al.
Comancheite new mercury mineral	Electron microprobe analysis, single-crystal X-ray study	Nariposa Mine, Terlingua, TX	1977	Roberts et al. 1991
Eruptive history of Pine Canyon Caldera (part of investigation of Trans-Pecos magmatic province)	130 thin section analyses, 12 new major-element chemical analyses	Pine Canyon, Chisos Mt., BBNP, TX	1977-78	Ogley 1978

GEOLOGICAL REFERENCES

<u>OBJECTIVE/SUBJECT</u>	<u>SAMPLING METHOD/REMARKS</u>	<u>LOCATION</u>	<u>DATE</u>	<u>REFERENCE</u>
Paleomagnetism of early tertiary	178 cores from 31 flows were obtained and measurements made by spinner magnetometer.	BBNP, Brewster and Presidio Co., TX	1978	Gilliland and Clark 1979
Age of alkaline rocks	Argon analysis were performed by standard mass techniques.	BBNP, TX	1978	Daily 1979
Gannaray and magnetic reconnaissance	Aerial survey, magnetometer magnetometer	BBNP, TX	1979	Anon. 1979
Geologic mapping of Santiago Mt. Range	Field mapping	Santiago Mt., TX	1979	Cobb 1980
Fauna, depositional environment, and sandstone provenance of early Eocene rocks	Measurement of stratigraphic sections, fossil preservation, collection and preparation	Tornillo Flats, BBNP, TX	1979-80	Hartnell 1980
Structural geology of Mesa de Anquilla	45 samples of 2 different rock types collected and thin sectioned for analysis of calcite twinning, feasibility of isotopic dating, and study of pressure solution surfaces, surface mapping	Mesa de Anquilla, BBNP, TX	1980	DeCamp 1981
History of the Chisos Mt.	Field observation	BBNP, TX		Wadden 1907
Geology of 4 selected sites in Big Bend	Observation	Big Bend area, TX		Gould 1936

GEOLOGICAL REFERENCES

OBJECTIVE/SUBJECT DESCRIPTION OF Big Bend's remarkable areas, geology ethnobotany and fauna	SAMPLING METHOD/REMARKS Literature review, personal experience	LOCATION Big Bend area, TX	DATE	REFERENCE Maywell 1948
Photos of Puerto Rico Mine	Photos	US - Mexico		Walthall 1949
Geologic history, stratigraphy and structure of the Big Bend area	Observation	Big Bend area, TX		Maywell and Diemich 1965a
Paleozoic outcrops in Santiago Mt.	Mapping: reconnaissance with aerial photos and enlarged topographic maps	Santiago Mt., TX		Pearson and Greenlee 1965
Paleozoic stratigraphic block Solitario and Marathon	Review of available data	Area between Solitario and Marathon, TX Big Bend		Wilson 1965
Geology of the Big Bend area	Review of available data	Big Bend area, TX		West Texas Geological Society 1965
Road log of geologic field trip	Field trip through area, observation	Brewster Co. and Presidio Co., TX		Maywell and Dietrich 1965b
A paleomagnetic study of early tertiary basalts	Lava flows measured, relative age of flows determined	West Texas		Winters 1967
Structure and petrology of a differentiated mafic alkaline sill	Observation, chemical analysis, wet analysis, X-ray fluorescence analysis	Near Maverick Mt., BBNP, TX		Cameron 1968

GEOLOGICAL REFERENCES

<u>OBJECTIVE/SUBJECT</u>	<u>SAMPLING METHOD/REMARKS</u>	<u>LOCATION</u>	<u>DATE</u>	<u>REFERENCE</u>
Provide general geologic and historic information of BBNP	Geologic map 1:62,500, a book, tour of the geology and history of BBNP, maps and abundant photos	BBNP, TX		Maxwell 1968
Geology of Castolon area	Observation	BBNP, TX		Stevens 1969
Caves of the Chisos Mt.	Location of caves	Pommel peak, BBNP, TX		Watson 1969
Crystallization of feldspars in alkaline rocks	Optical and electron microbe studies	Big Bend area, TX	c1970	Carmen and Cameron
Basement rock framework of parts of Texas, southern New Mexico, and northern Mexico	X-ray fluorescence analysis, argon measurements made on a 4.5 inch Reynolds type mass spectrometer	Chihuahuan Desert, TX, NM, MX		Denison et al. 1970
Lower cretaceous sedimentation and tectonics of the Coahuila and west Texas Platforms	Summary of stratigraphic work	Chihuahuan Desert, TX		Smith 1970
Mesozoic sedimentation, magmatic activity and deformation	Review of available data	Northern Mexico		DeCserna 1970
Vertebrate biostratigraphy	Review of available data	Trans-Pecos Texas		Wilson 1970
Oil and gas possibilities in the Chihuahuan area	Review of available data	Chihuahuan area		Greenwood 1970
Minerals in Chihuahuan tectonic belt	Review of available data	Chihuahuan area		McAnulty 1970

GEOLOGICAL REFERENCES

OBJECTIVE/SUBJECT	SAMPLING METHOD/REMARKS	LOCATION	DATE	REFERENCE
Discovery of rhonite in BBNP	Identified by optical properties in thin section (strong absorption and characteristic pleochroism) and confirmed by wet chemical analysis	Near Maverick Mt., BBNP, TX		Cameron et al. 1970
Description of type locality of San Vicente member of Boquillas formation	Description	San Vicente, BBNP, TX		Maxwell and Marks 1977
Geology of the Big Bend area	Review of available data	Big Bend area, TX		West Texas Geological Society 1972
Terlingua Mining District	Literature review	Terlingua Mining District, TX		Daugherty 1972
Mariscal Mining area	Inspections	BBNP, TX		Osepreqi 1973
Petrology of Rattlesnake Mountain Sill	Electron microprobe analyses optical examination of stained thin sections, new chemical analysis for major and selected trace elements Si, Al, Ti, Mn, Mg, Ca, K, analyzed by X-ray fluorescence	Rattlesnake Mt., BBNP, TX		Carpan et al. 1975
Magnetic history of 3 areas in BBNP	Collected 60 oriented rock cores from 6 sites from 2 laccoliths and a sill, Lab procedures: alternating field demagnetization, thin section analysis, magnetic susceptibilities, virtual geomagnetic pole positions, and statistical parameters	BBNP, TX		Lewis 1976

GEOLOGICAL REFERENCES

OBJECTIVE/SUBJECT	SAMPLING METHOD/REMARKS	LOCATION	DATE	REFERENCE
Contact metamorphism near Bee Mt. intrusion	Analyses	Bee Mt., BBNP, TX		Droddy 1976
Terlingua's secondary mercury minerals	Collection, literature review	Terlingua district		Crook 1977
Interdependence of gravity and topography in area of Rio Grande Rift	Review of available data	Chihuahuan Desert, TX, MX		Western and Aiken 1978
Gravity analysis of the Big Bend as part of a continental rift	Laboratory analysis	Big Bend area, TX		Metcalf and Clark 1978
Depositional environment and source area of the Javelina formation	Grain size analysis, paleocurrent analysis, petrography of the sandstone and shale	Javelina formation, BBNP, TX		Miller 1978
Rio Conchos-Rio Grande drainage evolution	Literature review	U.S., Mexico boundary		Deal 1979
Anhydrite and bassauite in caves in BBNP	Mineral identification by X-ray diffraction and optical techniques (oil immersion)	BBNP, TX		Hill 1979
Microstructure and thermal history of cryptoperthites in a dike from Big Bend	Transmission electron microscope observations of cryptoperthite phenocrysts in 8 samples of rhyolite, microprobe analyses	Big Bend area, TX		Christofferson and Schedl 1979
Description and evolution of structures between Santiago Mt. and Sierra del Carmen	Geologic map provided as data base	Transition between Sierra del Carmen and Santiago Mt., BBNP, TX		Poth 1979

GEOLOGICAL REFERENCES

OBJECTIVE/SUBJECT	SAMPLING METHOD/REMARKS	LOCATION	DATE	REFERENCE
Analyzed stability and synthesis relationships in 5 mercury minerals from Terlingua	Attempted to synthesize kienite, terlinguaite and pinchite by mixing mercury containing compounds in appropriate formulas. Stability reactions on same materials by placing in sealed tubes and heating at various temperatures for various time periods, then identifying different phases with X-ray diffraction techniques	Terlingua, Texas		Bums 1980
Hydrogeologic reconnaissance	Inventory of ground water	Rosillos Mt. BBNP area, TX		Christensen 1981
Structural geology and structural geologic history of the Persimmon Gap area	Analysis of Landsat multispectral scanner imagery, analysis of aerial photographs, and direct field observations	Persimmon Gap, BBNP, TX		Toelle 1981
Mine shaft inventory	Inventory	BBNP, TX		West 1982
Sedimentology and depositional history of the Quaternary-Tertiary old gravel deposits, Lower Tornillo Creek Area, BBNP, Texas		Lower Tornillo Creek, BBNP, TX		Thurwachter 1983

