FAUNAL REMAINS FROM THE SHOOFLY VILLAGE RUINS, ARIZONA

by

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ABSTRACT

Faunal remains recovered from the archaeological site of Shoofly Village are analyzed to reconstruct and explain the role of animal resources in the prehistoric economic system. A total of 4366 animal bones, representing at least 65 individuals and 35 different genera, is described and interpreted.

As is the case for many Southwestern sites, the faunal assemblage from Shoofly Village is dominated by artiodactyl and lagomorph remains. The prevalence of cottontails, as opposed to jack rabbits, suggests that the site vicinity was dominated by brush and cover during the period of occupation.

Taphonomic, zoogeographic, ethnographic, and archaeological data indicate that approximately 42% of the taxa are probably natural intrusions to the assemblage. Avian bones suggest procurement of birds for plumage, as well as for meat. It is likely that deer, cottontail, and black-tailed jack rabbit were the most important animal species to the human diet. The pattern of animal remains is consistent with procurement of most faunal resources within a short distance of the archaeological site.

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Naturally any errors, in content or form, are solely my responsibility.

TABLE OF CONTENTS

LIST OF TABLES.................................... vii

LIST OF FIGURES.................................... x

CHAPTER ONE, INTRODUCTION.............................. 1

CHAPTER TWO, PHYSIOGRAPHY AND ENVIRONMENT............. 9

CHAPTER THREE, SHOOFLY VILLAGE RUINS.................. 18

Archaeological Investigations of the Payson Region.. 18

Archaeology of Shoofly Village Ruins................ 20

CHAPTER FOUR, HISTORY AND METHODOLOGY OF SHOOFLY FAUNAL ANALYSIS.................................. 30

Field Collection Methods............................. 31

Comparative Osteological Collections Utilized....... 32

Taxonomy Employed.................................. 34

Method of Recording Data............................ 35

Quantification of Faunal Remains.................... 41

CHAPTER FIVE, OVERVIEW OF THE SHOOFLY FAUNAL ASSEMBLAGE.. 50

Class Amphibia - The Amphibians..................... 50

Class Reptilia - The Reptiles....................... 58

Class Aves - The Birds.............................. 66

Class Mammalia - The Mammals........................ 79

CHAPTER SIX, BONE ARTIFACTS FROM SHOOFLY VILLAGE...... 109

CHAPTER SEVEN, DISCUSSION AND CONCLUSIONS............. 125

Relative Abundances of Taxa......................... 125

Origin of the Archaeological Fauna............... 130

Relative Importance of Taxa............... 150

Animal Procurement Patterns............... 155

Bone Tool Assemblage............... 163

Conclusions and Suggestions for Future Research..... 166

BIBLIOGRAPHY............... 171

APPENDICES............... 190

Appendix One, Flotation Sample Faunal Remains....... 190

Appendix Two, Coding Format............... 193

Appendix Three, Taxonomic Codes............... 196

Appendix Four, Body Part Codes............... 213

Appendix Five, Bone Element Frequencies............... 215

LIST OF TABLES

Table		Page
1.	Sites and Projects Used for Comparison with Shoofly Village	4
2.	Reports of Archaeological Investigations in the Payson Area, 1954-1984	19
3.	Archaeomagnetic Dates	29
4.	Radiocarbon Dates	29
5.	Index Species for Size Classification	38
6.	Vertebrate Taxa Recovered from Shoofly Village	51
7.	Quantitative Summary of Shoofly Fauna	54
8.	Data Summary for *Bufo* sp	57
9.	Data Summary for Kinosternidae	60
10.	Data Summary for *Terrapene ornata*	61
11.	Data Summary for Iguanidae	63
12.	Data Summary for Colubridae	64
13.	Data Summary for *Pituophis melanoleucus*	65
14.	Data Summary for *Crotalus* sp	65
15.	Data Summary for *Anas platyrhynchos*	67
16.	Data Summary for *Accipiter cooperii*	68
17.	Data Summary for *Buteo* sp	69
18.	Data Summary for *Grus canadensis*	70
19.	Data Summary for *Colaptes* sp	72
20.	Data Summary for *Melanerpes* sp	73

21. Data Summary for Corvidae........................ 75

22. Data Summary for *Toxostoma* sp.................... 76

23. Data Summary for *Sturnella neglecta*............... 76

24. Data Summary for *Lophortyx gambelii*.............. 77

25. Data Summary for *Meleagris gallopavo*............. 78

26. Data Summary for *Lepus alleni*.................... 83

27. Data Summary for *Citellus* sp..................... 87

28. Data Summary for *Sciurus* sp...................... 89

29. Data Summary for *Thomomys* sp..................... 90

30. Data Summary for Heteromyidae..................... 92

31. Data Summary for *Peromyscus* sp................... 93

32. Data Summary for *Sigmodon* sp..................... 95

33. Data Summary for *Neotoma* sp...................... 96

34. Data Summary for Canidae.......................... 99

35. Data Summary for *Urocyon cinereoargenteus*........ 101

36. Data Summary for *Vulpes macrotis*................. 101

37. Data Summary for *Ursus americanus*................ 102

38. Data Summary for *Mephitis mephitis*............... 103

39. Data Summary for Artiodactyla..................... 105

40. Data Summary for *Cervus canadensis*............... 105

41. Data Summary for *Odocoileus* sp................... 106

42. Data Summary for *Ovis canadensis*................. 108

43. Bone and Antler Artifact Typology................. 110

44. Abundances of Selected Taxa Recovered from Shoofly Village and Other Southwestern Sites.... 129

45. Modifications Exhibited by Shoofly Village Faunal Specimens.................................. 133

46. Relative Frequencies of Burnt Artiodactyl and Lagomorph Body Parts......................... 138

47. An Assessment of the Cultural Derivation of Taxa Identified from Shoofly Village............ 151

48. Available Meat.................................... 153

49. Relative Frequencies of Identifiable Elements for Artiodactyls and Lagomorphs................. 157

LIST OF FIGURES

Figure Page

1. Shoofly Village and other archaeological sites discussed in text.............................. 2

2. Major physiographic and modern political features near Shoofly Village........................ 10

3. Excavations at the Shoofly Village ruins, 1984-1985.. 23

4. Origin of fauna recovered from Shoofly Village... 164

CHAPTER ONE

INTRODUCTION

Faunal remains recovered from archaeological sites are one primary source of information regarding human subsistence, social organization, environment, chronology, animal husbandry, and technology. This paper relates the data from, and interpretations of, the archaeological fauna recovered from the Shoofly Village ruins. The faunal analysis is used to reconstruct and explain the role of faunal resources in the economic system of Shoofly Village.

Shoofly Village (AZ O:11:6 (ASU)) is a large prehistoric settlement located approximately five kilometers northeast of present-day Payson, Arizona (see Figure 1). Lying within a rugged transition zone, bounded by the high elevations of the Mogollon Plateau to the north and arid expanses of the Basin and Range province to the south, the site is in an area of biotic abundance and diversity.

Precipitation in the region, largely concentrated in summer thunderstorms, averages about 51 cm each year. Geologic strata at the site are dominated by basalt and sandstone, although nearby chert, granite, and limestone deposits provided ample materials for prehistoric buildings and tools.

The site consists of a number of rooms, plazas, and open

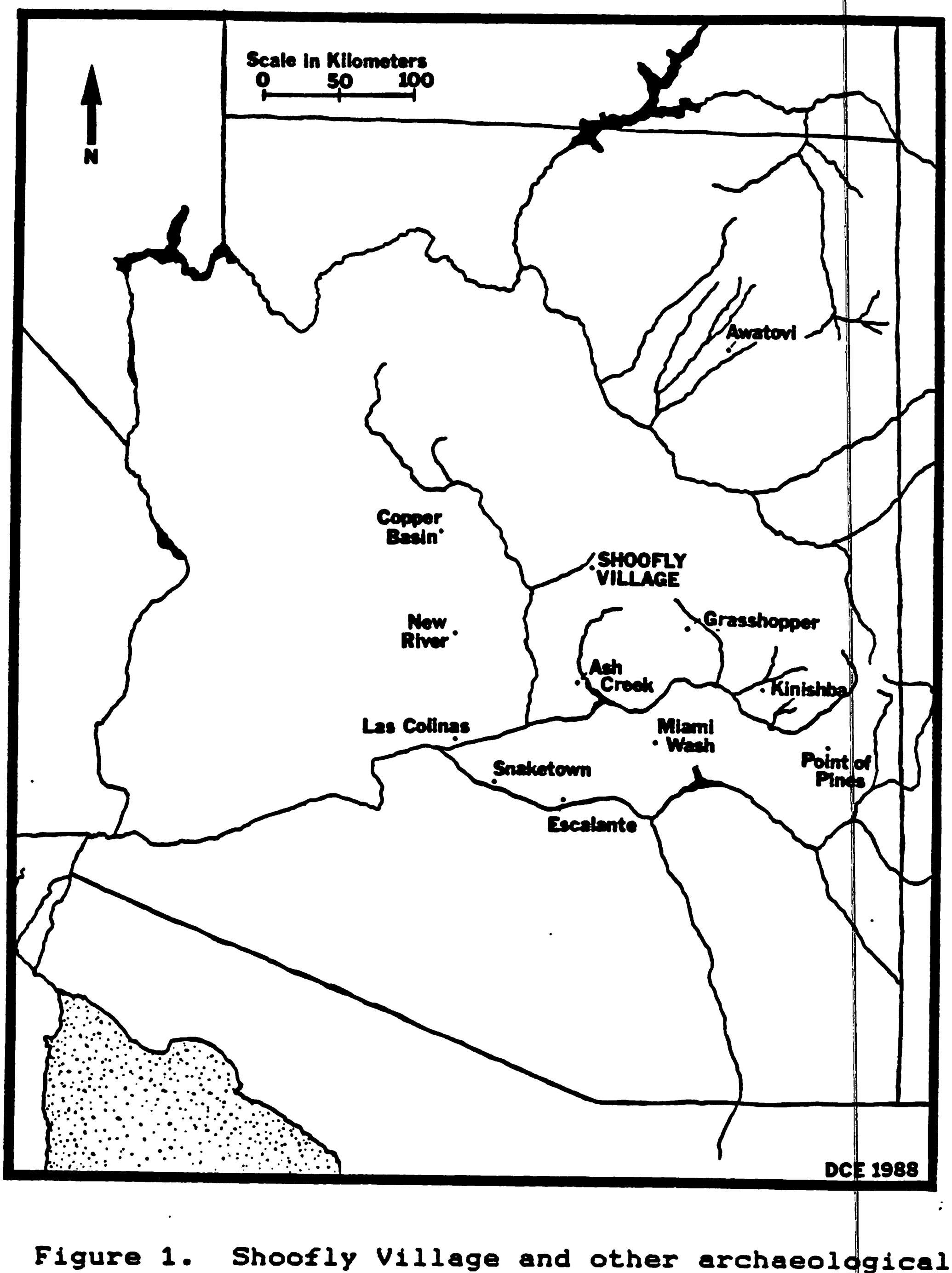

Figure 1. Shoofly Village and other archaeological sites discussed in text.

areas encircled by a masonry compound wall. Twenty-six relatively large, rectilinear rooms are located in a single room block at the center of the site. Outside the core area there are another 39 rectilinear rooms, which are generally smaller than those in the core, organized into several small clusters. This peripheral area also contains 14 curvilinear rooms, often freestanding, arranged in a dispersed pattern.

Although the site's occupational history is largely unknown, radiocarbon and archaeomagnetic samples indicate that the site was occupied from at least A.D. 1000 to A.D. 1200. The relationship between the site's occupants and known archaeological or ethnographic groups is not clear; it is possible that the Shoofly Village people are an indigenous, local population.

It should be recognized at the outset of this study that the interpretation of faunal remains recovered from Shoofly Village is hampered because I lack closely-related ethnographic and archeological groups to use for comparison. As partial remedy for this situation, I have drawn upon a variety of faunal studies from throughout central and south-central Arizona. Table 1 presents a list of these sites, the size of their faunal assemblages, and the citation of the primary faunal report.

Clearly this list of faunal studies is not exhaustive. Many sites were excluded because collection and reporting

Table 1. Sites and Projects Used for Comparison with Shoofly Village

SITE OR PROJECT	NUMBER OF SITES	TOTAL NISP	FAUNAL REPORT CITATION
Anamax Roosevelt	14	6,723	Glass 1984
Ash Creek	8	1,019	Bayham and Hatch 1984
Awatovi	1	?[a]	S. J. Olsen 1978
AZ U:1:31 (ASU)	1	407	Bayham and Bruder 1985
Central AZ Ecotone	12	964	Douglas 1975
Copper Basin	5	451	Bayham 1977
Coronado	7	557	Kriegh 1980
Dead Valley	7	216	Bayham 1980
Escalante	5	2,121	Sparling 1974
Fitzmaurice	1	1,496	Douglas and Whitman 1974
Grasshopper	1	40,246	J. Olsen 1980
Las Colinas	1	922[b]	Johnson 1981
Miami Wash	7	1,748	Sparling 1978
New River	9	7,346	Bayham and Hatch 1985
P.A.R.E. (1987)	8	1,124	Atwell 1988
Salt-Gila Aqueduct	28	13,424	Szuter 1984b
Snaketown	1	1,688[b]	Greene and Matthews 1976
TEP St. Johns	11	1,938	Czaplicki 1981

[a] Olsen does not report NISP for Awatovi.
[b] Indeterminate specimens were omitted from the NISP figure by the author(s).

methods differed widely from those used at Shoofly Village. Even the sites that are utilized must be considered in light of the fact that there are significant differences in: size of the archaeological sites and the human population which created them; size of the archaeological assemblage; environmental zones which were utilized; chronological period of occupation; and recovery and reporting methods.

Excavations at Shoofly Village were conducted by the Department of Anthropology of Arizona State University between 1984 and 1987. In addition to yielding thousands of artifacts, excavations during 1984 and 1985 produced the collection of 4,366 animal bones which are considered here.

Faunal specimens recovered from Shoofly Village reflect aspects of the natural environment, economy, technology, and history of the site. Animals recovered from Shoofly Village range from the very small (e.g., pocket mouse) to the very large (e.g., elk and black bear). At least 35 different genera have been identified. Taxa particularly common to the Shoofly Village fauna assemblage are artiodactyls (predominantly deer), cottontails, and black-tailed jack rabbits. This paper presents the archaeological data for these and other animals recovered from the Shoofly Village.

The broadest goal of this study is to examine the role of faunal resources in the economic system of Shoofly Village. The specific goals of the faunal analysis were to examine five major topics which might contribute to our understanding of prehistoric life at Shoofly Village. These topics are as follows:

(1) relative abundances of the taxa in the archaeological fauna.

(2) origin of the archaeological fauna;

(3) relative importance of the different taxa;

(4) animal procurement patterns; and

(5) description and interpretation of the bone tool assemblage.

Because this is one of the first studies to consider Shoofly Village, the initial chapters of this paper are devoted to presenting background information for the study. In Chapter Two, I describe the physiographic and environmental setting of the site. My purpose is to summarize the nature and location of the resources which may have been available to the prehistoric inhabitants of Shoofly Village. Chapter Three is primarily concerned with relating the archaeological investigations which have taken place at Shoofly Village and in the Payson region. It also serves to illustrate the dearth of subsistence information which exists for the area.

The details of the faunal analysis are presented in Chapters Four, Five, and Six. In Chapter Four, I document the methods and techniques used in collecting, cleaning, analyzing, coding, and quantifying the animal bones from the site. Chapter Five is a taxonomic review. My discussion includes: the number and type of elements identified for each species; current zoogeographic ranges and habitat preferences; occurrence at other Southwestern sites; and possible explanations for the presence and condition of each taxa. Chapter Six explores the bone tool assemblage.

Results, conclusions, and implications of this study are presented in Chapter Seven. It is here that I address each of the five major topics (as presented above) which pertain to understanding the role of animals in the Shoofly Village economic system. I suggest that, as is the case for many Southwestern sites, the faunal assemblage from Shoofly Village is dominated by artiodactyl and lagomorph remains. It is argued that the prevalence of cottontails, as opposed to jack rabbits, indicates that the site vicinity was dominated by brush and cover during the period of occupation.

Various taphonomic, zoogeographic, ethnographic, and archaeological data are used to distinguish taxa which are probably intrusive to the site. I suggest that 42% of the taxa (and 80% of the small animal species) result from physical or natural agencies, rather than cultural activities.

A high percentage of burnt bone from all major artiodactyl body portions is viewed as consistent with routine disposal of bones into a fire after food preparation or consumption. Deer, cottontail, and black-tailed jackrabbit are suggested to have been the most important species to the human diet. Finally, I suggest that the pattern of animal remains recovered from Shoofly Village is consistent with largely local procurement of most faunal resources.

CHAPTER TWO

PHYSIOGRAPHY AND ENVIRONMENT

The Shoofly Village ruins, a twelfth century settlement, lie approximately five kilometers northeast of present-day Payson, Arizona. The physical and natural setting of the site has recently been described by Redman and Hohmann (1985) and is briefly summarized here. Figure 2 shows the major physiographic and political features which are referenced in this discussion.

Regional Setting. Shoofly Village lies within the transition physiographic province, bounded by rugged mountainous areas to the south and the Mogollon Rim, an escarpment which is the exposed southern edge of the Colorado Plateau, to the north (Fenneman 1928; Hohmann and Redman 1986:2; Redman and Hohmann 1985:3; Snyder 1978:Figure 2, 37). Sellers (1964:4), in discussing the climate of Arizona, called this area the central topographic division. He described the area as of rugged terrain; a transition zone between the plateaus of the north and east and the arid deserts of the southwest (1964:6).

The immediate surroundings of the site, referred to as the Payson Basin (Hohmann and Redman 1986:2; Redman and Hohmann 1985:3) or Payson region (Redman and Hohmann 1986), have been defined as:

> ... a large shallow basin, the northern and northwestern boundaries including Birch Mesa, Houston

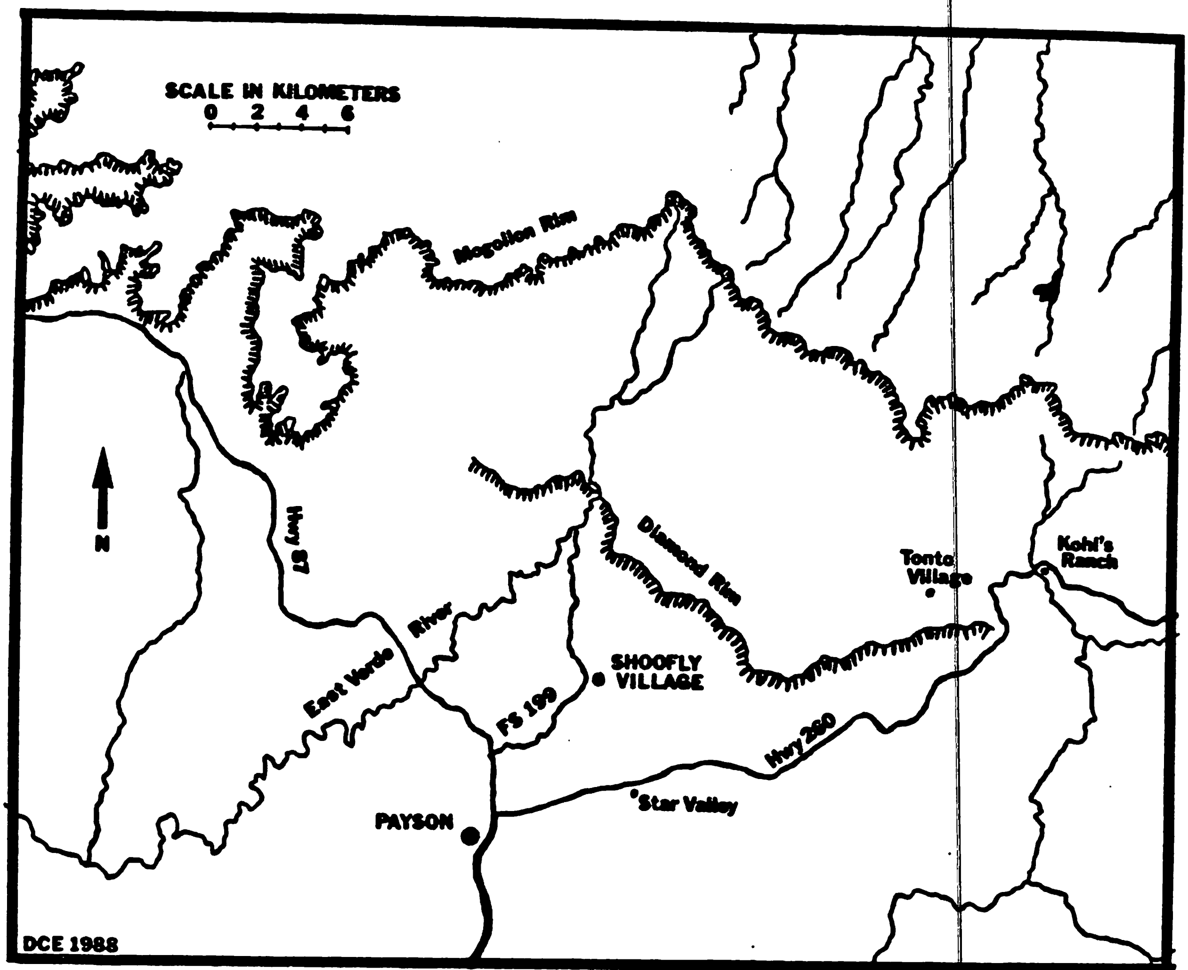

Figure 2. Major physiographic and modern political features near Shoofly Village (adapted from Shotts 1984).

> Mesa, and Walnut Flat ... These broad, generally level uplands are dissected by downcutting (sic) intermittent drainages such as Shoofly Wash, Butcher Creek, and Ash Creek, all of which drain north into the East Verde River. The Basin's eastern perimeter is drained by Star Valley and Houston Creek. Green Valley and American Gulch drain the western portion of the basin, which is bounded by the upper drainage of Rye Creek. The southern extent of the Payson Basin is usually referenced as Oxbow Hill. Gibson Creek and St. John's Creek drain this southern sector [Hohmann and Redman 1986:3].

The Payson region is characterized by high, open mountains and sediment-filled basin lowlands. Elevations within the area range from approximately 1460 to 1700 meters above sea level. Major drainages tend to flow southward. Slopes are typically moderate to steep, with steep slopes most frequently occurring at mesa edges or near deeply entrenched drainages (Hohmann and Redman 1986:2; Redman and Hohmann 1985:3).

Climate. Weather within the Payson region is influenced by both the Mogollon Rim and the Diamond Point ridge. Annual precipitation, as recorded at the Payson Ranger Station from 1931 to 1972, ranged from 29.17 cm (1950) to 78.71 cm (1965), with a mean annual precipitation of 51.69 cm. The area receives precipitation from both western and southwestern storm patterns in the winter, and southern and southeastern weather patterns in the summer. Precipitation is largely concentrated in summer thunderstorms during July and August, with spring and fall being relatively dry seasons (Sellers 1964:10; Sellers and Hill 1974:362-3). Winter precipitation, about one-quarter of which falls as snow (Hohmann and Redman 1986:2; Redman and Hohmann 1985:3), is most prevalent between December and March (Sellers 1964:10). Temperatures for the area average 2.3° C (36.2° F) in January and 23.1° C (73.6° F) in July. Recorded temperature extremes have been as low as -26.1° C (-15° F) (January 1937) and as high as 41.7° C (107° F) (July 1970). Freezing temperatures generally occur from October to May (Sellers and Hill 1974:362). Humidity varies, from 38 to 48% (Sellers and Hill 1974:362-363), with the upper ranges occurring during the summer thunderstorm season (Hohmann and Redman 1986:2; Redman and Hohmann 1985:3).

Geology and Soils. The geological composition of the Payson region is largely metamorphic and sedimentary formations of pre-Cambrian age, dominated by Troy quartzites and Tapeats sandstones. The erosional resistance of these formations has created sharp escarpments along mesa edges. The earliest strata are overlain by Devonian-aged limestone outcrops which contain chert and chalcedony nodules which were utilized by prehistoric people. These limestone strata weather rapidly and comprise a substantial portion of the surficial rock and soil material of the area. Limestone and granite outcrops are abundant, with the underlying sandstone strata being less accessible (Hohmann and Redman 1986:2; Redman and Hohmann 1985:3; Wilson et al. 1959).

Soils within the Payson region are typically finely textured with moderate moisture storage capacities. Soil depths range from thin deposits, frequently found around granitic outcrops, to deep deposits, found in mesa centers and drainage bottoms. Abundant fertile expanses within the area have high agricultural potential and are capable of supporting extensive foraging and browsing activities (Hohmann and Redman 1986:2; Redman and Hohmann 1985:4).

Water Availability. There are four drainages within one km of Shoofly Village, the closest of which is 735 meters from the site. All four of these water sources are intermittent streams. The nearest permanent source of water is the East Verde River, approximately 4.4 kilometers to the northwest. There has been speculation that a marked depression immediately east of the site was a tinaja or walk-in well; this has not, however, been demonstrated conclusively (Hohmann and Redman 1986; Redman and Hohmann 1985).

Flora. Plant species within the Payson region reflect prevalent juniper-pinyon woodland, interior chaparral, and plains grasslands plant associations (Hohmann and Redman 1986:2; Lowe 1964b:43-44, 48-49, 56; Redman and Hohmann 1985:4). During recent contract archaeology work in the Payson area, Hohmann and Redman (1986:2-3) noted that the principal plant taxa for the region are: pinyon pine (*Pinus edulis*), Utah juniper (*Juniperus osteosperma*), alligator juniper (Juniperus deppeana), ponderosa pine (Pinus ponderosa), scrub oak (Quercus turbinella), Emory oak (Quercus emoryi), Gambel oak (Quercus gambelii), manzanita (Arctostaphylos sp.), catclaw (Acacia greggii), prickly pear (Opuntia sp.), yucca (Yucca sp.), and a variety of wild grasses and weeds.

Fauna. The multifarious physiographic, climatic, and floral zones found within the Payson area have been inhabited by a variety of animal species. Modern zoogeographical studies suggest that riparian habitats, such as provided by the East Verde river, would have supported several types of fish, including Gila trout (Salmo gilae Miller), Arizona trout (S. apache Miller), Colorado chub (Gila robusta Baird and Girard), Colorado squawfish (Pytchocheilus lucius Girard), speckled dace (Rhinichthys osculus (Girard)), longfin dace (Agosia chrysogaster Girard), Sonoran sucker (Catostomus insignis Baird and Girard), flannelmouth sucker (C. latipinnis Baird and Girard), humpback sucker (Xyrauchen texanus (Abbott)), Gila sucker (Panatosteus delphinus (Cope)), and Gila topminnow (Poeciliopsis occidentalis (Baird and Girard)) (Miller and Lowe 1964; Minkley 1973). The distribution of a number of amphibians, reptiles, birds, and mammals would have coincided with Payson-area riparian, bottom-land, and adjacent wooded habitats, notably Woodhouse's toad (Bufo woodhousei Girard), canyon treefrog (Hyla arenicolor Cope), Sonoran mud turtle (Kinosternon sonoriense Le Conte) (Lowe 1964a:156), various waterfowl, herons, and other birds (Phillips, et al. 1964), muskrat (Ondatra zibethicus (Linnaeus)), raccoon (Procyon lotor (Linnaeus)), and river otter (Lutra canadensis (Schreber)) (Cockrum 1964).

Grassland, chaparral, and juniper-pinyon areas would have been inhabited by western spadefoot (Scaphiopus hammondi Baird), southwestern toad (Bufo microscaphus Cope), Great Plains toad (B. cognatus Say), Arizona treefrog (Hyla wrightorum Taylor), and various lizards and snakes (Lowe 1964a). Prevalent bird species are those characteristic of Upper Sonoran and Transition life zones in central Arizona (Monson and Phillips 1964). Phillips et al. (1964) provide a succinct summary of relevant avian geographical, seasonal, and abundance data which will not be elaborated on here. The Shoofly Village vicinity supported many different kinds of mammals. Some of the more characteristic species are: plain-nosed bats, black-tailed jack rabbit (Lepus californicus Gray), eastern cottontail (Sylvilagus floridanus (J. A. Allen)), desert cottontail (S. audubonii (Baird)), rock squirrel (Citellus variegatus (Erxleben)), Harris' antelope squirrel (C. harrisi (Audubon and Bachman), cliff chipmunk (Eutamias dorsalis (Baird)), Arizona gray squirrel (Sciurus arizonensis (Coues)), valley pocket gopher (Thomomys *bottae* (Eydoux and Gervais)), Merriam's kangaroo rat (*Dipodomys merriami* Mearns), Ord's kangaroo rat (*D. ordii* Woodhouse), beaver (*Castor canadensis* Kuhle), several types of mice, Stephens' wood rat (*Neotoma stephensi* Goldman), white-throated wood rat (*N. albigula* Hartley), Mexican vole (*Microtus mexicanus* (Saussure)), porcupine (*Erethizon dorsatum* Linnaeus), coyote (*Canis lantrans* Say), gray wolf (*C. lupus* Frisch), gray fox (*Urocyon cinereoargenteus* (Scherber), black bear (*Ursus americanus* (Pallas)), grizzly bear (*U. horribilis* Ord), ringtail (*Bassariscus astutus* (Lichtenstein)), badger (*Taxidea taxas* (Schreber), spotted skunk (*Spilogale putorius* (Linnaeus)), striped skunk (*Mephitis mephitis* (Schreber)), hooded skunk (*M. macroura* (Lichtenstein)), hog-nosed skunk (*Conepatus mesoleucus* Lichtenstein), mountain lion (*Felis concolor* Linnaeus), bobcat (*Lynx rufus* (Schreber)), javelina (*Pecari tajacu* (Linnaeus)), black-tailed or mule deer (*Odocoileus hemionus* (Rafinesque), antelope (*Antilocapra americana* (Ord)), and bighorn (*Ovis canadensis* Shaw) (Cockrum 1960, 1964; A. Edward Dittert, Jr., personal communication 1988).

The immediate proximity of higher elevation habitats associated with woodlands on the Mogollon Rim deserves special mention. Some rather unique mammalian species are known to inhabit these areas and may have been encountered during hunting, collecting, or other activities by the prehistoric inhabitants of Shoofly Village. These mammals include: golden-mantled ground squirrel (*Citellus lateralis* (Say)), gray-collared chipmunk (*Eutamias cinereicollis* (J. A. Allen)), Abert's squirrel (*Sciurus aberti* Woodhouse), red squirrel (*Tamiasciurus hudsonicus* (Erxleben)), pinyon mouse (*Peromyscus truei* (Shufeldt)), Mexican wood rat (*Neotoma mexicana* Baird), long-tailed weasel (*Mustela frenata* Lichtenstein), and elk (*Cervus canadensis* (Erxleben) (Cockrum 1960, 1964).

CHAPTER THREE

SHOOFLY VILLAGE RUINS

The Shoofly Village ruins were excavated under the direction of Dr. Charles L. Redman from 1984 to 1987. At the time very little was known about the prehistoric habitation of the site and research was designed to understand the overall composition and organization of the community.

Because of the recency of the archaeological investigations of Shoofly Village and adjacent areas, much of the literature pertaining to research methods and results is unpublished. The purpose of this chapter is to briefly review recent archaeological research in the Payson area and to describe the excavation procedures used, and cultural deposits encountered, at Shoofly Village.

Archaeological Investigations of the Payson Region

A considerable number of archaeological investigations have been conducted in the Payson area over the past 30 years (Hohmann and Redman 1986:1; Redman et al. 1987). A brief overview of reports describing this research is provided in Table 2. Several publications (see Hohmann and Redman 1986:5-7; Redman et al. 1987) provide summaries

Table 2. Reports of Archaeological Investigations in the Payson Area, 1954-1984

Year	Geographical Area	Archaeological Activity	Source
1954	Pine and Payson	Survey	Olson and Olson 1954
1956	East Verde River	Survey	Peck 1956
1969	Upper Tonto Basin	Excavation	Hammack 1969
	Payson	Survey	Kelly 1969
1970	Payson (Walnut Creek Site)	Excavation	Morris 1970
1971	Payson	Survey	Olson 1971
1973	Payson (Hardt Creek Site)	Excavation	Huckell 1973
1975	Payson	Survey Proposal	Dittert 1975
1976	Payson	Survey	Abbott 1976
	Northwestern Payson	Survey	Brase 1976
	Payson (AZ O:11:3 (ASU))	Excavation	Burnett and Lynn 1976
	Payson	Survey and Excavation	Dittert 1976a
	Payson (Camp Tontozona)	Survey and Excavation	Dittert 1976b
	Payson	Survey and Excavation	Dittert 1976c
	Eastern Payson	Survey	Dobbins and Szot 1976
	Payson	Survey	Hanson 1976a
	Star Valley	Survey	Hanson 1976b
	Payson (Shoofly Village)	Excavation	Most 1976
	Payson (AZ O:11:4 (ASU))	Excavation	Sexton 1976
	Payson (AZ O:11:2 (ASU))	Excavation	Smith, Willens, and Chase 1976
	Payson	Ceramic Study	Tjaden 1976
	Payson (Fossil Creek)	Survey	Wood 1976
1977	Payson	Survey	Abbott 1977
	Payson	Survey and Excavation	Dittert 1977
	Payson (AZ O:11:45 (ASU))	Excavation Proposal	Francis 1977a
	Payson (AZ O:11:45 (ASU))	Excavation	Francis 1977b
	Payson (Heliport Site)	Excavation	Henderson and Blank 1977
	Payson (Heliport Site)	Excavation	Henderson, Upham, and Blank 1977
	Walnut Flat	Survey	Johnstone 1977
	West Payson	Survey	Lightfoot, Abbott, and Praeger-Bergman 1977
	Payson (Old Pine Road)	Survey	Wood 1977
	Upper East Verde River	Survey	Wood and McAllister 1977
1978	Star Valley	Survey	Tjaden 1978
	Payson (AZ O:11:45 (ASU))	Excavation	Francis 1978
	Payson (Oxbox Hill)	Excavation	Huckell 1978
	Payson	Survey and Excavation	Jeter 1978
1979	Payson (Houston Mesa)	Survey	Johnstone 1979
	Payson	Lithic Study	Stafford 1979
	Payson (Walnut Flat)	Survey	Woodward 1979
1980	Payson	Survey	Effland and Green 1980
1981	Tonto National Forest	Overview	McAllister and Wood 1981
1982	Payson (Mud Springs)	Survey	Edwards 1982
1983	Payson	Survey	Halbirt 1983
1984	Payson (Soil Pit)	Survey	Wood 1984

of Payson area research which will not be reiterated here.

It is remarkable, however, that there has been little consideration of faunal remains from Payson area sites. Dittert has attributed this situation to poor preservation of archaeological bone, due in part to acidic soils, within the study area (personal communication 1988). In any event, I know of only one site report, for AZ:O:12:15 (ASU), which contains any discussion of faunal material. In the article, the author postulates that a circular mound of fine charcoal and burned limestone might have "resulted from the drying of meat from game animals" (Dittert 1976b:13) similar to a method recorded for the Acoma Indians. Two sherds, a Tonto Red and smudged ware, found near the south side of the mound imply that the site was produced sometime between A.D. 1050 to A.D. 1150 which is roughly contemporaneous with the occupation of Shoofly Village (Dittert 1976b:13).

Recent contract excavations at several Payson area sites have recovered small quantities of animal bone. Unfortunately faunal analyses for these sites are as yet unpublished.

