University of Oregon Archaeological Field School

Northern Great Basin Prehistory Project
Research Design

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The Northern Great Basin Prehistory Project is a joint undertaking of the University of Oregon (UO) Archaeological Field School, UO Department of Anthropology, Museum of Natural History, Department of Geography, and Office of Summer Sessions, the Lakeview, Prineville, and Burns District Offices of the Bureau of Land Management, the Deschutes (Bend) and Malheur (John Day) National Forests, and the Sundance Archaeological Research Fund and Department of Anthropology, University of Nevada, Reno (UNR). Community support of field operations by the North Lake County School District, Silver Lake, Oregon, is gratefully acknowledged.

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Acknowledgments

Since 1989 the University of Oregon Field School in Archaeology has surveyed and excavated each summer in the Northern Great Basin, centering its work in the Fort Rock region. To this point the Fort Rock field school has enjoyed 12 years of exciting and productive research and student training. The research is so far reported in one major monograph in print and another in preparation, and numerous published papers, student theses, dissertations, and professional meeting papers. As of summer 2000, the number of students enrolled in the Fort Rock field school is >300.

The field school is a function of several collaborating units, both within and beyond the UO. The Department of Anthropology provides administrative support and academic credit for the undergraduate and graduate students enrolled, and supplies advanced graduate students in training who serve as research assistants and group leaders in the field. The Office of Summer Session provides major logistical and financial support through the UO tuition and fee structure. The Department of Geography provides academic credit and supervision for students enrolled in the Geoarchaeology section of the field school. The Museum of Natural History provides the field school director and co-director, who are members of its faculty, and also provides long-term curation of the scientific specimens and records generated by the field school research. For their central contributions to all this work, special thanks are due to Summer Session Director Ron Trebon and his assistants Linda Walton and Dorothy Van Cleef, Patricia McDowell and Michael S. Droz of the Department of Geography, and Patrick O'Grady, of the Department of Anthropology. Finally, sincere thanks to the many students, teaching assistants, and volunteers whose exceptional participation over the years has made the UO Field School what it is today.

The Bureau of Land Management (Lakeview, Prineville, and Burns District Offices) and U.S. Forest Service (Deschutes and Malheur National Forests) are partners from beyond the university. Having primary stewardship responsibility for cultural heritage resources on public lands in the region, these agencies, through the leadership of Lakeview District Archaeologist William J. Cannon, who has been since 1989 integrally involved in designing and executing the research program of the Fort Rock field school, provide vital direction, funding, supplies, and equipment. Field school projects on public lands are as a matter of course oriented to and guided by the BLM's stewardship responsibilities. Deschutes Forest Archaeologist Paul Claeyssens, Malheur Forest Archaeologist Don Hann, Prineville District BLM Archaeologist John Zancanella, and Burns District Archaeologist Scott Thomas, in keeping with their own cultural resource management responsibilities and their leadership roles in the Central Oregon Heritage Group (COHG), are joining with the UO field school in cooperative research efforts and sharing in the necessities of funding and logistical support. Lucile Housley (Lakeview BLM) has contributed, as a field school collaborator over many years, invaluable research into modern and past distributions of ethnobotanical species within the study area, as well as indispensable coaching and training of field school staff and students on botanical matters.

Another key partner from outside the university is the North Lake County School District, Silver Lake, Oregon. Superintendents Mike Costello and Jim Chapman, and Principal John Biezenherz, have taken the lead since 1991 in developing and sustaining the cooperative effort which allows field school use of North Lake County School facilities. The school staff has made our stay in the field much more pleasant by assisting us in many different ways from transmitting mail and phone

messages to setting up the kitchen and laboratory facilities. In turn the field school maintains an educational display at the North Lake School, and provides annual community lectures on the archaeological research it is doing in the area. Student and community participation in the field research has also been invited and welcomed.

New partners in research and cooperative data sharing are the Sundance Archaeological Research Fund (SARF) and Department of Anthropology, University of Nevada, Reno. Don Fowler is the Executive Director and Acting Field Director of the SARF organization, Fred Nials is the SARF Program Field Geoarchaeologist, Matthew Moore the Assistant Field Director and Field Manager for Logistics, Ariane Pinson the Alkali Basin Project Manager, and Leah Bonstead and Alyce Branigan Assistant Field Directors.

Of particular importance, we thank the Klamath Tribes, the Confederated Tribes of the Warm Springs Indian Reservation, and the Burns Paiute Tribe, for the students they have sent at various times to the UO field school and we welcome members of the Grand Ronde and Chumash Tribes to this field season. These native students have shared their special perspectives on the archaeological work in ways that have opened the eyes and expanded the sensibilities of all field school participants, faculty and students alike. Gordon Bettles (Klamath Tribes), Scott Stuemke (Confederated Tribes of the Warm Springs Indian Reservation), and Linda Reed-Jerofke (Burns Paiute Tribe) facilitated the recruitment, introduction and enrollment of these Native American students to the field school. The Atlas Mining Corporation (Denver, Colorado) and Cornerstone Industrial Minerals, U.S.A. (Lakeview, Oregon) have paid tuition scholarships for many of these students.

It is a pleasure to list many other important UO field school supporters as well.

Contributor/Representative	**Contribution**	**Year(s)**
Dr. Hal Bergen	funds: special analyses, student training/travel	1998-2000
George and Pat Carlon	permission to excavate	1990, 1997
Clarence DeGarmo	Paiute story telling	1997
Ruth L. Greenspan (HRA)	faunal analysis, student training	1990-1999
Marge Helzer	paleoethnobotany	1999-2000
Lawrence and Marge Iverson	permission to excavate	1990,1997
Stephanie Livingston	faunal analysis	1995-1996
Northwest Obsidian Research Lab	obsidian sourcing and hydration analysis	1995-2000
(Craig Skinner, Owner-Director, Jennifer Thatcher, lab technician)		
Patrick O'Grady	faunal analysis	1995-2000
Oil Dri Corporation	funds: special analyses, heavy equipment	1993-96
(Plant Managers Mike Morrison, Jim Yancy)		
PaleoResearch Lab	macrobotanical/pollen analyses, student training	1992-1999
(Linda Cummings, Owner-Director)		
Guy Prouty	paleoethnobotany	1993-1996
Vivien Singer	faunal analysis	1993-1994
Guy Tasa	human osteology	1990-2000
George Wingard	funds: heavy equipment, special analyses	1997-98

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1 Introduction

Since 1989, the UO Archaeological Field School has centered its research in the Fort Rock Basin of south-central Oregon. This follows on earlier investigations initiated there in 1938 by Professor Luther S. Cressman, of the University of Oregon, who began the Field School as a means both of training students and exploring the prehistoric cultures of Oregon. Those remain the central objectives of the Field School today, in the context of strong state, federal, and tribal legal and policy frameworks oriented to the careful stewardship, conservation, and investigation of the nation's cultural sites.

Cressman's 1938 excavations at Fort Rock Cave recovered many beautifully crafted sandals made of woven sagebrush bark, among other traces of human activity (Cressman, Williams, and Krieger 1940). They had been buried by volcanic ash from the cataclysmic eruption, some 7600 years ago, of Mount Mazama (site of modern day Crater Lake) in the adjacent Cascades. With the advent of radiocarbon dating in the 1950s it was established that sandals of the Fort Rock type were being made 10,000 years ago. These investigations, and further studies in 1966-67 by Cressman and his last student, Stephen Bedwell (1970), established the Fort Rock Basin as the scene of the earliest documented human occupation in Oregon, extending back more than 13,000 years.

The research carried out in the Fort Rock, Alkali, Warner, Catlow, and Harney basins since the 1980s has proceeded as joint projects of the University of Oregon, University of Nevada, Reno, Washington State University, and the Bureau of Land Management (Cannon 1999), which has responsibility for the stewardship of cultural resources on the public lands which comprise most of the region. The aim of this work has been to fill out the prehistoric record of the Northern Great Basin, starting from the evidence for earliest occupation revealed by Cressman's work, and concentrating on the little known Middle and Late Holocene periods of the past 7600 years or so.

Much of the UO field school's recent research has been reported in a 1994 volume, titled in tribute to our distinguished predecessor, ***Archaeological Researches in the Northern Great Basin: Fort Rock Archaeology Since Cressman*** (Aikens and Jenkins 1994a). A companion volume, reporting more recent research, is now in the works. The studies developed over the past eleven years have been rewarding, and have given rise to a number of further research projects that will occupy future field seasons in the Fort Rock Basin. The work has also, however, led to the recognition of additional research questions that lead out of the Fort Rock Basin and into adjacent regions to the north, east, and south.

The research design presented in this document is an outgrowth of the past eleven year's work, and represents both a continuation of research in the Fort Rock Basin and a branching out into other areas. We have couched our future plans, therefore, in terms of a broader region, and henceforth will identify our work as the Northern Great Basin Prehistory Project (NGBPP). We hope to collaborate with investigators from other institutions and agencies, each with their own research interests in the region, and through cooperative linkages to make the whole of our joint results greater than the sum of the parts.

This research design envisions a continuation of the ecologically-oriented approach to investigating past human communities that we have pursued up to now. It is intended as a working document to guide our future research, to bring up to speed future cohorts of Field School students about the background, objectives and procedures of the Northern Great Basin Prehistory Project (NGBPP), to serve as a vehicle of cooperative research with other field schools, research funds, and agencies and to inform the interested public about our ideas and intentions. The text is largely excerpted from several published and unpublished reports generated by our past studies, though it also embodies a number of ideas not presented elsewhere. Most fundamentally, it is intended to point the way from the research completed to date in the Fort Rock Basin, to the research we contemplate there and farther afield over the next ten years.

2 Basic Research Concepts for the Study of Northern Great Basin (Oregon) Prehistory

The relationship between the shape of the land, the availability of water, and the plants and animals of the Northern Great Basin structured the lives of indigenous peoples in many far-reaching ways. In the 'wet' basins of this region, like Fort Rock, Lake Abert, Warner Valley, and the Harney Basin, the juxtaposition of dry rocky uplands and low-elevation wetlands settings was particularly important to the annual round of human activity throughout prehistory. Cycles of alternation between mobile foraging and more sedentary settlement depended closely on the seasonal and local distributions and abundances of the plants and animals that comprised peoples' food and industrial resources. Over time climatic change, growing population, and increasing reliance on food storage were major dynamic forces in the evolution of human settlement in the Northern Great Basin. By Late Holocene times (3000 BP to Historic) these dynamics resulted in a fundamental shift in the balance of subsistence economies and increased sedentism involving uplands spring villages and lowlands winter villages in some basins.

Though the organizing theme of this research design is the way in which varying topography, temperature-moisture regimes, biota, and human diets interacted to structure the patterns of activity, mobility, and settlement that people imprinted on their regional landscapes, there is little reason to doubt that human demography also played a significant role in the evolution of regional societies. The northwestern portion of the Great Basin in Oregon is well suited as a context for such research by virtue of its natural setting and long record of prehistoric occupation. To the north it is bounded by the western most extension of the Blue Mountains and the lower elevations of the Deschutes and Crooked River drainages which form the southwestern periphery of the Columbia Plateau. To the west are the Cascade Mountains, beyond which lie the western interior valleys and Pacific Coast. To the southwest are the hilly woodland/marsh countries of the Klamath-Modoc. To the east, across the Oregon desert is the Snake River and Owyhee Uplands region. The desert people of Oregon's Northern Great Basin were surely in contact with the occupants of these adjacent regions and were undoubtedly related to them, as they were to the inhabitants of similar regions to the south and east.

The Fort Rock Basin, the defining research area for much of the data presented here, lies immediately at the base of the Cascade range, the western edge of the basin sharply defining the juncture between coniferous montane uplands and sagebrush-covered desert lowlands. Fort Rock Cave, famed in the annals of Great Basin archaeology, sits in a treeless sagebrush-steppe within several miles of the vast pine forest that mantles the eastern Cascades. The topographic setting of the Fort Rock Basin, which lies in the rain shadow of the Cascades but periodically receives considerable water as runoff from montane precipitation and snow melt, fosters biotic conditions that are quite variable, both across space and through time. The central theme of this research design is that areal and temporal differences in biotic resources, grounded in geographic diversity and climate change, in combination with changing human demography, have fostered notable shifts in human subsistence and settlement patterns within the region throughout the past. We present the archaeological studies which follow in the belief that the relationships they demonstrate will contribute to the understanding of culture-environment relationships generally.

Most of these studies were carried out in the context of the cooperative research program of the University of Oregon field school in archaeology and the Bureau of Land Management, Lakeview District. This program was designed by the authors and William J. Cannon, Lakeview District BLM archaeologist, to investigate precisely the above themes through wide-ranging and long-term studies within a single well-defined regional setting, the Fort Rock Basin. This program, begun in 1989, was originally scoped at 10 years. Here we propose to continue this program another 10 years, to expand our research into adjacent subregions, and to assist other researchers in their own long-term research efforts in the Northern Great Basin of Oregon.

Our vision, and purpose here, is to initiate a decade long series of research efforts designed to construct extensive data bases, like those compiled by the Fort Rock Basin Prehistory Project (FRBPP), for each of a series of ***Research Areas*** in the Northern Great Basin of Oregon (Figure 1). We believe that focused, long-term research can lead to quantum leaps in the understanding of Northern Great Basin archaeology and we want to provide a robust forum that will assist field schools, other researchers, and graduate students in their research and reporting of the archaeology of this region. Cooperative agreements, like those already in place between the University of Oregon and the Lakeview, Prineville, and Burns District Offices of the BLM, will be sought with other State and Federal land management agencies--e.g. other BLM districts, the Forest Service and US Fish and Wildlife Service--and interested Native American groups. Funding will be sought from these agencies with the goal of enhancing current research efforts by attracting gifted graduate students with the possibility of providing funding for their graduate research projects. Funding will also be sought in the private sector, with the goal of establishing an endowment to provide recurring financial support for the long-term development of Northern Great Basin prehistoric research. Long-term research projects will then be directed toward the collection of substantial quantities of high quality data necessary to adequately address the questions outlined below.

In this introductory section we first present brief ethnographic profiles for the Northern Paiute and Klamath-Modoc who shared this region. We will then discuss some of the dominant variables affecting the study area and offer a general sketch of changing occupation patterns in the Fort Rock Basin as we currently understand them, as an example and starting point for research in other basins.

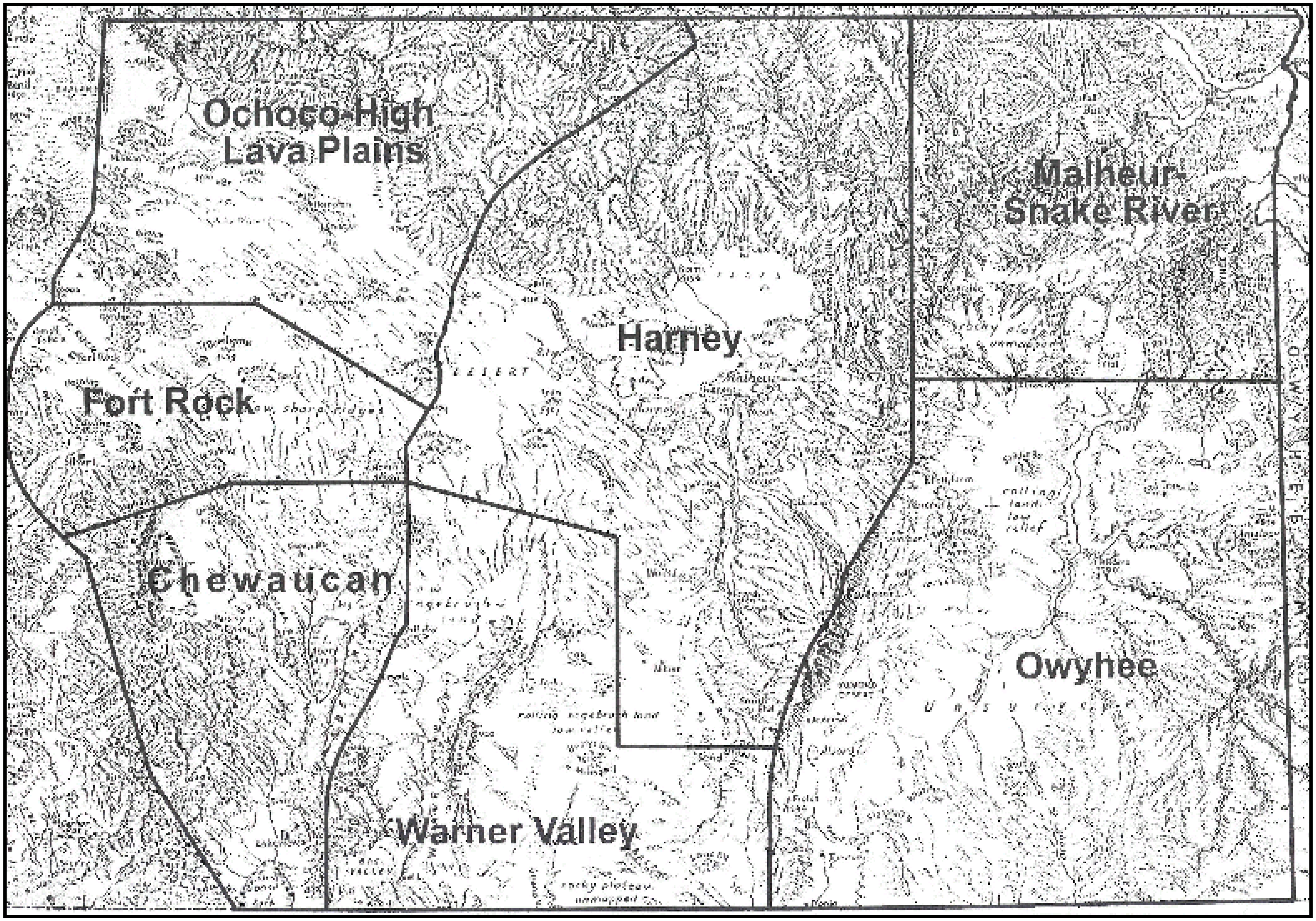

Figure 1. Map of Northern Great Basin Research Areas (After Raisz 1965).

3 Native Peoples

This section of the research design is quoted nearly verbatim from Jenkins et al. (2000a). At the time of European contact, the Northern Paiute, Klamath, and Modoc occupied the Klamath Basin/Northern Great Basin peripheral region. The *Kidutokado, Tuziyammo*, and *Yahuskin* bands of the Northern Paiute are representative of the Great Basin Numic cultures occupying the desert territories of this area (Kelly 1932). The Klamath and Modoc, on the other hand, were culturally more similar to the Columbia Plateau pattern located to the north of the Great Basin (Barrett 1910; Gatschet 1890; Kroeber 1925; Ray 1963; Spier 1930; Stern 1966; Stewart 1966). The boundaries between these groups apparently fluctuated with the fortunes of war and other social interactions. Treaty documents indicate that the area north of Goose Lake was neutral ground for all groups to travel, hunt, and gather in throughout the year (Wheeler-Voegelin 1955). Consequently, the cultures from both areas occupied the Lake Abert-Chewaucan Marsh, Summer Lake, and Fort Rock Basin region on a seasonal basis and ultimately shared many attributes; particularly in matters of subsistence and technologies. Thus, similarities shared between these groups were due to a merging of traits caused by close geographical proximity and inter/intra-group relationships, not all of them friendly.

The introduction of horses in the historic period undoubtedly altered and intensified foraging forays, as well as intercultural trade and hostile relationships. It is apparent that even prior to the introduction of the horse and firearms the Northern Paiute were expanding into the area (Aikens and Witherspoon 1986) and disputing with the Klamath and Modoc over territory. It is less clear as to what their relationship may have been, if any, in the pre-Contact era, though ethnographic accounts suggest that animosity may have always existed between them (Kelly 1932) while recent archaeological investigations in Warner Valley suggest the possible intermarriage of Paiutes and Klamath-Modoc and subsequent melding of cultural traits (Eiselt 1997).

Northern Paiute

The Northern Paiute occupied the Warner Valley region, and apparently shared the Lake Abert- Chewaucan-Summer Lake Basin, and Fort Rock Basin areas with the Klamath at the time of Euroamerican contact. Northern Paiute groups throughout much of southeastern Oregon, were geographically, ecologically, and socially distinct from each other, and were only loosely associated, predominantly through language and marriage ties (Fowler and Liljeblad 1986:436; Stewart 1939). The Northern Paiute language is a division of the Numic (Plateau-Shoshonean) stock of the Uto-Aztecan subphylum of the Aztec-Tanoan language phylum. There are three branches of the Numic stock found throughout different regions of the Great Basin. The Northern Paiute branch is composed of the Bannock, Mono, and Paviotso languages predominantly distributed throughout the northern and western Great Basin; the Central or Shoshoni branch includes the Panamint and Shoshoni languages located in the southern and central Great Basin; and the Southern Paiute branch consists of the Chemehuevi, Kawaiisu, Southern Paiute, and Ute languages distributed throughout the southern and eastern Great Basin (Voegelin and Voegelin 1973:1104). Glottochronological evidence collected by Lamb (1958), Hopkins (1965), and Miller (1986) suggests that these branches originated together in southern California and spread north and east into the Great Basin only about 1000 years ago. This reconstruction has been seriously questioned in recent years (Madsen and Rhode 1994), however, and the issue is far from resolution (Aikens 1994; cf. Musil 1995; Kelly 1932:186; Oetting 1989:276, Sutton 1986; Pettigrew 1985:194; Jenkins and Connolly 1994:153-157).

Socio-political Organization

Prior to acquiring substantial numbers of horses most Northern Paiute groups apparently were socially organized into simple, egalitarian, and bilateral nuclear families. This basic level of social organization, it is argued, was attributable to the sparse ecological conditions of the Great Basin which prevented people from either needing or establishing larger more formalized political groups such as bands. Rather, small, self-sufficient family groups were the most enduring socioeconomic and political units that existed in the arid Great Basin (Steward 1938, 1955:121).

There has been considerable debate, however, that bands, at least on the most elementary level, do exist in similarly harsh environments (Damas 1969; Helm 1968). Most of these arguments hinge on the redefinition of the word band, to include "micro" and "macro" bands. In the following discussion, microbands are defined as small, primarily family groups comprised of a closely related "core group", which changed little in composition and general territory from year to year; joined by relatives, friends, and partners which shifted almost constantly in composition and residence. Macrobands, then, were the composite of the microbands occupying a much larger territory. In the Great Basin these bands were simply known to outsiders by a prevalent food type found within their territory (i.e. Salmon Eaters, Ground-Hog Eaters, Elk Eaters, etc.). These macrobands held little or no political significance, but rather are believed to have formed vital information and mating networks facilitating the fluid movement of personnel to patchy resources as they came available throughout shared territory (cf. Fowler and Liljebland 1986; Thomas 1983; Thomas et al. 1986).

Microbands frequently attempted to maximize their kin ties with neighboring groups to facilitate the sharing of resources during periods of subsistence stress. They accomplished this through marriage, friendship, and trade relationships (Helm 1968; Couture et al. 1986). These relationships were advantageous in providing key ecological information on valuable plant and/or animal resources at a distance, especially when local food supplies were widely dispersed, unpredictable, and often sparse in nature. Thomas (1972) proposed that similar movements of foraging parties to the most abundant food resources, known as "fandangos" among the Western Shoshoni, was an integral part of their adaptive subsistence system, and it seems quite likely that similar gatherings served the same purpose among the Northern Paiute.

It should be noted, however, that macroband organization was fluid and loosely structured. The macrobands possessed no formal leaders and varied in composition from one year to the next depending on the availability and predictability of food resources. Individuals, as well as microbands, could easily shift membership from one macroband to another. Consequently, band sizes varied greatly, and territorial boundaries were extremely flexible (Fowler 1982; Fowler and Liljeblad 1986:437; Whiting 1950:19). In fact, these groups could completely disintegrate, as populations moved out in response to deteriorating local conditions, and reform in the same region at a later date. The regional gathering of microbands occurred seasonally, most often during the spring and fall. These large gatherings often involved members of other home districts who came to visit, trade, and gather or hunt whatever resource was abundant and predictable at that location.

The introduction of the horse caused far reaching changes in the Northern Great Basin, as it did throughout North America. The Northern Paiute and Bannock, in particular, rapidly gave up their fragmented socio-political pattern, consolidating into larger well-organized predatory bands after Euroamerican encroachment.

Settlement-Subsistence

The longest recurring Paiute settlements were winter encampments which varied in size and constitution, depending on the supply of stored foods and the availability of nearby collectable resources (Steward 1938, 1970). The seasonal rounds of the Northern Paiute were geared to the availability of plant and animal resources. The *Kidutokado* band of the Surprise Valley Paiute, who inhabited a broad area extending westward across the Warner Mountains to the eastern shoreline of Goose Lake and south to Buck Creek (Kelly 1932:70), relied largely on game, roots, and seeds. Berries, greens, and nuts were also collected, adding variety to the diet (Figure 2).

During the spring, the Kidutokado actively pursued deer and antelope, their most important game resources. Bear were hunted in the western Warner Mountains and along the eastern shores of Goose Lake. Deer and antelope were hunted by individuals, employing stalking and disguise techniques, and shot with bows and arrows. Herds were driven with fire into brush corrals and pitfalls constructed in trails. Squirrels were pursued during the spring, while groundhogs were hunted later in the season when they were "ripe" (Couture et al. 1986). Rodents were generally snared and trapped, or chased with dogs and dispatched with throwing sticks or shot with arrows (Kelly 1932:70-82).

Fishing and bird hunting were undertaken primarily during the spring. Ducks, geese, and swans were important staples and they were taken in great numbers with nets, decoys, and the bow and arrow. Robins, sage hens, grouse, and other birds were also snared and netted and their eggs collected. Fishing, although not as important as among the Modoc and Klamath, was pursued in the early spring before the commencement of the spring root gathering. Using basket traps, harpoons, bone gorgets, and bows and arrows, the Paiute fished for trout, chub, minnows, and suckers. Nets were not used since they did not fish from the shores of Goose Lake and the few streams that existed in the Warner Mountains were too small for their use (Kelly 1932:90-95).

Plants were very important staples to the Northern Paiute diet. The most abundant and cherished bulbs, roots, and tubers sought during the spring and early summer seasons were biscuitroot (*Lomatium* spp.), camas (*Camassia quamash*), epos (*Perideridia* spp.), bitterroot (*Lewisia rediviva*), onion (*Allium* spp.), and sego lily (*Calochortus macrocarpus*). Roots were dislodged from shallow rocky soils with digging sticks constructed of durable mountain mahogany. They were then washed, peeled, and dried for later use or prepared fresh for immediate consumption. Biscuitroot, for example, was eaten raw, boiled, dried, or sliced and baked in underground ovens. Roots and tubers were also dried in the sun and stored for winter use (Couture et al. 1986). Once dried, they could be ground into flour with stone manos and metates and made into bread-like cakes or patties.

The nutritional value of geophytic roots is substantial. For example, *Lewisia* supplies approximately 1300 calories per hour of collection time (Jones and Madsen 1991) while lomatiums

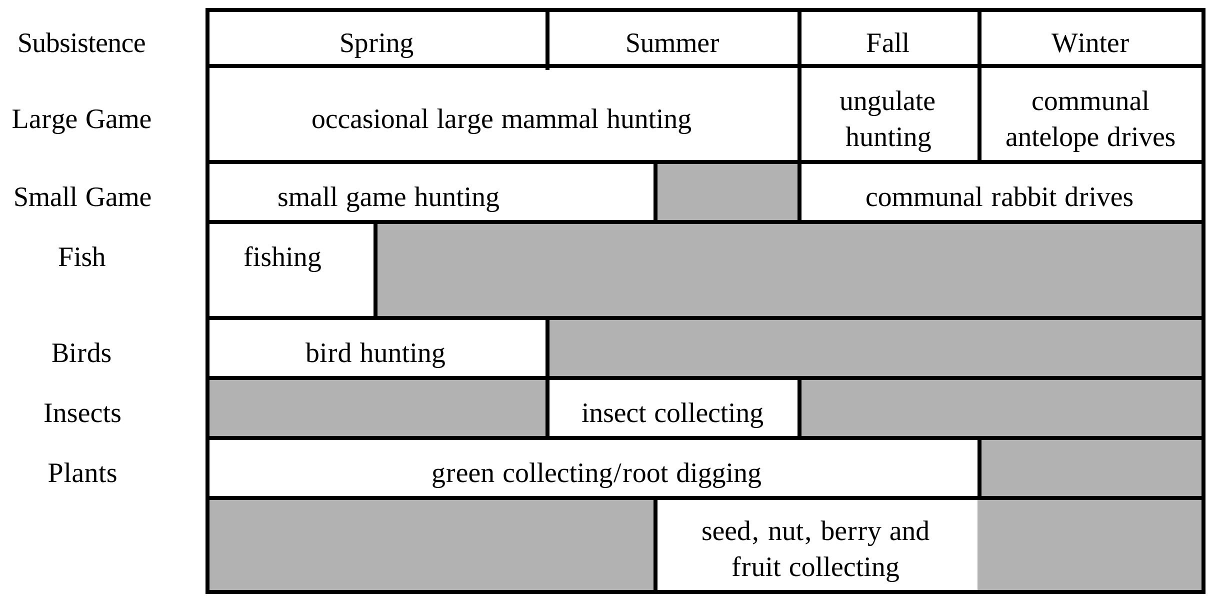

Figure 2. Surprise Valley Paiute seasonal rounds (from Masten 1985:316).

provide well over 3800 calories per hour (Couture et al. 1986; cf. Keely 1980). Together, these geophytic roots, with others, could yield about 50% of the necessary annual caloric intake of a family over a 40-60 day harvesting period (Hunn 1990).

Temporary windbreaks were constructed of sagebrush and/or juniper during the spring and summer seasonal collecting forays. The camps, generally consisting of only a few temporary structures, were occupied by small nuclear families for short periods, sometimes as little as a single week. These small camps were very mobile, moving from one valley or spring to another. Sagebrush and juniper, along with pine, were favorite fuel sources. The size of these "camp" (microband) territories varied between 100 and 200 square miles (Kelly 1932:105; Steward and Voegelin 1974:282-283).

Hunting and root gathering pursuits continued throughout the summer and into the early fall. Insects, worms, caterpillars, and ants were collected as they came available in sufficient numbers to warrant the effort. These, however, were only supplemental foods to roots, seeds, fish, and game (Kelly 1932:95, 97; Stewart 1941:373).

As late summer approached the *Tuziyammo* band of Surprise Valley Paiute committed most of their time to collecting seeds near Beatty, Oregon, and other areas west of the Warner Mountains. Highly ranked seeds included wada (*Suaeda depressa*), Indian rice grass (*Oryzopsis hymenoides*), chenopods (*Chenopodium* sp.), saltsage (*Atriplex* sp.), and Great Basin wildrye (*Elymus cinereus*). Dense stands of these plants were intensively collected during the late summer and fall. These seeds were parched and ground into flour which was then made into bread, or sun dried in cakes for later use (Kelly 1932:99-103).

The commencement of the fall season brought larger social gatherings for activities such as festival-mourning ceremonies, communal antelope and rabbit drives, circle dances, games, and gambling. Women collected fresh berries and fruits including chokecherries (*Prunus virginiana*), squaw currant (*Ribes cereum*), golden currant (*Ribes aureum*), hawthorn (*Crataegus douglasii*), huckleberries (*Vaccinium membranaceum*), pine nuts (*Pinus ponderosa*), and rose hips (*Rosa woodsii*) in the highlands. Few, if any, plant foods were available during the winter (unless they were stored), but communal rabbit and deer drives were important economic pursuits, adding fresh food to the predominantly dried and reconstituted vegetable diet (Kroeber 1925:584; Kelly 1932:76).

The annual round ended in November when the scattered family groups returned to their winter encampments. The Surprise Valley Paiute set up winter villages near streams and springs in the foothills of the Warner Mountains where they could obtain protection from cold winter winds and be near ample supplies of firewood. These camps frequently varied in location from one winter to the next, depending on the location of cached resources and the availability of fresh foods, especially rabbits and antelope. Winter encampments usually consisted of one to two families, but as many as five occasionally camped together. Winter houses were structures with circular floors, a central pole, and a conical roof manufactured of bark, grass, brush, and woven mats. Earth was sometimes banked up around the outside for added warmth. Few Northern Paiute groups excavated subterranean houses, as this required substantial effort and time, and most stayed in their winter encampments for relatively short times before moving on to be near food caches and to forage for food. These movements began in early spring, from March to early April, when stored foods ran low and spring roots were first ready for harvest (Fowler 1982:122, 133).

Modoc and Klamath

The Modoc, centered in the Lost River area of south-central Oregon and north-central California, comprised three groups: the *Gumpatwas*, the *Kokiwas*, and the *Paskanwas* (Barrett 1910; Ray 1963; Spier 1930). The boundaries of their extensive territory began near Mount Shasta on the Cascade Divide, continued eastward to the southwestern shore of Goose Lake, followed Drews Creek to Quartz Mountain, thence followed the divide between the Sprague and Lost Rivers westward to Yainax Butte, and then curved back southwest to the area of Mount Shasta. If we accept the largest limits of the territory they claimed, then Modoc territory encompassed roughly 9,400 km^2 (3,630 mi^2) (Sampson 1985:3).

The *Gumbatawa* or "People of the West" occupied Lower Klamath Lake, the Lost River, Tule Lake, and the area just south of the lake. The *Kokiwas* or "People of the Far-Out Country" lived to the east of the *Gumbatawa*, though their territory also included a portion of the Lower Lost River area.

Drews Valley and the project area are located within Kokiwas territory. The *Paskanwas* or "River People" inhabited the lower Lost River Valley from the Lost River gap to Tule Lake in northern California (Kroeber 1925:318; Powers 1877:252; Ray 1963:202-205). The Klamath, who were very similar culturally and linguistically to the Modoc, occupied Upper Klamath Lake, the Klamath Marsh, and the Williamson and Sprague Rivers in Oregon (Spier 1930; Kroeber 1925).

Much like Northern Paiute social networks, however, Modoc band territorial boundaries were fluid and personnel could move to other band areas easily. Band territories were simply "exploitation spheres". Individuals could move their places of residence to utilize another band's resources, such as roots and fish, and with prolonged residence could become members of the new group they resided with, though their previous associations were remembered and acknowledged by their new band associates (Ray 1963:201-211).

Intra-group relationships included trading, festivities, and marriage. These relationships served the same social networking functions that were so important for maintaining current information on the availability and productivity of plant and animal resources across the Northern Great Basin. Warfare and disputes, however, were common occurrences between the Modoc-Klamath and the Northern Paiute. They often disputed over specific territorial boundaries and the rights to the resources of the region they shared (Ray 1963:xii, 134-135, 139).

The Modoc and Klamath languages are linguistically complex. They have been associated with both the Sahaptin and the Penutian language families (Aoki 1963; Stern 1966). Ray (1963:xiv) contends that both the Modoc and Klamath were linguistically isolated and spoke a separate branch of Sahaptin, whereas Kroeber (1925:318) proposed that they spoke a dialect of Lutuami, a Penutian language. The Modoc referred to themselves as the *moatokni maklaks* or "People of Moatak", which refers to Tule or Rhett Lake lying to the *muat* or "south", and the Klamath referred to themselves as the "*Eukshikni maklaks"*. *Eukshi* is a derivation for Klamath Lake. The two dialects were mutually intelligible, but the Klamath and the Modoc considered themselves separate peoples and distinguished themselves, whenever necessary, by geographic designations (Kroeber 1925:319).

Chieftainship was hereditary and bestowed with authority and wealth among the Klamath. Leadership among the Modoc was a product of oratorical ability, wealth, and size of household, i.e. how many people relied on and backed the leader. All leaders among the Modoc were male (Ray 1963:3). Sociopolitical units were defined at the village level and were closely bound together by economic autonomy and cooperation, division of labor, marriage, and language. Kinship was traced bilaterally and religion was closely intertwined with morning sweat lodge rites, shamanism, zoomorphic and anthropomorphic animism, and the guardian spirit concept (Ray 1963; Kroeber 1925:320-322; Stern 1966).

In the Goose Lake and Drews Valley area, there were no known Modoc permanent claims or villages (Kroeber 1925:318), although Powers (1877:252) noted that they often visited the area. There is dispute on whether the Modoc claimed the western shore of Goose Lake, but it seems most probable that they shared the lake with both the Achomawi and the Northern Paiute.

Settlement-Subsistence

The Modoc and Klamath followed a dual residential mobility strategy between permanent winter and temporary spring-summer villages. Temporary spring through fall village locations, duration of occupations, and site functions were largely dependent on the seasonality, distribution, abundance, and predictability of plant and animal resources available. For example, settlements were located near important hunting grounds, productive fishing stations, and in areas with abundant roots and seeds. The best village locations were in areas where the women could collect roots while the men fished nearby. Logistical foraging parties also dispersed to a various resource locations throughout Modoc territory during prime food collecting seasons (Kroeber 1925:318; Masten 1985:328; Powers 1877:252; Ray 1963:201-211).

Modoc and Klamath winter settlements were located near lakes, marshes, and rivers in their respective territories. The Modoc located fixed winter villages on the southern shores of Lower Klamath Lake, Tule Lake, Clear Lake, Willow Creek, and Lost River. The Klamath situated winter villages along sheltered areas of running tributary streams of the Williamson and Sprague Rivers warm enough to prevent ice from forming. Although these locations were chosen because of the milder weather conditions that persisted in these areas, the availability of fresh food resources were also a consideration. The gathering of surplus food in such locations promoted a much greater degree of sedentism during the winter than the Northern Paiute experienced. Other activities, such as the manufacture and repair of houses and other material items, visiting, marriage, and ceremonies were also conducted during the winter (Spier 1930).

Permanent Modoc winter villages were typically comprised of three to seven lodges and associated structures. The smaller villages consisted of only two or three houses and the largest villages had eight or more houses, although if they reached this size, villages would split up into two different locations. Klamath winter villages, however, were typically larger than Modoc villages. They might consist of a few to a hundred or more semi-subterranean earth lodges and they may be stretched out along a river or stream for a half mile or more. An average Modoc or Klamath family consisted of five members. Typically one or two related families lived in the smaller houses, while six to eight families occupied the larger houses. Although other types of relations occasionally occupied a house, family group membership tended to remain relatively constant in a structure throughout the year. However, with each major move, such as returning in the fall to re-occupy the winter village, changes in memberships often occurred (Ray 1963:158, 203-204; Stern 1966).

The fishing and summer villages were semi-permanent in nature; being re-occupied year after year. They were in use only as long as the resources lasted, however. They were then abandoned as the Modoc dispersed across the landscape into new environments to utilize different resources as they came available through the seasons.