PALAEONTOLOGICAL REFERENCES

OBJECTIVE/SUBJECT	SAMPLING METHOD/REMARKS	LOCATION	DATE	REFERENCE
Invertebrate paleontology of BBNP	Geologic mapping, collection of fossils	BBNP, TX	1936	Eley 1938
Paleocene and lower eocene vertebrates at Tornillo Flat	Reconnaissance of Tornillo Flat area	Tornillo Flat, BBNP, TX	1952	Wilson et al. 1952
Pollen profile	14 surface soil samples collected for pollen analysis	BBNP, TX	1969	Meyer 1979
Paleoecology of the Tornillo formation	(1) Paleocurrent measurements, grain size trends, and petrographic analysis; (2) paleobotany leaf impressions and recovery of pollen; (3) fossil collection	BBNP, TX	1970-72	Lawson 1972
Invertebrate paleontology of BBNP	Description	BBNP, TX		Eley 1938
Micropaleontology of upper Eagle Ford and lower Austin groups, BBNP	Stratigraphic sections were measured and each unit described, samples washed and examined	BBNP, TX		Bostik 1960
Sedimentology of the Aguja formation	Measured 7 stratigraphic sections with Brunton compass and Jacob's staff and recorded lithology, fossil content, sedimentary structures, lithologic association, and shape of each bed, studied thin sections of 25 sandstones, 11 claystones and 4 conglomerates	BBNP, TX Aguja formation		Hopkins 1965
Cenozoic history of Big Bend area	Collections	Big Bend area, TX		Wilson 1965

PALEONTOLOGICAL REFERENCES

<u>OBJECTIVE/SUBJECT</u>	<u>SAMPLING METHOD/REMARKS</u>	<u>LOCATION</u>	<u>DATE</u>	<u>REFERENCE</u>
Woodrat middens	8 woodrat middens sampled	BBNP, TX		Wells 1966
Miocene formation and Castolon local fauna	Collection of specimens	Castolon area, BBNP, TX		Stevens et al. 1989
New geosyid rodent from oligocene Ash Spring local fauna	Collection of fossil vertebrates	Ash Spring, western Jeff Davis Co., TX		Harris and Wood 1985
New fossil rodents from the early oligocene of northeastern Chihuahua	Collection of specimens	Rancho Gaitan northeastern Chihuahua, MX		Ferrusquia, Villafranc Wood 1989
Sedimentology of paleocene Black Peaks formation	Observation, testing	Tornillo Flats, BBNP, TX		Schiebout 1970a
Equidae of the Vieja Group of trans-Pecos TX	Examination of specimens	Trans-Pecos Texas		Forsten and McGrew 1971
Enterodontidae in the Early tertiary of Trans Pecos (Vieja Group)	Collection of specimens			Wilson 1971
Provenance and depositional environments of the eocene formation	Collection, analyses	BBNP, TX		Riqsby 1978
Paleocene vertebrates of the Black Peaks formation	Not specified	BBNP, TX		Schiebout 1974
Largest Pterosaur from late cretaceous of BBNP	Literature review	BBNP, TX		Bedrossian 1975

PALEONTOLOGICAL REFERENCES

<u>OBJECTIVE/SUBJECT</u>	<u>SAMPLING METHOD/REMARKS</u>	<u>LOCATION</u>	<u>DATE</u>	<u>REFERENCE</u>
Pterosaur from late Cretaceous of Big Bend	Collection	BBNP, TX		Lawson 1975
Restudy of Castolon miocene fauna	Prospected for fossil vertebrates in lower part of Delaho formation	Near Castolon BBNP, TX		Stevens 1977
Paleocene environment		BBNP, TX		Schiebout 1979
Fauna from the eocene of the Hannold Hill formation, BBNP		BBNP, TX		Hartnell 1980
Ceratopsian bone bed from the Aguja formation	Excavation	BBNP, TX		Lehman 1982
Magnetic polarity stratigraphy	Collection	Black Peak Mt. BBNP, TX		Rapp and MacPadden 1981
Micropaleontology of lower portion of Boquillas formation near Hot Springs, BBNP	Samples taken from 15 foot stratigraphic intervals these were washed and examined			

HISTORICAL REFERENCES

OBJECTIVE/SUBJECT	SAMPLING METHOD/REMARKS	LOCATION	DATE	REFERENCE
International Park	Letters	BBNP, TX and Mexico	Historic	Garrison 1953
History of cattle in BBNP	Literature review	BBNP, TX	Historic	Utley 1962
History of cattlemen in BBNP	Literature, interview	BBNP, TX	Historic	Casey 1968
History of Hot Springs	Literature, letters, interviews	BBNP, TX	Historic	Levy 1968
History of the Big Bend area	Literature, letters, interviews	BBNP, TX	Historic	Casey 1969
Candelilla wax industry	Literature	BBNP, TX	Historic	Casey 1970
History of Brewster County	Literature review	Brewster Co.	Historic	Casey 1972
Historic structures at Camp Santa Helena	Literature review	BBNP, TX	Historic	Speire and Simmonds 1973
Effects of human activity on BBNP	Literature	BBNP, TX	Historic	Wauer 1975
History of BBNP since 1500s	Literature review	Big Bend area, TX	1532-1968	Madison 1968
Baronial forts of Big Bend area	Literature review	Big Bend area, TX	1530-1880	Corning 1967
Spanish and Indian battles in Trans-Pecos Texas	Review of available data	Trans-Pecos and Chihuahua	1787	Nelson 1935

HISTORICAL REFERENCES

<u>OBJECTIVE/SUBJECT</u>	<u>SAMPLING METHOD/REMARKS</u>	<u>LOCATION</u>	<u>DATE</u>	<u>REFERENCE</u>
History of Boquillas-Hot Springs area	Literature review	BBNP, TX	1852-Present	Casey 1978
Lajitas, TX	Literature review	Lajitas, TX	1852-Present	Casey 1971
History of Texas rangers in Big Bend area	Literature review	Big Bend area, TX	1881-1882	Townsend 1935
The G-4 ranch	Personal experience	BBNP, TX	1885-1895	Gillett 1933
Canyons along the Rio Grande	Personal account	BBNP, TX	1899	Hill 1901
Troubles with Mexican bandits along the border	Literature review	Big Bend area, TX	1900-20	Tyler 1975b
Homesteaders story-Hot Springs	Personal account	BBNP, TX	1909-42	Langford and Gipson 1979
Bandit raids in Big Bend area	Literature review	Big Bend area, TX	1915-20	Smithers 1963
Glenn Springs raid	Personal experience	BBNP, TX	1916	Cook 1963
Glenn Springs raid	Literature, interviews, personal account	BBNP, TX	1916	Raborq 1954
History of BBNP	Literature review	BBNP, TX	1930-52	Jameson 1974
Legislative developments in the creation of BBNP	Personal experience	BBNP, TX	1930-33	Wagstaff 1968

HISTORICAL REFERENCES

<u>OBJECTIVE/SUBJECT</u>	<u>SAMPLING METHOD/REMARKS</u>	<u>LOCATION</u>	<u>DATE</u>	<u>REFERENCE</u>
Recommended boundary for BBNP	Field investigation by foot, car, horseback, and plane	BBNP, TX	1935	Wirth 1935a
Field trip and description of various aspects of proposed BBNP	Field trip, observation	BBNP, TX	1935	Wirth 1935B
Accommodations at the newly created BBNP	Observation	BBNP, TX	1947	Wear 1947
Inventory of historic structures	Description, photos, floor plans, maps	BBNP, TX	1964	Brown et al. 1964
Ruins along Tornillo Creek	Literature review, observation	BBNP, TX	1974	Weedin 1975
Description of various aspects of Big Bend area	Observation, review of available data, personal experience	BBNP, TX		Toll 1934
General overview of various characteristics of Big Bend area	Literature review, personal experience	Big Bend area, TX		Schoffelmayer 1937
Discussion of establishment of BBNP	Literature review, personal experience	Big Bend area, TX		Morelock 1938
Description of BBNP	Personal experience	BBNP, TX		Tillotson 1942
BBNP wildlife conservation	Report on biology and natural history in Big Bend	BBNP, TX		Stevenson 1943

HISTORICAL REFERENCES

OBJECTIVE/SUBJECT	SAMPLING METHOD/REMARKS	LOCATION	DATE	REFERENCE
Developing BBNP	Observation	BBNP, TX		Tilden 1945
E. E. Townsend	Literature review	BBNP, TX		Bygness and Bentley 1947
History of Big Bend and establishment of the park	Review of available data, literature, personal experience	Big Bend area, TX		Casey 1948
Biography of E. E. Townsend	Literature review, interviews	West TX		Saxton and Casey 1958,
History of BBNP	Early historical account	BBNP, TX		Marvell 1951
Description of BBNP, its history and habitats	Personal experience	BBNP, TX		Kenney 1968
Research and management of historic structures	Documentation, mapping	BBNP, TX		Davila 1993
Clay tablets found at Hot Springs	Letters discussing finding of ancient Roman-Iberic tablets	Hot Springs, TX		MacGee
BBNP, TX project, Texas	Superficial summary of Big Bend's natural history	BBNP, TX		USDI
Webb expedition	Photos	Santa Elena Canyon, BBNP, TX		Webb

SOIL REFERENCES

<u>OBJECTIVE/SUBJECT</u>	<u>SAMPLING METHOD/REMARKS</u>	<u>LOCATION</u>	<u>DATE</u>	<u>REFERENCE</u>
Surface litter breakdown	Amount of decomposition of creosotebush litter was measured after 120+ days	NM State Univ. Ranch, Las Cruces, NM	1977	Whitford et al. 1980
Soils and vegetative characteristics	Survey of vegetation, observation, analysis of soil profile	Trans-Pecos, TX		Carter and Cory 1951