Archaeology of Shoofly Village Ruins

The first formal exploration of the Shoofly Village Ruins was supplemental to contract work conducted by the

Department of Anthropology at Arizona State University, under the direction of Dr. Alfred Edward Dittert, Jr. (1976a). Rachel Most, then a graduate student at ASU, supervised a short-term cultural inventory of the site as part of a class project.

Most's investigation of Shoofly Village entailed limited surface collection and excavation. Artifacts were collected from the surface in disturbed areas and within a judgement-selected 4 m diameter circle. A single 2 m^2 test pit was excavated to "obtain stratigraphically ordered collections of ceramics, lithics, flotation samples, and pollen samples" (Most 1976:18).

In her report, Most described Shoofly Village as being surrounded by a compound wall, in the shape of a polygon, with a maximum length of 140 m on a side. She estimated that there were "85 to 100 rooms, 25 plazas, and two refuse middens" (Most 1976:17) within the compound wall. Most also noted that grazing had not adversely affected Shoofly Village and that the site had evidently been avoided when the mesa top was chained (i.e. shrubs and trees removed).

Following Most's study of Shoofly Village, archaeological research at the site was discontinued until Tonto National Forest personnel could assess the recreational value of the area (Dittert, personal communication 1988). In 1984, Dr. Charles L. Redman of the Department of Anthropology at Arizona State University selected the site for a long-term research and training project. Archaeological investigations of Shoofly Village were conducted by Redman, with the cooperation of the Tonto National Forest, during summer field schools between 1984 and 1987, and are briefly summarized here.

The first field season, during the summer of 1984, was primarily concerned with determining the general nature of the Shoofly Village ruins. Initial activities focused on clearing the site of juniper and brush and mapping of the surface architectural remains. An east-north coordinate system was superimposed on the site; all excavation units were uniquely identified on this grid system. As Redman (1987:253) has reported, the surface remains indicated that Shoofly Village might have been arranged into seven architectural groupings and that the most meaningful interpretative units might be subcommunity groups of associated structures. Subsequent research efforts were aimed at determining the general nature of the site and of these subcommunity groups.

Research during the 1984 field season was facilitated by use of an explicit multi-stage research design (Redman 1973). As shown in Figure 3, three separate stages of excavation were conducted to investigate the cultural deposits at the site. Various conditions (see Redman 1987) precluded typical first stage research methods, such

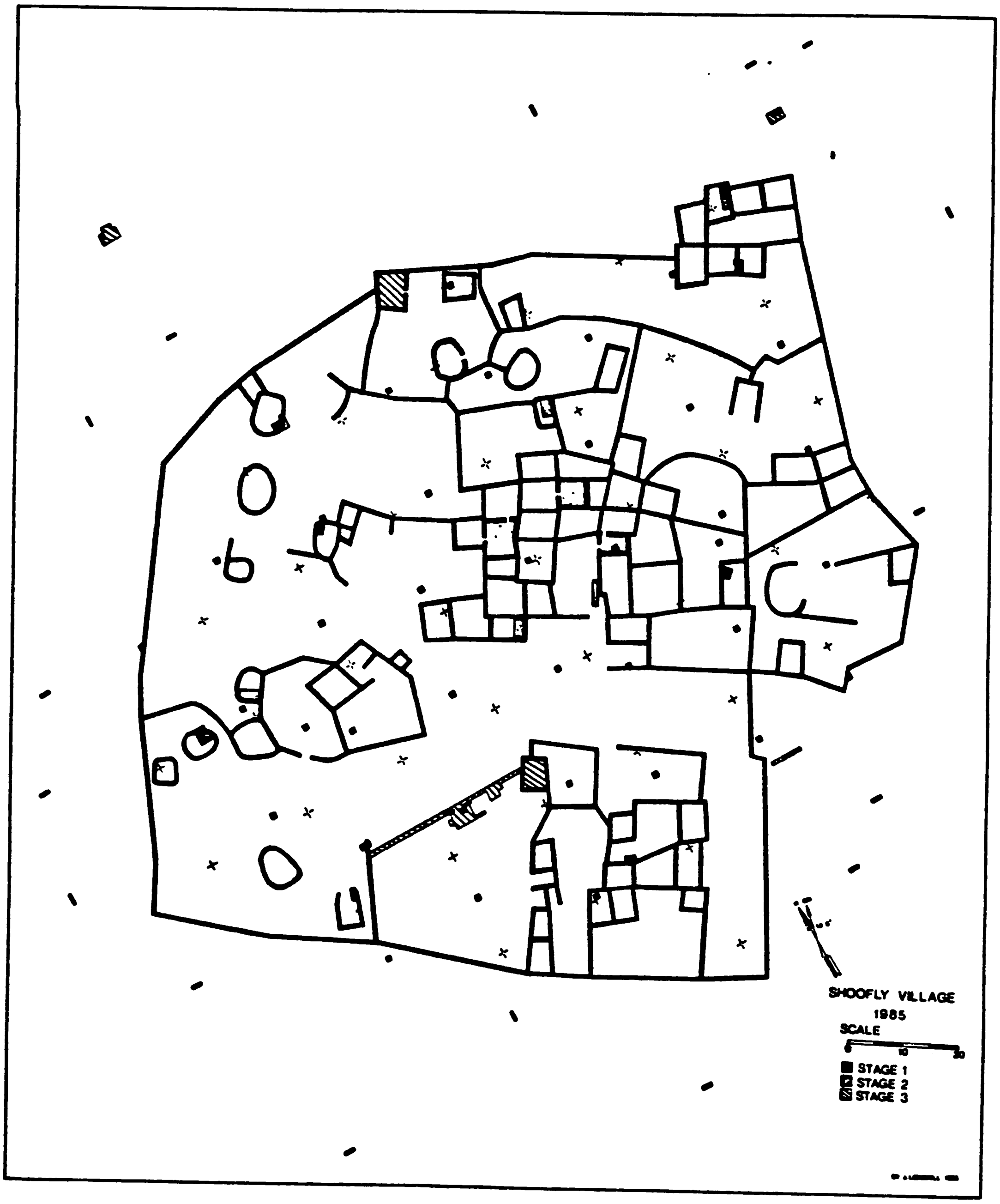

Figure 3. Map of Shoofly Village showing three-stage excavation program used during the 1984 and 1985 field seasons (Redman 1987:254).

as systematic surface collection of artifacts, coring, or magnetometer surveys, and resulted in excavations being the primary method of investigation.

The first stage of excavation was designed to monitor "site-wide patterns with a detailed map of surface architecture and evenly dispersed, small test excavation units" (Redman 1987:254). These units were 1 m^2 in size because this unit size was large enough for digging tools, recognition of stratigraphy, and recovery of a quantity of artifacts and biological materials, while remaining small enough to be dug quickly. The dimensions of these units measured 1 m by 1 m inside the compound wall and one-half m by 1 m outside the wall (Redman 1987:254).

Excavation units were selected from a stratified, unaligned sample generated by computer by Leta Franklin (Department of Anthropology, Arizona State University). Franklin's program located one test unit in each 20 m by 20 m block inside the compound wall and in each 40 m by 40 m block immediately outside the wall. Units were stratified in an arbitrary geometric fashion "in order to allow estimation of site-wide parameters and to provide information on overall distributions" (Redman 1987:255). In all, 35 1 m by 1 m excavation units were selected and excavated in the first stage of research (Redman 1984:1).

The second stage of excavation has been described by Redman (1987:255) as "designed to test the variability among the seven groupings of structures defined during the site mapping activity". At least two (Redman 1985:1) and as many as four (Redman 1987:255) structures for each of the architectural groups were selected for further test excavations. Seventeen 1 m by 2 m trenches were excavated within or adjacent to various structures. Several of these trenches were subsequently extended to uncover entire rooms or features which were particularly well-preserved (Redman 1984:1; Redman 1987:255).

The third stage of research was concerned with excavation of judgement-selected areas, "which were chosen to help solve specific problems" (Redman 1987:255). For the most part these units were rooms or areas which were unique or had been unusually productive in the second stage excavations (Redman 1984:1). The third stage of investigation involved 11 excavation units.

All three stages of archaeological investigation utilized similar excavation tools and recovery procedures. These have been partially summarized by Redman (1987). It is noteworthy that excavation activities largely relied on the use of picks, shovels, and trowels. Small probes and brushes were utilized where these fine tools were appropriate. All excavated soil from the first season was sifted through 0.635 cm (0.25 inches) wire mesh. All material remains which were recognized were collected.

The second season (1985) of field research was designed to explore a greater number of Shoofly Village's architectural features and to locate human burials. Excavations concentrated on room areas and on a program of trenching within plaza areas, middens, and outside the compound wall. Recovery methods and the tools used were similar to those utilized in the 1984 field season. It is noteworthy that soil excavated while trenching was not routinely sifted through mesh screens. Sifting was limited to situations where small items were noted during the course of excavation.

Field work continued at Shoofly Village during the summers of 1986 and 1987. These research activities are partially summarized by Redman et al. (1987) and will not be specifically discussed here.

Current interpretations of prehistoric life at Shoofly Village have been described by Redman (1984, 1987) and Redman et al. (1987). It is clear that Shoofly Village is approximately 140 m on a side and encircled by a continuous masonry wall. It has been estimated that slightly more that 1.5 ha were enclosed by the compound wall. Based on the quantity of wall fall, the compound wall is believed to have been at least 1 m high.

A variety of architectural forms have been documented, including large rectilinear, sub-rectangular, and curvilinear rooms. Approximately 45 percent of the site's surface area consists of plazas and other open spaces.

Sixteen percent of the area bounded by the compound wall is enclosed courtyards. The remaining 39 percent of space inside the site is divided into about 80 rooms. Redman (1984) has postulated that because less than half of the site's area is comprised of rooms, outside activities may have been important.

One of the most noteworthy features of Shoofly Village is that 26 relatively large, rectilinear rooms are located in a single room block at the center of the site. From the height of preserved walls and the abundance of wall fall materials, core rooms consisted of at least one (and possibly two) full-height masonry walls. An additional 39 rectilinear rooms, which are generally smaller than those in the core area, are scattered in small clusters around the periphery of the site. The remaining 14 rooms have at least one curved wall and are located in a dispersed, often freestanding, pattern around the site's periphery (Redman 1984, 1987).

Recent chronological data from archaeomagnetic and radiocarbon samples suggest that the occupation of Shoofly Village took place between approximately A.D. 950 and A.D. 1200. Table 3 presents dates from archaeomagnetic samples taken at the site.

It was not possible to secure dates for two other archaeomagnetic samples, one for wall material from E113 N124 and another from a later hearth in E123 N158.

Nine radiocarbon dates have been obtained for Shoofly Village (Redman et al. 1987:5). These are presented in Table 4. Calibration of radiocarbon dates followed procedures outlined in Stuiver and Becker (1986).

Table 3. Archaeomagnetic dates.

UNIT	MATERIAL DATED	POSSIBLE DATES
E87 N81	Hearth	A.D. 680-800; A.D. 835-1025; A.D. 1300-1450
E123 N158	Hearth	A.D. 680-800; A.D. 900-1025; A.D. 1300-1450

Table 4. Radiocarbon dates.

ID NUMBER	UNIT	SPEC NO.	YEARS B.P.	A.D. OLD	CALIBRATED AGE (A.D.)
Beta-23118	E91 N70 2-6	17319	650 +/- 70	1300	1296 or 1375 +/- 70
WSU-3490	E97 N85 4-5	6357	995 +/- 70	955	1005, 1006, 1156 +/- 70
WSU-3489	E113 N124 4-1	8162	900 +/- 50	1050	1133, 1136, 1156 +/- 50
WSU-3487	E123 N158 1-10	7520	1030 +/- 100	920	997 +/- 100
Beta-23120	E129 N174 5-15	20156	1030 +/- 100	920	997 +/- 100
WSU-3491	E130 N125 4-1	7554	1065 +/- 90	885	984 +/- 90
Beta-23121	E130 N125 7-15	19035	260 +/- 80	1690	1648 +/- 50
WSU-3488	E134 N114 6-9	8316	810 +/- 50	1140	1225 +/- 50
Beta-23122	E134 N114 6-30	19209	790 +/- 50	1160	1257 +/- 50

CHAPTER FOUR

HISTORY AND METHODOLOGY OF SHOOFLY FAUNAL ANALYSIS

The beginning of the recovery and analysis of faunal remains from the Shoofly Village ruins can be traced back to the initial preparation and planning by Michael Gregory and me prior to the 1984 field season. As neither of us had any substantive experience with faunal analysis we relied heavily on suggestions made by Lynne Christenson and Dr. Frank E. Bayham. Subsequent to the initial planning stage, I was directly involved with, and responsible for the direction of, faunal recovery and analysis during the 1984 and 1985 field seasons.

The purpose of this chapter is to describe the recovery and analytical procedures used to collect and study the animal bone from Shoofly Village. Although I limit my consideration in this manuscript to faunal material recovered from Shoofly Village during the summers of 1984 and 1985, it should be noted that various other analyses have focused on Payson area faunal materials. Dr. Frank E. Bayham and I identified the faunal material generated by the 1984 Payson Archaeological Research Expedition (PARE) contract season (results are reported in Redman and Hohmann 1986). Karen Atwell has analyzed faunal remains from various small sites excavated during the 1985 through 1987 PARE contract seasons. Finally, Steven James is presently studying faunal material recovered during the

1987 field season at Shoofly Village.

<u>Field Collection Methods</u>

Recovery of faunal remains from the Shoofly Village ruins took place within the site-wide strategy discussed in Chapter Three. Bones which were unearthed during excavation, sifted from excavated soils, or found within the heavy fraction of flotation samples were collected for subsequent analysis.

Faunal remains were collected and handled in a conventional manner (see S. J. Olsen 1971; Ziegler 1973:3). All animal bone which was uncovered was collected, placed in paper collection bags by provenience unit, and sent to the laboratory for analysis. Fragile specimens were wrapped in a protective covering of cotton batting and string. Smaller fragile specimens were wrapped in cotton batting and placed in empty 35 mm film canisters or pill vials. Bone tools, worked bone, and unusual specimens were usually bagged separately.

During the 1984 season extremely fragile specimens were coated with a preservative (Brown's Formula with Earthpak), prior to removal from the ground. The difficulty of application, the prolonged drying time, and complications in subsequent laboratory cleaning led to the abandonment of the use of preservatives for the 1985 field season.

Animal bone recovered during excavation and sifting of excavated material was supplemented by specimens retrieved from within the heavy fraction of flotation samples. This flotation procedure has been summarized elsewhere (Miller 1988) and is not discussed in detail here (animal bone recovered from flotation samples is summarized in Appendix One, Flotation Sample Faunal Remains). The intent of the flotation recovery was to obtain representative samples for each excavation unit, as well as from special features (e.g., hearths, pits, inside vessels). Ideally, samples were collected by "pinching" small quantities of soil from the surface of each level for every excavation unit. Miller, however, has suggested that the intensity with which excavation units were sampled is quite variable (personal communication 1988). An additional concern for faunal remains recovered from flotation samples is that the total volume of soil involved in the flotation samples is considerably less than the total volume of excavated material. As a result, the faunal material recovered during flotation represents a small portion of the micro-faunal assemblage from Shoofly Village.

Comparative Osteological Collections

My primary source of comparative osteological materials was a collection maintained by the Department of Anthropology at Arizona State University (ASU). The collection was, at that time, a combination of specimens curated with the Department by the Arizona Archaeological Society and items from Dr. Frank E. Bayham's personal collection. The ASU collection was adequate for sorting the assemblage and identifying the most common Arizona mammals, however it was limited and did not include many necessary species.

Several osteological keys were used to supplement the specimens within the ASU collection. I found the various keys by Stanley J. Olsen (1964, 1968, 1972, 1979), Gilbert (1980), and Gilbert et al. (1981) to be most helpful in aiding with preliminary identifications.

Many of the Shoofly faunal specimens were not identifiable given the material in either the ASU comparative collection or the above osteological keys. For identification of these specimens, I was able to secure limited access to more extensive collections maintained at other institutions. For the 1984 field season material, I used the U.S. National Park Service's Western Archaeological Center Faunal Collection at the Arizona State Museum in Tucson. Scheduling conflicts precluded my return to this collection for the identification of the 1985 material. Instead, these analyses were conducted at the Resource Collections of the

Laboratory for Environmental Biology at the University of Texas at El Paso.

Taxonomy Employed

The common and scientific names employed in this paper follow various recognized authorities. In general, my taxonomic usage follows the International Code of Zoological Nomenclature (International Commission of Zoological Nomenclature 1961). I have also incorporated various aspects of Schenk and McMaster's Procedure in Taxonomy (1956).

A few of my taxonomic practices warrant discussion. Most notably, I have encoded a measure of confidence within the taxonomic nomenclature. If there was the slightest doubt about the classification, this was denoted by the Latin "confer", which has been abbreviated as "cf.". This symbol means that the specimen is "to be compared to" the stated taxonomic level (Schenk and McMaster 1956:27). I used a question mark to indicate more serious doubt as to the certainty of an identification.

Amphibian and reptilian nomenclature and arrangement is that of the Society for the Study of Amphibians and Reptiles, as reported in Standard and Current Scientific Names for North American Amphibians and Reptiles (Collins et al. 1978).

Avian taxonomy follows the American Ornithologists' Union's Check-list of North American Birds (1957). Three publications, the Field Guide to the Birds of North America (National Geographic Society 1983), The Birds of Arizona (Phillips et al. 1964) and "Species of Birds in Arizona" (Monson and Phillips 1964), were particularly useful supplements.

Mammalian nomenclature was a problem because there is little consensus between the various recognized authorities. As a result I arbitrarily selected one, E. Raymond Hall's The Mammals of North America (1981) for use here. In a few instances I have substituted more prevalent nomenclature and noted Hall's (1981) terminology in parentheses. Additional information was derived from The Recent Mammals of Arizona: Their Taxonomy and Distribution (Cockrum 1960), "Recent Mammals of Arizona" (Cockrum 1964), and Mammals of Arizona (Hoffmeister 1986).

Method of Recording Data

The method with which I recorded the Shoofly faunal data is an adaptation of an unpublished coding system developed by Dr. Frank E. Bayham and Christine R. Szuter. Bayham (1982:176) utilized a similar method of data collection in his dissertation and attributed his method to a computer coding system developed by Gifford and Crader (1977).

Bayham and Szuter's coding system calls for data collection on a variety of attributes for each specimen, including its archaeological provenience, the kind of animal and part of the animal's body from which the specimen came, and the general condition of the bone. It assures that basic data are collected for each faunal specimen, that each specimen is examined in a similar fashion, and that the data are available for further qualitative and quantitative analyses.

The coding system for the Shoofly Village faunal assemblage involved consideration of 27 attributes for each specimen. These are summarized in Appendix Two ("Coding Format"). The variables are concerned with aspects of the specimen's archaeological provenience, its taxonomic affinity, the body part represented, the condition of the bone, and whether it was recovered during excavation or from a flotation sample.

The collected provenience information is identical to that recorded at the time of field recovery. The position of the specimen on the site is indicated by its location (excavation unit or room) on the Shoofly Village coordinate system (EAST and NORTH variables) and the location of the specimen within that excavation unit (LEVEL and LOCUS variables). It is noteworthy that the 1984-1986 coordinate-based provenience system was modified during the 1987 field season; most excavated rooms were given separate identifying numbers.

A field accession number, the so-called "specimen number" (SPECIMEN NUMBER variable), was also coded. Specimen numbers essentially abbreviate the provenience information with a single numeric label for an item (or group of similar items) collected from a particular portion of an excavation unit. Specimen numbers are rarely utilized within this discussion and primarily served as a means of reconstructing provenience when a specimen location had been recorded incorrectly.

Recording the type of animal that a particular bone came from was facilitated by use of a hierarchical taxonomic code (see Appendix Three, Taxonomic Codes). Basically each type of animal known to inhabit areas of Arizona (based on Lowe 1964b) was given a unique numeric label. Labels were assigned and organized taxonomically by: class, order, family, genus, and species. All mammals, for example, were CLASS=5. All artiodactyls were coded as CLASS=5 and ORDER=06. Mule deer were CLASS=5, ORDER=06, FAMILY=01, GENUS=02, and SPECIES=01, while white-tailed deer would have been in the same manner, except that their species designation was SPECIES=02. If classification was not possible at a given taxonomic level, then that level and all more specific levels were coded as zeros.

As has been discussed previously, a measure of confidence was assigned to each taxonomic classification. The CONFIDENCE variable was used to indicate if an identification was problematic ("cf." or "?").

The relative size of each specimen was recorded as the variable SIZE. This variable was used to identify the general types of animals which may have produced otherwise indeterminate bone and the size of the archaeological specimen relative to others at similar taxonomic levels.

Size in this case refers to size with respect to animals of the same taxonomic level. For example, a specimen identified as from a cottontail would be compared with the expected size of elements from cottontails, rather than all other mammals or vertebrates. For taxonomic identifications at the class level, various "index" species were envisioned as rough approximations of each size category. These are presented in Table 5.

Table 5. Index Species for Size Classification.

SIZE	AVES	MAMMALIA
Small	Sparrow	Mouse
Small-Medium	Cactus Wren	Cottontail
Medium	Gambel's Quail	Coyote
Medium-Large	Red-tailed Hawk	Mule Deer
Large	Sandhill Crane	Elk

Four variables were utilized to indicate the part of the animal's body the specimen came from. The variable SIDE indicates the side of the body that the specimen was from. The specific bone from which the specimen emanated was recorded as BODY PART. The arbitrary labels which I utilized to code each osteological element are summarized in Appendix Four (Body Part Codes). The various long bones and metapodials were additionally classified as to whether they represented the proximal, distal, or shaft portions of the element. PORTION was used to code the portion of the body part which was represented by the specimen. It should be emphasized that the variable PORTION is with respect to the body part. A given specimen, for example, could be identified as a distal humerus in BODY PART and the distal portion of that distal humerus in the variable PORTION. I would, as a result, be referring to the distal-most quarter of a humerus. PERCENTAGE was used to indicate the percentage of the portion of the body part which the specimen represented.

Eight variables were utilized to denote the condition of the faunal specimen. The variable FUSION was used to collect data regarding the degree of fusion between the epiphysis and diaphysis of the element. Whether a specimen had been exposed to fire was coded in the variable BURNING. Bones burnt such that they were largely dark brown or black in color were labeled "brown-black scorched"; more intensely burnt specimens, mostly bluish-white or white in color, were called "calcined".

The presence or absence of bone modifications such as butchering marks, spiral fractures, rodent gnawing, and carnivore chewing was also recorded. The WEATHERING variable was incorporated to give an indication of the general condition of the surface of the bone. BREAKAGE expresses the approximate age of any breaks exhibited by the specimen.

In an effort to minimize the number of lines of data which were coded, entered into the computer, and manipulated, the variable NUMBER OF FRAGMENTS was used to compress specimens with identical attributes into a single coded line.

As discussed previously, specimens were recovered during excavation activities and from the heavy fraction of flotation samples. The variable FLOTATION indicates the archaeological source of the specimen.

A final variable, COMMENTS, was a catch-all field for noteworthy attributes which could not be reported by any other variable. A variety of miscellaneous attributes was collected, including more precise identification of the part of the element involved, the name of carpal and tarsal, whether the bone was fashioned into a bone tool and its arbitrary bone tool identification number, and so on.

Quantification of Faunal Remains

Three basic approaches have been used by zooarchaeologists to quantify faunal remains: the number of identified specimens, the minimum number of individuals, and the weight method (Grayson 1978a:53). The merits and problems associated with these methods are reviewed by Binford and Bertram (1977), Bokonyi (1970), Casteel (1974, 1977a, 1977b, 1978), Chaplin (1971), Daly (1969), Fieller and Turner (1982), Gilbert and Singer (1982); Grayson (1973, 1978a, 1978b, 1979, 1981, 1984), Horton (1984), Krantz (1968), Lie (1980), Lyman (1979b), Shotwell (1955), Smith (1979), and Wild and Nichol (1983) and will be briefly summarized here.

The number of identified specimens (NISP) refers to the number of identified elements, bone fragments, or teeth for each taxon. Although NISP was used as the standard measure of taxonomic abundance within archaeological faunas for many years (Grayson 1984:17), various zooarchaeologists (starting with White (1953b) and continuing to the present) have criticized the measure for yielding biased and inappropriate results. Grayson, in his book Quantitative Zooarchaeology (1984), summarizes the most prevalent condemnations of NISP as follows:

(1) The number of identified specimens is affected by butchering patterns (Grayson 1984:20). Daly

(1969:149) labels this the "schlepp effect"--suggesting that the larger an animal is and the farther it is killed from the point at which it is to be consumed, the fewer of its bones will get transported back to the site. NISP may tend to under-represent larger animals.

(2) The measure assumes that all specimens are equally affected by chance or deliberate breakage (Grayson 1984:21).

(3) NISP assumes that all specimens will be equally preserved (Grayson 1984:21). Differential preservation has a direct affect on the number of identifiable specimens for each taxon.

(4) The number of identifiable elements in the skeleton varies from species to species (Daly 1969:149; Grayson 1984:21; Payne 1972:68). Daly reports that "Pigs have nearly twice as many identifiable foot bones as do deer and sheep ... This can clearly bias the result in favor of the animal with more recognizable parts" (1969:149).

(5) NISP treats all bone fragments, whether each is from the same or different animals, as equally important (Gilbert and Singer 1982:31; Grayson 1973, 1979, 1984:22).

(6) Using the number of identified specimens leads to difficulties in statistical treatment caused by

sample inflation (Grayson 1984:22). Payne (1972:68) reports having problems with NISP where a limited number of animals may be represented by a large number of identified specimens.

(7) NISP may be affected by collection techniques (Grayson 1984:22).

(8) The number of identified specimens is often irrelevant--we are primarily interested in the number of animals, or amount of meat, represented by the archaeological specimens. NISP cannot, by itself, address questions of meat quantities (Daly 1969:148) or biomass (Grayson 1984:22).

(9) NISP does not allow valid comparisons between archaeological faunas (Grayson 1984:23).

(10) The number of identified specimens approach does not support as many analytical techniques as the minimum number of individuals measure (Grayson 1984:23).

(11) Because each bone fragment is not necessarily independent of all other bone fragments, NISP figures may lead to erroneous conclusions about a taxon's abundance or importance (Grayson 1984:23-24).

White (1952) seems to have made the first attempt to address problems with NISP by calculating the number of individuals represented within an archaeological site.

His method, which he called the minimum number of individuals (MNI) technique, called for the analyst to "Separate the most abundant element of the species found ... into right and left components and use the greater number as the unit of calculation" (White 1953a:397).

Many subsequent modifications of White's MNI method have attempted to refine the measure such that minimum numbers more closely reflect the actual number of individuals at a site. Chaplin (1971) for example, has suggested that the analyst figure out how many bones have pairs, and then add this number to the remaining left and right specimens without pairs to arrive at a more accurate MNI. Others (see Horton 1984) have incorporated sex, age, and bone measurement data into their calculations.

It is clear that the accuracy of results from these methods depends on the ability of the analyst to identify pairs, sex, and age. The procedure is complicated by partial recovery of excavated remains, fortuitous similarities between specimens, incomplete excavation of the site, and breakage such that appropriate morphological criteria are lacking. Horton (1984:270) has reported that pairing, especially where bones from a single individual are not restricted to a single excavation unit, may result in an inflated estimate of the numbers of individuals.

MNI are frequently converted to the meat weight represented per taxon in order to assess the relative importance of those taxa to human subsistence. Meat weight estimates typically multiply the minimum number of individuals for each taxon by the average weight for a modern individual of that taxon (Grayson 1979; Smith 1975; Stewart and Stahl 1977; White 1953a).

Recent criticisms of the MNI approach has resulted in skepticism about its appropriateness for the study of archaeological faunas. Some of the problems which have been recognized are:

(1) MNI, because they rely on NISP calculations, suffer from many of the same problems. Disparate representation of the most common bones (on which estimates of MNI are based), as a result of butchering, breakage, preservation, or collection processes, may cause errors (Payne 1969:69).

(2) There are several methods by which to calculate MNI and most authors do not to state how they arrived at their figure (Payne 1972:69).

(3) MNI requires special assumptions and calculations without yielding results which significantly differ from those from NISP. Grayson (1979:224), for example, has argued that NISP provide much the same information on ordinal scale abundances as is provided by minimum numbers.

(4) MNI tends to exaggerate the importance of rarer animals (Payne 1972:69).

(5) The minimum number of individuals is influenced by the size of the sample from which these numbers were defined. In general, small samples tend to exaggerate minimum numbers (Grayson 1978a).

(6) MNI vary according to the excavation unit which is selected for analysis. Grayson (1979) demonstrated that the lowest minimum numbers are obtained when excavation material is treated as a whole, and that MNI increases as materials from stratigraphic and excavation units are separated for analysis. In a later critique of MNI approaches, Grayson reported that "when an analyst studies minimum number values, that person is studying not only taxonomic abundances, but also the decisions made concerning aggregation" (1984:49).

(7) Meat weight estimates, because they rely on MNI calculations, suffer from the same problems (Grayson 1984:173).

(8) Meat weight estimates typically lack consideration of regional variation in animal sizes and differences in the weight of individual animals (compare with Purdue 1987).

Given these criticisms of MNI and meat weight approaches, some analysts (see Grayson 1984) have become more cautious in their use of the MNI measure. Grayson's (1984:49) conclusion that MNI provides an extremely poor choice as the basic measure of taxonomic abundance has renewed interest in, and use of, the number of identified specimens per taxon.

The final measure often used to quantify archaeological faunas, the weight method, multiples the mass of the animal bones recovered by some figure to arrive at absolute meat weights. The method suffers because there is wide disagreement regarding appropriate factors of multiplication (Daly 1969:149). An additional problem with the weight method is that it is distorted by bone which is burnt. Wing and Brown (1979:109) have reported that burning can decrease the weight of bone by as much as 50 percent. In a mixed assemblage (burnt and unburnt) the weight method may be a gauge of whether recovered specimens were burnt or not, rather than an estimate of the relative importance of a taxon.

Given the advantages and disadvantages of the various methods for quantifying archaeological faunas, I selected both the number of identified specimens and the minimum number of individuals for studying the Shoofly Village remains. NISP is adopted as the primary means of reporting the actual quantities of bone recovered because it does not suffer from problems associated with the aggregation of analytical units and does not inflate the importance of rare taxa.

Minimum number of individuals is reported because it is considered an essential measure by many Southwestern faunal analysts (see Bayham and Hatch 1985:192). In addition, MNI (and meat weight estimates) is used to abstract possible patterns of animal exploitation for comparison with those based on NISP calculations.

MNI is determined by summing all the specimens representing the most common body part for each taxon. The most prevalent body part for a taxon was determined independently for each taxon. Where the minimum number of individuals at the most-specific taxonomic unit fails to account for all specimens recovered for related, less-specific taxonomic units, additional individuals were listed. For example, the two Sciurus aberti specimens recovered from Shoofly Village can be accounted for by a single individual, however portions of two right humeri at the genus level suggest that there are at least two Sciurus individuals present. Accordingly, one individual is reported at the species-level, and one at the genus-level designations.

No attempt was made to determine whether specimens were paired. Only a small portion of the site was excavated and I harbor serious doubts as to my ability to recognize and demonstrate pairs in such a context. Age and sex data are largely lacking and are not incorporated into the MNI calculations.

Minimum number of individuals is arranged following

Grayson's minimum distinction method (1984) wherein the site, as a whole, is the unit of analysis. Relationships between strata at Shoofly Village are poorly understood and calculation of MNI by stratigraphic divisions would yield arbitrary, and potentially misleading figures. It is noteworthy, however, that the minimum distinction method will tend to underestimate the actual number of animals (Horton 1984:269) recovered from Shoofly Village.

CHAPTER FIVE

OVERVIEW OF SHOOFLY FAUNAL ASSEMBLAGE

Overall, 4,366 faunal specimens were recovered from the Shoofly Village ruins during the 1984 and 1985 field seasons. Amphibian, reptile, bird, and mammal bone from at least 65 individual animals and representing at least 35 different genera have been identified. The purpose of this chapter is to describe the particular kinds and quantities of animal bone recovered from the site. These data are used to generate an understanding of the origins of the taxa represented in the archaeological fauna and to hypothesize about the cultural significance of various animals to the prehistoric inhabitants of Shoofly Village.

Scientific and common names for all analyzed taxa are presented in Table 6. Table 7 summarizes the number of specimens (NISP) and minimum number of individuals (MNI) recovered for each taxa. Percentages associated with both measures are rounded to four places where necessary.

Tables 6 and 7 are for all specimens recovered from Shoofly Village--regardless of recovery method. Appendix One (Flotation Sample Faunal Remains) provides summary figures for flotation samples alone.

Class Amphibia - The Amphibians

Six amphibian bones (0.14% of the total faunal

Table 6. Vertebrate Taxa Recovered from Shoofly Village.

AMPHIBIA[a]	Amphibians
Salientia	
Bufonidae	
Bufo species indeterminata	Toad
REPTILIA[a]	Reptiles
Testudinata	
Kinosternidae	
Kinosternon species indeterminata	Mud turtle
Emydidae	
Terrapene ornata Agassiz	Western box turtle
Sauria	
Iguanidae	
Crotaphytus cf. *C. collaris* Say	cf. Collared lizard
Squamata (Suborder Serpentes)	
Colubridae	
Pituophis melanoleucus Daudin	Gopher snake
Crotalidae	
Crotalus species indeterminata	Rattlesnake
AVES[b]	Birds
Anseriformes	
Anatidae	
Anas platyrhynchos Linnaeus	Mallard
Falconiformes	
Accipitridae	
Accipiter cooperii (Bonaparte)	Cooper's hawk
Buteo species indeterminata	Butenine hawk
Galliformes	
Phasianidae	
Lophortyx gambelii Gambel	Gambel's quail
Meleagrididae	
Meleagris gallopavo Linnaeus	Turkey
Gruiformes	
Gruidae	
Grus canadensis (Linnaeus)	Sandhill crane
Piciformes	
Picidae	
Colaptes species indeterminata	Flicker
Melanerpes species indeterminata	Woodpecker
Passeriformes	
Corvidae	
Corvus corax Linnaeus	Common raven
Mimidae	
Toxostoma species indeterminata	Thrasher
Icteridae	
Sturnella neglecta Audubon	Western meadowlark

Table 6. Continued.