As a result of these frequent population shifts throughout the year, the seasonal rounds of the Modoc and Klamath were diverse, resulting in the collection of a variety of resources (Figure 3). As soon as the snows ended the Modoc and Klamath dismantled their winter houses and moved to their early spring sucker fishing camps. This usually occurred in March. Two or more semi-permanent fish camps were commonly established close together in economically productive locations. The Klamath preferred to situate these camps relatively close to the winter village, reducing the cost of transporting the dried fish from the fishing village to the winter village. The fishing season lasted approximately a month. Both groups used a variety of methods for taking fish including gill-nets with tule floats, clubs, funnel traps, harpoons and two-pronged spears, hooks and lines, dip nets, and by hand. Chubs, minnows, and eels were also captured with bone gorgets and bone hooks. Rafts and cedar canoes were commonly used during fishing pursuits, though the Klamath used them more often than the Modoc did.

While the men caught suckers and occasionally hunted, the women divided their time between processing the fish and harvesting biscuitroots (*Lomatium* spp.) and other less economically important root-plant species. Assisted by the men, they also collected pine saplings from the mountains to construct fish drying racks at the camps (Ray 1963:180-196; Spier 1930). Waterfowl eggs were also actively sought after and gathered in the early spring.

The Modoc moved to their favorite digging grounds to harvest epos (*Perideridia oregana*) at the end of the spring sucker runs. This root crop played the largest role in the Modoc economy (Ray

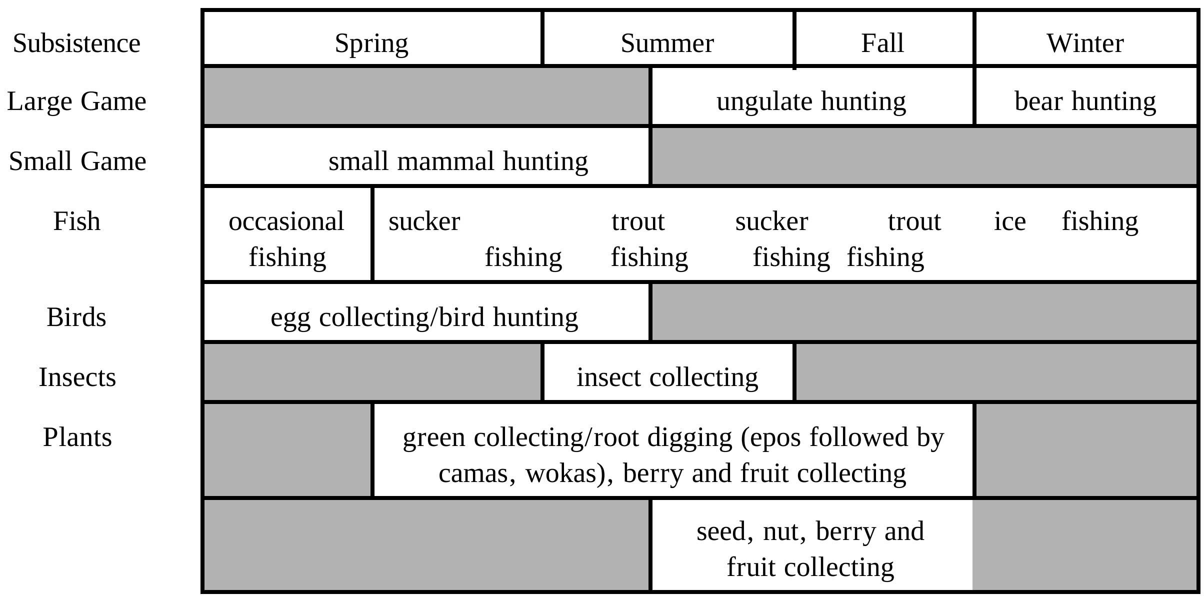

Figure 3. Modoc and Klamath seasonal rounds (after Masten 1985:316).

1963:198). Found at higher elevations between 4,000 and 7,000 feet, epos were gathered before blooming, usually in May, when the roots were milky and soft. Favorite collecting locations were in open pine forests, meadows, and rocky slopes. The primary choices for house locations during this time of year were near the banks of streams or rivers where trout and suckers were readily available and within easy walking distance of the epos digging grounds. The locations of summer villages were considered to be vitally important because of "the critical nature of the crop and because trout would be available until August" (Ray 1963:181).

The amount of time roots were collectable was typically very short, lasting only three or four weeks. The women had to work at a rapid pace to gather enough roots for winter storage, as well as daily use. The actual days of productive harvesting lasted only about two weeks because of the time involved in traveling and cleaning the roots. The cleaning had to be done every few days while the roots were still fresh. According to Ray (1963:198), a successful day's harvest yielded one basketful of roots. Each woman collected only for her family and the roots were not generally shared with others (Barrett 1910:243). Usually, large groups of women traveled together early each morning to various patches within working distance of the village. When the plants in these fields had been collected, the village was moved to another location. This process continued until the season was over.

A move was necessary during June and July when the camas (*Camassia* spp.) bloomed in wet meadows at the edges of coniferous forests between 4,000 and 7,000 feet elevation. Although camas was one of their favored root crops, it was not generally as abundant as the biscuitroot and epos. As a result, people frequently dispersed from camp to camp whenever necessary and the population was the most wide-spread at this time of year.

The Modoc and Klamath also collected the roots, stems, and shoots of cattail (*Typha latifolia*), sedges (*Carex* spp.) and Bur-reed (*Sparganium* spp.). Insects such as crickets, grasshoppers, and moths, were harvested, but these were considered only as supplemental foods (Gatschet 1890: xxv; Ray 1963:218; Stern 1966; Spier 1930; Voegelin 1942:59).

The harvesting strategy and processing problems were much the same for camas as for epos. Women dispersed widely from the villages to distant digging grounds as nearby fields were exhausted. The typical camas season lasted about one month. The camas bulbs were partially dried and cleaned at the digging site. They were carried back to the village to be roasted in subterranean earth ovens when the harvest was complete. Sagebrush, juniper, and pine were the primary fuels used in camas cooking ovens. After the bulbs were removed from the ovens, they were dried on tule mats, put inside bags, and placed in storage pits (Barrett 1910:243; Ray 1963:198).

Finally, during June and July, women collected water lily or wokas (*Nupher* spp.) seeds, the men fished for trout, hunted small game, and caught birds attracted with decoys in nets. Waterfowl were also shot with arrows, speared or clubbed. Goose Lake was considered a favorite area for waterfowl hunting by the Modoc (Ray 1963:182, 189, 210).

Late July marked the time when the Modoc and Klamath began hunting deer and pronghorn antelope, in earnest, in lowland locations. Pronghorn were commonly hunted in lava beds, such as south of Clear Lake, though deer were not generally hunted in this terrain. Hunting bows were made of juniper or yew (*Taxus brevifolia*) and arrows were constructed from willow (*Salix* spp.) or serviceberry (*Amelanchier alnifolia*). Large game were also driven into chutes and corrals of various kinds and dispatched with bows and arrows (Ray 1963:184-188).

Large game animals were considered more important in the Modoc economy. Thus, the Klamath placed more emphasis on fishing than the Modoc. This may be largely due to environmental factors; the Klamath typically lived in more lacustrine settings than the Modoc who occupied drier environments. Stern (1966:4-5) contends that the Modoc's heavier emphasis on hunting may also have been the result of not being as heavily influenced by neighboring fishing cultures as the Klamath were.

Another significant difference between the Modoc and the Klamath centered around the gathering of water lily or wokas seeds. The Modoc harvested wokas seeds only on a limited scale during June and July, whereas the Klamath collected their seeds in vast quantities in August and September in the Klamath Marsh, and considered them an important staple (Coville 1897; Kroeber 1925:324-325). They collected the unopened seed pods from canoes and sun dried them. Afterwards, the seeds were pounded out, winnowed, and then stored. The seeds and mashed pulp could also be parched and later boiled into a gruel. Klamath Marsh alone contained 15 square miles of wokas. A woman could gather on average four to six bushels of pods a day. This was equivalent to 6 or 7 pounds of edible seeds after winnowing.

From late July through September, women collected a variety of seeds and berries throughout the various parts of their territory. The Modoc placed more emphasis on seeds, barring the wokas seeds, of course, than did the Klamath. Important seed plants to the Modoc included waada, sunflower, water lily, buckwheat, blazing star, amaranth, goosefoot, balsamroot, knotweed, willow dock, ryegrass, plains mustard, manna grass, tarweed, and others. Both groups collected seeds with a snowshoe-shaped seed beater constructed of closely woven juniper withes. The Modoc also placed heavier emphasis on utilizing conical baskets like those typically found throughout the Great Basin. Pine nuts and various species of berries such as the Klamath plum, serviceberry, western chokecherry, currants, strawberries, and huckleberries were also favorites of the Klamath and Modoc (Barrett 1910:243; Gatschet 1890; Ray 1963:199-200, 218; Stern 1966:5, 14).

The second major run of suckers occurred during late August and early September. After this run subsided the men traveled to higher elevations to hunt deer, elk, mountain sheep, and bear. The women accompanied them to collect huckleberries and other high elevation berries. As October arrived, the groups returned to their winter villages and, among other things began hunting deer in earnest. Goose Lake was a favorite area for the Modoc to hunt antelope and deer. In December, the winter trout run commenced. The men continued fishing through the ice in streams and lakes. These runs, however, were not as productive as the earlier sucker or trout runs (Barrett 1910:243; Ray 1963:182-183, 210; Stern 1966:13-14; Voegelin 1942:58).

The men finished out the year by repairing and making household goods and rebuilding/refurbishing their winter houses. Rebuilding required two weeks time in late October-early November while constructing a new structure required four to six weeks.

Dwellings and Other Constructions

Both the Modoc and Klamath constructed a variety of different house structures: subterranean earth lodges, mat-covered lodges, dome-shaped houses, circular windbreaks, utility structures, and sweat lodges. During the winter, they occupied semi-subterranean, earth-covered lodges; elongated and rectangular mat-covered houses, and dome-shaped houses. The semi-subterranean houses averaged 1.2 m deep and ranged between 4.9 and 12.2 m in diameter, with 6.7 m the mode. Stern (1966:7) noted that the Modoc tended to excavate deeper lodges than the Klamath.

Lodges had conical roofs supported by pine, juniper, or cottonwood log beams and rafters. Three layers of insulative material covered the outside of the structures: tule mats fastened together by sagebrush or swampgrass cordage, covered by planking, bark or sagebrush, and finally a thick layer of earth (Ray 1963:146-152; Kroeber 1925:327).

The mat-covered houses ranged in size from 3 to 4.3 m wide and were about twice that in length. They were made in a shallow pit 30 to 40 cm deep and the walls were banked with earth from 30 to 70 cm high. The walls were covered with a thick layer of tule (*Scirpus*) mats (Ray 1963:154-155; Kroeber 1925:328). The dome-shaped, mat-covered structures were often used as winter homes for elderly persons who had difficulty using the ladders in earth-covered houses. Dome-shaped structures were simple in design and constructed out of a framework of bent willow poles covered with tule mats. Earth was banked up around the outside to seal them from cold drafts. These structures were approximately three meters in diameter and two meters high, had a central smoke hole in the roof, and a west facing door. They were usually used during the summer as domiciles (Ray 1963:156-157).

Utility structures, similar to the dome-shaped houses, were used for three purposes: (1) they served as cooking huts adjacent to earth-covered houses, (2) they served as storage huts for bulky non-food items (e.g. wood and mats) and consequently also functioned as work rooms where women sewed, spun, and made mats; and (3) they were used as menstrual/birthing huts (Ray 1963:158).

Finally, sweat lodges were either the earth-covered type or dome-shaped in nature. They were basically identical in construction to utility structures except for the omission of the door and the lack of the smokehole. They reached a height of 1.5 to 1.8 m high and were usually two or more meters in diameter (Ray 1963:160-161; Kroeber 1925:329).

The circular windbreak was the simplest of all structures constructed by the Modoc and Klamath, as they were simply temporary structures used for protection from the weather while traveling. They were roughly 1.2 m high, with diameters ranging between 1.8 and three meters (Ray 1963:146). The walls were made out of sagebrush branches lashed together.

Although Ray (1963:183) did not give a detailed description of Modoc storage pits, he does say that they were scattered at some distance from the villages to reduce the chance of theft, and that theft was expected should they be found. This suggests that caches would have been small and widely dispersed rather than large and clustered, as this would limit the amount of loss in the event of discovery. Spier (1930:167) describes the storage features found among the Klamath:

> Food is stored in the ground… Large communal storage pits are dug near the houses. Some of the Williamson river sites are surrounded by wide expanses of such pits. These are about fifteen feet in diameter, about three feet deep. A group of neighbors combine to dig and use such a pit. Tule mats are heaped over the sacks [of roots] before the dirt covering [the pit].

4 Land, Water, and Biota in the Northern Great Basin: Rocky Uplands and Wet Lowlands

The Northern Great Basin is a high desert covered with hardy, low-growing plants that form an extensive shrub-steppe biotic community spread across central and southern Oregon (Franklin and Dyrness 1988:234). The general aridity of the area is caused by the rain shadow effect of the Cascade Mountains which form the western border of the basin. These relatively high and massive mountains push warm, moisture-laden Pacific air up to mix with cooler air masses over the mountain crests. Most of the water condensed out by this drop in temperature is released on the western slopes of the Cascades, but the high Cascades and their flanks to the east are also comparatively well-watered. Within the adjacent Northern Great Basin, which in Holocene times has traditionally received much of its precipitation from storm tracks crossing northern California, precipitation is generally no more than 180 to 300 millimeters (6 to 12 inches) per year.

Environmental variability, related to elevational differences which affect local hydrology, is a dominant characteristic of the Northern Great Basin. Elevations range from a low of about 1,200 m (3,960 ft.) to the highest point of the Steens Mountains at roughly 2,930 m (9,669 ft.). The extremes in Northern Great Basin elevations are most generally caused by geologic fault-blocking, typical of the Great Basin as a whole. Dramatically upthrust, north-south trending fault-block escarpments, typically comprised of basalt and rhyolite, tower over low-lying lake basins. Moisture captured by these higher elevations is often reflected in upland forests of pine (*Pinus ponderosa* and *P. contorta*) with groves of aspen (*Populus tremuloides*) and mountain mahogany (*Cercocarpus ledifolis*), while the intermediate elevations are dryer, with juniper trees (*Juniperus occidentalus*), sagebrush (*Artemisia tridentata*), and grasses (*Festuca idahoensis, Elymus cinereus*) most prominent. The lowlands, otherwise quite arid and covered by xeric species such as sagebrush, greasewood (*Sarcobatus vermiculatus*), and saltbush (*Atriplex sp*.), harbor in certain places biotically rich wetlands systems that are fed by small streams coursing down from above, supporting tule (*Scirpus sp*.) and cattail (*Typha latifolia*) marshes and their associated terrestrial and aquatic biota. These marsh systems are often surrounded by sand dunes and sheets comprised of particles eroded from dry lake beds and deposited predominantly along the northeastern portions of the basins. Dense, rich carpets of Indian ricegrass (*Oryzopsis hymenoides*), wild rye, and needle and thread grass (*Stipa comata*) develop in these areas when moisture and temperature regimes are correctly balanced. When conditions are not right (too dry, too hot, too cold) some, if not most, plants in the region produce very little, a condition which in the past caused local populations considerable subsistence stress (Aikens and Jenkins 1994b:2-4).

A series of ‘wet’ basins, situated for instance, at the foot of the Cascades and Ochoco mountains on the western and northern peripheries of the Northern Great Basin, and at the foot of the Steens, Warner, and Hart mountains toward its center, were (and are today) extremely important as focal points of human occupation. The concentrated food and industrial resources offered by such wetlands have drawn people to them throughout human time in the region. They have been central places, anchoring communities that have exploited them and their neighboring uplands around the calendar and across the millennia (see Janetski and Madsen [1990] for a broad view of wetlands cultures throughout the far west).

The Fort Rock Basin is one such focal area. We believe that, to the extent we can learn the dynamics of cultural and environmental interaction here, we may also contribute to the understanding of such dynamics in similar settings throughout the Northern Great Basin. In addition to the importance of local geography in structuring peoples' economic lives--and therefore their social lives as well--is the importance of climatic variability in effecting changes in people's life ways over long periods of time. We take it that a dominant fact of everyday life for indigenous people making their living in the desertic Northern Great Basin was the productivity of wetlands and adjacent settings, in terms of the foods and other materials that were needed on a regular basis. And a dominant fact of nature affecting the place in which they lived was that wetlands systems, on which they heavily depended, expand and contract in response to changing water budgets reflecting the short (El Nino/La Nina) and long-term climatic changes that are characteristic of the Great Basin generally.

Intervals of increased winter precipitation, particularly when extending into warm, wet springs, can bring dramatic increases in biotic productivity to environmental settings like those of the Silver Lake/Fort Rock (SL/FR) channel system in the western Fort Rock Basin. Productivity is enhanced in situations where lakes or marshes are surrounded by "overflow wetlands" playas and channels, when these fill with water and remain filled for some significant interval of years. Cattails, tules, and sedges (*Carex spp*.), all of which have both edible parts and industrial uses, can grow in dense concentrations in and around the more perennial and shallow waters of lakes and marshes. Ducks (*Anas* spp.), geese (*Branta canadensis*), coots (*Fulica americana*), and other fowl congregate along the biotically productive fringes of these lacustrine resources. Muskrats (*Ondatra zibethecus*) and a variety of fur-bearing predators inevitably become more numerous as well. Fish species capable of living in slightly saline waters reinvade the playas, blow-out ponds, lakes, and channels of the over-flow wetlands systems. The fish, primarily Tui chub (*Gila bicolor*) and various suckers (*Cyprinidae)*, rapidly increase in size and numbers in the shallow nutrient rich waters (Greenspan 1994) as long as these ephemeral water sources remain full and fresh enough for them to survive.

The short, sharp climatic fluctuations so characteristic of the Great Basin environment were probably an aid in harvesting fish. For as the shallow waters of the channel system receded in dry years, large numbers of fish would have been trapped and slowly stupefied and then killed by increasing water salinity. Their bodies then collected in windrows on the shores, a windfall of calories for people who anticipated what was going to happen and scheduled their rounds to be there at the appropriate time (Cannon and Mehringer 1992). In any event, when the channel system began to dry up the fish were stranded in a myriad of shallow water sources, a trapped resource exploited by humans and animal populations.

Of course the wetlands cannot be considered independently of their surrounding uplands; both zones were integral to the native way of life. In the broad valley flats surrounding lake-marsh overflow systems, and on the gentler slopes of valley edges, are often found dunes and sand sheets, wind-carried from the surfaces of dry lake beds exposed during intervals of arid climate. Greater than normal precipitation, particularly when it comes in the form of late spring and early summer rainfall, fosters a dramatic increase in grass seed production in these sandy environments. Rabbits, squirrels, rodents, and large grazing mammals alike reap the benefits of this increased productivity, and in turn experience greater than normal reproductive success. Human groups drawn to harvest the ripening fields of grass could enjoy a broad diet, enhanced by the meat of both small and large mammals (Jenkins 1994a, 1994b).

At higher elevations, on the broad, stony slopes of the massive uplifted fault-blocks of the region, sufficient moisture will support a series of veritable vegetable gardens, which were regularly exploited by native people (Couture et al. 1986; Housley 1994; Prouty 1994; Stenholm 1994). Many plants in these upland settings (*Lomatium, Calochortus, Perideridia*), store calories in bulbs and enlarged tap roots to insure their reproductive success in the following year. The stems of these usually low growing plants are quite fragile. As the weather warms they dry out and snap off. The bulbs and tap roots, safe below the moisture-preserving stony mantle on and near the surface, await the next spring to send up blossoms again. Aboriginal populations obviously learned quite early to find and exploit the rich bounty hidden below the surface (Brashear 1994; Byram 1994). The primary limiting factor on people's exploitation of this valuable food source was the "harvesting window," the length of time the stems remained attached to the bulbs and roots, showing where to dig for them. This "harvesting window" is generally lengthened by warm moist weather and shortened by either unseasonable freezing or unusually dry or hot conditions.

The uplands also harbored other vegetal foods, as well as large mammals and small rodents for the taking. In the Boulder Village Uplands above Silver Lake, broken rimrocks, frequently covered with juniper, mountain mahogany, chokecherries (*Prunus virginianius*), serviceberries (*Amelancher alnifolia*), and Great Basin wildrye (*Elymus cinereus*), provide excellent habitat for mule deer (*Odocoileus hemionus*), mountain sheep (*Ovis canadensis*), and elk (*Cervus elephas*), while the more open sagebrush covered expanses are preferred habitat for pronghorn antelope (*Antilocapra americana*) and jackrabbits (*Lepus californicus*). Both the vegetal and the animal resources were attractive to people. The primary limiting factor to their distribution in this wild and beautiful country is water, and vernal pools that often hold winter snowmelt well into summer are common in many small, closed upland basins. Springs are also to be found in many places where bedrock outcrops carry ground water to the surface.

Changing Environments and Plant Food Distributions in the Fort Rock Basin

Currently a desert landscape of sagebrush flats, dynamic marshes, sand dunes, and flanking hills, the Fort Rock Basin held a huge pluvial lake 18,000 radiocarbon years ago. Since humans have occupied the region, over the past 13,000 years or so, it has periodically harbored much smaller but still important lakes and marshes, that have alternately attracted people and left them high and dry as inflowing waters from the Cascades ebbed and flowed with changing climate. Further, local environments are quite varied within the Fort Rock Basin as a whole, due to topographic differences.

The lakes and marshes mentioned are found principally within the Silver Lake Valley, one of three interconnected sub-basins that make up the larger Fort Rock Basin. Paulina Marsh, at the western end of Silver Lake Valley, is fed by three streams flowing from the adjacent Cascades. When input is sufficient, Paulina Marsh overflows into Silver Lake, to the southeast. Silver Lake has been more of an extension of Paulina Marsh than a lake throughout much of prehistory (Wingard 1999; Droz and Selby 1998). When it overflowed in the past--it currently holds two to three meters of water and would require many more to overflow--the discharge apparently cut rapidly through sands and silts plugging discharge channels at the north end of the lake to reestablish base levels at ca. 4,310 ft. At this level it flowed northward through braided channel systems into Thorn Lake and from there north into the SL/FR channel system that lies along the edge of the Fort Rock Valley and Christmas Valley sub-basins at the eastern foot of the Connley Hills. Eventually, water flowed into Beasley Lake, the SL/FR channel system terminus, near the town of Fort Rock in the northwestern-most corner of the basin (Droz and Jenkins 1999).

Neither the Fort Rock Valley nor Christmas Valley receive perennial runoff directly from adjacent uplands, and current evidence suggests that they have been consistently dryer than the Silver Lake Valley throughout Holocene times. To the extent that significant standing water has supported wetlands in these two sub-basins, the moisture has apparently come via the Silver Lake Valley during particularly wet periods.

Diverse forms of research in the Fort Rock Basin indicate that during much of what we will define below as the Late-Middle Holocene period the environment was much wetter than present (Bedwell 1970; Allison 1979; Allison and Bond 1983; Jenkins 1994a; Mehringer and Cannon 1994; Droz and Jenkins 1999). Climatic shifts toward wetter conditions apparently improved the lowland environment considerably, bringing trees useful for firewood and building materials down to the valley floor while increasing the volume of the Silver Lake overflow into Thorn Lake and the Fort Rock Valley. There is little doubt that biotic productivity increased dramatically with more frequent rain and flooding. Increased water flow improved water freshness, increased fish and waterfowl productivity, and generally improved range conditions.

The Fort Rock Valley subbasin contains many square kilometers of lowlands with elevations at or slightly below the floors of Paulina Marsh and Silver Lake. These lowlands are now covered by an extensive network of playas and deflation basins connected by shallow meandering channels. The deeper deflation basins, particularly those nearer Silver Lake (e.g. Thorn Lake and Bottomless Lake, but also Beasley Lake) continued to hold potable water for prolonged periods of time, providing habitat for fish and waterfowl as well as drinking water for humans and terrestrial mammals (Droz and Jenkins 1999).

Chenopodium and *Sueada* (waada) are plants particularly fond of the sandy, slightly saline soils found around the ephemeral lakes of the Northern Great Basin (Couture et al. 1986). Their importance as subsistence resources, as well as that of fish and various types of grasses, is demonstrated by their frequent occurrence in paleoethnobotanical samples taken in the Fort Rock Basin (Stenholm 1994). Their seeds have been recovered in soil samples taken at two Late Holocene villages (Boulder Village and Scott's Village) and two isolated houses in the Boulder Village Uplands (Teri's House and Ratz Nest), as well as at the Carlon Village site on the shores of Silver Lake (Jenkins 1994a; Jenkins and Brashear 1994; Wingard 1999). The widespread distribution of these small seeds--and the fish which almost always accompany them--clearly indicates they were an important part of the aboriginal diet (at least throughout the Middle and Late Holocene). Their increased availability during unusually wet periods undoubtedly affected human settlement and subsistence patterns in the Northern Great Basin.

Recent paleoethnobotanical studies at sites in the Boulder Village Uplands (Stenholm 1994) show that roots (e.g. biscuit root, yampah, sego lily, and wild onion) were exploited by Late Holocene (3000 to historic) aboriginal groups. The shallow, rocky soils of these upland settings were excellent habitat for such edible root crops (Housley 1994). Fairly large human populations apparently gathered in this area to exploit roots, as indicated by the many substantial houses found at Boulder Village and other sites in the area (Jenkins and Brashear 1994; Prouty 1995; O'Grady 1999). There is now strong evidence that these same abundant resources were known to Late-Middle Holocene (5600 to 3000 BP) populations as well (Byram 1991, 1994; Brashear 1992, 1994; Jenkins 1999).

The occupants of early village sites in the Silver Lake/Fort Rock Valley, being at best some 10 km (6 miles) from rich uplands root crops, probably established temporary camps and cache locations in the upland root grounds because of the increasing costs and decreasing returns involved with travel to and transport of food items from resource areas located far from camp (Kelly 1990:263). Survey evidence (Brashear 1994; Byram 1994) suggests that small temporary camps of the Early and Middle Holocene periods were established near water sources in the uplands. Presumably roots were dug by the women and children and game was hunted by the men. The presence of stone bowl mortars, pestles, metates, and manos at the lowland village sites suggests that plants, roots, and seeds formed an important part of the diet there (Jenkins 1994a).

A brief review of what is known from excavations about faunal distributions and their contributions to aboriginal subsistence patterns will complete this review of the primary subsistence resources in the Fort Rock Basin. The stage will then be set for discussion of varying human responses to the spatio-temporal distribution of both lowland and upland resources.

Faunal Distributions and Subsistence

The single faunal genus with the largest representation in Fort Rock Basin archaeological sites is *Lepus*. Rabbits are present in great numbers during much of the normal year and though rabbit populations fluctuate cyclically they are generally relatively high in the Silver Lake/Fort Rock valleys. Early 20th century ranchers staged massive rabbit drives in the Fort Rock Basin which destroyed literally thousands of jackrabbits but did not have a lasting affect on their numbers. Similarly successful drives were conducted on Buffalo Flat between 8000 and 9000 RCYBP (Oetting 1994) and must have been a relatively common occurrence in the Fort Rock Basin throughout prehistory. Rabbits were a rapidly replenished resource which, during cycles of abundance, provided a significant source of protein and furs; this no doubt explains why rabbits occur in every known archaeological assemblage in the Fort Rock Basin.

The remains of artiodactyls--deer, antelope, and mountain sheep--are common in archaeological assemblages but vary substantially in quantity between sites. Artiodactyls and rabbits apparently composed most of the faunal assemblage (by relative meat weight) at the Big M site (Jenkins 1994a). The floors of two houses at this site were scattered with fragments of artiodactyl bone. New evidence from the Late-Middle Holocene Bergen site suggests that this village may have been located on the shores of Beasley Lake because this location allowed the occupants to exploit the migratory resources of both the marshes (waterfowl) and a natural wintering ground for mule deer and antelope which annually migrate to the northern sector of the Fort Rock Basin and Connley Hills late each fall. Wildlife biologists have recorded 5000 to 17,000 deer in the immediate vicinity, along with large populations of pronghorns, during the winter months (Jenkins et al. 2000b). On the other hand, artiodactyl bone was virtually non-existent at the Late Holocene Zane Church site in the southern portion of the basin (Jenkins 1994a).

In Surprise Valley and in the Columbia Plateau-Snake River region, archaeological evidence suggests that artiodactyls made up a major portion of the diet during the Menlo (6000 to 5000 RCYBP) and Late Cascade (6500 to 4500 RCYBP) phases, respectively (O'Connell 1975; Leonhardy and Rice 1970). On the other hand, at Dirty Shame Rockshelter the pursuit of artiodactyls seems to have decreased in importance while small animals and root crops apparently increased in importance (Hall 1977; Hanes 1988). Artiodactyls were hunted in the Fort Rock Basin throughout prehistory, but unlike rabbits are much more susceptible to hunting pressure and changes in the nature and quality of browse related to climatic factors. Consequently, artiodactyls may have responded negatively to increasing human populations and climatic deterioration during the Late Holocene, though at this stage we can only speculate.

Fish remains have been recovered from at least 20 archaeological sites in the Fort Rock Basin and are generally important components of the faunal assemblage in wetlands sites (Jenkins 1994a, 1999). The vast majority of these remains have been identified by Greenspan (1984, 1985, 1990, 1994) as tui chub (*Gila bicolor*), a large minnow. These fish are most easily obtained in the late spring and throughout the summer when they spawn in the shallows. Preliminary analyses suggest that the majority of tui chubs at the Big M and Bergen sites were caught in the spring and summer, although a few were caught late in the summer (Greenspan 1994; Jenkins et al. 2000b). With proper drying and storage, these fish could have been consumed anytime throughout the remainder of the year, and could have been an important storable resource.

Fishing was important enough in the Fort Rock Basin that at least two, and possibly three, methods of capture--nets and fish gorges--were employed. Fish bones, net weights, and tiny bipointed gorges similar to those found at Pyramid Lake (Tuohy 1990:134), are strong evidence for the harvesting of fish at the Big M and Bergen sites. Tui chub is the predominant species of fish recovered from sound archaeological contexts at the site, and is the predominant species found in archaeological deposits throughout the basin (Greenspan 1991).

Tui chubs were taken with both nets and fish hooks by the Northern Paiute and apparently constituted a major resource in some Northern Great Basin locations (Fowler 1990:23-24; Raymond and Sobel 1990; Greenspan 1998). The fact that tui chubs were the predominant species of fish recovered at most sites in the Fort Rock Basin may mean that the water in the lower reaches of the drainage system, east of Silver Lake, was generally too warm and saline during the Holocene period to support the redband trout (*Oncorhynchus* sp.), and speckled dace (*Rhinichthys osculus*) still resident in the streams above Paulina Marsh (Greenspan 1990:211). Speckled dace does, however, occur in some Late-Middle Holocene samples from the Big M site.

Trout vertebrae are prevalent at the Big M, Locality III, DJ Ranch, and Zane Church sites (Greenspan 1985:186). In each case, however, there is the likelihood that these darkly stained bones represent fish naturally deposited prior to human occupation (Greenspan 1994). Fossil horse and camel bones were recovered from the contact zone between cultural deposits and the Pleistocene lakebed in the excavations at the Big M site. The relatively large trout vertebrae recovered at the Zane Church, Locality III, DJ Ranch, and Big M sites are stained in a manner similar to these fossils, suggesting that they too may be fossil remains unassociated with the human occupations of these sites. Final resolution of this taphonomic problem must await further research developments, although some data are already becoming available on the topic (Greenspan 1994).

Egg shells, recovered in soil flotation samples, suggest the springtime collection of bird eggs near many wetlands sites in the Fort Rock Basin (Jenkins 1994a). Fowler (1990:19,1992) identified at least 36 species of marsh waterfowl exploited for meat and eggs by the Northern Paiute in Stillwater Marsh. Eggs undoubtedly were important to the aboriginal diet, particularly around the lakes and marshes, and have been recovered from stone house rings in the Boulder Village Uplands as well (Stenholm 1994).

Virtually all of the ethnohistoric groups of the Northern Great Basin and surrounding regions, including the Northern Paiute, Klamath, and Modoc, located their villages near springs, marshes, and rivers so as to have easy access to potable water and the resources found in and around it (Couture et al. 1986; Fowler and Liljeblad 1986; Barrett 1910; Spier 1930). For instance, cattails, bulrush seeds, fish,
waterfowl, and eggs made up large portions of the Northern Paiute diet as well as those of the archaeological Lovelock Culture in Nevada (Fowler 1990, 1992).

The location of hamlets in ecotone settings of the Fort Rock Basin at particularly rich resource locations--on the edges of lakes and marshes--was most likely a form of insurance designed to provide easy access to a broad range of subsistence items during times of the year when food was difficult to come by (Jenkins 1994a; Aikens and Greenspan 1988). It also provided direct and short travel routes to cached resources (e.g. roots) in the uplands nearby(Cannon et al. 1990). This is not meant to imply that villages were always located in ecotone settings, but rather that these kinds of locations afforded their occupants additional advantages and thus may have been more frequently sought out.

Climatic Fluctuation, Biotic Productivity, and Human Response

The foregoing rather idyllic portrayal of the Northern Great Basin environment under the effects of a warm, moist winter/spring precipitation regime makes it sound as if food was abundant and life was easy for the native people of the region. Indeed, the archaeological evidence suggests that at times it was so (Droz and Jenkins 1999; Jenkins 1999, 1994a). It must be remembered, however, that even during generally favorable periods, Great Basin climate varies markedly from year to year and decade to decade. Short, sharp climatic fluctuations often tested the ability of aboriginal populations to find adequate subsistence resources under less than optimal conditions (Mehringer 1977, 1986).

In contrast to the picture sketched above, a dry winter (e.g. occurred in the late 1980s and early 1990s), which is typically followed by a dry spring and summer, has extremely deleterious effects on the plant and animal populations that were the food of aboriginal Northern Great Basin peoples. Dry winters contribute little to the snow pack in the upper elevations and are frequently unusually cold. Stream flow to the wetlands at the foot of the mountains diminishes, and the broad shallow lowland expanses of water begin to shrink, ultimately drying up completely in cases of extended drought. The hardy tui chubs and suckers of the desert waters reach their respective levels of tolerance for salt and sediment-laden water and begin to die off. Grasses and weeds surrounding the lowland lakes and marshes may temporarily do well on previously flooded mud flats, but after the first year of drought, begin an annual pattern of developing a meager crop of seeds which ripen early and quickly drop to the ground. The animals which depend on these plants and their seeds soon scatter further and further from the desiccated shores of the former wetlands, and, in their turn, experience reduced reproductive success. Grass stands in the sandy portions of the basins become thin, stunted, and produce little seed. In the uplands, roots and bulbs can persist under quite dry conditions, but they become fewer, and short flowering seasons caused by drought and cold make them harder to find. Chokecherries, serviceberries, and Great Basin rye all produce stunted crops under excessively dry conditions. In general, biotic productivity within the entire region is reduced, and the human food supply correspondingly diminished.

Native peoples' survival in the Northern Great Basin depended critically on their ability to routinely bridge such recurrent hard times. Typical responses to diminished resources probably included diversifying diets to include "starvation" foods not normally eaten, and exploiting parts of their extended range not normally visited. For brief intervals, disadvantaged groups could also share in the resources and food stores of friends and relatives who might live in areas more productive than their own. As long as good times alternated sufficiently often with the hard times, a relatively stable pattern of life could be maintained. In the longer run, however, if a series of bad years became a decades or centuries-long downturn in the productivity of their environment, people might either be forced into some combination of out-migration and thinning of their numbers to match local carrying capacities, or they might be obliged to develop a substantially different approach to the possibilities inherent in their natural surroundings. Either way, new patterns would be created. We believe that across the Holocene history of human occupation in the Fort Rock Basin, both things happened at different points in time.

Mobility, Food Storage, and Settlement

Settlement-subsistence patterns represent responses of human populations to subsistence resource variability in distribution and productivity within a region, e.g. the Northern Great Basin or sub-region like the Fort Rock Basin. There are at least two primary ingredients which affect the formation and variability of any settlement-subsistence pattern: environment and culture. Either of these variables can change through time, causing serious imbalances between the two. Imbalances between subsistence resource availability and human population densities, frequently caused by short and long term climatic changes, for instance, can cause stress on settlement-subsistence patterns. Short-term results may be a dispersal of local populations to distant resource localities, agglomeration of populations around a few relatively dense resources, and/or the intensification of lower ranked resource procurement strategies with their accompanying increased processing costs (cf. Oetting 1989:243-274 for an extensive review of human responses to decreased subsistence resources in the Great Basin, as proposed by various researchers).

Long-term effects are more difficult to predict. An evolutionary perspective on settlement-subsistence change through time, may be useful in terms of understanding the selective advantages accrued by more successfully adapting populations. Employing this perspective we can attempt to address questions like why did Late-Middle Holocene populations shift toward greater sedentism? And, why did Late Holocene populations shift their subsistence focus from small seeds to geophytic root crops? These questions are designed to elucidate known shifts in subsistence resource importance, the development of processing and storage technologies, and the seasonal availability of resources and place them within a regionally applicable framework.

As already noted, subsistence resources are not evenly distributed either spatially or temporally across the Great Basin landscape. The preceding discussion has suggested that when concentrated food resources were available under favorable climatic conditions they could be found in the uplands in the form of roots and bulbs during early spring and summer, and throughout much of the summer and fall in the lowlands in the form of fish, waterfowl, small game, grass seed, and the like. The human response to this situation, as known from the ethnographic record, was to coalesce for short periods at particularly rich resource locations, exploit the available resource intensively, prepare and store it against impending winter scarcity, then disperse to forage in smaller groups until the next concentrated resource was ready for harvest.

The necessity which drove this mobile subsistence system was the need to store sufficient food to get through a period of roughly two and a half to three months of cold winter and early spring when fresh food was extremely scarce. If the occupants of a region could not set aside sufficient food to get through this period, starvation would follow. Consequently, we believe foods were targeted for their relative productivity, dependability, storability, and/or seasonality. The end of the harvesting year found local populations moving into sheltered winter villages situated in proximity to cached food supplies, fresh water, and firewood. Placing winter villages along the ecotones between upland resource zones and low-elevation wetlands was a form of insurance that allowed easy access to stored foods in both areas, while providing access to fresh foods (e.g. cattails, fish, waterfowl, mammals) available in the wetlands throughout the winter (Aikens and Greenspan 1988).