FAUNA REFERENCES

OBJECTIVE/SUBJECT	SAMPLING METHOD/REMARKS	LOCATION	DATE	REFERENCE
History of bighorn sheep in Chihuahuan Desert	Historical records	Chihuahuan Desert	Historic	Hailey 1977
Bird list	Observation	Guadalupe Mt., and BBNP, TX Texas, BBMP	1901	Oberholser 1902
Summer resident birds of Brevster Co.	Collection	Brevster Co.	1904	Montgomery 1905
Reptiles and amphibians of Brevster Co.	Collection	Brevster Co., TX	1905	Streaker 1909
Changes in bird abundance associated with changes in vegetation	veg. plots, field observation, literature	BBNP, TX	1900's	Yayer 1977
Bird observations in Big Bend area	Observation, collection	BBNP area, TX	1916	Maxon 1916a
Bird observations in Big Bend area	Observation	BBNP area, TX	1916	Maxon 1916b
Birds of the Chisos Mt.	Observation, collection	Chisos Mt., BBNP, TX	1928	Van Tyne 1929
Birds of Brevster County, Texas	Observation, collection	Brevster Co. TX.	1928, 1932, 1933, 1935	Van Tyne and Sutton 1937
New species of Saturniid, <i>Pseudobazis chinatiensis</i>	Observation, collection	Chinati Mt. Presidio Co., TX	1929	Tinkham 1943
Cicadidae of the Big Bend area	Observation, collection	Big Bend area, TX	1929-30	Tinkham 1941

FAUNA REFERENCES

<u>OBJECTIVE/SUBJECT</u>	<u>SAMPLING METHOD/REMARKS</u>	<u>LOCATION</u>	<u>DATE</u>	<u>REFERENCE</u>
Discovery of the nesting area of the Colima warbler	Observation	Root Springs, Chisos Mt., BBNP, TX	1932	Van Tyne 1936
Early report on flora and fauna	Observation, collection	Big Bend area, TX		Thomson 1934
Bird life of Big Bend area	Observation, collection, description	Big Bend area, TX	1933	Sutton 1935
Bird distribution	Observation	BBNP, TX	1934	Quillan 1935
Bird survey of N. Coahuila	Observation, collection	Coahuila, MX	1936	Marsh and Stevenson 1938
Bird list	Observation, collection	BBNP, TX	1936-37	Borell 1938
New bird records from southern Brewster County (BBNP)	Observation, collection	Southern Brewster Co., BBNP	1936-37	Borell 1938
Checklist of BBNP mammals	Inventory	BBNP, TX	1936-37	Borell and Bryant 1942
Mammals found in BBNP	Collection	BBNP, TX	1936-37	Borell and Bryant 1942
Collections of Big Bend's reptiles and amphibians	Collection	Big Bend area, TX	1936-38	Schmidt and Smith 1944

FAUNA REFERENCES

<u>OBJECTIVE/SUBJECT</u>	<u>SAMPLING METHOD/REMARKS</u>	<u>LOCATION</u>	<u>DATE</u>	<u>REFERENCE</u>
Two new bird subspecies from the Chisos Mt.	Collection	Chisos Mt., BBNP, TX		Brandt 1938
New bird records from Brewster County	Observation, collection	Brewster Co., TX.		Stevenson and Smith 1938
Bird list	Observation, collection	BBNP, TX	1937	Stevenson and Smith 1938
Arachnids from the Chisos	Collection	Chisos Mt., BBNP, TX	1938	Gertsch
Amphibians and reptiles from Chisos Mt.	Collection	Chisos Mt., BBNP, TX	1938	Murray 1939
Snakes of northeastern Mexico	Collection	NE Mexico	1938-40	Smith 1944
Reptiles and amphibians of northern Coahuila, Mexico	Collection	Coahuila, MX	1938-39	Schmidt and Owens 1944
Colima warbler nesting	Observation	BBNP, TX	1941	Blake 1949
Ecological survey of BBNP	3 months field work by 9 people, general survey.	BBNP, TX	1944	Taylor et al. 1944
Birds of Brewster County	Observation	Brewster Co., TX	1949	Cruickshank 1950
Clark's nutcracker in the Chisos Mountains	Observation	Chisos Mt., BBNP, TX	1950	Galley 1951

FAUNA REFERENCES

<u>OBJECTIVE/SUBJECT</u>	<u>SAMPLING METHOD/REMARKS</u>	<u>LOCATION</u>	<u>DATE</u>	<u>REFERENCE</u>
Changes in competing populations of whiptail lizards in southwestern Texas	Fenced and trapped, sighting of marked individuals, stomach analysis	Black Gap WMA, TX	1951-52 and 1962	Milstead 1965
Manuals of Black Gap Wildlife Management Area and La Bota Mountain area	Collection	Black Gap, Brewster Co. and La Bota Mt. area, Presidio Co., TX	1951-52 1952	Tamsitt 1954
Plumage and territorial behavior of Lucifer hummingbirds in Chisos Mt.	Observation	Chisos Mt., BBNP, TX	1952-53	Fox 1954
Avifauna of the Sierra del Carmen	Observation, collection, analysis of available data	Sierra del Carmen Coahuila, MX	1953	Miller 1955
Behavior of Texas long-nose snake	Observation	BBNP, NM and TX	1954-66	McCoy and Gehlbach 1967
Colima warbler nest	Observation	BBNP, TX	1954	Snyder 1957
Abundance and food habits of kangaroo rat and quail	Yeg. transects, censuses, food habits	Gene Howe Wildl. Manage. Area, TX	1955-56	Davis et al. 1956B
Amphibians and reptiles of Big Bend region of Texas	Collection	Big Bend area, TX	1955	Minton 1958
New species <u>Coleonyx reticulatus</u> from Texas	Trapping, collection	Black Gap wildlife management area, TX	1956	Davis and Dixon 1958

FAUNA REFERENCES

<u>OBJECTIVE/SUBJECT</u>	<u>SAMPLING METHOD/REMARKS</u>	<u>LOCATION</u>	<u>DATE</u>	<u>REFERENCE</u>
Rodent-game relationships, ecological survey of BBNP	Seed availability, dead-trap lines, live traps, shooting, food habits, deer pellet-counts, veg. plots	BBNP-Gene Howe Manage. area, TX	1956	Davis et al. 1956
Deer and veg. transect data	Veg. transects, and deer pellet counts	BBNP-Black Gap, TX	1956	Davis et al. 1956
Rodent-game relationships, ecological survey of BBNP	Seed availability, dead-trap lines, live traps, shooting, food habits, deer pellet-counts, veg. plots	BBNP-Gene Howe Manage. area, TX	1957	Davis et al. 1957
Ecological survey of Big Bend area	Studies of population ecology of birds, rodents, and mule deer	Big Bend area, TX	1957-58	Dixon and Wallmo 1958
Ecology and distribution of desert scrub birds	Census of singing males	Big Bend area, TX	1956-58	Dixon 1959
New species <u>Trimotophodon wilkinsoni</u> , from BBNP	Capture	BBNP, TX	1956-57	Degenhardt and Steel 1959
Survey of herptofauna	General observation, trapping, and quantitative observation	BBNP, TX	1956-59	Degenhardt 1960
Quantitative study of herptofauna on the Chisos Mt.	Trapping and observation of lizards, number of lizards in quadrats and vegetation density	BBNP, TX	1956	Degenhardt 1966
New specimen of <u>Tantilla cucullata</u>	Collection	Chisos Mt.	1957	Degenhardt and Milst 1959

FAUNA REFERENCES

<u>OBJECTIVE/SUBJECT</u>	<u>SAMPLING METHOD/REMARKS</u>	<u>LOCATION</u>	<u>DATE</u>	<u>REFERENCE</u>
New scorpion species from BBNP	Collection	BBNP, TX	1957	Stahnke 1967
Two new species of long-horned beetle from Jamaica and Chisos Mt., BBMP	Collection, observation	Jamaica, W. I. Chisos Mt. BBNP, TX	1958-59	Howden 1960b
Summer behavior of <u>Sceloporus merriami</u> and <u>UROSAURUS ORNATUS</u>	Observation	BBNP, TX	1958-63 and 1966	Milstead 1970
Species of Oedemeridae in BBNP	Collection	BBNP, TX	1959	Arnetti 1965
Land use history of deer and veg. transect data	Veg. transects, deer pellet counts, interviews	Rio Grande area, TX	1959	Davis et al. 1959
Scarabae of Big Bend area including a new species <u>Phylrophaga</u>	Collection	Big Bend area, TX	1959	Howden 1960a
Status of bighorn sheep in Texas	Observation, review of available data	Texas	1960-80	Leopold and Krausman 1983
Bushtit taxonomy	Collection of specimens	BBNP, NM, AZ, Mexico	1960	Raitt 1967
Status of deer populations and vegetative cover	Roadside cruise-line method, sampling of permanent vegetation plots	Black Gap WMA, BBNP, TX	1960-61	Wallmo 1961

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<u>OBJECTIVE/SUBJECT</u>	<u>SAMPLING METHOD/REMARKS</u>	<u>LOCATION</u>	<u>DATE</u>	<u>REFERENCE</u>
Ecological distribution and zoogeography of land snails of the Chisos Mt.	Collection: 1-10m sample plots, for larger snails sampled litter and soil fauna with 25cm quadrats, snails were preserved; shell fragments in litter were saved and identified.	Chisos Mt., BBNP, TX	1963, 70, and 1971	Pratt 1972
Aspects of life history of silky pocket mouse	Collection: some caught by hand at night with light source, some taken in museum special traps. Aging, measuring, examining repro. tracts	New Mexico		Forbes 1963
Rodent research	Live trapping	Panther Junction, BBNP, TX	1961	Warner 1964d
Colima warbler	Casual observation	BBNP, TX	1964	Gehbach 1967
Population estimates of yellow-nosed cotton rat, Lincoln Index	Live trapping, 48 traps (6x8) on each of 2 grids	BBNP, TX	1964	Rasp 1964
Key to 5 species of Peromyscus from BBNP	Literature review	BBNP, TX		Wayer and Warner 1964
Nesting of Black-capped vireos in the Chisos Mt.	Observation	Chisos Mt. BBNP, TX	1966	Barlow 1967
Range extension of Elf Owl	Observation	Big Bend area, TX	1966	Barlow and Johnson 1967