MAMMALIA	Mammals
Lagomorpha	
Leporidae	
Lepus species indeterminata	Jack rabbit
?Lepus californicus Gray	? Black-tailed jack rabbit
Lepus cf. L. californicus Gray	cf. Black-tailed jack rabbit
Lepus californicus Gray	Black-tailed jack rabbit
Lepus cf. L. alleni (Mearns)	cf. Antelope jack rabbit
cf. Sylvilagus species indeterminata	cf. Cottontail
Sylvilagus species indeterminata	Cottontail
Rodentia	
Sciuridae	
Citellus[d] species indeterminata	Rock squirrel
Citellus[d] cf. C. variegatus (Erxleben)	cf. Rock squirrel
Citellus[d] variegatus (Erxleben)	Rock squirrel
Sciurus species indeterminata	Squirrel
Sciurus cf. S. aberti Woodhouse	cf. Abert's squirrel
Sciurus aberti Woodhouse	Abert's squirrel
Geomyidae	
Thomomys species indeterminata	Pocket gopher
?Thomomys bottae (Eydoux and Gervais)	? Valley pocket gopher
Thomomys cf. T. bottae (Eydoux and Gervais)	cf. Valley pocket gopher
Thomomys bottae (Eydoux and Gervais)	Valley pocket gopher
Heteromyidae	
Perognathus species indeterminata	Pocket mouse
Dipodomys species indeterminata	Kangaroo rat
Dipodomys cf. D. ordii Woodhouse	cf. Ord's kangaroo rat
Cricetidae	
Peromyscus species indeterminata	Mouse
Peromyscus cf. P. eremicus (Baird)	cf. Cactus mouse
Peromyscus boylii (Baird)	Brush mouse
Sigmodon species indeterminata	Cotton rat
Neotoma species indeterminata	Wood rat
Neotoma cf. N. albigula Hartley	cf. White-throated wood rat
Neotoma albigula Hartley	White-throated wood rat
Neotoma cinerea (Ord)	Bushy-tailed wood rat
Carnivora	
Canidae	
Canis species indeterminata	Canid
Canis cf. C. lantrans Say	cf. Coyote
Canis lantrans Say	Coyote
Canis familiaris (Linnaeus)	Domestic dog
Urocyon cinereoargenteus (Schreber)	Gray fox
Vulpes macrotis Merriam	Kit fox
Ursidae	
Ursus[e] americanus (Pallas)	Black bear
Mustelidae	
Mephitis mephitis (Schreber)	Striped skunk

Table 6. Continued.

Artiodactyla	
cf. Artiodactyla	
Cervidae	
Cervus canadensis (Erxleben)	Elk
cf. Odocoileus[f] species indeterminata	cf. Deer
Odocoileus[f] species indeterminata	Deer
Odocoileus[f] cf. O. hemionus (Rafinesque)	cf. Black-tailed or mule deer
Odocoileus[f] hemionus (Rafinesque)	Black-tailed or mule deer
Bovidae	
Ovis canadensis Shaw	Bighorn

[a]Common and scientific names follow Collins et al. 1978.
[b]Common and scientific names follow Monson and Phillips 1964.
[c]Common and scientific names follow Cockrum 1964.
[d]Also known as Spermophilus.
[e]Also known as Euarctos.
[f]Also known as Dama.

Table 7. Quantitative Summary of Shoofly Village Fauna.

	NISP	% NISP	MNI	% MNI
AMPHIBIA				
Salientia				
Bufonidae				
Bufo species indeterminata	6	.0014	1	.0154
REPTILIA				
Testudinata				
Kinosternidae	8	.0018	1	.0154
Kinosternon species indeterminata	4	.0009	1	.0154
Emydidae				
Terrapene ornata Agassiz	1	.0002	1	.0154
Sauria				
Iguanidae				
Crotaphytus cf. C. collaris Say	1	.0002	1	.0154
Squamata (Suborder Serpentes)				
Colubridae	4	.0009	-	-
Pituophis melanoleucus Daudin	1	.0002	1	.0154
Crotalidae				
Crotalus species indeterminata	1	.0002	1	.0154
AVES				
Anseriformes				
Anatidae				
Anas platyrhynchos Linnaeus	1	.0002	1	.0154
Falconiformes				
Accipitridae				
Accipiter cooperii (Bonaparte)	2	.0005	1	.0154
Buteo species indeterminata	2	.0005	1	.0154
Galliformes				
Phasianidae				
Lophortyx gambelii Gambel	2	.0005	1	.0154
Meleagrididae				
Meleagris gallopavo Linnaeus	3	.0007	1	.0154
Gruiformes				
Gruidae				
Grus canadensis (Linnaeus)	1	.0002	1	.0154
Piciformes				
Picidae				
Colaptes species indeterminata	2	.0005	1	.0154
Melanerpes species indeterminata	1	.0002	1	.0154
Passeriformes				
Corvidae	1	.0002	1	.0154
Corvus corax Linnaeus	2	.0005	1	.0154
Mimidae				
Toxostoma species indeterminata	1	.0002	1	.0154
Icteridae				
Sturnella neglecta Audubon	1	.0002	1	.0154

Table 7. Continued.

	NISP	% NISP	MNI	% MNI
MAMMALIA				
Lagomorpha				
Leporidae	56	.0208	-	-
Lepus species indeterminata	32	.0073	1	.0154
?Lepus californicus Gray	1	.0002	-	-
Lepus cf. L. californicus Gray	8	.0018	-	-
Lepus californicus Gray	54	.0124	4	.0615
Lepus cf. L. alleni (Mearns)	5	.0011	1	.0154
cf. Sylvilagus species indeterminata	5	.0011	-	-
Sylvilagus species indeterminata	205	.0470	12	.1846
Rodentia	2	.0005	-	-
Sciuridae				
Citellus species indeterminata	4	.0009	-	-
Citellus cf. variegatus (Erxleben)	1	.0002	-	-
Citellus variegatus (Erxleben)	25	.0057	2	.0308
Sciurus species indeterminata	8	.0018	1	.0154
Sciurus cf. S. aberti	1	.0002	-	-
Sciurus aberti Woodhouse	1	.0002	1	.0154
Geomyidae				
cf. Thomomys species indeterminata	2	.0005	-	-
Thomomys species indeterminata	18	.0041	4	.0615
Thomomys cf. T. bottae (Eydoux and Gervais)	4	.0009	-	-
Thomomys bottae (Eydoux and Gervais)	7	.0016	3	.0462
Heteromyidae				
Perognathus species indeterminata	1	.0002	1	.0154
Dipodomys species indeterminata	1	.0002	-	-
Dipodomys cf. D. ordii Woodhouse	1	.0002	1	.0154
Cricetidae				
Peromyscus species indeterminata	2	.0005	-	-
Peromyscus cf. P. eremicus (Baird)	2	.0005	1	.0154
Peromyscus boylii (Baird)	1	.0002	1	.0154
Sigmodon species indeterminata	2	.0005	1	.0154
Neotoma species indeterminata	18	.0041	-	-
Neotoma cf. N. albigula Hartley	3	.0006	-	-
Neotoma albigula Hartley	1	.0002	1	.0154
Neotoma cinerea (Ord)	2	.0005	2	.0308
Carnivora	2	.0005	-	-
Canidae	7	.0016	-	-
Canis species indeterminata	2	.0005	-	-
Canis cf. C. lantrans Say	2	.0005	-	-
Canis lantrans Say	2	.0005	1	.0154
Canis familiaris (Linnaeus)	1	.0002	1	.0154
Urocyon cinereoargenteus (Schreber)	1	.0002	1	.0154
Vulpes macrotis Merriam	1	.0002	1	.0154

Table 7. Continued.

	NISP	% NISP	MNI	% MNI
Ursidae				
<u>Ursus</u> <u>americanus</u> Pallas	1	.0002	1	.0154
Mustelidae				
<u>Mephitis</u> <u>mephitis</u> (Schreber)	1	.0002	1	.0154
Artiodactyla	187	.0429	-	-
cf. Artiodactyla	2	.0005	-	-
Cervidae				
<u>Cervus</u> <u>canadensis</u> (Erxleben)	1	.0002	1	.0154
cf. <u>Odocoileus</u> species indeterminata	2	.0005	-	-
<u>Odocoileus</u> species indeterminata	94	.0215	-	-
<u>Odocoileus</u> cf. <u>O.</u> <u>hemionus</u> (Rafinesque)	5	.0009	-	-
<u>Odocoileus</u> <u>hemionus</u> (Rafinesque)	52	.0119	2	.0308
Bovidae				
<u>Ovis</u> <u>canadensis</u> Shaw	1	.0002	1	.0154
SUB-TOTAL	882	.2020	65	1.0000
Indeterminate				
Indeterminate				
Unknown	9	.0021	-	-
Small	240	.0550	-	-
Small-Medium	170	.0390	-	-
Medium	7	.0016	-	-
Medium-Large	6	.0014	-	-
Birds				
Small	2	.0005	-	-
Small-Medium	4	.0009	-	-
Medium	6	.0014	-	-
Medium-Large	4	.0009	-	-
Mammals				
Unknown	7	.0016	-	-
Small	25	.0057	-	-
Small-Medium	639	.1464	-	-
Medium	1157	.2651	-	-
Medium-Large	1205	.2761	-	-
Large	3	.0007	-	-
SUB-TOTAL	3484	.7980	-	-
TOTAL	4366	1.0000	65	1.0000

assemblage) were recovered during excavations at Shoofly Village, all of which belonged to the family Bufonidae, commonly known as toads. All of the specimens were classified to the genus level (Bufo sp.). Species were left undetermined, partly because some of the specimens lacked specific diagnostic characteristics, but also as a result of deficiencies in the available comparative collections.

Specific data regarding the Bufo sp. specimens are reported in Table 8.

Table 8. Data Summary for Bufo sp.

TAXON	ELEMENT	PROVENIENCE	CONTEXT
Bufo sp.	R radio-ulna	E85 N82 3-3	South plaza midden (near burial 15)
Bufo sp.	R scapula	E85 N82 3-3	South plaza midden (near burial 15)
Bufo sp.	Urostyle	E88 N81 2-1	South plaza midden
Bufo sp.	R innominate	E98 N165 2-1	Room fill
Bufo sp.	Vertebra	E178 N133 2-0	Northeastern plaza
Bufo sp	Vertebra	Unknown	Unknown

Seven species of toads are currently found in Arizona. Of these, the green toad (Bufo debilis Girard) and the Sonoran green toad (B. retiformis Smith and Sanders) currently inhabit only extreme southeastern parts of the state (Lowe 1964a:156) and, as such, are unlikely to have been encountered anywhere near Shoofly Village. It is likely, however, that each of the remaining five species of toads (B. alvarius Girard, B. woodhousei Girard, B.

microscaphus Cope, *B.* *cognathus* Say, and *B.* *punctatus* Baird and Girard) would have inhabited areas near Shoofly Village (Lowe 1964a:155-156) and could account for the specimens recovered there.

It is not clear whether toads were utilized by Shoofly's prehistoric inhabitants. *Bufo* have been recovered in archaeological faunas from Grasshopper, the Salt-Gila Aqueduct project, and an Anasazi site (AZ K:12:3), but are generally viewed as intrusive aspects of the assemblages (Johnson 1978; J. Olsen 1980; Szuter 1984b). None of the Shoofly specimens exhibits cultural modifications such as burning, butchering marks, or spiral fractures. As a further complication, at least one species, the Colorado River toad (*B.* *alvarius* Girard) aestivates underground in rodent burrows (Lowe 1964a:156). John Olsen has suggested that this fossorial tendency is common for bufonids (1980:80) which makes their intrusion into archaeological deposits a distinct possibility.

Class Reptilia - The Reptiles

Twenty reptile bones have been identified within the faunal assemblage, representing approximately 0.46% of the Shoofly bone material. At least three orders (Testudinata, Sauria, and Squamata), five families, and five genera are present within the assemblage.

As subsequent discussions will demonstrate, most reptilian taxa from Shoofly Village currently inhabit areas immediately adjacent to the site and have fossorial tendencies. Given these characteristics, as well as a lack of cultural modifications, most taxa may represent natural intrusions into the cultural deposits.

Turtle bones are the most common reptilian specimens, accounting for 65% of reptilian remains. Elements from various snakes make up an additional 30% of the assemblage, with lizards accounting for the remaining five percent.

Order Testudinata - Turtles

Family Kinosternidae - Musk or Mud Turtles. Twelve bones were identified as Kinosternidae, which are commonly referred to as the musk or mud turtles. Four specimens were classified as *Kinosternon* sp.; the remainder were classified to the taxonomic family alone.

Table 9 provides an outline of Kinosternidae and *Kinosternon* specimens recovered from Shoofly Village. The four *Kinosternon* sp. specimens can be accounted for by a single individual. However, the two right scapulae at the family level suggest that there is at least one individual unaccounted for at the genus level.

Table 9. Data Summary for Kinosternidae.

TAXON	ELEMENT	PROVENIENCE	CONTEXT
Kinosternidae	R scapula	E85 N86 1-0	South plaza midden (near burial)
Kinosternidae	R scapula	E85 N86 1-0	South plaza midden (near burial)
Kinosternidae	R femur	E85 N86 1-0	South plaza midden (near burial)
Kinosternidae	Carapace fragment	E89 N165 1-3	Room fill
Kinosternidae	Carapace fragment	E123 N158 3-0	Room fill
Kinosternidae	Carapace fragment	E130 N125 3-0	Room fill
Kinosternidae	Coracoid	E134 N114 2-3	Room fill
Kinosternidae	Carapace fragment	E134 N114 3-3	Room fill
Kinosternon sp.	Nuchal scute	E113 N124 6-7	Room floor zone
Kinosternon sp.	Marginal	E130 N125 3-1	Room roof fall
Kinosternon sp.	Pleural	E134 N114 5-14	Room roof and wall fall
Kinosternon sp.	R hypoplastron	E134 N114 6-12	Room fill above floor

At present, two species of mud turtles are known to occupy parts of Arizona: the yellow mud turtle (K. flavescens Agassiz) and the Sonoran mud turtle (K. sonoriense Le Conte). The yellow mud turtle inhabits the extreme southeastern part of the state, particularly "permanent or temporary waters in the desert-grasslands in Cochise and Pima counties" (Lowe 1964a:158). Modern zoogeographic information would suggest that the Shoofly Village Kinosternon specimens are more likely to be from Sonoran mud turtles, as K. sonoriense Le Conte is found throughout the south-central and southeastern portions of Arizona (Lowe 1964a:158).

K. sonoriense Le Conte is semi-aquatic and is found in both permanent and semi-permanent streams (Lowe 1964a:158). Sonoran mud turtles would have been available to prehistoric inhabitants of the Payson area in and along the nearby East Verde River or its tributaries.

Kinosternon specimens have been recorded in archaeological faunas from the Escalante ruin group, Grasshopper, the Columbus Site in the Miami Wash project, and the Salt-Gila Aqueduct project (J. Olsen 1980; Sparling 1974; 1978; Szuter 1984b).

Given that few Kinosternon specimens were recovered from Shoofly Village, it is difficult to see mud turtles as being of great importance to the site's prehistoric inhabitants. It is interesting, however, that the Grasshopper Pueblo faunal assemblage, with over 40,000 specimens, contained only 14 Kinosternon specimens (J. Olsen 1980:329), while the Shoofly assemblage, approximately one-tenth the size of that of Grasshopper, had twelve.

Family Emydidae - Fresh-water and Marsh Turtles. A single specimen was classified as from a western box turtle (Terrapene ornata Agassiz). Information pertaining to this specimen is documented in Table 10.

Table 10. Data Summary for Terrapene ornata.

TAXON	ELEMENT	PROVENIENCE	CONTEXT
Terrapene ornata	Nuchal scute	E84 N82 2-0	South plaza midden (near burial 15)

Lowe (1964a:159) states that the western box turtle is "primarily a terrestrial species ... (which) often enters rain-formed pools and ponds during the summer". The presence of a western box turtle at Shoofly Village is of particular interest because, as Lowe notes, its distribution is limited to grasslands in the southeastern corner of the state, in Cochise and Pima counties.

The presence of western box turtle in archaeological faunas is generally limited to southern portions of the state (see Glass 1984 and Szuter 1984b). In contrast to these reports, John Olsen identified a Terrapene xiphiplastron from Grasshopper and suggested that "the presence of Terrapene at Grasshopper is of particular interest at (sic) this occurrence represents a substantial divergence from its presently known zoogeographic range" (1980:87). While box turtle remains from Shoofly Village, being even further removed from the distribution reported by Lowe than Grasshopper, would seemly add to our understanding of the species' past distributions, it should be noted that living box turtles were observed on the site by me and others during both the 1984 and 1985 field seasons. It is, therefore, entirely possible that Lowe's published Terrapene ranges are in error.

Order Sauria - Lizards

Family Iguanidae - Iguanas et al. A single specimen was recovered from the heavy fraction of a flotation sample and tentatively identified as from a collared lizard (*Crotaphytus* cf. *C. collaris* Say). Table 11 reports pertinent data for this specimen.

Table 11. Data Summary for Iguanidae.

TAXON	ELEMENT	PROVENIENCE	CONTEXT
Crotaphytus cf. *C. collaris*	R innominate	E113 N124 4-0	Room wall and roof fall

These lizards are known to inhabit most areas, from desert and grassland to evergreen woodland, throughout the state (Lowe 1964a:160). *Crotaphytus* were frequently observed at the Shoofly Village during both the 1984 and 1985 field seasons.

The single *Crotaphytus* specimen exhibits no cultural modifications, and given the species' present abundance and tendency to use rocks for shelter (Lowe 1964a:160), it is probably intrusive.

Order Squamata (Suborder Serpentes) - Snakes

Family Colubridae - Colubrids. Five Colubridae specimens were recovered during excavations at Shoofly Village and are summarized in Table 12. Family level identifications are to be expected as there is little morphological variation in the vertebral characters of related recent species (J. Olsen 1980:91). John Olsen encountered a similar problem at Grasshopper and stated that "positive identification to species level has not been possible" when dealing with isolated vertebrae (1980:91-92).

Table 12. Data Summary for Colubridae.

TAXON	ELEMENT	PROVENIENCE	CONTEXT
Colubridae	Vertebra	E111 N110 1-1	Room fill
Colubridae	Vertebra	E111 N110 1-1	Room fill
Colubridae	Vertebra	E111 N110 1-1	Room fill
Colubridae	Vertebra	E111 N110 1-1	Room fill
Colubridae	Vertebra	Unknown	Unknown

There are some 21 genera and 32 species of Colubrids presently known to inhabit Arizona (Lowe 1964a:167-172). These snakes occupy a variety of habitats and have diverse behaviors, which makes further interpretation of the family level specimens impossible.

A single specimen exhibited morphological characteristics which enabled it to be tentatively identified as from a gopher snake or bullsnake (Pituophis melanoleucus Daudin). Table 13 records pertinent data for this specimen.

Table 13. Data Summary for Pituophis melanoleucus.

TAXON	ELEMENT	PROVENIENCE	CONTEXT
Pituophis melanoleucus	Vertebra	E176 N103 2-0	Room fill

Pituophis melanoleucus Daudin is presently encountered statewide, "from 100 feet elevation at Yuma in the Sonoran Desert to over 9000 feet on several mountains" (Lowe 1964a:169). The bullsnake is largely "a ground dweller and rodent burrow hunter, it is a capable digger in loose earth" (Lowe 1964a:169) and is probably an indigenous, intrusive aspect of the faunal assemblage.

Family Crotalidae - Pit Vipers. A single rattlesnake (Crotalus sp.) vertebra was unearthed during the excavation of Shoofly Village; Table 14 documents specific data for this specimen. Identification of this specimen is particularly certain as Crotalidae "neural, hemal spines are strongly developed" (S. J. Olsen 1968:73).

Table 14. Data Summary for Crotalus sp..

TAXON	ELEMENT	PROVENIENCE	CONTEXT
Crotalus sp.	Vertebra	E85 N86 2-1	South plaza midden

Rattlesnakes were observed on the site during each field season. Ten rattlesnake species are known to inhabit various areas within Arizona. The most likely *Crotalus* to be encountered near Shoofly Village are the: western diamondback (*C. atrox* Baird and Girard), black-tailed rattlesnake (*C. molossus* Baird and Girard), Mohave rattlesnake (*C. scutulatus* Kennicott), and western rattlesnake (*C. viridis* Rafinesque) (Lowe 1964a:172-174). Lowe reports that the western diamondback and the western rattlesnake frequently inhabit rock outcrops and boulder fields. These two species, as well as the Mohave rattlesnake, have a proclivity for rodent burrows and wood rat nests (Lowe 1964a:172-173). Wall fall and the quantity of rodents living in the ruins at Shoofly Village provide optimal living conditions for such rattlesnakes. Given these characteristics and the lack of cultural modifications to the Shoofly *Crotalus* specimen, it is probable that rattlesnakes represent an indigenous, intrusive species to the archaeological assemblage.

Class Aves - The Birds

A total of 35 bird bones was recovered during the excavation of Shoofly Village. Avian remains comprise 0.802% of the total faunal assemblage and encompass six orders represented by a least nine families and eleven genera.

Bird remains from archaeological sites may represent residuals of natural intrusions into cultural deposits, food consumption, tool manufacture, or ritual or ceremonial activities. Identifiable avian specimens from Shoofly Village are predominantly elements from wings, which may indicate prehistoric procurement for plumage and wing fans.

Order Anseriformes

Family Anatidae - Swans, Geese, and Ducks. A single specimen was identified as from of a mallard (*Anas platyrhynchos* Linnaeus) and is summarized in Table 15.

Table 15. Data Summary for *Anas platyrhynchos*.

TAXON	ELEMENT	PROVENIENCE	CONTEXT
Anas platyrhynchos	R humerus shaft	E134 N114 3-3	Room roof and wall fall

Monson and Phillips (1964:186) describe *A. platyrhynchos* Linnaeus as a common transient and winter resident in areas with open water. The Arizona Bird Committee (1984) reports that mallards are present at all times of the year throughout Arizona. The species is known to nest on suitable ponds throughout Arizona (except the southeast), including high mountain lakes in the north, locally in the lower Colorado Valley, and formerly near Phoenix (Phillips et al. 1964:12). Anas platyrhynchos have been identified within archaeological faunas from Snaketown and Grasshopper (McKusick 1976; J. Olsen 1980).

While interpretations based on a single specimen are rather suspect, it is interesting to note that the element recovered represents a portion of a wing, which raises the possibility that the mallard was procured for its plumage, instead of (or in addition to) its meat.

Order Falconiformes

Family Accipitridae - Hawks, Old World Vultures, and Harriers. Two Shoofly Village specimens (see Table 16) articulate with each other and evidently represent a single adult Cooper's hawk (Accipiter cooperii (Bonaparte)). The specimens were recovered near Shoofly burials 5 and 6 and may have been associated with these features.

Table 16. Data Summary for Accipiter cooperii.

TAXON	ELEMENT	PROVENIENCE	CONTEXT
Accipiter cooperii	R humerus	E88 N81 2-1	South plaza midden (near burials 5 and 6)
Accipiter cooperii	R ulna	E88 N81 2-1	South plaza midden (near burials 5 and 6)

Cooper's hawks nest throughout Arizona and winter in southern and western Arizona (except in the higher parts of mountains). The species is regarded as a transient throughout the state (Monson and Phillips 1964:189; Phillips et al. 1964:20) and probably could have been encountered in the Payson area.

Two other Accipitridae specimens, identified as from buteo hawks (Buteo sp.), are reported in Table 17.

Table 17. Data Summary for Buteo sp.

TAXON	ELEMENT	PROVENIENCE	CONTEXT
Buteo sp.	Proximal R humerus	E129 N174 2-4	Room fill
Buteo sp.	First phalanx second digit of wing	E129 N174 3-0	Room fill

Nine Buteo species presently inhabit Arizona, although only the red-tailed hawk (B. jamaicensis (Gmelin)), Swainson's hawk (B. swainsoni Bonaparte), zone-tailed hawk (B. albonotatus Kaup), rough-legged hawk (B. lagopus (Pontoppidan)), ferruginous hawk (B. regalis (Gray)), and gray hawk (B. nitidus (Latham)) are considered common (Arizona Bird Committee 1984; Monson and Phillips 1964:189-190; Phillips et al. 1964:21-23). Given that the specimens were assigned to the genus level alone, specific discussion is inappropriate.

Accipiter and Buteo elements are frequently recovered from archaeological sites (e.g., Bayham 1977; Bayham and Hatch 1984, 1985; Czaplicki 1981; Glass 1984; McKusick 1976; J. Olsen 1980; S. J. Olsen 1978; Sparling 1974, 1978; Szuter 1984b). Interpretations typically rely on ethnographic accounts which document the ritual importance of hawk feathers and remains. All four Accipitridae specimens from Shoofly Village are from wing elements. It is possible that hawks were procured by Shoofly's inhabitants for wing feathers or fans, in addition to, or instead of, meat.

Order Gruiformes

Family Gruidae - Cranes. Table 18 presents data for a the single specimen identified as sandhill crane (*Grus canadensis* (Linnaeus)).

Table 18. Data Summary for *Grus canadensis*.

TAXON	ELEMENT	PROVENIENCE	CONTEXT
Grus canadensis	R carpometacarpus shaft	E95 N83 2-0	South plaza midden (near hearth)

Hargrave and Emslie (1979) and others (see Rea 1986:11) have reported that the fragmentary elements of *G. canadensis* are quite similar to those of the turkey (*Meleagris gallopavo*). The Shoofly Village specimen was classified as sandhill crane rather than turkey on the basis of its narrow intermetacarpal space, which is most typical of _G_. _canadensis_ (S. J. Olsen (1979:160-161).

Phillips et al. have reported that:

> Cranes were formerly abundant transients and winter residents along the lower Gila and Colorado River valleys, and fairly common transients generally in September, October, and late February to early April [1964:30].

Presently the sandhill crane is uncommon and an irregular winter resident in irrigated tracts of central and southern Arizona (Monson and Phillips 1964:193; Phillips et al. 1964:30).

Sandhill cranes are rather uncommon taxa for Southwestern archaeological faunas. _Grus_ specimens have been identified from Awatovi, Grasshopper, and Snaketown (McKusick 1976; J. Olsen 1980; S. J. Olsen 1978).

It is clear that the _Grus_ specimen was probably procured sometime between September and early April. It is tempting to use this fact to suggest that Shoofly Village was occupied during that period. The _Grus_ element is, however, from a wing, which raises the possibility of its procurement for plumage, rather than food. It is conceivable that the wing was obtained away from Shoofly Village - during the winter - kept intact, and later transported to the site.

Order Piciformes

Family Picidae - Woodpeckers and Wrynecks. Data for two flicker (Colaptes sp.) specimens are recorded in Table 19. The specimen from E101 N60 was recovered immediately adjacent to an infant burial.

Table 19. Data Summary for Colaptes sp..

TAXON	ELEMENT	PROVENIENCE	CONTEXT
Colaptes sp.	Distal L humerus	E88 N84 2-1	South plaza midden
Colaptes sp.	Distal R ulna	E101 N60 2-0	Room fill (near burial 1)

Until recently three flicker forms were considered separate species: the "yellow-shafted" flicker (C. auratus (Linnaeus)), the "red-shafted" flicker (C. "cafer" (Gmelin)), and the "gilded" flicker (C. "chrysoides" (Malherbe)) (Monson and Phillips 1964:206; National Geographic Society 1983:264). The two Colaptes specimens were compared with "gilded" and "red-shafted" flickers in comparative collections at the Arizona State Museum. The genus level designation was initially retained because the specimens lacked the morphological criteria necessary in differentiating between the two forms.

Because of extensive intergrading, a single species, the northern flicker (C. auratus (Linnaeus)), is presently recognized. While all living flickers are considered conspecific, it is not clear whether separate species existed prehistorically (cf. National Geographic Society 1983:264). The genus level designation, Colaptes sp., is used for the Shoofly specimens to emphasize the tentative nature of using modern northern flicker information to make inferences about prehistoric Colaptes.

According to Phillips et al. (1964:68), the northern flicker is a common summer resident of forested mountains and a common permanent resident in the wooded Lower Sonoran zone. Colaptes winter commonly in areas with trees, below, and uncommonly within, the Transition zone.

Flickers have been recorded within archaeological faunas from the Copper Basin, Grasshopper, the Salt-Gila Aqueduct project, and Snaketown (Bayham 1977; McKusick 1976; J. Olsen 1980; Szuter 1984b). Olsen reports that the flicker had significant symbolic connotations among many Southwestern pueblo groups and that the historic Zuni occasionally consumed flickers (1980:145).

One other Picidae, Melanerpes sp., was identified from a single specimen and is outlined in Table 20.

Table 20. Data Summary for Melanerpes sp..

TAXON	ELEMENT	PROVENIENCE	CONTEXT
Melanerpes sp.	Distal L ulna	E88 N81 2-1	South plaza midden

Two Melanerpes species have been known to inhabit Arizona: the red-headed woodpecker (*M. erythrocephalus* (Linnaeus)) and the acorn woodpecker (*M. formicivorus* (Swainson)). *M. erythrocephalus* (Linnaeus) is considered an accidental species, with one specimen taken about June 1894 in the Chiricahua Mountains, and one reportedly seen in Phoenix from March to May 1959. Based on the modern zoogeographic information, the Shoofly Village specimen is most likely *M. formicivorus* (Swainson). The acorn woodpecker is a common resident among large oaks in mountains throughout Arizona (Monson and Phillips 1964:207; Phillips et al. 1964:70).

All three of the Piciformes specimens were from elements of the wing, which may indicate prehistoric procurement of woodpeckers for plumage.

Order Passeriformes

Family Corvidae - Jays, Magpies, and Crows. A single specimen was identified as from the family Corvidae (see Table 21). There are currently 11 species of Corvidae known for Arizona (Monson and Phillips 1964:214-216). The specimen could not be assigned to a particular Corvidae species as it lacked the morphological criteria necessary to refine the family level classification.

Table 21. Data Summary for Corvidae.

TAXON	ELEMENT	PROVENIENCE	CONTEXT
Corvidae	Distal L tibia	E80 N174 2-1	Outside compound wall
Corvus corax	Distal L tibia	E86 N82 3-1	South plaza midden
Corvus corax	L first phalanx second digit of wing	E134 N114 6-6	Room roof and wall fall

An additional two elements were classified as from a common raven (Corvus corax Linnaeus); these are reported in Table 21. The phalanx is particularly noteworthy as it is calcined and represents the only bird bone from Shoofly Village which has been culturally modified.

According to Monson and Phillips (1964:215), C. corax Linnaeus is a common resident throughout open parts of Arizona wherever nesting cliffs are available. In addition, large congregations of common ravens are known to occur in northern and eastern Arizona at times (Monson and Phillips 1964:215; Phillips et al. 1964:106). C. corax elements have been recovered from the archaeological sites of Awatovi, Grasshopper, the Salt-Gila Aqueduct project, and Snaketown (McKusick 1976; J. Olsen 1980; S. J. Olsen 1978; Szuter 1984b).

The presence of two Corvidae distal left tibiae suggests that there are at least two Corvidae individuals represented in the assemblage. One is accounted for within Corvus corax Linnaeus. Accordingly, another individual is cited at the family level.

Family Mimidae - Mockingbirds and Thrashers. Thrasher (Toxostoma sp.) remains from Shoofly Village are reported in Table 22.

Table 22. Data Summary for Toxostoma sp.

TAXON	ELEMENT	PROVENIENCE	CONTEXT
Toxostoma sp.	R tarsometatarsus	E176 N103 3-0	Room fill

Five species of Toxostoma have been documented within Arizona (Monson and Phillips 1964:220-221; Phillips et al. 1964:120-126); at least three of which (T. bendirei (Coues), T. "dorsale" Henry, and T. curvirostre (Swainson)) may inhabit the Payson area (Monson and Phillips 1964:220-221). Thrasher remains have also been recovered from Grasshopper Pueblo (J. Olsen 1980).

Family Icteridae - Meadowlarks, Blackbirds, and Orioles. A single specimen (see Table 23) was identified as from a western meadowlark (Sturnella neglecta Audubon).

Table 23. Data Summary for Sturnella neglecta.

TAXON	ELEMENT	PROVENIENCE	CONTEXT
Sturnella neglecta	R coracoid	E134 N114 6-17	Room fill above floor

The western meadowlark is a year-round inhabitant of the

Shoofly Village vicinity. Monson and Phillips (1964:233) report that S. neglecta Audubon is a common summer resident in the grassy parts of northern and central Arizona and in most irrigated valleys throughout Arizona. It is common in all grassy and semi-grassy areas during migration (Monson and Phillips 1964:233). In the winter, the western meadowlark is present in grassy parts of Sonoran zones, farmlands of southern and western Arizona, and grassy or cultivated ponderosa pine openings (Monson and Phillips 1964:233). Sturnella have been identified at Grasshopper and Snaketown (McKusick 1976; J. Olsen 1980).

Order Galliformes

Family Phasianidae - Quails, Pheasants, and Peacocks. Two specimens were identified as from Gambel's quail (Lophortyx gambelii (Gambel)) and are described in Table 24.

Table 24. Data Summary for Lophortyx gambelii.

TAXON	ELEMENT	PROVENIENCE	CONTEXT
Lophortyx gambelii	R ulna shaft	E141 N71 2-0	Southeastern midden
Lophortyx gambelii	R femur	E134 N114 3-3	Room roof and wall fall

Gambel's quail are abundant residents in all areas where mesquite is found and occur locally at higher elevations (along the foot of the Mogollon Plateau) (Monson and Phillips 1964:192; Phillips et al. 1964:29). It is likely that *L. gambelii* could have been procured locally by the prehistoric inhabitants of Shoofly Village.

Gambel's quail are quite common in Southwestern archaeological faunas and are generally believed to have been sought for meat, as well as for feathers (e.g., Bayham 1977; Bayham and Bruder 1985; Bayham and Hatch 1984, 1985; Glass 1984; McKusick 1976; J. Olsen 1980; Sparling 1974, 1978; Szuter 1984b).

Family Meleagrididae - Turkeys. Three turkey (*Meleagris gallopavo* Linnaeus) specimens were recovered from Shoofly Village (see Table 25). The presence of a spur core on the tarsometatarsus indicates that the individual from which that specimen was derived was a male (S. J. Olsen 1968:111).

Table 25. Data Summary for *Meleagris gallopavo*.

TAXON	ELEMENT	PROVENIENCE	CONTEXT
Meleagris gallopavo	L fibula	E86 N85 2-0	South plaza midden
Meleagris gallopavo	Distal R carpometacarpus	E97 N85 4-4	Room fill
Meleagris gallopavo	L tarsometatarsus	E127 N154 3-0	Northern plaza

All three of the archaeological specimens were compared with domesticated and wild turkey elements. All of the Shoofly specimens were significantly smaller than the smallest of the domesticated examples. This suggests that the archaeological specimens were either from wild birds or that turkey captivity and/or domestication at Shoofly did not generate osteological changes.

Turkeys are believed to have been abundant residents of nearly all forests except the Hualapai Mountains and the Kaibab Plateau, and to have descended to some valleys during winter. Reconstruction of prehistoric turkey distributions or availability is problematic because populations decreased markedly by 1880, and, by 1930, turkeys lived only in the San Francisco and White Mountain regions (Monson and Phillips 1964:193; Phillips et al. 1964:30).

Turkeys are one of the most common vertebrates recovered from Southwestern archaeological sites. Turkeys were hunted and kept to obtain their feathers and bones for the manufacture of blankets, robes, tools, prayer sticks, and items of personal adornment. Whether turkeys were hunted and kept as a source of meat is currently a source of considerable debate (see J. Olsen 1980).

Class Mammalia - The Mammals

Mammalian bones made up 88.70% (3871) of the specimens recovered from Shoofly Village. Most of the bones were highly fragmented and 78.43% were identifiable to the class level only.

Of the indeterminant mammalian bones, 25 specimens (0.57% of the total assemblage; 0.65% of the mammalia) were categorized as small, about the size of osteological elements of a rodent. Cottontail-sized (i.e. small-medium) fragments accounted for 14.64% of the total assemblage and 16.51% of the mammalian remains. Some 1157 specimens (26.51% total; 29.89% mammal) were from mammals about the size of a coyote (i.e. medium). Another 1205 (27.76% total; 31.13% mammal) were classified medium-large (about as large those from a deer). Three specimens are larger than would be expected for deer, possibly as large as an elk or bear, and seven fragments were not classified as to size.