The "fusion-fission" settlement-subsistence systems described for the Central Great Basin (Steward 1938; Thomas 1983:32), must have also operated in some form throughout most if not all of Northern Great Basin prehistory. Much of this research design is about the investigation of settlement-subsistence system adjustments to changing climatic conditions and environments of the Northern Great Basin. It reports on ways in which people moved about, conducted their various activities, and utilized appropriate technologies and facilities to take advantage of nature's abundances and insulate themselves from its cyclical harshness. It is clear from this research that although the basic components of settlement-subsistence systems--that is, the harvesting and processing activities themselves--actually changed little, the relative emphasis placed on various components of the systems varied substantially through time.

It is important to recognize that the evolution of cultural systems in the Northern Great Basin was neither unicausal nor unilineal. Trends toward greater cultural stability and complexity, supported by relatively stable subsistence bases and efficient exploitative systems, could be, and apparently were, followed by periods of reduced cultural stability and fragmentation. The natural environment established the basic parameters within which cultural systems were formed and reformed. Human geography and demographics, cultural contacts, technological innovations, and changing cultural perceptions all played a part in the drama that we recognize as human prehistory in the Northern Great Basin.

5 Cultural Sequence in the Northern Great Basin: The View From Fort Rock

The discussion of time is of primary interest to archaeologists. Any method that will chronologically order data is quickly employed. The use of radiocarbon dating to establish the age of cultural and natural materials, as an aid to the development of regional culture-histories, is undoubtedly the single most important method of dating employed since the 1950s. The use of dendro-calibrated calender years is rapidly becoming the norm in the field of archaeology and related sciences as the number of dating techniques increases and notions about the importance of relative dating accuracy change (Moratto 1995; Bartlein et al. 1995).

Perhaps of most immediate importance to on-going research in the Northern Great Basin, in this regard, is the regular application and interpretation of obsidian hydration (OH) dates (cf. Pettigrew and Hodges 1995, for instance). OH is the process of molecular water adsorption by freshly exposed obsidian surfaces. The predominance of obsidian and its use in the production of stone tools in the Northern Great Basin makes this dating technique widely applicable throughout the region. OH dating depends in large measure on the comparison of associated radiocarbon ages with OH rind measurements. To be as accurate as possible, this process requires the use of calibrated calendrical radiocarbon dates, which tend to be more linear than uncalibrated radiocarbon dates. Uncalibrated radiocarbon dates may reflect significant 'clustering' due to non temporal causes, e.g. fluctuating solar activity, variance in atmospheric insulation, and the post-industrial 'bomb' effect. Thus, any investigation involving radiocarbon determined ages should begin with the calibration of dates, since there is often considerable variance between calibrated dates and uncalibrated dates (Bartlein et al. 1995).

Recent developments in more precise measurement of the C-14 half-life, and calibrating fluctuations in the long-term atmospheric C-14 curve through dating ancient tree-ring samples, have significantly improved the accuracy and precision of radiocarbon dating. These developments allow C-14 dates to be calculated in actual years before the present. In this document, dates previously expressed in radiocarbon years are now expressed in true calendar years, based on the dendro-calibration program of Stuiver and Reimer (1993). Readers will observe, therefore, somewhat different ages for known events than those commonly seen in older literature. For example, the age of Mount Mazama eruption, previously placed about 6850 radiocarbon years before present (RCYBP), is now calculated at about 7600 calendar years ago (BP). The age of the famed Fort Rock Sandals, previously placed at about 9000 RCYBP, is now recalculated at 10,000 BP.

Unpublished radiocarbon dates, sample numbers, the material dated (to species level, if known, for charcoal), sample weights or volume, and corresponding calibrated ages will be introduced in texts and tables of NGBPP documents, theses, and dissertations. All later citation of ages will represent the mean dendrocalibrated age(s) of the radiocarbon dated sample(s). *Such is already the case with the culture-historical periods defined throughout this document*.

Having defined how we will deal with time, we present below our current view of the cultural sequence of this region, based on the archaeological, ethnographic, and biological information available. The proffered statements are hypotheses subject to change as continuing study reveals more about the subject.

Definition of Chronological Periods in the Northern Great Basin

Throughout this research design we use the geologic term "Holocene" and divide it into four culturally meaningful sections: Early Holocene (12,000 to 7600 BP), Early-Middle Holocene (7600 to 5600 BP), Late-Middle Holocene (5600 to 3000 BP), and Late Holocene (3000 BP to historic contact). Each of these periods reflects some type of natural and/or cultural change in the Fort Rock Basin. We want to investigate its possible replication in some form in the other 'wet' basins of Oregon. The **Early Holocene** ranges from the end of the Late Pleistocene to the eruption of Mt. Mazama. The **Early-Middle Holocene** spans most of the warm-dry Middle Holocene climatic period, previously referred to as the Altithermal (Antevs 1948, 1955).

We define the **Late-Middle Holocene** period here as *the co-occurrence of climatically triggered environmental conditions, i.e. very extensive and stable marshes surrounded by biotically rich wetlands/grasslands ecotones, with cultural developments involving increased human populations, sedentism, and resource intensification in the Fort Rock Basin and its surrounding hinterland* (Jenkins 1999; Droz and Jenkins 1999). We recognize that the dates attributed to the Late-Middle Holocene as defined here may not precisely match pluvial events attributed to the so-called 'Neopluvial' in other sub-regions of the Great Basin because of widely diverging storm-tracks and extremely variant environmental settings across the vast area of the Great Basin (Mehringer 1985; Grayson 1993). We also recognize that within this period there were undoubtedly shorter periods of sharp climatic fluctuations which had dramatic effects on regional populations.

It will remain for further paleoclimatic, geomorphic, and archaeological investigations to verify the veracity of applying the Late-Middle Holocene period concept to other 'wet' basins of the Northern Great Basin. There is some reason at this stage, however, to believe that it may be fairly widely applicable in Oregon, at least.

At Diamond Pond in the Harney Basin 200 km. east of the Fort Rock Basin pollen studies indicate that the end of the Middle Holocene warm dry phase began about 6200 BP [5400 RCYBP] (Wigand 1987). Gradually improving (wetter/cooler) environmental conditions, characterized by expanding sagebrush and grass and reduced juniper (suggesting extremely cold winters?) continued after that point, with significant improvements in local range conditions occurring around Diamond Pond by ca. 5700 BP. Exceptionally high-water occurred beginning ca. 4000 BP and continued until about 3000 BP. Generally moist conditions for this period were terminated by a brief (50 years?) but severe drought about 2900 BP. Generally moist conditions returned to Diamond Pond after this drought and persisted until ca. 1900 BP (Wigand 1987:453).

At Nightfire Island, in the Lower Klamath Basin southwest of the Fort Rock Basin, occupants built an artificial island of basalt and earth for their pithouse village at about 5600 BP. Pithouses were abandoned there about 3100 BP and were replaced by more ephemeral above ground structures. Sampson suggests that this period may have been characterized by reduced marshes, reduced sedentism, and increased residential mobility (Sampson 1985:511-513).

In the Fort Rock Basin, the widespread occurrence of a dark humic soil in the Silver Lake-Fort Rock channel system suggests that water stood in lakes and channels of the Fort Rock Valley for perhaps centuries about 6200 BP (Aikens and Jenkins 1994b:12); the same time that hydrologic conditions began ameliorating in Diamond Pond (Wigand 1987:453). Dated cultural deposits from this period include a date of ca. 6200 BP on dispersed charcoal at Locality I (Mehringer and Cannon 1994) and a second date of ca. 6200 BP on a hearth/processing floor at the Bowling Dune site (Jenkins n.d.a). No definite house floors or storage pits have been dated to this period. It is not until about 5600 BP that house floors and storage pits made their regular appearance in the Fort Rock Basin, signaling greater relative sedentism and possibly increasing human populations

This increased sedentism was supported by intensification in marsh/grassland ecotone resources, e.g. small seeds, small mammals, and fish (Aikens and Jenkins 1994b; Jenkins 1999). In the marshes of the Fort Rock Basin, house floors and storage pits apparently fell out of use by about 2900 BP, suggesting that a shift to more transient occupations of the marshes had occurred. This may have initially been a response to reduced reliability of marsh resources brought on by drought (Wigand 1987); but the reason sedentism within the Fort Rock marsh was not reestablished at previous levels after the drought may well have more to do with long-term regional responses in the **Late Holocene** to demographic conditions (high populations) and increasing dependence (intensification) on geophytic root crops available in the uplands (Jenkins 1994b:614). The Late Holocene thus spans the last 3000 years of rapidly changing climatic, environmental, and cultural conditions.

Comparative Summary of Early Holocene and Middle Holocene Sites and Assemblages of the Northern Great Basin

So far there are no documented sites of the Clovis Paleo-Indian period in the Fort Rock Basin, though individual collector finds of Fluted points have recently been reported (Wingard 1999). Bedwell (1970) believed he had found a fluted point in the lowest deposits of Fort Rock Cave, but later analysis of this artifact from the perspective of lithic technology showed that it was basically similar to the stemmed point forms common in the early assemblages of this region, and probably not a true Clovis point (Fagan and Sage 1974). A well-defined Clovis occupation is attested at the Dietz Site, some 40 miles to the east in the adjacent Alkali Basin, so it is clear that these Paleo-Indian peoples were in the immediate vicinity, though how their lives may have varied from those of Early Holocene people is not well known (Pinson 1999, 1998, 1996; Fagan 1988; Willig 1988). The best evidence for early human occupations date to about 12,000 BP and that is where we will place the beginning of the Early Holocene.

The Early Holocene archaeology of the region is best known from the earlier works of Luther S. Cressman (1942), who excavated in Fort Rock Cave in 1938, Stephen F. Bedwell (1970) who excavated a series of caves in the Fort Rock Basin in 1966 and 1967, and the Sundance Archaeological Research Fund data base (Moore 1999; Nials 1999; Pinson 1999) which focuses exclusively on the Late Pleistocene-Early Holocene transition to roughly 6500 BP (Fowler 1996). The recent development of the Fort Rock Basin Prehistory Project (FRBPP) data base--an extensive multi-dimensional data base covering the entire Holocene and derived from open-air sites in the Fort Rock region (Aikens and Jenkins 1994a)--combined with advances in archaeological method and theory since 1970 (cf. Bettinger 1991), provide new perspectives from which we may address and refine questions pertaining to cultural processes and changes which occurred throughout the Northern Great Basin, beginning with the Early Holocene period.

The FRBPP is rich with Middle and Late Holocene data. Consequently, here we focus on the questions, what differences existed between cultures of the Early and Middle Holocene periods in the Fort Rock Basin? and what were the probable causes of these variances?, hoping to sharpen our understanding of Early Holocene assemblages by comparing them with much better defined Middle Holocene assemblages. The general correspondence of much of the target period with the Warm-Dry Middle Holocene climatic phase, previously termed the Altithermal, suggests that there should have been cultural responses to environmental effects triggered by locally changing climates. Evidence for some portion of this period of limited effective moisture, beginning about 8000 RCYBP and continuing until sometime around 4500 RCYBP in many locations, has been reported by numerous researchers throughout the Great Basin (cf. Mehringer 1986, Wigand 1987) and by Bedwell (1970) and Grayson (1979) within the Fort Rock Basin proper.

A relevant consideration in thinking about this period of *generally decreased* biotic productivity is the observation that variance in subsistence resource base quantity, quality, and reliability are frequently recognized as important factors involved in major cultural changes throughout the world. Common cultural responses to reduced local biotic productivity, for instance, include increased mobility and population dispersion (cf. Steward 1938 for Great Basin examples). These are changes which correlate well with archaeological assemblages exhibiting reduced artifact diversity, lower density distributions and artifact types designed for generalized multiple-use functions. Simply put, the proposition can made and submitted for testing in the region that,

> "If climatic desiccation was a factor in settlement-subsistence changes involving a shift to increasing mobility in the Fort Rock Basin during the Early-Middle Holocene transitional period between 7600 and 5600 BP then artifact assemblages should generally exhibit little diversity, low density distributions, and generalized multiple-use tools rather than specialized single-use tools. We might also expect a reduction in numbers of sites dating to this period (Jenkins 1999)".

A subsequent shift to moister 'Neopluvial' climatic patterns during the Late-Middle Holocene (5600 to 3000 BP), appears to have generally set the stage for major changes in human demography and corresponding settlement-subsistence shifts in the Fort Rock region. Environmental conditions were generally good for increasing human populations, both through natural biologic increase and through related intra/inter-regional population movements. But was population growth *necessarily* the local cultural response to increasing biotic productivity? Certainly, there is no evidence that human demography automatically shifted toward greater 'packing' during the Early Holocene in response to improving environmental conditions (cf. Beck and Jones 1997). Thus, we should not automatically assume that Middle Holocene populations would move toward greater degrees of 'packing' and its corresponding increases in sedentism and resource intensification, unless there is sufficient evidence that this was the case. Our second hypothesis then is,

> "If settlement-subsistence patterns shifted toward greater sedentism and more densely packed human populations, then we would expect evidence that should include houses, storage facilities and artifact assemblages which are both more numerous and more diverse (i.e. including more specialized artifacts) than Early Holocene and Early-Middle Holocene assemblages. Site numbers should also increase (Jenkins 1999)".

The reporting of UO investigations at the Locality III site (35LK3035), combined with a brief review of assemblages recovered from the Paulina Lake site (35DS34), the Connley Caves (35LK50), Cougar Mountain Cave, two sites at Buffalo Flat (35LK1881 and 35LK2076), and the Alkali Basin (Dietz Basin) sites will provide the data employed in demonstrating a first test of the expectations presented above for the Early Holocene and Early-Middle Holocene periods. Late-Middle Holocene expectations will be addressed by reference to data acquired from the Big M (35LK2737), DJ Ranch (35LK2758), Bowling Dune (35LK2736), GP-2 (35LK2778), Claim A1 (35LK3176), and Bergen (35LK3175) sites in the Fort Rock Basin.

Accumulation of the data base employed here in our comparative analysis spanned more than 60 years of investigations and roughly 12,000 years of prehistory. The most relevant data, accumulated in the FRBPP data base, required a long-term research commitment because it had to come through the investigation of multiple sites located in a single environmental setting; i.e. the Silver Lake/Fort Rock channel system of the western Fort Rock Basin. In such a situation, vital resources and distances to those resources remain constant, and variances observed between sites and site components of varying ages should be ascribable to changes or variations in culture, technology, biotic environment, or site settings.

Initial FRBPP assessment of the research potential at the extensively deflated Big M site (35LK2737) began in 1989 as a part of the BLM cultural resource management program, and excavations continued there through 1992 (Jenkins 1994a). The field school conducted surveys and excavations for the BLM on two mining claims located north of the Big M site in the dune fields of the Fort Rock Valley annually between 1992 and 1997. These investigations included extensive excavations at the DJ Ranch and GP-2 sites and the excavation of the Bowling Dune site located two kilometers north of DJ Ranch (Jenkins n. d.a, n. d.b; Jenkins et al. 1994; Moessner 1995). These sites produced radiocarbon dates and cultural assemblages ranging in age from 5600 to 2900 BP (i.e. Late-Middle Holocene). Patterns observed in the cultural assemblages at these sites will be contrasted at the end of this section with those of the Early Holocene and Early-Middle Holocene sites.

Peter J. Mehringer and William J. Cannon (1994:310-313) excavated a backhoe trench and two one meter by one meter test units at the east end of the Locality III site in 1983. They recovered culturally associated Early and Early-Middle Holocene radiocarbon dates of 7280 RCYBP and 9400 RCYBP through these limited excavations. The 9400 RCYBP date was taken on charcoal recovered from a well-defined "fire hearth [which] held Tui chub bones and an abundance of charcoal" (Mehringer and Cannon 1994:310). The 7280 RCYBP date was taken from dispersed charcoal encountered stratigraphically above the hearth. These limited tests suggested that the site had the potential to address questions important to our understanding of Early Holocene occupations among the lunette dunes of the Fort Rock Valley. Consequently, we chose to begin our Early Holocene to Early-Middle Holocene research at this site in 1995. Ultimately, radiocarbon dates spanning most of the Early Holocene and Early-Middle Holocene were obtained from this site.

Locality III (35LK3035)

Excavations at Locality III (35LK3035), a site located in a large lunette dune on the north shore of Lunette Lake in the Fort Rock Valley subbasin, sampled Early Holocene to Late-Middle Holocene cultural deposits in three separate loci: East, Central, and West. Re-excavation of the Mehringer/Cannon Trench in the East Locus provided correspondence in strata between UO field school investigations and those of Mehringer and Cannon (1994:310). Field school manual excavations along this trench failed to recover Early Holocene cultural materials reliably associated with the 10,370 BP occupation initially

sampled and radiocarbon dated by Mehringer and Cannon (1994:310; Appendix A) but recovered a substantial quantity of cultural material from the succeeding period of occupation (8600 to 7000 BP).

Field school excavations covered a total area of 124.25 m^2 and removed 133.6 m^3 of sediments. In general, the Locality III excavations produced relatively simple tool assemblages from three cultural components. Component 1 deposits, situated just above the silcrete bench on which the site formed, produced dendrocalibrated radiocarbon ages ranging from 11,890 BP to 9240 BP. Though no projectile points were recovered from reliable Component 1 contexts, one Western Stemmed point base was recovered near the deflated surface (0 to 10 cm) of the site at the base of the dune in the West Block. Faunal remains included only sparse quantities of small mammal and possibly waterfowl. Waterfowl egg-shells were present, but may not have been culturally introduced. Fish bones were recovered but probably are not culturally associated, either. Bulrush seeds were recovered from a 12,000 year old charcoal lens at the bottom of the cultural deposits, indicating the marshy nature of the Lunette Lake shoreline at that time and the possibility of the exploitation of this resource at this early date. Charred lomatium(?) and fruity tissues were recovered from a 10,000 year old charcoal lens in Cultural Component 1, suggesting the processing and transport of upland spring root plants and late summer fruits to lowland sites. Sagebrush, chenopodium, and possible juniper were other plant remains recovered from this component.

Component 2 dendrocalibration radiocarbon ages range from 7000 to 8580 BP, spanning both sides of the climactic eruption of Mt. Mazama some 7600 years ago. Most of these deposits produced relatively few artifacts and, concomitantly, simple (non-diverse) cultural assemblages. The most common chronologically diagnostic artifact type recovered was the Foliate point (33 specimens). Other point types include Northern Side-notched (three specimens), Elko (eight specimens), and Gatecliff Split-stem (five specimens). *Olivella* shell beads were found thinly scattered throughout the deposits and one was radiocarbon dated to 9240 BP. Bone beads were recovered only from the upper 40 cm of deposits in the West Block, and these may be Late-Middle Holocene rather than Early-Middle Holocene. Ground stone is commonly present. Paleobotanical remains include sagebrush, knotweed, waada, chenopodium, and possible lomatium (biscuit-root). Pollen and starch granules recovered from the surface of a metate suggest the processing of grass seeds and possibly camas root. Faunal remains generally include sparse quantities of small mammals, primarily rabbits, and waterfowl. Artiodactyl and canine bones are occasionally represented as well. Increased quantities and diversity of species occurs in the West Block, but this may be at least partially due to mixing with cultural debris left by later occupations (Late-Middle Holocene).

Component 3 has not been radiocarbon dated but has been dated by obsidian hydration to the Late-Middle Holocene. Projectile points include Northern Side-notched, Elko, and Gatecliff Split-stem. One small disk bead was recovered from sediments high in coarse Mazama pumice, and bone beads were recovered from the West Block in possibly intrusive deposits mixed with Component 2 cultural materials. Storage pits are relatively common, suggesting intensive collection and processing of abundant resources, at nearly all Middle Holocene sites of the Fort Rock Basin. What is different about this Late-Middle Holocene component at Locality III is the lack of fish bones, fishing equipment, and bone artifacts, all common attributes of most Late-Middle Holocene sites of the Fort Rock Basin.

In sum, artifact and faunal assemblage diversity at Locality III was generally low throughout all but possibly the latest occupation period (Late-Middle Holocene). Relatively few formed tools were recovered from Early Holocene and Early-Middle Holocene contexts in the East Locus. Conversely, the Early-Middle Holocene sediments of the West Block were relatively rich in cultural materials. These assemblages were also slightly more diverse than normal for this site, but this may be due simply to the increase in assemblage sizes.

The palimpsest nature of the West Block deposit, however, means that it is impossible to establish the presence of a house floor, and the "living floor" appears to be the product of an undetermined number of occupations spanning several thousand years. This does not preclude, of course, the possibility that a large proportion of the artifacts found on this floor may have been deposited during a single occupational episode. It simply means that we are currently unable to reliably separate them from superimposed artifact clusters.

The similarity of artifact and faunal assemblages of the various cultural components suggests that though the occupation of the West Block was more intensive, and probably somewhat more long-term, activities remained basically the same during all occupations. Projectile points, primarily Foliate (Cascade) types, are common as are relatively large oval to bipointed bifaces, utilized flakes, and ground stone fragments (mano and metate). Dark, charcoal stained soils include moderate quantities of tiny, charred, small mammal and waterfowl bone fragments (O' Grady n.d.; Singer n.d.). Faunal assemblages are comprised predominantly of rabbit and waterfowl, with an occasional canine or artiodactyl bone also appearing. Waterfowl egg-shell is common, and with unfused rabbit long-bones, suggests spring-time occupations. Conspicuously, most cultural deposits contain relatively little flaked stone debitage, suggesting that the Locality III occupations primarily reflect food processing activities (small animals and/or seeds) and brief periods of occupation, rather than retooling and refitting. The site thus appears to have been repeatedly occupied as a short-term campsite or base camp facilitating the exploitation of local marsh and grassland resources. Only during the Late-Middle Holocene did the nature of this exploitation pattern change to include more intensive exploitation of resources, requiring the construction of large storage pits.

Though the Locality III site was located on the edge of a small lake in the SL/FR channel system, the data collected at the site provide little evidence of a specialized, marsh oriented subsistence focus. Instead, they suggest a generalized foraging pattern involving the opportunistic exploitation of both lacustrine and terrestrial resources in a biotically rich wetland-grassland ecotone. These data, by themselves, however, are insufficient to address Early and Early-Middle Holocene settlement-subsistence issues because one site rarely offers a definitive solution to such a complex problem, since site location is fixed while settlement-subsistence patterns among hunter-gatherers generally involve population mobility and exploitation of a variety of environments. Consequently, data from other sites in the Fort Rock region must be reviewed with these issues in mind.

Fort Rock Basin Cave Sites: the Connley Caves, Fort Rock Cave, Cougar Mountain Cave

No discussion of Early Holocene occupation sites in the Northern Great Basin would be complete without a consideration of the cultural assemblages recovered by Bedwell (1970) and others (Cowles 1960) from the Fort Rock Basin cave sites. As mentioned above, Bedwell conducted excavations at the Connley Caves, Fort Rock Cave, and Cougar Mountain Cave #2. The interiors of these caves, in most cases, had been vandalized to some extent and Bedwell had to focus his excavations on the remaining portions of the cave deposits.

Connley Caves. The Connley Caves, six small rockshelter/caves located at the north end of Paulina Marsh, produced the deepest and oldest deposits, and it was from them that Bedwell compiled the most reliable record pertaining to Early Holocene occupations. Bedwell analyzed three basic cultural units from these caves: Unit 3 (Early Pre-Mazama Ash), with two phases, the first attributed an age from 14,000 to 11,000 RCYBP, the second dating from 11,000 to 8000 RCYBP; Unit 2 (Late Pre-Ash), the transitional phase between the WPLT and the Altithermal, dated from 8000 to 7000 RCYBP; and Unit 1 (Post-Altithermal) 4750 to 3000 RCYBP. Cultural materials in Phase 1 of Unit 3 were relatively sparse, predominantly hunting tools with a few abraders or manos and both large and small faunal remains. Bedwell thought these materials were deposited by very small populations of highly mobile hunters and gatherers living in a more forested environment.

It was in Phase 2 of Unit 3 (WPLT times), between 11,000 and 8000 RCYBP, that Bedwell encountered the richest cultural assemblage below the Mazama ash. Artifacts included Windust, Western Stemmed, and Foliate projectile points, bifaces, many scrapers, gravers, cobble stone tools, choppers, abraders, manos, and bone awls. Though the tool assemblage generally reflects high mobility and therefore no extreme diversity in forms, the relatively large numbers of specimens and their clear associations with increased quantities and diversity of faunal remains, primarily of rabbit, sage grouse and waterfowl, and associated large herbivores (bison, elk, deer, antelope, and mountain sheep), suggested the intensive exploitation of marshes surrounded by grasslands (Bedwell 1970).

Grayson (1979:446), noting normal sage grouse sex ratios (i.e. of non-breeding, dispersed populations) and a general lack of immature birds in these early assemblages, suggests that the data might best fit a late fall to late spring predation pattern. Connolly (1995:16) notes that the increased use of grouse and waterfowl in the 9500 to 7200 RCYBP period is primarily at the expense of lagomorphs. Bedwell (1970:191), in a footnote, suggests that the dramatic increase in scraper types and numbers in these early WPLT assemblages may well indicate both the increased processing of hides and more intensive winter occupation of the caves.

Paulina Marsh sustains resident and migratory populations of waterfowl throughout the winter, providing a source of readily available fresh food. Lagomorphs, on the other hand, are more susceptible to depletion of numbers during the late winter and early spring; which could occur in response to reduced mobility of human populations and continuous exploitation of *local* rabbit populations. In sum, considering both faunal and artifact assemblages, the Connley Caves appear to be good candidates as winter-time residential bases, particularly during the 9500 to 8000 RCYBP period. Before (11,000 to 9500 RCYBP) and after (8000 to 7000 RCYBP) that period, they do not appear to have been used as such a semi-permanent base, at least until the Late Middle-Holocene when they again appear to have been occupied in a more intensive, semi-sedentary fashion.

Fort Rock Cave. As mentioned at the beginning of this paper, Fort Rock Cave was initially excavated by Luther Cressman who directed UO field school excavations there in 1938 (Cressman 1942). Early pre-Mazama components at the site produced a large quantity of sagebrush sandals and a variety of other perishable items, along with a limited lithic assemblage typologically very similar to those later recovered by Bedwell's excavations in the 1960s. Projectile points included Western Stemmed varieties, Foliate, Lanceolate, Windust, and a mixture of possibly later forms. The remainder of the assemblage included the usual bifaces, abraders, scrapers, gravers, choppers, a crescent, a mortar, manos, awls, drills, fire drill, sandals and basketry. Some of the sandals were muddy, and with the relative size and complexity of the assemblage may suggest somewhat greater occupation length during periods of inclement (fall through spring?) weather. The recovered faunal assemblage is small. Its size and low relative diversity seem to imply exploitation of the fairly homogeneous valley floor environment surrounding the cave, e.g. rabbits, rodents, deer, antelope, and a few birds. This environmental homogeneity may have made the cave somewhat less attractive as a wintering location than the Connley Caves, though this reasoning must be approached cautiously since the environment may have included forests and marshes much closer than prevail near the site today.

Cougar Mountain Cave. Cougar Mountain is a small volcanic dome located roughly 19 km east of Fort Rock on the north side of the basin. Cougar Mountain Cave, situated at an elevation of about 1334 m (4446 ft.), was excavated to bedrock in 1958 by John Cowles, an avid artifact collector, who reportedly kept track of approximate artifact proveniences by one foot levels (Cowles 1960). The cave was filled to a depth of two meters (6.5 ft.) with rich cultural deposits.

Cowles reported the exclusive recovery of Lanceolate, Foliate, Western Stemmed, and Windust points and one crescent in the lowest two feet (60 cm) of deposits. Bison bones, dated no later than 8000 RCYBP at the Connley Caves, also occurred only in the lower two feet of deposits at Cougar Mountain Cave. Other artifacts included well-made ovate knives, scrapers, abraders and manos, stone drills, pipes, bone awls, bone atlatl spurs, bone needles, pressure flakers, bone beads, shell beads, basketry, twine, matting, leather, and wooden artifacts. Sandals, which were fairly common, were frequently muddy. This rich assemblage, including artifacts generally found more commonly in later assemblages (e.g. pipes, pressure flakers, and bone beads), undoubtedly contains materials stratigraphically out of context. Still, the diversity of this assemblage is quite a bit greater than that of the Connley Caves.

The dry condition of the cave interior at Cougar Mountain Cave clearly plays a major part in the variance in assemblage diversity between it and the Connley Caves. The interiors of the Connley

Caves had been vandalized prior to Bedwell's excavations, and he was generally forced to excavate in less desirable areas where perishables were generally absent. Removing perishables and artifact classes believed to be out of context from a comparison of the relative assemblage diversities, leaves the Cougar Mountain Cave assemblage very similar to those of the Connley Caves and much of this remaining difference may be attributable to uncommon artifact classes which normally could be expected to occur only in very large assemblages. All indications are that the Cougar Mountain Cave was a residential base which functioned in a very similar fashion to the Connley Caves.

Buffalo Flat

An intensive study, involving several phases of survey and excavation, was conducted during the 1980s on Buffalo Flat at the east end of the Christmas Valley subbasin of the Fort Rock Basin (Oetting 1994). Four of the 77 sites, recorded by the survey and later sampled through subsurface investigations, contained buried cultural remains ranging in age from 8000 to 10,000 RCYBP. Two of these sites produced discrete, datable cultural features. Features at 35LK1881 and 35LK2076 were predominantly small (< 50 cm) to very large (250 cm x 300 cm) pits filled with charcoal, rabbit bone, and sparse lithic assemblages.

35LK1881. Excavations at 35LK1881 investigated a large pit, roughly 250 cm x 300 cm x 75 cm, filled with charcoal and rabbit bone, and the immediate area surrounding it. Charcoal from the feature produced radiocarbon ages of 8080 RCYBP, 8880 RCYBP, 8950 RCYBP, and 9120 RCYBP. Excavations covered a total area of 27 m^2, removed 20.5 m^3 of deposits and recovered 286 flakes from within the feature and a total of 356 flakes from all subsurface contexts. The mean recovery rate for both feature and nonfeature excavations equals about 17.4 flakes per cubic meter and even the much higher density within the feature of 263 flakes in 2.1 m^3 of deposits only produces a mean of 125.2 flakes per cubic meter. Lithic tools were extremely sparse, with a total of only 10 tools recovered from the pit and another 11 recovered from subsurface contexts nearby. The assemblage includes bifaces, a Western Stemmed projectile point base fragment, cores, utilized flakes, ground stone (mano and metate fragments), and grooved abraders, none in large quantities. Faunal remains, on the other hand, were found in large quantities.

A total of 14,168 bone fragments was recovered from the site, 10,153 from inside the feature and the remaining 4,015 from deposits surrounding it. Deposits within the feature produced a mean of 4,835 bone fragments per cubic meter while those surrounding the feature only produced 218 fragments per cubic meter. At least 98% of these bones are, or appear to be, those of rabbits. This assemblage is believed to be the byproduct of intensive rabbit processing. The conclusion is that this site represents a processing location formed by either a single massive rabbit drive or repeated use of the site for multiple smaller rabbit drives during the Early Holocene (Oetting 1993:673).

35LK2076. Excavations at 35LK2076 investigated one large and three small charcoal and rabbit bone features similar to the one found at 35LK1881. The main block excavation covered 22 m^2, removed 17.1 m^3, and recovered 172 flakes, 12 tools, and 2,909 bone fragments. Charcoal samples from features 4 and 6 produced radiocarbon ages of 8780 RCYBP, 8870 RCYBP, and 10,020 RCYBP. The mean recovery rate of lithic debitage and faunal remains for these excavations is 10 flakes and

170 bone fragments per cubic meter. Lithic tools include three Western Stemmed projectile points, bifaces, utilized flakes, a core, and a ground or pecked piece of pumice. Faunal identifications were once again heavily weighted toward rabbits and the conclusion is that this site also served as a processing location for rabbits following one or more rabbit drives (Oetting 1993:673). Grayson and Cannon (1999:150), on the other hand, caution that this faunal assemblage merely indicates that rabbits were abundant, and says nothing about the method of their capture.

The other 75 sites on Buffalo Flat exhibited strikingly similar cultural and faunal assemblages (predominantly Lepus sp.) to those of the Early Holocene sites. Whatever increases there were in quantities and diversity of cultural remains identified in these sites, which span the entire Holocene, can easily be accounted for as a byproduct of long-term repeated site use. There is no evidence of structures or storage, no shell beads, little bone industry (one specimen), and surprisingly little variation in lithic assemblages throughout the Early, Middle, and Late Holocene periods. The monotonic nature of the dry, shrub-covered Buffalo Flat, broken only by the occasional grass-covered dune or shallow playa basin, clearly predicated the limited nature of subsistence pursuits which could successfully be employed in this arid section of the Fort Rock Basin (Oetting 1993:674).

The importance of the settlement-subsistence pattern exhibited at the 35LK1881 and 35LK2076 sites to our discussion is in the clearly opportunistic fashion in which Early Holocene populations moved out onto Buffalo Flat to take advantage of concentrated resources (rabbits and small seeds). The simple tool assemblages at these sites, and the low lithic debitage densities, bespeak extremely short-term occupations. Preparation of large pits for the processing of rabbits is the only unusual aspect of this segment of what appears to have been a broad-spectrum, foraging strategy.

The Early Holocene cultural and faunal assemblages of the Locality III site are nearly identical to those of the Buffalo Flat sites. The few exceptions are the inclusion at Locality III of waterfowl and their eggs to the faunal assemblages, a broader macrobotanical assemblage, and the recovery of a few *Olivella* shell beads. The low density and diversity of all these assemblages suggests a subsistence mode of extreme mobility, even in the relatively rich, more biotically diverse environs of the marsh-grasslands ecotone at Locality III. Individual site occupations were extremely short-term, perhaps lasting only a few days at a time. Rabbits form the major portion of these assemblages. Fish seldom appear in cultural assemblages and only in minute quantities. There are no structures or storage facilities currently known, though it seems reasonable to postulate that large hearth features like those found at the Early Holocene sites on Buffalo Flat may exist in the Fort Rock Valley subbasin also.

Newberry Crater

Investigations at the Paulina Lake site (35DS34) in Newberry Crater National Monument, some 40 kilometers northwest of Fort Rock, identified three Early Holocene cultural components in a paleosol located below 50 cm of coarse Mazama tephra. Excavation of a 106 m^2 block resulted in the removal of approximately 70 m^3 of paleosol sediments. Radiocarbon dates (13) on charcoal recovered below the Mazama tephra range from 6540 RCYBP to 9920 RCYBP, producing mean dendrocalibration ages ranging from 7390 BP to 11,010 BP. These dates form three clusters correlating well with depth below the Mazama ash. Component 1, the initial occupation of the site, dates to about 11,000 BP and comprises the assemblage recovered 40 cm and more below the ash. Component 2 dates from roughly 8660 BP to 10,000 BP and includes all materials encountered from 15 to 40 cm below the Mazama ash. Component 3 dates from 7390 BP to 8340 BP and comprises the assemblage recovered from 0 to 15 cm below the ash (Connolly and Jenkins 1995).

Cultural materials in Component 1 were relatively thin and for most analytical purposes were joined with those of Component 2. Component 1 was dated by a single radiocarbon determination of 9920 RCYBP, with a dendrocalibrated mean of 11,010 BP. This sample came from charcoal recovered from within a pit one meter in diameter and 45 cm deep. Grass pollen and starch granules suggest that this pit may have been grass lined; other pollens included mock orange (*Philadelphus*) and willowweed (*Onagraceae*) (Connolly and Jenkins 1995:153). Near the pit, semi-circular spaces cleared of stones suggest the possible presence of small structures, though no additional evidence exists to support this tantalizing possibility. Projectile points in this component include two Windust and three Foliate points. The remainder of the sparse assemblage includes bifaces, expedient flake tools, and an end scraper.

Component 2 comprised the majority of cultural deposits from the site. The removal of a total of 57.1 m^3 of Component 1,2 deposits produced 393 artifacts (6.9/m^3) and 28,486 pieces of lithic debitage (499/m^3). Excavations clearly defined the circumference of a small wickiup or tepee-like structure with a well defined hearth located near the center. The structure was roughly five meters long, four meters wide, and did not have an excavated floor. It was surrounded by stout posts up to 20 cm in diameter. Radiocarbon determinations on three of these posts returned dates of 8460 RCYBP, 8540 RCYBP, and 8670 RCYBP suggesting a mean dendrocalibration date for the structure of 9500 BP. The hearth core was roughly 70 cm in diameter and 30 cm deep. It was surrounded by a shallow depression with a maximum diameter of roughly 115 cm, filled with dispersed charcoal. The hearth core produced a date of 9060 RCYBP while the dispersed charcoal in the depression surrounding it produced a date of 8880 RCYBP. Old wood may account for the difference in ages of these two samples and the younger of the two, which is more compatible with the dated structural age, is accepted. Macrobotanical and pollen analysis identified chokecherry (*Prunus* cf. *emarginata*), bulrush (*Scirpus* sp.), sedge (Cyperaceae family), a nutlet, possible edible tissue, hazelnut (*Coylus*), salmonberry or blackberry (*Rubus*), lomatium (*Apiaceae*), and a variety of herbs. Beside the usual projectile points (Windust and Foliate types, many with ground stems) and bifaces, the assemblage is distinguished by a rich cobblestone tool assemblage including ground, battered, striated and pecked abraders, hammerstones, mauls, girdled stones, a plummet stone, handstones and grinding slabs. Blood residue (rabbit, bison, bear, deer, and possibly mountain sheep) was detected on chipped stone tools (Connolly and Jenkins 1995).

Component 2 clearly represents a summer residential base camp at which a broad range of subsistence resources were processed. Though the site is located in a caldera well-known for obsidian quarrying activities, quarrying was conducted only as a secondary activity necessary to replacing of exhausted chipped stone tools and does not appear to have been the primary reason for occupation of the site. The environment appears to have been both biotically rich and diverse. The artifact assemblage is like-wise fairly rich and diverse. Bone has not generally been preserved at this site and debitage is not particularly dense in this component, though it is comparable to flake densities encountered in Late-Middle Holocene house site deposits in the Fort Rock Basin.