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<u>OBJECTIVE/SUBJECT</u>	<u>SAMPLING METHOD/REMARKS</u>	<u>LOCATION</u>	<u>DATE</u>	<u>REFERENCE</u>
Butterfly fauna from central Coahuila, Mexico	Collection	Near Cuatro Ciénegas de Carrizosa, central Coahuila, Mexico	1966	Ciench
Survey of 7 small mammals from BBNP	Observation and trapping	BBNP, TX	1966	Judd 1967
Stomach analyses of spiny crevice lizard	Analyses	BBNP, TX	1966	Smith and Milstead 1971
Seasonal occurrence and distribution of birds at BBNP	Observations of the author, visitors to the park, and records on file in the Naturalists office	BBNP, TX	1966-71	Wauer 1973
Crowding response of canyon lizards	Capture, mark, and observation of lizards	BBNP, TX	1966-69	Milstead and Smith 1970
A new land snail from the Chisos Mt.	Collection	Chisos Mt. BBNP, TX	1966-67	Pratt 1971
First Texas record for pocketed free-tailed bat	Mist netting, collection	Yucca Flats BBNP, TX Yucca Flats BBNP, TX	1967	Easterla 1968
Ecology of yellow-nosed cotton rat	Lab observations for behavior, live-trapping in the field for population estimates	BBNP, TX	1967-70	Crowder 1970
Bats mist netted and observed in BBNP	Mist netting, observation	BBNP, TX	1967	Easterla 1967

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<u>OBJECTIVE/SUBJECT</u>	<u>SAMPLING METHOD/REMARKS</u>	<u>LOCATION</u>	<u>DATE</u>	<u>REFERENCE</u>
First record of spotted bat in Texas and notes on its natural history	Mist netting	BBNP, TX	1967	Easterla 1970
Determine status of <u>Leptonycteris nivalis</u> in BBNP	Observation, netting	Big Bend, TX and Coahuila, MX	1967	Easterla 1972
Ecology of bats of BBNP	Mist netting over water-holes	BBNP, TX	1967-71	Easterla 1972
Restoval tiger beetles in BBNP	Collection	BBNP, TX	1967-69	Gaumer 1973
Colima warbler census in the Chisos Mt.	Observation (bird census)	Chisos Mt., BBNP, TX	1967	Wauer 1967
Birds banded at BBNP during 1967 and 1968	Banding	BBNP, TX	1967-68	Wauer 1969
Records of wintering birds in Chisos Mt.	Collection and observation	Chisos Mt., BBNP, TX	1967-68	Wauer 1969
Anna's hummingbird	Collection and field observation	BBNP, TX	1967	Wauer and Rylander 1968
Occurrence of Charadriiformes in BBNP	Observation	BBNP, TX	1967-72	Wauer and Scudder 1972
Baseline data for Colima warbler	Censusing, vegetation plots	BBNP, TX	1967-76	Wauer

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OBJECTIVE/SUBJECT	SAMPLING METHOD/REMARKS	LOCATION	DATE	REFERENCE
Ecological distribution of Spiny lizards (Sceloporus)	Observation, collection	BBNP, TX	1968-69	Brown 1970
Diurnal lizard populations	Veg. plots and lizard censuses	BBNP, TX	1968	Dequenhardt 1968
Lizard populations, veg. parameters	Veg. plots and lizard censuses	BBNP, TX	1968-69	Dequenhardt 1970
Population status of diurnal lizard	6 permanent quadrats analyzed for herpetofauna, soil, and vegetation change since 1957-58	BBNP, TX	1968-69	Dequenhardt 1970
Checklist of chiggers	Collection	BBNP, TX	1968-71	Loomis et al. 1972
Behavior and ecology of Trans-Pecos skunks	Field observation	Balmorhea, Reeves Co., TX	1968-73	Patton 1974
Nesting of Lucifer Hummingbird in the United States	Observation, photograph	Basin area Chisos Mt., BBNP, TX	1968	Nelson 1970
Sighting of upland plover in BBNP	Observed and photographed	Rio Grande Village, BBNP, TX	1968	Wauer 1970
General introduction to BBNP for a naturalist	General nature book for visiting naturalist, good bibliography	BBNP, TX	1968-72	Wauer 1973
Black-vented oriole	Field observation, capture, and photographs	BBNP, TX	1968-69	Wauer 1970

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OBJECTIVE/SUBJECT	SAMPLING METHOD/REMARKS	LOCATION	DATE	REFERENCE
Ecology and distribution of rodents as influenced by secondary succession	Used plot quadrants and trap lines (Sherman live traps) to determine rodent species, 1325 specimens were collected. Length, weight, sex reproductive status and presence of ectoparasites were noted.	BBNP, TX	1969-71	Baccus 1971
Spotted bat behavior	Observation	BBNP, TX	1969	Easterla 1971
Pocketed free-tailed bat in BBNP area	Netting	Boquillas, Mexico; Castolon and Rio Grande Village, BBNP, TX	1969	Easterla 1970
Documentation of amphibians and reptiles and their ecological associations	Observations were made in the field by walking transects in selected associations, trapping, and road cutting	Presidio Co. TX, Chihuahua biotic province in MX, Chisos Mt., Brewster Co., TX	1969-71, 73, 74	Olson 1978
New record of Red Bat from Brewster Co., Texas	Netting, collection	Boquillo Ranch 10.5 mi N of Panther Junction, BBNP, TX	1969	Smith 1975
Observations of Lyophobosis and feeding habits of <u>Liometopum apiculatum</u>	Observation	Chisos Mt. BBNP, TX	1969-70	Van Pelt 1971
Insects of the Chisos Mt. woodlands	Collection	Chisos Mt. BBNP, TX	1969-75	Van Pelt 1975

FAUNA REFERENCES

<u>OBJECTIVE/SUBJECT</u>	<u>SAMPLING METHOD/REMARKS</u>	<u>LOCATION</u>	<u>DATE</u>	<u>REFERENCE</u>
Ants of the Chisos Mt.	Collection	BBNP, TX	1969 and 1972	Van Pelt 1983
Second swallow-tailed kite record for Trans-Pecos Texas	Observation	Rio Grande Village, TX	1969	Wauer 1970
Westward extension of bronzed cowbird range in TX	Observation	BBNP, TX	1969-72	Wauer 1973
Cave swallows nesting in BBNP	Observations	Mariscal Mt., BBNP, TX	1969-70	Wauer and Davis 1972
Reproductive behavior of roadrunners	Field and laboratory observation	BBNP, TX and Okla.	1969-70	Whitson 1971
First sighting of gray vireo wintering in BBNP	Observation	BBNP, TX	1970	Barlow and Wauer 1971
Examine and describe relationships of resource structure, quality, and availability to social behavior and organization of peccaries	Peccaries were observed in their natural environment. Individual peccaries were observed for time budgets. 1 of 5 groups of peccaries being observed was captured and ear tagged. Vegetation sampled, scats collected.	BBNP, TX	1970-74	Bissonette 1982
Bats in the Fronteriza Mt.	Netting, collection	Fronteriza Mt. Coahuila MX	1970	Easterla and Baccus 1973

FAUNA REFERENCES

OBJECTIVE/SUBJECT	SAMPLING METHOD/REMARKS	LOCATION	DATE	REFERENCE
Biogeographical analysis of Chihuahuan Desert through its herpetofauna	Fieldwork: collection, established general geographical and ecological orientation to Chihuahuan Desert through field journal, and slides, literature search, museum tour	Chihuahuan Desert	1970-71	Morafka 1977
Ecology of the Bolson tortoise	Field observation, vegetation transects	Bolson de Mapimi, MX	1970-79	Morafka et al. 1981
Seasonal and yearly fluctuations in Chihuahuan Desert lizard communities	Sampled lizards with pitfall traps, noosing, and hand capture; marked each lizard; estimated population using Lincoln index	Dona Ana range, New Mexico State Univ. Ranch, Las Cruces, NM	1970-75 1977	Whitford and Creusere
Ectoparasites on bats from BBNP	Collected external parasites from bats	BBNP, TX	1970-71	Whitaker and Easterla 1975
Status of white-tailed deer	Used Bahh cruise lines and pellet plot transect census techniques, pellet group counts, spot-lighting, predator scat analysis, observation	BBNP, TX	1971-72	Atkinson 1976
Food habits of 7 bat species from BBNP	Collected by mist netting at waterholes and hand-netting at night roosts, used dissecting scope to examine stomach contents	BBNP, TX	1971	Pastela and Whitaker 1972
Mycteroglyphine mite in guano of <i>Leptonycteris nivalis</i>	Collection	BBNP, TX	1971-77	O'Connor et al.
Winter-spring home ranges of coyotes in BBNP	Trapping, radio-telemetry	BBNP, TX	1971	Stine 1975

