

**PREHISTORIC ANASAZI DIET: A SYNTHESIS OF
ARCHAEOLOGICAL EVIDENCE**

by

MICHAEL JAMES BRAND

B.A. (Hon.), Simon Fraser University, 1991

**A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF
THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF ARTS**

in

**THE FACULTY OF GRADUATE STUDIES
(Department of Anthropology and Sociology)**

We accept this thesis as conforming
to the required standard~~d~~

THE UNIVERSITY OF BRITISH COLUMBIA

November 1994

© Michael James Brand, 1994

In presenting this thesis in partial fulfilment of the requirements for an advanced degree at the University of British Columbia, I agree that the Library shall make it freely available for reference and study. I further agree that permission for extensive copying of this thesis for scholarly purposes may be granted by the head of my department or by his or her representatives. It is understood that copying or publication of this thesis for financial gain shall not be allowed without my written permission.

Department of Anthropology and Sociology

The University of British Columbia
Vancouver, Canada

Date Nov. 14, 1994

ABSTRACT

Prehistoric Anasazi diet from the Basketmaker II to Pueblo III periods is examined through a synthesis of four lines of archaeological data taken from the literature: faunal analysis, flotation and pollen analysis, coprolite analysis and stable carbon isotope analysis. This study examines the importance of corn in Anasazi diet, the intensification of agricultural production and changes in diet which may be linked to the thirteenth century regional abandonments.

The core resources, or dietary staples, in the Anasazi diet are identified for each period of the Anasazi tradition. The results indicate considerable similarity in the diets of the people from the four Anasazi branches discussed and throughout the time periods considered. The analysis demonstrates that corn was the primary resource in the Anasazi diet beginning in the Basketmaker II period. Squash and a number of wild plants also made substantial contributions to the diet.

Evidence was found for stable agricultural production, with no indication of intensification aimed at the three commonly discussed cultigens: corn, squash and beans. The appearance of cotton in the later pueblo periods, however, may represent an attempt to increase food production through the adoption of a new cultigen.

This study has found that the utilization of food resources remained stable throughout the Anasazi occupation of the Colorado Plateau, including the period immediately prior to the regional abandonments.

TABLE OF CONTENTS

Abstract	ii
Table of Contents	iii
List of Tables	iv
List of Figures	v
Acknowledgment	vi
Introduction	1
Environmental Background and the Anasazi Tradition	4
Subsistence Systems and Diet	8
Ethnographic Pueblo Subsistence and Diet	11
Archaeological Remains of Anasazi Diet	17
Introduction	17
Faunal Analysis	18
Flotation and Pollen Analysis	42
Coprolite Analysis	52
Stable Carbon Isotope Analysis	61
Summary and Conclusions	67
References Cited	73
Appendix 1 Ethnographic resource use	84
Appendix 2 Faunal data	91
Appendix 3 Stable carbon isotope data	113

LIST OF TABLES

Table 1	Occurrence of charred plant remains from flotation analyses of Chaco branch sites	44
Table 2	Occurrence of charred plant remains from flotation analyses of Kayenta branch sites	47
Table 3	Occurrence of charred plant remains from flotation analyses of San Juan - Mesa Verde branch sites	49
Table 4	Macrofossil ubiquity values for Anasazi coprolites	54
Table 5	Pollen type ubiquity values for Anasazi coprolites	56

LIST OF FIGURES

Figure 1	Location of the Anasazi branches discussed in the text.	5
Figure 2	Relative taxonomic abundances (of taxa represented by at least 4% in any period) for the Basketmaker II period	22
Figure 3	Relative taxonomic abundances (of taxa represented by at least 4% in any period) for the Basketmaker III period	24
Figure 4	Relative taxonomic abundances (of taxa represented by at least 4% in any period) for the Basketmaker III - Pueblo I period	25
Figure 5	Relative taxonomic abundances (of taxa represented by at least 4% in any period) for the Pueblo I period	27
Figure 6	Relative taxonomic abundances (of taxa represented by at least 4% in any period) for the Pueblo I - Pueblo II period	28
Figure 7	Relative taxonomic abundances (of taxa represented by at least 4% in any period) for the Pueblo II period	29
Figure 8	Relative taxonomic abundances (of taxa represented by at least 4% in any period) for the Pueblo II - Pueblo III period	31
Figure 9	Relative taxonomic abundances (of taxa represented by at least 4% in any period) for the Pueblo III period	32
Figure 10	Relative taxonomic abundances (of taxa represented by at least 4% in any period) for the Kayenta branch	34
Figure 11	Relative taxonomic abundances (of taxa represented by at least 4% in any period) for the Chaco branch	35
Figure 12	Relative taxonomic abundances (of taxa represented by at least 4% in any period) for the San Juan - Mesa Verde branch	36
Figure 13	Stable carbon isotope values for prehistoric food resources	63
Figure 14	Stable carbon isotope values for Anasazi individuals (Decker and Tieszen 1989, Matson and Chisholm 1991, Chisholm and Matson in press)	65

ACKNOWLEDGEMENT

Only after one has written a thesis do they fully realize the importance of friends and colleagues around them. In the course of writing this thesis many people have generously offered assistance and advice. First, I must thank my advisor Professor R.G. Matson for many things, among them an opportunity to participate in fieldwork in the American Southwest, funding he was able to provide, assistance in working out this topic and his guidance during the writing.

I thank Professor Michael Blake consistently providing good comments on my thesis drafts, both as an archaeologist and a reader, helping to make the thesis a more integrated document.

I appreciate Professor Elvi Whittaker's thorough reading of my thesis and helpful comments she provided.

I thank Dr. Brian Chisholm for his encouragement, good humour given the numerous times he was trapped while walking past my door, and the advice he provided regarding the stable isotope section of the thesis. Dr. Chisholm also read and commented on an early draft of the thesis.

I would also like to thank my fellow graduate students, particularly Allison Young and Warren Hill, for their discussions and advice. Joyce Johnson has been a good friend from the moment I landed at UBC.

Professor Jon Driver and Natalie Munro from Simon Fraser University and Victoria Atkins of the Anasazi Heritage Center were very helpful in suggesting references and helping me obtain various reports. Professor Jane Kelley of the University of Calgary kindly sent me a paper through a fellow graduate student when other methods had failed to produce it. The staff of the Interlibrary Loan Department at UBC's Main Library are also to be commended for their assistance and excellent average in finding publications I requested by the dozen.

I thank Olga at Arts Computing for helping me out in a printing pinch.

I am indebted to the numerous archaeologists listed in the reference section for their hard work in producing the data upon which my thesis is based.

I especially want to thank Dori Bixler for her friendship. She has been a constant pillar of support, discussing numerous aspects of my work with me and reading numerous section drafts, as well as an entire early draft.

Most of all I would like to thank my family. From the moment I first said I wanted to be an archaeologist, my parents Jim and Kathy Brand and my brother Alan have supported me completely. Without them I could have never come this far.

INTRODUCTION

For a period of at least 2400 years the Anasazi inhabited the northern American Southwest, mastering agriculture in this arid environment, founding large aggregated communities and developing extensive trading networks. Archaeologists have been tracing Anasazi culture history for the last one hundred years, and many of the questions and debates stemming from their research are linked to subsistence. The focus of this thesis is Anasazi diet between the Basketmaker II (beginning at approximately 500 B.C.) and Pueblo III (ending at approximately A.D. 1300) periods. Archaeological projects undertaken during previous decades have produced voluminous quantities of subsistence related data. This thesis synthesizes data from faunal, paleobotanical, coprolite and stable carbon isotope analyses, into a reconstruction of Anasazi diet throughout the duration of the tradition.

This reconstruction is used to address three specific research questions: (1) when did cultigens, particularly corn, become the primary constituent of the Anasazi diet?, (2) is there evidence for the intensification of agricultural production during the Anasazi tradition?, and (3) are there changes in the Anasazi diet which may be linked to the regional abandonments of the 13th century A.D.? The time at which maize became the primary resource in the Anasazi diet and the use of intensification practices to increase agricultural yields are important elements in many studies of Anasazi population dynamics and settlement patterns. It is hoped that the results of this thesis will contribute to a better understanding of these phenomena. This reconstruction will also provide a better understanding of the variation which existed in diet throughout the tradition and between the different Anasazi branches.

The period in which cultigens became the dominant constituent of the Anasazi diet remains a topic of debate. Matson and Chisholm (1991) argue that the Basketmaker II Anasazi on Cedar Mesa were dependent on corn agriculture. Their analysis indicated little change in the importance of corn in the Anasazi diet on Cedar Mesa between the Basketmaker and Pueblo periods. Furthermore, they argue that a comparison of the Cedar Mesa Basketmaker II with other contemporaneous occupations, such as the White Dog Cave and Los Pinos Basketmaker II, indicates that they too relied heavily on maize (Matson and Chisholm 1991:456). Reinhard

(1988:157) also argues, in a synthesis of coprolite data, that little difference existed in the relative contribution of corn to the Anasazi diet between the Basketmaker and Pueblo periods.

The opposite side of the debate maintains that maize did not become a major part of the Anasazi diet until later in the tradition. Glassow (1972:296) believes that while farming was present during the Basketmaker II period, it did not achieve any importance until the Basketmaker III period. F. Plog (1979:111-112) has stated that both direct and indirect subsistence data indicate that cultigens were not an important constituent of the western Anasazi diet until after A.D. 800 (Pueblo I); two hundred years later the cultivation of domesticated plant foods was of paramount importance in many localities throughout the Anasazi area (F. Plog 1983:304). Similarly, S. Plog (1986:312) has stated that only after A.D. 850 (Pueblo I) were the Black Mesa Anasazi dependent on cultigens. These dates place the dominance of corn squarely in the Pueblo period. Powell (1983:16) has argued that simplistic interpretations which ignore the complexity of prehistoric subsistence systems have fostered the belief that the Anasazi were dependent on agricultural production. Powell's (1983:130) analysis of subsistence data from Black Mesa has lead her to conclude that the area's occupants were never fully dependent on cultivated foods. Sullivan (1987, 1992) has also argued that corn may not have played the all important role in Anasazi diet as traditional views of southwestern subsistence claim.

Models which posit a transition from a modified hunting and gathering mode of subsistence to a subsistence system based on agricultural production often propose increasing agricultural intensification through time. Agents thought to have initiated agricultural intensification include: social organization, population growth and environmental change (Dean *et al.* 1985:549). F. Plog (1979:112) cites indirect evidence from water and soil conservation facilities as an indication that the Anasazi were intensifying their agricultural production by A.D. 1000. The existence of large aggregated settlements at approximately this time has been interpreted as evidence that a new form of socioeconomic organization had occurred, which included agricultural intensification (Upham 1982:111).

The opposite development has also been suggested, that is, through time many Anasazi groups diversified their subsistence base as opposed to intensifying one part of it. The continued

presence of wild food resources in archaeological sites throughout the Anasazi tradition is often cited as evidence of subsistence diversification (Woosley 1980:321).

The Pueblo III regional abandonments have been and continue to be an important area of research in Southwestern archaeology. The explanation of these events is undoubtedly complex, relating to subsistence, as well as a number of other factors. The subsistence data presented here will be examined for changes in diet which may be linked with the area's depopulation.

In any discussion of subsistence and diet it is important to have an understanding of the environment in which people had to make a living. Therefore, the second section of this thesis provides a brief introduction to the Anasazi area and its climate. This section also discusses the chronological periods and the different branches of the Anasazi referred to in this thesis.

The third section takes a step away from the American Southwest and discusses human subsistence systems in general. This section briefly outlines the different cultural components which are affected by the subsistence system and in turn affect the subsistence system itself. Diet, reconstructed here for the Anasazi, is the end product of the subsistence system. The information presented in this section is important for understanding how the reconstruction of prehistoric diet can assist in addressing questions related to other components of culture.

The fourth section of this thesis provides a brief discussion of historic and modern Pueblo subsistence. Although the Pueblo way of life underwent a number of changes during the historic period, these data provide information on components of the subsistence system which archaeology cannot address. Such information may also be useful in understanding the presence of some food resources in the prehistoric diet.

The fifth section contains the subsistence data analyses. This section is organized into four parts, one for each type of evidence: faunal analysis, flotation and pollen analysis, coprolite analysis and stable carbon isotope analysis. Within these parts the data are brought together for each branch of the Anasazi, as well as synthesized as a whole.

The summary discusses the major patterns observed in the Anasazi diet and discusses the research questions. Finally, recommendations are made regarding lacunae in the data and further avenues of research are discussed.

ENVIRONMENTAL BACKGROUND AND THE ANASAZI TRADITION

Commonly referred to as the Northern Southwest, the Anasazi area (Figure 1) is primarily located in the Colorado Plateau physiographic province. The Anasazi occupation also extended, to a lesser degree, west into the Basin and Range province and east into the Southern Rocky Mountains and Great Plains provinces (Cordell 1984). The area is characterized by considerable geographic and climatic variability.

The Colorado Plateau is an extensive highland area of uplifted sedimentary formations with a limited number of igneous protrusions (Lipe 1983:442). Considerable topographic variability exists within the plateau. The majority of it lies between 1500 m and 2100 m, while in the highest areas elevations extend above 3657 m (Cordell 1984:23). The Colorado River and its numerous tributaries constitute the primary drainage system for the Plateau. These rivers and numerous other drainages have become deeply entrenched, cutting vertical walled canyons into the sandstones comprising the Plateau. Only a limited number of these drainages flow all year round. Other drainages periodically carry rainfall or snow melt from higher areas (Lipe 1983:422). Although permanent drainages are absent in some areas, many of the local sandstones are excellent aquifers. Numerous springs and seeps exist in canyons at the interface between the porous sandstones and impervious layers of rock (Lipe 1983:422).

The extensive topographic variation of the Plateau has a notable influence on floral and faunal communities (Plog 1979:110). The dominant plant communities include the Great Basin Conifer Woodland, characterized by juniper - pinyon forest primarily between 1500 and 2300 m and Plains and Great Basin Grasslands generally located above 1200 m elevation (Brown 1982a,b). Higher elevations are characterized by ponderosa pine and mixed coniferous forest. Drainages in all elevation zones are lined with riparian plant communities, including water - loving plants such as willow and cottonwood.

To the west and south of the Colorado Plateau, roughly parallel ranges of mountains separated by broad basins characterize the Basin and Range province (Hunt 1974, Cordell 1984). The province is quite arid as the large mountains to the west tend to trap most of the water

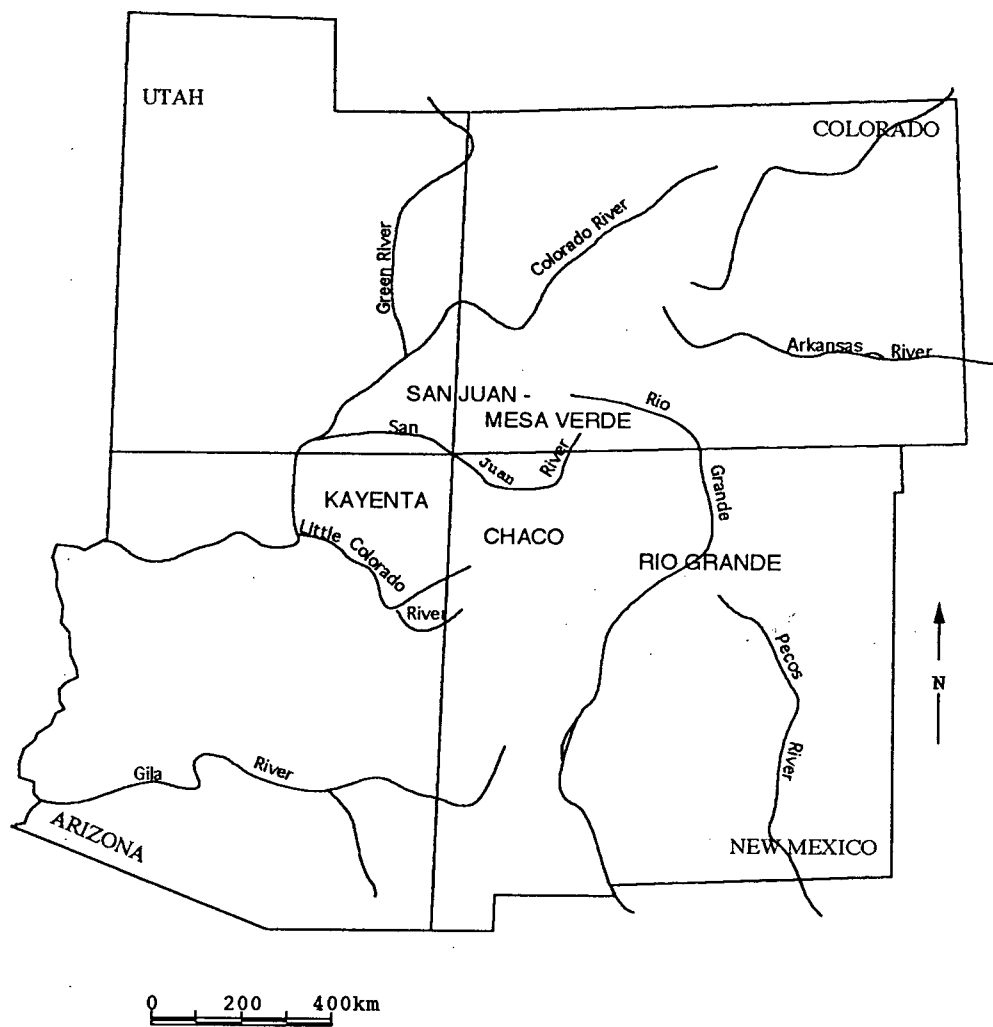


Figure 1. Location of the Anasazi branches discussed in the text.

carried from the Pacific by storms. On the eastern side of the Colorado Plateau are the Southern Rocky Mountains and Great Plains provinces. The Southern Rocky Mountains has considerably more moisture and with elevations ranging up to 4267 m the region is characterized by somewhat cooler temperatures (Cordell 1984, Lipe 1983). People concentrated in the lower regions of this province where the environment was similar to that of the Plateau. The Great Plains province is characterized by low topographic relief. Elevations generally range below 2133m (Cordell 1984:24).

The climate of the American southwest is generally arid. Moisture in the Anasazi area is derived from two precipitation patterns (Lipe 1983, Cordell 1984). In the west, during the months of July and August, moisture comes from the Gulf of Mexico as heavy rains. There is a second peak in precipitation, brought by storms from the Pacific Ocean, between December and March. The eastern area, New Mexico and Colorado, has a single peak in precipitation, originating from the Gulf of Mexico, during the June, July and August monsoon. The amount of precipitation received is highly localized and variable from one year to the next.

The regional diversity which existed among the Anasazi people and the area they inhabited, both in terms of material culture and local environment, has long been recognized by archaeologists. Cordell and Plog (1979) have argued against studies which ignore the diversity in Anasazi economic, cultural and organizational patterns, by making broad generalizations which are held to apply to the entire Anasazi area. In their contributions to the *Handbook of North American Indians: The Southwest* (Ortiz 1979), Plog (1979) and Cordell (1979) have divided the area into the Western and the Eastern Anasazi respectively. Similarly, distinctions between the material culture in different regions of the Anasazi area have resulted in the definition of a number of branches of Anasazi people.

In this thesis I intend to develop a synthesis of Anasazi diet by bringing together a number of lines of evidence from across the Anasazi area. To ignore the regional diversity which has been recognized throughout the area, however, would be to commit a serious mistake. I will therefore incorporate this diversity into my synthesis of Anasazi diet. A number of different branches of the Anasazi have been identified throughout the Northern Southwest.

Many of these branches had shifting boundaries and a limited temporal existence. This thesis will consider the regional diversity recognized in the Anasazi tradition in terms of the four major branches agreed upon in most of the literature: Kayenta, San Juan - Mesa Verde, Chaco, and the Rio Grande.

The Kayenta branch area used in this thesis consists of northeast Arizona from the Little Colorado River to the Utah border and parts of southern Utah below the San Juan River. Gumerman and Dean (1989) note that a number of smaller cultural units, such as the Tusayan, have been defined within this area, however, enough similarity exists that they can be incorporated within the Kayenta branch.

Centered around the Mesa Verde itself, the Mesa Verde branch of the Anasazi includes most of southwest Colorado and part of southeastern Utah. Rohn (1989) refers to this region as the Northern San Juan and states that Mesa Verde is only one subdivision within the region. In the following sections I refer to this branch as the San Juan - Mesa Verde.

The Chaco branch is a unique occurrence in the Anasazi tradition. The name Chaco itself is taken from Chaco Canyon; however, the branch as concerned in this thesis covers a much greater area. Chaco Canyon was at the center of what has been referred to as the Chacoan Phenomenon and the Chacoan System (Judge 1989). The Chacoan Phenomenon was an extensive system of sites, sharing a similar architectural style and material culture, all connected with Chaco Canyon by a system of roads. Vivian (1990) traces Chacoan beginnings to the Archaic and Basketmaker periods. Development of the Chacoan system began in the early decades of the tenth century, and over the next two and a half centuries the great houses, Chacoan outliers and road system were constructed. The Cibola area to the south of Chaco Canyon, was under the influence of the Chacoan system (LeBlanc 1989:347). By the middle of the twelfth century the Chacoan system had come to an end (Vivian 1990). However, there is evidence of a Mesa Verdian reoccupation of many Chacoan sites during the end of the twelfth and beginning of the thirteenth century (Vivian 1990).

The Rio Grande branch of the Anasazi inhabited the area around the Rio Grande Valley and surrounding areas to the east of the Chaco branch. Compared with the other branches of Anasazi the Rio Grande area is much better supplied with running water (Cordell 1989:297).

SUBSISTENCE SYSTEMS AND DIET

The constraints placed on the human body by its biological requirements for essential nutrients makes the subsistence system a critical component of human life. Steward (1955:37) regarded subsistence as the central element of the culture core. Dennell (1979:122) has defined subsistence as the procurement of resources needed to assure the survival of a community. Among most cultures subsistence - related activities consume the better part of each day (Roosevelt 1987, de Garine and Harrison 1988b). It is the complex interaction of environment, technology, sociopolitical organization and ideology which defines the subsistence system of all cultures.

The environment places constraints on the types and frequency of food resources available to people and thus has a strong hand in determining the nature of the subsistence system. The seasonal availability of certain resources further complicates the food quest and may lead to periods of shortage (de Garine and Harrison 1988b:469).

The technology used has the potential to dramatically increase the obtainable yield (de Garine and Harrison 1988a, Wing and Brown 1979). The adoption of agriculture, for example, will allow people to produce quantities of food resources previously not available. New agricultural technologies, such as irrigation, allow a community to further increase the yield. The success of new technologies is of course still limited by the environment to some degree. If agriculture is to be successfully practiced, adequate soils, temperature regimes, and precipitation must first be present in the environment. Storage is perhaps one of the most important types of technology included in many subsistence systems. It is the primary means by which cultures are able to cope with seasonal fluctuations in resource availability. It is important to note that technology may lead to changes in the environment (Steward 1977:50). There are a number of different technologies which may have this effect. Some practices result in an increase in

potential resources, such as the increase in edible weeds which thrive in disturbed areas (Bye and Shuster 1984, Ford 1984), and rodents attracted by the production of cultigens (Seme 1984).

A culture's socio-political organization influences subsistence systems through interactions with environment, technology and ideology. Socio - political organization refers to the size of groups in which people live, the organization of people within those groups and the relations these groups have with neighboring peoples. Both environment and technology place constraints on socio - political organization. To a degree technology influences the social organization; Steward (1955:171) has suggested that changes in technology resulting in increased food supply was one of the first steps in the change from lineage based societies to that of clans. There is a limit to the number of people who can make a living within any one location with a given technology. This limit has been termed the carrying capacity (Zubrow 1971). The adoption of agriculture or of technology which intensifies agricultural production are mechanisms for increasing the carrying capacity of the environment. In larger populations members of a group may be obligated to spend a set amount of time contributing to the subsistence of others as well as than their own. Among the Hopi, for example, a chief's fields were cultivated by voluntary work parties (Forde 1931:376).

Interaction between populations can have both positive and negative effects on their subsistence systems. Favorable trading relationships can provide populations with both a means of acquiring food during periods of resource stress and obtaining foods not locally available, thereby increasing the diversity in the diet. Just as favorable trading relationships are often built into a subsistence system, the same system may be required to include mechanisms to buffer against negative relations with neighboring groups. The loss of extracted subsistence resources to raiding parties from other populations is an example of a negative relationship.

Another aspect of socio-political organization, which leads us to the discussion of the effects of cultural beliefs on subsistence systems, is the practice of food sharing. The distribution of food within a population, may provide food to people in the group who are unable to obtain their own or who are involved in other activities which preclude their involvement in the food quest. The nature of food distribution within a population may, however, deprive

certain groups of the population of specific resource types. Rarely are food resources distributed equally to all members of a population (Roosevelt 1987:574). Inequality may be variously oriented along the lines of gender, age or status. The embedded patterns of food distribution within a culture serve to proclaim and maintain the prevailing status and power structure (Ross 1987:19).

Cultural beliefs have substantial influence on subsistence systems. The nature of the environment may define what resources are potentially available as food, but the resources which are actually used is largely decided by what the culture considers edible. Although food resources are not chosen solely on their nutritional qualities, food is recognized as critical to maintaining life. Cultural beliefs and ceremonies associated with the procurement of sustenance are often closely followed so the food supply is not endangered (Wing and Brown 1979:16). Such traditions may concern the procurement of resources from the environment, their treatment during preparation and their consumption.

The preceding paragraphs have outlined the effects of four factors on the nature of human subsistence systems: environment, technology, sociopolitical organization and ideology. Dennell (1979:122) has defined diet as simply what is eaten. From this point of view diet can be considered the product of the subsistence system. Any given diet can be viewed as consisting of a core set of food resources which provide the bulk of the diet and meet the majority of the nutritional requirements, and a variety of other food items which are consumed only occasionally and in small quantities. Gasser (1982:8) has defined dietary staples as resources which were widely exploited and used consistently through time. Staple food items must be relatively easy to obtain on a regular basis and in substantial quantities. Secondary resources are likely to be those with restricted availability, both spatially and seasonally, limited in their quantity and with poor storage possibilities.

Attempts to reconstruct prehistoric subsistence systems and diet by archaeologists have met with varying levels of success. There are numerous lines of archeological evidence which provide data on Anasazi subsistence. Dean et al. (1985), among others, have reconstructed the prehistoric environment. The remains of prehistoric technology are perhaps the most visible

indication of subsistence systems open to the archaeologist. Less information is available on the remaining factors influencing the Anasazi subsistence system. It has proven difficult to gather information on Anasazi socio-political organization and there is presently no way to archaeologically reconstruct the effects of Anasazi cultural beliefs on their subsistence system. One can, however, make analogies with historic Pueblo cultures.

ETHNOGRAPHIC PUEBLO SUBSISTENCE AND DIET

Ethnographic literature from historic and modern Pueblo peoples provides a range of information useful in the reconstruction and understanding of prehistoric subsistence systems. The ethnographic information collected by early ethnologists contains many references to wild resources, once part of the subsistence system, but have since fallen from the menu. These same volumes also contain a variety of other information regarding subsistence systems which may provide the archaeologist with possible explanations for observations made in the archaeological record which defy explanation in that context alone. This is not to say that we may simply take data from the present Pueblos and use it uncritically to explain what we observe in the archaeological record; only that it may offer ideas and hypotheses regarding that which did not preserve.

The Puebloan peoples first came into contact with members of the European cultures in the middle of the sixteenth century A.D. During their occupation of the American Southwest the Spanish, the first Europeans to come into contact with the Puebloan peoples, introduced a variety of new food resources which initiated substantial changes to the traditional Pueblo subsistence system and diet. A number of domesticated plants were introduced, including wheat, oats, peaches, apples, chile, peas and several new varieties of beans (Robbins *et al* 1916:76). The Spanish also brought domesticated sheep into the Southwest. The initial use of these resources eventually led to the disuse of many wild plant and animal species. With the incorporation of the Southwest into the United States more changes in the Pueblo subsistence system and diet began to take place. Unlike the Spanish, the Americans did not introduce new food resources the Pueblo people could produce themselves. Instead the Americans brought to the Pueblos pre-

processed foods, such as sugar. Unable to produce these goods for themselves the Pueblo peoples were drawn into a cash economy, which induced further changes in their subsistence system.

Considering the lengthy period of contact between Puebloan and European peoples, and the substantial changes associated with that contact, one may question the use of Pueblo ethnographic material in the study of prehistoric diet. Writing in 1939, Whiting (1966:11) has noted that although the Hopi were receptive to the introduction of new cultigens, the general substance of their agriculture remained relatively constant.

Data from the ethnographic record are present for six aspects which may be important to our understanding of prehistoric Anasazi subsistence systems: (1) wild resource utilization and food preparation, (2) agricultural technology and schedule, (3) storage, (4) food redistribution and trade, (5) utilization of resources for purposes other than food and, (6) the inclusion of food items in ritual. The relationship of these aspects to the preceding discussion of human subsistence systems and to Anasazi diet will be discussed in detail below.

As noted in the introduction, archaeologists have a number of methods which will indicate the resources, or at least many of the resources, which comprised the diet of prehistoric people. These methods generally do not indicate the ways in which the different resources were used. That is, we may know from the archaeological record that corn and beans were eaten, but we do not know how these foods were prepared and in which form they were eaten. This type of information is available to archaeologists in the ethnographic literature, and will receive limited discussion here.

The traditional subsistence system of the Pueblo Indians as it is represented in the ethnographic literature includes a wide array of plant and animal species, many of which were utilized by the Puebloans for purposes other than eating. Whiting (1966), lists one hundred and twenty-eight plants used by the Hopi, excluding introduced species; fifty-one of these plants were consumed as part of the diet. Robbins et al. (1916) list a total of seventy plants (excluding introduced species) used by the Tewa for a range of purposes; thirty-four of these plants were recorded as food items. Gnabasik (1981) has undertaken the task of sifting through much of the

Pueblo ethnographic literature for references to the use of animal species. Specific references were found for twenty-eight mammals, thirty-five birds and four reptiles and amphibians. Mention was also made of the use of certain insects or their products, and in the Rio Grande region, fish were noted. Gnabasik (1981) indicates twenty mammals, seven species of birds and two reptiles which were used as a source of food by the Pueblo peoples. Appendix 1 presents each of the species indicated in these sources and the various uses to which each was put.

Substantial data are also available on the methods of preparation and consumption of many of these resources. Cushing (1920) notes six ways corn is prepared and eaten by the Zuni: fresh, corn-flour, parched, baked, roasted on hot coals and boiled. A number of these forms are then used as ingredients in other products or meals. One of the primary constituents of the Pueblo diet is a form of wafer-bread; among the Hopi it is called *piki* (Whiting 1966:15), the Zuni equivalent is *hé-we* (Cushing 1920:564), and to the Tewa it is *Mowa* (Robbins *et al.* 1916:88). The purpose here is not to demonstrate the importance of corn in the diet of the historic Pueblo peoples, but to examine the effects of the different methods of preparation with respect to visibility in the archaeological record. If much of the corn consumed on a daily basis was used as flour in different types of bread we would perhaps expect complete digestion and thus little evidence of that corn in coprolites. Reinhard (1988), however, states that even when corn has been ground identifiable portions are still present. Corn kernels eaten whole, either fresh, baked, parched or boiled, may be less susceptible to complete digestion, and thus there is likely to be more evidence of them in coprolites. The Zuni ground numerous other plant foods into meal to be used in bread-making, these include: cactus fruits, juniper berries, pinyon nuts, acorns and sunflower seeds (Cushing 1920).

Other plant species used as food by the Puebloans were picked and eaten as greens (Whiting 1966). Among the Hopi, many of these greens were collected from specific plants in the spring when the new growth was present. Other plant species were used as herbs or seasonings. These include, purslane, beebalm, tansy mustard, wild onion, tomatillo and mint (Whiting 1966:19). These species may appear in limited amounts in the archaeological record. Beverages were made from different parts of a number of plants. The Hopi used both the berries

of sumac (or squawbush) and mistletoe for this purpose (Whiting 1966:20) and the Zuni often made warm drinks with corn-meal.

Bradfield (1971:21) concluded that the Hopi required approximately two and a half acres of farm land per person to provide the required amounts of food. The primary constraints he found placed on the Hopi farmer were those of having to locate fields in adequately watered areas with decent soils and enough time between the spring and fall killing frosts for the crop to mature. In the western Pueblo area (including Zuni, Hopi, and Acoma) farmers had to rely on rainfall, run-off, and springs for their water and thus had to locate their fields to obtain the maximum benefit from these sources (Jorgensen 1983:687). Farmers from the eastern pueblos were able to locate their fields and gardens near the banks of the Rio Grande or one of its tributaries.

Working with the Hopi, Hack (1942:8) found that a growing season of approximately 130 days, in an area with around twelve inches of rain annually, is required for successful dry - farming of corn. The Hopi (using dry - or floodwater farming at higher elevations) do not plant their main corn crop until the last weeks of May, along with the years bean and squash crops, to avoid the last frosts (Forde 1931:385). Spring is one of the driest periods of the year, requiring that the corn be planted deep enough to utilize winter moisture retained well below the ground surface, until the summer rains begin (Bradfield 1971:4). Early corn crops are planted by the Hopi during the month of April, this corn is planted for the *nimankatcina* ceremony, and is harvested green at the end of July. The main Hopi harvests begin in the early days of September. Beans and squash are harvested first and then the main corn crop is brought in through the rest of September and early October (Forde 1931:393). The Tewa along the Rio Grande (at a lower elevation and with the use of irrigation) plant their corn crops in April and begin the harvest near the end of September and continue on through the first weeks of October (Robbins et al. 1916:82-83). No major changes in the climate and environment of the American Southwest have occurred within the last two thousand years (Lipe 1983:421), thus it is probable the prehistoric Puebloans had to work within similar environmental constraints and likely had a

similar schedule as the historic Pueblos. Between planting and harvesting, the fields would have to be weeded and the young plants protected.