Component 3 comprises the upper 15 cm of the pre-Mazama deposits. The excavation of a total of 22.9 m^3 of deposit resulted in the recovery of 328 artifacts (14.3/m^3) and 22,588 pieces of lithic debitage (986/m^3). This represents a near two-fold increase in cultural materials per cubic meter over the earlier components of the site, though no cultural features were identified in this component. Samples of charcoal recovered from near the paleosol surface produced dates of 6540 RCYBP, 7080 RCYBP, and 7560 RCYBP, with dendrocalibrated mean ages of 7390 BP, 7900-7840 BP, and 8340 BP. Projectile points include both Windust and Foliate points with a decided shift to the predominance of Foliate points away from Windust and a dramatic reduction in the occurrence of stem grinding. Projectile points, point fragments, and unfinished points increase in number, as do the numbers of bifaces in general and ovate bifaces, in particular. Ground and pecked stone tools continue in the assemblage though in substantially reduced numbers. The suggested interpretation is that "the late pre-Mazama Component 3 occupants may have been more mobile hunters than the earlier Component 2 residents" (Connolly 1995:345).

Clearly, the large cultural assemblages of the Early Holocene components at the Paulina Lake site vary substantially from the tiny Early Holocene assemblages found in the open sites of the Fort Rock Basin. Projectile points, bifaces, abraders, and expedient flake tools are common in all of these assemblages, and actually appear to increase slightly in number during the latter portion of the period (8300 BP to 7300 BP). Ground and pecked stone artifacts occur in reduced numbers in the late pre-Mazama Component 3 at Paulina Lake and are present in small numbers in nearly all components of similar age in the Fort Rock Basin. Large game hunting clearly remains important at Paulina Lake, even though, and perhaps because of increasing environmental homogeneity and somewhat reduced biotic diversity of the area. In the open dunes of the Fort Rock Basin, projectile points, point fragments, and preforms comprise a major portion of the assemblage, even though the faunal remains recovered at these sites are predominantly rabbits and waterfowl which are most efficiently taken with nets. It seems entirely possible that projectile points in this case are serving as both points and cutting implements, as suggested by Beck and Jones (1997) for other Great Basin Early Holocene assemblages.

Alkali Basin Sites

Best known as the location of the Dietz Western Clovis site (35LK1529), the Alkali Basin has been the focus of periodic--and at times intense--archaeological investigation since it’s discovery by Dewey Dietz in 1982 (Fagan 1988, 1986; Pinson 1999, 1998, 1996; Willig 1988, 1989). Situated at the base of an east facing ridge located at the extreme northwest end of the Alkali Basin, the Dietz site is a large multi-component lithic scatter. The site--which covers a kilometer in length--incorporates a low-elevation Clovis component on the valley floor and a younger Western Stemmed component located slightly higher on the Dietz Hill slope (Willig 1988:427). The Tucker site (35LK1529) is another Western Stemmed site located in a lunette dune on the east side of the Dietz subbasin opposite the Dietz site. The results of geoarchaeological investigations by Willig (1989) and Pinson (1999) at these sites and other locations in the Alkali Basin have led to significant differences in paleoclimatic and paleoecological interpretations.

Dietz Site (35LK1529). Investigations at the Dietz site were initiated in the spring of 1983 by a volunteer crew of UO, Washington State University, and BLM archaeologists and graduate students.

Intensive mapping, surface collection, and subsurface testing was conducted at the site from 1984-1986 by the UO field school and a large contingent of volunteers. More than 60 fluted points and 52 otherwise diagnostic Clovis period artifacts have been recovered from the site along with at least 31 stemmed and shouldered points of the Western Stemmed Tradition and 17 Middle Holocene side and corner-notched projectile points (Elko, Northern Side-notched, Humboldt, and Pinto). Differential distribution of these points and associated artifact assemblages suggested that stratified subsurface deposits might be encountered at the interface between these components. Subsurface investigations, however, failed to discover significant cultural deposits, though flakes weathering from silica cemented sediments in backhoe trench walls suggested that buried cultural deposits of possible Clovis age could exist at the site. The primary contributions of the UO investigations at the Dietz Site are the point-plot collection and analysis of artifacts and the mapping, analysis, and reporting of stratigraphic sequences exposed in backhoe trenches (Willig 1989, 1988). Willig hypothesized the existence of four lake stands related to human occupations. Lake Koko a shallow lake and marsh dated to the Clovis occupation, the Sand Ridge Lake dated from early Western Stemmed times (10,000 to 9500 RCYBP), a shallower late Western Stemmed period Lake Delaine (8500 to 8000 RCYBP), and a deep though short-lived Lake Big Cut dating sometime between 6850 and 5000 BP.

Pinson reinitiated geoarchaeological excavations and mapping at this site in 1995 with the intension of testing Willig's "Four Lake Model" (Pinson 1996). She reexamined 12 skip trenches left open by the UO investigations, excavated another backhoe trench, manually excavated three test units (one 1x1 m, one 1x4 m, and one 4x4 m), and conducted further surface collections of artifacts in strips and blocks around the site. Pinson (1999:154) concludes,

> the stratigraphic sequence along Dietz Hill records two separate lake stands. The higher, earlier [Pleistocene] lake is represented by the Qb1 and Qbe1 deposits. The lake stood at or near 1322 m elevation and may have had a depth exceeding 6 m-10 m depending on how much sedimentation and erosion has since occurred across the basin. A second shallower, younger lake, represented by the Qb2 and Ql2 deposits, may represent either a recessional still stand of the older lake or the formation of a new lake following substantial lowering or desiccation of the Qb1 lake. This lake had a surface elevation of approximately 1318 m and may have had a depth of the order of 2 to 4 meters, placing it at the boundary between lake and pond in the classification system of Currey (1994b).

Radiocarbon dating and stratigraphic analysis at the Tucker site establishes the fact that this later dated lake was gone by 9610 RCYBP and replaced by a lunette-dune building wet meadow/playa system before 9540 RCYBP, the period of primary occupation at the Tucker site (Pinson 1999:171).

Tucker Site (35LK1529). UO investigations at the Tucker site involved the excavation of a 50 m backhoe trench and a 1m² test unit placed in the west flank of the site lunette. Charcoal, bone, and lithic debitage were observed eroding from the side of the exploratory trench and were recovered from depths of 120-130 cm below the surface in the initial test excavation. A single charcoal fleck was recovered near the west end of the trench at a depth of 166 cm below the surface. An accelerator date of 9610 ± 100 RCYBP (Willig 1989:217) was returned for this sample which was evidently recovered from stratum Qe3a as later defined by Pinson (1999). Bone recovered from the site is predominantly rabbit with some waterfowl. There is little if any artiodactyl bone directly associated with cultural deposits.

Pinson conducted much more extensive excavations at the Tucker site, ultimately excavating roughly 25 m^2 manually and locating four more backhoe trenches in the site. Radiocarbon dates of 9160, 9480, 9520, and 9540 RCYBP are reported by Pinson (1999:169) for the Tucker site Western Stemmed occupation of the lunette (stratum Qe3a) which formed on the edge of an ephemeral marsh, produced by alternating wet/dry conditions and aeolian processes. Thus, she favors the drying of the last shallow (ca. two meters deep) Early Holocene lake by 9600 RCYBP, followed by more xeric wet-meadow conditions. She finds no evidence to support Willig's Lake Big Cut, and instead interprets this "shoreline" as a Late Holocene aeolian blowout preserved by dune formation.

Willig (1988, 1989) questioned the efficacy of a predominantly large game hunting strategy in the Great Basin during the Western Clovis period and suggested the Clovis occupation at the Dietz site was related to a broad-spectrum foraging pattern not unlike that of later Archaic groups. She emphasized the fact that though Western Stemmed sites were generally found near streams, marshes, and lakes they did not represent a specialization in lacustrine resources as proposed by Bedwell (1970). Alternatively, she characterized the Western Stemmed adaptation to the Northern Great Basin as one that was "tethered" to mesic environments because they provided reliable resources during times of environmental stress (1989:276).

Pinson, on the other hand, believes the subsistence focus of the Western Stemmed period was on small mammals and waterfowl. This adaptation was related to "a risk-sensitive, variance-minimizing foraging strategy" which was a response to "tremendous ecological changes of the Initial Archaic" (1999:218). This strategy continued through the Early-Middle Holocene until about 5000 radiocarbon years ago when a return to more mesic conditions allowed the development of a relatively risk-indifferent foraging pattern including the pursuit of more large game.

Early Holocene (12,000 to 7600 BP) Sites of the Fort Rock Region: A Summary

The data for this time period suggest there are at least three basic Early Holocene site types, two of which (residential bases and temporary foraging camps) have been identified in marsh and lacustrine settings. Winter residential bases have been identified at the Connley Caves near Paulina Marsh, at Cougar Mountain Cave within a few miles of the northern-most arm of the Fort Rock Valley marsh, and possibly at Fort Rock Cave. Pre-Mazama components 1 and 2 at the Paulina Lake site appear to be summer residential bases frequented by populations which also visited or occupied the Fort Rock Basin (Connolly 1995). Temporary foraging camps in the Fort Rock Basin, e.g. the East Block at Locality III, were used very briefly in spring and summer while local resources were exploited. The third site type is the resource processing location camp, examples of which are found on Buffalo Flat in the arid eastern end of the basin.

Residential sites are characterized by increased artifact, macrobotanical, and faunal assemblage sizes and diversities, reflecting increased sedentism and a corresponding breadth of camp maintenance activities. Basic tool assemblages, present at all three types of sites, include projectile points (Western Stemmed, Lanceolate, and Foliate), ovate bifaces, expedient flake stone tools, abraders and manos. These are simple assemblages bespeaking high mobility and easy application to a broad variety of tasks. Substantial quantities of cobble stone tools, steep-end scrapers and gravers are present in residential bases, suggesting that large game hunting and animal processing assemblages are more common in such sites. Plant processing provided a consistent contribution to subsistence patterns, though it was undoubtedly somewhat less important at this early time than it was during the Late-Middle Holocene.

Pinson (1999) suggests that there is evidence of variance in game procurement patterns between the Early and Middle Holocene periods. She proposes an Early Holocene specialization in small animal procurement systems designed to reduce starvation risk by consistently pursuing those animals least susceptible to changing--and often more xeric--climatic conditions. Thus, in her reconstruction artiodactyl procurement during the Early Holocene was more infrequent than it was during the wetter Late-Middle Holocene period.

The procurement of rabbits, which were most efficiently taken by the net-driving method, was probably the most intensively and consistently pursued hunting activity engaged in throughout the Northern Great Basin. Increased use of waterfowl at the Connley Caves is most likely a product of their close proximity to Paulina Marsh and occupation of these sites through the late fall, winter, and early spring seasons when waterfowl apparently provided a replenished (migratory) fresh food resource. There is currently little evidence from the open sites of the Fort Rock Basin for intensive waterfowl exploitation. Waterfowl are present in most Early and Middle Holocene marsh side sites but generally appear in small numbers.

There is also little evidence for a specialized Early Holocene waterfowl procurement technology. Crescents, once thought to be a type of bird point (Tadlock 1966; Clewlow 1968), have been recovered from many open sites in the Northern Great Basin. The interpretation of crescents as bird points has recently been seriously questioned, however (cf. Beck and Jones 1997:207-208). The use of nets and snares to capture waterfowl is well documented among Northern Great Basin (Fowler and Liljeblad 1986) and Klamath Basin (Voegelin 1942) ethnographic groups, and traces of cordage that may bespeak nets have been found in the Fort Rock caves. Netting is known to have had many uses, however, and thus is not strong evidence of a specialized tool kit related to waterfowl procurement.

Instead, a broad-spectrum predation pattern is generally evident throughout the Early Holocene settlement-subsistence system, with occasional diversions to specialized processing locations, e.g. the Buffalo Flat rabbit drive/processing sites. Though storage of plants is suggested at the Paulina Lake site, storage has yet to be verified for this period in the Fort Rock Basin. Over-wintering sites generally appear to have been situated in biotically heterogeneous, ecotonal settings maximizing easy access to both local and migratory flocks of water and terrestrial fowl, and possibly migratory big game herds. Shelter, southern exposures, and the availability of firewood also appear to have been important considerations in the location of winter residential bases.

This conclusion is fairly consistent with the results of the PGT-PG&E Pipeline Expansion Project (Schalk et al. 1995:9-27, 9-28) which passes through the Deschutes River and Klamath basins to the west-northwest of the Fort Rock Basin. It also fits well with Ames' (1988) assessment of broad-spectrum settlement-subsistence patterns for the Pioneer Period (Windust and Early Cascade phases) on the Southern Columbia Plateau to the north. Thus, summer and winter residential site selections appear to be directed toward procurement of plentiful but differing animal resources, primarily big game in some locations and smaller game (birds and rabbits) in others. Roots, seeds, and fruits were also exploited but apparently contributed less to the diet than they would during subsequent periods.

Transitional Early-Middle Holocene (7600 to 5600 BP) Cultural Assemblages

Sites like Locality III and Bowling Dune, situated in the extremely rich wetlands/grasslands ecotone of the Fort Rock Basin, are examples of temporary foraging campsites common to the transitional period which spanned the end of the Early Holocene to about the end of the Early-Middle Holocene (ca. 6000 BP). The hypothesis presented at the beginning of this section states,

> "If climatic desiccation was a factor for settlement-subsistence changes involving a shift to increasing mobility in the Northern Great Basin during the Early-Middle Holocene transitional period (e.g. from 7600 to 5600 BP) then artifact assemblages should generally exhibit little diversity, low density distributions, and multiple-use tools rather than specialized single-use tools. We may also expect a reduction in numbers of sites dating to this period (Jenkins 1999)."

The evidence presented above suggests that tiny, highly mobile (family?) groups spent very short periods of time at temporary foraging sites in the Fort Rock Valley, exploiting local resources (rabbits, waterfowl, and waterfowl eggs) near each site for a few days and moving frequently to offset increasing costs and decreasing benefits as local resources were depleted (cf. Charnov 1976). Cultural assemblages are numerically small and continue to exhibit the predicted evenness (i.e. limited diversity) of previous assemblages. Artifact types, other than projectile points, change little. Projectile points for most of the period continue to be predominantly Foliate types. A few large corner-notched types have been dated by obsidian hydration to inexplicably early time periods >9000 BP (ca. 8000 RCYBP), but these points are generally made of Spodue Mountain obsidian and their dating is considered very tentative.

The inception of Side-notched types in the Fort Rock Basin is more commonly dated by obsidian hydration to about 7500 BP (ca. 6800 RCYBP), i.e. the post-Mazama period. Manos and metates are consistently present in these tiny cultural assemblages but continue to be primarily expedient, unformed types which generally comprise relatively small portions of the assemblage. Plant remains recovered from cultural contexts include scattered occurrences of chenopodia, bulrush, waada, knotweed, and grass seeds with sagebrush and juniper charcoal. Bifaces, expedient flake tools, and abraders continue as portions of the non-specialized tool assemblage, indicating continued high levels of mobility and low levels of tool/task specialization. Thus, the hypothesis appears to be supported by the data..

Occupation length at the residential bases in the Fort Rock caves seems to have been reduced during this period (Bedwell 1970, Cowles 1960) and occupation of the caves may have ultimately ceased altogether. The length of occupations at Newberry Crater also seems to have diminished (Connolly 1995). Climate appears to have changed somewhat toward a warmer and possibly drier mode, and plant communities may have begun to exhibit greater homogeneity across broader areas, requiring an increase in human mobility to achieve the levels of subsistence reliability more easily obtained from fewer locations during the previous period.

The presumed effects of the climactic eruption of Mt. Mazama postulated by Bedwell (1970) for the Fort Rock Basin have been debated (Grayson 1979), and there is, moreover, little evidence in the lunette dunes that the marshes were seriously impacted by the deposition of 50 cm or more of ash at about 7630 BP (Bacon 1983). Radiocarbon dates (Appendix A) bound this eruptive event closely, indicating that if the area was seriously impacted and abandoned, it was for a relatively short time of perhaps < 100 years (cf. Mehringer and Cannon 1994:323). Though individual site occupations were short, they continued sporadically throughout the warm-dry Mid-Holocene period. People were definitely present in the basin throughout much of the 7600 to 5600 BP period, but apparently on a less regular basis, and in fewer numbers, than during some portions of the Early Holocene. Numbers probably fluctuated with available resources and trended, in general, toward the low end of the demographic scale. Use of the caves as winter residential bases may have ceased altogether.

At Newberry Crater and along much of the Deschutes-Klamath river basin, the pollen and archaeological records indicate significant environmental and cultural use-pattern changes (Scott Cummings 1995; Connolly 1999; Schalk et al. 1995). Much of this area, which apparently received a heavier coating of Mazama ash than the Fort Rock Basin, became a "pumice desert" in which shrubs and lodge-pole pine became dominant, reducing biotic diversity/productivity. Thus, a massive area bordering the Fort Rock Basin, one which formed a major node of the Early Holocene settlement-subsistence pattern, was seriously altered and the local response can only be hypothesized to have changed to some unknown degree. Projectile points there appear in some cases to have actually *increased* somewhat in number, suggesting that the human response was to begin using the area in an even more ephemeral and specialized pattern involving highly mobile hunting excursions for large game (Schalk et al. 1995; Connolly 1999).

On the other hand, at sites like Locality III in the Fort Rock Basin marshes, there is no obvious evidence for a dramatic shift in settlement-subsistence patterns at the time marked by the eruption of Mount Mazama. People had apparently moved away from the caves, but continued to use the marshes whenever biotic productivity warranted. Water inflow, while undoubtedly reduced, was still occasionally altered by short-term unusually intense wet periods of sufficient duration for fish and marsh plants to reestablish themselves. Exploitation of the marshes continued to be a regular spring-time event, as evidenced by the presence of waterfowl egg shell in most archaeological deposits. Some evidence of inter-regional trade or travel is found in the presence of *Olivella* shell beads which appear in small numbers by 9200 BP and continue throughout this period.

Late-Middle Holocene (5600 to 3000 BP) Cultural Developments: Population and the Beginnings of Intensification

Our hypothesis for this period states,

> "If settlement-subsistence patterns in the Northern Great Basin shifted toward greater sedentism and more densely packed human populations, then we would expect evidence that should include houses, storage facilities and artifact assemblages which are both more numerous and more diverse (i.e. including more specialized artifacts) than Early Holocene and Early-Middle Holocene assemblages. Site numbers should also increase."

Our current understanding of changing settlement-subsistence patterns in the Northern Great Basin--as expressed in the Fort Rock Basin--incorporates several premises which should be clearly stated before the model is presented. First, human populations are generally assumed to have gradually increased through time over the last 5600 years. Climatic variation, however, resulted in significant fluctuations in the populations of the 'wet' basins--those with marshes and streams that originate in nearby mountain ranges--as people moved to concentrated resources available for varying periods of time.

Second, as discussed above, some increases in local populations were caused by people moving in from adjoining regions. Such movements help account for the "sudden" appearances of apparently large local populations that are suggested by clusters of Late-Middle Holocene and Late Holocene radiocarbon dates and habitation sites in the Fort Rock Basin (Droz and Jenkins 1999). Third, shifts in local settlement patterns are cultural responses to environmental and cultural changes occurring both within and without the local region. There are two levels of climatic/environmental variation which affect human demography, local and regional. Both are dynamic; local patterns tend to reflect short-term and thus rapidly fluctuating climatic variations, whereas regional patterns tend to smooth out the effects of local climatic variations and thus appear as longer-term general shifts in patterns that are less sharply fluctuating.

In the Great Basin, human adaptation to climatic fluctuation involved population movements at two levels. Ethnographically, local populations tended to fluctuate almost on a yearly basis in response to improving and worsening local conditions (Fowler and Liljeblad 1986:437). Hard times in one basin led to the shift of local personnel to adjacent basins. Unique ecological combinations in each basin generally assured that with some mobility--facilitated through inter-basin marriage arrangements--most of the regional population could be accommodated.

The effect of long-term regional climatic variation was to smooth out the yearly short-term population shifts from basin to basin, leaving an archaeological record which suggests that human populations in the 'wet' basins of the Northern Great Basin fluctuated in a synchronized pattern. Particularly rich locations in each basin would have maintained some resident population throughout most years and would have been the first localities reoccupied after temporary abandonments. When subsistence conditions were excellent--for instance when fish were stranded in drying playas--in any particular basin, people from the surrounding region would have gathered in large numbers to take advantage of concentrated resources and to socialize. These large "fandangoes" facilitated the arrangement of inter-basin marriages and later personnel movements to resource rich locations when resources were scarce locally (Thomas 1972). It is quite possible that this method of population adjustment has considerable time-depth and may have operated in some form throughout the last 6000 years or more of Northern Great Basin prehistory. The data from the Fort Rock Basin offer a chance to increase our understanding of how this general model of population movement could have affected human settlement patterns throughout the Northern Great Basin.

Occupations in the Fort Rock Basin apparently continued to be extremely transient until approximately 6000 BP when some evidence of caching behavior in the caves (Bedwell 1970:43,44,56) and more sedentary occupations on "living floors" begins to appear (Jenkins 1999; n.d.b). Exploitation of tui chubs intensified as did plant processing, particularly of small seeds, though mortars (used to process roots?) also appear at about this time.

Fishing and Intensification

Dramatic differences exist between the Early Holocene/Early-Middle Holocene assemblages at Locality III and the Late-Middle Holocene assemblages at the DJ Ranch site nearby. Few tui chub bones were recovered from Locality III. Yet, they were relatively common at DJ Ranch. Trout bones were relatively common in the beach deposits underlying the West Block at Locality III, but were practically unknown from the deposits of the DJ Ranch site. It is clear in the Locality III case, that most if not all of these bones are from natural deposits rather than cultural deposits, since they are clearly associated with a "high energy" beach deposit and there is extremely little cultural material associated with them. In other words, there is no clear evidence of fish exploitation at Locality III. At the DJ Ranch site, trout bones are of darker color and have a greater density than the tui chub bone, suggesting that they may be mineralized natural deposits there also.

The dramatic differences in tui chub distributions between Locality III and the DJ Ranch site are most likely the result of variance in water depth and/or environmental settings of the site locations. The DJ Ranch site is located on the edge of a small pond at the end of the overflow channel from Lunette Lake. This pond would only fill with water *after* Lunette Lake was full and overflowing. The pond was seldom more than one to two meters deep and would have dried up much more frequently than Lunette Lake, stranding fish in the pond and making their low-cost collection possible. Exploitation of fish in the deeper waters of Lunette Lake (three to four meters deep) would have required much more effort, involving fishing technology (e.g. nets and hook-line combinations), and additional labor. On the other hand, occupants at DJ Ranch could easily exploit resources available at Lunette Lake from their site while maintaining their residential position near stores of tui chub collected from the pond nearby.

Important to this question of varying settlement-subsistence patterns, is the fact that few fish bones were recovered from the Early-Middle Holocene (7600 to 5600 BP) deposits of the Bowling Dune site, though they were present in small quantities in several of the Late-Middle Holocene cultural features there, and were the primary faunal component in one of three large storage pits dated to ca. 5500 BP (Jenkins 1999). Tui chub comprised 12% of the identifiable faunal remains recovered from a rich anthropic soil (house floor?) dated at 6000 BP at the GP-2 site, near Locality III, and fully 34% of the identifiable faunal remains recovered from a charcoal-stained soil dated to 5000 BP at GP-2. Finally, fish are common in cultural features at the Big M site by 5600 BP (Dean 1994; Jenkins 1994a). In fact, fishing and a dramatic increase in ground stone use are hallmarks of the Late-Middle

Holocene period, along with the construction of houses and storage pits (Jenkins 1994c:222; Jenkins n.d.a).

These developments correspond closely with the numeric and type expansions of atlatl weights, pipes, beads and bone tools in the cultural assemblages of both caves and open sites in the Fort Rock Valley subbasin. The co-occurrence of these dramatic increases in artifact type diversity reflects the development of specialized artifact classes and suggests greater sedentism. The increased emphasis on fishing/fish collection and plant collection/preparation is evidence of intensification accompanying this shift to increased sedentism, a pattern which apparently began near the end of the Early-Middle Holocene (6000 BP) and was fully developed in the Fort Rock Basin by 5600 BP.

Sedentism in the Fort Rock Basin

Further evidence for this shift in residential patterns is found in the distribution density of lithic debitage and faunal remains. Lithic debris and bone fragments were recovered at very low quantities of 127 and 305 pieces per m^3, respectively, from the Early Holocene to Early-Middle Holocene deposits of Component 2 at Locality III. These recovery rates are comparable to those of pre-Mazama deposits at the Bowling Dune site. Totals of 1,754 flakes and 973 fragments of bone, at that site, were recovered from an excavation area of 20 m^2 with an excavated volume of 5.5 m^3, producing means of 319 flakes and 177 bone fragments per m^3. In contrast, excavations in Late-Middle Holocene deposits at the DJ Ranch site covered an area of 54 m^2 and removed 47.2 m^3 of deposit. These sediments produced means of 563 flakes and 1,192 bone fragments per m^3. Faunal assemblage diversity increases proportionately, with mule deer, mountain sheep, antelope, elk, rabbits and hares, canids, mustelids, many kinds of waterfowl, and fish present (O'Grady n.d.; Singer n.d.). This assemblage reflects both upland and lowland exploitation, indicating that large game animals (mountain sheep in particular) were hunted and brought back to the site from a significant distance, perhaps reflecting a shift to a more collector-like logistical strategy.

The Late-Middle Holocene shift from high residential mobility to greater sedentism was most likely a response to increased productivity/reliability in the marsh-grassland ecotones, which facilitated increased seasonal--particularly summer--resource processing, large volume storage, and increasing human populations (Jenkins 1994b; Jenkins n.d.). Increased biotic productivity alone is insufficient reason for increased sedentism to develop. The accompanying costs (increased labor, reduced caloric output per unit of labor, increased social interaction/organization requirements) and risks (failure and/or loss of vital food resources collected and stored for later consumption) of sedentism, that are generally involved in the intensification process were sufficiently daunting to keep it from happening regularly until the Late-Middle Holocene. If human demography was not the "kicker" that "pushed" people into greater sedentism, then the inception of sedentism should have occurred during the Early Holocene when marsh-grasslands ecotone biotic productivity was high over extended periods of time. Instead, the "pull" of high biotic productivity during the Early Holocene and Early-Middle Holocene merely resulted in the establishment of temporary camps which were frequently moved after very short stays, probably in response to reductions in caloric capture rates after a few days of "high-grading" local resource patches (cf. Charnov 1976).

By 6000 BP, however, increased sedentism in open sites was developing as an alternative method of exploiting this rich area of the Fort Rock Basin, and by the beginning of the Late-Middle Holocene (5600 BP), houses and large storage pits were common in site locations that offered easy access to both abundant lowland subsistence resources (fish, seeds, small animals) and the similarly productive uplands. Artiodactyls were hunted in both the uplands and lowlands, and carcasses were brought back to scattered house sites and hamlets. Upland roots were probably exploited by 10,000 BP but do not appear to have formed as large a part of the diet as lowland resources until sometime after 4000 to 3000 BP.

There appears to be a direct correlation between the construction of houses and storage pits in the open sites of the Fort Rock Basin and increased diversity-richness in artifact and faunal assemblages. These in turn co-occur with the development of more intensive fish and small seed production systems, i.e. resource intensification. Intensification and increased sedentism, apparently related to large volume storage of seasonally available resources, appear to have been unnecessary prior to about 5600 BP, most likely because human populations were low and residential mobility levels generally high. After that time, however, between 5600 and 3000 BP (4900 to 3000 RCYBP), sedentism in the Fort Rock Basin reached unusually intense levels suggesting that human populations were relatively high and social organization increasingly dynamic.

Exactly why and how this cycle of increasing sedentism/population, with its corresponding increased risks, ever began is another interesting question, the answer to which may not be found solely in the Fort Rock Basin. Jenkins (1994b) has suggested that local settlement-subsistence patterns are best conceived as segments of larger regional and inter-regional patterns. Middle Holocene populations undoubtedly fluctuated in and around the ‘wet’ basins of the Northern Great Basin as subsistence resources were affected by climatic and environmental variability. One of the possible effects of terminal Early-Middle Holocene (ca. 6000 BP) circumscription in such a setting might have been to dramatically and rapidly increase Fort Rock Basin populations when resources were abundant locally, and scarce extra-locally; such as when there was too-much water or snow in surrounding regions.

As noted above, paleoenvironmental data from Diamond Pond suggests that the inception of this period may well correspond with the amelioration of climatic conditions at the end of the long, warm-dry Early-Middle Holocene period about 5600 BP (Wigand 1987). Sagebrush and grass pollen increase at this time at the expense of salt tolerant, more xeric plants, and the water table appears to have been rising. Considering these evidences for improving range conditions, it is interesting to note that juniper pollens did not increase also. In fact, for some period of time these trees, which are sensitive to extremely cold winters, produced much less pollen and may have been severely stunted or actually retreating (Mehringer personal communication). If this was the case, it could indicate that the Late-Middle Holocene was ushered in by a period of *stress,* not particularly good for mobile hunter-gatherers in the Northern Great Basin.

Thus, the increased sedentism documented in the marshes of the Fort Rock Basin could be evidence of ‘push’ conditions caused by immigration of human populations to the basin from outlying regions. Under this scenario sedentism could have been a response to colder, protracted winters and cold, delayed springs. Upland root crops were exploited to some degree but were relatively less reliable than later season seed producers like chenopods, amaranths, chokecherries, and currants.

Proximity to caches of storable marsh resources (small seeds and dried tui chub), less desirable starvation foods (e.g. bulrush and cattails), and migratory waterfowl would have been vital to winter survival. Previously dispersed populations surrounding the Fort Rock Basin (e.g. Klamath Marsh, Sycan Marsh, Deschutes River Basin, and Harney Basin) may have gravitated toward the Fort Rock Basin due to local environmental disasters (excessive amounts of snow, ice, or flooded marshes). Fort Rock marshes probably did not flood because excess water could spread out over a very flat, shallow surface; conditions conducive to extreme evapotranspiration rates. Water may have ultimately also overflown into Christmas Lake Valley if conditions were ever excessively extreme (cf. Allison 1979).

Once residential population levels in the Fort Rock Basin were increased beyond previously attained levels a change in the local settlement-subsistence pattern may have been necessitated. Resource intensification, particularly in small seeds and fish which are less susceptible to spring temperatures, combined with increased storage and sedentism are plausible alternative methods of resource exploitation and settlement which may have been necessary to accommodate rapidly increasing populations gravitating to the Fort Rock Basin (cf. Testart 1982). Increasing social interactions involving the division and intensive exploitation of the marsh may have triggered the need for increasing social interaction, personalization of artifacts (art), and heightened levels of inter-regional trade, all of which implies movement toward greater cultural complexity (cf. Price and Brown 1985).

Cultural Developments: The Ebb and Flow of Late-Middle Holocene Populations

Paleoclimatic and ecological conditions vacillated regularly throughout Northern Great Basin prehistory. Cultural developments toward greater or lesser complexity must have occurred in many different locations at many different times. Droz and Jenkins (n.d.), employing the radiocarbon dates in Appendix A, demonstrate that there are two clusters of dates indicating phases of unusually intense sedentism in the Fort Rock Basin marshes during the Late-Middle Holocene. The first cluster of 15 dates, between 5600 and 4500 BP, exhibits a very strong peak in dates (47%) between 5650 and 5400 BP. It is marked by exceptionally large storage pits, intensification in small seeds, mammals, and fish, and the predominance of Northern Side-notch projectile points with foliate and Elko points commonly occurring as well. This may be have been a cultural phase initiated by unusual winter stress, particularly in surrounding uplands regions, when populations came to Fort Rock as a sort of refugium. After this initial period of stress, however, climate seems to have ameliorated and ‘good times’ may have generally returned for Northern Great Basin populations.

The second cluster of Late-Middle Holocene dates spans the period from 3800 to 2900 BP with 57% of these dates falling between 3800 and 3500 BP. The evidence from Diamond Pond suggests that this was a period of intense precipitation when ecological conditions were exceptionally good throughout much of the Great Basin (Wigand 1987; Mehringer 1985), though locally water may have risen too high and drowned out some marshes (Oetting 1990). When flood-waters rose too high in those basins given to rapidly increasing water depth they covered the biotically rich marsh ecozone and causing some periodic displacement of local populations.

In short, Late-Middle Holocene radiocarbon dates suggest that this period incorporated at least two major paleoclimatic events facilitating increased human populations and greater local sedentism in the Fort Rock Basin. Current levels of understanding about the Late-Middle Holocene period, however, do not provide the fine-grained data necessary to determine either the duration or affect of changing weather patterns (as opposed to ecological conditions) on populations. As noted earlier, we believe cultural change in the Northern Great Basin resulted from changing ecological and social conditions. There is much to be learned about the evolution of cultures in this region that will not be elucidated by presenting a static model of either of these conditions for any single period of time. Instead, we emphasize the constantly fluctuating nature of both environments and cultures throughout most of the Northern Great Basin. Populations shifted from one 'wet basin' to another with ease, often regularly incorporating exploitation of subsistence resource availability in other basins as a part of annual subsistence rounds. This is not to imply that cultural systems remained unchanged, but rather that the dependence on wetlands resources and the predominant use of wetlands for winter village locations made increased populations in the Northern Great Basin more sensitive to the *perception* of circumscription than any other aspect of their settlement-subsistence pattern. Thus, it is predominantly in lowlands winter villages and hamlet sites that we would expect to find the most dramatic evidences of cultural change in response to increasing populations.

In our view, cultural systems designed to deal with normally small, highly mobile, and thinly scattered populations were hard pressed to deal adequately with larger agglomerations that coalesced in locations like the Fort Rock marshes for prolonged periods of years or decades. We interpret the increased quantities of shell, stone, and bone beads, fancy bone tools, personalized functional tools (e.g. highly modified mauls, mortars and pestles), pipes, and art work found in wetlands sites of the Late-Middle Holocene and Late Holocene periods as individual and social group identifiers (cf. Wobst 1977), i.e. 'sociotechnic' artifacts. Rather than moving rapidly and steadily toward greater social complexity, however, we see these artifacts as evidence of short-term social adjustments designed to reduce tensions (e.g. 'scalar stress' related to information processing and decision making [Johnson 1982]), caused by packing of circumscribed populations with social organizations inadequate to the task of dealing with increasingly large and sedentary populations. This process of social adjustment appears to have been particularly intense during the second phase of increased sedentism (3800 to 3000 BP) in the Fort Rock Basin.

This phase of intense sedentism is marked by a shift to the overwhelming predominance of Elko series projectile points, along with Gatecliff, Humboldt, and some lanceolate forms. It was during this period that greater reliance on geophytic roots developed, perhaps aided by a climatic period when spring weather was characterized by warmer temperatures and springs were followed by wetter summers. Geophytic root crops like lomatiums and camas would have been more dependable and most ecosystems extremely productive. Range conditions appear to have been in general very good and human populations may have biologically increased due to reduced winter mortality. In other words, survival rates may have increased as populations shifted to dependable (at this time) early spring producers (e.g. lomatiums). Population packing under these conditions may have resulted in the 'budding off' of population groups into peripheral areas. If so, we would expect to see more intensive uplands exploitation and the development of hamlets around previously ephemeral water sources (e.g. currently dry lakes and playas) during this period. The importance of small seeds, fish, waterfowl, and mammals apparently continued unabated into historic times. There is some evidence already available that points to this scenario (Jenkins 2000,; Brashear 1994; Byram 1994), but much more work is necessary to verify these patterns.

Investigations in the Boulder Village Uplands (Brashear 1994; Byram 1994), Gerber Reservoir (Silvermoon 1994), Warner Valley (Cannon et al. 1990; Fowler et al. 1993; Tipps 1998) and Drews Valley (Jenkins 2000) most effectively elucidate the development of mid-elevation root ground exploitation patterns, a settlement-subsistence shift which may have begun during the latter half of the Late-Middle Holocene between 3800 and 3000 BP. The importance of small seed production systems in the Northern Great Basin continued unabated throughout the Late-Middle Holocene and Late Holocene periods, primarily because these were summer producers available in a broad variety of environmental settings at different elevations. Intensive upland root crop exploitation, generally limited to more rocky soils on valley slopes, was added at a time when populations were relatively high and sedentary. The selective advantage for intensification in root crops was both their early spring appearance and their generally high caloric and vital nutrient values (Hunn and French 1981). Root crops were some of the first fresh foods available, along with greens and some fish runs, in the early spring when food caches had been exhausted (Kelly 1932). Thus, they filled an extremely important niche in the annual subsistence round.

Camas and lomatiums were exploited in Oregon from Early Holocene times (Connolly 1995; Cheatham 1988:106). What caused the shift to more intensive processing of root crops at the end of the Late-Middle Holocene which continued on into the Late Holocene? Jenkins (1994:614) postulated that in the Fort Rock region,

> After that time [3500 RCYBP] conditions probably remained more moist than at present but may have begun to be less stable. Human populations, on the other hand, apparently were relatively high throughout the Northern Great Basin (Jenkins and Connolly 1990:147). As the average number of drought years per generation increased, local populations apparently dispersed to other regions and/or began to intensify their use of uplands root crops, as they had at a somewhat earlier date on the Columbia Plateau (Ames and Marshall 1980; Chatters 1989).

This model emphasized the interaction between population density, resource reliability, and dynamic (climatically induced) environmental conditions. In this document we have introduced the possibility that warmer early spring temperatures may have had a positive effect on the development of root crop intensification, also. With relative social circumscription throughout the region a long established pattern by this time (4000 to 3000 BP), any selective advantage in subsistence focus which increased winter survival rates and decreased mortality rates, e.g. the dependable appearance of particular root crops at a time in the early spring when other foods were exhausted, would direct the trajectory of participating social groups toward ever increasing reliance on that resource.

In the case of the Northern Great Basin and its adjoining regions, this process may have occurred not so much as a replacement of one subsistence focus with another (i.e. roots replacing seeds and fish), though in some areas like Drews Valley, a mid-elevational setting (ca. 5000 ft.) near Lakeview, Oregon (Jenkins and Connolly 2000), this may appear to have been the case. Instead, roots were being added to the initial resource base as another tier of intensification on which sedentism depended. If we are correct, there should be more site locations in the root grounds dating sometime after this shift than previous to it. Also, sites from which both early spring roots and early spring fish runs could be exploited should have been at an absolute premium after the shift in the importance of roots occurred. These archaeological correlates (site numbers and site locations) of increasing intensification, population, and sedentism are present throughout the region, and the predicted pattern was certainly the case indicated by Modoc ethnography, as well (Ray 1963). Though we have not proven that the shift to intensification in roots occurred because of increased populations and the increasing reliability of roots, it certainly is a plausible hypothesis. Easily testable hypotheses may now be constructed, from the expanded base of our understanding to further our archaeologically based knowledge of archaeology in this region.

We present the observations above as working hypotheses, not established facts. Much archaeological survey and excavation, with the goal of developing a large and diverse data base, must be conducted to test them. This future research will require further development of research questions, methods, and theories for application to specific issues spanning this period of human occupation in the Northern Great Basin.