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<u>OBJECTIVE/SUBJECT</u>	<u>SAMPLING METHOD/REMARKS</u>	<u>LOCATION</u>	<u>DATE</u>	<u>REFERENCE</u>
Ecological distribution of birds in the Chisos Mt.	Observation (preferred ecological association)	Chisos Mt., BBNP, TX		Wauer 1971
Ecology of <u>Orthoporus ornatus</u>	Observation aktograph recorded temp, induced molting, density estimates midsegment measurement	Tornillo Plats, BBNP, TX	1972-73	Crawford 1974
<u>Euderma maculatum</u>	Captured with mist nets. Kept in captivity and observed	BBNP, TX	1972-73	Easterla 1976
Predation upon snake by centipede	Observation, collection, X-ray	Study Butte, TX	1972	Easterla 1972
Collection of arachnids from Big Bend area	Collection	Big Bend area, TX	1972	Smith 1972
Natural history of of the Trans-Pecos rat snake	Collection, observation, review data	Big Bend area, TX	1972	Wallace and Hollander 1972
Ecology of Carmen Mt. white-tailed deer	Field observation, pellet counts, predator scat analysis, habits, vegetation analysis	BBNP, TX	1972-74	Krausman 1976
Forage relationships between white-tailed and mule deer	Analysis of stomach contents of 25 white-tailed and 29 mule deer	BBNP, TX	1972-74 1978	Krausman
Ectoparasites of reticulated geckos	Collection	BBNP, TX	1972	Loomis and Jahn 1973

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<u>OBJECTIVE/SUBJECT</u>	<u>SAMPLING METHOD/REMARKS</u>	<u>LOCATION</u>	<u>DATE</u>	<u>REFERENCE</u>
Checklist of chiggers	Collection	BBNP, TX	1972	Loomis and Wrenn 1972
Mountain lion ecology Carmen Mt.	Capture, radio-telemetry, field observation, pellet counts, observation, scat analysis	BBNP, TX	1972-76	McBride 1976
Taxonomy <u>Peromyscus boylii</u>	Electrophoresis	BBNP, TX US-Mexico	1973	Awise et al. 1974
Rattlesnake combat ritual	Observation	Dauas Zoo	1973-74	Carpenter et al. 197
Seasonal production in the desert millipede	Estimated density and size class structure by removing specimens, measured biomass, caloric values of millipedes	Tornillo Flat BBNP, TX Jornada Exp. Range, NM	1973-74	Crawford 1976
Ecology and reproductive observation of <u>Tantilla</u> <u>rubra cucalata</u>	Collection	BBNP, TX	1973-74	Easterla 1975
Mediterranean gecko in BBNP	Observation	Rio Grande Village, BBNP, TX	1973-74	Easterla 1978
Behavior of Colima warbler at Boot Springs	Observation	Boot Springs, BBNP, TX	1973	Robinson 1973
Foraging ecology 2 Chihuahuan Desert ant species	Observed rate of foraging activity; measured soil surface temp., air temp. and rel. humidity; estimated number of foragers per colonies by species with Lincoln method; measured critical temperatures	40 km NE of Las Cruces, NM	1973	Schumacher and Whitf 1974

FAUNA REFERENCES

OBJECTIVE/SUBJECT	SAMPLING METHOD/REMARKS	LOCATION	DATE	REFERENCE
Spatial and temporal variation in Chihuahuan Desert ant communities	Sampling-quadrat and quarter methods	Jornada experimental range, NM	1973	Schumacher and Whitf. 1976
Recent bird research sightings at BBNP	Personal experience, observation, literature review	BBNP, TX	1973-78	Scott 1978
Harlequin Quail release	Captured at night using dogs and nets	Noqales, AZ Pine Canyon BBNP, TX	1973	Wauer 1973
Status of peregrines in Europe and N.A. as compared to Chihuahuan Desert	Literature review, airplane survey, observation	Europe N. America, Chihuahuan Desert		Hunt 1974
Food habits of mule deer	Rumen contents of 46 deer were analyzed.	Pecos Co., TX	1974-75	Keller 1970
Study of competition between lizards	Marked, censused	Grapevine Hills, BBNP, TX	1974-77	Dunham 1978
Survey of peregrine falcons in the Chihuahuan desert	Observation	Chihuahuan desert	1974-75	Hunt 1975
Survey of avian usage of <u>Agave havardiana</u>	Observation gathered over 316 hrs.	BBNP, TX (Basin of the Chisos Mt.)	1975-76	Allen 1977
Identify avian use patterns of <u>Agave havardiana</u>	Observation, nectar samples collected in a calibrated syringe	BBNP, TX	1975-76	Allen and Neill 1979

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<u>OBJECTIVE/SUBJECT</u>	<u>SAMPLING METHOD/REMARKS</u>	<u>LOCATION</u>	<u>DATE</u>	<u>REFERENCE</u>
Terrestrial mammals in riparian zone of Rio Grande BBNP	Sampled rodents at 18 riparian sites, each for 720 trap nights for total of 12,960 trap nights - trapped 1292 rodents from 2 families, trapped specifically for <u>Dipodomys ordii</u> , Shannon-Weaver index of diversity	BBNP, TX	1975-76	Boeger and Schmidly 1977
Ecology of hummingbirds in Chisos Mt.	Listing of plant species in territories, insects in nectar, light intensities, plant characteristics of species used by hummingbirds	BBNP, TX	1975-76	Kuban 1977
Relationship of rainfall and season to activity of snakes	Collection	Northeastern Chihuahua, MX	1975-77	Reynolds 1982
Activity cycles of 3 sympatric lizards	Transect census of the Mapiimi Bolson	Bolson de Mapiimi, MX	1976	Barbault 1977
Resource partitioning in a Chihuahuan Desert lizard community	Transects collected for stomach content analysis	Southern Desert, near Ceballos, MX.	1976-79	Barbault and Maurcy
A, D, H, T, of riparian mammals and plants. Assess relationships between visitor usage and livestock impact on biological resources. <u>Dipodomys ordii attenuatus</u> and <u>Peromyscus leucopus texanus</u>	18 sites along the Rio Grande were trapped for small mammals. Tr-SH, Havahart live-traps, gopher traps. Vegetative canopy cover was measured. Subjective evaluations were made of human effect, livestock effect, site description, and wildlife characteristics for each of 64 sites	BBNP, TX and Rio Grande River	1976	Boeger 1977

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OBJECTIVE/SUBJECT	SAMPLING METHOD/REMARKS	LOCATION	DATE	REFERENCE
Beaver	One month fieldwork along Rio Grande	BBNP, TX	1976	Feeley and Connor 1977
Digestive enzymes of the desert millipede	Chemical and paper chromatography analyses	BBNP, TX		Nydenz and Crawford 1978
Incubation, hatching, and description of hatchlings of the reticulated gecko	Collection	Lajitas, TX	1976	Gallo and Reese 1978
Organization of small mammal populations in the Mapiimi Bolson	Transects established, capture/recapture	Bolson de Mapiimi, MX	1976-79	Grego and Serrano 1980
Small mammals and habitat partitioning	100-500 m transects and 4 permanent plots	Bolson de Mapiimi, MX	1976-80	Grego and Serrano 1981
Status of the peregrine falcon in the Western Chihuahuan Desert	Observation, aerial survey	Chihuahua and Durango, MX	1976-78	Hitchcock 1978
Survey of peregrine falcons and zone-tailed hawks in BBNP and GBNP	Aerial reconnaissance, ground surveys, time-lapse photography, observation from blinds	GNP and BBNP, TX	1976	Johnson 1976
Activity cycles of lizards	500-78m transects	Bolson de Mapiimi, MX	1976-78	Maury 1981
Determine nectar composition and avian use of <u>Agave havardiana</u>	Chemical analyses of nectar, observation of birds using the first flowering century plant	BBNP, TX	1976	Neill and Allen 1979

FAUNA REFERENCES

<u>OBJECTIVE/SUBJECT</u>	<u>SAMPLING METHOD/REMARKS</u>	<u>LOCATION</u>	<u>DATE</u>	<u>REFERENCE</u>
Structure and dynamics of a southern Chihuahuan avian community	Listened at station for 15 min. and counted all birds seen or heard within 50 meters for index of abundance	Bolsón de Mipimi, MX	1976-78	Thiollay 1979
Bird communities	Time-area counts, transects	Bolsón de Mipimi, MX	1976-78	Thiollay 1981
Foraging ecology in <i>Pheidole</i> (seed harvesting ants)	Examined nests for species, measured foraging intensity (counting number of foragers returning to nest in 2 min, removed forage from workers to examine composition)	Jornada Experimental Range, NM	1976	Whitford et al. 1976
Water turnover rate in 5 Chihuahuan Desert rodents	Injection with heavy water	Chihuahuan Desert	1977	Grenot and Serrano 1979
Food habits and parasites of scaled quail in southeastern Pecos Co. Texas	Collection, analysis of food habits and parasites	Near Sanderson, Texas	1977-78	Howard 1981
First record of Aztec Thrush in U.S. seen in Chisos Mt.	Observed and photographed	Boot Springs, Chisos Mt. BBNP, TX	1977	Wolf 1978
Status of kit fox in Trans-Pecos Texas	Trapped and radio-collared	Trans-Pecos Texas	1978	McLaughlin 1979
Bird records for 1978	Observation, interview	BBNP, TX	1978	Scott 1978
Establish information base for beaver and cottonwood at BBNP	Map riparian veg., identify areas used by beaver, identify plants eaten, describe den sites	BBNP, TX	1980-81	Strong 1982