Order Lagomorpha

Remains from rabbits and hares consist of 366 specimens, representing 8.38% of the total Shoofly Village faunal assemblage and 9.45% of the mammalian bones recovered from the site. Lagomorphs account for 41.20% of the bones identifiable beyond the class level.

Family Leporidae - Hares and Rabbits. Fifty-six specimens lacked the morphological characters necessary to determine genera and were identified as family Leporidae. These specimens are summarized in tabular form in Appendix

Five (Bone Element Frequencies).

Most of the rabbit bone from Shoofly Village is that of the cottontail (Sylvilagus species indeterminata). A total of 210 cottontail specimens was recovered during the 1984 and 1985 field seasons. These are summarized in Appendix Five (Bone Element Frequencies). Eight complete right innominates and portions of four right ischia at the genus level suggest that at least twelve Cottontails are represented in the assemblage.

Determining which cottontail species are present within the Shoofly Village assemblage is a problem. For archaeological specimens, osteological separation of cottontail species is seldom possible (Neusius and Flint 1985:51). A few authors, most notably Findley et al. (1975:84-85) and Hoffmeister (1986:130), submit that cottontail species can be established from mandibular and tooth characters. Neusius and Flint (1985:57) have, however, demonstrated that identification of cottontails is problematic and not as straightforward as Findley et al. (1975) and others suggest. My own experience is that there is considerable overlap in the osteology of the various species of cottontails which inhabit the southwestern United States. I believe that identifications of cottontail species from archaeological remains are highly suspect. As a result, the cottontail remains from Shoofly Village are classified to genus level alone.

Three species of cottontail currently inhabit areas in Arizona: desert cottontail (S. audubonii (Baird)), Nutall's cottontail (S. nutallii (Bachman), and eastern cottontail (S. floridanus (J. A. Allen)). S. nutallii is limited to higher elevations in extreme northern, northeastern, and eastern Arizona and is, therefore, probably not represented in the Shoofly assemblage (Cockrum 1960:71-75, 1964:251-252; Hoffmeister 1986:127-128, 134-135).

One hundred specimens from Shoofly Village were identified as elements of jack rabbits. Of these, 32 were identified only as genus Lepus. One Lepus sp. specimen, the distal portion of a left humerus, is not accounted for by species-level individuals, which suggests that at least one additional jack rabbit is represented at the genus level.

The most common jack rabbit within the Shoofly assemblage is the black-tailed jack rabbit (Lepus californicus Gray). Fifty-four specimens were identified as L. californicus (an additional eight bones were classified as L. cf. L. californicus and one as ?L. californicus). L. californicus specimens are summarized in Appendix Five (Bone Element Frequencies). The presence of the distal portions of four left humeri suggests that the Shoofly faunal assemblage contains at least four black-tailed jack rabbits.

The black-tailed jack rabbit (Lepus californicus Gray) is common throughout Arizona (Cockrum 1964:251; Hoffmeister 1986:140), "wherever open or semi-open country exists" (Hoffmeister 1986:140). These jack rabbits are found in mesquite, sagebrush, desertscrub, and open pinyon-juniper (Hoffmeister 1986:141) and could have been readily procured from areas adjacent to or near Shoofly Village.

The Shoofly Village jack rabbit remains included five specimens tentatively identified as antelope jack rabbit (Lepus cf. L. alleni (Mearns)) (see Table 26). L. alleni was distinguished from L. californicus primarily on the basis of the size of the elements. As Hoffmeister (1986:144) reports, L. alleni has a greater average cranium size and is one of the largest lagomorphs in North America.

Table 26. Data Summary for Lepus alleni.

TAXON	ELEMENT	PROVENIENCE	CONTEXT
Lepus cf. L. alleni	Femur shaft	E98 N125 2-0	Eastern plaza
Lepus cf. L. alleni	Distal R humerus	E129 N174 1-1	Room fill
Lepus cf. L. alleni	Distal L humerus	E134 N114 3-3	Room roof and wall fall
Lepus cf. L. alleni	L calcaneus	E134 N114 3-3	Room roof and wall fall
Lepus cf. L. alleni	R innominate	E178 N133 2-0	Northeastern plaza

All of the L. alleni bone can be accounted for by a single L. alleni individual.

The modern range of the antelope jack rabbit does not include the Shoofly area. Antelope jack rabbit bones from archaeological sites are generally restricted to excavations of distant Hohokam settlements, such as in the Anamax-Rosemont project, Snaketown, and the Salt-Gila Aqueduct project (Glass 1984; Greene and Matthews 1976; Szuter 1984b). Cockrum indicates that L. alleni occur only in "the central third of the southern half of the state" (1964:251). Hoffmeister reports that L. alleni inhabit "Deserts and semiarid grasslands of south-central Arizona" (1986:144). Zoological specimens have been collected from near Florence (Cockrum 1960:67; Hoffmeister 1986:145), Apache Junction (Hoffmeister 1986:145), and Queen Creek (Cockrum 1960:67), however these localities are at least 90 kilometers south of the Payson area.

The presence of antelope jack rabbits within the Shoofly faunal assemblage suggests that: (1) the site's inhabitants procured L. alleni from more southern peoples or areas, (2) the prehistoric distribution of L. alleni extended to the north of its present range, or (3) the criteria utilized to distinguish L. alleni from L. californicus were not sufficient and that the specimens are actually from very large black-tailed jack rabbits.

Order Rodentia

A total of 105 specimens, representing 2.40% of the total faunal assemblage and 2.71% of the mammalian specimens, was recognizable as from the order Rodentia. Of these, only two elements, left incisors, were identified to the order alone.

The economic importance of rodents recovered in archaeological faunas is uncertain. Although I will discuss this problem in more detail in my concluding comments, it is appropriate to summarize some of the interpretative problems here.

Rodents in archaeological faunas are potentially of economic importance. The use of rodents for meat has been ethnographically documented for several Southwestern populations. Particularly in meat-impoverished areas, rodents could provide a reliable source of meat and protein. On the other hand, rodents often occur naturally in or near archaeological sites and associated agricultural fields. Many species have been shown to burrow into cultural deposits and may represent natural intrusions into the faunal assemblage.

With a very few exceptions, rodent specimens in the Shoofly fauna lack direct cultural modification (e.g., burning, spiral fractures, or butcher marks), presently inhabit areas adjacent to the site, and are from taxa which are known to burrow into soft sediments. It is plausible, therefore, that most rodents in the Shoofly assemblage are natural intrusions.

Two of the wood rat (Neotoma) specimens recovered from the site are burnt. These burnt bones may indicate that wood rats were cooked for food. However, this condition may also result from intentional or unintentional discard into fires, burning of trash materials or areas, or catastrophic fires at the site during or after occupation. Evidence for prehistoric consumption of wood rats at Shoofly Village is, therefore, rather uncertain.

Indications of prehistoric procurement and consumption of Abert's squirrel (Sciurus aberti) is more convincing. This species does not presently occur in the immediate vicinity of the site; it has apparently been transported from ponderosa pine areas above the Mogollon Rim. It seems likely, therefore, that Abert's squirrel was consumed by the prehistoric inhabitants of Shoofly Village.

Family Sciuridae - Squirrels and Allies. Four specimens were identified as elements of spermophiles or ground squirrels (Citellus sp.) and are described in Table 27.

At least seven species of Citellus presently inhabit areas of Arizona (Cockrum 1964:252) (Note: Hall (1981:399), Hoffmeister (1986:173), and others refer to members of this genus as Ammospermophilus or

Table 27. Data Summary for Citellus sp.

TAXON	ELEMENT	PROVENIENCE	CONTEXT
Citellus sp.	R humerus	E134 N114 3-2	Room roof and wall fall
Citellus sp.	Proximal R ulna	E134 N114 3-2	Room roof and wall fall
Citellus sp.	Distal L humerus	E113 N124 4-10	Room roof and fill
Citellus sp.	R tibia shaft	E113 N124 4-10	Room roof and fill
Citellus cf. C. variegatus	L mandible	E113 N124 1-10	Fill above roof and wall fall

Spermophilus). The present distributions of two species, the rock squirrel (C. variegatus (Erxleben)) and Harris' antelope squirrel (C. harrisi (Audubon and Bachman), include the Shoofly Village area (Cockrum 1960:82-85; Hoffmeister 1986:170-176).

None of the Citellus sp. specimens exhibited evidence of burning or other cultural modifications. Given that both species currently known to inhabit the Shoofly area tend to dig burrows and live among rocks, it is possible that these specimens are intrusive to the archaeological assemblage (Hoffmeister 1986:172, 176-177).

Twenty-five Citellus specimens were identified to the species level. All of these represent elements of the rock squirrel (C. variegatus (Erxleben)). These specimens are summarized in Appendix Five (Bone Element Frequencies). A single specimen (see Table 27) was tentatively identified as Citellus cf. C. variegatus (Erxleben). Based on portions of two C. variegatus crania, at least two individuals are represented at the species level.

Rock squirrels are commonly encountered in Southwestern archaeological faunas. Several factors suggest that rock squirrels are likely to be intrusive to the Shoofly faunal assemblage. First, as Hoffmeister (1986:177) reports, rock squirrels "dig holes in the ground and have burrows and nests in and among the rocks". Second, none of the C. variegatus specimens exhibit any evidence of burning or other cultural modifications. Finally, most rock squirrel bones were found to be clustered within the core room E113 N124, and such clustering and skeletal completeness is frequently interpreted as indicating natural death and non-cultural burial (see Thomas 1971).

Eight bones from an unknown species of tree squirrel (Sciurus species indeterminata) were recovered from various excavation units at Shoofly Village (see Table 28).

One tree squirrel specimen (the cranium listed above) may be associated with Shoofly burials 8, 11, 12, or 14. None of the Sciurus sp. specimens exhibited any cultural modifications.

At present, three species of Sciurus inhabit areas of Arizona: S. aberti Woodhouse (Abert's squirrel), S. arizonensis (Coues) (Arizona gray squirrel), and S. apache J. A. Allen (Apache squirrel) (Cockrum 1964:253). The

Table 28. Data Summary for Sciurus sp.

TAXON	ELEMENT	PROVENIENCE	CONTEXT
Sciurus sp.	Cranium	E78 N209 2-0	North midden area
Sciurus sp.	Premolar	E113 N124 3-0	Room roof and wall fall
Sciurus sp.	Molar	E113 N124 3-0	Room roof and wall fall
Sciurus sp.	R scapula	E113 N124 3-0	Room roof and wall fall
Sciurus sp.	L humerus	E113 N124 3-0	Room roof and wall fall
Sciurus sp.	R humerus	E113 N124 3-0	Room roof and wall fall
Sciurus sp.	Distal R humerus	E113 N124 3-0	Room roof and wall fall
Sciurus sp.	Tibia	E113 N124 3-0	Room roof and wall fall
Sciurus sp.	Distal R humerus	E134 N114 4-2	Room roof and wall fall
Sciurus cf. S. aberti	Proximal L femur	E89 N81 2-0	South plaza midden
Sciurus aberti	Distal L humerus	E134 N114 4-1	Room roof fall

distribution of the Apache squirrel, which Hoffmeister (1986:199) calls the Mexican fox squirrel (S. nayaritensis), is limited to the Chiricahua mountains. Modern zoogeographic information suggests, therefore, that the Shoofly Sciurus sp. remains could be from either Abert's squirrels or Arizona gray squirrels.

One Sciurus bone was classified as from an Abert's squirrel (Sciurus aberti Woodhouse); another was tentatively identified as Sciurus cf. S. aberti (see Table 28). The latter bone is particularly noteworthy in that it has been burnt to the point of calcination.

The two Sciurus specimens identified to the species level can be accounted for by a single Abert's squirrel. Portions of two right humeri at the genus level, however, suggest that at least two Sciurus individuals are present within the Shoofly Village faunal assemblage. Accordingly one individual is listed for the genus level.

It is interesting that the current range of S. aberti is restricted to ponderosa pine areas north of the Mogollon Rim (Cockrum 1964:253). These squirrels live, nest, and feed in ponderosa pine forests (Hoffmeister 1986:200). S. aberti specimens were apparently transported to the site, probably as a result of hunting activities north of the Mogollon Rim.

Family Geomyidae - Pocket Gophers. Thirty-one Geomyidae specimens were recovered from Shoofly Village, all of which were identified as from a single genus, Thomomys (pocket gophers). Eighteen of these specimens were classified to the genus alone. These are summarized in Appendix Five (Bone Element Frequencies). Two elements were tentatively identified as cf. Thomomys species indeterminata and are described in Table 29.

Table 29. Data Summary for Thomomys sp.

TAXON	ELEMENT	PROVENIENCE	CONTEXT
Thomomys sp.	R scapula	E113 N124 4-1	Room roof fall
Thomomys sp.	R incisor	E134 N114 1-5	Room wall fall
Thomomys cf. T. bottae	Pelvis and sacrum	E86 N82 2-1	South plaza midden
Thomomys cf. T. bottae	L mandible	E113 N124 3-1	Room roof and wall fall
Thomomys cf. T. bottae	R femur	E113 N124 3-1	Room roof and wall fall
Thomomys cf. T. bottae	L mandible	E134 N114 4-5	Room roof fall

There are presently three species of *Thomomys* known to inhabit areas of Arizona: valley pocket gopher (*T. bottae* (Eydoux and Gervais)), southern pocket gopher (*T. umbrinus* (Richardson)), and northern pocket gopher (*T. talpoides* (Richardson)). *T. talpoides* is limited to higher mountains in the north and *T. umbrinus* to the southern part of the southeastern quarter of the state. Only the valley pocket gopher presently inhabits areas near Payson (Cockrum 1964:253; Hoffmeister 1986:220).

Seven specimens were classified as valley pocket gopher (*Thomomys bottae* (Eydoux and Gervais)). *T. bottae* elements are summarized in Appendix Five (Bone Element Frequencies). An additional four elements were tentatively identified as *Thomomys* cf. *T. bottae* and are described in Table 29. Based on right mandibles, at least four *Thomomys* species indeterminata and three *T. bottae* individuals are represented within the Shoofly faunal assemblage.

Thomomys remains are often recovered from Southwestern archaeological sites. Pocket gophers are probably intrusive to the archaeological assemblage. *Thomomys* are fossorial (Hoffmeister 1986:219) and "lead an almost completely subterranean existence" (Hall 1981:454). In addition, the archaeological specimens recovered from Shoofly Village lack evidence of cultural use or modification.

Family Heteromyidae - Kangaroo Rats and Pocket Mice. Three Heteromyidae specimens were recovered from the Shoofly Village ruins and are summarized by Table 30.

Table 30. Data Summary for Heteromyidae.

TAXON	ELEMENT	PROVENIENCE	CONTEXT
Perognathus sp.	L mandible	E123 N158 2-4	Room fill
Dipodomys sp.	Proximal L tibia	E130 N125 3-0	Room roof fall
Dipodomys cf. D. ordii	R femur	E85 N86 2-1	South plaza midden

The presence of pocket mice is not unusual for Southwestern archaeological faunas (e.g, Bayham and Hatch 1984; Bayham and Bruder 1985; Glass 1984; Johnson 1981; J. Olsen 1980; Sparling 1974; Szuter 1984b). Several species currently inhabiting areas adjacent to Shoofly Village, including the Arizona pocket mouse (Perognathus amplus Osgood), Bailey's pocket mouse (P. baileyi Merriam), desert pocket mouse (P. penicillatus Woodhouse), and rock pocket mouse (P. intermedius Merriam), may account for the archaeological specimen (Cockrum 1960, 1964).

Cockrum reports that five species of kangaroo rat (Dipodomys sp.) inhabit Arizona (1964:254). Two of these, D. ordii Woodhouse (Ord's kangaroo rat) and D. merriami Mearns (Merriam's kangaroo rat), currently live in the

Payson area (Hoffmeister 1986:298-319).

None of the Heteromyidae specimens has been culturally modified. As Hoffmeister (1986:298) reports, kangaroo rats are burrowing rodents, and as such may be intrusive to the archaeological assemblage.

Family Cricetidae - Native Rats and Mice. At least five forms of Cricetidae are present in the Shoofly Village faunal assemblage.

Two mouse (*Peromyscus* sp.) specimens were recovered during excavation of Shoofly Village and are described in Table 31. Cockrum (1964:255) and Hoffmeister (1986:336) report that there are between eight and nine species of *Peromyscus* currently found within Arizona. The current ranges of the cactus mouse (*P. eremicus* (Baird)), deer mouse (*P. maniculatus* (Wagner)), white-footed mouse (*P. leucopus* (Rafinesque)), and brush mouse (*P. boylii* (Baird)) include the Payson area.

Table 31. Data Summary for *Peromyscus* sp.

TAXON	ELEMENT	PROVENIENCE	CONTEXT
Peromyscus sp.	R mandible	E176 N103 2-0	Test unit fill
Peromyscus sp.	L tibia	E134 N114 6-16	Room fill above floor
Peromyscus cf. *P. eremicus*	R mandible	E134 N114 4-2	Room roof and wall fall
Peromyscus cf. *P. eremicus*	R incisor	E147 N151 2-0	Open plaza area
Peromyscus boylii	Cranium	E178 N133 2-0	Plaza area

Two Peromyscus specimens from flotation samples were tentatively identified as from a cactus mouse (P. cf. P. eremicus (Baird)) (see Table 31). Neither element is burnt or exhibits other cultural modifications.

P. eremicus presently inhabits most areas in western and southern Arizona (Cockrum 1964:255; Hoffmeister 1986:337-38). The species has also been reported from Grasshopper Pueblo (J. Olsen 1980). Although the species could have been procured by the prehistoric inhabitants of Shoofly Village, cactus mice are known to inhabit rocky areas and burrows abandoned by other animals, and could, therefore, be intrusive to the archaeological record.

A single brush mouse (Peromyscus boylii (Baird)) specimen was identified for the Shoofly fauna. Brush mice have been recovered from archaeological deposits at Grasshopper and Snaketown (Greene and Matthews 1976; J. Olsen 1980). Brush mice inhabit "mountains and mountain slopes throughout the state except for (the) southwestern corner" (Hoffmeister 1986:364). Hoffmeister has reported that:

> Brush mice live in a variety of habitats in Arizona. In places, they are abundant in the oaks, climbing in and through them with ease. In other places they are found among junipers and pinyons, in scrub oak either in flats or on steep slopes, around buildings, in caves and mine shafts, even in the riparian or wash habitat along some streams. In most places there are rocks and heavy brush where they occur [1986:365].

The P. boylii specimen has not been modified by humans and could be intrusive to the archaeological assemblage.

Cotton rat (Sigmodon sp.) remains from Shoofly Village were limited to two specimens (see Table 32), neither of which is burnt or exhibits cultural modifications.

Table 32. Data Summary for Sigmodon sp.

TAXON	ELEMENT	PROVENIENCE	CONTEXT
Sigmodon sp.	L mandible	E85 N81 2-0	South plaza midden
Sigmodon sp.	R femur	E130 N125 3-1	Room roof fall

Cockrum (1964:255-256) reports that three species of cotton rats currently inhabit Arizona: the hispid cotton rat (S. hispidus Say and Ord), the least cotton rat (S. minimus Mearns), and the yellow-nosed cotton rat (S. ochrognathus V. Bailey) (compare with Hoffmeister 1986:387). The modern range of one sub-species of the hispid cotton rat, S. h. arizonae Mearns, appears to border on the Payson area (Cockrum 1960:188-189; see also the range of S. arizonae in Hoffmeister 1986:390).

Wood rats (Neotoma sp.) are a prevalent mammal type within the Shoofly Village faunal assemblage. Eighteen specimens were classified as Neotoma species indeterminata. These are summarized in Appendix Five (Bone Element Frequencies). One Neotoma sp. bone (a right premolar) is particularly noteworthy in that it exhibits calcination.

Five species of Neotoma currently inhabit areas in

Arizona (Cockrum 1964:256; Hoffmeister 1986:402). The modern distributions of three of these, the white-throated wood rat (N. albiqula Hartley), Stephens' wood rat (N. stephensi Goldman), and the Mexican wood rat (N. mexicana Baird), include the Payson area (Hoffmeister 1986:401-432).

Two elements from Shoofly were identified as from a white-throated wood rat (Neotoma albiqula Hartley) (see Table 33). One of these, the molar, exhibits calcination. An additional three specimens were tentatively classified as Neotoma cf. N. albiqula Hartley. All N. albiqula and N. cf. N. albiqula specimens can be accounted for by a single individual at the species level.

Table 33. Data Summary for Neotoma sp.

TAXON	ELEMENT	PROVENIENCE	CONTEXT
Neotoma albiqula	R molar	E134 N114 4-3	Room roof and wall fall
Neotoma albiqula	R mandible	Unknown	Unknown
Neotoma cf. N. albiqula	Sacrum	E134 N114 2-4	Room roof and wall fall
Neotoma cf. N. albiqula	Cranium	E134 N114 3-3	Room roof and wall fall
Neotoma cf. N. albiqula	L femur	Unknown	Unknown
Neotoma cinerea	Cranium	E129 N174 0-4	Room floor surface
Neotoma cinerea	Cranium	E134 N114 1-5	Room roof and wall fall

White-throated wood rats would have been locally available for procurement as they are "Widely distributed at elevations below 7000 feet throughout all of the state south of the Colorado River" (Cockrum 1964:256). _N. albiqula_ were frequently seen on the site during the 1984 and 1985 field seasons; white-throated wood rats had a propensity for building nests under plastic tarps used to cover room excavations.

The economic importance of _N. albiqula_ to the prehistoric inhabitants of Shoofly Village is not clear. White-throated wood rats tend to build homes which include "several underground tunnels" (Hoffmeister 1986:406) and might, therefore, be intrusive. The presence of two calcined _N. albiqula_ teeth in the faunal assemblage may indicate that white-throated wood rats were of dietary importance, however, it is equally plausible that these specimens represent an individual that was caught and discarded, without being eaten, into a fire, or that the individual was burnt in a fire at the site after its abandonment by humans.

The presence of an additional _Neotoma_ species within the archaeological assemblage, the bushy-tailed wood rat (_Neotoma cinerea_ (Ord)), was documented by the two specimens which are described in Table 33. Neither element exhibits cultural modifications. At least two _N. cinerea_ individuals are present in the Shoofly Village assemblage.

The presence of _N. cinerea_ at Shoofly Village is problematic. Bushy-tailed wood rats presently inhabit northwestern portions of the state, as well as the Kaibab Plateau (Cockrum 1964:256), but are not known for the Payson area. Possible explanations for the presence of N. cinerea at Shoofly Village include that the animals were procured elsewhere and transported to the site, that the prehistoric distribution of the species included the Payson area, or that the specimens were misidentified. It is noteworthy that one of the specimens (from E134 N114) was classified with the assistance of Neotoma expert Dr. Arthur H. Harris of the University of Texas at El Paso. However, as Harris has reported,

> ... some specimens of one taxon overlap with members of another taxon to the point that they are indistinguishable on the basis of the characters used, again resulting in an incorrect or equivocal identification ... Neotoma has a nasty habit of occasionally having an otherwise stable character state shift to the mode seen in a different taxon in rare individuals [1984:167].

Order Carnivora

Twenty specimens, representing 0.46% of the total faunal assemblage and 0.52% of the mammalian specimens, were classified as from the order Carnivora.

Family Canidae - Dogs and Allies. Seven elements identified as family Canidae are described in Table 34. The cervical vertebra is particularly remarkable in that it exhibits butchering marks. Similar cut marks have been reported for canids recovered from Grasshopper and

Snaketown (Greene and Matthews 1976; J. Olsen 1980). Olsen (1980:221) has suggested that vertebral butchering marks indicate deliberate division of the carcass into manageable units to facilitate consumption.

Information for two specimens, identified as *Canis* sp., is detailed in Table 34. Neither bone exhibits cultural modifications. Cockrum (1964:257) reports that two species of *Canis* inhabit Arizona, the coyote (*C. lantrans* Say) and the gray wolf (*C. lupus* Frisch). In addition,

Table 34. Data Summary for Canidae.

TAXON	ELEMENT	PROVENIENCE	CONTEXT
Canidae	Proximal Ulna	E89 N165 4-0	Room fill
Canidae	Caudal vertebra	E113 N124 3-1	Room fill above roof fall
Canidae	Caudal vertebra	E113 N124 3-1	Room fill above roof fall
Canidae	Rib	E134 N114 3-0	Room wall fall
Canidae	Rib	E134 N114 3-0	Room wall fall
Canidae	Rib	E134 N114 3-0	Room wall fall
Canidae	Cervical vertebra	E134 N114 6-9	Room floor level
Canis sp.	R calcaneus	E88 N81 2-1	South plaza midden
Canis sp.	Sternum	E113 N124 5-12	Room roof fall
Canis lantrans	R ulna	E113 N124 6-4	Room floor zone
Canis lantrans	Lumbar vertebra	E134 N114 2-3	Room roof and wall fall
Canis cf. *C. lantrans*	R canine	E88 N83 2-0	South plaza midden
Canis cf. *C. lantrans*	Sternum	E113 N124 5-3	Room fill above floor
Canis familiaris	R innominate	E108 N102 0-0	Surface

the domestic dog (*C. familiaris* Linnaeus) has been present in the southwestern United States since prehistoric times. Given the "close osteological resemblance of most similar-sizes species of _Canis_ to each other" (S. J. Olsen 1985:xii) further discussion is not possible.

Coyote (_Canis lantrans_ Say) was identified from two specimens (see Table 34), both of which are burnt and brown-black in color. The ulna is particularly noteworthy because it had been fashioned into an awl. It is described in detail in the bone tool section of this paper. In addition, two elements were tentatively identified as _Canis_ cf. _C_. _lantrans_ Say. Neither of these specimens exhibits other cultural modifications. All of the _C_. _lantrans_ specimens can be accounted for by a single individual. It should be noted that the comparison of archaeological specimens with comparative specimens was limited to _C_. _lantrans_ and _C_. _familiaris_--_C_. _lupus_ was not available for examination.

Coyote currently "occur in every habitat and are abundant in Arizona" (Hoffmeister 1986:462) and would have been available locally to Shoofly Village's prehistoric inhabitants.

A single specimen from the Shoofly faunal assemblage was identified as domestic dog (_Canis familiaris_ Linnaeus) (see Table 34). The bone is exceptionally well-preserved and clearly a recent modern addition to the site; possibly from the nearby settlement on Houston Mesa.

Gray fox (_Urocyon cinereoargenteus_ (Schreber)) remains within the Shoofly fauna were limited to the single, unmodified vertebra described in Table 35. The specimen was distinguished from other canids on the basis of the shape and abrupt curvature of the spinous process (S. J. Olsen 1964).

Table 35. Data Summary for _Urocyon cinereoargenteus_.

TAXON	ELEMENT	PROVENIENCE	CONTEXT
Urocyon cinereoargenteus	Thoracic vertebra	E134 N114 3-3	Room roof and wall fall

Gray foxes are found throughout the state (Cockrum 1964:257; Hoffmeister 1986:475), most frequently "in the pinyon-juniper and oak belt or below" (Hoffmeister 1986:475).

One specimen was classified as from a kit fox (_Vulpes macrotis_ Merriam) (see Table 36). The kit fox is presently widely distributed in lower elevations of Arizona (120 to 5000 feet) (Cockrum 1964:257) and might have been encountered near Shoofly Village.

Table 36. Data Summary for _Vulpes macrotis_.

TAXON	ELEMENT	PROVENIENCE	CONTEXT
Vulpes macrotis	Posterior cranium	E134 N114 3-5	Room roof and wall fall

John Olsen (1980:230) has reported that foxes (both

Vulpes and Urocyon) hold special significance for contemporary puebloan peoples. He notes that fox pelts are used in various ceremonial activities. Given the small number of elements recovered, it is not possible to reconstruct the ritual or dietary role played by the foxes from Shoofly Village.

Family Ursidae - Bears. The single specimen of black bear (Ursus americanus Pallas) from Shoofly Village is summarized by Table 37. U. americanus was distinguished from grizzly bear (U. arctos Linnaeus) primarily on the basis of size. The specimen was not burnt or culturally modified in any manner.

Table 37. Data Summary for Ursus americanus.

TAXON	ELEMENT	PROVENIENCE	CONTEXT
Ursus americanus	Terminal phalanx	E118 N120 6-0	Room below floor surface

Black bears are believed to have been common throughout mountainous areas of state, but are now reduced in numbers and distribution (Cockrum 1964:257). Although black bears are generally associated with mountain ranges in Arizona, they may "live from semidesert grasslands through encinal woodlands to montane conifer forests" (Hoffmeister 1986:484). U. americanus may move into various environmental zones depending on climatic conditions and the availability of food (Hoffmeister 1986:484). It is quite possible that black bears were encountered near Shoofly Village, for as Hoffmeister (1986:484) reports, black bears tend to inhabit lower elevations during the spring and summer, where they feed on roots and manzanita berries.

Black bear have been reported in small numbers from Awatovi and Grasshopper (J. Olsen 1980; S. J. Olsen 1978). John Olsen has postulated that black bear carcasses were scavenged by Puebloan peoples as sources of bone for tools and hides. It is not clear, based on the single recovered element, how black bear was procured or utilized by the prehistoric inhabitants of Shoofly Village.

Family Mustelidae - Weasels, Skunks, and Allies. The archaeological fauna includes a single Mustelidae specimen, from a striped skunk (*Mephitis mephitis* (Schreber)) (see Table 38).

Table 38. Data Summary for *Mephitis mephitis*.

TAXON	ELEMENT	PROVENIENCE	CONTEXT
Mephitis mephitis	R mandible	E130 N125 3-0	Room roof fall

Striped skunk have been reported in sites of the Ash Creek project and Grasshopper Pueblo (Bayham and Hatch 1984; J. Olsen 1980). *M. mephitis* inhabit most areas of

Arizona (Cockrum 1964:258), except the southwestern quarter of the state where they occur only near the Colorado River (Hoffmeister 1986:509). Hoffmeister (1986:509) has observed that striped skunks often live in natural cavities, burrows dug by badgers or foxes, or enlarge holes made by ground squirrels or pocket gophers. This characteristic, as well as the fact the archaeological specimen lacks any evidence of cultural utilization, raises the possibility of striped skunk being indigenous and intrusive to the archaeological record.

Order Artiodactyla

A total of 344 specimens, representing 7.88% of the total faunal assemblage and 8.89% of the mammalian specimens, was determined to be from the order Artiodactyla. Artiodactyls account for 39.00% of the specimens identified beyond the class level.

Some 187 specimens were classified as class Artiodactyl alone. These are summarized in Appendix Five (Bone Element Frequencies). In addition, two elements were classified as cf. Order Artiodactyla (see Table 39). The ilium has been burnt and exhibits butchering marks on its surface. The humerus has been worked and is discussed in Chapter Six (see BT #49).

Table 39. Data Summary for Artiodactyla.

TAXON	ELEMENT	PROVENIENCE	CONTEXT
cf. Artiodactyla	L ilium	E134 N114 2-3	Room roof and wall fall
cf. Artiodactyla	L distal humerus	E134 N114 6-17	Room fill above floor

Family Cervidae - Deer and Allies. A single elk (*Cervus canadensis* (Erxleben)) specimen is included in the archaeological fauna (see Table 40). The bone has been burnt and is brown-black in color.

Table 40. Data Summary for *Cervus canadensis*.

TAXON	ELEMENT	PROVENIENCE	CONTEXT
Cervus canadensis	L tibia (medial epicondyle)	E86 N185 4-0	South plaza midden (from pit)

Elk are not commonly encountered in Southwestern archaeological faunas. I am aware of only two elk specimens from sites in central Arizona--a single phalanx from the Copper Basin assemblage (Bayham 1977) and a proximal ulna from a Hohokam site (AR-03-12-04-650 (TNF)) in the Payson area (Atwell, personal communication 1988).

It is not clear whether prehistoric elk ranges would have included the Shoofly Village area as elk were extinct in Arizona by the 1920s (Hoffmeister 1986:534). The *C. canadensis* which inhabit Arizona today have been reintroduced (Cockrum 1964:258; Hoffmeister 1986:534).

Cockrum (1964:258) has suggested that elk formerly occurred near most higher mountains of the state. Hoffmeister reports (1986:536) that elk in Arizona today tend to occupy mountain meadows and montane coniferous forests in summer and move to lower pinyon-juniper woodland, mixed conifer forest, plains grasslands, and even desertscrub in winter. Jay (personal communication 1988) reports that elk currently inhabit areas near Tonto Village. It is, therefore, conceivable that elk inhabited areas adjacent to Shoofly Village or lived near the Mogollon Rim during at least part of the year.

The most common cervid in the Shoofly Village assemblage is the deer, genus Odocoileus. A total of 153 Odocoileus bones has been recovered. Ninety-four specimens were classified as Odocoileus species indeterminata and are summarized in Appendix Five (Bone Element Frequencies) appendix. Two cf. Odocoileus sp. specimens are described in Table 41.

Table 41. Data Summary for Odocoileus sp.

TAXON	ELEMENT	PROVENIENCE	CONTEXT
cf. Odocoileus sp.	Humerus shaft	E141 N71 2-0	Midden
cf. Odocoileus sp.	Proximal metatarsal	E134 N114 1-20	Room north doorway
Odocoileus cf. O. hemionus	Molar	E134 N114 5-14	Room roof and wall fall
Odocoileus cf. O. hemionus	Thoracic vertebra	E134 N114 3-3	Room roof and wall fall
Odocoileus cf. O. hemionus	R scapula	E88 N81 2-1	South plaza midden
Odocoileus cf. O. hemionus	Ischium	E77 N209 2-0	North midden
Odocoileus cf. O. hemionus	Pubis	E113 N124 6-7	Room floor zone

Black-tailed or mule deer (Odocoileus hemionus (Rafinesque)) remains were prevalent in the assemblage; 52 specimens were identified and are summarized in Appendix Five (Bone Element Frequencies). Five specimens were tentatively classified as O. cf. O. hemionus (see Table 41). Odocoileus specimens tended to be highly fragmented, however, fragments of three scaphiods suggest that a minimum of two individuals is represented in the faunal remains from Shoofly Village.

Mule deer are currently found statewide, but are not uniform in their distribution (Cockrum 1964:259). Mule deer were observed in areas adjacent to the site during the 1984 and 1985 field seasons and would have been locally available for procurement by the prehistoric inhabitant of Shoofly Village.

Family Bovidae - Cows, Sheep, and Allies. Evidence of the family Bovidae at Shoofly Village is limited to a single weathered and unburnt bighorn (Ovis canadensis Shaw) horn core (see Table 42). The specimen was recovered from within an unlined circular pit in the plaza surface.

Ovis are presently restricted to scattered low desert mountains in Arizona (Cockrum 1964:259). Cockrum (1964:259) suggests that the former range was probably statewide in mountainous or rocky areas. It is possible

Table 42. Data Summary for Ovis canadensis.

TAXON	ELEMENT	PROVENIENCE	CONTEXT
Ovis canadensis	Horn core	E93 N82 2-0	South plaza midden

that bighorns inhabited areas adjacent to Shoofly Village in the past.

Bighorn specimens have been recorded for many Southwestern archaeological sites. The species was apparently sought for its horn, as well as for meat, hide, and bones. Ethnographically the Hopi used Ovis horns to produce a fiberglass-like substance to reinforce their bows (J. Olsen 1980:281). Beaglehole and Beaglehole report that "Mountain sheep horn was melted to a sticky gum which was rubbed along the bow. Wet strips of tissue were bound around the bow at regular intervals. Gum was applied on top of the tissue and the bow was left to dry" (1935:19). Horn cores recovered from domestic hearths at Grasshopper Pueblo have been used to hypothesize prehistoric preparation of this keratin mastic (J. Olsen 1980). The horn core from Shoofly, found in a pit in the south plaza, may indicate similar processing practices.