Storage was an important part of the Pueblo subsistence system. Food was stored both for winter use and as insurance against crop failure. Bradfield (1971:21), Forde (1931:393) and Hough (1897:35) all state that the Hopi stored large quantities of corn to support them in the following year should the crops of the present year fail. Hough has stated that a two year supply of corn was put away; Bradfield notes only a single year supply of corn in storage. Forde appears to suggest that as the Hopi people became more involved in the American cash economy, corn stored for the event of a crop failure became more of an ideal than a reality. Corn was stored either on or off the cob (Whiting 1966:15), generally in small rooms specifically for that purpose. A variety of other food resources were stored to add variety to the diet during the winter months. Cushing (1920) refers to jerked meat and the preparation of wild onions and cactus fruits for storage. Undoubtedly the list of foods which were put aside for winter from year to year was quite substantial.

Interaction with kinfolk, neighbors from the same pueblo, nearby villages, and people from distant areas helped avoid periods of food shortage and in obtaining non-local resources (Ford 1983:722). During the historic period the Hopi maintained trading relationships with the Zuni, Havasupai and the Navajo (Kennard 1979:559). Similarly, the Plains tribes east of the Colorado Plateau would often undertake trading expeditions to the pueblos (Ford 1983:713). Both wild and cultivated foods were important items in these trading relationships.

Social networks of exchange and food redistribution were important aspects of the relationships within each pueblo. Ford (1983:716) notes that borrowing and sharing food was a constant part of pueblo life. Some of the most important exchanges of food within a pueblo occurred in conjunction with ceremonies. Kinfolk would cooperate when arranging feasts and individuals who provided ceremonial services received food as payment, primarily corn-meal (Ford 1983; Kennard 1979).

The Puebloan peoples depended on the resources in their environment for more than food alone. Many species which were eaten served two or more purposes, such as medicine,

construction material, raw material for tool manufacture or were ritually important. In her study of ethnographic pueblo faunal utilization, Gnabasi (1981) found reference to seven avian species which were eaten, and twenty-five species of birds which were important for ceremonial purposes. These birds were captured or killed for their feathers, which are required for many of the Pueblo ceremonies. Similarly, Whiting (1966) found that the number of plant species which were used as medicine by the Hopi equaled the number of different plants used as food. Use of both plant and animal species for purposes other than food are identified in Appendix 1 (Tables A and B).

In summary this section has discussed six aspects of Puebloan subsistence with regards to data from the ethnographic literature: (1) wild resource utilization and food preparation, (2) agricultural technology and schedule, (3) storage, (4) food redistribution and trade, (5) utilization of resources for purposes other than food and, (6) the inclusion of food items in ritual. It is apparent that cultivated crops, particularly corn, were very important to the historic Puebloan people. Whiting (1966:5) has remarked that the Hopi have oriented all their ceremonies around the well-being of the pueblo, which would necessitate a successful harvest. He refers to corn as the "giver of life" (Whiting 1966:8), and notes that Hopi philosophy and religion were centered around it. Cushing (1920:18) has made this same statement for the importance of corn in the life of Zuni Pueblo. Many of the plants and animals within the Puebloan's environment, particularly those used for food play key roles in Pueblo ceremonial life. As noted above food was often used as payment for ceremonial services, however, the involvement of food in pueblo ceremony goes beyond this. Yucca suds are important for ritual cleansing, and a variety of plant species are involved in ceremonial smoking (Whiting 1966:41). Certain species are used as symbols for other things, for example, water may variously be symbolized by the likes of rushes, cattails or willows (Whiting 1966:43).

ARCHAEOLOGICAL REMAINS OF ANASAZI DIET

INTRODUCTION

In this section data from four independent lines of archaeological evidence, faunal, paleobotanical, coprolite and staple carbon isotope analyses, are examined to address the three research questions outlined above. A space-time framework which divides the Anasazi people into four branches and the Anasazi tradition into a series of occupation periods, is used to allow comparisons of diet between the different areas and through time. Spatially the Anasazi are considered in terms of the four branches discussed above: Chaco, Kayenta, San Juan - Mesa Verde and Rio Grande. The environments in each of these areas differed and may have affected the diet of the inhabitants.

Chronologically the analysis follows the periods outlined by the Pecos Classification (Kidder 1927), which divides the Anasazi tradition into three Basketmaker and five Pueblo periods. Here we are only concerned with the Anasazi occupation between the Basketmaker II and Pueblo III periods (Basketmaker II 500 B.C.-A.D. 500; Basketmaker III A.D. 500-A.D.750; Pueblo I A.D. 750-A.D. 900; Pueblo II A.D. 900- A.D. 1150; Pueblo III A.D. 1150-A.D.1300). Only sites reported with relatively precise chronological information were included in the analysis. Occupation episodes identified only as 'Pueblo' or 'Basketmaker' were avoided, as were reports which presented faunal remains as a single assemblage from sites with more than two occupations, or occupations which were not continuous. The original intention was to use only the five standard periods of the Pecos classification, however, due to problems with the availability of numerous reports and other requirements of the data discussed below, it was necessary to include some combined periods such as Pueblo II-III, to expand the number of sites in the analysis. Although these combined periods are referred to as periods in the text, they are not true periods in and of themselves in the sense of the Pecos Classification periods.

The sites from which data are taken vary from one type of evidence to the next as does the number of sites used in each analysis. Criteria for the inclusion of sites into this study exist on two levels, the study as a whole and each individual analysis. The sites used in this thesis are not the total of Anasazi sites investigated by archaeologists, but are those which were obtainable

within the time-frame allowed for this study. Following this each site had to be placed in one of the time periods just discussed. The analysis of each line of archaeological evidence has different limitations and data requirements. These specific criteria are discussed in the relevant sections below.

In the following subsections the analysis of each line of evidence examines the diet of each branch and time period as well as between branches and through time. Each subsection is divided into a brief note on methods, a discussion of the results of the analysis, a summary and short discussion on the implications of the findings to the research questions.

FAUNAL ANALYSIS

Assessing the relative importance of the animal taxa present in a faunal assemblage to the prehistoric inhabitants diet is a common practice in archaeology. Occasionally results from neighbouring sites are compared. Less common are studies which take a regional focus, such as Leonard's (1986, 1989) research on Black Mesa faunal assemblages and Neusius' (1986) analysis of faunal exploitation in the Dolores area of southwestern Colorado. The present analysis examines faunal assemblages from sites across the Anasazi area. Each of the four Anasazi branches discussed above are represented in the eighty-four assemblages included in this study (Appendix 2, Table A). This section is aimed at identifying animals, or groups of animals which were staple resources in the Anasazi diet.

Methods

The majority of the data used in this analysis are derived from individual sites. The exception is the material recovered from the Dolores Archaeological program excavations which Neusius (1986) has heretofore synthesized. These data are used here in their synthesized form, allowing the inclusion of the substantial body of data from the Dolores area. However, as discussed below, use of the data in this form also creates an inconsistency.

The measure of taxonomic abundance used in the following analysis is the number of identified specimens (NISP). The number of identified specimens has been chosen over the minimum number of individuals (MNI) due to a number of inherent problems, discussed by

Grayson (1984), with the latter measurement. Only faunal assemblages which were reported as full data sets, including mammals, birds and herpetofauna, were included in the analysis. Taxa such as 'Mammalia' or 'Aves', did not offer useful information to this analysis and have been excluded. Some general taxa, such as small, medium and large mammal and large bird, have been retained. These groups can be compared to more specific taxa based on general size, for instance low relative frequencies of taxa such as deer, antelope and Artiodactyla may be balanced by high relative proportions of large mammal elements. Medium mammal is the most problematic of these taxa, as analysts will have different animal size cut-offs for the taxon, resulting in the possibility of some overlap.

Faunal assemblages recovered from sites where screening was not part of the excavation procedures have been excluded from the analysis. The lack of screening produces an obvious bias against the recovery of small animal remains. However, the mesh size of screens used in excavations varies as will their potential to recover small remains. Leonard (1989:18), citing evidence from Eckles (1978), notes the bias against small mammals, relative to large mammals with the use of 1/4 inch screens. Experiments by Thomas (1969:394) indicate that as much as 90% of small rodent bones may not be recovered using 1/4 inch screens.

Very low NISP values for faunal assemblages can have an immense effect on relative taxonomic abundance (Grayson 1984). To account for this effect, assemblages which have an NISP of less than fifty have been excluded from this analysis. Admittedly this value was arrived at somewhat arbitrarily, however, attempts to use Grayson's (1984:122) methods for determining an appropriate cut-off did not produce useful results. The cut-off used for this analysis is viewed as a compromise between removing very small assemblages and maintaining as many sites as possible in the analysis. The mean relative frequencies used later in the analysis would be profoundly influenced by assemblages with only one or two identifiable specimens (where relative frequency could equal 100%).

A master taxonomic list was initially compiled from the data given in each of the reports used. Many of the taxa reported occurred in very small numbers, yet the possibility remains that these taxa may not have been important on a species basis, but were part of a larger group which

was important. An attempt was made to retain these specimens in the analysis by grouping taxa based on biological relationships (i.e., low frequency species were grouped into a similar taxon of the appropriate genus). This reduced the original faunal list to seventy-nine taxa, many of which were still represented by very low frequencies. Almost 60% of the taxa were represented by relative frequencies of 1% or less, and their occurrence throughout the assemblages examined was by no means consistent.

Although each of these taxa contributed to the diet of a site's occupants, the goal here is to identify the animals used consistently by the Anasazi across time and space. Therefore, the analysis was confined to those taxa which have the potential to have been dietary staples. Taxa represented by at least 4% in either of these two calculations discussed below, were thus selected for further analysis (these taxa are shown in Figure 2).

Leonard (1989:41) has suggested that prior to an analysis of changes in relative taxonomic abundance through time it is necessary to examine the variation which exists between sites within a single period. What appears to be changes in abundance from one period to the next may be the result of the varying assemblage sizes. The linear regression approach outlined by Leonard (1989) was used to examine the periods within each branch represented by an adequate number of sites for sample size effects. This test is limited to two taxa, cottontail rabbits and jackrabbits, as they appear to be the two most abundant taxa in the majority of assemblages. Leonard's (1989:45) regression approach is based on the assumption that the NISP of cottontail, for example, will increase as the total assemblage NISP (or sample size) increases when sampling from a mixed population consisting of groups with varying frequencies. This assumption is based on the collectors curve which postulates an increase in the number of taxa recovered with an increase in sample size.

The results of this test indicate that (in some periods) the variation in the relative abundances of cottontail and jackrabbit may result from sample size effect. However, in other periods the regression analysis shows an insignificant relationship between taxon NISP and sample size. Results were also obtained indicating sample size was responsible for variation in one of the two taxa, but not the other. In sum the results were somewhat ambiguous, but do

indicate the potential for sample size effects between the assemblages used here. Plog and Hegmon (1993), however, have cautioned against simply accepting significant correlations as evidence that sample size effects are responsible for the observed variation between individual sites.

Initially two methods were used to obtain a single value for the relative abundance of taxa in each period from each branch: (1) sum the NISP for each taxa from all sites in a period and divide by the sum of assemblage NISPs, and (2) the mean relative frequency for each taxon by period. Summing taxon NISP from each site and dividing by the sum of assemblage NISPs essentially produces a single assemblage, with greater influence given to the larger original assemblages. Mean relative frequencies, calculated by summing the relative frequency of each taxon from a number of sites and dividing by the total number of sites, were chosen for this comparison over relative frequencies based on summed taxa NISPs. Mean frequencies treat each assemblage separately and do not deny variation between assemblages. This method treats assemblages of varying sizes on a fairly equal basis, although it does increase the influence of smaller sites. Very small assemblages have the most potential to affect these values. The removal of these assemblages from the analysis (see above) decreases the effect of small assemblages on the mean relative frequencies used here. As noted above, data from the Dolores Archaeological Program are inconsistent with this procedure as the data from numerous sites were already combined. The Dolores sites from each time period are thus essentially treated as one site.

Discussion

Basketmaker II

Animal exploitation during the Basketmaker II period is only represented by sites from the Kayenta branch (Figure 2). The summed relative frequencies indicate the dominance of cottontails (*Sylvilagus* sp.), followed by jackrabbit (*Lepus* sp.). The relative frequency of small mammals is also moderately high. The majority of other taxa present have low relative frequencies.

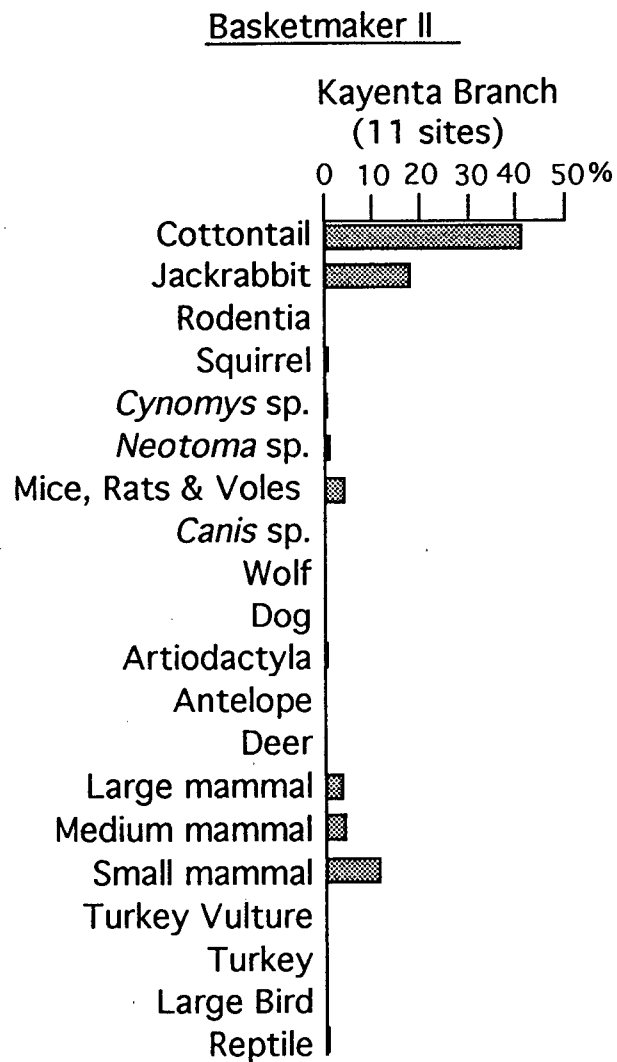


Figure 2. Relative taxonomic abundances (of taxa represented by at least 4% in any period) for the Basketmaker II period.

Basketmaker III

Basketmaker III sites from the Chaco and San Juan - Mesa Verde branches are present in this analysis. The mean relative taxonomic frequencies of these two branches are shown in Figure 3. The most striking difference between the two branches is the high relative frequencies of canids (*Canis* sp., wolf [*Canis lupus*] and dog [*Canis familiaris*]) in the San Juan-Mesa Verde branch and their near absence from the Chaco branch. The high relative frequencies of dog, wolf and *Canis* sp. result from two sites, 5LP110 and 5LP111, excavated by the Durango South Project (Anderson 1980), at which excavations recovered dog burials and the remains of a limited number of wolves. In this case it is obvious that a small number of individuals contributed considerably to the assemblage. The presence of such large quantities of these taxa will effect the abundance values for the other taxa present, relative to other sites, when the relative frequencies are calculated.

Cottontails at sites 5LP110 and 5LP111 have relative frequencies of 9% and 4.7% respectively, however, the relative frequency of cottontails in the one other assemblage for this period, Dolores Period 1, is almost double (17%) that of 5LP110. Removing the large numbers of *Canis* sp., wolf and dog bones from these sites results in a relative frequency of 28% for cottontails and 7% for jackrabbits. These values are very similar to the relative frequencies of these taxa in the Chaco branch. If all large animal taxa (Artiodactyla, antelope [*Antilocarpa americana*], deer [*Odocoileus* sp.] and large mammal) are grouped for comparison the resulting values from each branch are also very close to one another, differing by only a few percent. Removal of the canid elements from the San Juan - Mesa Verde sites, however, substantially increases the relative frequency of mice, rats and voles, in comparison to the low abundance of these animals in the Chaco branch.

Basketmaker III - Pueblo I

The Basketmaker III - Pueblo I period is represented in the Chaco and San Juan - Mesa Verde branches (Figure 4). Cottontail specimens have similar relative frequencies in both

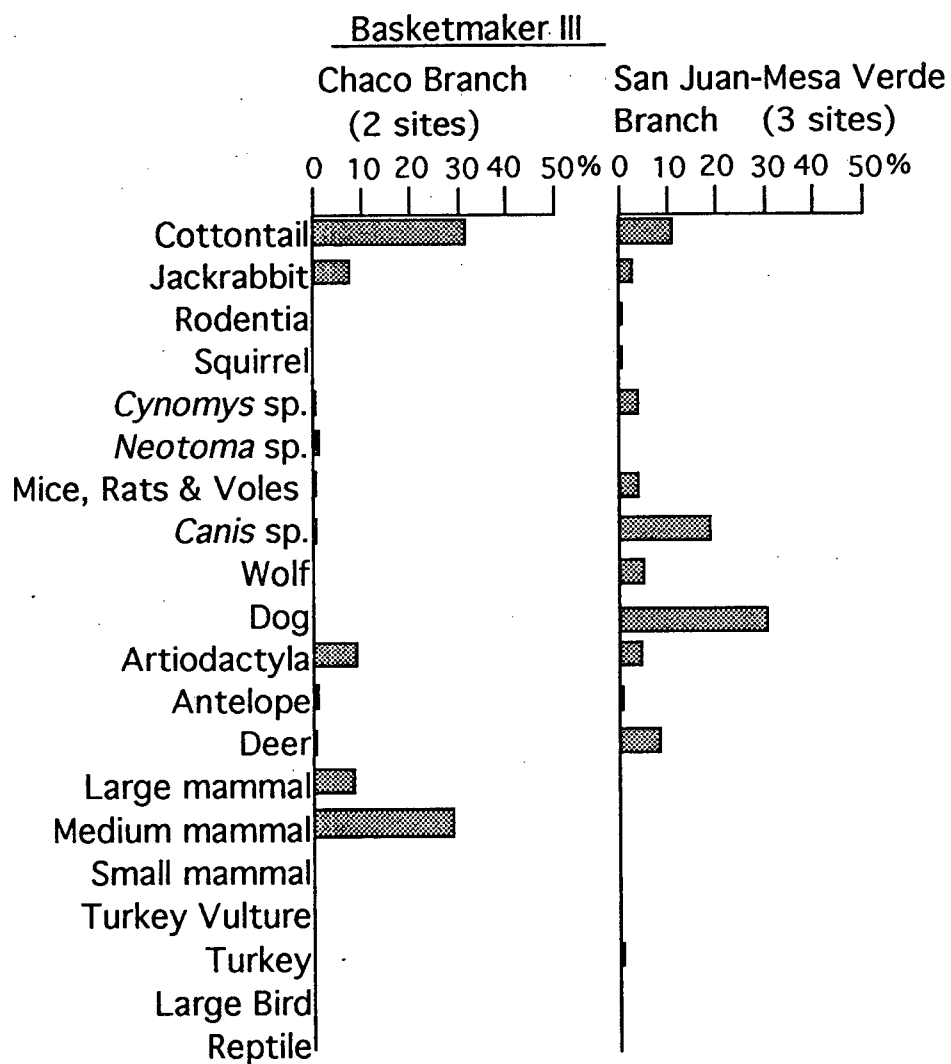


Figure 3 . Relative taxonomic abundances (of taxa represented by at least 4% in any period) for the Basketmaker III period.

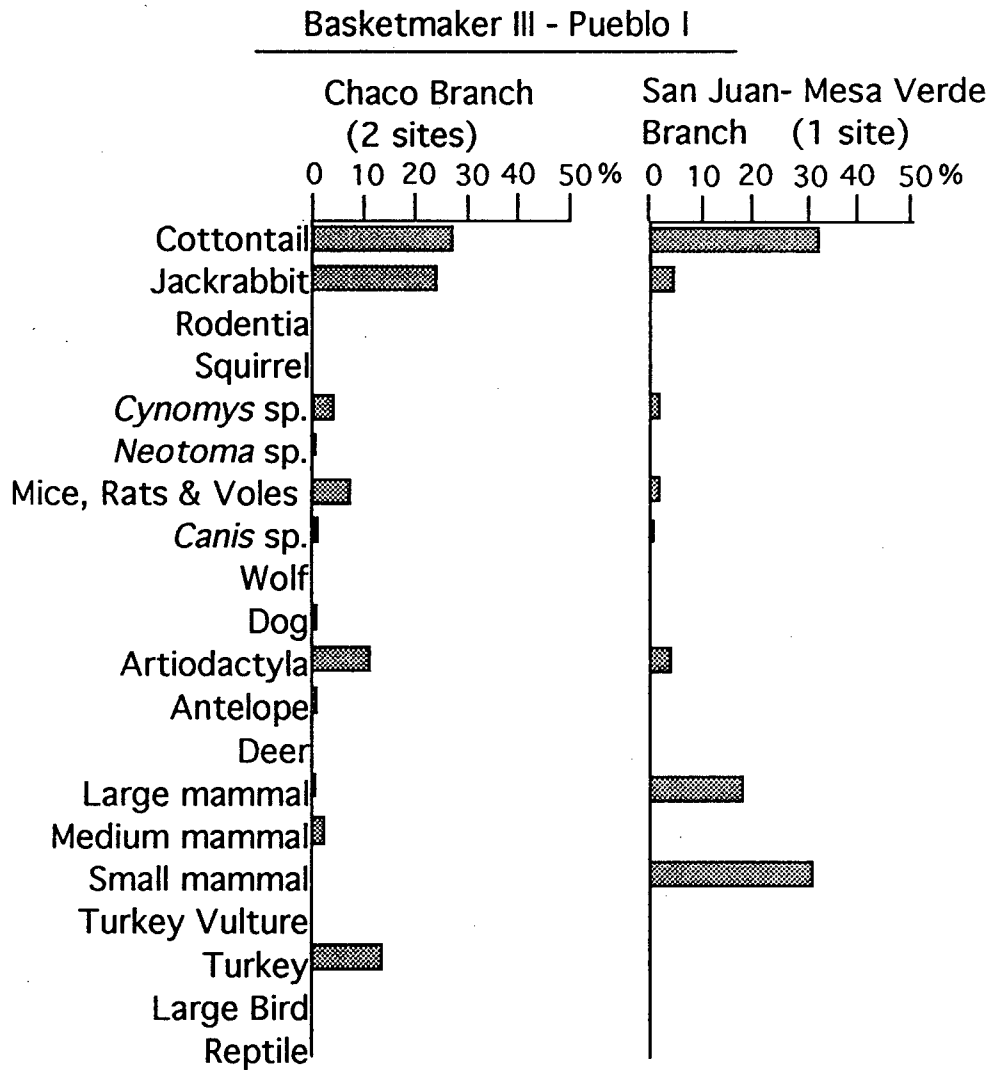


Figure 4. Relative taxonomic abundances (of taxa represented by at least 4% in any period) for the Basketmaker III - Pueblo I period.

branches. However, both jackrabbits and turkey have greater relative frequencies in the Chaco branch. The abundances of large animals in the San Juan - Mesa Verde branch is almost twice that of the Chaco branch. The general small mammal taxon is also very high in the San Juan - Mesa Verde branch, and although the relative frequencies of mice etc. and prairie dog (*Cynomys* sp.) are slightly higher in the Chaco branch they do not equal the former. The meaning of these differences must be considered tentatively as only a single San Juan - Mesa Verde branch site is present.

Pueblo I

The relative taxonomic frequencies for the Chaco, Kayenta and San Juan - Mesa Verde Branches during the Pueblo I period are portrayed in Figure 5. Immediately observable is the dominance of cottontail and jackrabbit. The lowest frequency of cottontail is in the Chaco branch, which in turn shows slightly higher representation of jackrabbits and other small rodents. The relative frequencies of the large animal taxa appear slightly higher for the San Juan - Mesa Verde branch.

Pueblo I - Pueblo II

Sites dating to the combined Pueblo I - Pueblo II period are present from the Chaco and Kayenta branches (Figure 6). The Chaco branch is represented by a single site. With the exception of the small mammal taxon in the Chaco branch, cottontail and jackrabbit specimens are the most abundant. However, it is quite likely that cottontail elements are included in the small mammal taxon. The relative frequency of cottontail for the Kayenta branch is greater than 40%. The relative abundances of Artiodactyla and large mammal are very similar in the two branches. The Chaco site shows slightly higher relative frequencies of the rodent taxa, such as prairie dog and mice, etc.

Pueblo II

The Pueblo II period is well represented by sites in the Chaco, Kayenta and San Juan - Mesa Verde branches (Figure 7). Cottontail specimens have the highest relative frequencies in all branches. Jackrabbit has a high relative frequency in the Chaco branch, however, it is significantly lower in the two other branches, both of which show higher relative

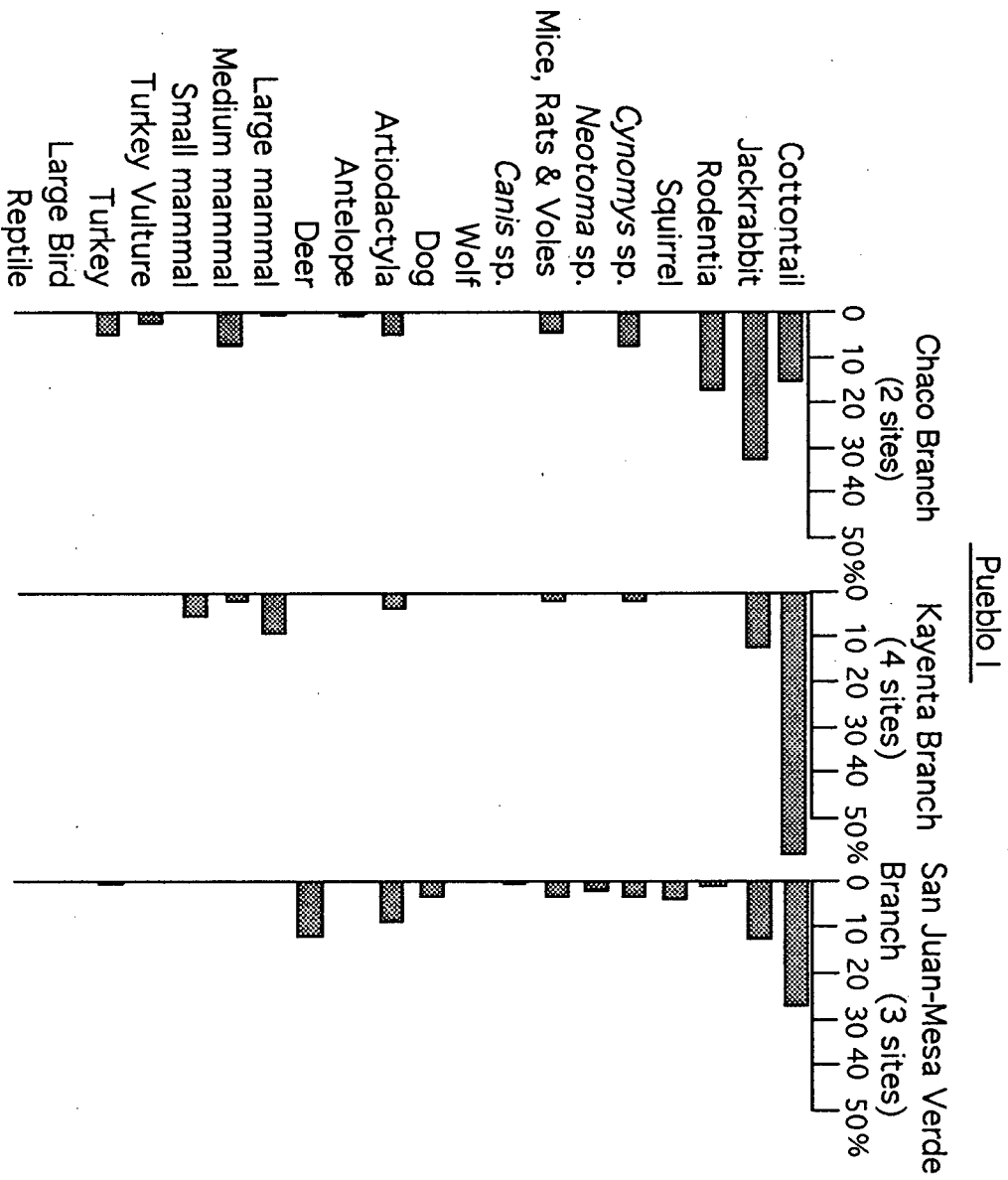


Figure 5. Relative taxonomic abundances (of taxa represented by at least 4% in any period) for the Pueblo I period.

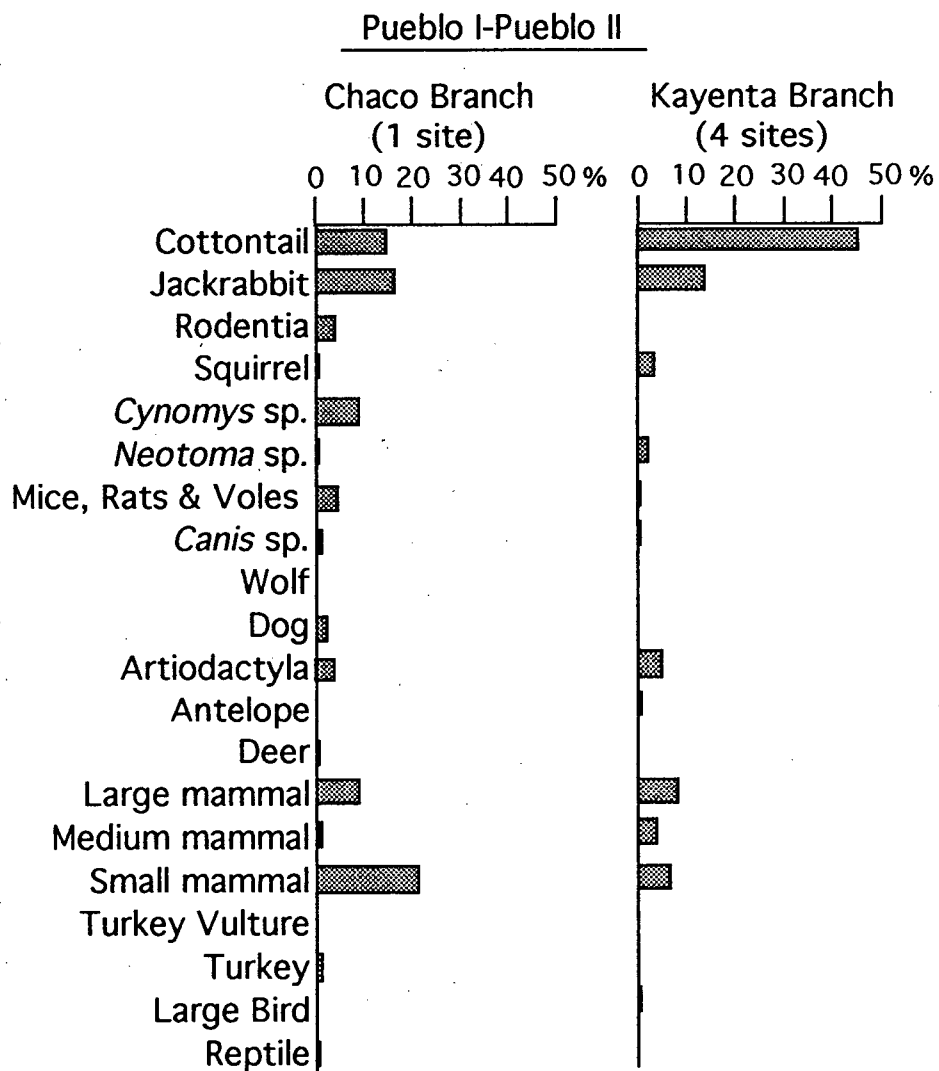


Figure 6. Relative taxonomic abundances (of taxa represented by at least 4% in any period) for the Pueblo I-II period.

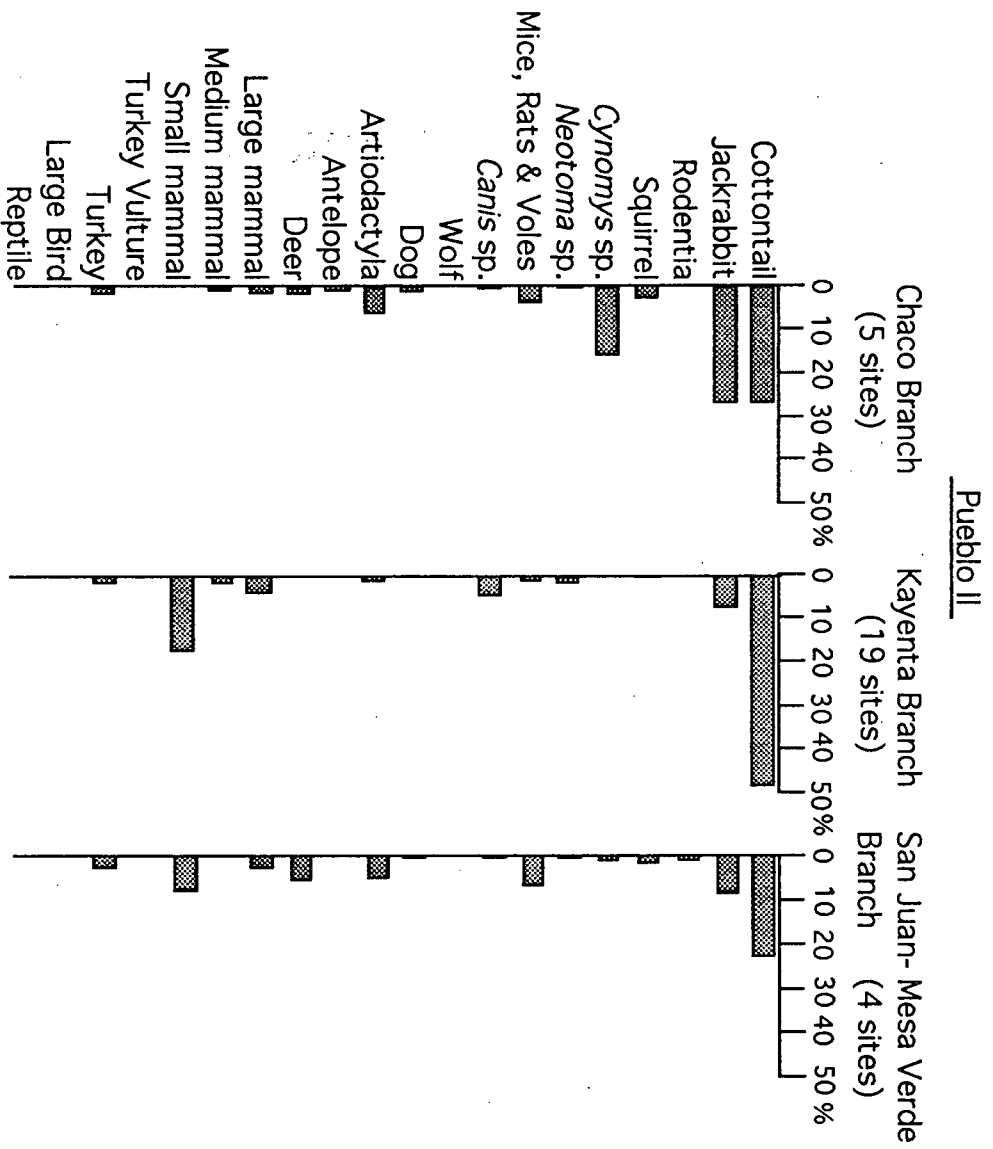


Figure 7 . Relative taxonomic abundance (of taxa represented by at least 4% in any period) for the Pueblo II period.

frequencies of the small mammal taxon. The relative frequencies of Artiodactyla, Antelope, Deer, and Large mammal if taken together are fairly similar for the Chaco and San Juan - Mesa Verde branches. The relative abundance of these taxa in the Kayenta branch is slightly lower. The Chaco branch shows a high relative frequency of prairie dog, not observed in either of the other branches.