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<u>OBJECTIVE/SUBJECT</u>	<u>SAMPLING METHOD/REMARKS</u>	<u>LOCATION</u>	<u>DATE</u>	<u>REFERENCE</u>
Management of beaver and Cottonwood	Cottonwood and willow stands were mapped, as were areas of beaver activity.	BBNP, TX	1980-81	Strong and Bissonette 1981
Home range and habitat preference of adult mule deer and mortality of fawns	Telemetry, 6 adults and 22 fawns collared	Pecos Co., TX	1980	Wampler 1981
Movement of water bugs	Mark and recapture	Jeff Davis Co., TX	1981	Thomas 1982
History and characteristics of the colima warbler	Collecting, analysis of available data	NE Mexico		Bangs 1925
Wildlife in proposed BBNP	Collection, observation	BBNP, TX		Smith 1936
Wildlife survey of Big Bend area	Observation, interviews with local residents	Big Bend area, TX		Johnson 1937
New subspecies of <u>Dipodomys ordii</u>	Collection, analysis of species	Brewster Co., TX		Bryant 1939
Diurnal lepidoptera in Big Bend area	Collection	Big Bend area, TX		Tinkham 1944
Status and range of <u>Pseudemys scripta gailgae</u>	Collection, analysis of of literature	Brooks and Shackelford Co., TX		Hamilton 1947
Orthoptera in the Big Bend area	Collection	Big Bend area, TX		Tinkham 1948
Mammals of San-Luis Potosi	Examination of specimens, records and literature	San Luis Potosi, MX		Dalquest 1953

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<u>OBJECTIVE/SUBJECT</u>	<u>SAMPLING METHOD/REMARKS</u>	<u>LOCATION</u>	<u>DATE</u>	<u>REFERENCE</u>
Geographical variation in the Blue-throated hummingbird	Analysis of specimens of Blue-throated hummingbird form in Mexico, Arizona, Chisos Mt.	Mexico Arizona Chisos Mt., BBNP, TX		Van Tyne 1953
Wild animal and arthropod vectors of disease	Collection, tissue samples	Marathon and Alpine to Rio Grande River, TX		Minton 1955
Mountain lion records	List of observations	BBNP, TX		Wallmo 1955
Mammals of Coahuila, Mexico	Collection	Coahuila, Mexico		Baker 1956
Relict species in Chihuahuan Desert	Review of available data	Chihuahuan Desert		Milstead 1960
New bat subspecies from Coahuila	Collection	Coahuila, Mexico		Stains 1957
Additional species of dragonflies from Big Bend area	Collection	Big Bend area, TX		Gloyd 1958
Lucifer hummingbird	Observation	Brewster Co., TX		Pulich and Pulich 1963
Birds in BBNP in winter	Observation	BBNP, TX		Wauer 1967
Checklist of BBNP mammals	Observation and literature	BBNP, TX		Wauer 1968A
Check of birds of BBNP	Observation, collection, and literature	BBNP, TX		Wauer 1968B

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OBJECTIVE/SUBJECT	SAMPLING METHOD/REMARKS	LOCATION	DATE	REFERENCE
Hummingbirds in BBNP	Observation	BBNP, TX		Wauer 1969
Spotted bat behavior	Captive observation			Easterla and Easterla 1969
Energetics of desert mammals	Measurement of rainfall, ambient and burrow temp., live trapping, marking, laboratory metabolic measurements	SE AZ		Chev and Chev 1970
Distribution of 2 lizards and factors affecting distribution of <u>Cnemidophorus tigris</u>	Observed lizards at different elevations, sampled vegetation diversity, meteorological observation	Pine Canyon, BBNP, TX		Lucchino 1970
Checklist of snails	Observation	BBNP, TX		Pratt 1971
Crevice spiny lizard	Stomach analyses	BBNP, TX		Smith and Milstead 1971
Birds' guide to BBNP	Observation	BBNP, TX		Wauer 1971
Sexual behavior of the greater road-runner	Observation, single frame analysis of 16mm films and spectrographic analysis of tape recordings	Texas and Oklahoma		Whitson 1971
Ecology of rock squirrel in Chihuahuan Desert	Observation, collection, analysis of food habits	Brewster Co., TX		Layton 1973
Checklist of birds reported from BBNP	Review of available data	BBNP, TX		Easterla 1973
Eocene rodents	Trapped, identification	SW Texas		Wood 1973

FAUNA REFERENCES

OBJECTIVE/SUBJECT	SAMPLING METHOD/REMARKS	LOCATION	DATE	REFERENCE
Photos of Puerto Rico Mine	Photos	US - Mexico		Walthall 1949
Ecological distribution of land snails in BBNP	Observation, collection	BBNP, TX		Pratt 1974
Ecology and systematics of lizards	Analyses	BBNP, TX		Deal 1975
Red bat in Mt. Emory Cave, Chisos Mt.	Review of available data	Mt. Emory, Chisos Mt., BBNP, TX		Easterla 1975
Beaver activity along the Rio Grande	Observation	Rio Grande from Cottonwood Canyon to R.G. Village		Connor and Peeley 1976
Use of Tamarix by Mexican beaver	Study of beaver, cottonwood Tamarix populations	BBNP, TX		Peeley and Connor 1976
Mammals of Trans-Pecos	Examination of species records	Trans-Pecos. TX		Schmidly 1977
Evaluation of insect and disease conditions	Collections, testing	BBNP, TX		Walter and Lucht 197
A mountain lion kill in southwestern Texas	Observation	Chihuahuan Desert		Van Pelt 1977
Significance of Rio Grande riparian system to avifauna	Literature review	Rio Grande from Big Bend area to Amistad, TX		Wauer 1977

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<u>OBJECTIVE/SUBJECT</u>	<u>SAMPLING METHOD/REMARKS</u>	<u>LOCATION</u>	<u>DATE</u>	<u>REFERENCE</u>
Resource partitioning in lizard species of the Bolson de Mapimi	Stomach analysis	Bolson de Mapimi, Durango, MX		Barbault et al. 1978
Biological and taxonomic status of white-winged doves	Banding, transects, specimen analysis	Big Bend area, TX		Gallucci 1978
Herpetofaunal diversity		Bolson de Mapimi, MX		Grenot et al. 1979
Taxonomic status, distribution and habitat of Carmen Mt. white-tailed deer	Cranial and antler measurements	Big Bend area, TX		Krausman et. al. 1971
Carrion communities in the northern Chihuahuan Desert	Daily carcass observations	Otero and Dona Ana Co., NM El Paso Co., TX		McKinnerney 1978
Structure and seasonal activity of Chihuahuan Desert and communities	Recorded number of colonies by species with random square meter plots, night sampling along fixed belt transects	Jornada Experimental Range, NM		Whitford 1978
Eco-physiological differences between high and low CAM species	Resting	Rosillos Mountain, Trans-Pecos, TX		Eickweier 1979
Mortality, home range, habitat and behavior of pronghorns antelope fawns	Radio telemetry	Brewster Co., TX		Tucker 1979

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<u>OBJECTIVE/SUBJECT</u>	<u>SAMPLING METHOD/REMARKS</u>	<u>LOCATION</u>	<u>DATE</u>	<u>REFERENCE</u>
Mercury concentrations in terrestrial and aquatic arthropods near Terlingua mining district	Collection of aquatic and terrestrial arthropods, dithizone method to analyze mercury	Terlingua, TX		Khan 1981
Nesting biology of <u>Tayoplymus moneduloides</u> and <u>Austaus icarioides</u>	Observation	Coastal GA, BBNP TX, Brisbane Austr.		Hook 1981
Nesting behavior of <u>Cremmibus centralis</u>	Observation	TX		Hook 1981
Spatial organization of lizards	Stratified censuses	Bolsón de Mapimi, Durango, MX		Murray and Barbault 1981
Spatial distribution of small vertebrate communities in the Chihuahuan Desert		Bolsón de Mapimi, Durango, MX		Gregot and Serrano 1982
Structure of bird communities in North American deserts	Regression analysis and Brayton-Curtis ordinations based on taxonomic and functional composition of plant and bird communities in 9 study areas in Western U.S.	BBNP, TX and western U.S.		Parker 1982

USE AND EFFECTS REFERENCES

OBJECTIVE/SUBJECT	SAMPLING METHOD/REMARKS	LOCATION	DATE	REFERENCE
Legislative developments in the creation of BBNP	Personal experience	BBNP, TX	1930-33	Wagstaff 1968
Accommodations at the newly created BBNP	Observation	BBNP, TX	1947	Wear 1947
Description of canyons of BBNP	Observation	Canyons of BBNP, TX	1948-49	Sprecher 1951
Insecticides in BBNP	Collected lizards, birds, rodents and samples of soil and vegetation from 8 sites in or near BBNP	BBNP and Lajitas, TX	1966 1968	Applegate 1970
Effect of use on veg. of Chisos basin	Veg. transects, species composition frequency, percent cover	BBNP, TX	1969	Whitson 1974
General management plan	Proposal	BBNP, TX	1970-79	USDI 1980c
Mercury content in water, soil, and silt	Samples collected from 10 sites in the Terlingua-BBNP area, oxidized mercury reduced to elemental mercury, absorption of ultra-violet light by mercury vapor recorded	BBNP, Brewster Co., TX	1973	Dumas 1974
Mercury content in lizard organs	Lizards were collected from 6 sites, 2 within BBNP	BBNP and Terlingua Creek, TX	1973	Gallagher 1974
Determine levels of mercury in BBNP and Terlingua Mining District	Soil, silt, lizards, fish, mice, and millipedes were analyzed to determine concentration of mercury	BBNP, TX	1974	Houston 1975