Late Holocene Patterns (3000 to Historic times)

We currently have little information on the settlement-subsistence patterns operating in the Fort Rock Basin between 3000 and 1500 BP. Recent excavations at the Carlon Village site, on the shore of Silver Lake, provide the best data available for this interval (Wingard 1999; Jenkins 1994b). This village is prominently marked by eight large stone ring structures, situated on top of a low rise that protrudes into the lake from the south shore. Though these structures have been thoroughly vandalized, other deposits at the site have survived the depredations of artifact collectors providing a model against which a very extensive assemblage of cultural materials recovered from the structures have been compared (Wingard 1999). Test excavations suggested that semi-subterranean structures may have been excavated into the deeper deposits of the site. Three stratigraphically sequent apparent house floors uncovered near the lake shore produced radiocarbon dates of 1780, 1890, and 2040 RCYBP (Jenkins 1994a), while accelerator mass spectrometry (AMS) dates on food remains from disturbed deposits within the houses indicate ages ranging from 2350 RCYBP to historic (Wingard 1999). Faunal and floral remains from this excavation reflect primarily the exploitation of locally available wetlands resources including fish, large mammals (artiodactyls), small mammals (squirrels and rabbits), waterfowl, bird's eggs, and shoreline weeds (chenopods, knotweed, and bunchgrass). Also recovered were ponderosa pine, mountain mahogany, and lomatium tissues, reflecting the use of species transported to the site from nearby uplands (Wingard 1999).

Wingard (1999) has demonstrated close correspondence between Carlon Village and Boulder Village radiocarbon date patterning--beginning 1500 BP--and obsidian source patterns. These data suggest that these sites may easily represent separate seasonal phases of a settlement pattern involving upland (early spring/summer) and lowland (winter) villages.

The presence of perennial water in the Boulder Village Uplands--in the form of a small lake--presented a unique situation in the Fort Rock Basin. Here, at an elevation of roughly 1615 m were all the primary resources necessary to the intensive use of uplands root crops: plants, firewood, water, and shelter. This situation made it possible for a relatively large population to congregate near a very productive root ground, shown by recent research to contain large quantities of biscuitroot and sego lily (Housley 1994; Stenholm 1994, Prouty 1994).

The Boulder Village site is an extensive scatter of stone ring houses located along one edge of this very productive root ground (Jenkins and Brashear 1994). The archaeological and paleoethno-botanical evidence suggests that roots were dug in large quantities, cleaned, dried, and cached in large talus slope storage pits located among the houses of the village and along large rocky outcrops within a few kilometers of the village. Hunn (1990:170-177) and Thoms (1989) have demonstrated for the Northwest generally that with intensive exploitation of root crops, as much as 50% of the annual caloric intake of a single family could be obtained during a typical 60-day harvesting period. Their figures should apply as well to the Boulder Village upland setting. Much of the necessary protein supplement to a primarily dried root diet could be found in the lowlands in the form of tui chubs, which could have been caught or collected in large quantities and dried for later consumption (Raymond and Sobel 1990).

At Boulder Village, the little lake provided a reliable source of water, while the steep ridge bordering the lake provided a sheltered locale for houses. Juniper, mountain mahogany, and other woods were available on the ridge itself for firewood and building materials. In addition, the dark basalt boulder field in which the site occurs would naturally have acted as a passive solar energy storage sink, collecting solar energy during the day and radiating it back during the night. The site faces east and thus receives direct early morning sunlight. This location would have offered a pleasant setting for a village.

The Boulder Village Uplands are more than 300 m above the floor of Fort Rock Basin, and would have been colder than the lowlands during the winter. Nevertheless, the residents of Boulder Village (and smaller villages located nearby) apparently chose, at least on occasion, to bring lowland resources (fish, chenopodium, waada) to these upland village sites rather than portage large quantities of roots down to villages in the lowlands. The continued use of lowland villages at choice locations--on the shores of Silver Lake for instance where, in years of abundance people could winter at lower, warmer elevations--cannot be ruled out. In such situations, the uplands villages may have served for early spring/summer residences and may have been abandoned during the winter, in a settlement pattern similar to the ethnographic Klamath/Modoc pattern of dual seasonal villages (Spier 1930; Barrett 1910).

Plant species in the upland root grounds are diverse enough that something is generally available throughout the spring and summer. The timing of root and bulb availability varies significantly, however, with climatic change (Housley 1994). Locating the winter village in the root grounds facilitated the collection of roots as soon as they were available in the early spring (cf. Ames and Marshall 1980 for similar considerations in the Columbia Plateau). Judging from the size and depth of cache pits observed in and around Boulder Village (as large as 4 m in diameter and 1 to 1.5 m deep), the inhabitants of the region were collecting very large quantities of roots. During years of high root crop productivity it may have been logistically more efficient to bring lowland resources to the uplands than to move massive quantities of roots to the lowlands, much in the way that the Owens Valley Paiutes further to the south occasionally wintered near their pinyon nut caches (Bettinger 1975).

To develop further the implications of the model then, during the waning portion of the Late-Middle Holocene, populations circumscribed by the growth of local surrounding populations gradually added root intensification to fish and small seed intensification in an evolutionary progression. In this manner they "insured" themselves against annual early spring subsistence shortages by increasing their dependence on more reliable root plants and by locating themselves near the first fresh foods to become available after the winter season. During the summer they processed (as before) the chenopodium, grasses, waada, and fish found in the lowland environments of the Northern Great Basin. The development of mid-elevation and uplands habitation sites was a product of this shift to greater dependence on roots.

By 1500 BP the uplands subsistence-settlement pattern was well established. Human populations apparently increased substantially in the Northern Great Basin between 1500 and 1000 BP (Jenkins and Connolly 1990:147, 149). The lowlands once again became extremely productive, though water levels probably were not as high or as stable as they had been during the preceding Late-Middle Holocene period. Lowland wetlands and extensive sand dunes provided dense stands of seed producing plants, and episodic filling of playas and blowouts expanded fish distribution throughout the marshes of the region.

Temporary camp site/processing locations like the Zane Church site reflect the agglomeration of human populations around highly productive short-term producers (grass, chenopods, amaranths, waada and stranded fish). Tiny campsites similar to this one have been recorded by the hundreds throughout the Northern Great Basin. They apparently reflect movement of populations from winter village sites to short-term processing locations such as those recorded in Christmas Valley (Oetting 1994b; Toepel and Minor 1994). They also reflect larger population movements from basin to basin as information about exceptionally productive patches of short-term producers was disseminated through the information network (Jenkins et al. 1999).

These large, short-term annual agglomerations of widely distributed residential populations --ethnographically referred to as "fandangoes" by the Western Shoshone of Nevada--facilitated inter-basin reciprocity subsistence networks. Inter-marriage between families located in the various "wet" basins of the Northern Great Basin region facilitated population movements to abundant resources during periods of subsistence stress. This system of reciprocity was effective as long as human populations were relatively low and environmental deterioration was subregional and short-term. It apparently collapsed, however, when human populations were relatively high and droughts were both long-term and/or region wide. Such a situation is postulated to have occurred about 900 BP as long-term drought conditions are indicated in Diamond Pond (Wigand 1987). A similar situation may have occurred about 300 years ago, accounting for a suggested increase in population on the Upper John Day River while the populations of the ‘wet’ basins in the Northern Great Basin were relatively low (Antevs 1938; Connolly et al. 1993).

Clustering of radiocarbon dates from stone ring structures in the Boulder Village Uplands between 500 and 600 BP may indicate that a phase of uplands occupation was beginning when something occurred regionally that terminated the process. Wigand (1987:427) suggests that drought conditions generally persisted from ca. 500 BP until about 300 to 400 BP. It is possible this climatic situation caused the withdrawal of most of the presumed ancestral Klamath inhabitants from the region and that before they could return the Northern Paiute moved into the region (Pettigrew 1985). Connolly et al. (1993:135) have pointed out, however, that this apparent decrease in population is inter-regional and suggest that it may reflect true biological reductions in populations due to epidemics rather than the more common geographical reductions associated with inter-regional population movements. Certainly, during the last 400 years both drought and disease could have been major causes for the inter-regional population reductions suggested by the data.

Radiocarbon dated artifact assemblages recovered from stone ring houses in the Boulder Village Uplands include either a predominance of Rose Spring or Desert Side Notched and Cottonwood Triangular projectile points (Jenkins and Brashear 1994). This suggests that both the Klamath and Northern Paiute occupied the region for sometime prior to the Historic period. Animosity and warfare were traditionally exhibited between these ethnic groups; however, a small population of intermarried Klamath and Northern Paiute inhabitants is reported to have lived in the Summer Lake Basin (Meacham 1875:232) and recently acquired archaeological evidence from Warner Valley supports this kind of intercultural admixture as well (Eiselt 1997; Fowler et al. 1993; Tipps 1998). The Fort Rock Basin was most likely occasionally used by both the Klamath and Northern Paiutes, serving as a buffer zone and resource area which was not generally inhabited on a long-term basis by either group during this period.

In conclusion, though this model is proposed specifically for the Fort Rock Basin subregion, it may be applicable for use and testing in other areas of the Northern Great Basin. The Summer Lake and Chewaucan Marsh/Lake Abert areas are close enough that their populations probably moved in and out of the Fort Rock Basin on a more or less regular basis, and pithouse/stone ring villages are the most prominent feature of Lake Abert archaeology (Pettigrew 1985; Oetting 1989). Radiocarbon dates from these villages, as well as probable village sites in the Harney Basin (Fagan 1974; Aikens and Greenspan 1988), cluster nicely with those from the Fort Rock Basin. This suggests that the populations of all three basins were fluctuating in a more or less synchronized pattern (Jenkins and Connolly 1990:147).

Stone ring villages in upland mesic settings are also known to exist in the Gerber Reservoir and Drews Valley districts between Lakeview and Klamath Falls, Oregon (Jenkins and Connolly n.d.). The UO Field School conducted surveys and excavations in the Gerber Reservoir district during the mid to late 1980s (Burnside 1987; Silvermoon 1994). Burnside and Silvermoon tested several stone ring houses in the small villages of this upland area. They recovered cultural assemblages very similar to the assemblages recovered from stone rings in the Fort Rock Basin (Jenkins 1994b; Jenkins and Brashear 1994). Radiocarbon dates of 103 RCYBP, 540 RCYBP, and 1080 RCYBP, associated with Desert Side-notched, Cottonwood Triangular, Gunther Barbed, and Rose Spring projectile points, fit well with the Late Holocene radiocarbon dates and projectile point assemblages recovered in Fort Rock Basin upland sites.

Silvermoon (1994) and Burnside (1987) conclude that in the Gerber Reservoir District use of stone ring houses in rich upland settings can be traced to the Historic Modoc occupation of that region. Ethnographic data (Spier 1930; Ray 1963; Stern 1966) indicate that whereas the Klamath intensively exploited fish and wocas seeds as subsistence mainstays, the Modoc, living in a more desert-like environment, relied heavily on fish, roots, and hard seeds. In the Fort Rock Basin, Late Holocene populations (Klamath/Modoc first, and then Northern Paiute) apparently emphasized fish and upland roots--biscuit root, yampah, and sego lily are particularly available (Housely 1994)--but, like the Modoc,
also continued to utilize lowland seeds--chenopods and waada--until they were displaced by Europeans about A.D. 1860.

Further excavation and analysis will be necessary to test and refine the land use model presented here for the Northern Great Basin. Questions remain as to when populations added a subsistence focus on uplands resources (roots) to effectively increase annual subsistence reliability. Did the predominant shift occur after 3000 years ago or between 3800 and 3000 years ago? Why did this shift occur? Was it because of population pressure and subsistence uncertainty? Or was it due to local technological advances such as root preparation and caching? Answers to these questions will continue to be sought by the Northern Great Basin Prehistory Project.

In sum, throughout the Late Holocene, lowland exploitation and occupation continued to be important, but a dramatic shift to residential concentration in the uplands is evident at about 1500 BP. At this time, a major change clearly occurred in the economic importance of upland root-crops, and thus in the subsistence focus of Fort Rock Basin occupants. This is shown by the presence of many stone ring habitation structures and associated talus slope storage pits in the Boulder Village Uplands, which form the divide between the Fort Rock Basin and the Summer Lake/Chewaucan Basin to the south. Here, at elevations of roughly 1500 to 1600 m (5000 to 5300 ft.), are found the remains of literally hundreds of relatively small but rugged structures. Excavations in 22 of these stone rings at Boulder Village show that most of them were probably occupied between 1500 BP and the historic period (Jenkins and Brashear 1994; O'Grady 1999).

These structures generally contain little bone and few non-utilitarian items. Some variation in the archaeological assemblages is evident, however, suggesting that although many of these units were generally inhabited in conjunction with spring/early summer root collecting, processing, and storage, occasionally some were occupied throughout the winter, or at least during some part of the winter as nearby root-crop caches were consumed. The recovery of lowland subsistence resources (small seeds and fish) in some of these structures supports this interpretation, suggesting that upland occupations were occasionally extended across the seasons to the point that dietary supplements to the primarily root-crop diet were necessary or at least desirable.

We believe that two processes were likely in operation here. First, survey data show a large number of sites marked by late-period projectile points suggesting that there had been significant long-term growth in the regional population during the relatively productive Late-Middle Holocene interval, culminating in a substantial Late Holocene population. Secondly, it seems probable that the local Late Holocene climate began to exhibit increasingly frequent wet-dry fluctuations, of the sort documented by Wigand (1987) for Diamond Pond in the Harney Basin only 120 miles to the east. With a considerable population to support and decreasing dependability of low-elevation wetlands resources, there may have been extreme selective pressure for Northern Great Basin populations to re-center subsistence around the intensification of upland root crop production. These resources had always been there (Housley 1994, Prouty 1995) and extensive archaeological surveys (Byram 1994, Brashear 1994) show that people had hunted, gathered, and camped in the root-rich Boulder Village Uplands consistently since Early Holocene times. Now, however, the abundance, ready storability, and early spring appearance of geophytic roots became paramount economic considerations in a way they had not been before.

There is some evidence of diachronic variability in the Late Holocene structures and cultural assemblages of the Boulder Village Uplands. First, the earliest known occupations of upland stone ring structures occurred at the Boulder Village site between 1500 and 900 BP, probably because, with

Squaw Lake nearby, water was most consistently available at this site. Structures averaged 4.3 m in length, 3.5 m in width, and 50 cm in depth. Hunting from the site appears to have been relatively unimportant, and few faunal remains are present in the majority of structures dating to this period. Usage of upland habitation sites apparently decreased significantly about 900 BP, and remained uncommon until about 600 BP. Then, between 600 and 500 BP, the use of upland villages and outlying structures appears to have increased dramatically throughout the Boulder Village Uplands. Small isolated structures were erected in wooded areas around playas, along ridges, and at the foot of canyon rimrocks (Brashear 1994; Byram 1994; Jenkins 1994c, Jenkins and Brashear 1994; O'Grady 1999). These structures averaged 3.75 m in length, 3.35 m in width, and 33 cm in depth, not differing significantly from those of the earlier time. Hunting, or at least collection of small mammals, increased in importance. Large mammals were also occasionally taken, and fish (not available in the uplands) were at least occasionally brought up from the lowlands to these upland structures. Boulder Village remained the population center, though small hamlets and villages were established near the playas surrounding it, suggesting that human populations were high and that many of these outlying settlements were occupied during particularly productive years.

Occupation of upland villages was again reduced shortly after 500 BP, though intermittent occupations undoubtedly continued to occur, and use of upland habitation sites was once again on the upswing by 200 BP. Sites containing Desert Side-notched and Cottonwood Triangular projectile points invariably date at or after 500 BP and generally produce "modern" radiocarbon dates in the 100 to 200 year range (Jenkins 1994c; Jenkins and Brashear 1994). Metal fragments and glass trade beads are occasionally present in assemblages including Desert Side-notched and Cottonwood Triangular projectile points, showing that this occupation dates to contact-historic times. Structures were small, 3 m or less in diameter, only partially encircled with stones, and generally contained quite shallow deposits (ca. 15 to 20 cm). These dwelling remains were quite different from the earlier ones, more evocative of lightly built wickiups than of substantial semi-subterranean lodges. Faunal remains were relatively common. Small seeds, possibly collected in large quantities in the lowlands, are found in association with charred roots native to the upland setting. It is possible that the introduction of horses had greatly increased people's mobility by this time and that regional occupants were routinely bringing subsistence items from a variety of environments to their habitation structures in the Boulder Village Uplands. In any event, seeds and roots which were collected during different seasons of the year, and from different environments, occur together in at least one wickiup-like structure at Boulder Village (Stenholm 1994).

As a footnote to this account we observe that in 1842, when John C. Fremont passed through the region, the Fort Rock Basin and adjacent desert lowlands were occupied by Northern Paiute peoples, while the higher Cascades foothills immediately to the west were occupied by the Klamath. Thus, ethnological, and archaeological evidence suggests that the Paiutes are relative late-comers to the Northern Great Basin, who probably gained some of their territory from Klamath antecessors. It seems quite possible that this transition is recorded in some of the late prehistoric changes in the Boulder Village Uplands (Kelly 1932; Aikens and Witherspoon 1986; Oetting 1989; Jenkins and Brashear 1994; Jenkins et al. 1999).

6 Research Orientations

Claude Warren pointed out to Jenkins years ago that, "Science progresses by refining questions and answering those *for which data are available*." Progress has been made in our understanding of cultural transitions throughout the Great Basin since Warren left Jenkins that insightful note in 1982. We have accumulated much new data, witnessed the development of stronger integrative theory, and answered some of the old questions. As always, new questions and hypotheses have developed in light of these advances. Future advances in our understanding will depend on our ability to reevaluate old data, predict what new data are necessary to address refined questions, and develop new methods to accumulate the data base to answer them.

In the next section of this research design we bring together a suite of questions for each of the chronologic periods discussed above: Early Holocene (12,000 to 7600 BP), Early-Middle Holocene (7600 to 5600 BP), Late-Middle Holocene (5600 to 3000 BP) and Late Holocene (3000 to Historic). We will indicate the data needed to address these questions and suggest methods to be applied to the accumulation of these data. We also present a relatively specific near-term plan that outlines proposed excavations, surveys, and personnel (when known) which will be involved in this research. We then present a general longer-term research plan that outlines the projected trajectory of our research in the Northern Great Basin. We will employ the Fort Rock data base as a standard against which to compare newly acquired data and as a measure of the quantity of data necessary to adequately understand cultural and natural events in other Northern Great Basin locations. Finally, we present the 2000 summer field school research plans as an addendum.

The research topics, hypotheses, questions, and applicable methodologies outlined below have evolved throughout the last 11 years of research, guiding all phases of fieldwork, analysis, and reporting of the Fort Rock Basin Prehistory Project. A set of general research questions, applicable to the Northern Great Basin in Oregon, is presented for each research topic presented below. The questions are intentionally robust, applicable in a some general manner across the entire Northern Great Basin. Examples of more specific topics, hypotheses, and questions to be addressed at individual sites are presented after the more general topics have been discussed.

Regional Culture History

The reconstruction of a regional chronology of human occupation remains a primary archaeological concern. Without the establishment of a chronologic framework for each site(s) investigated, questions pertaining to the nature of settlement and subsistence systems, the movement of populations, trade, and climatic change cannot be adequately addressed. Consequently, the determination of a local chronology and its relation to a regional chronology is one of the first steps in the interpretation of the archaeological record.

Placing the occupations of archaeological sites in the Northern Great Basin within a regional culture-history serves to reinforce the concept that these were regional populations, responding to regional cultural and environmental conditions. In other words, the observable cultural patterns in the archaeological record of subregions are best understood by conceiving of them as components of region-wide systems operating throughout the 'wet' basins (Goose Lake, Fort Rock, Harney, Warner, Guano, Summer, and Lake Abert/Chewaucan Marsh) of the Northern Great Basin and its peripheries. As such, they are the result of adaptations to changing environmental and cultural conditions not only in the Northern Great Basin, but also in the adjoining Cascades/foothills regions frequented by the Klamath/Modoc, Deschutes River/Blue Mountains regions frequented by Columbia Plateau populations and Northern Paiutes to the north and east, and the Owyhee Uplands and Snake River Plains Shoshones to the east.

A basic chronological outline for the region has been presented above (Jenkins 1999; Droz and Jenkins n.d.; Aikens and Jenkins 1994a). This review has served to partially refine our understanding of the Northern Great Basin's cultural chronology, particularly for the last 6000 years. Future Northern Great Basin Prehistory Project research will provide further opportunity to test the chronological model and continue to refine it, as well as expand its areal scope.

To reiterate, the culture-history of the Northern Great Basin encompasses the Early, Middle, and Late Holocene periods (Jenkins 1999). Throughout this research design we have used the geologic term "Holocene" and divided it into four culturally meaningful sections: Early Holocene (12,000 to 7600 BP), Early-Middle Holocene (7600 to 5600 BP), Late-Middle Holocene (5600 to 3000 BP), and Late Holocene (3000 BP to historic contact). Each of these periods reflects some type of natural and/or cultural change in the Fort Rock Basin which we believe were replicated in some form in the other 'wet' basins of Oregon.

The ***Early Holocene*** begins about 12,000 years ago and continues until about 7600 BP, spanning the end of the Late Pleistocene and continuing to the climactic eruption of Mt. Mazama. Chronologically diagnostic artifacts of this period include Western Stemmed and Cascade projectile points, crescents, and Fort Rock sandals. In the Fort Rock and Alkali basins (Bedwell 1970; Willig 1988; Pinson 1999) sites of this period are relatively common. Evidence collected from both caves and open sites in these basins predicts that site locations occupied at this period will occur primarily in close proximity to lowland water resources, though these were not the only areas frequented (Connolly 1999; Oetting 1994b; Brashear 1994; Pinson 1999). Populations appear to have been relatively low and extremely mobile, as suggested by high incidences of 'exotic' obsidian source types and relatively thin cultural deposits in most sites (Jenkins et al. 1999; Jenkins 1999; Pinson 1999). Caves located near marshes appear to have served as winter occupation sites favored because of their close proximity to migratory waterfowl and the availability of fresh starvation foods, e.g. cattails, in the marshes.

Early-Middle Holocene (7600 to 5600 BP) spans most of the warm-dry Middle Holocene climatic period, previously referred to as the Altithermal (Antevs 1948). Sites are marked by a predominance of Foliate and Northern Side-notched projectile points. Earlier point types were often collected and reused, resulting in the common occurrence of Western Stemmed points in these assemblages also, particularly when Early Holocene site components were present in occupation sites. In the Lake Abert/Chewaucan Marsh area these sites tend to be consistently located in the lower Chewaucan River area and to contain largely redundant artifact assemblages. This suggests to Oetting

(1989) that very similar activities were repeatedly pursued in the area during this time period suggesting a relatively high degree of residential mobility. Occupations appear to have been relatively short-term (high mobility) and populations relatively low (Jenkins 1999).

Late-Middle Holocene (5600 to 3000 BP) sites are first characterized by a predominance of Northern Side-notched and Elko series projectile points. Northern Side-notched points later disappeared from the assemblage and a shift to predominance of Gatecliff Split Stem--and related indented base points--and Elko series points occurred between 4000 and 3000 BP. Small seeds and fish compose substantial portions of the diet. Large volume storage appears as an important component of increasing sedentism. The latter half of this period is marked by a gradual shift in subsistence as roots became much more important and uplands environments apparently experienced increasing occupations (Brashear 1994; Byram 1994). Ground stone tools increased dramatically during the Late-Middle Holocene, and the first true villages appear in the Lake Abert-Chewaucan Marsh basin, Fort Rock Basin, and the Harney Basin (Oetting 1990; 1992; Jenkins 1994a).

The advent of wetter conditions during the Late-Middle Holocene (Medithermal) climatic phase is believed to account for a new degree of sedentism and increased population (Oetting 1990:200; Jenkins 1999). Cultural deposits are much denser than Early-Middle Holocene deposits, and incorporate complex cultural assemblages including shell, bone, and stone ornaments, stone balls, pipes, atlatl weights, net weights, fish gorge hooks, large awls, fancy ground stone, bipointed bone needles, bone spoons/ladles, houses, and large cache pits; all suggesting increasing sedentism, cultural interaction, subsistence intensification, and possibly new levels of social organization. Populations appear to have been relatively high at times and territories apparently reduced in size as populations increased.

The ***Late Holocene*** (3000 BP to historic contact) period is well represented in the archaeology of the region (O'Connell 1975; Pettigrew 1985; Oetting 1989, 1990, 1992; Fowler 1993; Musil 1995; Eiselt 1997; Tipps 1998; Wingard 1999) though the early portion of this period, between ca. 3000 and 2000 BP, is actually poorly understood. By about 2400 BP, there is evidence at the Carlon Village site in the Fort Rock Basin of the first construction of megalithic stone structures (Wingard 1999). There appears to have been a gradual shift to roughly equal numbers of Elko and Rosegate series projectile points by about 1900 BP (Wegener 1998) and by about 1000 BP Rosegate points were predominant. Villages were established around modern water sources like Silver Lake, Lake Abert-Chewaucan Marsh, Warner Lakes, and the extensive marshes of the Harney Basin. In the Harney Basin (Oetting 1992) and probably in the Warner Basin also more substantial streams feeding the lakes and marshes provided for relatively high and stable populations, perhaps leading to 'scalar stress' (Johnson 1982) and the necessity for increased social complexity, as suggested by the presence of large bifacial obsidian blades similar to 'wealth items' employed by complex Northern California societies (Oetting 1992) and the construction of megalithic structures in the Fort Rock Basin (Wingard 1999).

The Late Holocene settlement pattern suggests that people were more sedentary than at any time prior. The number of cultural features (pithouses, stone rings, cache pits, etc.) per village site increased dramatically while the number of sites apparently decreased. The most distinctive characteristics of the Late Holocene settlement pattern are: 1) the proliferation of village sites, indicating an apparent dramatic increase in population, 2) the consistent association of village sites with modern water sources--marshes, lakes, rivers, and springs (Oetting 1989, 1990), and 3) the appearance of upland village sites. Jenkins (1994a) has suggested that it was during this time that the historic Klamath/Modoc-like two village settlement pattern was established. Winter villages were generally located in lowlands settings near permanent water sources, in sheltered locations. Spring-summer villages were situated in more upland settings near highly productive root grounds. This shift to uplands villages does not coincide chronologically with the shift to more intensive use of root crops, which apparently began about 4000 to 3000 BP. Instead, it appears to be an adaptive mechanism, perhaps keyed to high human populations in the midst of increasingly unpredictable (rapidly fluctuating) resources.

The number and variety of sites in the Northern Great Basin and the intensity of occupation in these sites, indicates an unusual potential to test this emerging regional culture sequence. Beyond a chronology of artifact forms, the functional and temporal variation exhibited by these sites provides an opportunity to simultaneously address changes in land-use strategies and social organization through time. Charcoal for radiocarbon dating is commonly recovered from cultural deposits of all ages throughout the region. Radiocarbon dating, in association with obsidian hydration, has provided a relatively tight chronological sequence for the Fort Rock Basin, and this sequence provides information which, through its testing, will further refine regional chronological patterns.

Following are the main research questions to be addressed by future investigations in selected Northern Great Basin sites:

1) What is the antiquity of human occupation at this site?
2) Can the presence of chronologically distinct occupations be confirmed by radiocarbon dates, the development of an obsidian hydration rate, or sedimentological evidence?

While Jenkins (1999) acknowledges that occupations of *Early Holocene* age were frequently located near lowland water resources; he emphasizes the employ of a broad spectrum subsistence base and settlement pattern incorporating a variety of site types related to seasonal subsistence variations, occurring throughout the Holocene. Specifically, site types identified for the Early Holocene include winter base camps in caves located near marshes and migratory game (i.e., waterfowl and large game) over-wintering locations; summer base camps, and processing locations. Pinson (1999:218), on the other hand, believes Early Holocene settlement-subsistence patterns reflect a starvation risk-reducing strategy and contrast it with a “risk-indifferent foraging strategy” employed during the Late-Middle Holocene.

3) Where Early Holocene populations highly mobile so that they could live high on the food chain (Jenkins 1999)? Or, highly mobile so that they could insure access to reliable food sources during uncertain and often stressful times (Pinson 1999)?
4) In what quantities were resources exploited during Early Holocene times?
5) Did they differ in kind or intensity from those of later time periods?
6) Is there evidence for more widely spaced and short-term occupation during the Warm-Dry Middle-Holocene climatic episode (cf. Fagan 1974) which apparently corresponded to some degree with the Early-Middle Holocene (7600 to 5600 BP)?

7) Did occupation(s) increase at this site during periods of apparent increased regional populations during the Late-Middle Holocene and Late Holocene times (cf. Jenkins 1999; Droz and Jenkins n.d.; Brashear 1994; Byram 1994)?
8) How do periods of apparent population increase and decrease in the Fort Rock Basin compare with patterns observed throughout the Northern Great Basin?
9) Is there evidence for relatively lower populations between 3000-2000 BP and 1000-500 BP as observed by Jenkins (1994a) in the Fort Rock Basin?

***Data Needs and Data Collection Methodology*:**

Preservation is generally quite good and quantities of charcoal for radiocarbon dating are regularly encountered in the archaeological sites of the Northern Great Basin. Radiocarbon dates from the region span > 13,000 years, but even in the Fort Rock Basin where > 130 radiocarbon dates are currently available, there are substantial periods for which we have no dates. In other words, there are 'holes' in the data base and for most NGB Research Areas there are more holes than there are data points. We believe this is telling us something about the size of data bases required to adequately address the development of regional and sub-regional culture-histories.

Radiocarbon dating is an expensive process, however, and it may not be necessary to duplicate the same level of radiocarbon dating intensity as the Fort Rock Basin data base currently employs, provided the Fort Rock patterns of dates are duplicated in other research areas. In other words, if the Fort Rock Basin radiocarbon date patterns are duplicated in other research areas, i.e. cultural events across the Northern Great Basin were synchronized throughout prehistory, then it will not be necessary to date archaeological components quite so intensively since the Fort Rock data base will be directly applicable as support data in other research areas. It must be cautioned however, that such similarity must be proven first, not assumed first. The approach advocated here is to process as many reliable radiocarbon samples as possible each year. The Fort Rock Basin Prehistory Project has generally processed eight to 12 datable samples annually. Thus, a primary Research Area project goal is to recover datable organic material from occupation surfaces and features associated with well-defined cultural components at each site sampled by excavations. Site components that are not directly dated will be assigned an age based on obsidian hydration, stratigraphic analysis including known volcanic events, and chronologically diagnostic artifact (projectile points and shell beads in particular) cross-correlation.

Development of obsidian hydration rates for local obsidian are another NGBPP goal requiring direct association between radiocarbon dates and obsidian artifacts. Consistent XRF source characterization of obsidian specimens, the first necessary step in the development of a local obsidian hydration rate, also contributes to our understanding of local economic and social interaction issues. Systematic recording of stratigraphic profiles, accompanied by chemical and grain size analyses of sediments, cultural radiocarbon dates, and other stratigraphic horizon markers (such as volcanic ash) will be undertaken to provide information relating to the age of occupation, effective site environment, and other pertinent chronological information.

Paleoclimatic, Environmental, and Cultural Change in the Northern Great Basin

Settlement-subsistence patterns represent responses of human populations to subsistence resource variability in distributions and productivity within a region or sub-region. There are at least two primary ingredients--environment and culture--which affect the formation and variability of any settlement-subsistence pattern. Either of these variables can change through time. Imbalances between subsistence resource availability and human population densities, frequently triggered by short and long term climatic changes, for instance, can cause stress on settlement-subsistence patterns. The result may be a dispersion of local populations to distant resource localities, agglomeration of populations around a few relatively dense resources, and/or the intensification of lower ranked resource procurement strategies with their accompanying increased processing costs (cf. Oetting 1989:243-274 for extensive review of human responses to decreased subsistence resources in the Great Basin as proposed by various researchers). Therefore, analysis of settlement-subsistence patterns attempts to account for the distribution of archaeological sites in relation to identifiable subsistence resources, and to understand human adjustments to changes in them through time and space.

Resources available only in the Fort Rock Basin lowlands have been recovered in upland contexts around the basin and the converse situation--upland resources in lowland sites--has now been demonstrated also, although somewhat less frequently. Due to the limited availability of data on upland resource use in lowland sites, the emphasis in the land use model presented by Jenkins (1994a) was focused on the differential use of lowland resources, fish and seeds in particular, and the affects of their spatio-temporal distributions on human populations during the last 5600 years. Upland resources clearly affected the decisions of prehistoric Northern Great Basin populations--Late Holocene inhabitants in particular--and must, therefore, be considered concomitantly with lowland resources.

As we have pointed out above, temperature variability patterns, e.g. consistently warm biotically productive summers and/or generally warmer (probably wetter more cloudy) springs, may have affected the evolution of the historic ‘Plateau-like’ subsistence focus on root-crops at or near the beginning of the Late Holocene, also. Issues central to future investigations will involve the effects of climatic change on biotic productivity and plant resource reliability, increasing degrees of sedentism, settlement patterns, subsistence variations (lowland wetlands versus upland resources), and the intra/inter-basin human demography of the region. A detailed understanding of regional hydrology and paleoclimate is thus vital to the reconstruction of prehistoric human ecology and geography within the Northern Great Basin.

Current models of holocene climatic change emphasize the importance of variation in precipitation and temperature change, the importance of local and regional variations (individual storm-tracks), and the prevalence of short, sharp fluctuations in climatic patterns (Mehringer 1977, 1986; Miller et al. 1991; Cannon and Mehringer 1992). The overall climatic sequence, however,--recognizing that actual climatic patterns for any particular subregion of the Northern Great Basin may vary significantly--begins with the cool, moist post-Pleistocene (Anathermal) period, roughly 11,000 to 8000 BP. Conditions slowly became drier throughout most of this period with occasional short but significant reverses. There is evidence for a sharp increase in aridity in the Fort Rock Basin after

8000 years ago (Grayson 1979) and throughout most of the Desert West. Climate apparently continued to dry throughout the Warm-Dry Mid-Holocene period of roughly 8000-6000 BP. Sometime around 6000 BP, climatic conditions began to ameliorate, marking the beginning of what we have called the Late-Middle Holocene. Unusually moist climatic conditions prevailed throughout much of the Northern Great Basin from ca. 5600 to 2000 BP, with peak conditions varying in intensity and time from region to region (Mehringer 1986). The last 2000 years has seen dramatic fluctuations in climate from very wet to exceptionally dry and has often been characterized by oscillating--wet/dry--climatic patterns on the order of 10 to 30 years duration (cf. Antevs [1938] tree-ring data as an example).

In the Fort Rock and Christmas valleys, Late-Middle Holocene beach ridges provide evidence of large, shallow lakes (Allison 1979:54-61; Allison and Bond 1983; Droz and Jenkins n.d.). The presence of reworked volcanic tephra from the 7600 BP eruption of Mount Mazama in these beach features indicates that they are Middle Holocene in age and most likely date to Late-Middle Holocene climatic events (Droz and Jenkins n.d.).

Analysis of faunal assemblages from the Connley Caves (Grayson 1979) suggests that Paulina Marsh was most biotically productive between 7000 and 9500 RCYBP. Waterfowl and sage grouse reached their greatest numbers in strata dated to this time period, and Grayson (1979:447) believes this reflects an increase in size and stability of the nearby marsh over the preceding period (early Post-Pleistocene, 9,500-11,200 RCYBP). A relative reduction in the size of Paulina Marsh during the Warm-Dry Mid-Holocene period is suggested by reduced numbers of waterfowl and sage grouse in strata related to these occupations in the caves. Increased evidence of human activity in the Connley Caves, following a marked paucity of cultural remains between 7000 and 5000 RCYBP, led Bedwell (1970:37) to suggest that climatic amelioration had begun by about 5000 RCYBP and human populations began increasing in the Fort Rock Basin. Improved moisture conditions during the Late-Middle Holocene resulted in overflow into Silver Lake and the Fort Rock Valley at this time. Radiocarbon dates from excavated house floors at the Big M site suggest that occupation of habitation sites, associated with wetland features formed by this overflow, began ca. 5000 RCYBP (Jenkins 1994b).

The most current and detailed Holocene climatic records applicable to the Northern Great Basin are those provided by Wigand (1987) and Mehringer (1986) from the Harney Valley/Steens Mountain region based on pollen, seeds, and spores from pond and lake sediments. Between 5400 and 3600 RCYBP, submerged and emergent aquatic plants were abundant, as were mollusc remains, indicating a rising water table. Lakes and marshes in the Northern Great Basin apparently expanded dramatically during this period. Water continued to be high in Diamond Pond until 2000 BP. After that time the climate fluctuated rapidly between wet and dry cycles. Increased sagebrush pollen suggests that drier conditions prevailed between 2000 and 1500 BP. Moister conditions returned between 1500 and 900 BP, as indicated by increased grass and juniper pollen and a relative decline in sagebrush pollen. Drier conditions returned between 900 and 400 BP, with a marked drought occurring about 500 BP. The last 400 years appear to have been a time of moderately moist conditions (Mehringer 1986; Wigand 1987).

Climatic shifts toward wetter conditions during early post-glacial and Late-Middle Holocene times apparently improved lowland environments considerably, bringing trees useful for firewood and building materials down to the valley floors while increasing the scope of lake/marsh environments.

There is little doubt that biotic productivity increased dramatically with more frequent rain and flooding. Increased water flow improved water freshness, increased fish and waterfowl productivity, and generally improved range conditions. *Chenopodium* and *Sueada* (waada) are plants particularly fond of the sandy, slightly saline soils found around the ephemeral lakes of the Northern Great Basin (Couture et al. 1986). The widespread distribution of these small seeds with bulrush in archaeological sites in the Fort Rock Basin--and the fish which almost always accompany them in Late-Middle and Late Holocene times--clearly indicates that they were an important part of the aboriginal diet. Their increased availability during unusually wet periods undoubtedly affected human settlement and subsistence patterns throughout the Northern Great Basin.

Recent paleoethnobotanical studies at sites on Boulder Village ridge in the Fort Rock Basin (Stenholm 1994) show that roots (e.g. biscuitroot, yampah, sego lily, and wild onion) were exploited by Late Holocene aboriginal groups. The shallow, rocky soils of these upland settings were excellent habitat for such edible root crops (Housley 1994). Lithosols conducive to the proliferation of these important native foods are characteristic of valley margins and upland settings as well.