Pueblo II - Pueblo III

Pueblo II - Pueblo III is the only period in this analysis which contains sites from all four branches. Unfortunately the Rio Grande branch, making its first and only appearance, is represented by a single site. The first obvious difference between the branches, portrayed in Figure 8, is the extremely high relative frequency of turkey in the Rio Grande area. As no other comparable sites are included here there is no measure of just how representative these relative frequencies are for the Rio Grande area at this time. The relative frequencies of turkey (*Meleagris gallopavo*) remains are low in the other three branches. Cottontail and jackrabbit have the highest relative frequencies in the Chaco and San Juan - Mesa Verde branches. In the Kayenta Branch these taxa are rivaled by a fairly high relative frequency of woodrat (*Neotoma* sp.). The Chaco and San Juan - Mesa Verde branches share similar relative frequencies of large animal taxa, which are less abundant in the Kayenta branch.

Pueblo III

Pueblo III period sites included in this analysis are from the Chaco and San Juan - Mesa Verde branches (Figure 9). The comparison made here is at a disadvantage, as only a single site is present from the Chaco branch and Pueblo III Chaco is often considered to be a Mesa Verde reoccupation, thus this may be considered to represent a geographical distinction rather than a cultural one. This site is represented by very few taxa. It is interesting that cottontails are not present at all. Jackrabbits, prairie dog and mice, etc. are the most abundant taxa. These taxa, on the other hand, are relatively poorly represented in the San Juan - Mesa Verde branch. Cottontail and turkey have the highest relative frequencies for this branch. Turkey would be the more abundant of the two if, following Driver et al. (n.d.:4), the turkey and large bird taxa are combined. It is very likely that many of the specimens identified as large bird are the least

Pueblo II-Pueblo III

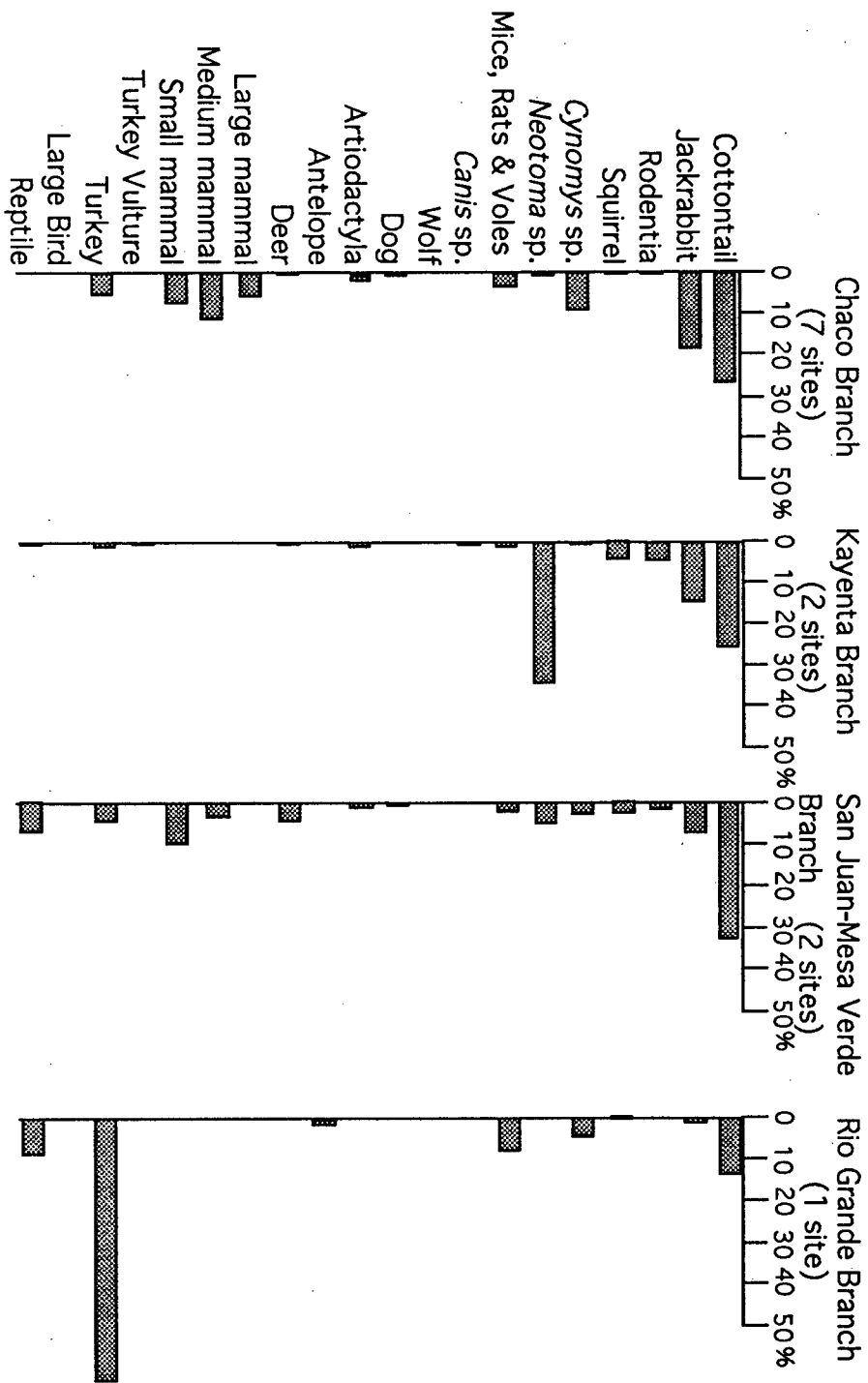


Figure 8. Relative taxonomic abundance (of taxa represented by at least 4% in one period) for the Pueblo II-III period.

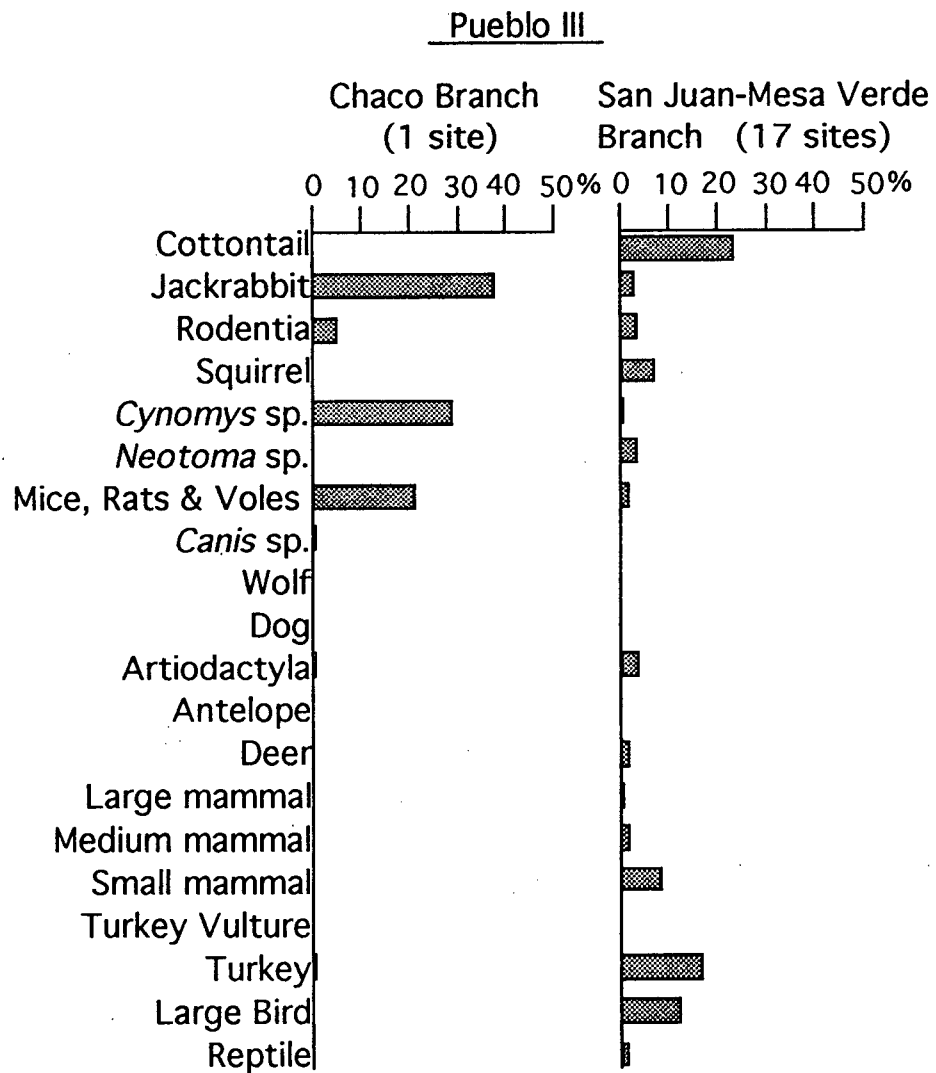


Figure 9. Relative taxonomic abundances (of taxa represented by at least 4% in any period) for the Pueblo III period.

diagnostic turkey elements. Large animal taxa have low relative frequencies in both branches, but are more abundant in the San Juan - Mesa Verde branch.

Comparison of faunal use between branches

Overall this comparison demonstrates that the relative frequencies of faunal remains from the different branches are quite similar over most time periods. The majority of the variation which exists between branches is found among the three general mammal taxa, differences in the relative frequencies of other taxa are generally insignificant. It is possible that some of this variation is the result of differences in the animal populations within a site's local environment.

There are, however, a few notable differences between branches in some periods. The San Juan - Mesa Verde branch had unusually high relative frequencies of canids in the Basketmaker III period, resulting from the excavation of complete or nearly complete individuals. The relative frequency of woodrats is much higher during the Pueblo II - Pueblo III Kayenta than in other branches. The relative frequencies of jackrabbit appears to be consistently higher in the Chaco branch than in any of the other branches across all time periods, likely due to the environmental characteristics of the area. The majority of the other large differences occur in cases where one or more branches are represented by a single site. In these situations there is no way of knowing how that site represents other sites in the same area for a similar time period. During the Basketmaker III - Pueblo I period the Chaco branch shows a relatively high frequency of turkey, a similar situation exists in the Rio Grande branch during the Pueblo II - Pueblo III period. The comparison of the Pueblo III period also suffers from a single site representing one of the two branches.

Comparison of faunal use through time

Before discussing which taxa can be considered dietary staples, variation in the relative frequencies of taxa through time must be addressed. In Figures 10 to 12 the relative frequency graphs for each period are placed in chronological order for each branch. Comparison of these figures shows that there is very little change in the relative frequencies of taxa through time in any of the three branches present. The majority of other obvious differences in Figures 10 to 12 occur in cases where a period is represented by one site, a situation considered insufficient for

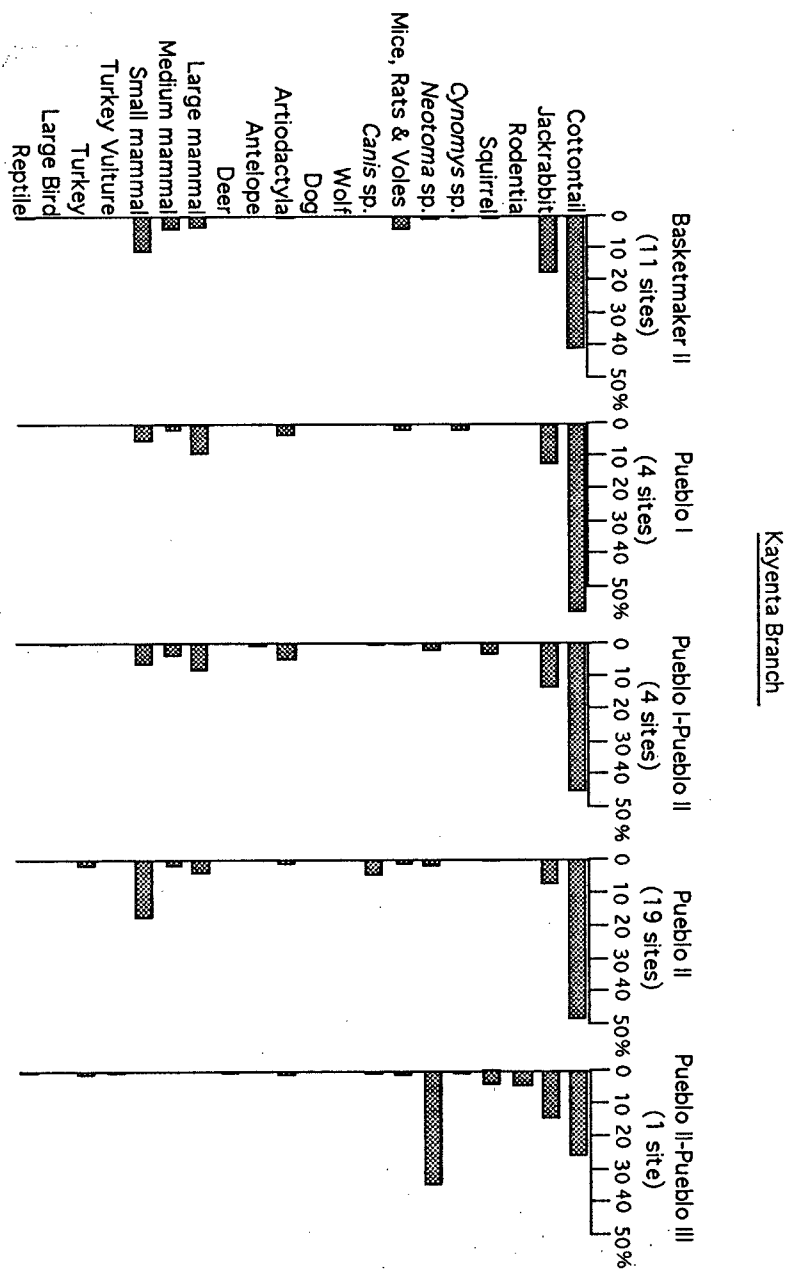


Figure 10. Relative taxonomic abundances (of taxa represented by at least 4% in any period) for the Kayenta Branch.

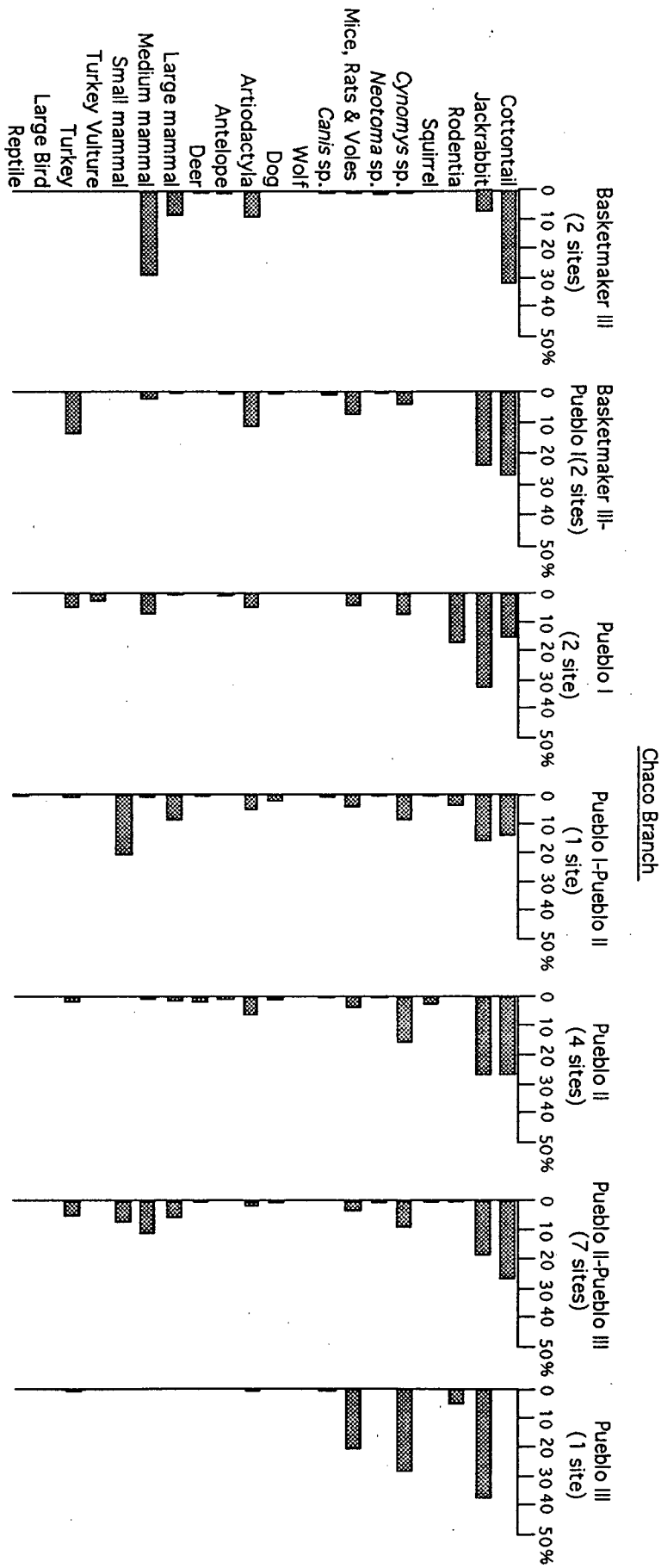


Figure 11. Relative taxonomic abundances (of taxa represented by at least 4% in any period) for the Chaco Branch.

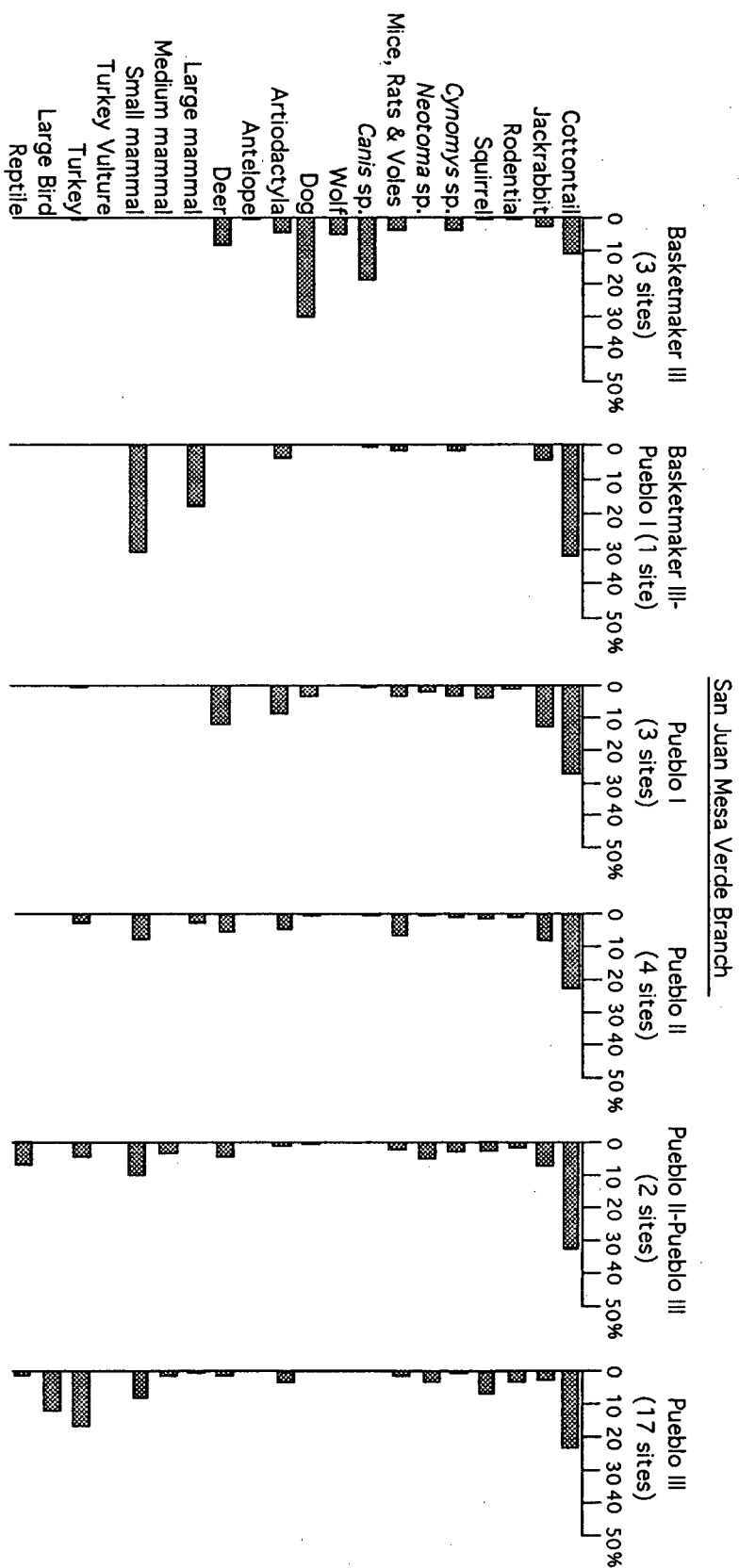


Figure 12. Relative Taxonomic Abundances (of taxa represented by at least 4% in any period) for the San Juan - Mesa Verde Branch.

reliable conclusions. Although relative frequencies for the majority of taxa in all branches are not identical, the variation that exists is best described as fluctuating rather than any recognizable pattern of change. Some of this fluctuation may be the effect of using percentages, creating a closed array in which change in one taxon results in an opposite change in other taxa (Grayson 1984:19).

There are a few observable differences in relative taxonomic frequencies worthy of note. Although the relative abundances of the large game animals remains fairly low in most periods there does appear to collectively be lower relative abundances of these taxa in the later Pueblo periods (Pueblo II - Pueblo III and Pueblo III) in the Chaco, Kayenta and San Juan - Mesa Verde branches. The increase in the relative frequency of woodrats in the Kayenta late Pueblo periods is of interest. However, with only one site present more data are required to establish whether this increase is a site specific occurrence, or part of a larger trend within the branch. A sharp increase in the relative abundance of woodrats was not observed in any other branch. There does appear to be an increase in the relative abundance of prairie dog between the Basketmaker and Pueblo periods in the Chaco branch (Figure 11), but once again this trend is not present in other branches. A number of possible significant changes are observable in the San Juan - Mesa Verde branch (Figure 12). Jackrabbits and deer are represented by relatively low frequencies in most periods, however, there appears to be a slight peak in their abundances during Pueblo I relative to all other periods. It is important to note that this peak is not much greater than the relative frequencies in other periods. The previously discussed dog burials from sites 5LP110 and 5LP111, make the canids stand out during the Basketmaker III period. The relative frequencies of these taxa remain low in subsequent periods. Finally, the only taxa which has any indication of increasing relative abundances over time is the turkey. The relative frequency of turkey specimens is low between the Basketmaker III and Pueblo I periods, a slight increase is notable in the Pueblo II period and by the Pueblo III period it is the second most abundant taxa. Turkey may even be the most abundant taxon if combined with large bird as discussed above.

Summary

In summary, with a few exceptions there does not appear to be any significant difference in the relative taxonomic abundances between branches or throughout the Anasazi tradition. These findings are in accord with those of Leonard (1989:94), who found little change in the fauna represented in Black Mesa assemblages through time. The definition of a dietary staple required both consistent use through time and across a wide area. The twenty taxa which have been the subject of this analysis are the animals (and animal groups) with the greatest potential to be dietary staples. Not all of these taxa, however, meet the criteria just stated. Three taxa, wolf, turkey vulture (*Cathartes aura*) and reptile occur only rarely and when present it is usually in small numbers. Thus, these taxa do not qualify as staples.

The remaining seventeen taxa qualify as dietary staples by Gasser's (1982) definition; they are present throughout the majority of the Anasazi tradition and in most sites from each branch. Of these taxa cottontail has the highest relative abundance by far. Following cottontail are the jackrabbits. It is also possible to note the increased importance of the turkey in the San Juan - Mesa Verde Pueblo III period.

The most interesting of the observed differences is the increase in the relative abundance of turkey in the later Pueblo Periods in the San Juan - Mesa Verde branch. This increase takes the turkey from a consistent but low presence to one of primary importance by relative abundance. The actual use of turkeys as a source of meat has been questioned. Akins (1985:381) for example, states that an adult turkey would consume the equivalent to its potential protein value in corn in only twenty days. Aasen (1984:39,44) found corn remains and pollen in turkey coprolites from Turkey Pen Cave. Add the increased cost of caring for the birds, providing adequate water and protection for example, makes turkey meat a relatively expensive dietary item. The presence of these birds may have been more closely linked to feather production. Gnabasiak (1981) records a number of uses for turkey feathers in the ethnographic literature. Akins (1985:369) suggests that in Chaco Canyon turkeys were not commonly used as a food resource until the later pueblo periods. The increase in the abundance of turkey remains

in San Juan - Mesa Verde sites may represent the increasing importance of the turkey in the diet, similar to Akins suggestion for the Chaco branch.

Ranking the rest of the taxa is difficult considering the presence of the general taxa, small, medium and large mammal, and large bird. These general taxa likely contain specimens of a number of different taxa. For example, cottontail, jackrabbit, squirrel, prairie dog, and woodrats may be represented in the Rodentia taxon and they may all be included in the small mammal taxon. Similarly, deer and antelope likely make up many of the Artiodactyla specimens, and all three likely contributed to the large mammal taxon. These two general taxa lie on the extremes and although we cannot know the exact representation of each potentially contributing taxa, we can limit it to smaller groups such as rodents or Artiodactyla. This is not possible for the medium mammal taxon. It may include the larger rodents, some carnivores or smaller Artiodactyls, depending on where the analyst draws the size boundaries.

The high relative frequencies of cottontail and jackrabbit elements indicate that these species may have been the most important animal resources in the Anasazi diet. Rabbits and other small rodents were likely readily available in the area immediately surrounding most sites. Akins (1985:335) notes that small animals generally occur in fairly high densities and reproduce relatively quickly. These characteristics are ideal for a stable supply of meat obtained with comparatively little labour and time input. Large mammals, on the other hand, are not as abundant and do not reproduce at the high rate of small mammals. These species were likely harder to obtain and have required more time and energy to capture. The relative abundances of large mammals in Anasazi sites are generally quite low, suggesting they were of lesser importance in the diet. However, as studies using meat weights are quick to point out, it takes a large number of rabbits to equal the meat available from a deer or an antelope. One must also consider the "schlepp effect" on large mammal procurement. Unlike small animals, large mammals captured at greater distances were likely not returned to a site complete. Instead only those parts which were economically important were transported (Wing and Brown 1979:150). Such actions would reduce the number of large mammal remains deposited in a site, hence these

animals would be underrepresented in recovered faunal assemblages. Testing for this bias is beyond the scope of this study, but the potential effects of such behaviour must be kept in mind.

The relative contributions of rabbits and large mammals to the Anasazi diet are often considered in terms of the total amount of meat represented by the remains of these animals recovered in archaeological assemblages. Another means of viewing the importance of these animals in the diet is to consider the potential frequency of their occurrence in meals. The large quantities of rabbit and small animal remains in the assemblages from Anasazi sites, coupled with the higher densities of these animals around sites suggests that these animals could have been obtained on a regular basis. Large mammals on the other hand, with fairly low relative abundances in sites and lower population densities were probably not captured as regularly. Gnabasik (1981:44) notes references in the ethnographic literature which suggest that the majority of meat brought into a pueblo was consumed fresh. Akins (1985:356) notes that most of the meat from large animals was probably consumed fresh and any remaining prepared for storage. Depending on the number of inhabitants of a particular site most of an animal may have been consumed in a relatively short period of time and the remaining stored for winter use. No test has been conducted to explore the validity of this idea. It is simply suggested that small animals such as rabbits may have been more important elements of the Anasazi diet by contributing small amounts of meat on a regular basis, as opposed to a large amount of meat on an occasional basis. Wing and Brown (1979:149) suggest a similar situation in which small animals eaten in large quantities constitute a significant part of the diet.

The occurrence of small mammals such as mice, rats, voles, prairie dogs and woodrats in prehistoric faunal assemblages is a point of concern for studies of ancient diet. These species continue to inhabit the Anasazi area today and there is a good chance that their intrusive remains have contributed to faunal assemblages after human occupation. In some cases intrusive individuals can be identified by complete, or nearly complete skeletons (Shaffer 1992:686). Indications that these species were also used in the past is provided by modified and burned specimens. The following discussion of coprolite analysis also indicates that many of these

animals were eaten by the Anasazi. The remains of cottontails, mice, squirrel, prairie dog, small bird and turkey have been recovered for Anasazi coprolites.

Finally, a note on the dog remains, which may also be present in the *Canis* sp. taxon. It is questionable whether these animals were actually used as a food resource. It is quite possible that they were occasionally eaten, however, the presence of burials containing complete individuals would suggest that they played a greater role in Anasazi society than simply a convenient source of food.

Thus, cottontail, jackrabbit and turkey (for the Pueblo III period in southwestern Colorado) can be assigned primary positions in the list of staple animal resources. The remaining staple resources, squirrels, prairie dog, woodrats, mice, rats and voles, dogs, deer and antelope varied in their relative abundances but were utilized consistently throughout the Anasazi area.

Implications for Research Questions

If the increase in rabbits and other small rodents in association with agricultural fields postulated by Seme (1984) and others is accurate, the dominance of rabbit remains in most periods could suggest that substantial agricultural practices were present from the Basketmaker II period on. This analysis has indicated that there was little change in the primary animal resources used across the Colorado Plateau and through time, suggesting that Anasazi diet remained relatively stable. The exception being the increase in the abundance of turkey remains in the later Pueblo periods of the San Juan - Mesa Verde branch. Rabbit, particularly cottontail, appears to have remained relatively constant, however, the abundance of large mammal remains does appear to be lower during the Pueblo II - Pueblo III and Pueblo III periods. Whether the increase in the abundance of turkey simply represents increased turkey use or an attempt to cover for decreasing availability of large game is unknown.

FLOTATION AND POLLEN ANALYSIS

Methods

This section discusses Anasazi plant utilization based on flotation and pollen analysis. These data are affected by a host of factors which can result in contamination of the record and biases in the representation of individual taxa (Gasser 1982:16-21). Plant remains may be transported into an archaeological site by various natural agents, including soil movement, wind, and rodent activity; this may occur at any time between the initial occupation of the site in the past and its excavation by archaeologists. One method commonly used to reduce the possible effects of contamination is the exclusion of all but charred plant remains from analysis (Minnis 1981, Gasser 1982, Matthews 1985). One drawback associated with this approach is the exclusion of resources not subjected to preparation methods which could result in charring. This procedure is followed for the most part in the present analysis, exceptions to this will be noted when appropriate. Charred plant material is generally assumed to have resulted from human actions. Charring could also result, however, from forest fires (Kirkpatrick and Ford 1977:262), or the post-occupation burning of structures.

The relative abundance of individual plant taxa in archaeological sites are the result of a combination of factors, some cultural and others natural. Unfortunately, it can be very difficult to separate the two. Plant characteristics determine to a large degree their relative representation in archaeological contexts. The physical characteristics of plant products, such as seeds with hard outer coats or shells, increase the chances of survival in the archaeological record (Gasser 1982:19). Similarly, there is a greater probability of high representation within sites of plants which produce large quantities of seeds (Minnis 1981:145) and easily dispersed pollen. Prehistoric food preparation practices also affect the survivability of various plant types (Gasser 1982). Preparatory techniques such as boiling and grinding often destroy protective seed coats reducing their defenses against the ravages of time. The end result is the possible over or under representation of the various plant types identified. Therefore, measures of abundance using seed counts, for example, or the weight of plant remains recovered, may be misleading.

Ubiquity is another way of obtaining information on the relative importance of plant types in the archaeological record (Gasser 1982:22). Ubiquity measures can be calculated using individual samples from a site or the presence of plant remains in a group of sites. The flotation data in this analysis are examined with ubiquity measures based on the frequency of occurrence in the sites of any given period. Flotation data are presented in the literature in a variety of ways. Ubiquity values using the site as the basal unit accommodate the greatest number of sites. The San Juan - Mesa Verde branch is an exception to this procedure, where the majority of data are from a synthetic report (Matthews 1986) providing summed counts of plant parts from all sites in each chronological period. It is not possible to derive ubiquity values from these data. Ubiquity is also used to examine evidence of plant exploitation from pollen data. It appears to be more common in reports of pollen analysis to present the results of individual samples. Therefore, the ubiquity values from pollen reports are calculated from individual samples as opposed to sites.