USE AND EFFECTS REFERENCES

OBJECTIVE/SUBJECT	SAMPLING METHOD/REMARKS	LOCATION	DATE	REFERENCE
Demonstrate utility of mandatory backcountry permits as a source of data, continuation of baseline data monitoring system and integration of such a system into park management	From a file of 3046 backcountry permits 36 variables were identified: first day of visit, length of stay, residence, number of boats, number of people in party, float trip, breakdown of sections of river floated, and location of campsites	Rio Grande BBNP, TX River, TX	1975-77	Alling 1978
Provide description of camping parties and use patterns along the River Road. Identify visitor perception of impacted parameters and management-related issues. Evaluate backcountry permit system	844 permits citing river road use were stratified by month and location. A sample of 448 was taken from this group and sent a mail questionnaire. Questionnaire packages included a 4 page questionnaire, cover letter, map and a self-addressed stamped envelope. 295 usable responses were received.	BBNP, TX	1975-76	Dittman et al. 1977
Identify motivation and level of satisfaction of river floaters on the Rio Grande	File of 329 float trip permits (June 1975-1976) at BBNP office, sample stratified by date and location of trip. All data were collected using mail-out questionnaires. 38 motivational items were listed. Respondents were asked to rank each item on a scale of importance.	Rio Grande River and BBNP, TX	1975-76	Graefe 1977
Investigate physical effect of visitors on the riparian corridor	Visitor use analysis, subjective site evaluation, biotic community analysis (rodent trapping), and photographic site establishment	BBNP, TX	1975-76	Schmidly and Dittman 1976

USE AND EFFECTS REFERENCES

OBJECTIVE/SUBJECT	SAMPLING METHOD/REMARKS	LOCATION	DATE	REFERENCE
Effects of human activity on riparian habitat	Inventory of small mammals at 18 sites, subjective evaluation sheets for 64 riparian sites, vegetation analyses, analysis of backcountry and river use permits (questionnaires sent to permittees), observation and photographic site establishment (campsites)	Rio Grande River and BBNP, TX	1975-76	Schmidly and Ditton 1979
Pesticide and silver concentrations of wells in BBNP	Gas chromatography	McKinney and Oak Springs, BBNP, TX	1976	Environmental Consultants, Inc. 1976
Impact of livestock and recreational use at BBNP and Amistad Recreational Area	BBNP- identified primitive campsites in riparian zones, used subjective site evaluation sheet to check human impact, monitored rodent population and analyzed vegetation by canopy cover. ARA- 3 study sites: (1) campsite- analyzed use with registration forms, observation, and photos, (2) adjacent overgrazed and (3) nongrazed areas- live trapped and marked small mammals, measured vegetation with point centered quarter method, and at all 3 sites point-quadrant method	Amistad Recreation Area and BBNP, TX	1976-77	Schmidly and Ditton 1980
Evaluating satisfaction of float trip experiences	Questionnaire to float trip participants to evaluate motives and satisfaction concerning float trip experience	Rio Grande River, BBNP, TX	1976	Taylor and Garefe 1978
Pictorial data base	Air craft and spacecraft photos	BBNP, TX	1977	Bonner 1978

USE AND EFFECTS REFERENCES

OBJECTIVE/SUBJECT	SAMPLING METHOD/REMARKS	LOCATION	DATE	REFERENCE
Determine spatial and temporal distribution, mode of transport within backcountry, and origin of user	4054 backcountry use permits were examined to determine area use levels within all areas of BBMP and user characteristics.	BBNP, TX	1980-81	Ditton and Bobbit 1982
Fire use plan and report for Boot Canyon	Regrowth studied on experimental plot	Chisos Mt., BBNP, TX	1980	Griese and Warren 1980
Air quality at BBNP	Particulate chemistry and visibility	BBNP, TX	1980-81	Yarborough and Warren
Report to MPS of planning	Presented to branch	BBNP, TX		Toll 1934a
Boundary line reports	6 reports of recommendations	BBNP, TX		USDI 1935
Description of proposed Park area	Not specified	BBNP area, TX		Winton 1936
Description of BBNP	Personal experience	BBNP, TX		Tillotson 1942
Developing BBMP	Observation	BBNP, TX		Tilden 1945
Development of International Peace Park	Meeting between international Park developer officials	Big Bend area, TX, MX		Morelock 1938
Improved range conditons in BBNP	Literature review, personal experience	BBNP, TX		Maxwell 1949
Site selection of Texas ICM vegetation plots	Remeasurement of transects	BBNP, TX		Vargo and Kittars 1986

USE AND EFFECTS REFERENCES

OBJECTIVE/SUBJECT	SAMPLING METHOD/REMARKS	LOCATION	DATE	REFERENCE
Historic Resources Management Plan	Literature review and park files	BBNP, TX		Brown and Wauer 1968
Insecticides in Presidio Basin	Sampled soil, vegetation and fauna along transect leading out of sprayed cotton field; sampled well water and water from Rio Grande	Presidio Basin, TX		Applegate et al. 1971
Wilderness study	Proposal for inclusion of more land to be added to BBNP's boundary	BBNP, TX		USDI 1971
Development concept for Chisos Basin, BBNP	Proposal to alleviate adverse environmental damage to Chisos Basin	BBNP, TX		USDI 1975a
Final environmental statement	Proposed wilderness classification	BBNP, TX		USDI 1975
Land use and ecological implications for the Chisos Mt.	Literature search, personal experience	Chisos Mt., BBNP, TX		Wauer 1975
Fire ecology	Reconnaissance sampling, establishment of permanent plots, fuel level estimates, analysis of fire and tree ring data	Chisos Mt., BBNP, TX		Dick-Peddie 1977

USE AND EFFECTS REFERENCES

<u>OBJECTIVE/SUBJECT</u>	<u>SAMPLING METHOD/REMARKS</u>	<u>LOCATION</u>	<u>DATE</u>	<u>REFERENCE</u>
Recreation and livestock impact on the riparian zone of the Rio Grande in BBNP	Study of aerial photos, conducted float trips, and identified riparian areas, analyzed visitor use from visitor permit system, did subjective site evaluation for riparian areas, used cluster analysis and principle component analysis to structure the site evaluation data base, sampled biological resources at riparian sites (trapped rodents at 18 different sites for 6 nights with 120 Sherman live traps and correlated with human and livestock use	Rio Grande River, BBNP, TX		Ditton et al. 1977
Environmental assessment of Developmental Concept Plan	Proposal, assessment	BBNP, TX		USDI 1977
Final environmental statement in master plan	Proposal; opinion	BBNP, TX		USDI 1979a
Management of BBNP	Proposal; opinion	BBNP, TX		USDI 1979
Development of mercury mining in Trans-Pecos Texas	Literature review	Trans-Pecos Texas		Sharpe 1980
Tourist guide to BBNP	Review of available data; personal experience	BBNP, TX		Deckert 1981
Environmental assessment for the general development plan	Proposal of 2 alternative strategies for development of Rio Grande Wild and Scenic River	Rio Grande River, TX		USDI 1980

USE AND EFFECTS REFERENCES

<u>OBJECTIVE/SUBJECT</u>	<u>SAMPLING METHOD/REMARKS</u>	<u>LOCATION</u>	<u>DATE</u>	<u>REFERENCE</u>
Fire management plan	Proposal; recommendations	BBNP, TX		USDI 1980b
Local participation in development of and conservation in the Hapimi Reserve	Literature review	Hapimi and Michilia Biosphere Reserves Durango, MX		Halfpter 1981
Mercury transport near Study Butte	Grid sampling of bedrock alluvium; stream sediment and bank surveys; grid and bank sampling of vegetation	Study Butte, TX		Morahan 1981
Contamination levels in songbirds in Texas	Collection	West Texas		USDI 1982
Determine particulate and visibility parameters for Big Bend	Collection of air samples; trace elemental analysis with atomic absorption spectrophotometry analysis of wet precipitation samples	BBNP, TX		Yarborough and Moyer 1983
Potential locations for longhorn range in Big Bend area	Observation	Big Bend area, TX		Russell
Environmental assessment of BBNP	Proposal for improved road	BBNP, TX		USDI
Mission 66 for BBNP	Proposes need to upgrade and update facilities	BBNP, TX		USDI

VEGETATION REFERENCES

<u>OBJECTIVE/SUBJECT</u>	<u>SAMPLING METHOD/REMARKS</u>	<u>LOCATION</u>	<u>DATE</u>	<u>REFERENCE</u>
Medicinal use of plants	Literature review	BBNP and Trans-Pecos, TX TX	History	Poster 1973
Vegetation changes in BBNP	Photography	BBNP, TX	1900-present	Warnock 1967
Collecting trip in Big Bend (esp. Chisos)	Observation, collection	Big Bend area, TX	1928	Palmer 1928
Quantitative vegetation data	Transects, literature	BBNP, TX	1933-69	Warnock 1970b
Ecology and vegetation of Chihuahua, Mexico north of 28th parallel	Review of available data, observation, examination	Northern Chihuahua, MX	1935-36	Lesueur 1938
Plant ecology survey	Observation, collection	BBNP, TX	1935	McDouqall 1935
Plant collection and vegetation response in exclosures	Collection, photographing	BBNP, TX	1935-37	Sperry 1938
Biological survey	Survey of plants and animals	Coahuila, TX	1936	Marsh 1936
Fire history of BBNP, weather data, insect collection	Interviews, temperature monitoring, rainfall monitoring, insect collecting	BBNP, TX	1936, 1937	Matthews (n.d)
Report on collecting work	Collection	BBNP, TX	1937	Marsh
Ecological survey of BBNP	3 months field work by 9 people, general survey	BBNP, TX	1944	Taylor et al. 1944
Dendrochronology	Collection and examination	BBNP, TX	1945	Schulman 1952