CHAPTER SIX

BONE ARTIFACTS FROM SHOOFLY VILLAGE

A total of 64 bone and antler artifacts was recovered from Shoofly Village during the 1984 and 1985 field seasons (see Table 43). The purpose of this chapter is to describe and reconstruct the prehistoric use of the bone and antler artifacts recovered from Shoofly Village.

Bone and antler artifacts were predominantly manufactured from medium-large mammal (probably deer) long bones and metapodials. Other animals, such as cottontail-sized mammals and coyote, are also represented within the artifact assemblage. Artifacts which may have been used in manufacturing basketry and stone tools and to work animal hides have been identified.

Bone tool manufacturing techniques have been summarized elsewhere (S. L. Olsen 1979:344-346) and will not be elaborated on here. Sandra Olsen (1979, 1981) provides excellent accounts of ethnographic and experimental studies which form the basis of much of my discussion here.

Awls. Thirty-one awls or awl fragments have been recovered from Shoofly Village. Three general types of awls have been identified within the Shoofly bone tool assemblage: an ulna awl, blunt-tipped cut awls, and fine-tipped cut awls. The ulna awl will be discussed separately below.

Table 43. Bone and Antler Artifact Typology.

TYPE	NUMBER
Stone Knapping Tools	
Antler Tine Flaker	2
Hide Processing Tools	
Scraper	1
Scraper Fragment	13
Ulna Awl	1
Awls and Sewing Tools	
Fine-Pointed Cut Awl	3
Blunt-tipped Cut Awl	6
Awl or Hairpin Fragment	22
Ornaments	
Ring Fragment	5
Ring Stock	4
Miscellaneous	
Perforated Antler	2
Perforated Scapula	1
Indeterminate Worked Bone	8
TOTAL	64

All of the awls which have been recovered from Shoofly Village are cut awls. Splinter awls, which rely on fortuitous bone splinters as tool blank material, are lacking from the assemblage. All awls exhibit longitudinal and diagonal striations along their surfaces. The Shoofly awls tend to be polished, although to varying degrees--from a slight polish to a high luster.

Awl classification and typology follows guidelines suggested by Sandra Olsen (1979, 1981). Fine-pointed awls are differentiated from blunt-pointed awls on the basis of the diameter of the tool at its tip. The diameter of each awl tip has been measured 0.10 cm from the actual tip, so as to account for blunting due to use. Those awls which have tip diameters greater than 0.10 cm are classified as blunt-tipped; those with tip diameters less than 0.10 cm are classified as fine-tipped awls.

Three fine-tipped awls are present in the assemblage. The tips of these artifacts are broken and tip diameters have been extrapolated from the diameter of the rest of the artifact. These awls range from 8.55 to 21.00 cm in length, 0.425 to 0.98 cm in width, and 0.17 to 0.58 cm thick. In general, fine-tipped awls appear to be round in cross section. One fine-tipped cut awl was fashioned from the metapodial of an unidentifiable medium-large mammal, possibly a deer. The other two fine-tipped cut awls were manufactured from bones of medium-small mammals, approximately the size of cottontail.

Six artifacts have been classified as blunt-tipped cut awls because their point diameters are greater than 0.10 cm, ranging from 0.120 to 0.205 cm. These awls extend from 11.16 to 1.02 cm in length, 0.17 to 0.76 cm in thickness, and 0.455 to 1.17 cm in width. Blunt-tipped awls are generally lenticular in cross section. One blunt-tipped awl has been manufactured from the long bone of a medium-small mammal, approximately the size of a cottontail. Another blunt-tipped awl was fashioned from an unknown mammal bone. The other four blunt-tipped awls were from an indeterminate medium-large mammal bone, similar in size to that of deer.

The vast majority, some 22 fragments (approximately 71%), of the awl specimens could not be classified as either blunt-tipped or fine-tipped. Nine of these awl fragments have been burnt. Fifteen of the fragments were manufactured from unknown medium to medium-large mammal bones; six were fashioned from the metapodials of medium-large mammals such as deer. Five of the awl fragments are round in cross section which suggests that they may be from fine-tipped cut awls. Eleven fragments are lenticular in cross section, which may mean that they were blunt-tipped awls. The other four specimens are neither clearly lenticular or round in cross section and thus defy even tentative classification.

Interpretation of the functions of the different types of awls is problematic. Sandra Olsen, in her analysis of bone tools from Grasshopper Pueblo, has suggested that the:

> ... category of bone awls was less clearly defined than the other categories because of the wide range of manufacturing quality, the multiplicity of uses, frequent resharpening of the tips (which destroys wear patterns), and the blending of the category of awls into ornamental hairpins [1979:341].

Based upon ethnographic accounts and an experimental replication study, Olsen (1979:353-356) believes that fine-tipped awls would have been preferred for basketry and piercing hides. Her studies have shown that the optimum tip diameter to pierce hides is less than 0.1 cm. Larger, blunter awls cannot pierce leather, but may have been used to enlarge perforations.

Scrapers. Thirteen scraper fragments and one complete scraper have been recovered from Shoofly Village. These tools are reminiscent of the "end scrapers" reported by Wheeler (1978:57-58) in his analysis of bone and antler artifacts from Awatovi. Wheeler (1978:57) notes that they are "thought to have been employed mainly to remove flesh from hides, particularly deer hides, and are often called "fleshers"" (1978:57). It is noteworthy that the flattest scrapers resemble so-called bone "spatulas" (Wheeler 1978:56), however the Shoofly specimens lack the sharp end associated with "precise cutting purposes" (Wheeler 1978:56).

All of the Shoofly Village bone scrapers were manufactured from the long bones of indeterminate medium-large mammals. Manufacture appears to have begun by splitting a bone shaft in half longitudinally. The rough edges of the break were then ground or sanded flat. Striations remaining in the break area are at an angle to the axis of the specimen, which suggests that this sanding was conducted at an angle to the axis of the tool. The exterior surface, at the point furthest from each of the broken edges, was also ground flat. The exterior flattened area was marked by lateral and longitudinal striations and tends to be slightly polished.

Of the thirteen fragments, seven were burnt. All of these artifacts exhibited a slight polish on the exterior surface. Most of the scraper fragments exhibited numerous striations on the exterior surface and along the longitudinal broken area. Only one scraper showed wear on the inside of the bone tool.

The general shape of the artifacts varies from deep and pronounced troughs (e.g., BT #30 and BT #41) to scrapers which were basically flat in cross section (e.g., BT #18, BT #19, BT #65, BT #2, and BT #20). Bone scraper fragments ranged from 1.79 to 6.655 cm long, 0.54 to 3.09 cm wide, and 0.145 to 0.498 cm thick.

One unbroken scraper was recovered (BT #41) from the fill (level 2, locus 4) within core room E134 N114. This artifact was fashioned from a right tibia shaft of an unidentifiable artiodactyl. During tool manufacture the bone was apparently broken longitudinally in half and the broken edges ground flat. The process produced numerous striations along the broken edge which do not appear to have been altered during use. Both ends of the bone were broken off and modified by chipping at the outside surface. Use-wear on the tool ends is limited to a slight smoothing along the manufactured edge. The scraper measures 18.48 cm in length, 3.42 to 1.795 cm in width, and 0.34 to 0.155 cm in thickness.

Ulna Awl. One fragmentary ulna awl (BT #21) was found at Shoofly Village. The artifact was fashioned from the right ulna of a coyote (*Canis latrans* Say). The tip of the specimen is broken, however it is apparent that the distal end of the bone had been sharpened and used as an awl. The distal portion of the bone has been rounded and longitudinal scratches cover its surface. The tool exhibits slight wear along the edges of the ulna, which may be associated with its prehistoric use as a scraper. The awl has been burnt and is partly black-brown in color. The artifact was recovered from within floor zone material (level 6, locus 4) in the core room, E113 N124.

Sandra Olsen (1979:353) has reported that ulna awls tend to be hide processing tools. She notes that:

> Because the edges of the ulnae are worn considerably more than the tips, the term "awl" seems somewhat

improper. If the tip was used occasionally, the term "beamer" is also not completely satisfactory, however. For convenience and consistency with earlier literature, this group of artifacts has been labelled as ulna awls, with the understanding that they were probably not used for basket making [S. L. Olsen 1979:353].

Antler Tine Flakers. Two antler tine tools were recovered from Shoofly Village. Antler tine flakers are often manufactured by hacking or breaking off tines from the main antler beam (S. L. Olsen 1979:345-348, 1980:55-56). These artifacts were probably used in pressure flaking stone tools (S. L. Olsen 1979:348).

One flaker (BT #22) measures 7.195 cm in length, 1.48 to 1.28 cm in diameter at its distal end, and 0.34 cm at the tip. Its tip is rounded and slightly polished from use. The tool exhibits a flat wear facet immediately adjacent to the tip. Sandra Olsen has suggested that this type of facet "often develops at the tip after extensive use of one area" (1979:348). The flaker has been burnt and is black in color. Longitudinal scratches and nicks mar its surface. This artifact was recovered from within roof fall (level 4, locus 10) in the core room E113 N124 (Room 3).

The other antler tine flaker (BT #64) is fragmentary, consisting of the tip alone. It is 2.455 cm long, 0.790 cm wide at its distal end, and 0.280 cm in diameter at the tip. The tip shows considerable wear, longitudinal scratches, and a slight flattening along one side. The distal portion has been slightly blackened by fire. The flaker tip came from fill near burial 4 (level 2, locus 0) in the south plaza midden area (E86 N82).

Rings. Fragments of five bone rings were recovered from the Shoofly Village ruins. All were manufactured from unidentifiable medium-large mammal bone.

The first ring fragment (BT #51) measures 1.07 to 1.145 cm in width and 0.305 cm in thickness. The specimen is 0.84 to 0.79 cm long, rendering estimates of the ring diameter impossible. The ring fragment is calcined, lacks surficial polishing, and is annularly scratched and pitted. This fragment was recovered from the core room, E134 N114.

A second ring fragment (BT #10) measures 2.145 cm long, 0.615 cm wide, and 0.245 cm thick. The inside diameter of the ring is estimated to have been 1.905 cm. It has been polished throughout and, as a result, lacks markings suggesting the method of manufacture.

The third ring fragment (BT #40) is heavily weathered and cracked. The ring fragment measures 0.94 cm in width and 0.405 cm in thickness. It was recovered from roof and wall fall material (level 3, locus 5) in the core room E134 N114.

Another ring fragment (BT #52) appears slightly polished. The fragment measures 0.44 to 0.345 cm in width and 0.12 to 0.105 cm in thickness. The inside diameter of the ring is estimated to have been approximately 1.09 cm.

The artifact was found within roof and wall fall (level 6, locus 14) in the core room E134 N114.

The fifth bone ring fragment (BT #56) is actually six heavily weathered fragments of the same ring. Taken together the portion of the ring that was recovered was 0.655 cm wide and 0.225 cm thick. Estimation of the inside diameter is impossible. The fragments were recovered from near the floor (level 3, locus 0) of room E117 N173.

Ring Stock. Four of the artifacts from the Shoofly Village Ruins served as stock for the manufacture of bone rings.

One of the stocks (BT #44) is part of the shaft of an unidentifiable medium-large mammal long bone. One end of the artifact exhibits breakage produced by "groove and snap" manufacturing. The entire circumference of the specimen was cut approximately four-fifths through and the remainder of the bone "snapped" apart. The artifact is calcined and displays annular scratches near the end from which ring blanks were removed. The stock is 3.97 cm long and 0.33 cm thick. Although the specimen is broken, the inside diameter of ring blanks is estimated to have been at least 1.26 cm. This artifact was recovered from the fill (level 3, locus 1) of the core room E113 N124.

The second ring stock specimen (BT #24) is from the proximal right femur of a mule deer (*Odocoileus hemionus*).

The distal portion of the artifact had been cut approximately half of the way through on one side. Ring blanks were probably removed from this artifact by "snapping" through the remaining half of the bone. There are several annular scratches near the distal end of the artifact. A pronounced groove, approximately 0.78 cm from the distal end, may indicate that another ring was to be detached from the stock. The artifact is 7.25 cm in length. The shape of the shaft, at the point that rings would have been manufactured, is roughly oval, with a inside diameter of between 1.31 and 1.21 centimeters. Bone along the area where rings were removed is 0.305 cm thick. Although the head of the femur is unfused, the head and shaft were collected together. It is probable that during the cultural use of the femur, a partial fusion existed which was sufficient to hold the specimen together. At some point prior to collection the portions were separated. This specimen was recovered from the fill (level 6, locus 4) of the core room E113 N124.

The third ring stock (BT #49) is the distal left humerus of an unidentifiable medium-sized artiodactyl. The artifact measures 3.64 cm in length and 0.30 cm in thickness. Rings appear to have been manufactured by annular cutting of the bone around its entire circumference. About three-fourths of the thickness of the bone was "grooved" before the remainder was "snapped" off. The surface of the artifact is annularly scratched and one pronounced groove, about 0.87 cm from the proximal surface, may have marked the width of another ring. Two longitudinal cracks in the specimen might have led to its discard. This ring stock was found near the floor zone (level 6, locus 17) of the core room E134 N114.

The fourth ring stock (BT #5) is the distal humerus of a mule deer (Odocoileus hemionus). The specimen is 8.21 cm long and 0.505 cm in thickness. It is broken and the diameter of ring blanks cannot be estimated. An annular groove was cut about half of the way through the thickness of the bone, around its entire circumference, and the remainder snapped off. While there are several annular scratches on the artifact, one deeper groove, approximately 0.6 cm from the broken surface, may mark a section from which a bone blank was to be removed. This artifact was recovered from the fill (level 3, locus 3) of the core room E134 N114.

Perforated Scapula. One unusual bone artifact recovered from Shoofly Village was made from the right scapula of a mule deer (Odocoileus hemionus). The specimen (BT #9) is broken but exhibits two perforations in the infraspinous surface. The artifact measures approximately 3.82 cm long, 5.54 cm wide, and 0.96 to 0.26 cm thick. One perforation is 0.835 cm in diameter, the other 0.895 cm. Each hole was drilled partially through from both sides.

The two holes are 1.27 cm apart and neither exhibits use-wear. This specimen was recovered from excavation unit E176 N103.

The function or use of this bone tool is particularly enigmatic. Bell (1971), Curwen and Curwen (1926), Dallman (1983:72-73), Wheeler (1978:60) and others have reported the use of scapulae as scrapers, hoes, shovels, cleavers, sickles, or knives, however the Shoofly specimen lacks the notching, sharpened edges, or wear associated with these tool types. Dallman (1983:77) notes that scapular sections may have been utilized in manufacture of bone disks; unfortunately the Shoofly Village specimen lacks the rounded edges which might be expected for bone disks. Sandra Olsen (1979:364) reports a similar use of scapulas as pendants in the bone tool assemblage at Grasshopper Pueblo. She describes three blanks and one drilled pendant, all manufactured from the thin blades of large mammal scapulae. The drilled pendant is depicted as round in shape with a hole near the top and heavy scratches on its surface (1979:364), which again appears to be quite different from the Shoofly specimen.

The precise use or function of the perforated scapula from Shoofly Village remains something of a mystery. The artifact's attributes do not correlate with those associated with bone pendants or disks; its lack of use-wear precludes prehistoric use as a tool.

Perforated Antler. Two bone artifacts recovered from Shoofly Village were perforated antlers. The first (BT #1) is 4.095 cm long, 3.855 to 2.11 cm wide, and 0.605 cm thick. The specimen is broken such that only one side of the original perforation remains. The hole is 0.615 cm in diameter. The artifact is burnt black and portions of what appears to be carbonized periosteum cover part of its surface. The specimen was collected from the roof and wall fall (level 3, locus 0) of room E130 N125. Several other antler pieces were encountered in the same excavation unit; none, however, had been drilled or articulated with the perforated piece.

The other perforated antler (BT #33) is a heavily weathered and calcined fragment. The artifact is 2.97 cm long, 1.27 cm wide, and 0.40 cm thick. The specimen is broken at the perforation and the diameter of the hole cannot be estimated. Comparison with the other perforated antler does, however, suggest that the perforation on BT #33 is slightly larger than that of BT #1. The specimen was collected from roof and wall fall material (level 3, locus 1) excavated from room E130 N125.

Perforated antler artifacts are rather unusual items in bone tool assemblages in the Southwest (S. L. Olsen 1980:64). Sandra Olsen characterizes the distribution of these artifacts as very restricted and notes that they are entirely lacking from Hohokam and Anasazi assemblages

(1980:64). She reports that recovery of perforated antler artifacts has been limited to Kinishba, Grasshopper (1979:351), and a few sites in the Point of Pines area (1980:62). Perforated antler tines have also been reported by Pendleton (1985) and Gifford (1940) from Hidden Cave, Nevada, and perforated bighorn sheep horn from Lovelock Cave, Nevada (S. L. Olsen 1979:351).

Perforated antlers have been labelled shaft-straighteners in many bone tool typologies "because of their superficial similarity to rib shaft-straighteners found in many areas of North America" (S. L. Olsen 1979:349). Dittert reports that larger perforations in awls and antler tools were used ethnographically to attach cordage so that a tool could be kept near a person's hand during use (personal communication 1988). Shoofly Village perforated antlers, however, lack use-wear which would be expected of shaft-straighteners and exhibit smaller perforations than those used to attach cordage (Dittert, personal communication 1988) and are, therefore, of an unknown function.

<u>Unknown Bone Artifacts</u>. Eight specimens of worked bone were recovered which could not be classified. Most of these were simply too small to be labelled with surety. Two exceptions, BT #28 and BT #47 are worthy of note. BT #28 is an artifact manufactured from the left calcaneus of a medium sized artiodactyl. The bone is unburnt and

weathered. The proximal portion of the artifact is missing and it cannot be determined whether the artifact was an awl or scraper. The specimen was recovered in the fill (level 6, locus 5) of the room E134 N114. It measures 5.595 cm long, 1.295 to 1.81 cm wide, and 0.385 to 1.2 cm thick.

BT #47 is an unknown bone tool fashioned from a distal metacarpal of a deer (Odocoileus sp.) recovered from fill above the floor level (level 6, locus 15) of core room E134 N114.. The bone has been split longitudinally in half and the left condyles remain intact. The specimen is unburnt and slightly weathered. There is no use-wear other than a slight polish along the broken surface near the tip of the artifact. The specimen is 11.27 cm in length, 1.500 to 2.055 in width, and 0.435 to 1.700 thick.

CHAPTER SEVEN

DISCUSSION AND CONCLUSIONS

In the preceding chapters I have described and interpreted selected aspects of the subsistence economy of the prehistoric inhabitants of Shoofly Village. My discussion has been primarily descriptive and focused on individual taxa or bone tool types recovered from the site. The purpose of this chapter is to draw together, and expand upon, the faunal data presented earlier. Here I have addressed larger economic, biogeographic, and taphonomic issues and their relevance to interpretation of prehistoric life at Shoofly Village. Five major topics are discussed, these are:

(1) relative abundances of taxa within the faunal assemblage;

(2) the origin of the archaeological fauna;

(3) relative importance of different taxa for the prehistoric inhabitants of Shoofly Village;

(4) animal procurement patterns; and

(5) conclusions and suggestions for future research.

Relative Abundances of Taxa

As is the case for most Southwestern faunal assemblages, the archaeological fauna from Shoofly Village is dominated by mammalian remains (review Table 7). Mammals account for more than 88% of the total number of specimens and 76% of the individuals identified within the assemblage. Birds (0.8% of the assemblage; 18.5% of the individuals), reptiles (0.5%; 9.4%), and amphibians (0.1%; 1.6%) are less common in the archaeological faunal assemblage. Fish remains are absent from Shoofly Village or at least have not been preserved and/or recovered.

A variety of factors may be responsible for different abundances for each class within the faunal assemblage. The prevalence of mammalian remains (and corresponding absence of other classes) may result from: the dietary preferences of the prehistoric group; relatively high nutritional value of mammalian flesh; relative ease (i.e., low cost) of procurement of such species; value placed on furs, hides, bones, or other products; natural abundances of these species at the site and in the surrounding area; or preservation and recovery factors. One must also take into consideration the fact that bird, amphibian, reptile, and fish bones are generally smaller and more fragile than those of mammals. Such bones are easily overlooked by investigators and are prone to destruction by physical, natural, and/or human processes.

The most abundant taxa in the Shoofly Village archaeological fauna are lagomorphs and artiodactyls. Cottontails account for the greatest number of specimens (210), followed closely by deer (153) and jack rabbits

(100). Pocket gophers (31), rock squirrels (30), wood rats (12), mud turtles (12), and tree squirrels (10) are also relatively well-represented.

The high number of cottontail and jack rabbit bones recovered from Shoofly Village is not unique for Southwestern faunal assemblages. A similar pattern has been documented at most Southwestern archaeological sites. Lagomorphs are not large (relative to artiodactyls or carnivores), but tend to be an abundant and predictable source of meat protein (Bayham and Hatch 1984:204).

Although rabbits and hares often occupy the same areas, jack rabbits are most common in open areas, while cottontails are more abundant in areas of dense foliage and brush (see Bayham [1980], Bayham and Hatch [1984], and Driver [1985] for further discussion of lagomorph behavior). It follows that the relative numbers of (or ratio between) cottontails and jack rabbits may be related to their local availability. This availability is probably a function of habitat preference. Bayham (1976, 1980) has argued that this information is useful in reconstructing environments near archaeological sites at the time of their occupation. He states that,

> Since it is not economically feasible for a hunter to travel considerable distances to exploit low-yield resources, the relative abundance of these animals in the archaeological record should reflect both their natural and local availability [1980:395].

If we assume that the relative abundance of cottontails and jack rabbits in the Shoofly Village archaeological fauna reflects their local availability, then the predominance of cottontail specimens in the assemblage indicates that the site vicinity was probably dominated by brush and cover (rather than open areas) during the period of occupation.

As for the lagomorphs above, the high numbers of deer and artiodactyl bones recovered from Shoofly Village are not unusual in Southwestern faunal assemblages. Deer are considered to be a staple food for prehistoric groups at many Southwestern archaeological sites, such as Arroyo Hondo, Awatovi, Grasshopper, and Snaketown (Greene and Matthews 1964; Lang and Harris 1984; J. Olsen 1980; S. J. Olsen 1978). While not as abundant as lagomorphs, artiodactyls are fairly common throughout the region and could have provided large quantities of meat protein and other desired items (e.g., hides, antlers, grease, sinews, and marrow) to prehistoric peoples.

One striking characteristic of the Shoofly Village faunal assemblage is that artiodactyl specimens outnumber the bones from cottontails, jack rabbits, or rodents. The quantity of artiodactyl remains recovered from Shoofly Village may indicate a primary focus by the prehistoric inhabitants of the site on the procurement of deer and allied species.

As shown in Table 44, this pattern is rare for

Table 44. Abundances of Selected Taxa Recovered from Shoofly Village and Other Southwestern Sites.

SITE OR PROJECT	ARTIODACTYLS[a]	COTTONTAIL	JACK RABBIT[b]	RODENTS
	% NISP	% NISP	% NISP	% NISP
SHOOFLY VILLAGE	7.9	4.8	2.3	2.5
Ash Creek	7.1	8.7	8.8	8.6
AZ U:1:31 (ASU)	19.2	29.5	31.6	11.3
Awatovi	10.5	30.3	31.8	
Copper Basin	10.7	27.8	24.8	8.4
Coronado	16.9	9.5	22.6	0.7
Dead Valley	1.4	12.0	17.1	6.0
Escalante	14.5	14.5	31.2	4.4
Fitzmaurice	15.3	31.8	15.0	28.9
Grasshopper	24.2	15.8	3.5	35.5
Las Colinas	5.9	16.9	40.7	32.8
Miami Wash	29.0	10.4	14.2	2.8
New River	4.8	4.1	32.9	2.7
P.A.R.E. (1987)	20.3	9.9	6.5	1.3
Salt-Gila Aqueduct	1.3	2.8	7.5	2.8
Snaketown	23.0	8.8	62.8	3.1
TEP St. Johns	2.3	13.6	18.8	12.3

a The artiodactyls category in this table combines specimens identified as artiodactyls, _Cervus_, _Odocoileus_, _Antilocapra_, _Ovis_, and _Bos_.

b The jack rabbit category in this table combines specimens identified as _Lepus_, _L._ _californicus_, and _L._ _alleni_.

Southwestern archaeological faunas. Southwestern archaeological assemblages usually contain higher percentages of cottontails, jack rabbits, or rodents than artiodactyls. Only faunal assemblages from Grasshopper, Miami Wash, and the 1987 Payson Archaeological Research Expedition (P.A.R.E.) exhibit the high relative percentages of artiodactyl remains reported for Shoofly Village.

Origin of the Archaeological Fauna

The abundance of an animal within an archaeological fauna is not necessarily equivalent to its economic importance to the human group. An archaeological fauna is only a sample of bones from the animals which were procured and utilized by prehistoric peoples. Only those taxa whose bones were buried at the site, survived until excavation, and were then excavated, collected, and analyzed are represented (Klein and Cruz-Uribe 1984:3). The character of the assemblage may be influenced by numerous factors, including:

(1) prehistoric human behavior (e.g., butchering, consumption, and disposal practices);

(2) physical processes (e.g., weathering, bone preservation, soil frost, running water);

(3) natural agencies (e.g., modification of cultural

materials by carnivores, scavengers, or other people, bones left by animals or other human groups, natural intrusions by burrowing species); and

(4) archaeological sampling, excavation, collection, and analytical methods (see Butzer [1982] and Klein and Cruz-Uribe [1984] for further discussion of this topic).

An appraisal of the cultural importance of animal taxa requires that the zooarchaeologist distinguish between specimens which are the result of cultural activities and those which have entered the archaeological deposit because of natural or physical processes. The problem is, therefore, to determine whether the bones recovered from Shoofly Village result from human behavior or non-cultural agencies.

Non-rodent mammal bones from archaeological sites in the Southwest, particularly those of artiodactyls, are typically <u>assumed</u> to result from human procurement, consumption, or discard activities at the site (e.g., Glass 1984; Greene and Matthews 1976; Szuter 1984b). It is clear, however, that bones from these animals may also be introduced into cultural deposits through:

(1) activities of various animal predators or scavengers;

(2) natural deaths at an abandoned archaeological site;

(3) bones being transported from other areas as a result of running water, gravity, deflation, or other physical agencies; and

(4) activities of subsequent populations.

Distinguishing between non-rodent mammal bones which result from cultural activities and specimens generated by other processes necessarily involves a consideration of the formation processes likely to have been at work at the site, condition and context of the recovered bone, and behavioral patterns of the animal taxa present in the archaeological fauna.

Although the formation processes for Shoofly Village are not well understood, given the site topography it seems likely that running water, gravity, deflation, or other physical processes added little, if any, animal bone to the archaeological fauna. The site is surrounded by a compound wall and sits atop the relatively level expanse of Walnut Flat. While it is possible that non-rodent mammal bones have been displaced vertically by physical agencies, transportation of large numbers of these bones over significant horizontal distances is unlikely.

As shown in Table 45, very few of the non-rodent mammal bones from Shoofly Village exhibit the surficial modifications which are characteristic of predator or scavenger utilization. Bone which has been chewed by carnivores accounts for only 0.25% of the total

Table 45. Modifications Exhibited by Shoofly Village Faunal Specimens.

	NISP	BURNT	CALCINED	BUTCHER MARKS	SPIRAL FRACTURE	RODENT GNAWED	CARNIVORE CHEWED
AMPHIBIA							
Bufo sp.	6	-	-	-	-	-	-
REPTILIA							
Kinosternidae	8	1	-	-	-	-	-
Kinosternon sp.	4	-	-	-	-	-	-
Terrapene ornata	1	-	-	-	-	-	-
Crotaphytus cf. *C. collaris*	1	-	-	-	-	-	-
Colubridae	4	-	-	-	-	-	-
Pituophis melanoleucus	1	-	-	-	-	-	-
Crotalus sp.	1	-	-	-	-	-	-
AVES							
Anas platyrhynchos	1	-	-	-	-	-	-
Accipiter cooperii	2	-	-	-	-	-	-
Buteo sp.	2	-	-	-	-	-	-
Lophortyx gambelii	2	-	-	-	-	1	-
Meleagris gallopavo	3	-	-	-	-	-	-
Grus canadensis	1	-	-	-	-	-	-
Colaptes sp.	2	-	-	-	-	-	-
Melanerpes sp.	1	-	-	-	-	-	-
Corvidae	1	-	-	-	-	-	-
Corvus corax	2	-	1	-	-	-	-
Toxostoma sp.	1	-	-	-	-	-	-
Sturnella neglecta	1	-	-	-	-	-	-
MAMMALIA							
Leporidae	56	10	9	-	-	3	-
Lepus sp.	32	4	6	1	-	3	-
?*Lepus californicus*	1	-	1	-	-	-	-
Lepus cf. *L. californicus*	8	1	1	-	-	1	-
Lepus californicus	54	7	12	-	-	2	-
Lepus cf. *L. alleni*	5	-	-	-	-	-	-
cf. *Sylvilagus* sp.	5	-	2	-	-	-	-
Sylvilagus sp.	205	22	26	1	1	6	1
Rodentia	2	-	-	-	-	-	-
Citellus sp.	4	-	-	-	-	-	-
Citellus cf. *C. variegatus*	1	-	-	-	-	-	-
Citellus variegatus	25	-	-	-	-	-	-
Sciurus sp.	8	-	-	-	-	-	-
Sciurus cf. *S. aberti*	1	-	1	-	-	-	-
Sciurus aberti	1	-	-	-	-	-	-
cf. *Thomomys* sp.	2	-	-	-	-	-	-
Thomomys sp.	18	-	-	-	-	-	-
Thomomys cf. *T. bottae*	4	-	-	-	-	-	-
Thomomys bottae	7	-	-	-	-	-	-
Perognathus sp.	1	-	-	-	-	-	-

Table 45. Continued.

	NISP	BURNT	CALCINED	BUTCHER MARKS	SPIRAL FRACTURE	RODENT GNAWED	CARNIVORE CHEWED
Dipodomys sp.	1	-	-	-	-	-	-
Dipodomys cf. D. ordii	1	-	-	-	-	-	-
Peromyscus sp.	2	-	-	-	-	-	-
Peromyscus cf. P. eremicus	2	-	-	-	-	-	-
Peromyscus boylii	1	-	-	-	-	-	-
Sigmodon sp.	2	-	-	-	-	-	1
Neotoma sp.	18	-	1	-	-	-	-
Neotoma cf. N. albigula	3	-	-	-	-	-	-
Neotoma albigula	1	-	1	-	-	-	-
Neotoma cinerea	2	-	-	-	-	-	-
Carnivora	2	-	1	-	-	-	-
Canidae	7	-	-	1	-	1	-
Canis sp.	2	-	-	-	-	-	-
Canis cf. C. lantrans	2	-	-	-	-	-	-
Canis lantrans	2	2	-	-	-	-	-
Canis familiaris	1	-	-	-	-	-	-
Urocyon cinereoargentus	1	-	-	-	-	-	1
Vulpes macrotis	1	-	-	-	-	-	-
Ursus americanus	1	-	-	-	-	-	-
Mephitis mephitis	1	-	-	-	-	-	-
Artiodactyla	187	56	30	6	-	3	3
cf. Artiodactyla	2	-	1	1	-	1	-
Cervus canadensis	1	1	-	-	-	-	-
cf. Odocoileus sp.	2	-	-	1	1	1	-
Odocoileus sp.	94	31	16	6	1	5	-
Odocoileus cf. O. hemionus	5	1	-	-	-	1	-
Odocoileus hemionus	52	23	4	2	-	3	1
Ovis canadensis	1	-	-	-	-	-	-
SUB-TOTAL	882	159	113	19	3	31	7
Indeterminate							
Indeterminate							
Unknown	9	-	-	-	-	-	-
Small	240	12	87	-	-	-	-
Small-Medium	170	9	75	-	-	1	-
Medium	7	-	5	-	-	-	-
Medium-Large	6	1	1	-	-	-	-

Table 45. Continued.

	NISP	BURNT	CALCINED	BUTCHER MARKS	SPIRAL FRACTURE	RODENT GNAWED	CARNIVORE CHEWED
Birds							
Small	2	-	-	-	-	-	-
Small-Medium	4	-	-	-	-	-	-
Medium	6	-	-	-	-	-	-
Medium-Large	4	-	-	-	-	-	-
Mammals							
Unknown	7	2	3	-	-	-	-
Small	25	1	8	-	-	-	-
Small-Medium	639	88	266	-	1	3	1
Medium	1157	158	300	5	-	7	-
Medium-Large	1205	270	367	19	5	8	3
Large	3	1	1	-	-	1	-
SUB-TOTAL	3484	542	1113	24	6	20	4
TOTAL	4366	701	1226	43	9	51	11

archaeological fauna and 0.27% of the bones identified from all mammals (excluding rodent specimens and small-sized unidentifiable fragments). Even for bones from taxa which exhibit the greatest overall number of carnivore chewing marks--artiodactyls and medium-large mammals--such marks are rare (less that 0.5%). Given these low rates, it is improbable that predators and scavengers were responsible for introducing many of the large animals bones recovered at the site.

Many of the mammal bones from Shoofly Village exhibit modifications which may be associated with cultural procurement, consumption, or discard practices (see Table 45). Butchering marks, a particularly diagnostic indicator of cultural processing, are present on artiodactyl (4.7%), carnivore (5.0%), lagomorph (0.5%), indeterminate medium mammal (0.4%), and indeterminate medium-large mammal (1.6%) specimens. Spiral fractures, which may be related to cultural activities (refer to Bonnichsen and Will [1980] and Klein and Cruz-Uribe [1984] for details of the debate surrounding interpretation of spiral fractures), are less prevalent, found on 0.6% of the artiodactyl, 0.8% of the lagomorph, 0.2% of the indeterminate small-medium, and 0.4% of the indeterminate medium-large mammal bones.

Burning is the most frequent modification identified for the archaeological fauna (see Table 45). Charring or calcination was noted for many of the non-rodent mammalian specimens. In general, specimens from artiodactyls (47.4%), indeterminate small-medium mammals (55.4%), indeterminate medium mammals (39.6%), and indeterminate medium-large mammals (52.9%) were more commonly burnt than those from lagomorphs (27.6%) or carnivores (15%).

Burnt bone is not, however, a direct indication of cultural utilization. Specimens may have been burnt during roasting or cooking activities, while processing grease or marrow, as a means of removing excess meat prior to discard in a midden or trash area, or unintentionally when sections of the site were destroyed by fire. While burnt bone may not <u>necessarily</u> result from cultural activities, it does signify that the specimen was interred prior to any catastrophic fires at the site and that the bone is unlikely to represent a recent intrusion into the archaeological record.

Bayham (personal communication 1985) has hypothesized that heavily burnt or calcined bone probably indicates prolonged exposure to fire after the meat was removed. The vast quantity (28.1% of the total number of specimens in the faunal assemblage) of calcined bone from the site suggests frequent disposal of food refuse into hearths or other types of fire pits.