Like the Fort Rock Basin, many other foraging ranges of populations centered in 'wet' basins combined diverse environments and resources which varied substantially in composition and productivity with climatic change. Radiocarbon dates recovered at sites in the Northern Great Basin exhibit significant tendencies to cluster through time. If these dates can be assumed to represent times when human populations were present in significant numbers within the region, then they suggest that at various points in time there were significant fluctuations in the population. Jenkins and Connolly (1990:147) suggest that there was a general synchronization of human population fluctuations with increased and decreased water budgets in the "wet basins" of the Northern Great Basin in general (cf. also Weide 1968; Bedwell 1973; Pettigrew 1985; Wigand 1987). Clusterings of radiocarbon dates in adjacent physiographic regions--the southern Columbia Plateau and Cascades-Coastal Ranges of southwest Oregon in particular--suggest that at times these populations fluctuated with those in the Northern Great Basin, and at other times responded in exactly the opposite manner, decreasing as Northern Great Basin populations increased (cf. Connolly et al. 1993:135). This suggests that cultural boundaries between these regions were fluid, allowing populations to ebb and flow across space in response to changing environmental and cultural parameters.

Northern Paiute oral history (Kelly 1932:72), and a substantial body of archaeological evidence (Oetting 1989; Connolly 1994), suggests that much of the Northern Great Basin was occupied until the last 400 years or so by the Klamath/Modoc, who maintained close trade and cultural relationships with speakers of related Penutian languages on the Columbia Plateau. In other words, various groups of Penutian-speakers may well have moved into the "wet" desert basins from adjacent regions as the marshes expanded and then moved back to their homelands--or into other basins--as marshes dried up. Such a mechanism has elsewhere been invoked as critical to the expansion of Numic-speaking peoples (including the Paiutes) out of their central Great Basin homeland in late prehistoric times (Aikens 1994; Aikens and Witherspoon 1986). If this was the case, then as has already been observed, artifact types in these regions should be quite similar during those periods of greatest cultural exchange (i.e. when marshes were greatly expanded). Great similarity in artifact styles is indeed evident in the assemblages of the Mid-Columbia River, Klamath, and Northern Great Basin regions (Dumond and Minor 1983; Sampson 1985; Oetting 1990). Basketry (Cressman 1936:39, 1942:140; Cressman, Williams, and Krieger 1940:15; Connolly 1994), ground stone (Oetting 1989:71-76), and projectile points (Sampson 1985:342-347; Dumond and Minor 1983:167) all exhibit considerable evidence of close cultural ties between these regions. There can be little doubt that substantial interaction between these populations occurred on a more or less recurring basis, resulting in cultural assemblages which continued to resemble each other closely. The mechanisms by which these cultural exchanges occurred is somewhat less clear, but the possibility that members of these various populations actually lived together around the shores of vastly expanded wetlands systems in the Northern Great Basin can not be ruled out.

The evidence presented above suggests that there were lakes and marshes in the Fort Rock Basin and other "wet" basins of the Northern Great Basin throughout much of the last 6000 years. Human occupation appears to have been most intense around these wetland resources and least intense away from them (Brashear 1994; Byram 1994; Cannon 1983b; Toepel et al. 1980; Toepel and Minor 1994). The question then is, how important were adjacent wetland resources to local inhabitants?

Long-term wet periods probably resulted in expanded lake-marsh conditions in local internally draining basins, improving their ability to support relatively dense, semi-sedentary human populations either pushed or pulled there by changing environmental patterns. Short-term wet periods would have resulted in water-filled playas, marshes, and meadows which dried up during the late spring and summer. Human populations are believed to have responded to these conditions by burgeoning during periods when dense, storable resources--fish and small seeds in lowland settings, camas, epos, lomatiums, and other roots in upland settings--could be intensively collected. As the productivity of these short-term resources waned seasonally, however, human populations dispersed to other locations, leaving any accumulated excess cached for later use in winter villages.

If climatic fluctuations of the degree suggested for the Warm-Dry Mid-Holocene period caused a movement out of drier lowland basin areas, then periods of intense settlement in more upland settings may correlate to these changes as suggested by Fagan (1974). If, on the other hand, a constant seasonal or year round settlement pattern for most of the Holocene is indicated then the effects of climate on local settlement-subsistence patterns may not have been as severe as suggested. The Northern Great Basin provides an archaeological record that has the potential to address questions about the movement of populations in a broad range of environmental contexts that have not previously been systematically explored, particularly as it pertains to responses to both long- and short-term climatic change throughout the Holocene.

Questions regarding paleoclimatic, environmental, and cultural change in the region generally include:

1) What environmental conditions prevailed in the area during the occupation of the site(s)?
2) Does the local environmental history fit the general three phase model of Post-Pleistocene environmental change listed above?
3) Are changing climatic conditions reflected by botanical assemblages?
4) Do periods of most intense occupation correspond with periods of greater effective moisture (pull) or did resources attract higher populations during relatively drier periods (push)?
5) Do upland sites exhibit evidence suggesting site occupations increased during the Warm-Dry Mid-Holocene period, as Fagan's (1973, 1974) model suggests?

6) Is there evidence for changes in hydrologic activity at the springs of the region?
7) Did the intensity of occupation vary with changing climatic conditions?
8) What plants and animals were utilized during the Warm-Dry Mid-Holocene and Late-Middle Holocene occupations?
9) Did the environment in the immediate vicinity of the site(s) vary significantly during these periods?
10) Did site occupation intensity increase during the early portion of the Late-Middle Holocene (5600 to 4000 BP)?
11) Has the value of stable water sources, hunting and gathering locations, tool stone sources, and more permanent settlement locations remained constant throughout different climatic periods?
12) Do radiocarbon dates from the site(s) coincide with periods of increased precipitation in the Northern Great Basin?
13) Do they cluster with radiocarbon dates recovered in structures in the Gerber Reservoir District and Fort Rock Basin?
14) Do peaks in periods of temporary camp use correspond in age with occupations at the habitation sites?
15) Were different resources exploited at different times?

Data Needs and Data Collection Methodology

Paleoethnobotanical analysis, including identification of macrobotanical remains and charcoal, roots, and seeds, and analysis of fossil pollens and starch granules in site sediments and features, will provide the foundation for paleoclimatic reconstruction. These data, as well as other cultural remains and features such as storage and processing tools and facilities, will aid in assessing cultural responses to environmental changes. Chronological information (discussed above) will be matched with economic and environmental data to aid in chronicling changes over time.

Environmental changes may be recorded in the types and proportions of plant materials in the deposits of sites. Consequently, sampling techniques (soil samples for flotation analysis, in situ and screen recovery, and washes of artifacts) designed to recover macro and micro fossils from a broad range of deposits and tool surfaces will be applied in sites. The excavation of significant portions of site deposits must precede, and facilitate, the recovery of these samples. The same is true in regard to faunal remains which may assist in the investigation and interpretation of paleoclimatic/paleoenvironmental changes. Large samples of each--plant and animal fossils--will provide greater reliability in the interpretation of the data.

More straightforward paleoclimatic investigations will involve pack rat midden and pollen core analysis by students and faculty from various institutions and departments throughout the west. Pollen analysis is the best known method of investigating paleoclimatic change through time in the Northern Great Basin (Mehringer 1985, 1990; Wigand 1987). While limited by the relatively small number of sites which have consistently provided completely anaerobic environments throughout the Holocene, pollen columns taken from the bottoms of lakes, ponds, and marshes are a well-proven method of investigating changing climate and environments through the comparative analysis of moisture and temperature sensitive plant pollens. As noted above, inter-disciplinary research involving the correlation of archaeological and palynological data promises to advance our understanding of both natural and cultural change throughout the region.

Settlement-Subsistence Patterns

A model of human demographic variation in the Northwestern Great Basin--sensitive to and corresponding with climatic/environmental variations--has been developed from recent investigations in the Fort Rock Basin (Brashear 1994; Byram 1994; Jenkins 1994a, 1994b; Jenkins and Brashear 1994; Toepel and Minor 1994). It also takes into account the evidence for changing settlement-subsistence patterns in adjoining regions, assuming that the occupants of the Fort Rock region had interactions with these populations and occasionally included them. The NGBPP will investigate any number of subregions and their population interactions throughout the next 10 years. Thus, the project offers the most appropriate and comprehensive chance to test the model developed for the Fort Rock Basin in the Northern Great Basin.

Thus far, we have primarily discussed the effects of annual climatic change on local resources, and indeed it was at this level that aboriginal populations directly responded to climatic fluctuations. Regional responses to long-term climatic trends, however, were more important to cultural evolutionary processes than were local responses to survival needs on an annual basis. Long-term climatic changes generally affected the entire region. Thus, the archaeological results of their affects on local settlement-subsistence systems are particularly significant to archaeological research. Isolated annual events, on the other hand, are for most practical purposes archaeologically invisible. It is the long-term pattern of cultural response to local, regional, and extra-regional conditions which are most generally detectable in the archaeological record.

Archaeological sites left by non-agricultural hunter-gatherer populations tend to be the product of repeated occupations occurring over some period of time. Activities conducted at particular sites are the product of decisions made in response to immediate (annual and local) environmental conditions. Predominant activities conducted at each site leave the majority of debris composing the cultural assemblage. Consequently, long-term climatic changes toward more stable conditions result in increased site reoccupations, whereas fluctuating conditions generally result in more frequent moves, site abandonments, varied site uses, and less patterned site occupations. The longer the trend toward environmental stability, the stronger and more identifiable the subsistence pattern will be within the sites, and the easier it will be for the archaeologist to detect it. Thus, strong patterns in site locations and subsistence activities are generally the result of strongly patterned cultural decisions, patterning which can only exist within parameters established by relatively stable (i.e. long-term) environmental conditions. Weakly detectable settlement-subsistence patterns, on the other hand, are generally the result of less intense site occupations and erratic, less patterned cultural responses to generally unfavorable environmental conditions.

It could be argued that long-term drought conditions, coupled with relatively high human populations might so limit human responses to local and regional environmental conditions that strong archaeological settlement-subsistence patterns would be developed, reflecting a reduction in viable choices available to the occupants of a region. A form of this argument has surfaced in relation to the development of marsh side villages in the Great Basin (Kelly 1985). It must be remembered, however, that marshes are not immune to changing environmental conditions, and that at the time they would most likely be intensively exploited under "stress" models, would frequently be in productivity decline themselves. This is not meant to imply that human populations under stressful conditions did not exploit marshes, for of course they did, but marshes are biotically productive places which were popular locations for winter villages because they offered fresh foods even during the long winter months common to the Northern Great Basin (Fowler and Liljeblad 1986:438). In other words, marshes were constantly incorporated into the settlement-subsistence pattern, and attempting to over-exploit any portion of the regional ecosystem, including the marshes, to compensate for a general reduction in regional biotic productivity could only result in further reductions in marsh productivity.

In other words, long-term "stress" conditions should have resulted in reductions in regional human populations and their residues (artifacts and sites). It is likely therefore, that the majority of archaeological data predominantly reflects the "good times" (Elston 1982), and not the "bad times" in the Northern Great Basin. If this is so, then radiocarbon dates acquired on cultural materials recovered from randomly selected sites should cluster strongly in certain time periods, for these were times when people were common throughout the region (cf. Jenkins 1994a; Droz and Jenkins n.d. for examples). Outlying radiocarbon dates can be expected to fill in between radiocarbon date peaks as numbers of dates increase, because human population densities in the Great Basin were continuously adjusted so that some people, although relatively few at times, were scattered throughout the region. Low numbers of radiocarbon dates, on the other hand, should generally indicate "bad times" or periods of extreme climatic fluctuations. It may be our greatest challenge in the area of settlement-subsistence investigations to identify the "bad" times and periods of extreme environmental fluctuations in various subregions of the Northern Great Basin and the cultural responses to the sequence of natural and cultural events which occurred during these times.

The character of individual basin hydrologic systems would have directly affected the nature of the local settlement-subsistence systems. Many sites located in or near marsh environments might become uninhabitable if water levels were too deep, flooding occupation sites and killing local plants, or too shallow, which could lead to frozen conditions during extreme winter temperatures. The recent 1981-1985 El Nino-influenced wet cycle brought just such flooding effects to the Northern Great Basin (Housley 1994), and prehistoric research at Nightfire Island, a long-occupied site on the Oregon-California border, shows how dramatically just such hydrologic changes could affect a marsh-oriented native population (Sampson 1985).

Throughout the Middle and Late Holocene, lowland exploitation and occupation continued to be important, but by about 1500 BP a dramatic shift to spring-summer residential concentration in the uplands was widely evident all along the western fringe of the Northern Great Basin (Jenkins 1994a, Jenkins and Connolly 2000; Silvermoon 1994; Fowler et al. 1993). We believe that two factors are likely responsible for this change. First, survey data shows a large number of sites marked by late-period projectile points, suggesting there had been significant long-term growth in the regional population during the relatively productive Late-Middle Holocene interval. Secondly, the Late Holocene climate began to exhibit increasingly frequent wet-dry fluctuations, of the sort documented by Wigand for Diamond Pond in the Harney Basin to the east. With a considerable population to support, and decreasing dependability of low-elevation wetlands resources, selective advantage fell to those groups that focused more time and energy on the intensification of storable upland resource (root crop) production. These resources had always been available to some degree and had always been exploited to some degree, but now their abundance, storability, and more reliable productivity--related to warming early spring temperatures and greater cloud-cover insulation/precipitation?--became paramount economic considerations in a way they had not been before.

Returning to the regional scale, it may be speculated that populations within particular "wet" basins of the far west, of which the Fort Rock Basin is an example, fluctuated through time as people moved to different locations to exploit the concentrated resources known to be available to them through extensive information sharing networks. These networks, built on marriage, friendship, and sharing/trading relationships, probably extended beyond the physiographic boundaries of the Northern Great Basin and thus, included populations from the surrounding regions of the Southern Columbia Plateau and the Klamath-Modoc homeland in the Cascades foothills region. Unusually productive conditions in the 'wet' basins and their surrounding uplands resulted in locally dense human populations, for at least brief periods of time, while visitors and locals alike took advantage of resources at their peak of productivity (Jenkins 1994b). These exploitative/social events served to strengthen the information sharing and inter-marriage networks, insuring continued ease of access to resource concentrations throughout the region.

The Fort Rock Basin settlement-subsistence model suggests that a gradual shift in village site locations occurred between ca. 3000 and 2000 years ago from a semi-sedentary lowlands residential pattern centered or "mapped on" to (Binford 1980) wetlands and terrestrial resources in lowland-wetland settings, to a similar--but possibly two-village--residential pattern emphasizing rich upland root crops.

The model assumes that while human populations gradually increased on a regional level over the last 5600 years, climatic variations necessitated significant fluctuations in the populations of the individual "wet" basins--those with marshes and streams that originate in nearby mountain ranges--as people moved to concentrated resources available for varying periods of time. As a result, some increases in local populations were the result of people moving in from adjoining regions. Such movements help account for the "sudden" appearance of apparently large local populations suggested by clusters of radiocarbon dates and habitation sites (Jenkins and Brashear 1994; Jenkins 1999; Droz and Jenkins n.d.; Jenkins and Connolly 2000). Thus, shifts in local settlement patterns may be viewed as cultural responses to both environmental and demographic changes occurring within and outside the local region. Cultural patterns observed in one locality can only be fully understood in a broader regional context.

In the Great Basin, human adaptation to climatic fluctuation involved population movements at two levels. Ethnographically, local populations tended to fluctuate almost on a yearly basis in response to improving and worsening local conditions (Fowler and Liljeblad 1986:437). Hard times in one basin led to the shift of local personnel to adjacent basins. Unique ecological combinations in each basin generally assured that with some mobility--facilitated through inter-basin marriage arrangements--most of the regional population could be accommodated (cf. Thomas 1972). It is quite possible that this method of population adjustment has considerable time-depth, and may have operated in some form throughout the last 6000 years or more of Northern Great Basin prehistory. The NGBPP will attempt to increase our understanding of how this general model of population movement could have influenced human settlement patterns in broad range of environmental settings across and adjacent to the Northern Great Basin.

Above we argued that between 5600 and 3000 years ago, a Late-Middle Holocene semi-sedentary small village or hamlet pattern in the Fort Rock Basin focused on the edges of wetland settings--marshes, lakes, and ponds--to facilitate winter food collection in biotically productive ecotones. During the spring and summer, when critical seasonal lowland resources such as fish and seeds were available, storable foods were processed and cached for winter consumption. Upland resources--roots and large game in particular--were taken by special task groups on short logistical moves of personnel to resources. As they were during the ethnohistoric period (Kelly 1932; Couture et al. 1986), roots were probably cached near the place they were gathered and transported back to the village late in the fall.

The location of Late-Middle Holocene lowland winter villages in Fort Rock Basin is postulated to reflect the fact that populations were, at least initially, focused on dense patches of wetland/grassland resources. This subsistence-settlement pattern was successful for two reasons. First, human populations were initially (ca. 6000 BP) relatively small and slowly growing, though they may have periodically been augmented for short periods by inter-basin population movements to extremely abundant seasonal resources. Later (by 5600 BP) they appear to have been substantially augmented by presumably immigrant inter-regional or inter-basin populations and hamlets and winter houses were situated near the densest and most productive subsistence resources. Second, highly productive lowland resources formed much denser, more reliable food "patches" during the Late-Middle Holocene than they did during subsequent climatic phases. Water sources were more constant and ***summer producing*** plants adapted to moist soils, such as chenopods, amaranths, sedge, bulrush, and waada, were concentrated around these water bodies. The evidence of fishing with nets and hook-line combinations suggests that nearby water bodies were stable enough to make fishing a profitable enterprise. Large volume storage and house floors appear at many sites in the marshes suggesting that intensification in lowland--marsh and grassland--resources had occurred, committing populations to the accumulation and defense of stored comestibles. General summer range conditions, at least, may have been greatly improved as well, and animal populations undoubtedly responded positively to this increased productivity. Extreme winter weather may have moved large herds of herbivores down to the valley floor and into the protection of adjacent, low elevation woodlands, as occurs on a regular basis today (Oregon Department of Fish and Wildlife, personal communication).

Following this initial phase of sedentism–after about 4500 BP--environmental conditions and cultural conditions appear to have changed for some reason at a time when the human population had been growing (Droz and Jenkins n.d.). Sedentism, while certainly not abandoned, may have been practiced in a more dispersed pattern, perhaps reflecting a general amelioration of conditions. A second phase of increased sedentism is indicated to have begun about 3800 BP. This phase appears to have been driven by substantially increased precipitation and may well have been accompanied by longer, warmer, and wetter springs and early summers. Initially, the subsistence emphasis may have remained on seeds and fish but gradually--between 3800 and ca. 3000 BP--the importance of storable, ***spring producing*** upland root crops increased, as had occurred at a somewhat earlier date on the Columbia Plateau (Ames and Marshall 1980; Chatters 1989).

The evidence for human occupation of the Fort Rock Basin between 3000 and 2000 BP is currently scanty though sporadic increases in human activity, in response to local conditions, seems likely. Between 3000 and 2000 BP the shift of subsistence focus to emphasize the intensive exploitation of upland root crops continued. Radiocarbon dates from the Fort Rock Basin lowlands suggest that occasionally there were brief periods of intense occupation as between 2300 and 2500 BP, probably related to the exploitation of short-term, highly productive resources like fish and seeds. In general, however, populations in the Fort Rock Basin lowlands appear to have been relatively low and populations exploiting local resources may have generally been based elsewhere (Sycan and Klamath marshes, Summer Lake, Abert Lake-Chewaucan Marsh, Harney Basin?). This pattern of reduced occupation was apparently duplicated at Nightfire Island in the Klamath Basin, as no radiocarbon dates from this site fall between 2300 and 3000 years BP (Sampson 1985:104).

It is interesting to note in this context that the Pithouse II period of occupation in the Lower Mid-Columbia region (a time of increased numbers of large villages) falls between 2400 and 3000 years BP (Chatters 1989:4). The correlation of dates in these three samples suggests that populations may have adjusted on an inter-regional scale to changing environmental and social conditions in the Northern Great Basin.

Present evidence suggests that during the last 1500 years a two-village settlement pattern emerged in the 'wet' basins, at least, of the Northern Great Basin. Winter settlements were situated near modern water sources as they were in the Abert Lake-Chewaucan Marsh Basin (Oetting 1989) and at Carlon Village in the Fort Rock Basin (Wingard 1999). Spring-summer villages were located in upland settings in close proximity to root crops which proliferate in shallow lithosols (Prouty 1995). Hunn (1990:170-177) and Thoms (1989) have demonstrated for the Pacific Northwest that with intensive exploitation of root crops as much as 50% of the annual caloric intake of a single family could be obtained during a typical 60-day harvesting period.

The occupants of Boulder Village (and smaller villages located nearby in the uplands) apparently chose to bring lowland resources (fish, chenopodium, waada) to upland village sites during the spring and summer rather than transport large quantities of bulky roots down to the lowlands during this extremely productive time of year. In such situations, the uplands villages may have served as early spring/summer villages and appear to have been abandoned during the winter in a settlement pattern similar to the ethnographic Klamath/Modoc pattern of dual seasonal villages (Spier 1930; Barrett 1910). In most years, people apparently wintered at lower, warmer elevations; however, annual climatic conditions occasionally resulted in exceptionally abundant root-crops. During those years, some portion of the winter was apparently also spent in the upland spring-summer villages near the resultant larger than normal caches of roots (Jenkins 1994a; Jenkins and Brashear 1994).

This model is based largely on evidence from the Fort Rock Basin, and has been developed with reference to food resources specific to that basin. However, the model provides a set of testable expectations regarding other areas of the Northern Great Basin. The Summer Lake and Chewaucan Marsh/Abert Lake areas are close enough that their populations probably moved in and out of the Fort Rock Basin on a more or less regular basis, and pithouse/stone ring villages are the most prominent feature of Abert Lake archaeology (Pettigrew 1985; Oetting 1989). Radiocarbon dates from these villages, as well as from probable village/hamlet sites in the Harney Basin (Fagan 1974; Aikens and Greenspan 1988), cluster closely with those from the Fort Rock Basin, suggesting that the populations of all three basins were fluctuating in a more or less synchronized pattern (Jenkins and Connolly 1990:147; Connolly et al. 1993:130-135; Jenkins and Connolly 2000). Stone ring villages in upland mesic settings are also known to exist in the Gerber Reservoir and Drews Valley districts between Lakeview and Klamath Falls, Oregon (Silvermoon 1994; Burnside 1987; Musil 1990).

Root ground habitation sites generally appear to have been located near water sources--e.g. creeks, springs, seeps, lakes, and playas--the wide spread occurrence of which often led to a relatively dispersed settlement pattern with small hamlets scattered around these sources of water. Additionally, the presence of secondary resources like big game, small seeds, natural tool stone deposits, and wooded settings which provided firewood, structural members used in the construction of houses, and wind breaks in the trees which made the unpredictable, and sometimes cold, spring weather bearable, often affected seasonal settlement patterns in upland settings (Jenkins 1994; Jenkins and Brashear 1994) . Reports of stone ring structures and hamlets in many upland and mid-elevation settings within the Northern Great Basin suggest that intense occupations similar to those documented in the Fort Rock Basin and Gerber Reservoir uplands, also occurred in other basins and valleys of this region.

Thus, NGBPP research will address the nature of human occupation across the south central to southeastern quarter of the state, including the length and intensity of occupation over time, seasonality of occupations, inter- and intra-site functional variability, and changes in these attributes over time. The evidence for substantial hamlet and village settlements in both lowlands marsh and uplands root grounds, throughout the region, suggests that Late Holocene settlement-subsistence patterns involved complex and often changing combinations of sedentism and mobility.

Ethnographic information pertaining to the Northern Paiute occupation of the Northern Great Basin describes a predominant pattern of seasonal transhumance (Kelly 1932; Whiting 1950; Couture et al. 1986) throughout the spring, summer, and early fall. Occupation of upland summer villages, of unknown duration and intensity, by the Modoc (Ray 1963) offers the most compelling settlement-subsistence model to account for the upland root ground stone ring villages and hamlets though the duration and construction of facilities by the Modoc in such settings as these is unclear. Limited testing of such sites in a variety of locations suggests that they have occasionally experienced intense, and sometimes longer term occupations, based on the size, depth, and density of the cultural deposits (Jenkins and Brashear 1994; O'Grady 1999). Currently, however, the predominant archaeological pattern indicates a limited number of activities generally associated with a land use pattern of short term task-specific sites (i.e. root collection and processing). Thus, current archaeological data suggests longer and more intense occupation of the uplands in prehistoric times than was indicated for the ethnographic period (Ray 1963; Kelly 1932; Fowler and Liljeblad 1986).

Jenkins (1994a), Silvermoon (1994), and Burnside (1987) suggest that a regional shift to relatively longer term upland habitation sites occurred between 4000 and 3000 years ago, reflecting a new focus on highly productive root crops which may have developed in response to Late-Middle Holocene climatic conditions.

1) Was there a shift to greater sedentism throughout the 'wet' basins of the Northern Great Basin about 5600 BP?
2) If so, was the development of greater sedentism related to a phase of exceptionally 'good times' marked by extreme biotic productivity, or were they stressful 'bad times' marked by unusually cold winters?
3) Is there evidence for domestic structures, storage pits, specialized activity and disposal areas, or other features in sites which may be expected of more long-term residential base sites?

4) Were residents of Late-Middle Holocene times engaged in the same intensive subsistence activities that are in evidence at Late Holocene settlements in upland/mid-elevational settings (root crop exploitation)?
5) Do faunal and botanical assemblages suggest emphasis on different resources during the Late-Middle Holocene and Late Holocene times?
6) During what season(s) of the year was the location occupied based on botanical and/or faunal evidence?
7) Is there a difference in season of occupation between sites in or between components of sites of different ages?
8) Is there evidence for the intensification of root plant harvesting at upland sites during the Late Holocene times, as occurs in the Fort Rock Basin?
9) If so, what plants were intensively collected?
10) During what season(s) of the year were these plants available and the sites occupied?
11) What were the activities pursued at temporary camps, and did their functions remain the same through time?
12) If sites functioned as temporary campsites, where did the site occupants come from originally?
13) Is there cultural or chronological evidence which suggest that the sites were visited from more permanent settlements in the near vicinity, or from more distant localities?
14) Were obsidian quarry and workshop locations also campsite locations as might be evidenced by artifacts or cultural features related to domestic activities?
15) Were artifacts found at quarry locations used on or near the sites or were they simply replaced and discarded at these locations?
16) Did these sites function as processing/manufacturing locations for activities which consumed large quantities of tool stone (e.g. wood and bone tool manufacturing)?
17) How does the utilization of this locality compare to the ethnographic and archaeological information already available for the area?
18) Do plant or animal remains recovered at the sites represent species that are no longer locally available?
19) How have these changes affected site function and local land use patterns?

Data Needs and Data Collection Methodology

The type, function, and age of sites will be the major emphasis of settlement-subsistence pattern studies of the NGBPP. The types of data needed to address these topics will involve the types and distributions of artifacts, faunal and floral remains, and types of features present in each site type. NGBPP excavations will center around cultural features--e.g. houses, living floors, cache pits, fire hearths, rock art, and bedrock mortars--which have been the activity centers of the sites and/or cultural components within the sites. This excavation strategy will provide for the recovery of a large sample of artifacts, faunal and floral remains, and identification of cultural feature types. Soil samples will provide supplementary samples of faunal and floral remains (fish, amphibians, rodents, and reptiles; and charcoal, charred seeds, bulbs, and berries; pollen, phytoliths, and starch granules). The identification of these remains and their relative proportions within the assemblages will tell much about settlement-subsistence issues in each location.

Investigating house structures, activity areas, and special function features such as storage pits, hearths, processing floors, and middens will require exposure of areas large enough to record and identify significant patterns of distribution. The requirement for areal exposures to adequately record cultural features is the most limiting element in establishing reasonable sample sizes for each component investigated. While many of the analyses required to address these issues, including obsidian hydration, radiocarbon dating, botanical analyses, sedimentological studies, etc., can be adequately addressed by in depth analysis of portions of the recovered materials, there can be no substitute for larger areal exposures when the unit of study (a house floor, a workshop station) is an area.

Cultural Relations and Ethnic Group Territories

Ethnographically, there were a number of border areas between the Northern Paiute, the Klamath/Modoc, various Southern Columbia Plateau groups, and Snake River Plains groups (Ray 1963; Stewart 1966; Murphy and Murphy 1986). Wheeler-Voeglin (1955) suggests, based on treaty documents, that the area north of Goose Lake was neutral ground utilized by different groups for hunting and collecting during the year.

Archaeological evidence for the use of the Drews Valley area is provided by the sourcing of obsidian artifacts from Nightfire Island and Kawumkan Springs (Hughes 1986) to the Drews Creek/Butcher Flat obsidian source. Drews Creek/Butcher Flat obsidian has also been found in Christmas Valley, 160 km to the north (Oetting 1993:584), and in sites in the upper Rogue River (Pettigrew and Lebow 1987). Artifacts submitted for source analysis from sites in Quartz Valley, a small valley to the northwest, source to the Drews Creek/Butcher Flat source and to sources to the west, north, and east of Drews Valley (Winthrop et al. 1987; Musil 1990).

Recent archaeological research in the Lake Abert/Chewaucan Marsh Basin (Oetting 1989) and Fort Rock Basin (Aikens and Jenkins 1994a) has led to the hypothesis that the area was populated by ancestral Klamath/Modoc peoples from at least 4000 BP until just before historic contact. This extension of Penutian speaking peoples into what was historically considered Northern Paiute (Numic speakers) territory further enhances the potential for sites in the Northern Great Basin to address questions on the ethnic affinity of prehistoric occupations. Likewise, incursions into the northern and eastern fringes of the Northern Great Basin by Plateau and Snake River populations are known to have occurred both historically (Couture et al. 1986) and prehistorically (Lyons 1998). Thus, questions related to cultural relations and ethnic group territories are:

1) Is there evidence that the site(s) have been occupied by different ethnic groups at various times in the past based on artifact styles or abruptly altered land-use strategies?
2) Within what area did the inhabitants procure their raw materials, particularly traceable obsidian tool stone?
3) Did procurement patterns, such as the range or direction of principal sources of obsidian or beads, change over time?

Sampson (1985) presents data which suggests that warfare, possibly connected with attempts to control the marine shell/obsidian trade networks between the coast and the interior, intensified around

1500 BP and may have disrupted the flow of marine shells to the Northern Great Basin. Jenkins and Wimmers (1994) have reported what appears to be a significant reduction or complete replacement of *Olivella* shell beads, which were quite prolific in earlier times, in sites dating after of 1500 BP in the Fort Rock Basin. Considering these data, we ask:

4) Are there exotic materials present in the archaeological assemblage(s) which would suggest contact with populations from adjacent physiographic regions such as Northern California, the Cascades, Klamath Basin, the Columbia Plateau, the southern Great Basin, and the ‘wet’ basins of the Northern Great Basin?
5) If marine shell artifacts are present are they found in all components or are they found only in deposits pre-dating 1500 BP?
6) Did the amount of locally procured obsidian vary through time?
7) Do habitation sites exhibit relatively higher percentages of local obsidian than temporary campsites?

Data Needs and Data Collection Methodology

The identification of exotic artifacts and materials is an important method of investigating the topic of cultural contacts. Steatite and sandstone pipes, atlatl weights, pinyon nuts, clay objects, marine shell beads, projectile points, and bifacial blades are all items which may have originated with nonlocal populations. Recovery of exotic items from firmly established and dated cultural contexts will be part of standard data collection procedures, but target numbers of such materials will not be part of the research design.

The chemical identification of obsidian sources will be the primary systematic technique which will be applied to the investigation of topics relating to land use changes and cultural affiliations. The expected recovery of large samples of obsidian artifacts will permit attention to these questions without special recovery strategies. Connolly and Jenkins (1997) have demonstrated that major changes in source direction of exotic (nonlocal) obsidian artifacts have occurred throughout the Late-Middle Holocene and Late Holocene periods on the southwestern periphery of the Northern Great Basin. Jenkins et al. (n.d.) demonstrated similarly significant changes through time in the Fort Rock Basin. These shifts in obsidian source directions are believed to reflect population movements and social interactions between various population centers of the Northern Great Basin. The broad distribution of obsidian throughout the region insures the widespread applicability of this method to issues of cultural interaction and ethnic group affiliation .

Prehistoric Technology

The prehistoric technology of the region is primarily represented by stone tools and debitage. Obsidian, an important material in the region's native economies, averages well over 90% of the tool stone present at most sites in the Northern Great Basin. It was often used extensively for cutting, piercing, chopping, sawing, and scraping tools, and in production activities such as hide processing and wood working. The location of obsidian tool stone sources was an important consideration for mobile hunting and gathering groups, and visits to lithic material sources would necessarily be incorporated into the regular seasonal movements of the group.

Tool and debitage analysis have allowed for the interpretation of the chipped stone tool manufacturing and maintenance functions utilized at each site. The analysis of lithic debitage has become an important part of lithic analysis and the morphology and size of the debitage is strongly correlated to the manufacturing techniques employed to produce chipped stone tools. Patterns of tool breakage and wear also contribute to an understanding of the function of stone tools. The analysis of lithic debris and discarded bifaces at sites may define separate reduction sequences for large corner-notched and small stemmed and corner-notched projectile points (cf. Musil 1999). Research into the delineation of biface reduction sequences (Callahan 1979; Flenniken 1985; Frison and Bradley 1980; Muto 1971) and the use-life of projectile points (Flenniken and Raymond 1986) and other tools can be informative also. Lithic debitage and chipped stone tool assemblages account for the majority of artifacts recovered at most sites in the Northern Great Basin and lithic analysis may provide important information about site function and activity area interpretations.

Obsidian, chert-chalcedony, and basalt-andesite quarry locations contain major components derived from the single primary activity of quarrying nodules, boulders, and outcrops and initially reducing the raw material to a form(s) suitable for further reduction at other sites. All three material types have been, at least experimentally, characterized through the application of XRF and other source identification techniques to facilitate the tracking of materials from their sources across the natural and cultural landscapes. Questions related to lithic assemblage analysis are:

1) What were the products of lithic procurement activities at quarry sites?
2) What is the distribution of these products in the sites of the surrounding area?
3) What biface reduction trajectories can be identified?
4) Do any have temporally restricted occurrences that may be culturally or functionally diagnostic?

Some processing of materials, wood and bone in particular, may have been conducted at lithic workshop sites (cf. Jenkins and Connolly 1990).

5) Are artifacts present which are end products (expedient flake and core tools) not associated with reduction trajectories?
6) Do their relative numbers vary significantly from those recovered at other site types in the area, suggesting intensification of these activities at lithic resource sites?

Many basic types of sites have been recognized throughout the Northern Great Basin. The quarry sites are places where cores, biface preforms, and large flakes were made for transport elsewhere. Habitation sites are locations at which many types of artifact reduction, camp maintenance, and raw material processing generally occurred relative to the length of occupation. Lithic reduction, use and disposal patterns at temporary campsites generally reflect the same types of camp maintenance and raw material processing as is found at more long-term base camps and habitation sites but may reflect a narrower *range* of activities, as occupation times in campsites was relatively shorter and more task-specific activities generally dominated the time and effort spent there. Thus, we ask:

7) Can specific characteristics of the lithic debitage be linked with specific products in a way that will allow debitage attributes to be used as a reliable indicator of site function?
8) Can tool types and their relative stages of reduction, use, and damage/discard inform on the type and relative length of occupation(s)?

Data Needs and Data Collection Methodology

The majority of data needed to address questions of prehistoric technology will be collected during the normal course of excavations in the form of lithic artifacts and debitage. It will be necessary to collect and analyze a sample from each component to track chronological variation in assemblages. Sampling levels established for other research needs will provide sufficient data to address these questions. Lithic analysis will be directed toward the study of attributes which can be consistently identified and quantified for use in the development and characterization of these site signatures.

7 Descriptions of Research Areas

The Northern Great Basin of Oregon, as defined here primarily for the sake of data base analysis, has a northwest corner located on the northwest slope of Powell Buttes in Township 16S, Range 15E. The northeastern corner is located on the Snake River on the Idaho border at Township 16S, Range 47E, some 12.5 miles north of Ontario, Oregon. The eastern border follows the Oregon-Idaho border south to the Nevada line. The southern border follows the Nevada-California border to the west side of Goose Lake. The western border is irregular, winding its way through the uplands bordering the ‘wet' Goose Lake, Chewaucan Marsh, Lake Abert, Summer Lake, and Fort Rock basins. It passes through Drews Valley to Quartz Mountain, northwest to Sycan Butte, then arcs northwest across Silver, Bridge, and Buck Creeks through Hole in the Ground to the Range 14E line, then north past Lavacicle Cave, China Hat, and the town of Alfalfa to Powell Buttes. Within this area we have defined seven research areas.

The NGBPP research areas are roughly based on what we know of ethnographic and archaeological Northern Great Basin settlement and mobility patterns (Aikens and Greenspan 1986; Cannon et al. 1990; Fowler 1986, 1992; Jenkins 1994). Specifically, in every case we have selected a major perennial water source as the focal point near which local populations would have presumably located winter villages because of the common availability of fresh food, e.g. fish, migratory waterfowl, muskrats, beaver, cattails, over-wintering herds of deer, elk, antelope, and bison. A radius of roughly 50 miles was then defined around each of these focal points as a rough measure of the distance unmounted populations would commonly forage during their annual or semi-annual rounds (Steward 1938; Whiting 1950; Couture et al. 1986).

The configuration of individual research area boundaries, however, has been altered to accommodate shared foraging areas where various basin populations regularly encountered each other during their normal seasonal rounds. Thus, the size and boundaries of each research unit vary greatly for a variety of reasons. For instance, the Fort Rock Research Area has long been defined by the UO Fort Rock Basin Prehistory Project as a relatively small area. It seems best to maintain this distinction, at least for now, recognizing that Fort Rock populations may have commonly foraged along the Sprague, Williamson, and Deschutes rivers, for instance. In the case of the Chewaucan and Warner Valley research units, large lacustrine systems fill elongated basins separated from each other only by the Warner Mountains/Abert Rim. Unusually large site complexes are well known for each of these basins and separate ethnographic populations may have existed in each as well. In other words, though these basins are very close to each other, and the populations were undoubtedly closely related, they may have formed separate winter village districts. Thus, it seems best to divide them at this stage for convenience of study. Obsidian distribution analysis suggests that they indeed may have experienced somewhat different demographic histories (Connolly and Jenkins 1997; Jenkins et al. 1999).