Discussion

Comparison of Floral Use Through Time in the Chaco Branch

Table 1 presents the occurrence of plant taxa in forty Chaco branch sites. The Basketmaker III - Pueblo I and Pueblo I periods are represented by only three sites each and only a single Pueblo III period site is present. It is important to keep these poorly represented areas in mind in the following discussion, as it is not known how well these sites represent other sites of the same period. Corn, beans and squash are all present within the Chaco branch flotation data. Corn is one of the most ubiquitous plants recovered in all time periods. If we ignore the single Pueblo III site for the time being, corn appears to become less common through time. Corn remains, found in all sites dating to the two earlier periods, are found in approximately 80% of the Pueblo I - Pueblo II and Pueblo II period sites, and drops again to a ubiquity value of 71% for the Pueblo II - Pueblo III period. Gasser (1982:24) found evidence for a decrease in the use of corn based on abundance measurements from sites excavated by the Coronado Project. His ubiquity values for the same sites, however, did not support this trend. The decrease in the ubiquity of corn remains apparent in Table 1 is not great, and corn remained one of the most commonly occurring plant types in Chaco branch sites. The pollen evidence does not support a

decrease in the use of corn through time. Although some fluctuation is observable, the ubiquity values for corn pollen remain high for all periods in the Coronado Project area (Gish 1982) and the Pueblo I and Pueblo II - Pueblo III periods in Chaco Canyon (Cully 1985).

Bean and squash remains were found in relatively few time periods, and their ubiquity remained relatively low. Gasser (1982:20) notes that beans tend to degrade quickly relative to other plants. Preparing beans for consumption by boiling further reduces their chances of preservation in the archaeological record. There is little evidence for the use of beans in the pollen data. Squash remains were recovered in only Pueblo II (18%) and Pueblo II - Pueblo III (6%) period sites. This evidence does not indicate extensive or sustained use of this cultigen. The ubiquity of squash pollen in the Coronado Project sites (Gish 1982), however, presents a picture quite different from the flotation analysis. Squash pollen was identified in 75% of the Basketmaker III - Pueblo I sites, decreasing to a low of 20% during Pueblo I - II times and increasing again through the Pueblo II and Pueblo II - III periods (57% and 80% respectively). Squash pollen was also found in the single Pueblo III period site present. During the Pueblo II - III period at Chaco Canyon squash pollen is moderately common, during the earlier periods, however, its ubiquity is quite low (Cully 1985).

Goosefoot (*Chenopodium* sp.) is the most ubiquitous plant type found in Chaco branch sites. Charred remains of this plant were recovered from every site included in this analysis. Goosefoot is a common pioneer plant (Ford *et al.* 1983:464) attracted to areas of disturbed soils such as Anasazi corn fields. Its seeds are small, easily transported and produced in very large quantities. In comparison to plants with larger seeds, one can see how goosefoot seeds with their small size could easily become lost and with their abundance have better chances for survival in the archaeological record. Four other plant taxa, groundcherry (*Physalis* sp.), dropseed (*Sporobolus* sp.), Globemallow (*Sphaeralcea* sp.) and stickleaf (*Mentzelia* sp.) showed little change in ubiquity from one period to the next. Gish's (1982) pollen data suggest an increase in the ubiquity of Globemallow pollen during the Pueblo II and Pueblo II - Pueblo III periods. The ubiquity values for purslane (*Portulaca* sp.) suggest a weak increasing trend through time in the Chaco branch. During the Basketmaker III - Pueblo I period purslane is found in 33% of the

sites present, it occurs in 75% and 64% of the Pueblo I - Pueblo II and Pueblo II period sites respectively. It is also common in sites of the Pueblo II - Pueblo III period, although the ubiquity value of 53%, is slightly lower than the preceding periods.

The ubiquity values given in Table 1 suggest a decrease in the use of amaranths, winged-pigweed (*Cycloloma* sp.), rice grass (*Oryzopsis* sp.), beeweed (*Cleome*), peppergrass (*Lepidium* sp.), banana yucca (*Yucca baccata*), wild buckwheat (*Erogium* sp.), sunflower (*Helianthus* sp.) and Leguminosae (pea family) through time. Caution must be used in this interpretation, however, in view of the low number of sites from the earlier periods. A variety of resources such as pinyon (*Pinus edulis*), juniper (*Juniperus* sp.), tansy mustard (*Descurania* sp.) and saltbush (*Atriplex* sp.) vary considerably from one period to the next.

The pollen data from sites excavated by the Coronado Project show an interesting increase in the ubiquity of most non-cultigens during the Pueblo II period. For some taxa the rise in ubiquity is small. Goosefoot is an exception to this apparent trend. The ubiquity of goosefoot, 75% for Basketmaker III - Pueblo I sites and 60% for both Pueblo I and Pueblo I - II sites, drops to 43% during the Pueblo II period. The ubiquity value for this plant returns to 60% in the succeeding Pueblo II - III period.

Comparison of Floral Use Through Time in the Kayenta Branch

The occurrence of plant taxa recovered from forty-nine Kayenta branch sites, all located on Black Mesa, is presented in Table 2. Accompanying pollen data are not presented here. The ubiquity of corn is high in all time periods for the Kayenta branch. The slight decrease through time in the ubiquity of corn remains observed for the Chaco branch is not reproduced in the Kayenta flotation data. Although beans and squash do not appear in Table 2, they were recovered from some Black Mesa sites. Beans were found at sites D:7:262 (French *et al.* 1982:300), D:11:2068 (Ford *et al.* 1983:463) and D:11:2030 (Ford *et al.* 1985:481). Squash remains were recovered from site D:7:2085 (Wagner *et al.* 1984:613). The majority of these sites had multiple occupations which did not fit the periods used in this analysis and are therefore absent from Table 2.

[illegible]

The ubiquity of goosefoot remains is high in all periods represented by Kayenta branch sites. Five other plant taxa, amaranths, pinyon, juniper, purslane and rice grass, are commonly recovered in Kayenta periods with moderate to high ubiquity values. Taxa which appear in a significant number of periods, with low to moderate ubiquity values include: Graminae (grass family), *Kochia*, saltbush and prickly pear (*Opuntia*). Remains of plants identified only to the cactus family, Cactaceae, occur with low frequency in the Basketmaker II and Pueblo II period and have moderate ubiquity values in the Pueblo II - Pueblo III period. Prickly pear remains during these periods actually decrease from the moderate ubiquity values of the early Pueblo periods.

Finally, there are four taxa which appear only in the Basketmaker II period sites: beeweed, stickleaf, tansy mustard and wild buckwheat. The ubiquity values of these plants are quite low. Stickleaf is the highest of the four with a ubiquity of 11%. The ubiquity values for the remaining three are all 5%. Among the Chaco branch sites the highest ubiquity value for beeweed is in the earliest period (Basketmaker III - Pueblo I). Although the ubiquity values decrease, beeweed is found in later sites from this branch. The highest ubiquity value for the remains of wild buckwheat are also in the Chaco Basketmaker III - Pueblo I period, however, the values continue to range from high to moderate in subsequent periods. Stickleaf and tansy mustard are not present in Chaco branch sites until the Pueblo I - Pueblo II period, after which they occur with moderate to high ubiquity values.

Comparison of Floral Use Through Time in the San Juan - Mesa Verde branch

As noted above the San Juan - Mesa Verde branch flotation data used for this analysis are presented as total presence by period as opposed to ubiquity values for each period (Table 3). The pollen data are primarily from the Hovenweep National Monument reported by Weir (1976). Scott (1976) and Short (1980) provide pollen data from Hoy House and two Basketmaker III sites excavated by the Durango South Project respectively. Corn and goosefoot are present in all periods of this branch as they are in both the Chaco and Kayenta branches. The ubiquity of corn pollen is 50% or greater for all periods, from Basketmaker II to Pueblo III (Weir 1976). Beans were identified in all six of the Dolores periods, but not in the Pueblo III period represented by

Table 3 . Occurrence of charred plant remains from flotation analysis from San Juan - Mesa Verde branch sites.

Period	BM III	BM III-P I	P I	P I-P II	P II	P II-P III	P III	
Area/Site	Dolores (1)	Dolores (1)	Dolores (1)	Dolores (1)	Dolores (1)	Dolores (1)	Guadalupe Ruin (2)	Salmon Ruin (3)
Amaranthus	x	x	x	x	x	x		
Bannana Yucca	x	x	x	x	x	x		x
Barley							x	
Bean	x	x	x	x	x	x		
Beardtongue			x	x				
Beeweed		x	x	x				
Birdbeak		x						
Bottle Gourd	x	x		x				
Bulrush							x	
Cheno-am	x	x	x	x	x	x		x
Compositae	x	x	x	x		x		
Corn	x	x	x	x	x	x	x	x
Cruciferae	x	x	x	x	x	x		
Cyperaceae	x	x	x	x	x	x		x
Dropseed							x	x
Globemallow	x	x	x	x	x			
Goosefoot	x	x	x	x	x	x	x	
Gramineae	x	x	x	x	x	x	x	x
Groundcherry	x	x	x	x	x	x		x
Hedge Cactus								
Jimsonweed			x					
Juniper	x	x	x	x	x	x	x	
Knotweed	x		x	x	x	x		
Leguminosae	x	x	x	x	x		x	
Malvaceae	x	x	x	x				x
Mulberry							x	
Nightshade		x	x	x	x	x		
Oak			x	x	x			
Panic Grass							x	
Pinyon	x	x	x	x	x	x	x	
Polygonaceae		x	x	x				
Prickly Pear		x	x	x	x		x	
Purslane	x	x	x	x	x	x	x	x
Rice Grass	x	x	x			x	x	x
Reed							x	
Rosaceae			x	x	x	x		
Rush							x	
Sage								x
Sedge								x
Serviceberry			x	x				
Solanaceae		x	x	x	x	x		
Squash	x	x	x	x			x	
Stickleaf	x	x	x	x	x	x		x
Sumac		x	x	x	x	x		x
Summer Squash	x		x	x				
Sunflower	x	x	x	x	x	x	x	
Tabacco	x	x	x	x	x	x		
Tansy Mustard		x	x	x	x	x	x	x
Wild onion				x				
Yucca	x	x	x	x	x	x	x	

(1) Matthews 1986, (2) Pippin 1987, (3) Doebley 1981

the Mesa Verde occupations at Guadalupe Ruin (Pippin 1987) and Salmon Ruin (Doebley 1981). Bean pollen was not identified in the Hovenweep sites used in this analysis. Squash remains were found in sites dating to the Basketmaker III through Pueblo I - Pueblo II periods in the Dolores area. They were not identified in Pueblo II and Pueblo II - Pueblo III period sites at Dolores, but are present in Pueblo III period samples from Guadalupe Ruin (Pippin 1987). Squash pollen was only identified in sites from the Pueblo II - Pueblo III period. The ubiquity value for this pollen type was only 5%.

Numerous other plant taxa were present in all time periods from the San Juan - Mesa Verde branch. These include: cheno - ams, yucca, pinyon, juniper, groundcherry, purslane, sunflower, Graminae and Cyperaceae (sedge family). The ubiquity values for pollen types support the common presence of cheno - ams, pinyon, juniper, Graminae and Cyperaceae (Weir 1976, Scott 1976, Short 1980). Stickleaf and tansy mustard are also present in all periods, in contrast to the Chaco branch where they do not occur until the Pueblo I - Pueblo II period, and the Kayenta branch in which they were not identified in sites after the Basketmaker II period. Beeweed occurred in only three time periods. As Table 3 indicates, other commonly recovered plant types from San Juan - Mesa Verde branch sites include: amaranth, Leguminosae (pea family), Rosaceae (rose family), sumac (*Rhus trilobata*), compositae, globemallow, knotweed (*Polygonum* sp.) and Malvaceae (mallow family).

Rice grass, present in all Kayenta branch periods and all but Pueblo I in the Chaco branch, was absent from the San Juan - Mesa Verde branch Pueblo I - Pueblo II and Pueblo II periods. The remains of prickly pear cactus were not identified in the Basketmaker III or Pueblo II - III periods in the San Juan - Mesa Verde branch. Prickly pear was also absent from the Pueblo II - III period in the Kayenta branch. Among the Chaco branch periods the lowest ubiquity for prickly pear was during the Pueblo II - Pueblo III period (6%). The plant was not present in the single Pueblo III site included in this analysis. The ubiquity values for prickly pear pollen indicate a decrease through time (based on data from: Weir 1976, Scott 1976, Short 1980).

Lepofsky (1986) has examined seven flotation samples from Turkey Pen Ruin, a Basketmaker II site in Grand Gulch, Utah. Although the data include uncharred remains they do show high frequencies (in the analyzed samples) of corn and squash. Goosefoot and rice grass were present in all samples. Other common non-cultigens include: amaranth, compositae, sunflower, prickly pear, banana yucca (*Yucca baccata*), and pinyon nuts.

Pollen types with relatively high ubiquity values in Weir's (1976) data which are not present in the flotation data discussed above include: greasewood (*Sarcobatus*), high and low spine composites, Liliaceae (lily family), cottonwood (*Populus*), cattail (*Typha*) and wild buckwheat.

Comparison of Floral Use Through Time in the Rio Grande Branch

Only two sites are present in this analysis for the Rio Grande branch of the Anasazi. Kirkpatrick and Ford (1977) report flotation results (not all remains are charred) for the sites MP4 (Basketmaker II) and NP1E (Basketmaker III), in the Cimarron District of New Mexico. Corn and bean remains were identified at both sites. Non-cultigen plants recovered from both sites include: goosefoot, juniper, pinyon, chokecherry (*Prunus*), marsh elder (*Iva*) and banana yucca. There are no plant taxa present in the Basketmaker II site which are not represented in NP1E. Plants identified only in the Basketmaker III site include: amaranth, beeweed, sunflower, knotweed, sumac, dropseed and Grama (*Bouteloua*). The data presented here are too limited to assign any significance to the differences in plant remains from these two sites.

Summary

Corn remains were one of the most ubiquitous plant types recovered in each of the Anasazi branches discussed above. The slight decrease in the ubiquity of corn in the later periods of the Chaco branch suggested by the flotation data is not supported by the pollen data, nor does it appear in the Kayenta branch. The remains of beans and squash were not common occurrences in the flotation samples from Anasazi sites. Pollen evidence from the Chaco branch, on the other hand, does indicate a significant amount of squash pollen in all time periods. Cotton, a fourth cultigen which is present in coprolite samples, was not identified in any of the flotation data discussed above.

Plant taxa which maintained a relatively consistent presence through each time period in all branches (with the exception of the Rio Grande branch, where the data is insufficient) include: amaranth, goosefoot, rice grass, Graminae, juniper, purslane and prickly pear. Pinyon remains were present in all periods from the Kayenta and San Juan - Mesa Verde branches, but in only two periods from the Chaco branch which is lower in elevation with less pinyon - juniper woodland. The flotation data, supported by the pollen data, indicate that these plants occur commonly enough through time and across the Anasazi area to be viewed as primary contributors, or staples in the Anasazi diet. Table 3 shows a number of plants, such as groundcherry, stickleaf and tansy mustard, which were recovered in every time period in the San Juan - Mesa Verde branch, but occur in relatively few periods in other branches. Dropseed is common only in the Chaco branch and kochia only in the Kayenta branch. With the exception of these two taxa, all other plant types which occur commonly in sites from either of these branches are also common in the other branches.

Implications for Research Questions

This analysis indicates that corn was one of the most commonly occurring plant types in all the time periods from each branch. This suggests that corn was an important component of the Anasazi diet since the Basketmaker II period. There is no evident increase in the ubiquity of corn which would suggest agricultural intensification. It should be noted, however, that ubiquity based on sites may not be the most appropriate means of addressing this problem through flotation evidence. Ubiquity values calculated from individual samples, or some measure of relative abundance such as seed count or weight, may be a more accurate means of approaching this question. There is no substantial decrease in the ubiquity of plant resources which would indicate a failing subsistence system severe enough to lead to regional abandonment.

COPROLITE ANALYSIS

The analysis of prehistoric feces, or coprolites, is one of the most direct means of assessing prehistoric diet available to archaeologists. The remains identified in coprolite samples represent food items which were actually consumed. However, many food items are completely

digested, hence coprolites rarely contain all that was eaten (Clary 1983:1). Furthermore, the abundance of resources which are present do not necessarily reflect the amount originally consumed (Fry 1977:9). The goal of the present analysis is to identify the resources the coprolite samples indicate were staples in the Anasazi diet. This analysis is not unique. Coprolite analysis is one of the few areas where archaeologists have attempted a synthesis of Anasazi diet. At least four studies of this sort have been done to date, Stiger (1977), Gasser (1982), Minnis (1989) and Reinhard (1988). There exists a core group of easily accessible coprolite studies which are continuously used for comparison. This analysis does not differ as the data brought together here are similar to the four studies mentioned above.

Methods

Reinhard (1988:40-41) has suggested that at least fifteen coprolites per site are required to provide an accurate characterization of past diet. Originally, coprolite data from thirty-one sites had been gathered for this analysis. Using fifteen samples as a cut-off reduced the number of usable sites to six, or seven if Stiger's (1977) combined Glen Canyon Pueblo III sites are used. This number is far too small to undertake a comparison of the four Anasazi branches. Thus, the analysis will focus on time periods for the Anasazi area as a whole. Ubiquity, or the number of samples in which a given taxa occurs, is the most commonly used measure in coprolite analysis. Reports routinely present the data in this form or in a manner which can easily be converted to ubiquity. Thus, the taxa identified in the coprolite samples used in this analysis are considered in terms of their ubiquity. Both macrofossil and pollen analyses are discussed below.

Macrofossil data are present for: Turkey Pen Ruin in Grand Gulch, Utah; Step House and Hoy House, Mesa Verde, Colorado; Antelope House in Canyon de Chelly, Arizona; Inscription House, Navajo National Monument, Arizona; and Salmon Ruin, New Mexico (Table 4).

Coprolites samples from these sites are present for all but the Pueblo I period. In his analysis of Anasazi coprolites, Gasser (1982:43) considered resources which appeared in at least ten percent of the coprolites analyzed to have been important plants in the Anasazi diet. Reasoning that anything eaten one out of ten times constitutes a common meal item. This is a valid measure, however, it is important to remember that one coprolite does not equal one meal. Coprolites may

Table 4. Macrofossil ubiquity values for Anasazi Coprolites.

SITE/PERIOD	Turkey Pen Ruin BM II	Step House BM III	Antelope House P II	Step House P III	Hoy House P III	Inscription House P III	Antelope House P III
REFERENCE	Aasen 1984	Stiger 1977	Fry & Hall 1986	Stiger 1977	Stiger 1977	Stiger 1977	Fry and Hall 1986
	N=28	N=20	N=15	N=17	N=56	N=16	N=68
TAXA	%	%	%	%	%	%	%
Amaranth	-	5	13.3	11.8	8.9	-	11.8
Bean	-	5	-	11.8	17.9	25	1.5
Beeweed	3.6	10	20	5.9	5.4	-	14.7
Bugseed	-	-	-	5.9	-	-	-
Bulrush	-	-	-	-	-	-	-
Buffaloberry	-	-	-	-	5.4	-	-
Cactus	-	-	-	-	-	50	-
Cactus epidermis	-	-	20	-	-	-	25
Cactus fiber	-	-	-	-	-	-	1.5
Cactus spine	-	-	26.7	-	-	-	35.3
Cheno-am	7.1	-	-	-	-	-	-
Chokecherry	-	5	-	5.9	3.6	-	-
Composite	-	-	-	-	-	-	-
Corn	89.3	65	100	88.2	100	68.8	89.7
Cotton	-	-	6.7	-	-	31.8	22.1
Cryptantha	-	-	-	-	-	-	-
Cycloloma	-	-	-	-	-	-	-
Dropseed	-	-	-	-	-	18.8	4.4
Franseria	10.7	-	-	-	-	-	-
Goosefoot	35.7	25	6.7	35.3	10.7	-	4.4
Grape	-	-	6.7	-	-	-	1.5
Grass	-	5	-	5.9	1.8	6.3	1.5
Groundcherry	-	20	46.7	23.5	26.8	12.5	7.4
Hackberry	-	-	-	-	-	18.8	-
Horsebrush	-	-	-	-	-	-	10.3
Indian Rice Grass	32.1	5	-	5.9	3.6	31.3	4.4
Juniper	-	-	-	5.9	-	-	-
Knotweed	-	-	-	-	-	-	-
Mormon Tea	-	-	-	-	-	-	-
Nightshade	-	-	-	-	-	-	-
Onion	-	-	-	-	-	-	2.9
Panic Grass	-	-	6.7	-	-	6.3	-
Pataya Cactus	-	-	-	-	-	-	-
Peppergrass	-	-	-	-	-	56.3	1.5
Pine Nut fragment	-	-	66.7	-	-	-	23.5
Pinyon	46.4	35	-	17.7	12.5	-	-
Poaceae	-	-	-	-	-	-	-
Prickly Pear	7.1	40	26.7	64.7	25	-	10.3
Purslane	3.6	25	60	23.5	17.9	6.3	10.3
Sagebrush	-	5	-	-	1.8	-	-
Saltbush	3.6	-	-	-	17.9	-	1.5
Skunkbush	-	-	-	17.6	-	6.3	-
Squash	10.7	40	66.7	24.9	19.6	-	20.6
Squawbush	-	-	-	-	-	-	8.8
Sumac	-	-	-	-	-	-	-
Sunflower	-	-	6.7	5.9	1.8	18.8	4.4
Tansy Mustard	-	-	-	-	-	-	-
Wild Buchwheat	-	-	-	-	1.8	-	-
Wild Rye	-	-	-	-	-	-	1.5
Yucca	-	-	6.7	-	-	-	-

contain between one and five days consumption (Clary 1983). Any food item found in one out of ten coprolites was consumed at least once within a minimum of probably twenty-four hours. It is not possible to arrive at the number or percentage of meals any one resource was a part of, as there is no way of identifying how many meals are represented in one coprolite.

Discussion

Basketmaker II

Turkey Pen Ruin is the only Basketmaker II site which has the required number of samples; Aasen (1984) has analyzed twenty-eight human coprolites. Corn macrofossils are present in almost 90% of the coprolites. Other commonly consumed plant resources include: pinyon, goosefoot, Indian rice grass, *Fraseria*, and squash. Prickly pear cactus and chenopods were found in slightly less than ten percent of the coprolites. Bone fragments were found in 14% of the coprolites. Weight analysis of these coprolites by Matson and Chisholm (1991:449) support the dominance of corn, and the importance of pinyon and rice grass. Reinhard (1988) has also examined coprolites from Turkey Pen Ruin (n=25), recovered during the clean up of pothunter's holes at the site (Powers 1984). Given the presence of post Basketmaker II occupations at the site and the recovery of these coprolites from disturbed contexts, the possibility exists that not all samples are from the Basketmaker II occupation. However, Reinhard's (1988:94) data support the high frequency of corn (96%); the common consumption of goosefoot and squash, and records the presence of beans in 4% of the coprolites. Macrofossil analysis of coprolites (n=3) from the Glen Canyon area (sites 42Sa681 and 42Sa693) also contained squash and prickly pear (Fry 1977:37).

The analysis of pollen in prehistoric coprolites (Table 5) is not as straight forward as macrofossils. People may ingest pollen by a number of means, some of which are unintentional. Wind borne pollen may be inhaled and pollen may be taken into the digestive system through drinking water (Gasser 1982:46), or through adherence to other food products. Pollen may also be consumed intentionally for ceremonial purposes or by eating flowers (Scott 1979). The correlation between the macrofossil and pollen analysis of Turkey Pen Ruin coprolites (Aasen 1984) are minor. Ranking the pollen types by ubiquity places corn in the sixth position, yet is it

Table 5 . Pollen type ubiquity values for Anasazi coprolites.

SITE/PERIOD	Turkey Pen Ruin BMII	Pueblo Alto PII	Antelope House PII	Antelope House PIII	Hoy House PIII
REFERENCE	Aasen 1984	Clary 1983	Williams-Dean 1986	Williams-Dean 1986	Scott 1979
	N=28	N=12	N=14	N=74	N=59
TAXA	%	%	%	%	%
Alder	7.1	-	-	-	-
Ball Cactus	-	-	-	-	9
Bean	-	-	-	4.1	7
Beeweed	28.6	50	100	81.1	95
Buffaloberry	-	-	-	-	2
Bulrush	-	-	-	-	3
Cactaceae	-	-	7.1	6.8	-
Cattail	-	-	42.9	29.7	17
Cheno-am	-	83	64.3	68.9	100
Composite	-	-	-	-	63
Corn	35.7	100	85.7	68.9	95
Cottonwood	3.6	-	21.4	55.4	2
Cruciferae	10.7	-	-	6.8	-
Currant	-	-	-	-	2
Globmallow	3.6	8	-	-	7
Gooseberry	-	25	-	-	-
Goosefoot	89.3	-	-	-	-
Grasses	28.6	67	-	-	10
Greasewood	7.1	-	-	-	17
Hackberry	-	42	-	-	-
High Spine Composite	-	67	50	46	-
Juniper	28.6	-	14.3	20.3	59
Labiatae	-	-	-	-	2
Low Spine Composite	-	67	50	50	-
Mormon Tea	25	25	-	-	20
Mtn. Mahogany	-	-	-	-	56
Oak	10.7	-	-	-	56
Peppergrass	-	-	-	-	19
Phlox	-	-	-	-	2
Picea	-	-	-	-	2
Pinyon	60.7	75	-	-	90
Plantain	-	-	-	-	2
Prickly Pear	-	-	7.1	12.2	14
Primulaceae	10.7	-	-	-	-
Purslane	-	25	21.4	5.4	27
Ragweed	71.4	-	-	-	44
Ranunculaceae	-	-	7.1	6.8	-
Ricegrass	-	-	-	-	54
Sagebrush	60.7	-	-	-	81
Sedge	-	8	-	-	-
Squash	21.4	25	57.1	28.4	24
Storksbill	-	-	-	-	2
Striped Cushaw Squash	-	-	-	-	37
Tubuliflorae	42.9	-	-	-	-
Umbelliferae	10.7	-	-	-	46
Wild Buckwheat	-	-	-	-	5
Yucca	3.6	8	-	-	-

the most commonly occurring taxa in the macrofossil remains. The pollen analysis shows high percentages of chenopods. These plants produce large amounts of wind transported pollen dramatically increasing the chance of unintentional ingestion. However, Aasen (1984:34) found great quantities of this pollen in a number of individual coprolites, suggesting that the pollen was being ingested through some intentional means as well. Other commonly occurring pollen types include: Ambrosia type (e.g., ragweed), pine, sagebrush and composite.

Basketmaker III

The Basketmaker III period is represented by twenty-two coprolites from Step House (Stiger 1977). Once again the most ubiquitous plant type is corn, present in 65% of the samples. Other commonly utilized plants at this site are similar to those discussed above: squash, prickly pear, pinyon, goosefoot, purslane, groundcherry and beeweed. Mouse bones were identified in one coprolite. Unidentifiable bone fragments were present in 30% of the coprolites.

Pueblo II

Fifteen Pueblo II period coprolites have been analyzed by Fry and Hall (1986) from Antelope House, Canyon de Chelly, Arizona. Corn remains were identified in all of the coprolites analyzed. Squash, pinyon and purslane were present in the majority of the coprolites (between 60 and 67%). Other commonly eaten taxa include: groundcherry, prickly pear cactus, beeweed and amaranth. Cotton seeds make their appearance in one of the fifteen coprolites from the Pueblo II occupation of Antelope House. Adams (1991:181) notes that cotton on the Colorado Plateau was obtained from the Hohokam beginning around A.D. 700; production of cotton by Anasazi people began in a limited number of areas during the A.D. 1100s. Bone fragments were found in 60% of the coprolites. The single Pueblo I coprolite from Antelope House shows a high percentage of corn remains, followed by squash. No cotton seeds were identified in this sample.

Clary (1983,1984) has analyzed twenty-two coprolites from Pueblo Alto for the Pueblo II period, and a smaller sample of thirteen coprolites from the same period at Pueblo Bonito. Ubiquity values for most plant taxa appear very low from Pueblo Alto. Corn is not listed in the occurrence tables in the 1983 thesis and no tables for macrofossil remains are given in the 1984

publication. Clary (1984:269) does note that corn, squash, purslane, pinyon, rice grass and dropseed were among the plant types recovered. Bone fragments were found in 74% of the coprolites from Pueblo Alto (Clary 1983). Four animals were identified, cottontail, prairie dog, mouse and small bird. A similar percentage (62%) of the coprolites from Pueblo Bonito also contained bone fragments.

Williams-Dean (1986) presents the most complete study of pollen from Antelope House coprolites. Only fourteen of the Pueblo II coprolites contained sufficient quantities of pollen for analysis. Beeweed is the most commonly occurring pollen type, followed by corn. Other well represented taxa include: cheno-ams, squash, high spine composite, low spine composite, cottonwood, purslane and juniper. The most abundant pollen type in the Pueblo Alto coprolites (n=14) was corn. Many of the more common plant taxa are similar to those from Antelope House: cheno-ams, beeweed, squash, purslane, high spine composite and low spine composite. Also common in the Pueblo Alto coprolites were pinyon, hackberry, grass and gooseberry pollen. The pollen content of Pueblo Bonito coprolites is quite similar.

Pueblo III

Coprolites dating to the Pueblo III period have been analyzed from Step House (Stiger 1977), Hoy House (Stiger 1977), Inscription House (Stiger 1977) and Antelope House (Fry and Hall 1986). Corn is the most common plant found in the coprolite samples from each of these four sites. Commonly consumed taxa occurring in three out of four of these sites include: squash, bean, groundcherry, purslane, pinyon and prickly pear/cactus. Amaranth was represented by more than 10% in two sites. Cotton is well represented at both Inscription House and Antelope House, whereas it was not identified in coprolites from Step House and Hoy House. Stiger's (1977:36) presentation of the coprolite data from Glen Canyon also indicates that cotton was fairly common (29%) in the Pueblo III period. Of the four sites, coprolites from Step House and Hoy House are very similar. Inscription House stands out with the lowest frequency of corn (68%), and a high ubiquity of peppergrass, rice grass, dropseed, hackberry, and sunflower.

Mean relative frequencies for the macrofossil data from the Pueblo III sites discussed above shows corn (87%) as the most ubiquitous plant resource recovered from the coprolites examined. Prickly pear is the second most commonly occurring plant type, represented in 25% of the coprolites. Other common plant resources, in rank order by frequency, include: groundcherry, cactus, squash, purslane, peppergrass, bean, pinyon, cotton, goosefoot and rice grass. Three taxa which fall below but relatively close to 10% representation are Amaranth, sunflower and beeweed. The average frequency of bone fragments in the Pueblo III coprolites (Step House, Inscription House and Antelope House) is 25%. The animal taxa identified in the samples are turkey, mice, squirrel and small rodent. Stiger (1977:38) records the occurrence of bone and sinew in 50% of the Pueblo III coprolites from Glen Canyon.

Williams-Dean's (1986) analysis of Antelope House coprolites is the only source of pollen data for the Pueblo III period. Beeweed is the most common pollen type, occurring in 81% of the samples. Other well represented taxa include: corn, cheno-ams, cottontail, composite, cattail, squash, juniper and prickly pear. Purslane and bean pollen occur infrequently in the coprolites examined.

Summary

The taxa present in at least 10% of the coprolites of any given period show surprising consistency through time. Corn is the most common food item represented in coprolite macrofossils in all four periods examined (Basketmaker II, III, Pueblo II, III). Also well represented in all time periods are pinyon and squash. Purslane, prickly pear and groundcherry are common plant taxa in all but the Basketmaker II period. The frequency of prickly pear (7.1%) is close to the 10% cut-off, and though not found in many coprolites, purslane and groundcherry are present for this period. The occurrence of goosefoot is high in the Basketmaker II, Basketmaker III and the Pueblo III periods. The frequency of this taxon is relatively low in Pueblo II coprolites. Three taxa are common in two of the four periods: rice grass (Basketmaker II, Pueblo III), cactus (Pueblo II, Pueblo III) and beeweed (Basketmaker III, Pueblo II). *Franseria* is only represented in 10% of the Basketmaker II coprolites and amaranth

is common only in the Pueblo II period. Beans, cotton and peppergrass, were only common elements in the diet of Pueblo III Anasazi.

The occurrence of bone fragments in the coprolite samples, indicating the consumption of meat, varies throughout the four periods discussed. Bone fragments are present in only 14% of the Basketmaker II coprolites (Aasen 1984). The frequency of bone in the Basketmaker III (30%) and Pueblo III (25%) periods are similar. Pueblo II period coprolites show high frequencies of bone fragments. Clary (1983) reports that bone was found in 74% of the Pueblo Alto coprolites, and in 60% of the Antelope House Pueblo II coprolites contained bone (Fry and Hall 1986). These figures suggest that during some periods meat was a common meal component. Cushing (1920:564), however, believed the Zuni custom of eating jerked meat frugally was a habit retained from the period prior to the introduction of domesticated animals. He suggests that when only wild meat was available it was eaten not as a regular food item but instead to add flavour to the rest of the meal.

The pollen data indicate five taxa which are represented in the coprolites from the Basketmaker II, Pueblo II and Pueblo III periods (no pollen data for Basketmaker III) : corn, squash, beeweed, juniper and cottonwood. The first three of these taxa have high frequencies in macrofossil remains. The pollen data, however, indicates that juniper and cottonwood pollen may have been commonly ingested, although it is not possible to identify how. Williams-Dean (1986:196) includes both of these taxa as economic pollen types. Plant resources which the pollen data identify as commonly occurring only during the Basketmaker II period include: sagebrush, oak, ragweed, Tubuliflorae, Primulaceae (primrose family) and Umbelliferae (carrot family). Taxa which are not common in the Pueblo II - Pueblo III macrofossil remains but are common pollen types include: cheno-am, composite (both high and low spine) and cattail.

The results of the coprolite data indicate that corn was the most commonly consumed plant food in the Anasazi diet. Other plant resources which can be considered dietary staples include pinyon, squash, purslane, prickly pear, groundcherry and goosefoot. Beans, cotton and peppergrass become important food resources during the Pueblo III period. The pollen data suggest that juniper, cottonwood, cheno-ams, composite and cattail may have made significant

contributions to Anasazi diet. Meat appears to have been an important component of the Anasazi diet, as indicated by the common occurrence of bone fragments in coprolites.

Implications for Research Questions

The analysis of coprolite data indicates that corn was an important component of the diet throughout the Anasazi tradition, including the Basketmaker II period. The ubiquity values for corn, although showing some fluctuation, remain consistently high. No indications for the intensification of corn production were found. However, one could interpret the appearance of cotton, with substantial ubiquity values in coprolites from some sites, as an attempt to increase food production, as well as to provide material for cloth.