Table 46 summarizes the relative frequency of burnt artiodactyl and lagomorph body parts. A high percentage

Table 46. Relative Frequency of Burnt Artiodactyl and Lagomorph Body Parts.[a]

	ARTIODACTYLA[b]		COTTONTAIL		JACKRABBIT[c]		LAGOMORPHA[d]	
ELEMENT	B/T	%	B/T	%	B/T	%	B/T	%
Antlers/Horns	22/23	(95.7)	-	-	-	-	-	-
Crania	6/11	(54.5)	4/14	(28.6)	1/2	(50.0)	5/17	(29.4)
Mandibles	20/25	(80.0)	3/17	(17.6)	1/1	(100.0)	5/19	(26.3)
Vertebrae	15/46	(32.6)	2/23	(8.7)	1/9	(11.1)	3/45	(6.7)
Ribs/Sterna	12/16	(75.0)	0/1	(0.0)	1/6	(16.7)	2/9	(22.2)
Scapulae	2/5	(40.0)	0/3	(0.0)	0/3	(0.0)	1/8	(12.5)
Humeri	6/16	(37.5)	8/27	(29.6)	6/18	(33.3)	14/49	(28.6)
Radii	4/10	(40.0)	4/9	(44.4)	3/8	(37.5)	7/18	(38.8)
Ulnae	1/3	(33.3)	3/6	(50.0)	4/4	(100.0)	7/10	(70.9)
Innominates	4/26	(15.4)	9/34	(26.5)	3/6	(50.0)	16/49	(32.7)
Femora	4/6	(66.7)	6/24	(25.0)	2/14	(14.3)	16/52	(30.8)
Tibiae	6/19	(31.6)	3/21	(14.3)	3/11	(27.3)	8/41	(19.5)
Metapodials	6/19	(31.6)	1/6	(16.7)	1/5	(20.0)	2/11	(18.1)
Carpals and Tarsals	12/28	(42.9)	7/15	(46.7)	5/8	(62.5)	13/25	(52.0)
Phalanges	17/46	(37.0)	0/4	(0.0)	0/4	(0.0)	0/10	(0.0)
TOTALS	137/299	(45.8)	50/204	(24.5)	31/99	(31.3)	99/363	(27.3)

[a] B/T lists the number of burnt bones over the total number of bones for each taxon. The percentage sign refers to the percentage of elements which are burnt. Teeth, sesamoid, and long bone fragments are not included in this figure.

[b] The artiodactyl category includes specimens identified as artiodactyls, elk, deer, and bighorn.

[c] The jack rabbit category includes jack rabbits, black-tailed jack rabbits, and antelope jack rabbits.

[d] The lagomorph category includes specimens identified as lagomorphs, jack rabbits, and cottontails.

of all artiodactyl body parts (except innominates) are burnt. In general, roasting of meat over fire results in charring which is restricted to the distal ends of long bones or metapodials (and associated elements). This is clearly not the case for the artiodactyls from Shoofly Village. All portions of the body display a high percentage of burnt specimens. This pattern is consistent with discard of artiodactyl bones into a fire after food preparation or consumption.

In contrast to the artiodactyl pattern, burnt lagomorph bone does indicate roasting of these taxa over fires. As would be expected from roasting, appendicular elements exhibit burning much more frequently than axial specimens. The relatively high percentage of burnt innominates suggests that the hind legs of rabbits and hares were separated from each other by breaking the pelvis along the pubic symphysis prior to roasting (Douglas 1975).

Distinguishing between animal bones resulting from cultural activities of the prehistoric population in question and those generated by subsequent prehistoric and historic groups is difficult. Except in the case of very recent animal bones, which may exhibit metal saw cut marks, ligaments, or decaying flesh, specimens deposited at different times by various groups may appear identical. In general, fine stratigraphic control is required to distinguish with certainty faunal assemblages arising from different cultural groups and/or time periods.

Unfortunately, the stratigraphic relationships between excavation units at Shoofly Village has not been firmly established. As a result, animal bones exhibiting modifications associated with cultural activities have been assumed to have been generated by the prehistoric inhabitants of Shoofly Village.

Behavioral data associated with animal taxa recovered from archaeological sites can be used to suggest whether a species might represent a natural intrusion into cultural deposits. As indicated several times in Chapter Five, many of the taxa recovered from Shoofly Village are known to burrow underground, inhabit the burrows of other animals, or live in the rockfall and debris provided by archaeological sites. The presence of such animals in an archaeological fauna may indicate natural deaths and intrusions into cultural deposits, rather than past cultural activities. While this is probably not the case for most non-rodent mammals in the archaeological fauna, it is a concern for fossorial carnivores such as skunks, foxes, and coyotes, and also for rabbits and hares.

Based on the preceding discussion of formation processes, archaeological context and condition, and animal behavior, it is my conclusion that most non-rodent mammal bones recovered from Shoofly Village are the result of prehistoric cultural activities. Artiodactyl and black bear specimens from the site clearly represent various aspects of cultural procurement, consumption, and disposal practices. Although rabbits and hares may occasionally have entered the archaeological record by dying in the burrows of other animals (or being carried into burrows by carnivores or scavengers), the abundance of culturally modified remains and well-documented utilization by prehistoric inhabitants at other Southwestern sites suggests that lagomorph bones result largely from cultural activities.

Coyote remains are more equivocal. While two coyote specimens recovered from Shoofly Village have been burnt, direct evidence of cultural use is lacking. All specimens from foxes and skunks, lacking any cultural modifications and from species known to inhabit underground burrows, are probably not related to cultural activities. The single domestic dog specimen is clearly a recent (and intrusive) addition to the prehistoric assemblage.

Like the non-rodent mammals above, avian bones recovered from archaeological sites may have resulted from a variety of cultural activities, physical agencies, and/or natural processes. However, because several ethnographic accounts document ceremonial use of birds, bird bones, and feathers, most avian remains from Southwestern sites are interpreted as being from ceremonial or ritual contexts (e.g., Czaplicki 1981; S. J. Olsen 1978, contra Bayham

1982).

With only one exception (a calcined phalanx from a common raven), bird remains from Shoofly Village do not exhibit modifications which might indicate human utilization. However, bird specimens recovered from the site are principally associated with the wings, which suggests that avian specimens may result from purposeful collection of plumage or wing fans. Although the sample size is quite small, of the 19 bird bones which were identifiable beyond the class level, 12 (63.2%) are elements from wings.

Avian assemblages consisting largely of wing elements have been reported for several Southwestern sites (e.g., Czaplicki 1981; S. J. Olsen 1978; Sparling 1978). Sparling has described a very similar pattern for several sites in the Miami Wash project. He reports a wing element of a flicker from the Tin Horn Wash site (AZ V:9:62) and suggests that "It was probably not utilized as a food item as this bird may have been collected as a source for decorative ornaments as its feathers are brightly colored" (1978:295). Hawk, eagle, vulture, falcon, and scrub jay bones (unspecified elements) from the Columbus site (AZ V:9:57) are likewise interpreted as the result of plumage exploitation. For the East site (AZ V:9:68), Sparling details a high proportion of red-tailed hawk bones--predominantly elements which were wing bones.

He concludes that "The wings and their feathers may have played a specific role in a religious/ceremonial context, as has been ethnographically demonstrated in many Southwestern Indian groups" (1978:298).

The origin of small animal remains is most problematic. Small animals may penetrate the archaeological record by dying naturally while within burrows dug into cultural deposits. Specimens from small animals may represent remains introduced into archaeological sediments by carnivorous or scavenging animals. Finally, small animal bones may enter cultural layers via various post-depositional disturbances, such as the actions of running water, soil frost, expansion and contraction of clays, micro-faulting, and other physical agencies (Butzer 1982; Driver 1985).

Five major types of information have been used by Southwestern faunal analysts to differentiate between small animals used for food or other cultural purpose and those naturally intrusive to the assemblage. These include:

(1) ethnographic accounts which discuss the use of small animals as food;

(2) studies on burrowing behavior;

(3) trapping of small animals at or around archaeological sites;

(4) modern zoogeographical distributions (Bayham 1977);

or

(5) archaeological information, particularly the context and condition of the recovered bone (Szuter 1984b:149).

In her discussion of the importance of rodents in the Hohokam diet, Szuter (1984b) reports that evidentiary lines are typically used to substantiate, rather than formulate, interpretations. As a result, the only information which is usually presented to the reader is that which substantiates the analyst's inferences regarding the origin of the small animal specimens (e.g., Czaplicki 1981:344). Szuter suggests that a better basis for interpretation is provided by examining the ethnographic, taphonomic, and archaeological evidence to formulate criteria with which to differentiate the possible causes for the presence of small animal bones at a site. I have adopted this procedure for the subsequent discussion of small animal remains from Shoofly Village.

Although direct linkage between the prehistoric inhabitants of Shoofly Village and any known ethnographic group is lacking, small animal use can be documented for many of the ethnographic groups which have inhabited adjacent areas during historic times. Information from ethnographies of the Havasupai, Western Apache, Pima, and Papago suggest that rodents were important and common sources of food.

Havasupai subsistence practices were primarily based on various forms of small game. They are known to have constructed deadfalls and traps near agricultural fields and storehouses to capture rodents, such as wood rats and rock squirrels (Dobyns and Euler 1970:57; Spier 1928:108; Whiting 1985:38-39).

Although deer were their most important hunted resource, the Western Apache diet also included wood rats and, less frequently, squirrels and prairie dogs. Western Apache youths hunted wood rats and other small animals to obtain meat as a courtship gift (Baldwin 1965:61; Castetter and Opler 1936; Goodwin 1942:293-294).

The Papago and Pima relied extensively on wood rats, cotton rats, and ground squirrels for food. Papago men frequently hunted rabbits and rats while the women gathered saguaro fruit. Pocket mice and kangaroo rats were also consumed by the Papago when meat was in short supply (Castetter and Bell 1942; Castetter and Underhill 1935:42; Szuter 1984b:150).

Descriptions of the methods of cooking small animals are not as common in the ethnographic literature as general references of rodent use by Southwestern groups. It is clear, however, that rodents were often roasted or boiled and eaten whole (including fur, viscera, and bones). Consumption of rodents in this manner would produce highly fragmented bone specimens (which might be recovered in fine screens or flotation samples). If rodents were roasted on a spit over a fire, then elements covered only by fur, skin, and little flesh, such as the distal limbs, would tend to be charred (Szuter 1984b).

The ethnographic accounts above suggest that rodents were frequently consumed by Southwestern populations. it is apparent that small animals provided these groups with a reliable and abundant supply of meat protein. The expected archaeological evidence of small animal consumption therefore consists of small, broken bones in human coprolites and burnt elements from the peripheral skeletons (Szuter 1984b).

There is very little evidence which suggests small animal consumption at Shoofly Village. Human coprolites were not found at the site. Only four small animal bones were recovered which were burnt: two wood rat teeth, a mud turtle carapace fragment, and the proximal left femur from an Abert's squirrel.

The second line of evidence which has been used by zooarchaeologists to interpret small animal remains pertains to burrowing or fossorial behavior. The implicit assumption of this approach is that small animals that have a proclivity for burrows may intrude into cultural deposits. As indicated at several points in Chapter Five, most of the small animals recovered from Shoofly Village are known to burrow underground, inhabit the burrows of other animals, or live in the rockfall and debris provided by archaeological sites. Small animals that die in burrows at the site would be expected to produce elements representing a larger portion of the skeleton than those that die as a result of cultural activities (Bayham 1977; Grayson 1984; Szuter 1984b; Thomas 1971).

The third type of information which can be used to interpret small animal bones is the modern presence of such species in or around archaeological sites. Szuter (1984b:154) reports that a frequent assumption in the zooarchaeological literature is that small animals, particularly rodents, are attracted to archaeological sites either during the period of occupation or after abandonment. The attractiveness of the archaeological site is then used to explain the presence of small animal remains at the site.

Small animals trapped or observed at a site can be used to justify assumptions about the attraction of small animals to sites. Species not presently at the site, but identified in the archaeological assemblage, may represent non-modern taxa (Harris 1963; Szuter 1984b).

A related technique used to interpret small animal bones from archaeological sites relies on data pertaining to the modern zoogeographic distributions of species recovered from archaeological sites (Bayham 1977). Bones of small mammals recovered from sites outside their current range may indicate cultural use, as well as environmental change or species adaptation.

Finally, the context in which small animal bones are recovered and the condition of the retrieved bone may indicate the origin and importance of the taxa. Proximity of small animal bones to burrows or loose soil or association with other elements from the same species, for example, probably indicates that the specimens are intrusive. Cultural modifications, such as burning (particularly of caudal vertebrae, metapodials, tarsals, carpals, and phalanxes), butchering, and spiral fractures, may suggest use of small animals in the human diet (Driver 1985; Szuter 1984b).

An examination of the small animal remains recovered from Shoofly Village indicates that there is little evidence supporting use of these taxa by humans. The potential of cultural origins for small mammal bones from the site has been demonstrated by:

(1) the fore-mentioned ethnographic accounts which discuss the use of various small animals;

(2) burnt mud turtle, wood rat, and Abert's squirrel elements;

(3) the presence of a mud turtle away from its preferred habitat--a permanent water source; and

(4) the presence of Abert's squirrel at a distance (about 18 km) from ponderosa pine forests above the

Mogollon Rim.

In contrast, several types of information suggest that most of the small animals in the archaeological fauna represent natural intrusions into the cultural assemblage, including:

(1) all of the small animals from Shoofly Village (except mud turtles, box turtles, and Abert's squirrels) are known to burrow underground, inhabit the burrows of other animals, or live in the rockfall and debris provided by archaeological sites;

(2) most small animal taxa from Shoofly Village currently inhabit the site or the surrounding area. Box turtles, collared lizards, rattlesnakes, rock squirrels, and wood rats have all been observed at the site; and

(3) burnt small animal bones are rare (3.0% of the total number of small animal bones). Of the specimens which were burnt, none are the elements which are expected from ethnographic roasting descriptions.

Based on the data that has been presented, most of the small animal bones recovered from Shoofly Village probably result from natural intrusions, rather than cultural activities. There are three possible exceptions to this pattern: mud turtles, Abert's squirrels, and wood rats.

The presence of taxa outside their preferred habitats, and of burnt elements, indicates that mud turtle and Abert's squirrel were procured and utilized by the prehistoric inhabitants of the site. The interpretation of wood rat bones is more equivocal. Although wood rats were utilized by many ethnographic groups and burnt wood rat bones were recovered from the site, the burnt bones may relate to catastrophic fires at the site. It is possible, therefore, that wood rats result from natural intrusions into the archaeological record.

My conclusions regarding the cultural or natural origin of animals recovered from Shoofly Village are summarized in Table 47. Each species has been placed into one of three derivational categories. Taxa listed as "non-cultural" lack cultural modifications and currently inhabit the site or its immediate vicinity. "Quasi-cultural" taxa are those for which evidence of cultural use is not quite compelling. Naturally, some specimens of taxa felt to be cultural may have resulted from natural processes or certain species classified as natural may have been eaten or used (Bayham 1982).

Relative Importance of Taxa

The combination of abundance data (see Table 7) and my conclusions regarding the origins of the taxa (see Table

Table 47. An Assessment of the Cultural Derivation of Taxa Identified from Shoofly Village.

TAXA	NON-CULTURAL	QUASI-CULTURAL	CULTURAL
AMPHIBIA			
Toad	X		
REPTILIA			
Mud turtle			X
Western box turtle	X		
Collared lizard	X		
Colubrid snakes	X		
Rattlesnake	X		
AVES			
Mallard		X	
Cooper's hawk		X	
Buteo hawk		X	
Gambel's quail		X	
Turkey		X	
Sandhill crane		X	
Flicker		X	
Woodpecker		X	
Common Raven		X	
Thrasher		X	
Western meadowlark		X	
MAMMALIA			
Black-tailed jack rabbit			X
Antelope jack rabbit			X
Cottontail			X
Rock squirrel	X		
Abert's squirrel			X
Valley pocket gopher	X		
Pocket mouse	X		
Kangaroo rat	X		
Cactus mouse	X		
Brush mouse	X		
Cotton rat	X		
Wood rats		X	
Coyote		X	
Domestic dog	X		
Gray fox	X		
Kit fox	X		
Black bear			X
Striped skunk	X		
Elk			X
Deer			X
Bighorn			X

47) confirm that the most important animals for the prehistoric inhabitants of Shoofly Village were probably lagomorphs and artiodactyls. Artiodactyls constitute a major source of meat protein and other desirable animal products (e.g., hides, antlers, sinew, grease, marrow, and bone for tools). Lagomorphs, while not as large as artiodactyls, provide an abundant and predictable source of meat protein.

The numbers of identified fragments for all lagomorphs (366) and all artiodactyls (344) are approximately equal. As discussed previously, within the lagomorph category, cottontails (210) were procured more frequently than black-tailed and antelope jack rabbits. Most identifiable artiodactyl bone is that of deer (94.4%); it is probable that most unidentified artiodactyl specimens are also from deer.

Other taxa which may have been economically important for the inhabitants of the site include: mud turtle (12 specimens), Abert's squirrel (10), coyote (4), wood rats (24), black bear (1), elk (1), and bighorn (1). Various species of birds may have had ceremonial or ritual, as well as economic, importance.

The relative contribution of each taxon to the prehistoric diet is quite different when one considers the amount of available meat from each taxon. Table 48 presents the available meat for all <u>cultural</u> taxa where

Table 48. Available Meat.

	MNI	MEAN LIVE WEIGHT (kg)	% U.M.	EDIBLE WEIGHT (kg)	TOTAL EDIBLE WEIGHT (kg)	SOURCE
Cervus canadensis	1	317.5	.500	158.8	158.8	(White 1953a:397)
Ursus americanus	1	136.1	.700	95.3	95.3	(White 1953a:397)
Odocoileus hemionus	2	56.7	.722	40.9	81.9	(Baynam 1982:232)
Ovis canadensis	1	71.2	.722	51.4	51.4	(Bayham 1982:232)
Canis lantrans	1	15.9	.700	11.1	11.1	(Bayham 1982:232)
Sylvilagus sp.	12	1.6	.500	0.8	9.6	(White 1953a:398)
Lepus californicus	4	2.3	.700	1.6	6.4	(Bayham 1982:232)

the estimated total edible meat for the site exceeds five kilograms. Mean live weight and percentage of usable meat (% U.M.) estimates are taken from studies by Bayham (1982), Stewart and Stahl (1977), and White (1953a).

The data utilized in the available meat approach are a source of much current debate within zooarchaeology. Estimates of live weights have been criticized because body weights vary with the individual animal. Live weights have been shown to be influenced by age, sex, size, general nutritional condition, and geographical location (Purdue 1987; Smith 1975; Stewart and Stahl 1977; Ziegler 1973).

Estimates of usable meat are also quite controversial (Bayham 1982; Binford 1981; Lyman 1979b). Stewart and Stahl (1978), for example, have criticized White's (1953) original figures for consistently over-estimating available meat for wild species. Bayham (1982) using sheep and caribou data from Binford (1978) has suggested the exact opposite--that White's percentages under-estimate the amount of available meat for artiodactyls.

Recent publications which have argued in favor of an alternative approach may serve to resolve many aspects of these debates. Purdue (1987) and Reitz et al. (1987) have suggested that body weight and usable meat estimates are more accurate if derived from the bone dimensions of the archaeological specimens themselves.

Examination of Table 48 suggests that the elk, deer, bighorn, bear, coyote, cottontails, and black-tailed jack rabbits contributed the greatest quantities of meat to the prehistoric diet. However, it is important to point out that conclusions based on meat weight estimates for the Shoofly Village archaeological fauna are rather tenuous because most taxa with high mean live weights are represented by only a single bone specimen. It is not clear whether only parts of these animals were consumed, other elements were simply not recovered, or bones were lost because of the "schlepp effect" (Daly 1969). The results of the meat weight method may be further distorted by the inclusion of species sought for non-meat products. The single bighorn specimen, for example, may result from prehistoric processing of the horn core into keratin mastic rather than procurement for meat protein.

Animal Procurement Patterns

Empirical data of animal resources from Shoofly Village indicate that most taxa could have been procured while hunting or collecting within a short distance (less than 5 km) of the site. All but seven of the taxa represented in the archaeological fauna currently inhabit either grassland, chaparral, or pinyon-juniper habitats near the site.

Taxa recovered from the site are not restricted to the Payson region. As described in Chapter Five, many of these animals are distributed throughout large areas of the Southwest. While most of the archaeological taxa could have been procured within a short distance of the site, they could also have been hunted or collected in more removed areas.

The relative frequency of identifiable body parts for artiodactyls suggests that these taxa were procured locally. Preliminary butchering practices reflect the costs of transporting animal carcasses from kill locations to habitation sites. In general, animals taken at kill sites which are distant from habitation sites will be butchered and only choice cuts transported. Procurement of animals from predominantly distant areas will tend to produce an archaeological fauna consisting of a relatively high percentage of major limb elements (Bayham 1977; Driver 1985; Glass 1984; Szuter 1984b).

As shown in Table 49, identifiable artiodactyl specimens from Shoofly Village include cranial, axial, and appendicular elements. Several elements which would be expected to be left at distant kill sites, such as the vertebrae and ribs, are well-represented at Shoofly Village. This pattern is suggestive of generally local artiodactyl procurement, where the whole carcass is carried back to, and butchered at, the habitation site.

Table 49. Relative Frequencies of Identifiable Elements for Artiodactyls and Lagomorphs[a].

	ARTIODACTYLA		COTTONTAIL		JACKRABBIT	
ELEMENT	N	%	N	%	N	%
Antler/Horn	23	(6.8)	-	-	-	-
Crania[b]	73	(21.7)	36	(17.2)	3	(3.0)
Vertebrae	46	(13.7)	23	(11.0)	9	(9.1)
Ribs/Sternum	16	(4.8)	1	(0.5)	6	(6.1)
Scapulae	5	(1.5)	3	(1.4)	3	(3.0)
Forelimbs[c]	29	(8.6)	42	(20.1)	30	(30.3)
Innominates	26	(7.7)	34	(16.3)	6	(6.1)
Hindlimbs[d]	25	(7.4)	45	(21.5)	25	(25.3)
Metapodials	19	(5.7)	6	(2.9)	5	(5.1)
Tarsals, Carpals, and Phalanges	74	(22.0)	19	(9.1)	12	(12.1)
TOTALS	336	(99.9)	209	(100.0)	99	(100.1)

[a] Figures do not include sesamoids and long bone fragments. In the table "N" refers to the number of specimens. Percentages ("%") are derived from the number of specimens for each element divided by the total number of specimens.

[b] The crania category includes crania, mandibles, and teeth.

[c] The forelimbs category includes humeri, radii, and ulnae.

[d] The hindlimbs category includes femora and tibiae.

The pattern of identifiable artiodactyl elements from Shoofly Village contrasts with that reported for many Southwestern sites. A predominance of appendicular elements has been noted at several Southwestern sites, including Arroyo Hondo, the Copper Basin project, Snaketown, and TEP St. Johns sites. The over-representation of limb elements at these sites probably indicates that preliminary butchering took place away from the habitation site (Bayham 1977; Czaplicki 1981; Greene and Matthews 1976; Lang and Harris 1984).

The pattern of artiodactyl elements at Shoofly Village also differs from that reported for many peripheral Hohokam sites. New River and Salt-Gila Aqueduct sites are characterized by a high percentage of low-meat bearing elements (e.g., crania, vertebrae, ribs). Bayham and Hatch (1984) have postulated that the high proportion of low-meat bearing elements at peripheral Hohokam sites in the New River area reflects part of a widespread system of artiodactyl utilization. They hypothesize that anatomical parts with high muscle portions (e.g., hindlimbs and forelimbs) will be most prevalent at major Hohokam sites and absent at peripheral settlements. Data from New River and Salt-Gila Aqueduct sites, as well as from Snaketown, conform to their model (Bayham and Hatch 1985; Szuter 1984b).

The preliminary butchering and procurement pattern for artiodactyls at Shoofly Village most closely resembles that described for the Fitzmaurice Ruin (near Prescott, Arizona) and several Hohokam sites in the Anamax-Roosevelt project. Elements representing all artiodactyl body portions are present at these sites. It is probable that the entire carcass was transported from kill to habitation areas and that butchering took place at the habitation site (Bayham 1977; Douglas and Whitman 1974; Glass 1984).

The element frequencies between cottontails and jack rabbits are quite different. Elements from cottontails, as with artiodactyls, represent all major body portions. The relative absence of ribs, scapulae, and metapodials may relate to the butchering or food preparation practices, bone density, or recovery and identification rates. In general, the relative frequencies of cottontail elements are consistent with local procurement; with butchering and processing executed at Shoofly Village.

Element frequencies for jack rabbits are more difficult to interpret. As shown in Table 49, there is a dramatic over-representation of limb elements. This pattern is expected if preliminary butchering took place away from the habitation site. It is also possible, though unsubstantiated, that appendicular and axial body portions from jack rabbits were prepared, consumed, or disposed in different fashions and that axial portions were destroyed, discarded elsewhere, or not recovered during excavation.

As indicated earlier, seven taxa recovered from Shoofly Village represent faunal resources which probably do not inhabit nearby grassland, chaparral, and/or pinyon-juniper ecological communities. These are: mud turtle; mallard; elk; Abert's squirrel; antelope jack rabbit; western box turtle; and bushy-tailed wood rat. Five taxa (mud turtle, mallard, elk, Abert's squirrel, antelope jack rabbit) may indicate exploitation of, and animal procurement in, additional environmental zones by the prehistoric inhabitants of the site. The other two species likely represent problems in the current zoogeographic literature or with taxonomic classification.

Mud turtle and mallard elements at Shoofly Village indicate prehistoric procurement of animals from nearby riparian areas. The riparian or riverine habitat closest to the site is that of the East Verde river, located about 4.4 kilometers to the northwest. Mud turtles and mallards may have been procured fortuitously while getting water or during separate hunting trips. It should be noted, however, that the complete absence of fish and other riparian amphibians, reptiles, birds, or mammals in the faunal assemblage implies that riparian areas were not heavily exploited by people from Shoofly Village.

Remains from elk and Abert's squirrel suggest that either the prehistoric hunting territory included higher elevation areas above the Mogollon Rim, people at Shoofly

Village traded with other groups for these animals, or the distributions of these species has changed. Both taxa probably could have been encountered and procured by Shoofly hunters foraging, at a minimum, 18 km away from the site. It is noteworthy that the past distribution of elk is open to debate. Native elk (Cervus canadensis merriami) were exterminated from Arizona by the 1920s. All elk which currently inhabit the state (i.e., C. c. nelsoni) are derived from transplants from Yellowstone National Park (Hoffmeister 1986). The distribution and habitat preferences of the native form may have differed from that presently exhibited by the transplanted subspecies.

Antelope jack rabbit elements from the site may indicate prehistoric exploitation of some animal resources from distant environments. As reported in Chapter Five, the modern range of antelope jack rabbits does not include the Shoofly area. The closest historical record of the species is at least 90 km to the south of the Payson area. While the presence of this taxa is suggestive of long-distance hunting expeditions or trade for meat or animal products with populations to the south, it is also possible that: there has been a change in the distribution of the species (and possibly the Payson area environment) within the last 800 years; published distributions are in error; or the specimens were not identified correctly.

Elements from two taxa, the western box turtle and bushy-tailed wood rat, also represent species which have not been reported in the Payson region. However, for reasons specified below, I do not believe that these animals reflect the procurement activities of the prehistoric inhabitants of Shoofly Village.

Bushy-tailed wood rats presently inhabit northwestern Arizona and the Kaibab Plateau. Although it is possible that the species was procured from these areas and transported to the site, or that its distribution has changed during the past 800 years, it is more likely that the specimens were misidentified. As Harris (1984) has reported, criteria used to distinguish different Neotoma species occasionally fail to identify the correct taxon.

The western box turtle specimen recovered from Shoofly Village would also seem to signify procurement of animals from areas outside central Arizona. Lowe (1964a) has reported that its current distribution is limited to grasslands in the southern portion of the state, primarily in Cochise and Pima counties. However, living box turtles were observed on the site by me and others during both the 1984 and 1985 field seasons. This seems to indicate an error in the published zoogeographic ranges for the taxa.

The empirical data on faunal resources at Shoofly Village indicate that the site's occupants primarily relied on animal procurement from nearby grassland, chaparral, and pinyon-juniper communities. Figure 4 depicts aspects of this procurement pattern. Most taxa could have been taken within 5 km of the site. Elk, Abert's squirrel, mallard, mud turtle, and antelope jack rabbit specimens suggest additional hunting and faunal collection in areas up to 90 km distant from the site.

Bone Tool Assemblage

The bone tool assemblage reveals that the prehistoric inhabitants of Shoofly Village used animal bones in a variety of cultural activities. As shown in Chapter Six, the most common bone artifacts from the site were fine-pointed and blunt-tipped cut awls, which were probably used in sewing and the making of basketry. The abundance of bone scrapers and blunt-tipped awls is the first archaeological evidence which suggests that hide-working was an important aspect of life at the site.

The bone and antler artifacts confirm the relative importance of artiodactyls and deer for the prehistoric inhabitants of Shoofly Village. Medium-large mammal bones, probably from deer, were the most common elements (87.5% of the assemblage) used in manufacturing bone artifacts. Cottontail-sized mammals (identified for 2 artifacts) and coyote (1) are also represented within the

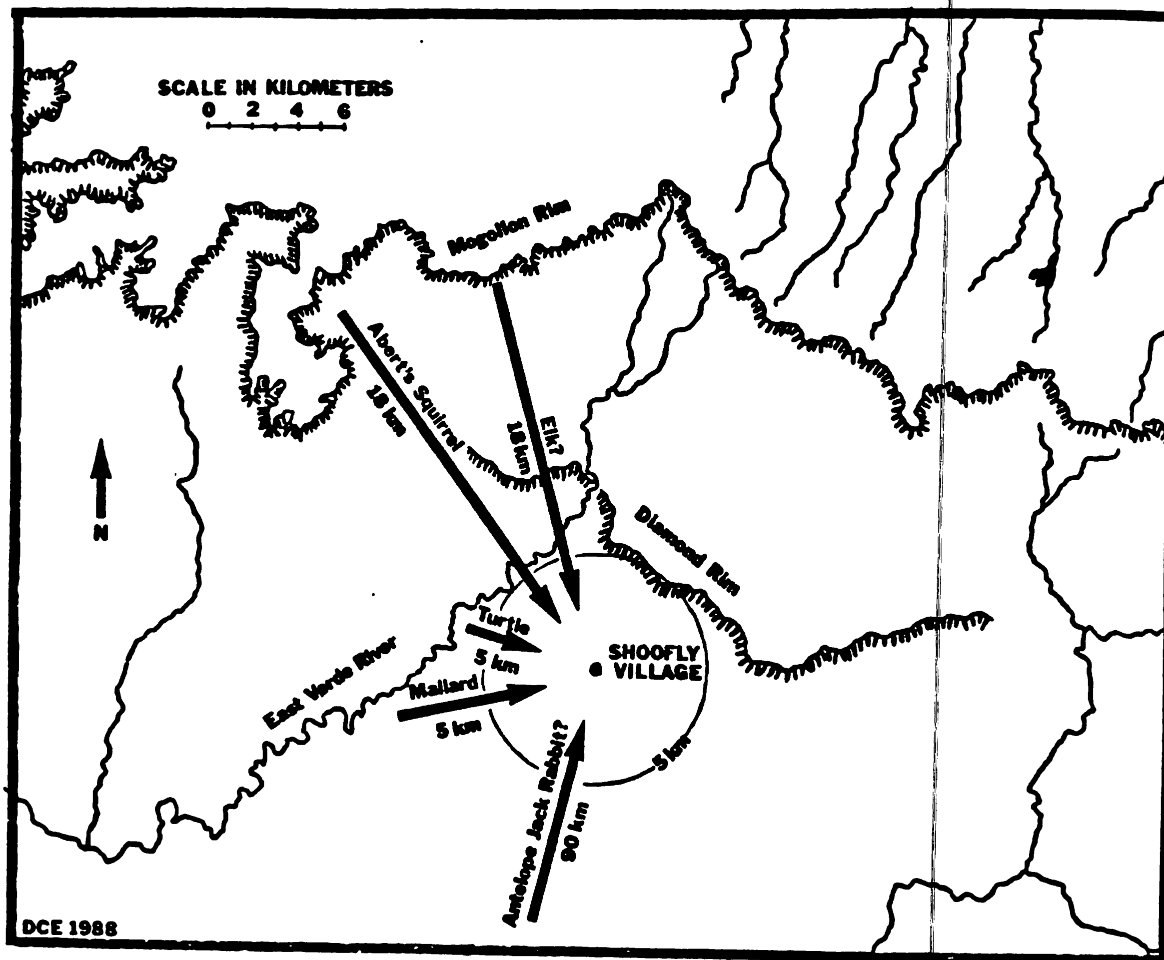

Figure 4. Origin of fauna recovered from Shoofly Village (adapted from Shotts 1984).

artifact assemblage.

One interesting feature of the Shoofly Village bone tools is the prevalence of burnt tool fragments. While it is possible that tools were burnt in unintentional and catastrophic fires at the pueblo, it is also feasible that tools were intentionally burnt by Shoofly's inhabitants as they became broken.

The bone tool assemblage from Shoofly Village is similar to those reported for many prehistoric North American and Southwestern sites. Cut awls, bone rings, and antler tine flakers are rather ubiquitous in North American archaeological sites and probably originated during the Upper Paleolithic when bone manufacturing techniques were invented (S. L. Olsen 1979). The larger blunt-tipped cut awls from Shoofly Village are reminiscent of the hairpins described at several Southwestern sites, including Arroyo Hondo, Awatovi, Grasshopper, and Kinishba (Beach and Causey 1984; S. L. Olsen 1979, 1980; Wheeler 1978).

The presence of two perforated antler artifacts provides a tentative link with the prehistoric Western Pueblos. Perforated antlers are extremely rare artifacts and have only been recovered from Point of Pines, Kinishba, Grasshopper, and a few smaller sites in eastern Arizona. Neither Hohokam or Anasazi sites have produced these artifacts (S. L. Olsen 1979, 1980).

The most unusual bone artifact recovered from Shoofly

Village is a perforated deer scapula. The precise use or function of this artifact remains something of a mystery. It does not resemble the scapular pendants, disks, or tools described for other North American archaeological sites. Instead, the perforated scapula appears to be unique to Shoofly Village.

Conclusions and Suggestions for Future Research

As is the case for many Southwestern sites, the faunal assemblage from Shoofly Village is dominated by artiodactyl and lagomorph remains. Artiodactyls outnumber cottontails, jack rabbits, or rodents. This may indicate that deer and allied species were the primary hunted resources. The prevalence of cottontails, as opposed to jack rabbits, suggests that the site vicinity was dominated by brush and cover during the period of occupation.

It is clear that many of the animal bones recovered from Shoofly Village were generated by natural or physical agencies, rather than cultural activities. Various taphonomic, zoogeographic, ethnographic, and archaeological data indicated that approximately 42% of the species (and 80% of the small animal taxa) are probably intrusive to the site.

Taxa which are likely to have resulted from cultural activities include: mud turtle; black-tailed jack rabbit; antelope jack rabbit; cottontail; Abert's squirrel; black bear; elk; deer; and bighorn. The cultural status of coyote and wood rat remains is more questionable. The predominance of avian wing elements suggests that birds may have been collected for their plumage, as well as for meat. There is no evidence supporting domestication of dogs or turkeys at Shoofly Village.