Below we describe the boundaries of each research area and identify the primary hydrologic features the units are based on (Figure 1). We emphasize again that these research areas are merely *beginning data base structures and are not intended to convey any established sense of propriety or socio-political reality*. They are proposed as a first effort at outlining data base parameters so that those who wish to participate in the Northern Great Basin Prehistory Project can quickly assess current data base strengths and weaknesses. We hope that other researchers will be attracted to the loose association of interested parties proposed here. We hope that by providing this structure we can help facilitate the establishment of long-term cooperative research programs involving field schools and various resource management agencies, e.g. BLM, Forest Service, and Native American tribes. We believe the cultural resources of the Northern Great Basin, and our knowledge of those resources, will benefit from the comprehensive and long-term research proposed in this document.

Ochoco-High Lava Plains

This research area forms the northwestern most corner of the Northern Great Basin and is formed around the Crooked River drainage. The northern boundary begins at Pilot Butte, continues east along the Township 16S line to Hwy. 395 on Silvies River. The eastern border follows Hwy. 395 southeast to Seneca. It then turns southwest to form a gentle arc through the Ochoco Forest and out onto the High Lava Plains to cross Hwy. 20 at the Wagontire cut-off road roughly 13 miles west of Riley. It follows this dirt road around the east flank of Wagontire Mountain to the townsite of Wagontire on Hwy. 395. The southern border begins at Wagontire, forms a straight line northwest past the south end of Benjamin Lake to the T24S, Range 20E juncture. It then turns due west along T24S.to the Deschutes National Forest (DNF) boundary near R15E and then continues in a gentle arc to R14E just inside the DNF boundary. The west border follows R14E north past Lavacicle Cave to T23S, then diagonally northeast along the west flank of China Hat to the junction of the East Lake Road, from there north to where the dirt road joins Hwy. 20 four miles west of Millican. It then proceeds north-northeast back to the top of Powell Buttes.

Fort Rock

The Fort Rock Research Area is a relatively small elongated district located just south of the Ochoco-High Lava Plains Research Area. It is formed around the Paulina Marsh-Silver Lake-Fort Rock channel system which often filled the western end of the Fort Rock Basin in the past. The northern border of the Fort Rock research area is formed by the southern border of the Ochoco-High Lava Plains area. The eastern border follows Hwy. 395 south from Wagontire to T29S. The southern border turns west along T29S to it’s juncture with R19E in the Boulder Village Uplands. It then turns southwest along the crest of these hills, crosses Hwy. 31 and Winter Rim in a straight line to the southern end of Thompson Reservoir. The western border of the area forms an arc crossing the upper reaches of Silver Bridge and Buck Creeks in the Fremont National Forest to and past Hole in the Ground back to the southern border of the Ochoco-High Lava Plains border as described above.

Chewaucan

The Chewaucan Research Area is located south of the Fort Rock Research Area. It's northern border is formed by the southern border of the Fort Rock area as defined above. From the juncture of T29S with Hwy. 395 the northern boundary of the Chewaucan area continues east to the Harney county line. The eastern border follows the county line south through Juniper Mountain to the point where the line bends east at 90°. From there it proceeds southwest along the crest of the Coyote Hills and Warner Mountains to the California line near the town of New Pine Creek. The southern border follows the state line due west to the county road on the west shore of Goose Lake. The western boundary forms a more or less straight line from the county road northwest through Drews Reservoir along Drews and Quartz creeks to Quartz Pass. From there it follows a straight line northwest to Sycan Butte, and from Sycan Butte a short straight line to the southern border of the Fort Rock Research Area at the south end of Thompson Reservoir.

Harney Basin

The Harney Basin Research Area is the largest research area of all. It is centered on and formed around the Malheur-Mud-Harney lakes hydrologic system which includes extensive marshes and sloughs around the town of Burns and in Diamond Swamp along the Donner und Blitzen River. The western border of the Harney Basin Research Area is largely formed by the eastern border of the Ochoco-High Lava Plains Research Area. Beginning at Hwy. 395 and T16S the border goes east along T16S to the Malheur county line. The eastern border follows the county line south to Hwy. 78 where it ascends the crest of the Steens Mountains and turns southwest to T36S near Skull Creek. The southern border proceeds due west along T36S through Catlow Valley to R31E, then north along R31E to T31N. From that point it forms a gentle arch northwest past the south shore of Foster Lake to the Harney-Lake county line where it joins the Chewaucan Research Area border and from there proceeds to Hwy. 395 to rejoin the east side of the Fort Rock and Ochoco-High Lava Plains research areas as described above.

Warner Valley

The Warner Valley Research Area is formed around the extensive lakes and marshes in Warner Valley. It is bordered on the north and east by the Harney Basin Research Area as described above. At Skull Creek the eastern border of the Warner Valley Research Area continues south along the crest of the Pueblo Mountains to the Nevada state line. The southern border follows the Nevada state line to join the eastern border of the Chewaucan Research Area at the crest of the Warner Mountains near the California state line. The western border is formed by the eastern boundary of the Chewaucan Research Area as defined above.

Malheur-Snake River

The Malheur-Snake River Research Area is formed around the confluences of the Malheur and Owyhee rivers with the Snake River, on the premise that these would have been good winter village locations for populations that ranged far inland along these river courses. It begins in the northwest at the juncture of the Harney-Malheur county line and T16S. It follows T16S east to the Snake River, some 13 miles north of Ontario. The eastern border follows the Oregon-Idaho state line south to T27S. The southern border follows T27S west to the Harney-Malheur county line which forms the western border of this research area and the eastern border of the Harney Basin Research Area.

Owyhee

The Owyhee Research Area is centered on the Owyhee River in the southeastern corner of the state. The northern border is formed by T27S, the southern border of the Malheur-Snake River Research Area. The eastern border follows the Oregon-Idaho state line south to the Oregon-Nevada state line. The southern border follows Oregon-Nevada state line west to the crest of the Pueblo Mountains. The western border of the Owyhee Research Area is formed by the eastern borders of the Warner Valley and Harney Basin research areas, basically following the crest of the Pueblo and Steens Mountains back to the Harney-Malheur county line and thence due north to T27S.

8 Near-Term and Longer-Term NGBPP Research Plans

The aim of this section is to clearly state where and how the first few steps of the new Northern Great Basin Prehistory Project (NGBPP) will be taken, and who will be involved in the earliest stages. While we can identify the first few projects to be conducted (Near-Term Research), we cannot currently know the particulars about areas to be surveyed or the sites which will ultimately be excavated as NGBPP research unfolds (Longer-Term Research). Instead, we present below specific plans for surveys, and more general plans for test excavations, and large scale "data recovery" investigations that will lead into the research of the next ten years.

Fort Rock Research Area

Investigation of the Fort Rock Research Area by the UO field school will continue with annual excavations designed to fill in gaps in the current data base, particularly those relating to the Early and Middle Holocene periods. These investigations will involve further excavation of sites located along the entire length of the Silver Lake/Fort Rock channel system from Carlon Village at Silver Lake to the Bergen site on Beasley Lake. This effort will be aided this year by geomorphological investigations of the Silver Lake/Fort Rock channel system. Michael Droz, PhD candidate in the UO Department of Geography, will initiate new channel surveys and Sherry Nelson will conduct post-graduate (MA) research of the channel system involving backhoe trenches near the Kelly site, previously investigated by Peter Mehringer and William Cannon (1994).

Connley Caves

Probing and test excavations at the Connley Caves site will involve teams of students working under the guidance of Dennis Jenkins and graduate student Tony Largaespada, who is conducting post-graduate degree related research. Excavations will be designed to locate and excavate undisturbed cave deposits with the emphasis on the micro analysis of stratigraphic profiles. Many forms of perishable data can only be found in dry cave deposits including basketry, sagebrush bark sandals, twine used to make netting and fishing lines, snares, wooden items, mats for housing and bedding, raw plant materials stored for later productions, stored foods, and scraps of materials resulting from tool production. Additionally, information on the use and discard of perishable materials within sites is only available in dry cave deposits. Some deposits may remain undisturbed at the Connley Caves. If so, they offer the unique possibility of extending and testing the data base previously collected by Bedwell (1970).

The Connley Caves are a half-dozen or so small alcoves which lie at the western base of the Connley Hills, less than a mile north of Paulina Marsh. Excavations in five of them revealed culture-bearing deposits that spanned most of Holocene time. A series of 21 radiocarbon dates ranged from 11,200 BP to 3140 BP; occupation continued thereafter, but no dates were obtained because the upper deposits of the caves had been badly roiled by illegal excavations. Volcanic ash from the Mount Mazama eruption established a thick marker bed, dating about 6850 BP, that was found in all the caves. The pre-Mazama deposits were rich in the bones of marshland species, including grebes, various kinds of ducks, coots, sage grouse, and other wetland-dwelling birds. Mammals present included ground squirrels, gophers, rabbits, a variety of small fur-bearing predators, and large game including bison, elk, deer, and pronghorn. The presence of these terrestrial species is also compatible with a wetlands setting, though most of them are not restricted to such habitats. A cooler and moister regime than exists at present in the area is attested by the bones of rock rabbit, or pika, a creature now at home in the higher, cooler reaches of the adjacent Cascade range. An additional indicator is the fact that campfire charcoal from the pre-Mazama layers is of pine, which now grows only at higher elevations far away from the caves; the trees that surround the site today are western juniper, which tolerates much dryer conditions than pine. Artifacts from the Early Holocene strata comprised a rich and diverse assemblage, including chipped stone projectile points, knives, scrapers, gravers, and drills, as well as milling stones and a variety of other items. Obviously the Connley Caves were a favored camping spot, well-sheltered and with substantial food resources nearby, that drew people consistently over several millennia (Bedwell 1973; Grayson 1979).

Jenkins (1999) has proposed the Connley Caves were used as a winter base camp from which fresh foods were foraged within the Connley Hills and nearby Paulina Marsh. He notes that large volume storage did not appear in the Fort Rock Basin until about 5600 BP. Local residents may have depended heavily on migratory waterfowl in Paulina Marsh and herds of over-wintering deer, pronghorn, elk, and bison in the sheltered lower forest/marsh ecotone around the Connley Hills to get through the winters.

Pinson (1999) has noted that considerable mixing of cultural and natural deposits may have occurred within Early Holocene cave deposits, thus affecting the accurate interpretation of Early Holocene subsistence patterns since large game comprises substantial quantities of faunal assemblages only in Early Holocene cave deposits throughout the Northern Great Basin. Bedwell's (1970, 1973) illustrations of point types recovered from supposed "pre-Mazama" contexts suggests that considerable mixing has indeed occurred at the Connley Caves and the separation of Early and Middle Holocene assemblages will be a major concern when excavations are initiated there in the summer of 2000.

The destruction of the interior cultural deposits at the Connley Caves makes excavation of the caves themselves impossible. Consequently, we initiated the new phase of research at this important site in 1999 with the excavation of a series of 25 cm auger holes leading from the mouth of each of the caves down slope to a point some 30 to 100 m away. Auger testing was not particularly successful as most holes were terminated in rock at one meter or less. However, one auger hole at the mouth of Cave #4 encountered what are believed to be undisturbed (Middle Holocene?) deposits at 150 cm. UO field school excavations will include short backhoe trenches in noncultural deposits at the toe of the apron in front of two or more caves. Manual excavations will then continue from the headwalls of trenches to the mouth of the caves. Further testing for undisturbed deposits in and around the caves will be conducted in areas of high probability.

Michael Droz, the geoarchaeology field school supervisor, and seven students will conduct geomorphological, stratigraphic, and sedimentological investigations of the site formation processes in these trenches. The goal of this research will be to more firmly establish the stratigraphic context of the Early Holocene deposits known to exist at the site. Droz will produce profiles of the strata exposed in the sidewalls of the trench. These stratigraphic studies will assist the archaeologists in identifying major depositional, erosional, biotic, or cultural events which may have affected the translocation of cultural materials between archaeological components. This is extremely important to our understanding of this site which produced radiocarbon dates nearly 12,000 years old.

Jenkins will direct the excavation of cultural deposits and Tony Largaespada, graduate student assistant, will provide close supervision for a crew of ca. 12 archaeological field school students. Their excavations will focus on sampling undisturbed archaeological deposits with the secondary goal of understanding the degree of mixing that has occurred between cultural components of varying ages in these deposits. This is very important research since it is clear that Bedwell failed to adequately address these issues during his investigations in 1967.

It is also important to note that the sediments removed by Bedwell's excavations were screened through quarter inch wire mesh which failed to adequately sample fish remains, fish gorges, and small beads. All Early Holocene sediments will be passed through eighth inch wire mesh during the 2000 excavations. This will allow us to test the hypothesis that fish were not a substantial part of the diet of pre-Mazama populations. This question will also be addressed through the flotation of paleoethnobotanical soil samples for the recovery of charred plant remains, microfaunal, and microlithic remains. This research will be conducted by Marge Helzer under the supervision of Linda Cummings at PaloeResearch Labs in Golden, Colorado. Patrick O'Grady will analyze the faunal remains with an emphasis on understanding site taphonomic processes.

Bergen Site

The Bergen site is located on a massive lunette-dune roughly six kilometers east-southeast of the townsite of Fort Rock on the northeast shoreline of ancient Beasley Lake. Portions of the site were previously known to Cannon and Jenkins, but it was not until 1998 that investigations began there in conjunction with the study of the Bergen Collection at the Burke Museum at the University of Washington, Seattle. The site, discovered by artifact collectors > 50 years ago, has been severely impacted by unauthorized collection and excavation. It is roughly 1600 m. long, 200 m. wide, and in many places contains cultural deposits exceeding three meters in depth.

Backhoe trenches were excavated in 1998 and 1999 from the crest of the dune to the sagebrush flats below in seven separate locations. These trenches clearly demonstrated the presence and nature of Early and Middle Holocene deposits at the site. No Early Holocene cultural deposits were encountered, however. Examples of the stratigraphic sequence exposed by these trenches will be illustrated and presented with the archaeological report for this site as well as in Droz's doctoral dissertation.

UO field school manual excavations at the site in 1998 involved 31 test probes and 15 one by one meter excavation units covering a combined area of 22.75 m2. The majority of the probes were distributed at 10 m. intervals to form a line along a north-south axis that lay west of the lunette-dune crest until it neared the southern end of the site where it terminated on the ridge top. These probes were dug in 10 cm. levels to a maximum depth of 70 cm. The larger test units were dug in 5 cm levels and basically formed two areas of investigations, a small northern block and a larger southern block. The southern block, composed of nine conjoined 1x1 and 1x2 meter units, cut across the western half of a shallow housefloor 20 cm. deep, three to four meters in diameter, and located at a depth of 80 to 90 cm below the surface. Dense charcoal in what appeared to be a shallow hearth in the center of this depression, produced a calibrated date of 4860 BP (4330 RCYBP) associated with Northern Side-notched and Elko projectile points. Waterfowl and large mammal bones formed a significant portion of the cultural materials located just above this charcoal lens. Fish bones, net weights, and fish gorge hooks all suggest that fishing composed a significant portion of the subsistence pattern at the Bergen site. The presence of large quantities of waterfowl and artiodactyl bones could indicate that this site, like the Connley Caves, may have served as a winter hamlet or village location.

The 1999 field school investigations at the Bergen site more fully investigated the Late-Middle Holocene house floor discovered in 1998. A search for other house floors of the same age revealed the presence of at least two other houses and probably many more at the southeast end of the site. These results were attained by 1) establishing a large block of 2x2 m excavation units over the entire area of the known house floor and 2) discovering other house floors through the excavation of 50x50 cm probes and 25 cm auger holes at five meter intervals across a large portion of the southeastern end of the site. A second house floor, dated at 5510 BP (4780 RCYBP), was encountered to the north of the first. This house will be sampled further in 2000.

All probes and auger holes were be dug in 10 cm levels and all site deposits thus removed passed through eighth inch wire mesh. Larger excavation units (1x1 m, 1x2 m, and 2x2 m) were be dug in 5 cm levels. All sediments removed from quad A of each unit was screened through eighth inch wire mesh. Sediments removed from the other three quads were first passed through quarter inch mesh inserts with eighth inch wire mesh screens beneath. All cultural materials caught in the quarter inch mesh were collected and bagged by provenience. The sediments and cultural materials caught in the eighth inch mesh below the quarter inch screen were searched for small items like beads, fish gorge hooks, fish bones, charred seeds and roots and anything else of interest before the sediments were discarded. Thus, at least 25% of all cultural materials were collected to the eighth inch mesh size from every excavation unit and all other sediments were rapidly inspected for smaller items of interest which may have passed through the quarter inch wire mesh of the inserts. This process dramatically increased the sample size while insuring that most of the smaller items collected in the eighth inch mesh got recovered. This process was deemed necessary because excavations at the site in 1998 year often recovered as many as 2000 microflakes and bone fragments per five centimeter level. This incredible quantity of tiny pressure flakes and bone fragments slowed excavation down considerably and resulted in little additional information. Consequently, the same excavation strategy will be employed during the 2000 excavations at this site.

Marge Helzer, PhD candidate at the UO, will be in charge of reporting the excavation and analysis of the Bergen site materials. She will be using this data as a part of her dissertation, which will involve conducting the flotation and analysis of macrobotanical remains recovered from this site and others under the supervision of Linda Cummings (PaleoResearch Labs, Golden, Colorado). Marge will lead excavation teams to the Bergen and Bowling Dune Middle Holocene sites of the SL/FR channel system to expand her sample of macrobotanical remains suitable to the testing of the hypotheses concerning the evolution of Late-Middle Holocene settlement-subsistence patterns and cultural developments.

Tony and Leah Largaespada, UO graduate students, will be assisting the supervision of excavations at the Connley Caves and Bergen sites, respectively. Tony is currently conducting research on Fort Rock Basin projectile point morphology and associations as a Master's thesis project. Leah is conducting Master's research on marine shells recovered from the Fort Rock Basin.

Long-Term UO Research

Long-term UO research will involve surveys of locations in the basin (southwest facing escarpments of volcanic tuff) which exhibit high potential for harboring previously undiscovered cave sites and in locations known to contain rockshelters and cave sites. Research on issues such as the possible genetic alteration of cheno-ams, grasses, camas, and lomatiums which may have resulted from the protracted intensive exploitation of these plants by human populations (proto-agriculture) can only be addressed with large samples of seeds, roots and fruits spanning a long time period. Cave deposits seem to offer the unique possibility of harboring the deposits necessary to such research.

Early and Middle Holocene occupations of upland settings are little understood in the Northern Great Basin. Excavations of carefully selected sites in the Sheeplick and Playa 1 areas of the Boulder Village Uplands may cast light on the Late-Middle/Late Holocene development of root plant intensification. Upland areas often exhibit dynamic holocene landscapes which have contributed to the destruction of sites by erosion. Depositional environments also exist in upland settings, however, and this is the case at Sheeplick Draw where wind blown sediments, picked up from the exposed floor of the Summer Lake Basin, have collected at the base of a massive upthrust. Windust and Cascade projectile points, bifaces, ground stone, and lithic debitage were consistently recorded in rodent burrowings in sites along the base of this escarpment suggesting that buried deposits of Early Holocene age may exist in this area (cf. Brashear 1994).

Sheeplick Lake, dry in 1991 but filled with water since the winter of 1992, is surrounded by low terrace beaches with gently sloping profiles. These beaches would have been good places to camp which would have provided easy access to resources surrounding the lake, those on top of the escarpment, and the extensive spring fed marshes at the northeastern end of Summer Lake. Sheeplick Lake may in the past have been much larger than present, actually filling two low basins before overflowing into Christmas Valley or Summer Lake, and would have formed an excellent, strategically located campsite on a major travel route between the Fort Rock and Summer Lake basins. Thus, it is an excellent location to search for buried deposits of Early to Middle Holocene age. Sheeplick Lake basin is a shallow depression steeply bordered to the east and west by escarpments. This setting may make it an excellent sediment trap for aeolian borne particles transported from the sand fields of Summer Lake to the south. The UO field school will conduct research in this area within the next five years.

It is most appropriate to begin UO NGBPP investigations in areas adjacent to the Fort Rock Basin since this is the research area best known archaeologically, and the close proximity will help facilitate the coordination and staging of projects from the Fort Rock Basin field school headquarters at the North Lake School. Proximity and coordination will be important because although field school supervisors (experienced graduate students) and students will often be operating in an independent mode from the main body of the field school in Fort Rock, they will always need to maintain close communication with Jenkins, Aikens, and the appropriate representatives of various state and federal resource management agencies, e.g. BLM, Forest Service, and Native American Tribes.

Fossil Lake

The Sundance Archaeological Research Fund (SARF) will be conducting surveys in the Fossil Lake area in conjunction with paleontologist James Martin from the South Dakota School of Mines and Paleontology in 2000. Matt Moore will direct the survey of the Fossil Lake area supervising 1-2 SARF staff members and 3-4 BLM volunteers. Martin will sample volcanic tephras from exposed strata in the area. Previously collected archaeological and paleontological specimens from this area will be investigated at a number of museums across the nation.

Alkali Basin

Ariane Pinson (SARF) will direct surveys and test excavations over the next several years in what she has termed the North Alkali Basin Study Area (NABSA). These investigations will be directed toward the continuing investigation of Western Stemmed and Clovis occupations in and around the Dietz Basin (cf. Pinson 1999; Willig 1988; Fagan 1988). She proposes to intensively survey and test sites in two areas of the basin, the first being at the base of Tucker Ridge east of the Dietz site and the second being in the Butte Creek Area east of the Dietz Basin. Her crew will comprise 3 SARF staff members and 4-6 UNR and BLM volunteers.

Ochoco-High Lava Plains Research Area

The first NGBPP research outside the Fort Rock Basin was initiated in 1999 in coordination with the Deschutes National Forest and the Lakeview District BLM. It involved archaeological survey and test excavations in the area of the Devil's Garden on the border between the Deschutes National Forest and Lakeview District BLM properties located northeast of the Fort Rock State Park. These surveys were supervised by Suzann Henrikson, a UO doctoral student who has worked for the BLM in Idaho as an archaeologist for seven years. UO field school students were trained to conduct archaeological surveys and record sites in groups of six students cycled through the survey program on a weekly basis throughout a four week period. In this manner, each group was trained for one week before returning to excavations in the Fort Rock Basin.

The Ochoco-High Lava Plains survey is a highly integrated effort planned to form the base for research spanning portions of the next five years or more. Data collected during the 1999 survey will be employed by Paul Claeyssens, Deschutes National Forest archaeologist, in his UO doctoral research on settlement-subsistence patterns in upland forested areas adjacent to the Fort Rock Basin.

Surveys will continue in the area north and east of Devils Garden in proposed burn areas managed by the Prineville District BLM office during the summer of 2000. These surveys will contribute to our knowledge of site locations and types in the region as far east as Benjamin Lake which lies south of Hamilton on Highway 20. This area was first investigated in 1996 as a joint UO, Prineville District and Lakeview District BLM survey preceding a proposed burn north of Benjamin Lake (Jenkins 1996). Investigations in the area have identified strong components of Late-Middle Holocene and Early Holocene occupations. There is a high probability that buried cultural components may exist in this area which will provide important insights into the settlement-subsistence patterns involving the ephemeral lake basins surrounding the Fort Rock Basin. These are prime areas for the investigation of Late-Middle Holocene to Late Holocene settlement patterns which may have resulted from the 'budding off' of increasingly circumscribed populations in the ‘wet’ basins into hamlets situated on the shores of ephemeral lakes in the adjacent ‘dry’ basins of the region.

Graduate student, Graham Dalldorf (UO Department of Geography) will be investigating the Benjamin Lake area with his advisor Patricia McDowell, Michael Droz, and the UO Geoarchaeological field school. Dalldorf is considering the area for graduate thesis research related to Early and Middle Holocene lake stands.

Harney Basin Research Area

Patrick O'Grady, a UO doctoral student who has assisted Jenkins with field school research since 1994, will take a group of UO field school students to conduct surveys of uplands areas south and north of Silver Creek, bordering the Malheur Wildlife Refuge at the west end of the Harney Basin, and in the Stinkingwater Mountains. O'Grady, accompanied by field school students and others (BLM volunteers), will also visit and record sites near springs which may have served as winter settlements. Excavation at such sites may address the question of the time-depth of winter house site construction near fresh water springs on the shores of Harney Basin lakes. Test excavations will be conducted at the Crystal Crane Hot Springs and possibly at other sites in the basin and Stinkingwater Mountains. Whenever possible, UO field school efforts will be dovetailed with projects benefitting BLM, Malheur National Wildlife Refuge, and Burns Paiute Tribal programs.

Biting Fly Site

On the south shore of Harney Lake, this site will be tested by SARF personnel in 2000. Site 35HA2828, located nearby, was extensively investigated in 1999 and found to contain excellent--though as yet undatable--Early Holocene deposits. Excavations at the Biting Fly site and possibly others will be conducted under the direction of Alyce Branigan, aided by 3-4 SARF staff members and several BLM volunteers.

China Lake

Don Frazier (SARF), with two volunteers, will conduct two weeks of reconnaissance survey in the China Lake area. This survey will focus on locating potential Early Holocene sites and tool stone source locations. Fred Nials has already preliminarily investigated the area and found several promising locations.

Owyhee Research Area

Fred Nials (SARF) will conduct a reconnaissance survey for possible Terminal Pleistocene-Early Holocene sites in the Alvord Desert-Pueblo Valley-Coyote Lake area. This area is known to contain excellent TP-EH sites (Pettigrew 1984).

References Cited

Aikens, C. Melvin
1994 Adaptive Strategies and Environmental Change in the Great Basin and its Peripheries as Determinants in the Migrations of Numic Speaking Peoples. In *Across the West, Human Population Movement and the Expansion of the Numa*, edited by David B. Madsen and David Rhode, pp. 35-43. University of Utah Press, Salt Lake City.

Aikens, C. Melvin and Ruth L. Greenspan
1988 Ancient Lakeside Culture in the Northern Great Basin: Malheur Lake, Oregon. *Journal of California and Great Basin Anthropology* 10: 32-61.

Aikens, C. Melvin and Dennis L. Jenkins (editors)
1994a Archaeological Researches in the Northern Great Basin: Fort Rock Archaeology Since Cressman. *University of Oregon Anthropological Papers* No. 50.

Aikens, C. Melvin and Dennis L. Jenkins
1994b Environment, climate, Subsistence, and Settlement: 11,000 Years of Change in the Fort Rock Basin, Oregon. In Archaeological Researches in the Northern Great Basin: Fort Rock Archaeology Since Cressman, edited by C. Melvin Aikens and Dennis L. Jenkins, pp. 1-20. *University of Oregon Anthropological Papers* No. 50.

Aikens, C. Melvin and Younger T. Witherspoon
1986 Great Basin Numic Prehistory: Linguistics, Archaeology, and Environment. In Anthropology of the Desert West: Essays in Honor of Jesse D. Jennings, edited by C.J. Condie and D.D. Fowler. *University of Utah Anthropological Papers* 110: 7-20.

Allison, Ira S.
1979 Pluvial Fort Rock Lake, Lake County, Oregon. *Oregon Department of Geology and Mineral Industries Special Paper* 7.

Allison, Ira S. and C.E. Bond
1983 Identity and Probable Age of Salmonids from Surface Deposits at Fossil Lake, Oregon. *Copeia* 2: 563-564.

Ames, Kenneth M.
1988 Early Holocene Forager Mobility Strategies on the Southern Columbia Plateau. Early Human Occupation in Far Western North America: The Clovis-Archaic Interface, edited by Judith A. Willig, C. Melvin Aikens, and John L. Fagan, pp. 325-360. *Nevada State Museum Anthropological Papers* No. 21.

Ames, Kenneth M. and Allen G. Marshall
1980 Villages, Demography, and Subsistence Intensification on the Southern Columbia Plateau. *North American Archaeologist* 2(1): 25-52.

Antevs, Ernst
1938 *Rainfall and Tree Growth in the Great Basin*. Carnegie Institute Washington and American National Geographic Society. Pp. 97.

1948 Climatic Changes and Pre-White Man. In The Great Basin with Emphasis on Glacial and Post-glacial Times. *Biological Series 10(7), University of Utah Bulletin* 38(20): 168-191. Salt Lake City, Utah.

1955 Geologic-Climatic Dating in the West. *American Antiquity* 20(4): 317-335.

Aoki,Haruo
1963 On Sahaptian-Klamath Linguistic Affiliations. *International Journal of American Linguistics* 29(2):107-112.

Bacon, C.R.
1983 Eruptive History of Mount Mazama and Crater Lake Caldera, Cascade Range. U.S.A. *Journal of Volcanology and Geothermal Research* 18:57-115.

Baldwin, Ewart M.
1981 *Geology of Oregon*. Third Edition. Kendall-Hunt, Dubuque.

Barrett, S.A.
1910 The Material Culture of the Klamath Lake and Modoc Indians of Northeastern California and Southern Oregon. *University of California Publications in American Archaeology and Ethnology* 5(4): 239-292. Berkeley.

Barlein, Patrick J., Mary E. Edwards, Sarah L. Shafer, and Edward D. Barker Jr.
1995 Calibration of Radiocarbon Ages and the Interpretation of Paleoenvironmental Records. *Quaternary Research* 44:417-424.

Beck, Charlotte and George T. Jones
1997 The Terminal Pleistocene/Early Holocene Archaeology of the Great Basin. *Journal of World Prehistory* 11(2):161-236.

Bedwell, Stephen F.
1970 *Prehistory and Environment of the Pluvial Fort Rock Lake Area of South Central Oregon*. Ph.D dissertation, Department of Anthropology, University of Oregon.

1973 *Fort Rock Basin: Prehistory and Environment*. University of Oregon Books, Eugene.

Bettinger, Robert L.
1975 *The Surface Archaeology of Owens Valley, Eastern California: Prehistoric Man-Land Relationships in the Great Basin*. Ph.D. dissertation in Archaeology, Department of Anthropology, University of California, Riverside.

1991 *Hunter-Gatherers: Archaeological and Evolutionary Theory.* Plenum Press, New York and London.

Binford, Lewis R.
1980 Willow Smoke and Dogs' Tails: Hunter-Gatherer Settlement Systems and Archaeological Site Formation. *American Antiquity* 45(1): 4-20.

Brashear, M. Ann
1992 *A Model for Subsistence and Settlement Activities in the Fort Rock Basin, with Special Attention to Upland Environments*. Master of Arts Paper, Department of Anthropology, University of Oregon.

1994 Assemblage Variation, Site Types, and Subsistence Activities in the Boulder Village Uplands, Fort Rock Basin, Oregon. *In* Archaeological Researches in the Northern Great Basin: Fort Rock Archaeology Since Cressman, edited by C. Melvin Aikens and Dennis L. Jenkins. *University of Oregon Anthropological Papers* 50.

Burnside, Carla D.
1987 Interim Report: Archaeological Survey and Excavations in the Gerber Reservoir Quadrangle. Report on file at the University of Oregon Department of Anthropology, Eugene.

Byram, R. Scott
1991 *Settlement Intensification in the Squaw Butte Uplands, South Central Oregon*. Master of Science Paper, Department of Anthropology, University of Oregon, Eugene.

1994 Holocene Settlement Change in the Boulder Village Uplands. *In* Archaeological Researches in the Northern Great Basin: Fort Rock Archaeology Since Cressman, edited by C. Melvin Aikens and Dennis L. Jenkins. *University of Oregon Anthropological Papers* 50.

Callahan, Errett
1979 The Basics of Biface Knappers in the Eastern Fluted Point Tradition: A Manual for Flint Knappers and Lithic Analysts. *Archaeology of Eastern North America* 7(1):1-179.

Cannon, William J.
1983 Cultural Resource Survey and Site Testing of Zane Church Trespass. U.S. Department of the Interior, Bureau of Land Management, Lakeview District. Report on file, Lakeview District.

1999 My Life as a Used Site Salesman. In *Models for the Millennium: Great Basin Anthropology Today*, edited by Charlotte Beck, pp. 256-260. University of Utah Press, Salt Lake City.

Cannon, William J. and Peter J. Mehringer, Jr.
1992 The Dating Potential of Holocene Dunes in the Fort Rock Valley. A paper presented at the 25th Great Basin Anthropological Conference, Boise, Idaho.

Cannon, William J., C. Creger, Don D. Fowler, Eugene Hattori, and Mary Ricks
1990 A Wetlands and Uplands Settlement-Subsistence Model for Warner Valley, Oregon. In Wetlands Adaptations in the Great Basin, edited by Joel C. Janetski and David B. Madsen, pp. 173-183. *Brigham Young University Museum of Peoples and Cultures Occasional Papers* No. l.

Charnov, E.
1976 Optimal Foraging: The Marginal Value Theorem. *Theoretical Population Biology* 9:129-136.

Chatters, James C.
1989 Resource Intensification and Sedentism on the Southern Plateau. *Archaeology in Washington* Vol. I, pp. 3-19. Association for Washington Archaeology.

Cheatham, Richard
1988 Late Archaic Settlement Pattern in the Long Tom Sub-Basin, Upper Willamette Valley, Oregon. *University of Oregon Anthropological Papers* No. 39.

Clewlow, C. William Jr.
1968 Surface Archaeology of the Black Rock Desert, Nevada. *University of California Archaeological Survey Reports* 73, pp. 1-94. Berkeley.

Connolly, Thomas J.
1994 Prehistoric Basketry from the Fort Rock Basin and Vicinity. *In* Archaeological Researches in the Northern Great Basin: Fort Rock Archaeology Since Cressman, edited by C. Melvin Aikens and Dennis L. Jenkins. *University of Oregon Anthropological Papers* 50.

1995 Human and Environmental Holocene Chronology in Newberry Crater, Central Oregon. A Report to the Oregon Department of Transportation, Salem, Oregon.

Connolly, Thomas J. and Dennis L. Jenkins
1995 The Paulina Lake Site (35DS34). In Human and Environmental Holocene Chronology in Newberry Crater, Central Oregon. A Report to the Oregon Department of Transportation, Salem, Oregon.

1997 Population Dynamics on the Northern Great Basin Periphery: Clues from Obsidian Geochemistry. *Journal of California and Great Basin Anthropology* 19(2):241-249.

Connolly, Thomas J., Dennis L. Jenkins, and Jane E. Benjamin
1993 Archaeology of Mitchell Cave (35WH122): A Late Period Hunting Camp in the Ochoco Mountains, Wheeler County, Oregon. *University of Oregon Anthropological Papers* 46.

Couture, Marylin D., Mary R. Ricks, and Lucile Housley
1986 Foraging Behavior of a Contemporary Northern Great Basin Population. *Journal of California and Great Basin Anthropology* 8(2): 150-160.

Coville, Fredrick V.
1897 Notes on the Plants Used by the Klamath Indians of Oregon. *Contributions, U. S. Natural Herbology* 5(2):87-108.

Cowles, John
1960 *Cougar Mountain Cave in South Central Oregon*. Daily News Press, Rainier, Washington.

Cressman, Luther S.
1936 Archaeological Survey of the Guano Valley Region in South-Eastern Oregon. *University of Oregon Monographs, Studies in Anthropology* 1. Eugene.

Cressman, Luther S., Howel Williams, and Alex D. Krieger
1940 Early Man in Oregon: Archaeological Studies in the Northern Great Basin. *University of Oregon Monographs, Studies in Anthropology* 3. Eugene.

Cressman, Luther S., Frank C. Baker, Henry P. Hansen, Paul S. Conger, and Robert F. Heizer
1942 Archaeological Researches in the Northern Great Basin. *Carnegie Institution of Washington Publication* 538.

Cummings, Linda Scott
1995 Pollen and Phytolith Analysis. In Human and Environmental Holocene Chronology in Newberry Crater, Central Oregon. A Report to the Oregon Department of Transportation, Salem, Oregon.

Damas, D.
1969 Contributions to Anthropology: Band Societies. Proceedings of the Conference on Band Organization. *National Museums of Canada Bulletin* 228. Anthropological Series No. 84. Ottawa.

Dean, Emily
1994 Faunal Remains from Structure 3 at the Big M Site, Fort Rock Basin, Oregon. *In* Archaeological Researches in the Northern Great Basin: Fort Rock Archaeology Since Cressman, edited by C. Melvin Aikens and Dennis L. Jenkins, pp. 505-530. *University of Oregon Anthropological Papers* 50.

Droz, Michael S. and Dennis L. Jenkins
n.d. Geoarchaeology of Wetland Settings in the Fort Rock Basin, South-Central Oregon. Manuscript in possession of authors.

Droz, Michael S. and Suanna C. Selby
1998 Examining Pleistocene and Holocene Paleoenvironments at Carlon Village, Oregon. A poster presented at the Society for American Archaeology Meetings, Seattle, Washington.

Dumond, Don E. and Rick Minor
1983 Archaeology in the John Day Reservoir: The Wildcat Canyon site (35-GM-9). *University of Oregon Anthropological Papers* 30.

Eiselt, B. Sunday
1997 Defining Ethnicity in Warner Valley: An Analysis of House and Home. *University of Nevada, Reno Department of Anthropology Technical Report* 97-2.

Elston, Robert
1982 Good Times, Hard Times: Prehistoric Culture Change in the Western Great Basin. In Man and Environment in the Great Basin, edited by David B. Madsen and James F. O'Connell. *SAA Papers* 2:186-206.

Fagan, John L.
1973 *Altithermal Occupation of Spring Sites in the Northern Great Basin*. Ph.D. Dissertation, Department of Anthropology, University of Oregon. Eugene.

1974 Altithermal Occupation of Spring Sites in the Northern Great Basin. *University of Oregon Anthropological Papers* 6.

1986 Western Clovis Occupation in Southcentral Oregon: Archaeological Research at the Dietz Site 1983-1985. *Current Research in the Pleistocene* 3:3-5.

1988 Clovis and Western Pluvial Lakes Tradition Lithic Technologies at the Dietz Site in South-Central Oregon. *In* Early Human Occupation in Far Western North America: The Clovis-Archaic Interface, edited by J. A. Willig, C. M. Aikens, and J. L. Fagan. *Nevada State Museum Anthropological Papers* 21: 389-416.

Fagan, John L., and Garry L. Sage
1974 New Windust Sites in Oregon. *Tebiwa* 16(2): 68-71.

Flenniken, J.J.
1985 Reduction Techniques as Cultural Markers. In *Stone Tool Analysis: Essays in Honor of Don E. Crabtree*, edited by M. Plew, J. Woods, and M. Pavesic, pp. 265-276. University of New Mexico, Albuquerque.

Flenniken, J.J. and Anan W. Raymond
1986 Morphological Projectile Point Typology: Replication Experimentation and Technological Analysis. *American Antiquity* 51(3): 603-614.