STABLE CARBON ISOTOPE ANALYSIS

The development of stable carbon isotope analysis has added a promising new dimension to the study of prehistoric diet, particularly in the American Southwest. Although this type of analysis is not new to the region, relatively little research of this type has been carried out in the Anasazi area. This discussion will be concerned primarily with the results presented in three publications. Decker and Tieszen (1989) examined populations from Mesa Verde and Mancos Canyon. Matson and Chisholm (1991) originally reported a series of carbon isotope values for Cedar Mesa Anasazi. Recently Chisholm and Matson (in press) have added new individuals to this data set as well as nitrogen isotope values. The two study areas covered in these reports are both within the Northern San Juan - Mesa Verde branch.

Methods

Discussions of this approach appear throughout the literature, thus it will be covered only briefly here. Useful summaries are found in van der Merwe (1982) and Chisholm (1989). During photosynthesis plants take in carbon from carbon dioxide in the atmosphere. Isotopic fractionation during photosynthesis alters the ratio of ^{12}C to ^{13}C , which, with minor exceptions, exist in a relatively constant ratio within atmospheric carbon dioxide (Chisholm 1989:12).

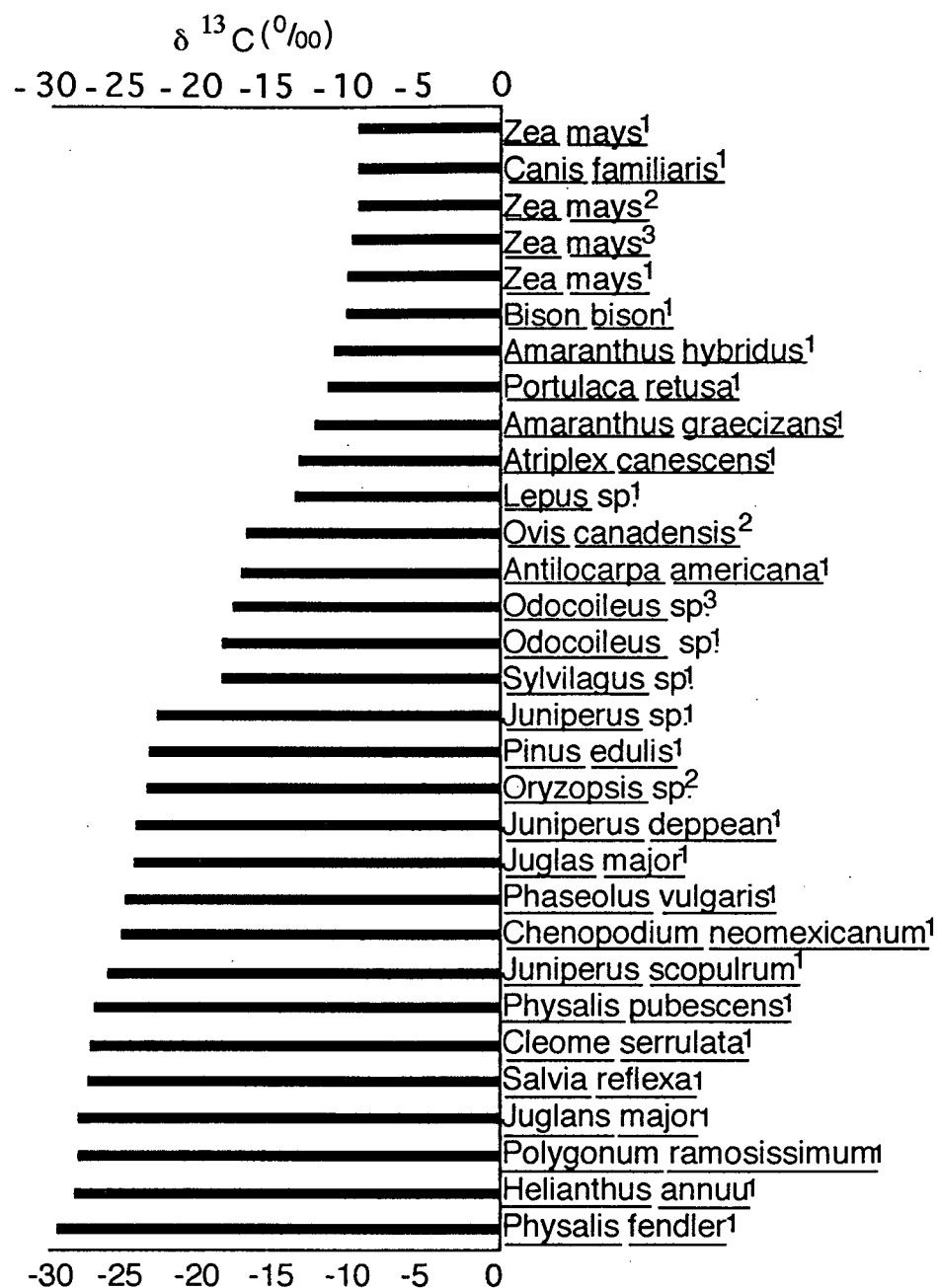
Plants use one of three different photosynthetic pathways, commonly referred to as C_3 , C_4 and CAM (Crassulacean Acid Metabolism). Isotopic fractionation in the C_3 and C_4

pathways result in different $^{13}\text{C}/^{12}\text{C}$ ratios, denoted as $\delta^{13}\text{C}$ (‰). $\delta^{13}\text{C}$ values produced by plants using the CAM pathway vary with the environment they inhabit. In arid environments, such as that inhabited by the Anasazi, CAM plants tend to have $\delta^{13}\text{C}$ values similar to C_4 plants (Matson and Chisholm 1991:452).

The $\delta^{13}\text{C}$ values for C_3 plants generally average -26.5 ‰ while C_4 plants average -12.5 ‰ (Matson and Chisholm 1991:452). Based on samples of C_3 plants from Cedar Mesa, Matson and Chisholm (1991:453) have used a value of -24.0 ‰ for C_3 plants. Using samples from the Mesa Verde area Decker and Tieszen (1989:38) produced a value of -27.0 ‰ for C_3 plants. Both studies used a value of -10.0 ‰ for C_4 plants based on samples of prehistoric maize. The difference between the $\delta^{13}\text{C}$ values for C_3 and C_4 plants is maintained in consumers, however, further fractionation of the carbon isotopes (the collagen enrichment factor) (Chisholm 1989:13) results in a difference of 5 ‰, or 4.5 ‰ for lipid free samples (Chisholm and Matson in press:4), between diet values and measured consumer bone collagen values. Based on Matson and Chisholm's (1991) values for C_3 and C_4 plants and a 4.5 ‰ collagen enrichment factor, individuals consuming only C_3 plants will have a $\delta^{13}\text{C}$ (diet) value of -19.5 ‰, compared to a value of -5.5 ‰ for an individual consuming only C_4 plant species.

Carbon isotope values for a variety of plant and animal resources that would have been available to the Anasazi are presented in Figure 13. These data indicate that there are three groups of resources which will have affected the $\delta^{13}\text{C}$ values of Anasazi individuals: C_3 plants, C_4 plants and a group of herbivores which consumed a mixed diet of C_3 and C_4 plants. Three animal species do not fit this pattern. The domestic dog has a very light carbon isotope value, which leads Katzenberg and Kelley (1991:212) to suggest that dogs shared a similar diet with their owners. The bison sampled obviously consumed a relatively large quantity of C_4 grasses, as did the jackrabbits, both likely due to habitat preferences (Katzenberg and Kelley 1991:212). Although the measured jackrabbit values are lighter than the other herbivores, they are right at the beginning of this second dietary group.

Unlike other regions in North America there are a number of C_4 plants in the American Southwest. These include: maize, the amaranths, chenopods and purslane. As earlier sections of



¹ Katzenberg and Kelley 1991; ² Matson and Chisholm 1991;
³ Decker and Tieszen 1989

Figure 13. Stable carbon isotope values for prehistoric food resources
 (note: Katzenberg and Kelley ran two samples of maize).

this thesis have demonstrated cacti were important resources in the prehistoric Anasazi diet, and in this environment they are likely to have $\delta^{13}\text{C}$ values similar to C₄ plants. The values given in this figure are intended only as a rough guide. A variety of factors such as geographical location, variation in climate and reservoir effects, can result in different values for a single species within a region (Chisholm and Matson in press:5).

Discussion

Carbon isotope values considered in this thesis are available for all time periods of the Pecos Classification, plus a group of samples from a combined Pueblo II - Pueblo III period (Figure 14, Appendix 3). Visual examination of Figure 14 demonstrates that, with the exception of a single Pueblo I individual and a single Pueblo II - Pueblo III individual, both from Mesa Verde, there is little variation in the $\delta^{13}\text{C}$ values for Anasazi individuals from the Basketmaker II period through to the Pueblo III period. This indicates that there was little change in the contribution of C₄ plants and herbivores which consumed C₄ plants, to the human diet in the San Juan-Mesa Verde branch throughout the Anasazi tradition.

Estimates of the percentage of C₄ plants in the diet of these individuals will not be calculated here. There are a number of factors which can reduce the reliability of these estimates (B.S. Chisholm, personal communication 1994). As previously noted, a variety of C₄ plants other than maize were prehistorically available to the Anasazi people. Although Figure 13 presents the $\delta^{13}\text{C}$ values for a number of plant resources, the majority of the samples were taken from a location quite distant from the homes of the individuals presented in Figure 14. Thus, values for a greater quantity and variety of local plant resources are required, particularly CAM plants such as the prickly pear cactus.

The presence of herbivore meat, a third dietary group in addition to C₃ and C₄ plants, presents a second problem in the calculation of the percentage of C₄ plants in the diet. As shown in Figure 13, the majority of the herbivore values are located between the C₄ and C₃ plants. Faunal analysis indicates which animals were exploited by Anasazi groups and the abundance of these species relative to one another. Unfortunately it cannot indicate the relative contributions of animals versus plants in the diet. Nitrogen isotope values can provide some measure of the

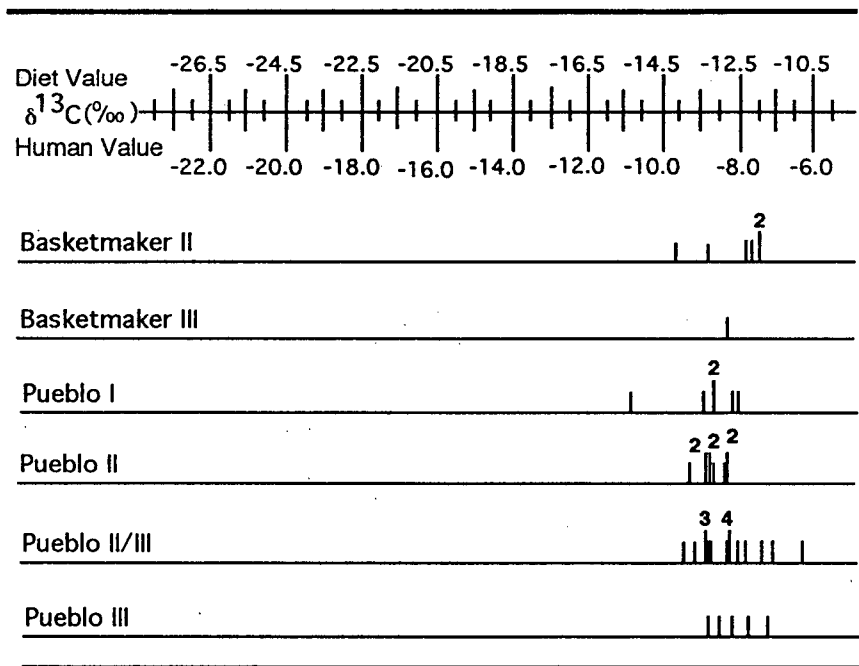


Figure 14. Stable carbon isotope values for Anasazi Individuals
(Decker and Tieszen 1989, Matson and Chisholm 1991,
Chisholm and Matson in press)

amount of meat consumed by individuals (Katzenberg and Kelley 1991, Chisholm and Matson in press), however, nitrogen values have only been done for one of the three studies discussed. Furthermore, even with this information much more data is required to identify which species consumed C₄ plants. The domestic turkey, for example, which was possibly fed corn, is one source of meat which must be tested (Chisholm and Matson in press:12). Aasen's (1984) analysis of two turkey coprolites indicated the presence of corn in their diets.

In the studies discussed two different approaches have been used to estimate the contribution of C₄ plants to the diet. Decker and Tieszen (1989:39-41) used a three component mixture with estimates of the amount of meat in the diet ranging from zero to fifty percent. They have calculated an average contribution of C₄ plants, for the entire sample, of 69% with 20% meat in the diet, or 80% with no meat consumed. Chisholm and Matson (in press:8-9) combined the herbivores and C₃ plants into a single dietary category based on the similarity of their $\delta^{13}\text{C}$ values. They estimate an average of 82% and 85% C₄ plants in the diet for the Basketmaker II and Pueblo II - Pueblo III periods on Cedar Mesa respectively.

Summary

If the outliers (the lowest and highest values) are excluded from Figure 14, all values across all time periods fall within a range of -13.5 ‰ to -11.0 ‰ diet value (-9.5 ‰ to -7 ‰ measured value). Based on Chisholm and Matson's (in press:8) range for C₃ plants (-24.0 ‰ to -20.5 ‰ diet value) Figure 14 indicates that the Anasazi individuals on Mesa Verde and Cedar Mesa relied heavily on C₄ plants in their diets. These results are similar to those presented by Katzenberg and Kelley (1991) for individuals from six sites in the Sierra Blanca region of New Mexico between AD 800 and AD1400.

Implications for Research Questions

The stable carbon isotope analyses which have been undertaken on Anasazi individuals to date indicates that there is no appreciable difference in the dependence on C₄ plants between the Basketmaker II and Pueblo III periods. Corn appears to be the primary C₄ plant in the diet and one may conclude that the Basketmaker II people, like those Anasazi who would follow, were dependent on corn agriculture.

SUMMARY AND CONCLUSIONS

Two common trends in the Anasazi diet are evident from the data presented in this thesis. With few exceptions rabbits dominate the faunal data from each period in all branches. Based on the relative abundances discussed above, cottontail rabbits were the primary meat resource in the Anasazi diet, followed closely in many periods by jackrabbits. In all time periods the relative frequency of jackrabbits is highest in the Chaco branch. An exception to the dominance of rabbits is the increasing relative abundance of turkey remains through time in the San Juan - Mesa Verde branch. Turkey remains in the Chaco and Kayenta branches generally have low relative abundances. A similar situation existed in the San Juan - Mesa Verde area until the Pueblo II period, when the relative frequency of turkey began to increase. During the Pueblo III period the relative abundance of turkey rivals that of cottontails. The single Pueblo II - Pueblo III period site from the Rio Grande area also shows a high relative frequency of turkey. As noted above turkey feathers are recorded in the ethnographic literature as important elements in Puebloan ceremonies. A trend toward increasing relative abundance is also evident for the remains of prairie dog in the Chaco branch. Unfortunately the Pueblo III period is represented by a single site. Although it contributes to the observed increase in prairie dog through time, no cottontail remains were reported for this site. There is no evidence for a corresponding decrease in the importance of cottontail in any other period. The relative abundance of cottontail remains are at their lowest during the Pueblo I and Pueblo I - Pueblo II periods, but still remained higher than prairie dog, and increase considerably in the following periods.

The relationship between relative abundances of rabbits and large animals, such as deer and antelope, and their relative contributions to the Anasazi diet present zooarchaeologists with a complex problem. In spite of low relative frequencies, two arguments can be made for the importance of large mammals in the Anasazi diet. Deer, antelope and mountain sheep contribute far more usable meat per animal than any of the small rodents. Second, large animals, generally taken at distant locations are underrepresented as a result of the schlepp effect. On the other hand, it could be argued that some excavation methods have created a bias equal to the schlepp

effect by using screen sizes which, as discussed above, fail to recover a substantial percentage small mammal remains. Patterns of consumption in the past could also greatly effect the contribution of larger animals to the Anasazi diet. If the greater portion of captured large mammals were consumed fresh, they could be viewed as making only occasional contributions to the diet. Although this practice has been noted in the ethnographic literature, there is no way to assess its reliability in terms of Anasazi practices. It is suggested here that the high abundances of cottontail and jackrabbit remains reflect their position as the primary contributors of meat to the Anasazi diet. These animals are abundant, reproduce relatively quickly and were locally available, as opposed to the less abundant and widely spaced large mammals, and as such contributed on a regular basis to the Anasazi diet. The attraction of these rodents to agricultural fields would also increase their availability. The ease of rabbit procurement and their substantial contribution to the diet may be offset if quantities of large mammal meat were prepared for storage, and used on a regular basis. I am not presently aware of any evidence which would indicate this practice.

The first research question asked above focused on when cultigens became the primary constituents of the Anasazi diet. The second common trend observed in the Anasazi diet is directly related to this question. The coprolite data indicate that corn was the most commonly consumed food item during all periods of the Anasazi tradition. This supports arguments which contend that the Anasazi were already relying on corn agriculture during the Basketmaker II period. No strong evidence was found for either a decrease or increase in the importance of corn throughout the Anasazi tradition. The stable carbon isotope data indicates a dependence on C₄ plants since the Basketmaker II period, and from the relative abundances in other types of data corn was the primary C₄ plant. The relative importance of the other cultigens, based on these data deserves further consideration. It has been suggested that the commonly discussed triad of corn, beans and squash were the primary dietary components. Although the ubiquity values for the occurrence of squash in Anasazi coprolite samples is generally high enough to be counted as a dietary staple, it occurs no more frequently than a number of wild plants. Beans on the other hand, are poorly represented in both coprolite and flotation data, possibly as a result of low

survivability. Based on the coprolite data beans may only be considered staple foods in the Pueblo III period. Cotton constitutes a fourth cultigen used by the Anasazi. The data, however, suggest that its use was limited spatially and indicates that its occurrence in any quantity is largely limited to the Pueblo III period.

The analysis of coprolite, flotation and pollen data have shown that there are a number of wild plant taxa which were staple resources in the Anasazi diet. Although few were consumed as often as corn (based on coprolite data) many were likely as abundant as squash, and on the basis of the data discussed here more common than beans. Plant types which are well represented in both the coprolite and flotation data include: goosefoot, purslane, pinyon, prickly pear, rice grass, amaranth, beeweed and groundcherry. Many of these plants are considered to be weedy pioneers that favored the cleared fields and disturbed soil areas around Anasazi settlements. Although there is evidence that numerous other plants were used as food resources, the above should be considered dietary staples. A number of these resources, like corn, were used during the historic period to make foods such as bread. Purslane was used as a herb or seasoning by the Hopi (Whiting 1966:19).

The second research question stated in the introduction concerned the intensification of agricultural production through time. Evidence of intensification may not show up in coprolite data, as intensification of agricultural production is not necessarily connected with increased consumption of these products. Intensification procedures may be used, for example, to produce surplus for trade or to feed an increasing population (Lightfoot and Plog 1984). In the latter situation individual corn consumption may remain constant. However, if by intensification, one means, increased per capita corn production and consumption, there is no indication of this in the coprolite data.

Dietary evidence of increased agricultural production would likely show up best in the flotation and pollen sample data. As the amount of corn produced increased, one could expect the amount of corn remains and pollen contained within a site to increase. However, the analyses presented above do not support increased cultigen production. The changes which are observed between the different time periods generally do not show any directional change, but

instead slight fluctuations possibly due to the sample of sites used. The exception being the ubiquity of corn in the Chaco branch, which according to the flotation data decreases slightly through time. This decrease in the presence of corn is not supported by the pollen data from this branch.

The discussion above has focused on corn as the primary object of agricultural intensification. The appearance of cotton in coprolites from a limited number of areas beginning slowly in the Pueblo II period may represent a second approach to increasing agricultural production. The coprolite data demonstrate that cotton was a dietary staple during the Pueblo III period at Antelope House, Inscription House and in the Glen Canyon area. During this period, the inhabitants of these sites may have attempted to meet increasing food requirements by adopting a new cultigen (i.e., cotton), which would also provide material for cloth. Adams (1991:179) notes that during the A.D. 1300s the Homol'ovi people in the central Little Colorado River Valley were producing large quantities of cotton. At present data on cotton in the Anasazi area is too limited to expand on this possibility. It appears that the best evidence for the intensification of agriculture, remains the construction of water and soil features around AD 1000 (Plog 1979, Doyel 1981, Cordell 1982).

The third research question asks if there were any changes evident in the diet which could be linked to the regional abandonments of the thirteenth century. No evidence of failing resources was observed in either the faunal analysis or analyses related to the exploitation of plants resources. The relative abundance of the resources identified here as being of primary importance remained relatively stable. A number of researchers have reported increases in the number of different taxa utilized in the later periods of the Anasazi occupation. Although not examined in this thesis, Leonard (1986, 1989) has demonstrated that observed trends toward a diversification of the subsistence base may be largely the result of sample size effects.

The wide area of comparison made in this thesis has necessitated the use of certain kinds of data, thus various information and problems have not been addressed. Finer scale variation may well exist that was not dealt with in this analysis. Numerous aspects of Anasazi diet remain to be examined. Among these are detailed comparisons of the dietary evidence from

sites within a branch or region for a single time period. The effect of local environmental differences on diet at sites within one branch offers an opportunity to further explore fine scale variation. Another important avenue of study is the comparison of dietary evidence between contemporary sites of varying size.

The study of Anasazi diet stands to profit considerably from the continued use of coprolite and stable isotope analysis. One particular gap in the interpretation of stable isotope values is adequate knowledge of the range of values for local food resources, particularly the parts which were actually consumed. This information would contribute to our understanding of how these resources affect the values observed for prehistoric people.

There are two important questions to be addressed regarding animals in Anasazi diet. The importance of meat in the diet is still an outstanding issue. The consumption of large mammal meat does not show up in coprolites, thus their contribution remains unknown. Although small mammal remains do appear in coprolites, we have no indication of how much meat was actually consumed during the period represented by a single coprolite. Nitrogen isotope analysis may offer some important data regarding this issue, however, very little of this analysis has been done. Secondly, the relative contributions of small versus large mammals in the diet remains unsettled. Further research into the relative abundances of these animals in faunal assemblages, their relation to the diet, as well as further consideration of the treatment of these animals by historic Pueblo people is required.

In summary, Anasazi diet was very similar in the four branches discussed in this thesis. The data indicate that corn was the major component in the Anasazi diet since the Basketmaker II period, and continued through to the Pueblo III period. Stable carbon isotope results show a similar degree of reliance on C₄ plants across all time periods. The data do not support arguments by Glassow, F. Plog and S. Plog that corn did not become an important component of Anasazi diet until late Basketmaker III or the Pueblo I period. Cottontail remains have the highest relative abundance in the majority of periods in all branches, generally followed by jackrabbits, which appear to be more common in the Chaco branch than in any of the other branches. The faunal analysis presented above indicates that there is a core group of seventeen

animals which can be considered dietary staples. Coprolite analysis provides the best estimate of the amount of meat in the diet. The data examined here indicate that meat was a meal component in 14% of the Basketmaker II coprolites, and up to 74% in coprolites from the later Pueblo periods. Although the stable carbon isotope data appear to suggest low meat consumption, the actual amount of meat in the diet must remain largely unknown at this time, as we do not know how much meat is represented by the small mammal remains found in coprolites, or the amount of large mammal meat consumed. Following corn, there is a mixture of domesticated and wild plant species which were consumed often enough to be considered staple resources. The consistency of the Anasazi diet through time is a tribute to the ability of the Anasazi people to survive in this environment, relying on a single subsistence strategy, with maize agriculture being the basis, followed by a variety of other cultivated and wild food resources.

REFERENCES CITED

- Aasen, D.K.
1984 Pollen, macrofossil and charcoal analyses of Basketmaker coprolites from Turkey Pen Ruin, Cedar Mesa, Utah. M.A. thesis, Department of Anthropology, Washington State University.
- Adams, E. Charles
1991 *The Origin and Development of the Katsina Cult*. The University of Arizona Press, Tucson.
- Akins, Nancy J.
1985 Prehistoric faunal utilization in Chaco Canyon: Basketmaker III through Pueblo III. In *Environment and Subsistence of Chaco Canyon*. ed. by F.J. Mathien, pp. 305-445. Publications in Archaeology 18-E. *Chaco Canyon Studies*, National Parks Service, Washington D.C.
- Anderson, Elaine
1980 Fauna. In *The Durango South Project, Archaeological Salvage of Two Late Basketmaker III Sites in the Durango District*, ed. by J.D. Gooding, pp. 123-149. The University of Arizona Press, Tucson.
- Bearden, S.E.
1984 *A Study of Basketmaker II Settlement on Black Mesa, Arizona: Excavations 1973 - 1979*. Southern Illinois University at Carbondale. Center for Archaeological Investigations, Research Paper No.4.
- Binford, Martha R.
1983 Faunal analysis. In *Economy and Interaction Along the Lower Chaco River*, ed. by P. Hogan and J.C. Winter, pp.367-374. Office of Contract Archaeology, University of New Mexico, Albuquerque.
- Binford, Martha R., W.H. Doleman, N. Draper and K.B. Kelly
1982 Anasazi and Navajo archaeofauna. In *Anasazi and Navajo Land Use in the McKinley Mine Area, Near Gallup, New Mexico Volume 1, Archaeology Part One*, ed. by C.G. Allen and B. Nelson. Office of Contract Archaeology, University of New Mexico, Albuquerque.
- Bradfield, Maitland
1971 *The Changing Pattern of Hopi Agriculture*. Royal Anthropological Institute Occasional Paper No. 30. Royal Anthropological Institute of Great Britain and Ireland, London.
- Brand, Michael J.
1991 Zooarchaeology of Sand Canyon Pueblo (SMT765), Shorlene's Site (SMT3918), Roy's Ruin (SMT3930), Lillian's Site (SMT3936) and Troy's Tower, Colorado. Honors Paper, Department of Archaeology, Simon Fraser University, Burnaby, British Columbia.
- n.d. Preliminary report on the identification of faunal remains from twenty-two prehistoric sites on Cedar Mesa, Utah. Unpublished report in possession of author, Department of Anthropology and Sociology, University of British Columbia, Vancouver.

- Brown, David E.
 1982a Great Basin Conifer Woodland. In *Biotic Communities of the American Southwest - United States and Mexico*. *Desert Plants* 4(1-4):52-57.
- 1982b Plains and Great Basin Grasslands. In *Biotic Communities of the American Southwest - United States and Mexico*. *Desert Plants* 4(1-4):115-121.
- Bye, Robert A. and Rita Shuster
 1984 Developing and Integrated Model for Contemporary Agricultural Subsistence Systems. In *Prehistoric Agricultural Strategies in the Southwest*, ed. by S.K. Fish and P.R. Fish, pp.125-145. Arizona State University Anthropological Papers No.33, Tempe.
- Chisholm, B.S.
 1989 Variation in diet reconstructions based on stable carbon isotopic evidence. In *The Chemistry of Prehistoric Human Bone*, ed. by T.D. Price, pp. 10-37. Cambridge University Press, Cambridge.
- Chisholm, B.S. and R.G. Matson
 in press Carbon and nitrogen isotopic evidence on Basketmaker II diet at Cedar Mesa, Utah. *Kiva* 60(2). (1994).
- Christenson, A.L. and W.J. Parry (eds.)
 1985 *Excavations on Black Mesa, 1983, A Descriptive Report*. Center for Archaeological Investigations, Research Paper no.46. Southern Illinois University, Carbondale.
- Clary, K.H.
 1983 Prehistoric Coprolite Remains from Chaco Canyon, New Mexico: Inferences for Anasazi Diet and Subsistence. Master of Science thesis, Department of Anthropology, University of New Mexico.
- 1984 Anasazi diet and subsistence as revealed by coprolites from Chaco Canyon. In *Recent Research on Chaco Prehistory*, ed. by W.J. Judge and J.D. Schelberg, pp.265-279. *Reports of the Chaco Center* 8. Division of Cultural Research, National Parks Service, Albuquerque.
- Cordell, Linda S.
 1979 Prehistory: Eastern Anasazi. In *The Handbook of North American Indians, Volume 9, The Southwest*, ed., by A. Ortiz, pp. 131-151. Smithsonian Institution, Washington.
- 1982 An overview of prehistory in the McKinley Mine area. In *Anasazi and Navajo Land Use of the McKinley Mine Area Near Gallup, New Mexico, Volume One: Archaeology, Part One*, ed. by C.G. Allen and B.A. Nelson, pp. 75-120. Office of Contract Archaeology, University of New Mexico, Albuquerque.
- 1984 *Prehistory of the Southwest*. Academic Press, New York.
- 1989 North and Central Rio Grande. In *Dynamics of Southwest Prehistory*, ed. by L.S. Cordell and G.J. Gumerman. pp. 293- 335. Smithsonian Institution Press, Washington.
- Cordell, Linda S. and Fred Plog
 1979 Escaping the Confines of Normative Thought: A Re-evaluation of Puebloan Prehistory. *American Antiquity* 44:405-429.

- Cowan, C. Wesley, Josselyn F. Moore, Richard I. Ford and Michael T. Samuels
 1978 A preliminary analysis of Paleoethnobotanical Remains from Black Mesa Arizona, 1977: Season. In *Excavations on Black Mesa, 1977 A Preliminary Report*, ed. by A.L. Klesert, pp. 137-156. Center for Archaeological Investigations, Research Paper No. 1, Southern Illinois University, Carbondale.
- Cully, Anne C.
 1985 Pollen evidence of past subsistence and environment at Chaco Canyon, New Mexico. In *Environment and Subsistence of Chaco Canyon, New Mexico*, ed. by F.J. Mathien, pp.135-245. Publications in Archaeology 18E. Chaco Canyon Studies. National Parks Service, U.S. Department of the Interior, Albuquerque.
- Cushing, Frank Hamilton
 1920 *Zuni Breadstuff*. Indian Notes and Monographs vol.8. Museum of the American Indian Heye Foundation, New York.
- Czaplewski, Nicholas J.
 1982 Faunal analysis. In *The Coronado Project Archaeological Investigations. The specialists volume: Biocultural Analysis*, compiled by R.E. Gasser, pp. 244-278. Coronado Series 4, Museum of Northern Arizona Research Paper 23, Flagstaff.
- Dean, Jeffrey S., Robert C. Euler, George J. Gumerman, Fred Plog, Richard H. Hevly and Thor N.V. Karlstrom
 1985 Human Behavior, Demography, and Paleoenvironment on the Colorado Plateaus. *American Antiquity* 50(3):537 - 554.
- Decker, Kenneth W. and Larry, L. Tieszen
 1989 Isotopic reconstruction of Mesa Verde diet from Basketmaker III to Pueblo III. *Kiva* 55(1):33-47.
- de Garine, I. and G.A. Harrison
 1988a Preface. In *Coping with Uncertainty in Food Supply*, ed. by I. de Garine and G.A. Harrison. pp. v-viii. Clarendon Press, Oxford.
 1988b Discussion and Conclusion. In *Coping with Uncertainty in Food Supply*, ed. by I. de Garine and G.A. Harrison. pp. 469-475. Clarendon Press, Oxford.
- Dennell, R.W.
 1979 Prehistoric Diet and Nutrition: Some Food for Thought. *World Archaeology* 11(2):121-135.
- Doebley, John F.
 1981 Plant remains recovered from trash at Salmon Ruin, New Mexico. *Kiva* 46(3):169-187.
- Doyel, D.E.
 1981 Prehistoric environment, subsistence, and land use in Dead Valley, east - central Arizona. *Kiva* 46(3):143-153.
- Driver, J.C., M.J. Brand, L. Lester and N. Munro
 in prep. Faunal studies. In *Small Sites Testing Program*, ed. by M. Varien. Crow Canyon Archaeological Center Occasional Paper.

- Eckles, D.
1978 Sources of Bias in the Analysis of Faunal Remains from Black Mesa, Arizona. Master of Arts thesis, Department of Anthropology, Southern Illinois University, Carbondale.
- Emslie, S.D.
1981 Bird Remains. contribution to: Big Westwater Ruin, by LaMar W. Lindsay, In *Excavations of Two Anasazi Sites in Southern Utah 1979-1980*. Cultural Resource Series No.9. pp. 162-171 Bureau of Land Management, Utah State Office.

1985 Faunal remains from the 1981 excavations on White Mesa, San Juan County, Utah. In *Anasazi Subsistence and Settlement on White Mesa, San Juan County, Utah*, ed. by William E. Davis, pp. 537-546.
- Ford, Richard I.
1983 Inter-Indian exchange in the Southwest. In *The Handbook of North American Indians, Volume 10, The Southwest*, ed., by A. Ortiz, pp. 711-722. Smithsonian Institution, Washington.

1984 Ecological consequences of early agriculture in the Southwest. In *Papers on the Archaeology of Black Mesa, Arizona, Volume II*, ed. by S. Plog and S. Powell, pp. 127 - 138. Southern Illinois University Press, Carbondale.
- Ford, Richard I., Jean French, Janet Stock, Tristine Smart, Grechen Hazen and David Jessup
1983 1981 Ethnobotanical recovery: Summary of analysis and frequency tables, In *Excavations on Black Mesa, 1981, A Descriptive Report*, ed. by F.E. Smiley, D.L. Nichols and P.P. Andrews, pp. 460 - 480. Center for Archaeological Investigations Research Report No.36. Southern Illinois University, Carbondale.
- Ford, Richard I., Pamela Vander Werf, Carol Golland and Heather B. Trigg
1985 Paleoethnobotany of Anasazi sites. In *Excavations on Black Mesa, A Descriptive Report*, ed. by A.L. Christenson and W. J. Parry, pp. 470 - 529. Center for Archaeological Investigations Research Report No.46. Southern Illinois University, Carbondale.
- Forde, C. Daryll
1931 Hopi agriculture and land ownership. *Journal of the Royal Anthropological Institute*, vol.61:357-405.
- French, Jean, Richard I. Ford, David Swain, Jim Kent, Tristine Smart and Grechen Hazen
1982 Paleoethnobotanical research on Black Mesa: 1980. In *Excavations on Black Mesa, 1980 A Descriptive Report*, ed. by P.P. Andrews, R. Layhe, D. Nichols and S. Powell, pp. 296 - 314. Center for Archaeological Investigations Research Report No.24. Southern Illinois University, Carbondale.
- Fry, G.F.
1977 Analysis of Prehistoric coprolites from Utah. *University of Utah Anthropology Papers* No. 97.
- Fry, G. and H.J. Hall
1986 Human coprolites. In *Archaeological Investigations at Antelope House*. ed. by D.P. Morris. National Parks Service, Washington D.C. pp. 165-188.