A high percentage (44.1%) of the bone material from Shoofly Village has been burnt. Although specimens may have become burnt during roasting or cooking, while processing grease or marrow, or in catastrophic fires at the site, the high frequency of calcined bone and burnt elements from all major artiodactyl body portions is consistent with routine disposal of bones into a fire after food preparation or consumption.

Data concerning relative abundances and origins of the archaeological fauna imply that prehistoric (animal) subsistence activities at the site were focused primarily on artiodactyls and lagomorphs. The number of identifiable specimens recovered from Shoofly Village points to the economic importance of deer, cottontail, and black-tailed jack rabbit. Meat weight estimates suggest that elk, bear, deer, bighorn, coyote, cottontail, and black-tailed jack rabbit (in that order) were significant sources of meat protein for the inhabitants of the site.

Archaeological and zoogeographic data indicate that most animal resources were procured within a short distance of the site. All but seven taxa identified in the assemblage could have been encountered in nearby grassland, chaparral, and pinyon-juniper habitats, probably within 5 km of the site. The proportionate representation of artiodactyl body parts corroborates this pattern of local procurement of animal resources. Similar numbers of axial and appendicular elements suggest that entire artiodactyl carcasses were transported from kill locations to Shoofly Village and that butchering took place at the habitation site. The presence of several less-local species documents hunting and collecting activities in riparian areas, such as provided by the East Verde River, higher elevation environments on the Mogollon Plateau, and more arid territories to the south.

Clearly my research here does not exhaust the vast potential of faunal studies in reconstructing the economic practices of the prehistoric inhabitants of Shoofly Village or the Payson region. Future research, addressing other data sets, will permit consideration of additional problem areas and topics. Perhaps the most important development would be to establish an understanding of the relationship between the various excavation units and stratigraphic contexts within the site. Given this kind of information, future faunal analyses would be able to address intrasite economic behavior and changes in economic practices and environmental conditions over time. Applications along these lines in other areas in the Southwest have yielded significant insights into site activity areas, changes in hunting behavior, environmental degradation, and subsistence stress (e.g., Bayham and Hatch 1985; Lang and Harris 1984; J. Olsen 1980)

Another area for future consideration relates to the fact that the conclusions of my study must be tempered against the realization that animal remains represent a small portion of the subsistence and economic activities which took place at the site. Information from other data sets could be used to develop a deeper understanding of the nature of, and interactions within, the prehistoric economy. I hope that the completion of on-going ethnobotanical and pollen research will permit a more comprehensive appraisal of the Shoofly Village economic system and its relationship to systems elsewhere in the Southwest.

Finally, the results of the Shoofly Village faunal analysis need to be integrated with those from several contemporaneous small sites within the Payson area. Recent contract investigations of these sites suggest that Shoofly Village is only part of a larger subsistence-settlement system (e.g., Redman and Hohmann 1985). Correlation of faunal assemblages from all Payson-area sites, including Shoofly Village, may produce a more general model for economic behavior in this portion of central Arizona.

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APPENDIX ONE

FLOTATION SAMPLE FAUNAL REMAINS

APPENDIX ONE. FLOTATION SAMPLE FAUNAL REMAINS.

(Common and Scientific Names)

REPTILIA	Reptiles
Sauria	
Iguanidae	
Crotaphytus cf. C. collaris Say	cf. Collared Lizard
MAMMALIA	Mammals
Lagomorpha	
Leporidae	
Sylvilagus species indeterminata	Cottontail
Rodentia	
Cricetidae	
Peromyscus cf. P. eremicus (Baird)	cf. Cactus Mouse
Neotoma species indeterminata	Wood Rat
Neotoma albigula Hartley	White-throated Wood Rat

APPENDIX ONE. FLOTATION SAMPLE FAUNAL REMAINS.

(Quantitative Summary)

	NISP	% NISP	MNI	% MNI
REPTILIA				
Sauria				
Iguanidae				
Crotaphytus cf. *C. collaris* Say	1	.0020	1	.2500
MAMMALIA				
Lagomorpha	1	.0020	-	-
Leporidae				
Sylvilagus species indeterminata	4	.0080	1	.2500
Rodentia	1	.0020	-	-
Cricetidae				
Peromyscus cf. *P. eremicus* (Baird)	2	.0040	1	.2500
Neotoma species indeterminata	1	.0020	-	-
Neotoma albigula Hartley	1	.0020	1	.2500
SUB-TOTAL	11	.0221	4	1.0000
Indeterminate				
Indeterminate				
Small	208	.4185	-	-
Small-Medium	62	.1247	-	-
Medium-Large	4	.0080	-	-
Birds				
Small	2	.0040	-	-
Small-Medium	1	.0020	-	-
Mammals				
Small	16	.0322	-	-
Small-Medium	146	.2938	-	-
Medium	38	.0765	-	-
Medium-Large	9	.0181	-	-
SUB-TOTAL	486	.9779	-	-
TOTAL	497	1.0000	4	1.0000

APPENDIX TWO

CODING FORMAT

APPENDIX TWO. CODING FORMAT.

Variable Number	Variable	Values	Number of Columns
1	EAST	Unit specific	3
2	NORTH	Unit specific	3
3	LEVEL	Unit specific	2
4	LOCUS	Unit specific	2
5	SPECIMEN NO.	1-99,999	5
6	CLASS	0 - Unknown	1
		1 - Osteichthyes	
		2 - Amphibia	
		3 - Reptilia	
		4 - Aves	
		5 - Mammalia	
7	ORDER	See "Taxonomic Codes"	2
8	FAMILY	See "Taxonomic Codes"	2
9	GENUS	See "Taxonomic Codes"	2
10	SPECIES	See "Taxonomic Codes"	2
11	CONFIDENCE	0 - strong	1
		1 - compares with	
		2 - questionable	
12	SIZE	0 - Unknown	1
		1 - Small	
		2 - Small-Medium	
		3 - Medium	
		4 - Medium-Large	
		5 - Large	
13	SIDE	0 - Unknown	1
		1 - Right	
		2 - Left	
		3 - Axial	
		4 - Fused right and left	
14	BODY PART	See "Body Part Codes"	2
15	PORTION	0 - Unknown	2
		1 - Complete	
		2 - Proximal	
		3 - Distal	
		4 - Shaft	
		5 - Anterior	
		6 - Posterior	
		7 - Middle/Medial	
		8 - Lateral	
		9 - Fragment	
16	PERCENTAGE	0 - Unknown	2
		1-98 - Percentage	
		99 - Complete	
17	FUSION	0 - Unknown	1
		1 - Fused	
		2 - Epiphyseal lines	
		3 - Unfused	

APPENDIX TWO. CODING FORMAT (Continued).

Variable Number	Variable	Values	Number of Columns
18	BURNING	0 - Not burnt 1 - Brown-black scorched 2 - Calcined	1
19	BUTCHERING MARKS	0 - Absent 1 - Present	1
20	SPIRAL FRACTURE	0 - Absent 1 - Present	1
21	WEATHERING	0 - Good condition 1 - Slightly weathered 2 - Heavily weathered	1
22	RODENT GNAWING	0 - Absent 1 - Present	1
23	CARNIVORE CHEWING	0 - Absent 1 - Present	1
24	BREAKAGE	0 - No breaks 1 - Old breaks 2 - Fresh breaks 3 - Old and fresh breaks	1
25	NUMBER OF FRAGMENTS	1-999	3
26	FLOTATION	0 - Excavated 1 - Flotation sample	1
27	COMMENTS		

APPENDIX THREE

TAXONOMIC CODES

APPENDIX THREE. TAXONOMIC CODES.

CLASS UNKNOWN	0 00 00 00 00
CLASS OSTEICHTHYES	1 00 00 00 00
Order Clupeiformes	1 01 00 00 00
Family Clupeidae	1 01 01 00 00
Dorosoma sp.	1 01 01 01 00
D. petenense	01
Order Salmoniformes	1 02 00 00 00
Family Salmonidae	1 02 01 00 00
Salmo sp.	1 02 01 01 00
S. gilae	01
S. clarki	02
S. gairdneri	03
S. trutta	04
S. fontinalis	05
Oncorhynchus sp.	1 02 01 02 00
O. nerka	01
Thymallus sp.	1 02 01 03 00
T. arcticus	01
Order Cypriniformes	1 03 00 00 00
Family Cyprindae	1 03 01 00 00
Cyprinus sp.	1 03 01 01 00
C. carpio	01
Carassius sp.	1 03 01 02 00
C. auratus	01
Notemigonus sp.	1 03 01 03 00
N. crysoleucas	01
Gila sp.	1 03 01 04 00
G. atraria	01
G. robusta	02
G. cypha	03
G. purpurea	04
G. ditaenia	05
G. copei	06
Ptychocheilus sp.	1 03 01 05 00
P. lucius	01
Rhinichthys sp.	1 03 01 06 00
R. osculus	01
Agosia sp.	1 03 01 07 00
A. chrysogaster	01
Tiaroga sp.	1 03 01 08 00
T. cobitis	01
Notropis sp.	1 03 01 09 00
N. mearnsi	01
N. lutrensis	02
N. stramineus	03
Pimephales sp.	1 03 01 10 00
P. promelas	01
Campostoma sp.	1 03 01 11 00
C. ornatum	01
Lepidomeda sp.	1 03 01 12 00
L. mollispinis	01
L. vittata	02
Meda sp.	1 03 01 13 00
M. fulgida	01
Plagopterus sp.	1 03 01 14 00
P. argentissimus	01
Family Catostomidae	1 03 02 00 00
Ictiobus sp.	1 03 02 01 00
I. cyprinellus	01
Carpiodes sp.	1 03 02 02 00
C. cyprinus	01
Catostomus sp.	1 03 02 03 00
C. insignis	01
C. bernardini	02
C. latipinnis	03
Pantosteus sp.	1 03 02 04 00
P. clarki	01
P. delphinus	02
Xyrauchen texanus	1 03 02 05 00
X. texanus	01
Order Siluriformes	1 04 00 00 00
Family Ictaluridae	1 04 01 00 00
Ictalurus sp.	1 04 01 01 00
I. punctatus	01
I. pricei	02
I. melas	03
I. nebulosus	04
I. natalis	05
Pylodictis sp.	1 04 01 02 00
P. olivaris	01
Order Atheriniformes	1 05 00 00 00
Family Cyprinodontidae	1 05 01 00 00
Fundulus sp.	1 05 01 01 00
F. zebinus	01
Cyprinodon sp.	1 05 01 02 00
C. macularius	01

APPENDIX THREE. TAXONOMIC CODES (Continued).

Family Poeciliidae	1 05 02 00 00
Gambusia sp.	1 05 02 01 00
G. affinis	01
Poeciliopsis sp.	1 05 02 02 00
P. occidentalis	01
P. sonoriensis	02
Order Periformes	1 06 00 00 00
Family Serranidae	1 06 01 00 00
Roccus sp.	1 06 01 01 00
R. mississippiensis	01
R. saxatilis	02
R. chrysops	03
Family Centrarchidae	1 06 02 00 00
Micropterus sp.	1 06 02 01 00
M. dolomieui	01
M. punctulatus	02
M. salmoides	03
Ambloplites sp.	1 06 02 02 00
A. rupestris	01
Chaenobryttus sp.	1 06 02 03 00
C. gulosus	01
Lepomis sp.	1 06 02 04 00
L. macrochirus	01
L. microlophus	02
L. cyanellus	03
Pomoxis sp.	1 06 02 05 00
P. annularis	01
P. nigromaculatus	02
Family Pereidae	1 06 03 00 00
Perca sp.	1 06 03 01 00
P. flavescens	01
Family Mugilidae	1 06 04 00 00
Mugil sp.	1 06 04 01 00
M. cephalus	01
Family Cottidae	1 06 05 00 00
Cottus sp.	1 06 05 01 00
C. bairdi	01
Family Eleotridae	1 06 06 00 00
Eleotris sp.	1 06 06 01 00
E. picta	01
CLASS AMPHIBIA	2 00 00 00 00
Order Caudata	2 01 00 00 00
Family Ambystomidae	2 01 01 00 00
Ambystoma sp.	2 01 01 01 00
A. tigrinum	01
Order Salientia	2 02 00 00 00
Family Pelobatidae	2 02 01 00 00
Scaphiopus	2 02 01 01 00
S. couchi	01
S. bombifrons	02
S. intermontanus	03
S. hammondi	04
Family Leptodactylidae	2 02 02 00 00
Eleutherodactylus sp.	2 02 02 01 00
E. augusti	01
Family Bufonidae	2 02 03 00 00
Bufo sp.	2 02 03 01 00
B. alvarius	01
B. woodhousei	02
B. microscaphus	03
B. cognatus	04
B. punctatus	05
B. debilis	06
B. retiformis	07
Family Hylidae	2 02 04 00 00
Pternohyla sp.	2 02 04 01 00
P. jodiens	01
Hyla sp.	2 02 04 02 00
H. wrightorum	01
H. arenicolor	02
Pseudacris sp.	2 02 04 03 00
P. nigrita	01
Family Microhylidae	2 02 05 00 00
Gastrophryne sp.	2 02 05 01 00
G. carolinensis	01
G. olivacea	02
Family Ranidae	2 02 06 00 00
Rana sp.	2 02 06 01 00
R. catesbeiana	01
R. tarahumarae	02
R. pipiens	03

APPENDIX THREE. TAXONOMIC CODES (Continued).

CLASS REPTILIA	3 00 00 00 00
Order Chelonia	3 01 00 00 00
Family Kinosternidae	3 01 01 00 00
Kinosternon sp.	3 01 01 01 00
K. flavescens	01
K. sonoriense	02
Family Emydidae	3 01 02 00 00
Terrapene sp.	3 01 02 01 00
T. ornata	01
Family Testudinidae	3 01 03 00 00
Gopherus sp.	3 01 03 01 00
G. agassizi	01
Family Trionychidae	3 01 04 00 00
Trionyx sp.	3 01 04 01 00
T. spinifera	01
Order Sauria	3 02 00 00 00
Family Helodermatidae	3 02 01 00 00
Heloderma sp.	3 02 01 01 00
H. suspectum	01
Family Gekkonidae	3 02 02 00 00
Colenyx sp.	3 02 02 01 00
C. variegatus	01
Family Iguanidae	3 02 03 00 00
Dipsosaurus sp.	3 02 03 01 00
D. dorsalis	01
Crotaphytus sp.	3 02 03 02 00
C. collaris	01
Gambelia sp.	3 02 03 03 00
G. wislizeni	01
Sauromalus sp.	3 02 03 04 00
S. obesus	01
Holbrookia sp.	3 02 03 05 00
H. maculata	01
H. elegans	02
H. texana	03
Callisaurus sp.	3 02 03 06 00
C. draconoides	01
Uma sp.	3 02 03 07 00
U. notata	01
Sceloporus sp.	3 02 03 08 00
S. scalaris	01
S. jarrovi	02
S. undulatus	03
S. virgatus	04
S. clarki	05
S. magister	06
S. graciosus	07
Urosaurus sp.	3 02 03 09 00
U. graciosus	01
U. ornatus	02
Uta sp.	3 02 03 10 00
U. stansburiana	01
Phrynosoma sp.	3 02 03 11 00
P. douglassi	01
P. cornutum	02
P. modestum	03
P. solare	04
P. platyrhinos	05
P. m'calli	06
Family Xantusidae	3 02 04 00 00
Xantusia sp.	3 02 04 01 00
X. arizonae	01
X. vigilis	02
Family Scincidae	3 02 05 00 00
Eumeces sp.	3 02 05 01 00
E. callicephalus	01
E. multivirgatus	02
E. obsoletus	03
E. gilberti	04
E. skiltonianus	05
Family Teidae	3 02 06 00 00
Cnemidophorus sp.	3 02 06 01 00
C. burti	01
C. exsanguis	02
C. velox	03
C. arizonae	04
C. inornatus	05
C. tigris	06
Family Anguidae	3 02 07 00 00
Gerrhonotus sp.	3 02 07 01 00
G. kingi	01
Order Serpentes	3 03 00 00 00
Family Leptotyphlopidae	3 03 01 00 00
Leptotyphlops sp.	3 03 01 01 00
L. dulcis	01

APPENDIX THREE. TAXONOMIC CODES (Continued).

L. humilis	02
Family Boidae	3 03 02 00 00
Lichanura sp.	3 03 02 01 00
L. trivirgata	01
Family Colubridae	3 03 03 00 00
Natrix sp.	3 03 03 01 00
N. rufipunctatus	01
Thamnophis sp.	3 03 03 02 00
T. eques	01
T. cyrtopsis	02
T. marcianus	03
T. elegans	04
Heterodon sp.	3 03 03 03 00
H. nascius	01
Masticophis sp.	3 03 03 04 00
M. bilineatus	01
M. flagellum	02
M. taeniatus	03
Salvadora sp.	3 03 03 05 00
S. grahamiae	01
S. hexalepis	02
Elaphe sp.	3 03 03 06 00
E. triaspie	01
Diadophis sp.	3 03 03 07 00
D. punctatus	01
Pituophis sp.	3 03 03 08 00
P. melanoleucus	01
Arizona sp.	3 03 03 09 00
A. elegans	01
Rhinocheilus sp.	3 03 03 10 00
R. lecontei	01
Lampropeltis sp.	3 03 03 11 00
L. getulus	01
L. doliata	02
L. pyromelana	03
Phyllorhynchus	3 03 03 12 00
P. browni	01
P. decurtatus	02
Ficimia sp.	3 03 03 13 00
F. quadrangularis	01
F. cana	02
Sonora sp.	3 03 03 14 00
S. semiannulata	01
Chionactis sp.	3 03 03 15 00
C. occipitalis	01
C. palarostris	02
Chilomeniscus sp.	3 03 03 16 00
C. cinctus	01
Oxybelis sp.	3 03 03 17 00
O. aeneus	01
Trimorphodon sp.	3 03 03 18 00
T. lyrophanes	01
Hypsiglena sp.	3 03 03 19 00
H. torquata	01
Tantilla sp.	3 03 03 20 00
T. nigriceps	01
T. atriceps	02
T. wilcoxi	03
Family Elapidae	3 03 04 00 00
Micruroides sp.	3 03 04 01 00
M. euryxanthus	01
Family Crotalidae	3 03 05 00 00
Sistrurus sp.	3 03 05 01 00
S. catenatus	01
Crotalus sp.	3 03 05 02 00
C. atrox	01
C. molossus	02
C. scutulatus	03
C. mitchelli	04
C. tigris	05
C. viridis	06
C. lepidus	07
C. pricei	08
C. willardi	09
C. cerastes	10
CLASS AVES	4 00 00 00 00
Order Gaviiformes	4 01 00 00 00
Family Gaviidae	4 01 01 00 00
Gavia sp.	4 01 01 01 00
G. immer	01
G. arctica	02
G. stella	03
Order Podicidipediformes	4 02 00 00 00
Family Podicipedidae	4 02 01 00 00
Podiceps sp.	4 02 01 01 00
P. auritus	01
P. caspicus	02
P. dominicus	03
Aechmophorus sp.	4 02 01 02 00
A. occidentalis	01
Podilymbus sp.	4 02 01 03 00

APPENDIX THREE. TAXONOMIC CODES (Continued).

P. podiceps	01
Order Pelecaniformes	4 03 00 00 00
Family Phaethontidae	4 03 01 00 00
Phaethon sp.	4 03 01 01 00
P. aethereus	01
Family Pelecanidae	4 03 02 00 00
Pelecanus sp.	4 03 02 01 00
P. erythrorhynchos	01
P. occidentalis	02
Family Sulidae	4 03 03 00 00
Sula sp.	4 03 03 01 00
S. nebouxii	01
S. leucogaster	02
Family Phalacrocoracidae	4 03 04 00 00
Phalacrocorax sp.	4 03 04 01 00
P. auritus	01
P. olivaceus	02
Family Anhingidae	4 03 05 00 00
Anhinga sp.	4 03 05 01 00
A. anhinga	01
Family Fregatidae	4 03 06 00 00
Fregata sp.	4 03 06 01 00
Order Ciconiiformes	4 04 00 00 00
Family Ardeidae	4 04 01 00 00
Ardea sp.	4 04 01 01 00
A. herodias	01
Butorides sp.	4 04 01 02 00
B. virescens	01
Florida sp.	4 04 01 03 00
F. caerulea	01
Dichromanassa sp.	4 04 01 04 00
D. rufescens	01
Casmerodius sp.	4 04 01 05 00
C. albus	01
Leucophoyx sp.	4 04 01 06 00
L. thula	01
Hydranassa sp.	4 04 01 07 00
H. tricolor	01
Nycticorax sp.	4 04 01 08 00
N. nycticorax	01
Nyctanassa sp.	4 04 01 09 00
N. violacea	01
Ixobrychus sp.	4 04 01 10 00
I. exilis	01
Botauras sp.	4 04 01 11 00
B. lentiginosus	01
Family Cicontidae	4 04 02 00 00
Mycteria sp.	4 04 02 01 00
M. americana	01
Family Threskiornithidae	4 04 03 00 00
Plegadis sp.	4 04 03 01 00
P. chihi	01
Eudocimus sp.	4 04 03 02 00
E. albus	01
E. ruber	02
Ajaia sp.	4 04 03 03 00
A. ajaja	01
Order Anseriformes	4 05 00 00 00
Family Anatidae	4 05 01 00 00
Olor sp.	4 05 01 01 00
O. columbianus	01
Branta sp.	4 05 01 02 00
B. canadensis	01
Anser sp.	4 05 01 03 00
A. albifrons	01
Chen sp.	4 05 01 04 00
C. hyperborea	01
C. caerulescens	02
C. rossii	03
Dendrocygna sp.	4 05 01 05 00
D. autumnalis	01
D. bicolor	02
Anas sp.	4 05 01 06 00
A. platyrhynchos	01
A. dinsi	02
A. strepera	03
A. acuta	04
A. crecca	05
A. carolinensis	06
A. discors	07
A. cyanoptera	08
Mareca sp.	4 05 01 07 00
M. penelope	01
M. americana	02
Spatula sp.	4 05 01 08 00
S. clypeata	01
Aix sp.	4 05 01 09 00

APPENDIX THREE. TAXONOMIC CODES (Continued).

A. sponsa	01
Aythya sp.	4 05 01 10 00
A. americana	01
A. collaris	02
A. valisineria	03
A. marila	04
A. affinis	05
Bucephala sp.	4 05 01 11 00
B. clangula	01
B. islandica	02
B. albeola	03
Clanguala sp.	4 05 01 12 00
C. hyemalis	01
Melanitta sp.	4 05 01 13 00
M. perspicillata	01
Oxyura sp.	4 05 01 14 00
O. jamaicensis	01
Lophodytes sp.	4 05 01 15 00
L. cucullatus	01
Mergus sp.	4 05 01 16 00
M. merganser	01
M. serrator	02
Order Falconiformes	4 06 00 00 00
Family Cathartidae	4 06 01 00 00
Cathartes sp.	4 06 01 01 00
C. aura	01
Coragyps sp.	4 06 01 02 00
C. atratus	01
Gymnogyps sp.	4 06 01 03 00
G. californianus	01
Family Accipitridae	4 06 02 00 00
Accipiter sp.	4 06 02 01 00
A. gentilis	01
A. striatus	02
A. cooperii	03
Buteo sp.	4 06 02 02 00
B. jamaicensis	01
B. harlani	02
B. lineatus	03
B. platypterus	04
B. swainsoni	05
B. albonotatus	06
B. albicaudatus	07
B. lagopus	08
B. regulis	09
B. nitidus	10
Parabuteo sp.	4 06 02 03 00
P. unicinctus	01
Buteogallus sp.	4 06 02 04 00
B. anthracinus	01
Aquila sp.	4 06 02 05 00
A. chrysaetos	01
Haliaeetus sp.	4 06 02 06 00
H. leucocephalus	01
Circus sp.	4 06 02 07 00
C. cyaneus	01
Family Panionidae	4 06 03 00 00
Pandiona sp.	4 06 03 01 00
P. haliaetus	01
Family Falconidae	4 06 04 00 00
Caracara sp.	4 06 04 01 00
C. cheriway	01
Falco sp.	4 06 04 02 00
F. mexicanus	01
F. peregrinus	02
F. femoralis	03
F. columbarius	04
F. sparverius	05
Order Gruiformes	4 07 00 00 00
Family Gruidae	4 07 01 00 00
Grus sp.	4 07 01 01 00
G. canadensis	01
Family Rallidae	4 07 02 00 00
Rallus sp.	4 07 02 01 00
R. longirostris	01
R. limicola	02
Porzana sp.	4 07 02 02 00
P. carolina	01
Coturnicops sp.	4 07 02 03 00
C. noveboracensis	01
Laterallus sp.	4 07 02 04 00
L. jamaicensis	01
Porphyrula sp.	4 07 02 05 00
P. martinica	01
Gallinula sp.	4 07 02 06 00
G. chloropus	01
Fulica sp.	4 07 02 07 00
F. americana	01
Order Charadriiformes	4 08 00 00 00
Family Charadriidae	4 08 01 00 00

APPENDIX THREE. TAXONOMIC CODES (Continued).

Charadrius sp.	4 08 01 01 00
C. semipalmatus	01
C. alexandrinus	02
C. vociferus	03
Eupoda sp.	4 08 01 02 00
E. montana	01
Pluvialis sp.	4 08 01 03 00
P. dominica	01
Squatarola sp.	4 08 01 04 00
S. squatarola	01
Arenaria sp.	4 08 01 05 00
A. interpres	01
A. melanocephala	02
Family Scolopacidae	4 08 02 00 00
Capella sp.	4 08 02 01 00
C. gallinago	01
Numenius sp.	4 08 02 02 00
N. americanus	01
N. phaeopus	02
Bartramia sp.	4 08 02 03 00
B. longicauda	01
Actitis sp.	4 08 02 04 00
A. macularia	01
Tringa sp.	4 08 02 05 00
T. solitaria	01
Catoptrophorus sp.	4 08 02 06 00
C. semipalmatus	01
Totanus sp.	4 08 02 07 00
T. melanoleucus	01
T. flavipes	02
Calidris sp.	4 08 02 08 00
C. canutus	01
Erolia sp.	4 08 02 09 00
E. melanotos	01
E. bairdii	02
E. minutilla	03
E. alpina	04
Limnodromus sp.	4 08 02 10 00
L. griseus	01
L. scolopaceus	02
Micropalama sp.	4 08 02 11 00
M. himantopus	01
Ereunetes sp.	4 08 02 12 00
E. pusillus	01
E. mauri	02
Limosa sp.	4 08 02 13 00
L. fedoa	01
Crocethia sp.	4 08 02 14 00
C. alba	01

Family Recurvirostridae	4 08 03 00 00
Recurvirostra sp.	4 08 03 01 00
R. americana	01
R. mexicanus	02
Family Phalaropodidae	4 08 04 00 00
Phalaropus sp.	4 08 04 01 00
P. fulicarius	01
Steganopus sp.	4 08 04 02 00
S. tricolor	01
Lobipes sp.	4 08 04 03 00
L. lobatus	01
Family Stercorariidae	4 08 05 00 00
Stercorarius sp.	4 08 05 01 00
S. pomarinus	01
S. parasiticus	02
Family Laridae	4 08 06 00 00
Larus sp.	4 08 06 01 00
L. glaucescens	01
L. occidentalis	02
L. argentatus	03
L. californicus	04
L. delawarensis	05
L. pipixcan	06
L. atricilla	07
L. philadelphia	08
L. heermanni	09
Xema sp.	4 08 06 02 00
X. sabini	01
Gelochelidon sp.	4 08 06 03 00
G. nilotica	01
Sterna sp.	4 08 06 04 00
S. forsteri	01
S. hirundo	02
S. albifrons	03
Hydroprogne sp.	4 08 06 05 00
H. caspia	01
Chlidonias sp.	4 08 06 06 00
C. niger	01
Order Columbiformes	4 09 00 00 00
Family Columbidae	4 09 01 00 00
Columba sp.	4 09 01 01 00
C. fasciata	01
Zenaida sp.	4 09 01 02 00
Z. asiatica	01
Zenaidura sp.	4 09 01 03 00

APPENDIX THREE. TAXONOMIC CODES (Continued).

Z. macroura	01
Columbigallina sp.	4 09 01 04 00
C. passerina	01
Scardafella sp.	4 09 01 05 00
S. inca	01
Order Psittociformes	4 10 00 00 00
Family Psittacidae	4 10 01 00 00
Phynchopsitta sp.	4 10 01 01 00
P. pachyrhyncha	01
Order Cuculiformes	4 11 00 00 00
Family Cuculidae	4 11 01 00 00
Coccysus sp.	4 11 01 01 00
C. americanus	01
Geococcyx sp.	4 11 01 02 00
G. californianus	01
Crotophaga sp.	4 11 01 03 00
C. sulcirostris	01
Order Strigiformes	4 12 00 00 00
Family Tytonidae	4 12 01 00 00
Tyto sp.	4 12 01 01 00
T. alba	01
Family Strigidae	4 12 02 00 00
Otus sp.	4 12 02 01 00
O. asio	01
O. trichopsis	02
O. flammeolus	03
Bubo sp.	4 12 02 02 00
B. virginianus	01
Glaucidium sp.	4 12 02 03 00
G. gnoma	01
G. brasilianum	02
Micrathene sp.	4 12 02 04 00
M. whitneyi	01
Speotyto sp.	4 12 02 05 00
S. cunicularia	01
Strix sp.	4 12 02 06 00
S. occidentalis	01
Asio sp.	4 12 02 07 00
A. otus	01
A. flammeus	02
A. acadicus	03
Order Caprimulgiformes	4 13 00 00 00
Family Caprimulgidae	4 13 01 00 00
Caprimulgus sp.	4 13 01 01 00
C. vociferus	01
C. ridgwayi	02
Phalaenoptilus sp.	4 13 01 02 00
P. nuttallii	01
Chordeiles sp.	4 13 01 03 00
C. minor	01
C. acutipennis	02
Order Apodiformes	4 14 00 00 00
Family Apodidae	4 14 01 00 00
Cypseloides sp.	4 14 01 01 00
C. niger	01
Chaetura sp.	4 14 01 02 00
C. pelagica	01
C. vauxi	02
Aeronautes sp.	4 14 01 03 00
A. saxatilis	01
Family Trochilidae	4 14 02 00 00
Calothorax sp.	4 14 02 01 00
C. lucifer	01
Archilochus sp.	4 14 02 02 00
A. alexandri	01
Calypte sp.	4 14 02 03 00
C. costae	01
C. anna	02
Selasphorus sp.	4 14 02 04 00
S. platycerus	01
S. rufus	02
S. sasin	03
Atthis sp.	4 14 02 05 00
A. heloisa	01
Stellula sp.	4 14 02 06 00
S. calliope	01
Eugenes sp.	4 14 02 07 00
E. fulgens	01
Lampornis sp.	4 14 02 08 00
L. clemenciae	01
Amazilia sp.	4 14 02 09 00
A. verticalii	01
Hylocharis sp.	4 14 02 10 00
H. leucotis	01
Cynanthus sp.	4 14 02 11 00
C. latirostris	01
Order Trogoniformes	4 15 00 00 00

APPENDIX THREE. TAXONOMIC CODES (Continued).

Family Trogonidae	4 15 01 00 00
Trogon sp.	4 15 01 01 00
T. elegans	01
Order Coraciformes	4 16 00 00 00
Family Alcedinidae	4 16 01 00 00
Megaceryle sp.	4 16 01 01 00
M. alcyon	01
Order Piciformes	4 17 00 00 00
Family Picidae	4 17 01 00 00
Colaptes sp.	4 17 01 01 00
C. auratus	01
C. cafer	02
C. chrysoides	03
Dryocopus sp.	4 17 01 02 00
D. pileatus	01
Centurus sp.	4 17 01 03 00
C. carolinus	01
C. uropygialis	02
Melanerpes sp.	4 17 01 04 00
M. erthrocephalus	01
M. formicivorus	02
Asyndesmus sp.	4 17 01 05 00
A. lewis	01
Sphyrapicus sp.	4 17 01 06 00
S. varius	01
S. thyroideus	02
Dendrocopos sp.	4 17 01 07 00
D. villosus	01
D. pubescens	02
D. scalaris	03
D. nuttallii	04
D. arizonae	05
Picoides sp.	4 17 01 08 00
P. tridactylus	01
Order Passeriformes	4 18 00 00 00
Family Cotingidae	4 18 01 00 00
Platypsaris sp.	4 18 01 01 00
P. aglaiae	01
Family Tyrannidae	4 18 02 00 00
Tyrannus sp.	4 18 02 01 00

T. tyrannus	01
T. vociferans	02
T. verticalis	03
T. melancholicus	04
T. crassirostris	05
Muscivora sp.	4 18 02 02 00
M. forficata	01
Myiodynastes sp.	4 18 02 03 00
M. luteiventris	01
M. crinitus	02
M. tyrannulus	03
M. cinerascens	04
M. nuttingi	05
M. tuberculifer	06
Sayornis sp.	4 18 02 04 00
S. phoebe	01
S. nigricans	02
S. saya	03
Empidonax sp.	4 18 02 05 00
E. fulvifrons	01
E. wrightii	02
E. oberholseri	03
E. hammondii	04
E. minimus	05
E. difficilis	06
E. flaviventris	07
E. virescens	08
E. traillii	09
Contopus sp.	4 18 02 06 00
C. pertinax	01
C. virens	02
C. sordidulus	03
Nuttallornis sp.	4 18 02 07 00
N. borealis	01
Pyrocephalus sp.	4 10 02 08 00
P. rubinus	01
Camptostoma sp.	4 18 02 09 00
C. imberbe	01
Family Alaudidae	4 18 03 00 00
Eremophila sp.	4 18 03 01 00
E. alpestris	01
Family Hirundinidae	4 18 04 00 00
Tachycineta sp.	4 18 04 01 00
T. thalassina	01
Iridoprocne sp.	4 18 04 02 00
I. bicolor	01
Riparia sp.	4 18 04 03 00
R. riparia	01

APPENDIX THREE. TAXONOMIC CODES (Continued).