Fowler, Catherine S.
1982 Settlement Patterns and Subsistence Systems in the Great Basin: the Ethnographic Record. In Man and Environment in the Great Basin, edited by David B. Madsen and James F. O'Connell. *SAA Papers* 2:121-138.

1990 Ethnographic Perspectives on Marsh-Based Cultures in Western Nevada. *In* Wetlands Adaptations in the Great Basin. Joel C. Janetski and David B. Madsen, editors. *Museum of Peoples and Cultures Occasional Papers* 1, pp. 17-32.

1992 In the Shadow of Fox Peak: An Ethnography of the Cattail-Eater Northern Paiute People of Stillwater Marsh. *Cultural Resource Series No. 5. U.S. Department of the Interior, Fish and Wildlife Service, Region 1*. Washington, D.C.

Fowler, Catherine S. and Sven Liljeblad
1986 Northern Paiute. In *Handbook of North American Indians*, Vol. 11, Great Basin, edited by Warren L. d'Azevedo, pp. 435-465. Smithsonian Institution, Washington D.C.

Fowler, Don D (Editor).
1993 Archaeological Investigations in Warner Valley, Oregon, 1989-1992: An Interim Report. *Department of Anthropology Technical Report Series* 93-1. University of Nevada, Reno.

1996 Foreword. In Archaeological Investigations at the Dietz Site (35LK1529) Lake County, Oregon, 1995, by Ariane Oberling Pinson, pp. V. University of Nevada, Reno, Department of Anthropology, Sundance Archaeological Research Fund Report No. 2.

Franklin, Jerry F., and C.T. Dyrness
1988 *Natural Vegetation of Oregon and Washington*. Oregon State University Press.

Frison, George C. and B. A. Bradley
1980 *Folsom Tools and Technology at the Hanson Site, Wyoming*. University of New Mexico, Albuquerque.

Gatschet, A. S.
1890 The Klamath Indians of Southwestern Oregon. *Contributions to North American Ethnology* 2:2.

Grayson, Donald K.
1979 Mount Mazama, Climatic Change, and Fort Rock Basin Archaeofaunas. In *Volcanic Activity and Human Ecology*, edited by Payson D. Sheets and Donald K. Grayson, pp. 427-457. Academic Press, New York.

1993 *The Desert's Past: A Natural Prehistory of the Great Basin*. Smithsonian Institution Press, Washington, D.C.

Grayson, Donald K. and Michael D. Cannon
1999 Human Paleoecology and Foraging Theory in the Great Basin. In *Models for the Millennium: Great Basin Anthropology Today*, edited by Charlotte Beck, pp. 141-151. University of Utah Press, Salt Lake City.

Greenspan, Ruth L.
1984 Holocene Lake Level Fluctuations Inferred from Fish Remains in the Fort Rock Basin. *Tebiwa* 21: 50-55.

1985 *Fish and Fishing in Northern Great Basin Prehistory.* Ph.D dissertation, Department of Anthropology, University of Oregon.

1990 Prehistoric Fishing in the Northern Great Basin. *In* Wetlands Adaptations in the Great Basin. Joel C. Janetski and Donald B. Madsen, editors. *Museum of Peoples and Cultures Occasional Papers* 1: 207-232.

1991 Preliminary Evaluation of Archaofaunas and Recommendation Plan for Zooarchaeological Analysis for the Fort Rock Basin Prehistory Project. HRA Letter Report 91-4 to U.S. Department of the Interior, Bureau of Land Management, Lakeview District, Lakeview, Oregon.

1994 Archaeological Fish Remains in the Fort Rock Basin. *In* Archaeological Researches in the Northern Great Basin: Fort Rock Archaeology Since Cressman, edited by C. Melvin Aikens and Dennis L. Jenkins. *University of Oregon Anthropological Papers* 50.

1998 Gear Selectivity Models, Mortality Profiles and the Interpretation of Archaeological Fish Remains: A Case Study from the Harney Basin, Oregon. *Journal of Archaeological Science* 25:973-984.

Hall, Henry J.
1977 A Paleoscatological Study of Diet and Disease at Dirty Shame Rockshelter, Southeast Oregon. *Tebiwa Miscellaneous Papers* 8.

Hanes, Richard C.
1988 Lithic Assemblages of Dirty Shame Rockshelter: Changing Traditions in the Northern Intermontane. *University of Oregon Anthropological Papers* 40.

Helm, June
1968 The Nature of Dogrib Socioterritorial Groups. In *Man the Hunter*, edited by R.B. Lee and I. Devore, pp. 118-125. Aldine, Chicago.

Henrikson, L. Suzann
1996 Prehistoric Cold Storage on the Snake River Plain: Archaeological Investigations at Bobcat Cave. *Archaeological Survey of Idaho, Monographs in Idaho Archaeology and Ethnology*, No. 1. Idaho Historical Society.

Hopkins, Nicholas A.
1965 Great Basin Prehistory and Uto-Aztecan. *American Antiquity* 31:48-60.

Housley, Lucile
1994 It's in the Roots: Prehistoric Plants and Plant Use in the Fort Rock Basin. *In* Archaeological Researches in the Northern Great Basin: Fort Rock Archaeology Since Cressman, edited by C. Melvin Aikens and Dennis L. Jenkins. *University of Oregon Anthropological Papers* 50.

Hughes, Richard E.
1986 Diachronic Variability in Obsidian Procurement Patterns in Northeastern California and SouthCentral Oregon. *University of California Publications in Anthropology* Vol. 17.

Hunn, Eugene S.
1990 *Nch'i-Wana: "The Big River" Mid-Columbia Indians and their Land*. University of Washington Press. Seattle and London.

Hunn, Eugene S. and David French
1981 Lomatium: A Key Resource for Columbia Plateau Native Subsistence. *Northwest Science* 55(2): 87-94.

Janetski, Joel C., and David B. Madsen (editors)
1990 Wetlands Adaptations in the Great Basin. *Brigham Young University Museum of Peoples and Cultures Occasional Papers* 1.

Jenkins, Dennis L.

1994a Archaeological Investigations at Three Wetlands Sites near Silver Lake in the Fort Rock Basin. *In* Archaeological Researches in the Northern Great Basin: Fort Rock Archaeology Since Cressman, edited by C. Melvin Aikens and Dennis L. Jenkins. *University of Oregon Anthropological Papers* 50.

1994b Subsistence-Settlement Patterns in the Fort Rock Basin: A Cultural-Ecological Perspective on Human Responses to Fluctuating Wetlands Resources of the Last 5000 Years. *In* Archaeological Researches in the Northern Great Basin: Fort Rock Archaeology Since Cressman, edited by C. Melvin Aikens and Dennis L. Jenkins. *University of Oregon Anthropological Papers* 50.

1994c Archaeological Survey and Excavations in the Duncan Creek Research Area: Changing Human Use of Uplands Environments West of Silver Lake. *In* Archaeological Researches in the Northern Great Basin: Fort Rock Archaeology Since Cressman, edited by C. Melvin Aikens and Dennis L. Jenkins. *University of Oregon Anthropological Papers* 50.

1996 Report of the 1996 University of Oregon Field School Archaeological Survey at Benjamin Point, North Lake County, Central Oregon. Letter report to William J. Cannon, Lakeview District Bureau of Land Management, Lakeview, Oregon..

1999 Early to Middle Holocene Cultural Transitions in the Northern Great Basin of Oregon: The View From Fort Rock. *In* Archaeological Passages: Transitions and Continuum Papers in Honor of Claude N. Warren, edited by Joan S. Schneider, Robert M. Yohe II, and Jeffrey Wedding. *Publications in Anthropology, Paleontology, and Archaeometry* Volume 1. San Jacinto Valley, CA: Western Center for Archaeology and Paleontology, University of California, Riverside.

2000 Human Adaptations in Drews Valley: A Mid-Elevation Setting on the Western Great Basin Periphery, South-Central Oregon, edited by Dennis L. Jenkins, with contributions by R. Scott Byram, Thomas J. Connolly, Linda Scott Cummings, Michael S. Droz, Thomas L. Jackson, Robert Losey, Susan E. Norris, Guy L. Prouty, Vivien J. Singer, and Guy L. Tasa. State Museum of Anthropology, University of Oregon, Report 2000-3.

n.d. The Grasshopper and the Ant: Middle Holocene Occupations and Storage Behavior at the Bowling Dune Site in the Fort Rock Basin, Central Oregon. Manuscript in possession of author.

Jenkins, Dennis L. and M. Ann Brashear

1994 Excavations at Four Habitation Sites in the Boulder Village Uplands: A Preliminary Report. *In* Archaeological Researches in the Northern Great Basin: Fort Rock Archaeology Since Cressman, edited by C. Melvin Aikens and Dennis L. Jenkins. *University of Oregon Anthropological Papers* 50.

Jenkins, Dennis L. and Thomas J. Connolly

1990 Archaeology of Indian Grade Spring: A Special Function Site on Stinkingwater Mountain, Harney County, Oregon. *University of Oregon Anthropological Papers* 42.

1994 Archaeological Excavations at the Paquet Gulch Bridge Site: A Pithouse Village in the Deschutes River Basin, Southwestern Columbia Plateau, Oregon. *University of Oregon Anthropological Papers* 49.

2000 Project Summary and Conclusions. *In* Human Adaptations in Drews Valley: A Mid-Elevation Setting on the Western Great Basin Periphery, South-Central Oregon, edited by Dennis L. Jenkins, pp. 335-376, with contributions by R. Scott Byram, Thomas J. Connolly, Linda Scott Cummings, Michael S. Droz, Thomas L. Jackson, Robert Losey, Susan E. Norris, Guy L. Prouty, Vivien J. Singer, and Guy L. Tasa. State Museum of Anthropology, University of Oregon, Report 2000-3.

Jenkins, Dennis L., Thomas J. Connolly, and Guy L. Prouty

2000a Cultural Background and Research Orientations. *In* Human Adaptations in Drews Valley: A Mid-Elevation Setting on the Western Great Basin Periphery, South-Central Oregon, edited by Dennis L. Jenkins, pp. 9-32, with contributions by R. Scott Byram, Thomas J. Connolly, Linda Scott Cummings, Michael S. Droz, Thomas L. Jackson, Robert Losey, Susan E. Norris, Guy L. Prouty, Vivien J. Singer, and Guy L. Tasa. State Museum of Anthropology, University of Oregon, Report 2000-3.

Jenkins, Dennis L., Marge Helzer, Leah Largaespada, and Patrick O'Grady
2000b Middle Holocene Adaptations on the Northwestern Great Basin/Southwestern Plateau Interface: Subsistence, Trade, and Social Organization in the Fort Rock Region of Central Oregon. A Paper Presented at the 53rd Northwest Anthropological Conference, Spokane, Washington.

Jenkins, Dennis L., Guy L. Prouty, Patricia F. McDowell, and Vivien Singer
1994 Exploratory Excavations at Nine Archaeological Sites on Mining Claims C and D of the Oil Dri Corporation, Fort Rock Valley, Central Oregon. Report of the University of Oregon Archaeological Field School, Department of Anthropology, to the Lakeview District, Bureau of Land Management.

Jenkins, Dennis L., Craig E. Skinner, Jennifer J. Thatcher, and Keenan Hoar
1999 Obsidian Characterization and Hydration Results of the Fort Rock Basin Prehistory Project. A Paper Presented at the 52nd Northwest Anthropological Conference, Newport, Oregon.

Jenkins, Dennis L. and Nina Wimmers
1994 Beads as Indicators of Cultural and Chronological Change in the Fort Rock Basin. *In* Archaeological Researches in the Northern Great Basin: Fort Rock Archaeology Since Cressman, edited by C. Melvin Aikens and Dennis L. Jenkins, pp. 107-124. *University of Oregon Anthropological Papers* 50.

Johnson, G.A.
1982 Organizational Structure and Scalar Stress. In *Theory and Explanation in Archaeology: The Southampton Conference*, edited by C. Renfrew, M.J. Rowlands, and B.A. Segraves, pp. 389-421.

Jones, Kevin T. and David B. Madsen
1991 Further Experiments in Native Food Procurement. Utah Archaeology 4(1): 68-76.

Keely, Patrick B.
1980 *Nutrient Composition of Selected Important Plant Foods of the Pre-Contact Diet of the Northwest Native American Peoples*. Master of Science Thesis, University of Washington, Seattle.

Kelly, Isabell T.
1932 Ethnography of the Surprise Valley Paiute. *University of California Publications in American Archaeology and Ethnology* 31: 67-210. Berkeley.

Kelly, Robert L.
1985 Hunter-Gatherer Mobility and Sedentism: A Great Basin Study. Ph.D. Dissertation, Department of Anthropology, University of Michigan, Ann Arbor.

1990 Marshes and Mobility in the Western Great Basin. *In* Wetlands Adaptations in the Great Basin. Joel C. Janetski and David B. Madsen, editors. *Museum of Peoples and Cultures Occasional Papers* 1: 259-276.

Kroeber, A.L.
1925 Handbook of the Indians of California. *Bureau of American Ethnology Bulletin* No. 78.

Lamb, Sydney M.
1958 Linguistic Prehistory in the Great Basin. *International Journal of American Linguistics* 24(2): 95-100.

Leonhardy, Frank C. and David G. Rice
1970 A Proposed Culture Typology for the Lower Snake River Region, Southeastern Washington. *Northwest Anthropological Research Notes* 4(1): 1-29.

Lyons, William H. and Peter J. Mehringer, Jr.
1996 Archaeology of the Lost Dune Site (35HA792), Blitzen Valley, Harney County, Oregon: A Report of Excavations by the 1995 WSU Field School. Submitted to U.S. Bureau of Land Management, Burns District.

Madsen, David B. and David Rhode
1994 *Across the West, Human Population Movement and the Expansion of the Numa*. University of Utah Press, Salt Lake City.

Masten, Ruth
1985 A Cultural Resources Survey and Site Testing of the Bonneville Power Administration's Malin-Warner 230 KV Transmission Line, Klamath County, Oregon, and Modoc County, California, edited by Michael J. Rodeffer and Jerry R. Galm. *Eastern Washington University Reports in Archaeology and History* 100-36 Archaeological and Historical Services, Cheney, Washington.

Meacham, A.B.
1875 *Wigwam and War-Path; or the Royal Chief in Chains*. J.P. Dale, Boston.

Mehringer, Peter J., Jr.
1977 Great Basin Late Quaternary Environments and Chronology. *In* Models and Great Basin Prehistory: A Symposium. Don D. Fowler editor. *University of Nevada, Desert Research Institute Publications in Social Sciences* 12. Reno.

1985 Late Quaternary Pollen Records from the Interior Pacific Northwest and Northern Great Basin of the United States. In *Pollen Records of Late-Quaternary North American Sediments*. Edited by V.A. Bryant and R.G. Holloway, pp. 167-189. American Association of Stratigraphic Palynologists.

1986 Prehistoric Environments. In *Handbook of North American Indians, Vol. 11, Great Basin*, edited by Warren L. d' Azevedo, et al., pp. 31-50. Smithsonian Institution.

1990 Comparisons of Late Holocene Environments from Woodrat Middens and Pollen: Diamond Craters, Oregon. In *Packrat Middens: The Last 40,000 Years of Biotic Change*, edited by J. L. Betancourt, T. R. Van Devender, and P. S. Martin, pp. 294-325. University of Arizona Press, Tucson.

Mehringer, Peter J., Jr., and William J. Cannon
1994 Volcaniclastic Dunes of the Fort Rock Valley, Oregon: Stratigraphy, Chronology, and Archaeology. *In* Archaeological Researches in the Northern Great Basin: Fort Rock Archaeology Since Cressman, edited by C. Melvin Aikens and Dennis L. Jenkins. *University of Oregon Anthropological Papers* 50.

Miller, Wick R.
1986 Numic Languages. In *Handbook of North American Indians, Vol.ume 11: Great Basin*, edited by Warren L. d'Azevedo, pp. 98-106. Smithsonian Institution, Washington, D.C.

Miller, Richard F., Paul Doescher, and Teal Purrington
1991 Dry-Wet Cycles and Sagebrush in the Great Basin. In *Management in the Sagebrush Steppe, Special Report* 880, pp. 8-15. Agricultural Experiment Station, Oregon State University and Agricultural Research Service, U.S. Department of Agriculture.

Moessner, Jean
1995 *DJ Ranch: An Investigation of a Mid- to Late-Holocene Occupation Site in Fort Rock Valley, South-Central Oregon*. Master of Science Thesis, Department of Anthropology, University of Oregon.

Moore, Matthew J.
1999 Prehistoric Land-Use Pattern Changes in the Vicinity of Beaty's Butte Southeastern Oregon. University of Nevada, Department of Anthropology, Sundance Archaeological Research Fund, Technical Paper No. 6.

Moratto, Michael J. (editor)
1995 Archaeological Investigations PGT-PG&E Pipeline Expansion Project Idaho, Washington, Oregon, and California, Michael J. Moratto, General Editor. Pacific Gas Transmission Company, Portland, Oregon.

Murphy, Robert F. and Yolanda Murphy
1986 Northern Shoshone and Bannock. In *Handbook of North American Indians, Vol.ume 11: Great Basin*, edited by Warren L. d'Azevedo, pp. 284-307. Smithsonian Institution, Washington, D.C.

Musil, Robert
1990 Preliminary Report of Archaological Testing at Fourteen Prehistoric Sites in the Drews Creek-Drews Gap Summit Section of the Klamath Falls-Lakeview Highway (OR 140), Lake County. Report on file at the Oregon Department of Transportation, Salem.

1995 Adaptive Transitions and Environmental Change in the Northern Great Basin: a View from Diamond Swamp. *University of Oregon Anthropological Papers* No. 51.

1999 The Archaeology of Quartz Valley: Human Occupation in the Uplands of South-Central Oregon. Report on file at the Oregon Department of Transportation, Salem.

Muto, G.R.
1971 A Stage Analysis of the Manufacture of Stone Tools. In Selected Papers of the Great Basin Anthropological Conference 1970, edited by C. Melvin Aikens, pp. 109-118. *University of Oregon Anthropological Papers* No. 1.

Nials, Fred L.
1999 Geomorphic Systems and Stratigraphy in Internally-Drained Watersheds of the Northern Great Basin: Implications for Archaeological Studies. University of Nevada, Reno, Department of Anthropology, Sundance Archaeological Research Fund, Technical Paper No. 5.

O'Connell, James F.
1975 The Prehistory of Surprise Valley. *Ballena Press Anthropological Papers* 4. Ramona, California.

O'Grady, Patrick
1999 *Human Occupation Patterns in the Uplands: An Analysis of Sourced Obsidian Projectile Points from Playa Villages in the Fort Rock Uplands, Lake County, Oregon*. Master of Science Thesis, Department of Anthropology, University of Oregon.

n.d. A Comparative Faunal Analysis of Three Sites in the Fort Rock Valley. *In* Early and Middle Holocene Archaeology of the Northern Great Basin. Manuscript in possession of author.

Oetting, Albert C.
1989 Villages and Wetlands Adaptations in the Northern Great Basin: Chronology and Land Use in the Lake Abert-Chewaucan Marsh Basin-Lake County, Oregon. *University of Oregon Anthropological Papers* 41.

1990 Aboriginal Settlement in the Lake Abert-Chewaucan Marsh Basin, Lake County, Oregon. *In* Wetlands Adaptations in the Great Basin. Joel C. Janetski and David B. Madsen, editors. *Museum of Peoples and Cultures Occasional Papers* 1: 183-206.

1992 Lake and Marsh-Edge Settlements on Malheur Lake, Harney County, Oregon. *Journal of California and Great Basin Anthropology* 14(1):110-129.

1993 The Archaeology of Buffalo Flat: Cultural Resources Investigations for the CONUS OTH-B Buffalo Flat Radar Transmitter Site, Christmas Lake Valley, Oregon. *Heritage Research Associates Report* No. 151.

1994a Prehistoric Land Use Patterns on Buffalo Flat, Christmas Lake Valley, Oregon. *In* Archaeological Researches in the Northern Great Basin: Fort Rock Archaeology Since Cressman, edited by C. Melvin Aikens and Dennis L. Jenkins. *University of Oregon Anthropological Papers* 50.

1994b Chronology and Time Markers in the Northwestern Great Basin: The Chewaucan Basin Cultural Chronology. *In* Archaeological Researches in the Northern Great Basin: Fort Rock Archaeology Since Cressman, edited by C. Melvin Aikens and Dennis L. Jenkins. *University of Oregon Anthropological Papers* 50.

Pettigrew, Richard M.
1984 Prehistoric Human Land-Use Patterns in the Alvord Basin, Southeastern Oregon. Journal of California and Great Basin Anthropology 6(1): 61-90.

1985 Archaeological Investigations on the East Shore of Lake Abert, Lake County, Oregon, Vol. 1. *University of Oregon Anthropological Papers* 32.

Pettigrew, Richard M. and Charles M. Hodges
1995 Prehistoric Hunter-Gatherer Land-Use Systems: Pacific Northwest. In Archaeological Investigations PGT-PG&E Pipeline Expansion Project Idaho, Washington, Oregon, and California, Michael J. Moratto, General Editor. Volume IV: Synthesis of Findings, Randall F. Schalk, Volume Editor, pp. 2-1 to 2-70. Pacific Gas Transmission Company, Portland, Oregon.

Pettigrew, Richard M. and Clayton G. Lebow
1987 Data Recovery at Sites 35JA27, 35JA59, and 35JA100, Elk Creek Lake Project, Jackson County, Oregon, Volume 1. Report of INFOTEC Research, Inc. to the U.S. Army Corps of Engineers, Portland District. IRI Report No. PNW87-7.

Pinson, Ariane Oberling
1996 Archaeological Investigations at the Dietz Site (35LK1529), Lake County, Oregon, 1995. Sundance Archaeological Research Fund Report Number 2. University of Nevada, Reno.

1998 Further Archaeological Investigations in the Dietz Basin, Lake County, Oregon: Results of the 1996 Field Season. Sundance Archaeological Research Fund Report Number 4. University of Nevada, Reno.

1999 Foraging in Uncertain Times: The Effects of Risk on Subsistence Behavior During the Pleistocene-Holocene Transition in the Oregon Great Basin. PhD dissertation, Department of Anthropology, University of New Mexico, Albuquerque.

Powers, Stephen
1877 Tribes of California. *Contributions to North American Ethnology* 3. Washington: U.S. Geographical and Geological Survey of the Rocky Mountain Region.

Price, T.D. and J.A. Brown
1985 *Prehistoric Hunter-Gatherers: The Emergence of Cultural Complexity*. Academic Press, San Diego.

Prouty, Guy L.
1994 Root Crop Intensification and the Development of Upland Habitation Sites: Paleoethnobotanical and Archaeological Research into the Distribution and Use of Economic Plants in the Fort Rock Basin. *In* Archaeological Researches in the Northern Great Basin: Fort Rock Archaeology Since Cressman, edited by C. Melvin Aikens and Dennis L. Jenkins. *University of Oregon Anthropological Papers* 50.

1995 *Roots and Tubers: Prehistoric Plant Use, Settlement and Subsistence Intensification, and Storage in the Fort Rock Basin, Northern Great Basin, Oregon*. Ph.D. Dissertation, Department of Anthropology, University of Oregon.

Ray, Verne F.
1963 *Primitive Pragmatists, the Modoc Indians of Northern California*. University of Washington Press.

Raymond, Anan W. and Elizabeth Sobel
1990 The Use of Tui Chub as Food by Indians of the Western Great Basin. *Journal of California and Great Basin Anthropology* 12(1): 2-18.

Sampson, C. Garth
1985 Nightfire Island: Later Holocene Lake-Marsh Adaptation on the Western Edge of the Great Basin. *University of Oregon Anthropological Papers* 33.

Schalk, Randol, Ricky G. Atwell, William R. Hildebrandt, Clayton G. Lebow, Patricia Mikkelsen, and Richard M. Pettigrew
1995 Mobility and Intensification. In Archaeological Investigations PGT-PG&E Pipeline Expansion Project Idaho, Washington, Oregon, and California, Michael J. Moratto, General Editor. Volume IV: Synthesis of Findings, Randall F. Schalk, Volume Editor, pp. 9-1 to 9-44. Pacific Gas Transmission Company, Portland, Oregon.

Silvermoon, Jon M.
1994 Archaeological Investigations at the Peninsula Site 35KL87 Gerber Reservoir, South-Central Oregon. U.S. Department of the Interior, Oregon State Office, *Cultural Resource Series* 10.

Singer, Vivien
n.d. Faunal Assemblages of Four Mid-Holocene Marsh-Side Sites in the Fort Rock Valley, South-Central Oregon. In Early and Middle Holocene Archaeology of the Northern Great Basin, edited by Dennis L. Jenkins and C. Melvin Aikens. Manuscript in possession of author.

Spier, Leslie
1930 Klamath Ethnography. *University of California Publications in American Archaeology and Ethnology* 30. Berkeley.

Stenholm, Nancy
1994 Fort Rock Basin Botanical Analysis. *In* Archaeological Researches in the Northern Great Basin: Fort Rock Archaeology Since Cressman, edited by C. Melvin Aikens and Dennis L. Jenkins. *University of Oregon Anthropological Papers* 50.

Stern, Theodore
1966 The Klamath Tribe: A People and their Reservation. *American Ethnological Society, Monograph* 41. University of Washington Press, Seattle.

Steward, Julian H.
1938 Basin-Plateau Aboriginal Sociopolitical Groups. *Bureau of American Ethnology Bulletin* 120.

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

1970 The Foundations of Basin-Plateau Shoshonean Society. In *Languages and Cultures of Western North America: Essays in Honor of Sven S. Liljeblad*, edited by Earl H. Swanson, pp. 113-151. Idaho State University Press, Pocatello.

Steward, Julian H. and Erminie Wheeler-Voegelin
1974 The Northern Paiute Indians. In *Paiute Indians III [1954], American Indian Ethnohistory: California and Basin-Plateau Indians*. New York: Garland.

Stewart, Omar C.
1939 The Northern Paiute Bands. *University of California Anthropological Records* 2(3).

1941 Culture Element Distributions, XIV: Northern Paiute. *University of California Anthropological Records* 4(3):361-446.

1966 Tribal Distribution of Boundaries in the Great Basin. In Current Status of Anthropological Research in the Great Basin, edited by Warren L. d'Azevedo, pp. 167-237. *Desert Research Institute, Social Sciences and Humanities Publication*, 1. Reno.

Sutton, Mark Q.
1986 Warfare and Expansion: an Ethnohistoric Perspective on the Numic Spread. *Journal of California and Great Basin Anthropology* 8(1): 65-82.

Stuiver, Minze and Paula J. Reimer
1993 Extended 14C Data Base and Revised Calib 3.0 14C Age Calibration Program. *Radiocarbon* 35(1): 215-230.

Tadlock, W.L.
1966 Certain Crescentic Stone Objects as a Time Marker in the Western United States. *American Antiquity* 31(5): 662-675.

Testart, Allain
1982 The Significance of Food Storage Among Hunter-Gatherers. *Current Anthropology* 23f:523-537.

Thomas, David H.
1972 Western Shoshone Ecology: Settlement Patterns and Beyond. *In* Great Basin Cultural Ecology: A Symposium, edited by Don D. Fowler, pp. 135-153. *Desert Research Institute Social Sciences and Humanities Publications* 8. University of Nevada, Reno.

1983 The Archaeology of Monitor Valley, 2: Gatecliff Shelter. *Anthropological Papers of the American Museum of Natural History* 59(1).

Thomas, David H., Lorann S.A. Pendleton, and Stephen C. Cappannari
1986 Western Shoshone. In *Handbook of North American Indians, Vol.ume 11: Great Basin*, edited by Warren L. d'Azevedo, pp. 261-283. Smithsonian Institution, Washington, D.C.

Thoms, Alston V.
1989 *The Northern Roots of Hunter-Gatherer Intensification: Camas and the Pacific Northwest.* Ph.D. dissertation, Department of Anthropology, Washington State University.

Tipps, Julie A.
1998 High, Middle, and Low: An Analysis of Resource Zone Relationships in Warner Valley, Oregon. *University of Nevada, Reno Department of Anthropology Technical Report* 98-1.

Toepel, Kathryn A. and Rick Minor
1994 100 Sites, 1000 Isolates, 10,000 Acres: A Survey Perspective on Prehistoric Land-Use Patterns in the Fort Rock Basin. *In* Archaeological Researches in the Northern Great Basin: Fort Rock Archaeology Since Cressman, edited by C. Melvin Aikens and Dennis L. Jenkins. *University of Oregon Anthropological Papers* 50.

Toepel, Kathryn A., Rick Minor, and William F. Willingham
1980 Human Adaptation in the Fort Rock Basin: A Class II Cultural Resources Inventory of BLM Lands in Christmas Lake Valley, South-Central Oregon. Report on file, Department of Anthropology, University of Oregon, Eugene and U.S. Department of the Interior, Bureau of Land Management, Lakeview District Office, Lakeview.

Tuohy, Donald R.
1990 Pyramid Lake Fishing: The Archaeological Record. *In* Wetland Adaptations in the Great Basin, edited by Joel C. Janetski and David B. Madsen. *Museum of Peoples and Cultures Occasional Papers* 1: 121-158.

Voegelin, Erminie W.
1942 Culture Element Distributions: XX Northeast California. *University of California Anthropological Records* 7(2).

Voegelin, C. F. and F. M. Voegelin
1973 Southwestern and Great Basin Languages. In *Current Trends in Linguistics*, edited by T. A. Sebeuk, pp. 1100-1142. Mouton, The Hague.

Wegener, Robert M.
1998 Late Holocene Stone Technology and Seed and Faunal Remains from Skull Creek Dunes Locality-6, Catlow Valley, Southeastern Oregon. Master of Arts thesis, Department of Anthropology, Washington State University, Pullman.

Weide, Margaret L.
1968 *Cultural Ecology of Lakeside Adaptation in the Western Great Basin*. Ph.D. dissertation, University of California, Los Angeles. University Microfilms, Ann Arbor.

Wheeler-Voegelin,
1955 The Northern Paiute of Central Oregon: A Chapter in Treaty-Making, Part 1. *Ethnohistory* 2(2):95-132.

Whiting, Beatrice
1950 Paiute Sorcery. *Viking Fund Publications in Anthropology*, No. 15.

Wigand, Peter E.
1987 Diamond Pond, Harney County, Oregon: Vegetation History and Water Table in the Eastern Oregon Desert. *Great Basin Naturalist* 47(3): 427-458.

Willig, Judith A.
1988 Paleo-Archaic Adaptations and Lakeside Settlement Patterns in the Northern Alkali Basin. *In* Early Human Occupation in Far Western North America: The Clovis-Archaic Interface, edited by Judith A. Willig, C. Melvin Aikens, and John L. Fagan. *Nevada State Museum Anthropological Papers* 21: 417-482.

1989 *Paleo-Archaic Broad-Spectrum Adaptations at the Pleistocene-Holocene Boundary in Far Western North America*. PhD dissertation, Department of Anthropology, University of Oregon, Eugene.

Wingard, George
1999 *Carlon Village: Land, Water, Subsistence, and Sedentism in the Northern Great Basin*. Ph.D. dissertation, Department of Anthropology, University of Oregon.

Wobst, H. Martin
1977 Stylistic Behavior and Information Exchange. In For the Director: Research Essays in Honor of James B. Griffen, edited by C.E. Cleland, pp. 317-342. *University of Michigan Museum of Anthropology Anthropological Papers* 61. Ann Arbor.

Appendix A - Radiocarbon Dates

Table 1. Radiocarbon dates from seven Early and Middle Holocene Fort Rock Basin sites.

Site Name	Sample No.	C-14 Dates (RCYBP)	Calib. Dates BP at 2F (Stuiver and Reimer 1993)	Material
Bowling Dune	BETA-67520	2830 ± 70	3150 (2940, 2910,2890) 2770	Charcoal
Bowling Dune	BETA-75078	2890 ± 70	3150 (2980) 2810	Charcoal
DJ Ranch	BETA-67525	2890 ± 110	3350 (2980) 2760	Charcoal
Bowling Dune	BETA-75083	3060 ± 60	3380 (3260) 3070	Charcoal
Claim A1	BETA-127073	3310 ± 70	3689 (3548, 3538 3479) 3362	Charcoal
Locality III	WSU-4869	3350 ± 170[1]	4060 (3580) 3180	Soil
DJ Ranch	BETA-75088	3370 ± 60	3810 (3620) 3470	Charcoal
DJ Ranch	BETA-75085	3380 ± 100	3860 (3630) 3380	Charcoal
DJ Ranch	BETA-75087	3510 ± 80	3980 (3820, 3790, 3760, 3730) 3570	Charcoal
Big M	BETA-48585	3530 ± 100	4090 (3830, 3780, 3740) 3560	Soil, hearth
Bergen	BETA-134688	3660 ± 70	4220 (3975, 3970, 3965, 3940, 3925) 3725	Soil, hearth
Bergen	BETA-134687	3990 ± 70	4785 (4420) 4180	Soil, hearth
DJ Ranch	BETA-71832	4050 ± 100	4830 (4520, 4460) 4240	Charcoal
DJ Ranch	BETA-67524/ CAMS-9895	4140 ± 60	4840 (4810, 4770, 4640, 4620 4580) 4450	Charcoal
DJ Ranch	BETA-75086	4160 ± 120	4980 (4810, 4760, 4690, 4680, 4650) 4360	Charcoal
DJ Ranch	BETA-67526	4280 ± 220	5460 (4840) 4230	Charcoal
Bergen	BETA-125651	4330 ± 90	5280 (4864) 4588	Charcoal
GP-2	BETA-85689	4410 ± 80	5300 (4980) 4830	Charcoal/soil.
Bowling Dune	BETA-67523	4460 ± 160	5580 (5040) 4580	Charcoal
Big M	BETA-48586	4550 ± 120	5580 (5290) 4860	Soil, hearth.
Bowling Dune	BETA-75079	4610 ± 90	5580 (5310) 4990	Charcoal
Bowling Dune	BETA-75081/ CAMS-15534	4710 ± 60[2]	5590 (5460, 5360, 5340) 5300	Charcoal
Bowling Dune	BETA-75084	4730 ± 120	5720 (5560, 5460, 5340) 5050	Charcoal
Big M	BETA-39908/ ETH-7046	4755 ± 65	5610 (5570, 5540, 5480) 5310	Charcoal.
DJ Ranch	BETA-67528	4780 ± 130	5850 (5580, 5520, 5490) 5070	Charcoal
Bergen	BETA-134689	4780 ± 90	5710 (5580, 5510, 5490) 5310	Soil, hearth
Bergen	BETA-134684	4880 ± 40	5710 (5600) 5590	Charcoal
Big M	BETA-39907	4880 ± 110	5900 (5610) 5320	Charcoal.
DJ Ranch	BETA-67527	4900 ± 80	5880 (5640, 5620) 5470	Charcoal
Big M	BETA-57008/ ETH-9944	4905 ± 65	5850 (5640) 5490	Charcoal.
Big M	BETA-57007/ ETH-9943	4910 ± 60	5840 (5650) 5490	Charcoal.
GP-2	BETA-85691	5190 ± 80	6180 (5930) 5750	Soil, living floor.
Bowling Dune	BETA-75076	5380 ± 70	6300 (6190) 5950	Soil, living floor.
Locality III	WSU-4867	5550 ± 80[3]	6490 (6310) 6190	Charcoal/soil, hearth.
Bowling Dune	BETA-75077	5720 ± 70[1]	6720 (6490) 6320	Soil
Bowling Dune	BETA-75080	6040 ± 120	7200 (6880) 6640	Charcoal
DJ Ranch	BETA-75089	6060 ± 80[1]	7160 (6890) 6730	Soil
Locality III	WSU-4861	6120 ± 180	7380 (7000) 6540	Charcoal/soil, hearth.
Locality III	BETA-99003	6140 ± 80[3]	7210 (7010) 6800	Charcoal/soil, hearth.
Locality III	WSU-4868	6200 ± 70[1]	7220 (7160, 7120, 7090, 7060, 7040) 6890	Soil

Table 1.(continued) Radiocarbon dates from seven Early/Middle Holocene Fort Rock Basin sites.

Site Name	Sample No.	C-14 Dates (RCYBP)	Calib. Dates BP at 2F (Stuiver and Reimer 1993)	Material
DJ Ranch	BETA-75090	6220 ± 140[1]	7390 (7160, 7110, 7090) 6760	Soil
Locality III	WSU-4864	6370 ± 190	7550 (7240) 6800	Charcoal/soil, hearth.
Bowling Dune	BETA-75082	6420 ± 230	7650 (7280) 6790	Charcoal
Carlon Village	BETA-114220	6470 ± 70	7390 (7380, 7340) 7270	Organic soil
Locality III	WSU-4865	6530 ± 80	7530 (7390) 7230	Charcoal/soil, hearth.
Bergen	BETA-134685	6560 ± 40	7520 (7440, 7430, 7420, 7410, 7400) 7380	Ostracods
GP-2	BETA-85690	6620 ± 70	7550 (7510, 7500, 7470) 7340	Soil
Locality III	BETA-85685	6900 ± 120	7920 (7670) 7480	Charcoal
Locality III	BETA-99002	7010 ± 90[3]	7950 (7800) 7620	Charcoal/soil, hearth.
Locality III	WSU-4866	7040 ± 135	8110 (7890, 7860, 7820) 7560	Charcoal/soil, hearth.
DJ Ranch	BETA-75091	7210 ± 170	8340 (7960) 7650	Soil
Locality III	WSU-2859	7280 ± 70	8170 (8070, 8040, 8010) 7920	Charcoal
Locality III	WSU-4860	7350 ± 130	8370 (8130) 7550	Charcoal
Locality III	WSU-4863	7445 ± 190[3]	8550 (8180) 7840	Charcoal/soil, hearth.
Locality III	BETA-85686	7670 ± 230	8990 (8410) 7960	Charcoal
Locality III	WSU-4862	7880 ± 240	9380 (8580) 8140	Charcoal/soil, hearth.
Bowling Dune	BETA-67522	8080 ± 90[2]	9250 (8980) 8600	Soil
Locality III	BETA-101739	8260 ± 60[4]	9430 (9240) 8990	*Olivella* shell bead
Locality III	BETA-85687	8940 ± 130	10,270 (9950) 9570	Soil
Locality III	WSU-3499	9400 ± 270	11,070 (10,370) 9890	Charcoal
Locality III	BETA-85688	10,170 ± 230[1]	12,580 (11,890) 10,950	Soil

[1] May not be cultural date.
[2] Stratigraphically out of sequence.
[3] Duplicate dates on same sample.
[4] ^{13}C corrected age, ^{14}C age is 7,830 ± 60 BP.