- Gasser, Robert E.
 1982 Anasazi diet. In *The Coronado Project: Archaeological Investigations: The Specialists Volume: Biocultural Analysis*, compiled by R.E. Gasser, pp.8-95. Coronado Series 4, Museum of Northern Arizona Research Paper 23, Flagstaff.
- Gish, J.W.
 1982 Pollen results. In *The Coronado Project: Archaeological Investigations: The Specialists Volume: Biocultural Analysis*, *Museum of Northern Arizona Coronado Series 4, Research Paper No.23*. Flagstaff.
- Glassow, Michael A.
 1972 Changes in the adaptations of Southwestern Basketmakers: A systems perspective. In *Contemporary Archaeology: A Guide to Theory and Contributions*, ed. by M.P. Leone. Southern Illinois University Press, Carbondale.
- Gnabasiak, Virginia R.
 1981 Faunal Utilization by the Pueblo Indians. M.A. thesis, Graduate Faculty of Anthropology, Eastern New Mexico University.
- Grayson, D.K.
 1984 *Quantitative Zooarchaeology*. Academic Press, Orlando.
- Gumerman, George J. and Jeffrey S. Dean
 1989 Prehistoric Cooperation and Competition in the Western Anasazi Area. In *Dynamics of Southwest Prehistory*, ed. by L.S. Cordell and G.J. Gumerman. pp. 99 - 148. Smithsonian Institution Press, Washington.
- Hack, John T.
 1942 The changing physical environment of the Hopi Indians of Arizona. *Papers of the Peabody Museum of American Archaeology and Ethnology, Harvard University*, vol.35(1) Reports of the Awatovi Expedition, Peabody Museum, Harvard University, Report 1.
- Harrill, Bruce G.
 1976 Faunal remains from the Johnson Canyon cliff dwellings. In *The Johnson-Lion Canyon Project: Report of the Investigation III*, assembled by Paul R. Nickens, pp.65-97. Bureau of Indian Affairs, Albuquerque.
- Hough, Walter
 1897 The Hopi in relation to their plant environment. *American Anthropologist* 10(2):33-44.
- Hunt, Charles B.
 1974 *Natural Regions of the United States and Canada*. W.H. Freeman and Company, San Francisco.
- Jorgensen, Joseph G.
 1983 Comparative traditional economics and ecological adaptations. In *The Handbook of North American Indians, Volume 10, The Southwest*, ed., by A. Ortiz, pp. 684-710. Smithsonian Institution, Washington.
- Judge, W. James
 1989 Chaco Canyon - San Juan Basin. In *Dynamics of Southwest Prehistory*, ed. by L.S. Cordell and G.J. Gumerman. pp. 209- 261. Smithsonian Institution Press, Washington.

- Katzenberg, M. A. and J.H. Kelley
 1991 Stable isotope analysis of prehistoric bone from the Sierra Blanca Region of New Mexico. In *Mogollon V*, ed. by P.H. Beckett, pp. 207-219. COAS Publishing, Las Cruces.
- Kennard, Edward A.
 1979 Hopi economy and subsistence. In *The Handbook of North American Indians, Volume 9, The Southwest*, ed., by A. Ortiz, pp.554-563. Smithsonian Institution, Washington.
- Kent, Susan
 1991 Excavations at a small Mesa Verde Pueblo II Anasazi Site in Southwest Colorado. *Kiva* 57(1):55-75.
- Kidder, A.V.
 1927 Southwestern archaeological conference. *Science* 66(1716):489-491.
- Kirkpatrick, David T. and Richard I. Ford
 1977 Basketmaker food plants from the Cimarron District, Northeastern New Mexico. *Kiva* 42(3-4):257-299.
- LeBlanc, Steven A.
 1989 Cibola: Shifting Cultural Boundaries. In *Dynamics of Southwest Prehistory*, ed. by L.S. Cordell and G.J. Gumerman. pp. 337- 369. Smithsonian Institution Press, Washington.
- Leonard, R.D.,
 1986 Patterns of Anasazi Subsistence: Faunal Exploitation, Subsistence Diversification and Site Function in northeast Arizona. Ph.D. dissertation, University of Washington, Seattle.
- 1989 *Anasazi Faunal Exploitation: Prehistoric Subsistence on Northern Black Mesa, Arizona*. Southern Illinois University, Center for Archaeological Investigations Occasional Paper No. 13, Carbondale.
- Lepofsky, D.
 1986 Preliminary analysis of flotation samples from the Turkey Pen Ruin, Cedar Mesa. Manuscript on file, Laboratory of Archaeology, University of British Columbia.
- Lightfoot, K.G. and F. Plog
 1984 Intensification along the north side of the Mogollon Rim. In *Prehistoric Agricultural Strategies in the Southwest*, ed. by S.K. Fish and P.R. Fish. pp.179-195. Arizona State University Anthropological Research Papers No. 33. Tempe.
- Lipe, William D.
 1983 The Southwest. In *Ancient North Americans*, ed. by J.D. Jennings, pp. 421-493. W.H. Freeman and Company, San Francisco.
- Matson, R.G. and Brian Chisholm
 1991 Basketmaker II subsistence: Carbon isotopes and other dietary indicators from Cedar Mesa, Utah. *American Antiquity* 56(3): 444-459.
- Matthews, Meridith H.
 1985 Agricultural Intensification and Multiple Cropping Practices: Testing Change in Exploitation of Pioneer Plant Resources. M.A. thesis, University of Colorado, Boulder.

Matthews, Meridith H.

- 1986 Section 2: The Dolores Archaeological Program macrobotanical data base: Resource mix and availability. Part of Chapter 4: Environmental Archaeology, by K.L. Petersen, M.H. Matthews and Sarah W. Neusius. In *Dolores Archaeological Program: Final Synthetic Report*, Compiled by D.A. Breternitz, C.K. Robinson and T.G. Gross, pp.184-199. United States Department of the Interior, Bureau of Reclamation, Engineering and Research Center, Denver.

Mignonette, Ray

- 1981 Faunal remains. contribution to: Big Westwater Ruin, by LaMar W. Lindsay, In *Excavations of Two Anasazi Sites in Southern Utah 1979-1980*. Cultural Resource Series No.9. pp. 157-162 Bureau of Land Management, Utah State Office.

Minnis, Paul E.

- 1981 Seeds in archaeological sites: Sources and some interpretive problems. *American Antiquity* 46(1):143 - 152.
- 1989 Prehistoric diet in the northern Southwest: Macroplant remains from four corners feces. *American Antiquity* 54:543 - 563.

Neusius, Sarah W.

- 1986 Section 4. The Dolores Archaeological Program Fauna Data Base: Resource availability and resource mix. Part of Chapter 4: Environmental Archaeology, by K.L. Petersen, M.H. Matthews and Sarah W. Neusius. In *Dolores Archaeological Program: Final Synthetic Report*, Compiled by D.A. Breternitz, C.K. Robinson and T.G. Gross, pp.199-303. United States Department of the Interior, Bureau of Reclamation, Engineering and Research Center, Denver.

Nichols, D.L. and F.E. Smiley (eds.)

- 1984 Appendix M. In *Excavations on Black Mesa, 1982 A Descriptive Report*. Research Paper No. 39, Southern Illinois University, Carbondale.

Ortiz, A. (editor)

- 1979 *The Handbook of North American Indians, Volume 9, The Southwest*. Smithsonian Institution, Washington.

Pippin, Lonnie C.

- 1987 *Prehistory and Paleoecology of Guadalupe Ruin, New Mexico*. University of Utah Anthropological Papers No. 112. University of Utah Press, Salt Lake City.

Plog, Fred

- 1979 Prehistory: Western Anasazi. In *The Handbook of North American Indians, Volume 9, The Southwest*, ed., by A. Ortiz, pp. 108-130. Smithsonian Institution, Washington.
- 1983 Political and economic alliances on the Colorado Plateaus, A.D. 400 - 1450. In *Advances in World Archaeology Vol.2*, ed. by F. Wendorf and A.E. Close, pp. 289-330. Academic Press, New York.

Plog, Stephen

- 1986 Understanding cultural change in the northern Southwest. In *Spatial Organization and Exchange*, ed. by S. Plog, pp. 310-336. Southern Illinois University Press, Carbondale.

- Plog, Stephen and Michelle Hegmon
 1993 The sample size - richness relation: The relevance of research questions, sampling strategies and behavioral variation. *American Antiquity* 58(3):489-496.
- Powell, Shirley
 1983 *Mobility and Adaptation*. Southern Illinois University Press, Carbondale.
- Powers, Margaret A.
 1984 *The Salvage of Archaeological Data from Turkey Pen Ruin, Grand Gulch Primitive Area, San Juan County, Utah*. Division of Conservation Archaeology, Contributions to Anthropology Series, No.808. San Juan County Museum Association, Farmington, New Mexico.
- Reinhard, Karl J.
 1988 Diet, Parasitism, and Anemia in the Prehistoric Southwest. Ph.D. dissertation. Department of Anthropology, Texas A & M University, College Station.
- Robbins, Wilfred, W., John P. Harrington and Barbara Freire-Marreco
 1916 *Ethnobotany of the Tewa Indians*. Bureau of American Ethnology, Bulletin 55. Smithsonian Institution, Washington.
- Rohn, Arthur H.
 1989 Northern San Juan Prehistory. In *Dynamics of Southwest Prehistory*, ed. by L.S. Cordell and G.J. Gumerman. pp. 149- 177. Smithsonian Institution Press, Washington.
- Rood, Ronald J.
 1991 Identification of faunal remains and modified bone from 5MT3879. Report prepared for Woods Canyon Archaeological Consultants Inc., Yellow Jacket, Colorado.
- Roosevelt, Anna
 1987 The Evolution of Human Subsistence. In *Food and Evolution: Toward a Theory of Human Food Habits*, ed. by M. Harris and E.B. Ross. pp.565-578. Temple University Press, Philadelphia.
- Ross, Eric B.
 1987 An Overview of the trends in Dietary Variation from Hunter- Gatherer to Modern Capitalist Societies. In *Food and Evolution. Toward a Theory of Human Food Habits*, ed. by M. Harris and E.B. Ross. pp. 7-55. Temple University Press, Philadelphia.
- Scott, Linda J.
 1976 Hoy House - a palynological study. In *The Johnson - Lion Canyon Project. Report of the Investigations III*, Assembled by Paul R. Nickens, pp. 8 - 49. Mesa Verde Research Center, University of Colorado, Boulder.
- 1979 Dietary inferences from Hoy House coprolites: A Palynological interpretations. *Kiva* 44(2-3):257-281.
- Seme, Michele
 1980a Appendix 6: Faunal analysis of material from the 1979 field season. In *Excavations on Black Mesa, 1979: A Descriptive Report*. ed. by S. Powell, P. Layhe and A.L. Klesert, pp. 465-508. Center for Archaeological Investigations Research Paper No. 18. Southern Illinois University, Carbondale.

Seme, Michele

1980b Analysis of Faunal Remains from Prehistoric Sites on Black Mesa, Northeastern Arizona. Master of Science thesis, Department of Biological Sciences, University of Texas, El Paso.

1984 The effects of agricultural fields on faunal assemblage variation. In *Papers on the Archaeology of Black Mesa, Arizona, Volume II*, ed. by S. Plog and S. Powell, pp. 139 - 157. Southern Illinois University Press, Carbondale.

Seme, Michele and Arthur H. Harris

1982 Appendix IX, 1980 faunal analysis. In *Excavations on Black Mesa, 1980 A Descriptive Report*, ed. by P.P. Andrews, R. Layhe, D. Nichols and S. Powell, pp. 322-350. Center for Archaeological Investigations, Research Paper No.24. Southern Illinois University, Carbondale.

Shaffer, B.S.

1992 Interpretation of gopher remains from Southwestern archaeological assemblages. *American Antiquity* 57(4):683-691.

Short, Susan K.

1980 Pollen analysis. In *The Durango South Project, Archaeological Salvage of Two Late Basketmaker III sites in the Durango District*, ed. by J.D. Gooding, pp. 149 - 156. The University of Arizona Press, Tucson.

Smiley, F.E., D.L. Nichols and P.P. Andrews (eds.)

1983 *Excavations on Black Mesa, 1981, A Descriptive Report*. Center for Archaeological Investigations, Research Paper No.36. Southern Illinois University, Carbondale.

Steward, Julian H.

1955 *Theory of Culture Change. The Methodology of Multilinear Evolution*. University of Illinois Press, Urbana.

1977 The Concept and Method of Cultural Ecology. In *Evolution and Ecology. Essays on Social Transformation*. By Julian Steward. Ed. by Jane C. Steward and R.F. Murphy. pp.43-57. University of Illinois Press, Urbana.

Stiger, M.A.

1977 Anasazi diet: The coprolite evidence. Master of Arts thesis, Department of Anthropology, University of Colorado, Boulder.

Struever, M.B.

1977 Relation of Pollen and Flotation Analysis to Archaeological Excavations, Chaco Canyon, New Mexico. Master of Arts thesis, Department of Biology, University of New Mexico, Albuquerque.

Sullivan, Alan P., III

1987 Seeds of discontent: Implications of a "Pompeii" archaeobotanical assemblage for Grand Canyon Anasazi subsistence models. *Journal of Ethnobiology* 7(2):137-153.

1992 Pinyon nuts and other wild resources in western Anasazi subsistence economies. In *Research in Economic Anthropology, Supplement 6. Long-term Subsistence Change in Prehistoric North America*, ed. by D.E. Croes, R.A. Hawkins and B.L. Issac, pp. 195-239 JAI Press Inc., London

- Thomas, David H.
 1969 Great Basin hunting patterns: A quantitative method for treating faunal remains. *American Antiquity* 34(4):392 - 401.
- Toll, Mollie S.
 1983 Taxonomic diversity in flotation and macrobotanical assemblages from Chaco Canyon, In *Recent Research on Chacoan Prehistory*, ed. by W.J. Judge and J.D. Schelberg, pp.241-250. Reports of the Chaco Center 8. Division of Cultural Research, National Parks Service, Albuquerque.
 1985 An overview of Chaco Canyon macrobotanical materials and analysis to date. In *Environment and Subsistence of Chaco Canyon*, ed. by F.J. Mathien, pp. 247-277. Publications in Archaeology 18-E. Chaco Canyon Studies, National Parks Service, Washington D.C.
- Toll, Mollie S. and Marcia Donaldson
 1982 Flotation and macrobotanical analysis of archaeological sites on the McKinley Mine Lease: A regional study of plant manipulation and natural seed dispersal over time. In *Anasazi and Navajo Land Use in the McKinley Mine Area Near Gallup, New Mexico Volume One: Archaeology. Part Two*, ed. by C.G. Allen and B.A. Nelson, pp. 712 - 786. Office of Contract Archaeology, University of New Mexico, Albuquerque.
- Upham, Steadman
 1982 *Politics and Power*. Academic Press, New York.
- van der Merwe, N.J.
 1982 Carbon isotopes, photosynthesis and archaeology. *American Scientist* 70:596-606.
- Vivian, R. Gwinn
 1990 *The Chacoan Prehistory of the San Juan Basin*. Academic Press, New York.
- Wagner, Gail, Tristine Smart, Richard I. Ford and Heather Trigg
 1984 Ethnobotanical Recovery, 1982: Summary of analysis and frequency tables, In *Excavations on Black Mesa, 1982 A Descriptive Report*, ed. by D.L. Nichols and F.E. Smiley, pp. 612 - 632. Center for Archaeological Investigations Research Report No.39. Southern Illinois University, Carbondale.
- Walker, Danny N.
 1989 Faunal remains from the Green Lizard Site (5MT3901), Colorado. Report prepared for the Crow Canyon Archaeological Center, Cortez, Colorado.
- Whiting, Alfred F.
 1966 *Ethnobotany of the Hopi*. Museum of Northern Arizona, Bulletin No. 15, Flagstaff.
- Weir, Glendon Hoge
 1976 Palynology, Flora and Vegetation of Hovenweep Monument: Implications for Aboriginal Plant Use on Cajon Mesa, Colorado and Utah. Ph.D. dissertation, Texas A&M University.
- Williams-Dean, G.
 1986 Pollen analysis of human coprolites. In *Archaeological Investigations at Antelope House*, ed. by D.P. Morris, pp.189-205. National Parks Service, U.S. Department of the Interior, Washington, D.C.

Wing Elizabeth S. and Antoinette Brown

1979 *Paleonutrition. Method and Theory in Prehistoric Foodways*. Academic Press, New York.

Woosley, Anne I.

1980 Agricultural diversity in the prehistoric Southwest. *Kiva* 45(4):317-335.

Vivian, R. Gwinn

1990 *The Chacoan Prehistory of the San Juan Basin*. Academic Press Inc., New York.

Young, Gwen

1980 Analysis of faunal remains. In *Tijeras Canyon: Analyses of the Past*, by L.S. Cordell, pp.88-120. University of New Mexico Press, Albuquerque.

Zubrow, E.B.W.

1971 Carrying capacity and dynamic equilibrium in the prehistoric Southwest. *American Antiquity* 36(2):127-138.

APPENDIX 1

Table A. Ethnobotanical resource use (Hopi: Whiting 1966; Tewa: Robbins et al. 1916); C=construction, D=decoration, F=fuel, H=household, M=medicine, R=ritual and T=tool.

COMMON NAME	SCIENTIFIC NAME	HOPI		TEWA	
		FOOD	OTHER	FOOD	OTHER
White Fir	<i>Abies concolor</i>		R		M,T
Juniper	<i>Juniperus utahensis</i>	x	D,F,M,T	x	F,M,T
Pinyon pine	<i>Pinus edulis</i>		M,R,C	x	F,M
West. yellow pine	<i>Pinus ponderosa</i>		C,R		R
Douglas fir	<i>Psudotsuga</i>		R		R
Mormon tea	<i>Ephedra torreyana</i>		M		
Narrow leaf cattail	<i>Typha angustifolia</i>	x	R		
Giant reed	<i>Arundo donax</i>		C,R,T		
Black grama	<i>Bouteloua eriopoda</i>		H		
Blue grama	<i>Bouteloua gracilis</i>		T		
Sand grass	<i>Calamovilfa gigantea</i>		R		
Galleta grass	<i>Hilaria jamesii</i>		R,T		
Purple hair grass	<i>Muhlenbergia pungens</i>		T		
Indian millet	<i>Oryzopsis hymenoides</i>	x			
Reed, Carrizo	<i>Phragmites communis</i>		C		T
Alkali sacaton	<i>Sporobolus airoides</i>	x			
Dropseed	<i>Sporobolus flexuosus</i>	x			
Giant Dropseed	<i>Sporobolus giganteus</i>	x	R		
Maize, Corn	<i>Zea Mays</i>	x	R	x	R
Sedges and Rushes	<i>J. balticus, S. lacustris</i>		R		
Wild Onion	<i>Allium sp.</i>	x		x	
Mariposa lily	<i>Calochortus aureus</i>	x	R		
Narrow leaf yucca	<i>Yucca angustissima</i>		H,M,R,T	x	H,R,T
Banana yucca	<i>Yucca baccata</i>	x	H,T	x	H,R,T
Mescal	<i>Agave sp.</i>	x			
Rocky mtn. aspen	<i>P. aurea, P. tremuloides</i>		R		M
Cottonwood	<i>Populus sp.</i>		C,R,T		T
Willow	<i>Salix sp.</i>		C,R		R,T
Oak	<i>Quercus sp.</i>		T	x	T
Mistletoe	<i>Phoradendron sp.</i>		M		M
Buckwheat	<i>Eriogonum sp.</i>		M		
Canaigre	<i>Rumex hymenosepalus</i>		D		
Fourwing saltbush	<i>Atriplex canescens</i>	x	F		
Saltbush	<i>Atriplex sp.</i>	x		x	
Lambsquarters	<i>Chenopodium sp.</i>	x			
---	<i>Cycloloma atriplicifolium</i>		M		
Seep weed	<i>Dondia fruticosa</i>	x	M		

APPENDIX 1

Table A. Continued.

COMMON NAME	SCIENTIFIC NAME	HOPI		TEWA	
		FOOD	OTHER	FOOD	OTHER
Greasewood	<i>Sarcobatus vermiculatus</i>		F,R,T		
---	<i>Acanthochiton wrightii</i>	x			
Pigweed	<i>Amaranthus blitoides</i>	x		x	
Sand verbena	<i>Abronia elliptica</i>		M		
Umbrella-wort	<i>Allionia coccinea</i>		M		
Four o'clock	<i>Quamoclidion multiflorum</i>		R	x	M
---	<i>Boerhaavia erecta</i>		T		
Purslane	<i>Portulaca oleracea</i>	x		x	
Sandwort	<i>Arenaria eastwoodiae</i>		M		
Larkspur	<i>Delphinium scaposum</i>		R		
Buttercup	<i>Ranunculus cymbalaria</i>		T		
Holly grape	<i>Odostemon fremontii</i>		M,T		
Spectacle pod	<i>Dithyrea wislizeni</i>		M		
Tansy mustard	<i>Sophia pinnata</i>	x	D	x	D
---	<i>Stanleya albescens</i>	x			
---	<i>Stanleya pinnata</i>	x			
Rocky mtn. beewee	<i>Cleome serrulata</i>	x	D		
---	<i>Wislizenia melilotoides</i>	x	D		
Wild current	<i>Ribes inebrians</i>	x	T	x	T
Mtn. Mahogany	<i>Cercocarpus eximius</i>		D,T		T
Cliff rose	<i>Cowania stansburiana</i>		M,R,T		
Apache plume	<i>Fallugia paradoxa</i>		T		T
Wild rose	<i>Rosa arizonica</i>	x			D,M
Serviceberry	<i>Amelanchier</i>	x	T		
---	<i>Parryella filifolia</i>		T		
---	<i>Petalostemon oligophyllum</i>		M		
Tepary	<i>Phaseolus acutifolius</i>	x			
Lima (sieva) bean	<i>Phaseolus lunatus</i>	x			
Scarlet runner bean	<i>Phaseolus multiflorus</i>	x			
String bean	<i>Phaseolus vulgaris</i>	x			
---	<i>Chamaesyce flagelliformis</i>		M		
---	<i>Croton texensis</i>		M		
---	<i>Reverchonia arenaria</i>		H,M		
Sumac	<i>Rhus trilobata</i>	x			R
Hopi cotton	<i>Gossypium hopi</i>		H,R		H,M
Globmallow	<i>Sphaeralcea sp.</i>		M		M

APPENDIX 1

Table A. Continued.

COMMON NAME	SCIENTIFIC NAME	HOPI		TEWA	
		FOOD	OTHER	FOOD	OTHER
Blazing star	<i>Mentzelia multiflora</i>	x	M	x	
Hedgehog cactus	<i>Echinocereus fendleri</i>	x			
Prickley pear cactus	<i>Opuntia hystricina</i>	x		x	
Cholla cactus	<i>Opuntia whipplei</i>	x			
Evening primrose	<i>Anogra pallida</i>		R		
Ironwood	<i>Forestiera neomexicana</i>		T		
Milkweed	<i>Asclepias galioides</i>		M	x	M,T
Gilia	<i>Gilia sp.</i>	x			M
Borage (family)	<i>Cryptanthe crassisepala</i>		M		
Borage (family)	<i>Cryptanthe jamesii</i>		M		
Borage (family)	<i>Onosmodium thurberi</i>		R		
---	<i>Chamaesaracha coronopus</i>	x			
Jimson weed	<i>Datura meteloides</i>		M		
Tomatilla	<i>Lycium pallidum</i>	x		x	
Wild tobacco	<i>Nicotiana attenuata</i>		R		R
Ground Cherry	<i>Physalis fendleri</i>	x		x	
Beebalm	<i>Monarda menthaefolia</i>	x		x	M
---	<i>Poliomintha incana</i>	x			
Sage	<i>Salvia carnososa</i>		M		
---	<i>Adenostegia wrightii</i>		M		
Painted cup	<i>Castilleja linariaefolia</i>		M		
---	<i>Pentstemon ambiguus</i>		D		
Common mullein	<i>Verbascum thapsus</i>		R		
Devil's claw	<i>Martynia louisiana</i>		D		
Plantain	<i>Plantago purshii</i>		M		
Wild gourd	<i>Cucurbita foetidissima</i>		T		M
Squash pumpkin	<i>Cucurbita moschata</i>	x		x	
Gourd	<i>Lagenaria vulgaris</i>		T		R
Sunflower (family)	<i>Actinea acaulis</i>	x	M		
---	<i>Aplopappus nuttallii</i>		M		
Wormwood	<i>Artemisia dracunculoides</i>	x			
Sand sagebrush	<i>Artemisia filifolia</i>		M		M
Mountain sagebrush	<i>Artemisia frigida</i>		R		
Sagebrush	<i>Artemisia tridentata</i>		M		M
Blue aster	<i>Aster cichoriaceus</i>		M		
White aster	<i>Aster leucelene</i>		M		

APPENDIX 1

Table A. Continued.

COMMON NAME	SCIENTIFIC NAME	HOPI		TEWA	
		FOOD	OTHER	FOOD	OTHER
---	<i>Chrysopsis villosa</i>		M		
Rabbitbrush	<i>Chrysothamnus sp.</i>		D,F,T		D,M,T
Thistle	<i>Cirsium pulchellum</i>		M		
Blanket flower	<i>Gaillardia pinnatifida</i>		M		
Snakeweed	<i>Gutierrezia sp.</i>		M,R		M
Sunflower	<i>Helianthus annuus</i>	x	R		T
Hopi sunflower	<i>Helianthus sp.</i>	x	D,H		
---	<i>Hymenopappus lugens</i>		M,R		
---	<i>Lygodesmia grandiflora</i>	x	M		
---	<i>Ptiloria exigua</i>		M		
---	<i>Ptiloria pauciflora</i>		M		
Groundsel	<i>Senecio longilobus</i>		M		
---	<i>Solidago missouriensis</i>	x			
Golden rod	<i>Solidago petradoria</i>		M		
---	<i>Tetradymia canescens</i>		M		
---	<i>Thelesperma gracile</i>	x		x	
---	<i>Townsendia arizonica</i>		M		
Crown beard	<i>Verbesina encelioides</i>		M		
---	<i>Wyethia scabra</i>		M		
Spleenwort	<i>Asplenium trichomanes</i>		R		
Lichen			M		M
Corn smut	<i>Ustilago zeae</i>	x	R		M
Alder	<i>Alnus tenuifolia</i>				D
Hackberry	<i>Celtis reticulata</i>			x	
Chokecherry	<i>Padus melanocarpa</i>			x	T
---	<i>Robinia neomexicana</i>				T
Skunkbush	<i>Schmaltzia bakeri</i>			x	
Mtn. Tewa fruit	<i>Sercotheca dumosa</i>			x	
Cocklebur	<i>Xanthium commune</i>				M
Green sage	<i>Artemisia forwoodii</i>				M
Crowfoot	<i>Halerpestes cymbalaria</i>				T
Praire clover	<i>Pentalsoteum candidus</i>			x	
Rocky mtn. beeplan	<i>Peritama serrulatum</i>			x	D
Mustard species	<i>Stanlyella wrightii</i>			x	D
Cane cactus	<i>Opuntia arborescens</i>			x	

APPENDIX 1

Table A. Continued.

COMMON NAME	SCIENTIFIC NAME	HOPI		TEWA	
		FOOD	OTHER	FOOD	OTHER
Ball cactus	<i>Mamillaria sp.</i>			x	
Panic grass	<i>Panicum barbipulvinatum</i>				T
Sage grass	<i>Schizachyrium scoparium</i>				T
Mesquite grass	<i>Bouteloua curtipendula</i>				T
Earth star	<i>Geaster sp.</i>				M
Cloakfern	<i>Notholanea fendleri</i>				M
Wild potato	<i>Saegobe sp.</i>	x		x	

APPENDIX 1

Table B. Ethnographic use of animal taxa (Gnabasik 1981);
A=hunting assistant, D=dress, F=famine food, H=hide, M=medicine and R=ritual.

COMMON NAME	SCIENTIFIC NAME	FOOD	OTHER
Bear	<i>Ursus</i> sp.		R
Beaver	<i>Castor canadensis</i>	x	
Bison	<i>Bison bison</i>	x	H,R
Bobcat	<i>Lynx rufus</i>		R
Coyote	<i>Canis latrans</i>		R
Deer	<i>Odocoileus</i> sp.	x	H,R
Dog	<i>Canis familiaris</i>	x	A
Elk	<i>Cervus canadensis</i>	x	H,R
Four-lined Colo. Chipmunk	<i>Eutamias quadrivittatus</i>	x	
Fox	<i>U. cinereoargenteus</i> , <i>V. velox</i>		R
Ground Squirrel	<i>C. lateralis</i> , <i>S. lateralis</i>	x	
Jackrabbit	<i>Lepus</i> sp.	x	
Mountain goat	<i>Oreamnos americanus</i>	x	R
Mountain lion	<i>Felis concolor</i>		H
Mountain sheep	<i>Ovis canadensis</i>	x	H,R
Otter	<i>Lutra canadensis</i>	x	H
Prarie dog	<i>Cynomys</i> sp.	x	
Pronghorn	<i>Antilocapra americana</i>	x	H,R
Cottontail rabbit	<i>Sylvilagus</i> sp.	x	R
Skunk	<i>Mephitis</i> sp. <i>Spilogale</i> sp.		H
Albert's Squirrel	<i>Sciurus alberti</i>	x	
Weasel	<i>Musrela</i> sp.	x	M
Wildcat (Mtn. lion ?)			H
Wolf	<i>Canis lupus</i>		H
Woodrat/packrat	<i>Neotoma</i> sp.	x	
Bluebird			R
Bluejay	<i>Cyanocitta cristata</i>		R
Bobwhite	<i>Colinus virginianus</i>		M
Crow	<i>Corvus brachyrhynchos</i>		R
Desert sparrow hawk	<i>Falco sparverius phalaena</i>		R
Duck		x	R
Dusky grouse	<i>Dendragapus obscurus</i>	x	
Eagle	<i>H. leucocephalus</i> , <i>A. chrysaetos</i>		R
Goose			R
Hawk			R
Hummingbird			R

APPENDIX 1

Table B. Continued.

COMMON NAME	SCIENTIFIC NAME	FOOD	OTHER
Jay			R
Macaw	Ara sp.		R
Magpie	Pica pica		R
Mockingbird	Mimus polyglottos		R
Mourning dove	Zenaidura macroura	x	R
Owl			R
Parrot	Rhynchopsitta pachyrhyncha		R
Quail		x	
Red tailed hawk	Buteo jamaicensis		R
Red-winged blackbird	Agelaius phoeniceus	x	
Roadrunner	Geococcyx californianus		R
Rockwren	Salpinctes obsoletus		R
Sparrowhawk	Falco sparverius		R
Steller's jay	Cyanocitta stelleri diaademata		R
Turkey	Meleagris gallopavo	x	R
Turkey vulture	Cathartes aura		R
Warbler			R
Woodpecker			R
Wren			R
Yellow Warbler	Dendroica petechia		R
Yellow-headed blackbird	Xanthocephalus xanthocephalus	x	
Lizard		x	F
Rattlesnake	Crotalus sp.		R
Snake		x	F
Turtle			R
American eel	Anguilla rostrata		D
Fish		x	
Ant			M
Bee		x	
Bumblebee		x	
Burrowing hornet		x	
Cornworm			M

APPENDIX 2

Table A. Sites included in the faunal analysis with publication references.

CHACO BRANCH	
<i>Basketmaker III</i>	
Shabik'eshchee Village	Akins 1985
29SJ423	Akins 1985
<i>Basketmaker III-Pueblo I</i>	
NA 14,674	Czaplewski 1982
29SJ628	Akins 1985
<i>Pueblo I</i>	
NA 14,654	Czaplewski 1982
29SJ724	Akins 1985
<i>Pueblo I-Pueblo II</i>	
29SJ629	Akins 1985
<i>Pueblo II</i>	
PM205	Binford et al. 1982
PM218	Binford et al. 1982
PM240	Binford et al. 1982
29SJ1360	Akins 1985
NA 14,662	Czaplewski 1982
<i>Pueblo II-Pueblo III</i>	
PM240	Binford et al. 1982
LA19553	Binford 1983
Pueblo Alto	Akins 1985
Una Vida	Akins 1985
29SJ627	Akins 1985
29SJ633	Akins 1985
NA 14,650	Czaplewski 1982
<i>Pueblo III</i>	
NA 14,667	Czaplewski 1982
KAYENTA BRANCH	
<i>Basketmaker II</i>	
D:7:152	Bearden 1984
D:7:236	Bearden 1984
D:11:1161	Bearden 1984
D:7:3107	Smiley, Nichols and Andrews 1983
D:11:244	Smiley, Nichols and Andrews 1983
D:11:3131	Nichols and Smiley 1984
D:11:3133	Nichols and Smiley 1984
D:11:449	Christenson and Parry 1985
D:7:239	Leonard 1986,1989
D:11:1410	Leonard 1986,1989
D:7:3013	Leonard 1986,1989
<i>Pueblo I</i>	
D:11:2023	Nichols and Smiley 1984
D:11:2025	Nichols and Smiley 1984

APPENDIX 2

Table A. Continued

D:11:2064	Smiley, Nichols and Andrews 1983
D:11:2062	Nichols and Smiley 1984
<i>Pueblo I-Pueblo II</i>	
D:7:234	Smiley, Nichols and Andrews 1983
D:11:2030	Christenson and Parry 1985
D:11:320	Seme 1980a
D:7:216	Leonard 1986,1989
<i>Pueblo II</i>	
D:7:18	Seme 1980b
D:7:23	Seme 1980b
D:7:704	Seme 1980b
D:11:73	Seme 1980b
D:7:725	Seme 1980b
D:11:275	Seme 1980b
D:7:109	Seme and Harris 1982
D:11:2001	Seme and Harris 1982
D:11:2108	Nichols and Smiley 1984
D:7:220	Seme 1980a
D:11:215	Seme 1980a
D:11:425	Seme 1980a
D:11:2042	Smiley, Nichols and Andrews 1983
D:11:426	Seme 1980a
D:11:316	Smiley, Nichols and Andrews 1983
D:7:2085	Christenson and Parry 1985
D:11:2051	Nichols and Smiley 1984
D:7:719	Leonard 1986, 1989
D:11:352	Leonard 1986, 1989
SAN JUAN - MESA VERDE BRANCH	
<i>Basketmaker III</i>	
5LP110	Anderson 1980
5LP111	Anderson 1980
Dolores Period 1	Neusius 1986
<i>Basketmaker III- Pueblo I</i>	
42 Sa6757	Emslie 1985
<i>Pueblo I</i>	
Dolores Period 2	Neusius 1986
Dolores Period 3	Neusius 1986
Dolores Period 4	Neusius 1986
<i>Pueblo II</i>	
5MT1786	Kent 1991
Dolores Period 5	Neusius 1986
Dolores Period 6	Neusius 1986
UGG4x-3	Brand n.d.