VEGETATION REFERENCES

OBJECTIVE/SUBJECT	SAMPLING METHOD/REMARKS	LOCATION	DATE	REFERENCE
Field trip through BBMP to study vegetation	Observation	BBMP, TX	1953	McDouqall 1953
Ecological survey of Big Bend area	Mapping, observation, collection	BBMP, TX	1955	Wapoch, Dixon, Wallmo, Deegenhardt, Cobb 1955
Plant succession as influenced by soil geomorphic processes	Transects, photos	BBMP desert grassland zone, TX	1955-81	Wongzell and Ludwig 1983
Primary productivity of a desert shrub (Creosotebush) community	Monitored air temperature, relative humidity, soil temperature, rainfall, air movement; detailed measurements of plant density and cover taken from line strips, quadrats; weighed and aged selected Larrea Shrubs; measured seed crops in line-strips; examined growth and rate of growth; calculated volume, age and standing dry weight	San Simon Valley, SE Arizona	1958-59	Chew and Chew 1965
Rust fungi of BBMP area	Collection	Jeff Davis, Brevster, Presidio Co., Texas	1961-62	Cummins 1964
Study of vegetation dynamics and human impact on plants in Boot and McKittrick Canyons	Vegetation sampling using transects, plots and line-intercept methods	Boot Canyon BBMP and McKittrick Canyon GSNP, TX	1964	Gehlbach 1965
Collect baseline woody plant data for Boot Canyon	Data collected on distribution abundance, and size of woody plant species	BBMP, TX	1964	Gehlbach 1965

VEGETATION REFERENCES

<u>OBJECTIVE/SUBJECT</u>	<u>SAMPLING METHOD/REMARKS</u>	<u>LOCATION</u>	<u>DATE</u>	<u>REFERENCE</u>
Permanent vegetation plots in Boot Canyon	Abundance, size, and distribution of plants within plots	BBNP, TX	1964	Whitson 1965a
Determine structure of woody plant species of Boot Canyon	Modified point-center quarter	BBNP, TX	1964	Whitson 1965b
Phytocoenology in Boot Canyon	Established permanent plot sites; sampling	Chisos Mt. BBNP, TX	1964	Whitson 1965
Phytocoenology of Boot Canyon	Cottam-Curtis point-centered quarter method, transects	Chisos Mt. BBNP, TX	1964	Whitson 1965
Aspen survey	Tally and measurement of DBH of dead and living trees	Mt. Emory BBNP, TX	1965	Burr 1966
Vegetation of dead Horse Mt.	Observation	Dead Horse Mt., BBNP, TX	1965	Wells 1965
Macrolichens in BBNP	Review of collections, collecting	BBNP, TX	1966, 69, 70	Wetmore 1976
Effects of fire	Observation at 10 burned areas, 0.1 - 95 acres.	Carlsbad Caverns, NM	1967-72	Kittams 1973
Dynamics of vegetation-soil relationships	Vegetation transects, soil samples	BBNP, TX	1967-68	Whitson 1970
Habitat description of Night-Blooming Cereus	Observation	Marathon, TX Phoenix, AZ	1969	Davis 1969
Ecology of the giant dagger in BBNP	Field observation	BBNP, TX	1969-71	O'Neil 1971

VEGETATION REFERENCES

OBJECTIVE/SUBJECT	SAMPLING METHOD/REMARKS	LOCATION	DATE	REFERENCE
Vegetation composition in BBMP	11 line transects (permanent)	BBMP, TX	1969	Warnock 1970c
Monitor vegetation	Circular plots	BBMP, TX	1970	Warnock 1970a
Description of vegetation of lower canyons of Rio Grande	Observation	Boquillas Cadyon, BBMP and Amistad Reservoir, TX	1971	Riskind 1971
Ecology, morphology, and distribution of <i>Hectia scariosa</i>	Transect lines, observation, and microscopic techniques	BBMP, TX	1972	Green 1973
Effects of soil moisture availability on above ground production and reproductive allocation in creosotebush	Treatment plots receive moisture; vegetative and reproductive growth were measured	New Mexico State Univ. Rancho Dona Ana County, NM	1973-74 1979	Cunningham et al.
Cacti of BBMP	Literature search, observation	BBMP, TX	1974-78	Kurz 1979
Determine chromosome numbers of cacti		BBMP, Trans-Pecos, TX	1975-82	Weedin and Powell 1982
Effects of fertilization on creosotebush and fluff grass	Measured biomass production before and after nitrogen fertilization	Jornada Exp. Range, Las Cruces, NM	1977	Ettershan et al. 1978
Control of creosotebush with pelleted tebuthiuron	Measured response of herbaceous vegetation following treatment with pelleted tebuthiuron	Fort Stockton, TX	1978-79	Jacoby et al. 1982

VEGETATION REFERENCES

<u>OBJECTIVE/SUBJECT</u>	<u>SAMPLING METHOD/REMARKS</u>	<u>LOCATION</u>	<u>DATE</u>	<u>REFERENCE</u>
Variations and inter-relationships of aquilegia populations of Trans-Pecos Texas	Field observation, collection and disposition of morphological specimens	Trans-Pecos TX	1978	Lott 1979
Vegetation monitoring	Vegetative parameters of 11,375 m square plots in the Chisos Mts. were collected as baseline data	BBNP, TX	1978	Moir 1980
Examined lichens in BBNP as indicators of air quality	Review of collections, present in area in previous studies, compared current photos to old photos, tagged & photographed dead tree limbs with lichens	BBNP, TX	1980	Wetmore 1981
Natural landmarks inventory	Inventory	NM, TX	1981-82	Dick and Peddie 1982
Establish survey plots in desert grassland	Vegetation sampling	BBNP, TX	1981-82	Meents and Moir 1982
Percent vegetation on grassland plots	Line transects on 4 plots	BBNP, TX	1981	Meents and Moir
Effects of fire on Chisos Mts. vegetation	Control burn, experimental and control plots	BBNP, TX	1981	Moir and Meents 1981
Compare floral ontogeny	Collected floral buds, fix in FAA	BBNP, TX	1982	Derstine 1982
Plants of Brewster Co., Texas	Collection	Brewster Co., TX		Sperry and Warnock 1941
Vegetation cover type map	Color coded map	BBNP, TX		USDI 1944

VEGETATION REFERENCES

<u>OBJECTIVE/SUBJECT</u>	<u>SAMPLING METHOD/REMARKS</u>	<u>LOCATION</u>	<u>DATE</u>	<u>REFERENCE</u>
Plant identification	Collection	BBNP, TX		McDougal and Sperry 1959
Big Bend ecological survey	Record of vegetation transects	Panther Junction, BBNP, TX		Wallmo 1955
Vegetation survey	Report, photos	BBNP, TX		Warnoch 1955
New rust fungi from the Big Bend of Texas	Collection, description	Big Bend area, TX		Cummins 1965
Biomes of Big Bend	A preliminary descriptive outline	BBNP, TX		Gelbach 1966
Lichens collected in BBNP	Collection	BBNP, TX		Wetmore 1969
History of land use and abuse	Historical records	BBNP, TX		Wauer 1970
Cacti of BBNP	Literature review, observation	BBNP, TX		Wauer 1970
Oaks of BBNP	Review of available data, personal experience	BBNP, TX		Wauer 1971
Moss flora of BBNP	Collections	BBNP, TX		Maquill 1972
Rare and/or endangered cacti of Texas	Review of available data	Texas		Riskind 1974
Taxonomy and key for genus Echinomastis	Review of available data	Chihuahuan Desert		Glass and Poster 1995

VEGETATION REFERENCES

<u>OBJECTIVE/SUBJECT</u>	<u>SAMPLING METHOD/REMARKS</u>	<u>LOCATION</u>	<u>DATE</u>	<u>REFERENCE</u>
Ecology of Chorro Canyon ecosystem	Collection of voucher specimens of plants and animals	Chorro Canyon, Presidio Co., TX		Burns 1976
Mosses of BBNP	Collection	BBNP, TX		Maqill 1976
Specimens in herbarium at BBNP	Collection, review of available data	BBNP, TX		Warnock 1976
Fire ecology	Reconnaissance sampling, establishment of permanent plots, fuel level estimates, fire and tree ring data analyses	Chisos Mt. BBNP, TX		Dick and Paddie 1977
Identify vegetation of Cuatro Ciénegas Basin	Identification	Cuatro Ciénegas Chihuahua, MX		Pinkava 1977
Transportation and propagation of Chihuahuan desert	Examined effect of season, root pruning, and transpiration reduction on transplanted shrubs	Chihuahuan Desert area		Tipton 1977
Model of primary production in creosotebush	Simulation, modeling	Chihuahuan Desert area		Cunningham and Revnold 1978
<i>Hectia scariosa</i> , a Bromeliad in BBNP	Observation	BBNP, TX		Smith 1978
Eco-physiological differences between high and low CAM species	Testing	Rosillas Mt., TX		Eickweier 1979
Forest and vegetation monitoring	Precise plotting and accurate reporting methods	Chisos Mt.		Moir 1980

VEGETATION REFERENCES

OBJECTIVE/SUBJECT	SAMPLING METHOD/REMARKS	LOCATION	DATE	REFERENCE
Effects of prescribed fire on production utilization, and nutritional value of alkali sacaton in Brewster Co.	Preburn veg. sampling, prescribed fire, rainfall monitoring, postburn vegetation production sampling	Brewster Co., TX		Gavin 1982
Fire history in Chisos Mts.	Stem sections of trees showing basal fire scars	Chisos Mt., BBNP, TX		Moir 1982
Largest trees of BBNP	Observation, measurement of tree dimensions	BBNP, TX		Liles 1983
Endangered cactus species	Surveying and monitoring in progress	Guadalupe Mt., BBNP, TX		Heil and Brack 1984