Stelgidopteryx sp.	4 18 04 04 00
S. ruficollis	01
Hirundo sp.	4 18 04 05 00
H. rustica	01
Petrochenelidon sp.	4 18 04 06 00
P. pyrrhonota	01
Progne sp.	4 18 04 07 00
P. subis	01
Family Corvidae	4 18 05 00 00
Perisoreus sp.	4 18 05 01 00
P. canadensis	01
Cyanocitta sp.	4 18 05 02 00
C. stelleri	01
Aphelocoma sp.	4 18 05 03 00
A. coerulescens	01
A. ultramarina	02
Cissilopha sp.	4 18 05 04 00
C. san-blasiana	01
Pica sp.	4 18 05 05 00
P. pica	01
Corvus sp.	4 18 05 06 00
C. corax	01
C. cryptoleucus	02
C. brachyrhynchos	03
Gymnorhinus sp.	4 18 05 07 00
G. cyanocephalus	01
Nucifraga sp.	4 18 05 08 00
N. columbiana	01
Family Paridae	4 18 06 00 00
Parus sp.	4 18 06 01 00
P. atricapillus	01
P. sclateri	02
P. gambeli	03
P. inornatus	04
P. wollweberi	05
Auriparus sp.	4 18 06 02 00
A. flaviceps	01
Psaltriparus sp.	4 18 06 03 00
P. minimus	01
Family Sittidae	4 18 07 00 00
Sitta sp.	4 18 07 01 00
S. carolinensis	01
S. canadensis	02
S. pygmaea	03
Family Certhiidae	4 18 08 00 00
Certhia sp.	4 18 08 01 00
C. familiaris	01
Family Cinclidae	4 18 09 00 00
Cinclus sp.	4 18 09 01 00
C. mexicanus	01
Family Troglodytidae	4 18 10 00 00
Troglodytes sp.	4 18 10 01 00
T. aedon	01
T. brunneicollis	02
T. troglodytes	03
Thryomanes sp.	4 18 10 02 00
T. bewickii	01
Campylorhynchus sp.	4 18 10 03 00
C. brunneicapillus	01
Telmatodytes sp.	4 18 10 04 00
T. palustris	01
Catherpes sp.	4 18 10 05 00
C. mexicanus	01
Salpinctes sp.	4 18 10 06 00
S. obsoletus	01
Family Mimidae	4 18 11 00 00
Mimus sp.	4 18 11 01 00
M. polyglottos	01
Dumetella sp.	4 18 11 02 00
D. carolinensis	01
Toxostoma sp.	4 18 11 03 00
T. rufum	01
T. bendirei	02
T. curvirostre	03
T. lecontei	04
T. dorsale	05
Oreoscoptes sp.	4 18 11 04 00
O. montanus	01
Family Turdidae	4 18 12 00 00
Turdus sp.	4 18 12 01 00
T. migratotius	01
T. rufo-palliatus	02
Ixoreus sp.	4 18 12 02 00
I. naevius	01
Hylocichla sp.	4 18 12 03 00
H. guttata	01
H. ustulata	02
H. minima	03
H. fuscescens	04
Sialia sp.	4 18 12 04 00
S. sialis	01
S. mexicana	02

APPENDIX THREE. TAXONOMIC CODES (Continued).

S. currucoides	03
Myadestes sp.	4 18 12 05 00
M. townsendi	01
Family Sylviidae	4 18 13 00 00
Polioptila sp.	4 18 13 01 00
P. caerulea	01
P. melanura	02
Regulus sp.	4 18 13 02 00
R. satrapa	01
R. calendula	02
Family Motacillidae	4 18 14 00 00
Anthus sp.	4 18 14 01 00
A. spinoletta	01
A. spragueii	02
Family Bombycillidae	4 18 15 00 00
Bombycilla sp.	4 18 15 01 00
B. garrula	01
B. cedrorum	02
Family Ptilogonatidae	4 18 16 00 00
Phainopepla sp.	4 18 16 01 00
P. nitens	01
Family Laniidae	4 18 17 00 00
Lanius sp.	4 18 17 01 00
L. excubitor	01
L. ludovicianus	02
Family Sturnidae	4 18 18 00 00
Sturnus sp.	4 18 18 00 00
S. vulgaris	01
Family Vireonidae	4 18 19 00 00
Vireo sp.	4 18 19 01 00
V. griseus	01
V. huttoni	02
V. bellii	03
V. vivinior	04
V. flavifrons	05
V. solitarius	06
V. olivaceus	07
V. philadelphicus	08
V. gilvus	09
Family Parulidae	4 18 20 00 00
Mniotilta sp.	4 18 20 01 00
M. varia	01
Protonotaria sp.	4 18 20 02 00
P. citrea	01
Helmitheros sp.	4 18 20 03 00
H. verminvorus	01
Vermivora sp.	4 18 20 04 00
V. pinus	01
V. peregrina	02
V. celata	03
V. ruficapilla	04
V. virginiae	05
V. luciae	06
Parula sp.	4 18 20 05 00
P. americana	01
Peucedramus sp.	4 18 20 06 00
P. taeniatus	01
Dendroica sp.	4 18 20 07 00
D. petechia	01
D. magnolia	02
D. tigrina	03
D. caerulescens	04
D. coronata	05
D. auduboni	06
D. nigrescens	07
D. townsendi	08
D. virens	09
D. occidentalis	10
D. cerulea	11
D. graciae	12
D. pensylvanica	13
D. striata	14
D. discolor	15
D. palmarum	16
Seiurus sp.	4 18 20 08 00
S. aurocapillus	01
S. noveboracensis	02
S. motacilla	03
Oporornis sp.	4 18 20 09 00
O. formosus	01
O. agilis	02
O. tolmiei	03
Geothlypis sp.	4 18 20 10 00
G. trichas	01
Icteria sp.	4 18 20 11 00
I. virens	01
Euthlypis sp.	4 18 20 12 00
E. lachrymosa	01
Cardellina sp.	4 18 20 13 00
C. rubifrons	01
Wilsonia sp.	4 18 20 14 00

APPENDIX THREE. TAXONOMIC CODES (Continued).

W. citrina	01
W. pusilla	02
Setophaga sp.	4 18 20 15 00
S. ruticilla	01
S. picta	02
Family Ploceidae	4 18 21 00 00
Passer sp.	4 18 21 01 00
P. domesticus	01
Family Icteridae	4 18 22 00 00
Dolichonyx sp.	4 18 22 01 00
D. oryzivorus	01
Sturnella sp.	4 18 22 02 00
S. magna	01
S. neglecta	02
Xanthocephalus sp.	4 18 22 03 00
X. xantocephalus	01
Agelaius sp.	4 18 22 04 00
A. phoeniceus	01
Icterus sp.	4 18 22 05 00
I. spurius	01
I. cucullatus	02
I. pustulatus	03
I. parisorum	04
I. galbula	05
I. bullockii	06
Euphagus sp.	4 18 22 06 00
E. carolinus	01
E. cyanocephalus	02
Cassidix sp.	4 18 22 07 00
C. mexicanus	01
Molothrus sp.	4 18 22 08 00
M. ater	01
Tangavius sp.	4 18 22 09 00
T. aeneus	01
Family Thraupidae	4 18 23 00 00
Piranga sp.	4 18 23 01 00
P. ludoviciana	01
P. olivacea	02
P. flava	03
P. rubra	04
Family Fringillidae	4 18 24 00 00
Richmondena sp.	4 18 24 01 00
R. cardinalis	01
Pyrrhuloxia sp.	4 18 24 02 00
P. sinuata	01
Pheucticus sp.	4 18 24 03 00

P. ludovicianus	01
P. melanocephalus	02
Guiraca sp.	4 18 24 04 00
G. caerulea	01
Passerina sp.	4 18 24 05 00
P. cyanea	01
P. amoena	02
P. versicolor	03
P. ciris	04
Spiza sp.	4 18 24 06 00
S. americana	01
Hesperiphona sp.	4 18 24 07 00
H. vespertina	01
Carpodocus sp.	4 18 24 08 00
C. purpureus	01
C. cassinii	02
C. mexicanus	03
Pinicola sp.	4 18 24 09 00
P. enucleator	01
Leucosticte sp.	4 18 24 10 00
L. tephrocotis	01
L. atrata	02
Spinus sp.	4 18 24 11 00
S. pinus	01
S. tristis	02
S. psaltria	03
S. lawrencei	04
Loxia sp.	4 18 24 12 00
L. curvirostra	01
Chlorura sp.	4 18 24 13 00
C. chlorura	01
Pipilo sp.	4 18 24 14 00
P. erthrophthalmus	01
P. fuscus	02
P. aberti	03
Calamospiza sp.	4 18 24 15 00
C. melanocorys	01
Passerculus sp.	4 18 24 16 00
P. sandwichensis	01
Ammodramus sp.	4 18 24 17 00
A. savannarum	01
A. bairdii	02
Pooecetes sp.	4 18 24 18 00
P. gramineus	01
Chondestes sp.	4 18 24 19 00
C. grammacus	01
Aimophila sp.	4 18 24 20 00
A. carpalis	01
A. ruficeps	02
A. botterii	03

APPENDIX THREE. TAXONOMIC CODES (Continued).

A. cassinii	04
A. quinquestriata	05
Amphispiza sp.	4 18 24 21 00
A. bilineata	01
A. belli	02
Junco sp.	4 18 24 22 00
J. aikeni	01
J. hyemalis	02
J. oreganus	03
J. caniceps	04
J. phaeonotus	05
Spizella sp.	4 18 24 23 00
S. arborea	01
S. passerina	02
S. pallida	03
S. breweri	04
S. atrogularis	05
Zonotrichia sp.	4 18 24 24 00
Z. querula	01
Z. leucophrys	02
Z. atricapilla	03
Z. albicollos	04
Passerella sp.	4 18 24 25 00
P. iliaca	01
Melospiza sp.	4 18 24 26 00
M. lincolnii	01
M. georgiana	02
M. melodia	03
Rhynchophanes sp.	4 18 24 27 00
R. mccownii	01
Calcarius sp.	4 18 24 28 00
C. lapponicus	01
C. pictus	02
C. ornatus	03
Order Galliformes	4 19 00 00 00
Family Tetraonidae	4 19 01 00 00
Dendragapus sp.	4 19 01 01 00
D. obscurus	01
Centrocerus sp.	4 19 01 02 00
C. urophasianus	01
Family Phasianidae	4 19 02 00 00
Colinus sp.	4 19 02 01 00
C. virginianus	01
Callipepla sp.	4 19 02 02 00
C. squamata	01
Lophortyx sp.	4 19 02 03 00
L. gambelii	01
Cyrtonyx sp.	4 19 02 04 00
C. montezumae	01
Phasianus p.	4 19 02 05 00
P. colchinus	01
Alectoris sp.	4 19 02 06 00
Family Meleagrididae	4 19 03 00 00
Meleagris sp.	4 19 03 01 00
M. gallopavo	01
CLASS MAMMALIA	5 00 00 00 00
Order Insectivora	5 01 00 00 00
Family Socicidae	5 01 01 00 00
Sorex sp.	5 01 01 01 00
S. merriami	01
S. vagrans	02
S. nanus	03
S. palustris	04
Notiosorex sp.	5 01 01 02 00
N. crawfordi	01
Family Marsupialia	5 01 02 00 00
Didelphis sp.	5 01 02 01 00
D. marsupialis	01
Order Chiroptera	5 02 00 00 00
Family Vespertilionidae	5 02 01 00 00
Myotis sp.	5 02 01 01 00
M. yumanensis	01
M. velifer	02
M. occultus	03
M. evotis	04
M. thysanodes	05
M. volans	06
M. californicus	07
M. subulatus	08
M. keenii	09
Lasionycteris sp.	5 02 01 02 00
L. noctivagans	01
Pipstellus sp.	5 02 01 03 00
P. hesperus	01
Eptesicus sp.	5 02 01 04 00
E. fuscus	01
Lasiurus sp.	5 02 01 05 00
L. borealis	01
L. cinereus	02
Plecotus sp.	5 02 01 06 00

APPENDIX THREE. TAXONOMIC CODES (Continued).

P. townsendii	01
P. phyllotis	02
P. maculata	03
Antrozous sp.	5 02 01 07 00
A. pallidus	01
Dasypterus sp.	5 02 01 08 00
D. ega	01
Euderma sp.	5 02 01 09 00
E. maculata	01
Family Molossidae	5 02 02 00 00
Tadarida sp.	5 02 02 01 00
T. brasiliensis	01
T. femorosaca	02
T. molossa	03
Eumops sp.	5 02 02 02 00
E. perotis	01
E. underwoodi	02
Family Phyllostomatidae	5 02 03 00 00
Mormoops sp.	5 02 03 01 00
M. megalophylla	01
M. californicus	02
Choeronycteris sp.	5 02 03 02 00
C. mexicana	01
Leptonycteris sp.	5 02 03 03 00
L. nivalis	01
Order Lagomorpha	5 03 00 00 00
Family Leporidae	5 03 01 00 00
Lepus sp.	5 03 01 01 00
L. californicus	01
L. alleni	02
Sylvilagus sp.	5 03 01 02 00
S. floridanus	01
S. nuttalli	02
S. audubonii	03
Order Rodentia	5 04 00 00 00
Family Sciuridae	5 04 01 00 00
Citellus	5 04 01 01 00
C. variegatus	01
C. harrisii	02
C. lateralis	03
C. tridecemlineatus	04
C. spilosoma	05
C. leucurus	06
C. tereticaudus	07

Eutamias sp.	5 04 01 02 00
E. cinericollis	01
E. dorsalis	02
E. minimus	03
E. quadrivittatus	04
E. umbrinus	05
Sciurus sp.	5 04 01 03 00
S. aberti	01
S. arizonensis	02
S. apache	03
Tamiasciurus sp.	5 04 01 04 00
T. hudsonicus	01
Cynomys sp.	5 04 01 05 00
C. ludovicianus	01
C. gunnisoni	02
Family Geomyidae	5 04 02 00 00
Thomomys sp.	5 04 02 01 00
T. bottae	01
T. umbrinus	02
T. talpoides	03
Family Heteromyidae	5 04 03 00 00
Perognathus sp.	5 04 03 01 00
P. amplus	01
P. hispidus	02
P. penicullatus	03
P. intermedius	04
P. flavus	05
P. apache	06
P. longimembris	07
P. parvis	08
P. formosus	09
P. baileyi	10
Dipodomys sp.	5 04 03 02 00
D. merriami	01
D. ordii	02
D. spectabilis	03
D. microps	04
D. deserti	05
Family Castoridae	5 04 04 00 00
Castor sp.	5 04 04 01 00
C. canadensis	01
Family Cricetidae	5 04 05 00 00
Onychomys sp.	5 04 05 01 00
O. leucogaster	01
O. torridus	02
Reithrodontomys sp.	5 04 05 02 00

APPENDIX THREE. TAXONOMIC CODES (Continued).

R. megalotis	01
R. montanus	02
R. fulvescens	03
Peromyscus sp.	5 04 05 03 00
P. eremicus	01
P. maniculatus	02
P. leucopus	03
P. boylii	04
P. truei	05
P. crinitus	06
P. merriami	07
P. pectoralis	08
P. nasutus	09
Sigmodon sp.	5 04 05 04 00
S. hispidus	01
S. minimus	02
Neotoma sp.	5 04 05 05 00
N. albigula	01
N. stephensi	02
N. mexicana	03
N. cinerea	04
N. lepida	05
Microtus sp.	5 04 05 06 00
M. mexicanus	01
M. montanus	02
M. longicaudus	03
Ondatra sp.	5 04 05 07 00
O. zibethicus	01
Clethrionomys sp.	5 04 05 08 00
C. gapperi	01
Baiomys sp.	5 04 05 09 00
B. taylori	01
Family Muridae	5 04 06 00 00
Mus sp.	5 04 06 01 00
M. musculus	01
Rattus sp.	5 04 06 02 00
R. norvegicus	01
R. rattus	02
Family Erethizontidae	5 04 07 00 00
Erethizon sp.	5 04 07 01 00
E. dorsatum	01
Family Zapodidae	5 04 08 00 00
Zapus sp.	5 04 08 01 00
Z. princeps	01
Order Carnivora	5 05 00 00 00
Family Canidae	5 05 01 00 00
Canis sp.	5 05 01 01 00
C. lantrans	01
C. lupus	02
C. familiaris	03
Urocyon sp.	5 05 01 02 00
U. cinereoargentus	01
Vulpes sp.	5 05 01 03 00
V. macrotis	01
Family Ursidae	5 05 02 00 00
Euarctos sp.	5 05 02 01 00
E. americanus	01
Ursus sp.	5 05 02 02 00
U. horribilis	01
Family Procyonidae	5 05 03 00 00
Bassariscus sp.	5 05 03 01 00
B. astutus	01
Procyon sp.	5 05 03 02 00
P. lotor	01
Nasua sp.	5 05 03 03 00
N. narica	01
Family Mustelidae	5 05 04 00 00
Mustela sp.	5 05 04 01 00
M. frenata	01
M. nigripes	02
Taxidea sp.	5 05 04 02 00
T. taxus	01
Spilogale sp.	5 05 04 03 00
S. putorius	01
S. gracilis	02
Mephitis sp.	5 05 04 04 00
M. mephitis	01
M. macroura	02
Conepatus sp.	5 05 04 05 00
C. mesoleucus	01
Lutra sp.	5 05 04 06 00
L. canadensis	01
Family Felidae	5 05 05 00 00
Felis sp.	5 05 05 01 00
F. concolor	01
F. domesticus	02
F. onca	03
F. pardalis	04
F. yagouaroundi	05
Lynx sp.	5 05 05 02 00
L. rufus	01

APPENDIX THREE. TAXONOMIC CODES (Continued).

Order Artiodactyla	5 06 00 00 00
Family Cervidae	5 06 01 00 00
Cervus sp.	5 06 01 01 00
C. canadenis	01
Odocoileus sp.	5 06 01 02 00
O. hemionus	01
O. virginianus	02
Family Antilocapridae	5 06 02 00 00
Antilocapra sp.	5 06 02 01 00
A. americana	01
Family Bovidae	5 06 03 00 00
Ovis sp.	5 06 03 01 00
O. canadensis	01
Bos sp.	5 06 03 02 00
B. taurus	01
Family Equidae	5 06 04 00 00
Equus sp.	5 06 04 01 00
Family Tayassuidae	5 06 05 00 00
Pecari sp.	5 06 05 01 00
P. tajacu	01

APPENDIX FOUR

BODY PART CODES

APPENDIX FOUR. BODY PART CODES.

00 Indeterminate
01 Antler
02 Cranium
03 Mandible
04 Tooth Indeterminate
05 Incisor
06 Canine
07 Premolar
08 Molar/Cheektooth
09 Vertebrate Indeterminate
10 Atlas
11 Axis
12 Cervical
13 Thoracic
14 Lumbar
15 Sacrum/Urostyle
16 Caudal
17 Ribs/Caraface
18 Sternum/Plastron
19 Pectoral Girdle/Coracoid
20 Scapula
21 Pelvis (Complete)
22 Ilium
23 Ischium
24 Pubis
25 Acetabulum (60%)
26 Longbone Indeterminate
27 Humerus*
28 Proximal Humerus
29 Distal Humerus
30 Radius*
31 Proximal Radius
32 Distal Radius
33 Ulna*
34 Proximal Ulna
35 Distal Ulna
36 Metacarpal/Carpometacarpus*
37 Proximal Metacarpal
38 Distal Metacarpal
39 Carpals
40 Femur*
41 Proximal Femur
42 Distal Femur
43 Tibia/Tibiotarsus*
44 Proximal Tibia
45 Distal Tibia
46 Fibula*
47 Proximal Fibula
48 Distal Fibula
49 Metatarsal/Tarsometatarsis*
50 Proximal Metatarsal
51 Distal Metatarsal
52 Patella
53 Tarsals
54 Astragulus
55 Calcaneus
56 Metapodial*
57 Proximal Metapodial
58 Distal Metapodial
59 Podial/Sesamoid Indeterminate
60 Phalange Indeterminate
61 Proximal Phalange
62 Medial Phalange
63 Terminal Phalange
64 Dermal Layer

* indicates that a category includes shaft or complete.

APPENDIX FIVE

BONE ELEMENT FREQUENCIES

APPENDIX FIVE. BONE ELEMENT FREQUENCIES.

Family Leporidae

SIDE	R	L	M	?
Antler/Horncore				
Cranium				
Mandible		1		
Tooth, Indeterminate				
Incisor				
Canine				
Premolar				
Molar				
Vertebrate, Indeterminate				
Atlas				
Axis				
Cervical			2	
Thoracic			3	
Lumbar			6	
Sacrum/Urostyle			2	
Caudal				
Ribs/Carapace		1		1
Sternum/Plastron				
Pectoral Girdle/Coracoid				
Scapula		1		1
Pelvis				
Complete	1	1		1
Ilium		2		
Ischium		2		1
Pubis				
Acetabulum	1			
Long Bone, Indeterminate				
Humerus, Complete				
Shaft		1		1
Proximal				
Distal		1		1
Radius, Complete				
Shaft				1
Proximal				
Distal				
Ulna, Complete				
Shaft				
Proximal				
Distal				

SIDE	R	L	M	?
Metacarpal/Carpometacarpus				
Complete				
Shaft				
Proximal				
Distal				
Carpals				
Femur, Complete				
Shaft		1		2
Proximal	3	1		1
Distal		2		4
Tibia/Tibiotarsus				
Complete				
Shaft	1			
Proximal		2		
Distal	1	1		1
Fibula, Complete				
Shaft				
Proximal				
Distal				
Metatarsal/Tarsometatarsus				
Complete				
Shaft				
Proximal				
Distal				
Tarsals				
Astragalus				
Calcaneus	1	1		
Metapodial, Complete				
Shaft				
Proximal				
Distal				
Sesamoid				
Phalanx, Indeterminate				
Proximal				2
Middle				
Terminal				
NISP	56			
MNI	1			

APPENDIX FIVE. BONE ELEMENT FREQUENCIES. (Continued)

<u>Lepus</u> sp.

SIDE	R	L	M	?
Antler/Horncore				
Cranium				
Mandible				
Tooth, Indeterminate				
Incisor				
Canine				
Premolar				
Molar				
Vertebrate, Indeterminate			1	
Atlas				
Axis				
Cervical			2	
Thoracic				
Lumbar			2	
Sacrum/Urostyle				
Caudal				
Ribs/Carapace				
Sternum/Plastron				
Pectoral Girdle/Coracoid				
Scapula	2			
Pelvis				
Complete				
Ilium				
Ischium				
Pubis				
Acetabulum		1		
Long Bone, Indeterminate				1
Humerus, Complete				
Shaft				
Proximal	1	1		
Distal	1	2		
Radius, Complete				
Shaft				2
Proximal				
Distal	1			
Ulna, Complete				
Shaft				
Proximal	1			
Distal				

SIDE	R	L	M	?
Metacarpal/Carpometacarpus				
Complete				
Shaft				
Proximal				
Distal				
Carpals				
Femur, Complete				1
Shaft				1
Proximal		1		
Distal	1	2		
Tibia/Tibiotarsus				
Complete				
Shaft	2	1		1
Proximal		1		
Distal		1		
Fibula, Complete				
Shaft				
Proximal				
Distal				
Metatarsal/Tarsometatarsus				
Complete				
Shaft				
Proximal				
Distal				
Tarsals				
Astragalus				
Calcaneus				
Metapodial, Complete				
Shaft				
Proximal				
Distal				
Sesamoid				
Phalanx, Indeterminate				
Proximal	1			1
Middle				
Terminal				
NISP	32			
MNI	1			

APPENDIX FIVE. BONE ELEMENT FREQUENCIES. (Continued)

Lepus californicus

SIDE	R	L	M	?
Antler/Horncore				
Cranium			2	
Mandible		1		
Tooth, Indeterminate				
Incisor				
Canine				
Premolar				
Molar				
Vertebrate, Indeterminate				
Atlas				
Axis				
Cervical			2	
Thoracic				
Lumbar			1	
Sacrum/Urostyle				
Caudal			1	
Ribs/Carapace		1	1	2
Sternum/Plastron				
Pectoral Girdle/Coracoid				
Scapula		1		
Pelvis				
Complete				
Ilium	2			
Ischium	1			
Pubis				
Acetabulum	1			
Long Bone, Indeterminate				
Humerus, Complete				
Shaft				
Proximal	2	1		
Distal	3	4		
Radius, Complete				
Shaft	2			
Proximal	2			
Distal	1			
Ulna, Complete				
Shaft				
Proximal	1			
Distal				

SIDE	R	L	M	?
Metacarpal/Carpometacarpus				
Complete				
Shaft				
Proximal				
Distal				
Carpals				1
Femur, Complete				
Shaft				
Proximal	1	2		1
Distal	1			
Tibia/Tibiotarsus				
Complete				
Shaft	1	1		
Proximal	1			
Distal		1		
Fibula, Complete				
Shaft				
Proximal				
Distal				
Metatarsal/Tarsometatarsus				
Complete		1		
Shaft				
Proximal				1
Distal				2
Tarsals				
Astragalus				
Calcaneus	3	3		
Metapodial, Complete				
Shaft				
Proximal				
Distal				
Sesamoid				
Phalanx, Indeterminate				
Proximal	1			1
Middle				
Terminal				
NISP	54			
MNI	4			

APPENDIX FIVE. BONE ELEMENT FREQUENCIES. (Continued)

Lepus cf. *californicus*

SIDE	R	L	M	?
Antler/Horncore				
Cranium				
Mandible				
Tooth, Indeterminate				
Incisor				
Canine				
Premolar				
Molar				
Vertebrate, Indeterminate				
Atlas				
Axis				
Cervical				
Thoracic				
Lumbar				
Sacrum/Urostyle				
Caudal				
Ribs/Carapace	1			1
Sternum/Plastron				
Pectoral Girdle/Coracoid				
Scapula				
Pelvis				
Complete				
Ilium				
Ischium				
Pubis				
Acetabulum				
Long Bone, Indeterminate				
Humerus, Complete				
Shaft	1			
Proximal				
Distal				
Radius, Complete				
Shaft				
Proximal				
Distal				
Ulna, Complete				2
Shaft				
Proximal				
Distal				

SIDE	R	L	M	?
Metacarpal/Carpometacarpus				
Complete				
Shaft				
Proximal				
Distal				
Carpals				
Femur, Complete	1			
Shaft				
Proximal				
Distal	1			
Tibia/Tibiotarsus				
Complete				
Shaft				
Proximal		1		
Distal				
Fibula, Complete				
Shaft				
Proximal				
Distal				
Metatarsal/Tarsometatarsus				
Complete				
Shaft				
Proximal				
Distal				
Tarsals				
Astragalus				
Calcaneus				
Metapodial, Complete				
Shaft				
Proximal				
Distal				
Sesamoid				
Phalanx, Indeterminate				
Proximal				
Middle				
Terminal				
NISP	8			
MNI	-			

APPENDIX FIVE. BONE ELEMENT FREQUENCIES. (Continued)

Sylvilagus sp.

SIDE	R	L	M	?
Antler/Horncore				
Cranium		2	10	2
Mandible	5	12		
Tooth, Indeterminate				
Incisor				
Canine				
Premolar	1			
Molar	1			2
Vertebrate, Indeterminate				
Atlas			1	
Axis			1	
Cervical			2	
Thoracic			1	
Lumbar			9	
Sacrum/Urostyle			9	
Caudal				
Ribs/Carapace				1
Sternum/Plastron				
Pectoral Girdle/Coracoid				
Scapula		2		
Pelvis				
Complete	8	3		
Ilium	3	7		
Ischium	5	4		
Pubis				
Acetabulum	3			
Long Bone, Indeterminate	1			
Humerus, Complete	1	2		
Shaft	1	2		
Proximal	4	3		
Distal	6	7		
Radius, Complete				
Shaft	1			
Proximal	3	2		
Distal	3			
Ulna, Complete	1	1		
Shaft				
Proximal	2	2		
Distal				

SIDE	R	L	M	?
Metacarpal/Carpometacarpus				
Complete				1
Shaft				
Proximal				
Distal				1
Carpals				
Femur, Complete	4			
Shaft	5			
Proximal	2	4		1
Distal	3	5		
Tibia/Tibiotarsus				
Complete	2	1		
Shaft	2	3		1
Proximal	1	4		
Distal	4	2		
Fibula, Complete				
Shaft				
Proximal				
Distal				
Metatarsal/Tarsometatarsus				
Complete	1	1		
Shaft				
Proximal				
Distal				2
Tarsals				
Astragalus				1
Calcaneus	6	8		
Metapodial, Complete				
Shaft				
Proximal				
Distal				
Sesamoid				
Phalanx, Indeterminate				
Proximal	1			2
Middle				1
Terminal				
NISP	205			
MNI	12			

APPENDIX FIVE. BONE ELEMENT FREQUENCIES. (Continued)

<u>Citellus variegatus</u>

SIDE	R	L	M	?
Antler/Horncore				
Cranium			2	
Mandible	1	1		
Tooth, Indeterminate				
Incisor				
Canine				
Premolar				
Molar				
Vertebrate, Indeterminate				2
Atlas				
Axis				
Cervical				
Thoracic				
Lumbar				
Sacrum/Urostyle				
Caudal				5
Ribs/Carapace				
Sternum/Plastron				
Pectoral Girdle/Coracoid				
Scapula	1	1		
Pelvis				
Complete				
Ilium				
Ischium				
Pubis				
Acetabulum				
Long Bone, Indeterminate				
Humerus, Complete		1		
Shaft				
Proximal				
Distal				
Radius, Complete				
Shaft				
Proximal				
Distal				
Ulna, Complete	1			
Shaft				
Proximal				
Distal				

SIDE	R	L	M	?
Metacarpal/Carpometacarpus				
Complete				
Shaft				
Proximal				
Distal				
Carpals				
Femur, Complete				
Shaft				
Proximal				
Distal				
Tibia/Tibiotarsus				
Complete				
Shaft				
Proximal				
Distal				
Fibula, Complete				
Shaft				
Proximal				
Distal				
Metatarsal/Tarsometatarsus				
Complete				3
Shaft				
Proximal				
Distal				
Tarsals				
Astragalus				
Calcaneus		1		
Metapodial, Complete				
Shaft				
Proximal				
Distal				
Sesamoid				
Phalanx, Indeterminate				
Proximal				3
Middle				2
Terminal				1
NISP	25			
MNI	2			

APPENDIX FIVE. BONE ELEMENT FREQUENCIES. (Continued)

Sciurus sp.

SIDE	R	L	M	?
Antler/Horncore				
Cranium			1	
Mandible				
Tooth, Indeterminate				
Incisor				
Canine				
Premolar				1
Molar				1
Vertebrate, Indeterminate				
Atlas				
Axis				
Cervical				
Thoracic				
Lumbar				
Sacrum/Urostyle				
Caudal				
Ribs/Carapace				
Sternum/Plastron				
Pectoral Girdle/Coracoid				
Scapula	1			
Pelvis				
Complete				
Ilium				
Ischium				
Pubis				
Acetabulum				
Long Bone, Indeterminate				
Humerus, Complete	1	1		
Shaft				
Proximal				
Distal	1			
Radius, Complete				
Shaft				
Proximal				
Distal				
Ulna, Complete				
Shaft				
Proximal				
Distal				

SIDE	R	L	M	?
Metacarpal/Carpometacarpus				
Complete				
Shaft				
Proximal				
Distal				
Carpals				
Femur, Complete				
Shaft				
Proximal				
Distal				
Tibia/Tibiotarsus				1
Complete				
Shaft				
Proximal				
Distal				
Fibula, Complete				
Shaft				
Proximal				
Distal				
Metatarsal/Tarsometatarsus				
Complete				
Shaft				
Proximal				
Distal				
Tarsals				
Astragalus				
Calcaneus				
Metapodial, Complete				
Shaft				
Proximal				
Distal				
Sesamoid				
Phalanx, Indeterminate				
Proximal				
Middle				
Terminal				
NISP	8			
MNI	1			

APPENDIX FIVE. BONE ELEMENT FREQUENCIES. (Continued)

Thomomys sp.

SIDE	R	L	M	?
Antler/Horncore				
Cranium			1	
Mandible	4	3		
Tooth, Indeterminate				
Incisor			1	
Canine				
Premolar				
Molar				
Vertebrate, Indeterminate				
Atlas				
Axis				
Cervical				
Thoracic				
Lumbar				
Sacrum/Urostyle				
Caudal				
Ribs/Carapace				
Sternum/Plastron				
Pectoral Girdle/Coracoid				
Scapula				
Pelvis				
Complete	1			
Ilium				
Ischium				
Pubis				
Acetabulum				
Long Bone, Indeterminate				
Humerus, Complete	2			
Shaft				
Proximal				
Distal				
Radius, Complete				
Shaft				
Proximal				
Distal				
Ulna, Complete				
Shaft				
Proximal				
Distal				

SIDE	R	L	M	?
Metacarpal/Carpometacarpus				
Complete				
Shaft				
Proximal				
Distal				
Carpals				
Femur, Complete	1	2		
Shaft	1			
Proximal				
Distal				
Tibia/Tibiotarsus	1			
Complete				
Shaft				
Proximal				
Distal		1		
Fibula, Complete				
Shaft				
Proximal				
Distal				
Metatarsal/Tarsometatarsus				
Complete				
Shaft				
Proximal				
Distal				
Tarsals				
Astragalus				
Calcaneus				
Metapodial, Complete				
Shaft				
Proximal				
Distal				
Sesamoid				
Phalanx, Indeterminate				
Proximal				
Middle				
Terminal				
NISP	18			
MNI	4			

APPENDIX FIVE. BONE ELEMENT FREQUENCIES. (Continued)

Thomomys bottae

SIDE	R	L	M	?
Antler/Horncore				
Cranium			1	
Mandible	3	2		
Tooth, Indeterminate				
Incisor				
Canine				
Premolar				
Molar				
Vertebrate, Indeterminate				
Atlas				
Axis				
Cervical				
Thoracic				
Lumbar				
Sacrum/Urostyle				
Caudal				
Ribs/Carapace				
Sternum/Plastron				
Pectoral Girdle/Coracoid				
Scapula				
Pelvis				
Complete				
Ilium				
Ischium				
Pubis				
Acetabulum				
Long Bone, Indeterminate				
Humerus, Complete		1		
Shaft				
Proximal				
Distal				
Radius, Complete				
Shaft				
Proximal				
Distal				
Ulna, Complete				
Shaft				
Proximal				
Distal				

SIDE	R	L	M	?
Metacarpal/Carpometacarpus				
Complete				
Shaft				
Proximal				
Distal				
Carpals				
Femur, Complete				
Shaft				
Proximal				
Distal				
Tibia/Tibiotarsus				
Complete				
Shaft				
Proximal				
Distal				
Fibula, Complete				
Shaft				
Proximal				
Distal				
Metatarsal/Tarsometatarsus				
Complete				
Shaft				
Proximal				
Distal				
Tarsals				
Astragalus				
Calcaneus				
Metapodial, Complete				
Shaft				
Proximal				
Distal				
Sesamoid				
Phalanx, Indeterminate				
Proximal				
Middle				
Terminal				
NISP	4			
MNI	-			

APPENDIX FIVE. BONE ELEMENT FREQUENCIES. (Continued)

Odocoileus sp.

SIDE	R	L	M	?
Antler/Horncore	1	1		14
Cranium	3	1	1	1
Mandible	1	1		2
Tooth, Indeterminate				1
Incisor				
Canine				
Premolar				
Molar				
Vertebrate, Indeterminate				
Atlas			1	
Axis				
Cervical				
Thoracic			4	
Lumbar			4	
Sacrum/Urostyle				
Caudal				
Ribs/Carapace	1	2		
Sternum/Plastron				
Pectoral Girdle/Coracoid				
Scapula	2			
Pelvis				
Complete	1			
Ilium	1			
Ischium				1
Pubis				
Acetabulum	1			1
Long Bone, Indeterminate				
Humerus, Complete				
Shaft	1			
Proximal	1			
Distal	1	1		
Radius, Complete				
Shaft				
Proximal	1			
Distal	2	1		
Ulna, Complete				
Shaft				
Proximal	1			
Distal	1			

SIDE	R	L	M	?
Metacarpal/Carpometacarpus				
Complete				2
Shaft				
Proximal				
Distal				
Carpals	4			4
Femur, Complete				
Shaft				
Proximal				
Distal				
Tibia/Tibiotarsus				
Complete				
Shaft				1
Proximal		3		
Distal		1		
Fibula, Complete				
Shaft				
Proximal				
Distal				
Metatarsal/Tarsometatarsus				
Complete				
Shaft				
Proximal				
Distal				
Tarsals				
Astragalus		1		
Calcaneus		1		
Metapodial, Complete				
Shaft				
Proximal				
Distal				1
Sesamoid				
Phalanx, Indeterminate				
Proximal				11
Middle				4
Terminal				5
NISP	94			
MNI	-			