APPENDIX 2

Table A. Continued

<i>Pueblo II-Pueblo III</i>	
Dolores Period 7	Neusius 1986
Big Westwater Ruin	Mignonette 1981, Emslie 1981
42Sa6396	Emslie 1985
<i>Pueblo III</i>	
5MT262	Driver et al. n.d.
5MT1825	Driver et al. n.d.
5MT3918	Driver et al. n.d.
5MT3030	Driver et al. n.d.
5MT3936	Driver et al. n.d.
5MT3951	Driver et al. n.d.
5MT3967	Driver et al. n.d.
5MT5152	Driver et al. n.d.
5MT10246	Driver et al. n.d.
5MT10459	Driver et al. n.d.
5MT10508	Driver et al. n.d.
5MT11338	Driver et al. n.d.
5MT765	Brand 1991
5MT3876	Rood 1991
5MT3901	Walker 1989
5MTUR2156	Harrill 1976
5MTUR2150	Harrill 1976
RIO GRANDE BRANCH	
<i>Pueblo II-Pueblo III</i>	
San Antonio (early)	Young 1980

APPENDIX 2

Table B. Chaco branch Basketmaker III faunal data.								
	SITE SHABIK'ESHCHEE		29SJ423		NISP SUM	NISP FREQ	FREQ SUM	FS/#SITES
TAXA	NISP	%	NISP	%				
Shrews								
Bats								
Lagomorpha								
Cottontail	103	30.6%	589	30.3%	692	30.4%	0.60893355	30.4%
Jackrabbit	36	10.7%	97	5.0%	133	5.8%	0.15677343	7.8%
Rodentia			6	0.3%	6	0.3%	0.0030896	0.2%
Squirrels								
Chipmunks								
Marmot								
Cynomys sp.	4	1.2%	6	0.3%	10	0.4%	0.01495903	0.7%
Geomyidae sp.	16	4.7%			16	0.7%	0.04747774	2.4%
Beaver								
Neotoma sp.	7	2.1%	7	0.4%	14	0.6%	0.02437604	1.2%
Mice, Rats and Vole	2	0.6%	12	0.6%	14	0.6%	0.01211391	0.6%
Muskrat								
Porcupine								
Carnivora								
Canidae								
Canis sp.	4	1.2%	9	0.5%	13	0.6%	0.01650383	0.8%
Coyote			10	0.5%	10	0.4%	0.00514933	0.3%
Wolf								
Dog	2	0.6%	2	0.1%	4	0.2%	0.00696458	0.3%
Fox			2	0.1%	2	0.1%	0.00102987	0.1%
Bear	1	0.3%	1	0.1%	2	0.1%	0.00348229	0.2%
Raccoon								
Marten								
Mustelidae sp.								
Badger								
Skunk								
Felidae								
Mountain Lion								
Bobcat	4	1.2%	3	0.2%	7	0.3%	0.01341424	0.7%
Artiodactyla	58	17.2%	30	1.5%	88	3.9%	0.18755482	9.4%
Elk			2	0.1%	2	0.1%	0.00102987	0.1%
Deer	5	1.5%	3	0.2%	8	0.4%	0.01638159	0.8%
Antelope	29	8.6%	11	0.6%	40	1.8%	0.09171768	4.6%
Mountain Sheep	4	1.2%	4	0.2%	8	0.4%	0.01392917	0.7%
Bison								
Large Mammal	20	5.9%	211	10.9%	231	10.1%	0.16799806	8.4%
Medium Mammal	39	11.6%	931	47.9%	970	42.6%	0.59512968	29.8%
Small Mammal								
Water fowl								
Canada Goose								
Ducks			1	0.1%	1	0.0%	0.00051493	0.0%
Blue-winged teal								
Merganser								
Falconiformes								
Turkey Vulture								
Eagle								
Hawk			2	0.1%	2	0.1%	0.00102987	0.1%
Falco sp.			1	0.1%	1	0.0%	0.00051493	0.0%
Grouse								
Turkey	1	0.3%			1	0.0%	0.00296736	0.1%
Quail			1	0.1%	1	0.0%	0.00051493	0.0%
Sandhill Crane								
Mourning Dove								
Owls								
American Coot								
Caprimulgidae								
Apodiformes								
Flicker								
Passeriformes								
Horned Lark	1	0.3%			1	0.0%	0.00296736	0.1%
Meadowlark								
Dark-eyed Junco								
Towhee								
Swallows								
Corvidae	1	0.3%			1	0.0%	0.00296736	0.1%
Wrens								
Turdidae								
Shrikes								
Blackbirds								
Fringillidae								
Macaw								
Large Bird								
Small/Medium Bird								
Amphibian/Reptile								
Amphibian								
Reptile			1	0.1%	1	0.0%	0.00051493	0.0%
Fish								
Speotyto cunicularia								
Succinedae								
Total	337		1942		2279			

APPENDIX 2

Table C. Chaco branch Basletmaker III - Pueblo I faunal data.								
TAXA	SITE 29SJ628		NA 14,674		NISP SUM	NISP FREQ	FREQ SUM	FS/#SITES
	NISP	%	NISP	%				
Shrews								
Bats								
Lagomorpha								
Cottontail	2042	41.3%	144	12.5%	2186	35.8%	0.53761769	26.9%
Jackrabbit	1717	34.7%	149	12.9%	1866	30.6%	0.47622374	23.8%
Rodentia	15	0.3%			15	0.2%	0.00303337	0.2%
Squirrels	4	0.1%	1	0.1%	5	0.1%	0.0016747	0.1%
Chipmunks								
Marmot								
Cynomys sp.	175	3.5%	61	5.3%	236	3.9%	0.08820313	4.4%
Geomys sp.	33	0.7%	12	1.0%	45	0.7%	0.01706302	0.9%
Beaver								
Neotoma sp.	16	0.3%	11	1.0%	27	0.4%	0.0127594	0.6%
Mice, Rats and Vole	20	0.4%	140	12.1%	160	2.6%	0.12525661	6.3%
Muskrat								
Porcupine								
Carnivora								
Canidae								
Canis sp.	60	1.2%	43	3.7%	103	1.7%	0.04936291	2.5%
Coyote	35	0.7%			35	0.6%	0.00707786	0.4%
Wolf								
Dog	15	0.3%	60	5.2%	75	1.2%	0.05498142	2.7%
Fox	5	0.1%			5	0.1%	0.00101112	0.1%
Bear	1	0.0%	1	0.1%	2	0.0%	0.00106803	0.1%
Raccoon								
Marten								
Mustelidae sp.			1	0.1%	1	0.0%	0.0008658	0.0%
Badger	31	0.6%	1	0.1%	32	0.5%	0.00713476	0.4%
Skunk								
Felidae								
Mountain Lion								
Bobcat	7	0.1%			7	0.1%	0.00141557	0.1%
Artiodactyla	233	4.7%	191	16.5%	424	7.0%	0.21248627	10.6%
Elk	1	0.0%			1	0.0%	0.00020222	0.0%
Deer	16	0.3%	1	0.1%	17	0.3%	0.00410139	0.2%
Antelope	63	1.3%	2	0.2%	65	1.1%	0.01447174	0.7%
Mountain Sheep	30	0.6%			30	0.5%	0.00606673	0.3%
Bison			5	0.4%	5	0.1%	0.004329	0.2%
Large Mammal	74	1.5%			74	1.2%	0.01496461	0.7%
Medium Mammal	226	4.6%			226	3.7%	0.04570273	2.3%
Small Mammal								
Water fowl								
Canada Goose								
Ducks								
Blue-winged teal								
Merganser								
Falconiformes								
Turkey Vulture								
Eagle								
Hawk	97	2.0%			97	1.6%	0.01961577	1.0%
Falco sp.								
Grouse								
Turkey	24	0.5%	328	28.4%	352	5.8%	0.28883607	14.4%
Quail			1	0.1%	1	0.0%	0.0008658	0.0%
Sandhill Crane	2	0.0%			2	0.0%	0.00040445	0.0%
Mourning Dove								
Owls			1	0.1%	1	0.0%	0.0008658	0.0%
American Coot								
Caprimulgidae								
Apodiformes								
Flicker								
Passeriformes								
Horned Lark								
Meadowlark								
Dark-eyed Junco								
Towhee								
Swallows								
Corvidae	3	0.1%	2	0.2%	5	0.1%	0.00233828	0.1%
Wrens								
Turdidae								
Shrikes								
Blackbirds								
Fringillidae								
Macaw								
Large Bird								
Small/Medium Bird								
Amphibian/Reptile								
Amphibian								
Reptile								
Fish								
Speotyto cunicularia								
Succinea								
Total	4945		1155		6100	100.0%		

APPENDIX 2

Table D. Chaco branch Pueblo I faunal data.									
TAXA	SITE 29SJ724		NA 14,654		NISP SUM	NISP FREQ	FREQ SUM	FS/#SITES	
	NISP	%	NISP	%					
Shrews									
Bats	1	0.2%			1	0.1%	0.0021645		0.1%
Lagomorpha									
Cottontail	133	28.8%			133	16.9%	0.28787879		14.4%
Jackrabbit	178	38.5%	88	27.2%	266	33.8%	0.65688632		32.8%
Rodentia	5	1.1%	102	31.5%	107	13.6%	0.32563733		16.3%
Squirrels			2	0.6%	2	0.3%	0.00617284		0.3%
Chipmunks									
Marmot									
Cynomys sp.	18	3.9%	38	11.7%	56	7.1%	0.15624499		7.8%
Geomyidae sp.	4	0.9%	1	0.3%	5	0.6%	0.01174443		0.6%
Beaver									
Neotoma sp.	3	0.6%			3	0.4%	0.00649351		0.3%
Mice, Rats and Vo.	9	1.9%	21	6.5%	30	3.8%	0.08429533		4.2%
Muskrat									
Porcupine									
Carnivora									
Canidae									
Canis sp.	1	0.2%	1	0.3%	2	0.3%	0.00525092		0.3%
Coyote	4	0.9%			4	0.5%	0.00865801		0.4%
Wolf									
Dog									
Fox	1	0.2%	1	0.3%	2	0.3%	0.00525092		0.3%
Bear									
Raccoon									
Marten									
Mustelidae sp.									
Badger									
Skunk									
Felidae									
Mountain Lion									
Bobcat	1	0.2%			1	0.1%	0.0021645		0.1%
Artiodactyla			34	10.5%	34	4.3%	0.10493827		5.2%
Elk									
Deer			2	0.6%	2	0.3%	0.00617284		0.3%
Antelope	2	0.4%	2	0.6%	4	0.5%	0.01050184		0.5%
Mountain Sheep									
Bison									
Medium Mammal	64	13.9%			64	8.1%	0.13852814		6.9%
Small Mammal									
Water fowl			1	0.3%	1	0.1%	0.00308642		0.2%
Canada Goose									
Ducks									
Blue-winged teal									
Merganser									
Falconiformes	1	0.2%			1	0.1%	0.0021645		0.1%
Turkey Vulture	26	5.6%			26	3.3%	0.05627706		2.8%
Eagle	3	0.6%			3	0.4%	0.00649351		0.3%
Hawk			1	0.3%	1	0.1%	0.00308642		0.2%
Falco sp.									
Grouse									
Turkey	1	0.2%	30	9.3%	31	3.9%	0.09475709		4.7%
Quail									
Sandhill Crane									
Mourning Dove									
Owls									
American Coot									
Caprimulgidae									
Apodiformes									
Flicker									
Passeriformes									
Horned Lark									
Meadowlark									
Dark-eyed Junco									
Towhee									
Swallows									
Corvidae									
Wrens									
Turdidae	1	0.2%			1	0.1%	0.0021645		0.1%
Shrikes									
Blackbirds									
Fringillidae									
Macaw									
Large Bird									
Small/Medium Bird									
Amphibian/Reptile									
Amphibian									
Reptile									
Fish									
Speotyto cunicularia									
Succinea									
Total	462		324		786	100.0%			

APPENDIX 2

Table E. Chaco branch Pueblo I - Pueblo II faunal data.									
SITE 29SJ629									
TAXA	NISP	%							
Shrews									
Bats									
Lagamorpha									
Cottontail	381	15.2%							
Jackrabbit	395	15.8%							
Rodentia	96	3.8%							
Squirrels	16	0.6%							
Chipmunks									
Marmot									
Cynomys sp.	225	9.0%							
Geomyidae sp.	55	2.2%							
Beaver									
Neotoma sp.	16	0.6%							
Mice, Rats and Vole	134	5.4%							
Muskrat									
Porcupine	4	0.2%							
Carnivora									
Canidae									
Canis sp.	32	1.3%							
Coyote	28	1.1%							
Wolf	2	0.1%							
Dog	67	2.7%							
Fox									
Bear									
Raccoon									
Marten									
Mustelidae sp.									
Badger	1	0.0%							
Skunk									
Felidae									
Mountain Lion	1	0.0%							
Bobcat	1	0.0%							
Artiodactyla	94	3.8%							
Elk	1	0.0%							
Deer	22	0.9%							
Antelope	8	0.3%							
Mountain Sheep	7	0.3%							
Bison									
Large Mammal	223	8.9%							
Medium Mammal	55	2.2%							
Small Mammal	542	21.7%							
Water fowl									
Canada Goose									
Ducks									
Blue-winged teal									
Merganser									
Falconiformes									
Turkey Vulture									
Eagle	11	0.4%							
Hawk	14	0.6%							
Falco sp.									
Grouse									
Turkey	54	2.2%							
Quail									
Sandhill Crane	1	0.0%							
Mourning Dove									
Owls									
American Coot									
Caprimulgidae									
Apodiformes									
Flicker									
Passeriformes									
Horned Lark									
Meadowlark									
Dark-eyed Junco									
Towhee									
Swallows									
Corvidae	1	0.0%							
Wrens									
Turdidae									
Shrikes									
Blackbirds									
Fringillidae									
Macaw									
Large Bird									
Small/Medium Bird									
Amphibian/Reptile									
Amphibian									
Reptile	12	0.5%							
Fish									
Speotyto cunicularia									
Succinea									
Total	2499								

APPENDIX 2

Table F. Chaco branch Pueblo II faunal data.																
	SITE		PM205		PM218		PM240		29SJ1360		NA14,662		NISP SUM	NISP FREQ	FREQ. SUM	FS/#SITES
TAXA	NISP	%		NISP	%	NISP	%	NISP	%	NISP	%					
Shrews																
Bats																
Lagomorpha																
Cottontail	313	34.1%		391	55.2%	30	39.5%	39	5.8%			773	32.6%	1.345967558	26.9%	
Jackrabbit	498	54.2%		198	28.0%	18	23.7%	145	21.7%	5	6.9%	864	36.4%	1.344906797	26.9%	
Rodentia																
Squirrels				1	0.1%	11	14.5%					12	0.5%	0.146149271	2.9%	
Chipmunks																
Marmot																
Cynomys sp.	9	1.0%		34	4.8%	6	7.9%	25	3.7%	44	61.1%	118	5.0%	0.785299482	15.7%	
Geomysidae sp.				3	0.4%			1	0.1%			4	0.2%	0.005734294	0.1%	
Beaver																
Neotoma sp.	38	4.1%		8	1.1%							46	1.9%	0.052648728	1.1%	
Mice, Rats and Vole	2	0.2%		4	0.6%	1	1.3%	4	0.6%	13	18.1%	24	1.0%	0.20752747	4.2%	
Muskrat																
Porcupine	6	0.7%										6	0.3%	0.006528836	0.1%	
Carnivora																
Canidae																
Canis sp.						1	1.3%	12	1.8%			13	0.5%	0.031121967	0.6%	
Coyote				1	0.1%			13	1.9%			14	0.6%	0.020873507	0.4%	
Wolf																
Dog				6	0.8%			60	9.0%			66	2.8%	0.098294936	2.0%	
Fox																
Bear																
Raccoon																
Marten																
Mustelidae sp.	2	0.2%										2	0.1%	0.002176279	0.0%	
Badger								1	0.1%	7	9.7%	8	0.3%	0.098719228	2.0%	
Skunk				1	0.1%							1	0.0%	0.001412429	0.0%	
Felidae																
Mountain Lion																
Bobcat	1	0.1%		9	1.3%	1	1.3%					11	0.5%	0.026957898	0.5%	
Artiodactyla						1	1.3%	171	25.6%	1	1.4%	173	7.3%	0.283034808	5.7%	
Elk																
Deer	39	4.2%		10	1.4%	2	2.6%	14	2.1%			65	2.7%	0.103835599	2.1%	
Antelope								52	7.8%			52	2.2%	0.077844311	1.6%	
Mountain Sheep								6	0.9%			6	0.3%	0.008982036	0.2%	
Bison																
Large Mammal				2	0.3%	2	2.6%	56	8.4%			60	2.5%	0.112972984	2.3%	
Medium Mammal								41	6.1%			41	1.7%	0.061377246	1.2%	
Small Mammal																
Water fowl																
Canada Goose																
Ducks																
Blue-winged teal																
Merganser																
Falconiformes																
Turkey Vulture																
Eagle																
Hawk	1	0.1%		1	0.1%	1	1.3%	3	0.4%			6	0.3%	0.020149481	0.4%	
Falco sp.								1	0.1%			1	0.0%	0.001497006	0.0%	
Grouse																
Turkey	10	1.1%		36	5.1%	1	1.3%	18	2.7%	2	2.8%	67	2.8%	0.129610631	2.6%	
Quail																
Sandhill Crane																
Mourning Dove				1	0.1%							1	0.0%	0.001412429	0.0%	
Owls				1	0.1%							1	0.0%	0.001412429	0.0%	
American Coot																
Caprimulgidae																
Apodiformes																
Flicker																
Passeriformes																
Horned Lark																
Meadowlark																
Dark-eyed Junco																
Towhee																
Swallows																
Corvidae								1	0.1%			1	0.0%	0.001497006	0.0%	
Wrens																
Turdidae																
Shrikes																
Blackbirds																
Fringillidae																
Macaw								5	0.7%			5	0.2%	0.00748503	0.2%	
Large Bird																
Small/Medium Bird				1	0.1%	1	1.3%					2	0.1%	0.014570324	0.4%	
Amphibian/Reptile																
Amphibian																
Reptile																
Fish																
Speotyto cunicularia																
Succinea																
Total	919			708		76		668		72		2371				

APPENDIX 2

Table G. Chaco branch Pueblo II - Pueblo III faunal data.																		
	PM240		LA 19553		Pueblo Alto		Una Vida		29SJ627		29SJ633		NA 14,650		NISP SUM	NISP FREQ	FREQ. SU	FS/#SITES
	NISP	%	NISP	%	NISP	%	NISP	%	NISP	%	NISP	%	NISP	%				
Shrews																		
Bats					4	0.0%									4	0.0%	0.000137	0.0%
Lagamorpha			21	15.2%											21	0.0%	0.152174	2.2%
Cottontail	43	49.4%	47	34.1%	5910	20.2%	629	19.1%	992	15.7%	1101	29.0%	260	18.2%	8982	20.3%	1.856712	26.5%
Jackrabbit	35	40.2%	9	6.5%	4799	16.4%	543	16.5%	1345	21.3%	351	9.2%	339	23.7%	7421	16.8%	1.338992	19.1%
Rodentia			5	3.6%	171	0.6%	62	1.9%	49	0.8%	36	0.9%	1	0.1%	324	0.7%	0.078829	1.1%
Squirrels	4	4.6%			24	0.1%	13	0.4%	2	0.0%	1	0.0%	3	0.2%	47	0.1%	0.053419	0.8%
Chipmunks																		
Mamnot																		
Cynomys sp.	1	1.1%	3	2.2%	2616	9.0%	266	8.1%	355	5.6%	160	4.2%	519	36.3%	3920	8.9%	0.664735	9.5%
Geomyidae sp.					118	0.4%	33	1.0%	24	0.4%	9	0.2%	7	0.5%	191	0.4%	0.025114	0.4%
Beaver																		
Neotoma sp.					74	0.3%	9	0.3%	30	0.5%	36	0.9%	120	8.4%	269	0.6%	0.10341	1.5%
Mice, Rats and Voles					912	3.1%	556	16.9%	72	1.1%	108	2.8%	26	1.8%	1674	3.8%	0.25787	3.7%
Muskrat																		
Porcupine					1	0.0%									1	0.0%	3.42E-05	0.0%
Carnivora													1	0.1%	1	0.0%	0.000699	0.0%
Canidae																		
Canis sp.					37	0.1%	6	0.2%	33	0.5%	4	0.1%	5	0.3%	85	0.2%	0.012864	0.2%
Coyote					16	0.1%	13	0.4%	53	0.8%			4	0.3%	86	0.2%	0.015684	0.2%
Wolf					2	0.0%			3	0.0%					5	0.0%	0.000544	0.0%
Dog					11	0.0%			89	1.4%			27	1.9%	127	0.3%	0.033358	0.5%
Fox					1	0.0%			3	0.0%					4	0.0%	0.00051	0.0%
Bear					1	0.0%									1	0.0%	3.42E-05	0.0%
Raccoon																		
Marten																		
Mustelidae sp.																		
Badger					8	0.0%			3	0.0%	2	0.1%	1	0.1%	14	0.0%	0.001975	0.0%
Skunk																		
Felidae																		
Mountain Lion																		
Bobcat					13	0.0%	9	0.3%	12	0.2%	2	0.1%			36	0.1%	0.005602	0.1%
Artiodactyla					2328	8.0%	161	4.9%			2	0.1%	19	1.3%	2510	5.7%	0.142306	2.0%
Elk					1	0.0%			5	0.1%					6	0.0%	0.000826	0.0%
Deer	1	1.1%			572	2.0%	22	0.7%	224	3.5%	1	0.0%			820	1.9%	0.073491	1.0%
Antelope					167	0.6%			65	1.0%	4	0.1%	1	0.1%	237	0.5%	0.017765	0.3%
Mountain Sheep					145	0.5%	34	1.0%	73	1.2%	1	0.0%			253	0.6%	0.027103	0.4%
Bison																		
Large Mammal			2	1.4%	2636	9.0%	287	8.7%	1561	24.7%	34	0.9%			4520	10.2%	0.448	6.4%
Medium Mamumal			18	13.0%	7165	24.5%	600	18.2%	1078	17.1%	11	0.3%			8872	20.0%	0.731276	10.4%
Small Mammal			29	21.0%							1139	30.0%			1168	2.6%	0.51004	7.3%
Water fowl											1	0.0%			1	0.0%	0.000263	0.0%
Canada Goose																		
Ducks					3	0.0%									3	0.0%	0.000103	0.0%
Blue-winged teal																		
Merganser																		
Falconiformes					1	0.0%									1	0.0%	3.42E-05	0.0%
Turkey Vulture																		
Eagle					82	0.3%	2	0.1%	6	0.1%	1	0.0%			91	0.2%	0.004626	0.1%
Hawk					266	0.9%			8	0.1%	5	0.1%			279	0.6%	0.011686	0.2%
Falco sp.					14	0.0%									14	0.0%	0.000479	0.0%
Grouse																		
Turkey	2	2.3%	1	0.7%	987	3.4%	17	0.5%	190	3.0%	766	20.2%	45	3.1%	2008	4.5%	0.33242	4.7%
Quail					7	0.0%					12	0.3%	4	0.3%	23	0.1%	0.006196	0.1%
Sandhill Crane					1	0.0%									1	0.0%	3.42E-05	0.0%
Mourming Dove					4	0.0%									4	0.0%	0.000137	0.0%
Owls					3	0.0%			2	0.0%	2	0.1%			7	0.0%	0.000946	0.0%
American Coot																		
Caprimulgidae																		
Apodiformes					1	0.0%									1	0.0%	3.42E-05	0.0%
Flicker					3	0.0%							2	0.1%	5	0.0%	0.001501	0.0%
Passeriformes					16	0.1%	6	0.2%							22	0.0%	0.002367	0.0%
Horned Lark					17	0.1%	2	0.1%	1	0.0%	1	0.0%	2	0.1%	23	0.1%	0.003009	0.0%
Meadowlark																		
Dark-eyed Junco					1	0.0%									1	0.0%	3.42E-05	0.0%
Towhee					2	0.0%					2	0.1%			4	0.0%	0.000595	0.0%
Swallows					1	0.0%									1	0.0%	3.42E-05	0.0%
Corvidae					31	0.1%			1	0.0%	1	0.0%	42	2.9%	75	0.2%	0.030853	0.4%
Wrens																		
Turdidae					3	0.0%									3	0.0%	0.000103	0.0%
Shrikes					3	0.0%									3	0.0%	0.000103	0.0%
Blackbirds					7	0.0%	2	0.1%							9	0.0%	0.000846	0.0%
Fringillidae					7	0.0%	3	0.1%							10	0.0%	0.001149	0.0%
Macaw																		
Large Bird			2	1.4%									2	0.1%	2	0.0%	0.014493	0.2%
Small/Medium Bird	1	1.1%	1	0.7%											2	0.0%	0.018741	0.3%
Amphibian/Reptile					1	0.0%									1	0.0%	3.42E-05	0.0%
Amphibian					31	0.1%									31	0.1%	0.001061	0.0%
Reptile							22	0.7%	33	0.5%	5	0.1%			60	0.1%	0.013217	0.2%
Fish																		
Speotyto cunicularia													2	0.1%	2	0.0%	0.001399	0.0%
Succinea																		
Total	87		138		29224		3297		6312		3798		1430		44286			

APPENDIX 2

Table H. Chaco branch Pueblo III faunal data.			
TAXA	SITE NA14,667 NISP	%	
Shrews			
Bats			
Lagomorpha			
Cottontail			
Jackrabbit	35	37.2%	
Rodentia	5	5.3%	
Squirrels			
Chipmunks			
Marmot			
Cynomys sp.	27	28.7%	
Geomys sp.	3	3.2%	
Beaver			
Neotoma sp.			
Mice, Rats and Vole	20	21.3%	
Muskrat			
Porcupine			
Carnivora			
Canidae			
Canis sp.	1	1.1%	
Coyote			
Wolf			
Dog			
Fox	1	1.1%	
Bear			
Raccoon			
Marten			
Mustelidae sp.			
Badger			
Skunk			
Felidae			
Mountain Lion			
Bobcat			
Artiodactyla	1	1.1%	
Elk			
Deer			
Antelope			
Mountain Sheep			
Bison			
Large Mammal			
Medium Mammal			
Small Mammal			
Water fowl			
Canada Goose			
Ducks			
Blue-winged teal			
Merganser			
Falconiformes			
Turkey Vulture			
Eagle			
Hawk			
Falco sp.			
Grouse			
Turkey	1	1.1%	
Quail			
Sandhill Crane			
Mourning Dove			
Owls			
American Coot			
Caprimulgidae			
Apodiformes			
Flicker			
Passeriformes			
Horned Lark			
Meadowlark			
Dark-eyed Junco			
Towhee			
Swallows			
Corvidae			
Wrens			
Turdidae			
Shrikes			
Blackbirds			
Fringillidae			
Macaw			
Large Bird			
Small/Medium Bird			
Amphibian/Reptile			
Amphibian			
Reptile			
Fish			
Speotyto cunicularia			
Succinea			
Total	94		

APPENDIX 2

Table 1. Kayenta branch Basketmaker II faunal data.																	
TAXA	SITE	D-7-152	D-7-256	D-11-181	D-7-3107	D-11-244	D-11-131	D-11-133	D-11-449	D-7-239	D-11-1410	D-7-3013	NISP SUM	NISP FREQ	FREQ SUM	PS/SITES	
		NISP	%	NISP	%	NISP	%	NISP	%	NISP	%	NISP					
Shrews																	
Bats																	
Lagomorpha		39	1.5%						13	1.2%	1	0.1%	3	0.3%	56	0.8%	
Concostal		1594	62.0%	61	31.6%	37	43.5%	25	37.3%	65	49.6%	74	35.4%	204	41.6%	128	11.4%
Jackrabbits		468	18.2%	23	11.9%	27	31.8%	18	26.9%	6	4.6%	20	9.6%	207	42.2%	111	9.9%
Rodents		2	0.1%	1	0.3%			1	0.3%								
Squirrels		11	0.4%	3	2.6%	1	1.2%			2	0.2%			3	0.5%	17	0.2%
Chipmunks																	
Marmos																	
Cynomyia sp.		11	0.4%	2	1.0%			2	1.3%			6	0.6%	1	1.8%	71	1.8%
Geomys sp.		90	3.5%	3	1.6%		1	1.5%	10	7.6%	2	1.0%			132	1.8%	
Beaver																	
Neotoma sp.		43	1.8%	3	1.6%			8	3.8%	3	1.6%	19	1.7%	3	0.2%	98	1.4%
Mice, Rats and Vole		23	0.9%	10	5.2%		1	0.8%	1	0.3%	2	0.4%	493	44.1%	1	0.1%	
Martens												2	0.2%			534	7.3%
Porcupine																	
Carnivora																	
Canidae										2	0.2%					2	0.0%
Canis sp.		1	0.0%	1	0.5%			2	1.5%	1	0.5%					1	0.0%
Coyote										1	0.1%					6	0.1%
Wolf										2	0.2%					2	0.0%
Dog																	
Fox		15	0.6%					1	0.3%							17	0.2%
Bear																	
Raccoon																	
Marten																	
Mustelidae sp.																	
Badger		1	0.0%														
Skunk												3	0.3%			4	0.1%
Felidae																	
Mountain Lion																	
Bobcat																	
Artiodactyla		7	0.3%	8	4.1%			2	1.5%	9	4.3%					10	0.1%
Elk																42	0.6%
Deer		9	0.4%	1	0.5%												
Antelope		2	0.1%	1	0.3%			2	1.5%							12	0.2%
Mountain Sheep				2	1.0%			1	0.8%							7	0.1%
Bison																13	0.2%
Large Mammal		61	2.4%	4	2.1%		1	1.3%	33	25.2%	4	1.9%					
Medium Mammal		22	0.9%	1	0.5%	6	7.1%	10	14.9%	1	0.8%	20	9.6%	25	5.1%	26	2.3%
Small Mammal		98	3.8%	31	26.4%	12	14.1%	10	14.9%	6	4.6%	64	30.6%	43	8.8%	160	14.3%
Water fowl																	
Canada Goose																	
Ducks																	
Blue-winged teal																	
Merganser																	
Falconiformes																	
Turkey Vulture																	
Eagle																	
Hawk		6	0.2%														
Falco sp.																	
Grouse																	
Turkey				4	2.1%												
Quail																	
Sandhill Crane																	
Mourning Dove																	
Owls																	
American Coot																	
Caprimulgidae																	
Apodiiformes																	
Picidae		5	0.2%													5	0.1%
Passeriformes		1	0.0%													2	0.0%
Horned Lark																1	0.0%
Meadowlark																	
Dark-eyed Junco																	
Towhee																	
Swallows																	
Corvidae		35	1.4%													38	0.5%
Wren																	
Turdidae		2	0.1%													2	0.0%
Shrikes																	
Blackbirds																	
Fringillidae																	
Macaw																	
Large Bird		16	0.6%													18	0.3%
Small/Medium Bird		2	0.1%				2	3.0%								5	0.1%
Amphibian/Reptile																	
Reptile		4	0.2%	12	6.2%											20	0.3%
Fish										4	0.4%						
Sperdyto cunicularia																	
Succinea																	
Total		2570		193		85		67		131		209		490		1118	

APPENDIX 2

--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

APPENDIX 2

Table K. Kayenta branch Pueblo I - Pueblo II faunal data.												
TAXA	SITE D:7:234		D:11:2030		D:11:320		D:7:216		NISP SUM	NISP FREQ	FREQ. \$UM	FS/#SITES
	NISP	%	NISP	%	NISP	%	NISP	%				
Shrews												
Bats												
Lagomorpha			16	0.6%					16	0.4%	0.00563579	0.1%
Cottontail	277	51.1%	1490	52.5%	16	32.0%	117	46.1%	1900	51.6%	1.81653272	45.4%
Jackrabbit	107	19.7%	175	6.2%	13	26.0%	14	5.5%	309	8.4%	0.57417651	14.4%
Rodentia			32	1.1%					32	0.9%	0.01127157	0.3%
Squirrels	4	0.7%	21	0.7%	2	4.0%	17	6.7%	44	1.2%	0.12170618	3.0%
Chipmunks												
Marmot												
Cynomys sp.			17	0.6%					17	0.5%	0.00598802	0.1%
Geomysidae sp.	7	1.3%	29	1.0%			1	0.4%	37	1.0%	0.027067	0.7%
Beaver												
Neotoma sp.	14	2.6%	69	2.4%			13	5.1%	96	2.6%	0.10131569	2.5%
Mice, Rats and Vole	13	2.4%	27	1.0%			2	0.8%	42	1.1%	0.04136965	1.0%
Muskrat												
Porcupine			1	0.0%					1	0.0%	0.00035224	0.0%
Carnivora	1	0.2%	22	0.8%					23	0.6%	0.00959423	0.2%
Canidae			1	0.0%					1	0.0%	0.00035224	0.0%
Canis sp.	8	1.5%	32	1.1%			1	0.4%	41	1.1%	0.02996873	0.7%
Coyote												
Wolf												
Dog												
Fox			4	0.1%			1	0.4%	5	0.1%	0.00534595	0.1%
Bear												
Raccoon												
Marten												
Mustelidae sp.	5	0.9%							5	0.1%	0.00922509	0.2%
Badger	12	2.2%	1	0.0%					13	0.4%	0.02249246	0.6%
Skunk			3	0.1%					3	0.1%	0.00105671	0.0%
Felidae												
Mountain Lion												
Bobcat	1	0.2%	54	1.9%					55	1.5%	0.0208658	0.5%
Artiodactyla	7	1.3%	66	2.3%	1	2.0%	39	15.4%	113	3.1%	0.20970606	5.2%
Elk												
Deer			8	0.3%					8	0.2%	0.00281789	0.1%
Antelope	2	0.4%	14	0.5%	1	2.0%	1	0.4%	18	0.5%	0.03255836	0.8%
Mountain Sheep	4	0.7%	37	1.3%	3	6.0%	6	2.4%	50	1.4%	0.10403488	2.6%
Bison												
Large Mammal	40	7.4%	230	8.1%	10	20.0%			280	7.6%	0.35481518	8.9%
Medium Mammal	8	1.5%	122	4.3%	4	8.0%	13	5.1%	147	4.0%	0.18891413	4.7%
Small Mammal	15	2.8%	315	11.1%			24	9.4%	354	9.6%	0.23311803	5.8%
Water fowl												
Canada Goose												
Ducks												
Blue-winged teal												
Merganser												
Falconiformes												
Turkey Vulture												
Eagle			1	0.0%					1	0.0%	0.00035224	0.0%
Hawk			7	0.2%					7	0.2%	0.00246566	0.1%
Falco sp.												
Grouse												
Turkey			2	0.1%			4	1.6%	6	0.2%	0.0164525	0.4%
Quail			5	0.2%					5	0.1%	0.00176118	0.0%
Sandhill Crane												
Mourning Dove												
Owls			3	0.1%					3	0.1%	0.00105671	0.0%
American Coot												
Caprimulgidae												
Apodiformes												
Flicker												
Passeriformes			4	0.1%					4	0.1%	0.00140895	0.0%
Horned Lark												
Meadowlark												
Dark-eyed Junco												
Towhee												
Swallows												
Corvidae												
Wrens												
Turdidae												
Shrikes												
Blackbirds												
Fringillidae												
Macaw												
Large Bird	11	2.0%	11	0.4%					22	0.6%	0.02416981	0.6%
Small/Medium Bird	6	1.1%	8	0.3%					14	0.4%	0.013888	0.3%
Amphibian/Reptile												
Amphibian			9	0.3%					9	0.2%	0.00317013	0.1%
Reptile			3	0.1%			1	0.4%	4	0.1%	0.00499372	0.1%
Fish												
Speotyto cunicularia												
Succinea												
Total	542		2839		50		254		3685			

104

Table L. Kayenta branch Pueblo II faunal data.

APPENDIX 2

Table M. Kayenta branch Pueblo II - Pueblo III faunal data.									
TAXA	SITE OHACO R.S.								
	NISP	%							
Shrews									
Bats									
Lagamorpha	1	0.8%							
Cottontail	30	25.0%							
Jackrabbit	15	12.5%							
Rodentia	7	5.8%							
Squirrels	7	5.8%							
Chipmunks									
Marmot									
Cynomys sp.	1	0.8%							
Geomyidae sp.	2	1.7%							
Beaver									
Neotoma sp.	42	35.0%							
Mice, Rats and Vo	2	1.7%							
Muskrat									
Porcupine									
Carnivora									
Canidae									
Canis sp.	1	0.8%							
Coyote									
Wolf									
Dog									
Fox	1	0.8%							
Bear									
Raccoon									
Marten									
Mustelidae sp.									
Badger									
Skunk									
Felidae									
Mountain Lion									
Bobcat	1	0.8%							
Artiodactyla	3	2.5%							
Elk									
Deer	1	0.8%							
Antelope									
Mountain Sheep									
Bison									
Large Mammal									
Medium Mammal									
Small Mammal									
Water fowl									
Canada Goose									
Ducks									
Blue-winged teal									
Merganser									
Falconiformes									
Turkey Vulture	1	0.8%							
Eagle									
Hawk									
Falco sp.									
Grouse									
Turkey									
Quail									
Sandhill Crane									
Mourning Dove									
Owls									
American Coot									
Caprimulgidae									
Apodiformes									
Flicker									
Passeriformes									
Horned Lark									
Meadowlark									
Dark-eyed Junco									
Towhee									
Swallows									
Corvidae									
Wrens									
Turdidae									
Shrikes									
Blackbirds									
Fringillidae									
Macaw									
Large Bird									
Small/Medium Bird									
Amphibian/Reptile									
Amphibian	1	0.8%							
Reptile	1	0.8%							
Fish	3	2.5%							
Speotyto cunicularia									
Succinea									
Total	120								

APPENDIX 2

Table N. San Juan - Mesa Verde branch Basketmaker III faunal data.												
	SITE		SLP110		SLP111		DOLORES Per		NISP SUM	NISP FREQ	FREQ SUM	FS/#SITES
TAXA	NISP	%	NISP	%	NISP	%						
Shrews												
Bats												
Lagamorpha	8	1.1%			7	0.9%		15	0.7%	0.01980041		0.7%
Cottontail	67	9.0%	30	4.7%	133	17.3%		230	10.7%	0.30929437		10.3%
Jackrabbitt	12	1.6%	5	0.8%	67	8.7%		84	3.9%	0.11088974		3.7%
Rodentia			1	0.2%	11	1.4%		12	0.6%	0.01584821		0.5%
Squirrels	1	0.1%	2	0.3%	26	3.4%		29	1.3%	0.03822992		1.3%
Chipmunks												
Marmot	2	0.3%	8	1.3%	13	1.7%		23	1.1%	0.03206049		1.1%
Cynomys sp.	1	0.1%			95	12.3%		96	4.5%	0.12471531		4.2%
Geomysidae sp.	5	0.7%			16	2.1%		21	1.0%	0.02747266		0.9%
Beaver					9	1.2%		9	0.4%	0.01168831		0.4%
Neotoma sp.			5	0.8%	2	0.3%		7	0.3%	0.01040999		0.3%
Mice, Rats and Vole	85	11.4%	3	0.5%	1	0.1%		89	4.1%	0.11977469		4.0%
Muskrat												
Porcupine					6	0.8%		6	0.3%	0.00779221		0.3%
Carnivora					8	1.0%		8	0.4%	0.01038961		0.3%
Canidae					2	0.3%		2	0.1%	0.0025974		0.1%
Canis sp.	420	56.2%			5	0.6%		425	19.7%	0.5687425		19.0%
Coyote			1	0.2%	5	0.6%		6	0.3%	0.00805601		0.3%
Wolf	110	14.7%			2	0.3%		112	5.2%	0.14985309		5.0%
Dog	3	0.4%	557	87.0%	20	2.6%		580	26.9%	0.90030259		30.0%
Fox			2	0.3%	23	3.0%		25	1.2%	0.03299513		1.1%
Bear			2	0.3%	3	0.4%		5	0.2%	0.0070211		0.2%
Raccoon												
Marten												
Mustelidae sp.												
Badger												
Skunk												
Felidae												
Mountain Lion												
Bobcat					8	1.0%		8	0.4%	0.01038961		0.3%
Artiodactyla					104	13.5%		104	4.8%	0.13506494		4.5%
Elk	9	1.2%			1	0.1%		10	0.5%	0.01334689		0.4%
Deer	15	2.0%	18	2.8%	151	19.6%		184	8.5%	0.24430922		8.1%
Antelope					15	1.9%		15	0.7%	0.01948052		0.6%
Mountain Sheep					14	1.8%		14	0.6%	0.01818182		0.6%
Bison												
Large Mammal												
Medium Mammal												
Small Mammal												
Water fowl												
Canada Goose					1	0.1%		1	0.0%	0.0012987		0.0%
Ducks												
Blue-winged teal												
Merganser												
Falconiformes												
Turkey Vulture												
Eagle					2	0.3%		2	0.1%	0.0025974		0.1%
Hawk												
Falco sp.												
Grouse					11	1.4%		11	0.5%	0.01428571		0.5%
Turkey	9	1.2%	6	0.9%	4	0.5%		19	0.9%	0.026618		0.9%
Quail												
Sandhill Crane												
Mourning Dove												
Owls												
American Coot												
Caprimulgidae												
Apodiformes												
Flicker					2	0.3%		2	0.1%	0.0025974		0.1%
Passeriformes					1	0.1%		1	0.0%	0.0012987		0.0%
Horned Lark												
Meadowlark												
Dark-eyed Junco												
Towhee					1	0.1%		1	0.0%	0.0012987		0.0%
Swallows												
Corvidae					1	0.1%		1	0.0%	0.0012987		0.0%
Wrens												
Turdidae												
Shrikes												
Blackbirds												
Fringillidae												
Macaw												
Large Bird												
Small/Medium Bird												
Amphibian/Reptile												
Amphibian												
Reptile												
Fish												
Speotyto cunicularia												
Succinea												
Total	747		640		770			2157				

APPENDIX 2

Table O. San Juan - Mesa Verde branch Basketmaker III - Pueblo I faunal data.

SITE 428A6757		
TAXA	NISP	%
Shrews		
Bats		
Lagomorpha		
Cottontail	98	30.7%
Jackrabbit	15	4.7%
Rodentia	1	0.3%
Squirrels	1	0.3%
Chipmunks		
Marmot		
Cynomys sp.	5	1.6%
Geomysidae sp.	2	0.6%
Beaver		
Neotoma sp.	1	0.3%
Mice, Rats and Voles	7	2.2%
Muskrat		
Porcupine		
Carnivora		
Canidae		
Canis sp.		
Coyote		
Wolf		
Dog	3	0.9%
Fox		
Bear		
Raccoon		
Marten		
Mustelidae sp.		
Badger	3	0.9%
Skunk		
Felidae		
Mountain Lion		
Bobcat		
Artiodactyla	14	4.4%
Elk		
Deer	1	0.3%
Antelope		
Mountain Sheep	9	2.8%
Bison		
Large Mammal	57	17.9%
Medium Mammal		
Small Mammal	102	32.0%
Water fowl		
Canada Goose		
Ducks		
Blue-winged teal		
Merganser		
Falconiformes		
Turkey Vulture		
Eagle		
Hawk		
Falco sp.		
Grouse		
Turkey		
Quail		
Sandhill Crane		
Mourning Dove		
Owls		
American Coot		
Caprimulgidae		
Apodiformes		
Flicker		
Passeriformes		
Horned Lark		
Meadowlark		
Dark-eyed Junco		
Towhee		
Swallows		
Corvidae		
Wrens		
Turdidae		
Shrikes		
Blackbirds		
Fringillidae		
Macaw		
Large Bird		
Small/Medium Bird		
Amphibian/Reptile		
Amphibian		
Reptile		
Fish		
Speotyto cunicularia		
Succinedae		
Total	319	

APPENDIX 2

Table P. San Juan - Mesa Verde branch Pueblo I faunal data.													
	SITE DOLORES Per			DOLORES Per			DOLORES Per			NISP SUM	NISP FREQ	FREQ. SUM	FS/#SITES
TAXA	NISP	%		NISP	%		NISP	%					
Shrews	8	0.3%								8	0.1%	0.00292398	0.1%
Bats													
Lagomorpha	25	0.9%		19	0.8%		28	1.9%		72	1.1%	0.03539191	1.2%
Cottontail	1039	38.0%		605	23.9%		301	20.1%		1945	28.8%	0.82044901	27.3%
Jackrabbit	398	14.5%		319	12.6%		189	12.7%		906	13.4%	0.39811067	13.3%
Rodentia	39	1.4%		54	2.1%		20	1.3%		113	1.7%	0.04899358	1.6%
Squirrels	156	5.7%		89	3.5%		57	3.8%		302	4.5%	0.13036193	4.3%
Chipmunks													
Marmot	103	3.8%		104	4.1%		38	2.5%		245	3.6%	0.10420425	3.5%
Cynomys sp.	145	5.3%		46	1.8%		60	4.0%		251	3.7%	0.11134673	3.7%
Geomysidae sp.	31	1.1%		111	4.4%		33	2.2%		175	2.6%	0.07730963	2.6%
Beaver	11	0.4%		16	0.6%		20	1.3%		47	0.7%	0.02373396	0.8%
Neotoma sp.	32	1.2%		131	5.2%		28	1.9%		191	2.8%	0.08223667	2.7%
Mice, Rats and Voles	92	3.4%		97	3.8%		54	3.6%		243	3.6%	0.10812539	3.6%
Muskrat				1	0.0%		2	0.1%		3	0.0%	0.0017341	0.1%
Porcupine	20	0.7%		55	2.2%		21	1.4%		96	1.4%	0.04311389	1.4%
Carnivora	3	0.1%		11	0.4%		15	1.0%		29	0.4%	0.0154862	0.5%
Canidae	5	0.2%		4	0.2%		2	0.1%		11	0.2%	0.00474783	0.2%
Canis sp.	11	0.4%		25	1.0%		32	2.1%		68	1.0%	0.03532481	1.2%
Coyote	7	0.3%		4	0.2%					11	0.2%	0.00414013	0.1%
Wolf							1	0.1%		1	0.0%	0.00066934	0.0%
Dog	65	2.4%		184	7.3%		29	1.9%		278	4.1%	0.11592432	3.9%
Fox	12	0.4%		3	0.1%					15	0.2%	0.0055722	0.2%
Bear				2	0.1%		10	0.7%		12	0.2%	0.00748427	0.2%
Raccoon													
Marten				1	0.0%					1	0.0%	0.00039541	0.0%
Mustelidae sp.	2	0.1%		2	0.1%		2	0.1%		6	0.1%	0.00286051	0.1%
Badger	7	0.3%		1	0.0%		1	0.1%		9	0.1%	0.00362324	0.1%
Skunk				1	0.0%		1	0.1%		2	0.0%	0.00106476	0.0%
Felidae													
Mountain Lion													
Bobcat	5	0.2%		6	0.2%		6	0.4%		17	0.3%	0.00821603	0.3%
Artiodactyla	82	3.0%		197	7.8%		245	16.4%		524	7.8%	0.27185645	9.1%
Elk	3	0.1%		4	0.2%		9	0.6%		16	0.2%	0.00870224	0.3%
Deer	298	10.9%		322	12.7%		222	14.9%		842	12.5%	0.38483556	12.8%
Antelope	9	0.3%		7	0.3%		6	0.4%		22	0.3%	0.01007343	0.3%
Mountain Sheep	7	0.3%		7	0.3%		7	0.5%		21	0.3%	0.01001178	0.3%
Bison													
Large Mammal													
Medium Mammal													
Small Mammal													
Water fowl				2	0.1%		1	0.1%		3	0.0%	0.00146017	0.0%
Canada Goose	2	0.1%		1	0.0%		1	0.1%		4	0.1%	0.00179575	0.1%
Ducks				6	0.2%					6	0.1%	0.00237248	0.1%
Blue-winged teal													
Merganser													
Falconiformes	2	0.1%		1	0.0%		5	0.3%		8	0.1%	0.00447313	0.1%
Turkey Vulture	1	0.0%								1	0.0%	0.0003655	0.0%
Eagle				2	0.1%		1	0.1%		3	0.0%	0.00146017	0.0%
Hawk				1	0.0%		1	0.1%		2	0.0%	0.00106476	0.0%
Falco sp.	12	0.4%		2	0.1%					14	0.2%	0.00517679	0.2%
Grouse	28	1.0%		43	1.7%		24	1.6%		95	1.4%	0.04330094	1.4%
Turkey	39	1.4%		17	0.7%		16	1.1%		72	1.1%	0.03168592	1.1%
Quail				4	0.2%					4	0.1%	0.00158165	0.1%
Sandhill Crane	16	0.6%								16	0.2%	0.00584795	0.2%
Mourning Dove				1	0.0%					1	0.0%	0.00039541	0.0%
Owls				1	0.0%					1	0.0%	0.00039541	0.0%
American Coot													
Caprimulgidae													
Apodiformes													
Flicker	3	0.1%		1	0.0%					4	0.1%	0.0014919	0.0%
Passeriformes	12	0.4%		2	0.1%		2	0.1%		16	0.2%	0.00651548	0.2%
Horned Lark													
Meadowlark	1	0.0%								1	0.0%	0.0003655	0.0%
Dark-eyed Junco													
Towhee	2	0.1%		8	0.3%					10	0.1%	0.0038943	0.1%
Swallows													
Corvidae	2	0.1%		5	0.2%		2	0.1%		9	0.1%	0.00404675	0.1%
Wrens													
Turdidae													
Shrikes													
Blackbirds													
Fringillidae	1	0.0%								1	0.0%	0.0003655	0.0%
Macaw													
Large Bird													
Small/Medium Bird													
Amphibian/Reptile													
Amphibian				4	0.2%					4	0.1%	0.00158165	0.1%
Reptile							2	0.1%		2	0.0%	0.00133869	0.0%
Fish													
Speotyto cunicularia													
Succineidae													
Total	2736			2529			1494			6759			

APPENDIX 2

Table Q. San Juan - Mesa Verde branch Pueblo II faunal data.												
	SITE SMT 1786		DOLORES Per		DOLORES Per		CM UGG4X-3		NISP SUM	NISP FREQ	FREQ SUM	FS/#SITES
TAXA	NISP	%	NISP	%	NISP	%	NISP	%				
Shrews			1	0.0%					1	0.0%	0.0%	0.0%
Bats												
Lagamorpha	14	8.0%	73	1.9%	2	0.1%	2	2.2%	91	1.4%	0.12096273	2.4%
Cottontail	55	31.3%	633	16.2%	724	28.7%	33	36.3%	1445	21.6%	1.12389694	22.5%
Jackrabbit	9	5.1%	836	21.4%	265	10.5%	3	3.3%	1113	16.6%	0.40271641	8.1%
Rodentia			56	1.4%	39	1.5%	5	5.5%	100	1.5%	0.08471293	1.7%
Squirrels	1	0.6%	123	3.1%	167	6.6%	1	1.1%	292	4.4%	0.11430574	2.3%
Chipmunks			1	0.0%					1	0.0%	0.00025543	0.0%
Marmot			55	1.4%	24	1.0%			79	1.2%	0.02356479	0.5%
Cynomys sp.	2	1.1%	120	3.1%	124	4.9%			246	3.7%	0.0911823	1.8%
Geomyidae sp.	1	0.6%	82	2.1%	29	1.1%			112	1.7%	0.03812571	0.8%
Beaver			38	1.0%	26	1.0%			64	1.0%	0.02001554	0.4%
Neotoma sp.	2	1.1%	34	0.9%	25	1.0%			61	0.9%	0.02996095	0.6%
Mice, Rats and Voles	40	22.7%	102	2.6%	25	1.0%	4	4.4%	171	2.6%	0.30719518	6.1%
Muskrat					1	0.0%			1	0.0%	0.00039651	0.0%
Porcupine			38	1.0%	64	2.5%			102	1.5%	0.03508294	0.7%
Carnivora			31	0.8%	7	0.3%	1	1.1%	39	0.6%	0.02168285	0.4%
Canidae			24	0.6%	18	0.7%			42	0.6%	0.01326746	0.3%
Canis sp.	4	2.3%	123	3.1%	18	0.7%			145	2.2%	0.06128209	1.2%
Coyote												
Wolf			1	0.0%	2	0.1%			3	0.0%	0.00104845	0.0%
Dog			67	1.7%	25	1.0%			92	1.4%	0.02702643	0.5%
Fox			2	0.1%	28	1.1%			30	0.4%	0.01161316	0.2%
Bear			3	0.1%	3	0.1%			6	0.1%	0.00195582	0.0%
Raccoon												
Marten					1	0.0%			1	0.0%	0.00039651	0.0%
Mustelidae sp.			1	0.0%	16	0.6%			17	0.3%	0.0065996	0.1%
Badger			3	0.1%	3	0.1%			6	0.1%	0.00195582	0.0%
Skunk					1	0.0%			1	0.0%	0.00039651	0.0%
Felidae												
Mountain Lion			1	0.0%					1	0.0%	0.00025543	0.0%
Bobcat			9	0.2%	24	1.0%			33	0.5%	0.01181511	0.2%
Artiodactyla			515	13.2%	215	8.5%	4	4.4%	734	10.9%	0.26075118	5.2%
Elk			24	0.6%	101	4.0%			125	1.9%	0.04617785	0.9%
Deer			611	15.6%	330	13.1%			941	14.0%	0.28691494	5.7%
Antelope			21	0.5%	30	1.2%			51	0.8%	0.01725931	0.3%
Mountain Sheep			18	0.5%	40	1.6%	2	2.2%	60	0.9%	0.04243615	0.8%
Bison												
Large Mammal	20	11.4%					3	3.3%	23	0.3%	0.1466034	2.9%
Medium Mammal	1	0.6%							1	0.0%	0.00568182	0.1%
Small Mammal	3	1.7%					31	34.1%	34	0.5%	0.3577048	7.2%
Water fowl			5	0.1%	4	0.2%			9	0.1%	0.00286318	0.1%
Canada Goose			3	0.1%	2	0.1%			5	0.1%	0.0015593	0.0%
Ducks			3	0.1%	3	0.1%			6	0.1%	0.00195582	0.0%
Blue-winged teal												
Merganser												
Falconiformes			1	0.0%					1	0.0%	0.00025543	0.0%
Turkey Vulture												
Eagle			1	0.0%	9	0.4%			10	0.1%	0.00382402	0.1%
Hawk			13	0.3%	7	0.3%			20	0.3%	0.00609614	0.1%
Falco sp.					2	0.1%			2	0.0%	0.00079302	0.0%
Grouse	8	4.5%	44	1.1%	52	2.1%			104	1.6%	0.07731193	1.5%
Turkey	16	9.1%	178	4.5%	49	1.9%			243	3.6%	0.15580427	3.1%
Quail												
Sandhill Crane			2	0.1%	1	0.0%			3	0.0%	0.00090737	0.0%
Mourning Dove			1	0.0%	1	0.0%			2	0.0%	0.00065194	0.0%
Owls			5	0.1%	6	0.2%			11	0.2%	0.0036562	0.1%
American Coot												
Caprimulgidae												
Apodiformes												
Flicker												
Passeriformes			1	0.0%	2	0.1%			3	0.0%	0.00104845	0.0%
Horned Lark												
Meadowlark												
Dark-eyed Junco												
Towhee												
Swallows												
Corvidae			9	0.2%	7	0.3%			16	0.2%	0.00507443	0.1%
Wrens												
Turdidae												
Shrikes												
Blackbirds												
Fringillidae												
Macaw												
Large Bird												
Small/Medium Bird							1	1.1%	1	0.0%	0.01098901	0.2%
Amphibian/Reptile												
Amphibian			2	0.1%					2	0.0%	0.00051086	0.0%
Reptile			1	0.0%			1	1.1%	2	0.0%	0.01124444	0.2%
Fish												
Speotyto cunicularia												
Succinea												
Total	176		3915		2522		91		6704			

APPENDIX 2

Table R. San Juan - Mesa Verde branch Pueblo II - Pueblo III faunal data.										
	SITE DOLORES Par		Big Westwater Ruin		428A6396		NISP SUM	NISP FREQ	FREQ. SUM	FS/#SITES
TAXA	NISP	%	NISP	%	NISP	%				
Shrews										
Bats										
Lagamorpha	42	5.2%			1	0.1%	43	1.6%	0.0526718	1.8%
Cottontail	251	31.0%	243	47.5%	260	19.7%	754	28.5%	0.98139201	32.7%
Jackrabbit	47	5.8%	41	8.0%	95	7.2%	183	6.9%	0.20998104	7.0%
Rodentia	56	6.9%	2	0.4%	2	0.2%	60	2.3%	0.07463923	2.5%
Squirrels	28	3.5%			36	2.7%	64	2.4%	0.06182151	2.1%
Chipmunks										
Marmot	2	0.2%					2	0.1%	0.00247219	0.1%
Cynomys sp.	60	7.4%	10	2.0%	7	0.5%	77	2.9%	0.09898789	3.3%
Geomyidae sp.	20	2.5%	13	2.5%	44	3.3%	77	2.9%	0.08337025	2.8%
Beaver	17	2.1%					17	0.6%	0.0210136	0.7%
Neotoma sp.	32	4.0%	47	9.2%	8	0.6%	87	3.3%	0.13739874	4.6%
Mice, Rats and Vole	49	6.1%			56	4.2%	105	4.0%	0.10289665	3.4%
Muskrat	2	0.2%					2	0.1%	0.00247219	0.1%
Porcupine	2	0.2%					2	0.1%	0.00247219	0.1%
Carnivora	3	0.4%					3	0.1%	0.00370828	0.1%
Canidae	2	0.2%			1	0.1%	3	0.1%	0.00322805	0.1%
Canis sp.	1	0.1%	1	0.2%			2	0.1%	0.00318922	0.1%
Coyote	4	0.5%	8	1.6%	1	0.1%	13	0.5%	0.02132523	0.7%
Wolf										
Dog					38	2.9%	38	1.4%	0.0287226	1.0%
Fox	9	1.1%	11	2.1%			20	0.8%	0.03260922	1.1%
Bear										
Raccoon										
Marten										
Mustelidae sp.	1	0.1%					1	0.0%	0.00123609	0.0%
Badger	3	0.4%			5	0.4%	8	0.3%	0.00748757	0.2%
Skunk			1	0.2%			1	0.0%	0.00195313	0.1%
Felidae										
Mountain Lion										
Bobcat	5	0.6%					5	0.2%	0.00618047	0.2%
Artiodactyla	41	5.1%			12	0.9%	53	2.0%	0.05975015	2.0%
Elk	6	0.7%			1	0.1%	7	0.3%	0.00817242	0.3%
Deer	66	8.2%	26	5.1%	2	0.2%	94	3.6%	0.13387517	4.5%
Antelope	3	0.4%					3	0.1%	0.00370828	0.1%
Mountain Sheep	7	0.9%			8	0.6%	15	0.6%	0.01469952	0.5%
Bison										
Large Mammal			4	0.8%	143	10.8%	147	5.6%	0.11590018	3.9%
Medium Mammal										
Small Mammal			21	4.1%	348	26.3%	369	14.0%	0.30405417	10.1%
Water fowl										
Canada Goose										
Ducks	1	0.1%	1	0.2%			2	0.1%	0.00318922	0.1%
Blue-winged teal										
Merganser										
Falconiformes										
Turkey Vulture										
Eagle										
Hawk	7	0.9%					7	0.3%	0.00865266	0.3%
Falco sp.										
Grouse	15	1.9%					15	0.6%	0.01854141	0.6%
Turkey	10	1.2%	42	8.2%	59	4.5%	111	4.2%	0.13898781	4.6%
Quail					1	0.1%	1	0.0%	0.00075586	0.0%
Sandhill Crane	1	0.1%			2	0.2%	3	0.1%	0.00274781	0.1%
Mourning Dove										
Owls			2	0.4%			2	0.1%	0.00390625	0.1%
American Coot			3	0.6%			3	0.1%	0.00585938	0.2%
Caprimulgidae										
Apodiformes										
Flicker										
Passeriformes	4	0.5%			1	0.1%	5	0.2%	0.00570023	0.2%
Horned Lark										
Meadowlark			1	0.2%			1	0.0%	0.00195313	0.1%
Dark-eyed Junco										
Towhee										
Swallows										
Corvidae	10	1.2%					10	0.4%	0.01236094	0.4%
Wrens										
Turdidae					2	0.2%	2	0.1%	0.00151172	0.1%
Shrikes										
Blackbirds										
Fringillidae										
Macaw										
Large Bird										
Small/Medium Bird										
Amphibian/Reptile										
Amphibian										
Reptile	2	0.2%	35	6.8%	190	14.4%	227	8.6%	0.21444456	7.1%
Fish										
Speotyto cunicularia										
Succinea										
Total	809		512		1323		2644			

Table S. San Juan - Mesa Verde branch Pueblo III faunal data.

Table S. San Juan - Mesa Verde branch Pueblo III faunal data.

112

	SITE	San Antonio	Early
TAXA	NISP	%	
Shrews			
Bats			
Lagomorpha			
Cottontail	62	13.4%	
Jackrabbit	9	1.9%	
Rodentia			
Squirrels	3	0.6%	
Chipmunks			
Mamot			
Cynomys sp.	18	3.9%	
Geomyidae sp.	3	0.6%	
Beaver			
Neotoma sp.			
Mice, Rats and Vole	35	7.6%	
Muskrat			
Porcupine	3	0.6%	
Carnivora			
Canidae			
Canis sp.			
Coyote			
Wolf			
Dog			
Fox			
Bear			
Raccoon			
Marten			
Mustelidae sp.			
Badger			
Skunk			
Felidae			
Mountain Lion			
Bobcat	1	0.2%	
Artiodactyla			
Elk			
Deer	2	0.4%	
Antelope	6	1.3%	
Mountain Sheep			
Bison			
Large Mammal			
Medium Mamumal			
Small Mammal			
Water fowl			
Canada Goose			
Ducks			
Blue-winged teal			
Merganser			
Falconiformes			
Turkey Vulture			
Eagle			
Hawk			
Falco sp.			
Grouse			
Turkey	283	61.3%	
Quail			
Sandhill Crane			
Mourning Dove			
Owls			
American Coot			
Caprimulgidae			
Apodiformes			
Flicker			
Passeniformes			
Horned Lark			
Meadowlark			
Dark-eyed Junco			
Towhee			
Swallows			
Corvidae			
Wrens			
Turdidae			
Shrikes			
Blackbirds			
Fringillidae			
Macaw			
Large Bird			
Small/Medium Bird			
Amphibian/Reptile			
Amphibian			
Reptile	37	8.0%	
Fish			
Speotyto cunicularia			
Succinedae			
Total	462		

APPENDIX 3

Table A. Stable carbon isotope values for Anasazi individuals.

SITE/SAMPLE NO.	LOCATION	PERIOD	d13C	RREFERENCE
Bu 9-6	Cedar Mesa	Basketmaker II	-7.9	Matson and Chisholm 1991
B C35-2	Cedar Mesa	Basketmaker II	-7.5	Matson and Chisholm 1991
NR C19.1 #18	Cedar Mesa	Basketmaker II	-7.5	Matson and Chisholm 1991
NR C19.1 #17	Cedar Mesa	Basketmaker II	-7.7	Matson and Chisholm 1991
Oldman Cave Fea. 3	Comb Wash	Basketmaker II	-13.1	Chisholm and Matson inpress
Oldman Cave Fea. 14	Comb Wash	Basketmaker II	-14.1	Chisholm and Matson inpress
Nonsite	Mesa Verde	Basketmaker III	-8.27	Decker and Tieszen 1989
Badger House (1676) #1	Mesa Verde	Pueblo I	-8.91	Decker and Tieszen 1989
Badger House (1676) #2	Mesa Verde	Pueblo I	-8.71	Decker and Tieszen 1989
Badger House (1676) #5	Mesa Verde	Pueblo I	-8.05	Decker and Tieszen 1989
Badger House (1676) #6	Mesa Verde	Pueblo I	-8.73	Decker and Tieszen 1989
Badger House (1676) #8	Mesa Verde	Pueblo I	-8.24	Decker and Tieszen 1989
Badger House (1676) #9	Mesa Verde	Pueblo I	-10.81	Decker and Tieszen 1989
Two Raven House (1645) #1	Mesa Verde	Pueblo II	-9.33	Decker and Tieszen 1989
Two Raven House (1645) #2	Mesa Verde	Pueblo II	-8.75	Decker and Tieszen 1989
Two Raven House (1645) #3	Mesa Verde	Pueblo II	-8.76	Decker and Tieszen 1989
Two Raven House (1645) #5	Mesa Verde	Pueblo II	-8.72	Decker and Tieszen 1989
Two Raven House (1645) #7	Mesa Verde	Pueblo II	-8.68	Decker and Tieszen 1989
Two Raven House (1645) #8	Mesa Verde	Pueblo II	-8.59	Decker and Tieszen 1989
Two Raven House (1645) #9	Mesa Verde	Pueblo II	-8.34	Decker and Tieszen 1989
Two Raven House (1645) #10	Mesa Verde	Pueblo II	-8.27	Decker and Tieszen 1989
Two Raven House (1645) #12	Mesa Verde	Pueblo II	-8.39	Decker and Tieszen 1989
820 #12	Mesa Verde	Pueblo II/III	-8.82	Decker and Tieszen 1989
820 #13	Mesa Verde	Pueblo II/III	-8.33	Decker and Tieszen 1989
820 #14	Mesa Verde	Pueblo II/III	-8.28	Decker and Tieszen 1989
820 #17	Mesa Verde	Pueblo II/III	-8.81	Decker and Tieszen 1989
820 #20	Mesa Verde	Pueblo II/III	-9.39	Decker and Tieszen 1989
Badger House (1452) #2	Mesa Verde	Pueblo II/III	-8.28	Decker and Tieszen 1989
Badger House (1452) #4	Mesa Verde	Pueblo II/III	-6.37	Decker and Tieszen 1989
Badger House (1452) #7	Mesa Verde	Pueblo II/III	-8.61	Decker and Tieszen 1989
Badger House (1452) #11	Mesa Verde	Pueblo II/III	-8.36	Decker and Tieszen 1989
Badger House (1452) #12	Mesa Verde	Pueblo II/III	-8.26	Decker and Tieszen 1989
Badger House (1452) #15	Mesa Verde	Pueblo II/III	-7.79	Decker and Tieszen 1989
Badger House (1452) #18	Mesa Verde	Pueblo II/III	-8.02	Decker and Tieszen 1989
Badger House (1452) #25	Mesa Verde	Pueblo II/III	-8.76	Decker and Tieszen 1989
Badger House (1452) #27	Mesa Verde	Pueblo II/III	-9.06	Decker and Tieszen 1989
Badger House (1452) #29	Mesa Verde	Pueblo II/III	-8.72	Decker and Tieszen 1989
GG C 12	Cedar Mesa	Pueblo II/III	-7.4	Matson and Chisholm 1991
HS C3-1 #26	Cedar Mesa	Pueblo II/III	-7.1	Matson and Chisholm 1991
2559 #7	Mancos Canyon	Pueblo III	-8.12	Decker and Tieszen 1989
2741 #3	Mancos Canyon	Pueblo III	-8.47	Decker and Tieszen 1989
2785 #6	Mancos Canyon	Pueblo III	-8.65	Decker and Tieszen 1989
2785 #14	Mancos Canyon	Pueblo III	-7.86	Decker and Tieszen 1989
Bu3x-10a	Cedar Mesa	Pueblo III	-7.3	Matson and Chisholm 1991